INTERNATIONAL COMMISSION
for the
CONSERVATION of ATLANTIC TUNAS

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INTERNATIONAL COMMISSION FOR THE CONSERVATION OF ATLANTIC TUNAS

Contracting Parties (as of January 1, 1995)

Angola, Brazil, Canada, Cape Verde, Côte d'Ivoire, Equatorial Guinea, France, Gabon, Ghana, Japan, Republic of Korea, Morocco, Portugal, Republic of Guinea, Russia, Sao Tomé & Principe, South Africa, Spain, United States, Uruguay, Venezuela.

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Dr. A. RIBEIRO LIMA, Portugal

First Vice-Chairman of Commission

Mr. K. SHIMA, Japan

Second Vice-Chairman of Commission

Mr. L. G. PAMBO, Gabon

Panel Membership (as of January 1, 1995)

Panel	**Contracting Parties**	**Chairman**
1	Angola, Brazil, Canada, Cape Verde, France, Gabon, Ghana, Côte d'Ivoire, Japan, Republic of Korea, Morocco, Portugal, Russia, Sao Tomé & Principe, Spain, United States, Venezuela.	Côte d'Ivoire
2	Canada, France, Japan, Republic of Korea, Morocco, Portugal, Spain, United States.	Morocco
3	Japan, South Africa, Spain, United States.	United States
4	Angola, Brazil, Canada, France, Japan, Republic of Korea, Portugal, Spain, United States, Venezuela.	Japan

Council

No election was conducted for the 1994-95 biennial period.

Standing Committees

Standing Committees:	**Chairman**
Committee on Finance and Administration (STACFAD)	Mr. D. SILVESTRE, France
Committee on Research and Statistics (SCRS)	Dr. Z. SUZUKI, Japan
Infractions Committee	Mr. A. J. PENNEY, South Africa
Permanent Working Group for the Improvement of ICCAT Statistics and Conservation Measures (PWG)	Mr. B. S. HALLMAN, USA

Secretariat
Estébanez Calderón, 3, Madrid 28020 (Spain)
Executive Secretary: Dr. ANTONIO FERNÁNDEZ
Assistant Executive Secretary: Dr. PETER M. MIYAKE

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, 1994-95, Part I (1994)"***, 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 Ninth Special Meeting of the Commission, held in Madrid, in November/December, 1994, 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.

Given that the combined length of these reports is too great for them to be included in one volume, the Report for 1994 has been published in two volumes. ***Volume 1*** includes 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). It also includes the National Reports mentioned above. ***Volume 2*** includes the SCRS Report 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. Due to a delay in the Commission's adoption of a part of the Proceedings of the Commission Meeting, Volume 2 was issued before Volume 1. The Report is available in the three official languages of the Commission: English, French and Spanish.

Dr. A. Ribeiro Lima
Commission Chairman

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ANNEX 25

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

(Madrid, November 21-25, 1994)

1. Opening of the meeting

1.1 Dr. Z. Suzuki, the Chairman of the SCRS, opened the meeting and welcomed all the participants. He noted that 1994 was a very busy year for the ICCAT SCRS with many inter-sessional meetings, but that significant progress had been achieved in many tuna research areas. He referred to the recent Conference on the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), and that Dr. J. S. Beckett (Canada) had represented ICCAT at this Conference. Dr. Suzuki also referred to the Report by the U.S. scientific review group (National Research Council) on Atlantic bluefin tuna stock assessments, that was presented to this year's SCRS Meeting. In view of this Report, he noted that a special western Atlantic bluefin tuna stock assessment session was convened, despite that the next stock assessment for western bluefin was scheduled for 1995.

1.2 Upon completion of his first year as SCRS Chairman, Dr. Suzuki thanked all the scientists for their collaboration and asked their continued support. He indicated that in the past, the SCRS has always put considerable effort in its stock assessment work, but pointed out that sometimes the Committee's management recommendations or the actions taken by the Commission occur after a stock has already been over-fished. The SCRS Chairman also emphasized the importance of good communication between the scientists and fishermen and between the scientists and their national administrators. He recognized that fishermen often have considerable empirical information on fish stock conditions, which is sometimes difficult to justify scientifically, but which may, in essence, have a lot of truth. He suggested that perhaps the Committee should find some way to utilize such information. He pointed out that feedback from the scientists to the fishermen will be essential in the future.

1.3 The SCRS Chairman reiterated that open channels of communication between scientists and administrators are essential, and emphasized that all conservation measures have to be based on solid scientific advice.

1.4 The ICCAT Executive Secretary, Dr. Antonio Fernández, reaffirmed his conviction that the SCRS teams, in spite of the difficulties and uncertainties of their work, are comprised of scientists with great capability of assessing the current state of the stocks under the mandate of ICCAT.

1.5 Dr. Fernández referred to the content of the notes, circulated by the Secretariat, from the U.S., Canada, Spain and Japan requesting the SCRS to conduct special assessment work on the status of bluefin, swordfish, albacore, billfish, yellowfin and bigeye stocks, as well as the notes from Dr. J. L.Cort (Spain) and Dr. B. Liorzou (France) concerning the special western bluefin stock assessment.

1.6 He pointed out that the marked increase (+30% with regard to 1993) in the number of scientific documents presented to these SCRS sessions, and the considerable rise in the number of inter-sessional meetings which ICCAT had organized, had often obliged the reduced Secretariat staff to work overtime. For this reason he asked for the support of the Committee for his proposed budget for 1995, which include the permanent hiring of a technical biostatistician and the modernization of computer equipment for the Secretariat.

1.7 He also recalled the request of the Infractions Committee for an extract of the SCRS conclusions on the impact of ICCAT regulations on the status of the different stocks.

2. Adoption of Agenda and Arrangements for the Meeting

2.1 The Executive Secretary noted the changes made in the Agenda from that of 1993 and the documentation circulated by the Secretariat in relation to the organizational aspects of the SCRS sessions. The Tentative Agenda was adopted without change (**Appendix 1 to Annex 25**). It was understood that the Committee would be flexible in the chronological order of addressing the Agenda items.

2.2 The following scientists served as rapporteurs for the 1994 SCRS Report:

Tropical Tunas (General)		A. Fonteneau
YFT:	Yellowfin	P. Pallarés
BET:	Bigeye	J. Pereira
SKJ:	Skipjack	X. Ariz
ALB:	Albacore	F. X. Bard, J. Santiago
BFT:	Bluefin (East)	B. Liorzou
	Bluefin (West)	J.J. Maguire
BIL:	Billfish	E. Prince
SWO:	Swordfish	J. Porter
SBF:	Southern bluefin	Y. Ishizuka
SMT:	Small tunas	L. Gouveia
Agenda Item 14		E. Prince
All other SCRS Agenda items:		P. M. Miyake

3. Introduction of Delegations

3.1 The scientific delegations were introduced. The List of the SCRS Participants is attached as **Appendix 2 to Annex 25**.

4. Admission of Observers

4.1 The observers (from four non-member countries and four international organizations) were introduced and duly admitted, since they had all been invited in accordance with the criteria approved by the Commission. The list of observers is included in the List of SCRS Participants (**Appendix 2 to Annex 25**).

5. Admission of Scientific Documents

5.1 The Committee noted that 188 scientific documents had been presented at this session (see **Appendix 3 to Annex 25**, List of SCRS Documents). A small group was formed to review the acceptance of these documents and Dr. J. Santiago (Spain) was nominated to lead this group. Dr. Santiago reported later that all the documents submitted met the criteria set up for the acceptance of documents established by the SCRS, except SCRS/94/166 and 167. While these two documents did meet the criteria for general papers, they were not received in time for the bluefin stock assessment session. However, considering the nature of the papers, which deal with the biology and the 1994 fishery of bluefin tuna, the Group recommended that they be accepted.

5.2 In view of the increased number of documents this year, the Secretariat pointed out some difficulties it encountered in following one SCRS criterion for scientific papers, i.e. that 80 copies would be made by the Secretariat for distribution at the SCRS of all those papers presented at least a month in advance the deadline. Since several inter-sessional meetings were held more than a month before the SCRS this year, all the papers (more than 120) presented for these meetings fell in this category. Thus, the Secretariat asked the authors to provide 80 additional copies for the Committee and this request was met by almost all the scientists. The Secretariat thanked the scientists for their spirit of collaboration. The Secretariat proposed that this criterion be reviewed for the future, under the appropriate Agenda item.

6. Review of National Fisheries and Research Programs

6.1 BRAZIL

Tuna fishing in Brazil is carried out by longliners and baitboats. In 1993 the longline fleet consisted of 19 national vessels and 36 foreign flag leased vessels. As regards the baitboat fleet, since 1992, when the Japanese leased baitboats were incorporated into the national fleet, only Brazilian vessels have been operating in the baitboat fishery. For the period 1992-93, a total of 57 vessels (50 iced well baitboats and 7 freezer baitboats) were engaged in the fishery.

The total catch of tuna and tuna-like species taken by the longline fleet increased from 8,230.5 MT in 1992 to 11,545.3 MT in 1993. in the 1993 longline catches, albacore and swordfish showed the highest catches for the leased fleet and the Brazilian fleet, respectively. Total catches of baitboats in 1993 (21,135 MT) were similar to those of the year before (21,963 MT). Skipjack is the target species, with a catch of 17,570 MT in 1993 (about 83% of the total catch).

The "Instituto Brasileiro do Meio Ambiente e Recursos Naturais Renovaveis" (IBAMA) has been responsible for the collection and compilation of the fishery statistics that are submitted regularly to ICCAT. In 1993, collection of tuna statistics and sampling for size frequency of the main species have continued and a total of 9,163 skipjack and 1,268 yellowfin were measured for length distribution from landings of baitboats at Santa Catarina.

In 1994, many Brazilian catch and effort data from longline fisheries, which were missing from the ICCAT data base, were made available to ICCAT, together with new series of effort data which included information on the number of hooks per basket. Annual weight frequency data for yellowfin, albacore and bigeye landed by national longliners during the period 1978-1983 have also been compiled and submitted to ICCAT.

In 1994, the ICCAT Data Preparatory Meeting for the South Atlantic Abundance Indices was held at CEPENE/IBAMA in Tamandaré, Pernambuco.

6.2 CANADA

In 1993, bluefin and swordfish regulations, consistent with ICCAT regulatory recommendations, were in effect. A Fishery Management Plan for porbeagle, shortfin mako and blue sharks was implemented in 1994.

In 1993, the Canadian nominal landings of swordfish were 2,224 MT, taken mainly by longline. The number of lines is restricted to 76 and nearly all were active. Bluefin tuna landings were 459 MT, leaving 129 MT of the combined 1992-93 quota (1,031 MT) uncaught. the 1994-95 quota is 817 MT and Canada has divided this equally between the years. Hence the 1994 quota was 408 MT. The inshore fishery was closed by 24 September 1994 when its quota was caught. Shark and other tuna landings are monitored and Task I and Task II data were submitted for 1993.

Research responsibility for both swordfish and bluefin tuna resides at the Biological Station, St. Andrews, New Brunswick. In 1993 and 1994, tagging studies and biological sampling continued. Historical swordfish catch and effort data were extensively edited and screened, to improve the biomass index. Further, an age-specific index of abundance for 1988-93 was developed. The primary research effort for 1994 is to develop a fisheries-dependent index of relative abundance for the Canadian bluefin fishery. Research responsibility for sharks resides at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia.

6.3 COTE D'IVOIRE

Côte d'Ivoire has not had any large tuna vessels registered under its national flag since 1988. Only a small coastal canoe fishery using "nifa-nifa" driftnets now operates. These activities are described in detail in documents SCRS/92/147 and SCRS/92/148. This fishery targets large pelagic fish and catches, among others, tropical tunas, billfish and swordfish. Total catches are some hundred tons per year. Billfish catches are sampled under the Billfish Program.

Nevertheless, the port of Abidjan remains the most important tuna port on the Atlantic; it is the base for 70 to 100 large tuna purse seiners which land or tranship between 150,000 and 200,000 tons of tropical tuna per year. There are more than three canning factories in operation.

In this context, the "Centre de Recherches Océanographiques of Abidjan" (CRO), in collaboration with ORSTOM carries out the important task of collecting biological and statistical data. This includes:

- The collection of logbooks of tuna vessels under the French, St.Vincent, Vanuatu, Liberian, and other flags.
- Multi-species size sampling on five species (yellowfin, skipjack, bigeye, frigate tuna and Atlantic black skipjack) at the rate of between 0.5 and one fish per ton landed/transhipped.
- Assisting in the collection of logbooks from Spanish tuna fishing vessels.

All these data are collected, verified and stored on magnetic tape and then transmitted to the authorities of the flag vessels for transmission to their national authorities. For vessels operating under flags of convenience, the data are sent to the responsible companies, or collectively to ICCAT. The only landing category which is not monitored at Abidjan is the transhipment of super-freezer longliners. These apparently important catches of large tuna are destined for the "shashimi" market and are re-exported in vessels with cold storage, usually to Japan.

The biological data are collected from tuna canneries, where the precise information on the vessel of origin of the dressed fish facilitates the observation and biological parameters of exact time-area strata. This is also true for tags recovered when unloading, especially by dock workers. Twenty-five (25) transatlantic tags of U.S. origin have been recovered in this way since 1985 to the present day, 22 having been perfectly identified for the location of the catches by the Abidjan CRO.

The CRO also provides technical support to Ghanaian tuna research and statistics.

Scientists of the CRO presented three documents this year. One deals with the quantity of small tunas landed and erroneously identified (SCRS/94/179), the importance of which has increased with the fishery using floating objects and the high demand in the local market (at least 12,500 MT in 1993). The other two documents discuss the abundance indices of billfish (SCRS/94/150 and SCRS/94/178) landed by the canoe fleet.

6.4 FRANCE

The French tuna catch was 86,000 MT in 1993, a 20% increase on the 1992 reported catch. As regards temperate species, the bluefin catch was very small, at 4,730 MT, while there has been a slight increase in the Atlantic catch to 1,098 MT. Albacore catches, mainly taken in the Atlantic, reached a new record of 6,360 MT. The main gears used are gillnet and pelagic paired trawl. Catches of tropical tunas rose to 74,064 MT (31,946 yellowfin, 32,223 skipjack and 9,859 bigeye, the highest since 1969.

French research relative to temperate tuna species is carried out by IFREMER, and that on tropical species by ORSTOM, in cooperation with Côte d'Ivoire, Senegal and Venezuela. French scientists have actively participated in the work of the SCRS, including the albacore meeting, the bluefin tuna stock assessment, and the meeting on growth variability by age, in 1994.

6.5 JAPAN

Since purse seine fishing was halted in 1992, longline is the only gear currently operating in the Atlantic Ocean in 1993. The longline fleet operated in the wide area of the Atlantic between 50°N to 45°S. The fishing effort level was low in the middle latitudes (10-25 N and S) and on the western side of the Ocean. The provisional total catch in 1993 for tuna and tuna-like fishes was 53,400 MT, which resulted in a slight increase (10%) compared to 1992. The major species are bigeye tuna (70 %), swordfish (12%) and yellowfin tuna (6 %). The fishing pattern is reported to be similar to previous years.

The National Research Institute of Far Seas Fisheries (NRIFSF) is responsible for the collection and compilation of fishery and biological data in the Atlantic. All these available data were submitted to ICCAT. Scientific research activities include many aspects such as monitoring of the fishery, standardization of CPUE, stock assessment, genetic and larval studies on tuna and billfish. Among these activities, it is worth noting that the NRIFSF conducted a bluefin larval survey this year in both the Gulf of Mexico and in the Mediterranean Sea, with the co-operation of U.S., Spanish and Italian scientists. The main objectives were the collection of samples for genetic analysis and comparison of sampling performance among research vessels.

More detailed information is given in SCRS/94/79 and SCRS/94/177.

6.6 KOREA

In 1993, four Korean tuna longliners were engaged in fishing activities in the Atlantic Ocean, and the total catch of the vessels amounted to 863 MT, showing a decrease of 24.8% over the previous year's figure. The 1993 total catch revealed the lowest value in the Korean tuna catch history in this ocean.

Bigeye tuna catches decreased from 866 MT in 1992 to 377 MT in 1993, although the proportion of bigeye in the 1993 catch remained at a high level as in past years, accounting for 43.7% of the total catch. Yellowfin tuna from the fishery amounted to 180 MT, a decline of 17.8% from the previous year's catch.

Routine scientific monitoring was carried out by the National Fisheries Research and Development Agency (NFRDA). This monitoring covers collections of catch and fishing effort statistics from Korean tuna longliners in the Atlantic to meet the data requirements of ICCAT.

To initiate an ageing study, some samples of first dorsal spines were collected from bigeye and yellowfin tunas respectively. Ageing studies will be undertaken continuously by the NFRDA in future.

6.7 MOROCCO

Morocco has a tuna fishery which operates in the Atlantic and the Mediterranean. This fishery mostly comprised of traps (7 in 1993) and about 120 artisanal longliners. The latter use small size drift nets and longline. There are also some purse seine by-catches of tuna species. This year, a new artisanal giant bluefin fishery has developed in northern Morocco. About 70 vessels using handline engaged in this fishery.

In 1993, overall production reached 2829 MT, showing a decline of 60% over the figure reported for the previous year. In terms of volume, small tunas are mainly fished. The new artisanal fishery produced, between August and October 1994, about 260 MT of large size (160 kg) bluefin tuna.

As concerns regulations, measures have been taken with regard to determining legal sizes, the use of driftnets, and the limiting of fishing areas and seasons.

Research activities included a program established to monitor the new artisanal bluefin fishery, within the framework of this program biological data are collected and reported to ICCAT.

6.8 PORTUGAL

The Portuguese tuna fishery takes place in the Azores and Madeira, where baitboats seasonally catch tuna using live bait. A longline fleet, targeting swordfish, operates off the coasts of continental Portugal and in waters of the Azores and Madeira islands.

In 1993, catches of tunas and tuna-like species reached 17,500 MT, comprised of 5,300 MT of bigeye, 5,500 MT of skipjack, 3,371 MT of albacore, 236 MT of bluefin tuna, and 2,100 MT of swordfish.

The total catch is slightly higher than that of 1992, but remains at a level below that observed in recent years. This is due mainly to the strong decrease in Azorean catches.

Research activities, port sampling and the collection of statistics continued in a satisfactory manner as in the past. Research has been carried out on temperate and tropical tuna species, and the results are provided in papers presented to the SCRS.

A research program on the effectiveness of fish aggregating devices is in progress in the Azores. In 1994, nine aggregating devices were placed in the water.

6.9 SPAIN

Spanish catches of tunas and tuna-like species reached 162,724 MT in 1993, which represents a slight decline (2%) with respect to the average catches of the last four years (1989-1992).

Catches of bluefin tuna in the Bay of Biscay fishery in 1993 were more than three times that of 1992, with an effort level similar to that of previous years.

In the south Atlantic area, recorded trap catches continued the declining trend which started in 1998, with a constant number of traps (four units in operation).

In the Mediterranean, catches as well as effort remained stable in 1992. Generally, for the last five years, bluefin tuna caught by Spain in the Mediterranean Sea represent 6% of the total reported catch of the Mediterranean, and 20% of the overall bluefin catches of the eastern stock.

The major component of the albacore catches are taken in the northeast Atlantic and the Cantabrian Sea. Both baitboat and troll fisheries reduced their catches in 1993.

Swordfish catches taken by the surface longline fishery in the north Atlantic remained at the same levels as in previous years. In 1993, this species continued to comprise about 70% of the catches taken in 1998 (a 30% reduction relative to that reference year). As concerns the south Atlantic, catches increased by about 1,000 MT with respect to the that last two years.

In 1993, in the Canary Islands area, total catches decreased with respect to previous years. In the tropical zone, for the same year, 30 Spanish flag vessels operated. Vessel carrying capacity again declined. It should be noted that there was an increase in skipjack and bigeye catches and a decline in yellowfin catches.

6.10 UNITED STATES

The total (preliminary) reported U.S. catch of tuna and tuna-like fishes (excluding billfishes) in 1993 was 24,384 MT. This represents a decrease of 2,366 MT (9% decrease) from 1992. The swordfish catch (including an estimated 408 MT of dead discards) decreased 50 MT to 4,186 MT, and landings from the U.S. fishery for yellowfin in the Gulf of Mexico decreased in 1993 to 2,708 from 4,587 in 1992. The 1993 Gulf of Mexico landings of yellowfin accounted for 64% of the total U.S. yellowfin landings in 1993. U.S. vessels fishing in the northwest Atlantic landed an estimated 1,184 MT of bluefin, a decrease of 28 MT compared to 1992. An estimated 30 MT of bluefin were discarded dead by U.S. longline vessels. Skipjack landings decreased by 235 MT to 290 MT, bigeye landings increased by 193 MT to 914 MT, and albacore landings increased by 76 MT to 453 MT. An experimental pelagic pair trawl fishery accounted for 15% of the total 1993 albacore landings with 68 MT landed.

In addition to monitoring the 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 1993 and 1994 focused on several items. Research continued on development of statistically based sampling programs for estimation of the U.S. recreational harvests of large pelagic species. The U.S. continued activities responsive to ICCAT recommended research primarily directed at determining the reproductive biology of Atlantic swordfish, and bluefin tuna. Research on development of methodologies to determine the genetic discreetness of large pelagic fishes in the Atlantic was also undertaken. Larval surveys for bluefin tuna and other large pelagic fish in the Gulf of Mexico was continued and, as part of the ICCAT Bluefin Year Program, a joint U.S.-Japanese larval research cruise in the Gulf of Mexico was conducted in 1994. Research continued on the development of new methods to estimate and index abundance of various large pelagic species. U.S. scientists participated in numerous 1994 ICCAT inter-sessional meetings, including the final meeting of the Albacore Research Program in June, the Second Consultation on Technical Aspects of Ageing Large Pelagic Species in July, the South Atlantic CPUE meeting in August, the joint ICCAT/GFCM and Bluefin Tuna Species Group meeting in September, and the Swordfish Species Group meeting in October. U.S. scientists also continued activities related to coordinating further increased efforts for the ICCAT Enhanced Research Program for Billfish. Cooperators in the Southeast Fisheries Center's Cooperative

Tagging Program tagged and released 7,252 billfishes (swordfish, marlins and sailfish) and 1,919 tunas in 1993. This represents a decrease of 9% from 1992 levels for billfish, and an increase of 2.6% for tunas.

6.11 URUGUAY

The Uruguayan tuna and tuna-like fisheries now constitute a small fleet comprised of four vessels which concentrate mainly on swordfish. This fleet uses Spanish or American type longline and operates in the Uruguayan Exclusive Economic Zone (EEZ) and adjacent international waters. Swordfish catches are followed in importance by those of bigeye, yellowfin and albacore, although more than 50% usually corresponds to shark catches.

In recent years some problems have arisen in the collection of statistics; meanwhile the data base is being corrected. Research has concentrated on analysis of the catch by area and the CPUE as well as on the study of dynamics of convergence fronts, for their correlation with the fishery.

6.12 VENEZUELA

The Venezuelan industrial fishery of tunas and billfishes consisted of three gear types: purse seine, pole and line (baitboat) and longline. The fleet is comprised of 31 purse seiners, 14 baitboats, and 27 longline vessels. The artisanal fishery for billfishes is comprised of 66 vessels which operate in the central (23 vessels) and east (43 vessels).

Yellowfin tuna was the most important species in the total 1993 catch, with 20,192 MT. The total skipjack catch was 8,121 MT.

At present, seven vessels of the longline fleet mainly target swordfish, and their catches in 1993 amounted to 182 MT. Catches by the artisanal fleet in 1993 reached 361 MT, comprised mainly of billfishes.

Current on-going research includes an analysis of catch and effort of both the industrial and artisanal fisheries, as well as biological analysis of some of the principal species, with the participation of national and international organizations, such as: FONAIAP, SARPA, ORSTOM, UDO and ICCAT.

6.13 CARICOM

At present, twelve Caribbean countries participate in the CARICOM Fisheries Resource Assessment and Management Program (CFRAMP). The fisheries in these countries are largely artisanal and generally do not catch significant amounts of large tuna species. However, recent developments in the use of longline gear in several islands have led to small increases in some species catches (SCRS/94/128).

In 1994, CFRAMP began implementation of a two year program of biological data collection in its participating countries. The CFRAMP/ICCAT project to tag billfish and large tunas has conducted a trial field trip in August 1994 to test and refine the method of tagging proposed by scientists of the ICCAT Enhanced Billfish Program. Antigua and Barbuda began tagging billfish at their 28th annual sport fishing tournament which took place in May 1994.

6.14 IRELAND

The Irish tuna fleet for albacore during 1994 consisted of 19 vessels which employed gillnets during the season. The vessels ranged in size from 18 m to 35 m, with an average size being approximately 23 m. The composition and size of the fleet was very similar to that of 1993.

The fishery took place from June to September with the main catches being taken during August.

The total catch of albacore (*T. alalunga*) was about 2,500 MT compared to 1,946 MT taken during 1993. Small catches of bluefin tuna, swordfish and ray bream were taken as by-catch.

A biological sampling program was undertaken on catches landed at the main ports. Sampling was confined to the collection of data on lengths and weights. A total of 2,443 albacore tuna were measured and 443 were weighed. Similar data on the 1993 fishery have already been submitted to ICCAT.

An experimental fishery, involving the use of paired mid-water trawls and trolls, as alternatives to gillnets, was conducted during August.

6.15 TAIWAN

In 1993, 98 conventional and 44 deep longliners operated in the Atlantic, and 6 longliners with super cold freezers operated in the Mediterranean Sea. A total catch of 36,248 MT was taken by these vessels (35,916 MT from the Atlantic and 332 MT from the Mediterranean). Of the Atlantic catch, albacore (25,700), bigeye (6,006 MT) and yellowfin (1,971 MT) are the main species, the proportions were about 71.6%, 17.2% and 5.5%, respectively. Of the total bluefin tuna catch of 332 MT, 328 MT were taken in the Mediterranean.

The Taiwanese Authorities have implemented ICCAT management measures in the national regulations, in compliance with the ICCAT recommendations. A working group, comprising specialists from the Fisheries Authority and scientists from the Institute of Oceanography, National Taiwan University, has been established to collect fishery data and logbooks and to process the data. The results are regularly submitted to the ICCAT Secretariat and are reported at the inter-sessional meetings of relevant species. The ICCAT Atlantic Pelagic Longline Data Preparatory Meeting was held in Taipei in May, 1994.

7. Reports of 1993 Inter-sessional Scientific Meetings

-- *Second Meeting of the Permanent Working Group for the Improvement of ICCAT Statistics and Conservation Measures (Tokyo, Japan - April 17-19, 1994)*

7.1 Dr. P. M. Miyake, ICCAT Assistant Executive Secretary, who served as Rapporteur for this Working Group, reported briefly the results of the meeting. The meeting was held in Tokyo, at the invitation of the Government of Japan. The Permanent Working Group met mainly to finalize details on the ICCAT Bluefin Tuna Statistical Document Program, to study various practical aspects of implementing this Program, and the problem of catches by non-contracting parties' fishing vessels which do not comply with ICCAT recommendations for regulatory measures. The Group evaluated the progress achieved by the Program so far. As concerns SCRS activities, the Secretariat reported to the Group on the availability of all the statistical information regarding bluefin tuna. It was pointed that one of the major mandates of the Permanent Working Group is to improve bluefin data. Since the waiver of validation of the Document by Government officials is dependent on whether or not a country satisfies the statistical requirements, the SCRS was requested to maintain close collaboration with this Group.

-- *Final Meeting of the ICCAT Albacore Research Program (Sukarrieta, Vizcaya, Spain - June 1-8, 1994)*

7.2 Dr. F. X. Bard (Côte d'Ivoire), the Coordinator of the ICCAT Albacore Research Program, reported the results of the Final Meeting. This Research Program started in 1989 and continued until 1993. The June meeting was held at the invitation of the Basque Autonomous Government to finalize the Program, evaluate and report the achievements reached by the Program, and to decide the future direction of albacore research.

7.3 Details of the Final Meeting are presented in COM-SCRS/94/16. This document contains all the information on developments in the albacore fisheries, and research carried out during this Program. The latest catch-at-size data base was created on which various stock assessment models were applied for the study of their feasibility.

7.4 Dr. Bard indicated that in spite of financial constraints, the Program was considered a success. He emphasized the complexity of the albacore fisheries, and the need for more biological information on albacore, and reiterated several short- and long-term recommendations for future studies. The Committee adopted the Report and forwarded it to the Commission for final approval.

- *Consultation on the Technical Aspects of Methodologies Which Account for Individual Growth Variability by Age (Brest, France, - June 27-29, 1994)*

7.5 The second meeting of this Group was held in Brest, France, at the invitation of the French Government. The Group reviewed the progress made on the tasks recommended by the first meeting (St. Andrews, Canada, 1993). Dr. G. Scott (U.S.A.), Convener of the Group, presented the Group's report (COM-SCRS/94/17). Various methods presented at the first meeting to convert catch at size into catch at age were applied to a simulated data set (catch at size) created at the first meeting, and the advantages and disadvantages were analyzed.

7.6 A new growth curve on yellowfin was presented and the application of ageing techniques was discussed. Albacore ageing using hard parts was also reviewed. The Group considered that the progress was satisfactory and proposed that another meeting be held to finalize its study.

7.7 The Committee praised the work done by the Group and noted the value of holding such meetings inter-sessionally, i.e. holding a meeting on a subject basis rather than on a species basis. It also recommended that the Group's work be continued. The Committee adopted the Report and all the recommendations contained therein, and forwarded it to the Commission for final approval.

— *Data Preparatory Meeting for the South Atlantic Abundance Indices (Tamandare, Pernambuco, Brazil - August 3-9, 1994)*

7.8 The 1993 SCRS recommended holding this meeting, provided that sufficient data were available. When the scientists involved concluded that the data were sufficient, the Secretariat called the meeting in Brazil, after having received an invitation from the Government of Brazil to hold it at Fishery Training Center of IBAMA, in Tamandare. U.S. scientists prepared a data preparation manual for the standardization of CPUE, which was circulated among the pertinent scientists well in advance of the meeting. The Committee expressed its appreciation to the U.S. scientists for this valuable contribution.

7.9 The Report (COM-SCRS/94/24) was presented by the Chairman, Dr. H. Menenses de Lima (Brazil). The Group reviewed all the catch and effort information available for the south Atlantic fishery, particularly on swordfish and albacore. It also discussed the factors affecting the variability of the data. GLM techniques were applied for most of the catch and effort data for the areas off Brazil and the longline fishery in the South Atlantic. The resulting data sets were further reviewed and these were used by various stock assessment sessions held later.

7.10 The Committee commended the work carried out by the Data Preparatory Meeting and recommended that the updating of the standardized CPUE be continued by the south Atlantic fishing nations. The participation of scientists working in the south Atlantic fisheries in the stock assessment session was strongly recommended.

7.11 The Committee adopted the report and forwarded it to the Commission, together with the recommendations included therein.

— *Ad Hoc GFCM/ICCAT Working Group on Stocks of Large Pelagic Fishes in the Mediterranean Sea (Fuengirola, Malaga, Spain, - September 19-23, 1994)*

7.12 The *Ad Hoc* GFCM/ICCAT Working Group held its first meeting in September at the Oceanographic Center of Malaga, in Fuengirola, Malaga, Spain, in September, at the invitation of the Spanish Institute of Oceanography (IEO) and with financing provided by the European Commission. Although this meeting was originally intended to be held in 1995, ICCAT thought it would be most convenient to hold it before the ICCAT swordfish and east Atlantic bluefin stock assessment sessions in 1994 (since these assessments are not scheduled to be held in 1995). ICCAT handled all the logistical aspects of the meeting, including sending the official invitations and providing Secretariat assistance during the meeting. The *Ad Hoc* meeting was scheduled so that it overlapped with the ICCAT SCRS east bluefin tuna stock assessment session, so that the scientists could participate in both meetings.

7.13 At the *Ad Hoc* Meeting, catch, catch and effort, tag release-recapture and size data for bluefin, swordfish and albacore, and the east bluefin catch-at-size data base were updated to include 1992 and 1993. The Report of the GFCM/ICCAT Working Group was presented as COM-SCRS/94/21.

7.14 The representative from FAO expressed appreciation to the ICCAT Secretariat and the ICCAT scientists. He further noted that the 9th Session of the Committee of Management of the GFCM recognized the efforts of the Working Group and adopted a Resolution whereby the ICCAT non-contracting parties, who are members of GFCM follow the fishery management recommendations by ICCAT on bluefin tunas.

7.15 The Committee noted that the joint GFCM/ICCAT session was a success, especially in that scientists from GFCM member countries that are not members of ICCAT were able to participate, for the first time, in the ICCAT bluefin stock assessment, and it was hoped that this would continue in the future.

7.16 In adopting the Report of the *Ad Hoc* GFCM/ICCAT Working Group, the Committee reiterated all the recommendations it contained, and forwarded it to the Commission for final approval.

-- *Ad Hoc Consultation on the Role of Regional Fishery Agencies in Relation to High Seas Fishery Statistics (La Jolla, California, U.S.A - December, 1994)*

7.17 The Assistant Executive Secretary attended this meeting, held in December, 1993, in La Jolla, California, U.S.A., at the invitation of FAO. He reported that the Group discussed the roles of the Regional Agencies in compiling high seas statistics, and ways to assemble information on a world-wide basis (COM/94/35-SCRS/94/26). The results of the discussion were reported to the U.N. Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks.

-- *Longline Data Preparatory Meeting for the South Atlantic (Taipei, Taiwan - May, 1994)*

7.18 The meeting was held in Taipei, Taiwan in May, 1994, at the invitation of the Institute of Oceanography of National Taiwan University. The Report of the meeting (SCRS/94/36) was presented by the Chairman of the meeting, Dr. Y. Uozumi (Japan). The Group compared the catch weight estimated from the catch-at-size data and Task I data and attempted to solve the problem of the discrepancies between these two data series and offered various solutions for them. Some work was also done to standardize the CPUE series.

-- *United National Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks (New York, March and August, 1994)*

7.19 The Executive Secretary referred to his participation in two sessions of this Conference held in New York in 1994, recalling that the United Nations Convention on the Law of the Sea (UNCLOS), adopted in December 1982, had entered into force on November 16, 1994, having been ratified by 60 States. The objective of this Conference is to develop the basis established by UNCLOS for the conservation and management of the straddling and highly migratory fish stocks, in the light of experience acquired since 1982 on the management of these stocks.

7.20 The Executive Secretary referred to Document COM-SCRS/94/18 which provided information on the development of this Conference, pointing out that at the session in March, 1994, he had presented the Declaration adopted by ICCAT in support of the Conference, and made particular reference to the need to manage the stocks of highly migratory fish throughout their area of distribution.

7.21 He made a short comment on the text for negotiation presented by the Chairman of the Conference in August, 1994, which will be examined during two further sessions scheduled for 1995, with a view to adopting the agreed text. He particularly drew the attention of the Committee to the increasing role which this text awarded to organizations such as ICCAT, and the content of Annex No. 1 (Minimum Standard for Collection and Sharing of Data) and No. 2 (Suggested Guidelines for the Application of Precautionary Reference Points in Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks).

-- *Report of the Ad Hoc Consultation on Atlantic Fishery Statistics (Madrid, Spain, July 11-15, 1994)*

7.22 The Commission offered to host the Fifteenth Session of the Coordinating Working Party on Fishery Statistics in Madrid.

7.23 The Consultation discussed mainly organizational matters. It found that the original Statute permits only three organizations (FAO, NAFO and ICES) as formal members. It was noted that the present CWP operates outside the Statute and it was agreed that it be changed to meet the reality of the CWP. At the same time, the word "Atlantic" was removed from the CWP Statute to allow non-Atlantic regional agencies to become members (see Document COM/94/36-SCRS/94/27).

-- *Inter-American Tropical Tuna Commission (Puerto La Cruz, Venezuela - June 7-9, 1994)*

7.24 Mr. D. Gaertner (France) represented ICCAT as an observer at the IATTC Meeting. The Report is presented as SCRS/94/10. He noted that the east Pacific tuna fisheries developed in a similar fashion as the east Atlantic fisheries. He reported in detail on the status of the fishery for tropical tunas in the eastern Pacific and the stock assessment efforts by the IATTC.

Item 8. Conclusion of the Albacore Research Program

8.1 The Report of the Final Meeting of the Albacore Research Program was reviewed by the SCRS. The Committee endorsed all the recommendations contained in the Report and commended the achievements made in the past few years in albacore research, in spite of budgetary constraints. The Committee also commended the work done by the Coordinator, Dr. F. X. Bard (Côte d'Ivoire). The Committee confirmed that the Report will be published in the Collective Volume series in enhanced form.

Item 9. Review of the progress made by the Enhanced Billfish Research Program

9.1 Document COM-SCRS/94/14, the Report of the 1993 Billfish Contributions and Expenditures, was presented to the Committee by the Western Atlantic Program Coordinator, Dr. E. Prince (U.S.A.). It was noted that this entire Program has been supported by independent funding, and that research in 1994 had been carried out according to the Program Plan. He thanked the Secretariat staff for its work in publishing the Billfish Workshop Report in an enhanced form in the "Collective Volume of Scientific Papers" series.

9.2 Details on the progress made in research are reported in SCRS/93/174 for the east Atlantic and in SCRS/93/147 for the west Atlantic. Most of the Program Plan had been accomplished and substantial improvements have been noted in billfish data. Document SCRS/94/150 reported the summary of coordinated research by five countries (Côte d'Ivoire, Ghana, Japan, Senegal and the U.S.) on sailfish in the east Atlantic.

9.3 The Committee noted that funding prospects have improved remarkably and that there was a substantial positive balance in the Billfish funds which would enable the continuance of this important research program during the next year.

9.4 The Report was reviewed and adopted by the Committee (**Appendix 5 to Annex 25**) and was submitted to the Commission for final approval.

Item 10. Review of the progress made by the Bluefin Year Program

10.1 The progress made by the ICCAT Bluefin Year Program (BYP) was reported by Dr. B. Liorzou (France), the East Atlantic Coordinator. Since this Program is not financed by the Commission, voluntary contributions (in terms of money and research) were solicited.

10.2 Dr. Liorzou reported on the programs developed by the EC which are carried out parallel with the BYP and which have contributed significantly to studies on bluefin tuna, on the reproductive biology of this species, and on bluefin tuna statistical data. He reported that many national programs also contributed to the BYP, and that this Program represented the consolidated efforts of all such programs.

10.3 Dr. Liorzou also referred to the program by Japan a research boat to the Gulf of Mexico and the Mediterranean Sea in 1994 to carry out research on the reproduction of bluefin tuna. During this research cruise, several countries joined in the efforts to calibrate the larvae collections, etc.

10.4 The Report of the Progress made in the BYP in 1994 was adopted by the Committee (attached as **Appendix 7 to Annex 25**), and recommended to the Commission for final approval.

10.5 In adopting the Report, it was noted that many difficulties were encountered in carrying out the Program due to the complete lack of funding by the Commission. The Committee believed that some financial support should be considered by the Commission, if the Program is to continue its work (see section BFT-4W.b, recommendation x).

11. Review of conditions of stocks

YFT - YELLOWFIN TUNA

YFT-1. Description of the fisheries

Yellowfin tuna is extensively fished in the intertropical Atlantic, between 45°N and 40°S by surface gears (purse seine, baitboat and handline) and by longline.

The baitboat fisheries have traditionally been developed in coastal regions (**YFT-Figure 1**), fundamentally targeting juvenile yellowfin which are associated, in mixed schools, with skipjack, juvenile bigeye and small tunas in the east Atlantic, and with skipjack and small tunas in the west Atlantic. The average weight of individuals caught by this gear is around 5 Kg, the range of sizes caught being between 30 and 130 cm in the east, and between 40 and 125 cm in the west.

The purse seine fishery developed rapidly in the east Atlantic during the 1970's, extending its fishing area from the coastal areas to the high seas, to target large yellowfin tuna present in spawning concentrations in the Equatorial areas during the first quarter of the year. In the coastal areas they catch, together with the baitboat fleet, small yellowfin associated in mixed schools with other species (**YFT-Figure 2**). The sizes caught show a bimodal distribution at 50 and 155 cm, low representation of intermediate sizes (70-100 cm), and the presence of large sizes (>160 cm). Venezuelan purse seine fisheries in the west Atlantic, with some exceptions, have been developed in coastal areas. The sizes caught show a narrower range than on the eastern side (40-140 cm) with a greater representation of intermediate sizes.

In recent years (1991-1993), in the east Atlantic, the main purse seine fleets (French and Spanish) have intensified fishing using floating objects, a traditional method of the tropical tuna fishery, which has been increasing with the placing of artificial floating objects. The main catches using objects are obtained during the fourth quarter of the year and the first quarter of the following year. The yellowfin catches by this type of fishery have not been very significant. Throughout this period (1991-93), catches using these artificial objects comprised 12% of the total, which represents an increase of less than 5% over the average percentage of catches using objects in previous years. The species composition and the sizes of associated schools have remained constant, although, with the fishery moving to the high seas, in the catches including small yellowfin, bigeye, skipjack and small tunas, large size yellowfin are found in greater proportion than when they are fished using natural objects. Together with the purse seiners, the baitboat fleet based at Tema has also modified its traditional fishing and now mainly fish using floating objects (the fleet based at Tema), the other fleets (baitboats, based in Dakar and the Canary Islands), have developed specific methods which consist of using the boats themselves to aggregate tuna, and fishing those aggregated tunas throughout the fishing season.

The longline fisheries that developed in an extensive area between 10°N and 15°S continue fishing in the entire Atlantic (**YFT-Figure 3**). The change in the target species to bigeye, with the consequent move of these fleets towards the areas of distribution areas of that species, and the practical disappearance of the Cuban, Panamanian, and Korean fleets, has caused the a substantial decline in the yellowfin catches. The catches by the longline fleet are comprised of large individuals with an average weight of over 40 kg. On the western side, fisheries have been developed on a more local level, such as the Brazilian fisheries in the southwestern Atlantic, which, while not specifically targeting yellowfin, fish considerable quantities of this species, or the United States surface longline fisheries in the Gulf of Mexico.

YFT-1.a Catches

YFT-Table 1 and **YFT-Figures 4, 5 and 6** show the historical development of Atlantic yellowfin catches by gear for the east, west and total Atlantic in past decades.

The 1993 catch shows a slight decrease from the catch of the previous year. The declining trend continues for the east Atlantic since the record year of 1990, although it is still at the highest levels of the historic series for the last five years. By gear, the purse seine and baitboat catches show a slight decline, while longline shows a minor increase in catches.

The purse seine catches included in the NEI ("not elsewhere included") category, in which vessels operating under flags of convenience are included, decreased by 25% in 1993, although it is possible that this is only an apparent decrease, due to the incompleteness of the statistical information on this fleet.

The west Atlantic catches remain at the same level as the last three years, with a slight increase in surface gears which is compensated by the decrease of longline catches (**YFT-Figure 5**).

YFT-1.b Effort

YFT-Table 2 and **YFT-Figure 7** show the development of carrying capacity of the tropical surface fleets operating in the east Atlantic, for the period 1972-1993.

Baitboat carrying capacity in 1993 shows no change, maintaining the same level as the last ten years, around 10,000 tons.

Contrary to the stability of the baitboat fisheries, the purse seine fisheries have undergone significant changes in the last 20 years, with the rapid development of purse seine fleets from the mid-1970s to the early 1980s, and reached 70,000 tons of carrying capacity in 1983, a sharp decline in the following years (to less than 50,000 t from 1986 to 1990), a slight recovery in 1991 and a minor reduction in the last two years.

YFT-Figure 8 shows, for the whole Atlantic, the development of nominal effort, standardized to fishing days of FIS category 5 purse seiners, and of the same nominal effort, but assuming an increase in the fishing efficiency of the fleet by 3% annually since 1980. Both measures of effort include all the fleets which operate in the Atlantic. The objective of the modification of nominal effort is to obtain some effective estimation of effort which, in the form of fishing mortality, is applied to the stock and is an attempt to quantify the increase in fishing power of the surface fleets which has been produced in recent years as a result of the introduction of numerous technical improvements (bird radar, extension of fishing by floating objects, etc), as well as a better knowledge of the fishery by the captains.

The overall effort has been obtained from the CPUE of the major purse seine fleets (FIS and Spanish) used as stock abundance indices. Traditionally, this index has been considered to be combined on the basis of the similar characteristics of both fleets (same fishing area, type of boat, fishing method, etc). However, in 1993 important changes took place (**YFT-Figures 9 and 12**) in the fishing strategy of both fleets. The French fleet rarely fishes in the Equatorial area during the first quarter of the year, nor has this fleet moved towards the north (Cape Verde, Senegal) during the summer months, but fished mainly in the areas around Cape Palmes, Cape Trois and Cape Lopez during the entire year, whereas the Spanish fleet has maintained its traditional fishing scheme. If these differences are maintained in the next few years, they will have to be borne in mind for developing models used to obtain standardized abundance indices.

In the west Atlantic, the Brazilian longline and baitboat fisheries have not undergone any significant changes in the last two years. However, during these two years, the longline fleet has targeted sharks, thus effort for yellowfin has been considerably reduced. The effort of surface fisheries of Venezuela in 1993 area remained at the level of the previous year.

For longline, U.S. fishing effort in the Gulf of Mexico declined slightly in 1993. The total Japanese longline fishing effort increased in 1993, although the shift of the fleet towards the southwest Atlantic, away from the yellowfin distribution area, resulted in a decline in effort directed at this species.

YFT-2. State of the stocks

During 1993 and 1994, in the east Atlantic, large yellowfin tagged in the northwest Atlantic have been recovered (five in 1993 and two in 1994). The systematic recovery of transatlantic tags since the initiation of the U.S. tagging program of large size yellowfin (+100 cm) was one of the main points which the Working Group on Atlantic Yellowfin, (Tenerife, 1993) bore in mind when rejecting the hypotheses of two independent stocks of Atlantic yellowfin separated at 30°W. The Group developed a migration model which includes a possible interchange of fish between the existing fisheries on both side of the Atlantic (**YFT-Figure 13**).

The 1993 SCRS recommended research on the stock structure and the development of models which consider mixing rates among stocks, more appropriate for the assessment of a stock with a structure like yellowfin, continue. This recommendation was reaffirmed. The Committee considered, however, that with the models in use, the assessment should be carried out on the hypothesis of one stock for the entire Atlantic.

As a result, the assessments, through both global and analytical models, have been carried out on the basis of a single Atlantic stock.

YFT-2.a.1 Production Model

An assessment of the stock was carried out using a generalized production model (PRODFIT). The model was fit for the period 1969-1993, on the total Atlantic catches and the abundance indices of the main purse seine fisheries in the east Atlantic, estimated from the catches of the French and Spanish fleets, and nominal effort, in fishing days standardized to French purse seiners in category 5, assuming a constant increase in effective effort of 3% annually from 1980.

Two trials were carried out for m=2 (Schaeffer's model) and m=1 (exponential model), with a value of k=4. **YFT-Table 3** shows the data used for the fit.

YFT-Table 4 shows the results obtained. For the two trials, the estimated maximum sustainable yields (149,900 and 153,700 MT) are similar to, and consistent with, results obtained in previous years. The catches corresponding to 1993 are very similar to MSY, while the level of effort are slightly below the effort corresponding to MSY (**YFT-Figure 14**)

It should be noted that the stock has shown stability in recent years (1985-93) with effort maintained at around 40,000 fishing days (with variations of less than 5%) and catches very close to the equilibrium curve.

YFT-2.a.2 Non-equilibrium production models

A non-equilibrium production model (ASPIC) was fit to the east Atlantic surface abundance index and the total yield from Atlantic. The use of total-Atlantic catches reflects the single-stock hypothesis, which SCRS now considers the most likely hypothesis for yellowfin. The use of the east Atlantic abundance index reflects the lack of success in constructing a reliable abundance index that includes data from the west Atlantic.

A production model that uses the east Atlantic abundance index to represent the entire Atlantic stock implicitly assumes that the stock in the Atlantic is well mixed. However, the present SCRS stock hypothesis is based on the concept of migration by size, in which mixing would not be complete. Thus, such a production model represents one of the two extreme hypotheses about mixing, while the SCRS believes that mixing is not extreme. As a sensitivity analysis, another ASPIC run was made with the other extreme assumption, i.e. no mixing between east and west Atlantic. This run used the same CPUE index as the base run, but with the east Atlantic catches only. This run would reflect the status of an east Atlantic stock under the two-stock hypothesis, and thus provides continuity with past analyses by SCRS. As stated, existing CPUE indices do not allow fitting a production model to the west Atlantic data only.

During this work, an error was discovered in the production model in the 1993 report; west Atlantic fishing effort was not properly accounted for. The model was refit to the correct data for 1993; the estimate of MSY would have been about 2.5% lower, and the estimate of stock level slightly lower, also. The recommendations made by SCRS in 1993 were not affected.

Results of the production model fits are summarized in **YFT-Table 5**. The total Atlantic model estimates that the stock is approximately fully exploited and that the present fishing mortality rate is very close to F_{MSY}. The fit of this run is shown in **YFT-Figure 15**. The trajectory of relative biomass and fishing mortality rates under the single-stock hypothesis are presented with approximate 80% confidence intervals in **YFT-Figure 16** and **YFT-Figure 17**. Estimates of stock status of the east Atlantic stock (under the two-stock hypothesis) are quite similar to those made under the total Atlantic hypothesis, although of course the estimate of MSY for the east alone (116,000 MT) is smaller than that for the total Atlantic.

The results from this year's analysis are slightly more optimistic than those from last year's analysis; this mainly results from the increased CPUE observed in 1993. Nonetheless, the stock is still estimated to be almost fully exploited.

YFT-2.a.3 Virtual Population Analysis (VPA)

The lack of availability of updated standardized abundance indices, needed to use integrated methods of assessment (ADAPT, XSA), required the use of a procedure similar to that used by the Committee in 1993, i.e., the simultaneous use of forward VPA, on a quarterly basis, and of separable VPA linked to a backward VPA, on an annual basis. However, some trials have been carried out with ADAPT, using the same indices used in the previous assessment, with only the longline indices being updated to 1993.

The analyses were carried out on the catch-by-age table for the 1975-1993 period (**YFT-Table 6**) in the case of forward VPA.

The backward VPA without calibration was applied assuming, for the last year, the fishing pattern which estimated the fishing mortality most fit to the effort series (.16, .5, .77, 1.0, 1.5 and 1.5 for ages 0-5+, respectively) and an F value of .6 for the reference age, coherent with the estimates of fishing mortality in previous years and with the development of effort in 1993. The value of natural mortality was assume to be .8 for ages 0-1 and .6 for ages 2-5+.

The forward VPA was applied from recruitment estimated by the backward VPA for the years 1975-1993 and an average constant recruitment for the previous period.

YFT-Table 7 and **YFT-Figures 18, 19, and 20** show recruitment, total biomass, spawning biomass and average fishing mortality, estimated by the VPA. Variable recruitment is observed as in previous years, without trend, and a spawning biomass recovered since 1985, owing to the reduction in effort and high recruitments in the early 1980s. **YFT-Figure 21** shows fishing mortality estimated by different methods (ASPIC, backward and forward VPA), where a similar development can be observed for the years 1975-93, all three analyses showing an upward trend in fishing mortality since 1985, although with differences in the absolute values estimated, and a clear discrepancy in the last four years between the VPA and ASPIC results. The uncertainties which exist in the estimates for the most recent years, when they are not measured by means of external indices, warrant caution when interpreting these results. Nevertheless, the three models show quite a stable picture for recent years, coherent with the fishery data, leading the Committee to consider that the status of the stock is stable and to hope to have indices available in the near future which make it possible to obtain adjusted estimations for recent years. The differences observed in the estimates of the two non-calibrated VPAs are most likely the result of the different time base used in the analyses (quarters for the forward VPA and years for the backward VPA) and should be studied in greater depth.

It should be pointed out that during the last three years, there has been a change in the fishing pattern of the fishery, i.e., the purse seine fishery, probably in relation to the development of fishing using floating objects. **YFT-Figure 22** shows fishing mortality by age class (quarterly base) for different periods in the series. The first pattern is observed at the beginning of the series with low spawner mortality, two intermediate periods with very similar patterns and a final period in which there is an increase in mortality of ages 1 and 2, together with an extension of the fishing season for large yellowfin, contrary to the strong seasonality of the fishery -almost exclusively in the first quarter- observed in the 1980-90 period. The catch at age (**YFT-Figure 23**) shows the changes which have taken place in the fishery. Similarly, the results of separable VPA applied to the last two periods (1985-89 and 1990-93) also detected the change in the overall fishery exploitation pattern. It would be interesting to test whether or not the changes detected, especially those referring to seasonality of the fishery, occurred simultaneously in all the purse seine fleets.

A VPA was also performed using ADAPT. This approach requires fewer assumptions about recruitment or levels of final F, because it permits calibration ("tuning") by means of independent indices of abundance. However, this advantage was limited somewhat in this case because some standardized indices of abundance had to be computed at the meeting and others could not be updated for the most recent years.

Due to restrictions in the software used, a constant natural mortality of 0.7 was used, rather than the usual M=0.8 for ages 0 and 1 and M=0.6 for older ages of yellowfin. Six series of abundance indices were used for tuning; four were based on the purse seine catch rates on ages 1, 2, 4, and 0-5$^+$, and the other two were derived from longline catch rates from the western Atlantic (ages 3 and 4) and the eastern Atlantic (ages 4 and 5$^+$). Case 1 used iterative re-weighting of the indices, based on the inverse residuals of sum of squares for each index (**YFT-Table 8**).

There are several concerns about the abundance indices used with ADAPT. The standardization for longline did not account for changing fishing patterns intended to increase catches of bigeye tuna; this may have caused lower yellowfin tuna catch rates in some areas. In order to limit the influence of any single index, a run was performed assuming equal weighting between indices (Case 2). Also of concern was the unavailability of purse seine indices after 1991. As an approximation, a run was performed assuming that standardized catch rates of ages 0, 1, and 2 in the missing years were equal to the average indices in the previous four years (Case 3).

The results from ADAPT were broadly similar to those of the untuned backwards VPA (**YFT-Figures 24 and 25**). The variability of ADAPT estimates for recent years demonstrates that recent recruitment and F estimates are greatly influenced by the indices used for tuning; and also by the assumptions made about fishing patterns in the terminal year. The discrepancies in the estimated fishing mortality for the earlier years (1975-79) are due to different fishing mortality of the last age class. The technical details and methodologies of obtaining data and the application of assessment models are given in the Yellowfin Appendix.

YFT-2.a.4 Yield per recruit

Yield per recruit analysis was carried out using average fishing mortality vector for the years 1989-1992, estimated by VPA on a quarterly basis.

YFT-Figure 26 shows the yield curve as a function of fishing mortality and the age at the first capture of the Atlantic stock. It is noted that current fishing mortality is very close to F_{MAX}, where increasing the effort reduces the yield. On the other hand, if the size at first capture is increased, yield can rise. If the age at first capture is considered in weight of fish, it could be considered that if yellowfin of less than the 3.2 kg minimum size adopted by the Committee are not fished, an increase of 11% in yield per recruit would result. These results are very similar to those of the yield per recruit analyses of the last few years, which proves the stability of the fishery.

YFT-3 Effects of current regulations

In 1973, the Committee adopted a minimum size of 3.2 kg for yellowfin, with an allowance of 15% in number of fish landed in the total yellowfin catches. **YFT-Figure 27** shows the percentage, in number, of Age 0 yellowfin caught during the 1975-1993 period, which indicates a minimum estimate of the number of individuals caught weighing less than 3.2 kg, bearing in mind that the upper limit of age 0 is less than that weight. It is noted that during the period, the percentage of fish less than the minimum weight was far above that established by the Commission.

YFT-4 Recommendations

YFT-4.a General

The coincidence of conducting a stock assessment of yellowfin, skipjack and bigeye in the Tropical Species Group during the same period has usually caused the group to concentrate on yellowfin, with less effort on other species. It is, therefore, recommended that in future, the analysis of yellowfin be alternated with that of the other two species, so that there will be sufficient time available to make progress towards a better understanding of all the species.

YFT-4.b Statistics

i) The Commission, at its 1993 meeting adopted the recommendation of the Committee and approved part of the budget, presented by the Executive Secretary, to carry out a detailed analysis of the sampling techniques of tropical tunas. During 1994, a preliminary study was carried out using partial data. The results obtained show some very interesting aspects regarding the improvement of the present scheme, applying simple techniques for the assessment and the monitoring of the quality of the sample for all delimited time area strata. The next step would be to carry out overall analyses, including fishing using floating objects as a specific stratum and to develop suitable techniques to monitor and improve the current sampling scheme. For this reason it is recommended that the work carried out be continued, in order to achieve these objectives.

ii) The recommendation that both the Secretariat and the scientists involved in the tropical tuna fisheries make a joint effort in order to continue to obtain statistics on vessels included in the NEI category, according to the SCRS norms, is maintained.

iii) Due to problems unrelated to scientific work, the coverage of statistics of the Spanish fleet, which has traditionally been of a high level, underwent a sharp decline in 1993, both in terms of the collection of logbooks and sampling. Given the importance of this fleet in relation to all the fleets which target yellowfin, it is recommended that the organizations involved in decision taking make an extra effort to solve the existing problems and to recuperate the coverage of previous years.

iv) The software to correct species composition, developed by the Working Group on Juvenile Tropical Tunas (1984), has been used then for the east Atlantic purse seine fleets' catches. This procedure could have some problems which cause the corrected statistics for the FIS and Spanish fleets show slight discrepancies. Thus, it is recommended that scientists of the countries involved give top priority to working on this matter, with the aim of making the verified statistics on the three species targeted by this fishery available as soon as possible.

v) The increase in unreported catches of small size yellowfin, skipjack and bigeye which are landed in certain points of Africa for the local market poses the problem that the number of small individual fish captured could be underestimated. For this reason, it is recommended that the scientists concerned with those ports where this type of landing is effected continue to monitor and estimate these landings.

YFT-4.c Research

i) The recommendation of the Working Group on Yellowfin Tuna relative to the need to develop tagging programs which allow the testing of the hypothesis developed by the Group on stock structure and the quantification of mixing rates is maintained and reinforced. Emphasis is especially placed on the recommendation establishing a juvenile tagging plan in the east Atlantic to determine if east Atlantic recruitment is the main source of medium-sized fish in yellowfin fisheries in the west Atlantic.

ii) Due to the lack of standardized abundance indices, the analytical assessment of the Atlantic yellowfin stock, using integrated assessment methods (ADAPT, XSA, etc.), could not be carried out. These methods incorporate calibration through external parameters which reduce the uncertainties associated with the Virtual Population Analysis (VPA) of all the parameters estimated for the last years of the series under consideration. Obtaining this type of index is, therefore, considered to be of the highest priority for yellowfin, and it is recommended that a Working Group be set up to analyze this problem and to obtain standardized abundance indices for yellowfin. For future meetings, these abundance indices ought to be available at the start of the meeting, and, if possible, should be presented as documents to the Committee.

iii) In 1994, following last year's recommendation of the Committee on the need to research the hypothesis on which the production models are applied, a non-equilibrium production model, based on the FOX model, has been presented to the Committee. It is recommended that the sensitivity of production models which assume conditions of non-equilibrium to the underlying curve patterns continue to be investigated.

iv) The recommendation relative to possible bias in the VPA estimates, applied on an annual basis to stocks subject to a high natural mortality and with very seasonal catches, and the development of assessment methods with calibration on a non-annual age base, is maintained.

v) It is recommended that work continue on the development of models which include components of stock mixing.

YFT-4.d Management

The two production models (PRODFIT and ASPIC), to which catch and effort data for the Atlantic are fit, show a stock status near full exploitation, even though they offer a more optimistic view of the status of the stock in relation to the last assessment, with a decline in 1993 in the overall level of effort. According to the ASPIC model, the 1993 catch is at MSY (149,000 MT), while relative to the two trials carried out using the PRODFIT model, the 1993 catch was slightly below the MSY of 153,700 and 149,999 MT. The 1993 effort is very similar to the effort corresponding to MSY, according to the ASPIC model, and somewhat below MSY, when the PRODFIT model is fit.

Despite the occurrence of a decline in the overall level of effort, the results of the analyses carried out show that there is no reason to expect sustainable increases in the catches if effort increases. Thus, the Committee maintains the recommendation not to increase fishing mortality, or its equivalent in effort, of Atlantic yellowfin tuna.

As regards the analysis of yield per recruit, the results are very similar to those of recent years, and hence the conclusions of previous years continue to be valid up to the present.

BET - B I G E Y E   T U N A

BET-1. Description of fisheries

Bigeye tuna are widely distributed in the tropical and temperate waters of the Atlantic Ocean, between approximately 45°N and 45°S. The presence of juveniles is only observed in the Gulf of Guinea, the only presently known nursery. Adult bigeye tuna are mainly exploited by longline between 15°N and 15°S. The principal fishing areas are located in the central and eastern Atlantic.

The stock is exploited in the entire area of distribution by different fleets and fishing gears: longline, purse seine and baitboats.

The main fishery for bigeye tuna (about 60% of the catches) is the longline fishery which operates during the whole year in the entire area of distribution. The longline fishery exploits adult bigeye tuna (weighing about 40 kg or more). Since the late 1970's, Japanese longliners directly target bigeye tuna using deep longlines and concentrate their effort in the time-area strata where the density of bigeye tuna is higher. Since 1980, Korean longliners began targeting bigeye tuna using deep longline. The same situation occurs for the Taiwanese longliners from 1990.

Of the surface fisheries, many local baitboat fleets seasonally target bigeye tuna in the areas of the Azores, Madeira and Canary Islands. These fisheries of the northeastern Atlantic islands exploit mainly pre-adult or adult bigeye tuna (average weight approximately 20 kg for the Canary Islands and 30 kg for the Azores).

Recently, the Canary Islands baitboats, like the Dakar-based baitboats, have changed their fishing strategy, in associating the tuna schools to the vessels during several months. This new fishing method makes it possible to extend the bigeye fishing season by various months in the Canary Islands fishery.

The Dakar-based baitboats, which fish off Senegal and Mauritania, seasonally catch medium-sized pre-adult bigeye tuna. (The mean weight observed for bigeye tuna taken by the Dakar-based baitboats was about 10 kg).

In the eastern tropical Atlantic, the purse seine and baitboat fleets take juvenile bigeye (mean weight of approximately 5.5 kg for the purse seiners and 2.5 kg for the Tema-based baitboats) which form mixed schools with skipjack and juvenile yellowfin. These last two fisheries do not directly target bigeye, but each year take significant amounts of juveniles, especially in terms of number of fish.

Since 1990, an increasing use of artificial floating objects has been observed in the tropical surface fisheries. The change in fishing strategy of these fleets due to the use of aggregating devices has caused an increase in the catch of juvenile bigeye tuna, simultaneously with the expansion of the purse seine fishing area towards the west, to 35°W, along latitudes near the Equator, following the drift of the floating objects. Since 1991 there have been significant catches of small bigeye by purse seiners to the south of the Equator (to 5°S), possibly associated to the use of artificial floating objects. The fishing operations with floating objects represent 40% of the total in the case of the Spanish purse seine fleet, between 1990 and 1993.

BET-1.a Catches

The annual catches of bigeye tuna, from 1962 to 1993, by country and fishing gear, are given in **BET-Table 1**, and the total catch, by gear, from 1950 to 1993 is shown in **BET-Figure 1.**

BET-Figure 2 shows the areas of operation and the size ranges characteristic of each gear. **BET-Figure 3** shows the changes in annual catches of these gears for the 1975-1993 period.

The total catch in the Atlantic increased regularly to 63,800 MT in 1974 and then showed a declining trend until 1979 (45,500 MT). In the following years, the catches gradually increased, reaching a maximum of 74,100 MT in 1985. They then decreased to 48,600 MT in 1987, and increased in the following years and are currently (1993) at the highest recorded level of 89,100 MT (preliminary).

The decrease in catches observed in the period 1986 to 1988 is mainly due to a decrease in the longline catch, but a decrease was also observed for the surface gears.

The between-year variability observed in the catches of bigeye tuna is mainly a result of the longline operation whose catches have represented 60 to 70% of the total up to 1990. This predominance of the longline in the bigeye catches has been the case since the beginning of this fishery in the Atlantic Ocean as well as in other oceans. The 1991 longline catch is the lowest observed in the last six years, but the catches have increased in 1992 and 1993. The catch by the longliners in 1993 probably is still under-estimated, since there is an increasing number of longliners that operate under flags of convenience and which do not report their catches to ICCAT. The increase in the catches of the surface gears (purse seiners) since 1991, result in the longline catches representing only 47% to 55% of the total bigeye catch during these three years.

As regards the surface gears, the catches show an increasing trend since 1989, and the 1993 catch, 44,300 MT (preliminary figure) is the highest recorded in the history of the fishery. This reflects overall the continuous increase in purse seine catches, which reached a record catch of 27,900 MT in 1993, and which corresponds to 33% of the total catch. The 1992 catch, 19,300 MT, corresponded previously to 25% of the total catches. In 1993, bigeye were caught by purse seiners in all the inter-tropical purse seine areas in the Gulf of Guinea. As regards these catches, it is noted that all sizes of bigeye are caught in large amounts by the purse seiners (**YFT-Figures 10 and 11**).

The total baitboat catches remained at a relatively stable level since 1990, varying from 15,400 MT to 17,100 MT. The strong inter-annual variability observed in the Portuguese and Canary Islands baitboat catches is most likely due to the variations in the local hydrological conditions.

BET-1.a Effort

The decline in the longline catches observed in 1986 and 1987 was caused by the decrease in the number of Japanese and Korean longliners in the Atlantic during this period. This situation has reversed since 1988 and, in 1992, the number of Japanese longliners that operated in the Atlantic was the highest of the last seven years. On the other hand, the reported number of Korean longliners has continued to decrease in recent years.

Nominal fishing effort of the FIS baitboats based at Dakar showed a declining trend until 1992, but in 1993 the fishing effort of this fleet showed a strong increase as compared to that of the previous year. In the baitboat fisheries of the Azores and Madeira, fishing effort increased in 1993, following the trend observed during the last few years.

The decrease in purse seine catches, observed from 1985 to 1989, is due to the decrease in effort which occurred after 1984, following the departure of part of the purse seine fleet to the Indian Ocean. Since 1985-1986, the number of purse seiners in the Atlantic has increased, which resulted in a regular increase in nominal effort and in their catches, particularly since 1990.

BET-2. State of the Stocks

The state of the bigeye stock was analyzed using the hypothesis of a single stock in the entire Atlantic. A single bigeye stock hypothesis is made mostly in view of the fisheries data, the geographic distribution of the species, the tagging results, the location of the spawning areas known in the tropical area between 15°N and 15°S, and in view of the fact that the only nursery known for young bigeye is found in the Gulf of Guinea.

BET-2.a CPUE trends

The only abundance indices used for the bigeye stock are those calculated from the catch rates of the longline fishery, which directly targets adult bigeye tuna in certain areas of the Atlantic. In fact, since the surface fisheries only catch bigeye seasonally or incidentally, and since they only catch certain sizes, their CPUE indices are not considered representative of stock abundance.

The CPUE of the seasonal fisheries of the northeastern Atlantic islands reflects the local abundance of a fraction of the Atlantic stock, and is subject to variability caused by local hydrological conditions. This situation is illustrated in **BET-Figure 4**, which shows the changes in CPUE of Azorean baitboats from 1979 to 1993, during the second quarter, when this species is fished. The CPUE shows a declining trend in recent years. The strong influence of hydrological conditions on this fishery indicates that this trend probably may not correspond to the abundance of the adult stock.

As concerns the FIS baitboat fishery, its CPUE, although seasonal, is less influenced by environmental changes (**BET-Figure 5**). The increase observed in CPUE during recent years is related essentially to a change in the fishing strategy and to an increase in fleet efficiency. For this type of fishing, vessels are constantly associated with tuna schools during several months, and a part of the school is caught each day.

As regards purse seiners, the CPUE could be interpreted as an index of abundance of juvenile bigeye. The FIS purse seine CPUE shows an increasing trend with important fluctuations during the 1969-93 period (**BET-Figure 6**). However, the increase in CPUE observed in recent years is related to the development of the use of artificial floating objects by purse seiners and to an southward extension of bigeye fishing areas, with an increase in abundance.

Standardized CPUE was updated for the Japanese longline fishery using the General Linear Modelling (GLM) approach (**BET-Figure 7**). Factors considered in this analysis are year, month, area, and by-catch information for whole history of the fishery. Information on longline gear configuration (traditional or deep longline) was also included for the years 1975-1993. Since the Japanese longline fishery quickly changed gear configuration to try to increase the catch of bigeye tuna, data which can be used to adjust this shift are limited to several years' observations. In this sense, the estimated abundance should be interpreted with caution.

The trend of this CPUE index seems more representative of the probable trend of the biomass of the stock than the Honma index, of which the increasing trend probably results from the development of deep longline and from the changes in fishing strategies (areas and seasons) that accompany the development the deep longline. The recent Japanese longline abundance index value of the 1988-1993 period is about 60% of that at the start of the fishery (1961-1965).

