INTERNATIONAL COMMISSION
for the
CONSERVATION of ATLANTIC TUNAS

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INTERNATIONAL COMMISSION FOR THE CONSERVATION OF ATLANTIC TUNAS

CONTRACTING PARTIES

(as of 31December 2000)

Algeria, Barbados, Brazil, Canada, Cape Verde, China, Côte d'Ivoire, Croatia, Equatorial Guinea, European Community, France (St. Pierre & Miquelon), Gabon, Ghana, Guinea Conakry, Japan, Korea (Rep.), Libya, Morocco, Namibia, Panama, Russia, Sao Tomé & Principe, South Africa, Trinidad & Tobago, Tunisia, United Kingdom (Overseas Territories), United States, Uruguay, Venezuela

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-2- Temperate tunas, North	Canada, China, Croatia, European Community, France (St. Pierre & Miquelon), Japan, Libya, Morocco, Panama, Tunisia, United Kingdom (Overseas Territories), United States	European Community
-3- Temperate tunas, South	European Community, Japan, Korea (Rep.), Namibia, South Africa, United Kingdom (Overseas Territories), United States	South Africa
-4- Other species	Angola, Brazil, Canada, China, European Community, Japan, Morocco, Namibia, South Africa, Trinidad & Tobago, United Kingdom (Overseas Territories), United States, Uruguay, Venezuela	United States

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FOREWORD

The Chairman of the International Commission for the Conservation of Atlantic Tunas presents his compliments to the Contracting Parties of the International Convention for the Conservation of Atlantic Tunas (signed in Rio de Janeiro, May 14, 1966), as well as to the Delegates and Advisers that represent said Contracting Parties, and has the honor to transmit to them the ***"Report for the Biennial Period, 2000-2001, Part I (2000)"***, which describes the activities of the Commission during the first half of said biennial period.

This issue of the Biennial Report contains the reports of the Twelfth Special Meeting of the Commission, held in Marrakech, Morocco, in November, 2000, and the reports of all the meetings of the Panels, Standing Committees and Sub-Committees, as well as some of the Working Groups. It also includes a summary of the activities of the Secretariat and a series of National Reports of the Contracting Parties of the Commission, relative to their activities in tuna and tuna-like fisheries in the Convention Area.

The Report for 2000 has been published in two volumes. ***Volume 1*** includes the Reports of yhe Secretariat on its activities, the Proceedings of the Commission Meetings and the reports of all the associated meetings (with the exception of the Report of the Standing Committee on Research and Statistics -SCRS), as well as the National Reports of the Contracting Parties of the Commission. ***Volume 2*** contains the Report of the Standing Committee on Research and Statistics (SCRS) and its appendices.

This Report has been prepared, approved and distributed in accordance with Article III, paragraph 9, and Article IV, paragraph 2-d, of the Convention, and Rule 15 of the Rules of Procedure of the Commission. The Report is available in the three official languages of the Commission: English, French and Spanish.

J. Barañano
Acting Commission Chairman

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(Madrid, Spain - 11 to 15 October 2000)

REPORT OF THE
STANDING COMMITTEE ON RESEARCH AND STATISTICS (SCRS)

(Madrid, Spain - October 16 to 20, 2000)

1 Opening of the meeting

The 2000 meeting of the Standing Committee on Research and Statistics (SCRS) was opened on Monday, October 16, at the Hotel Reina Victoria, in Madrid, by Dr. Joseph Powers, Chairman of the Committee. Dr. Powers welcomed all the participants and wished them a successful meeting.

2 Adoption of Agenda and arrangements for the meeting

2.1 The Tentative Agenda was reviewed and adopted by the Committee (attached as **Appendix 1**).

2.2 The following scientists served as rapporteurs for the species sections (Agenda item 12) of the 2000 SCRS Report:

Tropical tunas: general (Moratorium)	P. Pallares
YFT - Yellowfin tuna	C. Brown
BET - Bigeye tuna	N. Miyabe
SKJ - Skipjack tuna	J. Ariz
ALB - Albacore	M. Keatinge
BFT - Bluefin tuna - West	M. Sissenwine
Bluefin tuna - East	J. M. Fromentin
BIL - Billfishes	E. Prince
SWO - Swordfish	J. Porter
SBF - Southern bluefin tuna	K. Hiramatsu
SMT - Small tunas	L. Gouveia

2.3 The ICCAT Secretariat served as rapporteur for all the other SCRS Agenda items.

3 Introduction of Contracting Party delegations

Delegates from the following 19 Contracting Parties were present at the 2000 SCRS Meeting: Angola, Brazil, Canada, Cape Verde, Cote d'Ivoire, Croatia, European Community, Gabon, Ghana, Japan, Korea, Libya, Morocco, Sao Tomé & Principe, South Africa, Tunisia, United Kingdom (Overseas Territories), United States, and Venezuela. Each delegation introduced its members. The List of Participants is attached as **Appendix 2**.

4 Introduction and admission of observers

Scientists from the Iceland, Malta, CARICOM, FAO, IOTC and Chinese Taipei were admitted to the meeting as observers (see **Appendix 2,** List of Participants).

5 Admission of scientific documents

The Committee noted that, at the time of the opening of the meeting 186 papers had already been submitted to the 2000 SCRS, all of which met the criteria for the admission of documents. The List of Documents is given in **Appendix 3**.

6 Review of national fisheries and research programs

Angola

Taking into account that the data which Angola submitted to ICCAT was under-estimated, work is being carried out to correct and update these data since early 1999.

The initial observation shows that the total 1999 catches amount to 6,734 MT, with a slight decrease from those of 1998 (7,176 MT). These catches do not include the foreign fleet.

The major species caught are skipjack (3,000 MT), Atlantic bonito (1,998 MT), frigate tuna (618 MT), and yellowfin tuna (170 MT).

Work is currently being carried out to update and improve the information provided to ICCAT.

Brazil

In 1999, the Brazilian tuna longline fleet consisted of 70 vessels, of which 42 were national and 28 were foreign leased. There was a 4% increase in the total number of vessels from 1998, when 67 vessels were operating. The number of leased vessels, however, decreased by 24%, whereas the national fleet rose by 36%. This trend is a result of a national policy designed to promote the development of Brazilian high-seas fisheries and to use the chartering of vessels as a tool to internalize new fishing technologies. The number of baitboats remained stable at 42. For the first time, an experimental fishing operation in the equatorial zone was carried out with a leased purse-seiner, based in Cabedelo Port, resulting in a total catch of 240 MT of skipjack and 194.5 MT of other tuna species, mainly yellowfin tuna. From August 1999 to January 2000, a total of three fishing cruises were carried out and in all of them an observer was aboard the vessel, resulting in the collection of a large amount of data, including the measurement of 794 skipjack and 983 yellowfin tunas. The Brazilian catch of tunas and tuna-like fishes, including billfishes, sharks, and other species of minor importance was 39,709 MT (round weight) in 1999, representing a decline of about 10.2% from the catch in 1998 (44,237 MT). The majority of catch again was taken by baitboats (62.6%), with skipjack tuna being the most abundant species (22,947.5 MT), accounting for 92.3% of the baitboat catches. Total catch of the tuna longline fishery (14,407 MT), was about 22% higher than in 1998, mainly owing to an increase in catches of yellowfin tuna, by 30%. Swordfish catches in 1998 reached 4,721 MT. For the first time since the late 1960s, a catch of 12 MT of bluefin tuna was recorded. About 2,000 MT of sharks were caught as by-catch.

The responsibility for all issues relating to highly migratory species in Brazil (including data collection and submission to ICCAT) pertains presently to the Fisheries and Aquaculture Department of the Ministry of Agriculture, which prepared and submitted the ICCAT Tasks. More recently, on September 16, a National Committee for the Management of Tuna Resources was established. This Committee is formed by several Government bodies, as well as by the private sector, and constitutes a significant step towards the institutional strengthening of the tuna fishery in Brazil.

Canada

In 1999, tuna (bluefin, bigeye, albacore and yellowfin) and swordfish regulations, consistent with ICCAT Regulatory Recommendations, were in effect in Canada. The Canadian nominal landings of Atlantic bluefin tuna in 1999 were 576.1 MT, leaving 1.6 MT uncaught. In addition, 10.7 MT were estimated to be discarded dead from the swordfish longline fleet. Canada has 5.6 MT of the overall allowance for dead discards from ICCAT Recommendation 98-7. When this and the 1.6 MT uncaught quota are included, Canada was 3.5 MT over its allocated TAC (including the estimate of dead discards) in 1999, and this 3.5 MT was deducted from the 2000

quota. The Canadian nominal landings of swordfish in 1999 were 1118.5 MT, and resulted in a 23.0 MT overrun in quota which has been deducted from the 2000 quota. Canada also landed 263 MT of bigeye, 39 MT of albacore, and 22 MT of yellowfin.

Research responsibility for the tunas and swordfish resides at the Biological Station in St. Andrews, New Brunswick. Canada fully supports research that improves the basic inputs and approaches of the ICCAT stock assessments. In particular, Canada (government scientists and managers, and industry) has supported and participated in recent state-of-the-art bluefin tagging studies that have resulted in compelling new scientific information. Since 1997, these new fishery-independent pop-up satellite tagging efforts targeting adult and spawning size fish in New England and Canada showed that at least 30% of bluefin each year were located in the eastern management zone when their tags reported. Further, none of the spawning size fish were located in either known spawning ground when their tags reported their location, raising the possibility of a previously unknown spawning area in the Central Atlantic. As the management implications of possible spawning of bluefin tuna in the central Atlantic are enormous, Canada fully supports the Bermuda Working Group's Consensus Document (SCRS/00/125) recommending an exploratory research cruise to sample spawning size bluefin tuna and larvae in 2001. Further improvements were made to the Canadian commercial data collection system and the CPUE series. In 1999, there was 8% Observer coverage (by trip) on the longline fleet fishing for swordfish and other tunas.

Cape Verde

Total national catches have been somewhat irregular, showing a tendency to decrease. Catches of tuna and related species were 4,081 MT in 1999, which represents an increase of 44% compared with 1998. This increase could be due to the decline in the catch of small pelagic species, and a resulting increase in effort directed toward tuna and tuna-like species.

Within the national research program, the intensive collection of statistical catch data for tuna and related species, and the entry of these data in a data base, has been continued. A statistical bulletin is published every year; the 1999 issue will be published very soon.

China (People's Republic)

At present longlining is the only fishing method deployed by China for tuna and tuna-like species in the Atlantic Ocean. By the end of 1999, the number of tuna longliners with Chinese flag has reached 27, of which 16 vessels are between 501 and 1000 GRT and 11 vessels are between 201 and 500 GRT. The total catches of tunas and tuna-like species, including sharks, amounted 10,984 MT round weight in 1999. The increase is mainly explained by the incorporation of 11 longliners to the Chinese tuna fleet and improvements in fishing technology, as well as the harvest year in 1999. Bigeye tuna and yellowfin tuna are the main species targeted, and which comprised 66.8% and 19.94% of the total catches, respectively.

There are reasons for the over-limit of the different species. The catch over-limit of eastern bluefin tuna was caused by two vessels that targeted the stock before the relative Recommendation entered into force. After the Recommendation entered into force, the fisheries authority of China withdrew the fishing permit of one vessel that targeted this stock. At present, only one vessel can fish for the stock. Moreover, the fisheries authority of China did not sign the document on the catch over-limit. The catch over-limit catch of North Atlantic swordfish and South Atlantic swordfish resulted from dead by-catch.

The Bureau of Fisheries of China is concerned about the over-limit catch and has taken measures to guarantee that starting in 2001 the catch of eastern bluefin tuna will be under a catch limit allocated by ICCAT. The Chinese fishing company with the bluefin tuna permit has been requested to abide by the regulation. The Bureau of Fisheries will not sign bluefin tuna document if the catch is over the new catch limit and will impose a penalty on the company that catch over the limit. The penalty will include the cancellation of the fishing permit for eastern bluefin tuna. The fisheries authority of China has been encouraging fishing companies to use and develop new fishing technology to reduce the amount of by-catch. Considering that by-catch mitigation technology is not available to the Chinese fishing fleet at present, the Bureau of Fisheries of China has decided to send Chinese scientists to relative international meetings for such information.

Côte d'Ivoire

The CRO, as well as carrying out biological programs, monitors the landings of four maritime fisheries (tuna, sardine, demersal and artisanal). Only two of these fisheries are of interest to ICCAT.

- The tuna fishery is operated by foreign flag vessels (Côte d'Ivoire has had no tuna vessels since 1984). These vessels, mainly French and Spanish, operate in the east central Atlantic and make their landings or transhipments in Abidjan.

- The Artisanal gillnet fishery targets billfish and sharks in Ivorian waters.

In 1999, the CRO monitored the regular landings of 18 French and French controlled tuna vessels. These vessels landed 55,044 MT of tuna, comprised of 57.8% yellowfin, 36.3% skipjack, 5.6% bigeye and 0.4% albacore. Catches show an increase of 19% as compared with those of 1998. To this figure 11,923 MT should be added. At the same time, the landings of 23 Spanish and Spanish controlled tuna vessels were monitored by our Spanish colleagues. All these landings and transshipments (French and Spanish), the total of which annually represents more than half the catch of tropical tunas in the Atlantic, making Abidjan the major African port for tunas.

With regard to the artisanal gillnet fishery in 1999, the canoe (pirogues) fishery made 7000 trips, with a total catch of about 600 MT of large fish. These catches were comprised of 50% sharks and 50% billfish. The latter includes 67.7 MT of sailfish, 198.2 MT of blue marlin, 7 MT of white marlin and 30.3 MT of swordfish. A significant amount of small tunas (juvenile yellowfin, skipjack, Atlantic little tuna and frigate tuna) are caught as a by-catch to these target species.

Croatia

Bluefin tuna (*Thunnus thynnus*) comprise the major component of the catch (970 MT in 1999). However, bluefin catches declined in the last couple of years by more than 30%. This is a result of the specific fishing quota that has been imposed. It is also a consequence of the closed season for purse seiners in May. With regard to the closed season for purse seiners, which is aimed at protecting juveniles, it should be mentioned that this measure sometimes has counter-productive effects. Actually, small tunas (3.5-15 kg) form large schools in May because fishing operations do not disturb them. At the beginning of the fishing season (early days of June), fishermen fish large quantities of the undersized fish.

Catches of species of lesser importance included bonito (*Sarda sarda*) (120 MT) and swordfish (*Xiphias gladius*) (estimated at about 20 MT).

With regard to bluefin tuna farming, it should be noted that the farming period is becoming longer each year. This means that the tuna farmers are keeping the tuna in the cages for more than a year, and often, even more than two years. This could affect BTSD statistics as well as the system of control of exported fish because of the large increase of fish in captivity.

European Community (EC)

EC-France

French catches of tuna and tuna-like species in the Atlantic Ocean and Mediterranean Sea amounted to a total of 71, 281 MT in 1999, slightly higher than the 1998 catch level. On the other hand, this catch reflects a general decreasing trend in French catches since the mid-1980s, mainly due to the effects of the moratorium in the Gulf of Guinea, the decline in the number of tropical purse seiners, and to reductions in temperate tuna catches.

Albacore catches (7,191 MT) have increased in comparison to the previous year, in which catches had been particularly low. Bluefin tuna catches (6,741 MT) continued their decline of recent years. Catches of tropical tuna catches (57,192 MT) have shown a marked decline in recent years due to the double effect of the moratorium and the reduction in purse seine fishing effort.

Various programs relating to research and statistics were started or continued in 1999, including those on bluefin tuna (cooperation on statistics in the Mediterranean basin, biology and spawning, analysis of historical Mediterranenn trap data, direct estimates of abundance through aerial surveys), albacore (trials with techniques alternative to driftnets) and tropical tunas (improvement of the statistical system, study of the association between schools and baitboats, contribution to the BETYP, the processing of data from the bigeye program, anchoring of oceanographic buoys for real time monitoring of environmental conditions, etc). This list is far from exhaustive.

EC-Ireland

The summer driftnet fishery for albacore tuna has assumed considerable importance for Ireland since 1990, with more than 30 vessels taking part in the fishery annually at its peak. In 1999, participation was restricted to 18 vessels in line with ICCAT and European Union regulations. In addition, domestic legislation was introduced in 2000 restricting all fishing for tuna to vessels specifically permitted to do so. The total catch of albacore taken in the summer driftnet fishery amounted to 4,858 MT, together with by-catches of bluefin tuna (52 MT) and swordfish (81 MT).

In order to offset the unfavorable social and economic repercussions of the total ban on the use of driftnets at the end of 2001, Ireland initiated commercial trials in 1998 to establish new techniques such as pair pelagic trawling and mechanized trolling. In 1999, 27 vessels participated in exploratory fishing trials for albacore tuna: 23 of these vessels employed pelagic trawls, 3 trolling gear, and one further vessel employed long line. The fishery took place between late July and early October with catches taken mainly in an area bounded by latitudes 46°–50°North and longitudes 11°– 15°W and in an area bounded by 46°–47°North and 5°–6°West.

An extended scientific monitoring program was conducted during the 1999 fishery. This included onboard observers on all vessels taking part in experimental fishing trials and comprehensive sampling of landings from the driftnet fishery. The results of this program have been reported to ICCAT and indicate that typical landings from both the driftnet and paired pelagic trawl fisheries are in the size range 50–90 cm, with a median length of 71 cm.

EC-Italy

After joining ICCAT through the EC, Italy set up an improved and centralized data collection system at the Direction General for Fishery and Aquaculture (Ministry of Forestry and Agriculture Policy). The official system improved the already existing fishery statistical service and several regulations were issued according to the EC rules.

Catch data are currently provided directly to the EC-DGXIV, to be released to the ICCAT. At the same, the Direction General for Fishery created ten research groups, to carry out various investigations on large pelagic species in the 1998-2000 period and the results should be available in early 2001. Some of these groups are also collecting size frequency and CPUE data on bluefin tuna, albacore, swordfish, bullet tuna, Mediterranean spearfish and other pelagic species at sampling ports or from some fisheries, while other groups are engaged in biological studies, larval sampling, and tagging. Some of these research groups are also working with foreign institutions within the framework of the EC study project on large pelagic species.

After the enforcement of the quota system for bluefin tuna, the good collaboration that existed previously with the fishermen was seriously affected and, as a general statement, several significant difficulties in the data collection have been reported in the most recent years from all the research groups and for all the species covered. This situation is becoming even worse due to the improvement of controls at sea by the national authorities, particularly on the minimum size regulation and on driftnets.

For the tuna fishery, Italy set up an advisory board at the Ministerial level and issued a regulation on official data collection procedures, with official forms to be checked by the port authorities. A Ministerial decree lists all the vessels that have a license for bluefin fishing within the individual quota per year, including even the sport fishermen.

The driftnet fleet underwent a very strong reduction, decreasing from 770 vessels to about 150 boats and with the prevision to close this activity according to the EC regulation.

EC–Portugal

The Portuguese catches of tuna and tuna-like-species amounted to 8,104 MT in 1999 which represents a decrease of 42% from the 1998 catch (13,979 MT). This decreasing trend is mainly due to the decline in the baitboat fisheries in recent years.

The Portuguese tuna fishery takes place mainly in the Azores and Madeira islands, where local baitboat fleets target different species of tuna, depending on the season and the local abundance of each species. In 1999, these baitboat fleets caught 3,769 MT in the Azores and 1,572 MT in Madeira, which included 3,152 MT of bigeye tuna, 1,800 MT of skipjack, 281 MT of albacore, and 5 MT of bluefin tuna.

A longline fleet based at Continental Portugal targets mainly on swordfish and operates in the North and South Atlantic. This catch amounted to 888 MT of swordfish (507 MT caught in the northeast Atlantic and 381 MT in the South Atlantic). The longline fleet based in the Azores caught 247 MT in the northeast Atlantic.

Longliners based in Madeira has been operating since 1990 in the East Atlantic and in the Mediterranean, catching an average of 300 MT of bluefin tuna per year. A total of 482 MT of bluefin was caught in 1999. One trap has been operating in the South of Portugal since 1995, targeting bluefin tuna. In 1998, the bluefin catch taken by this trap was 2 MT.

Research programs on tuna have been carried out by the Azores University, the Fisheries Research Laboratory of Madeira and the IPIMAR in Portugal mainland. The collection of tuna statistics and sampling size frequencies have been routinely reported to ICCAT Secretariat and the results of the scientific research have also been submitted to the regular meetings and inter-sessional workshops of the SCRS.

An observer program on the Azores bait boat fishery has been carried out since 1998, covering more than 50% of the fleet. In the year 2000, under the ICCAT Bigeye Year Program (BETYP), a baitboat was chartered in the Azores during 2000, and 37 bigeye tuna and 115 skipjack were tagged. Attempts to carry out some opportunistic tagging have been made in Madeira area.

EC-Spain

Estimated landings of tunas and tuna-like species in 1999 in the Atlantic and Mediterranean amounted to 112,062 MT (19,978 MT yellowfin, 13,379 MT bigeye, 44,520 MT skipjack, 16,676 MT albacore, 10,658 MT swordfish, 5,357 MT bluefin tuna, and 1,465 MT of other tuna and tuna-like species). For ICCAT task II data, sampling was carried out in 1999 on a total of 407,080 fish (59,265 yellowfin, 103,987 skipjack, 34,309 bigeye, 72,415 albacore, 10,057 bluefin, 99,891 swordfish, and 27,156 other species). A total of 21 papers were presented this year to the SCRS (four dealing with albacore, five on bluefin tuna, three on swordfish, and nine on tropical and Canary Islands tunas. For more details, see SCRS/00/149.

Fisheries

• Tropical tunas and Canaries Islands tunas

The Spanish tropical purse seine fishery is directed at yellowfin and skipjack, with by-catches of bigeye and small tunas. In January, November and December, 1999, the Spanish fleet participated in the time/area closure established for the objects fishery (FADs). The number of vessels remained unchanged (19), although effort (in standardized days fishing) declined by 12%. The catches amounted to 63,547 MT (18,599 MT yellowfin, 38,912 MT skipjack, 5,021 MT bigeye and 1,015 MT other species) The baitboat fishery was comprised of seven baitboat vessels and their catches amounted to 4,324 MT for all species combined (787 MT yellowfin, 1,488 MT skipjack, 2,049 MT bigeye). The fishery in the Canary Islands area was carried out by 394 baitboat vessels in waters off the Canary Islands and the African coasts close to these islands. The catches by this fishery were 12,870 MT (32 MT

bluefin, 524 MT yellowfin, 1,972 MT albacore, 6,191 MT bigeye, 4,119 MT skipjack and 39 MT of other species). with 9,535 days at sea

• Temperate tunas

Catches of bluefin tuna amounted to 5,357 MT, of which 3,354 MT were caught in the East Atlantic and 2.003 MT in the Mediterranean). The catches, by fishery, were as follows: 1,311 MT by baitboat, 2,004 MT by four traps, and 32.6 MT by hand line. In the Mediterranean, fishing continued by purse seine (1,503 MT), longline (376 MT), and hand line (79 MT), among other, lesser important surface gears (35 MT). There were null catches again for the Mediterranean traps close to the Strait of Gibraltar.

The total catch of albacore taken by the Spanish surface fleets in the Cantabrian Sea and adjacent waters in the eastern Atlantic was 13,305 MT. The baitboat fleet caught 6, 435 MT with a nominal effort of 4,974 fishing days. Catches by the troll fishery amounted to 6,829 MT, with nominal effort of 11,461 fishing days. There were 130 baitboats and 460 troll vessels. In the autumn months, party of the Cantabrian baitboat fleet shifts to the southwestern area of the Iberian Peninsula in the Atlantic (41.3 MT). The Mediterranean fishery is not well developed, although in recent years, part of the swordfish longline fleet directs its effort at albacore during some months. Albacore is caught by the surface drift longline fishery, troll and baitboat (283 MT).

In 1999, swordfish were caught by the Spanish surface longline fleet in the North and South Atlantic and the Mediterranean Sea. A total of 10, 658 MT were caught (9,752 MT in the Atlantic, and 906 MT in the Mediterranean). The Atlantic fleet was affected by drastic domestic management measures that limited their activity. Catches in the Mediterranean were 906 MT (790 MT by surface longline). The decline in Mediterranean longline catches is due to the decline in fishing effort asa result of a change in the fishing strategy of the fleet and to the minimum size (120 cm LJFL) regulation imposed by the EC.

• Small tunas

These species are caught by trap and surface fishery gears in the Mediterranean. There were 669 MT of melva (*Auxis* spp.) caught and 432 MT of Atlantic bonito (*Sarda sarda*).

Research and statistics

• Tropical tunas and Canary Islands tunas

Nine papers were presented to the 2000 SCRS. In the purse seine fishery the major source of information are the fishing logbooks (61% coverage). Sampling is carried out at the main landing and/or transshipment ports (183,148 medium sized tunas from the Spanish, French and NEI fleets). Due to the introduction of fishing with FADs, the focus of research has changed in recent years. The Spanish-French research project (IEO-IRD-DG XIV 96/028) has concluded. This project was aimed at analyzing the causes for the increase in the bigeye catches by this fleet, based on observer data. The research trips started in June 1997 and ended in June 1999 (1,884 sets, 17% coverage). In 1999, two new joint IRD/IEO research projects were started (ESTHER, to study the development of fishing power of the Spanish-French tropical purse seine fleet, and TESS, to review the current data bases on tropical tunas and to incorporate these in the future European tuna laboratory, ORDET). In 2000, the BIOTHON research project was initiated to reinforce the current sampling level. In the baitboat fishery, the major source of information are the fishing logbooks that are completed by the vessel captains (close to 100% coverage). Size sampling is conducted at the port of Dakar (Senegal). In the Canary Islands area, there is a Sampling Information Network (RIM) at the 10 major tuna landing points and in Algeciras (100% coverage of the catches). There were 40,410 fish measured. Monitoring continued of the objects fishery ("manchas") by means of sampling and fishing logbooks. Within the framework of the BETYP, three bigeye tagging cruises were carried out in Canary Islands and African waters and 1,139 bigeye, 55 yellowfin, 4 skipjack and 1 bluefin were tagged, and there were 187 recoveries. In August, 2000, another tagging cruise was conducted, also within the BETYP, and 505 fish were tagged (463 bigeye, 41 skipjack and 1 yellowfin), of which 64 bigeye and 5 skipjack were recovered.

• Temperate tunas

Five papers were presented: SCRS/00/108, 109, 110, 111 and 151) on bluefin growth, traditional tagging, pop-up tagging, genetic analysis, and methodological aspects affected by the assignment of ages from size data. Sampling was carried out through the IEO Sampling Information Network (RIM) at Cantabrian ports for the baitboat fishery (1,777 fish sampled, 4% coverage); Spanish South Atlantic for the baitboat, trap and hand line fisheries, and at Canary Islands ports for the baitboat fishery. A study on growth was carried out (SCRS/00/108) and to compare the age composition of the estimated catches by three different methods (SCRS/00/151). For the Spanish South Atlantic region and the Mediterranean, a total of 8,257 tuna were samples (4,675 in the Atlantic area of the Strait of Gibraltar). Three papers were presented to the GFCM/ICCAT Ad Hoc Working Group Meeting (SCRS/00/109, 110, and 111). Various research projects were carried were carried out. One, the DG-XIV-97/029 EU, on the biology of Mediterranean bluefin tuna studied sexual maturity by means of hormonal analysis. The unloading of more than 4,000 MT of bluefin tuna from purse seiners flying foreign flags was monitored at Spanish ports. The FAIR-97/3975 EU Research Project concerning electronic tagging using pop-up satellite tags, has tagged 47 adult bluefin tuna up to now from Spanish fisheries (the results were presented at the 2000 GFCM/ICCAT), although two new signals have been obtained since that meeting. For information on the FAO COPEMED project, see the section on other activities.

Four papers were presented on albacore (SCRS/00/114, 115, 116 and 117). ICCAT-required data are prepared from information from the baitboat and troll fisheries that are obtained from the Sampling Information Network (RIM) at the major Cantabrian and South Atlantic area ports (13 ports) and from surveys (85-95% coverage) and sampling (baitboat: 12,092 fish, 0.9% coverage; and troll: 50,063 fish, 4.8% coverage). Indices of abundance for the troll and baitboat fleets were obtained (SCRS/00/114 and SCRS/00/115), a description of the time/area distribution of the baitboat fleet catches (SCRS/00/116) and studies on growth continued (SCRS/00/117). Tasks I and II for the Mediterranean were prepared from size sampling of 6,442 fish.

Three papers on swordfish were presented: a description of the fisheries (SCRS/00/154), standardized CPUE indices (SCRS/00/155), and the possible relationship of recruitment and environmental factors (SCRS/00/156). The ICCAT required data were obtained by combining information from surveys, sampling and on-board observers (99,891 fish from the Atlantic and Mediterranean, with an overall coverage of 35% of the fish landed). Other continuing research included biological size-sex sampling, voluntary tagging on the Atlantic fleet, on-board scientific observers, opportunistic tagging of swordfish and other species (such as pelagic sharks and billfishes), etc. The FAIR CT-3941 research project continued on the stock structure of Atlantic and Mediterranean swordfish using nuclear DNA, the SHKLL project to evaluate the levels of by-catch species caught by surface longline. In the Mediterranean area, the DG-XIV-97/074 EU research project to study the problem of juvenile catches, analyzing the favorable factors with a view towards compliance with the minimum size regulation imposed by the EU (120 cm LJFL). Under the DG-XIV-97/050 EU project concerning the by-catch of the surface longline fishery that targets swordfish in the Mediterranean, 480 observer days were carried out on board longliners and 8,257 bluefin, 10,154 swordfish and 6,442 albacore were sampled.

Other activities

• Tropical tunas

Monitoring of tropical tunas was carried out on the catches of the purse seine fleet that operates in the West Atlantic, classified as NEI, and which is made up of vessels of various countries that do not provide statistical information to ICCAT. Periodic monitoring of seven of these vessels was carried out, as well as size sampling and species composition.

• Other research projects

The priority research carried out by the FAO COPEMED project (Tunas'99), coordinated by the C.O. of Malaga, centered on various aspects of the biology of bluefin tuna and swordfish (sex-ratio by size, reproduction, spawning area and season, biometric relations, growth, stock structure by genetic analysis). This project also coordinates the research activities in various countries of the Mediterranean area, the results of which are of considerable interest to ICCAT. The second year of the DG-XIV-97/050 EU project has just ended. The research

concerns the by-catch of surface longline directed at swordfish in the Mediterranean. Species other than swordfish in the Spanish fishery represented 10% in weight. Through the SHKLL project, which concludes at the end of 2000, data from longliners that catch swordfish have been provided to ICCAT.

Ghana

Baitboats and purse seiners exploited tuna resources within the EEZ of Ghana. The total number of vessels currently in operation is 33, comprising 24 baitboats and nine purse seiners. Catches for 1999 increased from 6,500 MT in 1998 to 8,500 MT in 1999, with the size of fish mainly between 40 and 80 cm. This increase can be attributed to the influx of more purse seiners in the fishery (i.e. from two in 1996 to nine in 1999). Lately, the purse seiners work in association with baitboats, often sharing the catch under FADs. The use of Fish Aggregating Devices (FADs) has also enhanced the catch of tuna resources.

Ghana participated for the first time in an observer program (moratorium) in the Gulf of Guinea, aimed at protecting juvenile tunas from over-exploitation by the use of Fish Aggregating Devices (FADs). This moratorium on the use of FADs was successfully carried out from November 1999 to January 2000. The results of the moratorium were encouraging. A reduction of approximately 40% in overall catches was observed as compared to the same period a year before (November 1998-January 1999).

Tagging activities within the framework of the Bigeye Year Program (BETYP) were also initiated in November 1999 and are currently on-going. Low incidence of the species has been observed in four tagging cruises between November 1999 and July 2000. Over 400 bigeye tuna have been tagged so far, with only 10 recoveries as of September, 2000.

Beach sampling of billfish continued off the western coast of Ghana as part of the ICCAT Enhanced Billfish Research Program.

Japan

Longline is the only gear currently operated by Japan in the Atlantic Ocean. The number of Japanese longline vessels which operated in Atlantic in 1999 was about 240 (a decline of 10% from the previous two years). The provisional 1999 catches of tunas and tuna-like fishes in the Atlantic Ocean and Mediterranean Sea by the Japanese fishery are estimated to be 36,500 MT (4,000 MT or a 10% decrease from 1998). Bigeye is the most important species, accounting for about 65% of the total catch, followed by bluefin tuna, swordfish and yellowfin. In 1999, there was a general decline in the catches of most species: bigeye (1,000 MT or 4%), yellowfin (2,200 MT or 40%), bluefin tuna (800 MT, 20%), blue marlin (400 MT or 23%), swordfish (200 MT, 8%). Southern bluefin tuna and albacore catches showed slight increases.

The shift of fishing effort in the tropical waters has occurred during the last two years. The longline fleet shifted from the Gulf of Guinea in the South Atlantic to the North Atlantic between 5°N and 15°N. This resulted in a larger catch of bigeye tuna in the North Atlantic than in the South Atlantic.

The monitoring of fishing activities, including data collection, submission of fishing data, and the study on the improvement of stock assessment methodology, are important research items, for which the National Research Institute for Far Seas Fisheries (NRIFRSF) has been responsible. This year, Japan participated in all the ICCAT meetings and provided routine fisheries statistics (Task I and Task II) as well as catch at size for albacore, bluefin, bigeye, yellowfin, swordfish. With regard to the ICCAT research programs, Japan is now conducting cooperative research cruise in the tropical Atlantic under the Bigeye Year Program, and is trying to provide improved biological information on this species. Archival tagging of adult bigeye and sonic tracking around Fish Aggregating Devices are scheduled as major research items. In 1999, Japan conducted archival tagging of bluefin tuna in Croatia with the help of Croatian scientists. Sixty (60) fish of 70-90 cm fork length were tagged and released. To date, 10 recoveries were reported, and archived data were successfully retrieved from the tag. Although the area of recoveries was limited to the Adriatic Sea, where the fish were released, the data indicated detailed information on vertical movements, ambient water temperature, internal body temperature and light intensity.

Japan carried out one scientific observer trips this year in June and July. The main objectives of this project are the collection of fishery data, biological information on adult bigeye tuna, including size measurements and the collection of tissue, gonad and hard part samples, and some oceanographic data. The preliminary results of these observations were presented in the SCRS documents. Additional observer trips are currently on-going to cover bluefin operations in the north Atlantic.

Korea

In 1999, the annual catch of tuna and tuna-like fish by the Korean longline fishery in the Atlantic Ocean amounted to 277 MT, representing a decrease of 4.5% from the previous year. The shift in fishing area from the North to the South has caused some changes in the species composition of the longline catch. While bigeye and yellowfin made up the major component of the total Korean catch as in past years, accounting for 45% and 34%, respectively, an occasional catch of southern bluefin tuna was reported when the fishery moved further south. The catch of bigeye tuna decreased from 163 MT in 1998 to 124 MT in 1999, but that of yellowfin increased to 94 MT. Other tuna, such as southern bluefin tuna, and billfish were also caught by the longliners in small quantities.

Routine scientific monitoring was carried out by the National Fisheries Research and Development Institute (NFRDI). This monitoring covers the collection of catch and fishing effort statistics from the Korean tuna longliners in the Atlantic to meet data requirements of ICCAT. To implement the recommendations adopted by ICCAT, Korea has taken the necessary measures, including the introduction of new domestic regulations.

Libya

Bluefin tuna migrates every year from the Atlantic to the Mediterranean, the route of migration usually takes place along the north African coast, where it passes the western Libyan waters. The fish were caught by several gears, mainly traps, longline and purse seine. In 1999, three traps were in operation, with a total catch of about 100 MT of bluefin and about 20 MT of little tuna. The average weight of the bluefin was about 60 kg. A total of 450 MT was taken by surface longline, the weight of the fish ranging between 25 and 280 kg, with the majority between 25 and 70 kg. Purse seiners took a total of 195 MT, with weights ranging between 25 and 270 kg.

The Marine Biology Research Center is taking part in the COPEMED research program in which biological studies have been carried out in 1999 and 2000.

Morocco

In general, there were no new developments observed in 1999 in the Moroccan fisheries for tunas and tuna-like species. The total reported catches during this year amounted to 10,683 MT.

In 1999, total bluefin tuna catches were 2,227 MT, of which 30% were caught off the Mediterranean coast. The major gears used are trap (40% of the total catch; the catches by the Mediterranean trap are minor), and hand line (25% of the total catch was taken off the Mediterranean coast). The average size of the fish is 125 kg for the traps and 190 kg for the hand line fishery.

Swordfish catches in 1999 totalled 3,357MT, of which 95% were caught in the Mediterranean. The gears used are drift gill nets (90%) and longline (10%). The average size of the fish is between 15 and 65 kg, depending on the landing point.

Small tuna catches comprise about 30% of the total catch. About 80% of these catches are taken off the Moroccan Atlantic coast. Purse seine is the gear most used in this fishery.

As regards the research plan, the National Institute for Fishery Research participated in the activities coordinated by the FAO COPEMED project, which are aimed at the study of the biology and fishing of tunas in the western Mediterranean.

South Africa

The major fishery for tuna and tuna-like fishes in South Africa is a baitboat fishery targeted at southern albacore. The total catch for southern albacore in 1999 was 5101 MT which is about 3000 MT below the record catch taken in 1998. The drop in catch is attributed to environmental conditions that effect the availability of southern albacore in the near shore waters in the southeast Atlantic fished by this fleet. South Africa also has a developing pelagic longline fishery, which is primarily targeted at tuna, but with some swordfish targeting.

In its 1998 recommendation on "Revision, Implementation and Sharing of the Southern Albacore Catch Limit" the Commission requested that the four active participants in the fishery report their catches to South Africa on a bi-monthly basis and that South Africa inform the Secretariat when pre-determined threshold limits are reached. This system is not working. Not all participants were able to report their bi-monthly catches to South Africa in 1999 or 2000. Consequently, South Africa has been unable to monitor progress of the fishery. South Africa is concerned that, in the absence of approved equitable allocation criteria, the management of southern albacore and other species (e.g. southern swordfish) could suffer.

Trinidad and Tobago

During 1999, the national commercial fishing fleet of Trinidad and Tobago consisted of seven vessels, which operated primarily in waters under the jurisdiction of Trinidad and Tobago. Fish exports in 1999 by these local vessels were: 39.4 MT of yellowfin tuna, 38.95 MT of swordfish, 7.8 MT of bigeye tuna, 1.1. MT of mako, and 0.48 MT of albacore. Additionally, in 1999, Trinidad and Tobago implemented the Certificate of Eligibility for Swordfish, and this is approved only for locally flagged vessels. Recognizing the need for further improvement in the national fisheries data information system in order to fulfil reporting obligations to ICCAT, national fisheries personnel are conducting a survey to identify and to track the movement of tuna and tuna products within the country, landed by both local and foreign vessels. In 1999, a total of 93 foreign-flagged vessels used the port of National Fisheries Company Limited for the purposes of transshipment of catches taken on the high seas. During the time period identified, these foreign-flagged vessels landed significant quantities of yellowfin tuna, bigeye tuna and swordfish at the transshipment port.

Tunisia

In 1999, the catch of tuna and tuna like species reached 5812 MT. By weight, small tuna comprised 51.2% of the total catch, while the catch of bluefin tuna was only 40.7%. The proportion of swordfish was about 8.1% of the catch.

The total production of bluefin tuna was 2352 MT, which is significant increase over the 1998 figure. This increase of about 607 MT is 34.8% higher than the 1998 figure.

The three major fishing techniques are:

-- purse seiners, which operate from October to March in the Gulf of Gabès and from April until the end of July, following the migration of spawners from the north of the country down to the extreme south. Bluefin purse seine landings currently comprise 90% of the catch;

-- Traps, the catches of which are continuing to decline. In 1999, trap catches were not more than 35 MT, which is barely 2% of the total bluefin tuna catches; and

-- hand lines, that are used in conjunction with trawlers and for which catches vary significantly.

The small tuna fishery is important, with catches higher than 2000 MT. Little tuna alone represents 54% of the catch, followed by bonito at 41% and frigate tuna with 4%.

The swordfish fishery is becoming increasingly important, and is carried out all along the coast. The increase in effort is reflected in an increase in catches, from less than 200 MT per year until 1992 to more than 460 MT in 1999.

United Kingdom (Overseas Territories)

The United Kingdom (Overseas Territories) delegation represents those territories participating in ICCAT. These are: Anguilla, Bermuda, St. Helena and its dependencies of Tristan da Cunha and Ascension Island, the Turks and Caicos Islands and the Falkland Islands.

Anguilla has recently concluded an experimental fishery that has revealed the presence of swordfish and bluefin tuna in their local waters. There is likely to be further development of this fishery in the future.

The Bermuda commercial fishing fleet continues to direct fishing effort towards pelagic species. In addition to the artisanal fishing fleet that fishes primarily around the Bermuda seamount and off-lying banks, there are a small number of purpose-built vessels which longline throughout Bermuda's Exclusive Economic Zone and in international waters. Such vessels are equipped with satellite vessel monitoring systems. Target species include swordfish, yellowfin tuna, wahoo, and bluefin tuna although catches of other tuna species are also observed. Landings of all tuna and tuna-like species are regularly sampled for research and monitoring purposes.

Bermuda continues to be actively involved in the ICCAT Enhanced Research Program for Billfish and has, most recently, been involved in a pilot study to determine post-release survival of marlin caught on longlines.

At St. Helena, catches consist primarily of yellowfin tuna, skipjack tuna and some bigeye tuna. Southern albacore and swordfish are also present in those waters and these species form part of the overall St. Helena catch.

Turks and Caicos Islands report relatively minor catches of species included in the ICCAT convention although there is some likelihood of future development there as well.

It should also be noted that Bermuda was the venue for an international workshop to discuss the distribution and biology of bluefin tuna in the mid-Atlantic. The consensus document arising from this meeting is reported in SCRS/00/125.

United States

Total (preliminary) reported U.S. catch of tuna and tuna-like fishes (including swordfish, but excluding other billfishes) in 1999 was 28,020 MT. This represents an increase of about 8% (2169 MT) from 1998. Estimated swordfish catch (including estimated dead discards) decreased 70 MT to 3,585 MT, and provisional landings from the U.S. fishery for yellowfin in the Gulf of Mexico increased in 1999 to 2,899 from 2,006 in 1998. The estimated 1999 Gulf of Mexico landings of yellowfin tuna were about 38% of the estimated total U.S. yellowfin landings in 1999. U.S. vessels fishing in the northwest Atlantic landed an estimated 1,214 MT of bluefin, a decrease of 20 MT compared to 1998. Provisional skipjack landings increased by 47 MT to 152 MT from 1998 to 1999. estimated bigeye landings increased by 334 MT compared to 1998 to an estimated 1262 MT in 1999, and estimated albacore landings decreased from 1998 to 1999 by 513 MT to 317 MT.

In addition to monitoring landings and size of swordfish, bluefin tuna, yellowfin tuna, billfish, and other large pelagic species through continued port and tournament sampling, logbook and dealer reporting procedures, and scientific observer sampling of the U.S. fleet, major research activities in 1999 and 2000 focussed on several items. Research on development of methodologies to determine the genetic discreetness of large pelagic fishes in the Atlantic was continued. Larval surveys for bluefin tuna and other large pelagics in the Gulf of Mexico were continued. Research continued on development of robust estimation techniques for population analyses. Research was also continued on approaches for characterization of uncertainty in assessments and methods for translating that uncertainty into risk levels associated with alternative management approaches. U.S. scientists also continued to coordinate efforts for the ICCAT Enhanced Research Program for Billfish and for the Bluefin Year Program. Cooperators in the Southeast Fisheries Science Center's Cooperative Tagging Center tagged and released 2,555 billfishes (swordfish, marlins and sailfish) and 940 tunas in 1999. This represents a decrease of 2% from 1998 levels for billfish, and 62% decrease for tunas. Cooperative research was conducted with scientists from other nations on development of assessment methodologies, on biological investigations and on development of indices of abundance for species of concern to ICCAT.

Venezuela

The industrial tuna fishery in Venezuela operates with three types of fishing gear: purse seine, baitboat and longline. Additionally, there are artisanal fisheries defined in Venezuela as *"The activity of extraction carried out by fishermen individually or organized in cooperatives, with a high level of physical and personal effort based on their personal experience for generations, with traditional and/or developed fishing gears and whose area of operation, vessel type and financial dependence are subordinate to economic decisions by those who buy their catch."* These fisheries direct their operations toward the catch of tuna and related species, using gillnets and surface longline gears.

The catch of the industrial fleet in 1999 was 15,801 MT, of which 65.1% was taken by purse seiners, 30.1% by baitboats and 4.8% by longline. Yellowfin was the major species caught, at 63.4% of the purse seiners catch, 87.2% of the baitboat catch and 65.6% of the longline catch. The second most important species was skipjack, which comprised 26.2% of the purse seine catch and 5.9% of the baitboat catch. Bigeye was mainly taken by longline, comprising 8% of the total catch by this gear, while the catches of purse seine and baitboat were 0.73% and 0.08% respectively. Catches of swordfish taken by longliners were less than 10 MT, while the by-catch of sharks reached 83 MT. The catches of billfish reached 451 MT (including by-catch of the industrial longline fishery and the artisanal targeted fishery).

Venezuela carries out research programs aimed at evaluating tuna resources under the "Evaluation of Large Pelagic Fisheries" carried out by the *Fondo de Investigaciones Agropecuarias* (FONAIAP) in cooperation with the *Servicio Autónomo de los Recursos Pesqueros y Acuícolas* (SARPA). Catch and effort statistics are collected through this project for the baitboat, purse seine, industrial longline and artisanal longline fisheries which catch tuna and tuna like species. This project also carries out assessments of those fisheries which target *Scomberomorus cavalla* in the east of the country and adjacent areas. Tuna, billfish and small tuna size sampling has been continued at the landing ports. Research carried out under the Enhanced Billfish Program has continued with the cooperation of the FONAIAP *Centro de Investigaciones Agropecuarias* and the Oceanographic Institute of the *Universidad de Oriente*. This research includes studies on reproduction dynamics of yellowfin in the western Atlantic in cooperation with another Contracting Party, as well as an analysis of seasonality of the different species of billfish caught by the Venezuelan fleet (industrial and artisanal). Swordfish hard parts sampling is carried out for age and growth studies undertaken by the Oceanographic Institute in cooperation with another Contracting Party. Billfish size sampling is carried out at the landing ports for the industrial, artisanal and recreational fisheries. The on-board observer program on longlines, partially funded by the Commission, has collected information on size frequency and sex ratios of all the species of tuna and related species caught. This information has been reported to the Secretariat. Twenty three (23) juvenile swordfish under 100 cm LJFL were tagged and released under the juvenile swordfish tagging program during the last quarter of 1999 and the first half of 2000.

Observers

CARICOM

A number of CARICOM states have well-established small-scale fisheries for tuna and tuna-like species, with gradual development of longline fishing operations since the late 1980s-early 1990s. In 1999, generally the most important large pelagic species landed by islands in the southeast Caribbean were yellowfin tuna (672 MT), skipjack tuna (298 MT), blackfin tuna (229 MT), and wahoo (494 MT). The commercial fishery in Grenada also landed substantial amounts of Atlantic sailfish (148 MT) and blue marlin (100 MT). In case of Guyana, however, Spanish mackerel and shark species (unidentified) were more important, with total landings of 1143 MT and 2175 MT, respectively. Recognizing the complexity of the tuna fisheries in the CARICOM countries, there is need for further improvements in the data information systems and field sampling programs, to ensure adequate sampling coverage. In January-June 2000, CARICOM fisheries staff examined available data on wahoo from five eastern Caribbean countries for the period 1995-1998. Statistical and assessment analyses were conducted. The results of the statistical analyses indicate that the eastern Caribbean wahoo fishery was relatively stable during the short time period studied. The assessment analyses confirmed the need to incorporate data from other countries harvesting the same stock of wahoo.

Chinese Taipei

Traditionally, longlining is the only fishing method used by fishing vessels from Chinese Taipei in the Atlantic. There were 205 longliners in operation in 1999. The total catch made by these vessels in 1999 was preliminarily estimated at about 49,000 MT, a slight increase of about 3,000 MT from 1998 level. The increase in catch was mainly contributed by albacore catch, especially from the north Atlantic. On the other hand, catches of yellowfin, bluefin tuna, and billfishes decreased.

Regarding research and statistics, the collection and compilation of data on tuna fisheries are continuously performed, and the compiled data have been reported to the ICCAT Secretariat on due schedule. In addition, the results of scientific research have been presented at the workshops of the SCRS. To better understand the by-catch fishery statistics, an observer trip was made during 1999 to 2000. Shark statistics reported by fishermen through the logbook system were aggregated for all species. To improve this, sampling programs were adopted. According to the report in 1998, the dominant species are blue shark and thresher shark. In addition, sampling trips for 1999 and 2000 are currently proceeding.

Regarding management, in accordance with the relevant ICCAT Recommendations, a number of conservation and management measures are being executed. They include: (1) catch limitation on bigeye, eastern bluefin, northern and southern swordfish, blue marlin and white marlin; (2) reporting of catches of southern albacore to South Africa every two months; (3) limits on the number of fishing vessels for bigeye and northern albacore; (4) Minimum size limits for yellowfin, bluefin, bigeye, and swordfish; (5) time and area closure for bluefin tuna fishery in the Mediterranean; and (6) regulations on the application of the Bluefin Tuna Statistical Document and Swordfish Certification of Eligibility. Details are documented in SCRS/2000/186.

Iceland

In 1999, one Icelandic longline vessel operated for tuna in the NE-Atlantic. The total catch was 27MT of bluefin tuna and about 1MT of bigeye tuna and swordfish each.

The Marine Research Institute in Iceland continued the experimental fisheries for bluefin tuna within the Icelandic EEZ that initiated in 1996. In the experimental fisheries, five Japanese longline vessels operated for tuna in waters south of Iceland from early August to the end of October in 1999. Icelandic observers reported locations, sex, length and weight of each bluefin. Number of fish of other species was reported for each line-setting. Biological samples of bluefin were collected, including vertebrae (788) for age reading, gills (765) and liver (168) for genetical analyses, muscles (168) and gonads (735) for genetical and reproductive analyses.

Study of bluefin diet from 1998 and 1999 where emphasis is laid on comparing areas and periods with various CPUE's was continued in 1999.

Iceland cooperated with the BYP by collecting and supplying samples for stock structure and reproductive analyses to laboratories in Spain and U.S.A.

Malta

The bluefin tuna fishing season in Malta starts in May and extends until mid-July. In 1999, bluefin tuna were targeted by 52 multi-purpose vessels (less than 20 m in length) and by 150 full and part-time fishermen. The total landings for 1999 amounted to 267 MT, i.e. an 8.5% increase over 1998. From the samples studied, the average length was 226 cm, while the average weight was 148 kg. Age was estimated for the whole population and most of the fish belonged to the 8 to 10 years age group. The fishing gear used is the drifting surface longline. In May, effort is exerted mainly in the southwestern area of the region, and later further extends to the east, following the normal movement of bluefin tuna.

With regards to swordfish, the total landings for 1999 amounted to 147 MT. The total landings for albacore for 1999 were 6 MT.

This year a bluefin tuna penning farm has started operating in the northern part of the island. Malta is still taking part in the regional COPEMED Program in order to increase knowledge of large pelagics in the Mediterranean, mainly bluefin and swordfish.

7. Executive summaries on species

7.1 YFT - YELLOWFIN TUNA

YFT-1. Biology

Yellowfin tuna is a cosmopolitan species distributed mainly in the tropical and subtropical oceanic waters of the three oceans, where they form large schools. The sizes exploited range from 30 cm to 170 cm FL. Smaller fish (juveniles) form mixed schools with skipjack and juvenile bigeye and are mainly limited to surface waters, while larger fish are found in surface and sub-surface waters. Since the inception of the yellowfin tagging program which has been carried out in the North American sport fishery since 1985, individuals of this species have often been recovered in the West Atlantic, but the majority of the long-term recoveries are made in the East Atlantic where several recaptures are recorded each year. The main spawning ground is the equatorial zone of the Gulf of Guinea, with spawning occurring from January to April. In addition, spawning occurs during May to August in the Gulf of Mexico and from July to November in the southeastern Caribbean Sea, although the relative importance of these spawning grounds is unknown. Such separate spawning areas might imply separate stocks or substantial heterogeneity in the distribution of yellowfin tuna. Nevertheless, taking into account the transatlantic migration indicated by tagging, as well as other information (e.g. time-area size frequency distributions and locations of fishing grounds), a single stock for the entire Atlantic is assumed as a working hypothesis (Atlantic Yellowfin Working Group; Tenerife, 1993). From the Gulf of Guinea, the juveniles move towards more coastal waters off Africa. When they reach the pre-adult stage (60-80 cm: fish from age 1.5 - 2), it is presumed that the majority migrate west towards the American coasts, with the majority of these in turn returning to the East Atlantic fishing grounds for spawning when they reach about 110 cm. A 40-year time series of longline catch data indicates that yellowfin are distributed continuously throughout the entire tropical Atlantic ocean. Growth patterns are variable with size, being relatively slow initially, and increasing at the time the fish leave the nursery grounds. Males are predominant in the catches of larger sized fish. Natural mortality is assumed to be higher for juveniles than for adults. This assumption is supported by tagging studies for Pacific yellowfin.

YFT-2. Description of the fisheries

The distribution of yellowfin tuna catches in the Atlantic is shown in **YFT-Figure 1**. Yellowfin tuna are caught between 45ºN and 40ºS by surface gears (purse seine, baitboat, troll and handline) and with sub-surface gears (longline). Troll and handline, although used in artisanal fisheries, have never been a large component of the yellowfin fisheries, although these gear types can represent a large proportion of the catch by a nation. The baitboat fisheries in equatorial areas have always targeted juveniles in coastal waters, together with skipjack, young bigeye and other small tunas. Baitboat fisheries are still active in waters of Mauritania and Senegal, Ghana (Tema), the Canary Islands, Cape Verde, Madeira, Venezuela and Brazil. In the 1980's, the fleets which operate in the areas off Senegal developed a new fishing method in which the baitboat acts as a floating object which attract bigeye, and to a lesser extent yellowfin and skipjack; Mauritania and the Canary Islands began to adopt this method in the 1990's. Since the early 1990's, Ghanian baitboats have fished on artificial floating objects.

Purse seine fisheries began operating in the East Atlantic in the 1960's, and developed rapidly in the 1970's. Beginning in 1975, the fishing area was extended from coastal waters to the high seas, especially at the equator, where large sized yellowfin are caught during the spawning season. In coastal areas, purse seiners catch juveniles in mixed schools. This gear is very efficient as it catches a wide range of sizes (40 to 160 cm), although catches in the east include very few intermediate-sized fish (70 to 100 cm). Venezuelan purse seiners operating mostly in coastal areas of the West Atlantic mainly catch fish of intermediate sizes.

Particularly since 1991, the purse seine fleets which operate in the East Atlantic have developed a fishery which targets schools associated with artificial floating objects. This translates into an important increase in catches of skipjack, juvenile bigeye and, to a lesser extent, increases in catches of young yellowfin and by-catch, extending the fishing grounds westward to 30ºW and south of the equator.

Longline fisheries principally catch yellowfin larger than 70 cm. However, deep longlines, which began being used in the early 1980's, mainly target bigeye, and therefore the proportion of yellowfin caught by longliners in the Atlantic is becoming less important (in 1999, it amounted to 19% of the total). There are, however, longline fisheries directed at yellowfin tuna, most notably in the Gulf of Mexico and the Caribbean Basin. Coincident to the development of purse seine fisheries during the 1960's and 1970's, longline catches diminished. Amounts caught by this gear tend

to be somewhat higher in the West Atlantic than in the East Atlantic.

Yellowfin catches in the Atlantic as a whole reached a historical high in 1990 (192,500 MT), but have since declined by 27% to 140,000 MT in 1999 **(YFT-Table 1)**. However, the relative contributions of the various gear types have remained similar **(YFT-Figure 2)**. In the East Atlantic, landings reached a high of around 138,000 MT in 1981 and 1982, then declined to a low of 76,000 MT in 1984, gradually increasing to a new record of 157,000 MT in 1990, and subsequently fluctuating between 104,000 MT and 126,000 MT An average of about 80% of the total catches in the East Atlantic over the past 15 years have been taken by purse seiners. In the West Atlantic, total catches have exhibited relatively little fluctuation over the past 15 years, averaging about 33,000 MT, of which about 35% on average has been taken by purse seiners (although purse seine catches have fluctuated widely, ranging from 6,000 MT to 21,000 MT), about 15% was taken by baitboats, 30% by longliners, and the remaining 20% on average by other and unclassified gears.

Effective effort for the eastern tropical Atlantic purse seine fishery is estimated by first standardizing to French class 5 purse seiners, and then further adjusting based on the assumption of an estimated annual increase of 3% in fishing power since 1981. The need to adjust for increases in efficiency results from the many improvements in the purse seine fishery, including the use of floating objects, bird radar, sonar, and satellite imagery, and is supported by data analysis (See Yellowfin Tuna Detailed Report). These calculations indicate that effective effort for the purse seine fishery has declined from a high in 1983 to an average of 25,300 standard fishing days for the period 1991-99; the 1999 level was 21,000 standard fishing days.

Trends in catch at age are shown in **YFT-Figure 3**. The variability in overall catch at age is primarily due to variability in catches of ages 0 and 1 (note that the catches of age 1 have increased in 1998 and to a greater extent in 1999).

YFT-3. State of the stock

A full assessment was conducted for yellowfin tuna this year using various age-structured and production models; emphasis was placed on the development of the production models, thus the results from these forms of analysis were the basis for the Committee's advice.

Both equilibrium and non-equilibrium production models were examined. The data used for the equilibrium models assumed a fixed increase in fishing power of 3% per year. In contrast, the non-equilibrium estimated changes in fishing power trends internally by fleet.

The estimate of MSY based upon the equilibrium models ranged from 144,600 to 147,300 MT; the estimates of F_{MSY} ranged from 70,000 to 52,700 standard fishing days. The total 1999 yellowfin catch was 140,000 MT. The overall effective effort for 1999 is estimated to be 60,100 standard fishing days (in French purse seine units; this effective effort is obtained from the CPUE of the French and Spanish fleets, assuming a 3% annual increase in fishing power beginning in 1981). Therefore, the equilibrium model results estimate that the fishing effort in 1999 was either somewhat above or below F_{MSY}.

The point estimate of MSY based upon the non-equilibrium model was 152,200 MT; the point estimate for F_{1999}/F_{MSY} was 0.88 (**YFT-Figures 4a and 4b**). The Committee was unable to estimate the level of uncertainty associated with these point estimates. Therefore, the non-equilibrium model results estimate that the fishing effort in 1999 was somewhat below F_{MSY}. Estimates of changes in fishing power partially agree with the 3% assumption used in the equilibrium models for the French purse seine fleet and for the Spanish purse seine fleet until 1990 but differ for the Spanish purse seine fleet after 1990.

In summary, the production model analyses imply that although catches could be slightly lower than MSY levels, effort may be either above or below the MSY level, depending on the assumptions made about changes in fishing power. Consistent with the production model results, yield-per-recruit analyses also indicate that current (1999) fishing mortality rates could either be above or about levels which could produce MSY. Yield-per-recruit analyses further indicate that an increase in effort is likely to decrease the yield per recruit, while reductions in fishing mortality on fish less than 3.2 kg could result in substantial gains in yield per recruit and modest gains in spawning biomass per recruit **(YFT-Figure 5)**.

YFT-4. Outlook

Since reported yellowfin landings appear to be close to the MSY level and fishing effort and fishing mortality may be in excess of the levels associated with MSY, it is important to ensure that effective effort does not increase further. Thus the possibility that the fishing power of the purse seiners and other fleets may further increase, even if the total capacity of the fleet were to remain constant, is also cause for concern.

YFT-5. Effects of current regulations

In 1973, the Commission adopted a regulation that imposed a minimum size of 3.2 kg for yellowfin tuna, with a 15% tolerance in the number of fish per landing. This regulation has not been adhered to, as the proportion of landings of yellowfin tuna less than 3.2 kg has been far in excess of 15% per year for the purse seine and baitboat fisheries. Based on the newly-revised catch species composition and catch at size data arising from improved analyses of the European purse seine data and other revisions of the database, it now appears that overall catches in number by purse seiners averaged 53.1% undersized yellowfin tuna over the period 1993-98. In the same period, baitboat fisheries landed 75.2% undersized fish. Landings of undersized fish occur primarily in the equatorial baitboat fisheries. In 1999, the calculated proportions of undersized yellowfin were 70.9% for the purse seine fleet and 80.7% for the baitboat fleets. Overall percentages of undersized yellowfin considering all gears were estimated to be 54.5% in 1998 and 69.9% in 1999. The potential size sampling problems may have influenced these percentages. However, the overall percentages are almost certainly considerably higher than the 15% tolerance level. Almost all undersized yellowfin tuna are caught in eastern Atlantic waters, since larger sizes dominate in the West Atlantic. Unfortunately, it may be difficult to realize substantial reductions in catches of undersized fish in the East Atlantic because small yellowfin are mostly associated with skipjack, especially when fishing occurs on floating objects; thus it is difficult to avoid catching small yellowfin when catching skipjack, the latter being an important component of eastern Atlantic purse seine fleet catches. The Committee suggests that the Commission consider the practicality of maintaining the 3.2 kg minimum size regulation.

In 1993, the Commission recommended "that there be no increase in the level of effective fishing effort exerted on Atlantic yellowfin tuna, over the level observed in 1992". Although it is evident that total fleet capacity has declined somewhat in recent years, at least for the eastern Atlantic surface fleets (from 55,700 MT in 1992 to 42,900 MT in 1999), the direction and amount of change in effective fishing effort depends on changes in gear technology and fishing strategies which are assumed to have increased efficiency. If the assumption of a 3% annual increase in fishing power is considered, total effective effort has remained relatively stable since 1990.

The effects of the moratorium on FAD fishing are detailed in the Report of the Working Group for the Evaluation of a Closed Area-Season for the Use of FADs by Surface Fisheries.

YFT-6. Management recommendations

Estimated catches of yellowfin tuna have averaged 145,000 MT over the past three years. This estimate is within the range of MSY from the equilibrium production models and falls slightly below the estimate of MSY from non-equilibrium production model analysis. However, depending on the assumption about annual rates of increase in efficiency, recent levels of fishing effort and fishing mortality may be somewhat above or below the levels associated with equilibrium MSY catches. There are many other sources of uncertainty which may affect the estimates; these are discussed fully in the 2000 SCRS Yellowfin Tuna Detailed Report. Therefore the Committee reaffirms its support for the Commission's 1993 recommendation "that there be no increase in the level of effective fishing effort exerted on Atlantic yellowfin tuna, over the level observed in 1992". The Committee's current point estimates of effective fishing effort fall below the estimate for 1992.

The Committee also continues to recommend that effective measures be found to reduce fishing mortality of small yellowfin, based on results of yield per recruit analysis. Although there are insufficient data to fully evaluate the effects of the moratorium on fishing on floating objects (and other measures to reduce catches of small fish) begun in late 1997, in general, the approach was intended to benefit bigeye tuna and is not expected to reduce the mortality of juvenile yellowfin tuna. In fact, the fishing mortality on juvenile yellowfin tuna appears to have increased substantially during the moratorium years, although it is unclear that this is related to the moratorium.

ATLANTIC YELLOWFIN TUNA SUMMARY (yields in 1,000 MT)

	Results of 2000 SCRS:
Maximum Sustainable Yield (MSY)[1]	144.6 - 152.2
Current (1999) Yield	140.0
Current (1999) Replacement Yield	May be close to current yield
Relative Biomass B_{1999}/ B_{MSY}[2]	103%
Relative Fishing Mortality: F_{1999}/F_{MSY}[1]	88-116%
Management Measures in Effect	3.2 kg minimum size [74-1] Effective fishing effort not to exceed 1992 level [93-1] closed area/season for fishing on FADs [99-1]

[1] These are ranges of point estimates and no confidence limits are given.

[2] No estimate of uncertainty was calculated around this point estimate during the assessment. Point estimates during the 1998 assessment ranged from 92-135%.

YFT-Table 1. Estimated catches (reported and carried over, in MT) of yellowfin in 1977-1999, by major gear, area and flag.

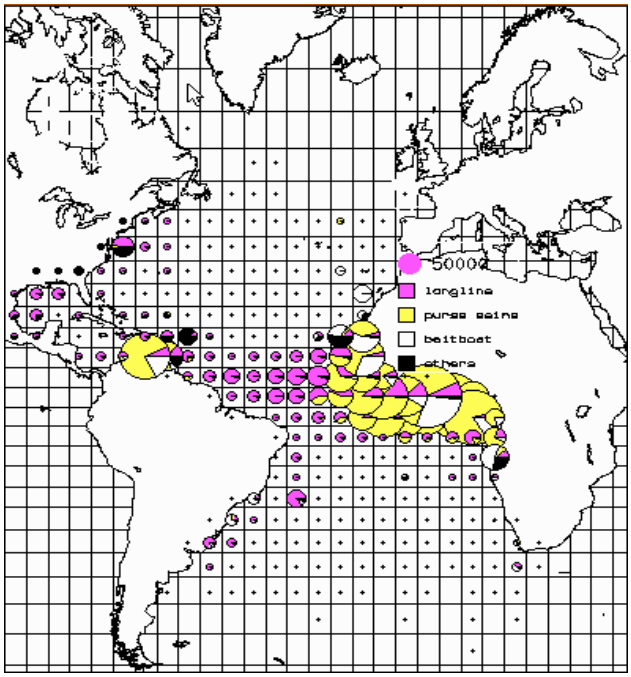
FLAG	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	
TOTAL	**131013**	**134044**	**127517**	**130961**	**155818**	**165001**	**165373**	**113939**	**156547**	**146534**	**144428**	**135219**	**161321**	**192456**	**166901**	**157920**	**160454**	**170456**	**152603**	**156988**	**140459**	**153994**	**139967**	
EAST ATL	*117541*	*119246*	*114158*	*117798*	*138114*	*138711*	*124953*	*76053*	*113656*	*106606*	*110304*	*99180*	*123238*	*157112*	*126432*	*117610*	*117097*	*116314*	*111696*	*118448*	*103770*	*118329*	*103639*	
SURFACE	*101879*	*107956*	*107381*	*105290*	*130128*	*128255*	*118913*	*67961*	*104212*	*102922*	*105823*	*91669*	*116853*	*149470*	*119410*	*112963*	*112423*	*107571*	*103256*	*109473*	*97101*	*110016*	*96918*	
Baitboat	*10943*	*8980*	*13715*	*7690*	*9788*	*13211*	*11507*	*14694*	*16120*	*15301*	*16750*	*16020*	*12168*	*19560*	*18521*	*15095*	*18461*	*15730*	*13604*	*13872*	*14042*	*17480*	*18899*	
Purse Seine	*90552*	*98098*	*92291*	*97026*	*114993*	*111820*	*103502*	*50860*	*86576*	*85325*	*86141*	*73117*	*102200*	*127673*	*98626*	*96103*	*92448*	*90176*	*88283*	*94063*	*81738*	*91292*	*76747*	
Other surface+	*384*	*878*	*1375*	*574*	*5347*	*3224*	*3904*	*2407*	*1516*	*2296*	*2932*	*2532*	*2485*	*2237*	*2263*	*1765*	*1514*	*1665*	*1369*	*1538*	*1321*	*1244*	*1272*	
LONGLINE	*15662*	*11290*	*6777*	*12508*	*7986*	*10456*	*6040*	*8092*	*9444*	*3684*	*4481*	*7511*	*6385*	*7640*	*5502*	*3903*	*4107*	*8503*	*7955*	*8567*	*5962*	*8009*	*6425*	
UNCL GEAR	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*2*	*1520*	*744*	*567*	*240*	*485*	*408*	*707*	*304*	*295*	
ANGOLA	2085	2296	904	558	959	1467	788	237	350	59	51	246	67	292	510	441	211	137	216	78	70	115	170	
BENIN	0	0	48	95	100	113	49	65	60	19	3	2	7	1	1	1	1	1	1	1	0	0	0	
C.IVOIRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	
CANADA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
CAP VERT	104	470	581	864	5281	3500	4341	2820	1901	3326	2675	2468	2870	2136	1932	1426	1536	1727	1781	1448	1721	1417	1417	
CAYMAN I	0	0	0	602	1460	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
CHI.TAIP	208	203	190	71	432	203	452	87	146	254	193	207	96	2244	2163	1554	1301	3851	2681	3985	2993	3643	3016	**
CHINA.PR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	74	63	60	
CONGO	0	0	0	140	50	0	0	0	11	20	15	15	21	22	17	18	17	14	13	12	0	0	0	
CUBA	3000	2339	3168	5128	2945	2251	1916	1467	1585	1332	1295	1694	703	798	658	653	541	238	212	257	269	0	0	
E.GUINEA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	
EC-ESPANA	35525	33636	40083	38759	51428	54164	51946	40049	66874	61878	66093	50167	61649	68603	53464	49902	40403	40612	38278	34879	24550	31337	19950	
EC-FRANCE	49948	55192	47776	54372	55085	45717	40470	7946	12304	17756	17491	21323	30807	45684	34840	33964	36064	35468	29567	33819	29966	30739	31246	**
EC-PORTUGAL	0	125	185	77	208	981	1333	1527	36	295	278	188	181	179	328	195	128	126	231	288	176	267	267	
ESTONIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	234	0	0	0	0	0	0	0	0	
GABON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	88	218	225	225	295	295	
GAMBIA	0	0	0	0	0	0	0	0	0	0	0	0	0	2	16	15	0	0	0	0	0	0	0	
GEORGIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	22	10	0	0	0	0	0	0	
GHANA	621	546	1426	1974	5510	9797	7689	9039	12550	11821	10830	8555	7035	11988	9254	9331	13283	9984	9268	12160	16504	17807	28328	
JAPAN	2647	1722	1241	2217	2863	4815	3062	4344	5765	3634	4521	5808	5882	5887	4467	2961	2627	4194	4770	4246	2741	4073	2970	**
KOREA	11060	8625	6449	5349	4288	4010	1629	1917	1668	965	1221	1248	1480	324	259	174	169	436	453	297	101	23	0	*
LATVIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	255	54	16	0	55	151	223	97	97	
LITUANIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	332	0	0	0	0	0	0	0	0	
MAROC	2167	3440	2986	3243	4817	4540	2331	614	2270	2266	1529	0	0	0	0	0	0	0	0	0	0	0	0	
NAMIBIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	14	72	69	3	147	
NEI-1	0	0	0	0	0	3121	5388	1104	0	0	2077	3140	5436	12513	6382	10478	9878	8282	8697	11938	11088	15337	10702	
NEI-166	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	
NORWAY	0	0	0	0	0	0	0	0	0	813	418	493	1787	1790	0	0	0	0	0	0	0	0	0	
PANAMA	1736	1477	739	1661	341	1933	1568	1653	3100	0	0	0	0	0	7452	4055	8157	8932	11833	11519	8425	7646	3	**
PHILIPNS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	126	173	
POLAND	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
RUSSIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3200	1862	2160	1503	2936	2696	4275	4931	4359	
S.AFRICA	167	281	4595	540	178	49	456	759	382	55	68	137	671	624	52	69	266	486	183	157	116	229	315	
SAO TOME	45	39	28	31	97	193	194	177	180	180	178	184	198	228	223	229	140	0	0	1	4	0	0	
SENEGAL	0	0	0	0	0	0	0	0	0	0	0	0	2	90	53	40	6	83	108	68	68	0	0	
UKRAINE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	215	0	0	0	0	0	0	0	0	
UK-S.HELENA	34	37	69	55	59	97	59	80	72	82	93	98	100	92	100	166	171	150	181	151	109	181	116	
USA	6400	8131	2884	1614	1472	636	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
USSR	1794	687	806	448	541	1004	1282	2168	3768	1851	1275	3207	4246	3615	0	0	0	0	0	0	0	0	0	

YFT-Table 1 (cont.)**.** Estimated catches (reported and carried over, in MT) of yellowfin in 1977-1999, by major gear, area and flag.