BET-2.b Cohort analysis

Cohort analysis of the bigeye tuna stock was conducted considering a natural mortality variable with age, which is higher for juveniles in the first two years (M=0.8) and lower in the following years (M=0.4), has been postulated for the cohort analysis.

The average rate of fishing mortality as a function of age, estimated by cohort analysis for the 1986-1990 period, with a vector of constant recruitment, indicates that in the recent period fishing mortality is at a relatively high level for the young fish of age classes 1 and 2, due to the tropical surface gears. For the adults, ages 4 +, fishing mortality is still at a relatively high level for the historical period, mainly due to the longline fishery (**BET-Figure 8**).

Fishing mortality observed for 1992 (**BET-Figure 9**) shows increased fishing mortality on juveniles, due to the tropical surface gears. This situation continued in 1993, during which the catches of juvenile bigeye by the purse seine have increased significantly, which could be due to a change in the catchability of juveniles. Fishing mortality on adult fish, is still at a high level, but remains at a level close to that which has been observed during recent years.

BET-2.c Yield-per-recruit analysis

The analysis of yield per recruit for bigeye tuna (**BET-Figure 10**) suggests that reducing fishing mortality on juvenile fish up to age 2, and simultaneously increasing the rate of fishing mortality on adult fish, could increase the yield per recruit. This modification in age-specific fishing mortality could increase the MSY; this possibility could be studied through simulation. However, if any fishing mortality or discarding mortality continues on the young fish, the increase in yield per recruit and MSY would not occur.

In spite of this, the real level of fishing effort in 1993 is certainly higher than the current estimated effort, due to the longliners that operate under flags of convenience (currently not taken into account due to the lack of statistical data).

Multi-gear yield per recruit analysis suggests that, under the current exploitation scheme, some gains could be obtained if the increase in fishing mortality of adult bigeye tuna is accompanied by a simultaneous decrease in mortality on juveniles (**BET-Figure 11**). On the contrary, if an increase in fishing mortality on juveniles occurs simultaneously with a decline in mortality on adults, a decline in yield per recruit may be observed. These findings are completely consistent with the preceding analysis.

BET-2.d Production model analysis

An updated production model analysis (PRODFIT), fitted to the data for 1961-93, estimated a MSY of 79,100 MT (Fox exponential model, m=1 and k.=4) and 72,300 MT (logistical model, m=2). This analysis suggests that the catches in 1993 were slightly higher than the estimated MSY (**BET-Figure 12**).

The production model analysis also indicates that current fishing effort on bigeye tuna is at a level slightly below the fishing effort (f_{opt}) estimated by the model to arrive at the MSY, which has always been the case in the previous analyses by this model.

A fit of the ASPIC non-equilibrium production model has also been carried out on bigeye data.

This fit of the model assumes a constant catchability for the entire time series, 1961-93. The results of this fit of the ASPIC model (equivalent to a logistical model, m=2) show a less optimistic assessment of the status of the stock and estimates MSY at 66,800 MT. Recent catches, since 1989, seem thus to have surpassed the MSY estimated by ASPIC. On the other hand, the estimate of the stock biomass starting in 1993 is slightly below the optimum level, and the 1993 fishing mortality rate seems to have exceeded by about 40% the optimum level (**BET-Figure 13**).

Another fit of the IFOX, non-equilibrium model (equivalent to a logistical model, m=1) was also done on the bigeye data. The results of this fit of the IFOX model estimates the MSY at 75,200 MT, a value comparable to that estimated by PRODFIT. The recent catches, of 1992 and 1993, seem thus to have exceeded the MSY estimated by IFOX. Fishing effort for 1993 is at a level below optimum calculated by the model (**BET-Figure 14**).

The Committee noted that the estimated MSY for the bigeye stock has increased regularly since the start of the analyses by the SCRS. This could be due to the existence of a variable fraction of the cryptic biomass (not very accessible to the fishing gears) of bigeye in the Atlantic (Die & Fox; Laloe).

Recent changes in selectivity (i.e. a higher proportion of small fish in the catches) could result in lower levels of MSY by not allowing fish that are caught to reach a size which maximizes yield per recruit.

The production model estimates that the stock is probably fully exploited, and the increase in catch suggested by yield per recruit analysis may not occur in equilibrium.

BET-3. Effects of current regulations

The bigeye minimum-size regulation of 3.2 kg has been in effect since 1980, which was adopted to reinforce the yellowfin regulation. It has been reported in recent years that the tropical surface fleets (baitboat and purse seine) continue to land a large number of juvenile bigeye tuna. This trend has increased in 1993 (BET-Figure 15).

Under the present conditions, the analyses indicate that the minimum size regulation of 3.2 kg would provide little gains in yield per recruit for bigeye tuna. This regulation is quite difficult to put into force since juvenile bigeye are caught mixed with skipjack and yellowfin. Nevertheless, given the current high exploitation rate on bigeye, the limit on juvenile catches is a useful objective to improve the state of the stock.

BET-4. Recommendations

A series of recommendations which also concern bigeye tuna are presented in the yellowfin and skipjack species sections. The Committee also recommended that:

BET-4.a Statistics

i) The increasing use of deep longline by the longline fleets poses problems for the standardization of the longline data. It is recommended that the relevant information on this aspect from all the longline fisheries be made available to the Committee.

ii) Evaluate the species composition and the volume of bigeye catches in the landings at African ports.

iii) Conduct research on the species corrections methods of the tropical purse seine fleets, in order to verify if the importance of the increase in the purse seine catches of bigeye in recent years is real or is biased by the methods of correcting the species composition from the logbooks.

BET-4.b Research

i) An abundance index be generated that encompasses information on the bigeye surface fisheries. This should include analyses on the apparent variability of recruitment based on the CPUE of FIS and Spanish purse seiners in the coastal areas, and on the CPUE by size class and by limited time-area strata, for purse seiners as well as for longliners.

ii) Research on changes in gear efficiency between traditional and deep longline operations be continued in order to calculate the effective effort exerted on bigeye tuna.

iii) Studies on the influence of the environment on bigeye CPUE should be developed.

iv) Further research on IFOX is recommended, specifically, possibly adapting it to an observation error estimator or evaluating the performance of the present IFOX in comparison to existing observation-error estimators, by application to simulated data of known characteristics.

v) Investigate the possible reasons for the increase of purse seine catches in the Gulf of Guinea in recent years, and assess the effect of these catches on stock status.

BET-4.c Management

According to the available assessment results, there are few potential benefits to increasing the age at first capture, in the current situation. However, the Committee recommended maintaining the regulations currently in effect, taking into account the increase in purse seine fishing effort and that the increased use of artificial floating objects increases the catch of juveniles. Thus, the current regulation is always useful for improving the yield per recruit of the stock.

The Committee noted the strong increase in bigeye catches observed in the last three or four years especially for small bigeye caught by surface fisheries. It expressed concern on the volume of the unreported catches by longliners that fly flags of convenience. The results of the production models applied to the bigeye stock indicate a high exploitation state, where the current catch has surpassed the estimated level of MSY. For these reasons, the Committee recommends that fishing mortality or bigeye catches be reduced towards the levels of recent years (for example, 1989-1992).

SKJ - S K I P J A C K T U N A

SKJ-1. Description of fisheries

Skipjack tuna is a cosmopolitan species distributed in the tropical and sub-tropical waters of the three oceans.

Skipjack tuna are caught almost exclusively by surface gears in the entire Atlantic Ocean, although by-catches of skipjack taken by longline are minor. In the eastern Atlantic, the major fisheries are purse seine, especially those of the Spanish and FIS fleets, followed by the baitboat fisheries of Ghana, Portugal, Spain, and the FIS fleets. The skipjack fishery underwent important changes in 1991 with the introduction of fishing using floating objects and the expansion of the purse seine fishery towards the west, at latitudes close to the equator, following the drift of floating objects, and the development of a new method in which the pole and line acts as an object, fixing and fishing a school during the whole fishing season, in Senegal, Mauritania and Canary Island waters. These changes have resulted in an increase of the exploitable biomass of the skipjack stock (due to the expansion of the fishing area), whereas the usual length distribution of the catches has been maintained. In the western Atlantic, the most important fishery is the Brazilian baitboat fishery, whose only target species is skipjack. Cuban and Venezuelan vessels also participate in this fishery. As regards the purse seine fisheries, whose total catches are considerably lower than those of the baitboat fisheries, catches were only taken by the Venezuelan, Colombian, Spanish, and U.S. fleets.

SKJ-Figure 1, shows the size distributions of skipjack catches by the principal Atlantic fisheries.

SKJ-1.a Catches

Skipjack catches, by gear, in the eastern and western Atlantic are shown in **SKJ-Table 1** and **SKJ-Figures 2 and 3.**

Eastern Atlantic skipjack catches in 1991 (165,700 MT) were the highest for the historical period of the fishery. In 1993, catches reached 143,800 MT, which represents an increase of 21% with respect to 1992. Consequently, it was the second highest in the history of the fishery. This increase in the 1993 catches is due exclusively to the increase in catches by the purse seine fleet. Baitboat catches decreased with respect to 1992.

The catches of the principal eastern Atlantic fisheries are shown in **SKJ-Figure 4.**

As regards the west Atlantic, there has been an increase in catches with respect to 1992 (30,300 MT in 1993) by 13%. This increase only affected catches by the purse seine fleets (their catches doubled), while the catches by baitboats decreased by 6%. The major baitboat fishery is the Brazilian fishery, whose catches comprise close to 90% of the catches taken by this gear. **SKJ-Figure 5** shows the catches by the principal western Atlantic fisheries.

SKJ-1.b Fishing effort

As regards fishing effort, there is no information available on effective skipjack effort. As in other years, vessel carrying capacity has been considered as a measure of nominal effort for the eastern Atlantic (**YFT-Table 2, YFT-Figure 7**). Carrying capacity is not an ideal measure of effort, as it does not take into account the increase in fleet efficiency, fleet interaction, etc., but only indicates the carrying capacity of the wells of the vessels.

Nominal effort, in days fishing, of the FIS and Spanish purse seine fleets was calculated, standardized to category 5 FIS purse seiners. The total effort was obtained by multiplying the sum of the standardized fishing times of the two main purse seine fleets, by an annual weighting factor equal to the ratio between the total catch and the catch of these fleets. Besides, after 1980, an annual constant increase of 3% in the fishing power of these fleets was assumed. This factor, established for yellowfin, attempts to adjust the nominal effort to real effort (fishing mortality), in order to adjust the continuous increase in the efficiency of the purse seiners.

The maximum carrying capacity was reached in 1983 (81,800 MT), and since then there was slow decline until 1988 (43,800 MT), due to the massive movement of vessels of the FIS and Spanish purse seine fleets towards the Indian Ocean (**YFT-Figure 7**). Afterwards there were slight increases in 1989 and 1990, and a moderate increase in 1991 to 56,600 MT, which is still considerably less than that of 1983. In 1992 and 1993, there was another slight decline in carrying capacity, to 51,500 MT.

Due to the lack of data on carrying capacity, estimates of total nominal effort for the western Atlantic could not be made, although there are indications that there has been a slight increase in effort, due to the increase in the number of purse seiners (from the Pacific Ocean) and to the stability of Brazilian baitboat effort, which is expressed in nominal effort, in days fishing, for the major part of the fleet.

SKJ-2. State of the Stocks

Up to now, studies carried out on skipjack stock structure in the Atlantic have not provided definitive information on stock structure to make it possible to divide the resource into smaller units. Two management units have been hypothesized: in the eastern Atlantic and in the western Atlantic, due to the absence of transatlantic tag recoveries.

SKJ-2.a East Atlantic stock

The last detailed skipjack stock assessment for the eastern Atlantic was carried out in 1984 by the Working Group on Juvenile Tropical Tunas. For these analyses, data and parameters obtained mainly during the International Skipjack Year Program were used. The results of this evaluation showed that the stock was under-exploited, just as the Group, and later the SCRS, had assumed.

In observing the change in vessel carrying capacity, it is noted that at the time of the assessment, the fishery supported the highest levels of exploitation of the historical period. Vessel carrying capacity in 1983 was 81,800 MT, while it is currently at 51.500 MT, which represents a 37% reduction. This decline in recent years, with respect to the time when the assessment was carried out (1984), might not have been accompanied by a similar drop in effective effort, taking into account the increase observed in the individual fishing power of the purse seiners and the important change that occurred, at the end of 1990 and during 1991, in the pattern of skipjack exploitation (the massive introduction of floating objects, especially by the purse seine fleets) since about 75% of the catches made in association with floating objects are of skipjack (**SKJ-Table 2**).

It is noted that the reported catches are underestimated, as a consequence of fishing with floating objects, since small sized tunas, among them skipjack, are discarded.

SKJ-Figures 6 and 7 show the relation between skipjack catch and carrying capacity for baitboats and purse seiners in the eastern Atlantic. It was observed that with a similar level of effort, since 1991, when fishing with floating objects was introduced, high skipjack catches have been attained.

As regards parameters such as CPUE, it is advisable not to interpret their changes as an index of skipjack stock abundance, since it can be considered an index of the biomass of the stock, only if the catchability is maintained constant from year to year. Also, it should be taken into account that skipjack is not the main target species of the purse seine and baitboat fisheries.

In recent years, there have been changes in the fishing strategy of the FIS purse seine fleet. During the 1984 through 1988 period, effort was concentrated in the time-area strata with high skipjack concentrations and consequently, high yields of this species were obtained, which were maintained during this five-year period. However, skipjack CPUE by the Spanish fleet show continuous fluctuations with an increasing trend (**SKJ-Figure 8**). Average CPUE for the purse seine fleets increased from 2.40 MT/day fishing to an average of 3.26 MT/day fishing in the 1991-1993 period.

YFT-Figure 9 shows the area where the fishery takes place and the 13 areas established for study by the Working Group on Juvenile Tropical Tunas (Brest, 1984).

The Spanish fleet (since the last quarter of 1990) and the FIS fleet (since early 1991) have started the massive use of artificial flotsam to aggregate the fish schools, mainly in the equatorial area (6°N-5°S and 3°W-20°W). This type of operation has been maintained at present. This change in fishing strategy has not changed the size distribution of skipjack catches (**SKJ-Figures 9 and 10**), but it has changed the fishing area, which has extended towards the west and south, following the drift of floating objects (**YFT-Figures 10, 11, and 12**).

SKJ-Figure 11 shows the relation between the eastern Atlantic catch and effort. A constant increase in effort is noted during the 1969-1983 period. Later, a significant decline is observed, due to the withdrawal of the purse seine fleet from the fishery, and finally, for the period corresponding to the latest years, there is a very important increase in the catch. As regards CPUE, there was a significant decline between 1969 and 1975, remaining stable thereafter. It should be noted, however, that effort is not directed primarily at skipjack.

In the baitboat fishery of the Azores Islands, which is the northern limit of the skipjack fisheries, the fluctuation of CPUE, with no trend, is much more marked, although in the last four years it has remained at lower levels than normal (**SKJ-Figure 12**). This is probably due to the influence of environmental changes. The recent environmental changes in other areas have had a favorable effect. Such is the case of the Madeira Islands, where after various years of practically null catches, the fishery has again developed. However, in the Canary Islands there was a notable decline in catches.

No definitive conclusion can be reached on the state of the eastern Atlantic stock, since the important increase in the catches could be due to various reasons: an increase in the available biomass, an increase in fishing mortality due to an increase in catchability, changes in fishing strategy, etc.

However, some studies on tagging and recoveries of skipjack (carried out in 1981) indicate that in the eastern Atlantic Ocean there is no interactions between the different fisheries and that this species is subjected to low rates of exploitation, although locally there is high fishing mortality in specific areas.

SKJ-2.b West Atlantic stock

Skipjack catches in the western Atlantic remain stable, for the various Venezuelan fleets (although standardized CPUE data are not available for the last three years) (**SKJ-Figure 13**) as well as for the baitboat fleet of Brazil (**SKJ-Figure 14**), in which the CPUE series does not represent the biomass of the stock since it has not been standardized. The low variability of the CPUE's, compared with the large fluctuations that are normally found in the catches of this species, would confirm the local character of these indices.

SKJ-3. Effects of Current Regulations

There are no regulations of any type in effect for skipjack.

SKJ-4. Recommendations

Some recommendations included in the yellowfin and bigeye species sections also affect skipjack. Additionally, the following are recommended:

SKJ-4.a Statistics

i) Continue and improve the evaluation on the volume of the catches of small-sized tunas that are landed at the port of Tema, as well as an estimation, through multi-species sampling, of the proportion of skipjack in these catches.

ii) Attempt to estimate the discards of skipjack of the purse seine fleets, in spite of the difficulties that this would cause.

iii) Improve sampling quality in the southwestern Atlantic in general, and that of Brazil, in particular.

iv) The Secretariat should update and improve the tables on carrying capacity of purse and baitboat vessels in the eastern Atlantic, and develop similar tables for the west Atlantic. In this respect, the countries concerned should provide historical data on composition of their fleets.

v) Skipjack market prices should be monitored, bearing in mind that such information will help gain knowledge on the target species each year.

vi) The Secretariat should prepare annual catch maps (Task II), by type of gear, for the SCRS meetings.

vii) The statistical and sampling coverage of the Spanish purse seine fleet should return to the 1992 levels.

SKJ-4.b Research

i) Improve knowledge on the associations of tropical tunas with (artificial and natural) floating objects, marine mammals, etc., in order to determine the repercussions that these interactions can have on the assessment of these species.

ii) Attempt to assess the stock condition of this species, carrying out the calculations with the current species compositions, which were not available when the last assessment was carried out in 1984.

iii) Carry out complementary research on skipjack reproduction in the west Atlantic.

iv) Analyze the changes in effective effort, caused by the decline in competition between vessels due to the decrease in the number of vessels and to the increase in purse seine vessel efficiency with the introduction of bird radars and fishing with artificial objects.

v) Continue research on the effect of environmental factors on abundance, recruitment and availability of skipjack. This would benefit new assessments of the skipjack stocks, particularly from an analytical standpoint.

vi) Conduct studies on indices of abundance in the fisheries of the western Atlantic in general, and of the Brazilian baitboat fishery in particular.

SKJ-4.c Management

It is not known if the high catches of 1991 and 1993 can be maintained, but due to the lack of conclusive analysis, no management measures are presented.

ALB - A L B A C O R E

ALB-1. Description of fisheries

ALB-1.a Historical description of the fisheries

The history of albacore fisheries in the Atlantic and Mediterranean is described in the report of the final meeting of the ICCAT Albacore Research Program held in Sukarietta (COM-SCRS/94/16).

North Stock

The most important and oldest fishery takes place in the Bay of Biscay and adjacent waters. Trolling was the first gear utilized in this area and also the most important until the introduction of baitboat in 1949. Both surface gears have been used mainly by Spain and France. Spanish fleets have remained relatively stable during the last decades, with a slight decline in the 1990's. On the contrary, French bait boat and troll fleets have declined gradually during the same period until their total disappearance in the late 1980's. In 1987, this country introduced two new surface gears in the fishery, drift net and pelagic trawl. Since 1990, Ireland and Great Britain have also developed drift net fleets targeting albacore. All the surface fleets target mainly juveniles and pre-adult albacore from 40 to 85 cm **(ALB-Figures 1 and 2)**

There is a Portuguese baitboat fleet fishing for albacore in the Azores and Madeira where fishing takes place mainly in the autumn. Eventually some Spanish vessels extend their fishing area towards the Azores and the Canary Islands targeting big albacore, there is also a small US surface fishery with rod and reel in the northwestern Atlantic.

Longline has been developed in the North Atlantic mainly by Japan and Taiwan. Catches of albacore have also been made by other countries including cuba and Korea. Japan started this activity targeting albacore in 1956 continuing at a high level until the end of the 1960's. After a transition period, this fleet changed target species and albacore catches became incidental since 1975 **(ALB-Figure 3)**. Taiwanese longline activity started later and remained at a high level until 1987, when there was a change in the composition and behavior of the fleet. Since then, only a minor fleet using conventional longline is still targeting albacore in the North **(ALB-Figure 4)**.

South Stock

The only albacore surface fishery is the South African baitboat fleet off the southwest of South Africa and off the coast of Namibia. This fleet catches mainly juveniles and pre-adults. Large albacore are also occasionally caught in equatorial areas by Spanish and French purse seiners **(ALB-Figure 1)**

A Japanese longline fishery developed in the south in a very similar way as in the north. Since the early 1970's, Taiwan has the main longline fleet targeting albacore. Its catches have remained at a high level until 1993, usually more than 15,000 MT. Minor Brazilian and Uruguayan longline fleets target albacore in some years and seasons.

Mediterranean

Italy and Greece are the main countries involved in the albacore fishery in the Mediterranean. the reported catches reached 4,100 MT in 1985, remaining relatively stable since that year. Driftnet, longline, handline and troll are the main gears used. Albacore are occasionally caught by French purse seiners, by the Spanish coastal fleets, as well as by the sport fishery. Since 1985, the Spanish baitboat fleet based in the Atlantic made albacore catches in the western Mediterranean in autumn.

ALB-Table 1 and **ALB-Figure 5** show the historical series of catches for the total Atlantic, and for the north and south Atlantic and Mediterranean stocks from 1963 to 1993.

Stock structure

It is generally assumed that the Atlantic albacore resource is composed of a north and a south stock, separated at 5°N latitude. However, the existence of purse seine albacore catches around the equator raises questions about the precise position of a suitable line of separation. An analysis on albacore stock structure, using mitochondrial DNA, was presented (SCRS/94/42). This study shows no significant difference in the haplotype frequency between the north Atlantic (Bay of Biscay) and south Atlantic (Brazil) samples. However, this result is not considered inconsistent with the hypothesis of two stocks: in the north and south Atlantic Ocean. Although there is a continuous distribution of longline albacore catches around southern Africa, it appears that only slight interchange occurs between Indian and Atlantic Ocean albacore stocks (see SCRS/94/16). The GFCM-ICCAT Expert Consultation meeting (Bari, 1990) confirmed that albacore in the Mediterranean should be considered as a third separate stock. At the Sukarietta meeting it was confirmed that working hypothesis of three stocks in the Atlantic is valid (COM-SCRS/94/16). Therefore, the following description of the recent catches and efforts of the fisheries is done assuming this stock structure.

ALB-1.b Catches

North Atlantic

ALB-Figure 6 shows the historical series of catches of this stock, by gear, from 1950 to 1993. Since the late 1970s, albacore catches in the north Atlantic have shown a downward trend. This decrease has resulted from a general reduction in fishing effort of the traditional gears (troll, summer baitboat), as well as from a significant reduction in longline effort since 1987. The recent increase of catches by the recently introduced new surface gears should be noted.

The total albacore catch in 1993 in the north Atlantic was 37,100 MT, compared to 1991 (26,100 MT) and 1992 (31,100 MT) The surface fisheries caught 30,000 MT in 1993, an increase since 1991 (22,700 MT) and 1992 (27,400 MT).

The Spanish troll fleet shows a decreasing catch (6,100 MT in 1993, following the 7,300 MT in 1992 and 9,000 MT in 1991).

The recovery of the surface fishery after the decline between 1990 and 1991 is mainly explained by other surface fisheries:

- a slight increase for Spanish baitboat since 1991: 12,300 MT were caught in 1993, from which 1,100 MT in the Azorean area and 1,300 MT in southwestern Portugal during the fall;

- a notable increase in the Portuguese baitboat catch in 1992 and 1993, with respectively 1,600 and 3,100 MT in the Azores and Madeira;

- a sharp increase of the new surface fishing gears. French driftnetters caught 4,600 MT in 1993 compared to 4,300 MT in 1992. The Irish catch amounted to 450 MT in 1992 and 1,930 MT in 1993, and the catch by Great Britain amounted to 43 MT in 1992 and 402 MT in 1993 (as reported by Scientific Technical Committee for Fisheries at the Commission of European Communities, 1993). French mid-water trawl catch decreased from 2,500 MT in 1992 to 1,700 MT in 1993.

In 1993, catches from longline was 7,100 MT, compared to 3,700 MT in 1992. This is explained mainly by an increase of the Taiwanese longliners during this period (6,400 MT in 1993 as compared to 2,800 MT in 1992).

South Atlantic

ALB-Figure 7 shows the historical catch series by gear for the south Atlantic stock. In general, catches have shown relatively large fluctuations between 15,000 MT and 40,000 MT during the last three decades. The total for catch in 1993 was 28,200 MT, compared to 30,400 MT in 1992 and 24,800 MT in 1991. Longline catches were 23,900 MT in 1993, almost similar to 1992 (23,300 MT). Catches from the South African surface fishery increased from 3,400 MT in 1991 to 6,400 MT in 1992, due to renewed access to fishing areas off Namibia, but decreased to 4,500 MT in 1993. An additional 1,000 MT caught off Namibia not reported to ICCAT were not included in the analyses. A recent analysis of by-catches by purse seiners around the Equator indicates albacore catches increased from 50 MT in 1989 to 2,300 MT in 1992 (see Yellowfin Report). However, these data were not used in the present assessment.

Mediterranean

Reported catches in the Mediterranean are still minor, ranging between 2,000 MT and 4,000 MT since 1984, to a maximum of 4,200 MT in 1985. Catch have been lower since 1988 stabilizing at about 2,000 MT in 1993..The low value observed in 1993 could be due to incomplete reporting of catches.

ALB-1.c Albacore Fishing Effort

Nominal effort

ALB-Table 2 summarizes the nominal fishing effort for all Atlantic main fisheries for albacore. The main features for recent years are:

-- North Atlantic

Surface gears

For trollers, a continuous and significant decline of effort of all fleets combined occurred between 1967 and 1975, followed by a moderate decrease from 1976 to 1984. Since then, the French troll fleet left the fisheries, whereas the Spanish effort remained rather stable until 1990. Since 1991, it decreased again to 11,400 fishing days in 1993.

The French baitboat fleet left the fishery before the trollers. The Spanish fleet remained and its nominal effort stabilized since 1977 at an average of about 10,000 fishing days. However, the 1993 value is the lowest of the series: 8,100 days fishing.

The nominal effort by the driftnet fleet was 2,601, 3,742 and 6,149 net days for the period 1991-1993 (as calculated by the Committee using 5 km as the length of a standard net. Fishing effort of new fleets from the United Kingdom is still not reported to ICCAT.

Mid-water trawl effort, beginning in 1988, has since been very variable, with a maximum of 3,000 fishing days in 1992.

Longline

It is noted that the longline vessels of Japan and Taiwan, after an initial period of targeting albacore, diverted their effort towards bigeye, (Japan in the early 1970's and Taiwan in 1989). Effort directed at albacore by this gear in the north Atlantic was low during the period 1990-1992. In 1993 it seems to have increased.

-- South Atlantic

Longline fishing effort is still directed at albacore by the Taiwanese fleet, at a high level, reaching 63.7 million hooks in 1993. The Japanese fleet began targeting bigeye in the early 1970s. South African baitboat fleet effort increased after cancellation of the restricted access to the Namibian EEZ.

-- Mediterranean

The trend of fishing effort of the various gears fishing for albacore in the Mediterranean Sea is still difficult to estimate, due to the insufficient length of the time series and probably to inadequate coverage of artisanal gears.

Effective effort

An attempt was made to estimate the effective effort for all the main gears in the north and south Atlantic since 1981, by dividing the nominal catch by CPUE. These CPUEs were standardized to GLM for longline, troll and baitboat.

The results are shown in **ALB-Figure 8.** For the north Atlantic (**ALB-Figure 8a**), the main features are: stability for the baitboats; continuous slow gradual decrease in the trollers since 1989. Longline effort increased sharply up to 1986, then decreased to a minimum in 1989. Since then, the effort apparently increased, but this could be due to an inaccurate estimate of the proportion of effort directed at bigeye. The Committee noted that the estimate of that effective longline effort for 1993 was five times higher than in previous years.

For the south Atlantic, overall effective effort for longlines shows an increase since 1984 and a stabilization at a high level up to 1992. The effective effort estimated for South African baitboats is shown in **ALB-Figure 8b.**

ALB-1.d Catch rates

Catch rates of the main gears in the north and south Atlantic, for 1963-1993 (**ALB-Figure 9**) were computed as nominal catch/nominal effort, to compare the trends as a reflection of economical viability. The main features observed are:

For surface gears, the Spanish troll catch rate is stable, whereas the catch rate of Spanish baitboats increased notably over the 1974-1990 period. It is believed that such an increase reflects the technological improvements made on these vessels, as described in section ALB-1. In 1991 and 1992, the catch rate of the baitboats decreased sharply and increased again in 1993. Since 1991, the decrease is notable in areas west of the Bay of Biscay (10°W). This could be explained by the possible interaction with the driftnet activity, as discussed in documents COM-SCRS/94/16, SCRS/94/35, 94/46 and 94/159). The steep increase of the catch rate of French driftnets over 1988-1992 is also noteworthy.

For longliners, the catch rates in the north and south Atlantic are comparable and rather stable over the 1968-1984 period. Since then, they declined to the lowest level in 1987 for the north, (and longliners switched their target species to bigeye) and in 1991 for the south.

ALB-2. State of the stocks

The following section describes the procedure in preparing the input parameters for the VPA.

Catch at age

The catch-at-age table was estimated by applying MULTIFAN to the quarterly catch-at-size distributions, taking into account the recommendations of the Final Meeting of the Albacore Research Program (COM-SCRS/94/16). These recommendations were to eliminate age 1 class from the analysis, to consider only those quarterly length distributions with an adequate sampling level when estimating parameters of the growth equation, and to introduce bounds for ages 2 and 3.

The period analyzed to estimate growth parameters values included the quarterly length distributions from 1988 to 1993, and the growth parameters obtained were applied to the complete series of quarters since 1975. The selection of years 1988-1993 was made due to the improvement in the sampling effort of surface fisheries observed during this period (**ALB-Figure 10**).

The estimates of the growth parameters were different from those obtained in previous analyses (**ALB-Table 3**). This is also reflected in the new catch-at-age, which was markedly different from that estimated in 1993. This new catch-at-age composition is shown in **ALB-Table 4.**

Some discrepancies were found between Task I and the catch computed from numbers-at-age and mean weight-at-age. These differences were also noted in document SCRS/94/7. The main differences affected surface gears from 1977 to 1980 and 1988. After revising Task I and II, the age composition was modified for years 1978 and 1988 in which catch in numbers were over-estimated.

The Committee considered the new catch-at-age table as the current, best estimate. It is based on growth parameters obtained from length distributions with an adequate sampling level; age 1 class was not included in the stochastic analysis (avoiding biases found in previous MULTIFAN runs that included this group) and the estimated mean lengths at age were very similar to those estimated with the Bard (1981) equation.

The Committee noted that estimates of growth equation parameter values should not change markedly with the introduction of further size frequency information. It agreed that calculation of catch at age to the next two years can be based on the growth equation estimated during the meeting (**ALB-Table 3**). The Group suggested that for purposes of CPUE standardization, the length-age-key for the most recent year can be assumed to be the same as for the previous year.

Abundance Indices

A summary of the indices used in the analysis and their values are shown in **ALB-Table 5** and **ALB-Figures 11 and 12**. Additional information is presented in COM-SCRS/94/16.

North Atlantic

Document SCRS/94/30 analyzed the data of almost 20,000 trips made by the traditional Spanish fleet (troll and baitboat) during the 1981-1993 period. Standardized indices (GLM) specified by age (gears aggregated and disaggregated) are presented. For the first time, standardized biomass indices, by gear and combined gears, are available.

The results obtained by age do not differ greatly from those obtained in previous analyses. The age 1 indices show considerable fluctuations as this age is not targeted (it is occasionally avoided). The Committee noted occasional inconsistencies in trends between ages 2 and 3. These may be due to gear interactions or differences in fishing mortality. However the indices obtained in ages 2 and 3 appear *a priori* more consistent as they are the ages which are clearly targeted by both gears and are well represented in the catches. Additional analyses were carried out for the troll gear (ages 2+3 and ages 2+3+4), which show a stable trend for the period analyzed.

The age 4 troll index shows considerable fluctuations, probably due to the scarce appearance of this age in the catch by this gear. This age group is more frequently caught by baitboat which shows a declining trend since 1986.

The biomass indices by gear were also reviewed by the Committee which decided not to use the baitboat indices due to possible problems which should be considered (improved technologies and possible gear interactions). The Committee therefore concluded that the troll index offered a better index of northern albacore abundance than the baitboat index.

Document SCRS/94/48 shows standardized abundance indices in number of fish from the logbook data of traditional French gears (troll and baitboat) for 1967-1986. As the data were grouped into three commercial categories (small, medium and large), the data were analyzed, assuming that the commercial categories correspond to ages 1, 2, and 3, respectively.

To address uncertainty in this assumption, the Committee also investigated standardized indices for the combined medium and large commercial categories, assuming them to be represent ages 2+3 combined. This index shows a stable or slightly increasing trend during the 1967-1979 period and a sharply declining trend between 1979 and 1985.

Longline

Documents SCRS/94/37 and SCRS/94/154 give information on the standardized indices of abundance in weight for the Japanese longline fleet, for the period between 1959 and 1993. This fleet mainly catches adult individuals (ages 5+). Due to the considerable changes in the fishing pattern of the fleet during this long period of time, in terms of gear, target species, fishing grounds, etc., analyses were carried out on three time periods: target fishery period (1959-1969), transition period (1969-1975), and by-catch period (1975-1992), in order to eliminate the possible bias during the standardization procedures. The results obtained suggest that in the north Atlantic, the CPUE declined during the three periods studied (**ALB-Figure 11**).

Document SCRS/94/153 provides information on CPUE in number of fish per unit of effort of the same Japanese fleet, for the period 1959-1993. The document compares the CPUEs obtained from two different fits of the General Linear Model (traditional GLM vs GENMOD). The trends obtained by both fits are very similar for the combined series. The Committee decided to use these indices to reflect abundance of large fish because the effects of targeting on other species (e.g. bigeye) and spatial coverage were accounted for during standardization.

Document SCRS/94/45 (revised) gives information on standardized indices of abundance (in number) for the directed Taiwanese fishery, for the 1968-1993 period. This is a fishery directed mainly at the adult component of the stock (assumed as mainly ages 5+). The results suggest a stable trend, with fluctuations, between 1968 and 1989, followed by a decline between 1990 and 1993.

South Atlantic

The south Atlantic indices of abundance analyzed are shown in **ALB-Table 5** and **ALB-Figure 12.**

Surface: Document SCRS/94/32 (revised) develops standardized indices of abundance (70 cm -90 cm FL) from catch and effort data of the South African baitboat fleet, for the 1985-1993 period. The indices indicate a slightly decreasing trend throughout the period studied. However, estimation of effective effort for this fleet is complicated by the rapid target switching over short periods of time (opportunistic fishing strategy).

Longline: Document SCRS/94/37 (updated in SCRS/94/154) provides information on standardized indices of abundance, in weight, of the Japanese fishery on adult albacore (ages 5+) carried out during the 1959-1992 period. The methodology applied is identical to that applied for the north Atlantic. The results indicate declining trends for the three periods defined.

Document SCRS/94/153 gives CPUE indices, in number, for this same Japanese fishery, and compares two standardization procedures. One (GLM) models CPUE as a log-normal variable that depends on a number of effects (year, area, etc.). The other (GENMOD) models catch as a Poisson variable that depends on effort, plus the other effects.

Documents SCRS/94/47 and SCRS/94/130 present information on standardized indices of abundance (in number) for the Taiwanese fishery for adult (5+) albacore in the 1968-1992 period. The results indicate the importance of accounting for targeting during standardization, and the index obtained shows a continuously declining trend for the combined period studied (**ALB-Figure 12**). The Committee also investigated the effect of weighting observations by fishing effort.

ALB-2.a North stock

-- Virtual Population Analysis (VPA)

The status of the northern stock was investigated using the ADAPT methodology for sequential population analyses. The catch-at-age data used was that obtained with the MULTIFAN method during the meeting. Natural mortality was assumed to be 0.3 per year. The relative abundance indices in numbers (see **ALB-Table 5**) selected for the base case were (a) Spanish troll (ages 2 and 3 combined) for the period 1981-1993; (b) French troll (ages 2 and 3 combined) for the period 1975-1980; (c) Japanese longline (ages 5+) for the period 1975-1993; and (d) Taiwanese longline (ages 5+) for the periods 1975-1989 and 1990-1993. The choice of these specific indices was based on recommendations made during the Final Meeting of the Albacore Research Program held in June, 1994 (SCRS/94/16).

Fishing mortalities in 1993 were estimated directly with ADAPT for 3 age classes (ages 2, 5 and 6). Fishing mortalities for other ages in 1993 were assumed to be proportional to those directly estimated, with the relative selectivities computed from a separable VPA: age 1 referenced to age 2; ages 3 and 4 referenced to age 2; and ages 7 and 8+ referenced to age 6. The separable VPA was run for the period 1987-1993 assuming $F_{93} = 0.3$, a reference age of 2, and a selectivity at age 7 of 0.2 (i.e., a dome-shaped selection pattern). The resulting selectivity vector for ages 1 to 7 was 0.28, 1.0, 0.988, 0.329, 0.146, 0.182 and 0.2. Selectivity of age 8+ fish was assumed to equal that of age 7.

The base case VPA results with equal weighting for all indices included in the analysis are given in **ALB-Table 6** and summarized in **ALB-Figure 13.** The estimated recruitment trend suggests somewhat higher recruitment levels in the 1970s than during the last decade, and the abundance of fish caught mainly by the surface and longline fisheries (ages 2-3 and 5+, respectively) appear to be about 25%-30% lower than in the 1970s. However, this is difficult to ascertain precisely because of variability in recruitment estimates for recent years. Fishing mortality on young albacore appears to have decreased in recent years after an increase in the late 1980s. Fishing mortality on adults (ages 5+) declined sharply after a peak in 1986 and is estimated to have been increasing again in recent years.

Sensitivity analyses were also conducted to determine the impact of excluding various indices of abundance from the base case analysis (**ALB-Table 7**, cases 1 to 6). Recruitment and adult abundance estimates from these sensitivity cases are shown in **ALB-Figure 14**. The major differences from the base case (case 1) were observed when the Japanese longline index for 5+ fish was excluded from the VPA (case 5). The higher abundance estimates for all ages in sensitivity case 5 are explained by the use of the Taiwanese longline indices for 5+ fish only, which do not indicate a declining trend, unlike the Japanese longline index (see **ALB-Figure 11**). The Committee noted that sensitivity cases 0, 2, 3, 4, and 6 were very consistent with the base case analysis.

The abundance indices based on longline catches are typically assumed to track abundance of 5+ old albacore (adults). However, examination of the longline catches relative to the total catch indicated that this gear could account for a large proportion of age 4 and a smaller proportion of younger ages caught in some years. Consequently, the Committee conducted two more sensitivity analyses (**ALB-Table 7**, cases 7 and 8). Case 7 assumed that Taiwanese longline abundance tracked all ages, with partial selectivities given by the longline partial catches. Case 8 made the same assumption for both Taiwanese and Japanese longline indices. The summary results of these analyses are presented in **ALB-Figure 14**. The results from these two cases are essentially the same as those for case 1 (base case).

The Committee conducted additional sensitivity runs to explore the consequences of using alternative catch at age data (**ALB-Figure 14**). Case "a" is essentially the same as the base case, without partial catches for computing age-specific selectivities for each index. Case "b" uses catch at age data derived from application of the growth parameters used by the SCRS in 1993, to the same catch at size data used in the base case. Case "c" uses catch at age data derived from revised catch at size data for 1978 and 1988 (see **ALB-Table 4**). Compared to the base case catch at age, case "b" (using 1993 growth parameters) results in higher estimates of adult abundance and a steeper decline over time. Estimated recruitment for case "b" is higher in some years and more variable than in case "a". Case "c" (revised catch at size) gives results nearly identical to the base case.

The Committee concluded that the base case VPA was robust to changes in the assumptions, as explored in the sensitivity analyses. The exception to this conclusion came from case 5 in which the Taiwanese longline indices only were used to track large fish abundance. Case 1, which includes both Taiwanese and Japanese longline indices, was kept as the base case, because the Committee had no objective means of deciding which index possessed more desirable characteristics for VPA calibration.

-- Yield per recruit modelling

Using the averaged vector of fishing mortalities generated by ADAPT tuned VPA, yield per recruit using the Ricker (1975) equation was computed based on the following assumptions:

i) F vector selected from base case (VPA), averaged over 1990-1993 judged to represent the recent exploitation pattern of the stock.

ii) Growth curve generated by MULTIFAN analysis (**ALB-Table 3**) and converted to weight, using the Santiago Length-Weight equation.

iii) Natural mortality constant set at $M=0.3$ per year.

The resulting curve is displayed in **ALB-Figure 15** which indicates that the northern albacore stock is near full exploitation.

-- Production Modelling

The Committee noted that methods based on equilibrium assumptions should not be applied to the albacore stocks (Polacheck *et al* 1993, Punt 1992, Roff and Faube 1982, Butterworth and Andrew 1984).

At the Final Meeting of the Albacore Research Program (ICCAT 1994) it was also noted that age-aggregated, non-equilibrium production models (e.g., AAPM, ASPIC) cannot fully capture the dynamics of the north stock for at least two reasons. First, the abundance indices available represent two separate fisheries acting on two separate age groups. Secondly, some of the trends in the individual indices are in conflict thus producing an averaging effect in the production model.

A variant of the age-structured production model (ASPM) was therefore developed to include explicitly the two-component nature of the fishery by allowing for fishery-specific selectivity patterns obtained from separable VPA (SCRS/94/51). The results of those analyses were very imprecise and the Committee did not attempt to use the method with the updated data.

Updated analyses using the standard ASPM model fitted to the Spanish troll, the French troll, and Japanese and Taiwanese longline indices also provided highly imprecise estimates of MSY (point estimate of 55,700 MT). However, the indication of a decline in the age 5+ biomass since 1975 was more precisely determined. The Committee recommended that, in future assessments, partial catches by gear and nation be used to compute partial selectivities for each abundance index that covers more than one age class.

From the analyses conducted, it was concluded that the tuned VPA assessments were more reliable than production model assessments. Past apparent conflicts between ADAPT VPA and ASPIC production model assessments resulted mainly from a mismatch between the production model assumptions and available data. The tuned VPA assessments were found to be relatively insensitive to underlying assumptions. The assessments indicate that the adult stock declined during the 1980s, but fishing mortality on this age group has subsequently declined. Earlier concern at the apparent decline in recruitment since 1982 has also been reduced by the results of the new analyses.

ALB-2.b South stock

-- VPA analysis

During the Final Meeting of the Albacore Research Program in Sukarietta, it was noted that the development of a suitable catch-at-age table for the south stock was not currently possible. Therefore, all the estimates of the state of the south stock were done using production models.

-- Production modelling

The production model analyses in papers SCRS/94/131 and SCRS/94/173 were revised during the meeting. The age-structured production model, ASPM, was selected as the base case assessment method. The sensitivity of the assessment results was evaluated in respect to: the choice of a model (ASPM, AAPM, ASPIC), the selection of abundance indices, the choice of CPUE model for the indices for Japanese longline fleet (log-normal vs Poisson), whether indices from the longline fishery apply to numbers of fish or biomass, the relative weight assigned to different indices, and the input information (i.e., growth model, rate of natural mortality, form of stock recruitment function). The base case analysis included indices based on all available data sets: the revised South African baitboat index (SCRS/94/32), the three indices developed for the Japanese longline fleet using the log-normal assumption (SCRS/94/153) and a revision to the index of abundance for the Taiwanese longline fishery developed during the meeting. The Committee expressed concern that analyses using either form of standardization for the Japanese longline index (GLM vs GENMOD) produced different perceptions of stock status (severe or moderate declines in abundance). Because of this concern and considering that the other available indices were standardized with GLM, the Committee chose the GLM-based set of indices for the base case assessment. The Committee recommended that the properties of both standardization procedures be examined before the next assessment. The base case indices apply to numbers rather than biomass because the mean weight needed to convert from numbers to biomass for the Taiwanese remain unstandardized.

The choices for the rate of natural mortality, the age-specific selectivity pattern, the length-weight relationship, and the length at maturity were the same as those selected by SCRS (1994). The growth model used in the base case analysis was the Bard (1981) model.

Qualitatively, the results of the various analyses are very similar (**ALB-Table 8**). The base case ASPM results indicate that MSY is 24,700 MT (95% Confidence Interval 21,000 - 27,500 MT) and the current 1993 replacement yield is 25,600 MT. The estimate of the ratio of current biomass to that at which MSY is achieved is 0.87 (95% CI 0.606 - 1.079) (**ALB-Figure 16**). The 1993 fishing mortality rate is 127% of that which corresponds to MSY (95% CI 0.91 - 2.28). It should be noted that the estimates of absolute abundance are less precise than those of biomass expressed as a fraction of some reference level (e.g. B_{MSY}).

The results of the ASPM assessment are consistent with those presented to the Committee in previous years. The results are, however, very sensitive to the choice of abundance indices. The results of those trials were in most cases less optimistic than those of the base case analysis. In particular, excluding the Japanese indices led to a marked reduction in the estimate of Maximum Sustainable Yield. There was little sensitivity of the results of ASPM to changes to the form of stock recruitment relationship, the growth curve or to the weighting factors assigned to different series.

Production model results obtained using the age-aggregated models ASPIC and AAPM were in close agreement with those from the base case ASPM trial although the estimate of current absolute abundance differed. As in earlier trials for the south stock (1993 SCRS, ICCAT 1994), agreement between ASPIC and ASPM was obtained if the biomass in the initial year (1957) was constrained to be equal to the unexploited equilibrium biomass.

Projections under various levels of catch from 1995 forward were based on results of 500 bootstraps for the base case ASPM assessment. For each of the bootstraps, ten simulations reflecting different future recruitment sequences were conducted. The selectivity pattern was assumed to be the same as for the 1965 - 1993 period, and the recruitment log-normally distributed about the predicted value by the stock-recruitment relationship with a coefficient of variation of 40% (SCRS/94/131). Projections were conducted for four alternative future management options:

1) status-quo catch (i.e. 28,000 MT);
2) a replacement yield option (i.e. the annual catch set so that the biomass at the end of the year is the same as that at the start);
3) a 20% reduction in catch; and
4) a 40% reduction in catch.

The 1994 catch in all projections was set to 28,200 MT (i.e. the 1993 catch).

ALB-Figure 17 shows median trajectories of B/B_{MSY}, F/F_{MSY}, and Catch for each management option. The biomass trajectory under the status option declines throughout the 20-year period reaching a ratio of 0.08 in 2013. In contrast, the other options lead to a stabilization of biomass within four years. The exploitable biomass stabilizes at a level larger than B_{MSY} for options 3 and 4.

It was noted that many previous concerns regarding the validity of production model assessments for southern albacore have been addressed to date as fully as possible. An index of abundance was generated for the South African surface fishery. Most problems with standardization of the Taiwanese longline data have been resolved, although uncertainties remain with respect to this and to catch levels.

All production model assessments conducted are consistent with assessments conducted since 1991. These indicate that this stock continues to decline and is now either fully exploited or over-exploited in terms of MSY levels.

ALB-2.c Mediterranean

No evaluation of the state of the Mediterranean stock has yet been possible due to the lack of sufficient data on this fishery.

ALB-3 Effects of current regulations

No ICCAT regulations are presently in effect for albacore in the Atlantic Ocean. The Committee noted the existence of a EU regulation restricting the length of drift nets to 2.5 Km.

ALB-4 Recommendations

The Committee endorsed the Sukarietta meeting (SCRS/94/16) recommendations, and noted, with pleasure, that most of the short-term recommendations have been fulfilled. Consequently, the Committee made the following recommendations:

ALB-4.a Statistics

1. It was emphasized that Task II data be submitted regularly and promptly, by appropriate time-area strata.

ALB-4.b Research

1. All information on growth derived from historic, current and future tag release-recapture data should be completed and used for future studies.

2. Since abundance indices from traditional longline fisheries became less representative of albacore due to the change in target species, the Committee recommended the collection of detailed catch and effort statistics from the baitboat fisheries operating in the autumn around the Azores, which target the adult albacore stock in the north Atlantic, to provide long-term indices for large albacore.

3. Validation of age and growth, and age at first maturity, particularly for the south albacore stock should be carried out.

4. Research strategy to access large albacore specimens should be developed and implemented, in view of the importance of sexual maturity information for stock assessment.

5. Further efforts should be made to investigate the relationship between Indian Ocean and south Atlantic albacore catches.

6. The relationship between equatorial purse seine albacore catches and those in the north and south Atlantic should be investigated.

7. Comparisons of historic albacore catch and effort information extracted from fishing records of trollers, baitboats, and driftnet vessels which have fished in the same area-time stratum should be conducted in order to study the catchabilities among the gears. Such results also contribute towards studies on the interaction, standardization, and competition among the gears.

8. A Working Group should be created for an in-depth study of estimation of abundance indices (e.g. their relation to population abundance). The properties of different standardization methods (GLM, GENMOD) should be examined.

9. All indices of abundance should be developed using data that are as disaggregated as possible in time and year.

10. Use the growth curve parameters used currently during the next years for any stock assessment, unless there is a major reason to change them.

11. Hold the next albacore assessment meeting in 1996, if possible separately from the SCRS. Data, particularly catch at size must be transmitted at least two months in advance to the Secretariat and after processing these data should be forwarded to the scientists without delay.

ALB-4.c Management

North stock

The Committee's assessment is that the northern albacore stock is probably not over-exploited, but that the stock appears to be at or near full exploitation. The Committee recommended that fishing mortality not be allowed to increase from its current level.

South stock

All analyses conducted indicate that recent catches are not sustainable and that they are above the MSY. The Committee concluded that catches should be appropriately reduced if the apparent decline in the southern albacore resource is to be stopped.

Mediterranean

There were no management recommendations for the Mediterranean stock.

BFT - B L U E F I N   T U N A

BFT-1. General Description of the Atlantic Fisheries

Of the tuna species found in the Atlantic and Mediterranean, bluefin tuna is among the most exploited throughout its area of distribution. Its life span is very long as compared to other tuna species. Atlantic bluefin tuna are fished in the eastern and western Atlantic and in the Mediterranean Sea. A large number of countries catch this species with a variety of gears, while longline and purse seine are the most important gears of this fishery. As regards the west Atlantic, the highest catches, in weight, are carried out by rod and reel, and formerly by purse seiners, whereas in the east Atlantic and the Mediterranean, the most important landings are those of the purse seiners and traps. The size of the fish caught varies depending on the gear utilized, the fishing period, and the fishing area.

Mixing between the two sides of the ocean occurs, and there is passage in both directions between the Mediterranean and the Atlantic, for feeding or spawning purposes. The SCRS has been conducting assessments of Atlantic bluefin tuna under the two separate stocks hypothesis under the assumption that the transatlantic mixing is small enough that management recommendations may be formulated on the basis of two separate stocks. The SCRS has considered that the eastern stock includes the fish in the Mediterranean and is separated from the west Atlantic stock, by a line at 45°W in the northern hemisphere and 25°W in the southern hemisphere **(BFT-Figure 1)**. In 1993, the SCRS considered in its assessments of the west Atlantic stock the sensitivity to the effect of mixing between the east and west stocks.

Because of the multiplicity of gears and nations fishing bluefin tuna, the landing statistics are difficult to update, especially for the east Atlantic, and even more so for the Mediterranean. In the case of non reporting or if the statistics were not received on time for the stock assessment, some 1993 catches used are either the preliminary estimates made by the scientists, or the report of the landings of the preceding year. When the catch figures are not definitive, the SCRS takes into account new information validating their origin, even for the old data series.

Taking into account these aforementioned considerations, the total catch of the entire Atlantic and the Mediterranean in 1993 reached 30,500 MT, or an increase of 2,000 MT as compared to 1992 catches **(BFT-Table 1 and BFT-Figure 2)**. This is the highest level recorded since 1965. This increase is primarily due to a very good fishing season for the Spanish baitboats operating in the Bay of Biscay. Thus, the east Atlantic catches went from 5,300 MT to 9,600 MT between 1989 and 1993, while in the Mediterranean, the catch reached a maximum in 1992 (19,000 MT), then declined to 18,400 MT in 1993. The west Atlantic catch has remained relatively stable since 1982, when the catch limitation was imposed.

As in other years, import data on the Japanese market have served as evidence of the under-reporting of certain national statistics, or the landings of vessels flying flags of convenience. The origin of the fish caught is not always known, especially in the case of the longline vessels often landing at ports that are far distant from their fishing zones. Furthermore, the product arrives in different forms and conditions of conservation, which causes difficulties in identifying the species in the trade statistics and estimations of live round weight. The SCRS expects that the ICCAT Bluefin Tuna Statistical Document Program will improve the estimates of the statistics of unreported catches of bluefin tuna in the immediate future.

Since 1991 and at the request of the SCRS, assessments on the east and west bluefin stocks are conducted in alternate years. The 1993 stock assessment was focused on the western Atlantic bluefin stock, while the 1994 stock assessment was to be conducted on the eastern Atlantic and Mediterranean stock. However, the SCRS revised the assessment of the western component in order to be able to carry out the analysis considering the mixing rates between the two stocks in the east and west.

BFTE-EAST ATLANTIC AND MEDITERRANEAN*

BFTE-1 Description of east Atlantic and Mediterranean fisheries

The reported east Atlantic and Mediterranean bluefin catch was higher in the 1950s than at the present time (36,000 MT in 1955). Catches in the Mediterranean were stable at around 6,000 MT from 1950 to 1973. Some fisheries which no longer operate but were active in the east Atlantic and represented an important part of the catch (Norwegian purse seiners, Moroccan and Spanish traps).

Since the 1970s, catches have been higher in the Mediterranean, although some fisheries have disappeared or are in decline in the Mediterranean (e.g. Black Sea and the Marmara, and a reduction in the number of traps).

BFTE-1.a East Atlantic (BFT-Table 1; BFT-Figures 3 and 4)

The majority of the landings reported in 1993 in the east Atlantic (9,600 MT) were mainly taken by Spanish baitboats (40%), longliners (29%), and traps (16%). The pelagic trawl catches made up the major part of the remaining 15%. The baitboat catches, which were stable in 1988 and 1989 (about 1,680 MT), dropped between 1990 and 1992 to about 1,466 MT, and increased again in 1993 to 4,000 MT. The 1993 increase is due to the Spanish baitboat catches, with relatively stable effort. The Spanish trap catch remained the same as that reported in 1992 after a decline in 1991, although, during the same period, the catches of the five Moroccan traps were quite low, but on the increase. Catches of the Japanese longliners (2,484 MT) declined by 30% as compared to 1992, but remained at a high level, due to the increase since 1990 in fishing effort during the winter season between 30°W to 45°W.

BFTE-1.b Mediterranean (BFT-Table 1; BFT-Figures 3 and 5)

The Mediterranean is characterized by a significant number of countries fishing for bluefin tuna using a wide variety of gears, both very old and very modern. Because of this, complete catch data of the Mediterranean fisheries are very difficult to obtain. Many of these countries are not members of ICCAT, while they are members of GFCM. Two joint GFCM/ICCAT Expert Consultations (Bari, Italy, 1990 and Iraklion, Crete, Greece, 1992) led to a significant improvement in the current and historical catch data. Since then, an *Ad Hoc* GFCM/ICCAT Working Group has been created. The first meeting of this Working Group, held in Malaga, Spain, was specifically scheduled to coincide with the ICCAT East Atlantic Bluefin Stock Assessment Session, so as to assure that the maximum number of scientists knowledgeable on the Mediterranean fisheries could attend both sessions at the same time.

The Mediterranean catches for 1993 (18,400 MT) were reviewed by the scientists present and the margin of tolerance in the statistical reporting of their countries during the course of the last 20 years was estimated (**BFT-Table 2**). There are still a lot of estimated catches that had to be estimated by scientists not always familiar with these fisheries.

As for the Atlantic, the study of the origin and the volume of the bluefin tuna imports to Japan has resulted in reporting under the NEI classification (not elsewhere included) a significant part of the under-reported or non-reported catches by some countries and those that fish under flags of convenience. These catches are often much higher in the Mediterranean than in the eastern Atlantic.

The SCRS reiterated its concern about the lack of important information on catch and size composition information for some fisheries.

Catches by French, Italian, Spanish, Turkish and Croatian purse seiners comprised 64% of the landings, which amounted to 11,720 MT in 1993. Catches by the French purse seiners showed a temporary decline in 1993 (4,730 MT), but have already surpassed in 1994 the historical record of 1992, as a result of an exceptional fishing season around the Balearic Islands from mid-May to the end of July. The 1993 Mediterranean longline catches have

* The SCRS East Atlantic Stock Assessment Session was held at Fuengirola, Malaga, Spain (September 21-27, 1994).

almost doubled (at 4,233 MT) since 1992 and are the highest on record. This increase is probably due to the increase in the number of longliners in the area.

Trap catches have been in decline since 1990, going from 1,615 MT to 366 MT. This decrease reflects the drop in Moroccan and Spanish trap catches, and to a minor degree, the Tunisian traps.

Japanese longliners increased their catch level in 1993 (793 MT), as compared to reported catches of 123 MT in 1992.

The unclassified gear catches represent 11% of the total Mediterranean catch. Of the catches in this gear category, 96% was taken by Algeria, Spain, Greece and Italy.

BFTE-2 State of the Stocks

BFTE-2.a Stock structure

As a first step in examining the state of stocks, the Committee discussed stock structure. All the available tagging data are entered in a newly restructured data base which is used in the calculation of the mixing rates between the different areas where Atlantic bluefin tuna are found. The Committee recognized that the main problem arises from the under-reporting of tag recovery data, a problem which has varied through time and varies according to the countries. It was then discussed that the tagging programs are aimed at different age classes as a function of time, i.e. the fish tagged at the start of the century were adults, while the fish tagged in more recent times are juveniles. Tagging mortality can be high, depending on the gear. Furthermore, the probability of recapture also varies by gear and catch level.

The preliminary analysis of the existing tag data, even though the data base is still to be improved, shows that out of a total of 31,746 tags released in the west, 4,376 were recovered. Of the 9,736 tags released in the east, Cort and Liorzou (SCRS/94/92) have reported that 431 have been recovered. Out of a total of 4,802 tags recovered 72 tags released in the west Atlantic were recovered in the east, and 17 tags in the inverse direction. These exchanges are small but could affect the conclusions of the stock assessments.

SCRS/93/138 reviewed the distribution of high seas longline fisheries and suggested that the distribution of fish from both sides of ocean overlap. SCRS/94/104 discussed the high degree of synchrony between year-classes in the eastern and western Atlantic, and that this is consistent with considerable mixing of fish from the two sides of the Atlantic. The Committee did not believe that these submissions are sufficient to conclude the existence of a unique Atlantic stock. Many parameters between the east and west Atlantic bluefin, such as growth rates, spawning grounds, spawning periods, and age at first sexual maturity, indicate differences between the two areas.

There is on-going research to determine the spawning areas of the Atlantic and Mediterranean Sea, as well as genetic studies on the larvae and on older age individuals. However, it is too soon to reach definitive conclusions on the state of the stock structure.

The Committee discussed SCRS/94/68 which considered the stock assessments on Atlantic bluefin tuna, which are based on a model of two populations with mixing, that was put forward at the 1993 SCRS meeting. The comments made by the Eastern Atlantic Bluefin Tuna Stock Assessment Group during this session are summarized in **Appendix BFTE-1** attached to this report. The final comments of the SCRS on this report are attached as **Appendix BFTW-1** of the western bluefin section.

Taking into account all the discussions and after a careful comparison with previous assessments, the Committee decided to carry out an assessment based on the assumption of an isolated stock in the east, and to investigate the implications of mixing on the results, if time permitted.

In an attempt to advance in the development of a conceptual model based on the displacement of fish in the Atlantic and the Mediterranean, bluefin tuna distribution and movement were discussed. The results of these discussions are presented in **Appendix BFTE-2**.

BFTE-2.b Available models

The Committee considered that VPA and production models based on the abundance indices would be used in the assessment and details are discussed in each section.

BFTE-2.c General data entry in the model

The Committee reviewed the data used for the stock assessments. **BFTE-Table 2** shows the range of uncertainties in estimating total catch (weight) which were used as the base for creating catch at size, except for the Japanese longline data (which are based on the number of fish). Also **BFTE-Table 3** and **BFTE-Figure 6** show the proportion of catches for which some size data are available (regardless of the quality of the data) and those for which data substitutions were required. There are some improvements in the collection of size data. The Committee stressed, however, that there are basic data problems in the catch and size for the data base used in the stock assessments.

Catch at size was estimated from Task I catch and size composition data. The Committee noted that there was a high level of uncertainty about the real catches for many fisheries and that there continued to be no size composition for over 45% of the catches (**BFTE-Table 3**). The new and revised fishery-specific catches and the size samples assigned to those samples by the Committee are documented in SCRS/94/107.

The conversion of catch at size to catch at age was accomplished with the age slicing algorithm used previously. The possible use of modal analysis of the length frequencies to calculate age composition (as is done for catches in the west Atlantic) was considered for the younger ages (1-3). It was concluded from visual examination of the catch at size by year, month and area (east Atlantic and Mediterranean Sea separately) that, in general, the slicing appeared to be adequately separating modes. Therefore, simple age slicing was used; the estimated catch at age is shown in **BFTE-Table 4**.

BFTE-2.d Abundance indices

Six indices of abundance were presented (**BFTE-Table 5 and BFTE-Figure 7**). The majority of these had been used in the 1992 stock assessment. The Committee also discussed the use of other indices, such as hand line of the Spanish fisheries in the Mediterranean, but decided against the use of that index due to difficulties in estimating effort. For all the CPUE series used in the final calibration of the VPA, trend analysis was conducted (see **BFTE-Table 6**).

-- Juvenile fish

Three abundance indices were used: French purse seiners in the Mediterranean (age-classes 2 and 3), and Spanish baitboats (age-class 2) of the Bay of Biscay.

The nominal, French Mediterranean purse seine index is for the 1982-1993 period. In this case, the fishing effort applied represents the days at sea with catches. The Committee discussed this circumstance and its possible influence on the final results. However, because of the coherence in the abundance obtained between age groups 2 and 3 in the same fishery, as well as the same manifestation of the strength of some cohorts between the age 2 index of this fishery and that of the same age group for some years in the Bay of Biscay fishery, its application was considered justified, as had been the case in previous analyses. This correlation, however, was not observed in 1993, possibly due to the influence of the significant migration of the 1991 bluefin tuna cohort between the western Mediterranean and the eastern Atlantic, as was shown by the recovery of numerous bluefin tuna tagged in the Mediterranean in 1991 and recovered two years later in the Bay of Biscay. Neither of the two French purse seine series used showed trends.

For the Bay of Biscay baitboat fleet, the nominal index of age 2 was applied, which was updated for 1975 as a result of new information obtained on fishing effort (SCRS/94/93). The Committee discussed the reasons for the considerable increase observed in 1993 which is believed corresponded to the high recruitment of the 1991 cohort. However, this circumstance was not observed in the purse seine fishery on the same age group in the Mediterranean (see explanation above).

As in previous analyses, the series was divided into two parts: 1970-1977 and 1978-1993. The reason, as explained in the 1993 SCRS Report, is due to the change in effective fishing effort that occurred as a result of the installation of sonar for the detection of schools.

The slope of the Spanish baitboat indices is positive for the 1970-1977 period, and for the 1978-1993 period.

-- Adult fish

The Committee discussed the indices for the traps (age-classes 7-10+) and Japanese longline (age-classes 8-10+).

The nominal index of the Atlantic traps of southern Spain were considered for the 1970-1993 period. Because of having utilized in previous analyses an index that represented one trap (the Barbate trap) and since that index showed a distinct trend in the residuals for VPA fits before and after 1981, the Committee decided to consider the possible use of a different index which included the entire Strait of Gibraltar area. In this respect, to carry out the initial trials of the analysis, the Committee used all the data from the Spanish and Moroccan traps in the area. The Committee applied catch data in weight and discussed the influence of environmental factors (wind, water transparency, and others), as well as the dispersing effect of the schools caused by killer whales, as some reasons which cast doubt on the representation of the index of abundance being used, which omits, up to now, all the aforementioned factors.

As regards the analysis of the trends of this index, a positive trend was observed in the 1970-1993 period, while there was a negative trend, if the 1982-1993 period is analyzed, although it should be noted that the associated standard error is large. For all these reasons, the Committee did not consider taking this index into account in the base case analysis.

The different trend between this index and that of the Japanese longline, which is discussed later, was a matter of discussion as concerns a possible interaction of these two fishing gears in the same area and directed at the same age groups.

The Japanese index of abundance for adult fish is the only one of all those used which is presented in a standardized form. This year the Committee used a different methodology from that of previous years, which can include a "Poisson" statistical error and also accounts for the significance of interaction with year-effect (SCRS/94/101). This document provides a bluefin abundance index for the east Atlantic and Mediterranean. At the same time, the observations used in the analysis are shown in two manners: aggregated and disaggregated (single operations, set by set). The Committee decided that the indices standardized series disaggregated by sets be used for the VPA.

For longline, the three periods analyzed showed a significantly negative trend (1975-1993, 1978-1993, and 1982-1993).

Summary

Mediterranean purse seine indices for ages 2 and 3 show no trend. The two Atlantic baitboat series show an upward trend, while the adult fish index of Japanese longliners show a downward trend throughout the series.

These indices were used for the calibration of the VPA, and for the ASPM model. In addition, the indices corresponding to the total number of traps in the eastern Atlantic and the total catch of French purse seiners in the Mediterranean Sea was used for the runs of the ASPM production model.

BFTE-2.e Results of analysis

Base Case Assessment

The assessment model chosen was a tuned Virtual Population Analysis (VPA), which estimates fishing mortality (and therefore stock size in number of fish) at age from the catch-at-age data and abundance indices. As in the past, the ADAPT model was used for this estimation. The sensitivity of the results to several uncertainties was also examined; the sensitivity analyses are described below. Approximate confidence intervals of the base-case VPA were estimated through bootstrapping.

— Analytical Details

Partial Recruitment: The Committee examined the partial recruitment patterns that existed in four different time periods: 1970-1973, 1974-1981, 1982-1987, and 1988-1993. These time periods were used to guide the selection of F-ratios, i.e. the ratio of fishing mortality rate for ages 10+ relative to that of age 9.

Separable VPAs were utilized to estimate partial recruitment. The analysis was conducted for 1988-1993 using ages 1-14, age 2 being the reference age for selection, M=0.14, a terminal F of 0.3 and selectivity on the oldest age (age 14) being the same as for age 2 (S=1). Previous tests on these data had shown that results are relatively insensitive to the choice of F; however, the F-ratios are sensitive to the choice of S. Therefore, two other choices for S were tested (S=0.5 and S=1.5). Results are given in **BFTE-Table 7.**

The partial recruitment of ages 1 to 9 during 1988-1993 was relatively insensitive to the choice of S; therefore, the partial recruitment vector for those ages in 1993 was taken as those estimated for S=1.

F-ratios were calculated as at the last assessment (1992) as the arithmetic mean of the selection of ages 10-14 divided by the selection of age 9. It was noted in doing this that selection did not change much between the 1974-1981 and 1982-1988 periods. Therefore, as in the previous assessment the F-ratio was estimated for the entire 1974-1988 period.

It was noted that estimation of selectivity in older ages is suspect due to the lack of discrimination in the ageing. The value S=0.5 was used by the Committee because such a value produced a more uniform selectivity curve on the oldest ages; the value S=1.0 produced a much higher selectivity on age 14 than on age 10. Therefore, the F-ratios were 0.471, 2.475 and 2.020 for the periods 1970-1973, 1974-1987 and 1988-1993, respectively. The alternative F-ratios using S=1 for each time period were examined in a sensitivity analysis.

After examination of the selectivity at age in the last period (1988-1993), it was decided that the VPA would estimate three parameters: the F of age 2 in 1993 (or equivalently, N age 3 in 1994), F of age 4 in 1993 (N of age 5 in 1994) and F of age 8 in 1993 (N age 9 in 1994). Limiting the parameters to these help to stabilize the estimate. The F's of other ages are then linked into three blocks of F's assuming that F of ages of 1 and 3 are related to the *F* of age 2 by their relative selectivities, as are ages 5-7 related to age 4 and ages 9 related to age 8. Therefore, the selectivities only act within a block. Hence, the effect of specifying the selectivity at age is not very restrictive on the estimation.

Statistical weighting: After some discussion, the Committee decided to continue the practice of weighting each abundance index equally. However, a sensitivity run was also conducted in which each series was weighted by the inverse of its error variance.

Indices considered: The Committee decided to omit the trap-fishery index from the base case because of concern that this index might reflect availability rather than abundance, of the stock. This index shows statistically different trends from that of the Japanese longliners, which cover a much wider area and therefore seem more likely to index overall abundance of large fish. The indices chosen for the base case were the French purse seine age 2 index, the French purse seine age 3 index, the Spanish baitboat index (divided into two indices, covering, the periods 1970-1976 and 1977-1993, respectively), and the Japanese longline index.