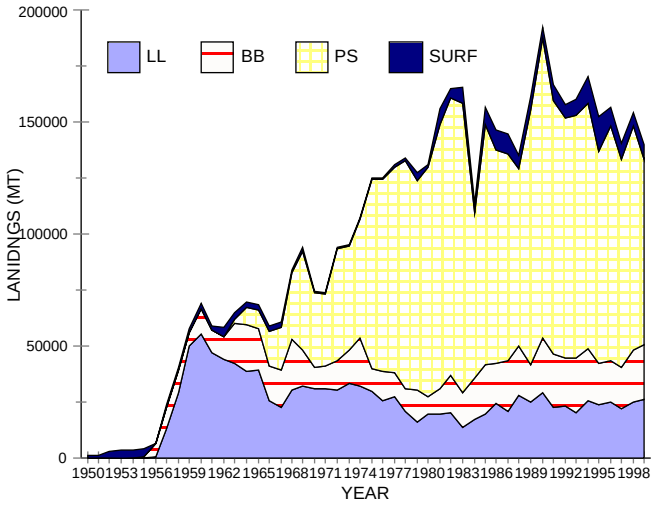
FLAG	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	
WEST ATL	**13472**	**14798**	**13359**	**13163**	**17704**	**26290**	**39666**	**37480**	**42365**	**31750**	**27680**	**30284**	**32807**	**27095**	**32632**	**32880**	**37429**	**46178**	**33940**	**30514**	**29433**	**26968**	**27632**	
SURFACE	*1457*	*4743*	*3637*	*5667*	*6083*	*16057*	*31638*	*27453*	*31380*	*17631*	*16902*	*14275*	*18722*	*12603*	*21658*	*19226*	*25180*	*31989*	*16266*	*19915*	*20093*	*17893*	*15897*	
Baitboat	*0*	*1012*	*605*	*392*	*1917*	*2970*	*3603*	*3698*	*5478*	*2421*	*5468*	*5822*	*4834*	*4718*	*5359*	*6276*	*6383*	*7094*	*5297*	*4560*	*4275*	*5511*	*5349*	
Purse Seine	*1073*	*3662*	*1035*	*5135*	*2822*	*12112*	*25749*	*23203*	*20994*	*9822*	*6665*	*6034*	*11647*	*6800*	*14414*	*11359*	*16081*	*19612*	*6338*	*10784*	*11710*	*9157*	*6283*	
Other Surface	*384*	*69*	*1997*	*140*	*1344*	*975*	*2286*	*552*	*4908*	*5388*	*4769*	*2419*	*2241*	*1085*	*1885*	*1591*	*2716*	*5283*	*4631*	*4571*	*4108*	*3225*	*4265*	
LONGLINE	*11374*	*9572*	*9277*	*6735*	*11323*	*9926*	*6969*	*8503*	*9743*	*12407*	*9990*	*14736*	*13033*	*13215*	*9410*	*11768*	*9906*	*9308*	*8731*	*8569*	*8505*	*8181*	*10943*	
UNCLASSIFIED	*641*	*483*	*445*	*761*	*298*	*307*	*1059*	*1524*	*1242*	*1712*	*788*	*1273*	*1052*	*1277*	*1564*	*1886*	*2343*	*4881*	*8943*	*2030*	*835*	*894*	*625*	
DISCARDS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	167	
ARGENTIN	43	4	0	0	8	7	0	0	44	23	18	66	33	23	34	1	0	0	0	0	0	0	0	
BARBADOS	58	67	81	40	30	36	51	90	57	39	57	236	62	89	108	179	161	156	255	160	151	0	0	
BRASIL	1302	852	1353	1008	2084	1979	2844	2149	2947	1837	2266	2512	2533	1758	1838	4228	5131	4169	4021	2767	2705	2514	4127	
CANADA	0	318	0	0	0	0	0	0	0	2	40	30	7	7	29	25	71	52	174	155	100	57	22	
CHI.TAIP	164	181	848	616	435	407	87	559	780	1156	709	1641	762	5221	2009	2974	2895	2809	2017	2668	1473	1685	1395	**
CHINA.PR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	555	555	*
COLOMBIA	0	0	0	0	0	3	29	0	180	211	258	206	136	237	92	95	2404	3418	7172	238	46	46	46	
CUBA	900	661	232	689	1997	1503	793	2538	1906	2081	1062	98	91	53	18	11	1	14	54	40	40	15	15	
DOMINICA	0	0	0	0	0	0	0	0	0	0	0	0	0	18	12	23	30	31	9	0	0	0	0	
EC-ESPANA	266	2029	1052	0	0	0	1957	3976	1000	0	0	1	3	2	1462	1314	989	7	4	36	34	46	23	
EC-FRANCE	0	0	86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GHANA	0	0	0	265	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GRENADA	364	166	148	487	64	59	169	146	170	506	186	215	235	530	620	595	858	385	410	523	302	302	302	
JAMAICA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	21	0	0	
JAPAN	1408	1647	1707	1117	2983	3288	1218	1030	2169	2103	1647	2395	3178	1734	1698	1591	469	589	457	1004	814	894	649	**
KOREA	6522	4259	4414	1933	3325	2249	1920	989	1655	853	236	120	1055	484	1	45	11	0	0	84	156	0	0	*
MEXICO	0	0	0	16	42	128	612	1059	562	658	33	283	345	112	433	742	855	1093	1126	771	826	788	1283	
NLD.ANT.	151	173	173	173	173	173	173	173	150	150	160	170	170	170	150	160	170	155	140	130	130	130	130	
PANAMA	582	1440	102	807	262	675	62	246	0	0	0	0	0	0	0	0	0	0	0	0	0	0	262	
PHILIPNS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	106	
ST.LUCIA	67	67	28	27	25	26	23	56	79	125	76	97	70	58	49	58	92	130	144	110	110	110	110	*
ST.VINC.	0	0	0	0	0	0	0	0	0	0	0	0	1	40	48	22	65	16	43	37	35	35	35	*
TRINIDAD	0	0	0	0	0	0	232	31	0	0	0	1	11	304	543	4	219	0	0	27	56	23	23	
UK-BERMUDA	10	12	26	35	21	22	10	11	42	44	25	23	22	15	17	42	58	44	44	71	51	53	57	
URUGUAY	0	0	0	0	67	214	357	368	354	270	109	177	64	18	62	74	20	59	53	171	53	88	88	
USA	808	1616	298	553	1688	1095	2553	2180	9735	9937	9661	11064	8462	5666	6914	6938	6283	8298	8131	7745	7674	5621	7734	**
VENEZUEL	827	1306	2811	5397	4500	14426	26576	21879	20535	11755	11137	10949	15567	10556	16495	13759	16647	24753	9686	13756	14656	13970	10670	
UNKNOWN AREA	*0*	*0*	*0*	*0*	*0*	*0*	*754*	*406*	*526*	*8178*	*6444*	*5755*	*5276*	*8249*	*7837*	*7430*	*5928*	*7964*	*6967*	*8026*	*7256*	*8697*	*8697*	
Longline	*0*	*0*	*0*	*0*	*0*	*0*	*754*	*406*	*526*	*8178*	*6444*	*5755*	*5276*	*8249*	*7837*	*7430*	*5805*	*7826*	*6790*	*7916*	*7256*	*8697*	*8697*	
CHI.TAIP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
CHINA.PR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	123	138	177	110	0	0	0	
PANAMA	0	0	0	0	0	0	0	0	0	7222	5147	3431	2496	4149	3519	3594	3134	3422	2588	1954	1156	358	358	
NEI-71	0	0	0	0	0	0	754	406	526	956	1297	2324	2643	3938	4240	3768	2555	3626	2913	3970	4155	4057	4057	
NEI-134	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	98	604	862	1315	1399	2894	2894	
NEI-105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	284	400	59	62	62	
NEI-81	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	393	1263	1263	
NEI-94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34	46	22	22	
NEI-40	0	0	0	0	0	0	0	0	0	0	0	0	137	162	78	68	18	174	143	223	48	41	41	

Shaded cells indicate estimated catches. In some cases the Committee has assumed the catch to be the same as the latest data available

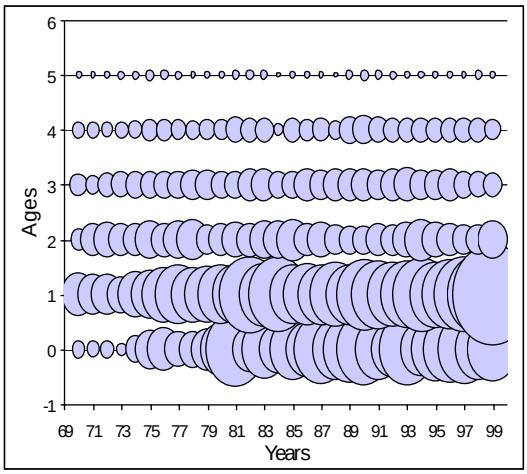
* Task 1was received after the assessment, and hence is not included in the table. (Table contains the data used at the assessments, July, 2000) ** preliminary estimates



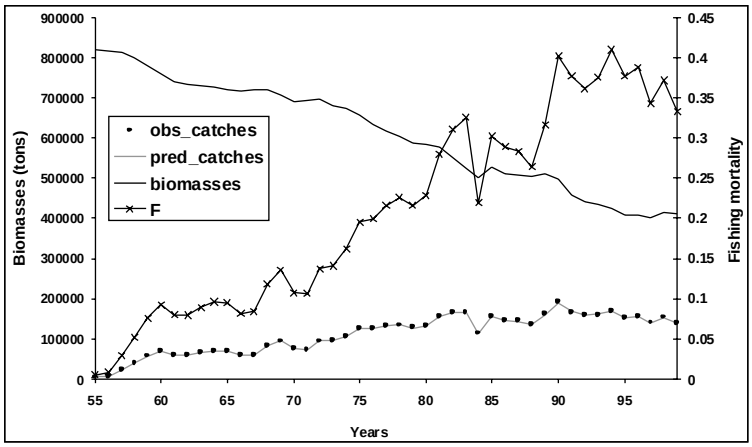
YFT-Fig. 1. Geographical distribution of annual yellowfin catches in 1950-1997, by gear.



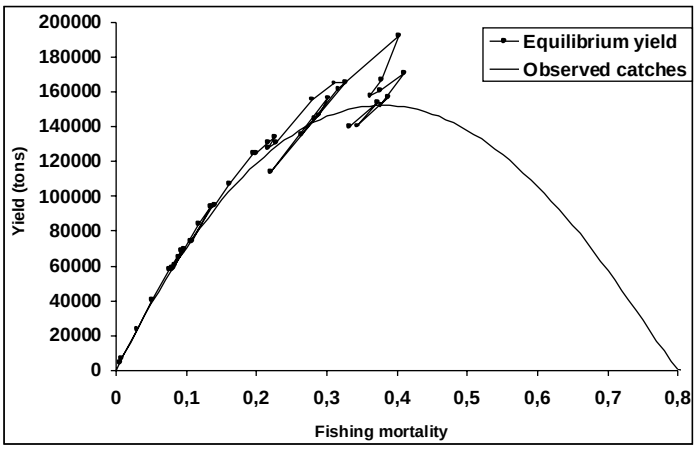
YFT-Fig. 2. Estimated landings (in MT) of yellowfin tuna by fishing gear in the Atlantic, 1950-1999.



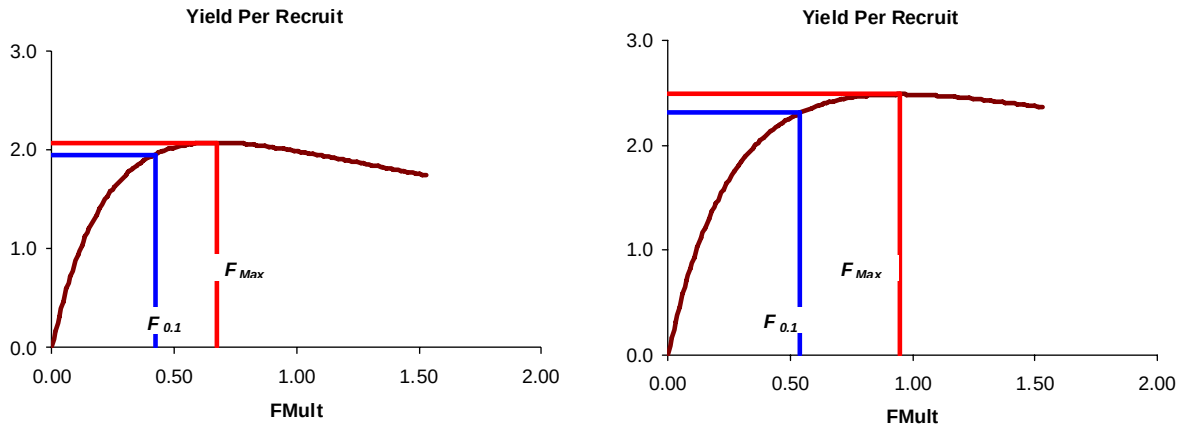
YFT-Fig. 3. Relative distribution of Atlantic yellowfin catches by age and year (bubble size is proportional to total catches).



YFT-Fig. 4(a). Nonequilibrium production model results for Atlantic yellowfin: Trajectories of estimated biomass and fishing mortality, and observed catches.



YFT-Fig. 4(b). Nonequilibrium production model results for Atlantic yellowfin: Equilibrium yield curve and observed catch trajectory (line with symbols).



YFT-Fig. 5. Results of equilibrium yield per recruit analyses for yellowfin tuna assuming a current exploitation pattern (left) or assuming zero catch of undersized fish (right). The assumed values of natural mortality (M) are 0.8 for ages 0-1 and 0.6 for ages 2+.

7.2 BET - BIGEYE TUNA

No new assessment was conducted this year for bigeye tuna since the Tropical Tuna Species Group concentrated its effort on yellowfin tuna and the evaluation of a closed area/season for the use of FADs by surface fisheries. Therefore, the major part of the status of stock and outlook is maintained from the last assessment in 1999. However, recent statistics and situation of the fisheries were incorporated as required.

Compared to other tuna species, bigeye has received less attention with respect to research on basic biological characteristics, in spite of the importance of this species for the Atlantic fisheries that are currently exploiting it. The lack of reasonable estimates of some biological parameters considerably hindered the stock assessment process, and sometimes led to unrealistic results. The ambitious Bigeye Tuna Year Program (BETYP) was proposed in 1996. This program was adopted by the Commission in the same year, and started its operation last year after external funds were made available. The on-going activities are given in **Appendix 7** (BETYP Report). The outcome of this program is expected to assist and improve the task of the Committee substantially.

BET-1. Biology

The geographical distribution of bigeye tuna is very wide and covers almost the entire Atlantic Ocean between 50ºN and 45ºS. This species dwells in deeper water than other tuna species and indicates extensive vertical movements. Archival tagging and sonic tracking studies conducted on adult fish in other Oceans revealed that they exhibit clear diurnal patterns being much deeper in the daytime than at night. Spawning takes place in tropical waters when the environment is favorable. From the spawning area fish tend to migrate into temperate waters as they grow larger. Catch information from the surface gears indicates that the Gulf of Guinea is a major nursery ground for this species. Various prey organisms such as fish, mollusks, and crustaceans are found in stomach contents. Bigeye exhibit relatively fast growth; fish about 100 cm in fork length correspond to three years old, and this is when they become mature. Young fish form schools mostly mixed with other tunas such as yellowfin and skipjack tunas. These schools are often associated with drifting objects, whale shark and sea mounts. This association appears to be less and less as they grow larger.

Circumstantial evidence, such as the time-area distribution of fish and movements of tagged fish, suggests an Atlantic wide single stock for this species, which is currently accepted by the Committee. However, the possibility of other scenarios, such as north and south stocks, should not be disregarded.

BET-2. Description of the fisheries

The stock has been exploited by three major gears (longline, baitboat and purse seine fisheries) and by many countries throughout its range of distribution **(BET-Figure 1)**.

The size of fish caught varies among fisheries: medium to large, small to large and small fish for longline, directed baitboat and purse seine fisheries, respectively. Corresponding average weights are 45-50 kg, 20-30 kg and 5 kg for these three types of fisheries. The economic value of fish is also different. Roughly speaking, the price per kg of longline-caught fish at the unloading site is six times higher than those caught by other fisheries such as purse seine.

Longline and baitboat fisheries have a long history that dates back before 1960. Major baitboat fisheries are located in Ghana, Senegal, the Canary Islands, Madeira and Azores. Unlike other Oceans, baitboats catch significant amounts of medium and large size bigeye tuna except in Ghana. Tropical purse seine fleets operate in the Gulf of Guinea and off Senegal in the East Atlantic and off Venezuela in the West Atlantic. Fleets comprising French, Spanish, Ghanaian and other flag vessels managed by EU countries are the major components in the East, and the Venezuelan fleet operates in the West. Bigeye catch by the Venezuelan fleet was very minor. While bigeye tuna is a primary target species for most of longline and baitboat fisheries, this species has been of secondary importance for purse seine fisheries.

There are two major longline fisheries, operated by Japan and Chinese Taipei, whose catch accounted for about one- third of the total catch in 1999. Korea has reduced its activity in the Atlantic considerably since 1990. The activities of the illegal, unreported and unregulated (IUU) longliners which fly flag of convenience appeared to be

started since the early 1980s, and became significant thereafter. In more recent years, the People's Republic of China (PRC) and Philippines started fishing in 1993 and 1998, respectively. The annual catch by PRC was less than 500 MT until 1997 but went up suddenly to 1500 MT and 7300 MT in 1998 and 1999, respectively.

Since about 1991, the purse seine and Ghanaian baitboat fisheries introduced a fishing technique that utilizes artificial fish aggregating devices (FADs). Similarly, baitboat fleets in Senegal and the Canary Islands have developed a method which makes use of baitboats as FADs. These new techniques have apparently improved fishing efficiency and contributed to the increase of bigeye catch.

Last year catches made by the IUU longline fleet was tabled and studied by the Committee for the first time. Those estimates were based on Japanese import statitics and are available since 1983. Honduras, Belize, Equatorial Guinea as well as St. Vincent are the major components, and Honduras has a long history of catch but the rest are newly emerged in the statistics. The estimates are considered minimal, as the weight is in product and not converted to round weight, but, on the other hand, the ocean origin is not clear. Similarly, Panamanian catch series during the early 1990s may include catches from other oceans as this catch series was obtained from the same data source. The estimated catches for IUU fleets have been increasing and at about 25,000 MT in 1999 **(BET-Figure 2)**.

Total annual catch **(BET-Figure 3)** exhibited an increase up to the mid-1970s reaching 60,000 MT and fluctuating between 45,000 and 84,000 MT over the next 15 years. In 1991, it passed 95,000 MT and continued to increase, reaching a historic high of nearly 131,000 MT in 1994. The catch had declined since then, but it came back in 1998 and 1999 reaching 121,000 MT. This trend in catch was similarly observed in all three types of fisheries, although the purse seine catch has reduced most significantly (35%) while the other two fisheries kept their magnitude at about same level since 1994. It was reported that the intense use of drifting natural log and artificial fish aggregating devices (FADs) was a primary cause of increased purse seine catch during the early 1990s, although other technological advances such as extensive use of sonar, deeper nets, bird radar, etc, may have contributed as well. The reason for the catch decline thereafter was not known but a decline in fleet size, lower abundance of juveniles and/or a reduction of directed effort appeared to be the possible reasons. The moratorium on fishing with FADs by the fleets of France, Spain and other flag vessels managed by the EU countries also contributed to the decline of catch between 1997 and 1999. On the other hand, the Ghanaian fleet has increased its catch since around 1995. The increase in longline catches up to 1994 is primarily due to a rapid shift of target species from albacore to bigeye by the fleet of Chinese Taipei, and increased fishing operations by the Japanese and Chinese Taipei fleets as well as the IUU fleet. While Japan reduced its catch and Chinese Taipei stabilized its catch due to a quota set for its fleet thereafter, IUU fleet as well as People's Republic of China continued to expand their catch. The baitboat catch in higher latitude tends to vary year to year suggesting possible influence by local oceanographic conditions. The increased catch after 1993 might have resulted from favorable oceanographic conditions in higher latitude as well as the increase of fishing effort directed to this species. The catch of various baitboat fisheries has maintained at relatively high level in recent years.

BET-3. State of the stocks

Two indices of relative abundance were used to assess the status of the stock: a standardized age-specific index of abundance from the Japanese longline catch and effort data that targets this species and represents roughly 25-40 % of the total catch **(BET-Figure 4)**; and data from the U.S. longline fishery (not age-specific). These indices relate to medium and large sized fish.

Two types of production model analyses were conducted using the Japanese longline index. One model failed to produce parameter estimates within biologically meaningful range, and therefore some parameters were fixed rather than to be searched freely. MSY values were also estimated by the alternative model for two data sets; 1961-1998 and 1961-1992. The estimated range for MSY was considered to be 79,000-94,000 MT. It should be noted that past MSY estimates tend to increase as new data points of high catches are added **(BET-Figures 5)**. The Committee discussed possible reasons, such as an increased productivity, change in availability, geographical and vertical changes in the range of fishing area and change in selectivity pattern, but the Committee could not identify the specific reason for this phenomenon, and thus could not specify the current stock level.

Apparently, the total catch has been larger than the upper boundary of the likely range of MSY since 1991, causing the stock to decline considerably. Results of production model analysis indicate that the estimated current biomass is likely below the corresponding biomass at MSY.

Two types of Virtual Population Analyses (VPA) were conducted using the Japanese and US longline indices. Catch-at-age for 1975-1998 was converted from the catch-at-size. Updated catch-at-age was considerably different from the previous one due to the revisions made in catch, size data and substitution. Unlike the previous assessment, the results were considerably different between the VPA models and depended strongly on the assumptions made regarding the selectivity of the oldest age group, especially in the trends in recruitment and spawning stock biomass except for the recent years. The Committee attempted to investigate the possible reason for this, such as the addition of longline catch by IUU fleets, changes in size selectivity at age (especially for older ages), but it was unable to do so due to time constraints. Despite their differences, however, the various VPAs all indicate that the spawning stock biomass has rapidly and substantially declined over the past 5 years and fishing mortality rates have increased quickly since the early 1990s.

Yield-per-recruit analyses **(BET-Figure 6)** provided the estimates of $F_{0.1}$ and F_{max}, which often used as benchmarks in the stock assessment. While current F is not well determined, it probably exceeds $F_{0.1}$ and is also likely to be higher than F_{max}, indicating that the bigeye stock is over-exploited. Current spawning stock biomass-per-recruit **(BET-Figure 6**) is less than 30% and probably around or lower than 20% of its maximum, which corresponds to a threshold at which recruitment over-fishing may occur for other fish species. Yield-per-recruit analysis suggests that there is no substantial increase in yield by intensifying fishing effort of any sector; however, yield-per-recruit can be increased by a reduction of fishing effort in the small-fish fisheries **(BET-Figure 7)**.

In VPA and yield-per-recruit analyses, the role of natural mortality (M), particularly for small fish, is very important; i.e., the impact of the small-fish catch on the large-fish fishery is large if M is relatively low, but it will be smaller if M is high. Without precise estimates of M, results could be misleading. Therefore, research designed to estimate M, such as tagging programs, should receive high priority.

BET-4. Outlook

Although stock projections were conducted, the results were not considered to be reasonable due to the problems encountered in VPA. Therefore, the outlook of this stock remains highly uncertain. Due to the revision made in the catch this year, 1998 catch increased by 15,000 MT compared with the figure when the current assessment was made. The 1999 catch was even higher (121,000 MT) despite the introduction of the moratorium on FAD fishing for the purse seine fishery as well as the catch limit imposed on Chinese Taipei. According to the available estimates on MSY and replacement yields, the current level of catch will not be sustained and further decline in biomass is anticipated.

BET-5. Effects of current regulations

The bigeye minimum size regulation of 3.2 kg was adopted in 1980 to reinforce the same regulation for yellowfin. It is clear that a large quantity of juvenile bigeye tuna smaller than 3.2 kg continue to be captured mostly from the equatorial surface fleets (baitboat and purse seine). The percentage of fish smaller than the minimum size **(BET-Figure 8)** has been generally increasing since 1991 and was at 53-55% for the last four years (1996-1999). According to the yield-per-recruit analysis **(BET-Figure 6)**, full implementation of this regulation could result in an increase in yield-per-recruit of almost 35% at F_{max}.

At the 1997 Commission Meeting, the Commissioners requested that the SCRS examine the results of observer programs adopted in 1996 for all tropical tuna fleets, including the results of a voluntary regulation which establishes a closed area and season of fishing on FADs for the purse seine fleet, in order to determine the areas and seasons of concentrations of juveniles and spawners. Although a full evaluation was not possible due to the multi-species nature of surface fisheries and existence of other types of fishery, this regulation appears effective in reducing fishing mortality for juvenile bigeye, at least for purse seine fishery which complied with this regulation (see Report of the evaluation of a closed area/season for the use of FADs by surface fisheries).

The last management measure for this species is a catch limit of 16,500 MT for Chinese Taipei. According to its catch report, the bigeye catch for Chinese Taipei in 1998 was below this limit (16,314 MT), but slightly higher in 1999 (16,837 MT).

BET-6. Management recommendations

The most recent catch statistics indicates a large increase of the total bigeye catch had occurred since around 1990, reaching a record high at around 131,000 MT in 1994 from less than 100,000 MT of catch in the 1990-1992 period. The total catch declined after 1994 to some extent but again went up to 121,000 MT in 1999. In general, all types of fishery showed similar increase in catch for the most recent few years. The results of all production model analyses indicated the stock is over-exploited in recent years, although MSY levels are not well determined. A declining trend in adult biomass, especially after about 1993, was also shown by various VPA runs. It is likely that catch level above or around 100,000 MT cannot be sustained in the long term and may result in further substantial declines in stock size.

In 1997, the Committee recommended a reduction of overall catch to at least the 1992 level (which was approximately 85,000 MT in the 1997 estimate but revised to 97,000 MT since then). The 1999 catch of 121,000 MT is considerably higher than the sustainable catch level. The result of production model suggested range of possible MSY somewhere between 94,000 MT (estimated for period 1961-1998, including the recent increase in catches) and 79,000 MT (estimated for period 1961-1992, before the recent increase of catches). As the present fishing mortality is larger than F_{MSY}, a significant reduction of fishing mortality for all fisheries, hence catch reduction, is required to reach a catch level which produces either of the MSY estimates for the two periods. Therefore, the Committee recommends a catch reduction towards 80,000 MT which could prevent a further decline of the stock, but a further reduction of catch is required to rebuild the stock at MSY.

A voluntary time/area closure of FAD fishing was introduced to the purse seine fishery from November 1997, to January 1998, and from November 1998, to January 1999, in order to protect juvenile tunas. This measure became an ICCAT regulation in June 1999, and was further expanded to cover all surface fleet since June 2000. The analysis of available data indicated that while the catch of juvenile tunas by the purse seine fleets which participated this measure have declined, this decline was compensated by the catch by the fleets who did not participated. Therefore, the effect would be higher if this closure was perfectly impremented by all the surface fleets fishing on FAD. The percentage of fish less than 3.2 kg (minimum size) has been the highest at 53-55% since 1996, and the Committee remains concerned that the percentage of undersized fish continued to be very high. The Committee, therefore, recommends that effective measures be found to reduce fishing mortality of small bigeye, taking into account multi-species nature of the surface fisheries. The benefit of reduction in small bigeye catch is supported by results of yield-per-recruit (leading to higher overall catch) as well as spawning biomass-per-recruit (leading to higher survival of spawning stock) analyses.

The Committee anticipates that the on-going BETYP will enhance the assessment in the near future to a great extent so that the Committee can provide the Commission with much more accurate advice.

ATLANTIC BIGEYE TUNA SUMMARY

Maximum Sustainable Yield (likely range)	79,000 - 94,000 MT*
Current (1999) Yield	121,000 MT
Current (1998) Replacement Yield**	72,000 - 85,000 MT ***
Relative Biomass (B_{1998}/B_{MSY})**	0.57 - 0.63***
Relative Fishing Mortality (F_{1998}/F_{MSY})**	1.50 - 1.82***
$F_{0.1}$****	0.22
F_{max}****	0.35
Management Measures in Effect	- 3.2kg minimum size [79-1] - 25% of FADs fishing vessels and 5% of others to be covered with observers [96-1] - Provide a list of vessels (>80 GRT) fishing Atlantic bigeye [97-13] - Limit on number (associated with GRT) of Atlantic BET fishing vessels (>24 m LOA) to average number of 1991-1992 (not applicable to countries catching less than 2000 MT average over recent five years) [98-3]. - Provide a list of vessels (>24 m LOA) fishing Atlantic BET by August 31 [98-2] - Limit number of Chinese Taipei BET fishing vessels to 125 [98-3] - Catch limit (16,500 MT) for Chinese Taipei [98-3]. - Moratorium on FAD fishing for all surface fleets, Nov. 2000 to Jan, 2001, in eastern tropical area [99-1]

* This range is representative of MSY ranges predicted by the non-equilibrium production model and the equilibrium production model.

** Non-equilibrium production model estimate.

***These are ranges of point estimates obtained and no confidence limits are given.

****Yield-per-recruit estimate based on the 1998 selectivity pattern.

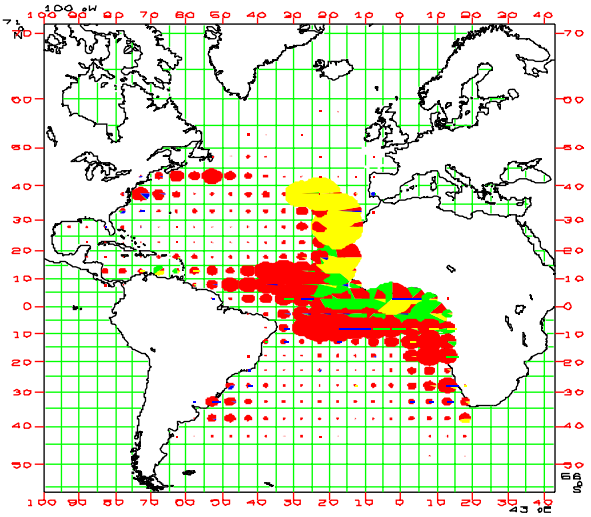
[ ] These indicate the reference numbers given in COM-SCRS/00/10.

BET-Table 1. Estimated catches (reported and carried over, in MT) of bigeye tuna in 1977-1999, by major gear and flag.

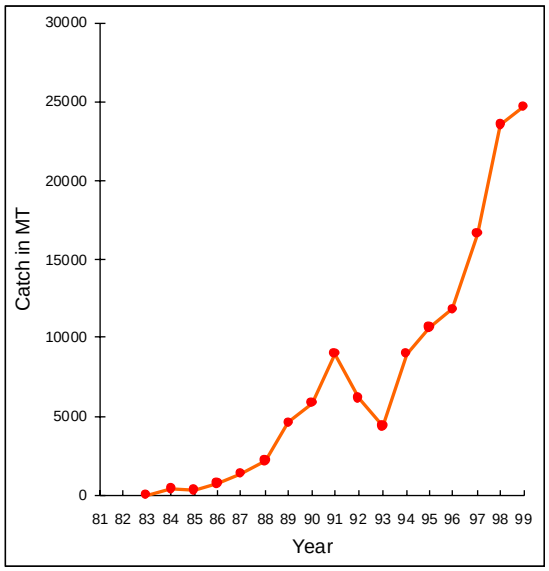
FLAG	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	
TOTAL	**54880**	**52693**	**45975**	**63596**	**67753**	**73493**	**59384**	**71051**	**78215**	**65395**	**55975**	**65796**	**78067**	**84336**	**96925**	**96682**	**109916**	**130283**	**125792**	**120719**	**105014**	**107319**	**124659**	
SURFACE	***25349***	***23897***	***18415***	***21919***	***26145***	***21688***	***25604***	***27691***	***25502***	***25388***	***20311***	***17981***	***19443***	***27693***	***35227***	***34196***	***46612***	***51806***	***50742***	***45682***	***36111***	***38293***	***42333***	
BAITBOAT	*12758*	*14629*	*9591*	*12349*	*10124*	*6922*	*9796*	*11439*	*17651*	*15618*	*12631*	*9710*	*12672*	*18106*	*18767*	*16248*	*16467*	*20296*	*25552*	*19040*	*18721*	*21027*	*21743*	
PURSE SEINE	*11875*	*9094*	*8343*	*9204*	*15656*	*14476*	*15654*	*16063*	*7554*	*9286*	*7148*	*7859*	*6371*	*9407*	*16169*	*17472*	*29676*	*30747*	*24888*	*26446*	*17037*	*17023*	*19539*	
OTHER SURF	*716*	*174*	*481*	*366*	*365*	*290*	*154*	*189*	*297*	*484*	*532*	*412*	*400*	*180*	*291*	*476*	*469*	*763*	*302*	*196*	*353*	*243*	*1051*	
LONGLINE	***29531***	***28796***	***27560***	***41677***	***41608***	***51805***	***33757***	***43303***	***52595***	***39942***	***35570***	***47758***	***58389***	***56537***	***61556***	***62359***	***63126***	***78267***	***74791***	***74880***	***68742***	***69012***	***82295***	
UNCL GEAR	***0***	***0***	***0***	***0***	***0***	***0***	***23***	***57***	***118***	***65***	***94***	***57***	***235***	***106***	***142***	***127***	***178***	***210***	***259***	***157***	***161***	***14***	***31***	
ARGENTINA	84	23	0	0	0	0	0	0	100	41	72	50	17	78	22	0	0	0	0	0	0	0	0	
BENIN	0	0	0	0	40	45	0	0	0	15	6	7	8	10	10	7	8	9	9	9	9	14	0	
BRASIL	1183	812	782	698	505	776	535	656	419	873	756	946	512	591	350	790	1256	596	1935	1707	1237	644	2024	
CANADA	0	0	0	0	0	0	0	0	0	11	144	95	31	10	26	67	124	111	148	144	166	120	263	
CAP-VERT	47	464	45	27	72	200	293	167	112	86	60	117	100	52	151	105	85	209	66	16	10	1	1	
CHINA PR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	70	428	478	520	427	1503	7347	
CHINESE TAIPEI	3364	2970	2486	2561	1887	2147	1623	925	1220	1125	1488	1469	940	5755	13850	11546	13426	19680	18023	21850	19242	16314	16837	
CONGO	0	0	0	5	0	0	0	0	8	19	10	10	14	15	12	12	14	9	9	8	0	0	0	
CUBA	1800	2300	2300	1385	711	521	421	447	239	171	190	151	87	62	34	56	36	7	7	5	0	0	0	
EC-ESPANA	9736	6849	5419	8430	10010	9332	8794	13617	10340	10884	8875	8475	8263	10355	14705	14656	16782	22096	17849	15393	12513	6854	13379	
EC-FRANCE	8970	8985	7308	6283	8020	7074	8124	4254	4615	4266	3905	4161	3261	5023	5581	6888	12719	12263	8363	9171	5980	5624	5529	
EC-PORTUGAL	4522	5350	3483	3706	3086	1861	4075	4354	6457	7428	5036	2818	5295	6233	5718	5796	5616	3099	9662	5810	5437	6334	3062	
G.EQUATORIAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	
GABON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	87	10	0	0	0	184	
GHANA	237	124	238	332	780	791	491	2162	1887	1720	1178	1214	2158	5031	4090	2866	3577	4738	5517	5805	7431	13252	11460	
GRENADA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	65	25	20	10	10	0	1	0	0	*
ICELAND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
JAPAN	10144	9863	12150	20922	22091	33513	15212	24870	32103	23081	18961	32064	39540	35231	30356	34722	35053	38503	35477	33171	26489	24657	23690	
KOREA	8090	9716	8022	10235	12274	10809	9383	8989	10704	6084	4438	4919	7896	2690	802	866	377	386	423	1250	796	163	124	
LIBERIA	0	0	0	0	0	0	0	0	0	0	0	0	206	16	13	42	65	53	57	57	57	0	0	
LIBYA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	508	1085	500	400	400	400	0	0	
MAROC	324	394	414	387	622	625	552	120	30	0	8	0	0	0	0	0	0	0	0	0	0	0	700	
MEXICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	0	6	8	6	
NAMIBIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	29	7	46	16	423	
NEI	0	0	0	0	0	338	1187	526	354	758	1491	2175	4743	6641	10859	7710	6772	11625	14878	17197	19659	28938	32406	
NORWAY	0	0	0	0	0	0	0	0	0	0	0	60	0	0	0	0	0	0	0	0	0	0	0	
PANAMA	1493	2127	513	4518	2500	2844	2732	3165	4461	5173	5616	3847	3157	5258	8462	8819	10438	13423	10374	6785	2837	1738	26	
PHILIPPINES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1154	943	
POLAND	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
RUSSIA FED.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	504	673	797	597	1125	1427	981	
SAO TOME & PRINCIPE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	
SENEGAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	4	126	177	135	135	0	0	
SOUTH AFRICA	0	0	19	422	381	137	187	60	102	168	200	553	367	296	72	43	88	76	27	7	10	41	41	
ST.LUCIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	*
ST.VINCENT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	4	2	0	0	*
TOGO	0	0	0	0	0	0	14	52	18	24	22	7	12	12	6	2	86	23	6	33	33	0	0	
TRINIDAD & TOBAGO	0	0	0	0	0	0	191	41	22	0	0	1	19	57	263	0	258	0	0	17	8	4	0	*
U.S.A	331	248	212	202	158	422	315	538	639	1084	1074	1127	846	623	974	813	1089	1402	1209	882	1137	928	1261	
U.S.S.R	4086	2202	2229	2813	2832	635	352	1233	870	1071	1887	1077	424	95	0	0	0	0	0	0	0	0	0	
UK-BERMUDA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	
UK-S.HELENA	5	22	8	9	14	23	14	19	0	0	5	1	1	3	3	10	6	6	10	10	12	17	6	
URUGUAY	0	0	0	0	86	397	605	714	597	177	204	120	55	38	20	56	48	37	80	124	69	59	59	
VENEZUELA	464	244	347	661	1684	999	4284	4142	2918	1136	349	332	115	161	476	270	809	457	457	189	274	222	128	

Shaded cells indicate estimated catches. In some cases the Committee has assumed the catch to be the same as the latest data available

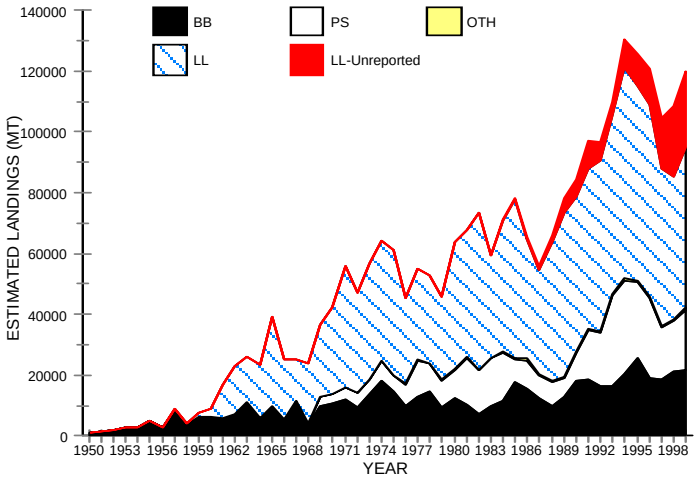
* Task 1was received after the assessment, and hence is not included in the table. (Table contains the data used at the assessments, July, 2000)



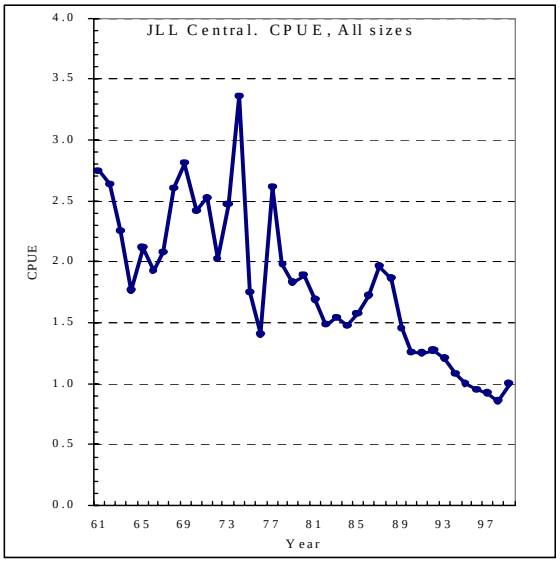
BET-Fig. 1. Geographical distribution of bigeye catch by major tuna fisheries. Dark shaded, light shaded, medium shaded and black areas in circles corresponds to catches by longline, purse seine, baitboat and other fisheries, respectively.



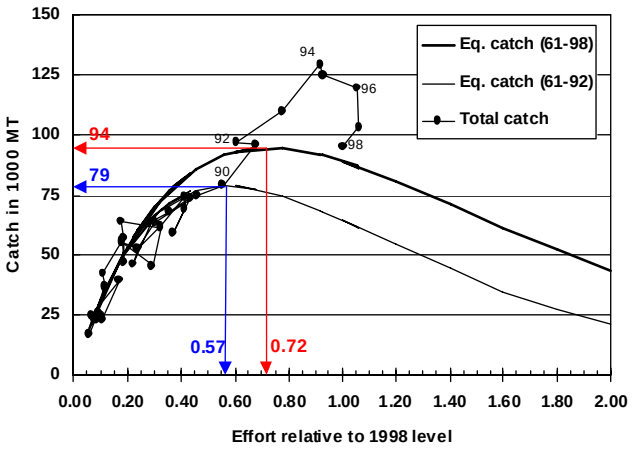
BET-Fig. 2. Estimates of non-reported catch of bigeye by longliners, based on the Japanese import statistics.



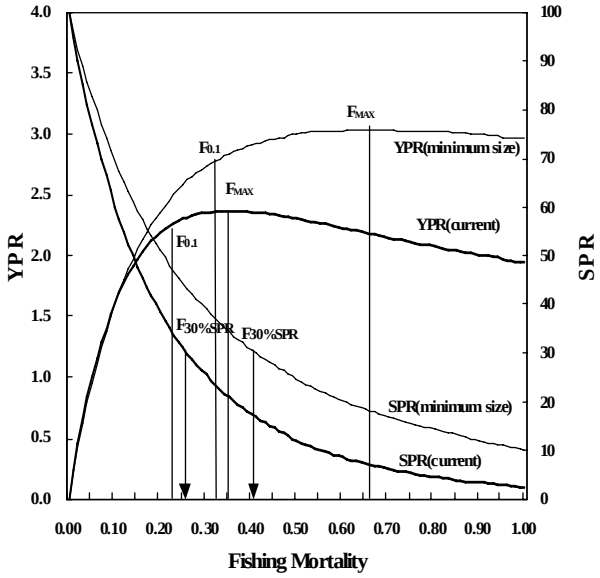
BET-Fig. 3. Cumulative landings (MT) of bigeye tuna in the Atlantic by gear categories: baitboat (BB), purse seine (PS), other (OTH), longline (LL), and IUU longline (LL-IUU).



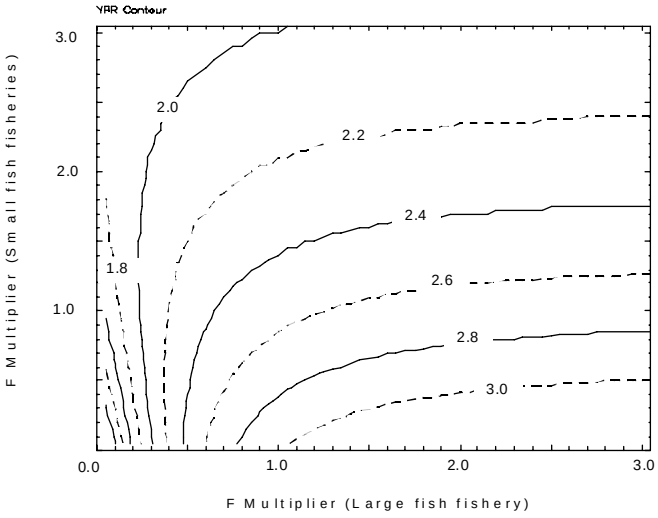
BET-Fig. 4. Abundance index (in relative numbers of fish) from the Japanese longline fishery.



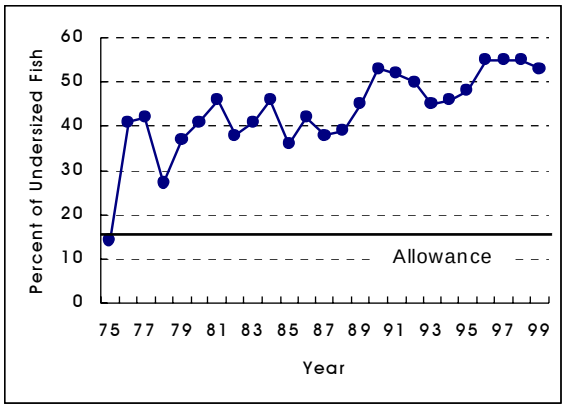
BET-Fig. 5. Production curve (shape parameter=1.01) estimated by PRODFIT plotted with observed catch-effort trajectory. Heavy (upper) line indicates curve estimated with all data points and fine line indicates one applied to data for 1961-1992.



BET-Fig. 6. Yield-per-recruit (YPR) and spawning biomass-per-recruit (SPR) for bigeye tuna assuming current selectivity (heavy lower curves) and selectivity of a full compliance of a 3.2 kg minimum size (fine upper curves). Vertical lines with an arrow indicate $F_{30\%SPR}$.



BET-Fig. 7. Results of multi-gear yield-per-recruit analysis reflecting the 1998 situation. Large fish fishery (X-axis) and small fish fishery (Y-axis) correspond to longline fishery and all other fisheries, respectively.



BET-Fig. 8. Annual trend in percentages of undersized bigeye (below the 3.2 kg minimum size) for the fishery overall.

7.3. SKJ - SKIPJACK TUNA

SKJ-1 Biology

Skipjack tuna is a cosmopolitan species forming schools in the tropical and subtropical waters of the three oceans. Skipjack spawn opportunistically throughout the year in vast areas of the Atlantic Ocean. The size at first maturity is about 45 cm for males and about 42 cm for females in the East Atlantic, while in the West sexual maturity is reached at 51 cm for females and at 52 cm for males. Skipjack growth is variable and seasonal, and substantial differences in growth rates have been reported between areas. There remain considerable uncertainties about these growth rates and the variability in growth between areas. It is therefore a priority to gain more knowledge on the growth schemes of this species.

Skipjack is a species that is often associated with floating objects, both natural objects or diverse FADs that have been used extensively since the early 1990s by purse seiners and baitboats (during the 1991 to 1999 period, about 40% of skipjack were caught with FADs. The concept of viscosity (low interchange between areas) could be appropriate for the skipjack stocks. A viscose stock can have the following characteristics:

- a local decline of a segment of the stock;
- over-fishing of that component will have little, if any, repercussion on the abundance of the stock in other areas;
- there is a minor proportion of fish that make large-scale migrations.

The introduction of fish aggregating devices could have changed the behavior of the schools and the migrations of this species. Prior to the use of those devices, the free schools of mixed species were much more common than now. Due to the large number of FADs, and the tendency of skipjack to associate with floating objects, substantial behavioral changes, including movements patterns, may occur. These behavioral changes may imply changes in the biological parameters of this species as a result of the changes in the availability of food, predation and fishing mortality. Skipjack caught with FADs are usually associated with small yellowfin (20%) and with small bigeye (17%) and also with other tuna species.

A comparison of size distributions of skipjack between periods prior to and after the introduction of FADs show that, in the East Atlantic, there has been an increase in the proportion of small fish in the catches, as well as a decline in the total catch in recent years in some areas.

The Committee reviewed the current stock structure hypothesis which consists of two separate management units, one in the East Atlantic and another in the West Atlantic, separated at 30ºW. The boundary of 30ºW was established when the fisheries were coastal, whereas in recent years the East Atlantic fisheries have extended towards the West, surpassing this longitude, and showing the presence of juvenile skipjack tuna along the Equator, to the West of 30ºW, following the drift of the FADs. This would imply the possibility of a certain degree of mixing **(SKJ-Figure 1).**

Taking into account the large distances, various environmental restrictions, the existence of a spawning area in the East Atlantic as well as in the northern zone of the Brazilian fishery, and the lack of additional evidence (e.g. transatlantic migrations in the tagging data), the hypothesis of separate East and West Atlantic stock has been maintained as the more plausible alternative.

In addition, taking into account the biological characteristics of this species and the different areas where fishing takes place, smaller management units could be considered.

SKJ-2. Description of the fisheries

Skipjack are caught almost exclusively by surface gears in the entire Atlantic Ocean, although minor amounts of skipjack are taken by longline as by-catch (see **Figure 1** for catch distribution). Reported catches are considered to be somewhat under-estimated, due to the discards of small-sized tunas, which include skipjack, by the purse seine fleets fishing under objects and by some baitboat fleets in the equatorial area of the East Atlantic.

Total Atlantic catches in 1999 amounted to 163,435 MT **(SKJ-Table 1, SKJ-Figure 2**.

As concerns the East Atlantic, the skipjack fishery underwent important changes in 1991, with the introduction of artificial floating objects (FADs), with the subsequent expansion of the purse seine fishery towards the West (30°W), in latitudes close to the Equator, following the drift of the objects, the introduction of FADs in the Ghanian purse seine and baitboats(1992), and the development of a fishing technique (whose main target species is bigeye) in which the baitboat is used as the aggregating device, fixing the school (comprised of bigeye, yellowfin and skipjack) during the entire fishing season in waters off Senegal, Mauritania and the Canary Islands (1992). These changes have resulted in an increase in the exploitable biomass of the skipjack stock (due to the expansion of the fishing area) and in its catchability. At present, the most important fisheries are the purse seine fisheries, mainly those of EC-Spain, EC-France, the NEI fleet (Vanuatu, Malta, Morocco, Belize, Guinea, Dutch Antilles, Panama, and St. Vincent) and Ghana, followed by the baitboat fisheries (Ghana, EC-Portugal, EC-Spain and EC-France). In 1999, catches reached 136,192 MT, which represents an increase of 13% as compared to 1998 (120,962 MT) **(SKJ-Figure 2).**

The most important fishery in the West Atlantic is the Brazilian baitboat fishery. As concerns the purse seine fisheries, whose catches are considerably less than those taken by baitboat, catches were only made by the Venezuelan, Panamanian and Brazilian fleets. The 1999 catches amounted to 27,043 MT, slightly less than in 1998 (28,799 MT) **(SKJ-Figure 4).**

There is no information available on the effective fishing effort exerted on skipjack in the East, particularly after the introduction of fishing with artificial floating objects. Considering the carrying capacity of the vessels as a measure of nominal effort, in the East Atlantic Ocean, the total carrying capacity of the baitboat fleets remained stable between 1972 and 1998. On the other hand, purse seine carrying capacity showed an increasing trend until 1983, and a spectacular decline in 1984, due to the shift of a part of the fleet to the Indian Ocean. Since 1991, this carrying capacity of the purse seine fleet has declined gradually, although in 1999 the decreasing trend of recent years was interrupted **(SKJ-Figure 5).**

The increase in the efficiency of the fleet due to technological improvements, the development of fishing with floating objects, etc., as described by the Working Group on Abundance Indices in the Tropical Tuna Surface Fisheries (Miami, 1998), have resulted in an increase (not well quantified) in the effective effort of the different fleets. Preliminary analyses estimated an average annual increase of 5% in efficiency of all the fleets for the period considered (1969-1998). Therefore, fishing effort expressed in number of fishing days is not a precise measure of effective fishing effort on skipjack, even though this type of information should be taken into account.

Fishing effort of Brazilian baitboats decreased by half between 1985 and 1996, whereas an increase in effort was observed between 1997 and 1998 which, in 1999, remained at the level of the previous year.

The fluctuation in the overall size of the area exploited by a fishery is an important component in the assessment of the eastern stock. The number of 1ºx1º squares in which the purse seine fishery caught skipjack in the East Atlantic shows an increasing trend since the end of the early 1970s **(SKJ-Figure 6)**. However, the expansion of the fishing grounds was not continuous throughout the years. It seems skipjack catches are very much related to the number of 1ºx1º squares exploited. In the absence of other measures of fishing effort, the number of squares exploited could be considered as an alternative measure.

SKJ-3. State of the stocks

The state of the Atlantic skipjack stocks, as well as the rest of the stocks of this species, show a series of characteristics that make it extremely difficult to conduct an assessment using current models. Of these characteristics, the most noteworthy are:

– Continuous recruitment throughout the year, but heterogeneous in time and area, making it impossible to identify and monitor the individual cohorts;

-- Apparent variable growth between areas, which makes it difficult to interpret the size distributions and their conversion to ages;

– The exploitation by many and diverse fishing fleets (baitboat, purse seine), having distinct and changing catchabilities, which makes it difficult to estimate the effective effort exerted on the stock in the East Atlantic.

For these reasons, no standardized assessments were carried out on the Atlantic skipjack stocks. Notwithstanding,

some estimates were made, by means of different indices of the fishery and some exploratory runs were conducted using a new development of the generalized production model.

Eastern stock

Standardized catch rates are not available. However, an analysis was made of the different indices of the purse seine fishery which could provide valuable information on the state of the stock. The indices analyzed were: catches, catch per day fishing, number of sets per fishing day, positive sets, catch by $1^{o}x1^{o}$ exploited **(SKJ-Figure 7)**, average weight, Grainger and Garcia index (annual growth rate of catches with respect to the average catch of the previous three years). For the majority of the indices, the trends were divergent, depending on the area, which may indicate the viscosity of the skipjack stock with limited mixing rates between areas. In general, the development of the catches (with stable nominal effort), the average weights, and the catch per positive set show a possible scenario of local over-fishing in the Equatorial area of maximum fishing concentration on FADs, even though the last index could be biased by increases in the catchability of the purse seiners. Other indices, such as the number of sets per fishing day or the catch by area fished could also show similar biases. In other areas, particularly in the Senegalese area where there is a predominance of fishing on free schools, the trends of the indices showed a completely distinct stock situation.

On an overall level, the Grainger & García index **(SKJ-Figure 8)**, a gross indicator of stock status for situations such as that of the skipjack fisheries in the East Atlantic with increasing effort, showed negative values since the early 1990s. This could be interpreted as a warning sign that catches are too high. However, the Group expressed doubts about the validity of this conclusion to the entire eastern stock.

A new, non-equilibrium production model was presented based on a generalized model. A run of the fit of this model showed a possible decline in the yield of the stock following the introduction of FADs, however the MSY estimates are considered too preliminary to be utilized as a measure of the state of the stock. In the same way, the model estimated a possible generalized increase in the efficiency of the fishing gears of about 5% annually.

Because of the difficulties to assign ages to the skipjack catches, the estimates of the values of natural mortality by age and obtaining indices of abundance (especially for the eastern stock), no catch-by-age matrices were developed and, consequently, no analytical assessment methods (VPA type) were applied.

Western stock

Standardized abundance indices up to 1998 were available from the Brazilian baitboat fishery and the Venezuelan purse seine fishery **(SKJ-Figure 9)**, and in both cases the indices showed a stable stock status.

SKJ-4. Outlook

Uncertainties in the underlying assumptions for the analyses prevent definitive conclusions regarding the state of the stock. However, the results suggest that there may be over-exploitation within the FAD fishery, although it was not clear to what extent this applies to the entire stock.

The Committee could not determine if the effect of the FADs on the resource were only at the local level or if it had a broader impact, affecting the biology and behavior of the species. Under this supposition, maintaining high concentrations of FADs would reduce the productivity of the overall stock. however, in the last two years (1997 and 1998) due to the implementation of a voluntary Protection Plan for Atlantic tunas, agreed upon by the Spanish and French boat owners in the usual areas of fishing with objects, has resulted in a reduction in the skipjack catches associated with FADs. Maintaining this closure could have a positive effect on the resource.

SKJ-5. Effects of current regulations

There is currently no specific regulation in effect for skipjack. However, the French and Spanish boat owners have voluntarily applied a “Protection Plan for Atlantic Tunas”, for the period of November, 1997, through January, 1998, and November, 1998, through January, 1999. A similar moratorium was recommended by the Commission and applied during the months of November and December 1999, through January 2000. The purse seine skipjack catches on FADs by fleets applying the Protection Plan were reduced by 65% in comparison to the average catches for the

1993-1996 period, before the moratorium, and those for the 1997-1999 period, when the moratorium was in place. Overall, skipjack catches taken by purse seine fleets that have complied with the moratorium have decreased by 37%, which corresponds to 37,000 MT annually.

SKJ-6. Management recommendations

No management recommendations were proposed.

ATLANTIC SKIPJACK SUMMARY

	East	*West*
Maximum Sustainable Yield	not estimated	not estimated
Current (1999) Yield	136,192 MT	27,043 MT
Current Replacement Yield (1998)	Not estimated	not estimated
Relative Biomass (B_{1999}/B_{MSY})	Not estimated	not estimated
Relative Fishing Mortality: F_{1999}/F_{MSY}	Not estimated	not estimated
Management Measures in Effect	None	None

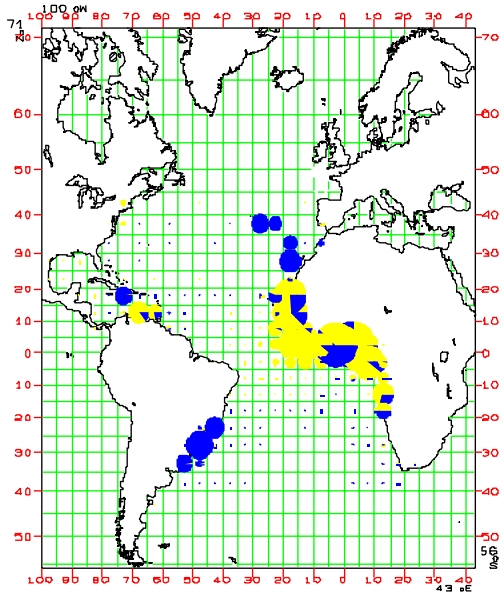
SKJ-Table 1. Estimated landings (reported and carried over, in MT) of skipjack tuna in 1977-1999, by major gear and flag.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TOTAL	**110577**	**108115**	**89696**	**111358**	**131060**	**154909**	**135038**	**126826**	**118713**	**122172**	**114565**	**139962**	**116119**	**138658**	**214373**	**157431**	**194232**	**175892**	**164304**	**155591**	**145266**	**150102**	**163435**
PURSE SEINE	*58283*	*62141*	*38455*	*59806*	*71127*	*84529*	*76613*	*79753*	*59539*	*63561*	*55517*	*69190*	*49726*	*78043*	*145419*	*98675*	*141118*	*113325*	*110212*	*98773*	*78722*	*81816*	*97254*
BAITBOAT	*44786*	*44177*	*49010*	*47485*	*56917*	*66890*	*54930*	*44856*	*58358*	*55287*	*57478*	*69072*	*64292*	*58815*	*66164*	*56512*	*51354*	*60655*	*51728*	*56053*	*65686*	*67001*	*65520*
OTHERS	*7508*	*1797*	*2231*	*4067*	*3016*	*3490*	*3495*	*2217*	*816*	*3324*	*1570*	*1700*	*2101*	*1800*	*2790*	*2244*	*1760*	*1912*	*2364*	*765*	*858*	*1285*	*661*
E. Atl Surface	**107128**	**100885**	**83119**	**98766**	**107919**	**122366**	**102600**	**91208**	**78435**	**89999**	**90396**	**116222**	**89670**	**112407**	**180210**	**127202**	**161009**	**145934**	**142394**	**128056**	**113395**	**120962**	**136192**
PURSE SEINE	*57683*	*58680*	*36966*	*56734*	*66473*	*74824*	*65492*	*61795*	*48348*	*58353*	*50553*	*66875*	*47260*	*74802*	*136892*	*90166*	*128324*	*107613*	*108153*	*95424*	*74375*	*77990*	*94386*
BAITBOAT	*42386*	*41365*	*44645*	*38134*	*38918*	*44488*	*34873*	*28085*	*29868*	*30009*	*38803*	*48015*	*41000*	*36569*	*42192*	*35660*	*31657*	*38010*	*33984*	*32312*	*38889*	*42277*	*41639*
OTHER SURFACE	*7059*	*840*	*1508*	*3898*	*2528*	*3054*	*2235*	*1328*	*219*	*1637*	*1040*	*1332*	*1410*	*1036*	*1126*	*1376*	*1028*	*311*	*257*	*320*	*131*	*695*	*167*
ANGOLA	4036	3501	3628	3482	2532	2257	318	46	131	56	80	30	85	69	66	41	13	7	3	15	52	2	32
BENIN	0	0	8	30	60	68	38	10	20	11	5	3	7	2	2	2	2	2	2	2	0	0	0
CANADA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAP-VERT	748	1284	998	2094	1588	1636	1400	1391	2030	877	2076	1456	971	806	1333	864	860	1007	1314	470	591	682	961
CAYMAN ILS	0	0	0	289	1800	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CONGO	0	0	0	1250	200	0	5	10	8	8	8	8	11	12	9	9	10	7	7	6	0	0	0
CUBA	100	200	100	196	198	189	135	310	246	569	81	206	331	86	0	0	7	0	0	0	0	0	0
EC-ESPAÑA	22257	25066	18748	26384	35458	38016	28934	46659	35100	41992	33076	47643	35300	47834	79908	53319	63660	50538	51594	38538	38513	36008	44519
EC-FRANCE	31138	25903	18602	25767	26926	31132	29727	12994	13645	13045	17114	16504	15211	17099	33271	21890	33735	32779	25188	23107	17023	18382	20344
EC-PORTUGAL	4388	4584	3074	1954	2825	5530	1113	3974	2409	5446	8420	14257	7725	3987	8059	7477	5651	7528	4996	8295	4399	4536	1808
GABON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	11	0	26	0	0	0
GHANA	3492	2866	4299	5812	7858	18272	24376	20697	19082	22268	24347	26597	22751	24251	25052	18967	20225	21258	18607	19602	27667	34150	43460
JAPAN	16845	14614	14686	12304	12935	9930	6002	1504	2098	2031	1982	3200	2243	2566	4792	2378	0	0	0	0	0	0	0
KOREA	3600	8132	12017	6718	7538	2827	1553	687	153	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAROC	3851	1891	1863	5001	3017	3956	2532	885	1015	1222	1041	428	295	1197	254	559	312	248	5024	684	4513	2486	858
NAMIBIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	15	0	1	0	0
NEI-1	0	0	0	0	0	1560	3383	927	590	540	791	2994	2263	10516	16986	15152	20627	17155	16015	23109	13250	17553	19601
NORWAY	0	0	0	0	0	0	0	0	0	0	581	738	0	0	0	0	0	0	0	0	0	0	0
PANAMA	3970	2980	1750	1735	144	2541	1611	0	0	0	0	0	0	0	8897	5126	14022	13435	16417	11911	3536	2498	719
RUSSIA FED.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1175	1110	1745	1705	2800	1939	3278	4100	3611
SAO TOME & PRINCIPE	118	100	34	33	90	78	103	18	20	20	20	21	22	25	24	25	15	0	0	0	7	0	0
SENEGAL	0	0	0	0	0	0	0	0	0	0	0	0	47	134	343	260	53	193	293	265	265	265	265
SOUTH AFRICA	40	90	2	48	88	37	44	11	64	87	88	157	96	17	15	7	6	4	4	1	6	2	1
U.S.A	5859	6797	2073	2608	2800	79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U.S.S.R	6674	2856	1161	2991	1750	3957	1223	1000	1404	1688	547	1822	1915	3635	0	0	0	0	0	0	0	0	0
UK-S.HELENA	12	21	76	70	112	271	103	85	62	139	139	158	397	171	24	16	65	55	115	86	294	298	13
VENEZUELA	0	0	0	0	0	0	0	0	358	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W. Atl Surface	**3229**	**6970**	**6187**	**12483**	**22904**	**32209**	**31433**	**34872**	**39963**	**31836**	**23928**	**23575**	**26106**	**25776**	**32885**	**29818**	**32927**	**28901**	**19979**	**27321**	**31619**	**28799**	**27043**
PURSE SEINE	*600*	*3461*	*1489*	*3072*	*4654*	*9705*	*11121*	*17958*	*11191*	*5208*	*4964*	*2315*	*2466*	*3241*	*8527*	*8509*	*12794*	*5712*	*2059*	*3349*	*4347*	*3826*	*2868*
BAITBOAT	*2400*	*2812*	*4365*	*9351*	*17999*	*22402*	*20057*	*16771*	*28490*	*25278*	*18675*	*21057*	*23292*	*22246*	*23972*	*20852*	*19697*	*22645*	*17744*	*23741*	*26797*	*24724*	*23881*
OTHER SURFACE	*229*	*697*	*333*	*60*	*251*	*102*	*255*	*143*	*282*	*1350*	*289*	*203*	*348*	*289*	*386*	*457*	*436*	*544*	*176*	*231*	*475*	*249*	*294*

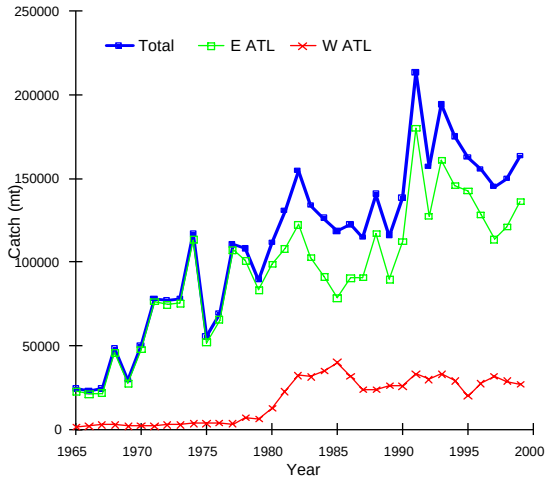
SKJ-Table 1 (cont.)**.** Estimated landings (reported and carried over, in MT) of skipjack tuna in 1977-1999, by major gear and flag.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
(W. Atl Surf.)																							
ARGENTINA	33	4	0	17	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BRASIL	188	633	2064	6070	13913	18322	15944	13567	25101	23155	16283	17316	20750	20130	20548	18533	17762	20582	16530	22519	26564	23786	23188
CANADA	0	86	0	0	180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COLOMBIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2074	0	0	0	0	0	0
CUBA	2400	1800	2000	2255	1086	1134	1700	1248	1632	1277	1101	1631	1449	1443	1596	1638	1017	1268	886	1000	1000	651	651
DOMINICAN REP.	41	64	87	59	71	80	106	68	204	600	62	63	117	110	156	135	143	257	146	146	146	146	146
EC-ESPANA	266	2031	1052	0	0	0	209	2610	500	0	0	0	0	0	1592	1120	397	0	0	0	0	0	0
EC-FRANCE	0	0	86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GHANA	0	0	0	185	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRENADA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0
JAPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PANAMA	0	720	161	1026	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	319
U.S.A	301	1632	737	981	2753	28	696	853	1814	1114	732	56	67	302	855	558	362	97	21	84	81	103	148
VENEZUELA	0	0	0	1890	4900	12645	12778	16526	10712	5690	5750	4509	3723	3791	8138	7834	11172	6697	2387	3572	3828	4113	2591
ALL ATLANTIC	**220**	**260**	**390**	**109**	**237**	**334**	**1005**	**746**	**315**	**337**	**241**	**165**	**343**	**475**	**1278**	**411**	**296**	**1057**	**1931**	**214**	**252**	**154**	**13**
LL+TRAW	*101*	*56*	*13*	*12*	*78*	*46*	*600*	*47*	*30*	*27*	*12*	*13*	*33*	*23*	*38*	*32*	*23*	*25*	*36*	*26*	*60*	*89*	*13*
UNCL GEAR	*119*	*204*	*377*	*97*	*159*	*288*	*405*	*699*	*285*	*310*	*229*	*152*	*310*	*452*	*1240*	*379*	*273*	*1032*	*1895*	*188*	*192*	*65*	*0*
ARGENTINA	0	0	0	0	0	137	243	505	101	138	90	7	111	106	272	123	50	1	0	0	0	0	0
BARBADOS	0	0	0	0	78	72	39	48	36	33	21	3	9	11	14	5	6	6	6	5	5	0	0
BENIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
BRASIL	2	2	1	1	0	0	1	0	0	0	3	0	0	0	0	2	9	6	30	9	0	3	0
BULGARIA	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHINA.PR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
CHINESE TAIPEI	0	12	10	7	9	20	8	13	7	1	2	8	22	0	37	29	11	17	5	15	54	75	4
COLOMBIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	789	1583	0	0	0	0
DOMINICA	0	0	0	0	0	0	0	0	0	0	0	0	0	60	38	41	24	43	33	0	0	0	0
EC-ESPAÑA	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
EC-GERMANY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
EC-PORTUGAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	8	2
ESTONIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	102	0	0	0	0	0	0	0	0
GABON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	51	0	0	59	0
GRENADA	0	1	4	8	1	1	15	12	7	9	5	22	11	23	25	30	25	11	3	11	15	15	15
JAMAICA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62	0	0	0
JAPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
KOREA	9	42	2	4	47	21	530	29	20	11	6	3	6	0	0	0	0	0	0	0	0	0	0
LATVIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	92	0	0	0	0	0	0	0	0
LITUANIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	221	0	0	0	0	0	0	0	0
MEXICO	0	0	0	1	3	0	25	30	48	11	13	10	14	4	9	8	1	1	0	2	3	0	2
NETHERLAND.ANT	0	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	45	40	35	30	30	30	30
PANAMA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RUMANIA	0	0	0	8	0	0	0	0	0	3	0	0	59	142	349	73	0	0	0	0	0	0	0
SOUTH AFRICA	0	0	0	0	22	0	60	3	2	14	0	0	0	0	0	0	0	0	0	0	0	0	0
ST.LUCIA	100	100	41	40	37	38	35	64	53	76	60	53	38	37	51	39	53	86	72	38	100	100	100
ST.VINCENT	0	0	0	0	0	0	0	0	0	0	0	17	28	29	27	20	66	56	53	37	42	42	42
TRINIDAD & TOBAGO	0	0	0	0	0	0	1	2	1	0	0	1	0	0	0	0	2	0	0	0	0	0	0
U.S.A	19	63	292	0	0	5	1	0	0	1	1	1	5	1	1	1	4	1	60	0	3	2	2
U.S.S.R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VENEZUELA	0	0	0	0	0	0	0	0	0	0	0	0	0	22	0	0	0	0	0	0	0	0	0

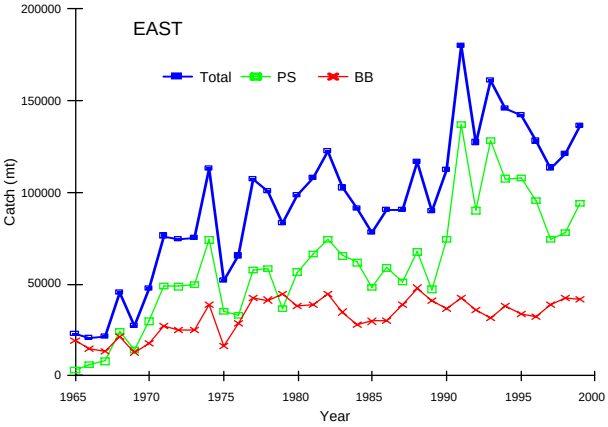
Shaded cells indicate estimated catches. In some cases the Committee has assumed the catch to be the same as the latest data available



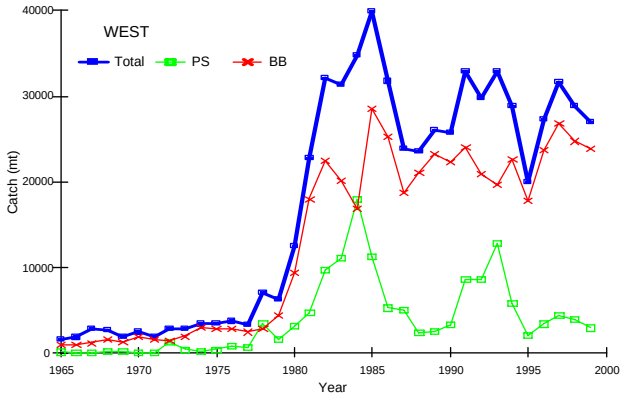
SKJ-Fig. 1. Distribution of reported surface skipjack catches by 5x5 area and by gear (medium shaded part represents purse seine and dark section represents baitboat catches).



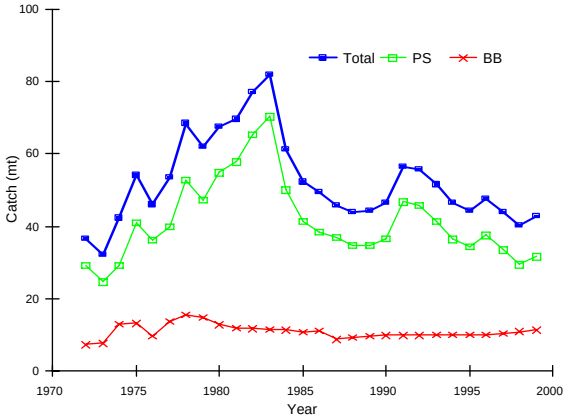
SKJ-Fig. 2. Total, eastern and western Atlantic skipjack landings (MT), 1965-1999.



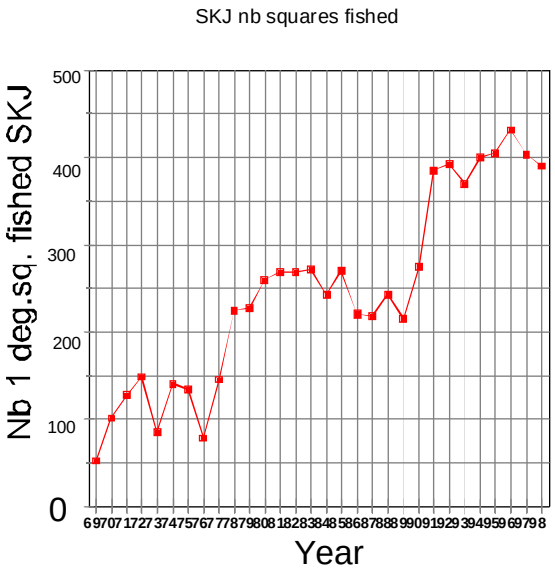
SKJ-Fig. 3. Reported landings of skipjack (MT) in the east Atlantic, by major gears.



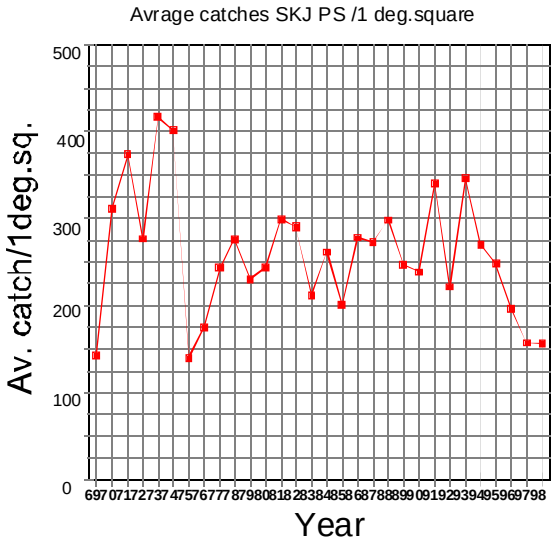
SKJ-Fig. 4. Reported landings of skipjack (MT) in the west Atlantic, by major gears.



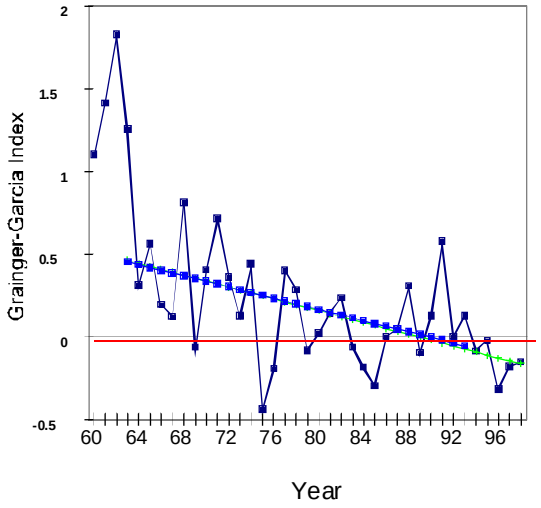
SKJ-Fig. 5. Carrying capacity of purse seiners and baitboats in the Atlantic.



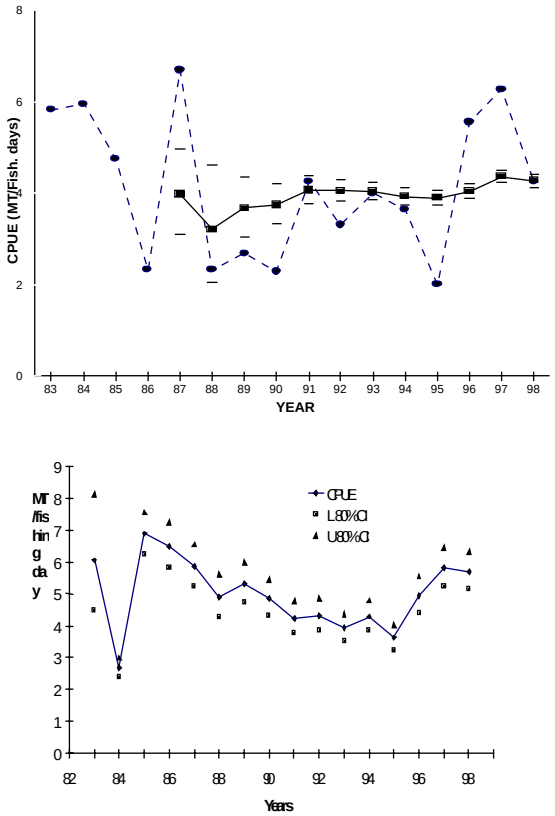
SKJ-Fig. 6. Number of 1x1 areas where skipjack catches were reported in the east Atlantic purse seine fisheries.



SKJ-Fig. 7. Skipjack catch per 1x1 square (where skipjack catches are reported) by the east Atlantic purse seine fishery during the period of 1969-1998.



SKJ-Fig. 8. Grainger and Garcia index and trend line calculated for east Atlantic skipjack.



SKJ-Fig. 9. Venezuelan purse seine (top) and Brazilian baitboat (bottom) CPUE estimated by GLM delta-log normal model. Dotted line on the top figure shows observed values.

7.4 ALB - ALBACORE

ALB-1. Biology

Albacore is a temperate tuna widely distributed throughout the Atlantic Ocean and Mediterranean Sea. On the basis of the biological information available, for assessment purposes the existence of three stocks is assumed: northern and southern Atlantic stocks (separated at 5ºN) and a Mediterranean stock (**ALB-Figure 1**).

Albacore spawning areas in the Atlantic are found in subtropical western areas of both hemispheres and throughout the Mediterranean Sea. Spawning takes places during austral and boreal spring-summer. Maturity is considered to occur at about 90cm FL (age 5) in the Atlantic, and somewhat smaller in the Mediterranean. Until this age they are mainly found in surface waters, where they are targeted by surface gears. Some adult albacore are also caught using surface gears but, as a result of their deeper distribution, they are mainly caught using longlines. Young albacore are also caught by longline in temperate waters.

ALB-2. Description of the fisheries

North Atlantic

The northern stock is exploited by surface and longline fisheries. Traditional surface fisheries include Spanish trolling and baitboats, used mainly in the Bay of Biscay and adjacent waters, and some Spanish and Portuguese baitboats around the Azorian Islands. New surface fishing gears, driftnets and pair pelagic/mid-water trawling, were introduced in 1987 in the Bay of Biscay and adjacent waters by France. Ireland and United Kingdom joined the driftnet fishery at the beginning of the 1990's. In 1998 Ireland initiated experimental fishing trials using trolling and pelagic trawling. These surface fisheries mainly target juveniles and sub-adults (50cm to 90cm FL). A longline fleet from Chinese Taipei targets sub-adult and adult albacore (60-120cm) in the central and western North Atlantic. Other fleets make minor catches and in most of the cases albacore constitute a component of the by-catch.

The total catch in the North Atlantic has shown a downward trend since mid 1960's, largely due to a reduction of fishing effort by the traditional surface and longline fisheries. In contrast, effort and catch in the new surface fisheries has increased since 1987. In 1999 the total catch (34,557MT) showed an increase on the catch in recent years (1996-1998). This increase occurred across all gear types.

South Atlantic

The main surface fleets that currently target the southern stock correspond to South Africa and Namibia. The resources were also exploited by Brazil and Chinese Taipei longliners. There are also some minor catches made by the purse seine fleet in the tropical area. The Chinese Taipei fleet target albacore at a fairly high level of effort. There has been an increase of the catches of young albacore in 1994-1996 by this fleet and also by the Namibian baitboats. South Africa initiated a tuna-directed, pelagic longline fishery in 1997 that takes a small bycatch of albacore.

Surface and longline catches have remained relatively constant at around 7,500MT and 20,000MT respectively during the last five years. This is due in part to the implementation of management regulations by some countries in response to the 1994 ICCAT resolution.

Mediterranean

The Mediterranean catches are highly uncertain. Estimated albacore catches in the Mediterranean, mainly by Italy and Greece, are still minor (<4000 MT) and do not show any significant trend over time (**ALB-Table 1** and **ALB-Figure 2**). Although EC-Italy and EC-Greece are the countries with largest catches in recent years, in 1999 EC-Italy did not report any catches. The Fifth Meeting of the GFCM/ICCAT Ad Hoc Working Group on Stocks of Large Pelagic Fishes in the Mediterranean recommended that in order to better identify which countries are catching albacore and what fishing methods are being used, a questionnaire should be devised and completed by nations operating in the Mediterranean.

ALB-3. State of the stocks

The Committee assessed the status of the North and South Atlantic albacore stocks after a review of Task I and Task II data available. The Committee recognized the considerable improvement in basic data for both stocks although some uncertainties still remain, especially in relation with some elemental biological parameters. No attempt was made to analyze the status of the Mediterranean stock. The GFCM/ICCAT meeting concluded that a Mediterranean stock assessment could not be attempted as even the level of catches are unknown.

North Atlantic

The Committee analyzed the state of the northern stock using a model (VPA) and data that were essentially the same as those used in previous assessments.

The results obtained (**ALB-Figure 3**) showed consistency with those from previous assessments. The abundance and biomass of adult fish (ages 5+) appear to have declined from mid-1970's to late 1980's, followed by an slight increase 1988-1990. The abundance and biomass of ages 5+ do not show any clear trend since 1990. Abundance of recruits (age 1) and juveniles (ages 2-4) varied from year to year with, perhaps, some declining trend from 1975-1985. The levels since then have been variable. The Committee noted that global environmental factors might explain some proportion of the recruitment variability during the last two decades. Moreover, previous studies based on historic data, indicate that it is possible that a higher level of recruitment occurred during the 1960's and 1970's associated with a different environmental regime.

The fishing mortality rate of juveniles (ages 2-4) shows a slight increasing trend during the period analyzed. Fishing mortality rates on adults (ages 5+) increased to a peak in 1986, then declined. Recent rates appear to be relatively high, but not as high as the peak year. The fishing mortality rate on ages 8+ also appears to be increasing, however, the estimation of this is quite variable.

With reference to the results shown in **ALB-Figure 4** equilibrium yield analyses, made on the basis of an estimated relationship between stock size and recruitment, indicate that current spawning stock biomass is about 30% below that associated with MSY. However, the Committee noted considerable uncertainties in these estimates of current biomass relative to the biomass associated with MSY (B_{MSY}), owing to the difficulty of estimating how recruitment might decline below historical levels of stock biomass. Thus, the Committee concluded that the northern stock is probably below B_{MSY}, but the possibility that it is above it should not be dismissed. However, equilibrium yield per recruit analyses made by the Committee indicate that the northern stock is not being growth-over fished ($F_{1999} < F_{max}$).

Sensitivity analyses were also conducted to explore the influence of several inputs and assumptions. Results of most sensitivity runs examined were very similar to the base case. However, these analyses suggest a possible conflict between two of the CPUE indices used in the model that needs to be addressed through further research. One of the sensitivity runs examined gave results that were considerably more optimistic than the base case.

South Atlantic

The age structured production model and VPA specifications for the South Atlantic albacore assessment were the same as used in 1998. The estimates of MSY from the production model (30,274 MT) and VPA (35,400 MT) models were comparable and both models estimate that current fishing mortality is about 50% below F_{MSY} (**ALB-Fig 5**). Spawning stock biomass appears to have declined substantially relative to the late 1980's, but the decline may have leveled off in recent years (**ALB-Fig 6**) and the estimates remain above the spawning stock biomass at MSY. Thus, the current assessment (based largely on the age structured production model) indicates that the stock is not being over fished and that the recent (1997-99) level of landings for the southern albacore stock can probably be maintained into the near future without causing a substantial decline in spawning stock biomass. However, the models do not fit the data well (**ALB-Fig 6**) and the parameters are very poorly estimated (as indicated by the very wide confidence intervals), as was true for the previous assessments. Therefore, the Committee cannot rule out the possibility that current fishing mortality is being underestimated until the Committee achieves greater certainty that relative abundance and catch are being measured appropriately.

ALB-4. Outlook

North Atlantic

In terms of yield per recruit, VPA assessment indicates that the fishing intensity is at, or below, the fully exploited level. Concerning MSY-related quantities, the Committee recalls that they are highly dependent on the specific choice of stock-recruitment relationship. The Committee believed that using a particular form of stock-recruitment relationship that allows recruitment to increase with spawning stock size provided a reasonable view of reality. This hypothesis together with the results of the VPA assessment indicate that the spawning stock biomass (B_{99}) for the northern stock (29,000MT) is about 30% below the biomass associated with MSY (42,300MT) and that current F is about 10% above F_{MSY}. However, an alternative model allowing for more stable recruitment values in the range of observed SSB values would provide a lower estimate of SSB at MSY, below the current value.

South Atlantic

The assessment indicated that the current level of exploitation may be maintained. The more optimistic perspective seen in 1998 is again evident in 1999, without the negative aspects shown in 1996 and 1997 assessments. This change in perception in 1998 can be partially explained by revision of some of the abundance indices adopted at that time.

ALB-5. Effects of current regulations

North Atlantic

In 1998, the Commission recommended that contracting parties, entities, and fishing entities fishing for northern albacore limit the number of vessels to the average number in the period 1993-1995. The Committee is unable to assess whether or not this recommendation has had an effect on the stock. However, the Committee noted that a limitation of the number of vessels is likely to be ineffective for this stock, and that, therefore, catch limits may be more appropriate from a practical point of view.

South Atlantic

In its 1998 recommendation on “Revision, Implementation and Sharing of the Southern Albacore Catch Limit”, the Commission requested that the four active participants in the fishery report their catches to South Africa on a bi-monthly basis and that South Africa inform the Secretariat when predetermined threshold limits are reached. This system is not working, as with the exception of Chinese Taipei, participants did not submit timely bi-monthly catch reports to South Africa during 1999-2000. Although the 1999 catch limit of 28,000 MT was not reached, the fishing fleets in the South Atlantic have a capacity to exceed the recommended catch limit. Therefore the Committee suggests that the Commission consider the practicality of maintaining such regulatory system, given the difficulties of implementation.

Mediterranean

There are no recommendations for the Mediterranean.

ALB-6. Management recommendations

North Atlantic

If the Commission wishes to maintain a stable Spawning Stock Biomass in the near future, then the Committee recommends that catch should not exceed the current catch level (34,500 MT) in the period 2001-2002.

Alternatively, if the Commission wishes the Spawning Stock Biomass to begin increasing towards the level estimated to support the MSY, then catches in 2001 and 2002 should not exceed 31,000 MT.

South Atlantic

If the Commission wishes to maintain a stable Spawning Stock Biomass in the near future, then the Committee recommends that catch should not exceed the estimated replacement yield (29,200 MT) in the period 2001-2002.

Mediterranean

There were no management recommendations for the Mediterranean stock. However the Committee recommends to the Commission that reliable data be provided on catch, effort and size for the Mediterranean albacore. Improvements to these basic inputs are essential before a stock assessment of Mediterranean albacore can be attempted.

ATLANTIC AND MEDITERRANEAN ALBACORE SUMMARY (MT)

	North Atlantic[1]	***South Atlantic***[2]	*Mediterranean*
Current (1999) Yield	34,557	27,293	Uncertain[3]
Maximum Sustainable Yield	32,600 [32,400 - 33,100]	30,200 [50 - 31,400]	Unknown
Current (2000) Replacement Yield	Not Estimated	29,200 [12,100 - 31,400]	Not Estimated
Relative Biomass			
B_{1999}/B_{MSY}	0.68 [0.52-0.86]	1.60 [0.01 - 1.98]	Not Estimated
Relative Fishing Mortality[4]			
F_{1999}/F_{MSY}	1.10 [0.99 - 1.30]	0.57 [0.34 - 556]	Not Estimated
F_{1999}/F_{MAX}	0.71 [0.66 - 0.78]	0.31 [0.28 - 0.33] [1]	Not Estimated
$F_{1999}/F_{0.1}$	1.25 [1.14 - 1.39]	0.84 [0.74 - 0.89] [1]	Not Estimated
Management measures in effect	Rec[5]. Limit num. of vessels to 1993-1995 average [98-5].	Rec[5]. Limit catches to 28,000 MT [98-9]	None

[1] VPA results based on catch data (1975-1999). 80% confidence intervals from bootstrap.

[2] ASPM results based on catch data (1956-1999). 80% confidence intervals from bootstrap.

[3] For the purpose of this executive summary, catches that were not reported were assumed to be equal to the reports for the previous year. In 1999, about 40% of the estimated catch was not reported (ALB-Table 1).

[4] $F_{1999} = (F_{current})$ North Atlantic Geometric Mean 1996-1998. South Atlantic, Geometric Mean 1994-1996

[5] COM-SCRS/00/10bis

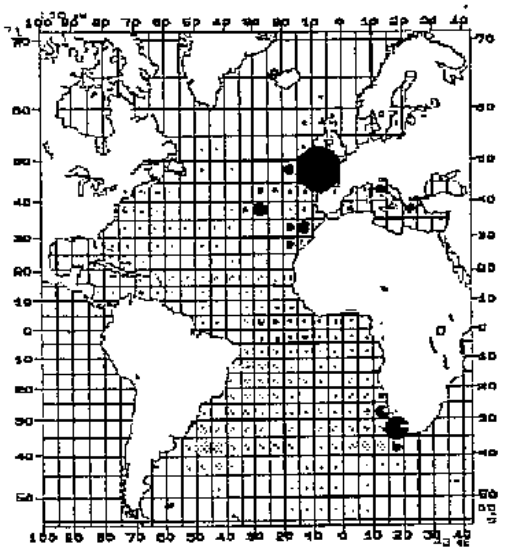
ALB-Table 1. Estimated catches (reported and carried over, in MT) of albacore in 1977-1999, by major gear, area and flag.

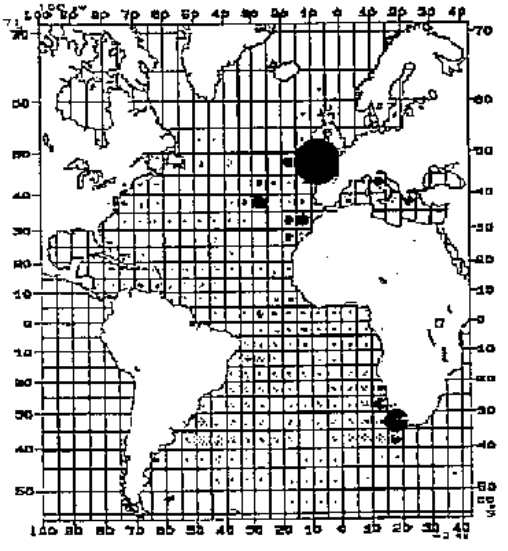
FLAG	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TOTAL	**76099**	**73806**	**74826**	**62136**	**60071**	**73616**	**67643**	**59842**	**76051**	**88553**	**82738**	**68048**	**63340**	**67167**	**56726**	**71198**	**73307**	**71229**	**67726**	**60385**	**59176**	**58683**	**64189**
NORTH ATL.	**53821**	**50047**	**51365**	**38706**	**34531**	**42672**	**51490**	**41829**	**40825**	**47553**	**38115**	**33878**	**32059**	**36557**	**27933**	**30809**	**38701**	**35032**	**38294**	**28777**	**28663**	**25380**	**34557**
BAITBOAT	*15559*	*11958*	*15764*	*16170*	*13410*	*15857*	*21108*	*8305*	*12589*	*15202*	*18756*	*16752*	*15374*	*18625*	*8985*	*12449*	*15646*	*11967*	*16411*	*11337*	*9820*	*7562*	*8781*
TROLLING	*17391*	*23931*	*23332*	*13059*	*10778*	*12831*	*12788*	*11029*	*10654*	*10847*	*11457*	*11329*	*10554*	*10350*	*8959*	*7348*	*6109*	*5959*	*10226*	*6652*	*7870*	*5894*	*6833*
OTH SURF	*2*	*0*	*62*	*24*	*516*	*778*	*695*	*2786*	*167*	*273*	*344*	*1091*	*1663*	*3866*	*4216*	*5305*	*7505*	*7778*	*3832*	*3599*	*4054*	*6815*	*7860*
LONGLINE	*20869*	*14157*	*12207*	*9451*	*9819*	*13206*	*16863*	*19709*	*17413*	*21231*	*7296*	*3013*	*2228*	*2683*	*5304*	*3100*	*7659*	*7195*	*4776*	*4617*	*4042*	*3872*	*6721*
TRAW & UNCL	*0*	*1*	*0*	*2*	*8*	*0*	*36*	*0*	*2*	*0*	*262*	*1693*	*2240*	*1033*	*469*	*2607*	*1782*	*2133*	*3049*	*2572*	*2877*	*1237*	*4362*
CANADA	0	0	0	0	0	0	0	0	0	1	21	47	22	6	5	1	9	32	12	24	31	23	38
CAP-VERT	0	0	0	0	0	0	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHINA.PR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	8	20	0	0	21
CHINESE TAIPEI	13723	9324	6973	7090	6584	10500	14254	14923	14899	19646	6636	2117	1294	3005	4318	2209	6300	6409	3977	3905	3330	3098	5785
CUBA	83	89	0	31	48	82	38	69	20	31	15	4	0	2	0	0	0	0	0	0	0	0	0
EC-ESPAÑA	25155	25404	29630	25202	20819	25478	29557	15685	20672	24387	28206	27557	25424	25792	17233	18176	18380	16998	20197	16323	17294	13285	15366
EC-FRANCE	7733	10400	9320	3955	2929	2855	2391	2797	1860	1200	1921	2805	4050	3300	4123	6924	6293	5934	5304	4694	4618	3711	7191
EC-IRELAND	0	0	0	0	0	0	0	0	0	0	0	0	0	40	60	451	1946	2534	918	874	1913	3750	4858
EC-PORTUGAL	62	85	149	79	442	321	1778	775	657	498	433	184	169	3185	709	1638	3385	974	6470	1634	395	91	324
EC-U.K	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	59	499	613	196	49	33	**33**	**33**
GRENADA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	6	6	6
JAPAN	825	531	1219	1036	1740	781	1156	576	844	470	494	723	764	737	691	466	485	505	386	466	414	446	524
KOREA	5579	3048	2997	797	938	1326	478	967	390	373	18	16	53	34	1	0	8	0	0	2	1	0	0
MEXICO	0	0	0	2	0	0	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NORWAY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PANAMA	557	768	425	193	177	494	357	2551	601	525	44	0	0	0	0	0	0	0	0	0	0	0	0
PHILIPPINES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
ST.LUCIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0
ST.VINCENT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
TRINIDAD & TOBAGO	0	0	0	0	0	0	268	194	318	0	0	0	0	4	0	247	639	0	0	0	1	1	0
U.S.S.R	0	0	59	0	51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
UK-BERMUDA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2
USA	2	1	0	21	472	698	347	2206	97	250	301	288	242	357	479	438	508	741	545	472	577	829	314
VENEZUELA	102	397	593	300	331	137	823	1076	467	172	26	137	41	95	314	199	246	278	278	312	49	105	91

ALB-Table 1 (cont.). Estimated catches (reported and carried over, in MT) of albacore in 1977-1999, by major gear, area and flag.

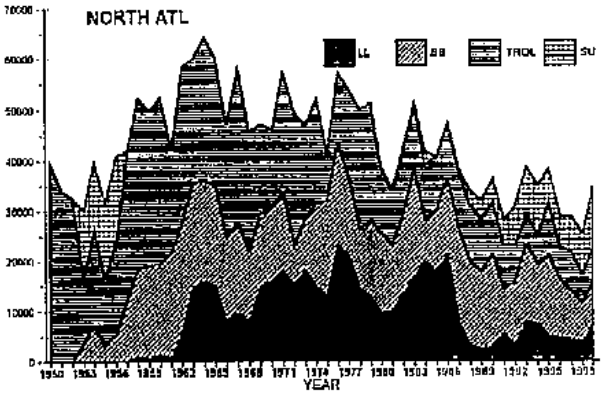
FLAG	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
SOUTH ATL.	**21665**	**23169**	**22628**	**22930**	**24040**	**29672**	**14918**	**14599**	**31097**	**37288**	**40630**	**30107**	**27221**	**28714**	**26094**	**37524**	**33381**	**35459**	**27446**	**27934**	**27864**	**30497**	**27293**
SURFACE	*471*	*363*	*785*	*2259*	*3614*	*4410*	*2922*	*4556*	*8272*	*7117*	*9197*	*7935*	*7450*	*6973*	*4319*	*10694*	*9728*	*11233*	*7728*	*7462*	*8417*	*10795*	*6719*
LONGLINE	*21194*	*22806*	*21843*	*20671*	*20426*	*25255*	*11941*	*9834*	*22672*	*29815*	*30964*	*21828*	*19407*	*21590*	*21698*	*26519*	*23650*	*24224*	*19718*	*20472*	*19447*	*19699*	*20574*
UNC GEAR	*0*	*0*	*0*	*0*	*0*	*7*	*55*	*209*	*153*	*356*	*469*	*344*	*364*	*151*	*77*	*311*	*3*	*2*	*0*	*0*	*0*	*0*	*0*
ARGENTINA	80	8	0	4	2	7	55	209	153	356	469	344	354	151	60	306	0	2	0	0	0	0	0
BELIZE.SH.OB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	8
BRASIL	688	494	515	476	276	800	731	732	382	520	395	421	435	514	1113	2710	3613	1227	923	819	652	3418	1872
CHINA.PR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39
CHINESE TAIPEI	16092	20467	20340	18710	18187	22800	9502	7889	19643	27592	28790	20746	18386	21369	19883	23063	19400	22573	18351	18956	18165	16106	17377
CUBA	17	11	0	27	53	29	36	67	27	24	10	2	1	2	0	0	0	0	0	0	0	0	0
EC-ESPAÑA	0	0	0	0	889	106	295	307	155	200	807	185	0	0	669	3634	1631	1556	674	198	319	193	1027
EC-FRANCE	112	40	172	457	912	947	372	7	18	35	100	0	0	0	50	449	564	129	82	190	38	40	13
EC-PORTUGAL	0	0	0	0	0	0	0	741	1357	1029	899	1153	557	732	81	184	483	1185	655	494	256	124	0
HONDURAS-OB.SH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	7	1	6
JAPAN	107	135	105	333	558	569	188	224	623	739	357	405	450	587	654	583	467	651	389	435	424	418	567
KOREA	3829	1413	878	803	682	563	599	348	511	321	383	180	54	19	31	5	20	0	0	18	4	7	0
MAROC	0	2	0	0	0	113	0	0	0	0	41	0	0	0	0	0	0	0	0	0	0	0	0
NAMIBIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	915	950	982	1199	1429	1162
NEI-1	0	0	0	0	0	0	0	0	0	0	0	0	0	4	8	88	71	53	59	40	13	221	0
NEI-166	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
PANAMA	377	354	125	167	129	210	0	0	0	280	924	0	0	0	79	78	182	216	14	45	0	11	0
PHILIPPINES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	4
SIERRA LEONE	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0
SOUTH AFRICA	150	150	480	1850	2320	3180	2760	3540	6697	5930	7275	6570	6890	5280	3410	6360	6881	6931	5214	5634	6708	8412	5101
U.S.A	0	9	11	0	2	102	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	1	1
U.S.S.R	212	74	0	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
UK-STA HELENA	1	12	2	4	7	11	7	9	0	0	2	1	1	1	5	28	38	5	82	47	18	1	1
URUGUAY	0	0	0	0	23	235	373	526	1531	262	178	100	83	55	34	31	28	16	49	75	56	110	110
MEDI	**613**	**590**	**833**	**500**	**1500**	**1272**	**1235**	**3414**	**4129**	**3712**	**3993**	**4063**	**4060**	**1896**	**2378**	**2202**	**856**	**242**	**1587**	**3125**	**2541**	**2698**	**2289**
SURFACE	*0*	*0*	*0*	*0*	*900*	*572*	*535*	*1663*	*1166*	*120*	*167*	*141*	*141*	*772*	*1355*	*1260*	*855*	*238*	*1499*	*1807*	*1451*	*1351*	*2180*
LONGLINE	*130*	*150*	*0*	*0*	*0*	*0*	*0*	*226*	*375*	*150*	*161*	*168*	*165*	*624*	*523*	*442*	*0*	*3*	*87*	*366*	*348*	*194*	*109*
UNCL.GEAR	*483*	*440*	*833*	*500*	*600*	*700*	*700*	*1525*	*2588*	*3442*	*3665*	*3754*	*3754*	*500*	*500*	*500*	*1*	*1*	*1*	*952*	*742*	*1153*	*0*
EC-ESPANA	0	0	0	0	900	572	535	1331	531	0	0	3	0	84	547	227	290	218	475	404	380	126	284
EC-FRANCE	0	0	0	0	0	0	0	141	250	20	60	31	31	121	140	11	64	23	3	0	5	5	0
EC-GREECE	0	0	0	0	0	0	0	0	0	484	500	500	500	500	500	500	1	1	0	952	741	1152	2005
EC-ITALY	613	590	833	500	600	700	700	1942	3348	3208	3433	3529	3529	1191	1191	1464	1	0	1109	1769	1414	1414	0
JAPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MALTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
NEI-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	500	0	0	0	0	0	0
YUGOSLAVIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
UNC. AREA																							
LONGLINE	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*321*	*663*	*369*	*496*	*399*	*549*	*108*	*108*	*0*
NEI-134	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	3	0	20	7	7	7
NEI-71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	160	281	145	130	110	160	43	43	43
PANAMA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	161	382	210	363	289	369	58	58	0

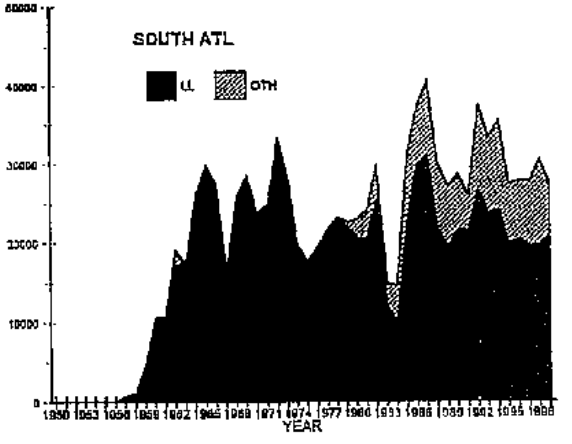
Shaded cells indicate estimated catches. In some cases the Committee has assumed the catch to be the same as the latest data available

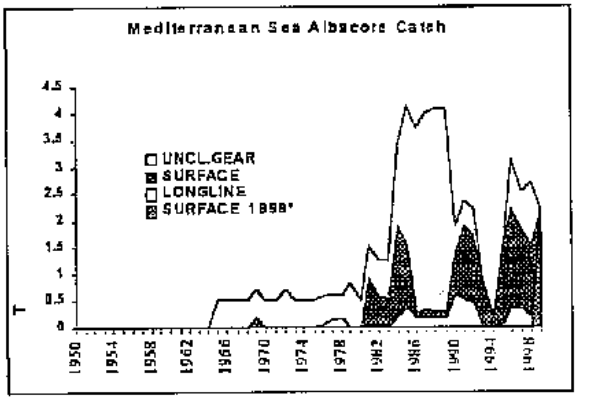




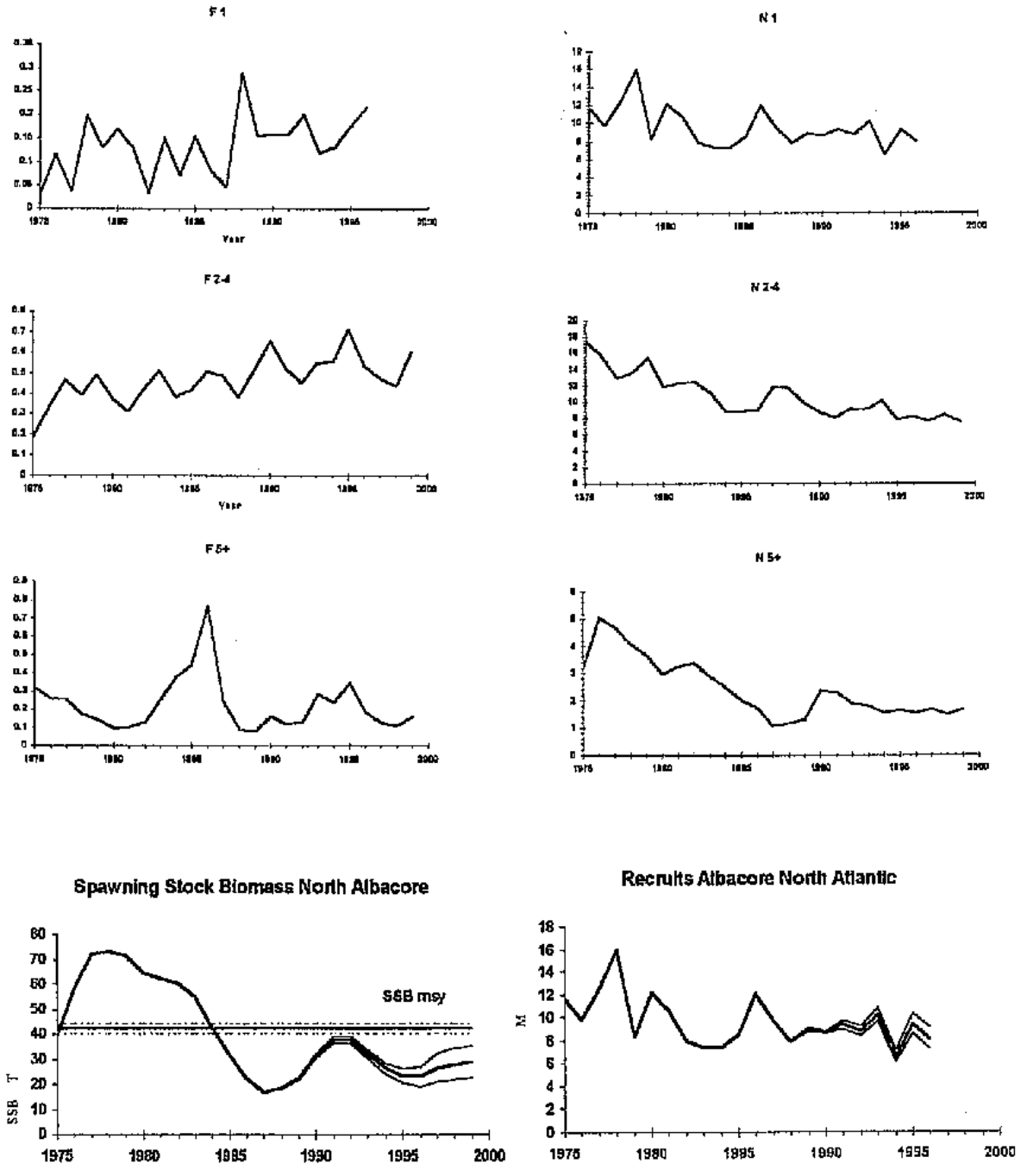
ALB-Fig. 1. Geographical distribution of annual albacore catches in 1980-1989 (top) and 1990-1997 (bottom). Light symbols represent longline and darker symbols represent various surface gears.



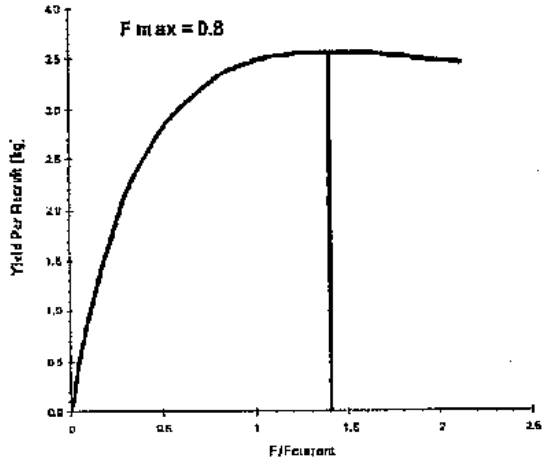


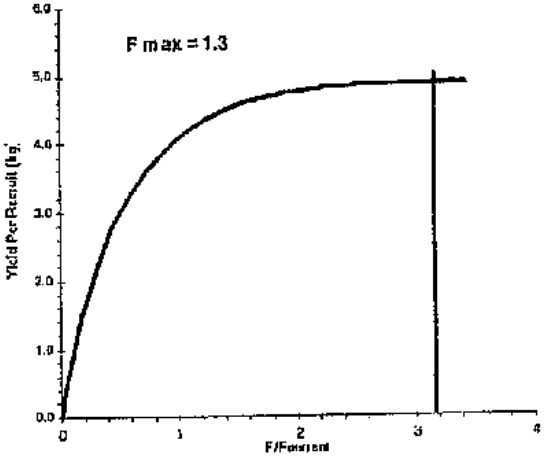


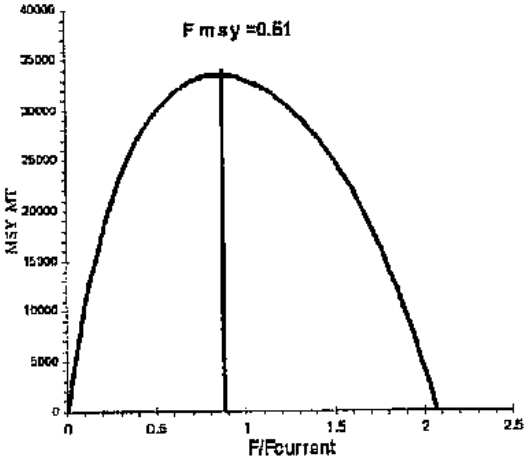
ALB-Fig 2. Albacore landings (MT) by stock and major gear types, 1950-1999. Data from the Mediterranean Sea are highly uncertain and are provisional for 1999.

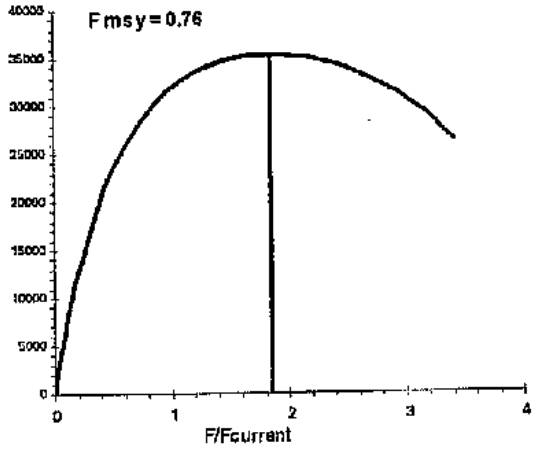


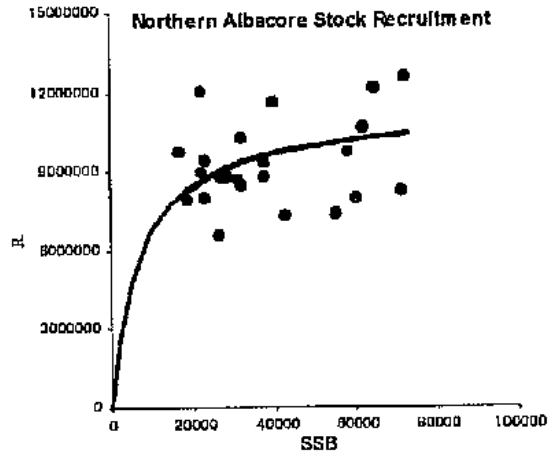
ALB-Fig 3. North albacore base case VPA estimates of fishing mortality (F) and numbers of fish by age-groups (top 6 panels), and Spawning stock biomass and recruits with 80% confidence limits (bottom panels).



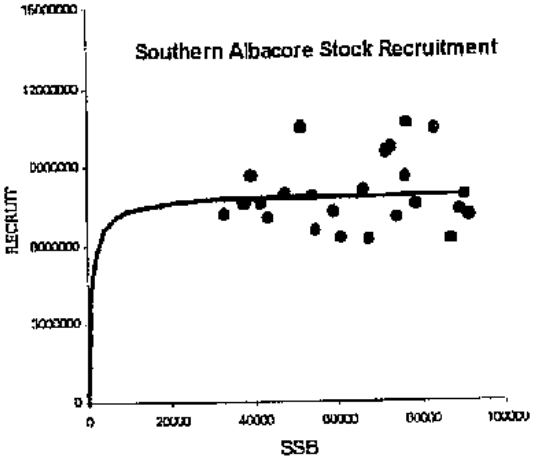




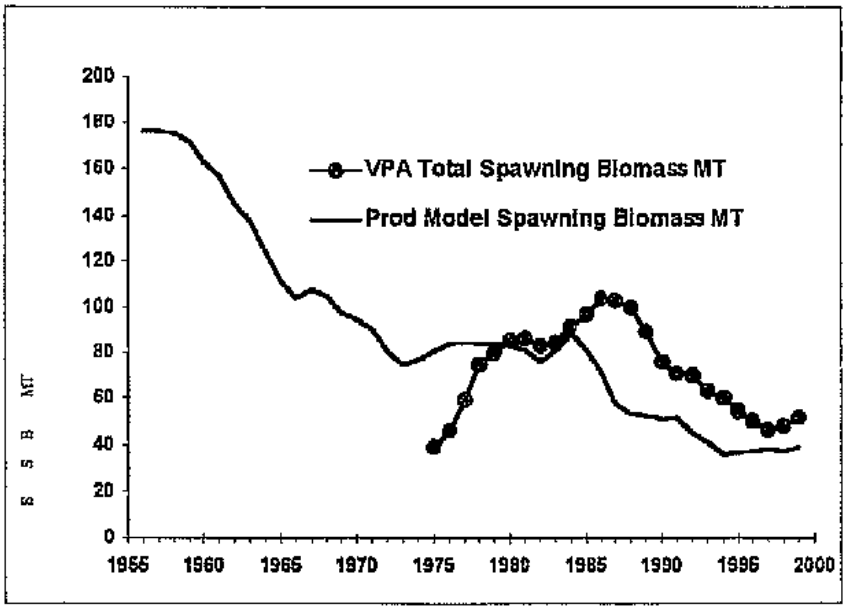




ALB-Fig 4. Yield Per Recruit (top), equilibrium yield (middle), and stock –recruitment relationship (bottom) estimated by VPA for the northern albacore stock. Fishing mortality axis (x-axis) is relative to current fishing mortality ($F_{99} = 0.57$)



ALB-Fig 5. Yield Per Recruit (top), equilibrium yield (middle), and stock –recruitment relationship (bottom) estimated by VPA for the southern albacore stock. Fishing mortality axis (x-axis) is relative to current fishing mortality ($F_{99} = 0.41$)



ALB-Fig. 6. Spawning stock biomass estimates obtained by VPA (ADAPT) and production modeling (ASPM) for the southern Atlantic albacore stock.

7.5 BFT - ATLANTIC BLUEFIN TUNA

In 1998, the Commission adopted a 20 year Rebuilding Program for the western Atlantic bluefin management area [Ref: 98-7] aimed at rebuilding to the stock size that will produce MSY (B_{MSY}) by 2018 with a 50% or greater probability. The Program states that the TAC for the West would only be adjusted from the 2,500 MT level adopted for 1999-2000 if SCRS advises that (a) a catch of 2,700 MT or more has a 50% or greater probability of rebuilding or (b) a catch of 2,300 MT or less is necessary to have a 50% or greater probability of rebuilding. According to the Program, the MSY rebuilding target can be adjusted according to advice from SCRS. In support of the Program, the stock assessment for the western Atlantic bluefin tuna management area was updated in 2000.

Accumulating evidence, including recent results from state of the art electronic tags, makes clear that the populations of fish and the fisheries in the western and eastern Atlantic management units are related. This relationship is most evident for the central Atlantic. Therefore, the Committee considered mixing assuming a variety of migratory behaviors, based on several scientific papers submitted to the Committee. One cannot distinguish on the basis of the existing data which migratory behaviors are more likely. Thus, mixing models and the available data are not yet considered sufficient to provide reliable prediction. The Committee believed that management inferences drawn from the assessment should be reasonably robust, if adequate management approaches are applied to both the eastern and western Atlantic management units.

BFT-1. Biology

Present fisheries for Atlantic bluefin tuna are distributed from the Gulf of Mexico to Newfoundland in the West Atlantic, from roughly the Canary Islands to south of Iceland in the East Atlantic, and throughout the Mediterranean Sea (**BFT-Figure 1**). In 1982, the Commission established a line for separating the eastern and western Atlantic management units on the basis of separate spawning sites (Gulf of Mexico in the West and the western Mediterranean for the East) (**BFT-Figure 1**). ICCAT conventional tagging data have shown that a number of fished tagged in the West have been recaptured in the East and vice versa. The recent electronic tagging data from bluefin tagged in the West provide new and exciting information on movement paths with several western released fish of spawning size transiting to the East Atlantic, and one of these fish subsequently returned to the West Atlantic. Bluefin released in southern Spain can migrate to the North of Norway, and south to the Canary and Cape Verde Islands. None of the 12 successful recoveries in 1998 or 1999 of electronic tags from fish tagged in the East demonstrated transatlantic migrations during a period of time under eight months, but much more tagging is needed to reach preliminary conclusions.

Atlantic bluefin tuna can grow to over 300 cm and reach more than 650 kg. The oldest age considered reliable is 20 years, based on an estimated age at tagging of 2 years and about 18 years at liberty, although it is believed that bluefin tuna may live to older ages. Bluefin tuna are, thus, characterized by a late age at maturity (thus, a large number of juvenile classes) and a long life span, which make it well adapted to variations in recruitment success, but more vulnerable to fishing pressure than rapid growth species such as tropical tuna species. Bluefin tuna in the West Atlantic generally reach a larger maximum size compared to bluefin caught in the East Atlantic. Bluefin in the West are assumed to first successfully spawn at age 8 compared to ages 4 to 5 in the East. Distribution expands with age; large bluefin are adapted for migration to colder waters. Bluefin tuna are opportunistic feeders, with fish, squid, and crustaceans common in their diet.

In the West Atlantic, bluefin tuna are thought to spawn from mid-April into June in the Gulf of Mexico and in the Florida Straits. Results of satellite tagging studies have shown bluefin of spawning size which were tagged in the West were present in the central Atlantic during the presumed spawning period, though this should not be considered as conclusive evidence of spawning. Juveniles are thought to occur in the summer over the continental shelf, primarily from about 35°N to 41°N and offshore of that area in the winter. In the East Atlantic, bluefin tuna generally spawn from late May to July depending on the spawning area, primarily in the Mediterranean, with highest concentrations around the Balearic Islands, Tyrrhenian Sea, and central Mediterranean where the sea-surface temperature of the water is about 24°C.

BLUEFIN TUNA - WEST

BFTW-2. Description of the fisheries

The Detailed Report updates the description of fisheries. One of the most noteworthy changes in the fisheries is a substantial amount of additional catch, that was revealed by the Bluefin Tuna Statistical Document, which is not in accordance with Commission's recommended allocation of catch. There is also some change in the estimates of catch as a result of revisions in the estimated amount of U.S. dead discards.

The reported total catches of western Atlantic bluefin tuna in 1998 and 1999 are estimated as 2,652 MT and 2,771 MT, respectively (**BFT-Table 1; BFT-Figure 2**). This is an increase of 12.5% from the previous two years. and the 1999 catch is the highest since 1991. The increase in 1999 is primarily a result of the estimate of unreported catch based on the Bluefin Tuna Statistical Document.

The Japanese longline fishery catches in the West Atlantic more than doubled in 1998 (compared to 1997 catches of 322 MT) to 691 MT, and were then down to 365 MT in 1999. The Canadian reported landings also increased in 1998 and 1999 to 596, and 576 MT, respectively (compared to 503 MT in 1997) exclusive of discards. The provisional estimates of Canadian dead discards in 1998 and 1999, respectively, are 16 and 11 MT. Reported catches of U.S. fisheries in 1998 and 1999 decreased slightly to 1,235 and 1,212 MT, respectively (compared to 1997 reported catches of 1,317 MT) exclusive of discards. Estimates of U.S. dead discards have been revised for the time series (1987 to present), although with considerable associated uncertainty. In 1998 and 1999, they were estimated to be 105 and 151 MT, respectively. It is unclear if this estimation method is appropriate for evaluating a time series for compliance; this will be further reviewed and reported upon in 2001. Bermuda reported landings of 2 and 1 MT in 1998 and 1999, respectively. In addition, there were 13 MT reported by Brazil (Equatorial Guinea flagged vessels chartered by Brazil), and 14 MT reported by Mexico. As noted above, there appears to be an additional 429 MT of western bluefin taken by Equatorial Guinea in 1999 which was not reported in the Task I data, but was indicated by Bluefin Tuna Statistical Documents from that nation.

BFTW-3. State of the stock

During the last western Atlantic bluefin assessment (Genoa, Italy, 1998) several forms of population analysis were used to examine the status of the resource. This year, the Committee decided to devote less time exploring alternative forms of population models and to concentrate instead on a deeper examination of the diagnostics of alternative calibrations of a virtual population analysis (VPA).

In response to questions raised during the last assessment, several analyses were conducted inter-sessionally to investigate appropriate ways to weight the basic input abundance indices in the population model. A VPA calibration estimating an equal weight for all indices was used to define the base case assessment. The alternative weighting schemes examined gave similar results to the base case analysis, as did other model runs designed to examine the sensitivity of the results to alternative sets of inputs and assumptions.

Estimated recruitment was generally higher from 1970 to 1976 than it has been since, with the exception of recent (since 1995) values. However, the Committee cautioned that there is high uncertainty associated with these recent estimates. The assessment shows the spawning biomass (age 8+) declined between the early 1970s and 1990, and has since then remained stable (**BFT-Figure 3**). In terms of the historical perspective, the results of this assessment are similar to previous assessments.

As explained in Section 4- Outlook, the calculation of the stock's long-term potential for productivity was made using two scenarios about the recruitment levels (low or high), to be obtained at high levels of spawning biomass. If the low recruitment scenario is correct, the current spawning biomass is estimated to be about 36 percent of the level expected to produce MSY. If the high recruitment scenario is correct, spawning biomass is expected to be about 10 percent of the biomass at MSY. The Committee's current assessment estimated the 1999 stock size as about 20% of the estimate for 1975. In the past, the Committee used the 1975 stock size as a proxy

for B_{MSY}, as indicated by production models. Thus, although the Committee was unable to determine which of the alternative recruitment scenarios is most likely, the assessment indicated that the stock is over fished according to the Convention's objective to maintain ICCAT stocks at the MSY-biomass level. The assessment also indicated that current fishing mortality is greater than that associated with MSY.

BFTW-4. Outlook

Western Atlantic bluefin tuna catches have remained similar since 1983 (the range over this period is 2,114 to 3,114 MT). Since the late 1980s, estimated stock size (measured as the biomass of fish 8 years old and older, which is also assumed to be the spawning biomass) has been relatively stable, as well. Thus, over an extended period of time, catches around recent levels have maintained stock size at about the same level.

In order to provide advice relative to rebuilding the western Atlantic bluefin population, the Committee conducted projections for two scenarios about future recruitment. One scenario assumed that future average recruitment will approximate the average estimated recruitment since 1976, unless spawning stock size declines to low levels (generally lower than those estimated to have occurred in the assessment). The second scenario allowed average recruitment to increase with spawning stock size up to a maximum level no greater than the average estimated recruitment for 1970 to 1974. These scenarios were referred to as the low recruitment and high recruitment scenarios, respectively. The low and high recruitment scenarios implied that the B_{MSY} (expressed in terms of the biomass of fish 8 years and older) is 53% and 215% of the biomass in 1975, respectively. With the current data the Committee could not determine which recruitment scenario is more likely, but both are plausible. Therefore, management strategies should be chosen to be robust to this uncertainty.

The results of projections based on the low recruitment scenario are given in **Figure 4** (for several catch levels) and **Figure 5** (for 2,500 MT only). The projections indicated that a constant catch of 3,000 MT per year has about a 75% probability of allowing rebuilding to the associated B_{MSY} by 2018. Furthermore, a constant catch of 2,500 MT per year has about a 56% probability of allowing rebuilding to the 1975 stock size by 2018.

The results of projections based on the high recruitment scenario are given in **Figure 4** (for several catch levels) and **Figure 6** (for 2,500 MT only). For the high recruitment scenario, a constant catch of about 3000 MT per year has about a 62% probability of allowing rebuilding to the 1975 stock size, and with a constant annual catch of 2,500 MT there is about a 47% chance of rebuilding to the associated B_{MSY}, by 2018.

Probability of achieving target in 2018

Catch (MT)	*Low recruitment scenario*		*High recruitment scenario*	
	B/B_{1975}	B/B_{MSY}	B/B_{1975}	B/B_{MSY}
500	*98%*	*100%*	*99%*	*86%*
1000	*94%*	*100%*	*99%*	*79%*
1500	*87%*	*100%*	*97%*	*71%*
2000	*74%*	*100%*	*87%*	*62%*
2300	*61%*	*99%*	*82%*	*53%*
2500	*56%*	*94%*	*74%*	*47%*
2700	*47%*	*86%*	*71%*	*43%*
3000	*34%*	*75%*	*62%*	*36%*

If the B_{MSY} that corresponds to the low recruitment scenario is adopted as a rebuilding target, then the TAC can be increased to 3,000 MT per year, or more, without violating the Commission's Rebuilding Program. In fact, the projections indicated that it is likely the stock will rebuild to B_{MSY} within a few years with a constant catch of 3,000 MT per year. If the B_{MSY} that corresponds to the high recruitment scenario is adopted as a rebuilding target, then a catch of about the level of the current TAC will satisfy the Rebuilding Program.

The Committee cautioned that these conclusion do not capture the full degree of uncertainty in the assessments and projections. The immediate rapid projected increases in stock size are strongly dependent on estimates of high levels of recent recruitment, which are the most uncertain part of the assessment. Inspection of past assessments indicate that these recent recruitments are less well estimated than indicated by the statistical uncertainty modeled in the assessments. Also, the Committee had some concern that the method used to estimate the probabilities of achieving rebuilding targets may be too optimistic. The implication of mixing between the eastern and the western management areas is not entirely clear, but it adds to the uncertainty. The Committee also noted that while its assessments have been stable over time in terms of the trend in abundance, projections of the future direction of the stock have been much less stable from one assessment to the next (e.g., the projections performed in 1996 were less optimistic than they were in 1994, and in 2000 the projections are more optimistic than they were in 1998).

BFTW-5. Effects of current regulations

The first regulatory measure for a scientific monitoring level was adopted for western Atlantic bluefin catches in 1981. Since then, monitoring levels have been changed in various years. Until 1987, both estimated catches and landings were below or equal to the level of the catch limits. However, from 1988 to 1997, estimated landings were very close to the level of the limits and, for some years, exceeded the limit by a maximum of 100 MT. Estimated catches (including discards) were higher than the limits every year during this period (by about 200 to 300 MT) with the exceptions of 1992 and 1997. The estimated catches exceeded the limits in 1998 and 1999, by approximately 300 MT. It should be pointed out that for compliance purposes, some countries are using fishing years that do not correspond to calendar years, while the catches discussed here are in calendar years. Also, according to the ICCAT regulatory measure, the amount of catch that exceeded quota or was left over from the quota can be carried over to succeeding years. Hence, the catch limit set for each year could have been adjusted accordingly. It should also be pointed out that the excess of the catch limits in most recent years is due to some new fisheries which operated without a quota (see Section BFTW-2).

For the West Atlantic, a size limit of 6.4 kg with 15 percent allowance, in number of fish, has been in effect since 1975. In addition, a prohibition on the taking and landing bluefin tuna less than 30 kg (or 115 cm) with an 8% tolerance, by weight on a national basis, became effective in 1992. It is noted that, since 1992, the proportion of undersized fish for all catches combined has been below the allowance level (4.2% and 2.1% in 1998 and 1999, respectively).

BFTW-6. Management recommendations

The Committee's management recommendation is directed at the Rebuilding Program (described in the first paragraph of the BFT section of this report) adopted by the Commission in 1998. In light of the uncertainty in the assessment (particularly with regard to estimates of recent high recruitment), projections, the choice between recruitment scenarios, and assumptions about mixing, the Committee recommended that the TAC should not be changed significantly from the current level of 2,500 MT per year. Projections based on the low recruitment scenario, assuming the estimates of recent high recruitment are accurate, indicate that the TAC could be increased without violating the Rebuilding Program; however high levels of recruitment are inconsistent with the low recruitment scenario. The high levels of recent recruitment estimated in this assessment point to a higher biomass level as a rebuilding target, such as the B_{MSY} associated with the high recruitment scenario, in which case there is almost a 50% probability of rebuilding with the current TAC of 2,500 MT. The Committee noted that B_{MSY} for the high recruitment scenario is not well determined by the spawner-recruit data examined in this assessment. Previous analyses, based on a longer time series of spawner-recruit estimates, indicated that the biomass level in 1975 is a reasonable proxy for B_{MSY}. Maintaining the annual catch at about the current TAC level gives at least a 50% probability of rebuilding to the 1975 biomass by 2018, for both recruitment scenarios.

One implication of mixing of bluefin tuna between the western and eastern management units that is clear from the work of the Committee is that the population of fish and the fisheries in the East and West are related. The condition of the eastern Atlantic stock and fishery could adversely affect recovery in the West Atlantic, which

was also noted in the Committee's 1998 report. Therefore, the Committee stressed the importance of continuing efforts to manage the fisheries in both the East and West Atlantic in a sustainable manner.

WEST ATLANTIC BLUEFIN TUNA SUMMARY

(Catches and biomass in MT)

Current (1999) Catch (discards included)	2,771	
Short-term Sustainable Yield	Probably >3,000 MT	
Maximum Sustainable Yield (MSY)	3,500 (3,200-3,800)[1]	7,700 (6,100-9,600)[2]
Relative Spawning Stock Biomass		
B_{1999}/B_{1975}	0.19 (0.12-0.31)[1]	0.21 (0.12-0.33)[2]
B_{1999}/B_{MSY}	0.36 (0.28-0.49)[1]	0.10 (0.06-0.14)[2]
Relative Fishing Mortality		
$F_{current}/F_{MSY}$	1.37 (0.96-1.87)[1]	2.22 (1.51-3.32)[2]
$F_{current}/F_{0.1}$	3.71	
$F_{current}/F_{max}$	2.14	

Management Measures in Effect:

-- No landing of fish <6.4 kg, with a 15% tolerance, in number [74-1, 98-7]
-- Limit catches <115 cm (30 kg) to no more than 8% by weight [91-1, 98-7]
-- TAC of 2,500 MT from 1999 to 2018 including dead discards subject to subject to revisions consistent with the Rebuilding Program [98-7].

[1] Median and approximate 80% confidence interval from bootstrapping; assumes a "low recruitment" scenario at high spawning levels.
[2] Median and approximate 80% confidence interval from bootstrapping; assumes a "high recruitment" scenario at high spawning levels.

BLUEFIN TUNA - EAST

BFTE-2. Description of the fisheries

The East Atlantic bluefin fisheries (including the Mediterranean) are characterized by a variety of vessel types and fishing gears with landing sites located in many countries. Therefore, the landing statistics are difficult to obtain, particularly for the East Atlantic and even more so for the Mediterranean. Historical statistics show there were important catches since more than ten centuries ago, with catches of more than 10,000 MT in the past and an average of about 30,000 MT in the 1950-65 period. Certain fisheries, such as the traps, go back to ancient times. Other fisheries, such as the Mediterranean purse seine fishery mainly emerged in the 1960s. Based on estimates of 1995-1999 catches, the most important catches, were from: longline, traps and baitboat for the East Atlantic; and from purse seine and longline for the Mediterranean; the purse seine fleet accounts for 60-80% of the Mediterranean catch. Additionally, it is suspected that large quantities of undersized fish are caught but not reported.

The reported total catch taken from the preliminary landings for the East Atlantic and the Mediterranean in 1999 amounted to 31,487 MT, which would be less than 1998 (35,864 MT). However, the 1999 reported catch especially is probably under-estimated because of increasing uncertainty about catch statistics as shown in part by the unprecedented large quantities of unreported catches (3,387 MT estimated by the SCRS from the Bluefin Statistical Document Program). The reported 1999 catch is well below the peak of 52,644 MT in 1996; however it remains among the top 30% of reported annual landings since 1950, and the total catches for the 1990s exceeded all previous decades since the 1950s and was roughly twice as high as in each decade from the 1960s through the 1980s (**BFT-Table 1** and **BFT-Figure 2**).

In 1999 the SCRS modified the Mediterranean reported catches to take into account revised Turkish catches. Those revisions were estimated from various sources: reports from fishermen associations, canning factory activities and market declarations; the Committee noted that those changes still need to be validated to check for possible double-counting. In the Mediterranean, the total reported catch amounted to 21,855 MT as compared to 24,964 MT in 1998 and 33,507 MT in 1997. It should be noted that the catches attributed to the «nowhere else included» (NEI) category (NEI in **BFT-Table 1**) declined from 1996 to 1998 but in 1999 increased to the highest level observed and could be even higher because of uncertainty about the (1) information from fish fattening operations (cages) and its relationship to reported national statistics and (2) about bluefin import statistics. Nevertheless, trade data from the Bluefin Statistical Document showed a decline in the catch coming from the IUU vessels in 1999 (so that, the NEI catch attributed to IUU subsequently declined in 1999). IUU longline activity seems, however, to be continuing, even during the Mediterranean closed season. The Committee strongly encourages the collection of information on the number, size and origin of fish entering cages, and the Committee recommends that it be given access to the basic Bluefin Statistical Document data so that it can attempt to further reduce uncertainty. Most notable is the decrease in the purse seine catches since 1997 (24,178 MT, 20,391 MT and 14,061 MT in 1997-1999, respectively). Most of the Mediterranean purse seine catches came from EC-France, EC-Italy, and Turkey, while smaller contributors included Croatia, Spain and Tunisia. Additionally, most of the purse seine catch of large fish is being transferred to cages for fattening and this has changed fishing strategies. Meteorological conditions, changes in fishing power, and in stock abundance may be determining factors in the success or failure of the fishing season conducted around the Balearic Islands on large fish.

East Atlantic catches (excluding the Mediterranean) in 1999 (9,632 MT) decreased in comparison to 1998 (10,900 MT). The 1999 catch is, however, the sixth highest on record since 1970, but is far below the reported catch of the 1950s. The recent catch magnitude was more or less even among the baitboat, longline and trap fisheries. Spain operates baitboat and trap fisheries that account for nearly one-third of the total catches in this area. A similar catch was made by the longline fishery (mostly Japan). Since 1994, the Japanese longliners continue to exploit a new fishing zone in the North Atlantic around 60°N and 20°W (including Icelandic waters), in addition to the traditional sectors. The East Atlantic (not including Mediterranean) trap catches in 1999 (2,859 MT) represented a 36% decline from the recent peak of 4,463 MT in 1997; nevertheless the 1997-1999 trap catches were the highest in recent years, but less than the levels reported in 1950s and early 1960's.

BFTE-3. State of the stocks

The Committee notes that basic catch statistics are still undergoing revisions by the reporting agencies and, also, the Committee suspects that there has been increased under reporting in the last few years, especially in 1999. Additionally, the CPUE and size data are not available for important fisheries. Thus, the Committee does not have confidence in updating assessments based upon these data. Therefore, the Committee's best determination of the state of the stock is that which was developed in the 1998 report. That discussion of status is repeated below.

An ADAPT VPA assessment was developed with appropriate specifications (given in the 1998 Detailed Report. Results of this assessment differ somewhat from the previous assessment, due, primarily to an abrupt increase of the catches of the spawning aged fish since 1994 and also to the revision of the catch statistics by various countries mentioned above.

After discussion, it was decided to use the natural mortality estimates made for southern bluefin tuna (a similar species) in which natural mortality is age specific as this is thought to be more biologically correct.

The assessment indicates a strong decline in number and biomass of older fish (spawning stock) since 1993. This corresponds with an the increase in fishing mortality rates (**BFT-Figure 7**). The decline in spawning stock (biomass and number of fish) beginning in 1993 followed a period of relatively stable abundance in the 1980's. There appears to have been a general trend of increasing recruitment in the early 1980's followed by a period without trend (**BFT-Figure 7**). Fishing mortality rates for all ages are estimated to have increased during the 1970-1997 period, particularly in the most recent years for the older age groups (**BFT- Figure 7**). Estimates in recent years should be judged with caution since such VPA estimates are generally imprecise.

The Committee recognizes that many of the inputs to the assessment are uncertain. These include doubts about the historical catches, the absences of size composition for many fisheries, the amount of mixing with the West stock, and the unknown accuracy of abundance indices available for model specifications. These uncertainties make it easier to interpret trends in relative abundance rather than absolute levels of the stock.

BFTE-4 Outlook

For the reasons noted in the status of stock section, the Committee's outlook on future conditions of the stock are best expressed using the 1998 analyses.

In 1998 projections were made assuming that future recruitment would vary around recent levels. Since the Committee was unable to identify adequate assumptions about the relationship between stock size and recruitment, projected recruitments were obtained by sampling from the bootstrap estimates of recruitment from the period 1980 to 1997. It should be noted that incomplete catch data from the period prior to 1950 might indicate that there have been periods in the past with very different levels of recruitment from that at present. Therefore, one should be cautious when making long term projections, especially if spawning stock biomass falls below historically observed levels. For these reasons the Committee focused the projections on the short term trends in abundance and mortality rate in relation to the Commissions recommendation for catch reduction.

Catch projections (**BFT-Figure 8**) were made for the East Atlantic using approximately 43,000 MT (the 1994-1997 average), 33,000 MT (75% of the 1994-1997 average) and 25,000 MT (as recommended in 1996). The projections indicate that the current catch level is not sustainable, and a reduction to 75% of the 1994 level is not sufficient to halt a continuing decline in spawning stock biomass. A catch of 25,000 MT halts the decline in spawning stock biomass in the medium term, but spawning stock biomass is not expected to return to historic levels. If spawning stock biomass falls below the 1997 level, the validity of the projections might be questioned since they used high recent estimates of recruitment which might no longer be appropriate. If future recruitment were to be reduced and fishing mortality were to remain at current levels then declines in spawning stock biomass would be expected.

When making decisions on these projections, the Commission should be aware that assessments (including those reported here) are inherently uncertain. Many sources of uncertainty are considered in the 1998 Detailed Report.

The Committee continues to be concerned about the intensity of fishing pressure on small fish. This contributes substantially to growth over-fishing, and it seriously reduces the long term potential yield from the resource. Additionally, recent abrupt increase of catches of large fish is of grave concern.

BFTE-5. Effect of current regulations

A regulatory recommendation stating that Contracting Parties should limit the fishing mortality to recent levels came into force in 1975 for one year and was extended indefinitely in 1982 for the East Atlantic. Fishing mortality rates have exceeded that of 1974 levels in most years (**BFT-Figure 7**).

The Commission recommended in 1998 that bluefin tuna catches in the East Atlantic Ocean and Mediterranean Sea should be reduced to 32,000 MT in 1999 and 29,500 MT in the year 2000. This recommendation entered into force in August, 1999 with exceptions noted for Morocco and Libya. Catches in 1999 were 31,487 MT (including SCRS estimates of unreported catches from the Bluefin Statistical Document Program **BFT-Table 1**). Note that there were unprecedented large quantities of these unreported catches (3,387 MT).

In 1975, a minimum size of 6.4 kg with a 15% tolerance, in number of fish, was recommended for the entire Atlantic (including the Mediterranean). The 6.4 kg size regulation had been poorly enforced for the East Atlantic and Mediterranean fisheries. Subsequently the Commission established a minimum size with no tolerance of 1.8 kg (prohibition of retention, landing and sale). This was amended by the Commission to 3.2 kg in 1998 to be implemented in 1999. While it is known that catches of age 0 fish (< 1.8 kg) are still occurring, the Committee does not have sufficient catch at size data to fully evaluate this. Clearly catches of age 0 fish are under-reported.

There is a regulation which entered into force on 1 June 1994 which prohibits large pelagic longliners of more than 24 m in length from fishing in the Mediterranean during the months of June and July. The objective of this regulation is to limit fishing mortality. Various measurements taken by ICCAT to curb IUU fishing activities (such as market-related measures, monitoring transfer of catches of IUU, etc.) appear to be having some positive effects as seen in the decline in bluefin tuna imports to the Japanese market from IUU fishing vessels.

In 1999 the prohibition of purse seine fishing in the Mediterranean (except for the Adriatic) was amended to include the period from 16 July through 15 August. Additionally, purse seining in the Adriatic was prohibited for the month of May. Both prohibitions were designed to protect juveniles. The Committee is not yet able to evaluate the effect of these new measures. However, reservations on the effects of this system were expressed. It seems, however, that previous closure (for the month of August in the Mediterranean) was being adhered to. In 1997 the Commission prohibited the use of airplanes or helicopters supporting fishing operations in the Mediterranean in the month of June. It is unclear whether this measure is or could be enforced.

BFTE-6. Management recommendations

The Committee strongly notes its concern about the quality of the catch, effort and catch at size data available to conduct quantitative assessments for East Atlantic (and Mediterranean) bluefin tuna now and in the future. Until such time as there is improvement, the Committee's best scientific advice for management is to continue under the recommendations expressed by the Committee in previous reports. That advice is repeated below.

The Committee expressed concern about the status of East Atlantic bluefin tuna resources in the light of assessment results and the historically high catches made in 1996-1997 (in excess of 50,000 MT). Analyses indicate that future catch levels of 33,000 MT, or more, are not sustainable (**BFT-Figure 8**). Catches of 25,000

MT or less would halt the decline of biomass. It should be noted that even these results may be optimistic since they assume that future recruitment continues at the average level observed since 1981. When making decisions based on these projections, the Commission should be aware that there are many sources of uncertainty (which are discussed in the 1998 Detailed Report). Given the large changes in catches in recent years, combined with the results of the 1998 analyses, the Committee maintains that a 35% reduction in catches from the 1993 to 1994 levels (i.e., to about 25,000 MT) would be necessary to prevent further decline of stock. The Committee remains concerned about the high catch of small individuals and recommends that every effort be made so that the current measures on the size limit of 6.4 kg be adhered to. The Committee reiterated that effective measures be taken to avoid catches of age 0 fish (<1.8 kg) (amended by the Commission in 1998 to "fish less than 3.2 kg"), and not allow any tolerance with respect to the percentage (in number) of age 0 fish in the landings. Because there are big differences between the size of the western and eastern Atlantic bluefin tuna stocks, mixing is likely to influence these two management units differently. Fisheries in the East Atlantic could thus adversely affect the recovery in the West Atlantic if a significant proportion of the western spawners migrate from West to East, and then harvested before returning to the West.

At this meeting (in the year 2000) the Committee noted that a quantitative assessment was not done due to the large uncertainties in the data. Nevertheless, the Commission should consider practical management measures that would be appropriate even when there is a lack of data. The Committee considers that significant enforcement of the controls of catches of undersized fish both at landing the sites and at the market could be such a measure.

EAST ATLANTIC AND MEDITERRANEAN BLUEFIN TUNA SUMMARY

Current (1999) Catch	31,487 MT
1997 Sustainable Yield	about 25,000 MT
Maximum Sustainable Yield (MSY)	not estimated
Relative Spawning Stock Biomass	$(SSB_{1997}/SSB_{1970}) = 0.19$
Relative Number	$N_{1997}/N_{1970} = 0.65$ (ages 8+)
Management Measures in Effect	- No landing of fish <6.4 kg, with a 15% tolerance in #of individuals [74-1] - Fishing mortality not to exceed circa 1975 level [74-1] - No longlining in Med. in June- July by vessels>24 m [93-7] - No purse seining in Adriatic in May [98-6] - No purse seining 16 July-15 August, in Med., except in the Adriatic [96-2] - No use of spotter helicopter or plane in Med., in June [96-2] - 32,000 MT quota in 1999 and 29,500 MT quota in 2000 (with exceptions noted by Morocco and Libya) [98-5] - No landing, retaining aboard or selling of fish <3.2 kg [98-4]

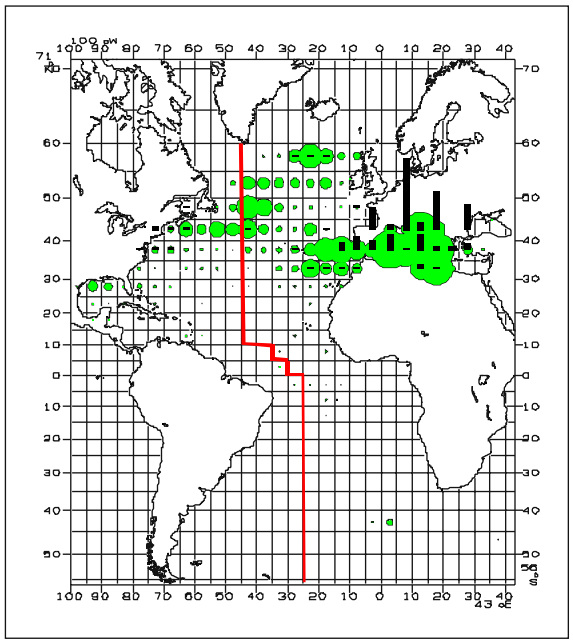
BFT-Table 1. Estimated catch and landings (in MT) of bluefin tuna in 1975-1999, by county/entity/fishing entity and gear.

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TOTAL ATLANTIC	26249	28168	25468	20408	18478	19904	19616	23820	24202	26717	24647	21373	20756	27030	23745	25950	29287	34064	38083	49014	50442	55233	49508	38516	34258
LANDING	26249	28168	25468	20408	18478	19904	19616	23820	24202	26717	24647	20859	20596	26913	23556	25809	29099	33848	37983	48929	50288	55065	49332	38395	34096
DISCARD	0	0	0	0	0	0	0	0	0	0	0	514	160	117	189	141	188	216	100	85	154	168	176	121	162
WEST ATLANTIC	5032	5883	6694	5763	6255	5801	5771	1445	2542	2292	2685	2322	2560	2913	2794	2806	2981	2286	2380	2114	2439	2496	2324	2652	2771
LANDING	5032	5883	6694	5763	6255	5801	5771	1445	2542	2292	2685	1808	2400	2796	2605	2665	2793	2070	2280	2029	2285	2328	2148	2531	2609
DISCARD	0	0	0	0	0	0	0	0	0	0	0	514	160	117	189	141	188	216	100	85	154	168	176	121	162
PURSE SEINE	2320	1582	1502	1230	1381	758	910	232	384	401	377	360	367	383	385	384	237	300	295	301	249	245	250	249	248
ROD & REEL + SPORT	328	590	630	475	499	535	523	308	476	401	466	328	539	439	557	780	728	354	628	533	1039	995	1145	1077	1108
LONGLINE	1522	3066	3752	3217	3691	3972	3879	363	829	835	1245	764	1134	1373	678	739	895	674	696	538	466	528	382	764	914
OTHERS & UNCL GEARS	862	645	810	841	684	536	459	542	853	655	597	356	360	601	985	762	933	742	661	657	531	560	371	441	339
DISCARD	0	0	0	0	0	0	0	0	0	0	0	514	160	117	189	141	188	216	100	85	154	168	176	121	162
ARGENTINA	0	0	0	0	0	0	0	0	0	0	6	0	2	0	1	2	0	0	0	0	0	0	0	0	0
BRASIL-E.GUINEA																									13
BRASIL-JPN	0	0	0	14	10	2	3	1	1	0	1	0	2	0	2	1	0	0	0	0	0	0	0	0	0
CANADA	641	846	972	670	245	324	425	291	433	264	142	73	83	393	619	438	485	443	459	392	576	597	503	595	576
CHI_TAIP	1	0	1	1	49	15	7	11	2	3	3	3	0	0	0	0	0	0	0	0	0	0	2	0	0
CUBA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JAPAN	1513	2902	3658	3144	3621	3936	3771	292	711	696	1092	584	960	1109	468	550	688	512	581	427	387	436	322	691	365
KOREA	8	7	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEXICO	24	37	14	28	22	10	20	14	0	0	0	0	0	0	0	0	0	0	0	4	0	0	2	8	14
NEI-81																									429
NEI-1	0	0	0	0	0	0	0	14	1	0	0	0	0	0	30	24	23	17	0	0	0	0	0	0	0
NEI-31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
NORWAY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PANAMA	0	157	92	58	10	9	14	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
POLAND	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ST. LUCIA	0	0	0	0	0	0	0	0	0	0	0	0	1	3	2	14	14	14	2	43	9	3	0	0	0
TRINIDAD	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
UK-BERMUDA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	1
URGUAY	0	0	0	0	0	0	1	3	0	9	16	6	0	2	0	0	1	0	1	0	2	0	0	0	0
U.S.A.	2845	1931	1956	1848	2297	1505	1530	807	1394	1320	1424	1142	1352	1289	1483	1636	1582	1084	1237	1163	1311	1289	1317	1235	1212
DISCARD																									
CANADA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	6	16	11
JAPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0
U.S.A.	0	0	0	0	0	0	0	0	0	0	0	514	160	117	175	141	188	216	100	85	154	168	162	105	151

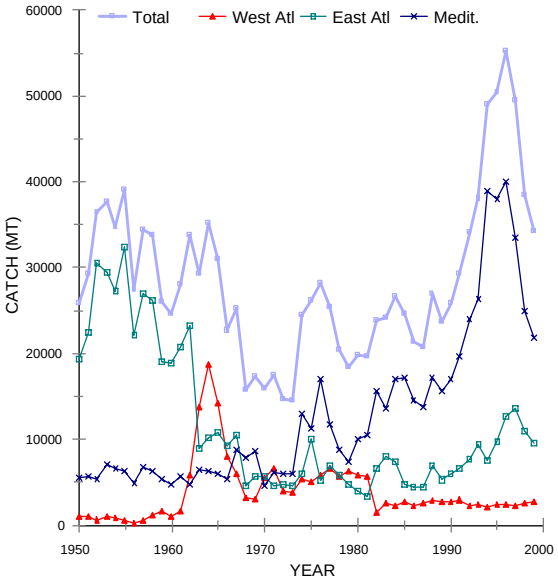
BFT-Table 1 (cont.)**.** Estimated catch and landings (in MT) of bluefin tuna in 1975-1999, by county/entity/fishing entity and gear.