It must be emphasized that this selection means that the downward trend in the Japanese longline index is very influential in the assessment of the current level of absolute abundance of large fish which is reported below.

-- Results

The VPA estimates of stock size are compared with the scaled CPUE indices in **BFTE-Figure 8.** Stock sizes and fishing mortality rates at age are given in **BFTE-Tables 8 and 9**, respectively.

In general, the assessment portrays a declining resource, except for the youngest age groups, as shown in **BFTE-Figure 9.** The number of fish in the age 2 through 4 group seems to be stable or increasing slightly during the period 1970 through 1994. However, the other age groups (4+, 5-9, and 8+) appear to be declining markedly. In particular the number of the age 8+ group is estimated to have decreased by about 87% between 1970 and 1993, and about 83% between 1983 and 1993.

Fishing mortality rates are estimated to have increased considerably during the period covered by the assessment (1970-1993). Fishing mortality on the youngest ages (2-4) follows this pattern (**BFTE-Figure 10**), and currently is estimated at about 0.7 per year, a very high rate when compared to the assumed rate of natural mortality (0.14 per year). The middle ages (5 through 9) are estimated as subject to the lowest rates of fishing mortality; current estimates are about 0.2 per year. The mortality rate on the age 8+ group is estimated to have increased sharply in the most recent years, to over 0.6 per year. However, the Committee considered that some of these conclusions are uncertain, as a retrospective pattern appears in estimates of F for the oldest ages (see Retrospective Analysis section below). Nonetheless, the F for the 8+ age group is estimated to have been over 0.2 in the late 1980s, and if a retrospective adjustment is applied, the current *F* is estimated at approximately 0.4. (see Section of Retrospective Analysis)

Bootstrapping was carried out to estimate uncertainty. It should be noted that these bootstrap estimates of variability should be taken as minimum estimates, as not all sources of uncertainty are included. Among those not included are the uncertainties from ageing, substitutions, etc.

Sensitivity analyses

The Committee considered that the investigation of the sensitivity of the VPA estimates to modeling and data assumptions should be pursued, but the Committee could not complete these in the time available. The variants of analysis which were computed, were used to assist in the selection of the base case.

Mixing Rates: One set of sensitivity runs suggested a mixing model that assumes a constant migration rate in each direction and also assumes that fish that have migrated are unlikely to return. The Committee considered that the realism of these assumptions is open to question and that the sensitivity of the results to alternative models of mixing, as specified in **Appendix BFTE-2**, should be examined.

Iterative re-weighting: In the base case, the Committee continued the practice of using equal weighting for each CPUE index. An alternative procedure is provided by iteratively re-weighting each series by the inverse of its estimated error variance. The Committee conducted an alternative analysis with iterative re-weighting to examine sensitivity to index weighting. The results did not differ substantially from those of the base case.

Spanish trap index: Replacement of the Japanese longline by the Spanish trap index for large fish leads to higher VPA estimates and different (and increasing) trends for ages 8+ group, However, these results are considered unreliable because of the reservations expressed about the Spanish data as an index of abundance.

Selectivity vector: The sensitivity of results to a wider set of values for the F10+ to F9 ratio should be examined.

In 1992, the Committee conducted sensitivity analysis for the uncertainty of the data used for the VPA. The conclusion was that only minor differences in the trajectories of estimated fishing mortality rates can be achieved by excluding the most doubtful data. Since these uncertainties remain at the same level, the Committee did not believe that the associated conclusions reached in 1992 need to be altered.

Retrospective analysis

After selection of the initial VPA, the Committee conducted a retrospective analysis to determine if there is some systematic trend in the estimates. This analysis was conducted by first performing a VPA analysis using only data from 1970-1990 to make N and F at age estimates, repeating the analysis using the data from 1970-1991, again for 1970-1992 and then again for the base case using data for 1970-1993. Then the estimates of the number of individuals at a given age in recent years are compared between the analyses. Any systematic trend in the N or F estimates for a particular age and year as more data are added is termed a retrospective pattern. If the pattern occurs in the number at a particular age, then the opposite effect will occur with the fishing mortality rates (if one goes up, the other goes down). Retrospective patterns may be due to a variety of reasons, including mis-specification of constants such as the natural mortality rate, under-reported catches, ageing errors, or the use of indices which are not actually proportional to abundance. Retrospective patterns are not unique to VPA models.

When a retrospective pattern occurs, it is not clear what actions, if any, one should take. One cannot say whether the pattern arises from variability in the data or from bias in the estimation. Adjustments for the pattern are *ad hoc* and might not result in more accurate or precise estimates.

The retrospective analysis was conducted with the eastern Atlantic VPA and the effect on numbers at ages 2, 8, 9 and 10+ are given in **BFTE-Figure 11**. This figure shows that a retrospective pattern appeared, especially for ages 2 and 10+. The reasons for this pattern are not fully understood, but it suggests that the base case assessment is under-estimating current abundance and over-estimating current fishing mortality. Therefore, a procedure was suggested for adjusting the F's and N's at age for incorporation into yield-per-recruit and projection analyses. This may resolve the potential incompatibility between the base case assessment results and large reported catch levels for 1994. The adjustment used was the ratio of the F at age relative to the F at the same age in 1993. These ratios were averaged over the years of the retrospective analysis. The average was then multiplied by the estimated F in 93 to get an adjusted F. The resulting F at age is shown in **BFTE-Figure 12**. The numbers at age were adjusted similarly. The resulting adjusted F and N in 1993 for age groups 2-4, 4+, 5-9 and 8+ are given in **BFTE-Figures 9 and 10** along with the trajectories for these age groups from the original VPA.

Note that the retrospective pattern dissipates as more data are available. Therefore, it is expected that the difference between the adjusted F's and N's in **BFTE-Figures 9 and 10** decrease as one goes back in time and are likely to be minimal within 4 or 5 years.

Yield per recruit analyses

As in previous years, the Committee carried out deterministic, equilibrium yield-per-recruit analyses. These analyses were made for two scenarios: the first was based on the estimated 1993 selectivity vector from the base-case VPA, and the second was based on a similar selectivity vector with age-specific adjustments from a retrospective analysis (**BFTE-Figure 12**) (see previous section). The yield-per-recruit computations were conducted to a maximum age of 30, using $M=0.14\ yr^{-1}$ and mid-year weights from the current growth curve.

For each of the two scenarios, the Committee also examined the effect of potential adherence to the current ICCAT size restriction (no catch of fish under 6.4 Kg, with a 15% tolerance). Adherence to this restriction was approximated by reducing the fishing mortalities of ages 0 and 1 by 100% and 50%, respectively, as a 6.4-Kg bluefin in the east Atlantic is about 1.6 years old. The current fishing mortality on age 0 fish was estimated as 35% of that on age 1 fish. (This estimate is based on reported catches of age 0 fish in 1989-1991 and the VPA estimates of numbers at age 1 for 1990-1992). An approximate 30% increase in yield per recruit could be obtained by eliminating catches of small fish. Because catches of age 0 fish are thought to be under-reported, the fishing mortality rate on age 0 bluefin was probably underestimated. If so, a greater gain in yield per recruit would be obtained from adherence to the minimum size.

BFTE-Figures 13 and 14 show the relationship between equilibrium yield per recruit and fishing mortality for the four cases examined. **BFTE-Table 10** indicates some long-term consequences of excluding fish under 6.4 Kg from the catch and/or reducing F to the level of F_{max} (the fishing mortality rate that gives the maximum yield per recruit).

Projections

The retrospective-adjusted population estimates for 1993 were projected forward 10 years under three alternative catch scenarios: 20,000, 27,000 and 34,000 MT. The 27,000 MT level was equivalent to the actual catch in 1993. The fishing mortality rate required to achieve the prescribed catch level was used to compute the abundance at the beginning of the next year. The value of the fishing mortality rate, however, was not allowed to exceed $2.0\ yr^{-1}$. The selectivity at age was fixed at the level which corresponds to the retrospectively adjusted fishing mortality for 1993.

Recruitment was constant at 1,330,270 fish (the geometric mean of the base-case estimates of recruitment between 1984 and 1991). Spawning stock biomass was approximated as the product of the projected abundances and the weight at age matrix estimated by the SCRS. One half of the age 4 fish and all fish aged 5 and older were considered mature.

The results of the projections are shown in **BFTE-Figure 16**.

Several results are evident from **BFTE-Table 10** and **BFTE-Figures 13 and 14**: (1) The potential gains in yield per recruit are somewhat lower if the retrospective adjustment is applied. (2) Even with the adjustment, large increases in yield per recruit and total yield from each cohort are to be expected from reducing the overall F or the F on the smallest fish. (3) If future recruitment remains at recent levels, current yields (27,000 MT or more per year) are probably not sustainable unless the rate of fishing mortality is reduced markedly. Even in that case, a period of lower yields would occur before the expected increase in yield could be taken.

The previous analysis estimates that adherence to the size restriction would result in considerable benefits in yield from the eastern stock. Another benefit is also possible. Since a certain number of fish from the eastern stock are believed to move to the western stock, restrictions in the east might increase yield in the west as well.

Production model analyses

The Committee examined the applicability of two types of stock-production models: a lumped-biomass model (ASPIC) and an age-structured production model (ASPM). The ASPIC model is fit to the total catch and an overall index of abundance, and the ASPM model is fit to the total catch and age-specific indices of abundance. Time did not allow computation of an overall abundance index for use with ASPIC, but the Committee attempted to fit the model to three indices separately. However, the available data did not support meaningful estimates from any of those indices. Estimates were obtained from the ASPM model, except when the trap index replaced the Japanese longline index. Because those estimates were extremely imprecise, the Committee does not present them here. However, the Committee notes that ASPM also estimated that the stock has declined considerably during the assessment period.

Whichever model used (VPA or production models), the choice of indices is of the utmost importance and greatly effects the results of the assessments. Uncertainties linked to the use of one index rather than another are greater than those generated by "bootstrapping".

BFTE-3 Effects of current regulations on east Atlantic and Mediterranean bluefin

The first ICCAT recommendations concerning the east Atlantic bluefin tuna stock entered into force in August, 1975.

There is a recommendation aimed at limiting fishing mortality of bluefin tuna in the entire Atlantic and the Mediterranean. If this is interpreted as a limit on catches, the efficiency of the recommendation could be considered in studying the catch trends after that time as compared to the previous period. The reference year is considered to be 1975.

The east Atlantic catches have gone from 23,000 MT (1962) to 10,000 MT (1975) then dropped to 5,200 MT in 1976 (**BFTE-Figure 4**). Catches later increased to about 7,000 MT in 1977, then regularly dropped to 3,300 MT in 1981. They later increased again during the following two years to about 8,000 MT. From 1985 to 1987, the catch was about 4,500 MT; in 1988 it increased to 7,000 MT and then dropped to 5,300 MT in 1989. The current catch level is higher (9,500 MT) than that of the late 1980's, and is similar to that attained in 1975.

In the Mediterranean, the reported catches varied at about 6,000 MT between 1962 and 1973, with a slight increase in the 1967 to 1969 period (**BFTE-Figure 5**). The catches increased afterwards and remained highly variable, ranging from 10,000 to 17,000 MT, except for 1978 and 1979 when catches dropped (8,800 and 7,400 MT, respectively), and in 1985 when catches reached a peak of 19,400 MT. During the next two years, catches seemed to stabilize at about 18,500 MT. The level of the catches for all the period following the regulation, since 1993, is almost always higher than the 1975 level (11,000 MT).

For the entire east Atlantic stock (including the Mediterranean Sea), catches declined from 1955 (36,000 MT) to 1973 (10,700 MT), increased during three years to above 20,000 MT, then decreased again to 12,000 MT by 1979. From 1982 to now, landings have been almost always higher than the 1975 level (20,500 MT).

The second regulation prohibits the catching and landing of bluefin tuna weighing less than 6.4 kgs in the entire Atlantic, with a tolerance level of 15% (in number) for by-catches. **BFTE-Table 11 and BFTE-Figure 15** show the estimated number and percentage of fish under 6.4 kg in the total catch of the Mediterranean and east

Atlantic for the period 1971 through 1993. A part of the variability observed in **BFTE-Table 11** could be due to the gaps in sampling, as well as to changes in the fisheries. Following the entry into force of this regulation, the percentage of fish less than 6.4 kg in the catch is still high in the east Atlantic and in the Mediterranean, with about 47% and 36%, respectively, of the average of the 1972-1993 period. While the percentage is variable, there was a notable decline in the east Atlantic in recent years (73% in 1988 to 15% in 1993), whereas the percentage shows strong variations in the Mediterranean, but seems to stabilize at about 30% for the last three years. Catches of age 0 fish is still considerably under-estimated, and the percentage of these under-sized fish could be even more significant than indicated in the official statistics. The market for these small fish is flourishing, as is the case for the large fish, which does not induce the fishermen to limit their catches of this size.

Another recommendation entered into force on June 1, 1994, which prohibits fishing by large pelagic longliners greater than 24 m in length in the Mediterranean during the months of June and July. This regulation is aimed at limiting fishing mortality. However, many large longliners have been seen fishing bluefin tuna in the Mediterranean during this period in 1994.

A regulation aimed at limiting catches for the 1994-1993 period to 1,300 MT, with a maximum of 715 MT in the first year in the area located to the north of 40°N and between 35°W and 45°W entered into force on September 2, 1994. The effect of this regulation on the level of catches in this part of the ocean is not yet known at present.

BFTE-4 Recommendations

The *Ad Hoc* GFCM/ICCAT Working Group, held concurrently with the ICCAT SCRS Eastern Bluefin Species Group Meeting, formulated recommendations concerning future meetings to be held. The main objectives of these meetings are to collect the maximum amount of data on the national fisheries from the coastal Mediterranean countries and encourage the participation of scientists from these countries in the stock assessments. The countries are requested to submit such information in the ICCAT format for statistical data.

BFTE-4.a Statistical data and analysis

The decision to carry out the assessment on eastern Atlantic bluefin tuna at the same time as the *Ad Hoc* GFCM/ICCAT Working Group Meeting was beneficial given that the number of scientists present from these Mediterranean countries who have knowledge on the fisheries and assessments. Furthermore, the data presented by the scientists from GFCM member countries were very useful to the stock assessment group. It was recommended that, if such joint meetings on bluefin are repeated, the scheduling of the two meetings (the *Ad Hoc* GFCM/ICCAT Working Group on Stocks of Large Pelagic Fishes in the Mediterranean and ICCAT stock assessment sessions) should be carefully to maximize the efficiency of both meetings.

The quality of the data is, in a general sense, very low. In an assessment of a stock where the fisheries are very diversified, it is essential that the ICCAT member and non-member countries fishing this species submit catch and effort data and size composition in the finest time/area breakdown as possible. Specific recommendations concerning the statistics are listed below:

-- Improve knowledge on catches by vessels unloaded at ports outside the flag country. This is valid for the vessels flying flags of convenience as well as those vessels that do not land their catches in neighboring countries.

-- Report the catches of age 0 and age 1 fish as detailed as possible. These catches involve all the artisanal vessels which target these small tunas at any given moment during the year.

-- Attempt to create new data series or improve the historical series on catch, effort and size composition of the fish caught, by area and by gear. This is particularly important for the eastern Mediterranean.

-- Report export and import data corresponding to destinations other than Japan.

-- Examine the differences between the Japanese data of imports from Korea and the latest reported catch data.

A regulation with a view to limiting bluefin tuna catches in the north central Atlantic entered into force on September 2, 1994. The Committee recommended an evaluation of the effects of this regulation in 1996 given the short period of implementation of this measure in 1994.

A considerable amount of the catch data have no corresponding size data. Also, the percentage of the data substitutions is significant (50%) for the eastern Atlantic and Mediterranean. Many of these substitutions may be inappropriate. The Committee asked the countries fishing bluefin tuna to provide the size compositions of their catches, in order to reduce the uncertainties.

Although the participation of more scientists from the countries involved in the bluefin tuna fishery in the Mediterranean area was secured at this session, due to the concurrent meeting with the *Ad Hoc* GFCM/ICCAT Joint Working Group on Stocks of Large Pelagic Fishes in the Mediterranean Sea, it was hoped that this would continue and that even more scientists would be able to participate in the future.

BFTE-4.b Research

The improvement made in the knowledge of the stock structure, feeding and spawning migration is insufficient. The Committee noted the on-going studies in many research areas (growth, fecundity, genetics, egg and larval surveys). These research items are studied under the ICCAT Bluefin Year Program (BYP) or in other international research programs financed by the EU. The Committee identified some of these research priorities, enumerated below.

Considering that the objectives of the BYP and the program financed by the EU are the same, and that the results of the latter will be reported in final form in 1995, The Committee considered it that an inter-sessional meeting of scientists who have taken part in the shared activities of both programs should be held, with an aim towards sharing their knowledge on Atlantic and Mediterranean bluefin tuna. The Committee requested that the Commission encourage the participation in such a meeting (by means of financial support) of scientists from ICCAT member countries, as well as non-member countries.

Growth studies using hard part of bluefin tuna still need to be validated, particularly during the winter phase, during which time few samples have been collected up to now.

Improved knowledge on the structure of the stock would be valuable for improving assessment and management. For example, the mixing patterns between the different stock units or sub-populations need further study. Even though tagging carried out up to now gives some indications of the movement of bluefin tuna, this information is incomplete and could be biased by non-reporting of recoveries. The traditional tagging activities on juvenile as well as adult fish should be continued and even increased in order to gain better knowledge on the migration patterns and the interchange between areas. This is particularly true for the eastern Mediterranean where little tagging is carried out, and consequently little is known about the mixing rate with the western basin. It is further recommended that all types of "intelligent" tags be evaluated to allow the monitoring the fish and their movements.

The ICCAT tagging file has been restructured and improved. However, there are still differences between the national tagging data bases and the ICCAT data base. The Committee thus requested that national scientists expedite transfer of data to the Secretariat and that the Secretariat continue to update the tag recovery files.

One type of analysis currently carried out by the SCRS uses the abundance indices to calibrate the VPA. The Committee found itself this year with two indices that were contradictory in their trends. A greater number of indices must be developed, for small fish as well as for large fish, from historical data (Tunisian traps, Italian purse seiners and driftnets) or for new fisheries or developing fisheries (Taiwan, Libya,). The data, in weight or number of fish be disaggregated as much as possible in order to proceed with their standardization. Finally, the CPUE series should be studied for fish ages 4 to 7.

The Committee noted that the trap indices may not consistently reflect abundance of the stock. Studies on the variability of catches in different traps operating on each side of the Strait of Gibraltar requires taking into account the environmental phenomena influencing the movement of the tuna schools, such as temperature, turbidity or the presence of killer whales. As has already been pointed out in the last assessment, the development of these indices should take into consideration information relative to the date and size at the time of capture of fish held for fattening.

In view of the inverse trends in the Japanese longline indices and the traps off the Strait of Gibraltar, the Committee suggested studying the effect of the proximity of the Japanese longliners on the trap catches.

Considering the need to quantify the rate of exchange across the Strait of Gibraltar, studies should be carried out on the movements of bluefin tuna by age in this area.

The trophic and environmental relations with the movement of tuna are evident. All research on this subject is desirable.

Models that take into account the mixing between the two distinct stocks have been implemented. The base hypotheses of these models are rather simple and may not correspond to a biological reality. The Committee began working towards more realistic assumptions and hoped that these concepts would be integrated in the models in the near future.

A regulation to limit the catch for the biennial period 1994-1995 to 1300 MT, with a maximum of 715 MT for the first year in the area north of 40° and between 35°W and 45°W entered into force on 2 September 1994. The effect of this regulation on the catch level in this part of the ocean is not currently known.

BFTE-4.c Management

In light of the yield-per-recruit analyses, which indicate that recent levels of fishing mortality are far in excess of that which will maximize the long-term yield, and the reported substantial increases in catches in 1994, the Committee expressed grave concern about the status of east Atlantic bluefin tuna resource. In spite of uncertainties in the above analyses, it is apparent that higher long-term yields could be realized if fishing mortality rates were reduced, especially on young fish (see **BFTE-Figures 13-15**). Also, it is possible that such actions can benefit the west Atlantic stock, if the hypothesis is confirmed that the east Atlantic or Mediterranean fish migrate towards the west Atlantic. The Committee is concerned about the high catch of small individuals and recommended that every effort be made so that the current measures on the size limit of 6.4 kg be adhered to. It is expressly recommended that measures be taken to avoid catches age 0 fish (<1.8 kg), without granting any tolerance with respect to the percentage (in number) in the landings. The fact that these recommendations are not complied with leads to a decline in the productivity of the fishery, damaging the yield per recruit, with the risk, over the long-term, of causing a strong decline in the spawning stock biomass.

The Committee noted that in 1974, it was recommended that fishing mortality on bluefin tuna in the entire Atlantic and Mediterranean be limited to recent levels. This recommendation entered into effect in 1975. Based on estimated F levels for young and oldest age group fishes, it is apparent that this recommendation has not been implemented, and estimates of current fishing mortality are considerably higher than this (see **BFT-Figure 10**), though this result is heavily dependent on the use of a large-fish index that shows a decline trend throughout the years. The yield-per-recruit analysis shows that substantial gains in terms of yield per recruit, catch and biomass could be obtained by reducing the overall fishing mortality rate. The Committee recommended that efforts be made to reduce the current level of fishing mortality.

B L U E F I N   T U N A

BFTW-WEST ATLANTIC*

BFTW-1. Description of west Atlantic fisheries

Catches in the west Atlantic (**BFTW-Table 1 and BFTW-Figure 1**) have been restricted by regulation from 1983 to 1992 to 2,660 MT annually, about half the average during the period 1973-1981 (in 1982 the catch limit was 1,160 MT). The catch limit for 1992-93 was reduced to an average of 2,394 MT per year with a maximum of 2,660 MT in 1992. The two-year catch limit for 1994-1995 was 3,195 MT divided in a quota of 1,995 MT in 1994 and 1,200 MT in 1995. The catch in 1993, including estimates of catches not reported to ICCAT, was 2,310

* The SCRS West Atlantic Stock Assessment Session was held in Madrid, Spain (November 14-18, 1994).

MT, about 124 MT more than in 1992. New regulations were put into effect in 1992 in conformity with ICCAT recommendations. These new measures may have affected catch and effort.

Preliminary information indicates that generally the timing and location of Canadian catches have been similar between 1993 and 1994. The 1994 quota was reduced from 1993 and the fisheries closed earlier. In 1994, there was a resurgence of fish in the St. Margaret's Bay trap fishery after an absence of about 15 years, possibly associated with warmer waters and an abundance of small pelagic fishes in the bay.

Preliminary information suggests that catch rates in the U.S. small fish fishery during 1994 were not markedly different from recent years. In the Virginia area, small fish catch rates remained low, while further north catches were irregular and catch rates not unusual. For larger fish, quotas for some fishery categories were met earlier than usual. An increased fraction of the catch is thought to have been of smaller fish in this size range (large mediums). Data are not yet available to indicate whether U.S. rod and reel and handline catch rates of larger bluefin have changed. For other large fish fisheries (purse seine and harpoon) unfavorable weather conditions resulted in catches generally taken later than in most previous years.

There have been reported sightings of medium and giant bluefin in many other areas of coastal New England and Atlantic Canada during 1990-1994. A number of factors might account for these reports of local abundance and sightings of fish in areas where they had not previously been sighted: distribution, environmental factors, changes in age-structure, and/or abundance.

The reported catch for the 1993-1994 fishing season for Japanese longliners is 20% lower than that for 1992-1993. The catch was much lower in November, 1993, but increased to more normal levels in the other months. The fishery closed in February, 1994.

BFTW-2. State of the stocks

BFTW-2.a Revision of 1993 assessment

During 1994, errors were discovered in the 1992 U.S. rod and reel catch and effort data for small and large fish used by SCRS in 1993 (using data through 1992) to calculate CPUE indices. These errors have been corrected and re-doing last year's assessment with the corrected CPUEs for 1992 increased the population estimates in 1992 by 25% for ages 1 to 3, 14% for ages 4-5, 4% for ages 6-7, and 30% for 8+. The overall trend in abundance remained similar with substantial decreases since 1975. The results are discussed further in **BFTW-2.e**, the catch rates section.

BFTW-2.b Catch at age

Catch at size was available from 1960-1993. **BFTW-Table 2** presents the size sampling information available for 1993 and the updating of the west Atlantic bluefin catch-at-size file in 1994. Since 1984 the SCRS has decided to restrict its virtual population analyses to the years since 1970, primarily because of concern that there was only a limited number of size samples available for earlier years for some fisheries. The catch at size was converted to catch at age using the age slicing system established by the SCRS in 1990. That system is primarily based on the growth curve estimated by Turner and Restrepo (SCRS/93/65) as done by SCRS in 1993*, though in some year-month strata, visually determined boundaries between modes in the size data are used to separate younger age groups (ages 1-3), which are not as distinctly separated by the growth curve. The estimated catch at age, through age 10+, is shown in **BFTW-Table 3**.

BFTW-2.c Catch rates

A number of catch rate indices were examined. Nine series were used in 1993 for calibration of the VPA, and the same nine were available for this purpose again in 1994. These included three Japanese longline series (catch rates for ages 3-5, 6-7, and 8+) and three U.S. series (U.S. rod and reel catch rates for large and small fish and the US Gulf of Mexico longline catch rates). In addition to updating the standardization of these six catch

* The 1993 SCRS Report mistakenly referred to Turner *et al* 1991.

rate series, evaluations of use of alternative error structures in the standardization procedures were also conducted for the same six series as well as for the Japanese longline catch rate series from the Gulf of Mexico. It was not possible to update the larval index and the Canadian tended line index.

For the Japanese longline series, General Linear Models were applied for standardization, with both log-normal and Poisson error structure assumptions. In contrast to the standardized series used for VPA calibration by the 1993 SCRS, the Japanese longline data used for these standardization were based on daily catch and effort information rather than on aggregated monthly catch and effort by 5° grid. In addition to use of daily catch and effort data, the 1994 analyses presented to the Committee included revised data for 1992, which indicated that average Japanese longline catch rates for bluefin by age groupings were approximately between 1.5 and 3 times higher than the 1992 relative catch rates used by the Committee in the 1993 bluefin assessment (**BFTW-Figure 2a**). The 1992 standardized value was among the highest for the 1976-1993 time series. It was suggested that a possible increase in targeting for bluefin by the Japanese fleet in 1992 might not be adequately accounted for in the standardization procedures applied to these data, or that bluefin availability had increased in that year. The Committee recommended that the relationship between bigeye and bluefin targeting practices by the fleet be further investigated and that alternative methods for standardizing for these effects be incorporated into the modelling procedures, if possible.

The Committee noted that the "age-specific" CPUE series from the Japanese longline catch and effort data showed similar patterns in that for certain years in the time series, all of the catch rates concurrently increased or decreased in a manner that would not be expected if the separate indices were reliably tracking year class strengths (see **BFTW-Figure 2a**). Previously, these data were disaggregated by size to provide indices for 3-5, 6-7 and 8+, but few age 10+ fish had been captured in those fisheries since 1980. For this reason, the Committee computed a single Japanese longline catch rate series for use in tuning ages 1 to 9 in the VPA .

For the U.S. rod and reel indices, an error in the 1993 analyses of large and small bluefin catch rates, which resulted from inadvertently excluding some 1992 catch from the catch and effort calculation, was corrected (SCRS/94/133, SCRS/94/134). Correction of this error resulted in an approximate 2 fold increase in the relative catch rate of large bluefin in 1992 relative to the value used in the 1993 assessment (**BFTW-Figure 2b**). The corrected analysis of these data showed a similar two-fold increase in the relative index value for 1992 small fish catch rates (**BFTW-Figure 2b**). The Committee investigated the effects of correcting these errors in the U.S. rod and reel indices on the results of the 1993 assessment, by using the index values to tune the VPA analysis used at the 1993 assessment. Results are shown in **BFTW-Figure 3 and BFT-Table 4.**

Alternative error assumptions (Poisson, Gamma, Delta-lognormal) were also investigated with the U.S. rod and reel indices and the U.S. longline catch rate index in the Gulf of Mexico (Cramer and Scott, MS). The Committee noted that the Poisson and Gamma error assumptions resulted in fits that had skewed and multi-modal residual patterns, while the Delta-lognormal fit had a bell-shaped residual pattern (SCRS/94/133). The Committee recommended further investigation into the reasons for such residual patterns and continued evaluation of alternative error distribution assumptions in the General Linear Modelling approaches used for standardizing catch rates.

Noting the small differences between the results for the standard approach (henceforth termed "GLM") and the Delta-lognormal results, and similarly between the Poisson and Gamma model results, further calculations were made for the GLM and Poisson models only, as software and data were available at the meeting to allow all CPUE series (excepting the Canadian tended line) to be standardized for both these error models.

The catch rate indices applied in various calibrations of the VPA are listed in **BFTW-Table 5** and **BFTW-Figure 4**. The log-normal models fit to the data added a constant of 10% of the mean catch rate to allow log transformation of the 0 CPUE data. The indices applied for calibration of the VPA included the U.S.A longline by-catch of large fish in the Gulf of Mexico and Japanese longline catch rate for the Gulf of Mexico 1974-1981 for large tuna, catch rates for the Gulf of St. Lawrence tended line fishery for very large tuna, the U.S.A. Atlantic coast rod-and-reel fisheries for small and large bluefin (separate indices) and the Japanese longline fishery for bluefin in the northwestern Atlantic (single series), together with the Gulf of Mexico larval bluefin index, a fishery independent index that is considered to provide information on the spawning component (large fish). The abundance indices were given equal weight in the calibration as in 1993.

Trends in the indices used in calibration were examined using a non-parametric analytical technique (Gilbert 1987). Results of these analyses are shown in **BFTW-Table 6.**

BFTW-2.d Virtual Population Analysis

The calibration of VPA was done in a manner similar to that used in recent assessments. The SCRS conducted the assessment under the hypothesis of a western stock with no mixing. The sensitivity of the results to the no-mixing hypothesis was tested and the results are described under mixing models later in this section. Natural mortality was assumed to be M = 0.14 in all calculations. Technical aspects of the calibration process are described in **Appendix BFTW-2** while a general description of important aspects of the assessment follows.

The Committee studied the partial recruitment pattern in 1993 using separable virtual population analysis (SVPA) as it has in the past. Catches for ages 1-15 from 1991-1993 were used to examine the selectivity pattern. Because the age of fish is difficult to estimate precisely past age 10, these ages are aggregated in a "plus" group. The Committee assumed that the F ratio on ages 10+ was equal to that between age 10 and age 9. Three periods were used because it was considered that this relationship may have been relatively stable during those years. The ratio was 2.13 for 1970-1973 when there was little or no directed fishing on bluefin in the Gulf of Mexico, 1.33 for 1974-1981 when the Japanese longline fishery for bluefin in the Gulf of Mexico was active, and 1.14 for 1982-1993 after the imposition of catch limitations.

As indicated in section BFTW-2.c, the catch rate indices used last year for calibration were updated where possible and analyzed further. The main change was that the Japanese longline series which was previously divided into three "separate" indices is now combined into a single index for ages 1 to 9. Another change related to the error structure assumed in the abundance index standardization process, as discussed above. Although the "GLM" approach for which these evaluations were conducted this year is the most similar to that applied in 1993, it was decided to use the Poisson error model results in the base case because these resulted in a notable reduction in the residual sum of squares of the fit with the VPA. Results from the GLM approach are shown in **BFTW-Figure 5**. It was stressed that this decision should not be interpreted as a judgement that the Poisson model for error structure is the most appropriate, as only very limited studies of this topic have been possible thus far. As a result of this improvement in the base case VPA fit there are no obvious systematic deviations between the model predictions and observed values for all the abundance indices considered, indicating that these different series of abundance data are not providing conflicting sources of information (**BFTW-Figure 6**).

Population trends

The results of the assessment (**BFTW-Table 7** and **BFTW-Figure 7**) generally show similar trends as previous assessments. Recruitment was generally higher from 1970 to 1976 than it has been since, although there is an indication of slightly increasing average recruitment in the 1980s. Ages 2 to 5 abundance reached a low in 1982 but it has increased thereafter, although the 1993 and 1994 values are lower than in previous years. This decrease is influenced by the assumption made about the strength of the 1990-1992 year-class. The abundance of ages 6-7 increased steadily since 1983 and it has been above the 1970 to 1994 average since 1992, while the abundance of ages 8+ declined steadily until 1993 with a slight increase in 1994.

Sensitivity tests

A number of sensitivity tests were conducted for this base case assessment. The point estimates of ages 10+ abundance were scarcely affected by replacing an equal weighting of the abundance series by iterative re-weighting (corresponding to maximum likelihood estimation), by the form of the error structure assumed in the standardizing the catch rates, or by omitting the five data points with the highest and five data points with the lowest standardized residuals (to test for the effects of outlier observations). Estimates of younger fish abundance (ages 2-5, 6-7) are more sensitive to these effects (**BFTW-Figure 5**). A limited variation of choices for estimable parameters and associated selectivity functions in the numbers-at-age vector for 1994 was explored, with little consequential differences in results for the base case. It was noted, however, that the available information did not permit reliable estimation of the 1990 to 1992 year-classes. Doubling the F_{10+} : F_9 ratios led to lower estimates of abundance of 10+ fish, but these nevertheless showed similar trends over time to comparable estimates for the base case.

Three further suggestions were raised regarding possible amendment to the base case: increasing the number of parameters estimated in the VPA fit, changing the plus group choice from 10+ to another age, and modifying the function minimized in the fitting process to depend on the logarithm of the abundance index values rather than the values themselves. Time did not allow examination of these suggestions, and they were deferred to the next meeting of the Committee.

Document SCRS/94/104, which examined the time and area coincidence of the 1974 to 1989 year-classes between the two management units, was updated with the results of the base case and those of the 1994 east Atlantic and Mediterranean assessments. The good correspondence between year-class sizes described in SCRS/94/104 is maintained when the results of the 1994 assessments are used. This examination showed that when eastern + Mediterranean year-class sizes are divided by western year-class sizes there is a systematic increase in the ratio. Possible reasons for this increase include the potential systematic over-estimation of recent year-classes in the east + Mediterranean or systematic under-estimation in the west. The differences could also be due to systematic changes in climatic conditions at the time the strength of the year-classes is determined. In order to verify if alternative assessment formulations could eliminate the trend in the ratios of year-class sizes, it was suggested that a future sensitivity test be conducted by not including the plus group in the calibration, therefore using only ages 1 to 9.

Biological Reference Points

The results of yield per recruit and spawning biomass per recruit are given in **BFTW-Table 8** and **BFTW-Figure 8a and b**.

F_{med} (F-median) was calculated from the median survival ratio (R/S) estimated from stock size and recruitment data (straight line through the origin in **BFTW-Figure 8b**). F_{med} is the fishing mortality rate on the spawning biomass per recruit curve (**BFTW-Figure 8a**) corresponding to the inverse of the median survival ratio. Current fishing mortality (F_{1993} = 0.270) is above F_{med}. Current fishing mortality is also larger than $F_{0.1}$, but approximately equal to F_{max}. While reductions in current F would not lead to gains in YPR, substantial gains in SPR could accrue (**BFTW-Table 8**).

Comparison of the 1994 and 1993 SCRS Assessments

Comparisons of the estimated population trajectories from the 1993 (revised) and 1994 SCRS base case assessments are shown in **BFTW-Figure 5**. A number of methodological and data differences were used in the 1994 assessment compared to the 1993 assessment, including updated catch and effort information, the application of alternative methods for standardizing the CPUE used in tuning, and some differences in the VPA model assumptions applied (e.g. F-ratios, see VPA section). In spite of these differences, examination of the estimated stock trajectories from 1970 to the mid 1980's reveals little quantitative difference between the 1993 SCRS assessment and the present base case assessment in all age groups estimated abundance trajectories, except for the spawning age fish (age 8+).

Several features of the 1994 assessment contrast with the 1993 revised assessment. Most notable are lower estimates of large fish abundance in the early time period and higher estimates of small (ages 2-5) and medium (ages 6-7) fish abundance in the recent period.

The Committee noted that the difference in age 8+ abundance is larger for the period prior to that for which catch rate observations are available (1976-1993). This difference is attributable to a combination of factors, but for the period prior to 1975, it is likely dominated by the change from 1993 to 1994 in the model assumptions used which specify the fishing mortality rate on the oldest fish in the analysis (ages 10+) relative to the next youngest age (age 9). In 1993 the Committee also examined this feature in the 1993 assessment and came to the conclusion that estimates of age 8+ fish abundance for the period during which no CPUE observations are available are more sensitive to this assumption than are the estimates for more recent years. The Committee noted that the most recent estimates of age 8+ abundance from the 1993 assessment are quite similar to those from the 1994 assessment, especially over the last 5 years of the 1993 assessment time series.

Differences in abundance estimates of age 2-5 and 6-7 fish for the revised 1993 assessment and the 1994 assessment are largely attributable to the assumption of model error structure used in standardizing the CPUE series used in tuning the VPA. For the bluefin assessment, the VPA tuned with Poisson error assumption standardized CPUE series resulted in higher estimates of young fish abundance than did the VPA tuned with lognormal assumption standardized CPUE. The Committee selected the VPA fit to indices with Poisson assumption as the base case assessment, using the criterion of proportional improvement in the residual sum of squares compared to the VPA fit to indices with lognormal error assumptions. However, the Committee was not able to determine which form of index standardization resulted in more accurate evaluations of abundance patterns for use in tuning the VPA.

The Committee expresses concern about important year-to-year changes in assessments, such as the change between the 1993 and 1994 assessments for western bluefin tuna. These assessments indicate different trends in recent population sizes for the same level of catch. These changes are large relative to confidence intervals calculated within assessments. They result from changes in model specification and the addition of new data sometimes from within the time period included in previous assessments. Confidence intervals calculated within assessments do not consider mis-specification of models or data revisions. Thus, current methods of calculating confidence intervals within assessments under-estimate uncertainty. This problem is not unique to bluefin tuna assessments.

Between year assessment variability, as described above, has both management and research implications. From a management perspective, ICCAT Commissioners should be cautious in reacting to a single assessment that indicates a substantial change from previous assessments. From a research perspective, methods for calculating confidence intervals that account for more sources of uncertainty should be investigated, changing model specifications should be done with caution, and assessment and management strategies that are more robust to all sources of uncertainty should be investigated.

Retrospective pattern

The base case assessment was examined for retrospective patterns. The consequences of making an *ad hoc* adjustment for this pattern (in the same way as effected for the assessment of the eastern north Atlantic bluefin population) were examined. A retrospective pattern was evident for ages 8, 9 and 10+ only **(BFTW-Figure 9)**. The adjustments would be to multiply 1994 numbers of age 8 by 0.44, age 9 by 1.707 and age 10+ by 1.201.

Mixing models

The estimates of population sizes and trends provided by models which allow for mixing between the western and eastern components of the overall north Atlantic bluefin population depend on the rates of the associated "migration", both east-to-west and west-to-east. The tag-recapture data base from which such rates have to be estimated is limited: since 1970, of the 21,208 fish tagged in the west, 2,295 were recovered, of which 26 were from the east. Of the 9,415 bluefin tagged in the east Atlantic and Mediterranean, 408 were recovered,of which 17 were from the west. Simulation studies by Porch (SCRS/94/75) indicate that migration rates are poorly estimated within a VPA framework because the catches, abundance indices, and natural mortality rate are imprecisely known. This is true even if the tagging data were perfect, so the low sample sizes of tag returns would no doubt exacerbate the problem.

Two possible problems with the mixing model put forward by Butterworth and Punt (1994) were discussed. The first is that treating the eastern North Atlantic and Mediterranean Sea as a single homogeneous unit for such calculations is unrealistic, as most trans-Atlantic recoveries have been tagged or recaptured in the eastern Atlantic rather than the Mediterranean where catches are much larger. Thus the model might need to be expanded from a two to a three compartment basis.

The second is that the present model assumes that fish retain no memory of migration, i.e., once having crossed the Atlantic, they are no more or less likely than any other fish on that side to migrate later in the reverse direction. To the contrary, some spawning site fidelity seems likely in reality, so that fish which have crossed the ocean are more likely to return to spawn in the area they were born, and on a time scale of months rather than years. The proportion of migrants which return to their original area each year will have substantial impact on the estimated transfer rates and can have a large influence on the effects of management actions and perceived abundance.

These considerations, and the methodologies by which they might be addressed, are discussed in more detail in the report of the eastern Atlantic bluefin tuna stock assessment session. Some progress is implementing the methodology suggested to accommodate spawning site fidelity in the model was reported by Porch (SCRS/94/149).

A number of attempts have been made to estimate mixing from the available tag-recapture data by means of fitting these and the abundance index information to the current mixing model usually within an ADAPT framework, e.g.. Anon SCRS/94/68, Punt and Butterworth (SCRS/94/72-rev, 125), Porch *et al* (SCRS/94/73). However, all these analyses and their associated estimates are dated to a certain extent by some combination of subsequent updates to the tagging data base and the indices of abundance selected for the eastern and western components of the overall population.

The tagging conducted to date was designed to elucidate the general movement pattern of fish harvested in various fisheries, not to estimate transfer rates. Because some of the fish were tagged during fisheries where fish of different origin could be mixed, their allocation to an "East + Mediterranean" or "West" management unit is problematic. There is concern that the estimation of mixing rates from the existing tagging data requires assumptions about similarity in all areas of tag reporting rates by fishermen, tag shedding rates and/or tagging mortality rates. There are indications that at least some of those rates may differ between areas.

Different estimates of the relative abundance of the east and west Atlantic resources could influence the estimates of transfer rates and the precision of neither of the assessments is considered to be sufficiently high to allow to choose between various options with respect to transfer rates from existing tagging data.

Given these uncertainties the Committee considered it appropriate to examine a few mixing scenarios to provide some indication of potential alternative estimates of the status of the resource, but believed that there is not sufficient information to select a most likely set of possible inputs.

Sensitivity tests to the mixing rates were conducted by assuming the following mixing rates in separate calibrations:

Case	*West to East*	*East to West*
1	1 %	2 %
2	2 %	4 %
3	4 %	1 %
4	2 %	1 %
5	4 %	4 %

and the results on the west population estimates were examined. For cases 3 and 4, the population estimates for the west were almost unchanged from the base case. For cases 1, 2 and 5 where the mixing from east to west is greater than 1%, unrealistically high 8+ abundances were obtained while there were recruitment failures in several years.

Projections

The Committee decided to present projections for a variety of future constant catch and one constant fishing mortality rate harvesting strategy implemented in the year 1995, following an assumed total catch of 1995 MT in 1994. Such projections require the specification of future recruitment. A stock-recruitment relationship was assumed for this purpose, following inspection of the spawning stock-recruitment plot for the base case assessment (**BFTW-Figure 8b**). For this purpose, spawning stock biomass (SSB) was defined as 8+ mid-year biomass. The relationship used gives the geometric mean recruitment of one-year-olds over the 1981-1990 period if the spawning biomass is above the threshold defined as the average SSB over the 1985-1989 period; for biomasses lower than this, recruitment is assumed to decrease linearly with biomass. Stochastic projections incorporated a log-normal distribution about this relationship, with variance estimated from the series of point estimates of recruitment from 1981-1990. This prescription was also used to set recruitment for the years 1991-1993, because these were not estimated reliably in the VPA. As a positive retrospective pattern was detected for ages 9 and 10+ only, no projections were made on retrospectively adjusted populations because of lack of time and because it was believed that the effect would have been small.

Further technical aspects of the projections may be found in **Appendix BFTW-3**, which also specifies how selectivities and weight-at-age are computed for future years in these projections. Deterministic projections were based on the base case point estimates of 1994 numbers at age, while stochastic projections incorporate the variability in these estimates as evaluated by the bootstrap procedure described in **Appendix BFTW-2.**

The scenarios that were projected were: (i) no catch for the years 1995-2003; (ii) 1,200 MT for 1995-2003; (iii) 1,995 MT for 1995-2003; (iv) 2,660 MT for 1995-2003; and (v) a constant fishing mortality rate of F=0.14 (the same as the assumed natural mortality rate) for the years 1995-2003. All scenarios assumed the catch in 1994 will be 1,995 MT. The median results for the five scenarios are given in **BFTW-Figure 10a** for the catch, fishing mortality rate and spawning biomass trends. These same trends with 90% bootstrap confidence intervals are given in **BFTW-Figure 10b.**

The median projection of spawning biomass for all scenarios increases from 1995-2003. The lower 5% confidence interval for the 1,995 MT and 2,660 MT scenarios decreases in the period 1995-2003; whereas, it increases for all other scenarios. The lower 5% confidence interval for the 2,660 MT scenario implies effectively a zero spawning biomass after the year 2001. The median percent increase of spawning biomass in 1998 relative to that in 1993 is 207%, 138%, 90%, 56%, and 105% for the 0 MT, 1,200 MT, 1,995 MT, 2,660 MT and F = 0.14 scenarios, respectively.

For the constant catch scenarios, the median fishing mortality rate decreases during the projection period, although the decline is small for the 2,660 MT scenario. The upper confidence intervals for fishing mortality rate for the 1,995 MT and 2,660 MT scenarios are very much higher than the median and are increasing.

The constant fishing mortality rate projection shows a gradual increase in catch as the projected stock size increases. The initial catch in 1995 under this scenario is about 1,400 MT increasing to about 2,500 MT in the year 2003. Note that the median spawning stock trajectory under this scenario is very similar to the one with a constant catch of 1,995 MT, but the confidence intervals are narrower.

The results of some of the scenarios described above as well as additional ones to encompass catch levels which could be rationalized for the next one or two years are presented in **BFTW-Table 9.**

BFTW-3. Effects of current regulations on west Atlantic bluefin

A regulation prohibiting the catching and landing of bluefin tuna less than 6.4 kg for the entire Atlantic went into effect in August 1975; an exemption allowed incidental catches of 15% (by number). After the regulation went into effect, the percentage of individuals less than 6.4 kg in the catch was low in the western Atlantic from 1976 to 1981 (1.7% to 7.2%), but it increased to 23.2 and 18.2% in 1982 and 1983 (**BFTW-Table 10**). The percentage then fluctuated between 2 and 10% before dropping to less than 2% in 1992 and 1993.

A regulation limiting catches in the western Atlantic to 1,160 MT was introduced for 1981 and increased to 2,660 MT for each year from 1983 to 1991. Directed fishing was prohibited on the spawning stock in the Gulf of Mexico. As a result, catches have been below or slightly above the catch limits set for scientific monitoring since that date. The 1992 catch was estimated to have been about 2,186 MT (**BFTW-Figure 1**). This contrasts with catches that had averaged approximately 6,100 MT from 1976 to 1981. The catch limit for 1992-93 was reduced to an average 2,394 MT for each of the two years. Preliminary estimates of the catch in 1993 are 2,310 MT.

A third regulation for the west Atlantic limited catches of bluefin tuna less than 120 cm straight fork length (FL) to no more than 15% of the catch (by weight) after 1983. The percentage (in weight) of bluefin less than 120 cm FL steadily decreased from 1975-1983, and since then has varied between 6 and 15% (**BFTW-Table 10**). This regulation was modified for 1992 and later. The limit was changed to 30 kg or 115 cm and the tolerance to 8% by weight of national catches. The overall catch of such fish is estimated to have been 5% in 1992 and 6% in 1993.

BFTW-4. Recommendations

BFTW-4.a Statistics

1) The continuation of the provision of data on Japanese imports of bluefin by country of origin should be encouraged. All nations should provide import and export statistics, including size composition.

2) Continued efforts are needed to obtain catch and biological data from non-reporting countries.

3) All nations should provide catch at size by length measurements (rather than weight).

4) Catch and effort data should be collected for as many fisheries as possible. In particular, the Committee recommended the development of a CPUE index for Canadian fisheries.

5) Revisions to catch and effort statistics are expected as the various ICCAT nations review, quality control, and receive new information. Because revised catch and effort data can result in change of scientific advice to the Commission, it is important that revisions are fully documented in scientific manuscripts to the SCRS or National Reports.

BFTW-4.b Research

The Committee endorses the research requirements in the Bluefin Year Program (BYP) and proposes the following recommendations to improve the scientific basis for management:

1) The Committee believes that the highest priority should be to resolve important questions concerning mixing rates, population structure and management of bluefin tuna. The goal is to have the capability to assign unknown individuals to their geographical origin with known probability. Carefully designed and executed field and laboratory studies aimed at contrasting micro-elemental structure of hard parts as well as rigorous morphometric analyses of hard parts and/or genetic markers taken from geographically isolated samples at ages which preclude prior mixing currently hold the most promise. These studies would be designed to quantify both spatial and temporal variability. The following points are considered to be relevant to this experiment:

- -- Initial training samples should be obtained from the Mediterranean and Gulf of Mexico for age 0 fish;
- -- Sample sizes and numbers of response variables to be measured should be determined by power analyses from both sites;
- -- Several single cohorts should be sampled in time and space to help resolve space and time variability; and
- -- State-of-the-art statistical and analytical methodology should be applied to all data.

With respect to tagging, a large-scale, carefully designed and long-term tagging program would be required to achieve success in resolving these questions. Given the state of catch statistics in some areas of the distribution range, reporting rates of tags are likely to be very variable. Intelligent tags (i.e. archival tags) may hold more promise.

Steps should be taken to obtain as much biological information as possible from bluefin fisheries in the central north Atlantic, including from fisheries around the Azores, as part of studies of the stock affinity of fish in the area 30°-45°W.

2) Studies on growth and the implications for bluefin stock assessment are also of high priority. Methods which enable accurate extension of the catch at age beyond 10+ are essential. A validated growth model should be developed with the use of hard parts. These improvements would eliminate the uncertainties associated with estimating F-ratios. In the meantime, these uncertainties and their influence on the VPA should be further explored.

Improved growth comparisons of bluefin tuna may be possible by utilizing alternative growth functions, such as the four parameter Richards function. These comparisons are possible only if adequate weight at age data are available. To this end, it is recommended that additional weight at age data be obtained.

3) Emphasis should be placed on developing and improving fisheries-independent measures of relative abundance and the Committee encourages current efforts to develop an index of abundance from aerial surveys off New England. The possibility of aerial surveys of spawners when they cross the Strait of Florida should be investigated.

4) Alternate error distributions and weighting schemes for CPUEs and model fitting in the calibration of VPA should be further explored. Sensitivity analyses of alternate methods for standardizing CPUEs need to be evaluated with simulated data of known characteristics.

5) On-going studies of bluefin maturity and fecundity should be continued and enhanced. Methodologies to assign maturity stages should be standardized between the two stock units.

6) Methods to characterize the range of uncertainty in stock assessments should be further investigated. Applications of alternate model structures and assumptions can help in evaluation of this uncertainty. In addition, further comparative research into methodologies such as "fuzzy arithmetic", Monte Carlo and Bootstrapping methodologies needs to be conducted.

7) Retrospective patterns in stock assessments should be investigated to determine their causes, and to develop methods to solve the retrospective problem.

8) There are few size composition samples for the catches in the Mediterranean Sea. In contrast, there is better sampling in the east and west Atlantic. In order to estimate the size and age composition of the catches in the Mediterranean Sea, it has been necessary to assume that the unsampled catches' size composition was similar to size samples of other catches in either other gears, other areas, or at other times. It is recommended that the sensitivity of estimates of abundance to other "reasonable" substitutions be studied.

9) Mixing models should be further developed to allow for spawning site fidelity and for the possibilities of treating the East Atlantic and the Mediterranean as separate compartments. This will allow the sensitivity of results from existing mixing models to other plausible mixing mechanisms to be examined.

10) Progress on the Bluefin Year Program initiated in 1992 has been slow despite efforts of member countries to increase knowledge on bluefin tuna in the Atlantic and Mediterranean. To improve the efficiency of the project, the Committee feels it is essential to have an inter-sessional meeting in 1995 to critically review the general scheme of the BYP. To maximize output from the inter-sessional meeting, the Committee requests that the Commission encourage participation (including financial assistance) of pertinent scientists from both member and non-member countries.

The efficient and coordinated delivery of these recommendations related to statistics and research will probably only occur if a truly international large-scale program, with a dedicated budget is implemented. This program should be planned thematically, geographically and temporally and it should be realized efficiently. To be efficient, such a program should be coordinated by an ICCAT staff recruited to that effect. SCRS would like the Commission's opinion on the opportunity of programming and budgeting such an ambitious program. A detailed program, including budgeting, could be prepared at the inter-sessional BYP meeting if the Commission wishes SCRS to do so.

Assessment Schedule

The approach for the assessment assumes two management units in the Atlantic, with limited mixing. The Committee recommended that while east and west assessments continue to be required for management purposes, they should incorporate estimates of the possible effect of mixing rates. Hence, east and west bluefin tuna assessments must be conducted jointly. Such Atlantic bluefin stock assessments should be held during an inter-sessional meeting.

Given that bluefin tuna is a long-lived species with many age-groups in the population, changes in stock status are not expected to occur abruptly. Although there has probably been no real changes in stock status of western Atlantic bluefin tuna between 1993 and 1994, the assessment presented above shows that our **perception** of stock size trends is different for ages 1 to 8. This should not come as a surprise given the uncertainties in the data and in the assumptions made in the assessment models. However, this is perplexing for Commissioners who have to consider possible or existing management measures in light of the information available. SCRS therefore suggests that the assessment of western Atlantic bluefin presented above could be used to make decisions on management measures for 1995 as well as 1996.

Considering that the east + Mediterranean and western Atlantic bluefin assessments must be conducted jointly, SCRS recommended that the next assessments of bluefin tuna be conducted as an inter-sessional meeting during 1996. The assessment methodology agreed at that meeting will be used without changes in the subsequent joint assessment to be held in 1998. The next comprehensive assessment of bluefin where assessment methodology could be changed would then occur in 2000. Considered with an enhanced Bluefin Year Program, this schedule is believed likely to allow for improvements in our knowledge of the basic biology and assessments of bluefin.

BFTW-4.c Management

The Committee has not been able to fully evaluate the effect of mixing on the assessments of bluefin in the Atlantic and Mediterranean, but it recognizes that mixing occurs. Given recent estimates that East and Mediterranean bluefin have declined substantially, and considering that under some mixing assumptions the decline could be even more pronounced, the Committee strongly supported the management recommendations for east and Mediterranean bluefin.

The present assessment of western bluefin tuna shows that the 1993 age 8 and older mid-year biomass is about 13% of the 8+ biomass currently estimated for 1975, while the 1994 value would be 16% of the 1975 8+ biomass. In 1993, the Commission requested that "a recovery program aimed at achieving a 50% increase from current levels in the spawning stock biomass by the year 2008" be developed. If the year-classes since 1983 are as abundant as estimated in the current assessment, this target could be achieved either by 1995 or 1998, depending on catches in the intervening years. The Committee believes that it would be judicious to take advantage of these year-classes to rebuild the spawning biomass in order to increase the probability of higher recruitment.

As indicated earlier, alternate assumptions about the error structure in CPUE standardization or exclusion of possible outliers would result in lower estimates of the year-classes since 1983. The relative merits of various error structures in CPUE standardization, as well as the implications of mixing, will be investigated further during 1995 and it would therefore be advisable to be cautious while awaiting those results as well as those of next year's assessment, should one be conducted. In addition, despite the positive signs estimated in the current assessment, the 8+ biomass remains close to the lowest levels observed while the estimated fishing mortality is higher than $F_{0.1}$ and close to F_{max}.

BFTW-Table 9 describes the results of various constant catch scenarios for 1995 to 2003.

The SCRS concluded, on the basis of the present assessment, that it is not necessary to reduce catches to 1,200 MT in 1995.

BIL - B I L L F I S H E S

BIL-1. Description of Fisheries

Billfishes (Istiophoridae) are distributed throughout the tropical and temperate waters of the Atlantic Ocean. Blue marlin, white marlin, sailfish, and longbill spearfish are commonly caught by many fisheries, both directed and incidental, throughout their ranges of distribution. Black marlin landings from the Atlantic, if any, are negligible. Major catches of billfishes are incidental to the tuna and swordfish longline fisheries of many countries, including Brazil, Cuba, Japan, Korea, and Taiwan.

Other major fisheries are the directed recreational fisheries of the United States, Venezuela, Dominican Republic, Senegal, Mexico, Jamaica, Bahamas, and Brazil. Smaller recreational fisheries also exist in Cuba, Bermuda, Trinidad and Tobago, Portugal (Azores, Madeira), Côte d'Ivoire, and numerous other countries in the

Caribbean Sea and eastern Atlantic. Major artisanal fisheries for sailfish occur along the west African coast, especially in Ghana and Senegal, but also in the Caribbean island country of Grenada. Artisanal fisheries for marlins and sailfish also exist in Venezuela, Côte d'Ivoire, Barbados, Trinidad and Tobago, Brazil, Aruba, Curaçao, and in most other Caribbean island countries.

Development and the geographical expansion of major longline fisheries in the Gulf of Mexico for tuna, Caribbean Sea for swordfish, and expansion of fisheries in the south Atlantic (south of 5°N) for swordfish and tunas have been reported by various nations (mainly Spain and the U.S. for the eastern and western Atlantic, respectively). Other countries that report longline fisheries in the Caribbean include Venezuela, Barbados, Grenada, and Trinidad. Development of industrialized longline fisheries using small diesel powered boats (11-14 m) and modern equipment, targeting yellowfin tuna, has also recently been reported in St. Vincent and Grenada. Because these regions are known to have significant concentrations of billfishes, incidental catches of these species can be expected to increase in areas of concentrated fisheries. The incidental nature of some billfish catches (mainly for the longline fleets, and tropical purse seine fisheries of numerous countries) also results in discards which are difficult to document and result in additional uncertainties in the billfish catch statistics.

BIL-2. State of the stocks

No new stock assessments were presented to the SCRS in 1994. The most recent stock assessments presented to the SCRS for blue and white marlin were in 1992; for western Atlantic sailfish in 1993; and for eastern Atlantic sailfish in 1988. Although a new assessment for eastern Atlantic sailfish was planned for 1994, delays in data compilation and analysis for major eastern Atlantic fisheries for sailfish could not be accomplished in time to conduct an assessment in 1994. However, as a result of the work accomplished at the Second ICCAT Billfish Workshop in July 1992 (SCRS/92/16), and further refinements in the data base during 1993 and 1994, an updated assessment for eastern Atlantic sailfish should be possible in 1995. A complete review of data preparations and assessment methods was provided in the 1992 Billfish Workshop Report and the 1993 SCRS Billfish Report. These are summarized below by species.

Stock structure for each species of billfishes was reviewed during the 1992 Billfish Workshop and hypotheses were formulated, in part, based on tag recapture information. However, other information was also considered, including distribution of catches, distribution of larvae, spawning areas, and some preliminary genetic analyses. Tag recapture data for blue marlin indicate that this species often makes transatlantic crossings; almost 10% of the recaptures of tagged blue marlin demonstrated movement from the U.S. Virgin Islands in the western Atlantic to the west coast of Africa in the eastern Atlantic. One particularly noteworthy tag return includes the first evidence of inter-ocean movement, when a blue marlin tagged off Delaware along the U.S. east coast was recaptured near the island of Mauritius in the Indian Ocean (**BIL-Figure 1a**). Several instances of trans-equatorial movements of blue marlin have also been reported (**BIL-Figure 1b**). These recent findings are consistent with a single Atlantic stock hypothesis for Atlantic blue marlin. Tag returns of white marlin indicate substantial movements of fish from the U.S. east coast to off the northern tip of South America (see **BIL-Figure 1b**, 1993 SCRS). Recent tag returns of interest include transatlantic (U.S. Virgin Islands to Morocco) and trans-equatorial (U.S. east coast to the Gulf of Guinea) movements for white marlin (**BIL-Figure 1b**). Recent tag returns for sailfish also indicate this species is capable of making long distance movements. For example, a sailfish tagged off the U.S. east coast (Beaufort, North Carolina) was recaptured less than a year later off the north coast of French Guiana (8° North) (**BIL-Figure 1b**).

BIL-2.a Blue marlin

Total reported Atlantic landings of blue marlin (**BIL-Table 1, BIL-Figure 2a**) increased rapidly from 1960, reaching a peak of more than 9,000 MT by 1963. Landings generally declined until 1967 and remained relatively stable through 1977, fluctuating between 2,000 and 3,000 MT. From 1977 to 1988, landings declined to a somewhat lower level, fluctuating between 1,300 and 2,700 MT. Landings increased to almost 4,000 MT in 1989 and since then have fluctuated between 2,700 and about 3,300 MT through 1993. The north and south Atlantic regions show trends similar to those for the total Atlantic. Most of these catches are incidental to the longline fisheries for tuna and swordfish; the general trends in catches have followed the intensity of these fisheries. It should also be noted that blue marlin (as well as other species of billfish) by-catch mortality in the U.S. longline fishery in the western Atlantic for 1989 through 1992 are considered under-reported. By-catches by the eastern Atlantic tropical purse seiners also be significant, but these data have not been updated since 1983.

New series of historical landings data for blue marlin and other billfishes were submitted to the SCRS by CARICOM for Trinidad and Tobago, and St. Vincent and the Grenadines and updated historical landings were reported for Grenada and Barbados. A question concerning possible Taiwanese billfish landings in the longline catch reported from Trinidad and Tobago needs to be resolved. This has apparently been done for 1993 but needs to be addressed for previous years. In addition, updating of Venezuelan landings for all billfish species should be done, particularly for recreational and artisanal gears. Historic Korean billfish landings also need revision since much of the billfish landings are unclassified as to species. Provisional estimates of the 1993 longline landings for the category of NEI (not elsewhere included) were made for blue marlin, as well as other billfishes. However, these landings are believed to be underestimated and need clarification, as well as expansion for previous years.

Production model assessments of Atlantic blue marlin presented to the SCRS in the early 1980s generally showed declines in the stock(s) biomass from the early 1960s to the mid-1970s, with some stabilization for the total Atlantic from the mid-1970s through 1980, but at values far below the 1965-1975 average. These results suggested that blue marlin were at least fully exploited and likely over-exploited by about 1980 or so. The updated assessments presented to the 1992 SCRS included an additional 10 years of data compared to assessments carried out in the early 1980s (CPUEs for each stock hypothesis are given in the 1993 SCRS Report and used a more flexible model structure (ASPIC). The general results from the analysis for each stock hypothesis **(BIL-Figures 3 and 4)** indicated that biomass had been below B_{MSY} for more than a decade. Based on recent transatlantic and trans-equatorial tag recoveries, the SCRS recognized the increased importance of the total Atlantic hypothesis for this species. These results are very similar to those of earlier stock assessments and the Committee considered these stocks to be over-exploited.

For the total Atlantic hypothesis, reported landings in 1991, 1992, and 1993 were somewhat larger than estimated equilibrium replacement yield (approximately 2,500 MT in 1990). These levels of landings are expected to have resulted in some decline in stock biomass. Reported landings of north Atlantic blue marlin are lower in 1991, 1992, and 1993 than the estimated equilibrium replacement yield (approximately 1,600 MT in 1990). These recent levels of landings are expected to have resulted in some improvement in stock status since 1990. On the other hand, landings of south Atlantic blue marlin in 1991, 1992, and 1993 were in excess of estimated equilibrium replacement yield (approximately 700 MT in 1990). These recent catch levels are expected to have resulted in continued decline in stock biomass.

The Committee is concerned about the continuing high level of fishing mortality which has depressed stock biomass to levels below that which could produce MSY in most stock hypotheses examined here.

BIL-2.b White marlin

Landings reported from the total Atlantic **(BIL-Table 1, BIL-Figure 2b)** increased rapidly from 800 MT in 1961 to almost 5,000 MT by 1965 and then gradually declined to 900 MT, with fluctuations, during the following 15 years. Landings during the last decade have been comparatively stable, fluctuating between 1,000 to about 1,800 MT.

As was the case for blue marlin, the white marlin stock assessments presented to the SCRS in 1992 were the first since the early 1980s. Early assessments generally showed a sharp decline in the stock(s) biomass from the early 1960s through 1970, with continued but more moderate declines (with variation) to low levels through 1980. The stock(s) were considered to be at least fully exploited and likely over-exploited by the later part of this time series (mid to late 1970s). The differences between early assessments (1979-1982 SCRS) and those presented to the 1992 SCRS, in terms of methodology and available data, for white marlin are the same as stated previously for blue marlin and the CPUEs for each stock hypothesis are given in the 1993 SCRS Report. The general results from the analysis for each stock hypothesis **(BIL-Figures 5 and 6)** illustrate declines in stock biomass to levels well below estimated B_{MSY} and corresponding increases in fishing mortality above estimated F_{MSY} through 1990.

Recent landings of north Atlantic white marlin (1991, 1992, and 1993) were lower than the estimated equilibrium replacement yield for this stock hypothesis (approximately 500 MT in 1990). These landings are expected to allow for some improvement in the status of this resource since 1990. In contrast, recent landings (1991, 1992, and 1993) of white marlin in the south Atlantic and total Atlantic have been in excess of estimated equilibrium replacement yields, approximately 325 MT and 875 MT in 1990 for the south Atlantic and total Atlantic stock hypotheses, respectively). These levels of landings are expected to have resulted in further reduction of biomass under these stock hypotheses.

For the south Atlantic and total Atlantic hypotheses, the fishing mortality rates are far too high to allow any recovery. As a result, the Committee considered these stocks to be overexploited.

The Committee felt that in spite of remaining uncertainties about the data base, substantial increases in available information and refinement in assessment methodology (compared to previous assessments) resulted in improved assessment of the current status of white marlin stock(s). The Committee remained concerned about the depressed state of white marlin biomass and the high levels of fishing mortality, which has been continuing for about two decades.

BIL-2.c Sailfish/spearfish

Landings reported for the total Atlantic (**BIL-Table 1, BIL-Figure 2c**) increased from about 300 MT in 1960 to almost 3,000 MT by 1965. Landings fluctuated around 2,000 MT through 1972 and then declined to less than 1,200 MT by 1975. Landings increased again to about 3,300 MT by 1979, declined to less than 2,000 MT by 1982 and then increased to over 3,700 MT the following year. After 1983, a steady decline to about 2,200 MT, with some fluctuation, in landings occurred through 1993. The long-standing problem of separating sailfish from spearfish landings from offshore longline fisheries of many countries remains unresolved, although a report to the 1994 SCRS indicated that sailfish and spearfish landing statistics are now being compiled separately by the Japanese longline vessels. Some of the database problems were addressed at the 1992 Billfish Workshop. For example, sailfish Task I data from Japanese (1961-1990) and Taiwanese (1967-1979) longline fisheries that had previously been reported for the total Atlantic were broken down into eastern and western Atlantic, using average size, and converting the number of fish to weight. Progress in resolving other problems with the eastern Atlantic sailfish landings, such as compilation and clarification of data from Senegal, Cote d'Ivoire, and Ghana, were reported to the 1994 SCRS. Despite these improvements, these data should still be considered provisional until problems are further clarified.

West Atlantic

No new stock assessments were presented to the 1994 SCRS for western Atlantic sailfish. Previous production model assessments for western Atlantic sailfish (1982 SCRS) indicated that this resource was moderately exploited. The updated assessment submitted to the 1993 SCRS included an additional 10 years' data compared to assessments carried out in the early 1980s and used a more flexible model (ASPIC), as discussed for blue and white marlin. Following significant refinements in data preparation, the western Atlantic database in the 1993 assessment consisted of catch and effort data from the Japanese longline fishery (fully standardized CPUEs), all other longline fisheries combined, and the Venezuelan, Mexican, and U.S. recreational fisheries (**BIL-Figure 7**). Models were fit to simultaneous time-series of catch and effort statistics using four different approaches, as described in the 1993 SCRS report.