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	
E. ATL +	21217	22285	18774	14645	12223	14103	13845	22375	21660	24425	21962	19051	18196	24117	20951	23144	26306	31778	35703	46473	47866	52644	47184	35864	31487	
BAITBO	2991	1803	2881	3904	2128	1874	1553	957	3032	2948	2366	2253	2128	2682	2683	1993	1648	1466	4000	2285	3093	5357	3538	2776	1586	
PURSE	11677	14830	10989	7556	6369	8978	8795	12786	10746	10302	11305	9621	8857	11198	9450	11284	13236	18242	19299	26006	24046	26344	25006	20708	14782	
TRAP	2027	2008	1717	1458	1350	1251	1446	3673	3274	4507	2390	1740	1953	3658	2789	4376	2993	2186	2001	3745	2083	2522	4848	3730	3344	
LONGLI	4323	3291	2445	912	970	1255	917	4255	3606	2734	1763	1448	1703	2396	1974	2439	5999	6324	6516	9438	13495	14841	10253	6858	9535	
OTHERS	199	353	742	815	1406	745	1134	704	1002	3934	4138	3989	3555	4183	4055	3052	2430	3560	3887	4999	5149	3580	3539	1792	2240	
ALGERIE	66	49	40	20	150	190	220	250	252	254	260	566	420	677	820	782	800	1104	1097	1560	156	156	157	0	0	
CAP-	0	0	0	0	0	0	0	0	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
CHINA.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48	85	103	
CHINESE	5	3	2	0	3	5	6	16	2	0	0	0	0	0	0	0	0	0	334	729	502	472	504	456	249	
CROATI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1418	1076	1058	1410	1220	1360	1105	906	970	
CYPRUS	0	0	0	0	0	10	10	10	10	10	10	10	10	10	10	10	10	10	14	10	10	10	10	21	31	
EC-	0	3	1	2	1	0	3	0	0	1	2	1	0	0	0	0	0	0	37	0	0	0	0	1	0	
EC-	2567	2255	3072	4190	3656	2468	2601	3813	5257	7547	5090	3577	3654	5995	5210	5379	3664	4532	7096	5878	8426	8762	8047	5800	5358	
EC-	2292	4067	3774	2320	1853	1961	2503	5028	4060	4202	5920	3838	4863	6504	4894	5223	5185	8270	8094	12179	10329	9690	8470	7713	6741	
EC-	0	0	0	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
EC-	0	0	0	0	0	0	0	5	0	0	11	131	156	159	182	201	175	447	439	886	1004	874	1217	286	248	
EC-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	21	52	
EC-	7083	10369	6263	4983	4020	6272	6017	6658	5865	7140	7199	7576	4607	4201	4317	4110	3783	5005	5328	6882	7062	10006	9548	4059	3277	
EC-	303	24	14	56	35	24	17	41	174	34	29	193	163	48	3	27	395	358	208	668	481	473	749	377	487	
EC-	2	8	2	2	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
EC-U.K	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	
FAROE-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	67	0	
ICELAND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	27	
ISRAEL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	
JAPAN	4160	2941	2114	638	729	999	615	3534	3286	2550	1426	1080	1180	1427	965	1636	3066	3473	3277	2611	4784	4106	3090	3654	3071	
KOREA	15	3	2	0	1	0	0	0	3	0	77	0	0	0	0	0	0	0	0	688	663	683	613	66	0	
LIBYA	780	799	336	677	424	398	271	310	270	274	300	300	300	300	84	258	290	650	546	1332	1500	1308	1029	1331	1256	*
MALTA	37	25	47	26	23	24	32	40	31	21	21	41	36	24	29	48	63	48	151	343	353	243	249	244	269	
MAROC	2664	332	891	36	208	161	179	993	366	175	98	344	472	577	746	1557	1456	767	494	1812	1713	1621	2603	2430	2227	
NEI-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1803	1088	392	666	0	3242	
NEI-1	0	0	0	0	0	0	0	1	0	25	3	172	183	638	763	415	1754	1349	1624	0	0	0	0	0	0	
NEI-105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	240	1990	362	368	0	
NEI-118	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	
NEI-134	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	145	398	0	0	0	0	
NEI-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	49	49	0	0	0	0	0	0	0	
NEI-71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	85	144	223	68	0	0	0	0	0	
NEI-81	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	300	71	904	267	76	
NEI-94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	66	0	
NEI-164	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	69	
NORWA	988	529	764	221	60	282	161	50	1	243	0	31	0	0	0	0	0	0	0	0	0	0	0	0	0	
PANAM	0	69	212	156	14	117	48	12	0	17	22	11	76	67	0	74	287	484	467	1500	1517	3400	491	0	13	
POLAND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
SOUTH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
TUNISIE	83	66	131	141	262	228	218	298	293	307	369	315	456	624	661	406	1366	1195	2132	2503	1897	2393	2200	1745	2314	
TURKEY	17	181	177	127	27	391	565	825	557	869	41	69	972	1343	1707	2059	2459	2817	3084	3466	4220	4616	5093	5899	1407	
U.S.A	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
YUGOSL	155	562	932	1049	756	573	376	486	1222	755	1084	796	648	1523	560	940	0	0	0	0	0	0	0	0	0	
YUGOSL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4	0	0	0	
AREA	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**427**	**137**	**93**	**0**	**0**	**0**	
CHINA.P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	97	137	93	0	0	0	
G.CONA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	330	0	0	0	0	0	

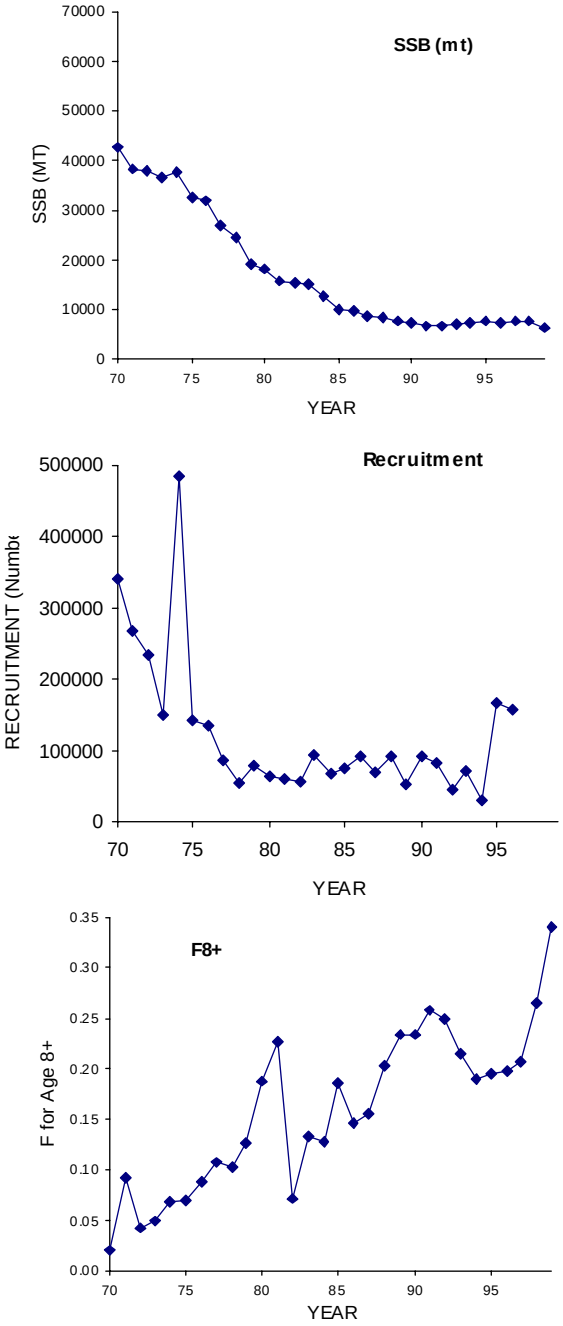
Mediterranean catch was reported, but not east Atlantic catch (the latter was carried over from 1998).



BFT-Fig. 1. Distribution of Atlantic bluefin catches by longline (in circles) and surface gears (histograms) for the period 1990-1997. The assumed boundary between east and west stocks is also shown.

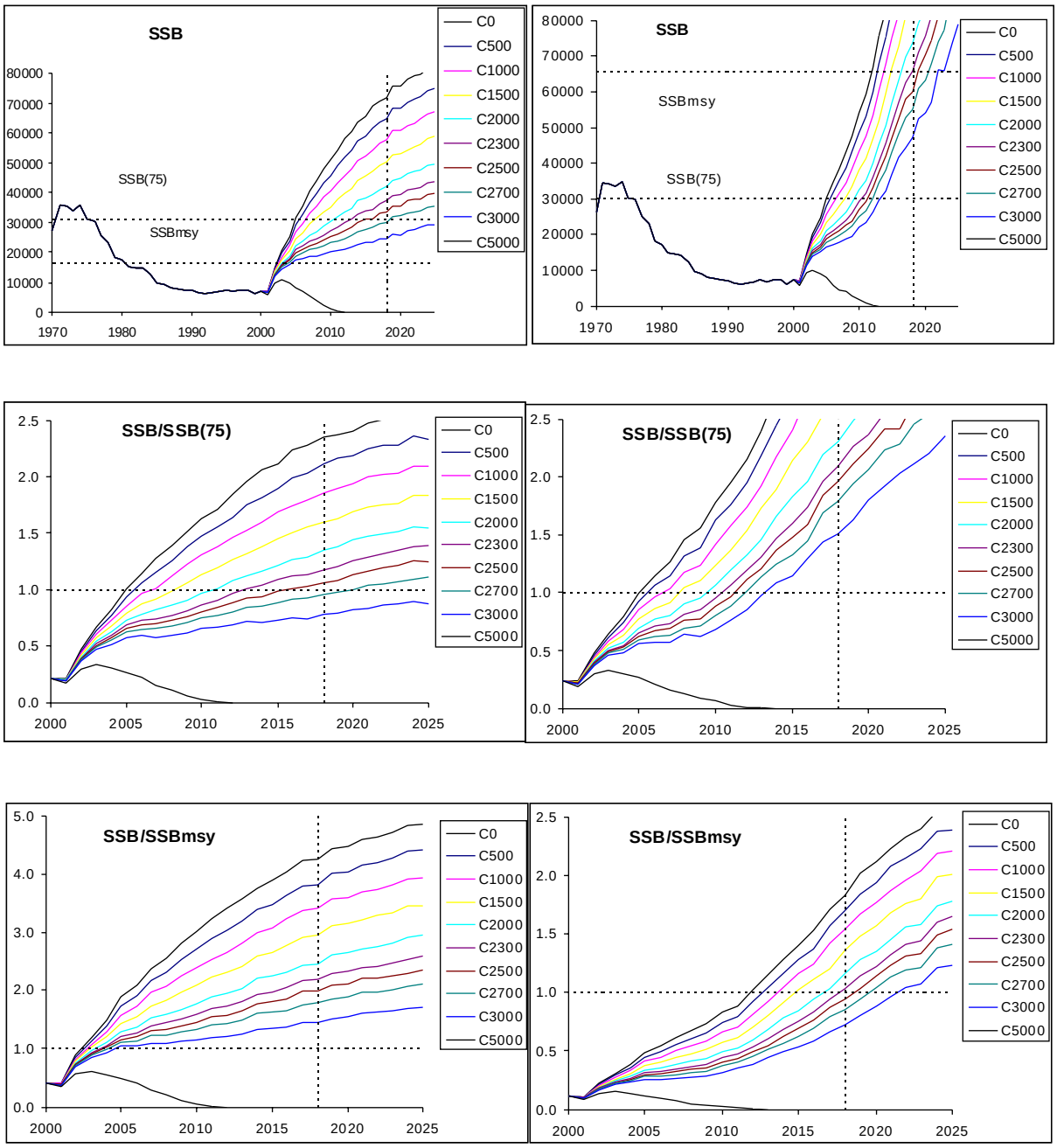


BFT-Fig. 2. Atlantic bluefin catches and discards by region (1950-1999).

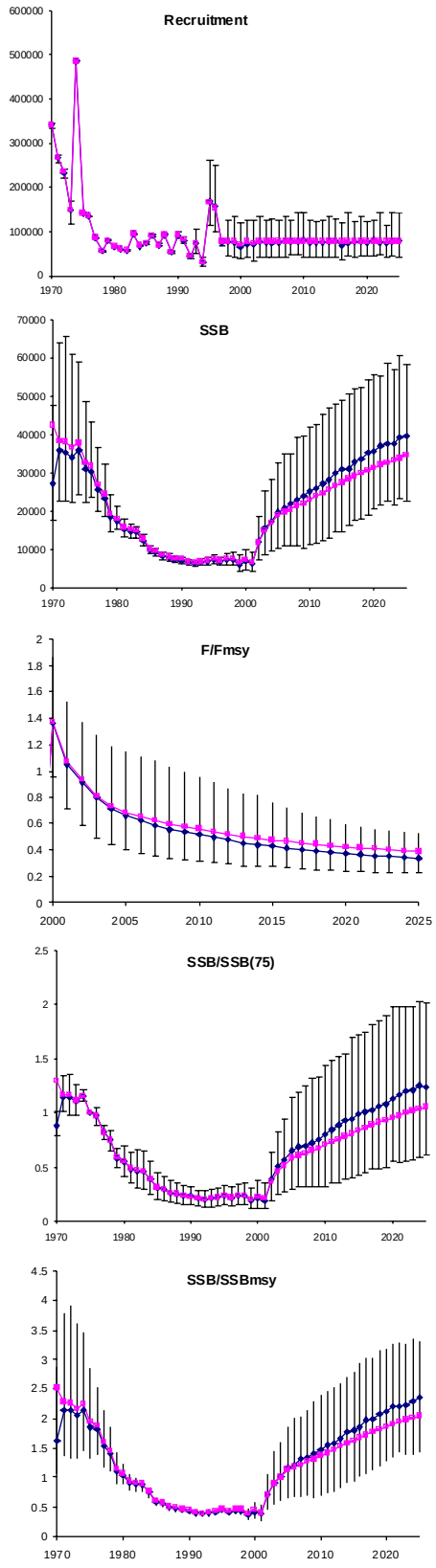


BFT-Fig. 3. West Atlantic bluefin tuna spawning biomass (MT), recruitment (in number of fish), and fishing mortality rates for fish of age 8+, estimated by VPA base case run.

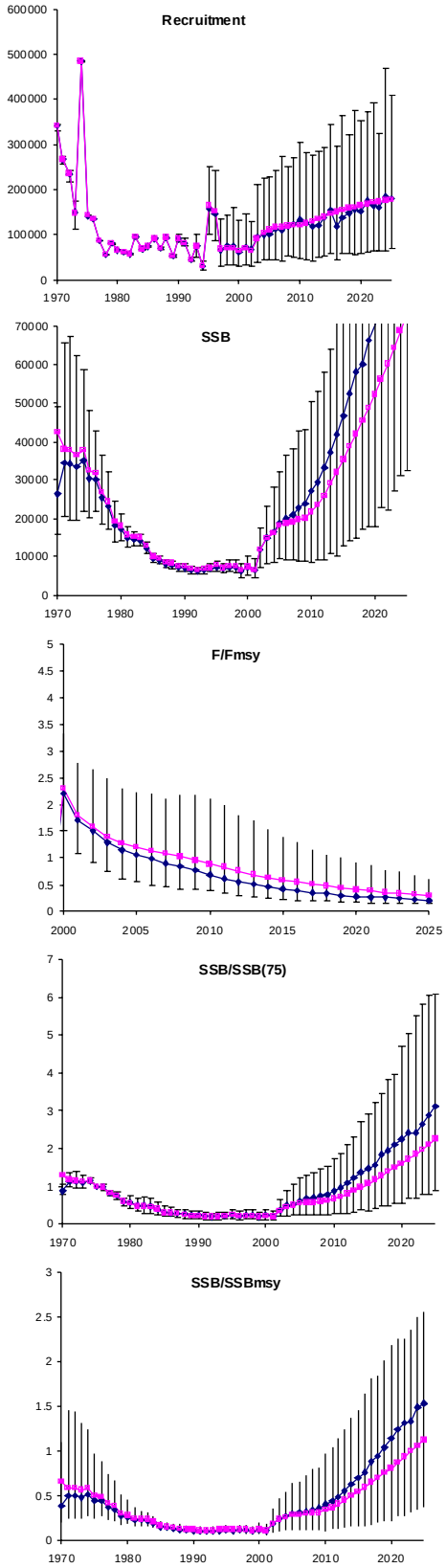
Low Recruitment Scenario **High Recruitment Scenario**



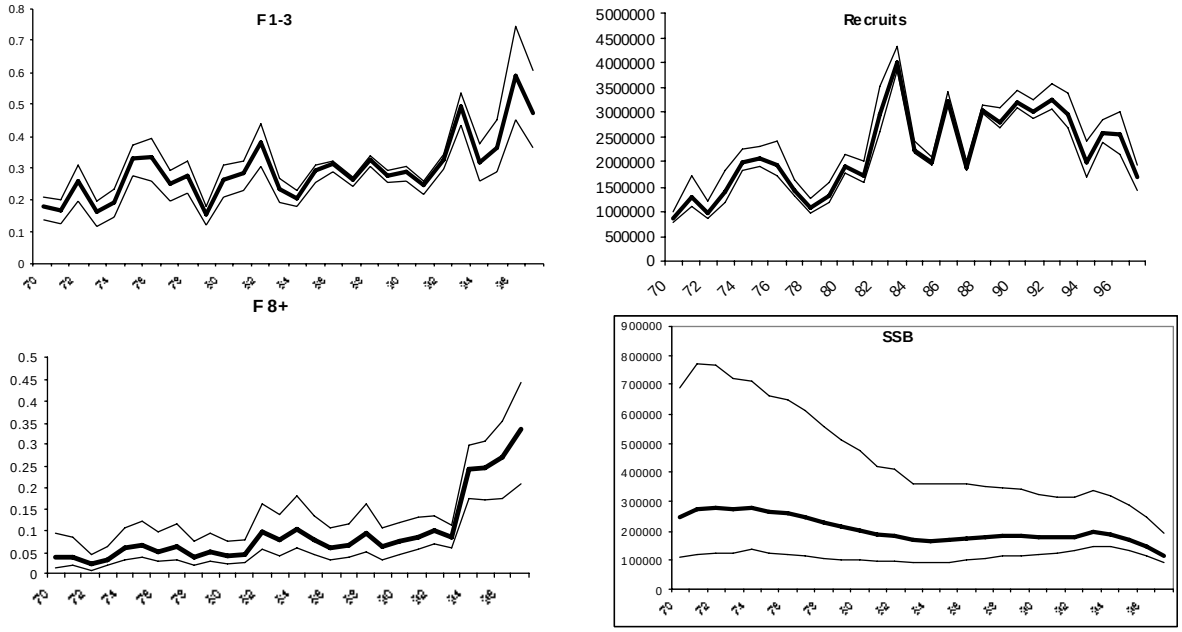
BFT-Fig. 4. Median projections of spawning stock biomass (SSB) with various levels of constant annual catches for west Atlantic bluefin tuna, expressed in absolute terms, relative to 1975 levels, and relative to estimates of BMSY from the low (left) and high (right) recruitment scenarios.



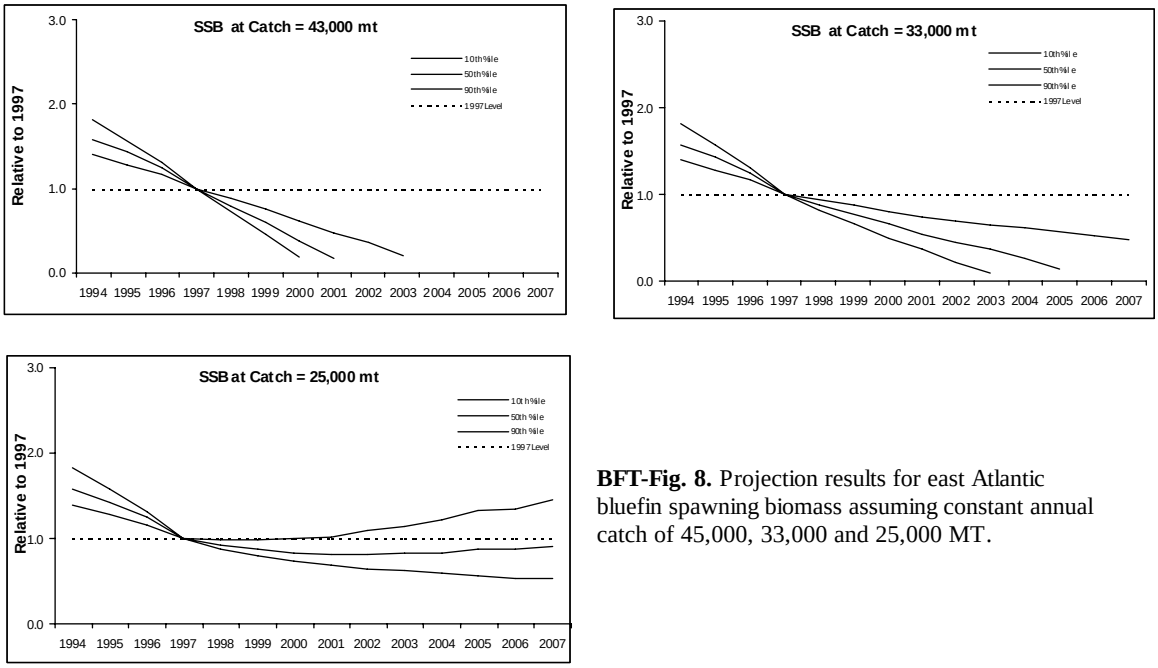
BFT-Fig. 5. Deterministic (squares) and medians (diamonds) with 80% bootstrapped confidence intervals for the base case **low recruitment** scenario projections for west Atlantic bluefin (with 2500 MT constant annual catches) for recruitment, spawning stock biomass (SSB), F/F_{MSY}, SSB/SSB_{75}, and SSB/SSB_{MSY}.



BFT-Fig. 6. Deterministic (squares) and medians (diamonds) with 80% bootstrapped confidence intervals for the base case high recruitment scenario projections for west Atlantic bluefin (with 2500 MT constant annual catches) for recruitment, spawning stock biomass (SSB), F/F_{MSY}, SSB/SSB_{75}, and SSB/SSB_{MSY}.



BFT-Fig. 7. Results (fishing mortality of ages 1-3 and 8+ as well as number of recruits and spawning stock biomass) estimated by base case VPA for east bluefin tuna.



BFT-Fig. 8. Projection results for east Atlantic bluefin spawning biomass assuming constant annual catch of 45,000, 33,000 and 25,000 MT.

7.6 BUM - BLUE MARLIN

BUM-1. Biology

Blue marlin are found throughout tropical and temperate waters of the Atlantic Ocean and adjacent seas, and range from Canada to Argentina on the western side, and from the Azores to South Africa on the eastern side **(BUM-Figure 1)**. Blue marlin are large apex predators with an average weight of about 100-175 kgs. Blue marlin have an extensive geographical range, migratory patterns that include trans-Atlantic as well as trans-Equatorial movements, and are generally considered to be a rare and solitary species relative to the schooling scombrids. Blue marlin are considered sexually mature by ages 2-4, spawn in tropical and subtropical waters in the summer and fall, and are found in the colder temperate waters during the summer. Young blue marlin are one of the fastest, if not the fastest growing of all teleosts, reaching from 30-45 kg by age 1. Females grow faster and reach a much larger maximum size than males.

Blue marlin feed on a wide variety of fish and squid, but show a dietary preference for scombrids. They are found predominately in the open ocean near the upper reaches of the water column and are caught most frequently as a by-catch by the offshore longline fisheries which target tropical or temperate tunas using gears intended to fish shallow. However, significant by-catch landings are also made by offshore longline fisheries that target swordfish and bigeye tuna using gear intended to fish deep.

Prior to 1995, the stock hypotheses for assessment purposes has historically been a North Atlantic and South Atlantic stock (divided at 5°N), and a total Atlantic stock. However, the 1995 SCRS recognized the increased importance of the single Atlantic hypothesis for blue marlin. More recently (1996), the Committee reviewed and discussed new data on genetic mitochondria DNA analysis, as well as tag release-recapture data, and concluded that these data were most consistent with a single (total) Atlantic hypothesis. Additionally, the Committee concluded that the North/South separation is arbitrary for this tropical species (as with white marlin). The Fourth Billfish Workshop reviewed all available data on stock structure and concluded that the single Atlantic hypothesis should be used as the management unit for Atlantic blue marlin.

BUM-2. Description of the fisheries

The fisheries for Atlantic blue marlin are characterized by many different participants. The major landings of blue marlin are incidental to the large offshore longline fisheries that have targeted tuna and swordfish, including Brazil, Cuba, Japan, Korea, Chinese Taipei, and others. Other major fisheries are the directed recreational fisheries of the United States, Venezuela, Bahamas, Brazil, and many other countries and entities in the Caribbean Sea and off the West coast of Africa. Other directed fisheries include artisanal fisheries in the Caribbean Sea and off West Africa. Development and geographical expansion of other longline fisheries that take blue marlin in the West Atlantic, Caribbean Sea, and east and south Atlantic by various countries have been reported (mainly Spain and the U.S. for East and West Atlantic, respectively). Tropical purse seine fisheries also have an incidental catch of blue marlin.

Landings for the total Atlantic first developed in the early 1960s, reached a peak of over 9,000 MT in 1963, declined to the range of about 2,000-3,000 MT during the period 1967-1977, and have fluctuated with an increasing trend over the period 1978-1996, and a decreasing trend thereafter **(BUM-Table 1 and BUM-Figure 2)**. The general trends in catches have followed the intensity of the offshore longline fisheries.

BUM-3. State of the stock

The previous Atlantic blue marlin assessment was conducted in 1996. The general results from this analysis indicated that in the mid-1990s biomass was about 25% of B_{MSY}, that fishing mortality was about 3 times F_{MSY}, and that over-fishing had been occurring for about three decades. MSY was estimated to be near 4,500 MT.

A new assessment was carried out this year using similar methods to the previous assessment, but with data sets that had been revised extensively in response to concerns raised since the 1996 assessment. The assessment might reflect a retrospective pattern wherein improvement in estimated biomass ratios result in estimated lower productivity. The new assessment is slightly more optimistic; it suggests that the total Atlantic stock is approximately 40% of B_{MSY} and that over-fishing has taken place in the last 10-15 years **(BUM-Figures 3, and 4)**. But this assessment also suggests a less productive stock than previously estimated, with an MSY of about 2,000 MT, and a

current fishing mortality that is about four times higher than F_{MSY}.

For the assessment, the Committee considered a range of models and data sets, including cases in which much of the historical data were disregarded or downweighted. While the sensitivity analyses were not meant to quantify possible biases, the committee notes that many of the sensitivity runs provided more optimistic results than those reported above, with stock estimates somewhat closer to B_{MSY} levels. However, most of the sensitivity results were within the range of uncertainty reported for the assessment. Thus, there is uncertainty in the assessment related to the historical data that is not well quantified. The Committee notes that the historical catch and effective fishing effort data must be validated and focused research be conducted before such uncertainties can be reduced. To address these uncertainties would require a substantial research investment in historical data validation efforts and in biological investigations of the habitat requirements of blue marlin.

BUM-4. Outlook

Blue marlin landings declined in 1999 by 28% from the 1996 level, in conformity with a recommendation made by the Commission (see section 5). As noted, there is uncertainty in the assessment related to the historical data that is not well quantified. However, given that the new assessment estimates that over-fishing is still occurring and that productivity (MSY and stock's capacity to replenish) is lower than previously estimated, it is expected that landings of the magnitude contemplated by the 1996 Commission Recommendation will continue to result in over-fishing of the stock beyond the MSY level.

BUM-5. Effect of current regulations

The only ICCAT regulation in effect for blue marlin is from the 1997 Commission resolution to reduce marlin landings by at least 25% from 1996 levels. This reduction was to be initiated in 1998 and fully implemented by the end of 1999. Estimated blue marlin landings for the total Atlantic were reduced by 28% relative to 1996 landings.

BUM-6. Management recommendations

The current assessment indicates that the stock is unlikely to recover if the landings contemplated by the 1996 Commission Recommendation continue into the future. While there is additional uncertainty in stock status and replacement yield estimates not reflected in bootstrap results, these uncertainties can only be addressed through substantial investment in research into habitat requirements of blue marlin and further verification of historical data. The Committee recommends that the Commission take steps to reduce the catch of blue marlin as much as possible. Steps such as release of live fish from fishing gear, reductions in fleet-wide effort, and establishment of time area closures, along with scientific observer sampling for verification could be considered.

ATLANTIC BLUE MARLIN SUMMARY *

	Total Atlantic
Maximum Sustainable Yield (MSY)	~ 2,000 MT [~ 2,000 - 3,000 MT]**
Current (1999) Yield***	3,316 MT
1999 Replacement Yield	~ 1,200 MT [~ 840 - 1,600 MT]**
Relative Biomass (B_{2000}/B_{MSY})	~ 0.4 [~ 0.25 - 0.6]**
Relative Fishing Mortality (F_{1999}/F_{MSY})	4.0 [~ 2.5 - 6.0]**
Management Measures in Effect	Reduced landing by 25% from 1996 levels [98-10]

* Approximately 80% CI from bootstrap for ASPIC model.
** Uncertainty in these estimates is not fully quantified by bootstrapping.
***Estimated yield including that carried over from previous years.

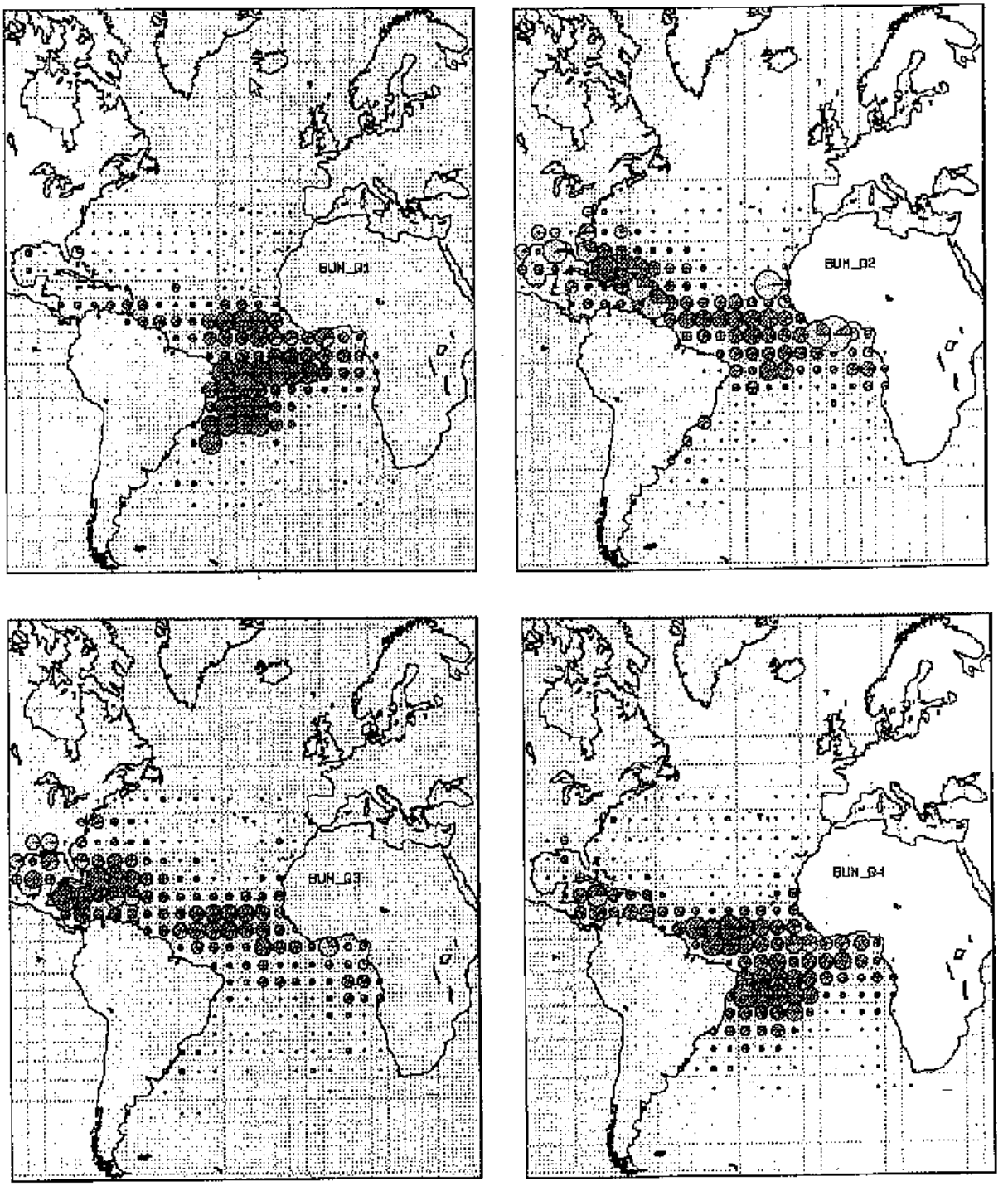
BUM-Table 1. Estimated catches (reported and carried over, in MT) blue marlin in 1977-1999, by region, gear and flag.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	
TOTAL ATL	**2181**	**1642**	**1527**	**1728**	**1903**	**2656**	**1914**	**2582**	**3161**	**1977**	**2048**	**2742**	**4206**	**4544**	**4156**	**2966**	**3254**	**4119**	**3948**	**4615**	**4303**	**3415**	**3316**	
North Atlantic	**1255**	**976**	**897**	**1084**	**1296**	**1650**	**1214**	**1378**	**1566**	**1069**	**835**	**909**	**1539**	**1941**	**1416**	**1046**	**1251**	**1618**	**1510**	**1838**	**1557**	**1185**	**1201**	
LANDINGS	*1255*	*976*	*897*	*1084*	*1296*	*1650*	*1214*	*1378*	*1566*	*1069*	*698*	*785*	*1349*	*1783*	*1276*	*939*	*1145*	*1515*	*1366*	*1642*	*1460*	*1136*	*1120*	
Longline	*876*	*553*	*480*	*643*	*792*	*1162*	*809*	*920*	*1223*	*695*	*327*	*415*	*1009*	*1597*	*981*	*628*	*815*	*1169*	*1032*	*1370*	*1185*	*772*	*733*	
Surface	*0*	*0*	*0*	*0*	*0*	*1*	*2*	*1*	*1*	*1*	*1*	*22*	*101*	*15*	*44*	*28*	*29*	*81*	*58*	*78*	*89*	*217*	*231*	
Rod&Reel+Sport	*298*	*301*	*299*	*301*	*300*	*299*	*199*	*206*	*168*	*213*	*180*	*186*	*142*	*48*	*55*	*81*	*108*	*112*	*68*	*60*	*49*	*35*	*44*	
Unclassified	*81*	*122*	*118*	*140*	*204*	*188*	*204*	*251*	*174*	*160*	*190*	*162*	*97*	*123*	*196*	*202*	*193*	*153*	*208*	*134*	*137*	*112*	*112*	
BARBADOS	81	72	51	73	117	99	126	126	10	14	13	46	3	18	12	18	21	19	31	25	25	25	25	
BRASIL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	
CANADA-JPN	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
CHINA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	26	22	28	43	43	*
CHINESE TAIPEI	64	81	51	160	98	100	125	102	148	117	52	26	11	937	716	336	281	272	187	170	355	80	68	
CUBA	220	97	156	162	178	318	273	214	246	103	68	94	74	112	127	135	69	39	85	43	0	12	0	
EC-ESPANA	0	0	0	0	0	0	0	3	4	1	0	8	7	2	1	7	7	6	0	22	5	6	0	
EC-PORTUGAL	0	0	0	0	0	1	2	1	8	12	8	2	1	1	4	2	15	11	10	7	3	47	41	*
GRENADA	0	0	0	1	1	12	6	8	11	36	33	34	40	52	64	52	58	52	50	26	47	47	47	*
JAMAICA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	0	0	
JAPAN	118	54	68	193	332	637	192	351	409	174	78	206	593	250	145	193	207	532	496	798	617	554	521	
KOREA	307	185	67	48	71	19	43	110	154	36	13	14	252	240	34	11	2	16	16	41	16	0	0	
MEXICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	13	13	13	13	27	35	
NEI-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	57	100	100	100	100	0	0	
NETH.ANT	0	50	50	50	50	50	50	50	50	50	50	50	50	50	40	40	40	40	40	40	40	40	40	
PANAMA	87	42	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
PHILIPPINES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	38	
SENEGAL	0	0	0	0	0	0	0	0	0	0	0	0	1	1	5	0	0	5	5	5	0	0	0	
ST.VINCENT	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2	2	2	0	1	0	0	
TRINIDAD & TOBAGO	0	0	0	0	0	0	3	8	3	17	2	0	28	4	6	4	226	150	150	150	13	0	0	
U.S.A	295	295	312	312	342	329	215	280	295	273	291	221	124	29	33	51	80	88	43	35	46	31	37	*
U.S.S.R	1	1	0	0	0	0	0	0	0	7	23	0	0	0	0	0	0	0	0	0	0	0	0	
UK-BERMUDA	2	5	2	4	1	2	7	8	9	11	6	8	15	17	18	19	11	15	15	15	3	5	7	
UKRAINE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	5	0	0	0	0	0	0	0	
VENEZUELA	80	94	134	81	106	83	172	117	219	218	60	76	149	70	56	65	66	133	97	130	124	202	218	
Discards	0	0	0	0	0	0	0	0	0	0	137	124	190	158	140	107	106	103	144	196	97	49	81	
U.S.A - LLD	0	0	0	0	0	0	0	0	0	0	137	124	190	158	140	107	106	103	144	196	97	49	81	

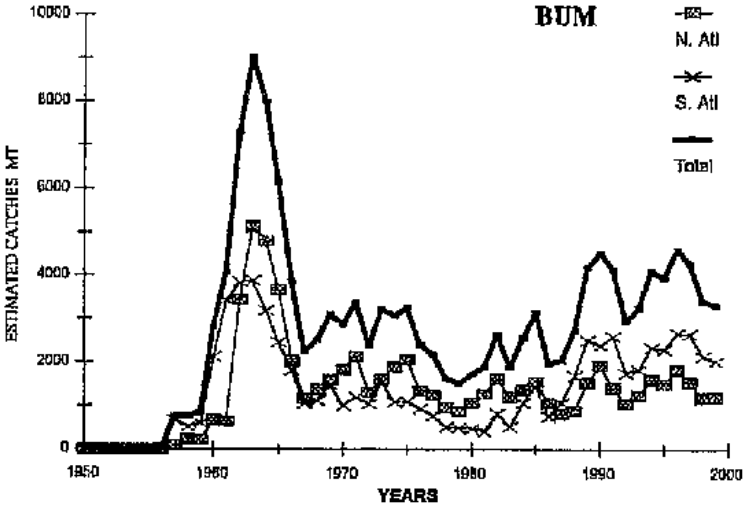
BUM-Table 1 (cont.). Estimated catches (reported and carried over, in MT) blue marlin in 1977-1999, by region, gear and flag.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	
South Atlantic	**792**	**530**	**504**	**500**	**438**	**832**	**533**	**1086**	**1473**	**773**	**1080**	**1696**	**2522**	**2403**	**2601**	**1765**	**1836**	**2360**	**2303**	**2673**	**2664**	**2150**	**2032**	
LANDINGS	*792*	*530*	*504*	*500*	*438*	*832*	*533*	*1086*	*1473*	*773*	*1080*	*1696*	*2522*	*2403*	*2601*	*1765*	*1836*	*2360*	*2303*	*2672*	*2622*	*2148*	*2030*	
Longline	*739*	*526*	*490*	*498*	*430*	*822*	*533*	*975*	*1362*	*661*	*964*	*1530*	*2017*	*1958*	*2280*	*1473*	*1415*	*1662*	*1587*	*2010*	*2302*	*1566*	*1706*	
Surface	*53*	*4*	*14*	*2*	*8*	*10*	*0*	*111*	*111*	*112*	*116*	*166*	*505*	*445*	*259*	*223*	*421*	*698*	*716*	*662*	*285*	*582*	*324*	
Unclassified	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*62*	*69*	*0*	*0*	*0*	*0*	*35*	*0*	*0*	
BENIN	0	0	0	0	6	8	0	9	10	7	4	12	0	6	6	6	6	5	5	5	0	0	0	
BRASIL	100	49	34	23	28	30	27	32	33	46	51	74	60	52	61	125	147	81	180	331	193	329	509	
CHINA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	47	40	50	76	76	
CHINESE TAIPEI	107	177	139	129	104	150	47	70	165	98	265	266	462	767	956	488	404	391	280	490	1123	498	418	
COTE D'IVOIRE	0	0	0	0	0	0	0	100	100	100	100	143	74	113	126	94	177	250	228	204	257	135	324	
CUBA	100	113	180	187	108	118	123	159	205	111	137	191	77	90	62	69	0	0	0	0	0	0	0	
EC-ESPANA	0	0	0	0	0	0	0	0	0	0	0	0	15	0	6	23	18	21	38	88	71	82	82	*
GABON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	8	0	0	0	
GHANA	0	0	0	0	0	0	0	0	0	0	0	0	430	324	126	123	236	441	472	422	0	447	0	
JAPAN	17	15	66	115	136	495	248	482	691	335	362	617	962	967	755	824	719	991	913	881	753	554	588	
KOREA	356	140	78	46	55	31	88	234	262	60	139	361	437	84	503	13	11	40	40	103	40	2	0	
NEI-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	117	100	100	100	100	0	0	
PANAMA	103	32	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
PHILIPPINES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	33	
SAO TOME & PRINCIPE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0	
U.S.S.R	9	4	0	0	1	0	0	0	7	16	22	32	5	0	0	0	0	0	0	0	0	0	0	
URUGUAY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	0	
Discards	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	42	2	2	
U.S.A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	42	2	2	
Area Unknown	**134**	**136**	**126**	**144**	**169**	**174**	**167**	**118**	**122**	**135**	**133**	**137**	**145**	**200**	**139**	**155**	**167**	**141**	**135**	**104**	**82**	**80**	**83**	
EC-PS	134	136	126	144	169	174	167	118	122	135	132	137	144	199	137	116	146	133	126	96	82	80	83	
U.S.A-UNCL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	
U.S.A-LL Discards	0	0	0	0	0	0	0	0	0	0	1	0	1	1	2	39	21	8	9	0	0	0	0	

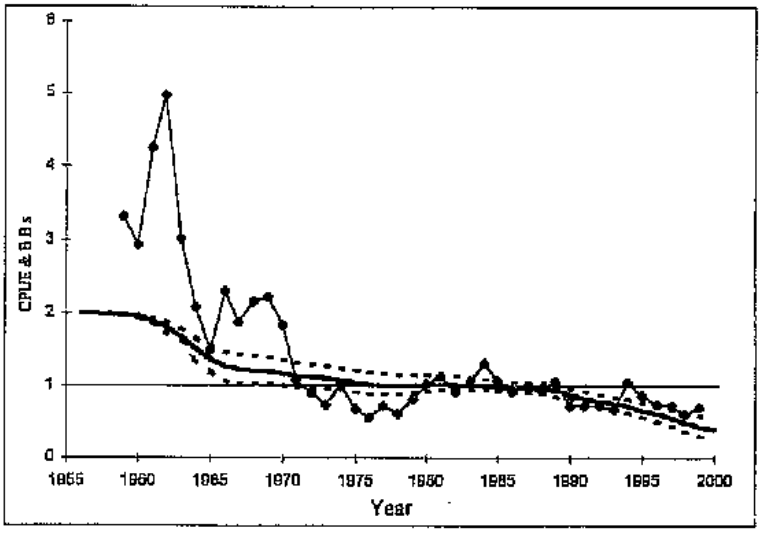
This table contains the data believed to be the best estimates by the Fourth Billfish Workshop.
The Task I data for the series of EC purse seiners (1977-1999) and Chinese longliners (1994-1999) were replaced with new estimates at the Workshop.
The figures in SCRS/00/141 which became available after the Workshop may be used to replace historical catch estimates of EC purse seiners in the future.
*Shows figures carried over from 1998 used in the assessment. Task I data were submitted after the workshop. U.S. RR was later found to be 49 MT in 1998
Shaded cells indicate estimate catches. In some cases, the Committee assumed the catch to be the same as the previous year (s)



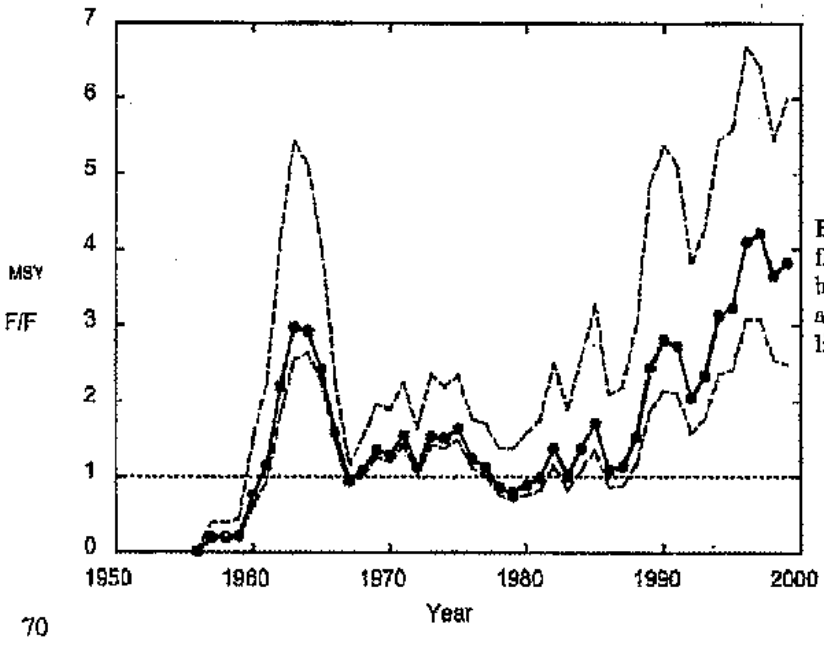
BUM-Fig. 1. Geographical distributions of reported catches of blue marlin by quarter, combined for all the years from 1950 to 1997. (Heavy-shaded areas represent longline catches and light-shaded areas represent gears other than longline.)



BUM-Fig. 2. Estimated catches (MT) of blue marlin in the Atlantic by region.



BUM-Fig. 3. Composite CPUE series (symbols) used in the blue marlin assessment compared to model-estimated median relative biomass (solid lines) from bootstrap results (80% confidence bounds shown by dotted lines).



BUM-Fig. 4. Estimated median relative fishing mortality trajectory for Atlantic blue marlin (center, dark line) with approximate 80% confidence range (light lines) obtained from bootstrapping.

7.7 WHM - WHITE MARLIN

WHM-1. Biology

White marlin are found throughout tropical and temperate waters of the Atlantic Ocean and adjacent seas. Their range is almost identical to that of blue marlin **(WHM-Figure 1)**. Their average size is about 20-30 kg. White marlin occur only in the Atlantic Ocean, which is not the case for blue marlin and sailfish. Although white marlin are generally considered to be a rare and solitary species relative to the schooling scombrids, they are known to occur in small groups consisting of several individuals. They spawn in tropical and subtropical waters in mid- to late spring, and are found in the colder temperate waters during the summer. Very little is known about the age and growth of white marlin, although they are considered to be very fast growing, as are all the Istiophoridae. Female white marlin grow faster and reach a larger maximum size than males.

White marlin are generally considered piscivorus, but also have been know to consume squid. They are found predominately in the open ocean near the upper reaches of the water column and are caught most frequently as a by-catch by the offshore longline fisheries which target tropical or temperate tunas using gear intended to fish shallow. However, significant by-catch landings are also made by offshore longline fisheries that target swordfish and big eye tuna using gear intended to fish deep.

As with blue marlin, the SCRS stock hypotheses for white marlin assessments historically has been a North and South Atlantic stock (divided at 5ºN), as well as a single (total) Atlantic stock. However, the 1995 SCRS recognized the increased importance of the total Atlantic hypothesis for white marlin. More recently (1996), the Committee reviewed and discussed new data on genetic mitochondria DNA analysis, as well as tag release-recapture data, and concluded that these data were most consistent with a total Atlantic hypothesis. In addition, the Committee concluded that the North/South separation is arbitrary for this tropical species (as with blue marlin). The Fourth Billfish Workshop reviewed all available data on stock structure and concluded that the single Atlantic hypothesis should be used as the management unit for Atlantic white marlin.

WHM-2. Description of the fisheries

See section on "Description of Fisheries" in Blue Marlin Executive Summary report.

Landings for the total Atlantic first developed in the early 1960's, reached a peak of almost 5,000 MT in 1965, declined to about 1,000 MT per year during the period 1977-1982, and have fluctuated between about 940 and 1,700 MT through 1999 **(WHM-Table 1 and Figure 2)**. Landings for the North Atlantic generally show a trend similar to that of the total Atlantic and have followed the intensity of the offshore longline fisheries.

WHM-3. State of the stock

The previous Atlantic white marlin assessment was conducted in 1996. The general results from this analysis indicated that in the mid-1990s biomass was about 20% of B_{MSY}, that fishing mortality was about 2 times F_{MSY}, and that over fishing had been occurring for about three decades. MSY was estimated to be near 2,200 MT.

A new assessment was carried out this year using similar methods to the previous assessment, but with data sets that had been revised extensively in response to concerns raised since the 1996 assessment. The new assessment is more pessimistic; it suggests that the total Atlantic stock less than 15% of B_{MSY}, that over-fishing has taken place for over three decades, and that the stock is less productive stock than previously estimated, with an MSY smaller than 1,300 MT **(WHM-Figures 3,4, and 5).** Current fishing mortality is estimated to be 7 times higher than F_{MSY}, or higher.

For the assessment, the Committee considered a few alternative models and data sets, including cases in which much of the historical data were disregarded or down weighted. While the sensitivity analyses were not meant to quantify possible biases, the committee notes that some of the sensitivity runs provided more optimistic results than those reported above, with stock estimates somewhat closer to B_{MSY} levels. However, most of the sensitivity results were within the range of uncertainty reported for the assessment. Thus, there is uncertainty in the assessment related to the historical data that is not well quantified. In addition, it is expected that the uncertainty in these quantities are

greater than that for blue marlin and would likely result in a wider range than would be estimated through bootstrapping alone. The Committee notes that the historical catch and effective fishing effort data must be validated and focused research be conducted before such uncertainties can be reduced. To address these uncertainties would require a substantial research investment in historical data validation efforts and in biological investigations of the habitat requirements of white marlin.

WHM-4. Outlook

White marlin landings declined in 1999 by 44% from the 1996 level, in conformity with a recommendation made by the Commission (see section 5). As noted, there is uncertainty in the assessment related to the historical data that is not well quantified. However, given that the new assessment estimates that over-fishing is still occurring, that productivity is lower than previously estimated, and that the stock is severely depressed below the B_{MSY} level, it is expected that landings of the magnitude contemplated by the 1996 Commission Recommendation will continue to result in over-fishing of the stock.

WHM-5. Effect of current regulations

The only ICCAT regulation in effect for white marlin is from the 1997 Commission resolution to reduce marlin landings by at least 25% from 1996 levels. This reduction was to be initiated in 1998 and fully implemented by the end of 1999. Estimated white marlin landings for the 1999 total Atlantic were reduced by 44% from 1996 levels.

WHM-6. Management recommendations

The current assessment indicates that the stock is unlikely to recover if the landings contemplated by the 1996 Commission Recommendation continue into the future. While there is additional uncertainty in stock status and replacement yield estimates not quantified in the base case results, these uncertainties can only be addressed through substantial investment in research into habitat requirements of marlins and further verification of historical data. The Committee recommends that the Commission take steps to reduce the catch of white marlin as much as possible. Steps such as release of live fish from fishing gear, reductions in fleet-wide effort, and establishment of time-area closures, along with scientific observer programs for verification could be considered.

ATLANTIC WHITE MARLIN SUMMARY *

	Total Atlantic
Maximum Sustainable Yield (MSY)	~ 1,300 MT [~ 900 - 2,000 MT]
Current (1999) Yield **	908 MT
2000 Replacement Yield	<1999 Yield***
Relative Biomass (B_{2000}/B_{MSY})	~ 0.15
Relative Fishing Mortality (F_{1999}/F_{MSY})	> 7
Management Measures in Effect	Reduced landing by 25% from 1996 levels [98-10]

* These estimates are highly uncertain. Estimates of uncertainty in benchmarks were not available for white marlin, but it is expected that the uncertainty in these quantities is greater than that for blue marlin and would likely result in a wider range than would be estimated through bootstrapping alone.

** Estimated yield including that carried over from previous years.

*** Estimates of replacement yield are not well determined.

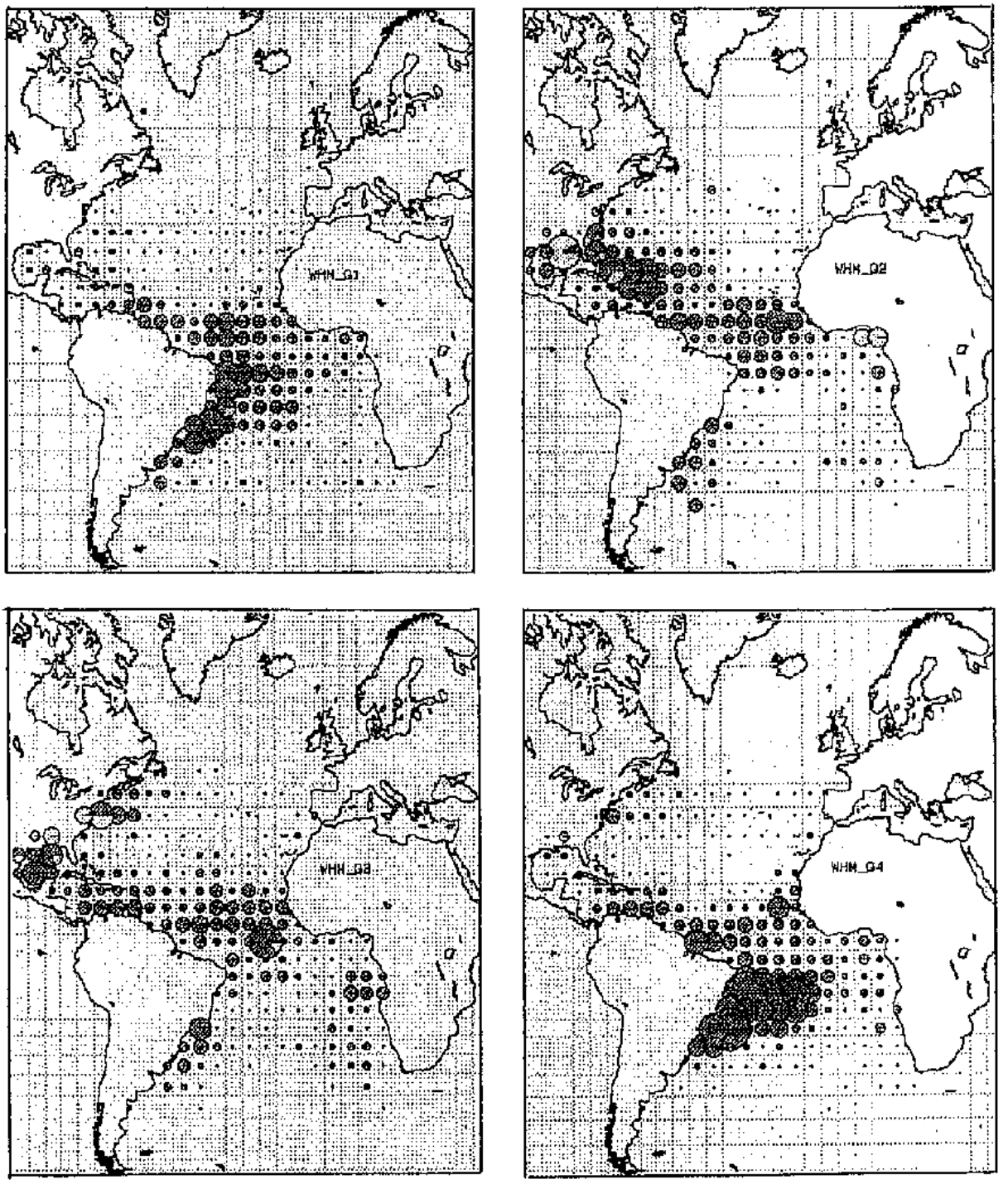
WHM-Table 1. Estimated catches (reported and carried over, in MT) white marlin in 1977-1999, by region, gear and flag.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	
TOTAL ATLANTIC	**1150**	**975**	**1039**	**970**	**1235**	**1144**	**1697**	**1233**	**1818**	**1613**	**1552**	**1399**	**1810**	**1628**	**1577**	**1320**	**1407**	**1926**	**1517**	**1636**	**1044**	**937**	**908**	
North Atlantic	**501**	**428**	**482**	**521**	**789**	**670**	**1347**	**740**	**966**	**908**	**647**	**453**	**372**	**395**	**223**	**486**	**446**	**611**	**546**	**551**	**357**	**324**	**315**	
LANDINGS	***501***	***428***	***482***	***521***	***789***	***670***	***1347***	***740***	***966***	***908***	***586***	***393***	***267***	***314***	***133***	***405***	***384***	***572***	***454***	***487***	***324***	***292***	***259***	
Longline	**390**	**317**	**370**	**403**	**671**	**548**	**1196**	**570**	**788**	**812**	**433**	**167**	**234**	**251**	**105**	**355**	**330**	**480**	**386**	**445**	**279**	**243**	**206**	
Rod-and-Reel & Sport	**111**	**111**	**111**	**112**	**111**	**110**	**146**	**153**	**149**	**35**	**99**	**76**	**22**	**23**	**11**	**18**	**24**	**30**	**20**	**15**	**3**	**2**	**1**	
Others + Unclassified	**0**	**0**	**1**	**6**	**7**	**12**	**5**	**17**	**29**	**61**	**54**	**150**	**11**	**40**	**17**	**32**	**30**	**62**	**48**	**27**	**42**	**47**	**52**	
BARBADOS	0	0	0	0	0	0	0	0	0	0	0	117	11	39	17	24	29	26	43	15	34	34	34	
BRASIL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
CANADA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	4	4	8	8	0	5	
CHINA.PR																		3	4	3	4	6	6	
CHINESE TAIPEI	44	79	62	105	174	134	203	96	128	319	153	0	4	85	13	92	123	270	181	146	62	105	96	
CUBA	67	43	68	70	189	205	728	241	296	225	30	13	21	14	0	0	0	0	0	0	0	0	0	
EC-ESPANA	0	0	0	0	0	0	0	9	14	0	0	61	12	4	8	18	15	25	10	75	71	65	65	*
JAPAN	80	27	42	99	118	84	27	52	45	56	60	68	73	34	45	180	33	41	31	80	31	36	70	
KOREA	71	33	16	18	49	12	6	18	147	37	2	2	82	39	1	9	4	23	3	7	2	0	0	
MEXICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	8	8	0	5	6	11	
NEI-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46	50	50	50	50	0	0	
PANAMA	20	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
PHILIPPINES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	
ST.VINCENT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	
U.S.A	109	109	110	116	117	122	148	168	181	119	185	89	16	19	5	8	13	11	9	4	2	2	1	
U.S.S.R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
UK-BERMUDA	0	0	0	0	0	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	
VENEZUELA	110	129	183	113	142	113	234	155	155	151	154	42	47	79	43	73	117	110	110	98	54	37	42	
DISCARDS																								
U.S.A	0	0	0	0	0	0	0	0	0	0	61	60	105	81	90	81	62	39	92	64	33	32	56	

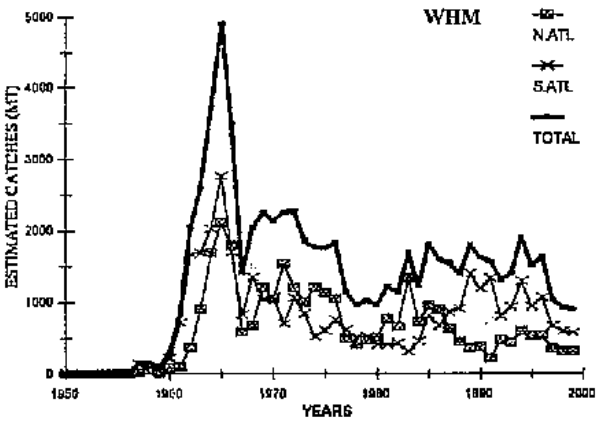
WHM-Table 1 (cont.). Estimated catches (reported and carried over, in MT) white marlin in 1977-1999, by region, gear and flag.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	
South Atlantic	**624**	**522**	**534**	**422**	**415**	**442**	**319**	**471**	**829**	**680**	**879**	**921**	**1409**	**1196**	**1343**	**817**	**945**	**1299**	**954**	**1075**	**677**	**604**	**585**	
	3	***2***	***534***	***422***	***415***	***442***	***319***	***471***	***829***	***680***	***879***	***921***	***1409***	***1196***	***1343***	***817***	***945***	***1299***	***954***	***1075***	***640***	***603***	***585***	
L		**0**	**530**	**419**	**340**	**442**	**308**	**471**	**825**	**654**	**870**	**832**	**1333**	**1152**	**1320**	**803**	**923**	**1298**	**948**	**662**	**593**	**555**	**571**	
Others + Unclassified	**3**	**2**	**4**	**3**	**75**	**0**	**11**	**0**	**4**	**26**	**9**	**89**	**76**	**44**	**23**	**14**	**22**	**1**	**6**	**413**	**47**	**48**	**14**	
ARGENTINA	2	0	0	0	0	0	0	0	4	4	0	0	8	9	6	0	0	0	0	0	0	0	0	
BELIZE.SH.OB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	
BRASIL	275	175	133	58	100	76	81	61	87	143	93	149	204	205	377	211	301	91	105	75	105	140	157	
CHINA.PR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	7	6	7	10	10	
CHINESE TAIPEI	119	198	155	145	136	227	87	124	172	196	613	565	979	810	790	506	493	1080	726	420	379	401	368	
COTE D'IVOIRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	7	
CUBA	57	127	205	212	116	45	112	153	216	192	62	24	22	6	10	10	0	0	0	0	0	0	0	
EC-ESPANA	0	0	0	0	0	0	0	0	0	0	0	1	1	0	9	4	8	0	18	32	3	4	4	*
GABON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	406	0	0	0	
GHANA	0	0	0	0	0	0	0	0	0	22	6	88	68	31	17	14	22	1	2	1	0	7	7	
JAPAN	26	14	15	7	25	27	17	24	81	73	74	76	73	92	77	68	49	51	26	32	30	17	22	
KOREA	111	5	24	0	36	57	9	44	225	34	25	17	53	42	56	1	4	20	20	52	18	0	0	
NEI-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	68	50	50	50	50	0	0	
NEI-166	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
PANAMA	31	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
PHILIPPINES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	8	
SAO TOME & PRINCIPE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	0	0	
U.S.S.R	3	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
URUGUAY	0	0	0	0	1	10	13	65	44	16	6	1	1	1	1	3	0	0	0	0	0	22	22	
Discards	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	37	1	0	
U.S.A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	37	1	0	
Unknown Area	25	25	23	27	31	32	31	22	23	25	26	25	29	37	11	17	16	16	17	10	10	9	8	
KOREA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	
EU-Espana	25	25	23	27	31	32	31	22	23	25	25	25	27	37	11	10	12	11	9	7	7	9	8	
U.S.A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3	0	0	0	
Discards	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***1***	***0***	***2***	***0***	***0***	***7***	***4***	***3***	***8***	***0***	***0***	***0***	***0***	
U.S.A-LLD	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	7	4	3	8	0	0	0	0	

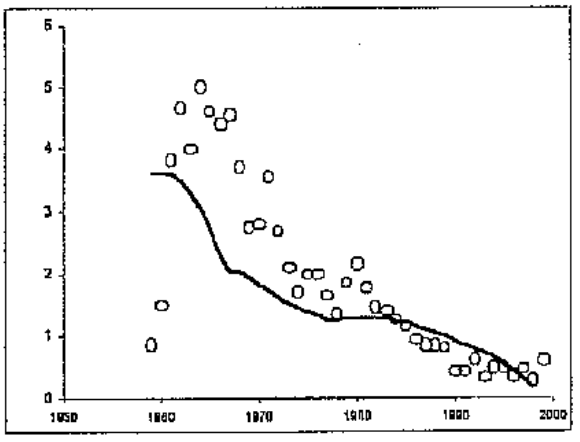
This table contains the data believed to be the best estimates by the Fourth Billfish Workshop.
The Task I data for the series of EC purse seiners (1977-1999) and Chinese longliners (1994-1999) were replaced with new estimates at the Workshop.
The figures in SCRS/00/141 which became available after the Workshop may be used to replace historical catch estimates of EC purse seiners in the future.
*Shows figures carried over from 1998 used in the assessment. Task I data were submitted after the workshop. U.S. RR was later found to be 49 MT in 1998
Shaded cells indicate estimate catches. In some cases, the Committee assumed the catch to be the same as the previous year (s)



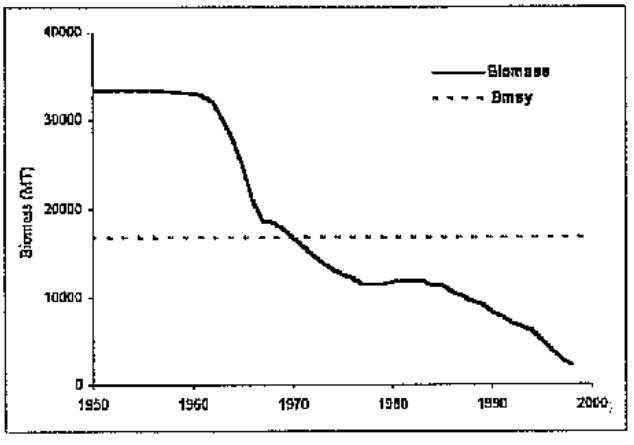
WHM-Fig. 1. Geographical distribution of reported catches of white marlin by quarter, combined for all the years from 1950 to 1997. (Heavy-shaded areas represent longline catches and light-shaded areas represent other gears.)



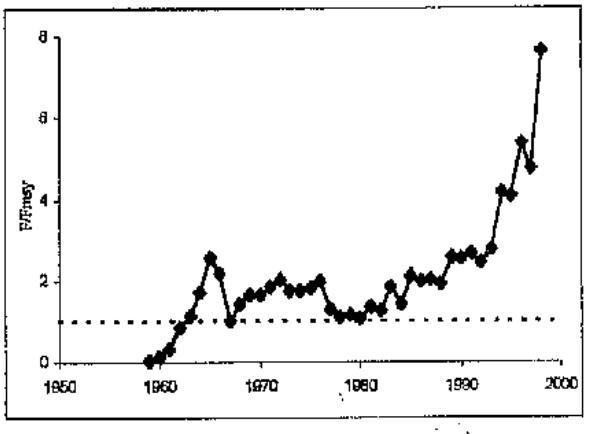
WHM-Fig. 2. Estimated catches of white marlin in the Atlantic by region.



WHM-Fig. 3. Fit of the biomass dynamic model (line) to combined CPUE index (symbols) for white marlin.



WHM-Fig. 4. Biomass trajectory estimated for white marlin using a single combined index of abundance.



WHM-Fig. 5. Relative fishing mortality trajectory for white marlin estimated with a logistic production model applied to catch and a composite CPUE series.

7.8 SAI - SAILFISH/SPEARFISH

No new assessment was conducted for sailfish this year. The conclusions reported here generally reflect the results of the last assessments.

SAI-1. Biology

Since longline catches of sailfish and spearfish have been reported together in ICCAT landing statistics (except for Japan since 1994), these species will be summarized together for the purposes of this report. Sailfish and spearfish have a circum-tropical distribution **(SAI-Figure 1)**. Although sailfish have high concentrations in coastal waters (more than any other istiophorid), they are still found in oceanic waters. Spearfish are most abundant in offshore waters. Tag returns for sailfish/spearfish have not demonstrated trans-Atlantic or trans-Equatorial movements. Although sailfish and spearfish are generally considered to be rare and solitary species relative to the schooling scombrids, sailfish are the most common Atlantic istiophorid and are known to occur along tropical coastal waters in small groups consisting of at least a dozen individuals. Spearfish are generally the rarest Atlantic istiophorid, even in the offshore catches. The stock hypotheses for sailfish/spearfish assessment purposes are a western Atlantic and eastern Atlantic stock (divided at 30º W).

Sailfish and spearfish are generally considered piscivorus, but also have been known to consume squid. They are found predominately in the upper reaches of the water column and are caught most frequently as a bycatch of the offshore longline fisheries. However, in coastal waters, artisanal fisheries using many types of shallow water gear target sailfish.

Sailfish spawn in tropical and subtropical waters in the spring through summer. Due to their relative rare abundance in offshore waters, virtually nothing is known about spearfish reproduction. Both sailfish and spearfish are considered to be very fast growing, although sailfish and spearfish are probably the slowest growing Atlantic istiophorids. Female sailfish grow faster and reach a larger maximum size than males.

SAI-2. Description of the fisheries

The fisheries in the West and East Atlantic for sailfish/spearfish are both characterized by participants from many different countries. For example, the recent major catches of sailfish in both the West and East Atlantic result from the artisanal fisheries. In the West Atlantic, the primary artisanal fisheries are from many countries in the Caribbean sea, whereas in the East Atlantic major artisanal fisheries are off West Africa (primarily Ghana, Senegal, Côte d'Ivoire, and others). Directed recreational fisheries for sailfish occur in the West Atlantic from the United States, Venezuela, Bahamas, Brazil, Dominican Republic, Mexico, and other countries in the Caribbean Sea. Directed recreational fisheries for sailfish in the East Atlantic also exist off West Africa in Senegal. Prior to the 1970's, the major sailfish/spearfish landings were a result of the bycatch from the offshore longline fisheries. The offshore longline fisheries in the West and East Atlantic include those from Brazil, Japan, Korea, Cuba, and Chinese Taipei. Development and geographical expansion of other longline fisheries in the West (by the U.S.) and East (by Spain) also include a bycatch of sailfish/spearfish. Mediterranean spearfish are usually a by-catch from longline and driftnet fisheries from a number of Mediterranean countries. Some occasional catches of spearfish are also made by a direct harpoon fishery.

Landings for the total Atlantic first developed in the early 1960`s, reached a peak of almost 3,000 MT in 1965, declined to about 1,600 MT by 1973, reach an historical peak of 6,100 MT in 1976, then fluctuated between 2,000 to 4,000 MT through 1996. Unfortunately, landings data are incomplete for 1997-1999 because many fisheries-areas that reported landings in 1996 failed to report their 1997/99 landings (**SAI-Table 1** and **SAI-Figure 2**). Landings for the East Atlantic generally paralleled the total Atlantic increasing trend, whereas the landings in the West were steady over the last decade. It should be noted that a significant segment of the landings between 1965 and 1983 were listed as unclassified regions. During the Third ICCAT Billfish Workshop data preparatory meeting (Miami, FL, July 1996) these data were partitioned into either the West or East Atlantic. The Committee continues to recognize that some uncertainties of the landings data, particularly in the East Atlantic, still persist. However, new landings data are becoming available for historically traditional fisheries, as well as some artisanal fisheries. The overall trend in Atlantic landings are very much governed by the large landings from artisanal fisheries off of West Africa.

SAI-3. State of the stocks

No new stock assessment was submitted to the 1999 SCRS for Atlantic sailfish/spearfish. The most current assessment for West Atlantic sailfish/spearfish was submitted to the SCRS in 1993 and these analyses included data through 1991. The general results from these exploratory analyses using a non-equilibrium production model indicated that biomass trends had declined to fully exploited or over exploited levels, particularly near the end of the time series **(SAI-Figures 3 and 4)**. Maximum sustainable yield was estimated from production model analyses for the West Atlantic to be about 700 MT, whereas landings for 1996, the most recent year landings were fully reported, were about 905 MT. Biomass in 1992 was estimated to be 62% of the biomass needed to produce MSY. Statements about the current yield are inappropriate due to incomplete landings reported for 1997-1999.

The most current assessment for East Atlantic sailfish/spearfish was submitted during the 1997 SCRS and this analysis, using a non-equilibrium production model, included data through 1995. The Working Group decided to exclude the Japanese longline CPUE from the current analysis because of the mixing of spearfish in the sailfish catch for the early part of the time series and changes in gear, deployment locations, target species, and reduced reports of sailfish landings in the most recent part of this time series. The general results from these exploratory analyses, using the artisanal fisheries as the primary index of abundance, indicated that biomass trend had declined to fully exploited levels near the end of the time series **(SAI-Figures 5 and 6)**. Maximum sustainable yield was estimated from the production model analyses for the East Atlantic to be about 1,390 MT, whereas landings for 1996 are about 1,906 MT. Biomass in 1996 was estimated to be 88% of the biomass needed to produce MSY. Similar statistics for 1997 cannot be developed because of incomplete landings for these years.

SAI-4. Outlook

The Committee remains concerned about the downward trend in the indices of abundance and the biomass trajectories for western Atlantic sailfish, which indicate the stock has declined to fully exploited or over-exploited levels. The reported landings for West Atlantic sailfish since 1992 were considerably higher than the replacement yield (about 600 MT) and therefore the stock biomass are expected to have continued to decline. However, landings for 1997-1999 were incomplete and therefore statements on current stock status are inappropriate, particularly since the most recent western Atlantic assessment was conducted in 1992.

The Committee is encouraged by the increase in information on eastern Atlantic sailfish (particularly standardized artisanal indices of abundance) but also recognizes continued improvement is still necessary. The Committee feels that the most recent assessment results (1995), which indicate the stock is likely fully exploited (more optimistic than for the West Atlantic), reflect the improvements to this data base. The Committee was also unanimous in its conclusion that the West African artisanal indices of abundance best describe populations trends for this stock hypothesis. The reported landings for East Atlantic sailfish in 1996 (1,906 MT) are higher than the replacement yield (about 1,473 MT) and therefore the stock biomass are expected to decline further.

SAI-5. Effect of current regulations

No ICCAT regulations are currently in effect for Atlantic sailfish/spearfish.

See section in the Blue Marlin Executive Summary Report.

SAI-6. Management recommendations

The most recent stock assessments for eastern Atlantic (1995) and particularly western Atlantic sailfish (1992) indicate that this species is at least fully exploited or possibly over-exploited and warrants consideration for development of methods to reduce fishing mortality rates. There is a need to update the sailfish assessments. The Committee is concerned about the incomplete reporting of landings, particularly for the last three years. The Committee recommends all countries landing sailfish/spearfish or having dead discards, report these data to the ICCAT Secretariat so assessments planned in the near future can proceed.

ATLANTIC SAILFISH SUMMARY

	West Atlantic[1]	*East Atlantic*
Maximum Sustainable Yield (MSY)	~ 700 MT	1,390 MT
Current (1999) Yield *	Incomplete (546 MT)	Incomplete (184 MT)
Current (1992-95) Replacement Yield	~ 600 MT	1,473 MT
Relative Biomass ($B_{1992/95}/B_{MSY}$)	~ 0.62	0.87
Relative Fishing Mortality: $F_{1991/95}/F_{MSY}$	~ 1.4	1.3
Management Measures in Effect	None	None

[1] Model D4

* Estimated yield including that carried over from previous years.

SAI-Table 1. Estimated catches (reported and carried over, in MT) of Atlantic sailfish and spearfish in 1977-1999, by region, gear and flag.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
SAI + SPF	2076	2937	3784	2574	2458	3330	3961	3175	2972	2774	3164	2516	1968	2697	2159	2601	3530	2153	2310	2688	2151	1716	827
SAILFISH										2720	3089	2506	1961	2696	2159	2601	3458	2115	2271	2655	2118	1690	730
UNKNOWN AREA	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**8**	**2**	**1**	**6**	**2**	**0**	**0**	**0**
CHINESE TAIPEI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JAPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U.S.A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	8	2	1	6	2	0	0	0
EAST ATLANTIC	**1144**	**2142**	**2881**	**1667**	**1627**	**2355**	**3188**	**2138**	**1964**	**1702**	**2172**	**1645**	**1218**	**1709**	**1300**	**1541**	**2284**	**1034**	**1410**	**1805**	**1552**	**599**	**184**
LONGLINE	*220*	*114*	*83*	*151*	*202*	*309*	*270*	*224*	*148*	*140*	*112*	*126*	*152*	*153*	*55*	*47*	*522*	*174*	*236*	*161*	*208*	*218*	*105*
SURFACE	*924*	*2028*	*2798*	*1516*	*1425*	*2046*	*2918*	*1914*	*1816*	*1562*	*2060*	*1519*	*1066*	*1556*	*1061*	*1294*	*1685*	*777*	*1102*	*1009*	*1205*	*381*	*79*
UNCL.GEAR	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*184*	*200*	*77*	*83*	*72*	*635*	*139*	*0*	*0*
BENIN	0	0	0	0	36	48	0	53	50	25	32	40	8	21	20	21	20	20	20	19	0	0	0
CAP-VERT	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHINESE TAIPEI	59	7	19	5	12	67	20	8	9	1	0	0	7	13	0	0	420	101	155	65	150	149	0
COTE D'IVOIRE	0	0	0	0	0	0	0	40	40	40	40	55	44	48	32	58	34	46	51	70	53	30	68
CUBA	65	69	40	79	79	158	200	115	19	55	50	22	53	61	184	200	77	83	72	533	0	0	0
EC-ESPAÑA	0	0	0	0	0	10	0	4	7	9	0	28	14	0	9	2	30	7	13	25	26	18	19
EC-PORTUGAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0	0	0	0	53
GABON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	109	7	0	0
GHANA	764	1885	2691	1191	891	1426	2408	1658	1485	925	1392	837	462	395	463	297	693	450	353	303	303	351	0
JAPAN	24	11	19	33	50	38	47	63	84	71	37	57	57	63	16	42	58	45	52	47	19	58	23
KOREA	46	18	5	34	24	33	3	34	29	2	20	15	17	16	30	3	3	6	6	14	5	0	0
NEI-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	15	10	10	10	0	0
PANAMA	13	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SAO TOME &	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	139	0	0
SENEGAL	160	143	107	325	498	572	510	163	241	572	596	587	552	1092	546	917	936	260	678	610	842	0	0
U.S.S.R	13	5	0	0	37	0	0	0	0	2	5	4	4	0	0	0	0	0	0	0	0	0	0
WEST ATLANTIC	**932**	**795**	**903**	**907**	**831**	**975**	**773**	**1037**	**1008**	**1018**	**917**	**861**	**743**	**987**	**856**	**1052**	**1172**	**1080**	**855**	**848**	**566**	**1091**	**546**
LONGLINE	*395*	*279*	*378*	*360*	*408*	*471*	*320*	*512*	*506*	*489*	*451*	*558*	*417*	*382*	*239*	*367*	*573*	*511*	*330*	*272*	*152*	*803*	*334*
SPORT + RR	*339*	*338*	*350*	*368*	*336*	*331*	*312*	*352*	*228*	*234*	*237*	*38*	*31*	*29*	*32*	*50*	*38*	*73*	*15*	*1*	*1*	*1*	*1*
SURFACE	*119*	*90*	*84*	*97*	*0*	*95*	*50*	*53*	*68*	*43*	*45*	*54*	*44*	*224*	*72*	*156*	*131*	*196*	*224*	*362*	*211*	*182*	*140*
UNCL.GEAR	*79*	*88*	*91*	*82*	*87*	*78*	*91*	*120*	*206*	*252*	*142*	*154*	*194*	*290*	*449*	*443*	*367*	*272*	*257*	*144*	*145*	*78*	*0*

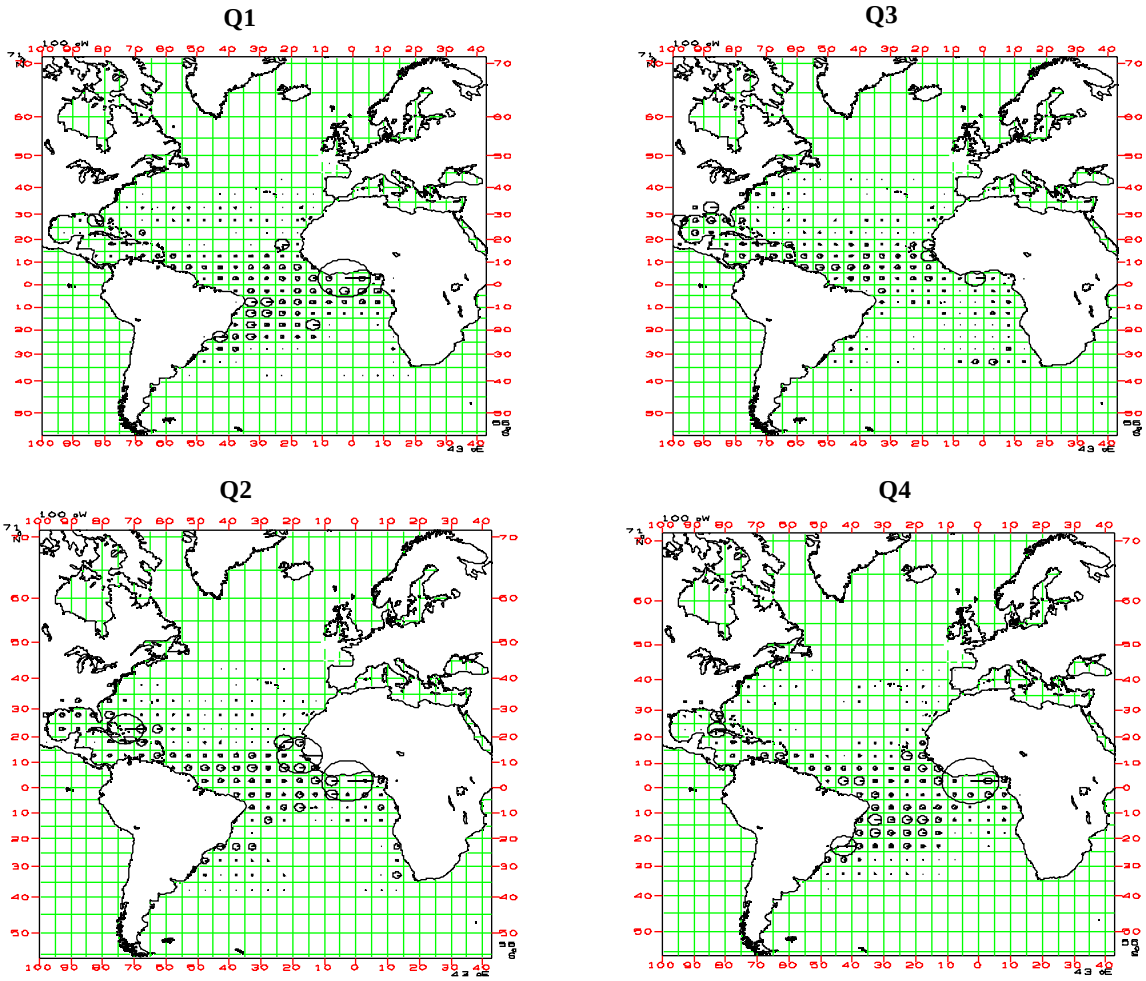
*

SAI-Table 1 (cont.). Estimated catches (reported and carried over, in MT) of Atlantic sailfish and spearfish in 1977-1999, by region, gear and flag.

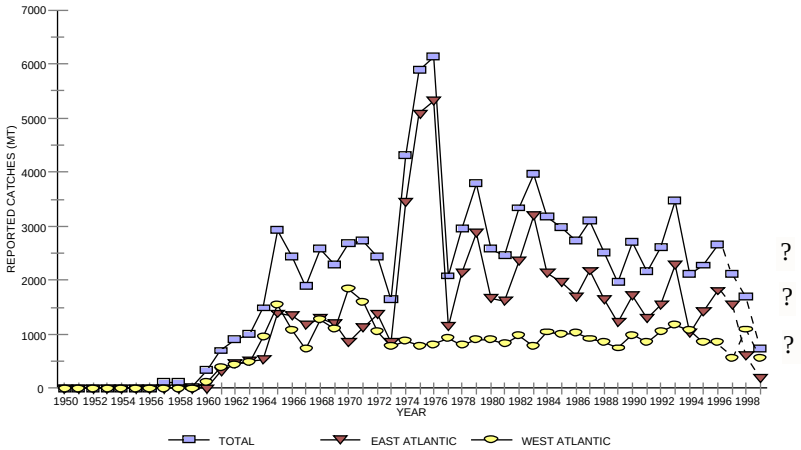
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	
(West Atl., cont.)																								
ARUBA	20	30	30	30	30	30	30	30	30	30	23	20	16	13	9	5	10	10	10	10	0	0	0	
BARBADOS	0	0	0	0	0	0	0	0	0	0	0	0	69	45	29	42	50	46	74	25	59	0	0	*
BRASIL	287	246	201	231	64	153	60	121	187	292	174	152	124	98	65	285	201	59	97	76	69	106	278	
CHINESE TAIPEI	5	10	18	36	81	22	31	45	39	64	31	300	171	83	73	33	223	233	38	37	4	4	0	
CUBA	91	51	151	119	134	181	28	169	130	50	171	78	55	126	83	70	42	46	37	37	0	0	0	
DOMINICAN REP.	0	0	0	0	0	22	50	49	46	18	40	44	44	40	31	98	50	90	40	40	0	0	0	
EC-ESPAÑA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	7	5	3	36	3	15	20	6	
GRENADA	31	37	40	31	36	27	37	66	164	211	104	114	98	218	316	310	246	151	119	56	83	0	0	*
JAPAN	23	9	20	22	44	135	22	34	38	28	6	22	22	25	73	1	2	8	2	4	17	3	8	
KOREA	65	14	19	51	41	19	0	52	72	14	1	0	17	25	0	3	0	8	8	22	8	0	0	
MEXICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	19	19	0	9	646	40	
NEI-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	30	30	30	30	0	0	
NETHERLAND.ANT	28	21	21	21	21	21	21	21	10	10	10	10	10	10	10	10	15	15	15	15	0	0	0	
PANAMA	18	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
ST.VINCENT	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	4	4	4	2	1	3	0	0	
TRINIDAD & TOBAGO	0	0	0	0	0	0	64	58	14	25	35	24	11	9	4	4	55	100	100	100	0	0	0	
U.S.A	308	308	308	308	308	308	311	311	197	199	200	18	2	4	2	7	7	45	10	1	0	1	1	
VENEZUELA	56	66	93	58	72	57	119	81	81	77	80	22	24	24	65	71	124	116	41	88	144	207	149	
DISCARDS	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*42*	*57*	*57*	*62*	*64*	*36*	*63*	*28*	*29*	*69*	*57*	*27*	*71*	
U.S.A	0	0	0	0	0	0	0	0	0	0	42	57	57	62	64	36	63	28	29	69	57	27	71	
SPEARFISH	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**54**	**75**	**10**	**7**	**1**	**0**	**0**	**72**	**38**	**39**	**33**	**33**	**26**	**97**	
UNKNOWN AREA	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**2**	**0**	**0**	**0**	
U.S.A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	
EAST ATLANTIC	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**8**	**36**	**29**	**26**	**32**	**18**	**61**	
JAPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	26	25	30	22	29	
CHINA.PR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	
EC-ESPAÑA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	3	1	1	1	30	
WEST ATLANTIC	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**54**	**75**	**10**	**7**	**1**	**0**	**0**	**64**	**2**	**8**	**5**	**1**	**8**	**36**	
EC-ESPAÑA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	22	
JAPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	4	1	8	10	
TRINIDAD & TOBAGO	0	0	0	0	0	0	0	0	0	54	75	10	7	1	0	0	62	0	0	0	0	0	0	
DISCARDS																								
U.S.A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0	0	

* Data were received too late to be included in the table

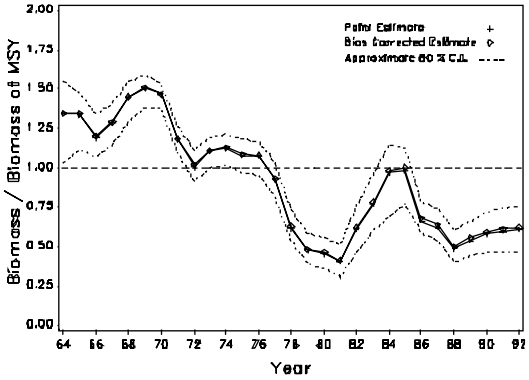
Shaded cells indicate estimate catches. In some cases, the Committee assumed the catch to be the same as the previous year (s)



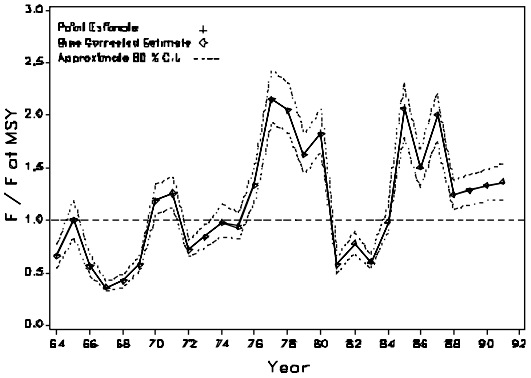
SAI-Fig. 1. Assumed distribution of estimated sailfish catches (reported and carried over) throughout 1950-1994.



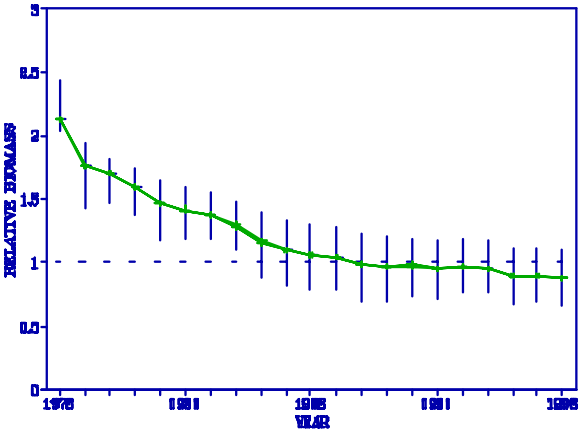
SAI-Fig. 2. Estimated catches (reported and carried over, in MT) of sailfish by region, 1950-1999. (Note: Because 1997-1999 data are incomplete, these points were connected with dashed lines and question marks were added).



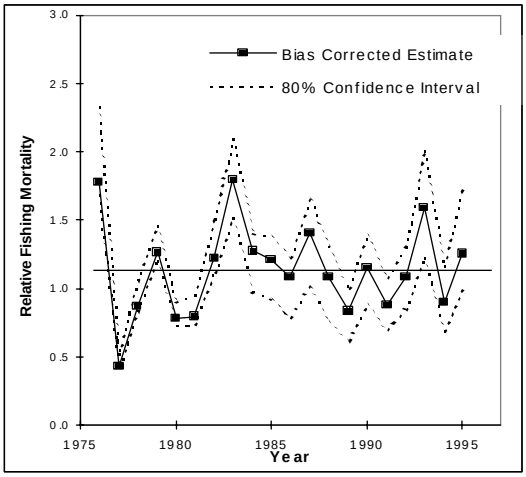
SAI-Fig. 3. Annual relative biomass (= Bt /B_{MSY}) estimated with the ASPIC production model fitted to west Atlantic sailfish catch and effort data. 80% confidence intervals are from bootstrapping; other sources of errors are not quantified. Annual values for the first two years are omitted due to extreme imprecision. (1993 SCRS Report).



SAI-Fig. 4. Annual relative fishing mortality (= Ft /F_{MSY}) estimated with the ASPIC production model fitted to west Atlantic sailfish catch and effort data. 80% confidence intervals are from bootstrapping; other sources of errors are not quantified. Annual values for the first two years are omitted due to extreme imprecision. (1993 SCRS Report).



SAI-Fig. 5. Annual relative biomass (= Bt /B_{MSY}) estimated with the ASPIC production model fitted to east Atlantic sailfish catch and effort data. 80% confidence intervals are from bootstrapping; other sources of errors are not quantified. (1997 SCRS Report).



SAI-Fig. 6. Annual relative fishing mortality (= Ft /F_{MSY}) estimated with the ASPIC production model fitted to east Atlantic sailfish catch and effort data. 80% confidence intervals are from bootstrapping; other sources of errors are not quantified. (1997 SCRS Report).

7.9 SWO-ATL - ATLANTIC SWORDFISH

No new Atlantic stock assessments were conducted in 2000. This report updates the Description of Fisheries, Current Regulations, and comments briefly on new information for 2000 in the Status of Stocks, Outlook, and Management Recommendations sections. Most of the report and the conclusions of the Committee, remain unchanged from the 1999 Report. For the purposes of this Executive Summary, catches that were not reported were assumed to be equal to the reports for the previous year. In 1999, this was a small amount in the North, but over 6% in the South (see **SWO-ATL-Table 1**).

SWO-ATL-1. Biology

Swordfish are distributed widely in the Atlantic Ocean and Mediterranean Sea, and range from Canada to Argentina on the western side, and from Norway to South Africa on the eastern side **(SWO-Figure 1)**. The management units for assessment purposes are a separate Mediterranean group, and North and South Atlantic groups separated at 5ºN. This stock separation is supported by recent genetic analyses. However, the precise boundaries between stocks are uncertain, and mixing is expected to be highest at the boundary in the tropical zone. Therefore there is uncertainty as to whether the management units used correspond exactly to the biological stock units. Hence, it is important to have effective management measures throughout the Atlantic and Mediterranean.

Swordfish feed on a wide variety of prey including groundfish, pelagics, deep-water fish and invertebrates. They are believed to feed throughout the water column, following the diel migration of the deep-scattering layer by maintaining their position within a preferred level of illumination (isolume). They are typically caught on pelagic longlines at night when they feed in surface waters.

Swordfish spawn in the warm tropical and subtropical waters throughout the year, although seasonality has been reported. They are found in the colder northern waters during summer months. Young swordfish grow very rapidly, reaching about 140 cm LJFL (lower jaw-fork length) by age 3, but grow slowly thereafter. Females grow faster than males and reach a larger maximum size. Swordfish are difficult to age, but 53% of females are considered mature by age 5, at a length of about 180 cm.

SWO-ATL-2. Description of the fisheries

Directed longline fisheries in EC-Spain, the United States and Canada have operated since the late 1950s or early 1960s, and harpoon fisheries have existed since the late 1800s. The Japanese tuna longline fishery started in 1956 and has operated throughout the Atlantic since then, with substantial catches of swordfish that are produced as a by-catch in their tuna fisheries. There are other primarily directed swordfish fisheries (i.e., Brazil, Morocco, Namibia, EC-Portugal, South Africa, Uruguay, and Venezuela,) and by-catch or opportunistic fisheries which take swordfish (i.e. Chinese Taipei, Korea, EC-France and Brazil). The SCRS scientists believe that ICCAT Task I landings data provide minimum estimates because of unreported catch of swordfish made in association with illegal, unreported and unregulated (IUU) fishing activities. However, because trade data are lacking or incomplete for estimating IUU swordfish catch, the amount of NEI swordfish catch by IUU vessels could not be estimated.

Total Atlantic

The total Atlantic estimated catch of swordfish (North and South, including discards) reached an historical high of 38,609 MT in 1995, 13% higher than the previous peak catch of 34,175 MT in 1989 **(SWO-Table 1** and **SWO-Figure 2**). The 1999 estimated catch (reported and carried over) was 27,377 MT. As a few countries have not yet reported their 1999 catches and because of unknown IUU catches, this value should be considered provisional and subject to revision.

North Atlantic

From 1989 to 1999, the North Atlantic estimated catch (landings plus discards) has averaged about 15,000 MT **(SWO-Table 1** and **SWO-Figure 2)**, although the 1999 landings plus discards were reduced to 11,914 MT in response to ICCAT regulatory recommendations. In 1999, EC-Spain and the U.S. have decreased their peak North Atlantic landings, by 64% since 1987 and by 55% since 1989, respectively, in response to ICCAT recommendations. If the U.S. discards are counted, the total U.S. landings and discards have declined by 47% from the peak catch level

of 1989. Reduced landings have also been attributed to shifts in fleet distributions, including movement of some vessels to the South Atlantic and out of the Atlantic. In addition, some fleets, including the United States, EC-Spain, EC-Portugal and Canada, have changed operating procedures to opportunistically target tuna and/or sharks, taking advantage of market conditions and higher relative catch rates.

South Atlantic

The South Atlantic estimated catch (landings plus discards) was relatively low (generally less than 5,000 MT) before 1980. Since then, landings have increased continuously through the 1980s and 1990s to a peak of 21,887 MT in 1995 (levels that match the peak of North Atlantic harvest). The increase of landings was in part due to progressive shifts of fishing effort to the South Atlantic, primarily from the North Atlantic, as well as other waters. Then the estimated landings decreased to 13,526 MT by 1998 (38% reduction). The reduction in catch following the peak in 1995 was in response to the regulations, and was partly due to a shift to other oceans and to a shift in target species. In 1999, the estimated landings increased 14% from 1998 levels and attained 15,463 MT. Brazil, People's Republic of China and Namibia, in particular, contributed to this increase.

Discards

Only U.S. (1991-1999) and Canada (1997-1999) report positive estimates of dead discards. EC-Spain reports zero dead discards. Both the U.S. and Canada used scientific observer data to estimate dead discards. The Canadian estimate sets the proportion of the weight of dead discards to reported landings equal to the proportion of dead discards observed compared to observed landings. However based on the information from national scientists the Committee is concerned about the representativeness of the Canadian sampling. The U.S. used CPUEs from the observer data and effort from the captain reported logbook data to estimate dead discards. These estimates are included in the stock assessment evaluation and in forward population projections.

SWO-ATL-3. State of the stocks

In 2000, some of the updated North and South Atlantic CPUE data were available and were examined. The time series show similar trends to those in recent years. The available series for the North stock continue to show signs of optimism as observed in 1999, and the one series examined for the South is stable over the time series.

In 1999, a new assessment of North and South Atlantic swordfish stocks was conducted. In the assessment, updated CPUE and catch data were examined. Sex and age-specific (North Atlantic) and biomass standardized catch rates (North and South Atlantic) from the various fleets were updated. The updated North Atlantic CPUE data show similar trends to previous years, but are also showing signs of stabilization or some improvement in the last few years. In particular, the recruitment index (1997 and 1998) and the catch at age (1997) used in the 1999 North Atlantic assessment show signs of substantially improved recruitment (age 1). The updated recruitment index also showed a high value in 1999.These recent improvements in recruitment have already manifested in younger ages and in the biomass index of some fisheries, and should allow for increases in spawning biomass in the future (2001 and thereafter) and a more optimistic outlook, if the recent year-classes are not heavily harvested. The CPUE patterns in the South Atlantic by fleet are assumed to reflect the abundance pattern of different age groups of the population.

North Atlantic

In 1999, the status of the North Atlantic swordfish resource was assessed using both non-equilibrium stock production models and sex-specific sequential population analyses (SPA) based on catch **(SWO-Table 1)** and CPUE data through 1998. The relationship between catches and standardized fishing effort is shown in **SWO-Figure 3**. The current base case assessments indicate that the decline in the North Atlantic swordfish biomass appears to have been slowed or arrested due to recent reductions in reported catch, especially compared to the peak catch values of 1987 **(SWO-Figure 4)**. In addition, estimated high recruitment (age1) in 1997 and 1998 could promote improvement in future spawning stock biomass, if these year classes are not heavily harvested. The pattern of decline in stock size followed by recent stabilization is reflected in the CPUEs for several fisheries, although variability in CPUEs leads to uncertainty about the degree of change in recent years. An updated estimate of maximum sustainable yield from production model analyses is 13,400 MT (with estimates ranging from 7,600 to 15,900 MT). Since 1983, only in four years (1984, 1997, 1998 and 1999) have North Atlantic swordfish catches been less than 13,400 MT **(SWO-Figure 5a)**; preliminary estimates of catches in 1999 were about 11,900 MT.

The biomass at the beginning of 1999 was estimated to be 65% (range: 51 to 105%) of the biomass needed to produce MSY. The 1998 fishing mortality rate was estimated to be 1.34 times the fishing mortality rate at MSY (range: 0.84 to 2.05). The replacement yield for the year 2000 was estimated to be about 11,700 MT. At the 1999 assessment meeting, anticipated catches in 1999 were expected to be about this level given the recent fishery performance and current regulations (i.e. about 10% over the ICCAT recommended catch levels for 1997 and 1998). This prediction has been confirmed in 2000; catches in 1999 were about 11,900 MT **(SWO-Table 1)**. Catches below replacement level are likely to allow the stock to recover.

Overall, the sex-specific sequential population analyses conducted for North Atlantic swordfish in 1999 were consistent with the stock production model results, particularly in terms of the trends in population trajectories. The Base Case sex-specific SPA point estimates for age 1 gradually increased in the early 1980's, shifting to a somewhat higher level from 1985 to 1989. Subsequently, the abundance of age 1 shifted back to a lower level between 1990 and 1996 and then increased to the highest levels of the time series in 1997 and 1998. The trends for ages 2, 3 and 4 are similar with the appropriate time lags, but the pattern is less pronounced. The estimated abundance of older (5+) fish declined to about one third of the numbers in 1978. The estimated fishing mortality rate has generally increased for all ages. The fishing mortality rate during the last three years was about 0.25 /year for males (age 5+) and 0.57 for females (age 9+). Given this fishing mortality pattern, the biomass of adult females would be reduced to a level of about 8 percent of the maximum at equilibrium. This is well below the level which is commonly considered to result in risks of recruitment over-fishing in other stocks.

South Atlantic

The Committee noted that catches have been reduced since 1995, as was recommended by the SCRS. Previous Committees expressed serious concern about the trends in stock biomass of South Atlantic swordfish based on the pattern of rapid increases in catch which could result in rapid stock depletion, and declining CPUE trends of some by-catch fisheries. The Committee has had uncertainties about the CPUE series and their relationship to the abundance of the stock. However, the by-catch index was used in the last assessment as it provided a long enough time series required for fitting a production model; CPUE series from target fisheries are only available for a relatively short time period. Some sources of bias were detected in 2000 in the methodological protocol to obtain catch in weight from a by-catch fleet. Additional methodological analyses presented to the Committee indicated some potential sources of bias which could affect any of the series considered.

A quantitative assessment for the South Atlantic swordfish stock was conducted in 1999 based on the available information at that time, yielding results with greater uncertainty than for the North **(SWO-Figure 6)**. In this non-equilibrium production model evaluation, the estimate of maximum sustainable yield was 13,650 MT (with estimates ranging from 5,000 to 19,600 MT). Biomass at the beginning of 1999 was estimated to be 110% (range: 84 to 140%) of the biomass needed to produce MSY. The 1998 fishing mortality rate was estimated to be 0.84 times the fishing mortality rate at MSY (range: 0.47 to 2.54). The surplus production (estimated replacement yield) for the year 2000 was estimated to be about 14,800 MT. Prior to 1989, South Atlantic catches were below the estimated MSY, but since 1991, only in the year 1998 (13,516 MT) have reported South Atlantic swordfish catches been less than 13,600 MT **(SWO-Figure 5b)**. Estimated catches in 1999 of 15,463 MT were below the average from 1991 to 1997 (17,400 MT).

SWO-ATL-4. Outlook

North Atlantic

For the North Atlantic swordfish stock, the baseline surplus production model showed that, although the decline in swordfish biomass has been slowed or arrested , the population biomass is estimated to be 35% below the level that would produce the maximum sustainable yield. If total catch, including discards and overages, was less than the status quo catch limit of 10,700 MT, there would be a greater than 50% chance that the population would reach B_{MSY} in 15 years, and be approaching B_{MSY} in 10 years. However, 11,800 MT would cause the median population trajectory to continue declining **(SWO-Figure 4)**.

Of the sensitivity analyses performed with other production model formulations and methods for characterizing uncertainty, some were more and some were less optimistic than the baseline model, but all showed that the population was below B_{MSY}. SPA assessments also showed that the female spawning stock biomass was low with respect to common reference points, but the catch levels necessary to rebuild within 5, 10 or 15 years depended on both the management objectives (proxy for B_{MSY}) and the assumptions made, including future recruitment levels, which are influenced by environmental conditions.

The high recruitment observed in recent years (age 1 in 1997, 1998 and 1999) should allow for a more optimistic outlook, if the recent year-classes are not heavily harvested. The updated indices examined in 2000 confirmed that a positive effect of this strong recruitment has already manifested in younger ages and in the biomass indices of several fisheries.

South Atlantic

The updated CPUE data presented in 2000 from a targeting fishery covering a very large geographical area indicates that the standardized CPUE in 1999 was slightly higher than in recent years, with a flat trend over the available time series. CPUE updates from the other fisheries were not available to examine in 2000.

Based on the 1999 Base Case assessment for South Atlantic swordfish, the recent biomass has declined to around 10% above the MSY level, and that F was around F_{MSY}. If the catch of 1998 (~13,500 MT) is continued into the future, the median trajectory was expected to increase slightly **(SWO-Figure 6)**. However, if total catch in the future is around the current catch limit (14,620 MT), the median trajectory was expected to decline slightly below B_{MSY}. Of the various sensitivity analysis done in 1999, some were more and some were less optimistic. The age structured production model sensitivity analyses were much more pessimistic. The status of the South stock was considered more uncertain than the status of the North stock, due to the limitations of the indices of abundance, and the absence of age and growth data.

SWO-ATL-5. Effects of current regulations

For the purposes of this Executive Summary, catches that were not reported were assumed to be equal to the reports for the previous year. Further, the minimum size evaluation of the level of compliance of fisheries is affected by the amount and criteria used for substitution procedures both between and within fisheries; the lack of catch-at-size data is more pronounced in the South Atlantic. For these reasons, caution should be exercised using scientific estimates for compliance purposes.

North Atlantic catch limits

The total allowable catch in the North Atlantic in 1999 was 10,700 MT. Estimated landings exceeded this by 6% (11,385 MT) and reported landings plus discards exceeded this by 11% (11,914 MT).

South Atlantic catch limits

The catch limit in the South Atlantic in 1999 was 14,620 MT. Estimated landings exceeded this by 6% (15,457 MT) and reported landings plus discards exceeded this also by 6% (15,463 MT).

Minimum size limits

In 1998, the percentage of swordfish reported landed less than 125 cm LJFL was about 19% (by number) overall for all nations fishing in the Atlantic. If this calculation is made using reported landings plus discards then the percentage less than 125 cm LJFL was about 23%. These calculations were not updated and examined in 2000.

The Committee expressed concern about the uncertainty of the stock structure of Atlantic swordfish and the possibility that the assumed North Atlantic stock does not include the entire catch from the biological stock. When boundaries are uncertain, in this case because of limited or imprecise data, it is important to implement appropriate measures which encompass several possible stock assumptions.

SWO-ATL-6. Management recommendations

No new assessment was developed in 2000, so the recommendations are mainly based on the results obtained in 1999 and updated with some new information provided to the SCRS in 2000.

North Atlantic

In the last assessment, the Committee indicated that the actions the Commission had taken to reduce catch in 1997

to 1999 appear to have slowed and/or arrested the decline in the North Atlantic swordfish stock. At that time, the Committee recommended to the Commission, if it desires to rebuild the North Atlantic swordfish stock to biomass levels that would support MSY within 10 years with a probability of greater than 50%, then the catch should be reduced to 10,000 MT. At a constant catch of the 1999 catch limit of 10,700 MT, there is a greater than 50% chance of reaching MSY levels in 15 years. However, this recovery probability is very sensitive to even a 10% overage, and if constant catches of 11,800 MT (1999 catch limit plus 10%) are continued for the next 15 years, the stock will likely not reach biomass levels that will support MSY with a probability of greater than 50%. Therefore if the Commission wishes to rebuild in a 15-year time frame, catch limits (including discards) should not be increased, and should not be exceeded. The Committee noted with concern that the 1999 catches were 11,914 MT, about 11% above the TAC. The management actions taken by the Commission in 1997 to 1999 clearly illustrate the resilience of swordfish, and the responsiveness of the stock to a decrease in fishing mortality. With just three years of management action under the strict quota scenario (introduced in 1997), there are positive signs from the fishery in terms of catch rates. However, the Committee noted that positive signs in recent recruitment may be in part due to environmental influence, and it is unknown if this influence will be positive or negative in the future.

The Committee expressed concern about the high catches (landings plus discards) of small swordfish and the lack of and possible inaccuracies of size data from many fisheries, and emphasized that gains in yield could accrue if the intent of current recommendations on small fish could be more effectively implemented. The high recruitment observed in recent years (age 1 in 1997, 1998 and 1999) should allow for a more optimistic outlook if the recent year-classes are not heavily harvested. The updated indices examined in 2000 confirmed that a positive effect of this strong recruitment has already manifested in younger ages and in the biomass indices of several fisheries

South Atlantic

The Committee noted that catches have been reduced from the 1991-1997 average, consistent with the recommendations by the SCRS. The estimated catches in 1999 were 15,463 MT. The SCRS continues to be concerned about the swordfish stock status in the South Atlantic based on the results of preliminary production model analysis conducted in 1999 and on the pattern of high catches and declining CPUE trends in some of the by-catch fisheries used in 1999 as indicators of abundance. The result obtained in 1999 was that the recent level of biomass was estimated to be at about 10% above the level that would support MSY. However, if there is a constant catch at the year 2000 catch limit (14,620 MT) for the next 10 years, there is a greater than 50% chance of biomass declining to levels slightly below the level that would support MSY. Catches at the level of 1998 (~13,500 MT) would keep the stock at about (and above) the biomass level that would support MSY. The Commission should be reminded that the production model is affected by high levels of uncertainty in the input data. If the Commission intends to increase the probability of keeping the stock in a healthy condition, it should keep fishing mortality rates, and hence catch, at about MSY levels.

ATLANTIC SWORDFISH SUMMARY

	North Atlantic	*South Atlantic*
Maximum Sustainable Yield[1]	13,370 MT (7,625 - 15,900)[4]	13,650 MT (5,028 - 19,580)
Current (1999) Yield	11,914 MT	15,463 MT
Current (2000) Replacement Yield[2]	11,720 MT (6,456 - 15,040)	14,800 MT (5,328 - 16,240)
Relative Biomass (B_{1999}/B_{MSY})	0.65 (0.51 - 1.05)	1.10 (0.84 - 1.40)
Relative Fishing Mortality:		
F_{1998}/F_{MSY}[1]	1.34 (0.84 - 2.05)	0.81 (0.47 - 2.54)
F_{1998}/F_{max}[3]	1.60 (1.52 - 1.68)	Not estimated[5]
$F_{1998}/F_{0.1}$[3]	3.52 (3.44 - 3.70)	Not estimated
Management Measures in Effect	Country-specific quotas [99-2]; 125/119 cm LJFL minimum size [99-2].	Country-specific quotas [97-7]; 125/119 cm LJFL minimum size [90-2] & [95-10].

1 Base case production model results based on catch data 1950-1998 (SWO-Table 1 1999 SCRS Report).
2 For next fishing year.
3 Base case sex-specific SPA results based on catch data 1978-1998 (SWO-Table 1 1999 SCRS Report); statistics computed based on females only.
4 80% confidence intervals are shown.
5 Production model results do not provide a basis for these estimates.

SWO-ATL-Table 1. Estimated catches (reported and carried over, in MT) of Atlantic swordfish in 1977-1999, by region, gear and flag.

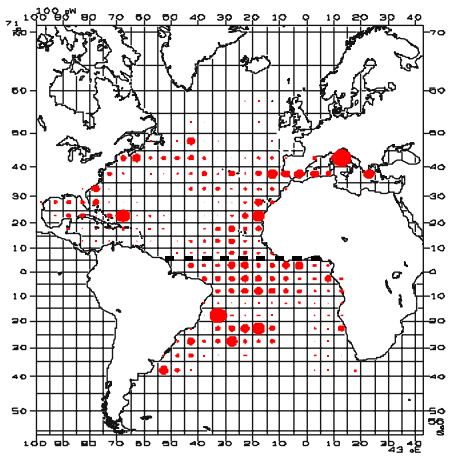
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TOT ATL (LAND+DISC)	9264	14601	15231	18881	15155	19662	19929	21930	23969	24380	26266	32470	34175	32886	28815	29195	32890	35112	38609	33180	31483	25788	27377
N. ATL(LAND+DISC)	**6409**	**11835**	**11937**	**13558**	**11180**	**13215**	**14527**	**12791**	**14383**	**18486**	**20236**	**19513**	**17250**	**15672**	**14937**	**15394**	**16845**	**15321**	**16722**	**15052**	**13102**	**12262**	**11914**
LANDINGS	***6409***	***11835***	***11937***	***13558***	***11180***	***13215***	***14527***	***12791***	***14383***	***18486***	***20236***	***19513***	***17250***	***15672***	***14722***	***15011***	***16437***	***14613***	***16196***	***14464***	***12651***	***11777***	***11385***
LONGLINE	*5458*	*11123*	*11177*	*12831*	*10549*	*13019*	*14023*	*12664*	*14240*	*18269*	*20022*	*18927*	*15348*	*14026*	*14208*	*14288*	*15755*	*14129*	*15615*	*13639*	*12261*	*10837*	*10754*
OTHER GEARS	*951*	*712*	*760*	*727*	*631*	*196*	*504*	*127*	*143*	*217*	*214*	*586*	*1902*	*1646*	*514*	*723*	*682*	*484*	*581*	*825*	*390*	*940*	*631*
DISCARDS	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***215***	***383***	***408***	***708***	***526***	***588***	***451***	***485***	***529***
BARBADOS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	12	12
CANADA	113	2314	2970	1885	561	554	1088	499	585	1059	954	898	1247	911	1026	1547	2234	1676	1610	739	1089	1115	1119
CHINA.PR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73	86	104	132	40	334	304
CHINESE TAIPEI	246	164	338	134	182	260	272	164	152	157	52	23	17	270	577	441	127	507	489	521	509	286	285
CUBA	398	281	128	278	227	254	410	206	162	636	910	832	87	47	23	27	16	50	86	7	7	7	7
EC-ESPAÑA	3309	3622	2582	3810	4014	4554	7100	6315	7441	9719	11135	9799	6648	6386	6633	6672	6598	6185	6953	5547	5140	4079	3993
EC-FRANCE	0	0	0	5	4	0	0	1	4	4	0	0	0	75	75	75	95	46	84	97	164	110	104
EC-IRELAND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	15	132	81
EC-ITALY	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EC-MARINIQUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EC-PORTUGAL	38	17	29	15	13	11	9	14	22	468	994	617	300	475	773	542	1961	1599	1617	1703	903	773	777
EC-U.K	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	1	5	11	11	11
GRENADA	0	0	0	0	0	0	0	0	0	0	0	56	5	1	2	3	13	0	1	4	15	15	42
ICELAND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
JAPAN	793	946	542	1167	1315	1755	537	665	921	807	413	621	1572	1051	992	1064	1126	933	1043	1494	1405	1566	1525
KOREA	541	634	303	284	136	198	53	32	160	68	60	30	320	51	3	3	19	16	16	19	15	0	0
LIBERIA	0	0	0	5	38	34	53	0	24	16	30	19	35	3	0	7	14	26	28	28	28	28	28
MAROC	7	11	208	136	124	91	129	81	137	181	197	196	222	91	110	69	39	36	79	462	267	191	119
MEXICO	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	14	0	0	14	28	24
NEI-1	0	0	0	0	0	0	0	0	0	0	0	76	112	529	0	0	0	0	0	0	0	0	0
NEI-2	0	0	0	0	12	0	0	0	0	14	3	131	190	185	43	35	111	0	0	0	0	0	0
NORWAY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PANAMA	22	76	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17
POLAND	0	6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RUMANIA	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SENEGAL	0	0	0	0	0	0	0	0	0	0	0	0	1	0	6	6	0	0	0	0	0	0	0
ST.LUCIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
ST.VINCENT	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	23	0	4	3	1	1	1
TRINIDAD & TOBAGO	0	0	0	0	0	0	21	26	6	45	151	42	79	66	71	562	125	0	0	43	14	15	15
U.S.A	912	3684	4619	5625	4530	5410	4820	4749	4705	5210	5247	6171	6411	5519	4310	3852	3782	3366	4026	3559	2986	3058	2908
U.S.S.R	15	23	10	21	0	69	0	16	13	18	4	0	0	0	0	0	0	0	0	0	0	0	0
UK-BERMUDA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	5	9	3
VENEZUELA	15	46	182	192	24	25	35	23	51	84	86	2	4	9	78	103	73	69	54	85	11	7	9
DISCARDS																							
CANADA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	52	35
U.S.A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	215	383	408	708	526	588	446	433	494

Shaded cells indicate estimate catches. In some cases, the Committee assumed the catch to be the same as the latest data available.

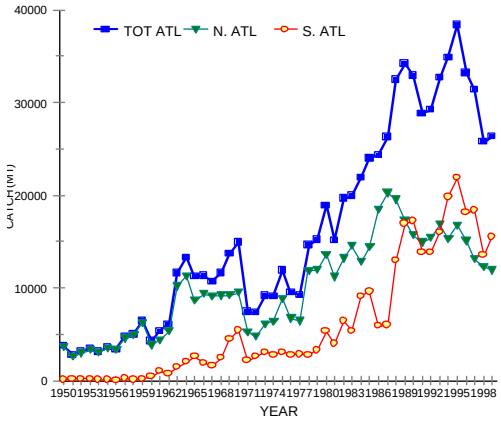
SWO-ATL-Table 1 (cont.)**. SWO-ATL-Table 1.** Estimated catches (reported and carried over, in MT) of Atlantic swordfish in 1977-1999, by region, gear and flag.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
S. ATL (LAND + DISC)	**2855**	**2766**	**3294**	**5323**	**3975**	**6447**	**5402**	**9139**	**9586**	**5894**	**6030**	**12957**	**16925**	**17214**	**13878**	**13801**	**16045**	**19791**	**21887**	**18128**	**18381**	**13526**	**15463**
LANDINGS	***2855***	***2766***	***3294***	***5323***	***3975***	***6447***	***5402***	***9139***	***9586***	***5894***	***6030***	***12957***	***16925***	***17214***	***13878***	***13801***	***16045***	***19791***	***21887***	***18127***	***18360***	***13516***	***15457***
LONGLINE	*2840*	*2749*	*3265*	*5179*	*3938*	*6344*	*5307*	*8920*	*8863*	*4951*	*5446*	*12404*	*16398*	*16705*	*13287*	*13173*	*15547*	*17365*	*20806*	*17799*	*18114*	*13366*	*14941*
OTHER GEARS	*15*	*17*	*29*	*144*	*37*	*103*	*95*	*219*	*723*	*943*	*584*	*553*	*527*	*509*	*591*	*628*	*498*	*2426*	*1081*	*328*	*246*	*150*	*516*
DISCARDS	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***1***	***21***	***10***	***6***
ANGOLA	0	0	0	0	0	0	0	26	228	815	84	84	84	0	0	0	0	0	0	0	0	0	0
ARGENTINA	132	4	0	0	0	20	0	0	361	31	351	198	175	230	88	88	14	24	0	0	0	0	0
BELIZE.SH.OB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	17
BENIN	0	0	0	0	18	24	0	86	90	39	13	19	26	28	28	26	28	25	24	24	24	24	24
BRASIL	396	372	521	1582	655	1019	781	468	562	753	947	1162	1168	1696	1312	2609	2013	1571	1975	1892	4100	3847	4720
BULGARIA	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMB.OB.SH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
CHINA.PR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	534
CHINESE TAIPEI	675	625	1292	702	528	520	261	199	280	216	338	798	610	900	1453	1686	846	2829	2876	2873	2562	1147	1168
COTE D'IVOIRE	0	0	0	0	0	0	0	10	10	10	10	13	5	9	21	15	17	24	22	30	21	17	30
CUBA	302	319	272	316	147	432	818	1161	1301	95	173	159	830	448	209	246	192	452	778	60	60	0	0
EC-ESPAÑA	0	0	0	0	0	0	0	0	0	66	0	4393	7725	6166	5760	5651	6974	7937	11290	9622	8461	5832	5758
EC-PORTUGAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	380	389	441	384	381
G.EQUAT(OB.SH)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
GHANA	0	0	0	110	5	55	5	15	25	13	123	235	235	235	235	235	235	235	235	140	140	106	106
HONDURAS-OB.SH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	4	5	2	8
JAPAN	514	503	782	2029	2170	3287	1908	4395	4613	2913	2620	4453	4019	6708	4459	2870	5256	4699	3619	2197	1355	985	810
KOREA	699	699	303	399	311	486	409	625	917	369	666	1012	776	50	147	147	198	164	164	7	18	7	0
LITUANIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	794	0	0	0	0	0
NAMIBIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	730
NEI-1	0	0	0	0	0	0	0	0	0	0	0	0	856	439	0	0	0	0	0	0	0	0	0
NIGERIA	0	0	0	0	0	0	83	69	0	0	0	0	0	0	0	3	0	857	0	9	0	0	0
PANAMA	28	83	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	105
SAO TOME & PRINCIPE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	14	14
SOUTH AFRICA	0	0	28	31	9	3	7	0	8	5	5	4	0	0	5	9	4	1	4	1	1	169	76
TOGO	0	0	0	0	0	0	0	0	6	32	1	0	2	3	5	5	8	14	14	64	0	0	0
U.S.A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	171	396	160	179
U.S.S.R	106	161	70	154	40	26	46	158	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0
URUGUAY	0	0	0	0	92	575	1084	1927	1125	537	699	427	414	302	156	210	260	165	499	644	760	791	791
DISCARDS	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*21*	*10*	*6*
U.S.A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	21	10	6

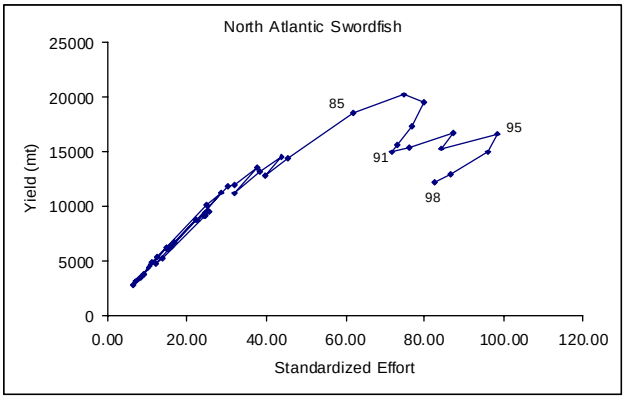
Shaded cells indicate estimate catches. In some cases, the Committee assumed the catch to be the same as the latest data available.



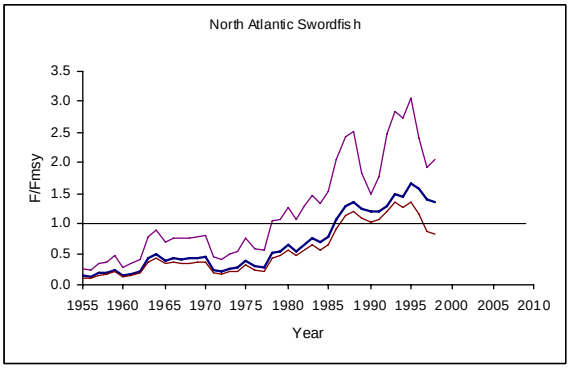
SWO-ATL-Fig. 1. Geographical distribution of swordfish longline catches in 1997. The dashed line at 5° is the assumed boundary between North and South management units.

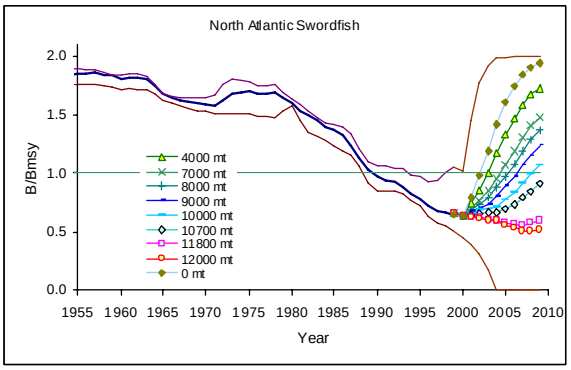


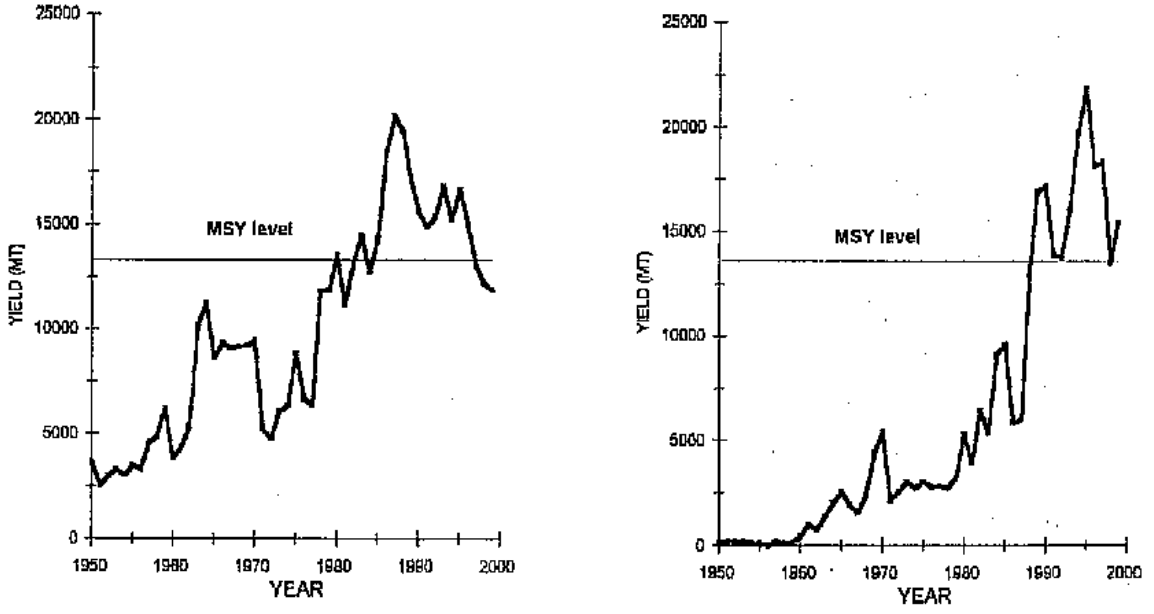
SWO-ATL-Fig. 2. Estimated catches (reported and carried over) of Atlantic swordfish (in MT, including discards).



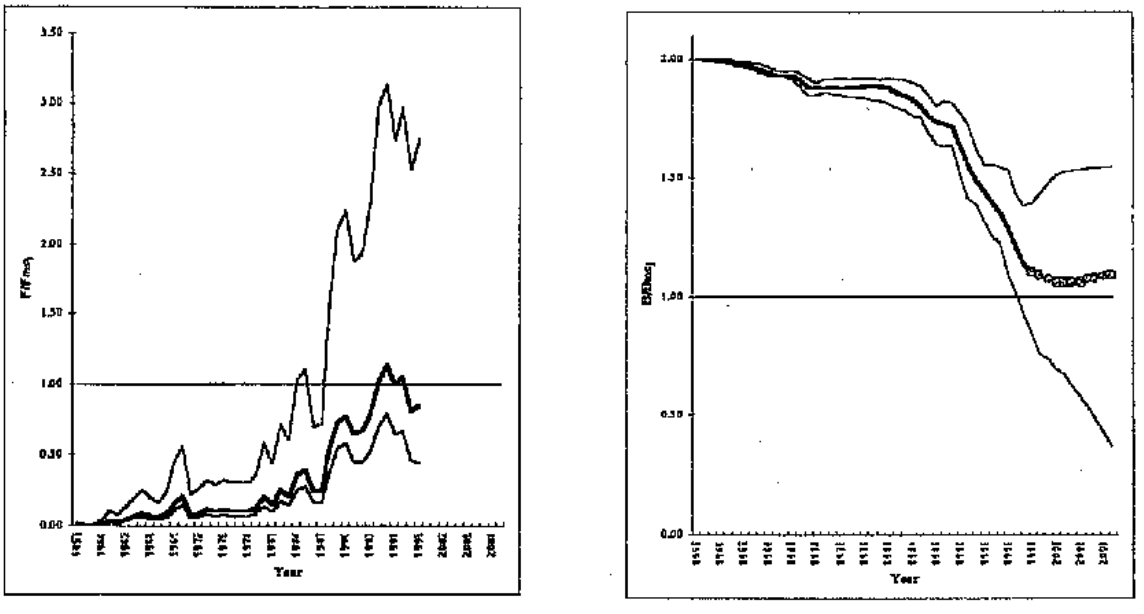
SWO-ATL-Fig. 3. Relationship between nominal catch and estimated standardized effort for North Atlantic swordfish. Selected years are indicated. (Figure from 1999 Report, and not updated in 2000.)







SWO-ATL-Fig. 5. Left panel: Annual yield (MT) for north Atlantic swordfish relative to estimated MSY level. Right panel: Annual yield (MT) for south Atlantic swordfish relative to the estimated MSY level.



SWO-ATL-Fig. 6. South Atlantic swordfish assessment results. Left panel: Estimated fishing mortality rate relative to Fmsy (F/Fmsy) for 1957-1998 (median with 80% confidence bounds based on bootstrapping are shown). Right panel: Estimated biomass relative to biomass at MSY (B/Bmsy) for 1957-1999 and projected biomass ratio under an assumed constant catch of 13,620 MT per year for the period 1999-2009 (median with 80% confidence bounds based on bootstrapping are shown). (Figure from 1999 Report, and not updated in 2000.).

7.10 SWO-MED - MEDITERRANEAN SWORDFISH

In September 2000, the Fifth Meeting of the GFCM/ICCAT Ad Hoc Working Group on Stocks of Large Pelagic Fishes in the Mediterranean Sea attempted to update the Mediterranean swordfish data base. The Committee continues to be concerned about the lack of data on catch, effort and size from some important fisheries in the Mediterranean. The absence of these data make it impossible to conduct reliable stock assessments. For the purposes of this Executive Summary, catches that were not reported were assumed to be equal to the reports for the previous year. In 1999, more than half of the estimated catch was not reported (see **SWO-MED-Table 1**).

SWO-MED-1. Biology

Swordfish is a cosmopolitan species found in the Atlantic Ocean and the Mediterranean Sea. Several recent genetic studies suggest that Mediterranean swordfish form a unique stock which is reproductively isolated from the Atlantic stocks. Several fisheries and biological studies suggest that there is limited movement from the Mediterranean to areas immediately adjacent in the North Atlantic. Genetic studies have confirmed this pattern.

Swordfish feed mainly in the meso-pelagic zone and its prey is comprised mostly of cephalopods and pelagic fish species. Spawning occurs in the Strait of Messina and the Tyrrhenian Sea and around the Balearic Islands and probably in other locations. It has been described that in the Mediterranean, swordfish spawn during the summer months and young swordfish grow very rapidly, reaching more than 80 cm by the end of their first year of life. Females grow faster than males and reach a larger maximum size. Female swordfish reach sexual maturity in their third year of life at a length of about 130 cm, while males mature one year earlier ; this is substantially younger than the age of maturity assumed for the Atlantic stocks (age 5).

SWO-MED-2. Description of the fisheries

Mediterranean swordfish fisheries are characterized by high catch levels. It should be noted that average annual reported catches (about 13,400 MT for the past 10 years) are similar to those of the North Atlantic. The Mediterranean is a much smaller body of water compared to the North Atlantic. However, the potential reproductive area in the Mediterranean is probably relatively larger than that in the Atlantic. Further, the productivity of the Mediterranean Sea is thought to be very high.

Swordfish fishing has been carried out in the Mediterranean using harpoons and driftnets at least since Roman times. Mediterranean total swordfish landings showed an upward trend from 1965-72, stabilized between 1973-1977, and then resumed an upward trend reaching a peak in 1988 (20,339 MT) (**SWO-MED-Table 1, SWO-MED-Figure 1**). The sharp increase between 1983 and 1988 may be partially attributed to improvement in the national systems for collecting catch statistics. Since 1988, the reported landings of swordfish in the Mediterranean Sea have declined and since 1990, they have fluctuated from about 12,000 to 16,000 MT. There has been a sharp decline in *reported* swordfish catch in the recent two years, largely due to the lack of reporting from Italy, so that the actual level of catch in 1998 and 1999 is highly uncertain.

Swordfish fishing is carried out all over the Mediterranean Sea. The biggest producers of swordfish in the Mediterranean Sea in the recent years were Italy (43%), Morocco (33%), and Spain (7%). Also, Algeria, Cyprus, Greece, Malta, Tunisia, and Turkey have fisheries targeting swordfish in the Mediterranean. Incidental catches of swordfish have also been reported by Croatia, France, Japan and Libya.

At present, mainly surface longlines and driftnets are used for fishing. Most of the above-mentioned countries operate longline fisheries, and large-scale driftnet fisheries are mostly limited to Italy (3632 MT in 1997) and Morocco (2979 MT in 1999). Swordfish are also caught with harpoons, purse seines and traps, but the latter two gears are not used for targeting swordfish.

There is a high demand for swordfish for fresh consumption in most Mediterranean countries.

SWO-MED-3. State of the stocks

The Committee is concerned about the high catches of juvenile swordfish (those which have never spawned) in the Mediterranean, the apparent scarcity of large fish in the catch, and high uncertainty in estimates of high annual recruitments. Even without the aid of a robust analytical assessment, there are obvious warning signs from the Mediterranean fishery which warrant concern. The fact that the fishery is based on 2-3 young year-classes **(SWO-MED-Figure 2)** makes it vulnerable to recruitment changes. Furthermore, compared to the North Atlantic swordfish stock, the age of maturity is substantially less and fish have a smaller size at age in the Mediterranean, either suggesting possible biological compensation for heavy mortality and/or the influence of different environmental conditions in the Mediterranean. The VPA conducted in 1995 was not updated in 1998 partly because of a lack of sufficient improvements to input data, and partly due to time constraints. The results of the 1995 analysis were highly uncertain owing to uncertainty in the biological parameters, catch (1990-1996 since revised upwards substantially), and standardized CPUE used in tuning the analysis. As such, there was uncertainty about the veracity of the estimated trends in abundance, exacerbated by a lack of knowledge of current stock sizes relative to an unfished condition.

SWO-MED-4. Outlook

Given the absence of a substantial portion of recent data (catch, effort and size), the short time series of reliable data and the long history of exploitation in the Mediterranean, it is uncertain where the Mediterranean stock is in relation to unexploited stock levels. The unknown status of the stock, the very large and uncertain catch of very small fish, and warning signs from the fishery are cause for concern.

SWO-MED-5. Effects of current regulations

Although ICCAT has no specific regulatory measures for Mediterranean swordfish fisheries, several countries do. The EC Mediterranean Member States are enforcing the regulations adopted by the EC to this effect and particularly the minimum size of 120 cm LJFL (with no tolerance). More restrictive measures were adopted by some of these countries at the national level, such as the ban of driftnet use in the Ligurian Sea; the implementation of a closed season (1 October-30 January) by Greece; the setup of a special licensing system for bluefin and swordfish fishing. Spain adopted a limit to the number and size of hooks for longline (2000 hooks). Non-EC Member Countries are enforcing the GFCM regulation of relevance to large pelagic fisheries, particularly the maximum size of driftnets to 2.5 km. Some non-EC Member Countries, such as Croatia and Turkey, apply the minimum size of 120 cm LJFL. Additional national regulations are described in SCRS/98/11-bis.

The Committee reviewed the various measures taken by member countries and noted the difficulties in implementing some of the management measures, particularly that of minimum size. This minimum size regulation may not be practical in all situations given that 64% of the Mediterranean catches of swordfish in 1994 were less than 120 cm. Alternate and complementary measures are suggested in the Report of the Fourth Meeting of the Ad Hoc GFCM/ICCAT Joint Working Group (Genoa 1998).

SWO-MED-6. Management recommendations

Consistent with the Precautionary Approach and if managers want to be assured of maintaining the Mediterranean stock of swordfish, then the Committee strongly recommends reducing the fishing pressure on juvenile swordfish in order to improve yield per recruit and spawning biomass per recruit. In addition, given the uncertainty of the location of the boundary between the Mediterranean and North Atlantic stocks, it is important to identify the biological origin of those catches reported at or near the boundary so that the resulting knowledge can be considered in the management of the North Atlantic and/or Mediterranean stocks.

The Committee continues to recommend that the Commission ensure that reliable data be provided on catch, effort and size for Mediterranean swordfish. Improvements to these basic inputs to the stock assessment are essential before an improved assessment of Mediterranean swordfish can be achieved.

MEDITERRANEAN SWORDFISH SUMMARY

Maximum Sustainable Yield	not estimated
Current (1999) Yield	incomplete *
Replacement Yield	not estimated
Relative Biomass (B_{1994}/B_{MSY})	not estimated[1]
Relative Fishing Mortality:	
F_{1994}/F_{MSY}	not estimated[1]
F_{1994}/F_{max}	~ 1.1 (0.9 - 1.4)[2]
$F_{1994}/F_{0.1}$	~ 1.9 (1.5 - 2.4)[2]
Relative Recruitment	not estimated[1]
Management Measures in Effect	No ICCAT regulations; National and European Union minimum size and effort controls

* For the purposes of this Executive Summary, catches that were not reported were assumed to be equal to the reports for the previous year. In 1999, more than half of the estimated catch was not reported (see **SWO-MED-Table 1**).

[1] Results suggest that it is unlikely that the Mediterranean stock can sustain continued high catches of juveniles without high recruitment. The odds of continued high recruitment diminish as mature fish are removed from the population.

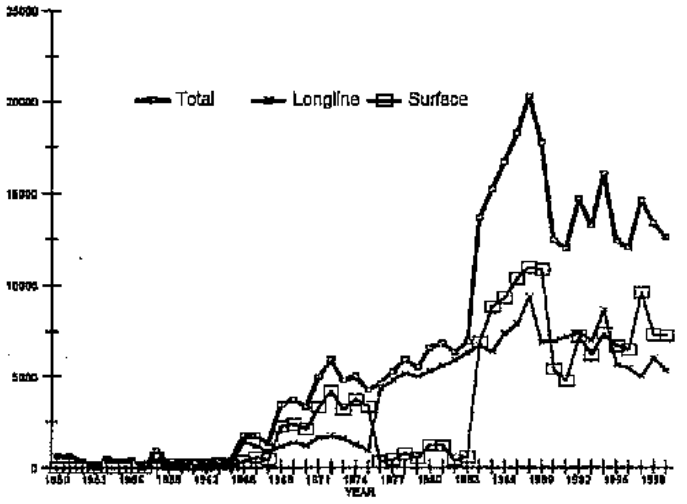
[2] Based on stock size weighted average F's for age 2 and 3 fish in 1993 from VPA analysis conducted in 1995. Approximate 80% CI based on estimated CV(F) = 0.2.

~ = approximate value.

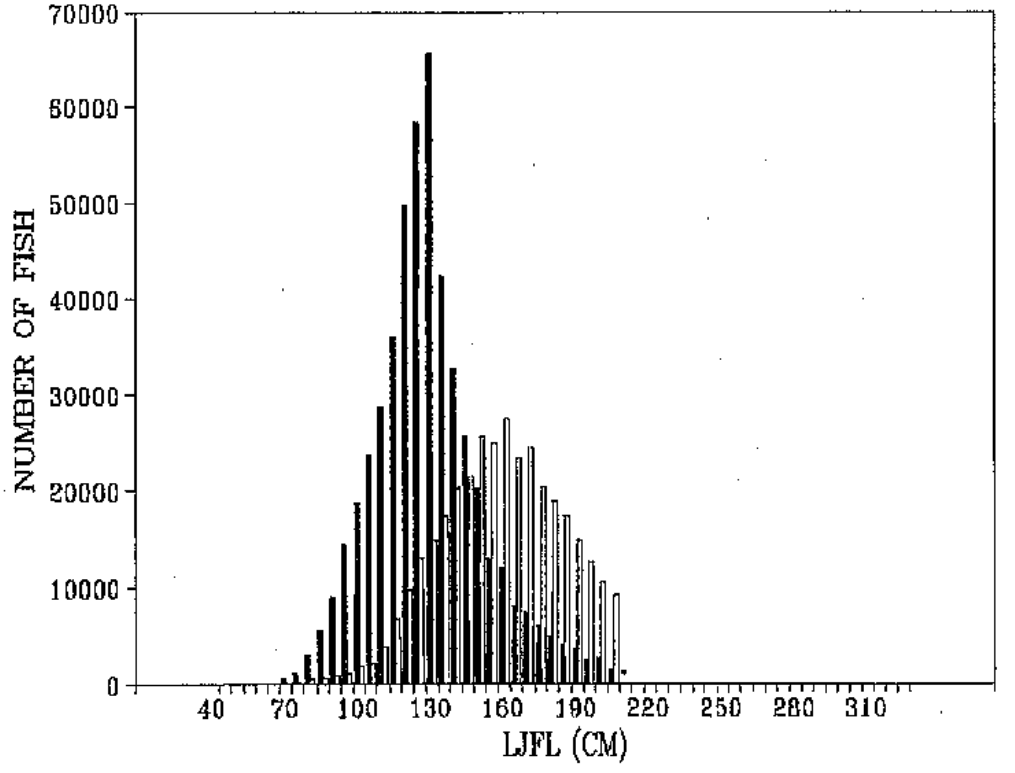
SWO-MED-Table 1. Estimated catches (reported and carried over, in MT) of Mediterranean swordfish in 1977-1999, by region, gear and flag.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
MEDITERRANEAN	**5280**	**5958**	**5547**	**6579**	**6813**	**6343**	**6896**	**13666**	**15226**	**16718**	**18288**	**20339**	**17761**	**12428**	**11987**	**14712**	**13250**	**16077**	**12414**	**12039**	**14645**	**13377**	**12626**
LONGLINE	*4829*	*5182*	*5028*	*5337*	*5603*	*5928*	*6298*	*6734*	*6368*	*7394*	*7912*	*9370*	*6905*	*6995*	*7202*	*7456*	*7008*	*8682*	*5692*	*5518*	*5025*	*6045*	*5358*
OTHER AND UNCL	*451*	*776*	*519*	*1242*	*1210*	*415*	*598*	*6932*	*8858*	*9324*	*10376*	*10969*	*10856*	*5433*	*4785*	*7256*	*6242*	*7395*	*6722*	*6521*	*9620*	*7332*	*7268*
ALBANIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	13	13	13
ALGERIE	370	320	521	650	760	870	877	884	890	847	1820	2821	590	712	582	395	562	600	807	807	807	0	0
CHINESE TAIPEI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	3	0	0
CROATIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	20
CYPRUS	95	82	98	72	78	103	28	63	71	154	84	121	139	173	162	73	116	159	89	40	51	61	92
EC-ESPAÑA	667	720	800	750	1120	900	1322	1245	1225	1337	1134	1762	1337	1523	1171	822	1358	1503	1379	1186	1264	1443	905
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
EC-GREECE	0	0	0	0	91	773	772	1081	1036	1714	1303	1008	1120	1344	1904	1456	1568	2520	974	1237	750	1650	1520
EC-ITALY	3747	4506	3930	4143	3823	2939	3026	9360	10863	11413	12325	13010	13009	5524	4789	7595	6330	7765	6725	5286	6104	6104	6104
JAPAN	0	2	3	1	0	5	6	19	14	7	3	4	1	2	1	2	4	2	4	5	4	7	8
LIBYA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0
MALTA	223	136	151	222	192	177	59	94	108	97	131	207	121	122	119	71	76	42	58	58	83	116	147
MAROC	144	172	0	0	0	0	43	39	38	92	40	62	97	1249	1706	2692	2589	2654	1696	2734	4900	3228	3238
NEI-2	0	0	0	728	672	517	532	771	730	767	828	875	979	1360	1292	1292	0	0	0	0	0	0	0
TUNISIE	0	0	0	0	7	19	15	15	61	64	63	80	159	176	181	178	354	298	378	352	346	414	468
TURKEY	34	20	44	13	70	40	216	95	190	228	557	589	209	243	100	136	292	533	304	320	320	320	113

Shaded cells indicate estimate catches. In some cases, the Committee assumed the catch to be the same as the latest data available.



SWO-MED-Fig. 1. Estimated catches (reported and carried over, in MT) of Mediterranean swordfish.



SWO-MED-Fig. 2. Comparison of 1993 size distributions of swordfish catches in the Mediterranean (dark bars) and north Atlantic (lighter bars). It should be noted that the biological parameters (e.g. growth rate, size of maturity, etc.) are different between these areas (see Sections SWO-MED-1 and SWO-ATL-1). (Figure from 1999 Report, and not updated in 2000).

7.11 SBF - SOUTHERN BLUEFIN TUNA

SBF-1. Biology

Southern bluefin tuna are distributed exclusively in the Southern Hemisphere of three oceans. The only known spawning ground is located in an area south of Java, Indonesia and off northwest Australia. Juveniles migrate southwards along the Australian West Coast and stay in the coastal waters of southwest, south, and southeast Australia. As fish grow, they extend their distribution to cover the circumpolar area throughout the Pacific, Indian and Atlantic Oceans.

Southern bluefin tuna are considered to be mature at age 8 at the length of 155 cm. Though the life span of this species was considered to be about age 20 from the tagging results, recent analysis revealed that a significant number of fish bigger than 160 cm were older than age 25. The maximum age obtained from otolith analysis was age 42. Age-specific natural mortality, higher for young fish and lower for old fish, is supported by tagging experiments and applied for stock assessment. Southern bluefin tuna is a unique example of an acceleration of growth rate observed through 1960's to 1980's, that was supported by tagging experiments in that periods. This acceleration of growth rate is partially due to the fact that the stock has been faced with high fishing pressure in last fifty years.

Preliminary results from recaptured archival tags suggest that young fish migrate seasonally between the south coast of Australia and middle of the Indian Ocean. Archival tagging is noted as a powerful tool to investigate the biology and movement of fish.

SBF-2. Description of the fisheries

Historically, the stock has been exploited by Australian and Japanese fishermen for more than 40 years. During this period, the Japanese longline fishery (taking older aged fish) recorded its peak catch of 77,927 MT in 1961 and the Australian catches of young fish by the surface fishery peaked at 21,501 MT in 1982. New Zealand, Chinese-Taipei and Indonesia have also exploited southern bluefin tuna, and Korea started a fishery in 1991.

The proportion of the catch made by surface fishery peaked around the 1980s at a level close to 50% of the total catch but it declined afterwards to 13% (**SBF-Table 1 and SBF-Figure 2**). The proportion of the surface catch started increasing again since 1994 and has reached around 30% in 1997.