Point estimates of maximum sustainable yield for western Atlantic sailfish ranged from 606 to 707 MT (eastern Atlantic sailfish MSY is about 2,700 MT) for the four assessment approaches (**BIL-Figure 8**). A description of these approaches is given in the 1993 SCRS Report. Bootstrapping techniques were used to construct bias-corrected estimates and approximate confidence intervals for MSY, as well as relative biomass and fishing mortality trajectories for each assessment approach (**BIL-Figures 9 and 10**. Annual values for the first two years for biomass and fishing mortality trajectories were omitted due to extreme imprecision, as was the case for similar analyses for blue and white marlin presented to the 1992 SCRS. All approaches estimated similar trends in biomass trajectories, with greatest biomass at the beginning of the time series and lowest values near the end of the time series. In addition, relative biomass trajectories exhibited a stable trend over the most recent years with respect to MSY. The opposite trend, as expected, was generally true for fishing mortality trajectories. Of the four approaches used in this assessment, (B) and (D) were designated as the "best" of those examined due to fit and variability of the models (**BIL-Figures 9 and 10**). Model B (**BIL-Figures 9 and 10**) indicates the stock is near or at the fully exploited level over the last seven years (1986-1992), while model D suggests over-exploitation during this period (**BIL-Figures 9 and 10**). These results should be interpreted with the caveats that the offshore longline landings still include an unknown proportion of spearfish in the sailfish catch and that the "other longline" section of the analysis assumes the Japanese CPUE is representative of stock abundance. An evaluation of sailfish and spearfish landings in the Japanese longline catch was submitted to the 1994 SCRS. Results from this study suggest that there is no statistical differences in the proportion of sailfish and spearfish (by 5 X 5 degree square) in the Japanese longline catch during the period 1956-1970 compared to those catches made in 1993. Considering

Atlantic sailfish but were only partially completed for eastern Atlantic sailfish (these included elements for both research and statistics). Research emphasis for these tasks should continue for eastern Atlantic sailfish. General recommendations of the Committee included, but are not limited to, the following:

i) Age and growth studies of marlins and sailfish should be continued. Active sampling of juvenile marlin and sailfish should be continued.

ii) Commercial and recreational fisheries data for billfishes (particularly for eastern Atlantic sailfish) should be analyzed and updated to develop standardized abundance indices.

iii) Full implementation of the ICCAT billfish tagging program will require special efforts regarding tag-recaptured fish. These procedures are described in detail in the 1995 Program Plan for the Enhanced Research Program for Billfish (**Appendix 6 to Annex 25**). All ICCAT Contracting Parties and reporting nations are encouraged to make a special effort to distribute tag-recapture cards, particularly to the larger offshore longline vessels, so tag recapture data and biological samples can be recovered by ICCAT. Tag release as well as tag recapture efforts from offshore longline fleets of all countries, as well as fisheries in Brazil and in the eastern Atlantic off Senegal, should be enhanced.

iv) The intensity of studies on the reproductive biology of billfishes in the eastern and western Atlantic needs to be continued and expanded. This will require analysis of data collected in the past, as well as obtaining new information.

v) Studies of telemetry or hook timing should be initiated to evaluate the short-term survival of billfish caught and released from longline vessels.

vi) Studies to investigate possible alternative gear and deployment schemes that could reduce fishing mortality of billfishes from longline fisheries targeting other species should be initiated.

BIL-4.c Management

Recent stock assessment results for blue and white marlins and western Atlantic sailfish, which indicate that these species are either fully or over-exploited, warrant consideration for development of methods to reduce fishing mortality rates on billfish at this time. Development of effective management measures for these stocks is particularly difficult, since the major portion of the landings are a result of off-shore longline fleets targeting tuna and swordfish. Thus, any mortality reduction measures implemented for billfish risk affecting the targeted species as well. A relatively large volume of available information indicates that about 1/4 to 1/2 of the marlin and sailfish caught by longline vessels appear to be alive when brought along side of the vessels. Therefore, releasing these may be one approach that could reduce the apparently high rates of fishing mortality without affecting landings of the target species. The Committee believed that such an approach would first have to be implemented on an experimental and selective basis while additional research is conducted (perhaps telemetry or hook timing studies) to determine the rate of survival of billfish caught and released off longline vessels. If the short-term survival of billfish released from longline vessels is sufficiently high, then this approach, in combination with an observer program to verify survival estimates, may be one practical method for reducing fishing mortality on these species.

Steps in implementing tag and release efforts from the offshore longline fleet were initiated in 1994 when the Japanese Tuna Federation (JTF) agreed, in principle, to start experimental and voluntary tagging of those billfish that appear to be alive when brought along side its vessels. Tags and related tagging materials (including Japanese translation of tagging literature) have been shipped to the Canary Islands for distribution to JTF longline vessels that use this location as a transhipment port. It is hoped that tagging activities for this program will start in the next few months. The initial goal is to tag and release up to 5,000 billfish during the next two years. The U.S. longline fleet has been actively tagging billfish the past several years and plans to continue this effort in the future. If this preliminary tagging program by the "Blue Water Fishermen"s Association" is successful, this approach will hopefully be adopted by other offshore longline fleets in the Atlantic. Such efforts may potentially make substantial reductions in billfish mortality, as well as contribute important scientific information on movement, migration, and stock structure.

In light of the recent assessments for blue and white marlins presented at the 1992 SCRS and the assessment of western Atlantic sailfish presented to the 1993 SCRS, the Committee recommended that the fisheries for billfishes be monitored closely.

SWO - S W O R D F I S H *

SWO-INTRODUCTION

Swordfish are distributed widely in the tropical and temperate waters of the Atlantic Ocean and Mediterranean Sea. They are known to spawn in the warm waters of the Atlantic Ocean (SCRS/94/121) and in the Mediterranean Sea. Total swordfish catches (Atlantic and Mediterranean) peaked in 1988 at 51,693 MT and declined by 14 percent to 44,292 MT in 1993 (**SWO-Table 1** and **SWO-Figure 1**).

SWO-ATLANTIC

SWO-ATL-1 Description of Fisheries

Total Atlantic landings of swordfish reached an historic high of 33,909 MT in 1989, declined to 27,550 MT in 1991, then increased to 32,009 MT in 1993 (**SWO-Table 1** and **SWO-Figure 1**). Swordfish are taken throughout the Atlantic by directed fisheries and as a by-catch of the tuna longline fisheries. Directed longline fisheries in Spain (**SWO-Figure 2**), the United States (**SWO-Figure 3**) 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 starting in 1956 has operated throughout the Atlantic and did catch swordfish as a by-catch (**SWO-Figure 4**). There are other directed swordfish fisheries (i.e., Portugal, Venezuela, and Uruguay) and by-catch fisheries which take swordfish (i.e., Taiwan, Korea, Brazil, Trinidad and Tobago).

North Atlantic catch and effort for swordfish increased continuously after 1978 when U.S. mercury standards were revised. Since the historic high of 20,234 MT in 1987 (**SWO-Table 1 and SWO-Figure 1**), the landings declined by 16% to 16,980 MT in 1993. The 1993 landings were higher than 1992 (15,593 MT), due to higher catches reported by Portugal and Canada. Major fishing nations, Spain and the U.S., have decreased their peak north Atlantic landings by 43% since 1987 and 39% since 1988, respectively. These decreases have been partially attributed to various implementations of minimum size regulations, a shift in some of the Spanish effort to south of 5°N starting in 1988, movement of some U.S. vessels to other fisheries and to the U.S. implementation of an annual quota (4,561 MT in 1992 and 1993).

Revisions to the landed catches in the north Atlantic reported by Spain (1991-1992), Portugal (1991-1992) and the United States (1982-1991) have resulted in an increase in the historic landed catches reported to ICCAT for 1982-1992. U.S. revisions were made on the basis of additional documentation of catches received from fishermen participating in the U.S. fleet since 1978 (SCRS/94/117) and by including discard estimates of small swordfish (<125 cm LJFL) back to 1991 (SCRS/94/115) when the minimum size regulation was implemented. Changes to the Portuguese and Spanish catches resulted from a review of Task I data from 1987 to 1993. Revisions to south Atlantic catches were also made for landings from 1988 to 1991(**Table 1**). In 1994, U.S. (**Table 2** of the Swordfish Background Document and SCRS/94/120) and Canadian (**Table 3** of the Swordfish Background Document) import/export data were reviewed and some revisions were made to **SWO-Table 1** (reported as NEI-2) which involved Caribbean and South American countries (See Background Document in "Collective Volume of Scientific Papers, Vol. LIII").

Total landings in the south Atlantic were relatively low (generally less than 5,000 MT) until the early 1980s. Since 1988, reported landings have exceeded 10,000 MT, reaching a peak in 1989 (16,610 MT). This was followed by a decline to 12,092 MT by 1992 and a subsequent increase to 15,032 MT in 1993. The decline was due in part to a shift of some of the Spanish fleet to the Pacific in 1990 and 1991, and to a reduction in the Japanese swordfish by-catch (SCRS/93/85). The reported increase in landings in 1993 are attributed to movement into the south Atlantic by some Spanish vessels from the south Pacific (due to "El Nino"), and to an increase in average weight and fishing effort directed at bigeye tuna by the Japanese longline fishery. Since 1988, the Spanish longline fishery has expanded its fishing grounds towards the south and southwest, as far as 40°S (**SWO-Figure 2**). More than 50% of Spanish landings (in weight) are from south of 5°N. In the southwestern Atlantic, South American longline fisheries target either swordfish or tunas, depending on the relative catch rates.

* The Swordfish Stock Assessment Session was held at the ICCAT Headquarters in Madrid, Spain (October, 1994). A Background Document on the Session is published in the "Collective Volume of Scientific Papers, Vol. LIII".

SWO-ATL-2 STATE OF THE STOCK

SWO-ATL-2.a Stock structure

The Committee reviewed all the information presented up to now that could contribute towards defining the structure of the stock, such as size distribution, mark-recapture data, sex ratio at size, genetic studies, and other biological and oceanographic information. The Committee noted that the stock structure questions are complex and that all biological, oceanographic, and fisheries information need to be considered when examining stock structure hypotheses. The Committee recommended that a detailed and comprehensive review of the new and historical information be conducted before the next meeting of SCRS. Information on stock structure is summarized in **SWO-Table 2.** Since 1991, when swordfish structure was last reviewed, additional information has been presented to the Committee.

Genetic Studies

The frequency distribution of mitochondrial DNA (mtDNA) types among a sample of 109 swordfish from the Pacific and Atlantic oceans, and the Mediterranean Sea was examined (SCRS 94/127). Very high values of genetic diversity were obtained for all areas. The results indicate that for most part these three regions behave as independent units. However, some exchange of genotypes between the northeastern Atlantic and Mediterranean may occur. The annual rates of exchange could not be estimated from these data.

Within the Atlantic Ocean, the available data does not allow discrimination of genetically distinct populations. A considerable number of genotypes found in the Atlantic sample have a ubiquitous distribution. The most likely explanation for this is that extensive mixing of genotypes has occurred within this Ocean. Mixing could be recent or could have occurred in the past few thousand years. Therefore, the present annual rates of exchange of fish between the east and the west Atlantic cannot be determined based on these observations.

It is important to note that the majority of the genotypes in the Atlantic sample occurred at low frequencies, thus the detection of within-region population substructure, if present, would require much larger sample sizes. Furthermore, since populations substructure may be masked by mixing within feeding areas, the analysis of samples from spawning grounds, preferably females with high gonadal stages or larvae, should be given priority. The importance of conducting parallel studies with nuclear markers was stressed.

A progress report on the study of nuclear genetic variation of Mediterranean swordfish using protein electrophoresis was presented (SCRS 94/138). Future directions include broad temporal and geographic sampling of swordfish in spawning areas within the Mediterranean. The analysis of mtdna sequence variation on the same sample is also planned.

Abundance Indices

The information presented on the standardized catch rates of various fleets (SCRS/94/52, 119 and 141) continue to show consistent trends between different areas of the north Atlantic, although the areas and periods of fishery expansion have been different through the historical series.

Spawning Areas

Two documents with additional information on spawning areas confirm the spawning areas described previously. Document SCRS 94/121 confirms the results of earlier analyses, as regards the presence of females with hydrated oocytes and high GSI values in sub-tropical areas of the northwestern Atlantic Ocean (between 18°N and 30°N). Document SCRS/94/126 describes the presence of females with high gonadal indices in the tropical boundary of the northwestern Atlantic (West of 20° West longitude). The sample shows a very distinctive sex-ratio-at-size pattern that could be related to the low catchability by surface longline of females approaching spawning. Both sex-ratio and spawning are probably related to the specific oceanographic characteristics of this area.

Tag Recapture

Document SCRS 94/135 presents information on released and recovered swordfish within the United States Cooperative Tagging Program. Data on the size and location of these fish are examined.

Assessment Priorities

Taking into account the stock structure information (**SWO-Table 2**), concerns expressed in 1992 and 1993 SCRS management recommendations, questions raised by various Commissioners, available information, limitations of the data base, time limitations, etc., the assessment priorities were established by the Committee as follows:

1) North Atlantic (North of 5° North latitude)
2) South Atlantic (South of 5° North latitude)
3) Total Atlantic
4) Mediterranean Sea

It is important to note that management measures are needed across the range of any stock hypothesis used for management purposes in light of the uncertainty associated with the swordfish stock structure hypotheses. (Note: options 1,2 and 3 do not include the Mediterranean Sea.)

SWO-ATL-2.b Catch at size/age

The Secretariat presented SCRS/94/8, which proposes procedures for updating the Atlantic catch-at-size table for swordfish through 1993. The procedure included modifications of the historic data base due to revised landings and/or catch-at-size for catches that were not previously reported and updates for 1992 and 1993 landings. SCRS/94/115 provided estimates of U.S. discards of swordfish both smaller and larger than the recommended minimum size. These estimates were lower than estimates provided previously (SCRS/93/103) as a result of larger numbers of observed sets within area-quarter strata and a revised estimation procedure that accounted for effort distribution within the fleet by area and quarter. The Committee referred to SCRS/93/94 which concluded that voluntary discards of swordfish were not common in the Spanish fleet, although there was some catch (about 2-4% of the total catch) which was either shark damaged, eaten on board, or discarded, and thus not counted in the historical landed catch statistics. Discarding is also thought to be low in the Japanese and Canadian fleets.

All catches are matched to size by quarter and area for six Atlantic reporting areas, unless sized by national scientists who use finer scaled matching criteria (month - 5 degree square). For the north Atlantic most of the landings are directly sized with appropriate size frequencies and the number of substitutions required is minor. Additional landings were reported as NEI (not elsewhere included) catches based on a review of U.S. swordfish import statistics (SCRS/94/120). Since these additional catches were primarily from Caribbean nations they were sized with U.S. Caribbean longline size frequencies which included estimates of sized discards of small swordfish.

The Committee reviewed and accepted the proposed matching, substitutions, and raising factors with a few minor modifications. The catch-at-size was updated through 1993 and made available for analytical assessments during the meeting. The committee recognized that improvements in its analysis of swordfish could be made by incorporating sexually dimorphic growth through the development of separate catch-at-size tables for males and females. SCRS/94/126 analyzed area-season patterns in sex-ratio size data suitable for subdividing the catch. Further work is need to consider substitution rules and procedures for evaluating inter-annual variability in sex ratios.

The catch-at size data were aged using the traditional age slicing method. Further discussion on ageing the size data can be found in subsequent sections of the report. Catch-at-age tables by major swordfish fishing nation are provided in **SWO-Table 3a, b** for the north and south Atlantic, respectively.

SWO-ATL-2.c Catch rates

The Committee examined standardized age-specific catch rate information from the Japanese (SCRS/94/141), Spanish (SCRS/94/52), U.S. (SCRS/94/119) and Canadian (SCRS/94/111) longline fisheries. The

Committee also examined catch rate information used to develop a standardized biomass index for the north Atlantic from the U.S., Canadian, Japanese, and Spanish data sets (SCRS/94/122). The Committee discussed the recommendations of SCRS/94/69, which described a number of useful methods for dealing with possible outliers in stock assessment analyses. The Committee noted that residual pattern analyses and other diagnostics have been used for evaluating potential outliers in some CPUE analyses presented to the Swordfish Species Group over several years. The Committee also noted that SCRS/94/122 applied an objective statistical procedure (a 2-stage analysis with a 5% tail trim based on standardized residual values from the first stage model) to examine the potential effects of outliers on the results of an analysis, an approach that might be useful in some other analyses of catch per unit effort (CPUE) information. In the case of SCRS/94/122, the Committee decided to use the results from the full data series since no differences in CPUE pattern were found between the two analyses and therefore avoided discarding information.

The Committee noted that significant progress had been made on standardizing catch rate information from fleets operating in the South Atlantic. Age-specific standardized catch rates from the Spanish fleet operating in South Atlantic waters were provided in SCRS/94/52 and an age-specific and biomass standardized CPUE from the Japanese fleet were presented in SCRS/94/141, and SCRS/94/49.

Document SCRS/94/49 also presented analyses of Taiwanese, Brazilian, Cuban, and Korean catch and effort data reported to ICCAT. Results of these analyses suggest that additional work may be required to standardize catch rates from these fleets for effects of targeting, smaller scale fishing area effects, and for the different size ranges of the swordfish likely caught by the fleets. This work needs to be completed before these time series would be suitable for tuning stock assessment models. As much of the information needed to conduct this work is not directly available in the catch and effort data reported to ICCAT, it was recommended that national scientists familiar with these fisheries be involved in the analyses still required. The Committee noted that national scientists from Taiwan reported progress on conducting analyses of this nature on swordfish catch rates for the Taiwanese fleet (SCRS/94/152), but the Committee considered the results too preliminary to be used for anything but exploratory assessment analyses during the SWO stock assessment session.

The Committee was pleased to note that much of the recent progress made on standardizing catch rates from South Atlantic fleets was made during the ICCAT Data Preparatory Meeting for South Atlantic Abundance Indices held in Tamandare, Brazil, in August 1994 (SCRS/94/7). At that meeting, available information on the various fleets operating in the South Atlantic was reviewed. In some cases, notably for several Brazilian fisheries, updated catch and more detailed effort data were made available to ICCAT, which provided an improved basis for standardizing catch rates from these fleets. The Committee noted that no additional information on the Uruguayan fleet, which primarily targets swordfish in the South Atlantic, was made available to ICCAT. Catch rate information from these fleets is important for assessment of the status of the South Atlantic swordfish resource. The Committee reiterates its previous recommendation that national scientists whose fleets catch swordfish become directly involved in the swordfish stock assessments of the status of the resource.

The Committee also noted that newly available information on nominal catch rates for swordfish from the Azores (SCRS/94/109) was presented. The Committee recommended that efforts be made to standardize this information for effects not related to swordfish abundance (e.g. fishing area, month of catch, gear change, etc.). The Committee further noted that the Azores nominal biomass index declines at a faster rate than that estimated in the north Atlantic biomass index (SCRS/94/122), which represents information from less localized north Atlantic fleets.

All of the standardized indices considered for use in VPA tuning and non-equilibrium stock production modelling for the north Atlantic stock hypothesis are shown in **SWO-Table 4**. In general, the trends of these indices are similar. The Committee noted that small fish (ages 1 and 2) standardized catch rate information based on analyses of landings data from the U.S. fleet is likely not an accurate indicator of small fish abundance after 1990. In 1991, the U.S. implemented a minimum size regulation, in conformity with the ICCAT recommendation. This regulation resulted in a decrease in the U.S. landed numbers of fish smaller than the minimum size. In the age-specific indices, ages 1 and 2 landed CPUE values were believed affected after 1990 and were not used in tuning the assessment models. The Committee noted that future analyses of swordfish catch rates based on U.S. fishery observer data will provide an additional basis for estimating age-specific standardized abundance indices from the U.S. fleet. The observer sampling program was put into effect in mid-1992 and sufficient data are not yet available to permit linking the observed catch rates with landed catch rate indices. Catch rates of small fish, based on landings records, in the Spanish, Japanese and Canadian fisheries were not believed to be affected to a large degree by minimum size regulations for the period over which analyses were conducted, although the minimum size regulation can produce changes in the fishing pattern of some fleets.

The Committee discussed the Canadian standardized time series, which was recently prepared for the 1994 swordfish assessment meeting. The series showed correlated patterns over the ages assumed represented in the indices. It is possible that the method used to size and age the Canadian CPUE did not adequately separate the series by age. The standardized CPUE was aged using the standard ICCAT swordfish age slicing algorithm applied to the other fleet age-specific indices, but was sized with the same size frequency data used in sizing the Canadian catch data. This procedure is unlike the Spanish and U.S. CPUE series, which are sized using the observed fish size distributions for each trip landing used in the analysis. The procedure used is similar to that applied in the Japanese analysis, although the JLL series includes only the age 5+ grouping, because of limited size observations and relatively low landed catches of fish younger than 5 years by the Japanese fleet. The Committee recommends use of individual catch at size data by trip in the CPUE analysis, to the degree that these data are available. The Committee also recommended evaluating finer scale size frequency data.

The available age-specific standardized indices for the north Atlantic stock hypothesis are plotted in **SWO-Figure 5**; the biomass index is plotted in **SWO-Figure 6.** The relationship between relative catches and standardized fishing effort (biomass index) is shown in **SWO-Figure 7.** The available age-specific standardized indices for the south Atlantic stock hypothesis are plotted in **SWO-Figure 8** and the available biomass indices for the south Atlantic hypothesis are plotted in **SWO-Figure 6.** The CPUE values for various indices estimated under the South Atlantic stock hypothesis are shown in **SWO-Table 5**. The Committee noted similar patterns in north Atlantic biomass CPUE with patterns from the south Atlantic Japanese longline, and the Taiwanese longline data. As previously noted, the Committee considers the Taiwanese CPUE series preliminary. The Committee noted that the south Atlantic Japanese and Taiwanese longline CPUE showed continuous declining trends. However, for the South Atlantic, the declining trend in the Japanese longline series was somewhat less up to the mid-1980s when the catch from the south was relatively low and thereafter showed a more rapid decline. The available age-specific standardized indices for the total Atlantic hypothesis, based on Spanish fleet data are plotted in **SWO-Figure 9.**

Length-specific, standardized CPUE indices (fish/10,000 hooks by 5 cm LJFL intervals) were also presented for the U.S. (SCRS/94/119) and Spanish (SCRS/94/52) longline fleets. These indices are used in length-based sequential population analyses (SCRS/93/51, SCRS/94/118) previously described at the swordfish stock assessments as a promising alternative stock assessment tool. The Committee recommended that length-specific, standardized CPUE also be developed for the Japanese longline fleet from 1975 through 1993 for use with the LSSPA method of SCRS/93/51 for consideration by the 1995 SCRS.

As in the previous report, the Committee noted that it is possible that changes in age-specific catchability, which are not detected in the present models used to standardize CPUE, could cause variation in stock assessment results. Fishing up or fishing down effects might reflect differences in catchability. It is not clear how much variation would be imposed, since this depends on the degree and direction of change in age-specific catchabilities, if any. Increasing or decreasing catchability by age not standardized in analyses could cause overly optimistic or pessimistic views of trends by age. Although it is possible that one or both kinds of change in catchability could have occurred in the various swordfish CPUE series, the extensive residual pattern analyses conducted to date have not identified any strong indications of trends in catchability over the time series studied. However, further study is needed to evaluate additional factors ("micro scale" changes, bio-economic and other factors).

Improvements to CPUE analyses through methods that might better accommodate the varying degree of skewness in CPUE observations, especially when considering CPUE in small units of effort (e.g. catch per set), need to be investigated. In this regard, it would be useful to evaluate different methods with respect to replicating known patterns in CPUE, based on analyses of simulated data with known characteristics, but with features similar to those considered typical of the various fisheries from which standardized CPUE indices are developed.

SWO-ATL-2.d Population parameters

Growth

In the 1992 swordfish stock assessment report, the Committee noted that a source of error in developing the catch at age was the practice of ignoring individual variability in length at age. (The current practice is to assume a one-to-one age-length relationship -a Gompertz growth curve- and to apply "cohort slicing" to the catches). It was then recommended that an inter-sessional meeting be held to address appropriate size/age conversions for swordfish and other tunas of interest to the SCRS. The Committee was pleased that two such inter-sessional meetings have been held since then, with very useful results. During the first such meeting (SCRS/93/17), very basic simulated data were generated to evaluate the performance of various assessment methods in the presence of individual growth variability. Results from applying the various assessment methods to the simulated data were presented this year (SCRS/94/17). The results indicate that while the practice of cohort-slicing introduces errors in the catch-at-age, the impact of such errors on assessment results is lessened by plusing the catches at a young age. This gives support to the decision made by the Committee several years ago to use a 5+ group.

No new estimates of swordfish growth rates were presented to the Committee in the background documents. However, document SCRS/94/67 reported progress in processing anal finrays from northwest Atlantic swordfish for estimating and validating sex-specific growth curves.

Document SCRS/94/135 presented an update of the U.S. tag-recapture data used as a basis for the Gompertz growth curve currently in use. The Committee noted that a number of new recapture observations have become available since the growth curve was estimated in 1988 and decided to carry out new analyses of the same data. A more detailed description of the methods used and results obtained is provided in the detailed report. The Committee recommended that the currently-adopted growth curve continue to be used, noting that the average relationship between length and age is particularly uncertain beyond age 5 or 6. The Committee reiterated that these new analyses are tentative and that the concerns raised give further support to the decision made by the Committee several years ago to use a 5+ group.

Biometric relationships

Document SCRS/94/110 presented new relationships between various size and weight measurements (LJFL, EOFL and GW) off Madeira. That document noted that the GW-RW conversion factor and the length-weight relationships currently used by ICCAT are valid for the fishery operating in that area.

Sex ratio at size

Document SCRS/94/121 presented an update of sex ratio-at-size data for samples in the northwest Atlantic. Document SCRS/94/126 presented an overview of sex-ratio at size collected in different areas around the World. Using a clustering analysis, the study defined five groups of area-semester combinations in which the available samples reflect very similar sex-at-size patterns. The Committee noted that these basic area-specific patterns should be used as a first approximation to separate the catch-at-size data into sex-specific data sets. The Committee recommended cooperative research or that an inter-sessional meeting be held in order to explore the most appropriate methods to separate catch at size by sex. That meeting should also examine the use of sex-specific growth models for computing catch at age.

Spawning

Document SCRS/94/121 reported the presence of females with hydrated oocytes south of the Sargasso Sea, in the upper Caribbean, and in the Straits of Florida, and indicates that these are spawning areas. Peak spawning activity in these areas occurs between December and February. Spawning may also take place elsewhere throughout the year, although less frequently, based on samples of females with high gonadal index values. Document SCRS/94/121 also reported a relationship between batch fecundity and size for the northwest Atlantic.

SWO-ATL-2.e Stock-production model

Papers Presented

The Committee reviewed three working documents related to production models. In SCRS/94/60, a production model was used to fit standard simulated data sets developed at the First ICCAT Workshop on Technical Aspects of Methodologies Which Account for Individual Growth Variability by Age. The model could mimic the simulated data (generated with random recruitment). In SCRS/94/61, the author discussed the dependence of MSY for a given stock on the selectivity pattern of the fishery. It was demonstrated by using simulated data that extreme changes in selectivity could cause very large changes in MSY. In SCRS/94/60, the authors endeavored to quantify this effect using simulated data similar to the swordfish fishery. It was estimated that changes in selectivity believed similar to those observed in the north Atlantic swordfish fishery (1963–present) would cause a reduction in MSY of about 8% over the simulated 30-yr time series (on a species with biological characteristics similar to swordfish). A production model (ASPIC) was fit to the simulated data and estimated MSY was within a few percent of the "true" simulated MSY estimated from the stock-recruitment curve and biological parameters.

Methods

In applying production models to north Atlantic swordfish, the Committee used a dynamic (non-equilibrium) model (ASPIC) used previously by SCRS for several species including swordfish. The Committee considered also using a model or models with the equilibrium assumption, but rejected that option, because such methods have drawn increasing criticism in the peer-reviewed fisheries literature (e.g., Sissenwine 1978*; Hilborn & Walters 1992). It has been shown that such models may tend to overestimate MSY and F_{MSY} when used to analyze a declining population.

The data used in production modeling were the total north Atlantic catch (**SWO-Table 1**) and the CPUE index presented in SCRS/94/122 (see section 2.c). Attempts to conduct either a total Atlantic or a South Atlantic production model analysis were unsuccessful (some exploratory results are described in the Swordfish Background Document). The base case used the North Atlantic catch data from 1950 to 1993. It was found necessary to constrain the starting (1950) biomass to obtain reasonable estimates of early biomasses. In the base case, this biomass was constrained to $1.75 * B_{MSY}$ (equivalent to $0.875 * K$). Numerous sensitivity analyses were conducted to evaluate sensitivity to this and other factors.

Results

Results from the base case, which the Committee considered to be the best estimate, are shown in **SWO-Figure 10** and **SWO-Table 6**. The model estimates that the stock at the beginning of 1994 was markedly below the optimum level ($B_{1994} = 0.68 * B_{MSY}$), and that the 1993 fishing mortality rate was almost twice the rate that could produce MSY ($F_{1993} = 1.8 * F_{MSY}$).

The sensitivity analyses are generally in accord with the base case, and support the conclusion that the fishing mortality rate is too high (**SWO-Table 6**). Sensitivity trials conducted demonstrate that the base-case production-model assessment results are robust to a wide range of assumptions. Further details of the sensitivity trials are contained in the Swordfish Background Document.

Discussion

Although there are undoubtedly more extreme assumptions that could produce different estimates, the production model analyses demonstrated a high degree of robustness to the factors considered. The analyses conducted by the Committee estimate a high probability that the optimal rate of fishing mortality is now exceeded, probably by a substantial amount. They also estimate a high probability that the population is significantly below its optimum level (**SWO-Figure 10**), and is probably around 68% of B_{MSY}.

Certain management strategies are suggested by the theory of production modeling. In the presence of some variability of catches, the most stability of both yield and population size is theoretically attained when the population is maintained above B_{MSY}. If this is done, catches that exceed the replacement yield for one year would lower the population size, but as long as the population size remained above B_{MSY}, an increase in surplus production would be expected to counteract the increased removals somewhat. If, in contrast, the population biomass was maintained at less than B_{MSY}, exceeding the replacement yield for even a single year would be expected to reduce both the population size and the surplus production. Thus, replacement yield in following years would be smaller. In order to maintain the population at a level above B_{MSY}, the average annual yield must be less than MSY and F must remain less than F_{MSY}. This might also be desirable for other reasons, explained in the following paragraph.

Several management benchmarks have been proposed based on production models. It has been shown in several published papers that, in the presence of variability in the environment, the maximum sustainable *constant*

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* Full citations of non-ICCAT references are included in the Swordfish Background Document.

yield that can be taken is always less than the maximum sustainable *average* yield. It has also been demonstrated that a management policy based on controlling fishing effort (equivalently, fishing mortality rate) is more robust than one based on controlling catches. This is because if the population should fall below its expected level (perhaps because of environmental variability, disease, or unreported catches), a policy that could control effort would result in a smaller catch; in contrast, taking a constant catch would result in an increased fishing mortality rate. A recent publication (FAO 1993) asserts that F_{MSY} should be considered a limiting reference point (i.e., a level never to be exceeded). The report suggests several target levels that are lower than F_{MSY}.

SWO-ATL-2.f Virtual Population Analysis (VPA)

Methods

Virtual population analysis was conducted under the north Atlantic stock hypothesis. Again this year, the VPA was calibrated to a suite of abundance indices (derived from standardized catch rates) using the ADAPT framework. The ADAPT framework has evolved continuously from its initial applications at ICCAT.

Eleven age-specific standardized indices of abundance were utilized to calibrate the VPA. The eleven indices were the same ones used in the prior assessment, i.e. indices for ages 1, 2, 3, 4 and 5+ from the Spanish and from the United States longline fleets and an age 5+ index from the Japanese longline fleet. Additionally, four new standardized indices from the Canadian longline fleet were developed for ages 2,3,4 and 5+ from 1988-1993. The Committee felt that the Canadian indices need additional development before general application in the assessment; however, the Committee was also encouraged with these developments and expects that these indices will be incorporated within the base assessment in the future. In any case, the general trends of the Canadian indices are similar to the others (**SWO-Figure 5**). Additionally, a sensitivity analysis was conducted in which the Canadian indices were included within the suite.

Two years have elapsed since the previous swordfish assessment; hence, there has been an addition of 18 index data points (2 years x 9 indices), an increase of approximately 20%. The larger sample size has provided increased confidence in the standardization process and has allowed for more flexibility in specifying the VPA model structure. The Committee attempted to utilize this flexibility to relax some of the model assumptions and to estimate more parameters within the model.

The VPA model specifications were similar to those in previous assessments. The model was run for ages 1 to 5+ for 1978-1993 with an instantaneous natural mortality rate of 0.2/yr for all years and ages. As discussed in the growth section, the 5+ age grouping was utilized because of our inability to reliably age fish older than 5. However, this creates a compromise in conducting the VPA in that the VPA calculation requires separation of the 5+ stock size into cohorts as one back-calculates to ages 4 and younger. The separation is done using the so-called "F-ratios", i.e., the ratio of the age 5+ fishing mortality rate relative to that of age 4. It has been noted that it is important that the F ratio be properly specified, since the plus group accumulates a large number of fish and can affect the perceptions of abundance (SCRS/91/35). Therefore, the Committee specified a model structure in which the F ratios for three time blocks were constant: 1978-1982, 1983-1987 and 1988-1993. In the previous assessment, the F ratios were assumed to be constant over all years.

It was noted that there were sufficient degrees of freedom to estimate some of the F ratios. However, at least one F ratio (or time block of F ratios) had to be specified before the other two could be estimated. The Committee conducted a lengthy discussion on which time block of F ratios should be fixed and at what level it should be fixed. The possibility of dome-shaped selectivity at age within the plus group was discussed, as well as the possibility of shifts of the selectivity by the fisheries within this group due to the change in fishing distribution over time. This discussion was coupled with sensitivity analyses to examine the dynamics of the F ratios. The Committee concluded that, although the F ratio was very uncertain, an appropriate assumption on which to base the analysis was that there was equal selectivity at age within the plus group for the period 1988-1993. Hence, the F ratio during this period (as determined by a separable VPA with "flat-topped" selectivity) was specified by 0.995; and F ratios of 1978-1982 and 1983-1987 were estimated within the ADAPT framework. However, this assumption was tested with sensitivity analyses.

The Committee wishes to reiterate that the use of F ratios is necessary due to our inability to accurately determine catch at age at older age groups. Any major improvements in the estimation of catch at size by sex and sex-specific growth curves (ultimately the assessment) await the resolution of these issues.

The 11 indices were tuned using iterative re-weighted least squares (IRLS), where the indices are weighted by the inverse of the variance of the fit of the indices to the VPA model and are updated after each iteration. Effectively, this method gives more weight to those indices that contribute least to the variance in the fit. This is the same procedure utilized by the Committee in previous assessments. However, equal weighting was also tested as a sensitivity case. Because the indices were of unequal length (Japan 5+ 1978-1993; Spain 1983-1993; U.S. 1 and 2 1981-1990 and U.S. 3, 4 and 5+ 1981-1993), IRLS and non-IRLS runs had affects on the early years and on the 1978-1982 F ratio. These will be discussed in the results.

In order to evaluate the variability of the fit of the indices to the catch at age through the VPA model, a bootstrapping analysis was performed in which the weighted deviations of the index data points and their predictions were randomly selected to generate new index points and the analyses were repeated 500 times. Additionally, the 1988-1993 F ratio was randomly selected within a uniform distribution ranging from 0.75 to 1.33.

Results

Estimated abundance by age is given in **SWO-Table 7** and **SWO-Figure 11**. Fishing mortality rates are in **SWO-Table 8** and **SWO-Figure 12**. Biomass at age is in **SWO-Table 9**.

Estimated recruitment (age 1) gradually increased in the early 1980s, then shifted to a higher level in 1985. Then recruitment peaked in 1989 and shifted to a lower level 1990-1993. Note that the estimates of recent recruitment are less precise (**SWO-Figure 11**). The age two abundance trend mimics that of age one with the appropriate one year lag. Ages 3 and 4 estimated abundance trends from the VPA were variable during the initial years of the time series with a decline in the most recent years (although the estimates for these years are less precise). Estimated abundance of age 5+ fish declined by about one half (**SWO-Figure 11**) from 1983 to 1993. The decline from 1978 to 1993 was also about one half; however the Committee is less certain about the trends from 1978-1983. This latter point is discussed later.

Fishing mortality rates at age for all ages generally show a gradual increase through the 1980s peaking in 1988. The percentage increase during this period was largest for ages 1 and 2 (**SWO-Figure 12**). The fishing mortality rates declined from 1988-1990 for all ages except age 2 (for which the rate in 90 was greater than 89, but less than 88). Fishing mortality rates for all ages increased in the most recent year (**SWO-Figure 12**). However, the Committee notes that the most recent years are more uncertain. Additionally, the F ratios in the middle years (1983-1987) appear to have been lower than the other two periods.

The indices compared to the appropriate stock size at age are given in **SWO-Figure 13**. Note that the Spanish age 5+ index and the U.S. age 3 index provide especially good fits. Conversely, the 1979-1980 Japanese age 5+ and 1981 U.S. age 5+ index points are not fit well.

As in previous years, a retrospective analysis was conducted by stepping back through the years of available data and conducting tuning at each step, ignoring all data in the subsequent years. The results indicate whether there is a pattern where the estimate of abundance of a particular age for a particular year increases or decreases systematically as more data are added. These so-called retrospective patterns can arise due to many reasons (e.g. unreported catches, mis-specification of indices or natural mortality rates or growth). Although *ad hoc* adjustments can be made, it is unclear whether they are an improvement. Results of the retrospective analysis for north Atlantic swordfish (**SWO-Table 10, SWO-SWO-Figure 14**) do not show a strong pattern especially in recent years. Age 5+ shows a pattern of increase in estimates using data through 1991, but the pattern shifts to a decrease in the latter years. The Committee chose not to adjust the stock sizes for retrospective pattern.

A number of sensitivity trials were conducted on the VPA. These included: not using IRLS, including the Canadian indices in the suite of indices used in the fit (without IRLS), using alternative U.S. age 1-2 indices without IRLS (alternative CPUE estimation model), estimating F ratios for 1978-1982 and separately for each year 78-1992 (without IRLS), specifying 1988-1993 F ratio at 0.75 (without IRLS), specifying 1988-1993 F ratio at 1.25 (without IRLS), specifying the 1978-1982 F ratio at 0.5 and estimating the 1983-1987 and 1988-1993 F ratios (with IRLS), specifying the 1978-1982 F ratio at 1.0 and estimating the 1983-1987 and 1988-1993 F ratios (with IRLS), specifying the 1978-1993 F ratio at 0.995 with IRLS (equivalent to base case in the previous assessment).

The Committee noted from these sensitivities that the most important factors were the specification of the fixed F ratio (this affected the scale of the estimated abundance of age 5+), and the degree of mis-specification (if any) of the 5+ indices from 1978-1981. In examining the latter question when IRLS was used as compared to no IRLS, the model was fit emphasizing the index points in the recent years. Therefore, poorer fits were obtained in the early years, the 1978 5+ stock size was lower and the fishing mortality rate was higher. When no IRLS was used, the model gave more weight to the early data points which resulted in a higher biomass and lower F ratios for this period. However, in either case the trajectories essentially converged by 1983. The Committee remains uncertain about the 5+ trajectory in the early years.

In order to assess this uncertainty two separate bootstraps were conducted, one with IRLS and one without and the results combined (essentially giving equal weight to the two alternative interpretations of the data in the early years). Results of the median biomass trends from the separate bootstrap experiments are very close to each other for 1982-1993 (**SWO-Figure 15**), but there is a wide range of uncertainty about the 1978-1982 trajectory. Possible factors that contribute to this uncertainty are the extent to which the 1978 Japanese index tracks abundance, the degree of under-reporting that might have occurred during the 1970s due to U.S. mercury restrictions, as well as the selectivity within the large fish age group.

The uncertainty in the fixed F ratio (the 1988-1993 F ratio fixed at 0.995) was evaluated by sensitivity analysis and by incorporating a uniform range within the bootstrap. While the Committee is very unsure as to the specific level of the F ratio, the Committee feels that the uncertainty incorporated into the bootstrap confidence intervals (**SWO-Figures 11, 12 and 15**) are reasonable.

The general conclusions to be drawn from the VPA analysis are that abundance of larger fish (5+) appear to have declined since 1983 to about one half of that level. Fishing mortality rates declined from their peak in 1988, but appear to have increased again in recent years, although not yet to the 1988 level.

SWO-ATL-2.g Yield per recruit

The Committee noted that the ICCAT recommendations for minimum size and other regulatory measures went into effect in 1991, although they may not have been fully implemented throughout that entire year. The last two years of the VPA (1992 and 1993) should, theoretically, represent the effects of full implementation. In fact, it does appear that the partial recruitment (including discard mortality) has shifted slightly away from age 1 in 1992-1993, as compared to 1988-1989 (**SWO-Table 11**).

Three yield per recruit (YPR) and 5+ biomass per recruit (BPR) scenarios were examined: 1) YPR and BPR under average 1988-1989 fishing conditions; 2) YPR and BPR under average 1992-1993 conditions; and 3) YPR and BPR under "optimistic" conditions where the partial recruitment (PR) is the same as the 1992-1993 average except that no age 1 or age 2 fish are captured or discarded. In all cases, the current fully-recruited (age 4) fishing mortality (0.506) is larger than common reference points such as $F_{0.1}$ and F_{MAX}. In addition, YPR and BPR estimates for the current fishing mortality are lower than the corresponding estimates for $F_{0.1}$ and F_{MAX}. **SWO-Table 12** and **SWO-Figures 16 and 17** show that the 1992-1993 PR results in little improvement in either YPR or BPR. However, if age 1 and age 2 fish could be avoided completely, there would be a small gain in BPR (**SWO-Figure 17**) and a substantial gain in YPR, particularly at current and higher levels of fishing mortality (**SWO-Figure 16**). In order to maximize YPR, fishing activity needs to be shifted towards the age of maximum biomass (about age 6). Analyses with alternative partial recruitments are presented in SWO/94/114.

SWO-Figures 16 and 17 indicate that increases in the effective minimum size offer the greatest opportunity for increasing long-term yields (i.e. small reductions in the current fishing mortality of 0.506 will not result in substantial increases in YPR), whereas overall reductions in current fishing mortality are required in order to achieve substantial increases in BPR (and, ultimately, the size of the spawning stock).

Approximate equilibrium estimates of MSY and B_{MSY} were obtained by multiplying the base case VPA geometric mean of recruitment from 1983-1991 (617,400) by the YPR and BPR estimates, respectively, for both $F_{0.1}$ and F_{MAX} (**SWO-Table 12**). $F_{0.1}$ and F_{MAX} have both been used as proxies for F_{MSY} in other assessments of stock status, although F_{MAX} is generally believed to overestimate F_{MSY}, while $F_{0.1}$ may be an over- or under-estimate, depending on the life history characteristics of the stock in question. For the three PRs and two reference fishing mortalities considered here, estimates of MSY ranged from 13,700 MT to 16,980 MT and estimates of B_{MSY} ranged from 21,610 MT to 60,880 MT (**SWO-Table 12**).

Bootstrap estimates of $F_{1993}/F_{0.1}$, F_{1993}/F_{MAX}, maximum yield at $F_{0.1}$ and F_{MAX}, and total and 5+ biomass at $F_{0.1}$ and F_{MAX} (**SWO-Figure 18**) were produced for the purpose of conducting stock projections (Section **2h.1**). Values corresponding to a probability of 0.5 (median estimates) in **SWO-Figure 18** are close to the point estimates for F and yield for the second run in **SWO-Table 12**; the two sets of biomass estimates differ slightly because the BPR analysis calculated beginning of year (time of peak spawning) estimates of biomass, while the bootstrap estimates were based on mid-year.

Estimates of BPR as a percentage of the maximum (attained at F=0) for the current fishing mortality range from 6.2% to 9.3%. These values are low relative to the commonly-used recruitment over-fishing threshold of 20%; however, large pelagic species may be more resilient to fishing than other fish.

SWO-ATL-2.h Projections

Stock Production Model

The Committee conducted a series of projections based on the production model results (**SWO-Table 13**). All of these projections assumed that the removals in 1994 would be the same as the recorded removals in 1993. Then the projections were run for a five-year period (1995-1999) under a range of simulated management controls based on either catch or fishing mortality rate. The Committee limited the time horizon of these projections in recognition of the deterministic character of production-model projections, particularly in respect to recruitment.

The projected catch-based controls resulted in a wide series of outcomes (**SWO-Table 13**). With no catch (or equivalently, no fishing effort) after 1994, the stock was projected to recover rapidly (**SWO-Figure 19a, b**). With an annual catch equal to half of the estimated MSY, the stock was projected to recover to a level higher than B_{MSY} by the year 2000 (**SWO Figure 19c, d**). With the projected annual catch at MSY, however, the stock was projected to decline to a low level by the end of the projection period (**SWO-Figure 19e, f**). When each year's catch was projected equal to that observed in 1993, the decline was similar, but even more rapid (**SWO-Figure 19g, h**).

Projected controls on fishing mortality rates generally produced lower yields initially, but as the stock recovered, the yields increased (**SWO-Table 13**). Projected fishing at F_{1993} was the exception, in that continued stock decline was projected (**SWO-Figure 20e, f**). Fishing at F_{MSY} was projected to allow a partial recovery during the projection period (**SWO-Figure 20c, d**). Fishing at half of F_{MSY} allowed the projected stock to rebuild to B_{MSY} by 1999 (**SWO-Figure 20a, b**).

Virtual Population Analysis (VPA)

The Committee carried out projections to the year 2005 based on bootstrap results from the base-case VPA (**SWO-Table 14**). All projections assumed that the total landings in 1994 were the same as in 1993. Projection computations were as follows for each bootstrap run: Selectivity for ages 1 to 5 was taken as the mean of the 1992-1993 selectivities; selectivities for ages 6 to 18 were set equal to selectivity at age 5. Weights at age were from the Gompertz growth curve and did not vary by bootstrap run. The plus group (age 5+ in 1993) was allowed to become one year older each year into the projection (age 6+ in 1994, 7+ in 1995, etc.) Recruitment for each projected year was obtained with random sampling of the available bootstrap-specific recruitment estimates for the period 1983-1991. Target fishing mortality rates or landings based on biological reference points were also bootstrap-specific (see Section 2.g).

The Committee considered seven projection scenarios:

CASE A: F = 0. This scenario provides an indication of the fastest possible biomass increase under average recruitment.

CASE B: Annual yield = 1993 yield = 16,977 MT, with a limit on F < 3. This scenario examines the consequences of maintaining current catch levels under average recruitment.

CASE C: Annual F = F in 1993 (bootstrap-specific). This examines the consequences of maintaining current exploitation levels under average recruitment.

CASE D: Annual F = $F_{0.1}$ (bootstrap-specific). This scenario examines a strategy based on a biological reference point often used as a target fishing mortality rate (FAO 1993).

CASE E: Annual yield = yield corresponding to $F_{0.1}$ under equilibrium conditions and average recruitment levels (bootstrap-specific). In this scenario the target is analogous to taking levels of catch close to the maximum possible.

CASE F: Annual F = F_{MAX} (bootstrap-specific). This scenario examines use of another biological reference point as a target.

CASE G: Annual F = $F_{0.1}$ (bootstrap-specific), constrained to annual reductions in yield of not more than 1250 MT. This scenario has the same target as CASE D, but the reduction in yield necessary to achieve $F_{0.1}$ levels is phased in more slowly. The maximum yield reduction of 1,250 MT is somewhat arbitrary (based on a reduction of not more than 15% from current catches every two years) and was selected for illustrative purposes.

The Committee considered the $F_{0.1}$ and F_{MAX} biological reference points to illustrate the possible consequences of using either of these as targets. The Committee notes that F_{MAX} is not generally considered to be a conservative target because, in the presence of a compensatory stock-recruitment relationship, F_{max} may lead to over-exploitation. $F_{0.1}$, on the other hand, is generally deemed to be a less risky target (FAO 1993).

Projection results are presented in **SWO-Figure 21.** The projections encompass a wide range of possibilities. Several overall conclusions can be drawn from these:

i) The north Atlantic swordfish stock appears over-exploited, and the current high levels of catch (about 17,000 MT) may not be sustained beyond 1996 unless recruitment increases substantially (CASE B). For CASE E (taking the maximum equilibrium yield under $F_{0.1}$ of about 14,000 MT), such yield appears to be similarly unsustainable beyond about the year 2001.

ii) If the current rate of fishing mortality is maintained, a rapid decrease in yield (to about 13,000 MT) is expected, as a consequence of the declining population size.

iii) Fishing at a target fishing mortality rate such as $F_{0.1}$ which is expected to give yields near the maximum average sustainable yield while minimizing the risks of over-exploitation requires a large reduction in yield from the present level. Recovery towards the corresponding biomass level is faster for large initial reductions in yield (e.g. CASE D) than it is for slow ones (e.g. CASE G).

The Committee discussed several caveats that should be kept in mind when examining the projections. The longer the projection horizon, the more the assumptions about recruitment become important. Recruitment was assumed to be independent of stock size in the projections carried out by the Committee, an assumption that may not hold at much higher or much lower biomass levels than the present ones. For instance, CASES B and E (constant high catches) predict a population that persists even if the spawning biomass collapses. At the other extreme, a recovery toward MSY-biomass levels may proceed faster or slower than predicted by CASES A, D, F or G, depending on the assumed stock recruitment relationship.

Summary

The Committee notes that total swordfish biomass corresponding to MSY levels may not be achieved in 5 or 10 years without substantial reductions in catch from current levels. The Committee notes that unless recruitment increases substantially, a constant TAC for a declining stock implies ever-increasing levels of fishing mortality and, therefore, ever-increasing over-exploitation. A large increase in recruitment is unlikely if the spawning stock size continues to decline and is unlikely on a sustained basis from any level of spawning biomass.

The Committee notes that target fishing mortality rates are less risky than constant catches for rebuilding over-fished stocks. The target F's are usually translated into corresponding TACs which require adjustment after each assessment, depending on the status of the stock.

Both types of projections (from the production model and VPA) agree in finding that large reductions in yield and F would be required to rebuild the stock in the short and medium term. Both also indicate that current catch levels are not sustainable.

SWO-ATL-2.i Other fishery indicators

Average weights (kg round weight) of swordfish caught from the North Atlantic are plotted in **SWO-Figure 22** for Japan, Spain, the U.S. (including discard estimates), Canada, and all nations combined. There is considerable variability in annual average weights, especially for Japan and Canada. Differences between nations reflect differences in selectivity and the geographical-seasonal operating characteristics of the fleets. The trends in average weights of swordfish caught by all fisheries has generally declined from 1978 through 1993. Since 1988 the overall average weight for the total north Atlantic has stabilized or increased slightly. Care must be taken when interpreting **SWO-Figure 22** since the trends are not adjusted for changing selectivity or a shift in age/size composition.

SWO-ATL-2.j Summary of Atlantic swordfish stock assessment

North Atlantic

Swordfish assessments rely on analytical results from stock production models and virtual populations analyses (VPAs) which integrate the available catch, effort, and biological data. Overall, the VPA and production model results for North Atlantic swordfish are very consistent in the major features upon which management advice is provided. Both analyses indicate that stock biomass continues to decline and that a large reduction in yields is required in the immediate future if the stock is to be rebuilt to the level of maximum sustainable catches (**SWO-Figure 15**). This consistency was encouraging, given that both types of analyses make very different assumptions. In particular, concerns about our inability to accurately age catches beyond age 5+ and sexual dimorphism and related problems, do not apply to the production model analyses used.

The current assessment indicates that the population has continued to decline despite reductions in total reported north Atlantic landings from peak values in 1988. These catch reductions have not resulted in reductions in fishing mortality. Because recent landings have exceeded surplus production, the stock has continued to decline and this is reflected in declining CPUEs for several fisheries (**SWO-Figures 5, 6**). In terms of a comparison of the current assessment to the most recent previous assessment (1992), the major differences are attributed to increased estimates of total landings after 1990 plus additional landings and CPUE data for 1992 and 1993. These increased landings are higher than the estimate of surplus production that was developed at the 1992 assessment.

The forward projections developed at the 1992 workshop were based on preliminary landings that are now known to have been underestimated. The prospects for the north Atlantic swordfish resource are pessimistic unless significant harvest reductions can limit fishing mortality to sustainable levels. ICCAT management recommendations which were implemented in the middle of 1991 have not been sufficiently effective to allow rebuilding. Even though some nations have reduced their landings and fishing mortality, increases in total landings by other nations, including non-ICCAT nations, have resulted in stock declines that have reduced the effectiveness of the actions taken by those nations in compliance.

Catches

The current assessment included data through the end of 1993 (**SWO-Table 1**). Reported landings declined from a peak in 1987 of 20,234 MT to 15,224 MT in 1991 (25% decline). Reported landings have subsequently increased to 16,977 MT in 1993 (16% below 1987). This corresponds to a decline in numbers from more than 475,000 swordfish landed in 1987 and 1988 to an estimated 336,000 in 1991 (29% decline in numbers; **SWO-Table 3**). Estimates of the total numbers landed has increased since 1991 to 378,000 in 1993, which is still a reduction of 21% from the peak estimate of 1988. These catches include revised estimates of historical landings for several fleets, as well as estimates of discards and catches by some non-member countries.

Stock Production Model

Stock production models provide estimates of MSY, the maximum sustainable (average annual) yield in weight and the corresponding fishing mortality (F_{MSY}), under the assumption of a constant current exploitation pattern. Previous MSY estimates ranged from 13,100 MT to 14,300 MT. MSY is not considered to be a conservative biological reference point and the FAO (1993) recommends that F_{MSY} be used as a limit reference point. Other more conservative reference points provide a greater cushion against recruitment over-fishing by allowing for a larger standing stock and/or spawning stock.

The current base case estimate (bias corrected) for MSY is 12,800 MT (80% confidence intervals from 5,200 MT to 17,100 MT; **SWO-Table 6**)). The estimated surplus production for 1994 is approximately 12,000 MT, which is substantially below current landings. Sensitivity runs incorporating different assumptions showed that the base case estimates are robust to a variety of assumptions.

The stock production model provides estimates of the current biomass (1994) relative to the optimum biomass, and current F (1993) relative to optimum F that would support an MSY of 12,800 MT (**SWO-Table 6**). The 1994 biomass is below the optimum stock size by approximately 32% (B_{94}/B_{MSY} = 68%). Sensitivity runs indicate a range of B_{94}/B_{MSY} from 54% to 81%. The production model estimates that the 1994 surplus production is 12,000 MT, including dead discarded catches. The Committee expects the 1994 catches to exceed this level and it is likely that the stock will decline further. This estimate includes discarded catch. Rebuilding the standing stock to the optimum biomass (an increase of 47%) would produce an 11% increase in sustainable yield to MSY. This indicates that the resource is not being optimally exploited in terms of current estimates of MSY.

Virtual Population Analysis (VPA)

VPAs provide estimates of age specific fishing mortality rates and abundance (stock size) of a year-class (all fish born in the same year). ICCAT swordfish VPA's have been restricted to the period after 1977, because of limited size samples and questionable landings data from earlier years. VPA's formed the basis of the 1991 ICCAT management recommendations. The VPA estimates of population numbers and fishing mortality rates for age 1, age 2-4, and age 5+ are illustrated in **SWO-Figures 11 and 12**. As in previous analyses, there are alternative biological and/or fishery assumptions (e.g., sexual dimorphism, procedures for estimating numbers at age, and selectivity patterns) that could influence the results and the perception of the status of the resource. These were addressed to some extent in sensitivity analyses.

The VPA estimates for age 1 gradually increased in the early 1980s, shifting to a higher level in 1985 and peaking in 1989 (**SWO-Table 7**). Subsequently recruitment (age 1) has shifted to a lower level between 1990 and 1993. However, estimates of recent recruitment are less precise (**SWO-Figure 11**). The age 2 abundance trend mimics the age 1 trend with the appropriate one year lag. Ages 3 and 4 estimated abundance trends from the VPA were variable during the initial years of the time series with a decline in the most recent years (although again these most recent estimates are less precise). Estimated abundance of age 5+ fish declined to about one half from 1983 to 1993. The decline from 1978 to 1993 was also one half; however the Committee is less certain about the trends from 1978 to 1983.

Fishing mortality rates at age for all ages generally show a gradual increase through the 1980s peaking in 1988 (**SWO-Table 8; SWO-Figure 11**). The percentage increase during this period is largest for ages 1 and 2. Fishing mortality rates declined from 1988 to 1990 for all ages except age 2 (for which the rate in 1990 was greater than 1989, but less than 1988). Fishing mortality rates for all ages increased in the most recent year. There is however, uncertainty in the VPA analysis, particularly for the youngest ages in the most recent year (1994). Current fishing mortality estimates are well above common biological reference points from yield per recruit (YPR) analyses. In addition, the long-term 5+ biomass per recruit (BPR) corresponding to the current F is very low (**SWO-Table 12**).

South and total Atlantic

The Committee was unable to conduct a quantitative assessment for the south or total Atlantic stock hypotheses, due to the data limitations. However, the Committee is seriously concerned about stock status in the south Atlantic and also the total Atlantic based on the pattern of high catches and declining CPUE trends in both the north and in several of the south Atlantic CPUE indices (**SWO-Figure 6**). If a total Atlantic stock was assumed, it is unlikely that the view of the status of the stock would be appreciably improved from that of the north Atlantic status. 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 appropriate to implement measures which encompass several possible stock hypotheses.

SWO-ATL-3. EFFECTS OF CURRENT REGULATIONS

ICCAT Regulatory Recommendations

The regulatory measures recommended by ICCAT for the conservation of Atlantic swordfish stocks took effect in July, 1991. The Commission recommended the following:

"Taking into account that the SCRS has determined that the present yield of the swordfish stock cannot be maintained over the long term without decreasing fishing mortality or the unlikely continued increase in recruitment over the next few years, and without decreasing fishing mortality over the next years, there is a significant probability of detrimental effects on future yield;

"The Commission recommends that effective in 1991:

"*First:* That the Contracting Parties whose nationals have been actively fishing for swordfish in the North Atlantic take measures to reduce the fishing mortality of fish weighing more than 25 kg in the area north of five degrees North latitude by 15 percent from recent levels. The reduction in fishing mortality shall be determined by the catch in 1988 or may be a reduction of fishing effort that will result in the equivalent reduction of fishing mortality.

"*Second:* In order to protect small swordfish, the Contracting Parties take the necessary measures to prohibit the taking and landing of swordfish in the entire Atlantic Ocean weighing less than 25 kg live weight (125 cm lower jaw fork length); however, the Contracting Parties may grant tolerances to boats which have incidentally captured small fish, with the condition that this incidental catch shall not exceed 15 percent of the number of fish per landing of the total swordfish catch of said boats.

"In addition, the Contracting Parties are encouraged to take other appropriate measures within their national jurisdictions to protect small swordfish, including, but not limited to, the establishment of time and area closures.

"*Third:* The Contracting Parties that are directly fishing for swordfish shall take the necessary measures to limit the fishing mortality of swordfish in the entire Atlantic Ocean to the level of catch in 1988, or will limit the fishing effort that will result in the equivalent level of fishing mortality.

"*Fourth:* That, notwithstanding the first and third paragraphs, Contracting Parties whose recent catch levels are small shall keep their annual catches within levels that are reasonable and abide by conservation measures mentioned in paragraph two.

"*Fifth:* That the Contracting Parties whose nationals do not target swordfish in the North Atlantic Ocean shall take necessary measures to limit the incidental catch to no more than 10 percent of the total weight of the entire catch so that fishing mortality of swordfish will stay at the current level.

"*Sixth:* That the Executive Secretary bring to the attention of governments of countries other than Contracting Parties, whose nationals fish for swordfish in the Atlantic Ocean, the measures being taken by the Contracting Parties and seek their cooperation in taking similar conservation measures consistent with the recommendations of the Commission."

In 1992, Panel 4 recommended that the following actions be carried out:

"1) That the Commission advise all nations involved in fisheries which harvest swordfish in the Atlantic Ocean to make every effort to maintain their catch levels or fishing capacity for the immediate future (1993-1994) at recent levels;

"2) That the SCRS be instructed to consider the impact of various management measures on Atlantic swordfish at the 1994 meeting that will enable the stock to rebuild over a reasonable period of time and be maintained at MSY levels; and

iv) Information on the number of undersized fish caught, and the numbers discarded dead and alive should be reported so that the effect of discarding is included in the stock assessment. The Committee noted that an observer sampling program had been implemented by Spain since 1990, by the U.S. since 1992, and Canada in 1994. Other countries should establish sampling programs that will acquire these data. In many cases, implementation of such a program will require observer coverage.

v) All countries with driftnet, trawl, and pair-trawl fisheries for tuna should report their swordfish catch, effort and size data.

vi) Deadlines for reporting Tasks I and II catch and size data must be strictly adhered to in order to facilitate timely stock assessments. Submission of late, unsized and unraised data may not be accepted after 31 July for inclusion in the current year assessment. A catch-at-size table must be available when the stock assessment session begins.

vii) It was recommended that fishery-specific conversion factors be developed for various measurements and weights.

SWO-ATL-4.b Research

The Committee recommended the following research items:

i) Studies on sex-specific growth and the implications for swordfish stock assessment must be of highest priority. A sex-specific growth model which enables the catch at size to be extended beyond 5+ is essential. The Committee recommended that joint work or an inter-sessional meeting be conducted to address this problem. Well in advance of this meeting, the Convener must coordinate both the appropriate data and software with national scientists and the Secretariat. All countries should provide information on sex-ratio at size by area and season. A validated growth model should be developed with the use of hard parts. The Committee proposed that back-calculations not be used and that the consistency of the pattern of rings on individual spines should be investigated.

ii) Studies on stock structure must also have high priority since stock assessments have been conducted mostly for the hypothetical north Atlantic stock. This recommendation has to aspects: definition and research. Definition: a definition of "stock" with consistent criteria for evaluation (e.g. validity of CPUE, tagging and other biological data) must be established for use across ICCAT species. Research: Genetic techniques to identify swordfish stock(s) and quantify annual rates of mixing should be continued and expanded. Samples for mtDNA analysis from various parts of the Atlantic and other ocean basins should be provided to develop the stock identification analysis. In addition, other aspects of biological, oceanographic, and fisheries information should be reviewed. However, in view of the time needed to conduct new studies, the sensitivity of the assessment results and management advice to various assumptions about the stock structure needs to be thoroughly evaluated (including conducting VPAs on the various stock hypotheses periodically).

iii) Development of scientific tagging experimental design to test hypotheses of growth and stock structure should be initiated. Development of cooperative tagging experiments over a wide geographical area by all pertinent nations should be encouraged.

iv) A new growth equation from tagging data should be calculated and implemented for the next assessment. The measurement error should be explored, using the sizes of fish at large for a very short time period.

v) Improvement of Canadian age-specific standardized CPUE indices are recommended. The Committee suggested using smaller areas to improve the matching of size and effort information. The collection of vessel-specific size and effort data is recommended.

vi) The Azores CPUE series should be reviewed and further standardized to examine in more detail the area and seasonal effects, if possible.

vii) Excellent progress was made on developing standardized south Atlantic CPUE series at the Brazil meeting, but further improvements on the new indices are encouraged. A combined biomass index for the south should be developed so that a south or total Atlantic assessment can be conducted in the near future. National

SWO-ATL-3. EFFECTS OF CURRENT REGULATIONS

ICCAT Regulatory Recommendations

The regulatory measures recommended by ICCAT for the conservation of Atlantic swordfish stocks took effect in July, 1991. The Commission recommended the following:

"Taking into account that the SCRS has determined that the present yield of the swordfish stock cannot be maintained over the long term without decreasing fishing mortality or the unlikely continued increase in recruitment over the next few years, and without decreasing fishing mortality over the next years, there is a significant probability of detrimental effects on future yield;

"The Commission recommends that effective in 1991:

"*First:* That the Contracting Parties whose nationals have been actively fishing for swordfish in the North Atlantic take measures to reduce the fishing mortality of fish weighing more than 25 kg in the area north of five degrees North latitude by 15 percent from recent levels. The reduction in fishing mortality shall be determined by the catch in 1988 or may be a reduction of fishing effort that will result in the equivalent reduction of fishing mortality.

"*Second:* In order to protect small swordfish, the Contracting Parties take the necessary measures to prohibit the taking and landing of swordfish in the entire Atlantic Ocean weighing less than 25 kg live weight (125 cm lower jaw fork length); however, the Contracting Parties may grant tolerances to boats which have incidentally captured small fish, with the condition that this incidental catch shall not exceed 15 percent of the number of fish per landing of the total swordfish catch of said boats.

"In addition, the Contracting Parties are encouraged to take other appropriate measures within their national jurisdictions to protect small swordfish, including, but not limited to, the establishment of time and area closures.

"*Third:* The Contracting Parties that are directly fishing for swordfish shall take the necessary measures to limit the fishing mortality of swordfish in the entire Atlantic Ocean to the level of catch in 1988, or will limit the fishing effort that will result in the equivalent level of fishing mortality.

"*Fourth:* That, notwithstanding the first and third paragraphs, Contracting Parties whose recent catch levels are small shall keep their annual catches within levels that are reasonable and abide by conservation measures mentioned in paragraph two.

"*Fifth:* That the Contracting Parties whose nationals do not target swordfish in the North Atlantic Ocean shall take necessary measures to limit the incidental catch to no more than 10 percent of the total weight of the entire catch so that fishing mortality of swordfish will stay at the current level.

"*Sixth:* That the Executive Secretary bring to the attention of governments of countries other than Contracting Parties, whose nationals fish for swordfish in the Atlantic Ocean, the measures being taken by the Contracting Parties and seek their cooperation in taking similar conservation measures consistent with the recommendations of the Commission."

In 1992, Panel 4 recommended that the following actions be carried out:

"1) That the Commission advise all nations involved in fisheries which harvest swordfish in the Atlantic Ocean to make every effort to maintain their catch levels or fishing capacity for the immediate future (1993-1994) at recent levels;

"2) That the SCRS be instructed to consider the impact of various management measures on Atlantic swordfish at the 1994 meeting that will enable the stock to rebuild over a reasonable period of time and be maintained at MSY levels; and

"3) That the Commission request ICCAT Contracting Parties to place a high priority on domestic efforts to meet the research need identified by the SCRS in its research need agenda.

Document COM/94/33 documents the implementation of these swordfish regulatory recommendations by the United States of America, Canada, Spain and Japan.

Effectiveness of Regulatory Recommendations

The objective of this Committee is to evaluate the effectiveness of these regulatory measures. Information is provided so that the Commission can evaluate compliance. Measures one through six are evaluated to the best of the Committee's ability. However, there are several undefined terms that make full interpretation difficult (i.e., "actively fishing", "small recent catch levels", "reasonable catches").

Measure #1 (15% reduction in North Atlantic)

North Atlantic landings (**SWO-Table 1**) have decreased from 19614 MT in 1988 to 16977 MT in 1993, a decrease of 13.4%. **SWO-Table 15** lists the weight of swordfish equal to or larger than 125 cm LJFL landed by nation along with an index value relative to 1988. The United States and Spain have reduced their landings in weight of fish equal to or larger than 125 cm LJFL by 31% and 26%, respectively, while countries such as Canada, Portugal and Japan showed increases.

Overall, VPA estimates of fishing mortality rates for North Atlantic swordfish equal to or larger than 125 cm appear to differ little between 1988 and 1993 (**SWO-Table 8**). Over the same time period, production model estimates of fishing mortality have increased substantially. It should be noted that all estimates of recent fishing mortality rate are very uncertain. **SWO-Table 16** shows partial fishing mortality rates by nation based on the base case VPA for the North Atlantic and the overall change in fishing effort relative to 1988. Because there is no clear definition for nations "actively fishing", those nations with at least 5% of the catch in 1993 are shown in **SWO-Table 16**.

Even though the U.S. and Spain have substantially reduced their landings (31 and 26%, respectively), large increases in landings by some other nations, including non-ICCAT nations, have resulted in stock declines that have reduced the effectiveness of the actions taken by the U.S. and Spain. Since 1988, Spain and the U.S. have reduced their fishing mortality rates on age 3+ fish by 18% and 15%, respectively, in full compliance of the regulatory measure. However, for the same time period, Canada, Portugal and Japan have increased fishing mortality rates on 3+ fish as illustrated in **SWO-Table 16** and **SWO-Figure 23**.

Measure #2 (Minimum size)

SWO-Table 17 lists the percentage of undersized swordfish landed (LJFL less than 125 cm) by nation in the north and south Atlantic Ocean. In 1992 and 1993, the percentage of swordfish by number less than 125 cm LJFL was about 14-16% overall for all nations fishing in the Atlantic. The Committee noted that the only marked decline in landings of swordfish less than 125 cm LJFL since 1991 was for the U.S. fleet in the North Atlantic. Estimates of United States discards were presented in SCRS/94/115 and **SWO-Table 18** and this source of mortality was considered in the North Atlantic population assessment. When discards were included with landings, the apparent effectiveness of Measure #2 was diminished; however, the U.S. partial fishing mortality rates on ages 1 and 2 still appear to have declined (for age 1, there was a 57% decline for 1993 relative to 1988 and a 23% decline for 1993 relative to 1991, **SWO-Table 16**).

Changes in fishing mortality rates of the younger fish were examined (**SWO-Table 8**). Changes in fishing mortality rates can be due to a combination of minimum size regulations and changes in stock size, catches and selectivity. Overall fishing mortality rates for the younger ages (1 & 2) have not changed appreciably since 1990, prior to minimum size regulations, though they are lower than 1988 values.

Given the relatively high catches (landings plus estimated dead discards) of swordfish less than 125 cm LJFL, particularly in the North Atlantic, and the lack of reduction in fishing mortalities in these age 1 and age 2 fish since 1990, the intended effect of the minimum size regulation apparently has not been fully realized. The effects of realized and potential changes in minimum size are further examined in SCRS/94/114. On the positive side, increased numbers of small fish have been tagged and some have been recaptured. This suggests that gains can be made by releasing these fish alive. There is also evidence of some level of fleet re-deployment by some fleet sectors attempting to avoid capturing small fish. Substantial gains in yield could accrue if fishing mortality on small fish could be further reduced (**SWO-Table 14**).

Measure #3 (limit F in entire Atlantic)

For the total Atlantic only catch data are available to evaluate the effectiveness of this measure. Overall in the Atlantic, catches in 1993 (32009 MT) are 2.1% more than in 1988 (31354 MT). The overall patterns in CPUE and increases in catch suggest that fishing mortality has increased. As it is not immediately clear from the regulatory measures which Contracting Parties are included in Measure #3, the Commission is referred to **SWO-Table 1** for details on Atlantic landings by nation.

Measure #4 (notwithstanding clause)

This measures cannot be evaluated as the terms "small", "recent", and "reasonable" catch levels are not defined. **SWO-Table 1** provides the necessary information on landings by nation and **SWO-Table 16** shows the partial fishing mortality rates by nation.

Measure #5 (by-catch nations)

For north Atlantic longline fisheries that do not target swordfish, **SWO-Table 19** provides estimates of the percentages of swordfish in the total catch of tuna and billfish from the Japanese, Korean, and Taiwanese longliners in the North Atlantic. These percentages are generally lower than the recommended 10% by-catch level, as they were prior to regulation.

Measure #6 (Non-Contracting Parties)

Catches for non-Contracting Parties are shown in **SWO-Table 1**. **SWO-Table 17** shows that for the North Atlantic, the "other" category has 1993 landings of fish less than 125 cm LJFL close to the 15% tolerance.

Summary

The 1991 regulations appear not to have been sufficiently effective to prevent further stock declines. The Committee emphasized the need for management measures throughout the Atlantic, to account for the uncertainty associated with the swordfish stock structure hypotheses. Further, the Committee recommends that recommended regulatory measures contain more precise terminology to maximize the effectiveness of the measures through implementation, and their subsequent evaluation.

SWO-ATL-4. RECOMMENDATIONS

SWO-ATL-4.a Statistics

i) All countries catching swordfish (directed or by-catch) should report catch and effort statistics by five degree rectangles or by smaller areas, and by month.

ii) All countries should carry out an adequate level of size sampling, and when possible, sampling by sex and utilizing lower jaw fork length (LJFL), preferably by month and by five degree rectangles. The Committee also recommended that the ICCAT Billfish Program continue to cover the Venezuelan longline fishery and that appropriate conversions from pectoral fin fork length (PFL) to LJFL be developed.

iii) Efforts by the national scientists should continue to collect critical fishery statistics not covered by the ICCAT data collection systems, especially for various Caribbean countries, Mexico, and large Portuguese longline boats.

iv) Information on the number of undersized fish caught, and the numbers discarded dead and alive should be reported so that the effect of discarding is included in the stock assessment. The Committee noted that an observer sampling program had been implemented by Spain since 1990, by the U.S. since 1992, and Canada in 1994. Other countries should establish sampling programs that will acquire these data. In many cases, implementation of such a program will require observer coverage.

v) All countries with driftnet, trawl, and pair-trawl fisheries for tuna should report their swordfish catch, effort and size data.

vi) Deadlines for reporting Tasks I and II catch and size data must be strictly adhered to in order to facilitate timely stock assessments. Submission of late, unsized and unraised data may not be accepted after 31 July for inclusion in the current year assessment. A catch-at-size table must be available when the stock assessment session begins.

vii) It was recommended that fishery-specific conversion factors be developed for various measurements and weights.

SWO-ATL-4.b Research

The Committee recommended the following research items:

i) Studies on sex-specific growth and the implications for swordfish stock assessment must be of highest priority. A sex-specific growth model which enables the catch at size to be extended beyond 5+ is essential. The Committee recommended that joint work or an inter-sessional meeting be conducted to address this problem. Well in advance of this meeting, the Convener must coordinate both the appropriate data and software with national scientists and the Secretariat. All countries should provide information on sex-ratio at size by area and season. A validated growth model should be developed with the use of hard parts. The Committee proposed that back-calculations not be used and that the consistency of the pattern of rings on individual spines should be investigated.

ii) Studies on stock structure must also have high priority since stock assessments have been conducted mostly for the hypothetical north Atlantic stock. This recommendation has to aspects: definition and research. Definition: a definition of "stock" with consistent criteria for evaluation (e.g. validity of CPUE, tagging and other biological data) must be established for use across ICCAT species. Research: Genetic techniques to identify swordfish stock(s) and quantify annual rates of mixing should be continued and expanded. Samples for mtDNA analysis from various parts of the Atlantic and other ocean basins should be provided to develop the stock identification analysis. In addition, other aspects of biological, oceanographic, and fisheries information should be reviewed. However, in view of the time needed to conduct new studies, the sensitivity of the assessment results and management advice to various assumptions about the stock structure needs to be thoroughly evaluated (including conducting VPAs on the various stock hypotheses periodically).

iii) Development of scientific tagging experimental design to test hypotheses of growth and stock structure should be initiated. Development of cooperative tagging experiments over a wide geographical area by all pertinent nations should be encouraged.

iv) A new growth equation from tagging data should be calculated and implemented for the next assessment. The measurement error should be explored, using the sizes of fish at large for a very short time period.

v) Improvement of Canadian age-specific standardized CPUE indices are recommended. The Committee suggested using smaller areas to improve the matching of size and effort information. The collection of vessel-specific size and effort data is recommended.

vi) The Azores CPUE series should be reviewed and further standardized to examine in more detail the area and seasonal effects, if possible.

vii) Excellent progress was made on developing standardized south Atlantic CPUE series at the Brazil meeting, but further improvements on the new indices are encouraged. A combined biomass index for the south should be developed so that a south or total Atlantic assessment can be conducted in the near future. National scientists whose fleets catch swordfish in the south Atlantic are encouraged to attend the swordfish stock assessment sessions.

viii) Development of a length-based, 5 cm LJFL, standardized CPUE from the Japanese longline data from 1975 was recommended.

ix) Alternate error distributions and weighting schemes for CPUEs should be explored. Research should be conducted in terms of fisheries and using the high points in the early years of longline CPUE series. Set-by-set approaches for all CPUE series are encouraged. The sensitivity of alternate methods for standardizing CPUE needs to be evaluated with simulated data of known characteristics.

x) Continue to develop alternatives to the age-slicing technique. The Committee endorses the work of the Workshop on the Technical Aspects of Methodologies Which Account for Individual Growth Variability by Age, and recommended that it continue.

xi) Methods less sensitive to outliers, such as robust regression techniques, should be explored. Year-to-year consistency in outlier rejection criteria must be maintained and the rationale for changes documented.

xii) Further research into spawning frequency, spawning seasonality and fecundity is recommended.

SWO-ATL-4.c Management

North Atlantic

The Committee recommended that the Commission, if it desires to rebuild the north Atlantic swordfish stock, must reduce both fishing mortality rates and catch considerably in the immediate future. The 1990 recommendations for regulatory measures were introduced to reduce both catch and effort, but these reductions have not occurred at the level required to allow the stock to increase. The current high catches and the declining CPUE trend alone, illustrate the continued declining trend of the north Atlantic swordfish stock. The results of the production model and virtual population analyses quantify the trends. The current population assessment indicates that the north Atlantic population has continued to decline despite reductions in total reported landings from peak values in 1988. These reductions have not resulted in reductions in fishing mortality rates because harvests have exceeded annual surplus production.

However, the state of the north Atlantic stock is not in such a depressed state that recovery cannot be realized in a reasonable time period. Immediate and appropriate action can improve the status of the north Atlantic swordfish stock, given that estimated stock sizes are below biomass at MSY, and given the resilient nature of swordfish. In order to arrest the declining trend, the level of harvest should not exceed replacement yield, which is now less than MSY. In order to allow for increase in stock biomass, the level of harvest needs to be below replacement yield for some time into the future. MSY is best used as a reference point for rebuilding the biomass rather than a target reference point for catches; MSY should be thought of as an upper bound to the sustainable yield that can be taken. The Committee emphasizes the importance of managing effective fishing effort (and thus the fishing mortality rate) rather than catch alone. Because the catch corresponding to a target fishing mortality rate depends on stock status, management measures are likely to require adjustment after each assessment to maintain the target fishing mortality rate. The current stock assessment illustrates this point well: though catches were reduced from 1988 levels, 1993 fishing mortality rates were not appreciably different from 1988.

The difference between the current assessment of the status of the stock and the 1992 assessment highlights the need to enhance monitoring and timely reporting of landings.

Projections indicate a range of management strategies that could be implemented to allow stock recovery, all of which indicate the need for substantial reductions in harvest from current levels. More specific recommendations for harvest restrictions could be provided if the Commission provides the SCRS with a more precise statement of its objectives, including the time frame in which it would like to achieve them and with what degree of certainty the Commission requires that its objectives be attained.

South and total Atlantic

The Committee is seriously concerned about stock status in the total Atlantic based on the pattern of high catches and declining CPUE trends in both the north and south Atlantic. If a total Atlantic stock was assumed, it is unlikely that the view of the status of the stock would be appreciably improved from that of the north Atlantic status. 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 appropriate to implement management measures which encompass several possible stock hypotheses. It is therefore recommended that effective management measures are implemented throughout the Atlantic. Until the full assessment for the south or total Atlantic stock can be completed, the catch for the south Atlantic should not be allowed to increase beyond the levels referred to as "recent" by Panel 4 in 1992.

SWO-MED-MEDITERRANEAN

The recent meeting *Ad Hoc* GFCM/ICCAT Working Group on Stocks of Large Pelagic Fishes in the Mediterranean Sea, held at Fuengirola, Spain, September 19 to 24, 1994, reviewed all the data and information available for the Mediterranean swordfish (COM-SCRS/94/121). Hence the SCRS only extracted their findings and considered the possibility of stock assessments.

SWO-MED-1. DESCRIPTION OF FISHERIES

Swordfish are widely distributed in the Mediterranean (including the Aegean and Ionian Seas) and are fished by many nations, mainly using longline, gillnet and harpoon. The largest producer is Italy (64%), followed by Greece (13%), and Spain (11%). Gillnet fishing was banned in Italy in 1990, but has resumed since 1991, and represents over half of the Italian swordfish catch. Spanish and Greek catches are mostly by longline. The national fisheries are well summarized in the "Report of the *AD Hoc* GFCM/ICCAT Working Group on Stocks of Large Pelagic Fishes in the Mediterranean".

The Mediterranean total swordfish catches (**SWO-Table 1 and SWO-Figure 1**) showed an upward trend from 1962-1972, stabilized between 1972-1977, and then resumed an upward trend. In particular, a sharp increase was recorded between 1983 and 1988 (about threefold). A part of the increase is an artifact of improved statistics during this period; particularly from Italy. A record catch of over 20,000 MT was made in 1988, and thereafter the catch has decreased to about 12,000 MT in 1993.

SWO-MED-2. STATE OF STOCK

SWO-MED-2.a Catch Statistics and Catch and effort data

The Committee noted that the annual total catch statistics have been improved to a large extent, due to the *Ad Hoc Working Group.* However, much uncertainty exists in the Mediterranean catch statistics in general. These concerns are well stated in SCRS/94/21.

Document SCRS/94/86 presented a study on the relations between the effect of the moon phases on Mediterranean swordfish CPUE for the Italian drifnet fishery. The study is still preliminary, and presents an interesting possibility for the standardization of CPUE.

Document SCRS/94/103 presented nominal catch and effort data for the Cypriot swordfish longline fishery for 1976 to 1993. This series was updated and improvements to the data presented at the Second GFCM/ICCAT Expert Consultation in Crete in 1992. Since the fishery expanded its area and season in recent years, standardization of the fishing effort would be essential for stock assessment purposes.

Document SCRS/94/53 presented a standardized CPUE for the Spanish swordfish longline fishery for the period between 1988 and 1993.

Documents SCRS/94/84, 92 and 97 presented nominal catch and effort data for 1992 on a monthly basis for various Italian fisheries (driftnet and longline) by area. It seems that these data are from the same fisheries for which the CPUE were available for past years. The *Ad Hoc* Working Group strongly recommended that these data be analyzed together with the past data to create standardized indices for the Italian swordfish fishery.

SWO-MED-2.b Size data and possibly catch-at-size data

The monthly mean weight of swordfish caught by the Cypriot longline fishery is presented in SCRS/94/103. There has been a sharp decline in the mean weight during the time series and this may be related to the expansion of the fishing area and time, but may also be related to the declining stock. It was noted, however, that there are no size frequency data available, since large swordfish are exported.

Document SCRS/94/59 presented data on size frequency (length and weight) of swordfish caught by the Turkish fleet and unloaded at the Istanbul market in the latter half of 1993. Spanish longline and surface swordfish size data were submitted to the ICCAT Secretariat earlier this year. Document SCRS/94/97 presented size frequencies on swordfish caught in Italian waters by fine regions. Size frequencies for swordfish caught in the Tyrrhenian Sea by the Italian driftnet and longline fisheries in 1992 and 1993 are presented in Document SCRS/94/92 and 84.

Due to time constraints, swordfish catch at size (1985-1991) created at the Second GFCM/ICCAT Expert Consultation in Crete in 1992 were not updated (see section on recommendations).

SWO-MED-2.c Biological parameters

Document SCRS/94/80 presented new length (LJFL)-weight (DW) relationships for the western Mediterranean. The analyses indicated that the relationships did not differ by sex, and that a month effect was statistically significant, although minor in magnitude.

Document SCRS/94/93 presented a study on the growth of swordfish in Algerian waters. The study used modal progression of swordfish size and estimated a new growth equation by sex in terms of length and weight.

SWO-MED-2.d Stock assessments

Estimated landings of swordfish from the Mediterranean increased steadily from about 300 MT in 1963 to 6,900 MT in 1983. The reported landings subsequently increased abruptly to 20,300 MT in 1988, possibly by harvesting accumulated biomass of this long-lived species. Landings declined as abruptly as they had increased to an average of about 12,000 MT for 1990 to 1993. Currently estimated landings, if they in fact represent a two-fold increase in real catches compared with the 1970 to 1983 period, is cause for concern, especially when considering that large amounts of small swordfish are apparently caught. The Committee did not attempt to assess the Mediterranean swordfish stock at this time (see section 4.b).

SWO-MED-3. EFFECTS OF CURRENT REGULATIONS

ICCAT has not made any management recommendations on the Mediterranean swordfish stock.

There have been no regulations recommended by the Commission for the Mediterranean areas. There are numerous national regulations on driftnets, swordfish sizes and fishing areas. For example, a minimum size regulation (LJFL), allowing only for a maximum of 10 percent per trip in weight of swordfish with a length less than 140 cm, has been adopted by Italy since the early 1980s. However, it is not clear to the Committee how they are implemented at the national level.

The Council of Ministers of the European Union (EU) adopted, in June, 1994, a regulation (Council Regulation (EC) no. 1626/94 of June 27, 1994) applicable to all fishing activities carried out by EU vessels (in European waters and on the high seas). This regulation will enter in force on January 1, 1995. The objective of the regulation is to harmonize the national regulations of the four coastal Mediterranean Member States. It focuses on the protection of juvenile fish, gear selectivity, and protection of the coastal area and fragile ecosystems. The regulation also includes certain technical limitations on the sizes of the fishing gears. The regulation affirms the recommendations adopted by ICCAT regarding the minimum sizes and establishes a minimum size for the Mediterranean of 120 cm for swordfish.

SWO-MED-4. RECOMMENDATIONS - MEDITERRANEAN

SWO-MED-4.a Statistics

While recognizing the marked progress made in reporting catches, size and effort data, the Committee is concerned that much of these data did not become available, until the joint ICCAT-GFCM sessions were held in past. The Committee recommended that:

i) All catch and effort as well as size data be sent to the ICCAT Secretariat by the set deadline date;

ii) All countries catching swordfish, report catches and effort in small time-area strata.

iii) The national experts attending to the ICCAT/GFCM joint session should include not only scientists familiar with a local fishery but also those responsible for national fishery statistics.

SWO-MED-4.b Research

It was noted that the catch-at-size matrix for swordfish was created for 1985-1991, for the first time as an outcome of the Second GFCM/ICCAT Expert Consultation on Stocks of Large Pelagic Fishes in the Mediterranean Sea held in 1992. The Committee recognized that this matrix, after its updating to 1993, includes a sufficient number of years to use it as an input for Virtual Population Analysis (VPA). The CPUE series, even though a bit sporadic, is now being developed for some fisheries (e.g. Italian Ionian Sea). The Ad-Hoc GFCM/ICCAT Working Group on Stocks of Large Pelagic Fishes in the Mediterranean Sea recommended that a preparatory work to VPA should be carried out at the next Meeting. The Working Group recommended that "this feasibility study should include the standardization of catch-per-unit of fishing effort series for swordfish and a detailed review and adjustments of substitutions of length-frequency samples. The Working Group's specific recommendations for related work are given in the said Report (SCRS/94/21, Appendix 6). Considering the high intensity of exploitation of swordfish, the Working Group recommended that the next Meeting will take place in 1995, if data warranted such a Meeting.

The Committee fully supported these above recommendations of the joint Working Group, and requested the Secretariat to organize such a data preparatory meeting for the Mediterranean swordfish in 1995 jointly with GFCM or should there be any problem, solely by ICCAT. In the meantime, the Committee requested that the Secretariat update the catch-at-size data base for the Mediterranean swordfish up to including 1993 and possibly 1994. Recognizing the Manual for developing standardized CPUE was very useful at the Data Preparatory Meeting for the South Atlantic Abundance Indices (Pernambuco, Brazil, July, 1994), it was recommended that a similar manual be adapted for Mediterranean swordfish and circulated to the pertinent scientists of the Mediterranean countries, well in advance of the proposed meeting.

The Committee commended the work that has been accomplished and was particularly encouraged by the standardized index for the Italian longline. The Committee recommended continued joint GFCM/ICCAT meetings and urgently recommended full development Mediterranean data sets and data bases.

SWO-MED-4.c Management

The Committee reiterated the concern expressed by the Ad-Hoc GFCM/ICCAT Working Group on Stocks of Large Pelagic Fishes in the Mediterranean Sea, of the large catches of juvenile swordfish in the Mediterranean Sea.

SBF - S O U T H E R N B L U E F I N

SBF-1 Description of Fisheries

Southern bluefin tuna are distributed exclusively in the three oceans of the southern hemisphere. The only known spawning ground is located in the waters off Java, Indonesia, and northwestern Australia. The habitat of young southern bluefin tuna is located in the coastal waters of western, southern and southeastern Australia, and as the fish grow, they migrate circumpolarly throughout the Pacific, Indian and Atlantic Oceans.

Historically, the stock has been exploited by Australian and Japanese fishermen for more than 40 years. During the course of 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 surface fishery peaked at 21,500 MT in 1982. In the 1970s, New Zealand participated in harvesting this species by handline, troll and longline in coastal waters. In 1993, preliminary catches by these three countries were 4,715 MT, 6,965 MT and 141 MT for Australia, Japan and New Zealand, respectively. In recent years, the catches by countries other than the aforementioned three increased and estimated to 1,768 MT in 1991, 1,460 MT in 1992, and 1,030 MT in 1993. As regards the Atlantic Ocean, southern bluefin tuna are caught by the longline fishery, mainly in the area off the southern tip of Africa. The Atlantic catch has varied widely between 400 and 6,200 MT during 1978 and 1993 period (**SBF-Table 1 and SBF-Figure 1**), reflecting the shifts of the Japanese longline fishery between the Atlantic and Indian Oceans. The average weight of the total southern bluefin tuna catches has increased in recent years mainly due to the Australian surface fishery reduction (**SBF-Figure 2**).

SBF-2 State of the Stocks

The workshop that reviewed biological research and catch data was held in Hobart, Australia, in January, 1994. The significant results confirmed by the workshop were:

i) the growth rate of southern bluefin tuna in the first year of life is faster than assumed in previous stock assessments;

ii) the growth rate increased between the 1960s and the 1980s. It should also be noted that a complex two stanza growth model (based on tag and recovery data) is used to describe the southern bluefin tuna growth;

iii) the average size at maturity is larger than assumed in previous analyses and the workshop concluded that rates of maturity for each age are 25% of age 7, 50% of age 8, 75% of age 9 and 100% of age 10+.

The Thirteenth Southern Bluefin Tuna Scientific Meeting of Australia, Japan and New Zealand was held in Wellington, New Zealand, in April 1994. Representatives from Taiwan and Indonesia attended the meeting as observers. In addition, invited outside scientists participated in the meeting. Fishery indicators were examined to provide a description of events in the fishery. The status of the stock was re-evaluated by Virtual Population Analysis (VPA):

-- The Japanese and Australian VPAs showed very similar trends in recruitment except for the most recent years. One possible cause for this difference in the estimated stock size is linked with a decreasing area of the fishing zone (the real biomass outside the exploited zone being difficult to estimate). They differed in their estimates of the actual amount of parental biomass but they showed similar trends of change in parental biomass. It is difficult to estimate the absolute value of the parental biomass from VPA, but the trends are not greatly influenced by the scale.

-- The continued very low abundance of the parental biomass is cause for serious biological concern. The present parental biomass is considerably lower than the 1980 level that is used as a reference level for rebuilding of the parental stock.

-- Almost all of the VPAs indicate that parental biomass continued to decline, but at a reduced rate through to the beginning of 1993. In most cases an increase in parental biomass is calculated for 1994 based on the catches already taken in 1993.

-- The relationship between parental biomass and recruitment at the present low levels of parental biomass is unknown for southern bluefin tuna. Some compensation (i.e., increased recruitment per unit of parental biomass) was observed in the estimated recruitment between 1965 and 1990.

-- All VPAs in this year's assessment had difficulty in simultaneously matching all of the information available. In particular, they could not match the continued catches and relatively constant catch rate of the age 12 fish and older (age 12+) with the data from the younger fish.

-- There is a clear indication in the catch rate of sequential rebuilding of the juvenile age-classes reaching age 6 in 1993 (**SBF-Figure 3**). This rebuilding has been reported over the last two years and is a very encouraging sign. The 6 year-olds in 1993 are the first year-class to pass through the fishery since the 1988 catch reductions.

-- Many projections of future abundance were performed under several stock-recruitment models. All projections indicate that the parental biomass will increase from the 1993 level over the next four to five years. This conclusion results from the estimated age structure of the current population and is not influenced by year-class strength of fish born in the 1990s.

-- After the expected increase in parental biomass, subsequent change depends on the level of recruitment experienced in the early 1990s and the catch levels in the next few years.

SBF-3 Effect of Current Regulations

Since 1971, as a first stock management action, Japanese longline fishermen have adopted a voluntary measure of restricting southern bluefin fishing in areas where young fish are abundant, to increase the age at first capture so as to expect a better yield per recruit. Since the 1984-1985 fishing season, Australia has maintained a national quota of 14,500 MT and a seasonal-area closure of its fishery off western Australia. Japan and New Zealand introduced national quotas of 23,150 MT and 1,000 MT, respectively, for the 1986 fishing season. Since the 1986-1987 fishing season, Australia and Japan reduced their catch limits to 11,500 MT and 19,500 MT, respectively. In the 1988-1989 fishing season, Australia, Japan and New Zealand substantially reduced their catch limits to 6,250 MT, 8,800 MT and 450 MT respectively. In 1989, the Tripartite Administrative Meeting decided to reduce the catch limits in the 1989-1990 fishing season to 5,265 MT for Australia, 6,065 MT for Japan and 420 MT for New Zealand. From 1990 to 1994, the administrative meeting decided to continue with the catch limits. The Commission for the Conservation of Southern Bluefin Tuna (CCSBT) was established in May 1994. This Commission is responsible for research and conservation strategy on southern bluefin tuna, which had been carried out since 1982 by Australia, Japan and New Zealand.

The sequential rebuilding of the juvenile age-classes in recent years is considered an effect of relatively good recruitment in the latter half of the 1980s and the substantial catch reduction since 1988, particularly the reduction in small southern bluefin tuna. This rebuilding will increase the parental biomass from the 1993 level at least over the next four to five years.

The high catch rate in recent years resulted in the Japanese fleet catching its catch limit in a shorter period than in previous years. Such a contraction results in a lack of CPUE data from many area-months and uncertainty about the stock abundance.

SBF-4 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.

The Commission for the Conservation of Southern Bluefin Tuna (CCSBT) is responsible for research and conservation strategy on souther bluefin tuna, which had been carried out since 1982 by Australia, Japan and New Zealand.

The Commission noted that while the newly-formed CCSBT has competence on the management of southern bluefin tuna as a whole in the three oceans, ICCAT is responsible for the management of southern bluefin tuna in the Atlantic Ocean (see Article IV of the ICCAT Convention). Therefore, close collaboration should be maintained between the two organizations as regards stock assessments and management measures.

The Committee made no recommendations for the management of southern bluefin tuna in the Atlantic Ocean.

SMT - S M A L L T U N A S

SMT-1. DESCRIPTION OF FISHERIES

Small tunas are exploited mainly by coastal and often by artisanal fisheries, although substantial catches are made either as target species or as by-catch by purse seiners and mid-water trawlers (i.e. pelagic fisheries in West Africa-Mauritania). Over ten species make up the small tunas category, but only five of these species accounted for about 68% of the total catch weight in 1993. These five species are: Atlantic bonito *(Sarda sarda)*, Atlantic black skipjack *(Euthynnus alletteratus)*, frigate tuna *(Auxis thazard)*, spotted Spanish mackerel *(Scomberomorus maculatus)*, and king mackerel *(Scomberomorus cavalla)* (**SMT-Figure 2**). The historical landings of small tunas are given in **SMT-Figures 1 and 2**. The reported total landings of all species combined increased from about 65,000 MT in 1963 to over 115,000 MT in 1969 (**SMT-Figure 1**). Reported landings remained stable between 1970 and 1979 at about 85,000 MT, increased to approximately 145,000 MT in 1982, followed by a steady decline to about 100,000 MT in 1986, and a subsequent increase to nearly 140,000 MT in 1988. Reported landings for the 1989-1991 period have remained relatively stable at about a mean value of 125,000 MT (**SMT-Figure 1**). The catch then decreased to about 108,000 MT in 1992. A preliminary 1993 estimate of total landings of small tunas amounted to 101,000 MT (**SMT-Table 1**).

The Committee noted the relative importance of small tuna fisheries in the Mediterranean Sea, which account for about 24% of total reported catches of tuna and tuna-like species for the last five years. However, the Committee noted that uncertainties remain regarding the accuracy of reported landings in all areas, including the Mediterranean.

The Committee noted that there is a general problem in the reporting of catch statistics for these species. This is probably due to the fact that small tunas are usually not the main target species of pelagic fishing fleets. As a result, small tunas are often discarded at sea or not recorded separately. This therefore leads to under-reporting or reporting of mixed catches.

a) Statistics

There have been some attempts to address the problem of obtaining more reliable statistics.

The Committee noted that the activities of the Ad-Hoc GFCM-ICCAT Working Group on Large Pelagic Fishes in the Mediterranean serves to improve small tuna catch statistics from Mediterranean countries.

It was noted that catch statistics from Martinique and Guadaloupe could be sent directly to ICCAT, in order to improve the database on these species. Both the IFREMER (Martinique) and CARICOM observers emphasized the importance of dolphinfish (*Coryphaena hippurus*) catches in the Caribbean and West Atlantic. Dolphinfish is normally simultaneously caught with several small tuna species in this region. The Committee noted that this species is not included in the ICCAT mandatory catch species list. This subject is further discussed under the agenda item 14.

In Venezuela, a national sampling program covering the artisanal fisheries has been implemented in 1994, in order to monitor catches of small tunas and other species caught by this fleet. In 1994, Venezuela also provided details of a local artisanal fishery for king mackerel (*Scomberomorus cavalla*), indicating gears used, seasonality of catches and CPUE data (SCRS/94/180).

Catch data from artisanal fisheries carried out in northeastern Brazil are missing from ICCAT data base since 1990. A statistical sampling program has been implemented in 1991 to provide catch and effort data from this fishery.

Document SCRS/94/172 refers to small tunas catches by Spanish purse seine fleet operations around floating objects during the 1990-1993 period. The increasing use of this fishing method may have led to an increase in fishing mortality on small tuna species. Frigate tuna (*Auxis thazard)*, bullet tuna (*Auxis rochei*) and Atlantic black skipjack *(Euthynnus alletteratus)* are often found in schools associated with floating objects in this fishery, but the catch is usually discarded at sea..

Document SCRS/94/179 provides an update on SCRS/93/118 which summarized fishing statistics of small tunas caught by purse seiners off the African coast based in Abidjan during the 1981-1993 period. Part of this fishery operates around artificial flotsam (fish attracting devices) placed for the purpose of increasing the catch rates. The mixed species landings of juvenile tunas and tuna-like species from this fishery have increased from about 3,000 MT in 1981 to 12,500 MT in 1993, most of them being sold on the local market. Species composition data has been provided by SCRS/93/118. The quantities landed appear to be highly correlated with catches of major tuna species.

b) Research

Four research documents from Mediterranean countries, concerning small tuna, were submitted to the AD-Hoc GFCM-ICCAT Working Group meeting in Malaga, held in September, 1994.

Some biological research is currently being undertaken on black skipjack (*E. alletteratus)* and bullet tuna (*A. rochei)* in Turkish waters (SCRS/94/57 and SCRS/94/58). 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.*For this species also, information is being collected on sex including gonad weight. A preliminary length-weight relationship for *A. rochei* was determined for the sexes combined.

Age and growth studies have been conducted on black skipjack (*E. alletteratus)* caught in Tunisian traps set in two local fishing areas (SCRS/94/108). The age composition of the catch confirmed that one common stock of *E. alletteratus* is being caught at the two locations studied.

Some preliminary results were presented on the genetic structure of bonito (*S. sarda)* along its Mediterranean distribution (SCRS/94/171). Samples of different localities in the Mediterranean Sea have been examined based on analysis of protein electrophoresis of the D-loop region in the mitochondrial DNA. This work is part of the European Project EEC/XIV-1/MED/91-012 on "Characterization of large pelagic stocks in the Mediterranean".

SMT-2 STATE OF THE STOCKS

There is no information to determine the actual structure of small tunas stocks and current available information generally does not allow an evaluation of the status of the hypothetical stocks assumed for most of these coastal pelagic species. The available information submitted in 1993 was reviewed by the Committee and is summarized below.

Annual, age-structured stock evaluations of spotted Spanish and king mackerels are carried out for coastal areas of southeastern United States and the Gulf of Mexico. The results of these assessments show that several of these stocks have been over-exploited and that reductions in fishing mortality rates would allow the stocks to recover to levels that can provide high average long-term yields and provide adequate safeguard against recruitment failure.

Information submitted by Brazil in 1992, corresponding to the 1963-1986 period, indicates that the Spanish mackerel stock off the Brazilian coast may have been over-exploited by 1986. No more recent information on this stock is available.

SMT-3 EFFECTS OF CURRENT REGULATIONS

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 for king *(Scomberomorus cavalla)* and Spanish *(Scomberomorus maculatus)* mackerels through implementation of catch quotas. It is believed that conservation actions in recent years have helped to improve overall stock conditions.

SMT-4 RECOMMENDATIONS

SMT-4.a Statistics

Catch and effort statistics for small tunas are incomplete for many of the coastal and industrial fishing countries. Therefore, the Committee recommended:

i) Special efforts be made to improve the catch data and corresponding nominal effort data on small tunas, by species, gear, and by fisheries (artisanal, industrial, recreational);

ii) Estimates of discards and total catch sold in the local informal markets, particularly along the African coasts, and estimates of other unreported catches of these species be made and provided to ICCAT.

SMT-4.b Research

There is a general lack of biological information needed for stock assessment of these species. For this reason, the Committee recommended:

i) Stock structure studies be conducted in order to determine migratory pattern and optimal management scale of those species, probably most often optimally managed at local (sub-regional) scale.

ii) Length-weight data continue to be collected on small tunas, and estimates of the relationship between weight and length be obtained for each species;

iii) Standardized catch-per-unit-effort series be developed with the Brazilian small tuna catch and effort information presented at the Data Preparatory Meeting for Southwest Atlantic Tuna and Tuna-like Species Fisheries, held in Recife (Brazil) in 1992;

iv) Age and growth investigations of small tunas be continued to develop reliable age-length relationships for these species;

v) Studies related to stock evaluation of small tunas be continued;

12. Report of Sub-Committee on Environment

12.1 The Report of the Sub-Committee on Environment was presented by the Convener, Mr. J. Pereira (Portugal). The SCRS reviewed the Report and adopted it together with all the recommendations contained therein. The Report is attached as **Appendix 8 to Annex 25.**

13. Report of the Sub-Committee on Statistics and review of Atlantic tuna statistics and data management system

13.1 The Report of the Sub-Committee on Statistics was presented by the Convener, Dr. S. Turner (U.S.A.). The SCRS reviewed the Report and adopted it with all the recommendations included. The Report is attached as **Appendix 4 to Annex 25.**

14. Collection of information on by-catches

14.1 The rapporteur of this Agenda Item, Dr. E. Prince (U.S.A.) introduced the discussions on by-catches with a review of the following five documents/reports: (1) "Summary of the survey of tuna fisheries by-catches, 1993" -by the ICCAT Secretariat (SCRS/93/10); (2) "Information on CCAMLR measures to prevent incidental mortality of seabirds during fishing operations", submitted by the Secretariat for information only); (3) "Captures de la pêcherie germoniere francaise au filet maillant derivant dans l'Atlantique nord-est", by M. Goujon, L. Antoine, and B. Leroy (SCRS 94/176); (4) "Driftnet impact on protected species: observers data from the Italian fleet and Proposal for a model to assess the number of Cetaceans in the by-catch", by A. di Natale (SCRS/94/85);

17.7 As regards swordfish, a full assessment review is scheduled for 1997, including the effects of regulations, was proposed. The 1994 advice to the Commission was quite complete, but and any revisions can be introduced in 1995 and/or 1996.

17.8 The Committee considered that the Canadian proposal was reasonable, but also considered that some flexibility should be maintained in scheduling these meetings, depending on the quotas or any other regulatory measures that might be adopted by the Commission and also depending on whether the Commissioners requests any special information from the Committee.

17.9 The Secretariat developed and presented a proposal for future meeting procedure, which is summarized as follows:

- The Commissioners prefer to receive reports that contain brief, concise advice from the scientists and are interested more in the conclusions reached by the assessments than in the methodologies applied.

- The scientists, however, want to keep a detailed record of all the hypotheses, procedures adopted (parameters entered, methodology applied, etc.).

17.10 The recent, significant increase in the length of the reports has met with some criticism, particularly because of the lack of time to review the report, there is not enough time to advise the Commissioners in a precise manner. Besides, the work load of the Secretariat and the SCRS scientists has increased disproportionately. Under the circumstances, the Secretariat proposes the following solutions;

1) Revert back to the system used some several years ago, whereby the reports of the species sections is divided into two segments: (1) an "executive summary" to be included in the SCRS Report; and (2) a more detailed background document to be included in the "Red Book" series.

2) The text of the reports (executive summary) should be short and precise so that the advice is easily understandable to the Commissioners. These "executive summary" drafts will be translated and discussed fully in the SCRS Plenary.

3) The background documents, however, may include any discussions on selections of parameters, methodologies and detailed results. These reports should be treated like SCRS contribution papers and should be included in the "Red Book" series.

4) The format of the SCRS Report (executive summary) should be revised to meet the recent demands of the Commissioners. The models that have been applied and the procedures for proposed changes to such applications should be defined.

17.11 This proposal was supported by the majority of the participants. There was some discussion as to whether the format should be standardized for all the species or if there should be some flexibility for each species, depending on the nature of the stock and the progress in research. There was a consensus that the SCRS "executive summary" should not include details, but rather only the conclusions of the assessments, the effects of regulations and major recommendations.

17.12 The addition of a section in the report on environmental factors influencing fisheries was proposed by the Convener of the Sub-Committee on Environment. The Committee agreed that this subject should be included as a routine item in the background documents, if this new procedure is adopted.

17.13 The SCRS Chairman created a "Chairman's Advisory Committee", whose terms of reference are to give the Secretariat's proposal form and to provide advice to the Chairman as to how future SCRS sessions should be carried out. Dr. J. Porter (Canada) was nominated Coordinator of the Advisory Committee and the SCRS Chairman asked her to collaborate with the species rapporteurs, the Conveners of the Sub-Committees, and the Secretariat. Any improvements which could be realized at the next SCRS session will be put into practice then, but items which might require further discussion by the SCRS Plenary will be presented at the 1995 session.

Inter-sessional scientific meetings in 1995

17.14 The overall organization of the SCRS sessions and the schedule for inter-sessional scientific meetings in 1995 were discussed together. The Committee recognized that the following inter-sessional meetings have been proposed for next year:

- Meeting of the Ad-Hoc GFCM/ICCAT Joint Working Group on Stocks of Large Pelagic Fishes in the Mediterranean Sea, to develop abundance indices of swordfish for the Mediterranean fisheries.

- Meeting to review the progress made in the Bluefin Year Program and to develop s new program plan for the immediate future.

- Preparatory meeting on methodologies for bluefin stock assessments, to discuss the standardization of methodologies between the east and west.

- A meeting to develop stock abundance indices for yellowfin.

17.15 A suggestion was made that the two bluefin meetings (BYP progress meeting and the preparatory meeting on methodologies for bluefin assessments) be organized consecutively at the same place. However, the organization of the preparatory meeting for assessments requires further discussion.

17.16 Another suggestion was made to hold the next *Ad Hoc* GFCM/ICCAT Working Group consecutively and at the same place as the BYP progress meeting, in order to assure the maximum participation of scientists from the Mediterranean countries. The Committee noted that the holding of the *Ad Hoc* Working Group depends on the availability of data.

17.17 The Committee was also informed that the yellowfin abundance indices meeting need not necessarily be held in 1995; hence, the dates will be confirmed later. The NMFS expressed a willingness to host this meeting at its Southeast Fisheries Science Center in Miami. Dr. M. Prager (U.S.A.) was elected to server as Convener of this meeting.

17.18 The Committee requested that the Secretariat, in consultation with the SCRS Chairman and the pertinent Conveners and Rapporteurs, make the detailed arrangements (i.e., meeting venues, dates, agendas, etc.) for all of the meetings indicated above, and that the invitations be issued well in advance of the meetings.

17.19 A detailed 1994 Plan for the Enhanced Research Program for Billfish was presented by Dr. E. Prince, the Western Atlantic Coordinator. This Plan was approved by the Committee and is attached as **Appendix 6** to the SCRS Report.

18. Cooperation with non-Contracting Parties and other organizations

18.1 The Executive Secretary expressed his appreciation to various non-Contracting Parties and international organizations for their cooperation in carrying out the Commission's scientific work, particularly in the collection of statistics. Particular mention was made of very close collaboration maintained with U.N., FAO, CARICOM, IATTC, EEC, CITES and Taiwanese scientists. The Executive Secretary noted that the Convention for the Conservation of Southern Bluefin Tuna (CCSBT) has entered into effect and that a copy of the Convention had been forwarded to ICCAT. He noted, in particular, the invitation extended by Taiwan to him to visit that country and study its fisheries.

19. Date and place of the next meeting of the SCRS

19.1 The Committee decided that the next meeting of the SCRS will be held for a five-day period during the week prior to the 1995 Commission meeting.

20. Other matters

20.1 The Representative of the EU informed the Committee that an EU inter-ministerial conference to study the serious problem of the management of the Mediterranean fisheries will be held from December 12 to 14, 1994, in Crete. He indicated that participants from all countries that border the Mediterranean or fish in the Mediterranean will be present. Mr. Rey indicated that an invitation to this meeting had been forwarded to ICCAT.

20.2 The ICCAT Executive Secretary reaffirmed the importance of this meeting to ICCAT's work and informed that the invitation to the Crete meeting had just been received. He noted, however, that it would be very difficult for someone from the Secretariat to attend due to the work of duplicating all the meeting reports, etc. In view of this, Dr. Fernández had already requested Dr. A. Fonteneau, who will be attending this meeting, to represent ICCAT.

21. Adoption of Report

21.1 The 1994 Report of the Standing Committee on Research and Statistics (SCRS) was adopted, with some modifications, and was presented to the Commission for final approval.

22. Adjournment

22.1 At the time of adjournment, Dr. Suzuki, the SCRS Chairman, expressed his appreciation to the Committee for the excellent collaboration throughout these sessions. He noted that in spite of extreme time constraints, all the work had been completed and a thorough report was ready for submission to the Commission. Dr. Suzuki also thanked the Secretariat staff and the interpreters for their excellent work performed in support of the scientists.

22.2 The Representative from FAO expressed his gratitude to the Secretariat and the ICCAT SCRS scientists for collaborating with FAO and GFCM, particularly in the work of the *Ad Hoc* Working Group on Stocks of Large Pelagic Fishes in the Mediterranean Sea, held in Malaga in September, 1994. He looked forward to continuing cooperation among FAO, GFCM and ICCAT.

22.3 The ICCAT Executive Secretary congratulated the SCRS Chairman and the Committee for their hard work during these scientific sessions. He also thanked the Secretariat staff and the interpreters for their work.

22.4 The 1994 Meeting of the Standing Committee on Research and Statistics (SCRS) was adjourned on Friday, November 25, 1994.

APPENDIX YFT
(to Item 11 - YFT)

APPENDIX TO ITEM 11:
YELLOWFIN SPECIES SECTION OF THE 1994 SCRS REPORT

1. Introduction

This appendix contains detailed information about many of the analyses conducted as part of the 1994 SCRS assessment of yellowfin tuna.

2. Abundance Index

The east Atlantic surface abundance index was used in both production model analyses (PRODFIT and ASPIC). This index is based on CPUE of the FIS and Spanish surface fleets for the years 1969 through 1993 (**YFT-Table 3**). The index presently includes an adjustment for a 3% presumed increase in fishing power starting in 1981, based on several estimates of changes due to bird radar and other improvements in technology. At this meeting, the index was recomputed using published Spanish effort data.

The index was computed from annual totals of yield and effort for each vessel, by the following steps:

(a) Obtain CPUE from the reference fleet (Category 5 FIS purse seiners, 4 vessels) by averaging, with a simple mean, the CPUE from each vessel. The CPUE for each vessel is computed by dividing total annual catch by total annual fishing time. The CPUE for the FIS reference fleet is designated CPUE(ref,FIS).

(b) Compute the standardized effort for the FIS fleet by assuming that its standardized CPUE is the same as that of the reference fleet. Thus:

$$f(tot,FIS) = Y(tot,FIS) \,/\, CPUE(ref,FIS),$$

where f(tot,FIS) is the estimated total standardized effort for the FIS fleet and Y(tot,FIS) is their catch. If available, NEI catch is included in the FIS catch.

(c) Obtain CPUE for the Spanish reference fleet by:

$$CPUE(ref,ES) = Y(ref,ES) \,/\, f(ref,ES).$$

(d) Compute the preliminary standardized effort for the Spanish fleet by assuming that its standardized CPUE is the same as the Spanish reference fleet. Thus:

$$f'(tot,ES) = Y(tot,ES) \,/\, CPUE(ref,ES).$$

e) Compute the final standardized effort for the Spanish fleet by multiplying the preliminary standardized effort by 1.52. The factor 1.52 is the mean relationship between FIS and Spanish CPUEs observed for the years 1980 through 1992.

$$f(tot,ES) = 1.52 \times f'(tot,ES)$$

(f) Obtain total standardized effort by adding the Spanish and FIS efforts:

f(tot) = f(tot,ES) + f(tot,FIS)

(g) Compute standardized CPUE by dividing total catch by total effort:

CPUE(tot) = {Y(tot,ES) + Y(tot,FIS)} / f(tot)

The result is a weighted average CPUE where the CPUE of the FIS reference fleet is weighted by the effective effort of the FIS fleet and the CPUE of the Spanish fleet is weighted by its effective effort. It is usually assumed that the power of a unit of standardized effort has increased by 3% of the 1980 value per year from 1981 to the present. The effort at step (g) is adjusted by this factor for this purpose.

3. Dynamic Production Model (ASPIC)

Production model estimates are sometimes sensitive to the assumptions made about the initial biomass level. Several steps were taken this year in order to minimize such effects. Catches for 1963 through 1968 were added to the beginning of the data, even though no corresponding CPUE data were available. This conditions the results on the historical catches. Also, the starting biomass in 1963 was not permitted to exceed the carrying capacity ($2 \times B_{MSY}$). By the use of historical (1963-68) catches, this effects of this constraint were separated from the present period. As sensitivity trials, additional runs were also made with different constraints on the starting biomass and with catches beginning in 1969. The results were very close to those of the basic run, demonstrating a lack of sensitivity to initial conditions.

Programming work was begun this year to facilitate non-equilibrium modeling with other than logistic (Schaefer) forms of production model. However, this work was not completed in time for the assessment meeting.

4. Equilibrium-Approximation Production Model (PRODFIT)

Values of m (exponent) used: 1 and 2.
Value of smoothing parameter: 4.

5. Untuned Backwards VPA

The steps followed for the analytical assessment of yellowfin by virtual population analysis (VPA) without calibration by external indices, were as follows:

(a) Size distributions of quarterly catches of yellowfin in the east and west Atlantic were obtained for the period 1975-1993. The substitutions made for obtaining these are presented in Document SCRS/94/11. The substitutions to obtain the size distributions of FIS purse seine catches were made on a quadrant of 5x5 and monthly basis, following a pre-established hierarchy.

(b) The catch-at-size matrix was converted to catch at age, using the slicing method directly assuming as age limits the sizes established during the Yellowfin Year Program, based on a study by Capisano and Fonteneau (1991) on modal monitoring. Different limits were used for east and west Atlantic yellowfin, taking into account the different growth patterns observed on both sides of the Atlantic.

The VPADOS program (Darby & Flatman, Lowestoft, 1994) was used in the assessment, applying separable VPA (Pope & Shepherd, 1982) and traditional VPA (Gulland, 1965) without calibration. In this program, the plus group was not accounted for in the analysis, but the same assumptions on F as for the previous age group were automatically applied.

(c) Separable VPAs were also run for two recent periods, 1986-1990 and 1990-1993. In both cases, age 3 was taken as the reference age and two s values were considered for the last age class (age 4) in relation to the reference age. This same s value was applied to the plus group. The values tested were 1.5 and 2, which were considered consistent with the catch by age relationship which occurs in the fishery.

F values of 0.4, 0.5, and 0.6 were tested. A natural fishing mortality of 0.8 for ages 0-1 and 0.6 for ages 2 to 5+ were assumed. The fishing patterns obtained presented some changes for ages 1 and 2, which, according to the analysis, would be fished more in the last period (probably due to the development of fishing using floating objects), and remained stable for the older ages.

(d) With the fishing pattern obtained for the latest period:

Age	0	1	2	3	4	5+
s1	.16	.5	.77	1	1.5	1.5
s2	.11	.39	.66	1	2	2

and with an F value of 0.4, traditional VPAs were run for the period 1980-1993, assuming a relationship between fishing mortality of age 4 to age 3 to be the same as the relationship between s(1.5 and 2); the F-BAR(0.4) obtained in both runs correlated to the effort, and the partial recruitment which provided the best fit was selected (s1).

(e) The catchability based on the effort series and average fishing mortality of fish ages 0 to 4 is estimated.

(f) For the 1975-1979 period, it was considered that the fishing pattern was different, since during those years, the fishery had not extended towards the high seas to fish spawners, and fishing mortalities of age 4 were obtained with catchability estimated from the previous step and specific efforts of each year.

(g) An F value of 0.6 on the reference age of the last year was used, which according to the fishing pattern considered, gave a fishing mortality for age-class 4 similar to that used in 1992. This appeared to be appropriate, considering that effort in 1993 was very similar to that of the previous year.

(h) A VPA run was made on the entire catch matrix, using F values for the last year and for older ages estimated according to the procedures explained above.

6. Untuned Forward VPA

Most VPA analyses are conducted using a "backward" calculation. In this backward calculation, the analysis of the catch-at-age vector starts from the oldest age, using an assumed terminal F. This analysis provides two vectors of estimated results--fishing mortalities at age and population sizes at age--from the oldest age in the catch vector to the youngest age (usually the age at recruitment into the fishery).

An alternate solution is the forward VPA, in which the VPA can be initiated starting from the catch taken during the first time interval. This solution of the VPA is less often used than the backward method for two reasons. First, the forward method cannot provide a solution when the assumed recruitment is too low. The second reason relates to convergenced properties: backwards VPA tends to converge to very similar estimates of recruitment (N_0) from widely different starting values of terminal F, while forward VPA diverges to widely different estimates of the terminal cohort size (N_T) from slightly different values of the starting population size N_0. Nonetheless, the two types of VPA are algebraically equivalent: a terminal F used in a backward VPA provides an estimated recruitment (N_0), which when used as an input in a forward VPA, will provide exactly the same vector of estimated fishing mortalities and population sizes by age. More specifically, the calculated final F in this forward VPA will be the original F used in the first backward calculation.

In this year's analysis of yellowfin tuna, a backward VPA was run first, using yearly catch intervals, and provided estimates of recruitment for each cohort. In a second step, those estimated recruitments were used in the forward analysis with a quarterly catch-at-age matrix. This analysis was done in order to evaluate better the effect of the seasonality of the fisheries in the VPA analysis (following a SCRS 93 recommendation).

7. Tuned Backward VPA (ADAPT)

The ADAPT VPA procedure was applied for three cases:

CASE 1: The six abundance indices used were iteratively re-weighted,

CASE 2: The six abundance indices used were equally weighted, and

CASE 3: For recent years, missing abundances indices for ages 0, 1, and 2 were estimated from the average of the most recent four years for which indices are available.

Data input: The following matrices were required for all three cases: (i) catch-at-age by year, for ages 0 to 5+ for 1975 to 1993; and (ii) mid-season weight at age for the same periods, assumed to be the same in each year (1.3, 4.3, 17.7, 41.9, 57.9, and 96.0 kg for ages 0 to 5+, respectively)

Input specifications: Natural mortality M was assumed to be age-independent and 0.7 per year. Because age determination for older fish is less reliable, catches of these ages are accumulated in a "plus group," currently chosen to be 5+.

Estimable parameters: The estimable parameters are some of the numbers-at-age at the start of the year following the last year for which catch-at-age data are available. In this case, the quality of the abundance index data available would only support the estimation of one parameter, the numbers at age 4.

Selectivities: Given a value for the estimable parameter specified above, a fishing mortality for age 3 can be computed for the last year for which catch-at-age data are available. The VPA calculations also require fishing mortalities for the remaining ages for that year. The results of SVPA applied to catch-at-age data for 1990-1993 were used to estimate the selectivities for each age relative to age 3 (0.16, 0.50, 0.77, 1.00, 1.50 and 1.50 for ages o to 5+, respectively).

Conducting the VPA for catch-at-age data including a plus group (5+) necessitates the specification of the ratio for F_{5+}:F_4 for each year. This ratio was obtained from the SVPA and was assumed constant at 1:1 for the entire period, 1975-1993. This approach may not take into account possible lower selectivities on older fish during 1975-1979.

Indices of abundance: The indices of abundance used to fit the VPA are as given in the following table:

Index name	Age range	Mid-year or start	Selectivity	Numbers or biomass	Recent years estimated for Case 3?	Case 3 estimated index
PS 1	1	mid	uniform	numbers	yes (1992-1993)	0.5707
PS 2	2	mid	uniform	numbers	yes (1992-1993)	0.363
PS 4	4	start	uniform	numbers	no	NA
PS 0-5	0-5+	start	input	biomass	yes (age 0 only, 1989-1993)	0.0591
JPN LL west	3-4	mid	uniform	numbers	no	NA
JPN LL east	4-5+	mid	uniform	numbers	no	NA

"Age range" indicates the set of ages to which the index relates.

"Mid-year or start" indicates the time of the year to which the index relates; if this is the middle of the year, the numbers-at-age in question are multiplied by exp($-Z/2$), where Z is the total mortality for the year and age concerned.

"Selectivity" refers to the relative weight given to each age group in the calculation of the predicted value of the index. The possibilities are: "Uniform" - equal weighting by age, or "Input" - applying to the Purse Seine 0-5 index only. This indicates that partial catch selectivity was applied in the available years prior to 1989, referring to the relative catches-at-age as estimated from SVPA (0.11, 0.34, 0.51, 0.67, 1.0, and 1.0 for ages 0 to 5+, respectively). This was used as an approximation for the selectivity because such data were not available for the current analysis. In addition, a selectivity of 1.0 for age 0 and 0.0 for ages 1-5+ were used for 1989-1993 in Case 3 to extend the indices for age 0 fish only.

"Numbers or biomass" specifies to which of these two quantities the index is assumed to be linearly proportional.

"Recent years estimated for Case 3?" identifies those indices and time periods for which index estimates were made in Case 3.

"Case 3 estimated index" specifies the index estimates obtained by averaging the four most recent available index values. For purse seine 0-5, this average was reduced according to the proportional catch-at-age of age 0 fish in the index (0.11) to obtain the value shown.

Appendix BFTE-1
(to Item 11 - BFTE)

Summary of the Discussion held at the Eastern Atlantic Bluefin Tuna Stock Assessment Session upon Presentation of Document SCRS 94/68: *"Report of the National Research Council Review of Atlantic Bluefin Tuna" - NRC Report* *

Although the SCRS East Atlantic Bluefin Tuna Stock Assessment Group, which met during the inter-sessional period (Fuengirola, Malaga - September, 1994) did not have sufficient time to review this document in detail, the Group felt it should comment because the document's conclusions address the SCRS, despite being generally addressed to the U.S. NMFS. The Group, hoped that these comments will serve as a basis for future discussions by the SCRS. In addition, the Group thanked Dr. J. Magnuson, Chairman of the NRC Committee that wrote the report, for his presentation and discussion of the document.

About population structure. The NRC Report concluded, based on genetic studies, microconstituent analyses and tagging data available to the NRC Committee, that evidence is that "a single stock hypothesis for bluefin tuna in the North Atlantic Ocean, with at least two spawning areas". Regarding this conclusion, the Group presented the following concerns:

1) Some conclusion stated in the NRC report gave the impression that SCRS has ignored the existence of mixing between the fish in two sides of the Atlantic. In contrast, SCRS has encouraged tagging programs and other research to help determine the amount and type of mixing. However, SCRS has at the same time taken the position that separation between east and west Atlantic bluefin is sufficient to allow management of two stocks, until the stock structure is better understood.

The difference between a management unit and a biological unit is an essential one. An amount of mixing too small to justify combined management might still indicate a single population from a genetic point of view. The Committee supported the continuation of genetic studies and microconstituent analyses to expand our knowledge of this important species, but believed that application of such research results to management issues will be complex.

2) Genetic studies that fail to detect heterogeneity do not necessarily prove homogeneity. Analyses of mitochondrial DNA are affected by many factors, particularly by the difficulty of detecting key segments in the DNA that can serve to distinguish different populations characterized by low mutation rates.

3) From analyses of tagging data, the NRC Committee estimated mixing rates in the order of 2% from east to west and 1% from west to east, by age and year. Because the number of recruits in the east appears to be much larger than that in the west, such relatively small mixing rates can still have a major impact on assessment results, particularly for the west. The Group raised several issues of concern with the analyses presented by the NRC. Mixing rate estimates are sensitive to the model choices - estimating mixing rates simultaneously with fishing mortality rates leads to estimated mixing rates from west to east that are higher than from east to west, an opposite conclusion from that of the NRC Report. The Committee noted that western recaptures of fish tagged in the east in these analyses amount to 17 fish, a small number implying imprecise estimates of mixing rates. Over 3,000 fish tagged in the Mediterranean were not included in the NRC

* Anon. 1994. An Assessment of Atlantic Bluefin Tuna. Committee to Review Atlantic Bluefin Tuna, National Research Council, National Academy Press. 148 pp.

Index name	Age range	Mid-year or start	Selectivity	Numbers or biomass	Recent years estimated for Case 3?	Case 3 estimated index
PS 1	1	mid	uniform	numbers	yes (1992-1993)	0.5707
PS 2	2	mid	uniform	numbers	yes (1992-1993)	0.363
PS 4	4	start	uniform	numbers	no	NA
PS 0-5	0-5+	start	input	biomass	yes (age 0 only, 1989-1993)	0.0591
JPN LL west	3-4	mid	uniform	numbers	no	NA
JPN LL east	4-5+	mid	uniform	numbers	no	NA

"Age range" indicates the set of ages to which the index relates.

"Mid-year or start" indicates the time of the year to which the index relates; if this is the middle of the year, the numbers-at-age in question are multiplied by $\exp(-Z/2)$, where Z is the total mortality for the year and age concerned.

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analyses. All the recoveries of the releases were from the east Atlantic and Mediterranean and were also excluded in the NRC analyses. Finally, the Committee noted that the assumption underlining the mixing model used is open to question. The NRC model assumed (a) mixing rates are constant by age and year; and (b) fish that transfer to the other side of the ocean are extremely unlikely to show fidelity to the side where they were spawned. The alternative models may be more realistic, and sensitivity to these should be investigated before final conclusions are drawn (see **Appendix BFTE-2**).

About the status of the stocks. The NRC Committee, based on its review of available genetics information and analyses of tagging data, carried out an age-structured assessment of the east and west bluefin using catch and relative abundance data from each side simultaneously and assuming fixed mixing rates. The NRC Report implied that the resulting assessment is the most defensible evaluation of Atlantic bluefin tuna. The SCRS East Atlantic Bluefin Tuna Stock Assessment Group, given the concerns expressed above, did not agree that this assessment was the most defensible one. The NRC assessment indicated that the stock sizes for large bluefin (ages 8+) in the west Atlantic were higher than those estimated by the SCRS in 1993, and also that the trend in large bluefin abundance has been stable or increasing since 1988. The Group noted that results from the same analyses not shown in the NRC Report, on the other hand, are indicative of much lower recruitment levels than those estimated by the SCRS in 1993. Therefore, the evidence presented to support the Report's conclusion that the bluefin stock is stable or increasing in the west Atlantic is not complete and does not include the trends of all age classes, even if the analyses conducted by the NRC were the most defensible. The Group expressed concern about the wording in the NRC Report regarding the optimistic status of bluefin in the Atlantic.

About Recommendations. The NRC Report contains a number of important research recommendations and the Group was pleased to note that most of these are contained in the Bluefin Year Program and/or have been part of SCRS's scientific recommendations for years. The Group noted that progress on important research in some eastern Mediterranean countries has been extremely slow due to lack of funds. The Group emphasized that research carried out in those countries on issues such as spawning grounds and migration patterns could elucidate much of what is unknown about bluefin.

The Group, while not agreeing with all of the NRC Report's conclusions, was very pleased with some of the recommendations made therein for continued research. Any efforts to advance the knowledge of bluefin tuna in the Atlantic Ocean are welcomed by the SCRS.

Appendix BFTE-2
(to Item 11 - BFTE)

Conceptual Model of Atlantic and Mediterranean Bluefin Tuna Distribution and Movement

A sub-group of tuna biologists met during the September inter-sessional East Atlantic Bluefin Tuna Stock Assessment Session to discuss improvements that could be made to the conceptual model of bluefin tuna distribution and movement. Their conclusions were as follows:

— *Spawning*

In general, when bluefin mature, they spawn in the area where they were spawned.

One bluefin does not spawn in the Gulf of Mexico and the Mediterranean in the same year.

In general, 5+ year old bluefin in the Mediterranean Sea during the spawning season participate in spawning. Some portion of 3 and 4 year old fish in the Mediterranean in the spawning season are also mature.

The reproductive status of 6-7 year old bluefin in the central and western North Atlantic is unclear. It is believed that 6-7 year olds observed moving into North American continental shelf waters in May-July do not participate in spawning. The area of origin and reproductive status of 6-7 year olds further offshore in the central and western parts is unclear.

— *Movement*

In general geographic distribution expands with age.

Trophic and reproductive instincts as well as thermal conditions provide primary motivations for movements.

There is a north-south component of seasonal movement, and there is also an east-west (on-shore/offshore) component of movement in the Atlantic. In the east it is thought that the north-south component is more marked.

Mature bluefin in the Atlantic move into and out of their natal spawning areas before and after spawning. Movement into the Mediterranean generally occurs from April-June, and movement out occurs in July-August. Movement into the Gulf of Mexico is thought to occur from January through April and movement out from May-July.

Part of the population of the small fish (to 20 kg) in the Mediterranean Sea moves into the east Atlantic Ocean. The similarity of young bluefin catch rates in the Bay of Biscay and Gulf of Lion suggests that similar age specific fractions of juveniles leave the Mediterranean Sea in most years.

Transatlantic movement of younger bluefin (ages 1-5) is thought to be episodic based on tagging data and the similarity of historical estimates of the relative size of some strong year classes from each spawning area. Estimates of transfer rates from tagging data could be influenced by differences in tagging mortality rates and recapture reporting rates between the two areas. The similarity of year class strengths could be affected by favorable environmental conditions common to both areas and single stock VPA's which had not accounted for transatlantic movement.

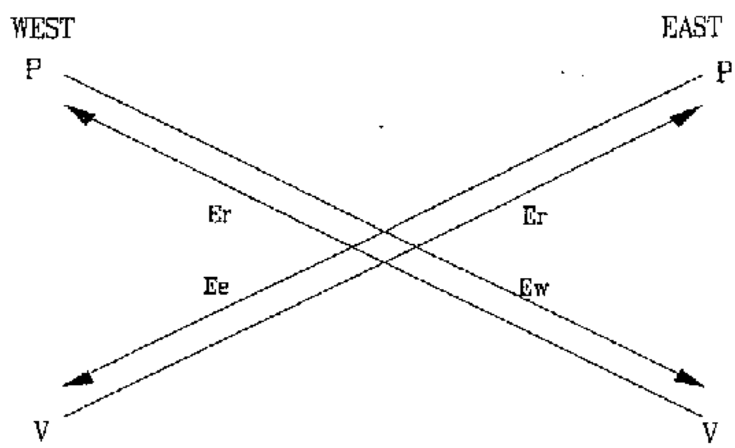
In light of the preceding, the Committee emphasized the two following concerns raised about the mixing model previously applied:

i) the "permanence" of movement across the north Atlantic Ocean - this is in contrast to fidelity to one of the two spawning areas (Gulf of Mexico and Mediterranean Sea), which was argued to be more plausible biologically; and

ii) the justification for treating the eastern Atlantic and the Mediterranean as a single homogeneous unit.

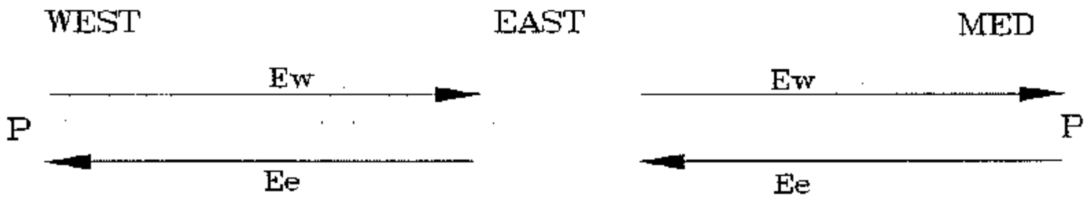
The Committee suggested that these two matters be the first addressed through modeling studies.

Initial investigations should consider these two matters separately. To address the first, the concept of "vacationers" is introduced - fish which, if crossing the Atlantic, have a high probability of returning to the side from which they came within a short period, and which will spawn on that side only. The structure of the model to address this is as follows:



In this extreme case there is no mixing between the "permanent" (P) resource components, but catches can be taken from the V component while on the other side. For simplicity, the return rate (Er) is assumed to be the same in both directions. Results should be computed for relatively high return rates (.3/.6/.9 per annum).

The model structure to address ii) above is as follows:



The east and Mediterranean components have a common spawning stock (in the Mediterranean). Thus, all "east" fish spend some time of the year in the Mediterranean, but in the interests of initial simplicity, this period is assumed to be sufficiently short that catches made from this group during that time are small enough to be ignored. Recruitment in the east is not governed by the migration rates indicated - rather, an estimable fraction of each year's Mediterranean progeny moves immediately to the "east".

In both cases, the conventional VPA approach of backward projection will probably not be practical because of the large number of coupled non-linear equations to be solved. Rather, methods involving forward projections of recruitments treated as estimable parameters merit consideration.

Appendix BFTW-1
(to Item 11 - BFTW)

Summary of the Discussion held at the Western Atlantic Bluefin Tuna Stock Assessment Session Concerning Document SCRS/94/68: *"Report of the National Research Council Review of Atlantic Bluefin Tuna" - NRC Report*

A discussion of the NRC Report took place at the East Atlantic Bluefin Tuna Meeting. Subsequent to the east Atlantic meeting, the NRC convened an information dissemination meeting to aid in the interpretation of their bluefin tuna report. Insights gained during the information dissemination meeting are reflected in SCRS/94/151.

The Committee considered the NRC Report a useful independent critique of Atlantic bluefin tuna assessments. While the Committee did not entirely agree with the NRC Report, it believed that the principal conclusions and recommendations are consistent with the approach the Committee is using to assess Atlantic bluefin tuna.

The NRC Report is comprehensive in scope, covering important issues about the biology and ecology of Atlantic bluefin tuna. It emphasized a serious lack of biological and ecological data, which ICCAT is attempting to address through the Bluefin Year Program. Progress has been slow due to a lack of funding, particularly in eastern Mediterranean countries. The NRC findings that are most pertinent to assessments and short-term management considerations for Atlantic bluefin tuna fall in three categories: mixing, population structure and management units, and population trends.

Mixing

The NRC concluded that tagging data and microconstituent analysis indicate some mixing between fisheries of the western and eastern Atlantic. While mixing rates are only a few percent per year, the NRC concluded they should be taken into account in resource assessments (i.e., by using mixing models).

The Committee concurred that mixing should be taken into account and it is moving in that direction as rapidly as practicable, but it did not view the NRC's specific estimates of mixing rates as the most appropriate for use in future stock assessments. Because of time constraints, the NRC estimates were not based on all existing tagging data. As noted by the NRC, their mixing rate estimates are dependent on several assumptions which may not be valid. Recent analyses of the tagging data by Turner and Powers (SCRS/94/74), Porch *et al* (SCRS/94/73) and Punt and Butterworth (SCRS/94/72), using different sets of data and less restrictive assumptions, give different results. Furthermore, another analysis (Porch, SCRS/94/75) concluded that the accuracy and precision of available data are such that different mixing rates with grossly different abundance trends cannot be discriminated. The NRC's mixing rate estimates are useful to confirm SCRS's (ICCAT, Biennial Report 1992-93, Part II (1993), page 201, English version) finding regarding the potential importance of taking account of even relatively small rates of mixing, but more analysis is needed to determine the best estimates of mixing rates based on all pertinent data. Ultimately, new data from rigorously designed studies to determine the geographic origin of individual fish, is required if ICCAT is to take account of mixing with an acceptable level of confidence. An approach for obtaining pertinent data on mixing is discussed in Section BFTW-4.b.

Population structure

The NRC concluded that although genetics data are sparse, they are consistent with a single (interbreeding) population. This conclusion is also consistent with evidence of mixing, since only a very low exchange rate between spawning grounds is required to prevent genetic differentiation. Even populations that have been isolated for long periods of time (i.e., since the last ice age, about 15,000 to 20,000 years ago) may not differentiate genetically (e.g., this is the case for several North Atlantic herring populations). This means that the available genetics data cannot be used to evaluate the possibility that the population dynamics of bluefin tuna of Gulf of Mexico and Mediterranean Sea origin are essentially independent. Information is needed on the likelihood that fish spawn on the spawning ground of their origin. No such information exists.

Faced with inconclusive evidence on the degree of interdependence of bluefin tuna of western and eastern Atlantic origin, but with the knowledge of some mixing, ICCAT established separate western and eastern Atlantic management units, commonly referred to as stocks. The intent was to be conservative by implementing comparable conservation regimes for both groups of fish. This approach would protect both western and eastern Atlantic bluefin if more conclusive data in the future established a high degree of independence in their population dynamics (Brown and Parrack 1985, World Angling Resources and Challenges, P. 279-289), assuming that comparable conservation regimes are actually implemented.

The NRC Report did not explicitly address the issue of stock in the context of management units, but the NRC conducted and recommended resource assessments that explicitly take account of mixing between the western and eastern Atlantic fisheries, which the Committee interpreted as an improvement in the ICCAT two stock (for management purposes) approach.

Population Trends

The NRC conducted an assessment of western and eastern Atlantic bluefin tuna using the SCRS database obtained from the U. S. National Marine Fisheries Service. In doing so, they found inconsistencies in U.S. rod and reel abundance indices, which led to the discovery and correction of input errors in some 1992 data. The Committee acknowledged that there was a data input error in the SCRS assessment.

The NRC used an assessment model that takes account of mixing between the eastern and western Atlantic. This mixing model was considered by the Committee at its 1993 meeting. In addition, the NRC used different statistical methods to standardize abundance indices. The NRC concluded "that there is no evidence that abundance of western Atlantic bluefin tuna has changed significantly" since 1988, with regard to 8+ fish.