The catches of Australia, Japan and New Zealand have been controlled by quota since 1986. The current catch limits are 5,265 MT for Australia, 6,065 MT for Japan, and 420 MT for New Zealand, which have remained at the same level since 1990. However, the catches by nations other than the aforementioned three have increased steadily and stayed at the level around 2,200 MT during the 1991–1994 period and then doubled to 4,689 MT in 1996. The catch by these nations remained high at 4,539 MT in 1997, then increased again to 6,318 MT in 1998. Japan caught an additional 1,464 MT in 1998 and 2,198 MT in 1999 for the Experimental Fishing which was conducted to evaluate fish density in an area where no commercial operations have occurred in recent years. Corresponding to the International Tribunal on the Law of the Sea (ITLOS) order of provisional measures requiring that the national allocation be sustained and to account for the catch taken in 1999 as part of the Experimental Fishing Program in 1999 and 2000 allocation, the commercial catch of 1999 was reduced to 5,354 MT. The ITLOS order of provisional measures was canceled by the Arbitral Tribunal in August, 2000.

The Atlantic catch has varied widely between 400 and 6,200 MT since 1978 (**SBF-Table 1 and SBF-Figure 1**), reflecting the shifts of longline effort between the Atlantic and Indian Oceans. The fishing ground in the Atlantic is located off the southern tip of South Africa (**SBF-Figure 5**).

Japanese longline vessels changed their catch retention practice to release fish less than 25 kg in 1995 and 1996, and a portion of these releases (considered to be dead discards) were incorporated into total estimate of catch.

SBF-3. State of the stocks

The stock assessment of this species has not been updated under the Conservation of Southern Bluefin Tuna (CCSBT) in 1999 and 2000. Therefore, the information described below is based on the results of the Fourth

Scientific Committee of CCSBT held in Shimizu and Tokyo, Japan, from July 23 to August 6, 1998.

The Japanese longline CPUE are standardized based on a range of hypotheses on fish density in cells without fishing effort (**SBF-Figure 3**). The CPUE for the parental stock (age 8 and older) continued to decline to the early 1990s and then stayed at about the same level except for one hypothesis. Juvenile CPUE declined through the 1970s to the mid-1980s but increased in 1993 to different levels according to the hypotheses and then remained at about the same level afterward. The sequential increases in the global CPUE by age for fish born in the late 1980s can be followed from 3-year-olds in 1990 to 8-year-olds in 1995.

Virtual Population Analyses (VPA) were conducted using various model structures, hypotheses on biological parameters, and different interpretations of Japanese CPUE series (**SBF-Figure 4**). All VPAs showed a similar recruitment trend of marked decline from the 1970s to the mid-1990s. The most recent recruitment estimate is about one-third of the 1970 level. Tagging data and results of aerial surveys suggested that recruitment of 1993 to 1995 cohorts for which no VPA results were available stayed at low levels.

The parental biomass is notably lower than the 1980 level, the management target level for stock recovery. The recent trend in parental biomass varied from a continuous decline to an upturn since 1994. These trends depend greatly on the way the plus group is treated and the CPUE series used. The overall estimates of current biomass level, after incorporating different beliefs in alternative hypotheses held by different nations, ranged from 25% to 53% of the 1980 level.

Japan conducted an Experimental Fishing Program in July and August 1998 as well as from June to August 1999, in an attempt to resolve uncertainties relating to CPUE series. The survey was designed to estimate fish density in areas without commercial operations relative to those in areas freely chosen by fishers. The survey results showed that the fish density in an area outside of commercially selected fishing area was about 30–60% of those in the commercially selected area, even when assuming no fish distribution in an area without survey effort, and supported the hypothesis that a substantial amount of fish is distributed outside the commercially fishing area.

SBF-4. Outlook

Future projections were performed to examine the medium to long-term consequences of the current global catch on parental biomass as well as the probability to recover to the 1980 level, based on a set of VPAs incorporating an agreed upon range of uncertainties. The probability of stock recovery to the 1980 parental biomass level before 2020 ranged between 6 to 87% reflecting different interpretations on the plausibility of various hypotheses. As noted above for the parental biomass estimates, the differences in plus group treatments and different interpretations of CPUE indices had major impacts on the assessment of the recovery probability. However, the results of Japanese Experimental Fishing Program suggested that the most pessimistic CPUE interpretations are highly unlikely.

SBF-5. Effects of current regulations

Southern bluefin tuna has been managed through quotas among Australia, Japan and New Zealand since 1985. The global quota was reduced several times from 38,650 MT in the 1984-1985 season and the current quota has been maintained at 11,750 MT since the 1989-1990 season.

Management measures of the CCSBT were successful in reducing catches by 1990 but non-member catches, which have shown a marked and continuous increase over the 1990s, have contributed to the erosion of benefits over this period.

The continued low abundance of the parental biomass is a cause for serious concern. The increasing pressure on the parental biomass, particularly on the spawning ground, is contributing to the continued low parental biomass. Also, the recent increase in the fishing mortality of juvenile fish is expected to lead to lower recruitment from these cohorts to the parental stock.

SBF-6. Management recommendations

The Committee noted that the ICCAT statistical system will continue to be important for monitoring the fishery for this species in the Atlantic Ocean. While the CCSBT, established in May, 1994, has competence on the management of this species as a whole in the three oceans, ICCAT is responsible for the management of southern bluefin tuna in the Atlantic Ocean. Therefore, close collaboration should be maintained between the two organizations as regards stock assessments and management measures.

No recommendation was made for the management of southern bluefin tuna in the Atlantic.

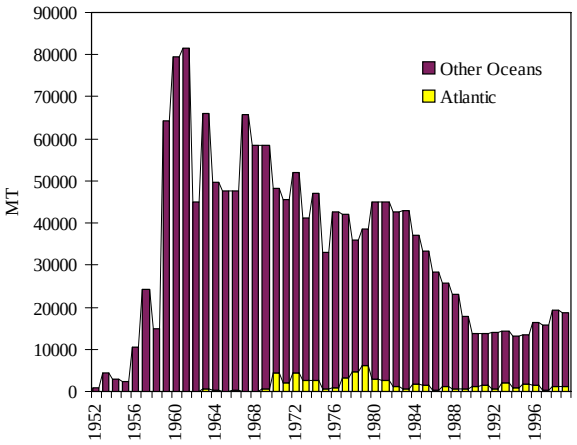
SOUTHERN BLUEFIN TUNA SUMMARY
(Global Stock)

Maximum Sustainable Yield	not estimated
Current (1999) Yield	18,640 MT (preliminary)
Relative Biomass SSB(1998)/SSB (1980)	0.25 - 0.53
Current Management Measures	global quota at 11,750 MT (applicable only to Australia, Japan, and New Zealand)

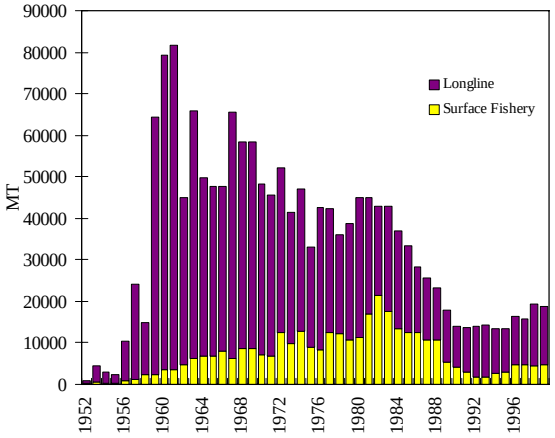
SBF-Table 1. Atlantic and world-wide catches (in MT) of southern bluefin in 1977-1999, by gear and flag.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998*	1999*
ATLANTIC TOTAL	**3168**	**4685**	**6205**	**2827**	**2578**	**1138**	**525**	**1636**	**1497**	**432**	**1204**	**622**	**711**	**1266**	**1346**	**539**	**2144**	**767**	**1612**	**1376**	**365**	**1161**	**1262**
-CATCH BY GEAR																							
Longline	3168	4685	6205	2814	2572	1138	525	1636	1497	432	1200	620	705	1266	1346	539	2144	767	1612	1376	365	1161	1262
Baitboat	0	0	0	13	6	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Sport	0	0	0	0	0	++	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0	4	2	5	0	0	0	0	0	0	0	0	0	0
-CATCH BY FLAGS																							
Chinese-Taipei	0	34	13	26	66	3	20	0	29	43	80	72	80	64	15	14	456	172	168	157	47	234	161
Japan	3168	4651	6192	2788	2506	1135	505	1636	1468	389	1120	548	625	1202	1331	525	1688	595	1444	1219	308	917	1073
Korea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	10	28
Poland	0	0	0	0	0	0	0	0	0	0	4	2	5	0	0	0	0	0	0	0	0	0	0
South Africa	0	0	0	13	6	++	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
World Catches	***42185***	***36002***	***38673***	***45054***	***45104***	***42794***	***42881***	***37091***	***33325***	***28319***	***25575***	***23145***	***17842***	***13869***	***13638***	***14076***	***14372.5***	***13280***	***13456***	***16329***	***15777***	***19251***	***18640***
Longline	*29600*	*23658*	*27890*	*33859*	*28348*	*21263*	*25143*	*23678*	*20610*	*15344*	*14212*	*11977*	*12355*	*9500*	*10528*	*12140*	*12149*	*10726*	*10550*	*11552*	*10929*	*14632*	*13905*
Surface Fishery	*12569*	*12190*	*10783*	*11195*	*16843*	*21501*	*17695*	*13411*	*12589*	*12531*	*10821*	*10591*	*5434*	*4319*	*2873*	*1835*	*1899*	*2554*	*2906*	*4777*	*4848*	*4619*	*4735*

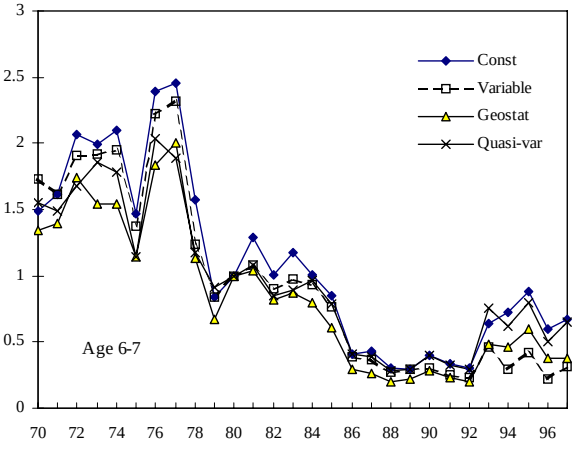
*Preliminary
++ Catch < 0.5 MT

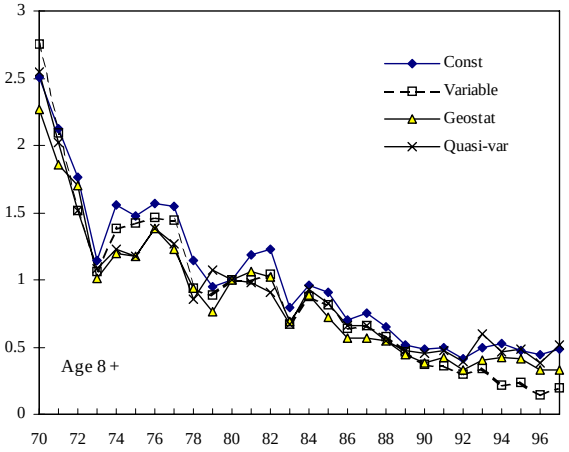


SBF-Fig. 1. Worldwide and Atlantic catches of southern bluefin tuna.

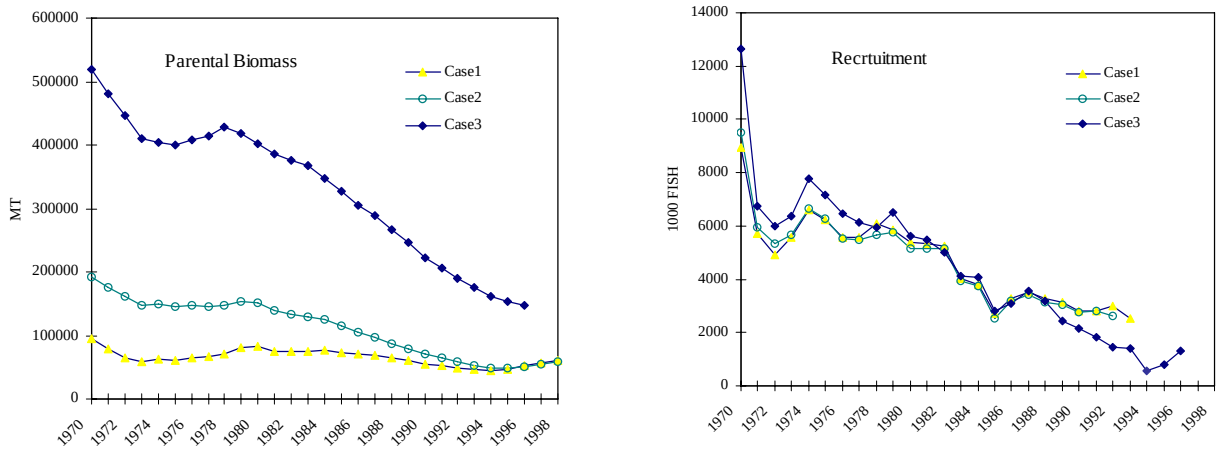


SBF-Fig. 2. Southern bluefin tuna world catch by fishery.

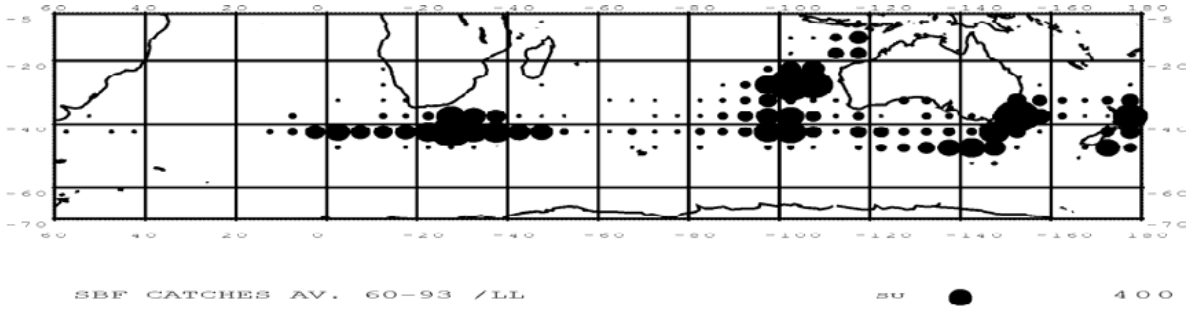




SBF-Fig. 3. Standardized CPUE of Japanese longline relative to 1980 for juvenile (ages 6-7) and parental (ages 8+) southern bluefin tuna. Different lines correspond to different hypotheses on fish abundance within time-area strata without fishing effort. (References: CCSBT/SC/9807/27 and 37)



SBF-Fig. 4. Results of stock size estimates by VPA. Japanese and Australian reference cases (Case 1 and Case 2) and the result based on different approach (Case 3) were selected for presentation. (Reference: CCSBT/SC/9807/17, 27 and 31 with a modification to make them comparable.)



SBF-Fig. 5. Geographical distribution of southern bluefin tuna catches by longline. 1960-1993.

7.12 - SMT - SMALL TUNAS

SMT-1. Biology

Very little is currently known about the biology of small tunas. In fact, scientific studies on these species, are rarely undertaken. This is largely because many of these species are considered to have little economic importance to the Atlantic tuna fleets, and because of difficulties in sampling landings from artisanal fisheries, which constitute a high proportion of the fisheries exploiting small tuna resources. The exceptions are some stocks of Spanish and king mackerel, such as those found in U.S. and Brazilian waters. The large industrial fleets often discard small tuna catches at sea or sell them in local markets, especially in Africa. The amount caught is rarely reported in logbooks.

These species are widely distributed in the tropical and subtropical waters of the Atlantic Ocean, the Mediterranean Sea, and the Black Sea. They are often found in large schools with other small sized tunas or related species in coastal and offshore waters. They have a varied diet with a preference for small pelagics (e.g. clupeids, mullets, carangids and ammodytes), crustaceans, mollusks and cephalopods. The reproduction period varies according to species and spawning generally takes place near the coast, where the waters are warm.

In the eastern tropical Atlantic, the size-at-first-maturity is about 42 cm for Atlantic black skipjack (*Euthynnus alletteratus)*, 30 cm for *Auxis spp.*, 38 cm for Atlantic bonito (*Sarda sarda)*, and 45 cm for mackerel *(Scomberomorus* spp.). The growth rate currently estimated for these species is very rapid for the first two or three years, and then slows as these species reach size at first maturity.

Recent studies indicate that some species of small tunas, ex. *Auxis sp.*, could have an important role in large yellowfin diet. This was observed in the Pacific Ocean but also in the Atlantic tropical waters, where large quantities of frigate tuna were found in large yellowfin stomach contents (Menard et al. 1999).

Some biological research is currently undertaken on Atlantic black skipjack (*E. alletteratus)* and bullet tuna (*A . rochei*) caught in Turkish waters (SCRS/00/48 and SCRS/00/49). In particular, data are being gathered on individual fish fork length, weight and age using first dorsal fin spines and also otoliths in the case of *A . rochei*. A preliminary length-weight relationship was determined for both species, sexes combined.

SMT-2. Description of then fisheries

Small tunas are exploited mainly by coastal fisheries and often by artisanal fisheries, although substantial catches are also made, either as target species or as by-catch, by purse-seiner (SCRS/00/121), mid-water trawlers (i.e. pelagic fisheries of West Africa-Mauritania), handlines and small scale gillnets (U.S. fisheries, SCRS/00/142) Unknown quantities of small tuna also comprise the incidental catches of some longline fisheries. Some U.S. sport fisheries target Spanish and king mackerels on a seasonal basis.

There are over ten species of small tunas, but only five of these account for 85% of the total reported catch by weight each year. These five species are: Atlantic bonito *(Sarda sarda)*, frigate tuna *(Auxis thazard)*, spotted Spanish mackerel *(Scomberomorus maculatus)*, king mackerel *(Scomberomorus cavalla)*, and Atlantic black skipjack *(Euthynnus alletteratus)* **(SMT-Figure 2)**.

Historical landings of small tunas for the period 1977 to 1999 are shown in **SMT-Table 1**. The total reported landings of all species combined during the period 1977 to 1979, reached 80,000 MT. In 1980, there was a marked increase in reported landings, which continued to increase, reaching a peak at about 144,000 MT in 1988 **(SMT-Figure 1)**. Landings reported for the period 1989-1996 decreased to about 109,000 MT. A preliminary estimate for the total nominal landings of small tunas in 1999 is 79,023 MT. The Committee noted the relative importance of small tuna fisheries in the Mediterranean Sea, which account for 28% of the total reported catch in the period 1977-1999.

Since 1991, tropical purse-seiners operating around artificial flotsam (fish aggregating devices) may have led to an increase in fishing mortality of small tropical tuna species. These species usually comprise part of the by-catch, and are often discarded. This source of mortality is not yet fully reflected in the Task I tables.

Despite recent improvements in statistical reporting by some countries, the Committee also noted that uncertainties remain regarding the accuracy and completeness of reported landings in all areas, including the Mediterranean, and that there is a general lack of information on the mortality of these species as by-catch.

SMT-3. State of the stocks

There is little information available to determine the stock structure of many small tunas species. Some size data has been reported, by 1°x1° square and by month, under an observer program covering the European purse seine tuna fleets operating in the Atlantic Ocean, during last years.

Status of stock information reported to the Committee is summarized as follows: Age-structured stock assessments of Spanish mackerel and king mackerel are carried out for the coastal areas of the southeastern United States and the Gulf of Mexico. These assessments indicated that the stocks of Atlantic Spanish mackerel and king mackerel in the Gulf of Mexico were over-exploited. Reductions in fishing mortality were considered necessary, and hence a number of regulations (commercial trip limits, seasonal and area quotas, and recreational bag limits) have been implemented in order to allow the stocks to recover to levels that could provide high average long-term yields and to provide adequate safeguards against recruitment failure. Improvement in stock status has been observed in the Gulf of Mexico Spanish mackerel and king mackerels

Current information does not generally allow for an evaluation of stock status by the Committee for most of the coastal pelagic species. Most stocks, however, probably do not have an ocean-wide distribution. For this reason, the majority of the stocks can be managed at the regional or sub-regional level.

SMT-4. Outlook

The results of an ICCAT questionnaire circulated in 1996 indicate that small tuna fisheries are very diverse and complex , involving both artisanal and industrial fisheries using a variety of gears, as well as different types and sizes of vessels. The results also indicate that data collection and research including size sampling, age and growth research, maturity studies and tagging, are being conducted by several countries.

Nonetheless, catch and effort statistics for small tunas remain incomplete for many of the coastal and industrial fishing countries. There is also a general lack of available biological information needed to assess the stocks of most of these species. On the other hand, many of these species are of importance to coastal fishermen, especially to some developing countries, both economically and as a source of protein. The Committee therefore reiterates its previous recommendation that studies should be conducted to determine the state of these stocks and the best way to manage them. Such studies are probably best carried out at the local or sub-regional level.

SMT-5. Effects of current regulations

There are no ICCAT regulations in effect for these small tuna species.

A "U.S. Fishery Management Plan (FMP) for coastal pelagic species in the Gulf of Mexico and Atlantic Ocean Region" has been in effect since 1983. Under the FMP, fisheries management procedures were established to reduce fishing mortality on king and Spanish mackerels. It is believed that vessel landing limits, geographical quotas, and minimum size restrictions have helped to stabilize and improve overall stock conditions.

SMT-6. Management recommendations

No recommendations were presented due to the lack of data and analyses.

SMT-Table 1. Estimated landings (reported and carried over, in MT) of small tuna species in 1977-1999, by region and flag.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	
TOTAL	**78950**	**75631**	**80697**	**115299**	**115795**	**133654**	**127109**	**111485**	**93300**	**91960**	**113745**	**143845**	**126345**	**130948**	**120401**	**96622**	**97735**	**88832**	**89736**	**108781**	**106607**	**81995**	**79023**	
ATLANTIC	64208	59997	60606	89408	81378	93613	83731	87842	67524	68638	84698	110758	105620	97837	86101	75383	68109	67135	68311	83315	85261	62278	57170	
MEDITERRANEAN	14742	15634	20091	25891	34417	40041	43378	23643	25776	23322	29047	33087	20725	33111	34300	21239	29626	21697	21425	25466	21346	19717	21853	
BLF - T.atlanticus	**1251**	**1341**	**1205**	**1175**	**1973**	**1941**	**1738**	**1908**	**1403**	**2822**	**3462**	**3322**	**2834**	**3887**	**4201**	**4352**	**3532**	**2710**	**4048**	**4487**	**3901**	**3948**	**3833**	
BRAZIL	273	195	173	181	85	89	57	203	133	172	254	229	120	335	130	49	22	37	153	649	418	55	55	
CUBA	0	0	0	0	721	622	558	487	157	486	634	332	318	487	318	196	54	223	156	287	287	0	0	
DOMINICA	0	0	0	0	0	0	0	0	0	0	0	1	4	19	10	14	15	19	30	0	0	0	79	
DOMINICAN REPUBLIC	68	78	105	125	124	144	144	106	90	123	199	4	564	520	536	110	133	239	892	892	892	892	892	
EC-ESPANA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	307	46	0	0	0	0	0	0	
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	
EC-GUADELOUPE	530	530	470	440	460	490	482	490	460	470	470	450	460	470	460	470	440	440	480	500	500	500	500	
EC-MARTINIQUE	300	400	300	300	301	352	327	331	295	259	199	366	395	395	750	700	700	890	890	540	540	540	540	
GRENADA	71	76	95	68	84	143	102	232	193	256	141	220	134	293	195	146	253	189	123	164	126	126	94	
JAMAICA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	148	0	0	0	
LIBERIA	0	0	0	0	0	0	0	0	0	0	0	229	0	0	0	0	0	0	0	0	0	0	0	
NETHERLAND.ANT	0	55	55	55	55	55	55	55	55	60	60	70	70	70	60	60	65	60	50	45	45	45	45	
STA LUCIA	0	0	0	0	0	0	0	0	0	0	2	1	1	17	14	13	16	82	47	35	40	40	41	
ST.VINCENT	0	0	0	0	0	0	0	0	0	0	0	19	15	38	11	7	53	19	20	18	22	22	15	
USA	0	0	0	0	139	41	7	0	11	32	44	154	87	80	111	126	508	492	582	446	547	707	617	
UK-BERMUDA	9	7	7	6	4	5	6	4	9	17	11	7	14	13	8	6	5	7	4	5	6	6	9	
VENEZUELA	0	0	0	0	0	0	0	0	0	947	1448	1240	652	1150	1598	2148	1222	13	621	758	478	1015	946	
BLT - Auxis Rochei	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**357**	**723**	**3634**	**2206**	**814**	**394**	**177**	**100**	**0**	**464**	**28**	**1056**	
EC-PORTUGAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	263	
RUSSIAN FED.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2171	814	70	100	100	0	464	0	477	
TURKEY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	324	77	0	0	0	0	316	
U.S.A	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	
U.S.S.R	0	0	0	0	0	0	0	0	0	0	0	357	723	3634	0	0	0	0	0	0	0	0	0	
BON - Sarda sarda	**20676**	**17273**	**19971**	**31733**	**40053**	**43687**	**42837**	**22505**	**25433**	**21990**	**30252**	**46901**	**30062**	**28940**	**34389**	**22298**	**30709**	**21918**	**21262**	**25131**	**25620**	**23408**	**23500**	
ATLANTIC	*11977*	*7854*	*6485*	*12568*	*10760*	*12169*	*6840*	*6849*	*6946*	*5892*	*7395*	*22353*	*17766*	*6843*	*8301*	*6902*	*4587*	*5807*	*6228*	*7862*	*9102*	*7970*	*6690*	
ANGOLA	938	531	251	377	196	253	124	225	120	101	144	180	168	128	102	4	49	20	9	39	32	0	2	
ARGENTINA	2026	1746	1288	2600	846	1775	310	2058	1399	699	1607	2794	1327	1207	1794	1559	434	4	138	0	0	0	0	
BENIN	0	0	13	19	32	36	16	25	30	6	3	4	7	0	0	0	0	0	0	0	0	0	0	
BRASIL	0	0	0	0	0	0	0	187	179	523	345	214	273	226	71	86	142	142	137	0	0	0	0	
BULGARIA	37	22	0	75	8	23	46	0	0	2	0	0	3	0	0	0	0	0	0	0	0	0	0	
CUBA	0	0	0	0	0	0	0	0	0	0	23	173	26	28	0	0	0	0	0	0	0	230	0	
EC-ESPAÑA	1978	1919	717	220	589	434	414	173	398	145	41	91	57	18	8	39	5	3	2	2	1	0	12	
EC-FRANCE	0	0	0	8	0	0	2	17	1	0	0	0	0	0	0	0	52	0	0	0	0	0	24	
EC-GERMANY	0	0	0	0	0	0	0	0	0	0	0	0	0	53	0	0	0	0	0	714	0	0	0	
EC-GREECE	0	30	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
EC-GUADELOUPE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
EC-MARITINIQUE	510	400	500	500	502	587	545	552	491	431	331	395	427	430	820	770	1000	990	990	610	610	610	0	**
EC-PORTUGAL	0	0	6	13	31	55	86	56	50	168	371	377	80	202	315	133	145	56	78	83	49	98	97	
EC-U.K	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	287	0	0	0	
ESTONIA	0	0	0	0	0	0	0	0	0	0	0	668	859	187	8	0	0	0	0	0	0	0	0	
GEORGIA	0	0	0	0	0	0	0	0	0	0	0	39	54	0	0	0	0	0	0	0	0	0	0	
GERMANY D.R	0	0	0	288	440	146	274	26	40	23	1	0	0	0	0	0	0	0	0	0	0	0	0	
GHANA	9	9	0	77	5	71	13	8	10	0	943	0	0	0	0	0	0	0	0	0	0	0	0	
GRENADA	136	157	53	52	61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	6	0	0	

SMT-Table 1 (cont.). Estimated landings (reported and carried over, in MT) of small tuna species in 1977-1999, by region and flag.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	
JAMAICA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	
LATVIA	0	0	0	0	0	0	0	0	0	0	0	1191	1164	221	7	4	0	3	19	301	0	318	0	
LITUANIA	0	0	0	0	0	0	0	0	0	0	0	1041	762	162	11	10	0	0	0	0	0	0	0	
MAROC	131	171	196	312	477	535	561	310	268	251	241	589	566	492	794	1068	1246	584	699	894	1259	1557	1390	
MEXICO	81	59	174	271	408	396	567	744	212	241	391	356	338	215	200	657	779	674	1144	1312	1312	0	0	
POLAND	177	44	32	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	225	0	0	0	
RUMANIA	139	19	0	64	81	249	192	8	32	71	3	255	111	8	212	84	0	0	0	0	0	0	0	
RUSSIA FED.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	948	29	6	0	0	0	0	0	0	
SENEGAL	614	523	159	140	1327	202	497	200	495	510	463	2066	869	558	824	378	227	600	354	570	570	570	570	
SIERRA LEONE	0	0	0	57	30	5	5	5	10	10	10	10	10	10	4	6	0	0	0	0	0	0	0	
SOUTH AFRICA	2	16	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
ST.LUCIA	0	0	0	0	0	0	0	0	0	0	0	1	0	3	3	3	4	1	1	1	0	0	0	
TOGO	0	0	0	0	0	0	0	0	254	138	245	400	256	177	172	107	311	254	145	197	197	197	197	
TRINIDAD & TOBAGO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	703	750	750	750	750	750	
U.S.A	268	224	502	198	333	209	253	217	110	84	130	89	278	298	468	497	170	127	116	155	182	75	83	
U.S.S.R	4164	1602	2125	6433	4559	6329	2375	1290	2073	1085	1083	8882	7363	706	0	0	0	0	0	0	0	0	0	
UKRAINE	0	0	0	0	0	0	0	0	0	0	0	1385	985	0	0	25	0	0	0	342	2786	1918	1918	
URUGUAY	0	0	16	3	1	0	1	0	0	3	0	0	0	0	26	0	0	0	0	0	0	0	0	
VENEZUELA	767	382	443	861	833	864	554	748	774	1401	1020	1153	1783	1514	1514	1443	0	1646	1646	1348	1348	1647	1647	*
MEDITERRANEAN	*8699*	*9419*	*13486*	*19165*	*29293*	*31518*	*35997*	*15656*	*18487*	*16098*	*22857*	*24548*	*12296*	*22097*	*26088*	*15396*	*26122*	*16111*	*15034*	*17269*	*16518*	*15438*	*16810*	
ALBANIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	
ALGERIA	206	196	515	640	740	860	867	874	880	459	203	625	1528	1307	600	600	596	847	351	351	351	0	0	
BULGARIA	44	11	1	13	191	4	24	1	1	0	13	0	0	17	17	20	8	0	25	33	0	0	0	
CROATIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	49	128	6	70	0	0	0	25	0	*
EC-ESPAÑA	610	711	713	480	710	990	1225	984	1045	729	51	962	609	712	686	228	200	344	632	690	628	333	433	
EC-FRANCE	0	0	0	0	0	0	33	16	0	0	0	10	0	1	10	5	6	0	0	0	0	0	0	
EC-GREECE	550	610	712	809	1251	1405	1367	1732	1321	1027	1848	1254	2534	2534	2690	2690	2690	1581	2116	1752	1559	945	2135	
EC-ITALY	1533	1378	1403	1180	1096	1102	1806	2777	1437	1437	2148	2242	1369	1244	1087	1288	1238	1828	1512	2233	2233	2233	2233	
EGYPT	1	17	10	3	2	23	14	48	62	68	35	17	358	598	574	518	640	648	697	985	725	724	724	
LIBYA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	71	70	0	0	0	0	0	0	
MALTA	2	2	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	7	0	0	
MAROC	456	128	155	62	309	71	92	75	57	51	127	108	28	69	69	31	25	93	37	67	45	39	120	
NEI-2	0	0	0	295	274	276	452	694	359	359	537	561	342	311	311	311	300	300	300	300	75	0	0	
RUMANIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
TUNISIE	768	791	865	700	381	748	600	600	482	504	500	600	422	488	305	643	792	305	413	560	611	855	881	
TURKEY	4503	5536	9082	14910	24300	25978	29485	7818	12809	11426	17333	18133	5008	14737	19645	8863	19548	10093	8944	10284	10284	10284	10284	*
U.S.S.R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
YUGOSLAVIA	26	39	29	72	39	61	31	37	34	38	62	36	98	79	0	0	0	0	0	0	0	0	0	
YUGOSLAVIA REP. FED.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	0	3	2	6	10	0	0	0	
BOP - O. unicolor	456	970	492	698	1448	584	38	49	133	87	564	1482	1116	457	501	465	403	622	548	2017	249	30	627	
ATLANTIC	*321*	*817*	*464*	*698*	*1448*	*584*	*38*	*49*	*124*	*86*	*538*	*1474*	*1109*	*420*	*487*	*424*	*349*	*599*	*525*	*2004*	*246*	*28*	*626*	
BENIN	0	0	1	1	2	2	1	1	1	3	1	2	1	1	1	1	1	1	1	1	0	0	0	
EC-PORTUGAL	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
MAROC	231	727	373	596	968	483	0	0	83	33	487	1422	1058	369	486	423	348	598	524	2003	246	28	626	
MAURITANIE	90	90	90	101	478	99	37	40	40	50	50	50	50	50	0	0	0	0	0	0	0	0	0	
MEDITERRANEAN	*135*	*153*	*28*	*0*	*0*	*0*	*0*	*0*	*9*	*1*	*26*	*8*	*7*	*37*	*14*	*41*	*54*	*23*	*23*	*13*	*3*	*2*	*1*	
LIBYA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	40	0	0	0	0	0	0	
MAROC	135	153	28	0	0	0	0	0	9	1	26	8	7	37	14	1	14	23	23	13	3	2	1	

SMT-Table 1 (cont.). Estimated landings (reported and carried over, in MT) of small tuna species in 1977-1999, by region and flag.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	
BRS - Sc.	**3188**	**3484**	**3722**	**5617**	**5841**	**6019**	**6632**	**8129**	**3501**	**6549**	**6212**	**9510**	**10778**	**7698**	**8856**	**6051**	**8049**	**7161**	**7320**	**8997**	**8435**	**7297**	**8441**	
BRASIL	986	1522	1191	2826	3466	4342	4511	6259	1504	5011	4741	5063	5927	2767	1437	1149	842	1149	1308	3047	2125	1516	1516	
GRENAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
GUYANE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	211	571	0	1143	
TRINIDA	0	0	0	0	0	0	0	0	0	0	0	2704	2864	2471	2749	2130	2130	2130	2130	2130	2130	2130	2130	*
VENEZU	2202	1962	2531	2791	2375	1677	2121	1870	1997	1538	1471	1743	1987	2460	4670	2772	5077	3882	3882	3609	3609	3651	3651	*
CER - Sc	**629**	**698**	**586**	**604**	**628**	**687**	**677**	**680**	**574**	**500**	**392**	**219**	**234**	**225**	**375**	**390**	**450**	**490**	**429**	**279**	**279**	**279**	**29**	
DOMINIC	119	98	86	104	106	76	110	106	63	52	48	57	59	50	45	79	50	90	29	29	29	29	29	*
EC-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
EC-	510	600	500	500	522	611	567	574	511	448	344	162	175	175	330	310	400	400	400	250	250	250	0	**
ST.VINCE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	
FRI -	**20020**	**8343**	**12575**	**20912**	**15913**	**25240**	**21690**	**25903**	**22876**	**20306**	**23406**	**25151**	**21416**	**23333**	**13735**	**7892**	**6691**	**11020**	**11241**	**13981**	**12375**	**9678**	**5348**	
ATLANTI	*16611*	*4776*	*8868*	*16960*	*12235*	*19197*	*15870*	*19566*	*17636*	*15249*	*19666*	*19025*	*15029*	*14973*	*7338*	*3261*	*4012*	*6203*	*6223*	*7362*	*8549*	*7703*	*2412*	
ANGOLA	197	357	357	256	351	515	212	256	90	21	115	20	70	28	1	0	4	6	21	29	12	31	2	
ARGENTI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
BENIN	0	0	25	37	64	72	32	49	50	1	3	6	3	0	0	0	0	0	0	0	0	0	0	
BRASIL	0	0	0	0	0	72	11	634	623	941	1260	1904	700	592	746	291	608	906	558	527	215	162	116	
BULGARI	0	0	0	3	3	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
CAP-	0	0	0	0	0	0	0	0	0	0	2	86	105	75	135	82	115	86	13	6	22	191	152	
EC-	574	1249	1211	6260	5295	3128	2691	5746	3702	3164	4538	3938	1877	2240	541	228	362	297	386	947	581	570	22	
EC-	0	0	0	0	0	0	0	640	416	1904	3392	3392	3008	3872	703	796	1134	1063	857	800	850	853	920	
EC-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	250	
EC-	0	0	0	0	0	0	0	14	30	32	1	2	4	26	3	0	0	0	0	0	1	31	5	
ESTONIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	198	0	0	0	0	0	0	0	0	
F.I.S	0	0	0	0	1856	1984	2800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GERMAN	0	0	0	0	0	106	55	40	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	
GHANA	13914	1047	4286	7566	2048	6062	5632	4530	4500	3256	4689	0	0	0	0	0	0	0	0	0	0	0	0	
GRENAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	
JAPAN	89	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
LATVIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	243	0	0	0	0	0	0	0	0	
LITUANIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	290	0	0	0	0	0	0	0	0	
MAROC	688	770	694	968	1267	1126	1271	198	424	302	465	194	599	1045	1131	332	274	122	645	543	2614	2137	494	
NEI-1	0	0	0	0	0	0	333	46	0	0	17	381	155	237	1	3	29	62	65	642	467	473	0	
PANAMA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	247	374	129	350	368	491	247	0	0	
RUMANIA	0	0	0	0	0	0	0	0	0	51	15	0	0	0	0	0	0	0	0	0	0	0	0	
RUSSIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1078	627	150	405	404	46	36	761	0	
SAO	0	0	0	0	0	0	0	32	0	0	0	0	0	0	0	0	0	0	0	79	323	0	0	
SENEGA	0	0	0	0	0	0	0	0	0	0	0	810	784	1082	311	201	309	309	309	0	0	0	0	
TRINIDA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	199	367	367	367	
U.S.A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
U.S.S.R	242	803	450	694	407	5623	1655	5903	6055	3465	2905	5638	5054	2739	0	0	0	0	0	0	0	0	0	
VENEZU	907	550	1845	1176	944	509	1171	1478	1746	2109	2264	2654	2670	3037	1710	327	881	2597	2597	3053	2813	2127	84	
MEDITER	*3409*	*3567*	*3707*	*3952*	*3678*	*6043*	*5820*	*6337*	*5240*	*5057*	*3740*	*6126*	*6387*	*8360*	*6397*	*4631*	*2679*	*4817*	*5018*	*6619*	*3826*	*1975*	*2936*	
ALGERIE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	947	947	947	0	0	
CROATIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	21	52	22	28	26	26	26	26	0

SMT-Table 1 (cont.). Estimated landings (reported and carried over, in MT) of small tuna species in 1977-1999, by region and flag.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	
EC-ESPAÑA	1184	1676	1771	2120	1700	1935	2135	2301	2047	1555	631	2669	2581	2985	2226	1210	648	1124	1472	2296	604	487	669	
EC-FRANCE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	4	0	0	1	0	0	0	0	
EC-GREECE	0	0	0	0	516	2192	1887	2060	1419	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1426	1426	0	0	
EC-ITALY	1147	1177	1342	1376	1193	1299	1494	1610	1344	1344	906	609	509	494	432	305	379	531	531	229	229	229	229	
MALTA	9	33	11	18	4	9	11	4	1	13	5	8	18	21	20	11	10	1	2	3	6	6	0	
MAROC	234	69	73	10	14	77	57	52	48	175	178	811	1177	2452	1289	1644	170	1726	621	1673	562	1140	682	
TUNISIE	811	589	493	409	237	517	218	294	367	538	606	588	660	985	985	35	20	13	14	13	26	87	1330	
YUGOSLAVIA	24	23	17	19	14	14	18	16	14	32	14	41	42	23	0	0	0	0	0	0	0	0	0	
YUGOSLAVIA REP. FED.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	1	0	0	2	6	0	0	0	
KGM - Sc cavalla	**8732**	**6769**	**11450**	**15656**	**18513**	**18149**	**14607**	**13182**	**9964**	**12187**	**11890**	**13038**	**10835**	**12232**	**11530**	**12438**	**14461**	**13868**	**14372**	**17773**	**19123**	**12232**	**12341**	
ANTIGUA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	
ARGENTINA	988	379	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
BRASIL	790	845	848	1598	1612	1929	2695	2588	806	2890	2173	2029	2102	2070	962	979	1380	1365	1328	2890	2398	3595	3595	
CHINESE TAIPEI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DOMINICA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	
DOMINICAN REP.	0	0	0	0	0	0	0	0	0	0	0	20	29	33	34	47	52	0	0	0	0	0	0	
GRENADA	162	175	73	25	30	43	40	19	0	0	0	0	0	0	0	0	0	0	0	2	4	0	14	
GUYANE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	270	0	398	
MEXICO	1331	1535	2249	1946	2740	4409	2874	2164	2303	2643	3067	3100	2300	2689	2147	3014	3289	3097	3214	4661	4661	0	0	
STA LUCIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	0	
TRINIDAD & TOBAGO	0	0	0	0	0	0	20	43	11	38	82	752	541	432	657	0	1192	0	0	1029	875	875	875	
U.S.A	3837	2507	6292	10726	12565	9863	7068	7444	6011	5683	5628	5807	4363	5939	6502	7091	7747	6922	7345	7051	8772	7422	7423	
VENEZUELA	1624	1328	1988	1361	1566	1905	1910	924	833	933	940	1330	1500	1069	1228	1307	800	2484	2485	2139	2139	340	0	*
KGX - Scomb. spp	**471**	**424**	**197**	**214**	**339**	**283**	**20**	**485**	**22**	**149**	**261**	**491**	**105**	**131**	**225**	**356**	**320**	**508**	**512**	**831**	**0**	**250**	**158**	
BARBADOS	135	157	0	0	0	0	0	0	0	138	159	332	68	51	45	51	55	36	42	49	0	0	0	
BRASIL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
COLOMBIA	108	92	54	73	160	80	20	485	22	11	102	159	37	25	7	12	21	148	111	539	0	0	0	
CUBA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	236	0	
EC-GUADELOUPE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
EC-MARINIQUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GABON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	140	145	86	0	0	158	
GRENADA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
MEXICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
PUERTO RICO-TR.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53	84	86	134	106	0	0	0	
RUSSIA FED.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	0	0	0	0	14	0	
ST.LUCIA	0	0	0	0	0	0	0	0	0	0	0	0	0	55	79	150	141	98	80	50	0	0	0	
ST.VINCENT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	
TRINIDAD & TOBAGO	228	175	143	141	179	203	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
UKRAINE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	94	90	0	0	0	0	0	0	0	
LTA E. alleteratus	**8344**	**17633**	**14673**	**19214**	**13847**	**15839**	**22214**	**20625**	**12895**	**8809**	**19741**	**25135**	**29855**	**28831**	**23125**	**21978**	**12150**	**12211**	**12424**	**13155**	**13146**	**14091**	**13459**	
ATLANTIC	*5845*	*15138*	*11803*	*16440*	*12401*	*13359*	*20653*	*18975*	*10855*	*6643*	*17317*	*22730*	*27820*	*26214*	*21324*	*20807*	*11379*	*11465*	*11074*	*11590*	*12147*	*11789*	*11353*	
ANGOLA	1326	826	646	1328	1171	1734	1632	1632	1433	1167	1345	1148	1225	285	306	14	175	121	117	235	75	406	118	
ARGENTINA	0	0	0	0	0	36	0	0	11	2	2	0	1	1	0	0	0	0	0	0	0	0	0	
BENIN	0	0	16	24	40	45	20	31	30	90	14	7	43	66	61	49	53	60	58	58	58	86	86	
BRASIL	0	0	0	0	45	10	0	765	785	479	187	108	74	685	779	935	985	1225	1059	834	507	920	10	
BULGARIA	1	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
CANADA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
CAP-VERT	0	0	0	128	236	258	34	16	160	29	14	1	18	65	74	148	17	23	72	63	86	110	751	

SMT-Table 1 (cont.). Estimated landings (reported and carried over, in MT) of small tuna species in 1977-1999, by region and flag.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	
COTE D'IVOIRE	431	38	57	177	0	0	0	0	0	20	5300	38	4900	2800	100	142	339	251	253	250	114	108	108	
CUBA	0	0	0	131	53	77	6	15	16	24	55	53	113	88	63	33	13	15	27	23	23	0	0	
EC-ESPAÑA	33	56	4	485	7	3	2	27	34	12	11	7	11	55	81	1	0	0	10	55	27	110	5	
EC-FRANCE	0	0	0	0	1098	1120	0	0	0	0	0	0	195	0	1512	1023	948	1116	1009	1033	924	1079	1061	
EC-GERMANY	0	0	0	0	0	0	0	0	0	0	0	0	0	38	0	0	0	0	0	0	0	0	0	
EC-ITALY	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
EC-MARINIQUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	610	
EC-PORTUGAL	0	0	5	121	8	0	0	0	0	80	21	86	91	2	61	73	45	72	72	218	320	171	14	
ESTONIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	66	0	0	0	0	0	0	0	0	
GABON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	182	0	18	0	
GERMANY D.R	0	0	0	0	0	397	543	99	40	10	2	0	2	0	0	0	0	0	0	0	0	0	0	
GHANA	1185	6049	5547	4134	3287	2141	5009	5966	901	649	5551	11588	12511	14795	11500	11608	359	994	513	113	2025	359	306	
ISRAEL	0	0	0	227	203	640	282	271	76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
LATVIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	65	0	0	0	0	0	0	0	0	
LITUANIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	
MAROC	15	21	289	16	19	26	19	15	447	47	108	49	14	367	57	370	44	43	230	588	195	189	67	
MAURITANIE	50	50	50	31	86	77	54	60	60	50	50	50	50	50	4	0	0	0	0	0	0	0	0	
NEI-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	7	21	53	0	0	6	0	
PANAMA	0	3	2	58	36	0	0	0	0	0	0	0	0	0	0	0	65	0	0	0	0	0	0	
POLAND	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	
RUMANIA	86	2	17	9	12	291	216	266	126	81	7	88	0	0	0	0	0	0	0	0	0	0	0	
RUSSIA FED.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	617	306	265	189	96	49	0	88	0	
SAO TOME & PRINCIPE	0	0	0	0	0	0	0	101	0	0	0	0	0	0	0	0	0	0	0	40	159	0	0	
SENEGAL	1540	1446	1697	2444	1586	5017	5623	8408	4566	2392	2985	6343	6512	4775	3767	4088	4883	4072	4072	3773	3773	3773	3773	
STA LUCIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	
ST.VINCENT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	
USA	53	113	12	88	97	87	107	41	73	104	118	204	129	173	228	597	1286	1142	1312	2229	2014	1546	1623	
USSR	690	6127	2184	6307	3615	1085	6528	613	1040	271	61	1707	543	667	0	0	0	0	0	0	0	0	0	
UK-BERMUDA	9	7	7	11	11	4	5	5	7	13	13	17	14	8	10	11	5	6	6	7	5	5	6	
VENEZUELA	426	390	1270	721	791	311	573	644	1050	1123	1467	1236	1374	1294	1963	1409	1889	2115	2115	1840	1840	2815	2815	*
MEDITERRANEAN	*2499*	*2495*	*2870*	*2774*	*1446*	*2480*	*1561*	*1650*	*2040*	*2166*	*2424*	*2405*	*2035*	*2617*	*1801*	*1171*	*771*	*746*	*1350*	*1565*	*999*	*2302*	*2106*	
CROATIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	2	15	15	0	0	0	0	**
CYPRUS	18	11	17	17	22	33	17	31	32	13	25	41	20	23	25	21	11	23	10	19	19	19	19	
EC-ESPAÑA	1059	1192	993	800	6	705	0	32	12	5	0	5	0	0	0	0	0	0	15	18	9	15	0	
ISRAEL	300	200	170	105	35	110	35	60	259	284	273	135	124	129	108	126	119	119	215	119	119	119	119	
LIBYA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	52	0	
MALTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	1	8	8	8	3	3	0	0	
MAROC	4	0	6	0	61	12	0	1	0	0	0	12	0	16	0	0	0	0	1	0	1	14	8	
NEI-2	0	0	0	0	0	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
SYRIA	105	109	89	80	73	90	80	96	95	73	121	99	121	127	110	156	161	156	155	270	270	270	270	
TUNISIE	1009	983	1595	1772	1249	1330	1228	1224	1441	1590	1803	1908	1566	2113	1343	664	242	204	696	824	333	1113	740	
TURKEY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	500	750	
YUGOSLAVIA	4	0	0	0	0	0	1	6	1	1	2	5	4	9	0	0	0	0	0	0	0	0	0	
YUGOSLAVIA REP. FED.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	28	21	35	22	0	0	0	
OTHERS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	90	0	0	0	
MAW - Sc. tritor	**2572**	**6716**	**4167**	**4921**	**3156**	**5312**	**4716**	**4498**	**3989**	**3292**	**1799**	**3915**	**2934**	**5610**	**4025**	**1437**	**1775**	**1270**	**1264**	**1316**	**1264**	**1162**	**1077**	
ANGOLA	20	81	24	70	68	138	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
BENIN	0	0	23	35	60	68	30	46	50	104	17	13	334	211	214	202	214	194	188	188	188	0	0	
ESTONIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	49	0	0	0	0	0	0	0	0	
GABON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	85	0	**

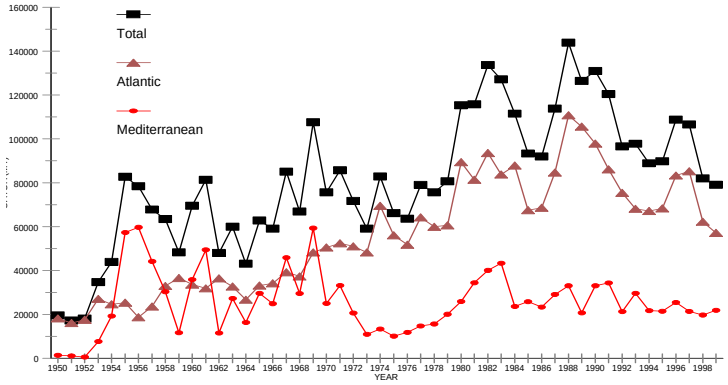
SMT-Table 1 (cont.). Estimated landings (reported and carried over, in MT) of small tuna species in 1977-1999, by region and flag.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
GERMANY D.R	0	0	0	0	0	851	537	33	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GHANA	720	771	1569	4412	1983	2982	2225	3022	3000	1453	0	1457	1457	1500	2778	899	466	0	0	0	0	0	0
LATVIA	0	0	0	0	0	0	0	0	0	0	0	0	0	208	34	0	0	0	0	0	0	0	0
LITUANIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	52	4	0	0	0	0	0	0	0
RUSSIA FED.	0	0	0	0	0	0	0	0	0	0	0	143	195	1032	242	0	19	0	0	44	0	0	0
SAO TOME & PRINCIPE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0
SENEGAL	1188	1054	1112	404	1045	671	754	1174	732	1516	1754	2159	753	1419	656	332	1076	1076	1076	1076	1076	1077	1077
USSR	644	4810	1439	0	0	602	1170	223	206	219	28	143	195	1240	0	0	0	0	0	0	0	0	0
SLT -	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**
UK-FALKLANDS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
SSM - Sc Maculatus	**12218**	**11528**	**10899**	**13945**	**11164**	**13633**	**9574**	**11362**	**11590**	**14117**	**14531**	**12712**	**13946**	**14500**	**15546**	**16346**	**16231**	**14777**	**13857**	**18292**	**19007**	**6785**	**6785**
COLOMBIA	283	228	199	213	408	8	10	77	101	81	72	151	112	76	37	95	58	69	69	0	0	0	0
CUBA	400	600	400	578	657	476	689	544	443	621	1606	803	746	665	538	611	310	409	548	613	613	0	0
DOMINICAN REP.	174	317	415	479	503	384	168	1058	1267	1271	1321	1415	1401	1290	728	735	739	1330	2042	2042	2042	2042	2042
GRENADA	10	2	0	1	1	1	1	1	4	17	0	0	1	3	0	0	1	2	2	0	0	0	0
MEXICO	4414	5138	5751	5908	5908	7799	5922	5777	5789	6170	6461	5246	7242	8194	8360	9181	10066	8300	7673	11050	11050	0	0
TRINIDAD & TOBAGO	1484	1933	1208	1337	939	1218	0	0	0	0	0	0	0	0	0	0	0	0	0	1567	1698	1698	1698
USA	5453	3310	2926	5429	2748	3747	2784	3905	3986	5957	5071	5097	4444	4272	5883	5724	5057	4667	3523	3020	3604	3045	3045
WAH - A. solandri	**393**	**452**	**760**	**610**	**2920**	**2280**	**2366**	**2159**	**920**	**1150**	**1235**	**1612**	**1507**	**1470**	**1687**	**1805**	**2570**	**2100**	**2359**	**2522**	**2744**	**2807**	**2367**
ANTIGUA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
ARUBA	100	115	115	115	115	115	115	115	115	120	90	80	80	70	60	50	50	125	40	50	50	50	50
BARBADOS	0	0	189	116	144	219	222	219	120	138	159	332	51	51	60	51	91	82	42	35	47	47	47
BENIN	0	0	1	1	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BRASIL	3	6	69	1	1	0	0	0	21	141	133	58	92	52	64	71	33	26	1	16	58	40	40
CAP-VERT	0	0	0	24	2307	1464	1588	1365	142	205	306	340	631	458	351	350	326	361	408	503	603	429	464
DOMINICA	0	0	0	0	0	0	0	0	0	0	0	0	0	38	43	59	59	59	58	58	58	58	50
DOMINICAN REP.	0	0	0	0	0	0	0	0	0	0	0	1	3	6	9	13	7	0	0	0	0	0	0
EC-ESPANA	0	0	0	0	0	0	0	0	4	9	9	32	18	23	28	32	22	20	15	25	25	29	28
EC-FRANCE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	147	0
GRENADA	0	35	31	25	23	41	94	50	51	82	54	137	57	54	77	104	96	46	49	56	54	54	82
NETHERLAND.ANT	178	215	215	215	215	215	215	215	245	250	260	280	280	280	250	260	270	250	230	230	230	230	230
SAO TOME & PRINCIPE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80	52	52	52
ST.LUCIA	0	0	0	0	0	0	0	0	0	0	0	0	0	77	79	150	141	98	80	221	223	223	310
ST.VINCENT	0	0	0	0	0	0	0	0	0	0	0	4	4	28	33	33	41	28	16	23	10	10	52
TRINIDAD & TOBAGO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	118	1	0	0	0	0	0	367	0
U.S.A	0	0	0	0	0	0	0	0	13	12	57	128	110	82	134	203	827	391	764	608	750	614	857
UK-BERMUDA	35	23	33	46	24	40	49	46	46	65	43	61	63	74	67	80	58	50	93	115	105	108	101
UK-S.HELENA	6	4	7	10	12	9	16	23	15	15	18	18	17	18	12	17	35	26	25	23	0	0	0
VENEZUELA	71	54	100	57	77	175	66	125	147	113	106	141	101	159	302	331	513	538	538	479	479	349	4

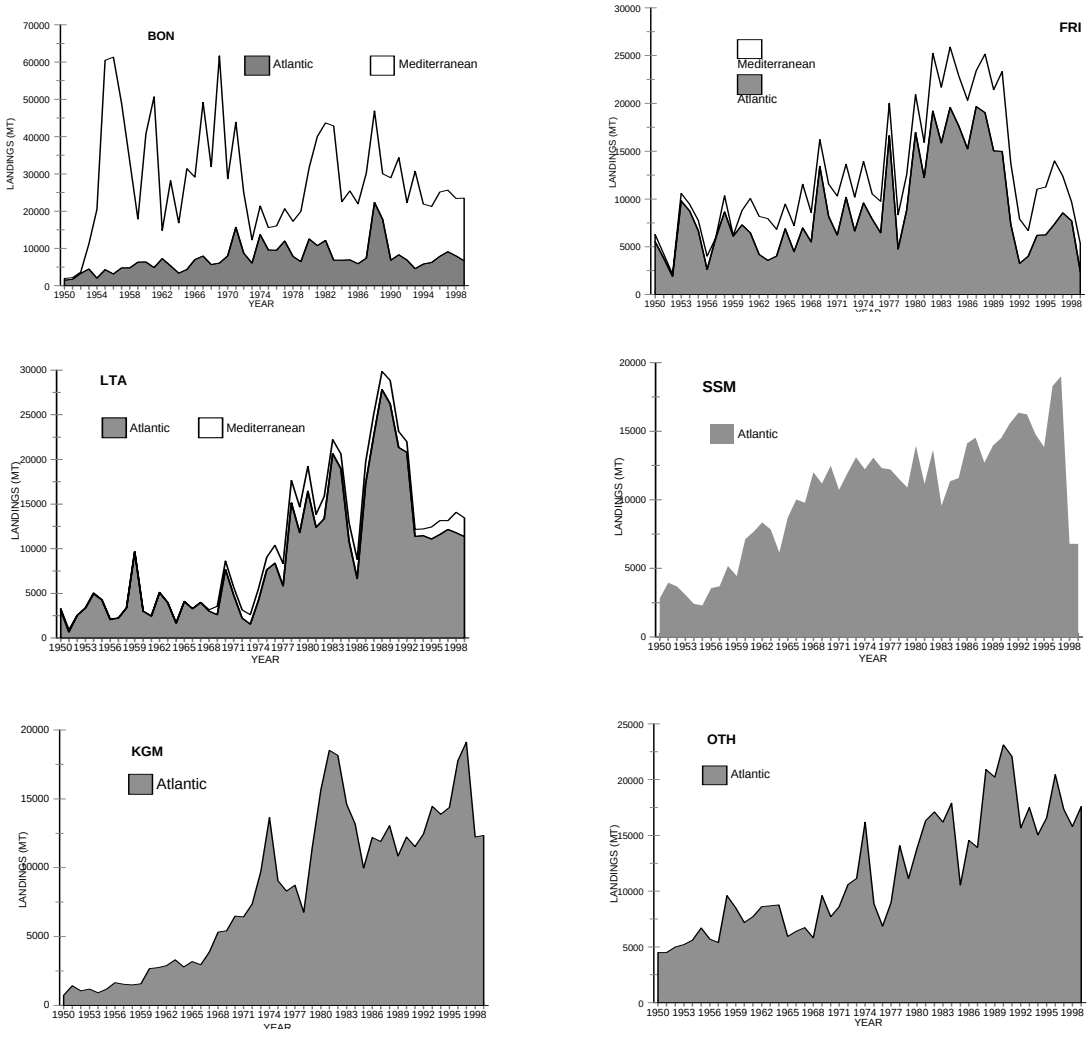
Shaded cells show estimated catches . In many cases, the Committee assumed the catch to be the same as the previous year.

* Data were received too late to be included in the table

** Catches are identified as or included with other small tuna species



SMT-Fig. 1. Estimated landings (MT) of small tunas, all species combined, in the Atlantic and Mediterranean, 1950-1999. (Data for recent years are incomplete.)



SMT-Fig. 2. Total landings (MT) of major species of small tunas in the Atlantic Ocean and Mediterranean Sea, 1950-1999. (Data for recent years are very incomplete.)

8 Report of the Assessment Methods Working Group

8.1 The Report of the Assessment Methods Working Group meeting held from May 8 to 11 in Madrid (see SCRS/00/20 and SCRS/00/21) was presented.

8.2 The Committee supported the continuation of the Working Group in the future, as it could provide valuable support to the work carried out by the species groups. It was noted that the terms of reference should be defined carefully so that the focus would not evolve towards any single species or stock.

8.3 The Committee also felt that the Working Group should play a critical role in advising on more realistic assessment models that would better capture and reduce uncertainty (e.g., by better accounting for knowledge about fisheries, biology or the environment). However, it was also noted that it was the ultimate responsibility of the species groups to integrate all of the available knowledge for any one stock in the process of formulating advice to the Commission.

8.4 The Committee recommended that the Working Group meet again next year to investigate approaches for extending the assessment time series for ICCAT stocks back in time. As this task involves fishery and biological data issues as well as methodological ones, the Committee expressed hope that the meeting would be attended by a variety of experts. It was also pointed out that the Secretariat would need to do work before hand to describe data availability for different stocks.

8.5 The Committee also recommended that the Catalogue for assessment methods be implemented following the guidelines suggested by the Working Group. Recognizing that this involves a heavy workload, it was recommended that the Secretariat and a steering committee coordinate the activities from prioritization of catalogue entries, to validation tests. The addition of new methodology to the catalogue is the responsibility of the scientists.

9 Report of the Precautionary Approach *ad hoc* Working Group and its future plan

9.1 The activities of the *ad hoc* Working Group during the last two years were presented (see **Appendix 5**).

9.2 The Committee noted that one of the difficulties in terms of the precautionary approach was to find a proper balance between the research and time investment required to estimate uncertainty appropriately, and the need to provide managers with practical solutions. This has obvious implications in terms of finding improved ways for feedback between scientists and managers.

9.3 The Committee considered that the future direction for this ad hoc Working Group should be discussed at the next meeting of the Commission.

10 Review of the ICCAT Bluefin Year Program (BYP): Activities, progress & future plans

10.1 The BYP Program Coordinator presented the report to the Committee, including the progress made through 1999 and 2000 and the research plan for 2001. It is expected that the positive balance of BYP funds at the end of 2000 will be US$19,800. He commented that the expenditures for the past few years have been less than expected since the major costs for the sampling of bluefin samples has been covered by national budgets and by the FAO COPEMED project.

10.2 The BYP recommended Commission funding of $37,000 to cover expenses associated with stock structure and maturity sampling for bluefin in 2001, which the Committee considered has the highest priority. The actual costs of conducting this research are substantially higher but significant contributions in kind are made to the BYP from national research programs (see Item 19 for more details).

10.3 The report was reviewed and adopted, and is attached as **Appendix 6**.

11 Review of the ICCAT Bigeye Year Program (BETYP) - activities, progress & future plans

11.1 The Report on the BETYP activities from October 1999 to September 2000 (COM-SCRS/00/16) was presented, with special emphasis on the importance of increasing conventional tagging activities in the Gulf of Guinea.

11.2 The Committee complimented the Coordinator for the development of the initial activities of the program and for the co-ordination between the scientists and the participating countries.

11.3 The Committee felt the need for more frequent monitoring and coordination by the BETYP Coordinating Committee in the activities of the Program.

11.4 The Committee encouraged the assistance of scientists from Côte D'Ivoire in the tagging and sampling activities in the Gulf of Guinea.

11.5 The Committee recommended continuing conventional tagging operations from the Canary Islands.

11.6 The delegation of Japan commented on the activities of the RV/*Shoyo-maru* in relation with the BETYP.

11.7 The Committee recommended strong continuing financial support to the BETYP.

11.8 The Committee also recommended requesting the Contributors to the Program to allow the use of funds not spent in 2000 to enhance the intensive tagging program in the Gulf of Guinea in 2001.

12 Review of the ICCAT Program of Enhanced Research for Billfish: Activities, progress & future plans

12.1 A report on the progress made in the ICCAT Program of Enhanced Research for Billfish and the Program Plan for 2001 was presented by the West Atlantic Coordinator, Dr. E. Prince. This report is the product of the combined efforts of the Coordinator and the scientists involved. The report includes financial balance sheet as of the time of the SCRS meeting, reflecting 2000 activities (**Appendix 8**, Tables 1 and 2) and the Proposed Budget for 2001 activities (**Appendix 8**, Table 3).

12.2 The detailed research plan for 2001 is included in the report. The Committee noted that the Billfish Program continued producing very positive results and valuable information on billfish research, and endorsed the proposal of the 2001 budget and recommended that the Commission again provide the same level of research funding in 2001 as it did in 2000. In addition, voluntary contributions (including those from The Billfish Foundation and Chinese Taipei) will also be necessary to carry out the Program Plan in 2001.

12.3 Some clarification was made about the tagging program. The possibility of carrying out a pop-up tagging project is dependent on the success of fund raising. The pilot study of pop-up tags in the past was encouraging and the Coordinator requested all the scientists to solicit possible outside funding.

12.4 The Committee noted that there may be a change involving the East Atlantic Coordinator at the end of the year, as T. Diouf (Senegal) may not be able to continue as Co-Coordinator. If this change does occur, Mr. N. N'Goran of Côte d'Ivoire will replace Mr. Diouf as Co-Coordinator for the East Atlantic. The Committee expressed its full appreciation for Mr. Diouf, who has served for many years as Co-Coordinator of the Billfish Program and has contributed considerably to billfish research.

12.5 The Committee approved the report, which is attached as **Appendix 8**.

13 Report of Sub-Committee on Environment and future plans

The Sub-Committee on Environment met during the SCRS. The report was presented to the SCRS by the Convener, Dr. J. M. Fromentin. The Sub-Committee proposed that a workshop be held in 2001 and a larger-scale

Symposium in 2002. The recommendation is also shown in Agenda Item 19. The report was adopted by the Committee and attached as **Appendix 9**.

14 Report of the Sub-Committee on Statistics, review of Atlantic tuna statistics and data management system, and future plans

14.1 An informal meeting of the Sub-Committee on Statistics was held during the week preceding the SCRS Plenary. The regular meeting of the Sub-Committee on Statistics was held during the 2000 SCRS. The detailed report of the Sub-Committee on Statistics is published in the Collective Volume of Scientific Papers (Vol LII).

14.2 The informal meeting reviewed developments related to the new ICCAT relational data base (RDB), Internet access, bibliography and improvement of the ICCAT web-page. The report of the meeting is attached to the detailed report of Sub-Committee on Statistics.

14.3 Concerning data collection, the Sub-Committee discussed the deadline for data submissions, revisions of historical data series, estimation of misreported or unreported catches, shark statistics, observer data, and quality control and reduction of uncertainties associated with data. The Sub-Committee noted that the Task I data, that are supposed to be the scientists' best estimates, are now considered as being official statistics and, as regulations have come into effect, have become less and less reliable. It was agreed that some solution must be found for this problem in order for the assessments to be carried out based on more reliable scientific estimates. The Secretariat was asked to draft a discussion document before the next Sub-Committee in order to further address this issue. The procedures through which the uncertainties associated with data can be evaluated and/or reduced was also discussed.

14.4 The Sub-Committee expressed satisfaction that the Secretariat had put into effect many of the recommendations which it had made in 1999, especially as regards the progress towards the creation of the relational data base, including the recruitment of a biostatitician, the establishment of a LAN and the design and development of the new RDB, improvement in the ICCAT Web-Page, and improvement in data quality control consideration. The Sub-Committee established an *Ad Hoc* Advisory Committee on the Design and Implementation of the Relational Data Base System. This Advisory Committee held its first meeting and the report is attached to the detailed Report of the Sub-Committee on Statistics as Appendix 3. This *Ad Hoc* Advisory Committee will meet again once important progress has been made and the point at which decision taking is necessary has been reached.

14.5 The Sub-Committee reviewed the new digitalized scientific publications, the data base available on the Web-Page and collaboration with other Regional Fisheries Management Organizations related to statistical issues. It also reviewed the proposed project of FIRMS (Fish Resources Monitoring System) which is being carried out under the FAO FIGIS project.

14.6 The major recommendations made by the Sub-Committee are included under Agenda Item 19.

Note by the Secretariat: Summaries of two activities were prepared by the Secretariat and made available to the Committee. These were a plan for ICCAT to become a partner in the Aquatic Sciences and Fisheries Abstracts (ASFA) , attached as **Appendix 10**, and a strategy for implementing the new RDB, attached as **Appendix 11**.

15 Report of the Sub-Committee on By-catches and future plans

The report of the Sub-Committee on By-catches was presented by the Convener, Dr. H. Nakano. It was recommended that ICCAT take the lead in conducting stock assessments for Atlantic blue, porbeagle and mako sharks and that the initial stock assessment evaluations should be scheduled for the year 2002. The recommendations of this Sub-Committee are included under Item 19. It was agreed that the Report of the Sub-Committee on By-catches would be published in the *Collective Volume of Scientific Papers*.

16 Scientific meetings where ICCAT was represented

16.1 After some discussion as to whether this item only included meetings to which ICCAT was officially invited and had been represented to participate, or all relevant scientific meetings in which ICCAT scientists had

participated, it was agreed that the criteria should be flexible since the objective was to learn about the activities of various organizations related to the tuna research. When ICCAT receives invitations to scientific meetings, the relevant scientists should be informed of such meetings. ICCAT participation in the following meetings was reported to the 2000 SCRS:

Working Party on Monitoring Status and Trend of Fish Resources *(FAO Headquarters, Rome - November 30 to December 3, 1999).* Dr. Peter Miyake attended this meeting as an invited expert (SCRS/00/174). This was presented and discussed in the Sub-Committee on Statistics.

Indian Ocean Tuna Commission (IOTC) Scientific Committee (SC) and Commission Meeting *(Kyoto, Japan - December 7 to 10 and December 13 to 16, 1999).* Dr. Peter Miyake participated in the meetings as an invited observer from ICCAT. His report is presented as COM-SCRS/00/14. As the fisheries are similar, common fleets are fishing in two oceans, and statistical collection systems are also similar, there is mutual interest in the exchange of information, both at the Scientific Committee (statistics and assessments) and at the Commission level (management measures).

CWP Inter-sessional Atlantic Agency Meeting *(ICES headquarters, Copenhagen -February 10 and 11, 2000).* Dr. Peter Miyake attended in representation of ICCAT (see SCRS/00/26). The meeting report was fully reviewed by the Sub-Committee on Statistics.

CWP Inter-Sessional Meeting on Precautionary Approach Terminology *(ICES headquarters, Copenhagen - February 14 to 16, 2000).* Dr. Victor Restrepo attended, in representation of the ICCAT Secretariat His report is presented as SCRS/00/27 and was discussed under the Agenda Item 8.

International Pelagic Shark Workshop *(Monterey, California - February 14 to 17, 2000).* Many ICCAT scientists participated in this Workshop. According to the recommendation by the Sub-Committee on By-catch, and at the invitation of the organizer, Dr. Peter Miyake from the Secretariat also participated representing ICCAT and presented a report summarizing ICCAT activities related to sharks (see SCRS/00/88). His report on the meeting is given in SCRS/00/173. Both documents were reviewed by the Sub-Committee on By-catches

Workshop on the Seabird Incidental Catch in the Waters of Arctic Countries *(Halifax, Canada - April 26 to 28, 2000).* Halifax, Canada (see SCRS/00/118). Dr. Julie Porter represented ICCAT at the Workshop. This was the first formal opportunity for different stakeholders to gather and discuss the incidental catch of seabird issue since FAO's approval of the IPOA-Seabirds. Specific recommendations appear in document SCRS/00118. Further discussion can be found in the Report of the Sub-Committee on By-Catch.

Workshop on the Biology of Bluefin Tuna in the Mid-Atlantic *(Hamilton, Bermuda - May 5 to 7, 2000)* (see SCRS/00/125). Upon the invitation, several ICCAT scientists participated. The Delegate of the United Kingdom (Overseas Territories) advised the Committee of the workshop that was co-sponsored by the Bermuda Ministry of the Environment in conjunction with the East Coast Tuna Association of the United States fishing industry. The outcome of the workshop was a proposal for a research initiative for sampling of larvae and spawning-sized bluefin tuna in the central Atlantic. SCRS scientists were invited to collaborate in this project.

Expert Consultation on Implications of the Precautionary Approach for Tuna Biological and Technical Research *(Phuket, Thailand - March 6 to 15, 2000).* The meeting was organized by FAO and several ICCAT scientists participated. Drs. Peter Miyake and Victor Restrepo attended from the Secretariat (see COM-SCRS/00/12).

Meeting of the IATTC Working Group on Incidental Catches *(La Jolla, California - April 4 to 6, 2000).* ICCAT was represented by Mr. Javier Ariz, who had been invited to this meeting. His report (SCRS/00/153) was presented and reviewed by the Sub-Committee on By-Catch.

First Meeting of the Scientific Working Group of the Inter-American Tropical Tuna Commission (IATTC) *(La Jolla, California - April 10 to 13, 2000).* The meeting was attended by Dr. Victor Restrepo who was invited and represented ICCAT. His report on the meeting is presented as SCRS/00/28. It was reviewed by the Tropical Tuna Species Group.

Meetings of **General Fisheries Commission for the Mediterranean Sea (GFCM)**. ICCAT was represented by Dr. Peter Miyake at various GFCM meetings. The reports of these meetings are presented in COM-SCRS/00/13. Further details can be found under Agenda Item 20.

Technical Consultation on the Suitability of the Cites Criteria for Listing Commercially-exploited Aquatic Species *(FAO Headquarters, Rome - June 28-30, 2000)*. Dr. Peter Miyake was invited and represented ICCAT (see COM/00/22). This subject was fully discussed by the Sub-Committee on By-catch.

Expert Consultation on IPOA to Combat IUU Fishing *(Sydney, Australia - May 15 to 19, 2000)* and Technical Consultation on Illegal, Unreported and Unregulated Fishing (FAO Headquarters, Rome - October 2 to 6, 2000). Dr. Peter Miyake participated in the first meeting as an invited expert and in the second meeting in representation of ICCAT in an observer capacity. His report on both meetings is presented in SCRS/00/30 (COM/00/22).

17 Review of ICCAT scientific publications

The item was dealt with by Sub-Committee on Statistics and included in its report. The Committee noted that *Statistical Bulletin* is now distributed with a diskette containing the data base (with software to extract the data), and that the *Collective Volume of Scientific Papers* is also now published on CD-ROM. The Committee noted that this CD-ROM publication is beneficial to the scientists, and commended the Secretariat staff for their efforts.