The Committee agreed that the methods used by the NRC to calculate abundance indices have merit, and should be explored further in future assessments. The NRC's conclusion that abundance of 8+ bluefin in the west has not changed significantly since 1988 is consistent with the Committee's current assessment. On the other hand, abundance of mature fish in the west is much lower than it was during the 1970's.

Although the NRC assessment primarily focused on abundance of 8+ fish, the abundance of this group of fish does not tell the whole story about the status of Atlantic bluefin tuna. The NRC noted that as a consequence of including mixing in their specific assessment is that their model estimates "recruitment failure in the west for several years". In general, the effect of mixing on recruitment estimates depends on the relative rates of westward and eastward migrations, and relative abundance in the West and East.

Appendix BFTW-2
(to Item 11 - BFTW)

Detailed Specifications for the VPA Base Case Assessment as Presently Conducted

Data input

The following matrices, as most recently updated and refined, are required:

i) catch-at-age by year, for ages 1 to 10+ for 1970 to 1993 and
ii) mid-season mass-at-age by year, for the same periods.

Input specifications

First the natural mortality by age must be specified; this is presently assumed to be age-independent, and equal to 0.14 per year.

Further, because age determination for older ages in the catch is unreliable, these catches are accumulated in a plus group, currently chosen to be 10+.

Estimable parameters

The quality of the abundance index data available for fitting the VPA will not support the estimation of a large number of parameters, so that this number is at present restricted to 4. These estimable parameters are some of the numbers-at-age at the start of the year following the last year for which catch-at-age data are available. The ages chosen at present are 3, 5, 7 and 9.

Selectivities

Given values for the estimable parameters specified above, fishing mortalities for certain ages (presently 2, 4, 6 and 8) can be computed for the last year for which catch-at-age data are available. The VPA calculations also require fishing mortalities for the remaining ages for that year. To this end, the ages are grouped (present grouping 1-3, 4-5, 6-7, 8-9) and SVPA applied to estimate the relative selectivities within each group.

At present SVPA is applied to the catch-at-age data for 1991-93 for this purpose, because changed regulations prior to that date probably mean that selectivities were different at earlier times. Inspection of the output has indicated that within each of the groupings specified above, the selectivity can for practical purposes be considered flat. Thus the present base case assessment assumes that for the last year for which catch-at-age data are available: $F_2=F_3$, $F_4=F_5$, $F_6=F_7$ and $F_8=F_9$. The only exception to this specification is for the 1-year-olds, for which F_1 is set to $0.318F_2$ on the basis of the SVPA results.

Conducting the VPA for catch-at-age data including a plus group (presently 10+) necessitates the specification of the ratio for F_{10+}:F_9 for each year. This ratio is taken to be a (different) constant for each of three periods for which it may have been relatively stable: 1970-73 when there was little or no directed fishing on bluefin in the Gulf of Mexico, 1974-81 when the Japanese longline fishery for bluefin in the Gulf of Mexico was active, and 1982-present which is the period since the imposition of catch limitations.

Previously, the values input for these ratios were obtained from an SVPA for the period in question, carried out for catch-at-age data differentiated up to age 16+. However, it has since been noted that the results from this process are heavily dependent upon the value chosen for the terminal age selectivity which is a required input for the SVPA. Further, there is little confidence in catch-at-age data for ages above 10+ because the cohort slicing method used for ageing is increasingly less reliable for higher ages. This fact also mitigates against bypassing the problem of setting the F_{10+}:F_9 ratios by carrying out VPA to an age higher than 10. It has, however, also been noted that SVPA results for the F_{10}:F_9 ratio are insensitive to the terminal age selectivity input to SVPA. The present procedure is therefore to set the F_{10+}:F_9 ratio equal to that for F_{10}:F_9 from the SVPA, under the assumption that selectivity is constant for ages 10 and above. The broad indications from SVPA are that selectivity does increase somewhat with age for ages above 10 (presumably as a result of age-dependence in fish distributional patterns, as fishing operations are unlikely to be able to target fish above this age (and size) differentially), so that this assumption is probably not completely correct. This concern should be addressed by means of sensitivity tests in which the ratios input are increased.

Indices of abundance

The indices of abundance used to fit the VPA include many based on catch rate (CPUE) data. These indices are first standardized by linear modelling techniques which assume that the various factors considered act multiplicatively. The conventional "GLM" technique used has transformed the data as follows to linearize the model while allowing for possible zero catch rate entries amongst the data:

$$\text{CPUE} \rightarrow \log(K + \text{CPUE}) \qquad K = \text{constant}$$

Earlier practice was to take K to be equal to 10 times the largest CPUE value in the set, effectively changing the underlying model from multiplicative to additive. At this meeting, it was decided to amend this procedure to set K to 10 percent of the mean of the CPUE values in the set, in line with the recommendations of SCRS/94/68.

This "GLM" standardization option assumes a normal error structure for the transformed CPUE data. An alternative "Poisson" approach is to model catch (C) by:

$$C = E \times \text{multiplicative factors} + \epsilon$$

where E is the fishing effort and ϵ is assumed to be Poisson distributed. The present base case procedure is to adopt the "Poisson" approach, for reasons given on the basis of a better value of the statistic proposed later in this appendix under "fitting criteria".

The indices of abundance accepted at present for fitting the VPA are as follows:

Name	*Age range*	*Middle/ Begin*	*Selectivity*	*Numbers /Biomass*
Larval	8+	middle	uniform	biomass
Japanese longline: NW Atlantic	1-9	begin	partial catches	numbers
Japanese longline: Gulf of Mexico	10+	begin	uniform	numbers
Canadian tended line	10+	middle	pre-specified	numbers
U.S. rod & reel: Small	1-5	middle	partial catches	numbers
U.S. rod & reel: Large	8+	middle	partial catches	numbers
U.S. longline: Gulf of Mexico	8+	begin	partial catches	numbers

The associated columns provide information required to calculate the value of the index predicted by the VPA from the basic numbers-at-age matrix computed by the VPA:

1) "Age range" indicates the set of ages to which the index relates.

2) "Biomass/numbers" specifies to which of these two quantities the index is assumed to be linearly proportional.

3) "Middle/begin" indicates the time of year to which the index relates; if this is the "middle" of the year, the numbers-at-age in question are adjusted by a multiplicative factor exp (-Z/2), where Z is the total mortality for the year and age concerned.

4) "Selectivity" refers to the relative weight given to each age group in the calculation of the predicted value of the index. There are three possibilities:

a) "Uniform": equal weighting by age

b) "Partial catches": this calculation requires the catch-at-age matrix for the fleet concerned:

$$F^{f}_{y,a} = F_{y,a} \left(C^{f}_{y,a} / C_{y,a} \right)$$

where f=fleet, y=year, a=age

and these values are used to provide weights for a particular year (after division by the largest $F^{f}_{y,a}$ value for that year) for aggregating the numbers-at-age vector for that year to provide a predicted value for the index.

c) "Pre-specified": this applies to the Canadian tended line only, and is intended to make allowance for the fact that this index applies to 13+ rather than 10+ fish. Values of this factor for the years 1981-90 are respectively: (0.645; 0.474; 0.445; 0.338; 0.325; 0.407; 0.396; 0.375; 0.337; 0.329).

Fitting criteria

The values of the estimable parameters ($\underset{\sim}{P}$) of the VPA are obtained by minimizing a function of the form:

$$SS(\underset{\sim}{P}) = \sum_{\substack{indices\\ i}} w_i \sum_{\substack{years\\ y}} [I_{i,y} - q_i \hat{I}_{i,y} (\underset{\sim}{P})]^2$$

where $I_{i,y}$ is the (standardized) index of abundance for index i in year y,

$\hat{I}_{i,y}$ is the value of this index predicted from the VPA numbers-at-age, and
q_i is the constant of proportionality for index i.

These constants are estimated simply from the formula:

$$\hat{q}_i = \left(\sum_y I_{i,y} \hat{I}_{i,y} \right) / \left(\sum_y \hat{I}_{i,y}^2 \right)$$

with the values of the parameters $\underset{\sim}{p}$ then obtained by a non-linear minimization routine.

The present base case procedure assumes equal weighting of each series ($w_i = 1$). An alternative iterative weighting approach (equivalent to maximum likelihood estimation) sets:

$$w_i = n(i) \left[\sum_y (I_{i,y} - \hat{q}_i \hat{I}_{i,y})^2 \right]^{-1}$$

where n(i) is the number of values in series i.

When comparing fits of the mode to different sets of abundance indices, a generalization of the correlation coefficient may prove a helpful statistic. This is defined by:

$$r^2 = 1 - SS(VPA)/SS(\text{"mean"})$$

where SS("mean") is the value of SS for the case where the predicted value of an index in a year is given by the average value of that index. Better fits can be argued on the basis of higher values of this statistic.

Bootstrap replication

This procedure is applied to estimate confidence intervals and provide realizations of the distributions of current year numbers-at-age for the purposes of computing stock projections under future possible harvesting policies.

Variability in two factors only is taken into account in these replications. First fish abundance index data is regenerated as follows to provide replicate U:

$$I_{i,y}^U = \hat{q}_i \hat{I}_{i,y} + \epsilon_{i,y}^U \qquad \epsilon \ \textit{from} \ N(0, \sigma_i^2)$$

where

$$\sigma_i^2 = [n(i)]^{-1} \sum_y (I_{i,y} - \hat{q}_i \hat{I}_{i,y})^2$$

Second, it is necessary to allow for the fact that the $F_{10+}:F_9$ ratio for each year will actually fluctuate about the constant (f_y) assumed for each block of years. Replicates are generated as follows:

$$\hat{F}_{y,10+}^U = f_y \ F_{y,9}^U \exp(\eta_y^U) \qquad \eta \ \textit{from} \ N(0, \sigma_y^2)$$

where

$$\sigma_y = 0.4 \qquad y < 1975$$

$$\sigma_y = 0.25 \qquad y \geq 1975$$

by current convention.

The VPA fit is then repeated for each replicate set U of abundance index series and $F_{10+}:F_9$ ratios, keeping other factors (such as the catch-at-age matrix) fixed.

Appendix BFTW-3
(to Item 11 - BFTW)

Technical Specifications of Projections

Future recruitments

Consider recruitment to be defined by the numbers of 1 year-olds at the start of the year. If R_y is the recruitment estimated for year y, then calculate:

$$\overline{\ln R} = \frac{1}{10} \sum_{y=81}^{90} \ln R_y \quad ; \quad R_{med} = \exp(\overline{\ln R})$$

$$\sigma_R^2 = \frac{1}{9} \sum_{y=81}^{90} [\ln R_y - \overline{\ln R}]^2 \qquad (3.1)$$

$$\overline{B} = \frac{1}{5} \sum_{y=85}^{89} B_y$$

where B_y is the spawning (mid-year 8+) biomass for year y. The stock recruitment relationship is then taken to be a straight line through the origin to the point ($\bar{B}$, R_{med}) (which corresponds to the 1985-89 cluster of points on the left-hand side of the stock-recruit plot (see **BFTW-Figure 8b**), and thereafter a constant whose value is R_{med}. Hence, recruitment in a future year y is given by:

$$R_y = \begin{cases} R_{med} \exp(\epsilon_y) & B_{y-1} \geq \overline{B} \\ R_{med} (B_{y-1}/B) \exp(\epsilon_y) & B_{y-1} \leq \overline{B} \end{cases} \qquad (3.2)$$

where ϵ_y is drawn from a normal distribution with mean zero and variance σ_R^2. Note the dependence on spawning biomass from the previous year, which is a consequence of recruitment being defined in terms of numbers of 1 year-olds.

Past recruitments

The VPA is unable to estimate R_{1991}, R_{1992} and R_{1993} with reliability. Thus projections are based on values for recruitment in these years given by equations (3.2). Known catches-at-age from the associated year-classes for these years are taken into account in projecting forward to give numbers at ages 2, 3 and 4 at the start of 1994.

The random component of equations (3.2) can sometimes lead to situations in which the recruitment generated is insufficient to allow the catches already made from the year-class to be realized. In such cases, the recruitment in question is regenerated from the distribution specified in equations (3.2).

Selectivity-at-age for future catches

The geometric mean over the years 1989-91 is taken of the fishing mortality at age for each ages. The values obtained are scaled by dividing by their maximum over all the ages. The consequent values for ages 1, 2 and 3 are then multiplied by 0, 0.28 and 0.28 respectively to make allowance for the effects of changes in regulation which came into force in mid 1991.

Weight-at-age in the future

Ages 1-9 are taken to have the same average weight as estimated for 1993 for all future years. The average weight of 10+ fish in the future varies because of the change in the age composition of the older fish over time. This average is calculated from the average age by means of the equations:

$$\left.\begin{aligned} w(t) &= 28.61 \times 10^{-6}\,[l(t)]^{2.929} \\ l(t) &= 380.1\,[1 - \exp(-0.0787\,(t+0.731))] \end{aligned}\right\} \quad (3.3)$$

where weight w is in kg and age t is in years.

If $\overline{a_y}$ is the average age of mid-year 10+ fish in year y, and $N_{y,a}$ the number of fish at the start of year y of age a, then:

$$\overline{a_{y+1}} = \frac{(\overline{a_y}+1)\, N_{y,10+}\, \exp(-Z_{y,10+}) + 10.5\, N_{y,9}\, \exp(-Z_{y,9})}{N_{y,10+}\, \exp(-Z_{y,10+}) + N_{y,9}\, \exp(-Z_{y,9})} \quad (3.4)$$

where $Z_{y,a} = F_{y,a} + M$

The value of $\overline{a_{1993}}$ is calculated from the growth curve equation (3.3) by substituting the observed value for the average weight of 10+ fish that year. Equation (3.4) is then applied recursively to calculate mean age for future years, with equation (3.3) used to evaluate the corresponding average weight (this approach assumes approximate linearity of weight with age for ages of 10 and above).

These calculations assume that there is uniform selectivity on fish of age 10 and above, so that the average weight mass of 10+ animals caught is the same as that in the population.

Future catches

It was agreed to assume that the 1994 catch would total 1,995 MT, and to project forward for 10 years in total.

One set of projections is based on a constant catch, with the levels of catch initially investigated being 0, 1,200, 1,995 and 2,660 MT each year. However, these catches are subject to the constraint that the fishing mortality on the fully selected age-class does not exceed 1.4 in any year.

A further projection is based on a constant fishing mortality, with the level of this mortality chosen so that it is equal to M = 0.14 on the fully selected age-class.

Deterministic projections

These are based on the point estimates of numbers-at-age at the start of 1994 from the base-case assessment, together with the specifications above except that recruitments from 1991 onwards are given by equation (3.2) with ϵ_y = 0 (i.e., no variation about the stock-recruitment relationship assumed).

Stochastic projections

Realizations of distributions of quantities of interest are provided by a large number of bootstrap replicates of the process described above.

First, the point estimates of numbers-at-age at the start of 1994 are replaced by their bootstrap replicates evaluated in terms of the prescription set out in **Appendix BFTW-2**. The parameters R_{med}, $\overline{B}$ and $\tilde{O}_R$ required to calculate the time series of recruitments from 1991 onwards by application of equations (3.2) are then calculated from the past numbers-at-age matrix for that bootstrap replicate VPA fit.

Selectivity-at-age and 10+ mass projections are re-evaluated similarly for each bootstrap replicate.

YFT-Table 1. Atlantic yellowfin catches (1000MT) by region, gear and nations (as of November 21, 1994).

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
TOTAL	65.0	69.3	68.0	58.8	60.2	83.2	92.7	73.3	73.3	93.5	94.7	106.7	124.6	124.8	131.1	134.0	127.6	130.5	154.3	163.2	162.0	112.1	149.1	134.3	135.0	127.8	155.4	176.9	158.3	147.4	148.4
EAST ATL.	42.4	47.4	54.2	43.3	52.6	73.8	80.3	59.1	57.6	78.2	79.7	92.2	108.2	110.9	117.8	119.2	114.3	117.6	138.0	137.9	124.7	75.6	111.6	105.7	110.2	99.0	123.3	151.5	122.7	113.7	111.8
-SURF	19.2	28.5	26.7	30.7	35.5	51.9	59.9	43.1	42.9	60.2	59.3	72.8	92.8	98.1	102.1	107.9	107.5	105.2	130.1	128.0	118.6	67.0	104.1	101.8	105.5	91.6	116.9	145.2	118.2	110.7	108.4
BB	17.8	21.2	18.5	15.1	16.8	22.1	15.7	9.6	10.6	13.1	14.7	19.7	9.7	12.7	11.0	9.0	13.8	7.6	9.8	13.1	11.5	13.7	16.0	15.0	16.4	16.0	12.1	15.5	15.5	12.6	14.2
ANGOLA	2.1	3.6	1.9	1.3	0.9	1.1	0.4	0.3	0.5	0.6	0.6	0.8	0.1	1.0	1.9	2.0	0.8	0.5	0.7	1.4	0.7	0.2	0.3	0.1	0.1	0.2	0.1	0.3	0.5	0.4	++
CAP VERT		0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.5	0.4	0.4	0.4	0.1	0.1	0.5	0.6	0.9	0.6	0.8	0.9	0.9	0.7	1.3	0.9	0.5	0.9	0.5	0.7	0.2	0.1
FIS	12.3	13.2	12.7	13.1	14.4	18.6	14.0	7.5	7.4	7.4	5.5	6.3	2.9	3.7	3.4	2.8	2.2	2.1	3.0	3.0	2.7	3.5	2.9	3.8	3.8	4.4	2.3	3.8	4.6	2.9	2.8
GHANA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.1	0.3	0.7	0.8	0.6	0.3	1.2	1.7	2.5	5.6	5.0	5.5	8.9	8.2	8.9	8.4	6.9	8.2	7.1	7.2	9.5
JAPAN	0.9	2.1	1.3	0.5	1.3	2.2	1.0	0.8	2.0	3.5	6.5	7.1	1.1	4.9	2.6	1.4	1.0	0.5	1.7	1.2	1.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KOREA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.7	2.7	1.0	1.2	1.4	3.9	1.4	1.0	0.4	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PANAMA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.1	1.1	0.8	1.0	0.9	0.4	0.2	++	0.1	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SAFRICA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	0.0	0.0	0.0	3.8	0.4	0.1	++	0.3	0.7	0.3	++	++	0.1	0.7	0.3	++	0.1	0.3
ESPANA	2.5	2.3	2.6	0.2	0.2	0.2	0.3	0.7	0.4	0.7	0.8	2.0	1.0	0.2	0.3	0.2	0.1	0.1	0.1	0.4	0.7	2.4	2.8	1.6	2.7	2.3	1.2	2.4	2.6	1.8	1.5
OTHERS		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	0.0	0.0	++	0.0	0.0	++	++	0.2	++	++	++	0.1	++	++	++	++	++
PS	1.3	7.3	8.2	15.6	18.7	29.8	44.2	33.4	32.2	47.0	44.5	53.0	83.0	85.3	90.7	98.0	92.3	97.0	115.0	111.7	103.2	50.9	86.5	84.5	86.1	73.1	102.3	127.6	100.7	95.4	91.8
CAYMAN I		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FIS		5.8	6.5	8.9	9.0	12.7	14.4	16.7	18.6	23.8	26.2	31.9	43.8	47.9	46.6	52.4	45.6	52.2	52.1	42.7	37.7	4.5	9.4	14.0	13.7	16.9	28.5	41.9	28.7	28.6	36.2
GHANA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.2	3.0	4.2	2.7	3.5	3.7	3.6	1.0	0.0	0.0	0.0	0.0	0.0	0.0
JAPAN		0.5	1.1	4.8	5.2	7.5	4.7	1.1	2.0	2.5	1.2	0.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.2	1.3	2.6	2.3	2.8	2.2	2.1	1.7	1.4	0.8	0.0
MAROC		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.0	1.6	2.2	3.4	3.0	3.2	4.8	4.5	2.3	0.6	2.3	2.3	1.5	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	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	1.8	1.8	0.0	0.0	0.0
PORTUGAL		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.2	0.9	1.3	0.3	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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2	1.9	2.2
ESPANA		1.0	0.6	1.3	2.9	3.1	5.4	6.4	7.4	8.6	13.3	14.0	23.7	33.2	35.3	33.4	39.9	38.7	51.3	53.8	51.1	37.5	64.0	60.2	63.4	47.9	60.5	66.2	55.7	48.6	41.9
USA		0.0	0.0	0.0	0.9	5.8	18.8	9.0	3.8	12.0	3.0	5.6	14.0	1.7	6.4	8.1	2.9	1.6	1.5	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
USSR		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	++	0.1	0.9	1.2	1.8	3.4	1.4	0.7	2.2	3.7	3.4	0.0	0.0	0.0
NEI_1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	5.4	1.1	0.0	0.0	2.1	3.1	5.4	12.5	11.7	15.5	11.5
OTHERS	1.3	0.0	++	0.6	0.7	0.7	0.9	0.2	0.4	0.1	0.5	0.4	0.3	0.6	0.2	0.5	0.6	0.4	0.5	0.1	0.3	0.3	1.1	0.7	0.5	0.3	0.3	0.1	++	++	0.0
OTH+UNCL	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.4	0.9	1.4	0.6	5.3	3.2	3.9	2.4	1.6	2.3	3.0	2.5	2.5	2.1	2.0	2.7	2.4
ANGOLA	0.1																														
CAP VERT		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	2.7	3.4	2.0	1.2	2.0	1.8	2.0	2.0	1.6	1.3	2.1	2.1
OTHERS		++	++	++	++	0.0	++	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.4	0.9	1.4	0.6	0.7	0.5	0.5	0.4	0.4	0.3	1.2	0.5	0.5	0.5	0.7	0.6	0.3
-LL	23.2	18.9	27.5	12.6	17.1	21.9	20.4	16.0	14.7	18.0	20.4	19.4	15.4	12.8	15.7	11.3	6.8	12.4	7.9	9.9	6.1	8.6	7.5	3.9	4.7	7.4	6.4	6.3	3.6	2.3	3.4
CHITAIW		0.0	0.0	0.8	1.9	6.6	7.0	3.9	3.4	3.5	1.5	1.0	1.3	0.6	0.2	0.2	0.2	0.1	0.4	0.2	0.4	0.1	0.1	0.2	0.2	0.2	0.1	0.9	0.4	0.2	0.5
CUBA		0.0	0.5	0.4	2.4	1.2	0.9	1.1	1.4	3.2	4.5	3.0	1.7	1.8	2.9	1.9	2.6	4.9	2.5	2.1	1.6	1.2	1.1	0.7	0.8	1.4	0.4	0.7	0.0	0.0	0.0
JAPAN	23.1	18.5	26.5	10.6	10.1	9.8	6.4	2.5	1.6	2.3	1.3	0.7	1.7	0.3	0.1	0.3	0.3	1.7	1.2	2.8	0.9	2.9	3.1	1.3	1.7	3.6	3.8	4.2	2.8	1.9	2.7
KOREA		0.0	0.0	0.0	0.0	1.6	4.2	8.0	6.9	7.8	8.3	10.1	7.6	6.6	9.8	7.3	2.6	3.9	3.3	3.6	1.5	1.7	1.6	1.0	1.2	1.2	1.5	0.3	0.3	0.2	0.2

YFT-Table 1. Continued.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
PANAMA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	3.6	2.1	1.2	1.9	0.9	1.1	0.5	1.6	0.3	1.1	1.6	2.2	1.3	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0
USSR		0.1	0.5	0.8	2.7	2.7	1.9	0.5	1.4	1.1	1.2	2.5	1.9	1.6	1.8	0.5	0.5	0.1	0.2	0.1	++	0.3	0.3	0.4	0.6	1.0	0.6	0.2	0.0	0.0	0.0
OTHERS	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.0	0.0	0.0	0.0	0.0	0.1	0.1	++	++	0.1	0.2	++	++	0.0	0.0	++	++	0.1	++	0.0
-UNCL GEARS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.7	++
OTHERS		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.7	++
WEST ATL.	22.2	21.6	13.6	15.5	7.6	9.4	12.4	14.2	15.7	15.3	15.0	14.5	16.4	13.9	13.3	14.8	13.3	12.9	16.3	25.3	37.3	36.5	37.5	28.6	24.8	28.8	32.1	25.4	35.6	33.7	36.6
-SURF	0.2	0.1	0.0	0.0	0.2	0.1	0.0	0.0	0.0	3.4	2.3	1.6	2.0	0.7	1.5	4.7	3.7	5.7	4.7	15.0	29.4	27.0	25.8	14.6	14.6	13.7	18.2	14.6	26.0	22.5	27.1
BB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.4	0.0	0.0	1.0	0.6	0.4	1.9	2.9	3.6	3.7	4.3	2.5	3.9	6.0	5.0	4.9	6.3	6.5	6.9
BRASIL		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.9	1.0	1.8	1.3	2.2	0.8	1.6	1.6	1.4	1.0	1.2	2.7	3.2
JAPAN		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	1.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESPANA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VENEZUEL		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	1.0	1.9	1.8	2.4	2.1	1.7	2.3	4.4	3.6	3.9	5.1	3.8	3.7
OTHERS		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.2	0.0	0.0	++	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PS	0.2	0.1	0.0	0.0	0.2	0.1	0.0	0.0	0.0	3.4	2.3	0.3	1.6	0.7	1.1	3.6	1.1	5.2	2.8	12.1	25.8	23.2	21.0	10.7	8.4	6.8	12.2	8.9	18.6	15.3	19.2
FIS		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	1.7	0.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COLOMBIA																															2.4
ESPANA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.8	0.0	0.3	1.0	0.8	0.0	0.0	0.0	2.0	4.0	1.0	0.0	0.0	0.0	0.0	0.0	1.5	1.3	0.8
USA		0.1	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.3	0.6	0.0	0.4	0.5	0.8	1.6	0.3	0.5	0.3	0.1	0.1	1.1	4.4	0.6	0.1	0.0	++	0.3	1.0	0.4	0.2
VENEZUEL		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	2.5	12.0	23.5	17.8	15.6	10.1	8.3	6.8	12.2	8.6	16.1	13.6	15.8
OTHERS	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	1.0	0.0	0.3	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.1	2.0	0.1	0.0	0.0	0.0	0.1	0.5	1.4	2.3	0.9	1.0	0.8	1.1	0.7	1.0
USA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	0.0	++	0.1	0.2	1.3	2.2	0.9	0.9	0.6	1.0	0.5	0.7
VENEZUEL		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	0.4	0.1	0.2	0.1	++	++	++	++	0.3	0.1	0.1	++	0.1	0.2	0.1	0.2	0.3
-LL	18.8	19.2	11.4	13.0	4.9	7.8	10.4	13.9	15.4	11.6	12.4	12.5	14.0	12.7	11.2	9.6	9.2	6.5	11.3	9.8	6.9	7.9	10.6	12.5	9.7	14.0	13.0	10.0	8.5	9.7	8.0
BRASIL	2.4	1.6	0.7	0.5	0.8	0.8	0.5	0.8	0.3	0.2	0.2	0.2	0.3	0.7	0.9	0.8	1.1	0.5	1.2	0.9	0.9	0.5	0.5	1.1	0.7	0.9	1.1	0.6	0.4	0.4	0.6
BRASTAI		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	1.1
CHITAIW		0.0	0.0	0.3	0.8	1.3	3.8	3.2	1.0	1.2	1.2	1.3	1.1	1.1	0.1	0.2	0.8	0.5	0.4	0.4	0.1	0.5	0.6	1.0	0.6	1.2	0.5	2.1	0.9	1.6	1.4
CUBA	1.7	0.9	0.2	0.4	0.6	0.7	0.6	0.5	0.3	0.4	0.0	0.4	0.6	1.2	0.9	0.7	0.2	0.7	2.0	1.5	0.8	2.5	1.9	2.1	1.1	0.1	0.1	0.1	0.0	0.0	0.0
JAPAN	14.6	16.6	10.4	11.8	2.7	4.2	3.6	4.3	9.1	4.2	2.5	2.8	2.4	3.1	1.4	1.6	1.7	1.1	3.0	3.3	1.2	1.0	2.2	2.1	1.6	2.4	3.2	1.7	1.9	1.0	0.6
KOREA		0.0	0.0	0.0	0.0	0.7	1.8	3.5	3.0	3.3	4.5	5.4	7.7	4.6	6.5	4.3	4.4	1.9	3.3	2.2	1.9	1.0	1.7	0.9	0.2	0.1	1.1	0.5	++	++	++
PANAMA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	2.0	1.1	1.2	1.3	0.6	0.7	0.0	0.8	0.3	0.7	0.1	0.2	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
USA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	0.0	0.1	0.1	1.7	3.8	4.7	8.4	6.4	4.4	4.3	5.6	3.4
VENEZUEL		0.0	0.0	0.0	0.0	0.0	0.0	1.6	1.5	1.9	1.9	1.2	0.6	0.6	0.8	1.3	1.0	1.0	1.0	0.5	1.2	1.7	1.6	0.9	0.6	0.7	0.5	0.3	0.3	0.4	0.7
OTHERS	0.1	0.1	0.1	0.0	++	0.1	0.1	0.0	0.2	0.4	0.1	0.1	0.1	0.1	++	++	0.0	0.0	0.1	0.3	0.6	0.4	0.4	0.3	0.1	0.2	0.1	0.3	0.6	0.1	0.2

YFT-Table 1. Continued.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
-UNCL GEARS	3.2	2.3	2.2	2.5	2.5	1.5	2.0	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.6	0.5	0.4	0.7	0.3	0.5	1.0	1.6	1.1	1.5	0.5	1.1	0.9	0.8	1.1	1.5	1.5
MEXICO		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.0	0.0	0.6	1.1	0.6	0.7	++	0.3	0.3	0.1	0.4	0.7	0.7 *
VENEZUEL	3.1	2.2	2.1	2.4	2.4	1.4	1.9	0.0	0.0	0.0	0.0	0.0	++	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHERS	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.6	0.5	0.4	0.7	0.3	0.5	0.4	0.5	0.5	0.8	0.5	0.8	0.6	0.7	0.7	0.8	0.8 *
UNCL REGION	0.4	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-LL	0.4	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHERS	0.4	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

++.0 CATCHES: < 50 MT AND >= 1 MT
FOR EACH REGION-GEAR GROUP, COUNTRIES WITH < 950 MT ANNUAL CATCH DURING THE ENTIRE PERIOD COVERED ARE INCLUDED IN OTHERS.
* Carried over from 1992 figures.

YFT-Table 2. Carrying capacity (1000 MT), by gear, of east Atlantic surface fleets.

YEAR	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
TOTAL BB+PS	36.5	32.2	42.3	54.1	46.0	53.5	68.4	62.0	67.6	69.6	77.1	81.8	61.3	52.3	49.5	45.8	43.9	44.3	46.5	56.6	55.7	51.5
TOTAL BB	7.3	7.6	13.0	13.2	9.7	13.7	15.5	14.7	12.8	11.8	11.7	11.5	11.3	10.8	11.0	8.8	9.2	9.6	9.9	9.9	9.9	10.0
FISM	2.7	2.1	2.0	1.8	1.5	1.3	1.3	1.4	1.3	1.3	1.3	1.2	1.2	1.1	1.0	0.5	0.7	0.8	0.9	0.6	0.6	0.7
TEMA-BASED	3.2	4.0	8.7	9.2	7.3	11.0	12.8	11.6	9.7	8.7	8.1	8.0	7.2	6.6	6.6	4.8	4.8	4.8	4.8	4.8	4.8	4.8
SPAIN (CANAR.)	0.6	1.0	1.9	1.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
ANGOLA	0.3					0.5	0.5	0.5	0.4	0.5	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3
CAP VERT.									0.2	0.2	1.0	1.0	1.0	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
PORTUGAL	0.5	0.5	0.4	0.6	0.3	0.3	0.3	0.6	0.6	0.5	0.3	0.3	0.9	0.9	1.2	1.4	1.6	1.8	2.0	2.3	2.3	2.3
SPAIN (TROP.)																		0.1	0.1	0.1	0.1	0.1
TOTAL PS	29.2	24.6	29.3	40.9	36.3	39.8	52.9	47.3	54.8	57.8	65.4	70.3	50.0	41.5	38.5	37.0	34.7	34.7	36.6	46.7	45.8	41.5
FISM	9.2	12.4	14.5	17.2	17.5	14.6	17.6	16.5	17.2	16.8	16.3	16.8	4.8	3.0	3.0	5.1	6.0	6.0	7.0	12.7	10.1	10.1
SPAIN	5.2	7.1	8.4	12.6	16.8	20.7	24.4	25.9	29.5	30.6	31.7	38.0	33.5	30.3	27.3	23.7	20.5	19.5	19.7	22.8	23.6	18.7
U.S.A.	11.9	2.9	5.5	10.4	1.7	4.2	10.5	3.2	2.2	1.6	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
JAPAN	1.9	1.9	0.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.8	0.8	0.8	0.8	0.4	0.4	0.4	0.3	0.0
U.S.S.R.	0.1	0.1	0.1	0.1	0.1	0.1	0.2	1.0	3.0	3.9	4.9	4.9	4.9	5.4	5.4	5.4	5.4	5.4	4.2			
RUSSIA																				4.2	4.2	4.2
OTH.**	0.9	0.2	0.2	0.4	0.2	0.2	0.2	0.7	2.9	4.9	10.8	10.2	6.4	2.0	2.0	2.0	2.0	3.4	5.3	6.6	7.6	8.5

* Provisional
** Ghana (1982-87), Mexico (1983), Congo (1980-81), Gran Cayman (1982-83), Portugal (1979-81), Venezuela (1983), and for recent years Morocco, Norway, Malta, Panama, Vanuatu.

YFT-Table 3. Data used in fitting production models to YFT. Catch data are in units of 1,000 MT. Abundance index is not available before 1969.

Year	E. Atlantic catch	Total Atlantic catch	Abundance index
1963	42.4	65.0	---
1964	47.4	69.3	---
1965	54.2	68.0	---
1966	43.3	58.8	---
1967	52.6	60.2	---
1968	73.8	83.2	---
1969	80.3	92.7	7.281
1970	59.1	73.3	4.600
1971	57.6	73.3	4.087
1972	78.2	93.5	5.333
1973	79.7	94.7	5.182
1974	92.2	106.7	4.712
1975	108.2	124.6	5.049
1976	110.9	124.8	4.837
1977	117.8	131.1	5.375
1978	119.2	134.0	5.358
1979	114.3	127.6	3.722
1980	117.6	130.5	3.405
1981	138.0	154.3	3.656
1982	137.9	163.2	3.119
1983	124.7	162.0	2.708
1984	75.6	112.1	2.128
1985	111.6	149.1	3.666
1986	105.7	134.3	3.973
1987	110.2	135.0	3.499
1988	99.0	127.8	3.332
1989	123.3	155.4	4.180
1990	151.5	176.9	4.590
1991	122.7	158.3	3.273
1992	113.7	147.4	3.093
1993	110.2	146.8	3.747

YFT-Table 4. Estimation of MSY (1,000 MT) and F_{MSY} of Atlantic Yellowfin stock, according to the equilibrium production model (PRODFIT).

Model	m	K	MSY	F_{MSY}
PRODFIT	1	4	153.7	56.3
PRODFIT	2	4	149.9	45.2

YFT-Table 5. Nonequilibrium production model runs for yellowfin tuna. A bootstrap with 501 trials was used to obtain bias-corrected estimates and approximate 80% confidence intervals (shown) for total Atlantic stock hypothesis. Ordinary point estimates are shown for the east Atlantic hypothesis.

	Stock hypothesis	
	Total Atlantic	East Atlantic
MSY, 1000 MT/yr	149 (123-164)	116
f_{MSY}	50.0 (40.7-61.4)	35.1
B_{94}/B_{MSY}	1.05 (0.81-1.30)	0.95
F_{93}/F_{MSY}	0.92 (0.67-1.34)	1.0

YFT-Table 6. Atlantic yellowfin tuna catch at age (year and quarter) by area.

Yr	Total	0				1				2				3				4				5+			
	Age(yr) / Age(qtr)	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Numbers by age (year and quarter): East																									
75	7588	1	48	1035	627	903	676	752	675	423	357	668	258	172	73	106	150	234	99	68	83	116	27	18	20
76	8384	2	26	1167	970	591	440	1586	1108	613	187	333	106	174	201	145	124	158	178	52	55	92	50	12	15
77	8433	1	35	688	642	940	604	1805	890	246	601	546	286	113	202	166	121	204	108	62	49	71	22	20	10
78	8337	3	90	540	884	848	1010	1164	703	619	471	600	213	212	205	162	184	199	89	31	44	42	14	6	5
79	8175	6	80	721	1023	959	945	1522	619	270	269	309	158	133	176	186	248	229	112	53	67	50	21	11	6
80	9321	6	122	1038	1805	1438	618	1116	921	328	283	295	172	131	123	184	194	191	71	97	97	40	13	23	15
81	13012	5	1143	1991	2913	1410	995	979	790	601	340	255	174	228	93	152	96	389	159	95	41	101	35	20	8
82	11129	3	281	360	1372	2284	1935	1363	853	377	334	220	148	329	180	172	169	326	167	44	46	101	46	9	8
83	10200	11	571	1025	2014	1566	1164	760	499	337	283	312	278	240	165	186	74	399	71	69	25	108	22	16	6
84	9293	10	467	1082	917	1067	1391	1584	1304	221	205	259	166	161	92	92	79	80	32	34	14	22	5	6	2
85	9372	4	496	1708	1827	598	1502	642	280	169	339	369	199	224	114	83	140	434	74	32	53	70	6	5	5
86	9031	16	315	908	2117	1187	814	1244	585	71	149	176	129	307	115	125	227	299	64	34	60	68	8	7	6
87	11031	4	627	2170	2462	1282	773	1067	453	317	266	279	178	179	88	126	155	367	78	37	47	55	9	5	6
88	10189	1	351	1413	2225	1406	1371	1117	381	191	180	204	160	386	178	101	96	248	73	28	19	48	7	4	1
89	10593	10	1493	1345	1813	1265	1822	654	178	36	72	190	76	368	79	154	134	527	86	79	64	111	16	12	9
90	10738	1	158	2342	2406	796	858	1050	435	220	145	241	171	328	206	161	181	524	174	78	45	156	32	24	5
91	10555	15	1085	990	1667	1623	1457	1105	587	124	114	180	234	180	100	131	86	250	190	65	32	164	100	54	22
92	9314	9	480	1264	1484	1749	1178	571	258	278	152	333	177	225	141	172	125	316	169	69	35	87	30	10	5
93	12211	4	514	976	2338	2837	2214	1059	291	292	91	141	103	193	146	233	91	308	157	101	29	61	16	13	4
Numbers by age (year and quarter): West																									
75	390	0	0	0	0	0	0	0	0	0	4	6	4	43	121	52	28	16	25	23	5	13	28	20	3
76	387	0	0	0	0	0	0	0	1	0	1	38	19	14	63	93	34	18	21	30	11	5	17	17	5
77	405	0	0	0	0	0	0	0	8	0	8	40	32	16	52	71	46	24	43	22	9	9	7	16	2
78	542	0	0	0	0	0	0	14	1	31	9	47	37	84	25	70	122	16	12	28	22	4	3	13	5
79	420	0	0	0	0	0	0	0	6	0	24	31	24	35	26	120	58	20	9	20	23	7	9	6	2
80	731	0	0	0	0	1	1	0	89	2	99	27	143	9	199	64	30	9	6	18	7	10	6	5	5
81	864	1	0	0	0	24	24	9	21	56	139	115	73	32	115	111	48	15	18	16	12	4	12	9	9
82	1453	0	0	0	0	5	8	0	44	12	18	353	539	60	139	86	79	11	22	20	13	5	14	19	5
83	2033	0	0	0	0	1	32	53	32	48	210	387	416	55	209	199	243	45	16	13	39	15	5	5	11
84	2960	0	0	0	0	38	0	17	69	195	100	946	749	314	155	174	67	83	16	11	10	4	6	4	2
85	2478	0	0	2	3	22	16	13	212	20	107	818	471	56	185	272	102	68	38	22	24	9	7	7	4
86	1788	0	4	0	0	5	9	21	29	132	353	415	147	208	128	131	71	43	39	20	10	8	7	4	5
87	1519	0	0	0	0	11	6	2	39	239	96	294	301	178	102	96	67	17	25	22	8	6	3	3	3
88	1715	0	0	0	0	1	3	8	7	111	335	425	252	104	193	77	64	22	34	40	19	4	11	5	1
89	1770	0	0	0	1	0	0	58	69	201	232	200	200	134	222	210	120	26	31	22	15	7	10	8	6
90	1766	0	0	0	0	0	0	33	11	10	238	748	306	85	71	86	59	42	18	12	15	16	6	7	3
91	2798	0	0	0	0	16	30	57	66	345	421	596	521	210	193	167	94	24	16	15	7	7	6	7	4
92	2422	0	0	1	0	3	8	27	23	309	137	829	285	271	147	220	51	34	31	12	3	15	12	3	0
93	2351	0	4	0	0	4	96	10	27	193	1082	245	53	76	399	28	33	9	61	4	1	1	24	1	0
Numbers by age (year and quarter): Entire Atlantic																									
75	7979	1	48	1035	627	903	676	752	675	423	361	674	262	215	194	158	177	250	123	91	88	129	55	38	23
76	8771	2	26	1167	970	591	440	1586	1108	613	189	372	125	188	264	237	158	175	199	82	66	98	66	29	20
77	8838	1	35	688	642	940	604	1805	898	247	609	586	318	129	254	237	167	228	151	84	57	79	29	36	13
78	8879	3	90	540	884	848	1010	1178	704	650	480	647	250	296	230	231	305	214	102	59	66	46	16	19	10
79	8594	6	80	721	1023	959	945	1523	624	270	293	340	182	167	202	306	306	248	121	73	90	57	30	17	9
80	10052	6	122	1038	1805	1439	620	1116	1010	330	382	323	314	141	322	248	224	200	77	115	104	50	19	28	19
81	13876	6	1143	1991	2913	1434	1018	988	810	657	479	370	246	260	208	263	144	404	177	111	52	105	47	29	18
82	12582	3	281	360	1372	2290	1943	1363	897	388	352	573	687	389	319	258	247	338	190	64	59	106	60	28	12
83	12233	11	571	1025	2014	1567	1196	814	531	385	493	699	695	295	374	385	318	444	87	82	63	122	27	20	17
84	12253	10	467	1082	917	1105	1391	1601	1374	416	305	1204	915	475	247	266	146	163	48	45	24	26	11	10	4
85	11850	4	496	1710	1830	620	1518	655	492	188	447	1187	670	280	298	355	242	502	112	55	77	79	13	12	8
86	10819	16	319	909	2117	1191	822	1265	614	203	502	591	276	516	242	256	299	342	103	53	70	76	15	11	11
87	12551	4	627	2170	2462	1293	779	1069	492	557	362	573	480	357	190	222	222	384	103	59	56	60	13	8	8
88	11904	1	351	1413	2225	1407	1375	1125	388	302	516	629	412	490	371	178	160	270	107	68	38	52	18	8	2
89	12363	10	1493	1345	1813	1265	1822	712	248	237	304	390	276	501	301	363	254	553	117	101	78	119	25	20	16
90	12503	1	158	2342	2406	796	858	1084	446	230	383	989	477	413	277	247	240	567	191	91	60	172	38	30	8
91	13353	15	1085	990	1667	1639	1486	1161	653	469	535	775	756	390	293	298	180	274	205	79	39	171	106	60	26
92	11736	9	480	1265	1484	1752	1186	598	281	587	289	1163	462	496	288	392	175	349	200	82	38	102	42	13	5
93	14562	4	517	976	2338	2841	2310	1070	318	485	1173	385	156	269	546	262	125	316	217	105	31	62	40	13	4

YFT-Table 7. Recruitment, biomass, spawning stock biomass and average fishing mortality (ages)-4) estimated by non-calibrated VPA on an annual basis.

Year	Recruits No.	Total Biomass	Total Sapawning Biomass	Landings	F-Bar = 0.4
1975	76,242,504	651,702,336	279,614,432	125	0.1574
1976	65,976,016	611,206,400	254,118,944	125	0.1671
1977	61,225,300	558,546,944	230,039,248	131	0.1885
1978	53,925,696	480,894,656	183,327,984	134	0.2246
1979	58,730,516	420,865,728	159,283,392	128	0.2479
1980	58,031,480	375,510,688	121,055,752	131	0.2969
1981	83,645,560	398,025,824	132,787,456	154	0.3793
1982	71,757,632	373,152,544	105,150,672	163	0.4976
1983	82,946,624	368,161,440	90,665,472	162	0.607
1984	55,752,524	356,686,688	75,948,664	112	0.3698
1985	76,090,312	403,358,752	116,988,032	149	0.3951
1986	79,124,848	417,778,048	117,724,784	134	0.3357
1987	63,640,484	403,091,584	118,663,328	135	0.3197
1988	69,368,208	402,136,160	105,999,848	128	0.3353
1989	72,725,672	453,902,144	148,179,184	155	0.358
1990	69,895,912	439,394,432	154,659,696	177	0.3844
1991	55,816,280	410,376,320	142,503,312	158	0.4226
1992	84,668,296	400,002,464	118,640,984	147	0.4327
1993	60,477,276	366,036,480	104,011,496	147	0.4716

YFT-Table 8. Indices used in tuning ADAPT VPA runs and (bottom) statistical weights estimated for each index during ADAPT Case 1 run. (NA: index not available in that year.)

Year	PS 1	PS 2	PS 4	PS 0-5+	LL 3-4	LL 4-5
Abundance index values						
1975	NA	NA	NA	0.887	0.982	0.578
1976	NA	NA	NA	0.853	0.732	0.795
1977	NA	NA	NA	1.000	0.536	0.661
1978	NA	NA	NA	0.679	0.833	0.605
1979	NA	NA	NA	0.696	0.782	0.668
1980	0.412	0.577	NA	0.577	0.725	0.961
1981	0.289	0.891	0.293	0.594	0.673	0.799
1982	0.910	0.636	0.313	0.495	0.718	0.732
1983	0.296	0.619	0.374	0.485	0.473	0.950
1984	0.572	0.536	0.313	0.406	0.833	0.870
1985	0.103	0.268	0.190	0.594	0.826	0.827
1986	0.209	0.782	0.184	0.829	0.599	0.763
1987	0.643	1.000	0.551	0.679	1.000	0.674
1988	0.627	0.176	0.320	0.768	0.935	1.000
1989	0.212	0.356	0.463	NA	0.663	0.814
1990	0.444	0.460	1.000	NA	0.706	0.851
1991	1.000	0.460	0.905	NA	0.583	0.542
1992	NA	NA	NA	NA	0.358	0.666
1993	NA	NA	NA	NA	0.438	0.411
Statistical weights (Case 1)						
	0.048	0.069	0.083	0.305	0.308	0.188

BET-Table 1. Bigeye catch (in 1000 mt) by gear, country and region (as of November 2, 1994).

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
TOTAL	26.0	23.3	39.2	24.9	24.7	23.0	35.9	41.4	55.0	46.6	56.5	63.8	60.8	44.8	54.7	52.3	45.5	63.5	67.6	73.2	60.4	68.8	74.1	59.0	48.6	58.1	68.8	71.3	72.0	77.9	89.1
-SURFACE	10.9	5.6	9.8	5.2	11.6	4.2	12.8	13.9	15.8	14.1	18.5	24.6	19.8	17.4	25.4	23.8	18.3	22.0	26.1	21.4	26.9	27.3	25.3	24.6	19.7	17.0	19.0	26.6	38.4	35.1	43.9
BB	10.9	5.6	9.8	5.2	11.5	3.8	9.8	10.5	11.8	9.4	13.6	18.0	14.5	9.9	12.8	14.5	9.5	12.2	9.6	6.8	9.9	11.0	17.6	15.2	12.2	9.0	12.3	16.9	17.1	15.4	15.7
FIS	2.4	0.8	++	++	1.7	0.2	2.4	1.5	1.3	1.1	1.2	1.0	1.3	1.4	2.6	3.6	2.0	2.5	2.2	1.8	2.1	2.1	4.0	3.2	2.7	2.5	2.0	2.7	2.2	1.7	2.8
GHANA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.1	0.1	0.1	0.2	0.1	0.2	0.3	0.5	0.4	0.3	1.1	1.3	1.4	1.1	1.2	2.2	4.2	3.7	2.8	2.6
JAPAN		++	0.1	++	0.4	0.6	0.3	0.2	0.5	0.9	1.7	1.9	0.1	0.9	1.0	0.6	0.2	0.4	1.0	0.6	++	++	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KOREA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.5	0.3	0.2	0.5	0.5	0.7	1.3	0.6	0.2	0.0	++	++	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PORTUG	8.0	4.7	8.7	4.1	8.1	1.6	5.6	5.1	2.9	4.0	5.9	10.9	6.8	2.9	4.5	5.3	3.3	3.5	2.6	1.8	3.8	3.9	6.4	7.0	4.5	2.2	4.9	5.9	5.5	5.3	5.3
ESPANA		0.1	1.0	1.1	1.3	1.4	1.5	3.6	7.0	3.1	4.4	3.2	5.7	4.2	3.6	3.8	3.0	4.0	2.4	1.5	2.5	2.8	5.0	3.5	3.6	2.6	2.8	3.8	5.5	5.5	4.9
OTHERS	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.2	0.4	0.2	0.2	0.4	0.6	0.1	0.2	0.3	0.5	1.2	1.1	0.9	0.1	0.3	0.5	0.4	0.3	0.2	0.1	0.1
PS	0.0	0.0	0.0	0.0	0.1	0.4	3.0	3.4	4.0	4.7	4.9	6.6	5.3	7.1	11.9	9.1	8.3	9.2	15.7	14.3	16.9	16.1	7.6	9.1	7.0	7.6	6.3	9.5	21.0	19.3	27.9
FIS		0.0	0.0	++	++	++	1.3	2.4	2.6	2.9	3.2	4.2	3.6	5.1	6.4	5.4	5.3	3.8	5.8	5.2	7.3	2.1	0.6	1.0	1.2	1.7	1.2	2.3	4.0	5.5	11.2
JAPAN		0.0	0.0	0.0	0.1	0.4	1.3	0.3	0.5	0.7	0.3	0.2	++	0.0	0.0	0.0	0.0	0.0	0.0	++	++	0.5	0.5	0.3	0.4	0.4	0.1	0.2	0.9	0.6	0.0
LYBIA																														0.2	0.3
ESPANA		0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.4	0.9	1.3	1.3	1.6	1.7	4.8	3.0	2.4	4.4	7.6	7.5	6.2	10.8	5.4	7.4	5.3	5.4	4.9	6.1	12.6	11.6	14.7
USSR		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	++	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VENEZUEL		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.2	++	1.2	1.1	0.5	0.0	0.0	++.0	++.0	0.1	0.3	++	0.0
NEI_1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.1	0.2	0.0	0.0	0.1	++.0	0.1	0.8	3.2	1.4	1.7
OTHERS	0.0	0.0	0.0	0.0	0.0	++	0.1	0.2	0.5	0.2	0.1	0.9	0.1	0.3	0.7	0.6	0.6	0.6	1.1	1.3	1.1	1.4	0.6	0.4	++	0.1	++.0	++	++	++	++
SURF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.7	0.2	0.5	0.6	0.8	0.3	0.1	0.2	0.1	0.3	0.5	0.4	0.4	0.2	0.3	0.4	0.3
OTHERS		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.7	0.2	0.5	0.6	0.8	0.3	0.1	0.2	0.1	0.3	0.5	0.4	0.4	0.2	0.3	0.4	0.3
-LONGLINE	15.1	17.7	29.4	19.7	13.1	18.8	23.1	27.5	39.2	32.5	38.0	39.2	41.0	27.4	29.3	28.5	27.2	41.5	41.5	51.8	33.5	41.4	48.7	34.3	28.8	41.0	49.6	44.6	33.5	42.7	45.2
BRASTAI		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	1.1
CHITAIW		++	0.0	0.6	2.2	5.3	7.5	7.6	5.5	5.0	3.8	3.1	4.0	3.3	3.0	2.6	2.2	2.3	1.7	1.9	1.4	0.8	1.1	1.0	1.3	1.3	0.7	4.9	0.8	4.7	6.0
CUBA		0.0	0.1	0.3	0.2	0.9	1.0	4.1	3.2	2.0	2.6	2.4	1.9	1.3	1.8	2.3	2.3	1.4	0.7	0.5	0.4	0.4	0.2	0.2	0.2	0.2	0.1	0.1	0.0	0.0	0.0
JAPAN	14.5	17.3	28.5	17.6	8.5	10.3	10.3	9.0	20.3	18.1	20.0	20.9	17.4	7.3	9.1	9.3	12.0	20.5	21.0	32.9	15.1	24.3	31.6	22.8	18.6	31.7	39.4	35.0	29.5	34.9	35.8
KOREA		0.0	0.0	0.3	0.3	0.3	1.9	4.1	7.4	5.7	5.8	7.4	10.2	6.7	7.6	9.2	7.3	9.0	11.7	10.6	9.4	8.9	10.7	6.1	4.4	4.9	7.9	2.7	0.8	0.9	0.4
LYBIA																														0.3	0.8
PANAMA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.7	1.8	2.0	2.0	1.2	2.0	0.5	4.5	2.5	2.9	2.7	2.0	1.1	0.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0
ESPANA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	1.5	1.4	0.0	0.0	0.0	++	0.3	0.1	++	++	++	0.0	0.0	0.0	0.5	0.5	0.5	0.0
USSR		0.0	0.4	0.7	1.8	1.7	2.2	2.6	2.7	1.6	3.0	3.4	3.7	4.9	4.1	2.1	2.0	2.6	1.7	0.6	0.4	1.2	0.9	1.1	1.9	1.1	0.4	0.1	0.0	0.0	0.0
VENEZUEL		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	0.5	0.2	0.3	0.3	1.5	1.0	2.4	2.0	1.7	0.9	0.1	0.1	++.0	++	0.1	++	0.0
OTHERS	0.6	0.4	0.4	0.2	0.1	0.3	0.2	0.1	0.1	++	0.1	0.2	0.3	0.4	0.6	0.8	0.6	0.9	0.7	1.1	1.6	1.8	1.4	1.6	1.9	1.7	1.1	1.3	1.7	0.8	1.1
-UNCL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.0
OTHERS		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.0

++.0 CATCHES: < 50 MT AND >= 1 MT

FOR EACH GEAR GROUP, COUNTRIES WITH < 950 MT ANNUAL CATCH DURING THE ENTIRE PERIOD COVERED ARE INCLUDED IN OTHERS.

SKJ-Table 1. Annual catch (mt) of the Atlantic skipjack by region, country and gears (as of November 18, 1994).

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
TOTAL	18.8	24.1	22.8	24.4	48.4	29.3	50.3	78.4	77.4	78.4	117.3	56.3	69.3	110.5	108.2	89.8	111.5	130.9	155.7	133.5	126.4	118.7	124.5	116.5	139.6	115.1	139.5	194.7	145.8	174.4
SURF-E. ATLAN	13.2	22.6	21.0	21.4	45.8	27.3	47.5	76.2	74.4	75.1	113.3	52.2	65.4	107.1	101.0	83.2	98.8	107.8	122.6	101.3	91.0	78.5	90.1	90.7	116.6	89.6	114.7	165.7	118.8	143.8
PS	0.9	3.3	6.1	7.9	24.2	14.3	29.8	48.8	48.8	49.9	74.2	35.4	33.1	57.7	58.7	37.0	56.7	66.4	75.0	64.2	61.8	48.4	58.4	51.2	67.5	47.2	73.7	117.4	77.6	111.3
CANADA	0.0	++	0.0	0.6	0.9	0.1	0.6	1.2	++	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAYMAN I	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.8	++	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONGO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.2	0.0	++	++	++	++	++	++	++	++	++	++	0.0
FIS	0.5	0.9	2.2	1.5	5.1	2.6	7.8	13.1	13.6	8.0	22.6	10.5	14.9	28.5	22.6	15.3	22.6	24.3	26.8	25.8	9.2	10.4	11.2	15.2	13.7	11.0	13.6	28.7	18.8	36.5
GHANA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.1	0.0	0.0	0.0	0.3	2.7	3.9	2.8	3.7	2.9	1.7	0.8	0.0	0.0	0.0	0.0	0.0	0.0
JAPAN	++	1.8	1.4	2.2	6.3	0.7	3.5	6.2	3.4	1.5	0.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	1.4	1.4	1.1	2.1	2.0	2.0	3.2	2.2	2.6	4.8	2.4	0.0
MAROC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.7	1.9	1.9	5.0	3.0	4.0	2.3	0.9	1.0	1.2	0.9	0.0	0.0	0.1	++	0.1	0.0
RUSSIA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.1	0.5
ESPANA	0.4	0.6	2.5	3.1	8.7	6.2	6.1	11.9	19.5	17.8	30.6	16.9	15.6	21.5	24.5	17.4	24.2	31.3	34.7	27.6	44.6	29.4	39.5	29.7	44.2	29.5	43.2	65.2	42.8	54.3
USA	0.0	0.0	0.0	0.5	3.2	4.7	11.8	16.2	12.2	21.2	20.0	7.4	1.8	5.9	6.8	2.1	2.6	2.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
USSR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.1	++	0.0	1.5	0.6	1.0	1.4	1.7	0.5	1.8	1.9	3.6	0.0	0.0	0.0
NEI_1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	3.4	0.9	0.6	0.5	1.4	3.7	2.3	10.5	17.5	12.4	20.0
OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.1	0.3	0.2	0.1	0.5	0.2	0.4	0.3	1.0	0.3	0.4	0.6	0.6	0.7	0.9	0.3	0.1	++	0.0	0.0
BB	11.8	19.2	14.9	13.5	21.6	12.9	17.6	27.2	25.3	25.0	39.0	16.7	28.6	42.3	41.4	44.7	38.1	38.9	44.5	34.9	27.9	29.9	30.1	38.5	47.8	41.0	39.5	47.1	39.8	32.4
ANGOLA	1.0	1.3	2.8	2.0	4.2	1.8	0.9	1.9	1.5	1.3	3.4	0.6	1.5	3.8	3.2	3.6	3.5	2.3	2.2	0.3	++	0.1	0.1	0.1	++	0.1	0.1	0.1	++	++
CAP VERT	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.0	1.5	1.4	1.3	1.2	0.8	0.7	1.3	1.0	2.1	1.6	1.6	1.3	1.0	2.0	0.9	2.1	1.4	0.9	0.8	1.3	0.7	0.3
FIS	1.4	2.7	3.3	3.7	7.3	3.6	4.2	5.6	3.7	3.2	4.4	1.8	2.1	2.6	3.3	3.3	3.2	2.6	4.4	2.7	3.8	3.3	1.9	2.0	2.7	4.2	3.5	1.5	1.3	2.1
GHANA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.7	1.3	2.1	3.5	2.9	4.0	4.7	4.9	14.3	20.5	16.2	16.2	19.2	22.8	26.0	22.2	26.6	30.3	23.2	20.8
JAPAN	3.1	6.3	4.4	3.7	7.3	4.9	7.5	11.7	10.1	13.0	18.7	3.7	15.0	16.8	14.6	14.7	12.3	12.9	8.5	4.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KOREA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	2.1	4.5	1.9	3.6	8.1	12.0	6.7	7.5	2.8	1.6	0.7	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAROC	0.0	3.2	1.5	0.9	0.9	0.1	1.1	0.1	++	0.1	++	0.3	++	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PANAMA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.2	1.0	1.9	2.5	4.0	3.0	1.8	1.7	0.1	2.5	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PORTUGAL	3.1	2.2	2.3	2.5	1.1	1.7	1.0	4.2	3.7	2.2	1.9	0.6	2.1	4.4	4.4	3.0	1.7	2.7	4.8	1.0	3.8	2.4	5.4	8.0	14.1	7.7	3.9	8.0	7.4	5.5
ESPANA	3.2	3.5	0.6	0.7	0.8	0.8	1.8	2.7	4.1	2.6	5.4	0.8	0.6	0.7	0.6	1.3	2.2	4.2	3.4	1.3	2.0	5.7	2.5	3.4	3.4	5.8	4.6	5.9	7.2	3.7
OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	++	0.0	0.0	0.0	0.0	++	0.1	++	++	++	++	0.1	0.1	0.2	0.1	++	++	++	++
OTH	0.5	0.1	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.2	0.1	0.1	3.7	7.1	0.9	1.5	4.0	2.5	3.1	2.2	1.3	0.2	1.6	1.0	1.3	1.4	1.5	1.2	1.4	0.1
GHANA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.8	0.2	0.1	1.0	0.8	0.0	1.4	0.7	0.6	0.6	0.6	0.6	0.6	0.0
USSR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	6.7	0.5	1.1	3.0	1.8	2.5	0.7	0.0	0.0	++	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHERS	0.5	0.1	0.0	++	++	0.1	0.1	0.2	0.3	0.2	0.1	0.1	0.1	0.4	0.4	0.1	0.2	0.5	0.5	0.5	0.5	0.2	0.2	0.3	0.7	0.8	0.9	0.6	0.8	0.1
SURF-W. ATLA	5.5	1.6	1.8	2.8	2.6	1.9	2.4	1.9	2.8	2.8	3.3	3.4	3.7	3.2	6.9	6.2	12.6	22.8	32.2	31.2	34.7	39.9	34.1	25.7	22.8	25.2	24.3	28.2	26.7	30.3
PS	4.4	0.1	++	++	0.1	0.1	0.0	0.0	1.2	0.4	0.1	0.4	0.7	0.6	3.4	1.5	3.1	4.7	9.7	11.1	17.9	11.2	6.8	6.1	1.7	1.8	2.0	4.8	5.0	10.2
COLOMBIA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1
ESPANA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.3	1.0	0.8	0.0	0.0	0.0	0.2	2.6	0.5	0.0	0.0	0.0	0.0	0.0	1.6	1.1	0.4
USA	4.0	0.1	++	++	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.2	0.5	0.3	1.6	0.7	1.0	2.6	++	0.6	0.8	1.8	1.0	0.6	0.0	++	0.2	0.0	0.5	0.3
VENEZUEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	1.9	9.5	10.0	14.1	8.9	5.8	5.5	1.7	1.8	1.8	3.2	3.4	7.4
OTHERS	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.4	0.1	0.1	0.2	++	0.8	0.0	0.2	0.2	0.2	0.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SKJ-Table 1. Continued.

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
BB	0.7	1.0	1.0	1.2	1.6	1.3	1.8	1.6	1.4	1.9	2.9	2.8	2.8	2.4	2.8
BRASIL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CUBA	0.7	1.0	1.0	1.2	1.6	1.3	1.8	1.6	1.4	1.5	1.8	2.3	2.8	2.4	1.8
JAPAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	0.4	0.0	0.0	0.0
PANAMA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++
ESPANA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
VENEZUEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.1	0.0	0.0	0.0
OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTH	0.4	0.5	0.8	1.6	0.9	0.5	0.6	0.3	0.2	0.5	0.3	0.2	0.2	0.2	0.7
BRASIL	0.4	0.5	0.7	1.5	0.8	0.4	0.4	0.1	0.0	0.0	0.0	0.0	0.1	0.2	0.6
OTHERS	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.5	0.3	0.2	0.1	++	0.1
SURF-UNCL. RE	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.2	0.5	0.7	0.7	0.2	0.2	0.3
LL+TRAWL	++	++	++	++	++	++	++	0.1	0.1	0.1	0.2	0.2	++	0.1	0.1
OTHERS	++	++	++	++	++	++	++	0.1	0.1	0.1	0.2	0.2	++	0.1	0.1
UNCL	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.4	0.5	0.5	0.2	0.1	0.2
OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.4	0.5	0.5	0.2	0.1	0.2

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
BB	4.4	9.4	18.0	22.4	20.0	16.7	28.5	26.1	19.4	20.9	23.1	22.1	23.1	21.2	19.9
BRASIL	1.8	6.1	13.9	18.2	15.6	13.1	25.1	22.5	16.2	17.2	20.5	20.0	20.4	18.9	17.6
CUBA	2.0	2.3	1.1	1.1	1.7	1.2	1.6	1.3	1.1	1.6	1.4	1.4	1.6	1.6	1.6
JAPAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PANAMA	0.2	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESPANA	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VENEZUEL	0.0	0.0	3.0	3.1	2.7	2.4	1.8	2.3	2.1	2.1	1.2	0.7	1.1	0.7	0.7
OTHERS	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTH	0.3	0.1	0.1	0.1	0.1	0.1	0.2	1.2	0.2	0.2	0.3	0.2	0.3	0.5	0.2
BRASIL	0.2	0.0	0.0	0.0	0.0	++	++	0.6	0.1	0.1	0.2	0.1	0.1	0.3	0.2
OTHERS	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.6	0.1	0.1	0.1	0.1	0.2	0.2	++
SURF-UNCL. RE	0.4	0.1	0.3	0.9	1.0	0.7	0.3	0.3	0.1	0.2	0.3	0.5	0.8	0.3	0.3
LL+TRAWL	++	++	0.1	++	0.6	++	++	++	++	++	++	0.1	++	++	++
OTHERS	++	++	0.1	++	0.6	++	++	++	++	++	++	0.1	++	++	++
UNCL	0.4	0.1	0.2	0.9	0.4	0.7	0.3	0.3	0.1	0.2	0.3	0.4	0.8	0.3	0.3
OTHERS	0.4	0.1	0.2	0.9	0.4	0.7	0.3	0.3	0.1	0.2	0.3	0.4	0.8	0.3	0.3

++ indicate catches less than 500 MT but more than 0 MT.

SKJ-Table 2. Annual percentages of skipjack of catches made with natural and artificial objects, and the assumed percentages of the annual skipjack in the catch.

YEAR	1990	1991	1992	1993
Natural object	79.1	85.4	78.3	83.5
Artificial object	100	81.3	83.6	88.5
% of annual skipjack catches	50	71	79	60

ALB-Table 1. Albacore landings (in 1000 MT) by country, gear and regions (as of November 17, 1994).

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
TOTAL	77.3	90.3	90.7	75.2	74.9	71.8	76.4	70.4	83.0	83.3	75.8	72.6	59.2	77.2	76.2	73.7	74.7	62.1	59.6	72.9	67.8	56.9	74.6	87.6	81.7	66.7	63.2	66.4	54.3	65.3	66.8
NORTH ATL.	60.0	64.4	60.4	47.4	58.5	45.6	47.3	46.3	57.6	49.3	47.1	52.3	41.0	57.2	53.9	49.9	51.3	38.7	34.0	42.0	51.5	39.8	40.7	47.3	37.8	33.7	32.1	36.5	26.8	31.1	37.2
-SURFACE	45.3	48.5	45.7	39.6	48.9	37.9	32.5	30.2	39.7	34.7	28.9	37.7	28.4	34.3	33.0	35.8	39.1	29.3	24.3	28.8	34.4	20.0	23.4	26.1	30.6	30.8	30.2	33.8	23.4	27.4	30.0
BAITBOAT	20.7	20.5	20.1	16.8	18.3	13.9	14.6	14.4	15.7	8.2	10.2	16.7	18.9	20.4	15.6	12.0	15.7	16.2	13.4	15.9	21.2	8.3	12.6	15.1	18.7	16.8	15.4	18.6	9.0	12.4	15.4
FRANCE	6.4	6.8	4.2	3.5	3.9	2.2	1.7	1.7	1.5	0.5	1.1	0.6	0.4	1.1	0.6	0.6	0.2	0.4	0.4	0.2	0.2	++	0.1	0.1	0.1	0.0	0.3	0.0	0.0	0.0	0.0
PORTUGAL	1.0	0.5	0.8	0.3	0.7	0.1	0.5	0.2	0.3	0.4	0.9	1.2	0.9	0.6	0.1	0.1	0.1	0.1	0.4	0.3	1.8	0.8	0.6	0.4	0.4	0.2	0.2	3.2	0.7	1.6	3.1
ESPANA	13.3	13.2	15.1	13.0	13.7	11.6	12.4	12.5	13.9	7.3	8.2	14.9	17.6	18.7	14.9	11.3	15.4	15.7	12.6	15.3	19.0	7.4	11.8	14.6	18.2	16.6	14.9	15.4	8.3	10.8	12.3
OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.1	++	0.0	0.0	0.0	++	++	++	0.0
TROLLING	24.6	28.0	25.6	22.8	30.6	24.0	17.9	15.8	24.0	26.5	18.7	21.0	9.5	13.9	17.4	23.8	23.3	13.1	10.7	12.8	12.8	11.0	10.7	10.9	11.4	11.4	10.6	10.3	9.0	7.3	6.1
FRANCE	9.8	12.7	11.4	10.0	11.6	11.0	7.7	4.5	7.7	8.7	5.8	7.9	5.0	5.7	7.1	9.7	9.1	3.6	2.5	2.7	2.2	2.8	1.8	1.1	1.4	0.4	0.1	0.0	0.0	0.0	0.0
ESPANA	14.8	15.3	14.2	12.8	19.0	13.0	10.2	11.3	16.3	17.8	12.9	13.1	4.5	8.2	10.3	14.1	14.2	9.5	8.2	10.1	10.6	8.2	8.9	9.8	10.0	11.0	10.5	10.3	9.0	7.3	6.1
OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	++	++
OTHER SURFAC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.1	0.4	0.7	0.1	0.1	0.5	2.6	4.2	4.9	5.4	7.7	8.5
CHITAIW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0
FRANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.4	4.0	3.3	4.8	6.9	6.3
IRELAND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.1	0.5	1.9
USA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.0	0.0	++	0.1	++	++	++	++	0.1	0.2	0.1	0.2	0.2	0.3	0.2	0.3
VENEZUEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.6	0.1	++	0.0	0.1	++	++	0.2	0.1	0.0
OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	++	0.1	++	0.0	0.1	++	++	++	++	++	++	++	++	++
-LONGLINE	14.7	15.9	14.7	7.8	9.6	7.7	14.8	16.1	17.9	14.6	18.2	14.6	12.6	22.9	20.9	14.1	12.2	9.4	9.7	13.2	17.1	19.8	17.3	21.2	7.2	2.9	1.9	2.7	3.4	3.7	7.2
CHITAIW	++	0.1	0.1	0.2	0.8	1.9	2.4	4.7	2.9	4.4	9.5	9.5	8.1	14.8	13.7	9.3	7.0	7.1	6.6	10.5	14.3	14.9	14.9	19.6	6.6	2.1	1.3	1.7	2.4	2.8	6.4
CUBA	0.0	0.0	0.1	0.2	0.1	0.3	0.1	0.0	0.0	++	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
JAPAN	14.6	15.7	14.3	5.9	4.8	3.3	4.7	5.9	6.5	1.3	1.5	2.1	1.3	1.3	0.8	0.5	1.2	1.0	1.7	0.8	1.2	0.6	0.8	0.5	0.5	0.7	0.4	0.7	0.7	0.5	0.5
KOREA	0.0	0.1	0.2	1.5	3.9	1.6	6.8	5.0	7.7	7.9	4.8	2.8	2.8	5.4	5.6	3.0	3.0	0.8	0.9	1.3	0.5	1.0	0.4	0.4	++	++	0.1	++	++	0.0	0.1
PANAMA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.2	0.2	1.2	0.6	0.8	0.4	0.2	0.2	0.5	0.4	2.6	0.6	0.5	++	0.0	0.0	0.0	0.0	0.0	0.0
TRINIDAD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.3	0.0	0.0	0.0	0.0	++	0.0	0.2	0.0
VENEZUEL	0.1	0.0	0.0	0.0	0.0	0.6	0.8	0.5	0.8	0.8	0.0	0.0	0.1	0.1	0.1	0.4	0.6	0.3	0.3	++	0.3	0.4	0.3	0.1	++	++	++	0.1	0.1	++	0.0
OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.1	0.1	0.1	0.1	0.0	++	++	0.1	0.1	0.1	++	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2
-UNCL + TRAWL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FRANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.0	++	0.0	0.0	0.0	++	0.0	++	0.0	++	++	0.0	0.0	0.0	0.0	0.0	0.0	++	0.0	++	0.0
SOUTH ATL.	17.3	25.9	29.8	27.3	15.9	25.7	28.4	23.6	24.9	33.3	28.2	19.8	17.7	19.5	21.7	23.2	22.6	22.9	24.1	29.6	15.1	13.8	29.7	36.5	39.8	28.9	27.0	28.0	24.8	30.4	28.4
-SURFACE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.2	0.5	0.3	0.8	2.3	3.6	4.4	3.0	3.8	7.0	6.0	8.3	6.8	6.9	6.2	3.4	6.8	4.5
BRASIL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	++	0.1	0.1	++	0.1	0.1	0.3	0.1	++	0.1	++	++	++	++	++	++
CHITAIW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0
FIS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.1	++	0.2	0.5	0.9	0.9	0.4	++	++	++	0.1	0.0	0.0	0.0	0.0	0.0	0.0

ALB-Table 1. Continued.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
SAFRICA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.5	1.5	1.8	3.1	2.2	3.2	6.7	5.8	7.3	6.6	6.9	5.3	3.4	6.4	4.5
ESPANA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.1	0.3	0.3	0.2	0.2	0.8	0.2	0.0	0.0	0.0	0.0	0.0
NEI_1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	0.4	0.0
OTHERS	0.0	++	0.0	0.0	0.0	++	0.0	0.0	0.0	0.1	++	0.0	++	0.0	0.1	0.1	++	0.2	++	0.2	++	++	0.0	0.0	++	++	++	++	++	++	0.0
-LONGLINE	17.3	25.9	29.8	27.3	15.9	25.7	28.4	23.6	24.9	33.2	28.1	19.6	17.5	19.3	21.2	22.9	21.8	20.6	20.5	25.2	12.0	9.8	22.5	30.1	31.0	21.8	19.7	21.6	21.3	23.3	23.9
ARGENTIN	1.5	1.5	1.1	0.8	0.7	1.2	0.4	0.5	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRASIL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.3	0.5	0.5	0.4	0.4	0.3	0.7	0.7	0.5	0.3	0.5	0.3	0.4	0.4	0.5	0.3	0.2	0.3
BRASTAI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	2.1	3.7
CHITAIW	0.0	0.0	0.0	0.0	1.1	6.8	12.5	12.2	17.5	25.0	22.2	16.7	13.4	14.6	16.1	20.5	20.3	18.7	18.2	22.8	9.5	7.9	19.6	27.6	28.8	20.7	18.4	20.4	19.5	20.4	19.3
JAPAN	15.1	23.7	28.3	21.0	7.7	11.9	6.3	5.9	3.2	2.1	0.3	0.1	0.3	0.1	0.1	0.1	0.1	0.3	0.6	0.6	0.2	0.2	0.6	1.0	0.4	0.4	0.7	0.6	0.7	0.6	0.4
KOREA	0.0	0.1	0.3	5.3	6.4	5.7	9.2	5.0	3.8	5.7	3.7	2.4	3.2	3.4	3.8	1.4	0.9	0.7	0.7	0.6	0.6	0.3	0.5	0.3	0.4	0.2	0.1	++	++	++	0.2
PANAMA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.2	0.3	0.8	0.4	0.4	0.1	0.2	0.1	0.2	0.0	0.0	0.0	0.3	0.9	0.0	0.0	0.0	0.0	0.0	0.0
SAFRICA	0.7	0.6	++	0.1	0.0	0.0	0.0	0.0	0.0	0.0	++	0.0	0.0	0.0	0.0	0.0	++	0.3	0.5	0.1	0.6	0.3	++	0.1	0.0	0.0	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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.2	0.4	0.5	1.5	0.3	0.2	0.1	0.1	0.1	++	++	0.0
OTHERS	0.0	0.0	0.1	0.1	++	0.1	++	0.0	0.1	0.3	++	++	0.1	0.1	0.3	++	0.0	++	0.1	++	++	0.1	++	++	++	++	++	++	++	0.0	++
-UNCL + TRAWL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.4	0.5	0.3	0.4	0.2	0.1	0.3	0.0
ARGENTIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.1	0.2	0.2	0.4	0.5	0.3	0.4	0.2	0.1	0.3	0.0
SAFRICA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	0.0
MEDITERR.	0.0	0.0	0.5	0.5	0.5	0.5	0.7	0.5	0.5	0.7	0.5	0.5	0.5	0.5	0.6	0.6	0.8	0.5	1.5	1.3	1.2	3.3	4.2	3.8	4.1	4.1	4.1	1.9	2.3	2.1	0.4
-SURFACE	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.6	0.5	1.6	1.2	0.1	0.2	0.1	0.1	0.8	1.3	1.2	0.4
FRANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	++	0.1	++	++	0.1	0.1	++	0.1
ITALY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.1	0.1	0.1	0.1	0.6	0.7	1.0	++
ESPANA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.6	0.5	1.3	0.5	0.0	0.0	0.0	0.0	0.1	0.5	0.2	0.3
OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0																					
-LONGLINE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.2	0.2	0.2	0.2	0.6	0.5	0.4	0.0
ITALY											0.0	0.0	0.0	++	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.2	0.2	0.2	0.2	0.6	0.5	0.4	0.0
OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.0	0.0	0.0	++	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.0	0.0	0.0	++	0.0
-UNCL + TRAWL	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.7	0.5	0.5	0.5	0.5	0.5	0.4	0.8	0.5	0.6	0.7	0.7	1.5	2.6	3.5	3.7	3.8	3.8	0.5	0.5	0.5	0.0
GREECE											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	++
ITALY	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.8	0.5	0.6	0.7	0.7	1.5	2.6	3.0	3.2	3.3	3.3	0.0	0.0	0.0	0.0
OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2																					
UNCL REGION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.7	0.8
-SURFACE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.7	0.8
ESPANA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.7	0.8

-UNCL + TRAWL GEARS

++.0 CATCHES: < 50 MT AND >= 1 MT

FOR EACH REGION-GEAR GROUP, COUNTRIES WITH < 250 MT ANNUAL CATCH DURING THE ENTIRE PERIOD COVERED ARE INCLUDED IN OTHERS.

ALB-Table 2. **Nominal efforts by gears, north and south Atlantic (Source: 1993 SCRS, updated by the albacore stock assessment group). Data in ( ) are still preliminary. For Japan and Taiwan longline, ND=non-directed.**

YEA	BB SPAIN NORTH	BB FRANCE NORTH	TROL SPAIN NORTH	TROL FRANCE NORTH	GILL FR-IRL NORTH	MWTD FRANCE NORTH	BB S. AFRIC SOUTH	LL TAIWAN NORTH	LL TAIWAN SOUTH	LL JAPAN NORTH	LL JAPAN SOUTH	LL-ND TAIWAN NORTH	LL-ND JAPAN NORTH	LL-ND JAPAN SOUTH
61	13.6	8.7	26.9	21.1						6.6	20.0			
62	12.7	7.4	42.1	28.9						22.2	32.8			
63	13.3	6.4	37.3	24.7						26.4	28.6			
64	12.3	6.3	35.0	29.0						45.3	39.6			
65	20.2	5.6	30.5	24.5						43.0	54.5			
66	15.0	4.0	37.1	28.9						21.5	32.2			
67	13.2	3.8	46.7	28.5						13.8	17.4			
68	16.1	3.0	37.6	31.8				6.1	19.8	11.5	18.8			
69	20.9	2.9	20.0	19.9				9.1	26.4				10.6	19.2
70	14.9	2.0	27.5	11.0				16.8	21.2				16.6	25.0
71	21.6	2.3	33.4	15.8				15.0	35.7				37.7	18.2
72	11.6	0.8	30.4	14.8				10.4	39.0				24.9	19.1
73	13.6	1.8	24.4	18.9				21.0	36.0				15.4	20.5
74	11.6	0.5	23.7	12.1				21.3	32.4				27.1	10.1
75	17.2	0.7	15.4	9.0				19.2	30.5				43.6	14.0
76	21.6	1.2	20.0	9.9				29.3	42.2				25.6	5.8
77	10.0	0.4	20.1	9.7				38.7	53.4				16.6	15.4
78	10.0	0.4	22.5	12.0				19.5	48.8				16.5	28.1
79	10.2	0.1	17.0	10.0				14.5	33.1				19.3	36.0
80	10.4	0.3	16.7	11.2				14.5	40.0				26.8	32.7
81	11.5	0.4	17.2	5.3				13.5	45.7				40.7	31.2
82	10.9	0.1	17.2	6.0				18.4	55.5				34.9	41.2
83	16.1	0.2	16.1	3.3				29.7	22.8				19.8	23.0
84	7.2	0.0	12.4	4.2				31.0	15.3				22.0	40.8
85	9.9	0.1	23.4	4.7			0.3	34.8	52.4				26.3	44.2
86	12.8	0.1	20.7	2.3			5.0	53.1	65.2				23.5	29.6
87	10.3	0.1	24.7	3.5			5.2	29.1	84.9				20.5	24.2
88	12.0	0.0	19.7	0.7	1.2	0.8	5.8	5.5	67.7				25.3	42.3
89	9.5	0.2	21.9	0.2	1.5	2.9	9.1		63.6			4.3	40.0	51.0
90	9.0	0.1	18.9	0.1	1.3	0.8	8.8		80.2			18.8	33.7	62.7
91	7.9	0.0	14.0	0.0	1.9	0.3	5.1		94.3			32.5	34.1	56.8
92	9.4	0.0	12.5	0.0	2.4	3.0	6.7		87.0			34.0	42.4	46.7
93	8.1	0.0	11.4	0.0	3.3		6.6		(63.7)			(95.0)	(28.9)	(62.4)

Units: Surface gears (BB, TROL, GIL, MDWT): 1000 fishing days
LL: millio million hooks

ALB-Table 3. Growth parameters used to apply MULTIFAN to complete sets of 1975-1993 quarterly distribution of catch at size (Source: J. Santiago). The optimum selection by the Committee is in the right column, SCRS-94.

	SCRS-93	SCRS-94
Period analyzed	83 - 91	88 - 93
Number of age groups	11	8
von Bertalanffy K	0.123	0.217
Loo	141.5	122.8
Average SD	3.439	3.593
Ratio SD	1.039	1.391

ALB-Table 4. Catch at age, 1975-1993, computed with MULTIFAN, using the optimum growth parameters selection. The last two rows are revised figures using corrections to Task II data.

	AGE								
YEAR	1	2	3	4	5	6	7	8+	TOTAL
75	303956	893888	1271630	341757	252901	227942	194945	95109	3582128
76	899020	2125840	882851	894416	413324	361421	134909	79894	5791675
77	444703	2321833	1620123	393395	389958	316788	98111	73119	5658030
78	2787037	2425412	1410631	622859	235715	224261	100041	25924	7831880
79	898113	3250353	2106532	238708	142397	113646	67025	116173	6932947
80	1818355	1825804	1458812	314250	105173	53059	24122	51825	5651400
81	1105147	1590108	1002094	333596	74302	53087	44690	60359	4263383
82	205698	1625916	1785167	406928	81122	72541	41766	138289	4357427
83	866313	1352959	1699996	772352	244825	167231	72572	106776	5283024
84	411984	1112801	1016609	341223	233245	140296	110990	215092	3582240
85	1013440	1238783	1101270	281311	248402	162021	34757	204293	4284277
86	767657	1411722	1259635	408302	440843	188173	85163	144891	4706386
87	362726	2102185	1596952	212529	48641	47460	30970	66034	4467497
88	1735006	2125575	1230557	202787	42052	17959	16294	17094	5387324
89	1093604	1703315	1507900	172389	43610	25430	13043	13675	4572966
90	1081633	2510949	885937	261233	87919	80975	32424	77544	5018614
91	1137569	2239240	616126	104912	50629	28967	23436	50592	4251471
92	1305166	1809441	904726	234348	35302	94286	40679	29478	4453426
93	947548	1982582	1108664	226341	80249	38826	92203	176686	4653099
78	2410864	2315532	1286629	515375	227057	220802	97036	25055	7098350
88	1683433	1973456	1163167	187740	40348	16326	14678	15482	5094630

ALB-Table 5 Indices of abundance used for estimation of the state of stocks, base case and various sensitivity analyses).
Source: SCRS documents - see Section 2 - Abundance indices

AREA	North	North	North	North	North	North	North	North	South	South	South	South	South	South
COUNTRY	Spain	Spain	Spain	France(1)	Japan(2)	Japan	Japan(2)	Taiwan(4)	S. Africa	Japan	Japan	Japan	Taiwan	Taiwan
FISHERY	Surface	Surface	Surface	Surface	LL	LL	LL	LL	Surface	LL	LL	LL	LL	LL
GEAR	Troll	Troll	Troll	Troll+BB	LL	LL	LL	LL	BB	LL	LL	LL	LL	LL
UNIT	No.	No.	No.	No.	No.	No.	Bio	No.	Bio	No	No	Bio	No.	Bio
AGE	2	3	2+3	Juvenile	5+	5+	5+	5+	Middle size	5+	5+	5+	5+	5+
METHODS	GLM	GLM	GLM	GLM	GENMOD	GLM	GLM	GLM	GLM	GENMOD	GLM	GLM	GLM	(3)
SOURCE	94/30	94/30	94/30	94/48	94/153	94/37	94/154	94/45	94/32	94/153	94/37	94/154	Group	Group
59					1.00	11.60	178.45			1.00	24.50	394.71		
60					0.80	10.92	156.37			0.80	21.52	315.55		
61					0.64	8.03	107.18			0.64	15.53	237.98		
62					0.42	10.13	144.08			0.42	12.26	216.45		
63					0.31	8.64	118.12			0.31	10.17	142.93		
64					0.35	7.34	94.26			0.35	10.23	122.47		
65					0.29	5.24	79.08			0.29	6.83	76.86		
66					0.27	5.43	73.40			0.27	6.73	75.21		
67				0.69	0.28	6.60	83.70			0.28	8.07	99.26		
68				1.11	0.25	6.46	95.69	10.13		0.25	7.02	74.75	14.20	203.77
69				1.12	0.13	5.92	63.40	9.88		0.13	4.66	48.58	11.37	180.10
70				0.63	0.09	5.71	49.52	9.23		0.09	3.30	30.35	7.22	113.86
71				1.25	0.11	3.59	30.69	5.51		0.11	3.74	35.37	6.28	95.71
72				1.33	0.06	2.15	14.71	9.63		0.06	2.83	28.32	5.37	78.94
73				1.31	0.05	3.03	23.92	11.76		0.05	1.89	16.74	4.51	62.46
74				1.36	0.04	2.72	25.03	11.97		0.04	1.95	16.70	4.96	73.85
75				0.95	0.14	1.43	9.89	9.31		0.03	1.20	7.17	5.37	78.62
76				1.23	0.14	1.44	9.02	13.42		0.03	1.24	9.91	5.03	64.43
77				1.46	0.09	1.21	6.20	9.10		0.02	1.22	9.13	5.22	75.78
78				1.27	0.06	0.93	5.13	10.74		0.02	1.24	8.74	5.39	73.25
79				1.46	0.09	0.98	5.62	10.36		0.01	0.94	6.20	4.69	63.64
80				1.13	0.07	0.76	3.85	11.82		0.01	0.93	5.81	4.31	77.79
81	24.12	16.88	44.08	0.99	0.08	1.02	5.61	11.56		0.02	1.17	8.86	4.62	65.19
82	27.04	26.26	56.81	0.60	0.07	0.81	4.72	14.16		0.02	1.15	8.47	3.80	51.57
83	19.76	28.54	52.50	0.47	0.09	0.86	4.23	13.94		0.01	0.91	6.13	4.11	59.68
84	21.17	15.25	38.33	0.71	0.06	0.74	3.72	11.35		0.01	0.95	6.25	5.02	88.05
85	12.77	12.52	28.77	0.67	0.06	0.81	5.42	10.26	1.00	0.02	1.21	9.19	4.25	52.74
86	26.65	13.44	44.29	0.24	0.04	0.51	3.10	8.05	0.82	0.02	1.26	9.23	4.12	54.38
87	23.87	19.80	46.48		0.04	0.45	2.66	8.47	1.39	0.01	0.84	5.96	3.71	51.42
88	28.67	15.40	44.25		0.05	0.66	3.71	13.82	0.96	0.01	0.73	4.14	3.15	48.70
89	16.33	11.26	29.29		0.05	0.63	3.65	13.71	0.76	0.01	0.79	5.30	3.19	54.26
90	22.83	10.45	36.63		0.03	0.52	2.50	5.44	0.62	0.01	0.83	5.30	2.62	40.98
91	40.93	9.41	53.44		0.04	0.50	2.34	5.21	0.73	0.01	0.78	5.41	2.47	37.10
92	33.30	12.98	49.05		0.04	0.47	2.29	3.90	1.08	0.01	0.77	4.78	2.38	35.03
93	25.51	13.26	41.30		0.04	0.59	2.97	2.23	0.75	0.01	0.79	5.00	2.76	42.95

(1) Data are from commercial categories, which was assumed coincide with age categories. (only 80-86 period was used for VPA).
(2) These indices were developed using three time periods (59-69, 69-75, 75-93). For the future VPA analysis, the Committee recommended to use only the period of 75-93 (by-catch period).
(3) These indices were calculated by multiplying indices in number of fish by annual mean weight of fish.
(4) These indices were calculated in three time period: 68-71, 72-89, 90-93. Last two periods were used independently in the VPA runs.

(*) LL indices in number of fish are normally assumed as mostly 5+ age group. However it is possible that a wider range of ages are included.
Note: Additional indices can be found in documents referenced in the text.

ALB-Table 6. Results of the base case VPA (run 1) in terms of abundance and fishing mortality of fish for ages 1 to 8+ and residuals for the indices used.

N at age (in millions of fish)

	AGES							
YEAR	1	2	3	4	5	6	7	8+
75	13.69	6.20	6.03	4.37	1.45	0.75	0.42	0.20
76	10.89	9.88	3.83	3.38	2.94	0.86	0.36	0.21
77	13.87	7.30	5.51	2.09	1.75	1.83	0.33	0.25
78	16.37	9.89	3.44	2.71	1.21	0.96	1.08	0.28
79	9.57	9.75	5.27	1.36	1.48	0.70	0.52	0.90
80	13.91	6.32	4.47	2.12	0.80	0.97	0.42	0.90
81	11.27	8.75	3.13	2.08	1.30	0.50	0.67	0.91
82	9.07	7.41	5.13	1.47	1.25	0.90	0.33	1.08
83	9.04	6.54	4.10	2.29	0.74	0.86	0.61	0.89
84	7.48	5.96	3.70	1.60	1.04	0.34	0.49	0.96
85	9.40	5.19	3.46	1.87	0.90	0.57	0.14	0.80
86	12.26	6.10	2.79	1.63	1.15	0.45	0.29	0.49
87	11.12	8.42	3.31	1.01	0.86	0.48	0.18	0.38
88	7.85	7.93	4.45	1.11	0.56	0.60	0.31	0.33
89	8.91	4.34	4.07	2.25	0.65	0.38	0.43	0.45
90	11.69	5.67	1.77	1.74	1.52	0.45	0.26	0.63
91	11.06	7.73	2.08	0.57	1.06	1.05	0.26	0.56
92	10.61	7.22	3.83	1.02	0.33	0.75	0.75	0.55
93	10.07	6.75	3.81	2.07	0.56	0.22	0.47	0.90

F at age

	AGES							
YEAR	1	2	3	4	5	6	7	8+
75	0.026	0.182	0.278	0.095	0.225	0.428	0.760	0.760
76	0.100	0.284	0.308	0.362	0.177	0.655	0.554	0.554
77	0.038	0.453	0.411	0.245	0.297	0.223	0.417	0.417
78	0.218	0.331	0.631	0.307	0.254	0.312	0.113	0.113
79	0.115	0.480	0.609	0.227	0.118	0.208	0.161	0.161
80	0.163	0.402	0.467	0.187	0.164	0.065	0.069	0.069
81	0.120	0.235	0.456	0.205	0.068	0.130	0.080	0.080
82	0.027	0.291	0.507	0.382	0.078	0.097	0.159	0.159
83	0.117	0.271	0.639	0.488	0.473	0.254	0.149	0.149
84	0.066	0.242	0.379	0.280	0.298	0.628	0.299	0.299
85	0.133	0.320	0.452	0.190	0.382	0.392	0.348	0.348
86	0.075	0.309	0.720	0.338	0.576	0.639	0.416	0.416
87	0.038	0.338	0.792	0.278	0.067	0.122	0.224	0.224
88	0.293	0.367	0.381	0.235	0.090	0.035	0.062	0.062
89	0.153	0.594	0.550	0.093	0.081	0.080	0.036	0.036
90	0.113	0.701	0.836	0.190	0.069	0.235	0.154	0.154
91	0.126	0.403	0.414	0.238	0.057	0.032	0.110	0.110
92	0.153	0.339	0.317	0.307	0.131	0.158	0.064	0.064
93	0.115	0.411	0.406	0.135	0.182	0.232	0.255	0.255

Residuals

		INDICES			
YEAR	SP2+3	FR2+3	JPNLL	TWLL1	TWLL2
75		-0.1196	0.6570	0.1272	
76		-0.0292	0.2162	-0.0719	
77		0.1300	0.0095	-0.1725	
78		-0.0401	-0.0810	-0.0186	
79		0.0327	-0.0871	-0.1900	
80		0.0627	-0.0975	-0.0195	
81	-0.0930		0.0492	0.0343	
82	0.0728		-0.2284	-0.0239	
83	0.0957		0.1379	0.1358	
84	-0.0130		-0.0862	0.0357	
85	-0.0690		0.0194	0.0558	
86	0.0996		-0.1593	-0.0304	
87	-0.0280		-0.0200	0.1010	
88	-0.0950		0.1487	0.3728	
89	-0.0370		0.0866	0.3434	
90	0.0762		-0.1248		0.0329
91	0.1034		-0.0511		0.1006
92	-0.0200		-0.0679		-0.0544
93	-0.0300		0.0723		-0.1098

ALB-Table 7. Sensitivity analyses to the base case VPA for the North Atlantic. An 'X' represents abundance indices used in the analyses. SP2+3 = Spain Troll, FR2+3 = France Troll, JPNLL = Japanese longline; TWLL1 = early Taiwan longline, TWLL2 = later Taiwan longline. Summary results are shown in ALB-Fig. 15.

Case	SP2+3	FR2+3	JPNLL	TWLL1	TWLL2
1	X	X	X	X	X
2	X	X	X	X	X
3	X	X	X	X	
4	X	X	X		
5	X	X		X	X
6	X	X	X	X	X
7	X	X	X	X	X
8	X	X	X	X	X
a	X	X	X	X	X
b	X	X	X	X	X
c	X	X	X	X	X

2 Indices weighted by the inverse of their mean squared error.
6 Spanish Troll indices for ages 2 and 3 used as separate series
7 As case 1, assuming Taiwan LL indexes all ages.
8 As case 1, assuming Taiwan and Japan LL index all ages.
a As case 1, without partial gear selectivities.
b Uses catch at age derived with 1993 growth parameters.
c Uses catch at age derived with 1994 growth parameters and alternative catch at size data (ALB-Table 5).

ALB-Table 8. Production model results for south Atlantic albacore for three models.

Age structured model:			
	Base Case Run (ASPM)	**Sesitivity Runs**	
Statistic	ASPM Model GLM Indices (Numbers)	ASPM model GLM Indices (weight)	ASPM Model GENMOD Indices
MSY (MT)	24,700	24,100	24,600
RY	25,600	25,000	26,400
B(1993)	38,700	37,900	19,500
B(1993)/K	0.222	0.213	0.131
B(1993)/B(MSY)	0.870	0.778	0.492
Steepness	0.867	0.832	0.982
F(1993)/F(MSY)	1.297	1.483	2.200

Sensitivity Trials: Age-aggregated Models:						
Statistics	AAPM Model		AAPM Model		ASPIC Model	
	Fox	Schaefar	Fox	Schaefar	Weighted	Unweighted
Statistic	GLM Indices (Numbers)		GLM Indices (Weight)			
MSY (MT)	21,600	18,800	22,100	19,700	22,300	22,040
RY	19,700	14,200	19,900	16,500	21,900	20,400
B(1993)	70,600	104,500	62,500	90,300	88,700	64,300
B(1993)/K	0.224	0.251	0.217	0.242	0.43	0.31
B(1993)/B(MSY)	0.608	0.502	0.590	0.484	0.87	0.73
r *	0.186	0.181	0.208	0.211	0.44	0.50
F(1993)/F(MSY)					1.14	1.38

* r is equal to r/ln(K) for the AAPM models.

BFT-E-Table 1. Summary of bluefin catches for 1963-1993 (as of Sept. 24, 1994). Total Atlantic and west Atlantic catches were up-dated later and found in BFT-W-Table 1.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
TOTAL	29318	35213	31002	22706	25207	15738	17385	15924	17461	14634	14607	24516	26249	28168	25468	20409	18478	19904	19617	23820	24274	26716	26836	22662	20429	27280	24871	24884	27051	28547	30498
WEST ATLANTIC	13838	18679	14171	8090	5940	3176	3012	5466	6591	3948	3871	5393	5032	5883	6694	5763	6255	5801	5771	1445	2542	2292	2685	2322	2591	3011	2867	2798	2992	2186	2538
EAST ATLANTIC	9020	10239	10834	9290	10523	4629	5683	5764	4675	4732	4685	6067	9976	5212	6977	5800	4767	4064	3331	6669	8082	7392	4759	4325	4199	6950	5320	5930	6735	7373	9563
BB	1178	1079	1820	3347	1805	1474	1826	3017	3055	3032	3142	2348	2991	1803	2881	3904	2128	1874	1553	957	3032	2948	2366	2253	2128	2682	2683	1993	1648	1466	4000
CAP VERT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	1	0	0	0	0	0	0	0	0	0
FRANCE	543	400	621	1624	860	390	534	732	680	740	540	522	692	267	592	723	275	260	153	150	400	566	380	272	533	479	306	367	448	372	164
JAPAN	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	0	0	0	0	0	0
PORTUGAL	0	0	0	0	0	0	0	0	0	0	0	191	303	24	14	56	10	17	16	30	53	15	3	28	58	29	1	12	0	++	2
ESPANA	635	676	1199	1723	945	1084	1292	2285	2375	2292	2602	1635	1996	1512	2275	3125	1843	1597	1384	777	2569	2366	1983	1953	1537	2174	2376	1614	1200	1094	3834
PS	1575	3458	3378	2737	4022	1149	1435	669	598	961	932	1455	3612	860	1426	257	266	437	266	655	262	414	86	288	0	0	0	8	4	66	14
MAROC	1419	2059	906	1778	2048	453	678	406	30	531	512	590	2624	331	662	36	206	155	105	600	187	127	86	122	0	0	0	8	4	66	14
NORWAY	156	1390	2472	959	1974	696	757	263	568	430	420	865	988	529	764	221	60	282	161	50	1	243	0	31	0	0	0	0	0	++	0
PORTUGAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	74	3	0	123	0	0	0	++	0	0	++
SAFRICA	0	9	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	0	0	0	0
ESPANA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41	0	12	0	0	0	0	0	0	0
USA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
TRAP	4472	5059	5172	3123	4540	1790	2220	1786	663	372	505	20	448	490	561	450	600	706	859	2309	2028	2271	1630	891	1062	2624	1478	2139	1799	1355	1498
MAROC	2318	2256	1882	1601	1331	635	59	286	63	122	1	7	0	0	222	0	0	6	72	393	166	0	0	0	123	235	304	228	759	84	254
PORTUGAL	354	303	90	122	209	55	261	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ESPANA	1800	2500	3200	1400	3000	1100	1900	1500	600	250	504	13	448	490	339	450	600	700	787	1916	1862	2271	1630	891	939	2389	1174	1911	1040	1271	1244
LL	1618	582	434	81	141	208	201	274	254	261	91	2243	2923	2048	1806	733	748	1002	575	2705	2626	1538	535	770	904	1169	853	1566	3114	3689	2813
CHITAIW	0	0	0	0	0	138	114	46	12	2	1	12	5	3	2	0	3	5	6	16	2	0	0	0	0	0	0	0	0	0	5
FRANCE	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	0	0	0	0	7	0
JAPAN	1618	582	404	50	100	13	2	21	157	240	44	2195	2900	1973	1594	577	630	880	515	2573	2609	1514	420	739	900	1169	838	1464	2981	3350	2484
KOREA	0	0	0	0	0	0	0	0	0	19	43	36	15	3	2	0	1	0	0	0	3	0	77	0	0	0	0	0	0	0	0
LIBYA	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	0	0	0	0	312	312
MAROC	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	0	0	8	2	16	8
NORWAY	0	0	30	31	41	57	85	207	85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PANAMA	0	0	0	0	0	0	0	0	0	0	3	0	0	69	208	156	14	117	48	12	0	17	22	11	4	**	**	**	**	**	0
PORTUGAL	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	0	0	62	99	4	4
ESPANA	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	100	0	6	104	12	7	16	20	0	0	15	32	32	0	0
OTH+UNCL	177	61	30	2	15	8	1	18	105	106	15	1	2	11	303	456	1025	45	78	43	134	221	142	123	105	475	306	224	170	797	1238
DENMARK	4	61	30	2	15	8	1	++	1	++	2	1	++	3	1	3	1	0	4	++	++	0	2	1	++	0	0	++	++	++	0
FRANCE	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	36	110	76	0	245	154	143	117	515	935
GERFR	++	++	++	++	0	++	++	14	1	6	2	0	0	0	0	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0
GREECE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	++	5	0	0	0	0	0	0	0	0	0	0	0
MAROC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	84	44	0	0	0	202	144	59	30	246	0
NETHERLA	0	0	0	0	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	0	0	0	0	0	0	0

BFT-E-Table 1. Continued.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
POLAND	0	0	0	0	0	0	0	0	100	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PORTUGAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	7	1	11	47	16	26	42	105	19	2	15	18	34	19
ESPANA	173	0	0	0	0	0	0	0	0	0	0	0	0	0	300	450	998	38	70	27	2	119	1	0	0	4	0	0	0	2	0
SWEDEN	++	0	++	++	++	++	0	4	3	0	0	0	2	8	2	2	++	++	1	++	1	++	0	0	0	++	++	0	1	++	0
NEI_1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	3	4	0	5	6	7	4	0	284
AZORES**	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	0	0	2	2	0	0
DENMARK	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	0	2	0	0	0	0
GERMANY F.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0
IRELAND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	2	2	0	0	0	190
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	0	1	0	0	0	0
PORTUGAL**	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	0	0	0	0	0	54
U K	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	3	1	5	2	0	40
MEDITERRANEAN	6460	6295	5997	5326	8744	7933	8690	4694	6195	5954	6051	13056	11241	17073	11797	8846	7456	10039	10515	15706	13650	17032	19392	16015	13639	17319	16684	16156	17324	18988	18397
PS	1533	1261	435	1876	2919	3341	3629	2393	3904	4084	4324	8119	8065	13970	9563	7299	6103	8541	8529	12131	10484	9888	13408	10788	8755	11365	10512	11148	12255	13467	11729
CROATIA	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	0	0	0	538	347	176
FRANCE	0	0	0	1000	1500	2500	1500	1100	2200	1100	1400	1800	1600	3800	3182	1566	1527	1701	2300	4818	3600	3570	5400	3460	4300	5750	4404	4663	4570	5970	4730
ITALY	1256	990	301	630	1088	691	1828	1203	1336	2783	2700	6000	6270	9607	5431	4663	3705	6120	5704	6442	5552	5382	4522	4789	2579	2229	2345	2531	2660	3730	3597
LIBYA	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	0	0	109	122	200	400
MAROC	0	0	0	0	0	0	0	0	42	1	0	2	40	1	7	0	2	++	2	++	0	0	0	0	0	0	0	0	0	0	1
ESPANA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	277	0	79	45	110	170	160	300	635	807	1366	1431
TUNISIE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	21	113	147	97	108	110	102	127	109	148	153	94	114	1073	1126	984
TURKEY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2230	1524	910	1550	2809	2137	2436	679	361
YUGOSLAV	277	271	134	246	331	150	301	90	326	200	224	317	155	562	932	1049	756	573	376	486	1222	755	1084	796	648	1523	560	940	0	0	0
NEI_2	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	0	0	19	49	49	49
TRAP	2059	3081	3872	2250	3337	3082	3768	1394	1548	1465	1041	2362	1579	1518	1156	1008	750	545	587	1364	1318	2236	760	683	913	1034	1311	1615	581	791	366
ALGERIE	++	++	++	150	150	150	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ITALY	1227	1652	1264	945	1949	1739	1324	961	1044	835	367	739	713	650	698	210	195	152	209	155	284	327	295	293	310	301	301	290	263	368	115
LIBYA	100	400	600	700	800	1000	2000	0	208	449	475	1469	780	799	336	677	424	339	255	130	270	274	0	0	0	0	0	26	29	150	160
MAROC	0	0	172	11	27	5	0	0	37	36	1	7	0	0	0	0	0	0	0	0	0	0	0	38	110	96	286	580	22	82	4
ESPANA	472	653	1235	151	104	4	217	280	53	88	146	11	3	3	2	1	0	0	3	66	37	621	302	168	219	228	231	470	24	16	6
TUNISIE	260	376	601	293	307	184	77	153	206	57	52	136	83	66	120	120	131	54	120	188	170	145	163	184	274	409	493	249	243	175	81
TURKEY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	825	557	869	0	0	0	0	0	0	0	0	0
LL	800	300	400	500	300	600	400	69	129	236	520	2387	1363	1218	592	153	199	229	310	1510	949	1175	1207	637	726	1166	1055	839.1	2458	2607	4233
ALGERIE	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	0	0	0	0	304	0
CYPRUS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	10	10	10	10	10	10	10	10	10	10	10	10	10
ITALY-TYR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	41	62	1	65	63	63	59	82	52	33
ITALY-ADR	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	0	0	0	0	7	11
JAPAN	0	0	0	0	0	0	0	0	0	112	246	2195	1260	968	520	61	99	119	100	961	677	1036	1006	341	280	258	127	172	85	123	793
LIBYA	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	0	0	123	139	320	546
MALTA	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	0	0	0	63	94	151
MAROC	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	0	0	1	0	0	1
PANAMA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

BFT-E-Table 1. Continued.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
PORTUGAL	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	0	0	0	278	320	183
CHI-TAIW	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	0	0	0	0	0	328
ESPANA	800	300	400	500	300	600	400	69	129	124	274	192	103	250	68	92	100	100	200	538	233	69	129	117	116	135	98	59	51	28	40
NEI_1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	19	0	168	255	699.5	756.8	415.1	1750	1349	2137
CANARIAS	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	0	0	0	78	247	0
GHANA	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	66	0	0	0	0	0
HONDURAS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	123	403	353	168	428	274	287
KOREA***	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	19	0	156	1	12	45	20	229	101	573
MALTA***	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	0	0	0	0	111	156
MOROCCO***	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	0	0	0	0	0	0
PANAMA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	72	67	0	74	333	616	1121
ST VINCENT	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	0	0	0	105	0	0
VENEZUELA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	59	151	359	154	578	0	0
OTH+UNCL	2068	1653	1290	700	2188	910	893	838	614	169	166	188	234	367	486	386	404	724	1089	701	899	3733	4017	3907	3245	3754	3806	2554	2030	2123	2069
ALGERIE	0	0	0	0	0	0	0	100	100	1	++	33	66	49	40	20	150	190	220	250	252	254	260	566	420	677	820	782	800	800	800
CYPRUS	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	0	0	0	0	0	4
FRANCE	668	953	390	0	0	0	0	0	0	0	0	0	0	0	0	31	51	0	50	60	60	30	30	30	30	30	30	50	50	30	30
GREECE	1200	600	700	500	600	500	500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	131	99	102	131	155	123	92	329
ITALY	0	0	0	0	0	0	0	100	100	100	100	100	100	112	134	110	120	0	104	61	0	1390	2320	2493	1653	1608	1608	794	490	395	319
ITALY-ADR	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	0	0	0	0	4	4
LIBYA	0	0	0	0	0	0	0	500	392	0	0	0	0	0	0	0	0	59	16	180	0	0	300	300	300	300	84	0	0	0	0
MALTA	100	100	100	100	100	100	++	++	++	++	++	21	37	25	47	26	23	24	32	40	31	21	21	41	36	26	34	66	0	0	0
MAROC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	12	18	0	44	9	6	7	2	1
ESPANA	0	0	0	0	0	0	0	0	0	0	0	0	14	0	88	72	15	33	101	108	542	1974	984	306	673	905	1016	658	510	755	537
TUNISIE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	27	1	2	13	60	79	22	34	62	74	43	50	45	45
TURKEY	100	0	100	100	1488	310	393	138	22	68	66	34	17	181	177	127	27	391	565	0	0	0	0	0	0	0	0	0	0	0	0

"++ CATCH: < 0.5 MT

* Nowhere else included - Based on import statisics but flags of fishing vessels and regions of catches are uncertain.

** CATCH: UNKNOWN

*** Import (converted to live weight) less reported national catch

NOTE ON NEI CATCH ESTIMATES:

- Estimation was based on import statistics to Japan. All the products of "bluefin", "tunas and marlins", "tuna meat" and "tuna fillet", the unit price of which exceded 2000 yen per kg (in case of GG, exceded 1000 yen) were considered to be bluefin tuna.
- Estimation for U.K and Irland is based on the proportion of albacore vs. bluefin catches of French drift net.
- Original data for GG (gilled and gutted) were not separated for head-off or head-on. Hence separation was made by the SCRS based on the national information on products.
- Others" were, in principle considered as as "GG head off". However 1/3 of the "Others" from Spain was considered as belly while 2/3 was considered as GG head off.
- Tunas and marlins" from Portugal was excluded, although the price was higer than the cut-off line. This is because the major part of these products were considered as bigeye tuna.
- Import from St Vincent and Ghana were considered those caught in the Mediterranean Sea by these flag vessels.
- Year of import was assumed to be the same as year of catch

CONVERSION FACTORS (to ROUND WEIGHT) USED

1.250 X GG (Gilled and Gutted) HEAD OFF
1.160 X GG (Gilled and Gutted) HEAD ON
1.670 X F (Fillet)
12.500 X Belly part

BFT-E-Table 2. Uncertainties of data, as indicated by scientists involved in research of respective fishery.

AREA	COUNTRY	GEAR	PERIOD	ESTIMAT	RANGE (%) "-"	RANGE (%) "+"
3	ALGERIE	LL	92	MEAN	5	5
3	ALGERIE	HAND(UNCL)	70-78	MEAN	10	10
3	ALGERIE	HAND(UNCL)	79-85	MAX	50	0
3	ALGERIE	HAND(UNCL)	86-93	MAX	70	0
3	SPAIN	BB	84	PRECISE	0	0
3	SPAIN	BB	85	MIN	0	20
3	SPAIN	BB	90	MIN	0	50
3	SPAIN	BB	91-92	MIN	5	50
3	SPAIN	BB	93	MEAN	5	5
3	SPAIN	HAND	83-87	MIN	0	5
3	SPAIN	HAND	88	MAX	10	1
3	SPAIN	HAND	89	MIN	1	10
3	SPAIN	HAND	90	MIN	1	5
3	SPAIN	HAND	91	MIN	0	50
3	SPAIN	HAND	92	MIN	1	50
3	SPAIN	HAND	93	MEAN	5	5
3	SPAIN	LLHB	81	MEAN	5	5
3	SPAIN	LLHB	82		50	5
3	SPAIN	LLHB	83		20	5
3	SPAIN	LLHB	84		5	20
3	SPAIN	LLHB	85		5	10
3	SPAIN	LLHB	86	MEAN	5	5
3	SPAIN	LLHB	87-93		5	10
3	SPAIN	PS	84		0	5
3	SPAIN	PS	85		0	20
3	SPAIN	PS	86		0	10
3	SPAIN	PS	87-88		0	20
3	SPAIN	PS	89		0	10
3	SPAIN	PS	90-91		0	5
3	SPAIN	PS	92		0	1
3	SPAIN	PS	93		0	0
3	SPAIN	SURF	83-84		0	5
3	SPAIN	SURF	85		20	1
3	SPAIN	SURF	86		10	10
3	SPAIN	SURF	87		10	1
3	SPAIN	SURF	88		0	10
3	SPAIN	SURF	89		20	0
3	SPAIN	SURF	90		0	5
3	SPAIN	SURF	91		0	10
3	SPAIN	SURF	92-93		0	5
1	SPAIN	TRAP	81-93		1	1
3	SPAIN	TRAP	81-93		1	1
3	SPAIN	UNCL	85		5	30
3	SPAIN	UNCL	86		5	20
3	SPAIN	UNCL	87		5	10
3	SPAIN	UNCL	88-91		1	5
3	SPAIN	UNCL	92		1	1
3	SPAIN	UNCL	93		0	0
3	NEI-I	LL	82-89	MIN	0	50
3	NEI-I	LL	90-92	MIN	0	100
3	NEI-I	LL	93	MIN	0	200
3	TUNISIE	PS	77-93	MIN	0	15
3	TUNISIE	TRAP	64-79	MAX	10	0
3	TUNISIE	TRAP	80-93	MEAN	5	5
3	TUNISIE	HAND	79-93	MEAN	5	5

AREA	COUNTRY	GEAR	PERIOD	ESTIMAT	RANGE (%) "-"	RANGE (%) "+"
3	FRANCE	PSM	70-80		10	20
3	FRANCE	PSM	81-93		5	10
3	FRANCE	SPORT	81-93		10	20
3	FRANCE	UNCL	78-79		10	20
3	FRANCE	UNCL	81-83		10	20
1	FRANCE	GILL	88-93	MAX	10	0
1	FRANCE	MWTD	88-93	MEAN	10	10
1	FRANCE	TROL	84-86	MEAN	10	10
1	FRANCE	UNCL	89	MEAN	10	10
3	GREECE	UNCL	86-87	MEAN	10	10
3	GREECE	UNCL	88-92	MEAN	20	20
3	GREECE	UNCL	93		227M	329MT
3	ITALY	PS	70-93	MIN	0	5
3	ITALY	HAND	70-77	MEAN	25	25
3	ITALY	HAND	78-79	MEAN	10	10
3	ITALY	HAND	80-83	MEAN=65	10MT	120MT
3	ITALY	HAND	84-85	MEAN	20	20
3	ITALY	HAND	90-91	MEAN	10	10
3	ITALY	HAND	92	MIN	0	5
3	ITALY	HAND	93	MIN	0	10
3	ITALY	HARP	76-93	PRECISE	0	0
3	ITALY	LL	83-89	MEAN	5	5
3	ITALY	LL	90-93	MEAN	5	10
3	ITALY	SPOR	90-93	MEAN	10	10
3	ITALY	TRAP	70-93	MIN	0	5
3	ITALY	UNCL	81-82	MEAN	5	10
3	ITALY	UNCL	84-89	MEAN	5	10
3	ITALY-LIG	PSFS	72-93	MIN	0	5
3	ITALY-LIG	GILL	91-93		0	0
3	ITALY-LIG	SPOR	84-85	MIN	0	7
3	ITALY-LIG	SPOR	86-89	MEAN	5	5
3	ITALY-LIG	UNCL	91	MIN	0	5
3	ITALY-ADR	PS	71-73	MIN	0	10
3	ITALY-ADR	PS	76-78	MIN	0	10
3	ITALY-ADR	PS	79-83	MEAN	25	25
3	ITALY-ADR	PS	84-85	MIN	0	5
3	ITALY-ADR	PS	86-93	MEAN	25	25
3	ITALY-ADR	RR	84-93	MEAN	25	25
3	TURKEY	PS	85-88		0	0
3	TURKEY	PS	89-93	MEAN	15	15
3	TURKEY	TRAP	82-84		0	0
3	TURKEY	UNCL	64-66		0	0
3	TURKEY	UNCL	67	MAX	70	0
3	TURKEY	UNCL	68-81		0	0
3	TURKEY	UNCL	92-93	MEAN	15	15
3	MAROC	PS	86-93	MEAN	5	5
3	MAROC	TRAP	86-90		0	0
3	MAROC	TRAP	91-93	MEAN	25	25
3	MAROC	UNCL	86-93	MEAN	5	5
1	MAROC	PS	86-93	MEAN	5	5
1	MAROC	TRAP	86-91	MIN	0	5
1	MAROC	TRAP	92-93	MIN	0	15
1	MAROC	LL	90-93	MEAN	5	5
1	MAROC	UNCL	88-93	MEAN	5	5

BFT-E-Table 3. Size data availability for East Atlantic catches (NO=data not available, YES=data available).

YEAR	EAST ATLANTIC MT		%		MEDITERRANEAN MT		%		TOTAL EAST MT		%	
	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
1970	2608	3156	45.2	54.8	2353	2341	50.1	49.9	4961	5497	47.4	52.6
1971	2343	2332	50.1	49.9	2898	3297	46.8	53.2	5241	5629	48.2	51.8
1972	2880	1852	60.9	39.1	4505	1300	77.6	22.4	7385	3152	70.1	29.9
1973	2441	2244	52.1	47.9	4184	1792	70.0	30.0	6625	4036	62.1	37.9
1974	2770	3297	45.7	54.3	8081	4006	66.9	33.1	10851	7303	59.8	40.2
1975	5610	4366	56.2	43.8	4048	7047	36.5	63.5	9658	11413	45.8	54.2
1976	2069	3143	39.7	60.3	12121	4952	71.0	29.0	14190	8095	63.7	36.3
1977	2469	4508	35.4	64.6	3758	8039	31.9	68.1	6227	12547	33.2	66.8
1978	1198	4602	20.7	79.3	3997	4849	45.2	54.8	5195	9451	35.5	64.5
1979	511	4256	10.7	89.3	1973	5483	26.5	73.5	2484	9739	20.3	79.7
1980	543	3521	13.4	86.6	4715	5314	47.0	53.0	5258	8835	37.3	62.7
1981	461	2870	13.8	86.2	5713	4792	54.4	45.6	6174	7662	44.6	55.4
1982	1236	5433	18.5	81.5	6261	9436	39.9	60.1	7497	14869	33.5	66.5
1983	889	7138	11.1	88.9	7510	6160	54.9	45.1	8399	13298	38.7	61.3
1984	870	6522	11.8	88.2	8248	8799	48.4	51.6	9118	15321	37.3	62.7
1985	839	3920	17.6	82.4	6974	12479	35.9	64.1	7813	16399	32.3	67.7
1986	651	3677	15.0	85.0	7333	8629	45.9	54.1	7984	12306	39.3	60.7
1987	830	3379	19.7	80.3	5723	7891	42.0	58.0	6553	11270	36.8	63.2
1988	997	5762	14.8	85.2	5797	11449	33.6	66.4	6794	17211	28.3	71.7
1989	914	4405	17.2	82.8	6600	9708	40.5	59.5	7514	14113	34.7	65.3
1990	892	5021	15.1	84.9	10331	5660	64.6	35.4	11223	10681	51.2	48.8
1991	1392	3884	26.4	73.6	10942	4750	69.7	30.3	12334	8634	58.8	41.2
1992	1673	5686	22.7	77.3	11520	7013	62.2	37.8	13193	12699	51.0	49.0
1993	1999	7562	20.9	79.1	11632	6828	63.0	37.0	13631	14390	48.6	51.4

BFT-E-Table 4. Catch at age for the east Atlantic bluefin tuna - 1994 assessment session.

AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	131718	10520	116581	142935	187116	696771	96878	217545	151715	75632	111411	149769
2	76235	88641	148601	66885	130118	289275	188236	289457	194104	33969	164498	339497
3	26881	53183	77235	83721	57043	34843	281023	45387	152611	103914	124021	111215
4	16341	14685	11366	6270	63113	19915	39694	64050	19182	50033	30602	13009
5	9845	12392	8306	3326	7489	6115	20424	2332	5166	7012	9127	14867
6	8217	3631	7119	3331	5034	4443	5059	5261	1547	2414	4644	5662
7	4541	4389	4302	6777	3306	3268	3175	3983	2875	2293	3080	3839
8	3550	9643	2341	7931	4702	3394	2030	2461	1799	3939	2281	4566
9	5576	5632	3339	8541	10901	5428	3793	2499	1224	3659	2385	3424
10+	24765	18506	15927	16824	42250	54549	39131	36196	26771	22795	24489	17676
Total	307669	221222	395119	346541	511072	1117999	679444	669172	556994	303659	476537	663524

AGE	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	700457	706903	172846	216821	624913	259574	817095	461926	499863	317315	306030	312830
2	226063	169908	643032	358976	276312	445351	170048	421292	364630	435371	527801	536431
3	191499	121275	48840	316563	167550	109516	249796	89397	196724	153820	203744	285356
4	23557	24955	36453	31835	74999	30342	29549	64496	54680	37445	32308	47317
5	5344	12516	19563	13311	8290	9776	9719	37856	24471	18708	9605	14050
6	3290	3354	10181	9010	5691	7727	10801	6746	8104	6439	8542	11228
7	5218	9849	6222	4100	2760	8291	11849	11855	6946	2712	8773	5488
8	8963	5858	6622	3596	2031	4023	6626	6798	10029	3636	7682	3415
9	5182	4495	10289	3831	3021	3470	5545	4747	10768	10201	10135	5132
10+	38936	39683	46584	33307	26879	23764	35880	24503	24412	33692	44468	47867
Total	1208508	1098795	1000631	991351	1192446	901835	1346907	1129617	1200627	1019338	1159088	1269114

BFT-E-Table 5. Abundance indices available for 1994 east bluefin assessment.

Index	JPN	Fr 2	Fr 3	BB 2	BB 2	Trap B
Country	Japan	France	France	Spain-1	Spain-2	Spain
Gear	LL	PSM	PSM	BB	BB	TRAP
Area	E. Atl.	G. Leons	G. Leons	E. Atl. B. Biscay	E. Atl. B. Biscay	E. Atl. Gibrartal
Unit	No.	No.	No.	No.	No.	Biomass
Ages	8+	2	3	2	2	7+
Year						
1950	-	-	-	-	-	8265
1951	-	-	-	-	-	5856
1952	-	-	-	-	-	6944
1953	-	-	-	-	-	10447
1954	-	-	-	-	-	7610
1955	-	-	-	-	-	8423
1956	-	-	-	-	-	13371
1957	-	-	-	-	-	15824
1958	-	-	-	-	-	16622
1959	-	-	-	-	-	11061
1960	-	-	-	-	-	10430
1961	-	-	-	-	-	7576
1962	-	-	-	-	-	9014
1963	-	-	-	-	-	4472
1964	-	-	-	-	-	5059
1965	-	-	-	-	-	5172
1966	-	-	-	-	-	3123
1967	-	-	-	-	-	4540
1968	-	-	-	-	-	1790
1969	-	-	-	-	-	2220
1970	-	-	-	36.1	-	1786
1971	-	-	-	27.5	-	663
1972	-	-	-	26.7	-	372
1973	-	-	-	51.2	-	505
1974	-	-	-	38.8	-	20
1975	1.000	-	-	81.3	-	448
1976	0.835	-	-	53.6	-	490
1977	1.163	-	-	58.6	-	561
1978	0.570	-	-	-	33.0	450
1979	0.459	-	-	-	10.4	600
1980	0.793	-	-	-	22.6	706
1981	0.727	-	-	-	33.8	859
1982	0.873	245.7	143.7	-	31.5	2309
1983	0.522	124.3	109.4	-	44.2	2028
1984	0.425	332.9	35.9	-	140.0	2271
1985	0.581	114.7	172.7	-	67.9	1630
1986	0.450	85.7	86.0	-	48.5	891
1987	0.709	245.3	60.9	-	86.0	1062
1988	0.555	52.2	142.4	-	59.8	2624
1989	0.286	280.5	54.0	-	63.2	1478
1990	0.387	201.5	62.2	-	33.7	2139
1991	0.391	253.6	53.9	-	63.8	1799
1992	0.332	304.7	77.9	-	64.7	1355
1993	0.304	157.2	56.9	-	142.5	1498

BFT-E-Table 6. Trends and 90% confidence limits for CPUE indices used.

Series	S - max Year	End Year	Annual change Est.	(C.V.)	[90%, C.I.]	End year/S-max year Est.	(C.V.)	[90%, C.I.]
JLL	75	93	-0.058	(0.18)	[-0.075, -.0.41]	0.35	(0.19)	[0.26, 0.48]
	78	93	-0.049	(0.27)	[-0.071, -0.026]	0.48	(0.20)	[0.34, 0.67]
	82	93	-0.070	(0.29)	[-0.103, -0.037]	0.47	(0.22)	[0.32, 0.66]
ES-TRAP	70	93	0.081	(0.32)	[+0.039, +0.122]	6.39	(0.66)	[2.47, 16.45]
	82	93	-0.022	(>10)	[-0.068, +0.024]	0.79	(0.30)	[0.47, 1.30]
FR-PS-2	82	93	0.210	(2.20)	[-0.063, +0.104]	1.26	(0.57)	[0.50, 3.15]
FR-PS-3	82	93	-0.056	(0.69)	[-0.121, +0.008]	0.54	(0.43)	[0.26, 1.09]
ES-BB-1	71	77	0.147	(0.36)	[+0.063, +0.238]	2.42	(0.33)	[1.46, 4.18]
ES-BB-2	78	93	0.091	(0.31)	[+0.044, +0.135]	3.90	(0.48)	[1.93, 7.60]

Note: Series estimated from linear regression fit to log (abundance) data.

BFT-E-Table 7. Partial recruitment for different periods, east bluefin stock

Ref. age	2	2	2	2	2	2	2	2
S=	1	0.5	1	1	0.5	1	0.5	1.5
F=	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Period	70-73	70-73	74-81	82-87	74-87	88-93	88-93	88-93
AGE								
1	0.360	0.371	0.583	0.694	0.632	0.588	0.600	0.583
2	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
3	1.289	1.238	1.121	0.753	0.902	0.871	0.844	0.883
4	0.470	0.432	0.607	0.298	0.389	0.382	0.359	0.393
5	0.342	0.305	0.174	0.141	0.135	0.246	0.225	0.256
6	0.208	0.181	0.124	0.115	0.089	0.155	0.139	0.163
7	0.240	0.203	0.133	0.151	0.099	0.168	0.147	0.177
8	0.432	0.354	0.151	0.158	0.111	0.176	0.150	0.187
9	0.847	0.650	0.207	0.196	0.139	0.282	0.234	0.304
10	0.411	0.292	0.269	0.387	0.204	0.526	0.417	0.578
11	0.362	0.241	0.342	0.471	0.248	0.669	0.494	0.761
12	0.328	0.204	0.449	0.607	0.307	0.618	0.416	0.738
13	0.510	0.293	0.821	0.891	0.461	0.897	0.536	1.159
14	1.000	0.500	1.000	1.000	0.500	1.000	0.500	1.500
F-ratio	0.616	0.471	3.104		2.475	2.631	2.020	

BFT-E-Table 8. Estimates of east Atlantic bluefin stock size (on January 10) by age for 1970-1993

AGE	70	71	72	73	74	75	76	77	78	79	80	81	82
1	475914	655284	518333	691606	1278462	1272378	1061554	871533	554804	670669	1025570	852981	1377950
2	294230	291525	559877	342352	468476	937464	463470	832723	555731	341547	512696	787944	602353
3	216889	185035	171235	348827	235483	286547	546740	228700	455709	303269	265321	293207	370953
4	201678	163553	111525	77451	225526	151761	216704	215872	156656	254725	169191	116030	151910
5	297330	160123	128523	86380	61498	137506	113414	151507	128262	118349	174963	118648	88771
6	112728	249318	127671	104000	71999	46499	113848	79616	129540	106697	96360	143607	89319
7	54699	90354	213364	104362	87310	57906	36290	94265	64318	111176	90510	79447	119571
8	55771	43327	74462	181483	84421	72824	47300	28595	78240	53239	94516	75818	65493
9	38084	45183	28710	62553	150389	69015	60150	39230	22570	66343	42617	80044	61663
10+	343934	303874	280987	251306	249253	298014	263336	241311	207912	174333	184629	172563	199972
2-4	712798	640113	842638	768630	929486	1375771	1226914	1277295	1168096	899541	947208	1197181	1125216
4-10+	1104225	1055732	965243	867535	930396	833525	851042	850395	787499	884862	852786	786158	776699
5-9	558612	588305	572731	538777	455617	383750	371083	393212	422931	455804	498967	497565	424817
8-10+	437790	392384	384160	495341	484063	439853	370786	309136	308722	293915	321763	328426	327128

AGE	83	84	85	86	87	88	89	90	91	92	93	94
1	2391511	1099267	929773	1781774	816697	1860450	1294075	1532576	1687614	1380422	766438	0
2	551172	1423399	794973	606981	969962	469335	861687	697051	868974	1172292	915869	376785
3	314294	321605	642889	359202	272224	431539	250492	359928	269437	353378	531113	301978
4	145710	160940	234184	266488	157411	135290	144965	134941	131448	92453	119441	198447
5	110164	103481	106063	173985	162091	108653	90172	66383	66701	79536	50436	60035
6	72200	84128	71784	79826	143538	131813	85414	43366	35044	40631	60211	30811
7	74587	59645	63668	54025	64099	117591	104541	67977	30168	24482	27389	41911
8	99092	55683	46065	51533	44397	48015	91206	79855	52632	23701	13155	18712
9	48603	80693	42248	36700	42909	34851	35579	72962	60095	42373	13481	8266
10+	186456	163308	159340	140748	126479	121947	97876	88859	108017	105428	77939	30661
2-4	1011176	1905944	1672047	1232671	1399598	1036164	1257144	1191920	1269858	1618122	1566423	877210
4-10+	736812	707879	723353	803305	740925	698161	649754	554343	484105	408604	362052	388843
5-9	404646	383631	329829	396069	457035	440923	406912	330543	244640	210723	164672	159735
8-10+	334152	299685	247653	228981	213785	204813	224662	241676	220744	171502	104576	57639

BFT-E-Table 9. Estimates of east Atlantic bluefin tuna stock fishing mortality rates by age for 1970-1991

AGE	70	71	72	73	74	75	76	77	78	79	80	81	82
1	0.3501	0.0174	0.2748	0.2495	0.1702	0.8699	0.1028	0.3100	0.3451	0.1286	0.1236	0.2079	0.7763
2	0.3238	0.3921	0.3331	0.2342	0.3516	0.3992	0.5663	0.4628	0.4657	0.1125	0.4188	0.6133	0.5105
3	0.1423	0.3663	0.6534	0.2961	0.2993	0.1394	0.7893	0.2384	0.4417	0.4436	0.6871	0.5176	0.7945
4	0.0907	0.1010	0.1155	0.0906	0.3548	0.1513	0.2179	0.3806	0.1404	0.2356	0.2149	0.1278	0.1813
5	0.0361	0.0865	0.0717	0.0421	0.1396	0.0488	0.2138	0.0166	0.0441	0.0655	0.0575	0.1439	0.0666
6	0.0812	0.0157	0.0616	0.0349	0.0778	0.1079	0.0488	0.0734	0.0129	0.0245	0.0530	0.0432	0.0403
7	0.0931	0.0534	0.0218	0.0721	0.0414	0.0623	0.0983	0.0463	0.0491	0.0223	0.0371	0.0532	0.0479
8	0.0705	0.2715	0.0343	0.0479	0.0615	0.0512	0.0471	0.0966	0.0249	0.0825	0.0262	0.0667	0.1583
9	0.1703	0.1432	0.1329	0.1579	0.0808	0.0880	0.0699	0.0706	0.0599	0.0609	0.0618	0.0469	0.0943
10+	0.0802	0.0674	0.0626	0.0744	0.2000	0.2177	0.1731	0.1748	0.1482	0.1507	0.1530	0.1161	0.2333
2-4	0.1973	0.3024	0.3569	0.2460	0.3388	0.3104	0.5819	0.4050	0.4064	0.2493	0.4446	0.5316	0.5398
4-10+	0.0732	0.0724	0.0602	0.0676	0.1709	0.1331	0.1536	0.1586	0.0829	0.1181	0.1010	0.0897	0.1331
5-9	0.0627	0.0671	0.0487	0.0613	0.0767	0.0653	0.1047	0.0461	0.0325	0.0464	0.0473	0.0722	0.0732
8-10+	0.0865	0.0966	0.0621	0.0747	0.1368	0.1673	0.1389	0.1536	0.1090	0.1173	0.1020	0.0874	0.1905
F10+/F9	0.4710	0.4710	0.4710	0.4710	2.4750	2.4750	2.4750	2.4750	2.4750	2.4750	2.4750	2.4750	2.4750

AGE	83	84	85	86	87	88	89	90	91	92	93
1	0.3789	0.1841	0.2864	0.4681	0.4140	0.6297	0.4787	0.4274	0.2244	0.2703	0.5701
2	0.3987	0.6548	0.6544	0.6619	0.6699	0.4879	0.7330	0.8105	0.7598	0.6517	0.9695
3	0.5293	0.1772	0.7406	0.6850	0.5592	0.9509	0.4786	0.8673	0.9296	0.9447	0.8445
4	0.2022	0.2770	0.1571	0.3572	0.2307	0.2657	0.6411	0.5646	0.3624	0.4660	0.5479
5	0.1296	0.2257	0.1442	0.0524	0.0668	0.1006	0.5921	0.4988	0.3557	0.1383	0.3528
6	0.0510	0.1387	0.1442	0.0794	0.0594	0.0918	0.0863	0.2229	0.2187	0.2544	0.2223
7	0.1523	0.1184	0.0715	0.0563	0.1489	0.1141	0.1294	0.1158	0.1013	0.4811	0.2410
8	0.0654	0.1361	0.0873	0.0431	0.1021	0.1597	0.0832	0.1443	0.0768	0.4242	0.3247
9	0.1042	0.1467	0.1021	0.0922	0.0906	0.1865	0.1540	0.1718	0.2002	0.2950	0.5201
10+	0.2580	0.3630	0.2528	0.2283	0.2242	0.3768	0.3111	0.3470	0.4045	0.5958	1.0507
2-4	0.4055	0.5220	0.5976	0.5939	0.5885	0.6178	0.6664	0.7957	0.7426	0.6965	0.8878
4-10+	0.1580	0.2296	0.1582	0.1797	0.1348	0.1843	0.2978	0.3123	0.2861	0.3813	0.5027
5-9	0.1003	0.1595	0.1163	0.0607	0.0812	0.1144	0.1964	0.2168	0.2010	0.2571	0.2942
8-10+	0.1744	0.2565	0.1934	0.1614	0.1700	0.2883	0.1881	0.2230	0.2611	0.4891	0.8482
F10+/F9	2.4750	2.4750	2.4750	2.4750	2.4750	2.0200	2.0200	2.0200	2.0200	2.0200	2.0200

BFT-E-Table 10. **Estimates of equilibrium yield per recruit for east Atlantic bluefin tuna.**

BASE CASE

F level	*F* [93][a]	*F* [93][b]	F_{max}[a]	F_{max}[b]
Yield/recruit (kg)	7.218	10.020	21.857	23.215
% Change*	0%	38.8%	202.8%	221.6%
Yield (1000 mt)**	10.2	14.2	31.0	32.9

RETRO-ADJUSTED

F level	*F* [93][a]	*F* [93][b]	F_{max}[a]	F_{max}[b]
Yield/recruit (kg)	9.974	11.807	20.336	21.309
% Change*	0%	18.4%	103.9%	113.6%
Yield (1000 mt)**	14.1	16.7	28.8	30.2

a. Includes catch of fish under 6.4 kg.
b. Approximates agreement for no catch of fish under 6.4 kg.
* Change in yield per recruit relative to that obtained from the 1993 F.
** Equilibrium yield corresponding to the geometric means of the estimated recruitment for the period 1982-1991 (1.417 million fish).