18 Consideration of other SCRS activities

Organization of the SCRS, including quality assurance activities

18.1 In the past, the *Ad Hoc* Committee on SCRS Organization made several important recommendations towards improving the SCRS meetings. In 2000, the Committee did not meet, as many of their recommendations had already been implemented (e.g. Working Group on Assessment Methods) and been further developed.

18.2 Document SCRS/00/40 presented a proposal for a quality control procedure for ICCAT. This could require funding by the Commission, but the Biennial budget for 2000 and 2001 did not include this funding, and could not, therefore, be carried out in 2000 or 2001. The SCRS decided to keep this item as a priority on the Agenda for consideration at its 2001 meeting.

18.3 The Committee commended the development of the "Glossary of Fishery Terms", which is now available in three languages. It was noted that the Glossary is on the web page and is occasionally updated. Dr. Restrepo requested the scientists to comment, particularly about new entries, so that necessary improvements could be made before each update.

18.4 SCRS/00/40 also includes items for inclusion in the new ICCAT Manual, which is under consideration. The present Field Manual could be expanded, with the collaboration of scientists, to include some guidance for usage of assessment related software and other topics. This proposal was supported. Inclusion of some guidance for diagnosis for available options would make the choice and application of software easier.

18.5 The Committee noted that during the yellowfin, bluefin and albacore assessment sessions, appointing one scientist to be responsible for the preparation of input used in the assessments and in the table and figures, as well as the collection of data files resulted very well. It helped the group obtain results based on the same data string and good graphics and tables, as well as helping the Secretariat to finalized the report. It was recommended that this procedure should be practiced in all the Working Group and assessment meetings.

18.6 The informal meeting of the sub-Committee on statistics proposed that the priority of translations by the Secretariat be given to detailed reports from the inter-sessional meetings associated with stock assessments. Nevertheless, clear criteria should be developed to set priorities in translations of the various intersessional meeting reports. It also recommended that the drafts of such reports be disseminated as early as possible. It proposed that drafts be placed on FTP-like site in the ICCAT web, which would be available only to those to whom the address

was known. The address should be made available to all meeting participants, chief scientists and SCRS Officers. The Committee endorsed this proposal and recommended that this system be applied to this SCRS Report, as far as feasible.

Inter-sessional scientific meetings proposed for 2001

18.7 The Sub-Committee on Environment will hold a Workshop focusing on the relationship between the environment and recruitment and/or stock assessments (SCRS/00/165) in early 2001. (A larger scale Symposium is planned for 2002).Prior to the workshop, the terms of reference should be developed and distributed to the relevant scientists. There is some possibility of funding being provided to invite selected scientists from the budgets of ICCAT Programs (e.g. BETYP or BYP), as this subject is of considerable interest to the scientists in such research.

18.8 The bluefin species group proposed to hold an intersessional meeting to integrate all the available information on biology of bluefin.

18.9 The Methodology Working Group proposed to hold another meeting in 2001 to continue its research.

18.10 The *Ad Hoc* Advisory Committee on the Design and Implementation of the Relational Data Base System is planning to meet in 2001.

18.11 The Sub-Committee on By-catch proposed to hold a data preparatory meeting for pelagic sharks during the latter half of the inter-sessional period, in anticipation of holding first stock assessment session for those species in 2002.

18.12 The Committee approved these meetings but decided that the venues and exact dates would be decided by the Chairman of each meeting, in consultation with the SCRS Chairman and the Executive Secretary.

19 Responses to the Commission and general recommendations

19.1 Impact of the moratorium on tropical tuna stocks

Following the recommendations of the Committee on the need to reduce fishing mortality of bigeye tuna, especially that of juvenile bigeye, the Community frozen tuna producers' associations, ORTHONGEL, OPAGAC and OPTUC-ANABAC, established an "Agreement of Community Frozen Tuna Producers for the Protection of Atlantic Ocean Tuna" in April 1997. This agreement implied a voluntary auto-regulation of fishing with floating objects through the prohibition of anchoring and fishing with floating objects in a wide area of the Atlantic Ocean, between the African coast and 20° West longitude and between latitudes 5° North and 4° South, during the months of November and December 1997 and January 1998. Later, this agreement was extended to the same months in 1998 and 1999.

In 1998, the Commission adopted a recommendation in the same terms as this agreement, for the period 1 November 1999 and 31 January 2000, binding on all purse seiners flying Contracting Party and Cooperating Party/Entity/Fishing Entity flags.

In 1999, the Commission extended the recommendation to all surface fleets and requested the Committee to analyze the impact of the moratorium on the stocks and recommend any changes considered necessary to increase its effectiveness, in order to evaluate possible modifications to be applied to the moratorium. The Committee carried out the required analyses in order to respond to the Commission's request. This Executive Summary outlines the work done by the Committee.

Framework

The effects of the moratorium were estimated by considering the three purse seine moratoria together: November-December 1997-January 1998; November-December 1998-January 1999 and November-December 1999-January 2000.

The analyses were carried out by gear, fleet and species, with more detailed analysis being concentrated on the purse seine fleets. The fleets considered were:

Purse seine. The following three categories were considered:

- European fleet (French and Spanish), from which detailed information is available both from the fishery and from observers. This fleet was taken as a reference as it was considered that it would reflect the maximum effect of the moratorium, as it has complied with three periods and has, furthermore, reduced its effort.

- The NEI fleet associated with Community interests. In most cases information is available at a level similar to that of Community fleets.

- Ghanian fleet. General information is available from the fishery, but very partial information from observers.

Baitboat. Three categories were considered by area:

- The Ghanian fleet, which fishes in the equatorial area with floating objects, on the same component of the stocks of yellowfin and bigeye as purse seiners.

- Fleet based in Dakar (French, Spanish and NEI), which fishes in the area near Senegal

- Azores/Madeira/Canary Island fleet, fishing north of 25° N

Longline. This was analyzed as one fleet as the effects of the moratorium will have the same overall effects on all longliners.

Other fleets. These include other surface gears (hand line...), and fleets of a lesser importance (Venezuelan purse seine and baitboat, South Africa baitboat etc) in terms of catch levels and/or their distance from the moratorium area.

The years 1993 to 1999 were chosen as a reference period, as it was considered that the floating object fishery was fully developed by 1993 and 1999 was the most recent year for which information is available. To evaluate the effects, this was separated into a pre-moratorium (1993-1996) period and the moratorium period (1998-1999). 1997 was excluded from the analyses as it only contained 2/3 of a moratorium period.

For the description of fishery data, all boats associated with Community country interests were considered as NEI. However, the analyses was carried out using the size distribution of the catches which appear in the ICCAT data base as NEI, in which catches of Contracting Party flag vessels are included. For this reason, the totals do not always coincide. These differences should not affect the general results of the analysis as the vessels have similar characteristics and strategies, leading to a similar distribution of size frequencies. Another possible difference between the conclusions of one or other section is the source of the data. In the section on statistics all the data used are from fishing logbooks, while the analyses were carried out using size frequencies based on sampling and, in many cases, substitutions.

Descriptive statistics

Purse seine

European fleet and NEI associated: The total catches of this fleet have been reduced by 34% (72,131 MT) during the years of the moratorium (1997-1999) with respect to the previous period (1993-1996) **(Table MOR-1)** due to a sharp decline (25%) in the catches from floating objects which have decreased from 53% to 40% of the total catch **(Figure MOR-1a)**. By species **(Figures MOR-1b-d)**, the major decreases have been noted in the catches of skipjack and bigeye, species which are mainly caught using objects.

From a time/area consideration, the decrease in the catches from objects occurs entirely during the months of the moratorium, within the area of the moratorium (**Figure MOR-2**). Comparing the time-area distribution of the catches during the two periods (**Figure MOR-3**), one can see that the drastic reduction in catches from objects in the closed area is not offset by similar increases in catches of free schools and/or objects outside the moratorium area. Similarly, no expansion of the fishing grounds as a result of the moratorium has been noted.

The most important changes in regard to the species composition was the increase in the proportion of yellowfin in the catches, which increased from 38% to 43%, while the proportion of bigeye decreased from 13% to 9%.

Figure MOR-4 shows the evolution in the number of vessels and nominal effort in days fishing. A continuous reduction in the fleet is observed during the period. Nevertheless, the evolution of effort in fishing days shows an additional decrease during the moratoria years.

Bearing in mind that the fleet has continued to reduce during the moratoria years, the decreases observed in the catches cannot be exclusively attributed to the effects of the moratoria. Comparing expected catches (based on the monthly catch trend of the previous period), in the event that there were no moratorium, with the catches obtained with the implementation of the moratorium, a decrease of about 12% in the total catch (15-20,000 MT per year), especially in fish less than 10kg, has been estimated as being attributable to the moratoria.

Ghanian fleet: **Figure MOR-5** shows cumulative monthly catches of yellowfin, skipjack and bigeye taken by the Ghanian purse seine fleet from 1996-1999. A continuous increase can be observed for the three species during the period, as this fleet began operations in 1996 and has been expanding during the moratoria years, from two boats in 1996 to eight in 1999 (**Figure MOR-4**). During the year, the greater catches are made during the second semester.

Baitboat

Ghanaian fleet: **Figure MOR-5b** shows accumulated monthly catches of yellowfin, skipjack and bigeye by the Ghanian baitboat fleet for 1996-1999. An increase in the catches of the three species is observed during the moratoria years due, in part, to the association of this fleet with the purse seine fleet (the baitboats help in the search and in the transport of the catch) and possibly also due to the effects of the moratoria. The increase in CPUE (**Figure MOR-6**) of this fleet during the moratoria years can be similarly explained. As in the case of purse seine, the major catches are made in the second half of the year.

Taken together, the Ghanian purse seine and baitboat catches, which are made up of the same range of sizes and taken in the same area as the European and associated fleet, have increased by 30,000 MT during the moratoria years.

Dakar-based fleet: **Figure MOR-6** shows the catch rate for the European and associated NEI fleet based in Dakar. The stable values of these rates indicate that the moratoria do not seem to have an effect on this fleet.

Longline

Fleets of Japan, Chinese Taipei: **Figure MOR-7** shows the evolution of catch rates for the Japanese and Chinese Taipei fleets. Both figures show an increase in catch rates for 1999. It would not be advisable to establish a relationship between longline catch rates and the moratoria until a longer data series is available.

Other fleets

There was no information relevant to other gears or fleets.

Analyses

Fishing mortality and selectivities

To estimate selectivities the group decided to use forward cohort analysis because the imprecision in the estimates of fishing mortality in recent years, obtained by tuned VPA, did not allow the detection of changes which may have occurred. This method assumes constant recruitment. The recruitment values used were based on the estimates of previous assessments. Forward cohort analyses suggest that there have been substantial changes in the selectivity and fishing mortality trends between the pre-moratorium period (1993-1996) and the years in which a full three months of moratorium took place (1998-1999). Fishing mortality estimates from the eight fisheries for the two periods are shown in **Figure MOR-8**.

Fishing mortality levels for small bigeye tuna (ages 0 to 3) (**Figure MOR-8a**) attributable to the European purse seine fleet were lower during the moratorium than during the pre-moratorium period. Some of this reduction was due to the moratorium and some was due to changes in the fishing effort of this fleet. However the contribution of these two sources to the reductions cannot be quantified. When the fishing mortality's for all fleets were combined, this reduction was more than offset by increased mortality levels for small fish (ages 0 and 1) in the Ghanaian and NEI purse seine fisheries as well as the Ghanaian and northern baitboat fleets. Overall, fishing mortality increased somewhat for ages 1, 4 and 7+.

Overall fishing mortality of yellowfin tuna increased for small (age one) and decreased for large fish (ages 3 and 4) during the moratorium years. Increased mortality of small yellowfin is largely attributable to increased total landings by the Ghanaian purse seine and northern bait boat fleets. Reduction in fishing mortalities for large yellowfin were seen in the European purse seine and other surface fisheries. Fishing mortality on small yellowfin caused by the European purse seine fleet seems to have continued to increase.

Yield per recruit and spawning biomass per recruit

In order to estimate the effect of the moratorium, the estimated fishing mortality patterns from these cohort analyses were used to calculate yield per recruit and spawning biomass per recruit.

Bigeye

According to the forward cohort analysis, survival to three years of age decreased during the moratorium years. This survival would have increased if, during the moratorium years, all purse seine fleets had reduced effort by the same proportional reduction observed in the EU purse seine fleet.

Yield per recruit did not change during the moratorium years. If fishing mortality had decreased for all purse seine fleets rather than just for the European fleet, yield per recruit would have increased by less than 5%.

Spawning biomass per recruit decreased during the moratorium years, but would have decreased further if the moratorium had not been implemented. Spawning biomass per recruit would have decreased less if fishing mortality had decreased for all purse seine fleets rather than just for the European fleet.

Yellowfin

In order to better understand the results obtained for yellowfin, it should be borne in mind that the moratoria were not aimed at reducing fishing mortality of juvenile yellowfin, as recruitment of this species mainly occurs outside the period of the moratoria.

Survival to three years of age decreased during the moratorium years, and there was also a decline in yield and spawning biomass. These facts do not appear to be directly related to the moratoria.

Summary of the results

The results of the analyses of the statistics show that the behavior of the fleets during the years in which the moratorium was established (1997-1999) has been different. Some fleets have maintained a continual decrease in nominal effort since the beginning of the 1990s, with larger decreases in the years in which the moratorium was implemented, while other fleets have drastically increased effort during the moratorium years. The increases in effort have resulted in increased fishing mortality, in the case of bigeye, on the youngest ages (surface fleets) and as well as the adult stock (longline fleets).

The analyses conducted assume that recruitment has been constant since 1985, something that according to the last assessments for bigeye and yellowfin is not strictly true. Because of this assumption, any changes in recruitment will be interpreted as changes in fishing mortality. There is, however, a strong suggestion from the above analyses and from the most recent assessments that substantial changes in fishing mortality for both yellowfin and bigeye have occurred during the period of the moratorium years. Some of these changes may be the direct or indirect result of the moratoria, some other changes however, may be unrelated to the moratoria. The Committee has been unable to quantify the source of these changes.

Conclusions

For bigeye, the species which the moratorium was intended to benefit most, the effect of the overall increase in effort has been larger than the effect of the moratorium and has resulted in an increase in juvenile selectivity and a decrease in yield per recruit, and in spawning biomass per recruit. Even in the hypothetical case wherein all the purse seine fleets implemented the moratorium and reduced fishing mortality in the same proportion as the European purse seine fleets (which implemented the moratorium in all three years), the moratoria would not have improved the situation of the stock. In this hypothetical case, the relative fishing mortality levels for the youngest ages would be maintained, the spawning biomass per recruit would be reduced, and would only produce small increases in yield per recruit. Nevertheless, if the moratorium had not been implemented, the situation of the stock would have been worse.

The moratorium was not designed to affect yellowfin either positively or negatively because yellowfin recruitment mainly occurs outside the period of the moratorium. However, during the moratorium years, fishing mortality on small yellowfin increased beyond what would have been expected by changes in fishing effort. It is possible, however, that this increase in fishing mortality resulting from an increase in catchers of ages 0 and 1, is not real and reflects increases in recruitment of yellowfin. Yield and spawning biomass per recruit indicators are worse during the recent moratorium years.

During the years of the moratoria, catches in weight of skipjack associated with floating objects made by the European fleet and the European components of the NEI fleets decreased by 53%. During those years the skipjack catches made by such fleets were mainly obtained from free schools. Such decrease in the catch of skipjack associated with floating objects may have lessened the possibility of local depletion that had been suggested in the last assessment.

MOR-Table 1a. Yearly catches of the European (French and Spanish) and NEI purse-seine fleet from 1993 to 1999 and changes in these catches prior to and during the moratorium years. In brackets are indicated for the three main species the proportion of each in the total catch (from logbook data after species composition correction).

Year	*Yellowfin*	*Bigeye*	*Skipjack*	*Others*	*Total*
1993	79916	28112	114202	2642	224871
1994	81444	30187	101032	3314	215977
1995	81554	24513	100219	2711	208998
1996	77331	23776	81950	3800	186857
1997*	62613	15367	62699	2817	143496
1998	65957	11081	59583	3200	139820
1999	48576	11960	64901	2381	127818
Average					
1993-1996	80061 [38%]	26647 [13%]	99351 [47.5%]	3117	209176
1997-1999	59049 [43%]	12803 [9.5%]	62394 [45.5%]	2799	137045
Variation**	-21012	-13844	- 36957	-318	-72131
	- 26%	**- 52%**	**- 37%**	**- 10%**	**- 34%**

MOR-Table 1b. Catches realized during the months of the moratorium (November, December and January) by the European (French and Spanish) and NEI purse-seine fleet from 1993 to 1999 and changes in these catches prior to and during the moratorium years. In brackets are indicated for the three main species the proportion of each in the total catch (from logbook data after species composition correction).

Year	*Yellowfin*	*Bigeye*	*Skipjack*	*Others*	*Total*
1993	14265	9123	31976	357	55721
1994	18868	9177	28203	1021	57269
1995	20804	8703	33561	853	63920
1996	18046	7908	31559	1412	58925
1997*	4440	2875	8509	246	16070
1998	8720	2163	9894	910	21687
1999	10378	2416	6260	426	19481
Average					
1993-1996	17996 [30.5%]	8728 [15%]	31325 [53%]	911	58959
1997-1999	7846 [41%]	2485 [13%]	8221 [43%]	527	19079
Variation**	-10150	-6243	-2310	-384	-39880
	- 56%	**- 72%**	**- 74%**	**- 42%**	**- 68%**

* For the year 1997, the moratorium concerns only November and December.

** Between average 1997-1999 and average 1993-1996 data.

MOR-Table 2a. Yearly catches of the purse-seine fleet of Ghana from 1993 to 1999 and changes of these catches prior and during the moratorium years.

Year	*Yellowfin*	*Bigeye*	*Skipjack*	*Total*
1996*	3295	135	5147	8577
1997**	7627	109	6922	14658
1998	7294	2130	12538	21962
1999	12285	2411	21525	36221
Average 1997-1999	9069	1550	13662	24280
Variation***	5774	1415	8515	15703
	+175%	**+1048%**	**+165%**	**+183%**

MOR-Table 2b. Catches realized during the month of the moratorium (November, December and January) by the purse-seine fleet of Ghana from 1993 to 1999 and changes of these catches prior and during the moratorium years.

Year	*Yellowfin*	*Bigeye*	*Skipjack*	*Total*
1996	814	60	1264	8577
1997*	2167	41	1141	14658
1998	2068	538	3320	21962
1999	4056	623	4915	36221
Average 1997-1999	2764	401	3125	6290
Variation***	1950	341	1861	4152
	+240%	**+568%**	**+147%**	**+194%**

* The fishery started in 1996.
** For the year 1997, the moratorium concerns only november and december.
***Between average 1997-1999 and 1996 data.

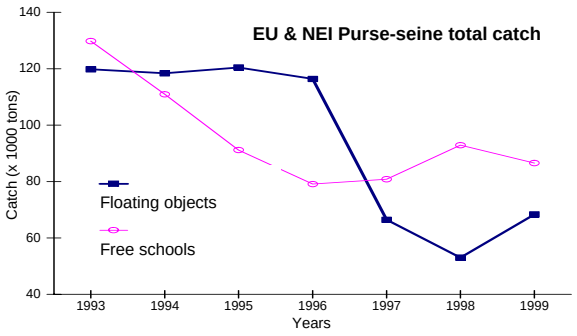
MOR-Table 3a. Yearly catches of baitboat and longline fleets from 1993 to 1999 and changes of these catches prior and during the moratorium years,

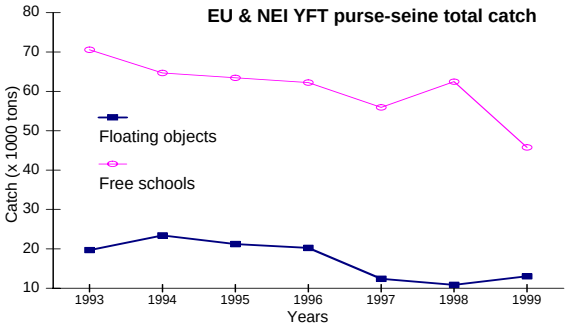
Year	*BB Ghana*	*BB Dakar*	*BB Europe*	*LL* (en nombre)
1993	36856	8945	19118	1238001
1994	36973	10296	25697	1510741
1995	33905	8937	27551	1341653
1996	33266	8511	25974	1558990
1997*	38338	10942	21600	1230493
1998	43497	14747	20115	1066045
1999	47196	17078	15608	NA
Average				
1993-1996	35250	9172	24585	1148269
1997-1999	43010	14256	19108	76374
Variation**	7760	5083	-5477	-264077
	+ 22%	**+ 55%**	**- 22%**	**- 19%**

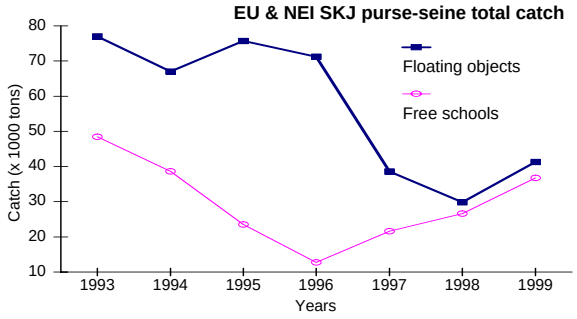
MOR-Table 3b. Catches realized during the month of the moratorium (November, December and J5anuary) by baitboat and longline fleets from 1993 to 1999 and changes of these catches prior and during the moratorium years.

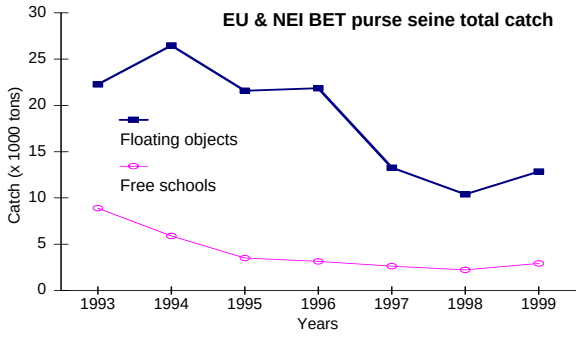
Year	*BB Ghana*	*BB Dakar*	*BB Europe*	*LL*
1993	5339		6165	388862
1994	5717		6296	465226
1995	8251		5538	454983
1996	11834		3333	504866
1997*	9558		4068	342635
1998	10176		3964	326456
1999	12917		13053	NA
Average				
1993-1996	7785		5333	453584
1997-1999	10884		7028	334545
Variation**	3098		1695	- 118939
	+ 40%		**+ 32%**	**- 26%**

* For the year 1997, the moratorium concerns only November and December.
**Between average 1997-1999 and average 1993-1996 data.

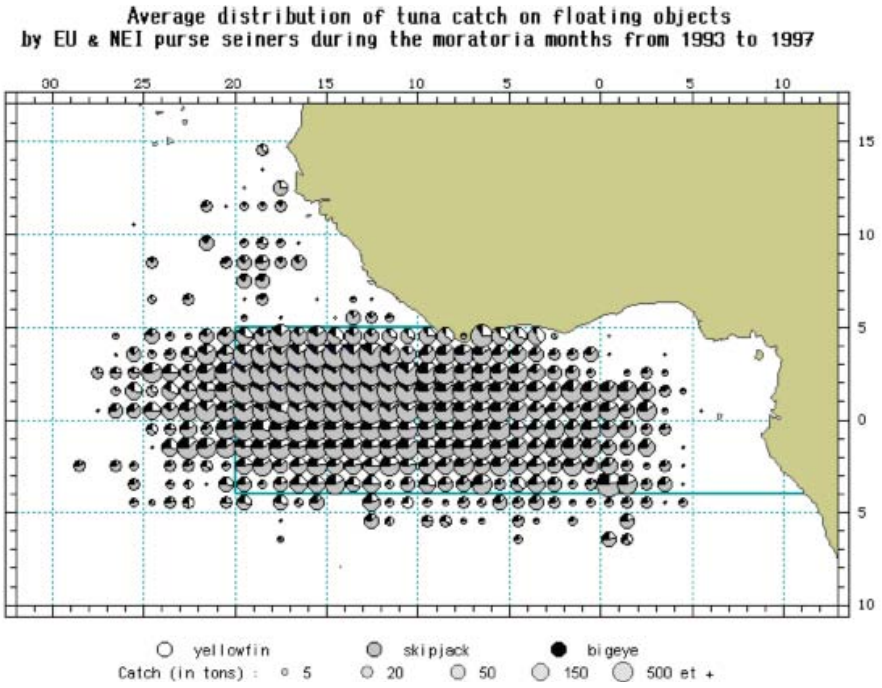


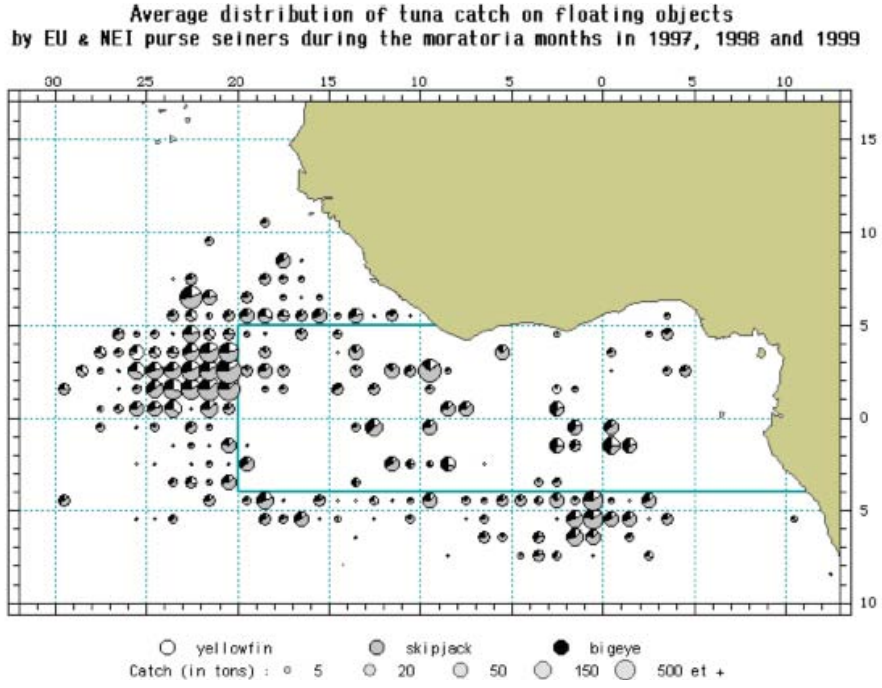




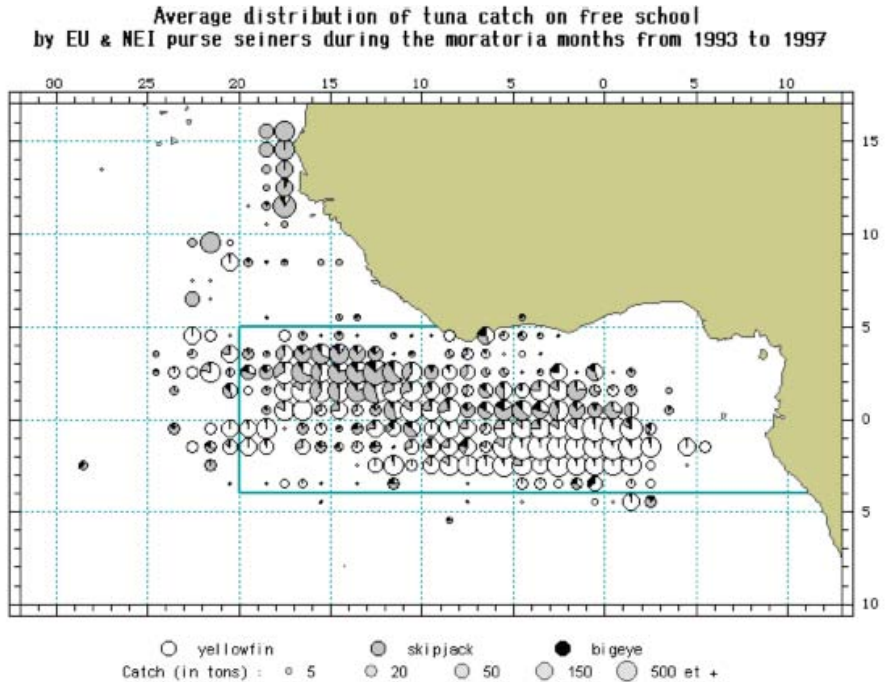


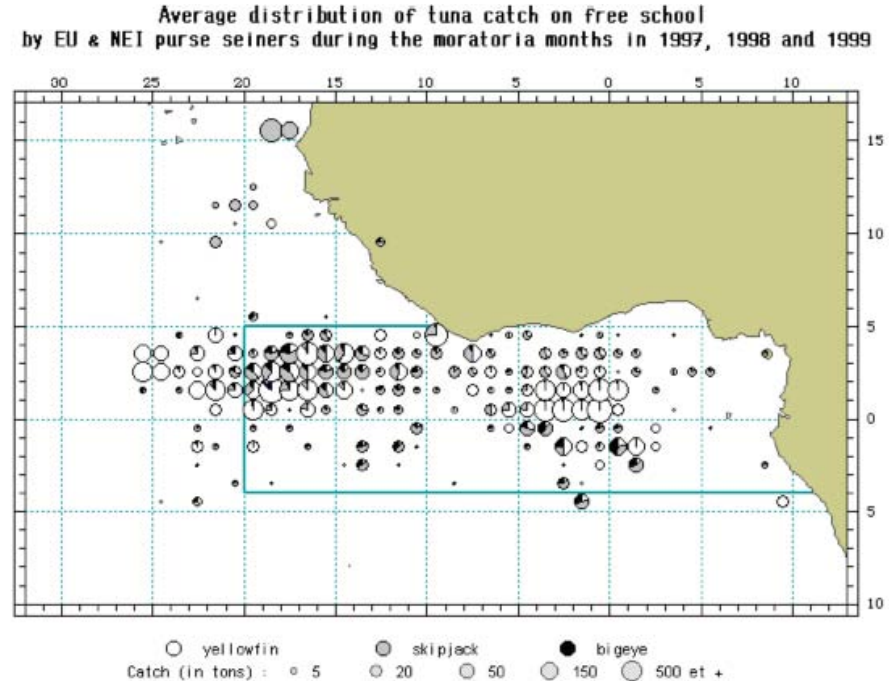
MOR-Fig. 1a-d. Evolution of the catch on floating objects and on free schools of the EU and NEI purse seine fleet from 1993 to 1999.



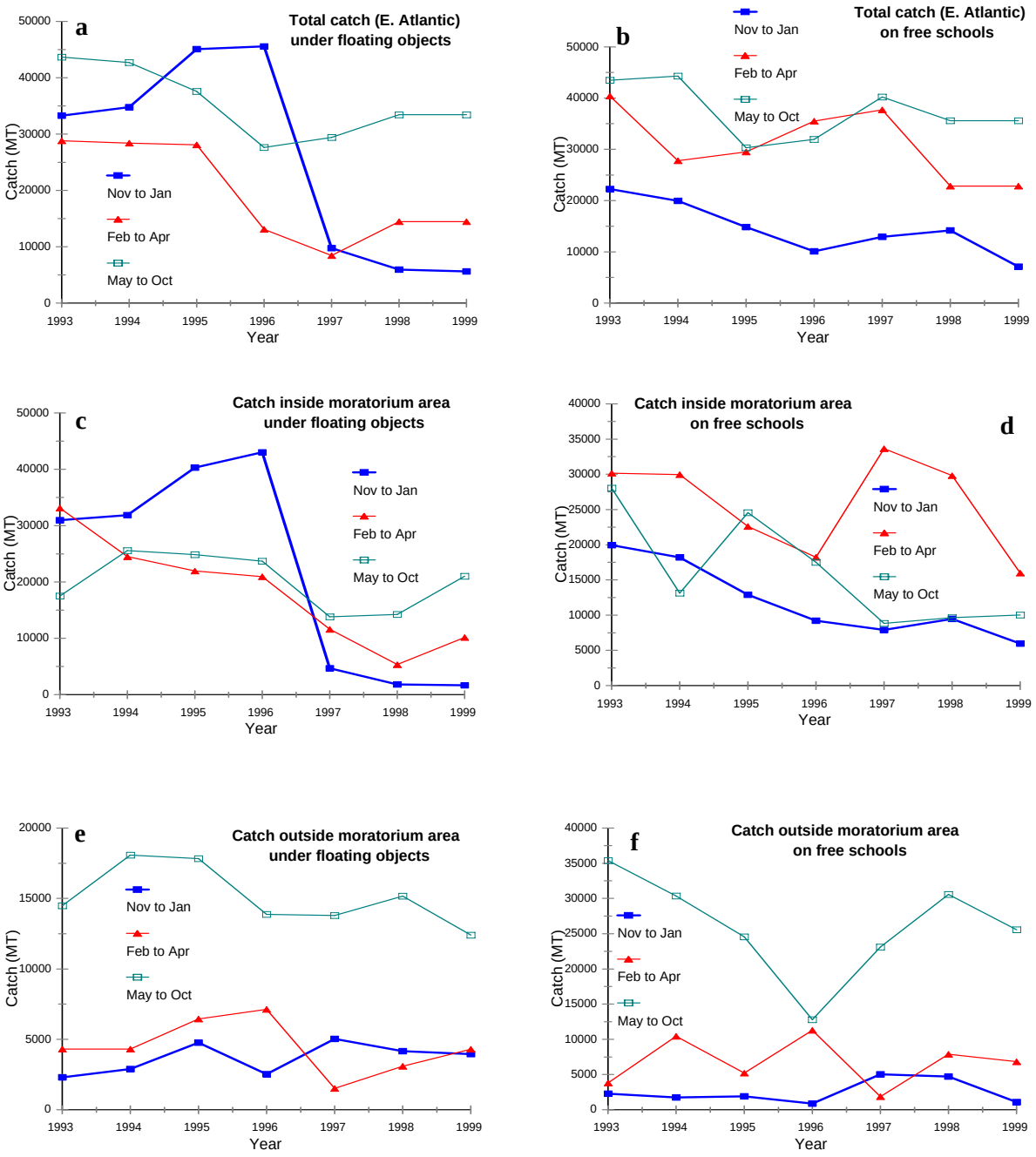


MOR-Fig. 2a-d. Distribution of the catch of the EU and NEI purse seiners prior to and during the moratorium years**.**

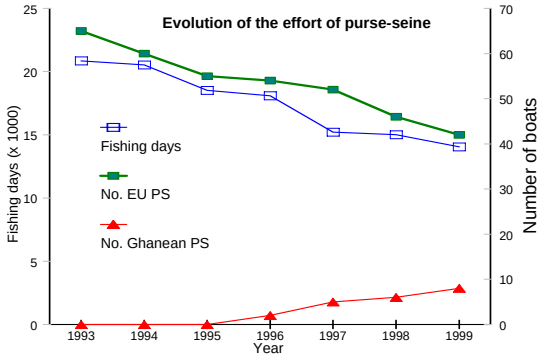




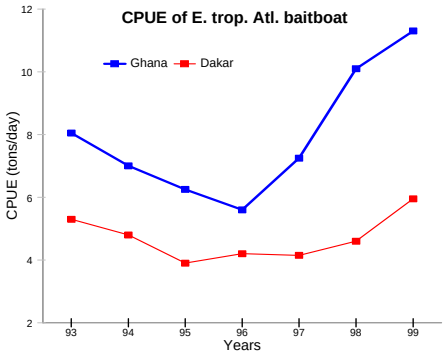
MOR-Fig. 2a-d (cont.). Distribution of the catch of the EU and NEI purse seiners prior to and during the moratorium years**.**



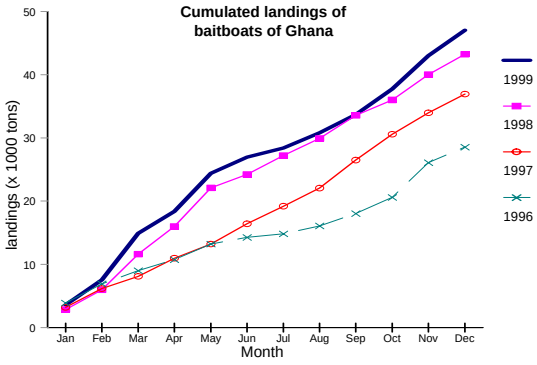
MOR-Fig. 3a-f. Monthly evolution of the catch on floating objects and on free schools by the EU and NEI purse seine fleet from 1993 to 1999.

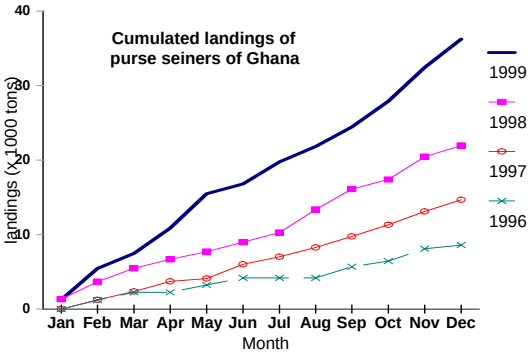


MOR-Fig. 4. Evolution of the nominal effort of the purse seine fleet of EU (including NEI managed by EU tuna boat owners)and Ghana from 1993 to 1999.

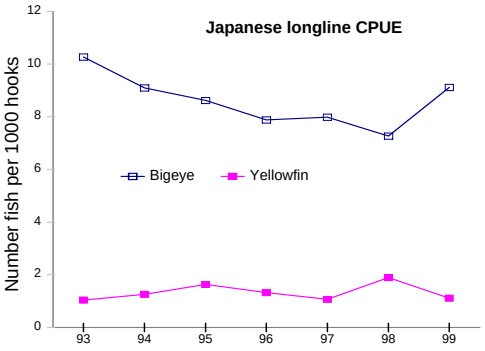


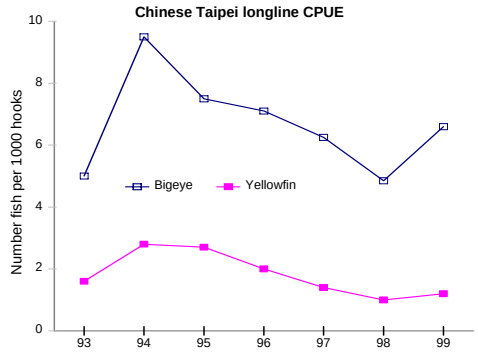
MOR-Fig. 6. Catch per unit of effort of eastern tropical Atlantic baitboats from 1990 to 1999.





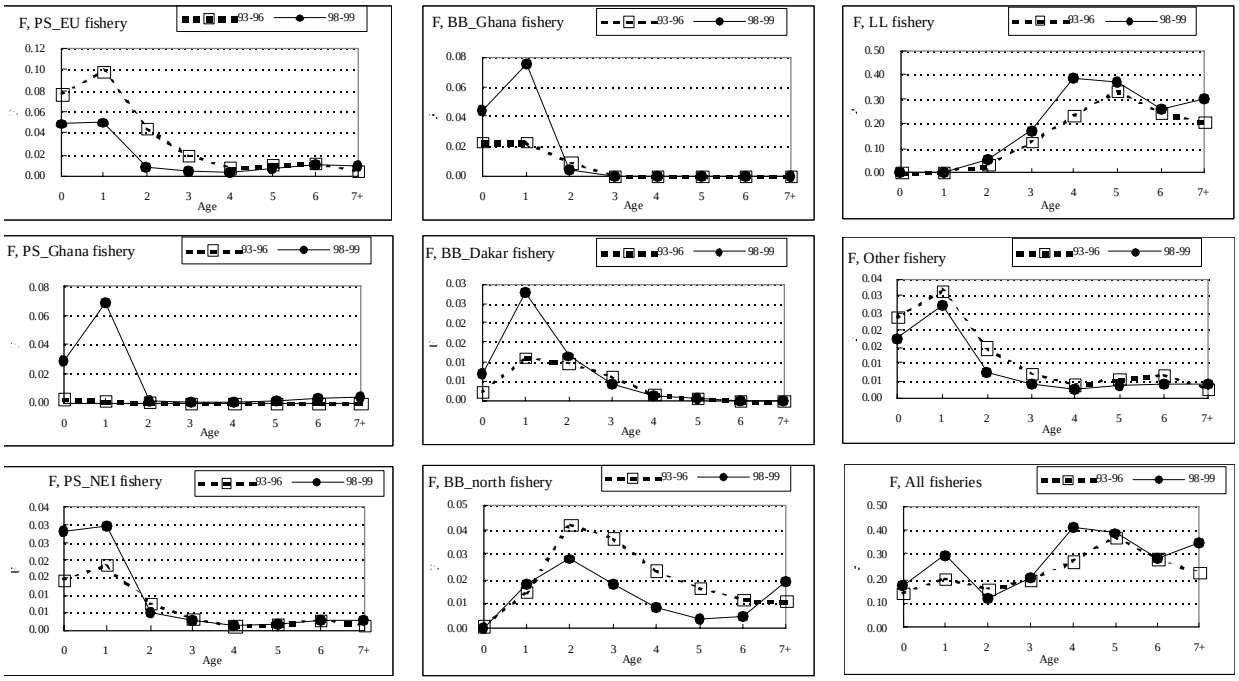
MOR-Fig. 5a-b. Evolution of the cumulated landings of Ghanian baitboats and purse seiners from 1996 to 1999.



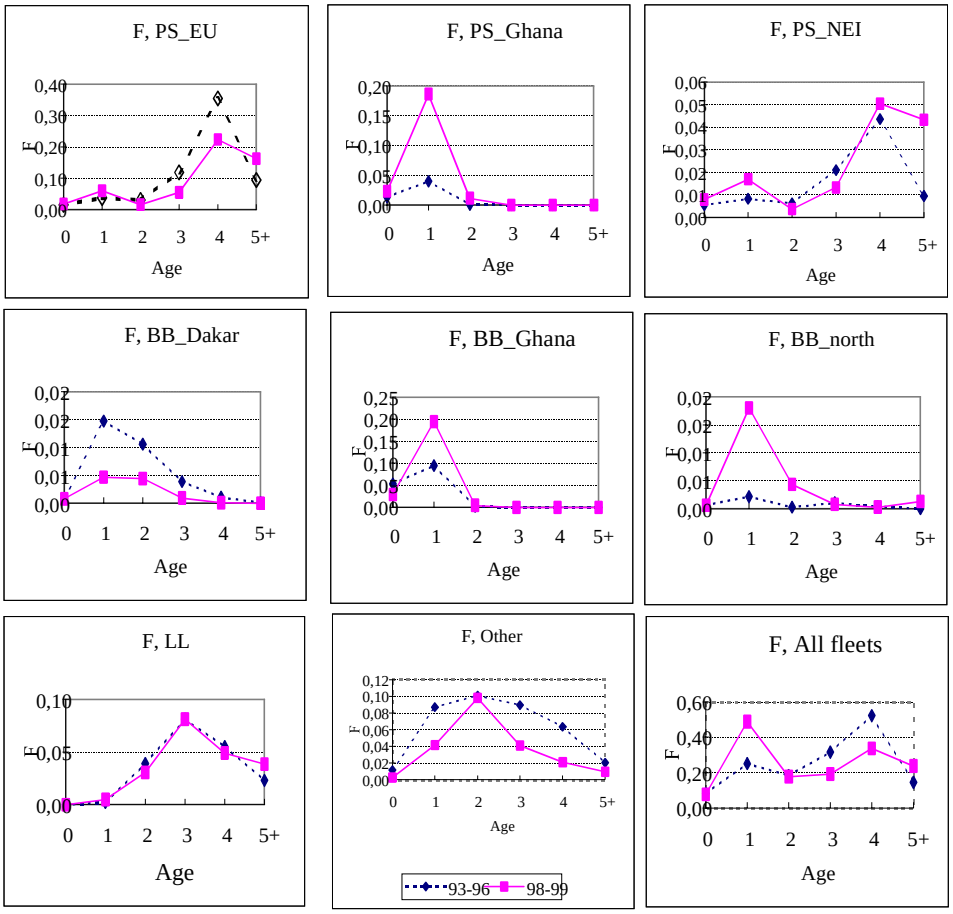


MOR-Fig. 7a-b. Longline catch per unit of effort from 1993 to 1999.

Bigeye



Yellowfin



MOR-Fig. 8a-b. Bigeye (top) and Yellowfin (bottom) fishing mortality rates by fleet prior to and during the moratorium years, obtained from forward-VPA.

19.2 Fishing effort correspondence for northern albacore

The response to the 1999 Commission recommendation concerning possible management measures for northern Albacore and carrying *"out an evaluation of the fishing capacity of the different fleet/gears that participate in the fishery with a view to establishing fishing effort correspondence"* is as follows:

Statement of the problem

In its 1999 meeting, the Commission adopted a recommendation "concerning possible management measures for northern albacore". In this recommendation, the Commission requested SCRS (paragraph 2 of the recommendation): *"to carry out an evaluation of the fishing capacity of the different fleet/gears that participate in the fishery with a view to establishing fishing effort correspondence, taking as the reference period the years 1993-1995. […]. In the event of […] lack of data, the SCRS should estimate the missing data from those available."*

Referring to paragraph 1 of the recommendation, special attention should be paid to fishing capacity as measured by the number of vessels.

The Commission further requires (paragraph 3 of the recommendation): *"In the event that SCRS will not be able to ascertain the correspondence of effective fishing effort among gears, or if the SCRS feels that the existing management measurers are insufficient to limit fishing mortality, it may suggest any other appropriate management measures, including different possible stock recovery scenarios, as necessary, taking into account the scientific assessment of the stock at that time."*

The Committee felt that the Commission request could be split into two questions:

- Evaluate the relative efficiency of different fleets during the reference period 1993-1995.
- For each fleet, evaluate the relevance of the number of boats as a proxy for fishing mortality, considering in particular time trends.

Comparing the efficiency of different fleets

The impact of fishing activities on the stock is measured by fishing mortality. For each fleet, the average (1993-1995) partial fishing mortality vector can thus be considered as an appropriate measure of impact of activity of this fleet during this period. Because of the multidimensional nature of fishing mortality, it is difficult to find a unique method to compare partial fishing mortality vectors between fleets. In other words, the question of how to compare a given value of fishing mortality on a given age with another value of fishing mortality on another age can have many different answers, depending on which criterion is used. To be able to compare different fishing mortality vectors, one needs a "common currency", in order to adequately transform a vector into a scalar. Possible criterions are: impact in terms of equilibrium yield, impact in terms spawning biomass, impact in terms of reproductive potential, impact in terms of number of fish caught relative to the total number of fish etc.

The Committee felt that it could not provide a single answer to this question. Many criterions can be envisaged, leading potentially to quite different results; thus the choice of a given criterion would be quite arbitrary and subjective.

Number of boats and effective fishing effort

Another question is to evaluate, for a given fleet, the appropriateness of the number of vessels as a measure of effective fishing effort or fishing mortality. Looking for an appropriate combination of well chosen technical factors to get a relevant measure of effective fishing effort is one of the basic questions of fishery biology, especially for CPUE analysis and stock assessment purposes. Such factors may include the number of vessels, but also fishing time, dimension of the gear, fishing area, fishing depth, target species, the use of detection devices, competition or co-operation between vessels, interaction with fish behavior, etc.

Although the number of boats obviously contributes to the definition of effective fishing effort for a fleet, the Committee considers that it too simple a measure to capture the true value of effective fishing effort. Although Task II effort data is a more satisfactory measure of effective fishing effort than the number of vessels, paper

SCRS/00/107 seems to show that significant trends in catchability remain, due to factors not taken into account in the used measure of fishing effort.

Conclusions

The Committee concluded that:

- It is possible to carry out a direct comparison of partial fishing mortality between different fleets, but a "common currency" with which to compare the results has not yet been defined. The Committee considers that the definition of such a common currency is highly subjective, since many possibilities can be envisaged.

- For general reasons, and also referring to the analyses carried out in paper SCRS/00/107, the number of vessels is not proportional to fishing mortality for this stock. As a consequence, limiting the number of vessels will probably not prove to be a sufficient measure to limit fishing mortality.

- Effort limitation based on units of effort other than the number of vessels may be possible in theory, however, the Committee noted that many countries do not provide the data necessary to facilitate this analysis. Therefore, from a general point of view, the Committee considers that catch limits provide a more efficient way to limit fishing mortality than the number of vessels.

19.3 General recommendations to the Commission

The recommendations relative to management are found at the end of each species section (Item 6). In this section, only the major recommendations concerning research and statistics are compiled.

Tropical tunas

The last assessments of tropical tuna stocks have faced serious problems, both at statistical and methodological levels, which have hampered analytical assessments of the stocks from being carried out.

Together with the general problems of the ICCAT data base, which have been widely identified and discussed, there are problems specific to tropical tuna (unreported catches, quality of sampling from the Tema-based fleet, double reporting of NEI purse seine catches and catches of Contracting Parties, sample substitution criteria, especially for longline and baitboat, coverage of size sampling) which need to be analyzed in depth in order to take appropriate decisions. During assessment meetings, the short of time available and the need to obtain results make it difficult to carry out these analyses. For this reason, on many occasions, the best possible decisions are taken under the circumstances, but not necessarily optimal.

From a methodological point of view, the models used are usually based on a series of assumptions which do not allow rigorous statistical treatment of the various types of data which are used. For example, the VPA assumes the catch-at-age matrix is perfectly known, without any error; a better statistical treatment of the data would assume that the catch estimates are subject to errors and use the sample size frequency data. Currently, "statistically integrated" models exist which allow this type of modeling to be carried out, but their use requires a detailed study on how to treat each type of available data, which cannot be done during the assessment without prior preparatory work. With BETYP funds, the task of developing one of these models for bigeye tuna will begin in 2001. This work will be coordinated by the Secretariat and will take about two years, during which the several experts will collaborate in the design of the model.

Bearing in mind that: (1) The ICCAT data base is being restructured and it is vital that this new base contain the best possible data; (2) Work is being carried out on an integrated statistical model appropriate to the assessment of species with the characteristics of tropical species; and (3) Until this model is developed, attempts to carry out assessments using standard analytical methods will presumably lead to results as uncertain as those obtained in previous assessments.

It is recommended that the assessment of the bigeye stock planned for next year not be carried out. Instead, a tropical tuna statistics group will be formed and will meet during the week prior the 2001 SCRS. The aim of the group will be to revise the data bases for three species (yellowfin, skipjack and bigeye) in depth , and will develop criteria for the automatic validation of statistics. These criteria could be incorporated into the new ICCAT data base and a catalogue of available data, including the format in which they are available, be created.

Albacore

The following recommendations were made:

- As there is a general lack of information and data from the Mediterranean albacore fisheries especially for the recent years, it is recommended that future GFCM/ICCAT joint meetings consider, as a priority, the compilation of albacore fishery statistics in the Mediterranean Sea.

- It was noted that some of the main north albacore fisheries are still not reporting Task II effort data. Therefore, it is strongly recommended that these data be collected.

- It was noted that for some south albacore fisheries Task II catch at size are not reported. Therefore, the Committee recommends that the available information shall be reported and additional efforts be made to increase collection of this data.

- Validation of age and growth and age at first maturity should be carried out for northern and southern stocks. Efforts must be made to biologically sample large (adult) albacore to obtain size at maturity and sex ratio information for northern and southern stocks.

- Preliminary application of genetic methodology to North and South Atlantic, Mediterranean and Indian Ocean albacore has provided promising results: additional efforts should be made to increase the size and spatial coverage of the samples throughout the Atlantic and eastern Indian Ocean in order to validate the stock structure assumed by the SCRS.

- Concern was expressed at the lack of standardized CPUE for major fisheries in the North stock. The Committee recommends that indices of abundance be developed for all the surface fleets targeting albacore in the North Atlantic stock.

- There are large uncertainties associated with the assessment models. Some this uncertainty can be attributed to the lack of precise estimates of natural mortality. The Committee recommends carrying out a comprehensive tagging in the North Atlantic.

- A continuous change of trend in CPUE indices, since the 1997 analysis, has been observed in the South Atlantic. This has a large impact on the analysis of the stock done in 2000, and serious concern was expressed by the Committee. It is strongly recommended that the analyses carried out for all the south Atlantic indices used in the assessment be revised and critically examined.

Bluefin tuna

The SCRS has again stressed the importance of better understanding the uncertainties associated with the bluefin tuna stock assessments in order to improve the quality of advice to the Commission in the future. The Committee continues to recommend that the Commission ensure that the ICCAT Secretariat be provided with reliable data on catch, effort, size in the format requested, and on as fine a scale as possible. The Committee emphasizes the importance of logbook data as well as independent observer programs for such data collection. These obligations are considered as minimum standard as they are clearly stated in the ICCAT Convention, FAO's Code of Conduct for Responsible Fisheries as well as the UN Implementation Agreement (UNIA). Further attention must also be paid to the investigation of NEI catches and estimation of dead discards.

Several improvements to the biological knowledge of bluefin tuna are required before an improved assessment of western bluefin tuna can be achieved.

- Accumulating evidence, including recent results from state-of-the art electronic tags, make clear that the populations of fish and the fisheries in the western and eastern Atlantic management units are somewhat related. Very clearly an increase in general knowledge on bluefin biology is required (see below).

- There is a need to study the best proxy for MSY (in the absence of a direct estimate). The Committee endorses the simulation activities of the *Ad Hoc* Working Group on Precautionary Approach.

- There is also a need to increase the accuracy on estimation of recruitment levels. The Committee endorses the recommendation of the Sub-Committee on Environment to hold a workshop to address the effects and relationship between environment and recruitment and how these could be reflected in the stock assessments.

Enormous improvements to the basic inputs (catch, size distribution of the catch, and CPUE) to the stock assessment are essential before an improved assessment of eastern bluefin tuna can be achieved.

- The SCRS has little confidence in the catch figures in recent years

- The Committee is alarmed that we are still lacking appropriate data to calculate reliable indices of abundance from directed bluefin tuna fisheries.

- The Committee recommended the collection of information on the number, size and origin of fish entering cages.

Apart from uncertainties in basic inputs, issues associated with spawning site fidelity, migration paths, and mixing are among the most important of the uncertainties in the assessment and management of Atlantic bluefin tuna.

- The Committee endorses the research recommendations of the BYP (see below), the GFCM/ICCAT Joint Meeting (COM-SCRS/00/25) and the Western Bluefin Species Group (SCRS/00/24).

- The Committee recommends continued and enhanced cooperation among scientists conducting research on the eastern and western stocks, in order to collaborate on tagging experiments, and to collect and analyze samples for genetics and micro-constituents studies. The Committee endorses the concept of proposed exploratory research sampling of larvae and spawning-sized bluefin the central Atlantic as outlined in SCRS/00/125. It also recommends that sampling design be elaborated.

- The Committee supports the recommendation for an intersessional meeting to review and integrate research results as they relate to biological mechanisms and how they should be best addressed in stock assessments. The need for dialogue between scientists and managers was also highlighted as new research results point to the need to rethink both assessments and management approaches.

Billfish

The Committee recommends the following:

- Accelerate efforts to improve estimates of basic biology of billfish, including growth, maturity, fecundity, trophic ecology, and spawning time and season for each species of billfish.

- Continue and expand studies to assess the post-release survival of billfishes from commercial and recreational fisheries (using pop-up satellite archival tag or similar technology);

- Initiate research to collect information to define the habitat of billfishes, such as depth, temperature, dissolved oxygen, and other oceanographic and biological parameters (using pop-up satellite archival tag or similar technology). Based on the information obtained by these studies, the quantitative relationship could be constructed between billfish distribution (horizontal and vertical) and environmental variables;

- Simulation studies should be continued to investigate the adequacy of standardization of CPUE, especially for situations when the data are unbalanced, have a high proportion of zero catch, or depend on accurate characterizations of billfish habitat or depth of deployment of fishing gear;

- Initiate research to develop data required to model species specific efficiency of longline hooks deployed under representative gear configurations, in the presence of environmental and hydrographic variability. This should include examination of existing CPUE data to develop and evaluate marlin habitat hypotheses for use in standardization of indices;

- Accelerate conventional tagging activities of billfishes, particularly those billfish that are still alive when brought alongside vessels. The resolution adopted by the Commission in 1997 relative to conventional tagging of billfish should be fully implemented, continued and expanded (e.g. ICCAT tag recovery network) to encourage the reporting of tag recaptures and associated biological information;

- Develop approaches to verify the historical catch and effective fishing effort for each billfish species, country, and major gear.

- Continuation of the ICCAT Enhanced Research Program for Billfish will be essential to address the above recommendations, since this program has been responsible for many of the improvements to Atlantic-wide billfish research. The Commission should continue supporting this program.

Swordfish - Atlantic

It is recommended that the next swordfish stock assessment not be conducted before 2002 in order to advance basic research and assessment methods. During the intersessional period National Scientists should continue research on stock structure, reproductive dynamics, ageing, CPUE, and stock assessment methods as outlined in the 1999 Swordfish Detailed Report. This type of work is both time-consuming and expensive, but must be made a priority.

In particular, the Committee recommends that work be conducted to improve CPUEs as follows:

- There are methodological problems for the by-catch series that must be addressed.

- The selectivities of deep and shallow longline should be investigated and compared.

- Ways to more directly include habitat and environment into CPUE series should be explored.

Swordfish - Mediterranean

The Committee recommends that countries that have not yet provided the mandatory data to ICCAT (Task I and II catch, effort and size) or have only provided official data, should try to provide the scientists' best estimates as early as possible, and not later than the 2001 Species Group meetings. The size frequency data should be provided by small strata (gear-time-area) breakdown.

The Committee also recommends that before a new assessment for Mediterranean swordfish can be conducted, a data preparatory meeting of the GFCM/ICCAT *Ad Hoc* Working Group on Stocks of Large Pelagic Fishes in the Mediterranean should be held to determine and standardize the time series of CPUE which may be used as indices of abundance in the stock assessments.

Assessment Methods Working Group

The Assessment Methods Working Group recommends the following:

- The Committee recommends that the catalogue of stock assessment applications be initiated following the guidelines suggested by the Assessment Methods Working Group.

- The Committee recommends that the Assessment Methods Working Group meet in 2001 to investigate methodological approaches to extending ICCAT assessments back in time. Key issues include, among others: uncertainty in length sampling, uncertainty in catches, uncertainty in CPUE, changes in areal extend of fisheries.

Precautionary Approach ad hoc Working Group

The Committee recommends that the future direction for this ad hoc Working Group be discussed at the next meeting of the Commission.

Bluefin Year Program (BYP)

The following BYP recommendations required funding in 2001:

As highest priority for the BYP in 2001, the Committee recommends expenditures of $37,000 to cover expenses associated with stock structure and maturity sampling for bluefin during the upcoming year. Taking into account the current estimated balance for BYP, this would require a Commission contribution of approximately $17,000 (~3,200,000 pesetas) in 2001. It is recognized that the actual costs of achieving this research is substantially higher, but that significant costs are contributed to the BYP by national research programs. This amount, however, assumes that COPEMED will contribute to some extent in 2001. In 2000, COPEMED funding covered approximately $7000 (~1,310,000 pesetas) of the overall costs of the sampling activities.

As next priority for the BYP in 2001, the Committee recommends expenditures of $20,000 (~3,740,000 pesetas) to contribute to the expenses for planning and coordinating 4 research activities viewed as critical to the future of BYP. Of the 4 items below, the first two have somewhat higher direct application to the BYP. The last two items are of a more general nature and would benefit from support by other research programs (BETYP, Enhanced Research Program for Billfish).

- The Committee endorses the concept of the proposed exploratory research sampling of larvae and spawning-sized bluefin tuna and the associated oceanographic conditions in the central Atlantic as outlined in SCRS/00/125. It recommends that the sampling design be further elaborated. The Committee recognizes that this research is very expensive and is beyond the current capability of the Bluefin Program, but recommends that $5000 (~930,000 pesetas) be contributed to support planning, coordination with the following activity identified below, and implementation.

- The Committee endorses the proposed research sampling of larvae and spawning-sized bluefin tuna and the associated oceanographic conditions in and around the Balearic Islands as outlined in the research proposal developed by EC-Spain. The Committee recognizes that this research is very expensive and is beyond the current capability of the Bluefin Program, but recommends that $5000 (~930,000 pesetas) be contributed to support planning, coordination with the first activity identified above, and implementation.

- There is also a need to increase the accuracy on estimation of recruitment levels. The Committee endorses the recommendation of the Sub-Committee on the Environment to initiate planning for a workshop in 2002 to address the effects and relationship between environment and recruitment and how these could be reflected in the stock assessments. This will require convening a steering committee meeting in 2001 to facilitate the workshop. The Committee recommends that $5000 (~930,000 pesetas) be contributed to support this work in 2001.

- There is a need to study the best proxy for MSY (in the absence of a direct estimate). The Committee endorses the simulation activities of the *Ad Hoc* Working Group on Precautionary Approach. The Committee recommends that $5000 (~930,000 pesetas) be contributed to support this work in 2001.

Bigeye Year Program (BETYP)

The Committee recommends a strong continuing financial support to the BETYP.

The Committee also recommends requesting the contributors to the program to allow the use of funds not spent in 2000 to enhance the intensive tagging program in the Gulf of Guinea during 2001.

Program of Enhanced Research for Billfish

The Committee noted that the Billfish Program continued producing very positive results and valuable information on billfish and valuable information on billfish research, and the Committee endorsed the proposal of the 2001 budget and recommended that the Commission again provide the same level of research funding in 2001 as it did in 2000 (i.e. US$10,000).

Sub-Committee on Environment

The Sub-Committee on Environment recommended that a working group on the recruitment-environment relationship meet in 2001 in order to: define the most influential environmental events, analyze the repercussions of variations in recruitment on stock reproduction and catches, and to test how environmental variables could be integrated into stock-recruitment models.

Sub-Committee on Statistics

The Sub-Committee made the following recommendations to the Commission:

- It was recommended that the Commission request that countries importing bluefin provide copies of individual BFTSD to the Secretariat for inclusion in the data base, in order to check possible double reporting and to make further investigations when the origin of the products are in question

- Following the recommendations by the GFCM/ICCAT *Ad Hoc* Working Group on Stocks of Large Pelagic Fishes in the Mediterranean, the Sub-Committee recommended that the Secretariat develop a well structured detailed questionnaire on national statistic collection systems and procedures, and carry out a survey among all countries/entities/fishing entities fishing for tuna in the Atlantic Ocean, in order to understand the uncertainties associated with the national statistics.

- The Sub-Committee endorsed the recommendations on observer data made by the Sub-Committee on By-catch. Discards estimates are requested but not always reported. Logbook data are not adequate and observer data would be very useful in estimating discards, and should be used where available and feasible. However, care should be taken when using observer data, as the presence of an observer may influence fishermen's behavior.

- Noting that good progress was made by the Secretariat on data management, an *Ad Hoc* Advisory Committee on the Design and Implementation of the Relational Data Base System was created to review the further developments and it was recommended that this Advisory Committee meet during the 2001 inter-sessional period to review progress and provide advice on any issues in this area as they become necessary.

- The Sub-Committee recommended that the Commission endorse the pilot program proposed by the Secretariat, together with FAO, relating to the FIRMS (Fish Resources Monitoring System) under FAO FIGIS project.

- The Sub-Committee repeated its recommendation that the Commission not use Task I and II data which are collected as best estimates for scientific use, for the purpose of evaluating compliance of Contracting Parties to the ICCAT regulatory measures, as this will adversely affect the accuracy of such scientific data.

- The Sub-Committee recommended that the Commission approve the IATTC's application for membership to the CWP.

Sub-Committee on By-catches

It is recommended that ICCAT take the lead in conducting stock assessments for Atlantic blue, porbeagle, and mako sharks and that the initial stock assessment evaluations should be scheduled for the year 2002. To this end, it was further recommended that ICCAT require of member countries and request of cooperating countries and fishing entities, that they report the *total* catches and landings (including estimates of dead discarded catch) of Atlantic blue, porbeagle, and mako sharks. Furthermore, it is recommended that ICCAT request of member nations, cooperating nations and cooperating fishing entities, other related data, such as tagging databases and databases resulting from genetics studies. In anticipation

of a pelagic shark stock assessment evaluation possibly taking place in year 2002, it is recommended that a data preparatory meeting to review the shark catch statistics reported, be held in year 2001.

In view of the above, it is also important to again note that only 25 of the more than 80 countries, entities, and fishing entities have provided shark catch information to ICCAT. The Committee again stressed its previous recommendation that all member nations and Atlantic tuna fishing nations establish adequate data collection systems for collecting Task I and Task II data for sharks and provide the data in annual reports to ICCAT. The Committee also acknowledges that using information on total removals will be critical to future evaluations of shark stock status, and hence reporting discards accurately is essential.

The Committee considers that it is the responsibility of the nations fishing sharks to collect adequate data and urged these countries to carry out good scientific observer programs, if such have not been already implemented. Responses to the ICCAT questionnaire: "Survey for availability of observer data" indicate that a number of nations have observer programs, and that the information can or has been be provided to ICCAT. It is recommended that the Secretariat develop a database system to house scientific observer data and that member nations, cooperating nations and fishing entities that indicated observer data could be provided, provide that data to ICCAT.

It is recommended that ICCAT endorse the FAO IPOAs for sharks and seabirds and encourage member countries, cooperating countries, and cooperating fishing entities to develop NPOAs as soon as possible.

20 Collaboration with non-contracting Parties, entities or fishing entities and other fisheries organizations

20.1 The Committee noted that relations with many non-Contracting Parties/Entities/Fishing Entities are excellent, particularly with Mediterranean countries, where very close collaboration has been maintained through the GFCM. The collaboration and voluntary funding for tuna research from Chinese Taipei was also noted and appreciated by the Committee.

20.2 Relations with FAO and various Regional Fisheries Management Organizations (RFMOs) have much improved, in many aspects. These organizations include IATTC, IOTC, ICES, NAFO, SPC, EUROSTAT, CCAMLR. ICCAT invited Dr. J. Hampton of SPC and M. Garcia from IOTC to advice on matters relating to the BETYP and the RDB, respectively. Their contribution to ICCAT scientific work was greatly appreciated by the Committee.

20.3 The Committee was informed that the GFCM has adopted all the ICCAT regulatory measures relating to Mediterranean tuna at its Commission meeting in October, 2000. It also noted that formal letters were exchanged between ICES and ICCAT to exchange information on Quality control.

21 Date and place of the next meeting of the SCRS

The SCRS proposed to hold the next meeting in Madrid, but indicated hat the exact dates would be determined by the Commission. For planning purpose, the Secretariat was asked to inform the scientists of the meeting dates as soon as possible after the decision is made.

22 Other matters

22.1 The Committee was informed that the Third International Billfish Symposium is being planned in Cairns Australia, 19 to 23 of August, 2001. Already several ICCAT scientists have been invited to the Symposium. Participation is open to all scientists, and ICCAT scientists will be most welcome.

22.2 The report which dealt with the FAO draft International Plan of Action to Prevent, Deter and Eliminate IUU Fishing Activities provided a draft definition of IUU fishing. Questions were raised regarding whether "unreported catches" may be considered as a result of IUU fishing, whether this concept can be applied retroactively to past data, and whether this is a matter with which the SCRS should be concerned. The SCRS agreed that these would involve legalities and were definitely beyond the scientific committee's mandate.

22.3 From a scientific point of view, there was considerable discussion whether the absence of data submission means "no catch" or "no reporting" and the judgement between these two are sometimes difficult. Therefore, the

Committee agreed to add a note on the SCRS species catch tables to the effect that for catches are not reported estimates had been made, where appropriate (e.g. the number carried over from previously reported catches).

23 Adoption of the report

The SCRS Report, together with all its Appendices ,were reviewed and adopted, with some modifications.

24 Adjournment

24.1 The SCRS Chairman thanked the Committee and commended the work carried out by the scientists over the past two weeks, both in the meetings of the Species Groups and the Plenary Sessions. On behalf of the Committee, Dr. Powers also expressed appreciation to the Secretariat staff and the interpreters for their excellent work.

24.2 The 2000 Meeting of the Standing Committee on Research and Statistics (SCRS) adjourned on Friday, October 20.

Appendix 1

2000 SCRS AGENDA

1 Opening of the meeting
2 Adoption of Agenda and arrangements for the meeting
3 Introduction of Contracting Party delegations
4 Introduction and admission of observers
5 Admission of scientific documents
6 Review of national fisheries and research programs
7 Executive Summaries on species:
YFT-Yellowfin, BET-Bigeye, SKJ-Skipjack, ALB-Albacore, BFT-Bluefin, BIL-Billfishes, SWO-Swordfish, SBF-Southern Bluefin, SMT-Small Tunas
8 Report of the Assessment Methods Working Group
9 Report of the Precautionary Approach *ad hoc* Working Group and its future plan
10 Review of the ICCAT Bluefin Year Program (BYP): Activities, progress & future plans
11 Review of the ICCAT Bigeye Year Program (BETYP): Activities, progress & future plans
12 Review of the ICCAT Program of Enhanced Research for Billfish: Activities, progress & future plans
13 Report of Sub-Committee on Environment and future plans.
14 Report of the Sub-Committee on Statistics, review of Atlantic tuna statistics and data management system, and future plans
15 Report of the Sub-Committee on By-catches and future plans.
16 Scientific meetings where ICCAT was represented
17 Review of ICCAT scientific publications
18 Consideration of other SCRS activities
--Organization of the SCRS, including quality assurance activities.
--Inter-sessional scientific meetings proposed for 2001
19 Responses to the Commission and general recommendations
20 Collaboration with non-contracting parties, entities or fishing entities and other fisheries organizations
21 Date and place of the next meeting of the SCRS
22 Other matters
23 Adoption of the report
24 Adjournment

Appendix 2

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Appendix 4

EXECUTIVE SUMMARY

FIRST MEETING OF THE ICCAT WORKING GROUP ON STOCK ASSESSMENT METHODS

(Madrid, Spain - May 8 to 11, 2000)

In accordance with decisions made by the SCRS during its 1998 and 1999 meetings, a Working Group on Stock Assessment Methods was created. The overall mandate for this Working Group was to provide a mechanism for cross-fertilization of scientific ideas between species working groups and to implement quality management for stock assessment methods, leading to the review, testing and documentation of assessment methods used by the SCRS. The initial meeting of that Working Group was held at the ICCAT Secretariat May 8-11, 2000. The specific objectives for this first meeting were to: a) develop a protocol for the review of methods, and prioritize future work by the Working Group; b) to evaluate methods for CPUE standardization that take targeting into account; c) to evaluate methods for CPUE standardization that take spatial heterogeneity into account; and d) advice on assessment mechanisms to monitor stock rebuilding. Other stock assessment methodological issues were also presented and commented upon.

The Working Group discussed quality control aspects of stock assessments within and between ICCAT working groups and discussed quality control procedures within other international commissions. As an initial step in this process, ICCAT's Methods Working Group recommended that a catalogue of ICCAT approved applications (i.e. software) be developed. The catalog would address only whether the software implementing the method works as intended, and whether the software is properly documented. The catalog is *not* intended to evaluate the merits of the analysis method, itself. Suggestions were made for protocols for conducting assessments within species working groups to facilitate record-keeping, transparency, peer review and the implementation of innovation.

Several methods for incorporating targeting and spatial heterogeneity into CPUE standardization have been used and were discussed. Simple deterministic simulations were conducted to evaluate possible strengths and weaknesses of the targeting methods. Of the options examined, using the ratio of catch of the species of interest to the total catch as a variable to define targeting tended to perform better than the other options, but in some circumstances even that method could be misleading. The long term solution appears to be data collection of detailed effort characteristics. This recommendation has previously been made by various species working groups.

A number of issues related to mechanisms for monitor stock rebuilding were discussed, particularly in regard to balancing the need for consistency of the stock rebuilding evaluation methods versus the need to implement appropriate improvements of methods. Suggestions were made to facilitate the evaluation and communication of management advice on rebuilding progress. In particular it was suggested that if changes in the stock evaluation methods are truly needed during the rebuilding period, then parallel analyses are needed, i.e. examining the rebuilding scenarios using both the old method and the new method.

The development of terms of reference for this Working Group were discussed. It was suggested that terms of reference for specific meetings be very focused on specific issues. However, a limited time at meetings (e.g. 20%) should be allowed to present and discuss new methodological ideas and issues. A process for developing terms of reference for specific meetings was suggested.

Appendix 5

EXECUTIVE SUMMARY

REPORT OF THE AD HOC WORKING GROUP ON PRECAUTIONARY APPROACH

Background

The *FAO Code of Conduct for Responsible Fisheries* and the *Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and management of Straddling Fish Stocks and Highly Migratory Fish Stocks* developed several concepts relating to precautionary approaches in fisheries, including:

i actions to manage and conserve fisheries resource should be applied using a precautionary approach;

ii absence of adequate scientific information should not be used as a reason for postponing or failing to take measures;

iii specific targets and limit reference points appropriate to precautionary approaches should be determined and established;

iv the level of uncertainty in status and risk associated with actions should be encompassed into strategies;

v enhanced data are required to decrease or lessen restrictive actions.

To address the scientific ramifications of these and other precautionary issues, the Standing Committee on Research and Statistics (SCRS) created an *ad hoc* Working Group in 1997 to develop a discussion document of what "precautionary approaches" means in the context of ICCAT stocks including: (a) likely criteria (benchmarks); (b) ecological, environmental and distributional aspects; (c) the role of uncertainty; (d) how precautionary information should be communicated to the Commissioners in the future; and (e) other issues as appropriate.

The SCRS notes the distinction between targets (management objectives) and limits (conservation reference points considered to be deleterious and should be avoided). The choice of a particular limit rests with the risks that the managers wish to take and the consequences of the events.

Based on language in the ICCAT Convention, F_{MSY} is probably the most appropriate fishing mortality-based target reference point. However, note that the corresponding B_{MSY} is only appropriate as a target in an average or equilibrium sense; i.e. in natural systems where F_{MSY} is the target, biomass should be expected to fluctuate around BMSY, so there should be no unnecessary cause for alarm when biomass falls somewhat below B_{MSY}. Thus, it may make more sense to consider F-targets in conjunction with biomass limits, rather than biomass targets, per se. Other potential candidates for target fishing mortality rates include biological reference points that have frequently been used as proxies for F_{MSY}.

Annex II of the Straddling Stocks Agreement states that F_{MSY} should be a minimum standard for a limit reference point. This is potentially in conflict with the objectives of the ICCAT Convention, which imply that F_{MSY} is the target. In fact, there are very few examples where fishing mortality has been limited to F_{MSY} over a significant period of time, even where MSY has been the stated management objective, and the Committee was not aware of any examples where stocks have collapsed despite fishing mortality being maintained near F_{MSY} over a substantial period.

The SCRS working group has (1) summarized existing information relevant to Atlantic tunas benchmarks, (2) conducted an inter-sessional meeting in 1999 for addressing these items, (3) initiated the development of a simulation framework for evaluating management strategies, and (4) co-sponsored an Expert Consultation on Implications of the Precautionary Research for Tuna Biological and Technological Research in 2000. This document reports the progress of the SCRS on these activities and preliminary findings.

The breadth of scientific aspects of the precautionary approach

The SCRS notes that precautionary approaches include several scientific aspects as applied to tuna and tuna-like species in the Atlantic including biological, ecological and environmental considerations; technological/fishing issues; data collection mechanisms and the characteristics of stock assessments. These themes were addressed during the 1999 meeting of the *ad hoc* Working Group on the Precautionary Approach and also during the Expert Consultation held in March 2000.

The ecological and biological framework within which tuna exist is spatially broad and heterogeneous. The species are highly migratory, existing under variable environmental conditions. Additionally, environmental conditions affecting tuna productivity may shift over long time frames. Temperate and tropical tunas can have very different life histories which affect their productivity and resistence to fishing pressure. Precautionary criteria should encompass these characteristics.

The technology of fishing has affected both the rate of exploitation and, perhaps, biological and ecological characteristics. Factors include by-catch of various species and gears designed to reduce that by-catch; possible effects of fish aggregating devices on migratory behavior and resulting biological processes; and the use of multiple gears has important consequences for the estimation of many biological reference points which depend on the overall selectivity (at age or length) of the mix of gears. Also, abundance estimates for tunas are almost entirely based on catch and effort data. There is difficulty in standardizing these data for technological advances in gear technology and fishing methods; improvements in fishing efficiency due to dramatic improvements in fishing gears are not always well estimated, and may be dangerously interpreted as an increase in stock abundance. Also, little is known about the influence of tuna fishing gears on the physical habitat, although it is believed that its influence is small.

No ICCAT stock is considered to be information-rich (8 of 17 are considered information-moderate and the rest information-poor). Therefore, there is consensus within the SCRS for the need for improved data collection in order to facilitate implementation of precautionary approaches. The terms "information-rich", "moderate" and "poor" relate to both the amount of data available and to the accuracy of recent assessments. Thus, information level is judged both in terms of the amount of available data and our current understanding of the biological dynamics. Specific information needs are for stock identification research to reduce uncertainty. Information-poor stocks need better basic catch, effort and size sampling data. For all stocks there is a lack of fishery-independent measures of abundance, no or poor estimates of natural mortality, and a need to incorporate environmental influences into assessments. Methods for direct aging are also required. Thus, what is needed is to move to higher levels of information-richness, by collecting more of the same types of data that are already being collected. These require additional funding support at all levels of the entire fishery management system from data collection, to research, to assessment, to monitoring of regulations.

The data that the SCRS requires are to be utilized in stock assessments. Stock assessment is the process of integrating the relevant scientific information and providing management advice on the status of the tuna resources relative to management objectives and constraints. Two common measures of stock status (biological reference points) are used; these relate to whether "over-fishing" is occurring and whether a stock is "over-fished". The distinction between the two is important. "Over-fishing" relates to the act of fishing and occurs when fishing mortality is "too high". "Over-fished" refers to the state of the resource stock and occurs when stock biomass is "too low" or depleted. It is possible to be over-fishing without being over-fished and, conversely to be over-fished without over-fishing. The worst situation is that where over-fishing is occurring on an over-fished stock. Both types of reference points should be used. However, although reference points are useful abstractions, care must be taken to incorporate relevant dynamics into their determination. Preliminary categorization of ICCAT stocks (**Table 1**) indicate that of the 16 stocks categorized, 8 are estimated to be below biomass at MSY (or an appropriate proxy) and 9 are estimated to be above fishing mortality rate at MSY (or an appropriate proxy). The eight stocks estimated to be below B_{MSY} are also experiencing fishing mortality rates above F_{MSY}. The Committee noted that, in the past, MSY-related reference points have been mis-estimated due primarily to subsequent area and depth expansion of the fisheries. However, the Committee is doubtful that the same magnitude of mis-estimation problems will occur in the future, due to limited scope for future expansion for most ICCAT fisheries. It should be noted that these classifications should not be considered definitive. However, they do provide an indication of exploitation levels as related to the stated objectives of the ICCAT Convention.

Conclusions and recommendations

The adoption of the precautionary approach for fisheries management requires a proper balance between acquiring knowledge and taking management actions. In the opinion of the SCRS, such proper balance cannot and should not be established by scientists alone. As the discussions that took place during the 1999 *ad hoc* Working Group meeting and during the Expert Consultation suggest, there are many areas in which uncertainty can be reduced with increased investment. In addition, more work is required to refine the methods used to characterize uncertainty.

For the Commission's purposes, a realistic prioritization of research investments cannot be undertaken unless it is cast in the context of the management framework that is being targeted as the main beneficiary of the reduced uncertainty. Considerable feedback is needed between managers and scientists to move forward substantially in this sense.

The SCRS will continue to encourage and guide research designed to (a) better measure uncertainty in stock status, (b) reduce uncertainty through improved knowledge, and, (c) evaluate management strategies, because all such research is important not only to a precautionary management approach, but also to the basic conduct of fishery science.

The SCRS also recommends to the Commission that it consider the potential usefulness of a future meeting between ICCAT Commissioners and SCRS scientists with the objective of developing a work plan on issues related to the precautionary approach. In the interim, the SCRS recommends that the *ad hoc* Working Group on Precautionary Approaches continue to monitor the research highlighted in the preceding paragraph.

Table 1. Status of ICCAT stocks relative to biomass at MSY, and to fishing mortality at MSY[1]

	Relative to B_{MSY}				*Relative to F_{MSY}*			
Stock	*Above*	*Near*	*Below*	*Unknown*	*Under*	*Near*	*Over*	*Unknown*
YFT		X				X		
BET			X				X	
SKJ-E				X				X
SKJ-W				X				X
ALB-N			X				X	
ALB-S	X				X			
ALB-M				X				X
BFT-E				X			X	
BFT-W			X				X	
BUM			X				X	
WHM			X				X	
SAI-E			X				X	
SAI-W			X				X	
SWO-N			X				X	
SWO-S		X			X			
SWO-M				X				X

[1] These classifications are based on the point estimates of biomass and B_{MSY} (or a proxy) or fishing mortality and F_{MSY} (or a proxy) from the most recent assessment. They should not be considered definitive, but rather they provide an indication of exploitation as related to the stated objectives of the ICCAT Convention.

Addendum 1 to Appendix 5

Expert Consultation on Implications of the Precautionary Approach for Tuna Biological and Technological Research[1]
(Phuket, Thailand, 7-15 March 2000)

Background

A proposal for this Commission originated from a recommendation of the ICCAT Tuna Symposium held in Azores in 1996, which recognized that the various agencies concerned with tunas would face common research problems with the implementation of the precautionary approach. The Consultation was organized by FAO and was attended by 20 participants and 17 observers from various national and international agencies. ICCAT was represented by P. Miyake (as a member of the Steering Committee and a member of the working group on statistics) and V. Restrepo.

Objectives

The objective of the Consultation was to identify the likely problems that would be encountered in the implementation of the precautionary approach for tunas and to propose research or actions that should be taken in order to confront such problems. The emphasis of the consultation was on four topics: Stock assessment, data collection and statistics, biological and environmental research, and fisheries technological research. Due to logistical problems, the technology theme was integrated with the other three. Participants joined one of the three groups, Data, Biology or Assessment, according to expertise. The Consultation also met frequently in plenary for general discussions and to prepare the report. The output of the consultation includes proposed research actions that elaborate the likely demands to characterize and reduce the uncertainties involved in the management of tuna fisheries.

Data collection and statistics

The Consultation concluded that current fishery statistical and data collection programs do not always provide a complete and accurate dataset for assessing the status of the stocks or for assessing environmental effects and impacts. It was recognized that a full description of the inherent uncertainties in the data would help in evaluating the uncertainties in the results of the stock assessments. The following were identified as sources of uncertainty that are often substantial: IUU fishing; different methods for recording weight/length; mis-identification of species;, deliberate distortion of catch reports; shortcomings in voluntary logbook programs, especially the focus on landings rather than catch; lack of complete data on technology, environment and incidental catches; weak port-sampling systems particularly for transshipments and artisanal fisheries; inadequate estimates of fleet composition in surveys and inadequate sample coverage for artisanal fisheries. Some of the proposed actions were to: better design of stratification and survey systems; widespread implementation of Vessel Monitoring Systems; improved ability of RFBs to handle confidential data from the industry; well-designed tagging programs; well-designed observer programs.

Biological and environmental research

The Consultation carried out a review of tuna and billfish biology, emphasizing those items that required special attention from the point of view of implementing a precautionary approach, such as: their pelagic nature and distribution across a wide range of ecosystems; the ability of most tunas to thermo-regulate; their schooling behavior; their apex predator position in the food chain. Some of the most important factors of biological uncertainly impacting the assessments are: a generally poor understanding of mixing and movement rates between areas; their schooling behavior and its interaction with fishing operations; the lack of direct data on natural mortality rates; variability in growth; a lack of understanding of stock-recruitment relationships and the effect of the environment upon them. Some of the proposed research was to: conduct routine direct aging; conduct more tagging studies for growth, mixing rates and stock structure; estimate natural mortality rates; intensify genetic

1 Originally presented as Document COM-SCRS/00/12 (by V. Restrepo and P. Miyake) to the 2000 meeting of the Commission.

studies; develop studies for discerning the effects of the environment from the effects of fishing on the stocks; develop studies directed at non-target species, including direct surveys; develop ecosystem models to understand the effects of tuna fishing on the ecosystem; develop observer programs to better quantify by-catch; develop/improve methods to sample and identify tuna larvae and eggs; develop applications for remote sensing.

One of the difficulties encountered was the definition of by-catch as there were certainly differences in its usage among scientists.

Stock assessment

The Consultation concluded that the implicit scientific obligations to precautionary management are to determine status relative to limits and targets, to predict outcomes of management alternatives for reaching the targets and avoiding the limits, and to characterize the uncertainty in both of these. Some of the specific research needs for stock assessments and monitoring identified were to: Use control rules as a framework for evaluating management alternatives; improve the ability of models to account for uncertainty; improve the mathematical techniques needed for quantifying the uncertainty of stock status relative to limit and target reference points; develop techniques for incorporating additional sources of uncertainty (e.g. from sensitivity analyses) into the management advice.

Appendix 6

EXECUTIVE SUMMARY

BLUEFIN YEAR PROGRAM

The Committee reviewed the progress made under the Bluefin Year Program, concluding that most of the research goals outlined for 1999/2000 had been met, though at a lower direct cost to the BYP than anticipated. This is largely due to national contributions to the BYP and due to the FAO COPEMED program, which will continue in the year 2001.

The current financial status is reviewed below and recommendations for direct BYP-funded research for the year 2001 in particular, and for the future in general, are made. The two primary areas of research considered important by the Committee are stock structure and maturity, and the particular expenditures needed to accomplish the Committee objectives in the year 2001 are outlined. While sampling for stock structure and maturity remains the highest immediate priority of the BYP, the Committee also recommends support of several additional research activities, which are also itemized below.

Financial report

The financial status through 20 October 2000 with anticipated expenditures through December 31, 2000 is in Table 1 of the Detailed Report. At the end of 2000 there should be a balance of approximately $19,800 (~3,700,000 pesetas).

Progress in 1999 and 2000

The Committee reviewed the progress to date in late 1999 and 2000 with respect to the sampling plan detailed in the 1998 and 1999 BYP reports to evaluate progress in accomplishing the plan. It was noted that expenses to date had been lower than anticipated, though a number of the objectives from the research plan described in the 1999 BYP report have yet to be met, largely due to the multi-year nature of the sampling plan.

The necessary equipment for the Sample Archive Center at the University of Gerona in Spain, was purchased and the Center has received samples during 2000 from multiple countries.

Stock structure sampling targets for 1999 were generally met. Stock structure sampling targets for 2000 were met or partially met in the western Mediterranean for age 0 (partially met); the target for age 1 and age 2 have not been met, but sampling is still underway or anticipated for ages 0, 1 and 2. Sampling targets for the eastern Mediterranean had not been met by early September, but additional sampling efforts were anticipated. Stock structure sampling targets in the East Atlantic (Spain) have been partially met and should be complete by the end of the year. In the West Atlantic to date, the stock structure sampling target was partially met for age 2 and 3; continued sampling is anticipated for age 1. Much of the planned sampling in 1999 and 2000 was conducted at lower direct cost to the BYP than originally anticipated, due in large part to the existence of the FAO's COPEMED program and due to national contributions to the BYP.

Some maturity sampling targets outlined in the 1999 BYP plan are regarded as multi-year targets because of the difficulty of obtaining samples when landings are low or because of the need to sample at sea to achieve some of the targets. Maturity sampling targets were partially met in the eastern Mediterranean. In the western Mediterranean sampling targets appear to have been fully met for many of the components, in large part due to the COPEMED and European Union project. Targets for the year 2000 are anticipated to be met in the East Atlantic through the substantial cooperation and contribution to the BYP by Iceland. In the West Atlantic, substantial progress was made on achieving the targets for most components of the sampling plan.

Research Plan for 2001

Stock structure sampling

The Committee recommended to place highest priority to continue sampling in 2001 under the sampling design established in 1998 and as further elaborated in 1999. That plan calls for sampling very young bluefin in the eastern Mediterranean (Turkey/Cyprus and Croatia), the western Mediterranean (Spain, Italy, Malta, Morocco, Tunisia), the East Atlantic (Spain) and in the West Atlantic (United States) for the purpose of comparing stock structure signatures (genetic and microconstituent) between areas. The western Mediterranean has been sampled in multiple locations during the past two years, and the group recommended continuing that sampling in 2001 so that stock structure signatures between relatively close sites can be examined; such examination is particularly important for microconstituent analysis because the elemental composition of otoliths is thought to be influenced by the environment.

The target sampling levels in 2001 will be: from the western Mediterranean 260 age 0 (30-50 from multiple locations), 110 age 1 and 50 age 2; from the eastern Mediterranean 50 age 0 if available, 50 age 1 (age 2 if age 1 is not available) and 50 age 2; from the East Atlantic 50 age 1 and 50 age 2; from the West Atlantic 125 per age class. The Committee recognized that these sampling targets are part of the sampling design in place in the United States since 1977, and are high for some age classes in the West (age 0 in nearly all years and age 1 in most years). Recommended expenditures in the year 2001 to meet these objectives are outlined in **Table 1**.

Maturity sampling

During 1999 and 2000, two projects (one European Union project and the other a U.S. project) reported successfully developing methods of determining maturity by measuring hormones in muscle tissue. The Committee noted that these techniques actually attempt to measure possible reproductive activity within a specific year rather than whether a fish is capable of spawning in that or other years. The Committee noted that it was desirable to accomplish three tasks to complete the research and to begin development of maturity at size relationships. The first is to obtain samples of muscle, gonad and blood at various stages of maturity in different periods and from both sexes, the second is to define the period when the reproductive hormones are present in the tissues, and the third is to obtain samples from a representative sample of the population to characterize the maturity at size. The Committee further noted that for some time/area strata, multiple years of sampling may be needed to obtain desired sample sizes. Investigations are also underway in the Mediterranean (EU+COPEMED) using gonosomatic indices and histological studies.

- Limited sampling to obtain blood, muscle and gonads

Samples of blood, muscle and gonad samples from the same fish were requested during various periods before, during and after the spawning season to fully demonstrate the validity of their assays. Sampling targets appear to have been met or probably will be met for the western Mediterranean (Spain and other COPEMED countries) and in the East Atlantic due to the voluntary contributions of Iceland to the BYP. Continued sampling in time and size strata not available to those fisheries will be needed in 2001. Sampling that has taken place in recent months and also anticipated later in the year in the eastern Mediterranean, which was not originally planned, may in fact fulfill targets for the third and fourth quarters. Some progress was made on this component in the West Atlantic (quarters 1 and 2).

- Sampling to determine hormone presence

There is uncertainty about the months in which reproductive hormones are present in bluefin muscle. Samples were obtained in 2000 and earlier years which meet the sampling targets defined for many months for the western Mediterranean and the West Atlantic and good progress was made in the eastern Mediterranean and the East Atlantic. To complete the sampling design will require continued sampling in some areas and from fisheries not sampled in 2000.

- Sampling to estimate maturity at size

This part of proposal is to obtain numerous samples over a broad size range for estimating maturity at size. Ideally sampling would occur from before and after the spawning period (rather than during the spawning period) when both reproductively active and inactive bluefin might be mixed. Good coverage is noted from samples collected in 2000 as well as in earlier years (assuming that samples preserved in ethanol can be used for maturity studies; these are tabulated with frozen tissues which can be used for such studies). Sampling targets were or will be met for many size strata and months in the western Mediterranean, the East Atlantic (larger fish) and the West Atlantic. It is believed that some additional samples may have been obtained from the eastern Mediterranean in recent months. Additional sampling will be needed to complete the sampling designs for the some sizes and months.

Recommendations

Recommendations for BYP funding in 2001

As highest priority for the BYP in 2001, the Committee recommends expenditures of $37,000 to cover expenses associated with stock structure and maturity sampling for bluefin during the upcoming year. Taking into account the current estimated balance for BYP, this would require a Commission contribution of approximately $17,000 (~3,200,000 pesetas) in 2001. It is recognized that the actual costs of achieving this research is substantially higher, but that significant costs are contributed to the BYP by national research programs. This amount, however, assumes that COPEMED will contribute to some extent in 2001. In 2000, COPEMED funding covered approximately $7000 (~1,310,000 pesetas) of the overall costs of the sampling activities.

As next priority for the BYP in 2001, the Committee recommends expenditures of $20,000 (~3,740,000 pesetas) to contribute to the expenses for planning and coordinating four research activities viewed as essential to the future of BYP. Of the 4 items below, items i and ii have somewhat higher direct application to the BYP. Items iii and iv are of a more general nature and would benefit from support by other research programs (BETYP, Enhanced Research Program for Billfish).

i The Committee endorses the concept of the proposed exploratory research sampling of larvae and spawning-sized bluefin tuna and the associated oceanographic conditions in the central Atlantic as outlined in SCRS/00/125. It recommends that the sampling design be further elaborated. The Committee recognizes that this research is very expensive and is beyond the current capability of the Bluefin Program, but recommends that $5000 (~930,000 pesetas) be contributed to support planning, coordination with the activity identified under ii) below, and implementation.

ii The Committee endorses the proposed research sampling of larvae and spawning-sized bluefin tuna and the associated oceanographic conditions in and around the Balearic Islands as outlined in the research proposal developed by EC-Spain. The Committee recognizes that this research is very expensive and is beyond the current capability of the Bluefin Program, but recommends that $5000 (~930,000 pesetas) be contributed to support planning, coordination with the activity identified under i) above, and implementation.

iii There is also a need to increase the accuracy on estimation of recruitment levels. The Committee endorses the recommendation of the Sub-Committee on the Environment to initiate planning for a workshop in 2002 to address the effects and relationship between environment and recruitment and how these could be reflected in the stock assessments. This will require convening a steering committee meeting in 2001 to facilitate the workshop. The Committee recommends that $5000 (~930,000 pesetas) be contributed to support this work in 2001.

iv There is a need to study the best proxy for MSY (in the absence of a direct estimate). The Committee endorses the simulation activities of the *Ad Hoc* Working Group on Precautionary Approach. The Committee recommends that $5000 (~930,000 pesetas) be contributed to support this work in 2001.

Recommendations for BYP activities not requiring BYP funding

The Committee recommends that information on the Bluefin Program be added to the ICCAT web site. That information should include objectives of its primary sampling programs, current sampling targets and information on samples collected to date as well as sampling protocols and where and how to ship samples.

The Committee recommends that a steering committee of scientists from entities involved in Atlantic bluefin research be formed to develop procedures for scientists to follow when submitting requests for access to the sample materials collected and archived in the eastern and western Atlantic sample Centers under the BYP. These procedures will require a proposal to be reviewed by the steering committee participants. These procedures should be developed through correspondence and recommended to the SCRS early (by March) in 2001.

The Committee recommended that each sample archive center (NOS in Charleston, South Carolina, U.S.A. and University of Girona, Spain) submit reports on samples available in their archives to the SCRS for each annual meeting and that a second report be submitted to the ICCAT Secretariat by 1 April each year covering at lEast all samples collected during the previous year. The group requested that laboratories which have independently collected samples and which have not sent duplicate material to one of the sample archive centers, also submit reports to ICCAT and the SCRS. All groups should take care to avoid double counting samples which have been exchanged between groups by separately tabulating samples received from other laboratories.

The Committee recommends continued tagging efforts in the East Atlantic and Mediterranean and supports the collaboration of the European Union and COPEMED countries in this regard. It also encourages continued collaboration between western Atlantic and eastern Atlantic-Mediterranean electronic tagging research groups. It is noted that the recent GFCM-ICCAT meeting identified the need to discover and adjust for the differences in the success rates observed between the different groups.

Table 1. Anticipated expenditures (pesetas) for bluefin program sampling for stock structure and maturity studies during 2001

	Pesetas
Croatia	263,200
Iceland	238,500
Italy (Ionian)	333,000
Italy (Ligurian)	307,000
Italy (Tyrrhenian)	81,000
Libya	300,000
Malta	650,000
Morocco	475,000
Portugal (Madeira)	225,000
Spain (Bay of Biscay)	650,000
Spain (Mediterranean/Gibraltar)	1,675,000
Tunisia	225,000
Turkey	752,000
additional shipping	939,000
TOTAL	**7,113,700**

Appendix 7

EXECUTIVE SUMMARY

REPORT ON THE BETYP ACTIVITIES FROM OCTOBER 1999 UP TO SEPTEMBER 2000

The Coordinator of the Program visited the National Laboratories in the main areas of the Program, including Azores, Madeira, Canary Islands, Ivory Coast and Ghana. Meetings of the BETYP Committee took place in Madrid in January, May and September, 2000. Conventional tagging activities started out of Tema following a training period in October and November 1999. Agreements were signed with a vessel owners from Azores and Ghana for the use of fishing vessels for tagging activities. Tagging activities were carried out in Azores and Canary Islands. Arrangements were made for an external tagging expert to participate in the Working Group meetings that took place during the 1999 SCRS meetings. A tagging manual was prepared and distributed to the National Laboratories. Contacts were maintained to pursue hard parts and genetic studies and for archival tags deployment. The program of activities for the *R/V Shoyo-Maru* research cruise was followed.

BETYP 2000 Budget (in US$) and Status as of September 15, 2000

ITEM	*2000 Budget*	*Expenses to September 15**
Salaries	$105,000	$73,576
Coordination expenses	$20,000	$7,854
Travel	$20,000	$7,790
Meetings	$30,000	$510
Tagging activities, conventional tags:		
Azores	$20,000	$13,334
Madeira	$20,000	
Canary Islands	$20,000	$22,406
Senegal		
Tema	$250,000	$28,320
Tagging strategy research		
Tag materials	$10,000	$9,178
Tag rewards	$10,000	
Various	$15,000	
Pilot study, electronic tags	$70,000	$2,697
Statistic improvements Tema	$5,000	$846
Sampling for growth hard parts	$10,000	
Printing and Publications	$0	
Contingencies	$10,000	
Total expenses	**$615,000**	**$166,511**

* Some expenses are best estimates

REPORT ON THE BETYP ACTIVITIES

Contributions

The following contributions were received from January to September, 2000:

Origin	*US $*
Azores	4,606
European Commission (20% from 1999)	46,189
European Commission (80% from 2000)	163,442
Japan	230,945
Chinese Taipei (50% from 1999)	50,000
ANABAC	4,530
Other Income (bank interest)	2,133
TOTAL INCOME	**501,845**

Note: The exchange rate of the month when the contribution was received was applied for the Peseta/Dollar conversion.

Travel

The Coordinator traveled to Azores, Madeira, Canary Islands, Ivory Coast and Ghana to visit the National Laboratories in order to coordinate the BETYP activities, as well as to maintain the necessary contacts for the contracting of fishing vessels to be used in tagging operations

Meetings

Meetings of the BETYP Coordinating Committee were held in Madrid on January May and September, 2000. A meeting on the Archival Tagging chapter of the Program was held at the AZTI office on September 15, 2000 (See Appendices 1, 2, 3 and 4 in SCRS/00/16 Rev. in *Collective Volume of Scientific Papers, Vol. LII.*)

Conventional tagging operations

Azores

An agreement was signed with the owner of a bait boat fishing vessel for its use during 30 days of tagging operations at a price of 3,000,000 Portuguese Escudos. (Equivalent to 2,87,787 Pesetas and approximately US$ 14,000.00).

All catch remaining on board due to impossibility or inadvisability of its tagging, was sold in the local market and the proceeds credited to the BETYP.

During the operation, 37 bigeye and 115 skipjack were tagged. The activities took place between June 15 and July 18, 2000.

Madeira

Up to September 15, 2000 no tagging operations were performed due to lack of tuna in the surrounding fishing areas.

Canary Islands

The personnel of the "Instituto Español de Oceanografía" based in Tenerife carried out one tagging cruise as the fleet was not fishing at full capacity during this season. The trip started on August 15 and ended on August 28, 2000, and 463 bigeye, 41 skipjack, and 1 yellowfin tunas were tagged. The cost of this operation, which amounted to 4,179,280 pesetas (approximately US$ 23,000.00) was paid by the BETYP.

Tema, Ghana

The tagging activities are carried out by personnel of the Marine Fisheries Research Division (MFRD) after receiving training the last week of October and first week of November, 1999. An agreement was reached with Dr. Alain Hervé from the IRD to be the instructor. During the on board portion of the training course, 17 bigeye, 411 yellowfin and 285 skipjack tunas were tagged and released. (SCRS/00/31).

An initial agreement was reached with the fishing company TTV Limited from Tema, Ghana, for the exclusive use of a baitboat fishing vessel in tagging operations. The price agreed was US$ 6,000 per day. All fish remaining on board at the end of each trip was sold and the proceeds credited to the BETYP. This cruise on board the *F/V Gbese 9* took place between November 15 and December 12, 1999, tagging 372 bigeye, 217 yellowfin and 281 skipjack tunas. The cost of this operation was $144,982.00.

At the BETYP Coordinating Committee Meeting in January 2000, this operation was analyzed and the conclusion reached was that dedicated tagging was not being cost effective in the Gulf of Guinea, so the Coordinator was instructed to explore the possibility of contracting with TTV, Ltd. opportunistic tagging operations.

A new contract considering this modality was reached with TTV, Inc. in which BETYP would pay US$200 per day plus the market cost of the tagged and released tuna. The following table shows the tagging cruises made and number of tagged tunas by species:

Vessel	*From:*	*To:*	*Bigeye*	*Yellowfin*	*Skipjack*
Gbese 11	April 12, 2000	May 4, 2000	11	58	317
Gbese 6	April 18, 2000	May 13, 2000	0	16	284
Gbese 9	July 1, 2000	July 31, 2000	5	104	141
Gbese 6	July 1, 2000	August 1, 2000	0	59	239

The personnel were instructed to sample no less than 50 tuna specimens at random during each fishing operation; a total of 4083 tunas were sampled.

Tagging plan

The Coordinator contacted Dr. John Hampton from the South Pacific Commission (SPC) as suggested by several members of the BETYP Committee. Dr. Hampton agreed to participate in the 1999 SCRS and Working Group meetings and he presented a Review of the ICCAT Bigeye Year Program (see document SCRS/99/149)

Tag Posters

The posters have been translated into English, Spanish, French, Portuguese, Chinese and Japanese and are being distributed by the national laboratories to appropriate institutions

Pilot study using electronic tags

The Coordinator has been in touch with two manufacturers of Electronic Tags and with Dr. Molly Lutcavage from the New England Aquarium who has experience in this matter. A project with the collaboration of AZTI, DOP, Dr. Lutcavage and the financial assistance of the Basque Government has been established for tagging with electronic tags large bigeye from Azores during the 2001 fishing season. A preparatory meeting was held at the AZTI office on September 15, 2000. (See Appendix 4 of SCRS/00/16 Rev. in *Collective Volume of Scientific Papers, Vol. LII.*)

BETYP will collaborate with two pop-up tags to be deployed in addition to the two already scheduled during the *Shoyo-Maru* cruise later in 2000.

Statistics improvement - Tema, Ghana

Extensive work has been carried out at MFRD regarding support to improve the sampling, statistics and tagging operations. This work has been done by Mr. Paul Bannerman with the assistance of Dr. Xavier Bard who is stationed at IRD Abidjan. Bannerman and Bard are presenting a joint document on their progress to SCRS (SCRS/00/121)

Otoliths and hard parts

After the May 2000 BETYP Committee meeting, Francis Marsac communicated to the Coordinator that he had received a positive reply from Pr. Dean to his proposal of a co-operative work between his lab (Marine Science Program, University of South Carolina) and IRD, regarding the growth of bigeye (more specifically the potential change in growth rate induced by the massive aggregation at FADs) using the otolith processing technique. The Coordinator suspended negotiations with AZTI on this subject.

Genetic studies

Contacts continue with Dr. Jaime Alvarado Bremer from Texas A&M University.

Research cruise by the R/V Shoyo-Maru

See Document SCRS.

Proposed BETYP activities for 2001

Conventional tagging

Continue conventional tagging activities as in the two previous years in Azores, Canary Islands and Madeira.

Increase the tagging activity in the Gulf of Guinea for which the European Commission and Japan whose contributions were received in September 2000 are requested to allow to carry over any unspent contributions from 2000 into 2001.

Archival and pop-up tagging

Carry out the program proposed during the September 2000 meeting with the participation of AZTI and DOP.

Otoliths and hard parts

Carry out the program in collaboration with IRD.

Genetic studies

Carry out the program in collaboration with Dr. Jaime Alvarado Bremer of Texas A&M University.

Improvements to Tema statistics

Continue assisting MFRD with the collaboration of Dr. Xavier Bard.

Integrated statistical model

Carry out throughout the third quarter of 2000 and the years 2001 and 2002 the program proposed by Dr. Victor Restrepo. (See Appendix 5, SCRS/00/16 Rev. in *Collective Volume of Scientific Papers, Vol. LII.*)

Endorsement

The outlook of the bigeye stock remain uncertain. The Committee anticipates that the on-going BETYP will enhance the assessment in the near future to a great extent, so that the Committee can provide the Commission with more accurate advice. The Committee recommends strong support by the Commission to this Program.

Proposed 2001 budget for the BETYP

The BETYP proposed budget for 2001 is presented in **Table 1** and it is for the amount approved in the 1999 Revised Plan, Madrid, Spain, January 28-29, 1999 (SCRS/99/22).

Table 1. BETYP 2001 Proposed Budget (in US$)

ITEM	*US$*
Salaries	**115,000**
Coordination	**15,000**
Travel	**15,000**
Meetings	**25,000**
Tagging	**340,000**
Azores	20,000
Madeira	20,000
Ghana	250,000
Canary Islands	20,000
Rewards	10,000
Various	15,000
Materials	5,000
Archival and Pop-up Tags Pilot Study	**50,000**
Tema statistic improvements	**5,000**
Hard parts	**10,000**
Contingencies	**10,000**
TOTAL 2001 BUDGET	**585,000**

Appendix 8

ICCAT ENHANCED RESEARCH PROGRAM FOR BILLFISH
2000 Expenditures/ Contributions, Program Highlights, & Program Plan for 2001

Program objectives

The original plan for the Enhanced Research Program for Billfish (SCRS 1986) included the following specific objectives: (1) to provide more detailed catch and effort statistics, and particularly size frequency data; (2) to initiate the ICCAT tagging program for billfish; and (3) to assist in collecting data for age and growth studies. The plan was initially formulated in 1986 and implemented in 1987 with the intention of developing the data necessary to assess the status of the billfish stocks. Efforts to met this goal have continued through 2000 and are highlighted below.

The ICCAT Enhanced Research Program for Billfish, which began in 1987, continued in 2000. The Secretariat coordinates the transfer of funds and the distribution of tags, information, and data. The General Coordinator of the Program is Dr. J. Powers (USA); the East Atlantic Coordinators are Dr. T. Diouf (Senegal) and Mr. P. Bannerman (Ghana), while the West Atlantic Coordinator is Dr. E. Prince (USA). The billfish data base is maintained at the NMFS Southeast Fisheries Science Center (Miami, Florida) and at the ICCAT Secretariat. A tentative change involving the East Atlantic Coordinators may occur at the end of the year, as T. Diouf (Senegal) may not be able to continue as Co-Coordinator. If this change does occur, Mr. N. N'Goran of Côte d'Ivoire will replace Mr. Diouf.

Contributions and expenditures in 2000

This report presents a summary of the contributions and expenditures for the ICCAT Enhanced Research Program for Billfish during 2000. In 2000, funding for the ICCAT Enhanced Research Program for Billfish operated under the new financial arrangement established by the 1997 SCRS (see 1997 STACFAD Report, item 9.3). The STACFAD specified that the Commission should make at least a symbolic contribution (US$ 10,000) to the Enhanced Research Program for Billfish and this was continued in 2000 (1997 STACFAD Report, items 9.5 and 9.9). As a result of this development, the Program in 2000 was fully coordinated by the Secretariat in consultation with area coordinators and member countries.

Table 1 shows the status of funds available towards Billfish Program activities, expenses for 2000, and the current balance of Billfish Program funds (7,036,107 Pesetas or ~US $37,456, as of October, 2000). It should be noted that accounting of all income and expenses is carried out in Pesetas, and U.S. Dollar amounts are converted to Pesetas at the official monthly UN exchange rate in effect when the accounting entry is made.

At the start of Fiscal Year 2000 there was a balance of 3,558,941 Pts (~US$18,946) available from the previous year for 2000 Program activities (**Table 1**). This balance included a voluntary contribution of 826,105 Pts (US $5,000) from Chinese Taipei that was received in December, 1999. Additional contributions in 2000 included an allocation of 1,700,000 Pts (~US$10,000) from the regular Commission budget, and voluntary contributions amounting to 6,425,602 Pts (US$35,699) from The Billfish Foundation. Thus the total funds available for the 2000 Billfish Program (**Table 1**) amounted to 11,684,543 Pts (~US$62,201). It should be noted that additional funds were donated to the Billfish Program in 2000 by The Billfish Foundation to support travel to the Fourth ICCAT Billfish Workshop and for hard cover publication of the Billfish Workshop report (US$5,000).

Starting in 1996, the FONAIAP (Venezuela) and in 1997, the *"Instituto Oceanográfico"* (University de Oriente) has provided personnel and other resources as in-kind contributions to the at-sea sampling program, thereby reducing the amount of funds needed for this activity from the ICCAT billfish funds. In addition, the *"Instituto de Pesca"* and IBAMA (Brazil) have provided in-kind contributions by making logistical arrangements for a training course of at-sea observers, which was conducted by the Western Atlantic Coordinator in Santos,

Brazil. IBAMA had intended to cover half the costs of the first at-sea observer sampling program from Brazil, but unfortunately this could not be accomplished in 2000 due to administrative delays. This activity has been re-scheduled for 2001 under the auspices of the Fisheries and Aquaculture Department of the Ministry of Agriculture. The U.S. National Marine Fisheries Service assumed some of the costs of coordination travel for the West Atlantic as an in-kind contribution to the Billfish Program for 2000 (see SCRS/00/150 for details). The Department of Agriculture and Fisheries of Bermuda also contributed in-kind contributions by providing personnel and other resources, as well as substantial financial resources for purchasing pop-up satellite tags used for assessing post release survival of Atlantic blue marlin in the recreational fishery (SCRS/99/97).

Overall, the Program Plan for 2000 was successfully carried out in a timely manner and An SCRS working document or report summarizing the Billfish Program at-sea sampling data base was not presented this year. Instead, electronic copies of the at-sea sampling data base was made available to the Fourth ICCAT Billfish Workshop (SCRS/00/23) held in Miami, Florida, from July 18-28, 2000.

Table 2 shows the 2000 Billfish Budget and Expenditures (as of October 9, 2000). Several additional expenditures are expected to be incurred before the end of 2000 and into the first quarter of 2001, such as payment of observer coverage in Venezuela and Brazil, and Program coordination travel. Therefore, there is a need to carry over the 2000 balance in Billfish Program funds to the 2001 Budget, as has been the practice for this and other special programs in previous years. Several budgetary items show a zero expenditure and this is due to the fact that authorization of some 2000 budgetary expenditures was dependent on the sufficiency of funds, while in other cases no request for funding by Program participants was submitted. The Working Group requests that the Commission again provide the same level of research funding in 2001 as it did in 2000. In addition, voluntary contributions, including those from The Billfish Foundation and Chinese Taipei will also be necessary to carry out the program plan in 2001.

Research carried out during 2000 is summarized in the Report of the Fourth Billfish Workshop (SCRS/00/23). A total of 24 working documents were submitted to the Workshop for inclusion in the Report. Additional documents submitted to the 2000 SCRS concerning billfish included: SCRS/00/141, SCRS/00/150, SCRS/00/163, SCRS/00/176, and SCRS/00/177.

Program highlights

The goals of the Program were at least partially fulfilled with the exploratory stock assessments for blue marlin (SCRS/92/69) accomplished at the Second ICCAT Billfish Workshop in July, 1992, and later with refined blue marlin and white marlin assessments submitted to the 1992 SCRS (SCRS/92/128 and SCRS/92/129). In addition, further progress was made at the 1993 SCRS meeting with the submission of the assessment for west Atlantic sailfish (SCRS/93/99) and improvements in the data base for east Atlantic sailfish reported to the 1994 SCRS (SCRS/94/150, SCRS/94/155, and SCRS/94/156). An exploratory stock assessment for east Atlantic sailfish was submitted to the 1995 SCRS (SCRS/95/105). Assessments for blue marlin and white marlin were accomplished at the Third ICCAT Billfish Workshop (COM-SCRS/96/19, SCRS/96/159). Estimated parameters from these marlin assessments were used to make future projection of relative biomass and relative fishing mortality and these projections were submitted to the 1997 SCRS (SCRS/97/71). Some progress was also made at the 1997 SCRS concerning standardization for east Atlantic sailfish CPUE (SCRS/97/53, SCRS/97/68, and SCRS/97/52), but some problems concerning the data persist. More recently, the Fourth ICCAT Billfish Workshop (COM-SCRS/00/23) updated assessments for blue and white marlin and further refined the data base upon which the assessments were based. Estimated parameters from the recent blue marlin assessment were used to make future projections of relative biomass and relative fishing mortality and these were submitted to the 2000 SCRS (SCRS/00/163). The results of the Fourth ICCAT Billfish Workshop (SCRS/00/23) agreed with the previous two assessments that blue and white marlin are over-exploited and have been for at least 10 to 15 years.

A study reviewed during the 1998 SCRS demonstrated that spatial and temporal variability in the species composition of U.S. longline catches could be exploited to reduce marlin catches with less than equal effect on the target species (SCRS/98/122). The Committee felt that similar analysis should be performed for the Atlantic basin as a whole. Progress was also made during the 1998 SCRS in evaluating the robustness of the non-equilibrium production model used to assess the stock status of blue marlin populations (SCRS/98/121). The study used an age and length structured blue marlin simulation model to generate time-series of catch and CPUE data similar to that

available from the actual fishery. These data were analyzed using ASPIC to estimate the status of the simulated stock, and the results were compared to the known conditions from the simulations. The study concluded that ASPIC estimates of fishing mortality were slightly optimistic and estimates of current stock status were slightly pessimistic, but the error was small for reasonable biological representations of the blue marlin population. Further, the greatest source of potential error in the current assessment is undoubtedly associated with uncertainty in the actual catch and CPUE data used in the assessment, not with the use of the production model itself.

During the 1999 SCRS, preliminary scientific by-catch landing estimates were submitted for the first time for blue marlin, white marlin and sailfish/spearfish, from the Spanish off-shore longline fleet that targeted swordfish for the period 1988-1998 (SCRS/99/110). In addition, two separate documents (SCRS/99/49 and 132) provided information on the by-catch of billfish from tropical purse seine fisheries (Spain and France) and these data may provide a means for estimating the billfish by-catch from these fisheries. One additional paper describing the billfish by-catch from tropical purse seine fleets was submitted to the Fourth Billfish Workshop (SCRS/00/23) and these data were used by the Workshop to estimate historical landings for this gear. In addition, a document on this topic was also submitted to the 2000 SCRS (SCRS/00/141). A pilot study conducted off Bermuda examined the feasibility of using pop-up satellite tag technology to evaluate the post-release survival of blue marlin caught in the recreational fishery (SCRS/99/97). A second related document evaluated the factors affecting the robustness of estimates of release mortality using pop-up tag technology (SCRS/99/100). Initial results from this work indicate blue marlin survival from recreational catches are quite high and the study recommended its use for commercial longline gear as well. However, pop-up satellite technology is expensive and sample size requirements for precise estimation of Atlantic-wide post release survival per gear category may be large. Additional research using pop-up satellite tags to assess post-release survival from longline vessels were initiated in 2000 (brief summary in the U.S. National report, SCRS/00/142) and this research was also quite successful.

Relative to the new information submitted to the 1999 SCRS, the Committee recommended an evaluation of the species composition of the catch by different fleets and time area strata to see if it is possible to estimate historical catches by the Spanish longline fleet from Spanish longline effort by year and area prior to 1988. Also, the Committee believes there should be an effort to evaluate the relative catchabilities of marlin and other species by gear and fishing area, and some of this was accomplished during the data preparatory session of the Fourth ICCAT Billfish Workshop (COM-SCRS/00/23). The Committee recommends continued examination of the robustness of ASPIC and other alternative assessment schemes that may be applied to blue marlin and other billfishes in the future. The Committee also recommends that the Enhanced Research Program for Billfish be continued and expanded in critical areas, as recommended by the Second, Third, and Fourth ICCAT Billfish Workshops (SCRS/92/16, COM-SCRS/96/19, COM-SCRS/00/23), as many of the data acquisition problems for all billfish species remain, including landings and CPUE data identified above as the greatest sources of potential error in assessments. In addition, maintenance of important elements of the billfish databases, to insure uninterrupted time series, also requires the Enhanced Research Program for Billfish to be continued and expanded.

Program coordination, protocols, and plan for 2001

It was confirmed that Drs. J. Powers and E. Prince (U.S.A.) will continue to function as the General Coordinator and West Atlantic Coordinator, respectively. Dr. T. Diouf (Senegal) and Mr. P. Bannerman (Ghana) will act as Co-Coordinators for the East Atlantic Ocean. Research results as described in the Report of the Fourth ICCAT Billfish Workshop (SCRS/00/23), Executive Summaries for each species, as well as a financial summary for 2000, were presented to the 2000 SCRS and Commission meetings.

The summary of the 2001 proposed budget is attached as **Table 3**. Highlight reports of research activities will be provided to interested parties annually. In addition, names and addresses of individuals receiving the reports and those involved or interested in the research program will continue to be made available upon request. Projected funds for future research activities will be available in subsequent annual plans.

All agencies and/or personnel receiving funding from the special Billfish Program account are required to summarize annual expenditures of funds to the Commission and research activities, either in the form of a working document to the SCRS or a report to the Program Coordinators. Due to changes in the financial structure of the ICCAT Billfish account, all participating cooperators in this Program are now required to request the release of funds (via fax or email) directly from the ICCAT Secretariat, as well as General Program Coordinator and area

Coordinators. In other words, the release of Program funds are not automatic, even if expenditures are described in the Program Plan– release of funds are contingent upon requests being received by the ICCAT Secretariat and Program Coordinators. In addition, program participants are required to submit data collected in previous years to area Coordinators or directly to the ICCAT Secretariat.

Statistics and sampling

Shore-based sampling

West Atlantic

- Bermuda

Shore-based sampling of the annual billfish tournament will be conducted in Bermuda in 2001. Dr. B. Luckhurst of the Department of Agriculture and Fisheries of Bermuda will coordinate this activity, and no funds will be required. Bermuda will continue to conduct research involving pop-up satellite tags to evaluate the post-release survival of blue marlin caught off Bermuda in 2001, provided sufficient funds for this activity can be obtained. This work may also require some travel to Bermuda by the western Atlantic coordinator to facilitate this research.

- Brazil

Shore-based sampling of selected billfish tournaments will be continued in Brazil for 2001 in the general vicinity of Santos, as well as other locations off southeastern Brazil. Dr. A. Amorin, *"Instituto de Pesca"*, will coordinate tournament-sampling activities. Shore-based sampling will begin in Fernando de Noronha Island and other locations of northeastern Brazil and this activity will be coordinated by UFRPE. It is not anticipated that this activity will require funds in 2001.

- Cumaná, Playa Verde, Punto Fijo, and Margarita Island, Venezuela

Shore-based sampling of size frequency data for billfish carcasses off-loaded from industrialized longline boats at the port of Cumaná will be continued in 2001. Funding will be $720 since some of this activity occurs on weekends and after normal working hours. Likewise, sampling artisanal fisheries in Playa Verde will be accomplished by contracting a technician on a part time basis. Funding for this activity in 2001 is $1,680. Sampling artisanal longline boats and artisanal fisheries in Punto Fijo and Margarita Island will be conducted in 2001 and the requested funding for these segments is as follows: Punto Fijo $360, and Margarita Island $720. Trips by the West Atlantic Coordinator or his designee may be necessary to organize sampling, collect data, and transport biological samples to Miami in 2001. In addition, the amount of $900 will be required for tag rewards in Venezuela for 2001 that are made by FONAIAP staff (this budget item is identified in the Section on Tagging).

- La Guaira, Venezuela

Shore-based sampling and detailed analysis of the recreational fishery (centered in La Guaira, Venezuela) will be continued in 2001. This sampling includes coverage of ten recreational billfish tournaments held in Puerto Cabello, La Guaira, Falcon, and Puerto La Cruz. Requested funding for this activity in 2001 is $1,000 since much of this sampling is conducted on weekends and some travel expenses are incurred while attending these events. Also, shore-based sampling, including documentation of the catch and effort statistics for the important recreational fishery at Playa Grande Marina, will be accomplished by contracting a technician on a part-time basis. Funding for this activity in 2001 is $480. Shore-based sampling in all Venezuelan locations, as well as at-sea sampling (see next section) in Venezuela will be coordinated by Mr. L. Marcano of FONAIAP.

- Grenada

Shore-based sampling of size frequency and total landings from the artisanal and recreational fishery for billfish will be continued by the Ministry of Agriculture, Lands, Forestry, and Fisheries (coordinated by Mr. C. Isaac and Mr. P. Phillip) in 2001. Shore-based sampling activities will start in early November, 2001, to coincide with the start of

the pelagic fishery at this location. This activity will also include sampling of the Spice Island Billfish tournament. Requested funding for 2001 is $1,000.

- Jamaica

Shore-based sampling of the size frequency, total landings, and catch and effort statistics from the recreational fishery can not be continued in 2001 until a new contact can be made in this location. Dr. Guy Harvey has since moved to the Cayman Islands and can no longer continue this work. Requested potential funding, should contacts be made. will be $1,000 for 2001.

- St. Maarten, Netherlands Antilles

Shore-based sampling of size frequency data for off-loaded billfish carcasses from longline vessels will be continued in 2001 through the Nichirei Carib Corporation. Requested funding for this in 2001 is $1,500. Shore-based sampling of the annual recreational billfish tournament, initiated in 1992, may be continued in 2001 by the West Atlantic Coordinator or his designee (if time permits). Since this tournament normally contributes travel expenses for the week of the tournament, the West Atlantic Coordinator may also assist Nichirei Carib employees in sampling during his stay on the island. Thus, funds for this latter activity will not be required from the Program.

- Uruguay

An evaluation of the historical billfish landings and CPUE data base from Uruguay will be conducted by Mrs. O. Mora, *Instituto Nacional de Pesca* (INAPE) in order to assess the possibility of recovering historical landing statistics in the necessary formats required for Task I and Task II reporting. A report will be submitted to the 2001 SCRS concerning this activity but will not require funding in 2001.

- U.S. Virgin Islands

Shore-based sampling of recreational billfish tournament in the U.S. Virgin Islands maybe continued in 200 if staff from the Virgin Islands Big Game Fishing Club in St. Thomas is agreeable. Requested funding for 2001 is $2,000.

- Trinidad and Tobago

Shore-based sampling of size frequency data for off-loaded billfish carcasses from China-Taiwan and longline vessels from Trinidad may be re-initiated in 2001. This work, if conducted, will be supervised by Ms. C. Chan A Shing of the Ministry of Food Production and Marine Exploitation (Fisheries Division). At least one trip by the West Atlantic Coordinator, or his designee, will be necessary to review the research plan and organize field research activities. Requested funding for 2001 is $1,000.

East Atlantic

- Dakar, Senegal

Shore-based sampling of the Senegalese artisanal, recreational and industrial fisheries for billfish size frequency, sex determination, and catch and effort data will be continued in 2001 by Dr. T. Diouf, the East Atlantic Coordinator. Requested funding for 2001 is $1,500. The East Atlantic Coordinator may travel to Gabon, Ghana, Sao Tome & Principe, and other West African countries in 2001 to verify species identification of recent reported landings.

- Côte d'Ivoire

Abidjan shore-based sampling of the artisanal and recreational fisheries for billfish will be continued and directed by Mr. N. Nestor of CRO in 2001. Funding for 2001 will be $1,500.

- Gabon

A sampling plan for the artisanal fisheries of Gabon that catch billfish will be developed by Mr. O. Rue Robert, Director of artisanal fisheries (Ministry of Fisheries), in consultation with the Eastern Atlantic Coordinator. No program funds will be required for 2001.

- Ghana

Shore-based sampling of size frequency and sex determination, and catch and effort of the artisanal gillnet fisheries for billfish will be continued in 2001 by Mr. P. Bannerman. Funding for 2001 will be $1,500. Some travel by the East Atlantic Coordinator may be required to accomplish this task in 2001.

- Canary Islands

Shore-based sampling of size frequency of off-loaded billfish carcasses from Chinese Taipei longline vessels may be continued in 2001. Requested funding for 2001 is $400.

- Morocco

Inquires will be made by Dr. A. Srour, of the "*Institut National de Recherche Halieutique*", to improve the knowledge of the recreational fishery for billfish in Morocco and for establishing a sampling program in 2002. Funding for this activity in 2001 is not anticipated.

At-sea sampling

West Atlantic

- Venezuela

At-sea sampling out of the ports of Cumaná, Puerto La Cruz, and Margarita Island will be continued in 2001. A total of about 15 tuna trips and 15 swordfish trips on mid-sized industrial longline vessels will be made in 2001, and the cost will be $15,000. In addition, two long-range trips on large Korean-type vessels ($2,880), and two trips on smaller longline vessels ($528) will be made in 2001. Therefore, the total West Atlantic at-sea sampling for 2000 will be $18,408. In addition, insurance for at-sea sampling for 2001 will be $1,200.

- Brazil

At-sea sampling on Brazilian, Spanish, and U.S. longliners will be initiated in 2001. Dr. F. Hazin from the UFRPE will direct these research activities. Independent funding of this activity from Brazil in the amount of $4,000 is planned to cover at least five trips. Likewise, funding from the ICCAT Billfish Program is intended to match this effort, with a proportionate increase in the total number of trips that can be accomplished in Brazil during 2001. Insurance for Brazilian observers are estimated at $35 per 30 day trip. Total insurance is about $350 if 10 trips are accomplished. Requested funding for 2001 will be $4,000 for sea pay and $350 for insurance.

- Bermuda

At-sea sampling of home based longline vessels targeting pelagic species maybe initiated in 2001 by the Department of Agriculture and Fisheries, provided this fishing activity takes place. Possible biological sampling opportunities on home based longline vessels will also be assessed. ICCAT funding of this research activity is not required in 2001. In addition, the Department of Agriculture and Fisheries will continue to facilitate deployment of pop-up satellite tags on blue marlin from recreational and longline vessels fishing off Bermuda. This proposed work represents a continuation of a commitment to study the post release survival of blue marlin. Some travel costs for Dr. Luckhurst may be required for his participation relative to deployment of pop-up satellite tags in various Atlantic locations. Travel costs for this activity in 2001 will be $5,000.

Post-release survival using pop-up satellite tags

A proposal to evaluate post release survival of blue and white marlin using pop-up satellite tag technology is planned by scientists from the Virginia Institute of Marine Science (Dr. John Graves), Bermuda Department of Fisheries (Dr. Brian Luckhurst), and the U.S. National Marine Fisheries Service (Dr. Eric Prince). This project is independently funded but will require funding of air faire for research associates to travel to various Atlantic locations for the deployment of tags in 2001 in the amount of $5,000.

- Uruguay

At-sea sampling aboard home based longline vessels was initiated in 1998 by the *"Instituto Nacional de Pesca* (INAPE)" of Uruguay, but no detailed data are collected on billfish, except for measuring length. Starting in 2001, Ms. O. Mora of INAPE has agreed to initiate detailed data collection for billfish (as required for other at-sampling in the Billfish Program) from the existing observer program on a trail basis. This activity will involve four trips of about 20 days duration each during the 2001 sampling season. A portion of the costs of observers will be covered by the ICCAT billfish program budget ($10 per day) but this expenditure will be limited to a total of $500 for 2001.

Tagging

The following conventional tagging activities and expenditures are proposed. Tags and tagging equipment for east Atlantic billfish tagging in 2001, distributed to participants by the ICCAT Secretariat, are not anticipated in 2001 because substantial tagging equipment purchases were made previously. The total for tag rewards (including the $900 needed in Venezuela) will amount to $1,500 for 2001. A lottery reward of $500 will also be necessary for 2001.

Age and growth

Requested funding for biological samples from juvenile and very large billfish, as well as tag-recaptured billfish, is $500 for 2001.

Coordination

Training and sample collection

Experience in the West Atlantic (SCRS/90/20, SCRS/91/18, SCRS/92/24, SCRS/93/102, SCRS/94/147, SCRS/95/107, SCRS/96/90, SCRS/97/67, SCRS/98/118, SCRS/99/96, SCRS/00/150) continues to indicate that it will be necessary to make a series of trips to specific Caribbean island locations, and occasionally to West Africa, Madeira (Portugal), Bermuda, and Brazil, to maintain quality control of on-going research. The purpose of this travel will be to train samplers in data collection, pick up data, assist in pop-up tagging and data analysis, hand-carry frozen biological samples back to Miami, monitor the rapidly changing pelagic fisheries, and maintain contacts with project cooperatives. The travel to West Africa will be to assist the East Atlantic Coordinators in refining sampling programs, particularly to encourage tag release and recapture activities. Funding for 2001 will be $14,000. Travel may include the following areas:

- West Atlantic

Cumaná, Margarita Island, Caracas, and La Guaira (Venezuela)
Grenada
Santos and Recife (Brazil)
St. Maarten (Netherlands Antilles)
St. Vincent
Trinidad and Tobago
Cancún and Cozumel (Mexico)
Bermuda
Other Caribbean countries

- East Atlantic

Dakar (Senegal)
Abidjan (Côte d'Ivoire)
Ghana
Madeira (Portugal)
Gabon
Other West African countries

Miscellaneous/Mailing

The requested funding for 2001 for east Atlantic miscellaneous and mailing is $100. Similar needs for the West Atlantic Coordinator are covered by the U.S. domestic budget.

Data base management

During the 1999 SCRS meeting, a problem surfaced relative to data base quality control and data entry for the at-sea and shore-based sampling components of this program. This problem was partially resolved in 2000. Given quality control and data entry is still lagging behind due to shortage of NMFS staff to accomplish these duties, it is proposed that a work study student from the University of Miami again be contracted for these data entry functions. Costs for quality control and data entry for 2001 are estimated at $4,000.

Bank charges

Charges by the bank for the transfer of funds and bank checks in 2001 are estimated at $250.

Because of unforeseen changes in the fisheries and opportunities for sampling, it may be necessary for the ICCAT Secretariat and the General Coordinator to make adjustments in budgeted program priorities. These changes, if any, will be duly transmitted to the area Coordinators. Also, the proposed budget for regular Program activities in 2001 is attached as (**Table 3**). The expansion or reduction of expenses will depend, to a large degree, on the available funds. It should be noted that the regular Program activities will be implemented based on receipt of sufficient funds and the carry-over of unused funds from 2000.

Table 1. Funds available in 2000 for the Billfish Program (as of October)

SOURCE	*In US $*	*In Pts.*
Balance at start of Fiscal Year 2000*	$19,080	3,558,941
Allocation from ICCAT Regular Budget	$10,000	1,700,000
Voluntary contribution: The Billfish Foundation	$35,699	6,425,602
TOTAL FUNDS AVAILABLE	$62,201	11,684,543
TOTAL EXPENDITURES (see **Table 2**)	$25,837	4,648,436
BALANCE IN BILLFISH PROGRAM FUNDS	**$37,456**	**7,036,107**

* Includes a $5,000 contribution from Chinese Taipei received in December, 1999.

Table 2. 2000 Budget & Expenditures of the Enhanced Research Program for Billfish (as of October) [1]

Chapters	*Amount budgeted*	*Expenditures*
AGE AND GROWTH: Purchase of hard parts	500.00	0.00
TAGGING		
Tag rewards	1,000.00	0.00
Lottery rewards	500.00	0.00
Hard part rewards	500.00	0.00
Printing posters and recapture cards in Japanese/Chinese/Portuguese	0.00	0.00
Tags and tagging equipment	2,000.00	0.00
STATISTICS & SAMPLING ENHANCEMENT		
West Atlantic shore-based sampling:		
Bermuda tournaments	0.00	0.00
Barbados	0.00	0.00
Brazil tournaments	0.00	0.00
Cumaná, Venezuela	720.00	637.00
Margarita Island, Venezuela	720.00	637.00
Punto Fijo, Venezuela	360.00	319.00
Playa Verde, Venezuela	1680.00	1489.00
Playa Grande Marina, Venezuela	480.00	425.00
Venezuela tournaments in Puerto Cabal and Falcon	1,000.00	886.00
Grenada	1,000.00	0.00
Jamaica	1,000.00	0.00
Martinique	1,500.00	0.00
Trinidad & Tobago	1,000.00	0.00
St. Maarten Netherlands Antilles	1,500.00	0.00
U.S. Virgin Islands	2,000.00	0.00
West Atlantic at-sea sampling:		
Venezuela	18,408.00	15,114.00
Insurance for Venezuelan Observers	1,200.00	1,200.00
Telemetry/Hook timer studies (travel)	2,000.00	0.00
Brazil	4,000.00	0.00
East Atlantic shore-based sampling:		
Dakar, Senegal	1,500.00	0.00
Côte d'Ivoire	1,500.00	1,500.00
Ghana	1,500.00	0.00
Canary Islands	400.00	0.00
COORDINATION		
Travel by Coordinators	14,000.00	2,203.44
Mailing & miscellaneous--East Atlantic	100.00	0.00
Secretariat support	1,000.00	0.00
Bank charges on Billfish account	250.00	76.17
4th ICCAT BILLFISH WORKSHOP		
Workshop Activities	15,000.00	3624.10
Hard Cover publication	5,000.00	0.00
GRAND TOTAL	**$83,318.00**	**$28,110.71**

1 The Billfish Program Budget for 2000 was prepared in US$ and all the 2000 expenditures were made in that currency.

Table 3. ICCAT Enhanced Research Program for Billfish Budget for 2001 (in US$)
(The release of funds is contingent upon conditions described in the text.)

Budget Chapters	*Amount budgeted* (US$)
STATISTICS & SAMPLING	
West Atlantic shore-based sampling:	
Bermuda tournaments	0
Brazil tournaments	0
Venezuela (Cumaná, Punto Fijo, Playa Verde, Margarita Island,La Guaira Playa Grande Marina, Venezuelan tournaments in Puerto Cabello, La Guaira, Puerto La Cruz, and Falcon)	4,960
Grenada	1,000*
Jamaica	1,000*
St. Maarten, Netherlands Antilles	1,500*
Uruguay	0
U.S. Virgin Islands	2,000*
Trinidad & Tobago	1,000*
West Atlantic at-sea sampling:	
Venezuela (Cumaná, Puerta la Cruz, and Margarita Island)	18,408
Brazil	4,000*
Bermuda	5,000*
Pop-up Satellite Study	5,000*
Uruguay	500
Insurance for Venezuelan Observers	1,200
Insurance for Brazilian Observers	350
East Atlantic shore-based sampling:	
Dakar, Senegal	1,500
Côte d'Ivoire	1,500
Ghana	1,500
Morocco	0
Canary Islands	400*
TAGGING	
Tag rewards	1,500
Lottery rewards	500
Hard part rewards	500
Printing posters and recapture cards in Japanese, Chinese, and Portuguese	0
Tags and tagging equipment	0
AGE AND GROWTH	
Purchase of hard parts	500*
COORDINATION	
Coordination (on site training of samplers, collection of statistical and biological samples)	14,000*
Mailing & miscellaneous-East Atlantic	100
Data base management	4,000
Bank charges	250
Hard Cover Publication of Fourth ICCAT Billfish Workshop	5,000
GRAND TOTAL:	**$ 77,168**

* Authorizing these expenditures depends, in part, on additional funds being available.

Appendix 9

REPORT OF THE SUB-COMMITTEE ON ENVIRONMENT

1Opening of the meeting

The meeting of the Sub-Committee on Environment took place on October 18, 2000, in the Hotel Reina Victoria, Madrid. Dr. J.-M. Fromentin (EC-France) chaired the session and welcomed the participants.

2 Adoption of the agenda and meetings agreements

The same agenda as the previous year, with the exception of item 5 which changed to "influence of environmental variations on recruitment of Atlantic tuna populations", was adopted. The Chairman pointed out that the future agenda as well as activities of the Sub-Committee on Environment for year 2001 would be discussed in item 8. Dr. C. Ravier (EC-France) was nominated rapporteur.

3 Review of contribution papers

3.1 From the documents submitted to the 2000 SCRS, five were identified as relating directly to the work of the Sub-Committee on Environment: documents SCRS/00/100, 119, 140, 155 and 156.

3.2 Documents 119 and 156 refer to the possible existence of a relationship between the North Atlantic Oscillation (NAO) and the fluctuations in Atlantic tuna yields, through either recruitment (119, 156) and/or changes in catchability (119). It was further noted that another document, SCRS/00/100, also related to the NAO. The Chairman first gave a brief introduction on the mechanisms of the NAO, before these documents were concisely presented by their authors.

3.3 Document SCRS/00/156 updated a previous paper on the possible relationship between the fluctuations of the NAO index and those of age 1 CPUE of the North Atlantic swordfish (considered as a proxy of the recruitment) during the 1983-1999 period. It highlights the fact that the level of recruitment obtained in 1998, explained by CPUE age 1 in 1999, is around the expected value according to previous predictions. The Chairman drew the attention of the Sub-Committee to the methodological difficulties resulting from the comparison between series of CPUE, which is smoothed and highly auto-correlated, with the NAO series which displayed higher variability. This interesting study should be thus followed up in the two next years, since the NAO indices in 1999 and 2000 were particularly strong.

3.4 Document SCRS/00/119 proposed, based on the fact that young albacore concentrate along the frontal zones, that environmental fluctuations in sea surface temperature (reflected by NAO index) could change the trophic migration patterns of young albacore. The consequences of such a feature would be a change in the spatial habitat of young albacore, and thus in the catchability within traditional fishing grounds. On the basis of previous works, the author suggested that fluctuations could also affect recruitment, but the mechanisms appear less clear. Moreover, changes in the environment could also affect the vertical habitat of large albacore, and thus their vulnerability to long lines.

3.5 Document SCRS/00/100 investigated the relative predictive power of the winter NAO and estimates of spawning stock biomass for western bluefin tuna over the period 1960-1997. The authors showed a much stronger predictive relationship between SSB and recruits than between NAO and year class strength. When considered jointly, the winter NAO provides no significant additional predictive power relative to SSB. Under an hypothesis that environmental variability (as measured through the effects of winter NAO) affects the survivorship of young of the year, one would expect to observe a correlation between survival ratios (R/SSB) and the winter NAO. For the estimates available from the present study, R/SSB estimates are uncorrelated with NAO.

3.6 The Chairman and the participants stressed that it was important to understand and study the relationship between the NAO and the recruitment of Atlantic tuna. However, such work deserves careful and deeper investigations.

3.7 Documents SCRS/00/140 and 165 were presented in section 4 and 5 respectively.

4 Anomalies in oceanographic conditions affecting tuna catches

4.1 Influence of anomalies in oceanographic conditions on catchability has been highlighted many times in the past and appears to be one of the two important environmental questions for tuna fisheries. These anomalies could be related to high scale climatic phenomenon such as *El Niño*. The Chairman briefly introduced the mechanisms of *El Niño* in the Pacific and its influence in the equatorial Atlantic. He indicated that the status of this phenomenon in 1999 (characterized by a *La Niña* event) should not induce any increase in the sea surface temperature (SST) or any sinking of the thermocline in the Atlantic, so that no particular decline in catchability of yellowfin tuna should be expected in relation to environmental changes.

4.2 Document SCRS/00/140 presents new elements on the influence of SST anomalies on spawning areas and catchability of bigeye tuna. It shows, firstly, that SSTs higher than 26º seem to delimit bigeye spawning areas in the Atlantic. The author points out that the north equatorial counter-current gives rise to strong shearing of water masses, which could have an adverse effect on the deep longline fishery, thus protecting one of the main bigeye spawning areas. The author then shows how vertical fluctuations in the isotherms 15º C and 11ºC, which limit the optimal temperature layer for bigeye, play a primary role in the catchability of bigeye by deep longliners.

4.3 The Convener and the participants emphasized the importance of environmental changes on the catchability and habitat of tuna, including yellowfin, bigeye and albacore. As the repercussions of these changes on stock assessments may be not negligible, the Sub-Committee recommended that these effects be taken into account by the working groups when, for example, calculating CPUE indices. The Sub-Committee also noted that this issue raised methodological questions, particularly with regard to scale differences between environmental information and information on fishing effort.

5 Influence of environmental variations on recruitment

5.1 Following the recommendations of the last Sub-Committee on Environment, the Sub-Committee discussed the question of the influence of the environment on recruitment of Atlantic tuna. The Committee recognized that this issue constitutes the second main environmental question for tuna fisheries

5.2 Document SCRS/00/165, which is related to this issue, firstly reviews the sources of variability in recruitment. This can be related to three main classes of factors: 1) human activity, through over-exploitation of the spawning stock and pollution; 2) biological processes, such as predation, cannibalism and competition and 3) environmental events, mainly through sea temperature and food availability. These factors can interact and must be taken in account in stock management, especially if stocks are over-fished (for this purpose, the example of the North Sea cod was briefly recalled). The second part of the document summarises life history traits of 11 Atlantic tuna and concludes that (1) the probability of stable recruitment is much higher for tropical than for temperate tuna populations, and (2) that temperate tuna are more adapted to the risks of recruitment failures than tropical ones. The document also shows how noise in the recruitment can lead to low frequency fluctuations in both the spawning stock and the yields. The third part of the document deals with the modelling of the stock-environment/stock-recruitment relationship used by ICCAT working groups to establish projections (i.e., Ricker or Beverton and Holt models). As stochastic processes make difficult the choice of a pertinent deterministic stock-recruitment relationship, the authors propose to move to a stock-recruitment relationship, when this appears relevant; a step which should be tempered by careful thinking about the physical, biological and behavioural processes affecting Atlantic tuna.

6 Conclusions of international meetings on environment

The goals and conclusions of two recent international meetings (PICES and Alaska Sea Grant Meeting on Spatial Processes and Management of Fish Populations) were presented. The Chairman drew the attention of the Sub-Committee on two forthcoming workshops, the first on the NAO, the second on "Inter-annual Climate Variability and Pelagic Fisheries".

7 Work Plan for the Sub-Committee, including proposed inter-sessional meeting on the effects of the environment on recruitment

As mentioned in the 1999 recommendations, and from what has been seen in the various tasks which have been proposed to the SCRS over the last ten years, the Sub-Committee on the Environment proposed that an inter-sessional meeting be held on the topic of recruitment of Atlantic tuna. This proposal was received with great interest and supported by the Committee. The aim of the meeting would be to address the direct effects of the hydroclimate on recruitment, the conditions defining the spawning areas , the analyses in greater depth of some recruitment-environmental relationships, as well as methodological problems, with the objective of integrating an environmental component into the stock-recruitment models. Discussion took place as to whether this meeting should be held as a working group or a conference. It was decided that a working group, open to all ICCAT scientists, and to which outside experts could be invited, should first meet in Madrid in 2001. This working group would be followed by an international conference in 2002. Financial support by the Commission will be requested for this conference

8 Other matters

No other matters were discussed.

9 Adoption of the report

The report of the Sub-Committee was adopted.

10 Adjournment

The 2000 meting of the Sub-Committee on Environment was adjourned.

Addendum 1 to Appendix 9

Agenda of the Sub-Committee on Environment

1 Opening of the meeting
2 Adoption of the Agenda and meeting arrangements
3 Review of contribution papers
4 Anomalies in oceanographic conditions affecting tuna catches
5 Impact of environmental variations on recruitment of Atlantic tuna populations.
6 Conclusions of international meetings on environment
7 Working plan for the Sub-Committee, including proposed inter-sessional meeting of recruitment in relation to the environment.
8 Other matters
9 Adoption of the report
10 Adjournment

Appendix 10

EXECUTIVE SUMMARY

A PARTNERSHIP WITH ASFA FOR MAINTAINING THE ICCAT BIBLIOGRAPHIC DATABASE[1]

In past years, the SCRS recommended that a bibliographic database be created for publications included in the Collective Volume of Scientific Papers series. A preliminary database was established in 1999 and the SCRS recommended that it be expanded and improved to overcome various shortcomings.

After studying the needs of the scientific community and the various ways in which they could be addressed, the Secretariat decided to become a partner in an arrangement called Aquatic Sciences and Fisheries Abstracts (ASFA). ASFA is a large database that includes about 800,000 citations and abstracts of papers and monographs dealing with technology, science and management of marine and freshwater resources that appear in journals, conference proceedings, and literature such as the Collective Volume series. ASFA is managed by FAO and is published for commercial use by Cambridge Scientific Abstracts. Besides the published, the ASFA Partners include: 4 UN co-sponsors, 6 International Partners (including ICCAT), and 31 National Partners. The ICCAT partnership agreement was signed in May, 2000.

As a "partner", ICCAT is obliged to provide its own entries for the ASFA database and to participate in making the decisions that shape ASFA. In return, the Secretariat will receive the following entitlements: One subscription to the 5 ASFA journals; one copy of the CD-ROM and updates/upgrades; one Internet Database Service subscription, and, the ability to provide ASFA extracts to our user community (the retail price of the entitlements exceeds US$12,000). This partnership means that ICCAT does not need to maintain a separate database system in order to provide its scientific community with the database. In addition, there are other benefits to be achieved by joining a large-scale product like ASFA.

There are three economic costs associated with being as ASFA partner: Attending an initial training exercise for learning how to make the ASFA entries (accomplished in September 2000), attending an annual meeting of the ASFA Board (starting in 2001), and the time commitment required to make the entries. Note that the latter cost is one that would be incurred anyway if an in-house bibliographic database were to be maintained at ICCAT; the first cost in one-time only.

It is envisioned that ICCAT will become an active partner in the first quarter of 2001, when it starts making its entries. Until then, the current ICCAT bibliographic database will be maintained and updated for use by ICCAT scientists.

1 Originally presented as document COM-SCRS/00/17 (by V. Restrepo) to the 2000 meeting of the Commission.

Appendix 11

EXECUTIVE SUMMARY

STRATEGY TOWARDS THE ICCAT RELATIONAL DATABASE MANAGEMENT SYSTEM (ICCAT-RDB)[1]

In response to concerns about the ability of the Secretariat to fulfil the current and future needs of the SCRS with the existing database system, the 1999 SCRS Committee defined as crucial the immediate implementation of a new Relational Database Management System (ICCAT-RDB).

The main reason of this determination was associated with two main weaknesses observed in the current database management system. A structural limitation characterized by the ASCII flat-file model, and a functional inefficiency in the data collection process (e.g. non-accomplishment of current data submission rules). As a result, it will not respond adequately to the present and future requirements of the SCRS scientists.

A detailed description of the proposed plan for the ICCAT-RDB development has been presented to the SCRS (SCRS/00/43). The database is being developed by the Biostatistician in close consultation with other Secretariat staff, with the SCRS Sub-committee on Statistics, and with external experts.

The strategy towards the implementation of the ICCAT-RDB is planned in three distinct phases. All phases involve considerable planning in areas such as the study of current data structures, the forecast of ICCAT future data needs, elaboration of conceptual models (based on the current data structures), and prototyping of structural models. Phase 1 is a short-term one, and its major goal is to have a first intermediate client relational database management system implemented in time for the 2001 SCRS. The Secretariat will maintain both systems (current database and new database) running in parallel at least during phase 1 in order to avoid potential problems. Phase 2 is the medium-term component and aims to intensively review historical data, to improve the quality of data collected, and finally to migrate the client database system of phase 1 to a client/server relational database system, by 2003. Phase 3 is a long-term component with the goal of developing web functionality (ability for users to query the ICCAT databases online).

The Commission has already made a commitment to finance the first two phases. It is expected that the third phase will require additional funds, but it is premature to estimate specific needs at this time.

1 Originally presented as document COM-SCRS/00/18 (by C. Palma) to the 2000 meeting of the Commission.