BFT-E-Table 11. Estimated number and percentage of bluefin tuna weighing less than 6.4 kg in the total catches by region

Year	EAST ATLANTIC				MEDITERRANEAN				E. ATLANTIC + MEDITERRANEAN			
	No. fish <6.4 kg	No. fish > 6.4 kg	No. fish Total	% (No.) < 6.4kg	No. fish <6.4 kg	No. fish > 6.4 kg	No. fish Total	% (No.) < 6.4kg	No. fish <6.4 kg	No. fish > 6.4kg	No. fish Total	% (No.) < 6.4kg
71	7214	115937	123150	5.9	176831	97557	274388	64.4	184045	213494	397538	46.3
72	85173	129260	214434	39.7	37224	181234	218459	17.0	122398	310494	432892	28.3
73	136976	93559	230535	59.4	91995	118185	210180	43.8	228971	211744	440715	52.0
74	122497	149496	271993	45.0	188206	198024	386230	48.7	310703	347519	658223	47.2
75	550606	281463	832069	66.2	192386	259042	451427	42.6	742991	540505	1283496	57.9
76	69438	102288	171726	40.4	102609	503471	606079	16.9	172046	605759	777805	22.1
77	142895	175043	317937	44.9	300430	305612	606042	49.6	443324	480655	923979	48.0
78	90266	163925	254190	35.5	195668	298452	494120	39.6	285933	462377	748310	38.2
79	72521	76451	148972	48.7	52003	155545	207548	25.1	124524	231996	356520	34.9
80	97854	73923	171777	57.0	62470	296235	358705	17.4	160324	370158	530482	30.2
81	115316	67543	182859	63.1	62423	453480	515904	12.1	177739	521023	698763	25.4
82	178362	86622	264984	67.3	288783	730914	1019698	28.3	467145	817536	1284682	36.4
83	391005	128459	519466	75.3	535590	386052	921642	58.1	926595	514511	1441108	64.3
84	48549	241441	289991	16.7	88315	624012	712327	12.4	136864	865453	1002318	13.7
85	44882	171158	216041	20.8	541382	623019	1164402	46.5	586264	794177	1380443	42.5
86	371518	126869	498388	74.5	780444	501866	1282311	60.9	1151962	628735	1780699	64.7
87	61992	156177	218169	28.4	269230	509057	778287	34.6	331222	665234	996456	33.2
88	352205	129229	481435	73.2	464484	430708	895193	51.9	816689	559937	1376628	59.3
89	207264	201121	408385	50.8	184812	556001	740813	25.0	392076	757122	1149198	34.1
90	71615	112877	184493	38.8	634979	614076	1249055	50.8	706594	726953	1433548	49.3
91	60870	115933	176804	34.4	325125	633118	958243	33.9	385995	749051	1135047	34.0
92	118931	146788	265719	44.8	266561	732813	999374	26.7	385492	879601	1265093	30.5
93	66242	372204	438446	15.1	268434	595193	863627	31.1	334676	967397	1302073	25.7

Estimate is based on catch-at-size table and should be considered the minimum estimates of small fish (particularly for Mediterranean)

BFT-W-Table 1. Summary of west Atlantic bluefin catches for 1963-1993 (as of OCT. 10, 1994 10:20). For east Atlantic and Mediterranean, see BFT-E-Table 1.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
TOTAL	29318	35213	31002	22706	25207	15738	17385	15924	17461	14634	14607	24516	26249	28168	25468	20409	18478	19904	19617	23820	24274	26716	26836	22662	20429	27280	24871	24884	27051	28547	30270
WEST ATLANTIC	13838	18679	14171	8090	5940	3176	3012	5466	6591	3948	3871	5393	5032	5883	6694	5763	6255	5801	5771	1445	2542	2292	2685	2322	2591	3011	2867	2798	2992	2186	2310
PS	5770	5158	3331	1006	2082	687	1118	4288	3769	2011	1656	960	2320	1582	1502	1230	1381	758	910	232	384	401	377	360	367	383	385	384	237	300	295
CANADA	323	579	461	0	0	0	0	1161	935	260	635	103	291	332	298	241	0	0	105	0	0	0	0	0	0	0	0	0	0	0	0
NORWAY	0	8	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	0	0	0	0
USA	5447	4571	2870	1006	2082	687	1118	3127	2834	1751	1021	857	2029	1250	1204	989	1381	758	805	232	384	401	377	360	367	383	385	384	237	300	295
RR	1162	601	1062	3726	343	619	1008	587	1049	1084	519	2913	328	590	630	475	499	535	523	308	476	401	466	328	539	439	557	780	728	426	628
CANADA	90	99	94	111	56	180	170	151	88	188	239	409	206	342	302	208	214	259	279	0	71	1	1	2	1	7	0	28	32	30	88
USA	1072	502	968	3615	287	439	838	436	961	896	280	2504	122	248	328	267	285	276	244	308	405	400	465	326	538	432	557	752	696	396	540
LL	6558	12410	9469	3085	3126	1665	593	268	1390	339	1127	946	1522	3066	3752	3217	3691	3972	3879	363	829	835	1245	764	1134	1373	678	739	895	674	697
ARGENTIN	271	204	100	100	60	21	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BRASIL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	10	2	3	1	1	++	1	0	2	++	2	1	++	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	32	33	104	53	4	6	9	25
CHITAIW	0	0	0	0	0	12	7	2	13	7	2	20	1	0	1	1	49	15	7	11	2	3	3	3	0	0	0	0	0	0	0
CUBA	0	0	139	465	2352	1351	468	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JAPAN	6191	12044	9147	2471	694	272	116	66	1375	321	1097	905	1513	2902	3658	3144	3621	3936	3771	292	711	696	1092	584	960	1109	468	550	688	512	581
KOREA	0	0	0	0	0	0	0	0	0	11	23	20	8	7	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NORWAY	0	63	4	10	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	0	0
PANAMA	0	0	0	0	0	0	0	0	0	0	2	0	0	157	92	58	10	9	14	12	0	0	0	0	0	0	0	0	0	0	0
TRINIDAD	0	0	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	0	0
URUGUAY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	9	16	6	0	2	0	0	1	0	0
USA	96	99	79	39	20	9	2	0	++	0	1	1	0	0	0	0	0	10	83	30	114	127	132	139	139	158	125	160	177	136	89
NEI_1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	1	0	0	0	0	0	30	24	23	17	2
COSTA RICA	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	0	0	0	0	1	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	0	0	0	30	24	9	0	0
N ANTIL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	1	0	0	0	0	0	0	0	0	0	0
PUERTO RICO	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	0	0	++	0	0	0
TRINIDAD	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	0	0	0	13	16	2
OTH+UNCL	348	510	309	273	389	205	293	323	383	514	569	574	862	645	810	841	684	536	459	542	853	655	597	356	359	601	999	762	933	742	659
ARGENTIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	2	0	1	2	0	0	0
CANADA	229	318	81	87	174	101	193	130	59	29	144	256	144	172	372	221	31	65	41	291	362	263	141	39	49	282	580	406	447	404	346
MEXICO	0	0	0	0	0	0	0	0	0	23	29	39	24	37	14	28	22	10	20	14	0	0	0	0	0	0	0	0	0	0	0
POLAND	0	0	0	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STLUCIA	0	0	0	0	0	0	0	**	**	**	**	**	**	**	**	**	**	0	0	0	0	0	0	0	++	3	2	14	14	14	0
USA	119	192	228	186	215	104	100	193	324	462	396	276	694	433	424	592	631	461	398	237	491	392	450	317	308	316	416	340	472	324	313
LL-DISCARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	514	192	215	248	133	199	44	31
USA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	514	192	215	248	133	199	44	31

BFT-W-Table 2. Update of catch-at-size table for west Atlantic bluefin tuna, during the 1994 SCRS.

CATCH DATA										MATCHED SIZE DATA									
AREA	COUNTRY	COUN	GEAR	GEAR	YEAR	TIME	CATC	YPE	R.F.	AR	COUNT	CONT	GE	GEAR	YEAR	TIME	WGHT	NO.	REMARKS
2	TRINIDAD	41	LL	1	85		1		0.00824	2	U.S.A.	25	LL	1	85	17			RF=TaskI/Est'd wght
2	MEXICO	31	LL	1	89	17	29		0.00000										Double entry. Delete
1	CANADA	4	LL	1	90		4		0.14351										Gear shift. TaskI/TaskI
1	CANADA	4	RR	22	90		28		1.05742	1	CANAD	4	LL	1	90				Gear shift. TaskI/TaskI
2	MEXICO	31	LL	1	90	99	21		0.00000										Double entry. Delete
2	ARGENTIN	2	UNCL	13	91	99	2		0.00000										Delete (no task I)
2	ARGENTIN	2	UNCL	13	92	99	2		0.00000										Delete (no task I)
1	CANADA	4	LL	1	93		25		1.00000								24582	602	C/Size by Nat. Sci.
1	CANADA	4	TRAP	10	93		29		1.00000								28892	78	C/Size by Nat. Sci.
1	CANADA	4	HARP	18	93		33		1.00000								32681	145	C/Size by Nat. Sci.
1	CANADA	4	RR	22	93		88		1.00000								88409	230	C/Size by Nat. Sci.
1	CANADA	4	TL	36	93		284		1.00000								284261	1125	C/Size by Nat. Sci.
2	JAPAN	12	LLHB	4	93	17	581		1.00000										C/Size by Nat. Sci.
2	U.S.A.	25	LL	1	93	17	89		1.00000								0	982	C/Size by Nat. Sci.
1	U.S.A.	25	PS	6	93		295		1.00000								0	3428	C/Size by Nat. Sci.
1	U.S.A.	25	UNCL	13	93		1		1.00000								0	9	C/Size by Nat. Sci.
1	U.S.A.	25	HARP	18	93		88		1.00000								0	455	C/Size by Nat. Sci.
1	U.S.A.	25	HAND	19	93		224		1.00000								0	1648	C/Size by Nat. Sci.
2	U.S.A.	25	RR	22	93	17	331		1.00000								0	1968	C/Size by Nat. Sci.
2	U.S.A.	25	RRFS	27	93	17	209		1.00000									3955	C/Size by Nat. Sci.
1	U.S.A.	25	RRFL	28	93		0		1.00000								0	8046	C/Size by Nat. Sci.
1	U.S.A.	25	LLD	33	93		23		1.00000								0	664	C/Size by Nat. Sci.
2	NEI	73	LL	1	93		2		0.02522	2	U.S.A.	25	LL	1	93	17			Trinid.RF=TaskI/Est wgt

BFT-W-Table 3. Catch (in number of fish) at age estimated for west bluefin tuna.

AG	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	64886	62998	45402	5105	55958	43556	5412	1274	5133	2745	3160	6087	3528	4173	868	568	563	1513	4850	787	2368	3327	420	329
2	105064	153364	98578	74311	20056	148027	19781	22419	10863	10552	16183	9616	3729	2438	7504	5523	5939	13340	9149	12877	4238	14533	5985	1130
3	127518	38360	33762	30482	21094	8328	72393	9717	20015	16288	11068	16541	1654	3268	1848	12310	7135	9137	11745	1679	17958	10761	1997	5215
4	21455	46074	3730	7161	6506	11963	2910	32139	6315	14916	8881	5244	498	894	2072	2814	3442	5491	3933	3815	1947	2924	711	3689
5	3677	672	3857	2132	3170	821	2899	4946	10530	3448	2866	6023	342	866	2077	4329	1128	4385	4144	1713	2747	1650	1425	2089
6	914	1673	118	1451	683	547	344	3633	4061	3494	2982	3721	751	911	1671	4019	1726	2318	4220	2082	1825	2166	737	1883
7	176	2109	569	953	916	317	206	957	655	2612	5533	2884	477	1402	594	1024	931	1566	2258	2677	1629	2347	1916	1598
8	172	1350	576	1544	913	671	1168	513	472	599	3454	3211	519	1353	759	612	520	1251	1631	1864	2388	1946	1870	2456
9	535	1133	261	555	1081	1651	558	1109	341	557	1061	2764	896	1039	1091	696	345	1014	1600	1461	1522	1915	1323	1479
10+	3726	5957	5519	4444	12508	9472	14033	13532	11982	12283	12213	10621	3077	5628	4574	5603	5335	3856	4555	5356	4253	4485	4383	2922
TO	328125	313689	192371	128138	122885	225354	119703	90240	70366	67495	67400	66710	15472	21974	23058	37498	27064	43872	48084	34310	40875	46055	20768	22790

AG	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	64886	62998	45402	5105	55958	43556	5412	1274	5133	2745	3160	6087	3528	4173	868	568	563	1513	4850	787	2368	3327	420	329
2	105064	153364	98578	74311	20056	148027	19781	22419	10863	10552	16183	9616	3729	2438	7504	5523	5939	13340	9149	12877	4238	14533	5985	1130
3	127518	38360	33762	30482	21094	8328	72393	9717	20015	16288	11068	16541	1654	3268	1848	12310	7135	9137	11745	1679	17958	10761	1997	5215
4	21455	46074	3730	7161	6506	11963	2910	32139	6315	14916	8881	5244	498	894	2072	2814	3442	5491	3933	3815	1947	2924	711	3689
5	3677	672	3857	2132	3170	821	2899	4946	10530	3448	2866	6023	342	866	2077	4329	1128	4385	4144	1713	2747	1650	1425	2089
6	914	1673	118	1451	683	547	344	3633	4061	3494	2982	3721	751	911	1671	4019	1726	2318	4220	2082	1825	2166	737	1883
7	176	2109	569	953	916	317	206	957	655	2612	5533	2884	477	1402	594	1024	931	1566	2258	2677	1629	2347	1916	1598
8	172	1350	576	1544	913	671	1168	513	472	599	3454	3211	519	1353	759	612	520	1251	1631	1864	2388	1946	1870	2456
9	535	1133	261	555	1081	1651	558	1109	341	557	1061	2764	896	1039	1091	696	345	1014	1600	1461	1522	1915	1323	1479
10	779	1362	785	801	802	1522	1388	1454	490	605	896	1400	931	1200	1073	975	689	646	1037	1417	1056	1274	1414	836
11	1207	1752	1618	1091	2711	1967	3573	1774	990	1735	875	1237	360	1156	1300	1464	1208	837	1027	1244	887	996	1068	557
12	833	1605	1405	1009	2418	2507	3738	2958	2178	2661	2053	1293	277	775	767	1537	1511	987	816	960	877	921	725	433
13	479	823	991	928	3945	1827	2573	3333	2949	2968	3476	1460	313	767	466	751	945	571	765	753	678	645	513	401
14	282	310	505	477	1663	1096	1769	2312	2660	2033	2409	1465	451	697	331	364	542	356	447	518	438	316	322	365
15	72	82	186	115	915	387	731	1187	1590	1373	1508	1531	360	517	297	226	136	243	176	236	179	191	195	194
16+	73	24	29	24	54	167	262	514	1125	906	997	2235	386	515	341	286	304	216	286	228	138	141	146	136
TO	328125	313689	192371	128138	122885	225354	119703	90240	70366	67495	67400	66710	15472	21974	23058	37498	27064	43872	48084	34310	40875	46055	20768	22790

BFT-W-Table 4. **Revised VPA estimates using the model applied at the 1993 SCRS, incorporating revisions to the U.S. rod and reel large and small fish catch rate indices (see BFT-W-Figure 3 to compare results with the 1993 SCRS assessment).**

F matrix:

Ages	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92
1	0.23255	0.29938	0.24275	0.04364	0.13113	0.39170	0.04371	0.01600	0.10503	0.03864	0.05451	0.11817	0.07472	0.05120	0.01501	0.01034	0.00542	0.03919	0.05274	0.01985	0.05483	0.04289	0.01790
2	0.79872	1.21722	0.97656	0.72245	0.22458	0.55214	0.28873	0.23877	0.17184	0.30280	0.30965	0.21783	0.09257	0.06366	0.11493	0.11715	0.13336	0.16015	0.32449	0.18051	0.13244	0.50385	0.09500
3	0.96899	0.72144	0.92642	0.88998	0.42635	0.12829	0.53556	0.20987	0.32390	0.38942	0.55417	0.55431	0.04945	0.10288	0.05902	0.26064	0.20396	0.29035	0.19338	0.08463	0.38063	0.53051	0.10983
4	0.29602	1.13448	0.12679	0.46858	0.43718	0.42591	0.05664	0.44960	0.19189	0.39694	0.35488	0.51708	0.02615	0.03203	0.08234	0.11253	0.10087	0.22344	0.18274	0.08318	0.12520	0.09108	0.05496
5	0.10415	0.01253	0.22970	0.09311	0.36345	0.08330	0.16072	0.12086	0.24138	0.14264	0.11434	0.40368	0.05242	0.05443	0.09094	0.23056	0.05652	0.16889	0.24500	0.10596	0.07453	0.13933	0.05496
6	0.01294	0.05920	0.00255	0.11865	0.03665	0.09131	0.04279	0.28896	0.12933	0.11022	0.16544	0.19934	0.07429	0.17991	0.13244	0.23768	0.12677	0.14769	0.22758	0.17503	0.14690	0.07280	0.07998
7	0.00688	0.03518	0.02416	0.02400	0.09597	0.02013	0.04233	0.15049	0.07220	0.10778	0.23817	0.22316	0.03313	0.18081	0.16002	0.10520	0.07432	0.15200	0.19630	0.20644	0.18877	0.26704	0.07998
8	0.00235	0.06279	0.01132	0.07934	0.02714	0.08870	0.09006	0.13206	0.09673	0.08203	0.18988	0.19797	0.05325	0.11632	0.13181	0.23003	0.06702	0.12690	0.21880	0.23078	0.26763	0.33573	0.32880
9	0.01210	0.01803	0.01458	0.01272	0.06882	0.05890	0.09255	0.10880	0.11426	0.14853	0.19110	0.21380	0.07305	0.13462	0.12139	0.16057	0.18427	0.16896	0.22169	0.29332	0.27872	0.33358	0.37375
10+	0.02264	0.03371	0.02726	0.02378	0.06510	0.05572	0.08755	0.10292	0.10809	0.14051	0.18078	0.20226	0.06202	0.11429	0.10306	0.13633	0.15644	0.14345	0.18821	0.24902	0.23664	0.28321	0.31732

N matrix:

Ages	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93
1	334218	260032	225099	128053	487195	143367	135541	86006	55106	77581	63787	58447	52467	89550	62430	59156	111514	42165	101103	42894	47534	84875	25361	
2	202802	230269	167574	153513	106570	371494	84243	112794	73583	43131	64889	52512	45148	42329	73965	53466	50899	96421	35248	83379	36557	39119	70689	21657
3	217788	79322	59266	54864	64802	74011	185934	54871	77230	53870	27700	41390	36716	35779	34529	57321	41343	38725	71420	22152	60515	27839	20548	55885
4	89424	71846	33518	20402	19587	36781	56595	94616	38672	48564	31727	13836	20671	30379	28064	28298	38399	29310	25182	51172	17695	35954	14238	16006
5	39789	57822	20086	25669	11101	10998	20886	46492	52470	27749	28387	19342	7172	17507	25578	22469	21983	30179	20379	18236	40936	13573	28536	11716
6	76146	31170	49642	13879	20332	6710	8797	15462	35817	35832	20917	22012	11230	5917	14413	20303	15512	18061	22159	13867	14260	33032	10265	23481
7	27514	65347	25540	43047	10716	17039	5324	7327	10068	27360	27900	15412	15678	9064	4297	10976	13917	11880	13545	15343	10119	10703	26701	8238
8	78407	23756	54846	21674	36535	8463	14518	4437	5480	8143	21356	19115	10719	13186	6576	3183	8589	11232	8871	9677	10851	7284	7124	21428
9	47643	68003	19395	47144	17405	30912	6733	11534	3380	4325	6522	15355	13633	8835	10204	5011	2199	6983	8601	6197	6679	7218	4527	4458
10+	178303	192461	219834	202592	212453	187181	179245	148101	125154	100278	78991	61999	54809	55800	49984	47056	39405	30886	28390	26437	21935	19445	17231	13615

BFT-W-Table 5. Catch rate indices considered for tuning the VPA.

YEAR ERROR	LARVAL	JLLGOM 1	JLLGOM 2	CANTLN	USRRLG 1	USRRLG 2	USLLGM 1	USLLGM 2	USRRSM 1	USRRSM 2	JLLNWA 1	JLLNWA 2
1974	-	1.467	1.1751	-	-	-	-	-	-	-	-	-
1975	-	1.020	0.8416	-	-	-	-	-	-	-	-	-
1976	-	0.896	0.7536	-	-	-	-	-	-	-	0.7620	0.2419
1977	3.966	0.670	0.5760	-	-	-	-	-	-	-	1.6696	0.8840
1978	9.485	0.935	1.0160	-	-	-	-	-	-	-	1.3697	0.4667
1979	-	0.938	1.0953	-	-	-	-	-	-	-	0.5130	0.2460
1980	-	1.513	1.0194	-	-	-	-	-	1.2216	1.5215	0.9674	0.4138
1981	2.145	0.561	0.3919	0.206	-	-	-	-	0.1285	0.4465	1.3876	0.5986
1982	2.466	-	-	0.185	-	-	-	-	1.3535	2.8637	0.6671	0.3348
1983	2.011	-	-	0.137	3.5388	5.7208	-	-	0.7885	1.1246	0.4705	0.1502
1984	1.064	-	-	0.094	1.5685	1.9983	-	-	-	-	0.7988	0.4282
1985	-	-	-	0.045	1.5017	1.5830	-	-	0.5413	0.6700	0.9337	0.4451
1986	0.425	-	-	0.054	1.0492	0.6293	-	-	1.0083	1.1655	0.5363	0.1995
1987	0.725	-	-	0.035	0.9932	0.9325	1.00	1.00	1.2245	1.4526	1.0764	0.3640
1988	3.169	-	-	0.055	1.8902	1.4920	0.39	0.32	1.6201	1.0382	0.8219	0.3937
1989	1.300	-	-	0.040	0.9753	0.8644	0.60	0.55	1.3457	1.4339	0.6948	0.2856
1990	0.772	-	-	0.026	0.8888	0.7935	0.65	0.60	0.7396	0.8661	0.7264	0.3320
1991	0.594	-		-	1.1022	1.0023	0.89	0.96	1.3394	1.3266	0.7048	0.3942
1992	1.000	-	-	-	1.2502	1.0892	0.30	0.23	0.8038	0.9028	1.7624	0.8683
1993	-	-	-	-	1.0000	1.0000	0.16	0.06	1.0000	1.0000	1.0000	0.5309

Assumed error distribution:
1 Assumes Poisson error structure and was used in the base-case VPA.
2 Assumes a Lognormal error structure and was not used in the base-case VPA.

Indices: LARVAL = Larval index from Gulf of Mexico
CANTLN = Canadian tended line index
USLLGM = U.S. longline logbook catch rates from the Gulf of Mexico
JLLGOM = Japanese longline catch rates from the Gulf of Mexico
USRRLG = U.S. rod-and-reel large fish index
USRRSM = U.S. rod-and-reel small fish index
JLLNWA = Japanese longline catch rates from the northwest Atlantic

BFT-W-Table 6. Trend analysis* of catch rate indices used in calibration of the 1994 west Atlantic bluefin tuna assessment. Slope indicated is Sen's nonparametric estimates of slope.

INDEX	SAMPLE SIZE	SLOPE	P-VALUE
Larval	13	-0.146	0.017
CAN TendL	10	-0.227	0.002
US LL GOM (lognorm)	7	-0.123	0.223
US LL GOM (Poisson)	7	-0.123	0.223
JPN LL GOM (lognorm)	8	-0.043	0.536
JPN LL GOM (Poisson)	8	-0.048	0.536
JPN LL GOM (SCRS-93)	8	-0.234	0.035
US RR Large (lognorm)	11	-0.098	0.161
US RR Large (Poisson)	11	-0.067	0.087
US RR Small (lognorm)	13	-0.020	0.502
US RR Small (Poisson)	13	0.020	0.669
JPN LL NWAtl (lognorm)	18	0.004	0.762
JPN LL NWAtl (Poisson)	18	-0.003	0.999

* Trend techniques are from: Gilbert, R.G., 1987. Statistical Methods in Environmental Pollution Monitoring. Van Nostrand, Reinbold, NY.

P-value is the approximate probability of a larger Z-statistics for the Mann-Kendall test for monotonic trend.

Indices: Larval - Larval index from Gulf of Mexico; CAN TendL - Canadian tended line index; US LL GOM - US longline logbook catch rates from the Gulf of Mexico; JPN LL GOM - Japanese longline catch rates from the Gulf of Mexico; US RR Large - US rod-and-reel large fish index; US RR Small - US rod-and-reel small fish index; JPN LL NWAtl - Japanese longline catch rates from the northwest Atlantic.

lognorm: lognormal error assumption in the standardization procedure applied,
Poisson: Poisson error assumption in the standardization procedure applied.

BFT-W-Table 7. Point estimates of stock size and fishing mortality rates from the 1994 SCRS base case VPA.

N-matrix

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991*	1992*	1993*	1994*
1	335201	260889	225684	127645	486216	143749	136446	86847	55407	78090	64839	59823	54569	92330	65002	68483	85119	80735	112877	76200	105772	61129	53638	49168	50282
2	205581	231121	168317	154022	106216	370643	84575	113581	74315	43392	65332	53426	46344	44156	76382	55702	59007	73475	68779	93615	65512	89749	50048	46259	42466
3	219504	81721	59993	55503	65241	73704	185197	55159	77913	54506	27927	41774	37510	36819	36118	59422	43287	45773	51479	51285	69410	53008	64515	37939	39144
4	93481	73322	35591	21027	20138	37162	56328	93977	38923	49157	32278	14033	21004	31070	28968	29679	40224	30999	31304	33848	43022	43674	36086	54227	28134
5	41393	61345	21351	27471	11644	11475	21217	46260	51916	27968	28902	19821	7343	17796	26178	23255	23183	31766	21846	23557	25877	35589	35246	30709	43709
6	64944	32564	52705	14977	21898	7181	9212	15749	35615	35351	21107	22460	11646	6065	14665	20825	16194	19104	23538	15142	18885	19941	29403	29315	24753
7	23421	55608	26753	45710	11670	18401	5734	7688	10318	27185	27482	15577	16067	9425	4426	11195	14371	12473	14452	16541	11228	14720	15321	24875	23732
8	64469	20198	46379	22728	38850	9293	15702	4793	5794	8360	21203	18751	10862	13524	6890	3295	8779	11627	9387	10465	11892	8246	10615	11537	20138
9	38454	55887	16302	39783	18321	32925	7454	12564	3690	4597	6711	15223	13317	8960	10498	5284	2296	7148	8944	6645	7366	8120	5362	7490	7749
10+	126742	139647	163386	150831	161055	143295	142843	117086	99092	77892	59778	45470	40333	42943	38922	37693	31506	24106	22644	21744	18351	16994	15893	13183	13885

F-matrix:

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	0.232	0.298	0.242	0.044	0.131	0.390	0.043	0.016	0.104	0.038	0.054	0.115	0.072	0.050	0.014	0.009	0.007	0.020	0.047	0.011	0.024	0.060	0.008	0.007
2	0.783	1.209	0.969	0.719	0.225	0.554	0.287	0.237	0.170	0.301	0.307	0.214	0.090	0.061	0.111	0.112	0.114	0.216	0.153	0.159	0.072	0.190	0.137	0.027
3	0.957	0.691	0.908	0.874	0.423	0.129	0.538	0.209	0.321	0.384	0.548	0.548	0.048	0.100	0.056	0.250	0.194	0.240	0.279	0.036	0.323	0.245	0.034	0.159
4	0.281	1.094	0.119	0.451	0.422	0.421	0.057	0.453	0.191	0.391	0.348	0.508	0.026	0.031	0.080	0.107	0.096	0.210	0.144	0.129	0.050	0.074	0.021	0.076
5	0.100	0.012	0.215	0.087	0.343	0.080	0.158	0.122	0.244	0.141	0.112	0.392	0.051	0.054	0.089	0.222	0.054	0.160	0.227	0.081	0.121	0.051	0.044	0.076
6	0.015	0.057	0.002	0.109	0.034	0.085	0.041	0.283	0.130	0.112	0.164	0.195	0.072	0.175	0.130	0.231	0.121	0.139	0.213	0.159	0.109	0.124	0.027	0.071
7	0.008	0.041	0.023	0.023	0.088	0.019	0.039	0.143	0.070	0.109	0.242	0.221	0.032	0.173	0.155	0.103	0.072	0.144	0.183	0.190	0.169	0.187	0.144	0.071
8	0.003	0.074	0.013	0.076	0.025	0.080	0.083	0.122	0.091	0.080	0.191	0.202	0.053	0.113	0.125	0.221	0.066	0.122	0.205	0.211	0.242	0.290	0.209	0.258
9	0.015	0.022	0.017	0.015	0.065	0.055	0.084	0.099	0.104	0.139	0.185	0.216	0.075	0.132	0.118	0.152	0.175	0.165	0.212	0.268	0.249	0.290	0.306	0.237
10+	0.032	0.047	0.037	0.032	0.087	0.073	0.111	0.132	0.139	0.185	0.246	0.287	0.085	0.151	0.134	0.173	0.200	0.188	0.242	0.305	0.284	0.331	0.349	0.270

Mid-Year Biomass (MT):

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	891	734	820	431	1529	430	486	353	245	379	294	295	196	327	283	235	332	313	401	276	438	282	284	201
2	1089	989	938	892	885	2279	704	969	687	390	637	492	446	403	755	501	514	596	677	887	672	997	549	477
3	2156	1143	686	695	847	1533	2494	964	1343	919	424	637	727	653	773	846	740	859	881	1052	1046	879	1124	817
4	2833	1266	1273	624	560	960	1741	2466	1171	1478	903	352	663	1081	1025	873	1473	1046	1046	1169	1526	1648	1322	1859
5	2067	3428	1030	1530	522	602	949	2126	2331	1235	1358	795	398	953	1401	951	1199	1599	1055	1162	1265	1999	1887	1555
6	4790	2420	4163	1025	1664	504	682	953	2290	2453	1534	1474	859	438	1101	1227	1205	1260	1602	1101	1299	1510	2245	2176
7	2456	5511	2833	5035	1067	1949	626	653	994	2539	2597	1394	1700	937	445	976	1503	1181	1332	1597	1074	1446	1490	2453
8	8913	2452	5907	2911	4955	1176	2138	574	750	1057	2526	2230	1480	1776	895	361	1176	1409	1129	1246	1440	1010	1256	1354
9	6121	8720	2591	6358	2798	4922	1145	1843	598	717	1065	2219	2172	1444	1689	777	355	1040	1346	957	1088	1187	771	1081
10+	31400	33983	42367	39832	42485	35812	34989	29893	27408	20353	15801	12054	11400	11621	10165	8999	7948	6117	5492	4942	4255	3753	3426	3143

* Recruitments shown (age 1 abundance) were assumed and used in projections. Cohort abundances for subsequent years are based on these assumed levels, after accounting for catches.

Mid-year biomass was approximated as N-age,year*(exp(-(M+F-age,year)/2)*MT-age,year. MT-age,year is the average weight of the catch by age and year. N-age,year is beginning year stock size, F-age,year is the age specific fishing mortality

BFT-W-Table 8. Reference points for western Atlantic bluefin tuna.

	F	YPR (kg/R)	SPR (kg/R)	SPR as % maximum
$F_{0.1}$	0.189	44.1	193.7	27.8
F_{max}	0.268	45.4	131.6	18.9
$F_{med\ (70\text{-}89)}$	0.173	43.2	213.3	30.7
$F_{med\ (80\text{-}89)}$	0.259	45.3	137.6	19.8
F_{1993}	0.270	45.3	131.4	18.9

BFT-W-Table 9. Estimated probabilities that the 1998 or 2030 biomasses will be equal to or 20% greater than the 1993 or 1975 biomass.

CATCH (KG)	Prob. 8+ in 98/8+ in 93 Equal	+ 20%	Prob. 8+ in 2003/8+ in 93 Equal	+ 20%
1200	0.992	0.976	0.992	0.992
1600	0.980	0.954	0.976	0.964
1995	0.944	0.894	0.906	0.880
2200	0.914	0.846	0.846	0.822

CATCH (MT)	Prob. 8+ in 98/8+ in 75 Equal	+ 20%	Prob. 8+ in 2003/8+ in 7 Equal	+ 20%
1200	0	0	0.050	0.008
1600	0	0	0.036	0.006
1995	0	0	0.010	0.002
2200	0	0	0.006	0.002

Based on the current assessment, the catch scenarios shown could be rationalized to decide on catches for the next 1 or 2 years. The Table compares the 8+ biomass in 1998 and 2003 with those in 1993 and 1975. The Table presents the probabilities that the 1998 and 2003 biomasses will be equal to or 20% greater than the 1993 or 1975 biomasses. For example, the Table shows 8 zero values in the bottom leftmost corner. This means that the probability of the 1998 biomass being equal to or 20% greater than the 1975 biomass is zero for all 4 catch scenarios. The upper part of the Table suggests that there is a high probability that the biomass will increase by 20%.

BFT-W-Table 10. Estimated bluefin tuna catches by size categories (at 6.4 kg-69 cm; at 120cm and 115 cm) - west Atlantic

Year	Total No.	<6.4 kg No.	<6.4 kg %	=or>6.4 kg No.	Total Kg.	<120 cm Kg.	<120 cm %	=or>120 cm Kg.	Total Kg.	<115 cm Kg.	<115 cm %	=or>115 cm Kg.
68	74920	5145	6.87	69775	3038632	753407	24.79	2285224	3038632	741521	24.40	2297111
69	84115	9242	10.99	74873	3022186	958267	31.71	2063918	3022186	926993	30.67	2095192
70	328224	68411	20.84	259813	5556570	3420918	61.57	2135652	5556570	3322482	59.79	2234087
71	313689	77996	24.86	235692	6250581	3315055	53.04	2935526	6250581	2781028	44.49	3469553
72	192371	47374	24.63	144996	4000227	1853708	46.34	2146519	4000227	1848166	46.20	2152061
73	128137	5938	4.63	122198	3595403	1342661	37.34	2252741	3595403	1326219	36.89	2269184
74	122885	56729	46.16	66155	5387409	832961	15.46	4554447	5387409	810770	15.05	4576638
75	225367	44281	19.65	181086	5252315	1853597	35.29	3398718	5252315	1726527	32.87	3525788
76	119730	5429	4.53	114301	6120010	1665220	27.21	4454790	6120010	1603601	26.20	4516410
77	90262	1487	1.65	88774	6462044	793130	12.27	5668913	6462043	628546	9.73	5833496
78	70411	5383	7.65	65028	5729015	673178	11.75	5055837	5729015	629417	10.99	5099598
79	67501	2709	4.01	64791	5804725	561993	9.68	5242732	5804726	495589	8.54	5309137
80	67631	3122	4.62	64508	6453298	584184	9.05	5869114	6453299	506244	7.84	5947055
81	66728	4777	7.16	61951	6055806	596407	9.85	5459399	6055806	527071	8.70	5528735
82	15483	3586	23.16	11897	1468310	100146	6.82	1368163	1468310	93545	6.37	1374765
83	21974	3990	18.16	17983	2605975	115362	4.43	2490612	2605975	106627	4.09	2499347
84	23084	977	4.24	22106	2250416	148608	6.60	2101808	2250416	130463	5.80	2119952
85	37497	616	1.65	36881	2748735	331461	12.06	2417274	2748735	298587	10.86	2450148
86	27104	797	2.94	26307	2419710	224371	9.27	2195339	2419710	199972	8.26	2219738
87	43961	2314	5.26	41647	2688721	377882	14.05	2310838	2688721	326891	12.16	2361830
88	48088	4833	10.05	43254	3234907	394993	12.21	2839914	3234907	343122	10.61	2891785
89	34380	879	2.56	33501	2974694	204023	6.86	2770670	2974694	190394	6.40	2784299
90	40895	1897	4.64	38997	2818624	420121	14.91	2398502	2818624	405410	14.38	2413213
91	46054	3320	7.21	42734	3029737	439643	14.51	2590094	3029737	411471	13.58	2618265
92	20774	276	1.33	20498	2228838	128094	5.75	2100744	2228838	118490	5.32	2110347
93	22846	383	1.68	22463	2216402	187074	8.44	2029328	2216402	138691	6.26	2077711

BIL-Table 1. Annual landing (in MT) of billfishes in the Atlantic by major region and gear (as of November 21, 1994).

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
BLUE MARLIN																															
TOTAL	9037	8010	6155	3859	2240	2434	3091	2864	3194	2366	3177	3016	3185	2310	2047	1506	1384	1617	1920	2750	1801	2227	2694	1949	1871	2517	3743	3293	3043	3060	2711
NORTH ATL.	5141	4809	3682	2040	1173	1344	1601	1845	2115	1315	1616	1916	2076	1366	1255	976	880	1064	1248	1615	1146	1197	1302	1041	661	960	1487	1227	1145	1136	842
-LL	5010	4645	3517	1884	970	1170	1388	1635	1932	1122	1406	1497	1683	978	876	553	480	639	780	1154	763	806	1062	726	384	622	1245	1058	871	849	593
CANADA		0	0	0	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	0
CHITAIW	27	8	2	34	131	337	348	369	158	300	155	183	105	169	64	81	51	160	98	100	106	74	86	117	52	20	8	391	388	336	94
CUBA	123	128	144	91	223	167	122	108	149	67	223	516	594	250	220	97	156	162	178	318	273	214	246	103	68	94	74	112	0	0	0
JAPAN	4759	4434	3330	1677	485	474	658	758	1223	335	229	267	551	260	118	54	68	193	332	637	192	351	409	174	78	206	593	250	145	193	267
KOREA	0	1	4	46	66	93	214	368	221	215	457	385	304	174	307	185	67	45	70	18	25	57	83	49	15	8	99	78	108	108	5
MEXICO	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	0	0	0	0	0	3
NEI	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	0	0	0	0	0	57
PANAMA	0	0	0	0	0	0	0	**	**	10	208	62	44	47	87	42	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ESPANA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4	1	0	0	23	2	4	4	0
USA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	61	92	280	428	205	187	127	144
USSR	0	0	1	1	3	3	3	2	3	7	10	1	3	0	1	1	**	0	0	0	0	0	0	7	23	0	0	0	0	0	0
VENEZUELA	101	74	36	35	62	96	43	30	178	188	124	83	82	78	79	93	132	79	102	81	167	107	214	214	55	14	20	20	39	81	23
-R R	131	164	165	156	203	174	213	210	183	193	210	236	243	268	298	301	299	301	300	299	199	206	168	213	180	186	142	48	55	81	97
BERMUDA	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	5	2	4	1	2	7	8	9	11	6	8	15	17	18	19	11
PORTUGAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	11	7	2	0	0	0	0	0
TRINIDAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	++	1	++	++	1	++	1	1	2	1	++
USA	128	161	163	149	197	168	207	204	179	191	209	234	241	265	295	295	295	295	295	295	187	187	147	187	161	173	121	25	30	49	76
VENEZUELA	3	3	2	7	6	6	6	6	4	2	1	2	1	1	1	1	2	2	4	2	5	10	5	4	5	3	5	5	5	12	10
-OTH & UNCL	0	0	0	0	0	0	0	0	0	0	0	183	150	120	81	122	101	124	168	162	184	185	72	102	97	152	100	121	219	206	152
BARBADOS	0	0	0	0	0	0	0	**	**	**	**	183	150	120	81	72	51	73	117	99	126	126	10	14	13	46	7	17	14	22	12
BERMUDA	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	0	0	0	0	0	11
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	0	0	0	77	85	0
GRENADA	0	0	0	0	0	0	0	**	**	**	**	**	**	**	**	**	**	1	1	12	6	8	11	36	33	54	40	52	64	52	58
NLDANT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	50	50	50	50	50	50	50	50	50	50	50	50	40	40	40
PORTUGAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	1	1	1	++	1	1	4	2	5
SENEGAL	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	0	1	1	5	0	0
ESPANA	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	2	0	0	0	4	0
USA	0	0	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	0
UKRAINE	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	0	0	0	15	0	0
VENEZUELA	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	0	0	0	0	0	24
STVINCE	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	0	1	++	++	1	2
SOUTH ATL.	3896	3201	2473	1819	1067	1090	1490	1019	1079	1051	1561	1100	1109	944	792	530	504	553	459	854	510	930	1292	808	1110	1457	2156	1966	1798	1824	1769
-LL	3896	3201	2473	1819	1067	1090	1489	1018	1079	1051	1561	1100	1109	933	739	526	490	544	431	824	507	819	1174	696	994	1346	1660	1562	1526	1565	1558
BRASIL	12	12	12	12	6	15	17	38	14	17	4	15	15	30	47	45	20	21	26	28	27	30	32	41	39	63	66	50	40	17	27

BIL-Table 1. Continued.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
BRAS-HON	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	0	0	0	++	0	++
BRASTAI	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	0	0	0	28	49	107
CHITAIW	21	5	2	35	160	385	1016	560	604	628	537	369	422	240	107	177	139	129	104	150	39	50	95	98	265	204	335	320	517	488	302
CUBA	22	26	32	27	221	113	43	41	17	22	75	170	195	159	100	113	180	187	108	118	123	159	205	111	137	191	77	90	0	0	0
JAPAN	3841	3156	2421	1693	588	472	302	247	172	85	117	17	57	4	17	15	66	115	136	495	248	482	691	335	362	617	962	967	753	824	755
KOREA	0	1	3	47	79	93	98	120	258	251	532	449	354	392	356	140	78	92	56	33	67	91	141	83	168	239	188	132	184	184	25
NEI	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	0	0	0	0	0	117
PANAMA	0	0	0	0	0	0	0	**	**	12	244	72	51	107	103	32	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRINIDAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	7	3	12	1	++	27	3	4	3	225
USSR	0	1	3	5	13	12	13	12	14	36	52	8	15	1	9	4	**	0	1	0	0	0	7	16	22	32	5	0	0	0	0
-OTH & UNCL	0	0	0	0	0	0	1	1	0	0	0	0	0	11	53	4	14	9	28	30	3	111	118	112	116	111	496	404	272	259	211
BENIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	8	0	9	10	7	4	12	0	6	6	6	0
BRASIL	0	0	0	0	0	0	1	1	0	0	0	0	0	11	53	4	14	9	22	22	3	2	8	5	12	11	1	2	1	++	1
CIVOIRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	100	100	100	88	65	72	77	58	110
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	0	0	0	62	69	0
GHANA	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	0	430	324	126	126	100
UNCL REGION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	213	281	145	100	100	100	100	100	100	100	100	100	100
-PS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	213	281	145	100	100	100	100	100	100	100	100	100	100
FIS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	150	180	100	100	100	100	100	100	100	100	100	100	0
ESPANA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	63	101	45	0	0	0	0	0	0	0	0	0	0

WHITE MARLIN

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
TOTAL	2614	3735	4906	3512	1426	2047	2254	2097	2260	2280	1792	1750	1577	1819	1125	949	1015	955	1121	1091	1694	1089	1531	1630	1466	1283	1672	1035	1739	1299	1132
NORTH ATL.	914	1694	2127	1798	588	692	1212	1048	1547	1208	995	1218	1088	1052	501	428	481	508	780	653	1382	702	842	928	583	419	294	295	267	345	333
-LL	848	1620	2048	1711	497	594	1114	932	1440	1099	886	1103	977	938	390	317	370	396	669	543	1236	549	693	893	484	202	245	236	236	290	284
CANADA		0	0	0	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	0	0
CHITAIW	4	3	2	32	47	58	132	97	178	244	120	248	84	142	44	79	62	105	174	130	203	52	100	319	153	++	4	31	12	66	55
CUBA	35	45	69	118	127	103	58	61	45	34	112	256	294	68	67	43	68	70	189	205	728	241	296	225	30	13	21	14	0	0	0
JAPAN	754	1493	1913	1417	174	273	451	419	915	339	328	381	404	540	80	27	42	99	118	84	27	52	45	56	60	68	73	34	41	32	53
KOREA	0	1	1	51	44	52	204	340	219	213	106	90	71	64	71	33	16	12	48	12	28	8	79	42	3	1	24	75	104	104	1
MEXICO	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	0	0	0	0	0	2
NEI	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	0	0	0	0	0	46
PANAMA	0	0	0	0	0	0	0	**	**	10	48	14	10	17	20	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ESPANA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	14	0	0	0	13	4	2	2	0
USA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	39	11	103	89	82	72	40	39	22	23
USSR	0	0	0	0	1	1	1	0	1	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VENEZUELA	55	78	63	93	104	107	268	15	82	258	170	114	113	107	108	127	181	110	140	112	230	148	148	148	148	38	38	38	38	64	104

BIL-Table 1. Continued.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
-R R	66	74	79	87	91	98	98	116	107	109	109	115	111	114	111	111	111	112	111	110	146	151	148	35	98	76	22	23	11	18	23
BERMUDA		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	++	++	++	1	1	++	1	1	1	1	1	1	1	0
USA	64	70	76	76	81	87	76	104	95	99	104	108	107	109	109	109	109	109	109	109	141	143	141	31	91	72	16	17	5	8	13
VENEZUELA	2	4	3	11	10	11	22	12	12	10	5	7	4	5	2	2	2	3	2	1	4	7	7	3	6	3	5	5	5	9	10
-OTH & UNCL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	1	141	27	36	20	37	26
BARBADOS	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	117	27	36	20	29	21
BERMUDA	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	0	0	0	0	0	1
CANADA	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	0	++	0	0	0	0
ESPANA	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	24	0	0	0	8	0
VENEZUELA	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	0	0	0	0	0	4
USA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	**	1	++	0	0	0	0	0
SOUTH ATL.	1700	2041	2779	1714	838	1355	1042	1049	713	1072	797	532	489	767	624	521	534	447	341	438	312	387	689	702	883	864	1378	740	1472	954	799
-LL	1700	2041	2779	1714	838	1355	1042	1049	713	1072	797	532	489	742	621	519	530	444	341	438	312	387	684	676	874	775	1301	696	1294	782	799
ARGENTIN	0	0	0	0	3	14	0	**	20	100	57	++	2	2	2	**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BRASIL	17	17	17	17	9	21	24	54	17	33	18	32	32	43	272	173	129	55	25	76	70	61	88	143	90	148	206	193	294	117	86
BRAS-HON	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	0	0	0	1	0	6
BRASTAI	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	0	0	0	67	79	161
CHITAIW	10	3	2	29	134	327	436	469	260	469	412	279	255	377	119	197	155	145	136	220	87	66	134	196	613	514	979	292	700	363	433
CUBA	9	17	33	23	67	15	7	8	4	6	21	48	55	38	57	127	205	212	116	45	112	153	216	192	62	24	22	6	0	0	0
JAPAN	1664	2002	2718	1585	494	815	392	284	65	101	27	9	14	3	26	14	15	7	25	27	17	24	81	73	74	76	73	92	75	64	49
KOREA	0	2	7	58	125	157	177	230	341	332	165	139	109	220	111	5	24	25	37	60	13	18	121	56	29	12	20	112	156	156	1
NEI	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	0	0	0	0	0	63
PANAMA	0	0	0	0	0	0	0	**	**	16	75	22	16	59	31	1	2	0	0	0	0	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	1	10	13	65	44	16	6	1	1	1	1	3	0
USSR	0	0	2	2	6	6	6	4	6	15	22	3	6	0	3	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
-OTH & UNCL	0	0	0	0	0	0	0	0	0	0	0	0	0	25	3	2	4	3	0	0	0	0	5	26	9	89	77	44	178	172	0
ARGENTIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0	0	8	9	6	0	0
BRASIL	0	0	0	0	0	0	++	++	0	0	0	0	0	25	3	2	4	3	++	++	++	++	1	++	3	1	1	4	++	++	++
- GHANA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	6	88	68	31	172	172	0
SAILFISH*																															
TOTAL	998	1483	2919	2420	1900	2596	2112	2778	2805	2420	1638	1347	1182	1553	1950	2661	3369	2773	2064	1947	3780	3121	2937	2764	3197	2540	2122	2430	2073	2372	2130
EAST ATL.	495	515	1334	1242	571	1145	739	580	860	1035	717	311	227	363	894	1775	2421	1812	1070	845	2918	2105	1963	1701	2163	1666	1362	1761	1318	1535	1719
-LL	495	515	1334	1242	495	1069	658	493	748	913	571	196	83	149	96	58	38	33	87	209	247	191	135	138	93	90	169	151	35	20	80
CAP VERT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
CHITAIW	0	0	0	0	77	508	414	387	609	785	491	168	38	144	59	42	19	0	0	0	0	9	9	0	0	0	0	13	0	0	6
CUBA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	158	200	115	19	55	50	22	53	61	0	0	0
JAPAN	0	515	1331	1237	404	548	230	95	125	89	66	19	38	4	24	11	19	33	50	38	47	63	84	71	37	57	57	63	16	1	63

* INCLUDES SPEARFISH (T. PFLUEGERI & T. BELONE)

BIL-Table 1. Continued.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
KOREA	495	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	1	1	7	8	14	19	19	0
NEI	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	0	0	0	0	0	11
ESPANA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	4	7	9	0	0	47	++	++	++	0
USSR	0	0	3	5	14	13	14	11	14	39	14	9	7	1	13	5	**	0	37	0	0	0	0	2	5	4	4	0	0	0	0
-R R	0	0	0	0	2	5	7	13	38	48	70	33	61	76	93	79	77	62	88	69	49	41	25	45	73	46	37	51	47	45	60
SENEGAL	0	0	0	0	2	5	7	13	38	48	70	33	61	76	93	79	77	62	88	69	49	41	25	45	73	46	37	51	47	45	60
-TROL	0	0	0	0	74	71	74	74	74	74	74	74	61	113	67	64	30	263	0	0	0	0	0	1	9	45	95	51	28	9	0
SENEGAL	0	0	0	0	74	71	74	74	74	74	74	74	61	113	67	64	30	263	0	0	0	0	0	1	9	45	95	51	28	9	0
-GILL+HAND+U	0	0	0	0	0	0	0	0	0	0	2	8	22	25	638	1574	2276	1454	895	567	2622	1873	1803	1517	1988	1485	1061	1508	1208	1461	1579
BENIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	48	0	53	50	25	32	40	8	20	21	20	0
CIVOIRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	40	40	40	67	55	62	40	71	44
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	0	0	0	184	200	0
GHANA	0	0	0	0	0	0	0	0	0	0	2	8	22	11	638	1574	2246	1191	449	16	2161	1658	1497	925	1392	837	482	385	463	297	693
KOREA	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PORTUGAL	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	0	0	0	0	1	2
SENEGAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	263	410	503	461	122	216	527	524	541	516	1041	500	872	840
WEST ATL.	476	914	1470	920	727	862	759	1319	1127	575	581	646	568	813	758	727	731	691	630	914	747	1016	974	1063	1034	874	755	669	755	837	411
-LL	317	737	1279	715	516	644	523	1059	860	304	308	353	272	437	221	211	206	154	152	430	289	494	473	535	615	638	394	394	374	383	310
BRASIL	46	46	46	46	23	57	27	21	43	64	37	78	76	124	139	128	77	77	38	58	60	80	139	232	133	100	117	94	57	42	46
BRAS-HON	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	0	0	0	0	0	8
BRASTAI	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	0	0	0	8	205	233
CHITAIW	0	0	0	0	106	86	179	111	170	17	107	80	28	126	5	10	18	0	0	0	0	42	39	49	19	300	126	83	73	33	183
CUBA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	181	28	169	130	50	171	78	55	126	0	0	0
JAPAN	240	655	1140	608	274	422	228	499	321	132	78	118	112	133	23	9	20	22	44	135	22	34	38	28	6	22	22	25	73	37	3
KOREA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	37	39	21	24	5	7	38	53	53	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	0	0	0	0	0	0	0	2
NEI	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	0	0	0	0	0	31
TRINIDAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64	58	14	78	110	34	16	6	3	2	117
USA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	78	80	32	21	37	10	18
VENEZUELA	31	36	93	61	113	79	89	428	326	91	86	77	56	54	54	64	91	55	70	56	115	74	74	74	74	19	19	19	19	36	60
-R R	159	177	191	205	211	218	236	232	239	243	245	255	258	266	339	338	350	368	336	331	312	352	228	234	237	38	31	26	32	49	41
BRASIL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	28	40	57	26	22	0	37	26	35	36	27	23	19	25	33	21
TRINIDAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	++	++	++	1	++	++	1	1	++	++	0
USA	157	173	188	194	201	207	214	220	227	233	240	248	254	261	308	308	308	308	308	308	308	308	195	195	195	8	2	1	2	6	10
VENEZUELA	2	4	3	11	10	11	22	12	12	10	5	7	4	5	2	2	2	3	2	1	4	7	7	3	6	3	5	5	5	10	10
-OTH & UNCL	0	0	0	0	0	0	0	28	28	28	28	38	38	110	198	178	175	169	142	153	146	170	273	294	182	198	330	249	349	405	60
ARUBA	0	0	0	0	0	0	0	++	++	++	++	10	10	20	20	30	30	30	30	30	30	30	30	30	23	20	16	13	9	5	0
BARBADOS	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	0	161	42	34	42	0

BIL-Table 1. Continued.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
BRASIL	0	0	0	0	0	0	0	0	0	0	0	0	0	62	119	90	84	87	55	53	8	4	23	25	5	10	0	15	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	0	0	0	0	0	0	0	83	70	0
DOMINR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	50	49	46	18	40	44	44	40	31	98	0
GRENADA	0	0	0	0	0	**	**	**	**	**	**	**	**	**	31	37	40	31	36	27	37	66	164	211	104	114	98	125	180	177	0
NLDANT	0	0	0	0	0	0	0	28	28	28	28	28	28	28	28	21	21	21	21	21	21	21	10	10	10	10	10	10	10	10	0
TRINIDAD	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	0	1	2	1	2	0
USA	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	0	0	0	0	0
VENEZUELA	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	0	0	0	0	0	60
STVINCE	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	0	0	2	1	1	0
UNCL REGION	27	54	115	258	602	589	614	879	818	810	340	390	387	377	298	159	217	270	364	188	115	0	0	0	0	0	5	0	0	0	0
-LL	27	54	115	258	602	589	614	879	818	810	340	390	387	377	298	159	217	270	364	188	115	0	0	0	0	0	5	0	0	0	0
CHITAIW	4	2	2	34	0	0	0	0	0	0	0	0	0	0	0	0	0	49	86	140	108	0	0	0	0	0	0	0	0	0	0
CUBA	23	49	102	75	371	314	71	100	51	30	100	229	262	185	156	120	191	198	213	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	0	0	0	0	0	0	0	0
KOREA	0	3	11	149	231	275	543	779	767	745	165	139	109	151	111	32	24	23	65	48	7	0	0	0	0	0	5	0	0	0	0
PANAMA	0	0	0	0	0	0	0	**	**	35	75	22	16	41	31	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-OTH & UNCL	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	0	0	0	0	0	0

BILLFISH UNCLASSIFIED

AREA	COUNTRY	GEA	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
ETRO	GABON	UNC	116	++	++	++	++	++	++	++	++	++	++	++	0
GOFM	MEXICO	LL	0	0	0	0	0	0	0	0	0	0	0	0	2
GOFM	USA	LL	0	0	0	0	11	0	0	0	0	0	0	0	0
GOFM	USA	RR	0	0	0	0	++	0	0	0	0	0	0	0	0
NE	LIBERIA	UNC	0	0	0	129	78	68	94	74	103	18	20	38	0
NE	PORTUGAL	PS	0	0	0	0	0	0	0	0	4	0	0	0	0
NE	PORTUGAL	SUR	0	0	0	0	0	0	5	1	1	1	++	0	++
NE	UKRAINE	TRA	0	0	0	0	0	0	0	0	0	0	0	5	0
NW	GRENADA	UNC	0	0	0	0	0	0	0	0	0	0	0	0	0
NW	ST.LUCIA	HAN	0	0	0	0	0	0	0	0	0	0	0	0	0
NW	USA	GILL	0	0	0	0	++	0	0	0	0	0	0	0	0
NW	USA	HAN	0	0	0	0	1	0	0	0	0	0	0	0	0
NW	USA	LL	0	0	0	0	36	0	0	0	0	0	0	0	0
NW	VEN-FOR	LL	0	0	0	0	5	0	0	29	0	0	0	0	0
SW	BRASIL	SUR	0	0	0	0	21	0	0	0	0	0	0	0	0
WTRO	GUADELOU	SUR	0	0	0	0	0	0	0	0	0	0	0	0	0
WTRO	MARTINIQ	SUR	++	++	++	++	++	0	0	0	0	0	0	0	0
WTRO	TRINIDAD	LL	0	0	21	32	4	70	153	74	19	16	7	0	0

++ CATCH: < 0.5 MT

** CATCH: UNKNOWN

SWO-Table 1. Swordfish catches in metric tons (round weight) in the Atlantic and Mediterranean Sea (as of November 22, 1994).

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
TOTAL	11924	13681	12990	13020	11940	14912	17151	17896	12159	13079	13631	13903	15923	13864	14331	20377	20402	25267	21804	25825	26702	35540	39104	41018	43740	51693	51671	42860	39740	40385	44289
NORTH ATL	10189	11258	8652	9338	9084	9137	9138	9425	5198	4727	6001	6301	8776	6587	6352	11797	11859	13527	11138	13155	14464	12753	14348	18447	20234	19614	17299	15865	15224	15593	16977
LL	9192	10833	7759	8492	8656	8950	8938	9127	5140	4430	5446	5078	7015	5125	5401	11085	11099	12800	10507	12959	13960	12626	14205	18233	20025	19028	15399	14106	14133	13943	15575
CANADA	6682	6888	4155	3731	4534	4342	4149	4800	0	0	0	2	21	15	113	2314	2970	1794	542	542	960	465	550	973	876	874	1097	819	953	1487	2206
CHITAIW	2	1	1	37	76	115	218	234	226	129	243	204	209	362	189	126	260	103	140	200	209	126	117	121	40	18	13	207	574	132	108
CUBA	125	134	171	175	336	224	97	134	160	75	248	572	280	283	398	281	128	278	227	254	410	206	162	636	910	832	87	47	0	0	0
JAPAN	311	700	1025	658	280	262	130	298	914	784	518	1178	2462	1149	793	946	542	1167	1315	1755	537	665	921	807	413	621	1572	1051	992	1044	1126
KOREA	0	1	2	27	46	24	22	40	159	155	374	152	172	335	541	634	303	284	136	198	53	32	160	68	60	30	320	51	3	3	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	0	0	0	0	0	0	0	6
MAROC	6	18	14	12	11	13	16	14	21	15	10	12	15	12	6	11	208	136	124	91	125	79	137	178	207	195	219	18	9	17	0
NORWAY	0	0	++	300	300	200	600	400	200	**	**	**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PANAMA	0	0	0	0	0	0	0	**	**	7	171	24	25	91	22	76	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PORTUGA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	15	448	984	612	292	457	755	495	1396
ESPANA	1000	1800	1433	2999	2690	3551	3502	3160	3384	3210	3833	2893	3747	2816	3309	3611	2582	3810	4013	4554	7100	6315	7431	9712	11134	9600	5696	5736	6506	6351	6392
TRINIDAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	26	6	45	151	42	79	66	71	562	562 *
USA	1053	1279	945	534	340	180	93	0	0	0	0	0	0	0	0	3020	3888	5015	3986	5271	4510	4666	4642	5143	5164	6020	5855	4967	4184	3741	3668
USSR	0	0	5	8	22	21	11	24	24	28	26	17	32	19	15	20	10	21	0	69	0	16	13	18	0	0	0	0	0	0	0
VENEZUE	13	12	8	11	21	18	100	23	52	27	23	24	52	43	15	46	182	192	24	25	35	23	51	84	86	108	57	158	86	111	111 *
NEI_1	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	76	112	529	0	0	0
LL-DISCAR	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	0	0	0	215	383	408
USA	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	0	0	0	215	383	408
OTH & UNC	997	425	893	846	428	187	200	298	58	297	555	1223	1761	1462	951	712	760	727	631	196	504	127	143	214	209	586	1900	1759	876	1267	994
CANADA	800	211	519	702	260	51	108	0	0	0	0	0	0	0	0	0	0	91	19	12	128	34	35	86	78	24	150	92	73	60	28
CHITAIW	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	0	0	1	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	0	0	0	0	0	0	0	232	273	0
FRANCE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	4	0	0	1	4	4	0	0	0	75	75	75	75 *
GRENADA	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	56	5	1	1	2	0
IRELAND	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ITALY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBERIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	38	34	53	++	24	16	30	19	35	3	0	7	0
MARTINIQ	**	**	**	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	0	0	0
MEXICO	++	++	++	++	++	++	++	0	0	2	4	3	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAROC	0	100	86	49	23	30	4	3	12	28	8	3	0	0	1	0	0	0	0	0	4	2	0	0	0	1	4	185	183	335	457
POLAND	0	0	0	0	0	0	0	0	++	0	100	0	0	0	0	6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PORTUGA	0	9	6	15	11	12	11	8	11	21	37	92	58	32	38	17	29	15	13	11	9	7	7	20	10	5	8	12	16	45	11
ROUMANI	0	0	0	0	0	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	0
ESPANA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	1	0	0	0	10	7	1	199	952	650	127	321	203
STLUCIA	0	0	0	0	0	0	0	++	++	++	++	++	++	++	++	++	++	0	0	0	0	0	0	0	0	0	0	0	0	0	0
USA	197	105	282	80	134	94	77	287	35	246	406	1125	1700	1429	912	664	731	610	544	139	310	83	63	67	83	151	556	552	126	111	109
USSR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0
STVINCE	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	0	0	3	0	3	0
NEI_2												0	0	0	0	0	0	0	12	0	0	0	0	14	3	131	190	185	43	35	111

Portuguese catches were reported as gilled and gutted and have not been converted to round weight.

SWO-Table 1. Continued.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	
SOUTH ATL	1417	2029	2578	1930	1539	2335	4290	5130	1986	2394	2823	2568	2846	2640	2699	2622	2996	5161	3853	6327	5342	9121	9528	5853	5218	11740	16610	16357	12326	12092	15032	
LL	1417	2029	2578	1930	1539	2235	4090	5130	1984	2394	2823	2568	2846	2640	2684	2605	2967	5017	3816	6224	5247	8879	8805	4910	4634	11190	16078	15847	11955	11719	14753	
ARGENTI	400	508	400	200	79	259	500	400	63	100	48	10	10	111	132	4	0	++	0	0	0	0	0	0	0	0	0	0	0	0	0	
BRASIL	125	125	125	125	62	100	181	162	154	121	161	465	514	365	384	367	520	1579	654	1018	781	467	569	761	956	1159	989	1499	815	636	675	
BRAS-HON	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	0	0	0	17	0	70	
BRASTAI	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	0	0	0	527	1200	1014	
CHITAIW	4	2	1	73	128	375	637	985	599	621	849	617	719	573	519	481	994	540	406	400	201	153	215	166	260	614	469	689	837	1271	641	
CUBA	63	101	164	122	559	410	170	148	74	66	221	509	248	317	302	319	272	316	147	432	818	1161	1301	95	173	159	830	448	0	0	0	
JAPAN	825	1288	1845	1300	474	859	2143	2877	662	1023	480	191	805	105	514	503	782	2029	2170	3287	1908	4395	4613	2913	1877	3426	4019	6254	3696	2613	5256	
KOREA	0	1	4	54	79	77	370	382	256	249	602	563	279	812	699	699	303	399	311	486	409	625	917	369	666	1012	776	50	147	147	147	*
PANAMA	0	0	0	0	0	0	0	**	**	12	274	90	40	219	28	83	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
SAFRICA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	3	3	0	0	0	0	0	0	
ESPANA	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	4393	7725	6166	5760	5651	6749	
URUGUAY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	92	575	1084	1927	1125	537	699	427	414	302	156	201	201	*
USSR	0	4	39	56	158	155	89	176	176	202	188	123	231	138	106	149	70	154	36	26	46	146	60	0	0	0	0	0	0	0	0	
NEI_1	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	0	856	439	0	0	0	
OTH & UNC	0	0	0	0	0	100	200	0	2	0	0	0	0	0	15	17	29	144	37	103	95	242	723	943	584	550	532	510	371	373	279	
ANGOLA	++	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	228	815	84	84	84	++	++	0	0	
ARGENTI	0	0	0	0	0	0	0	0	0	0	0	0	0	++	0	0	0	0	0	20	0	0	361	31	351	198	175	230	88	88	14	
BENIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	24	0	86	90	39	13	19	26	28	28	26	26	*
BRASIL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	5	1	3	1	1	0	1	++	1	0	0	0	0	0	0	0	
BULGARI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
CHITAIW	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	0	0	4	0	0	0	
CIVOIRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	10	10	10	10	10	10	10	7	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	0	0	0	0	0	0	
GHANA	**	**	**	**	**	100	200	0	0	0	0	0	0	0	0	0	0	110	5	55	5	15	25	13	123	235	235	235	235	235	235	*
JAPAN	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
NIGERIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**	**	83	69	0	0	0	0	0	0	0	3	0	
SAFRICA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	31	9	3	7	23	3	2	2	4	++	0	5	9	4	
TOGO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	32	1	++	2	3	5	5	0	
USSR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	4	0	0	12	0	0	0	0	0	0	0	0	0	

SWO-Table 1. Continued.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
MEDITERRA	318	394	1760	1752	1317	3440	3723	3341	4975	5958	4807	5034	4301	4637	5280	5958	5547	6579	6813	6343	6896	13666	15228	16718	18288	20339	17761	10638	12184	12694	12280
LL	94	282	1423	1192	869	1196	1350	1114	1426	1529	1388	1089	712	4138	4606	5046	4877	5115	5411	5751	6239	6640	6260	7297	7781	9163	6784	5810	7607	6628	6565
ALGERIE	0	0	0	0	0	0	0	**	++	++	100	196	500	368	370	320	521	650	760	870	877	884	890	847	1820	2621	590	173	173	6	173
CYPRUS	0	0	0	0	0	0	0	0	0	++	++	++	5	59	95	82	98	72	78	103	28	63	71	154	84	121	139	173	162	73	116
GREECE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	91	773	772	1081	1036	1714	1303	1008	1120	1344	1904	1456	1568
ITALY	0	0	0	0	0	0	0	0	0	0	0	0	0	3435	3330	3750	3455	3642	3362	2583	2660	2759	2493	2622	2831	2989	2989	2439	3359	3463	3315
JAPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	3	1	0	5	6	19	14	7	3	4	1	2	1	2	2
MALTA	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	0	0	0	119	71	76
MAROC	94	282	223	192	169	196	250	214	326	229	183	193	118	186	144	172	0	++	++	0	43	39	38	92	40	62	97	43	24	34	22
ESPANA	0	0	1200	1000	700	1000	1100	900	1100	1300	1105	700	89	89	667	720	800	750	1120	900	1321	1243	1219	1337	1134	1760	1250	1438	1132	790	1293
NEI_3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	517	532	552	499	524	566	598	598	198	733	733	0
OTH & UNC	224	112	337	560	448	2244	2373	2227	3549	4429	3419	3945	3589	499	674	912	670	1464	1402	592	657	7026	8968	9421	10507	11176	10977	4828	4577	6066	5715
ALGERIE	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	0	0	539	389	389	389 *
FRANCE	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	0	0	0	++	++	++
ITALY	**	**	**	**	**	1568	2240	2016	3248	4144	3136	3730	3362	312	417	756	475	501	461	356	366	6601	8370	8791	9494	10021	10020	2975	2855	4123	4561
LIBYA	0	0	224	224	336	560	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
MALTA	**	**	++	++	++	++	++	112	224	224	224	192	214	175	223	136	151	222	192	177	59	94	108	97	131	207	121	122	0	0	0
MAROC	0	0	1	0	1	1	0	0	1	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	246	454	649	414
ESPANA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	8	0	0	2	87	85	39	32	65
TUNISIE	0	0	0	0	0	0	0	++	++	++	++	5	3	5	0	0	0	0	7	19	15	15	61	64	63	80	159	176	181	178	150
TURKEY	224	112	112	336	111	115	133	99	76	60	59	15	10	7	34	20	44	13	70	40	216	95	190	226	557	589	209	243	100	136	136 *
NEI_3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	728	672	0	0	219	231	243	262	277	381	442	559	559	0
UNCL. REGI	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	0	1	0	6	6	0
OTH & UNC	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	0	1	0	6	6	0
ANGOLA																															
SENEGAL	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	0	1	++	6	6	0

++ CATCH < 0.5 MT

** UNKNOWN QUANTITY OF CATCH

* Estimated catch, carried over from the previous year

NEI_1: Nowhere else included - 1. Portuguese flag vessels unloaded in Spanish ports.

NEI_2: Nowhere else included - 2. Unreported catches estimated based on U.S. import statistics.

NEI_3: Nowhere else included - 3. Estimated unreported catches due to underreporting in national statistics.

SWO-Table 2. **Atlantic and Mediterranean swordfish stock structure hypotheses and affirmative/negative comments regarding support of the various hypotheses by available data (adapted from 1991 SCRS Report).**

Stock hypotheses	CPUE by age	Larval distrib.	Catch distrib. (JLL data)	Mark/ Recapture	Size distrib.	Recruit. trends	Genetic	Spawning areas
Mediterranean single stock?	?	Yes	?	Yes	?	?	Yes[1]	Yes
North Atlantic single stock?	Yes	Yes	Yes	[2]	Yes	Yes[2a]	[3]	?
North (E & W) separate stocks?	No	No	No	[2]	No	No	[3a]	?
North+South single stock?	?	Yes	Yes[4]	No[5]	--	--	?	[6]

1 Preliminary evidence suggests population structure with some mixing possible.

2 There have been no transatlantic recoveries reported which indicate direct E-W or W-E movement. Movement has been demonstrated from the tropical eastern area to the temperate central area and from the temperate central area to the sub-tropical western area. The different probabilities for obtaining recoveries in different areas of the Atlantic have no been taken into account.

2a In VPAs, run separately for eastern and western stocks, recruitment trends were generally parallel. However, VPA analyses have not been updated, and it is uncertain that this pattern holds, given more recent information.

3 Statistical analysis of the frequency distribution of genotypes failed to reject the null hypothesis of a homogeneous distribution of genotypes.

3a Statistical analysis of the frequency distribution of genotypes rejected the alternative hypothesis of differences between East and West samples.

4 Catch rates of the Spanish fleet also indicate a continuous tropical band.

5 No recovery from the north Atlantic has been reported in the south. The different probabilities for obtaining recoveries in different areas of Atlantic have not been taken into account.

6 A common spawning stock in the tropical zone could be feeding north and south stocks.

SWO-Table 3. Atlantic swordfish catch (in number) at age, by mjor fishing countries (includes dead discarded catches).

(A) NORTH ATLANTIC

JAPAN

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
0	47	68	166	31	64	7	97	106	20	54	133	77	8	109	255	55
1	183	702	817	540	311	75	632	408	173	474	538	931	169	574	694	484
2	693	1336	2113	3063	1865	660	1467	2466	1058	888	1659	4055	1603	1537	2231	1698
3	1786	1552	3450	4299	4272	2252	2419	3254	2397	1528	2732	7410	3639	3162	3289	4338
4	2740	1502	2423	4859	4445	2294	2410	3566	2609	1805	2852	6222	4958	3747	3479	4388
5+	6041	2929	6685	6467	10232	2872	3870	4990	4533	3189	4319	7357	6490	5915	5954	6317
Total	11490	8090	15654	19258	21187	8161	10894	14790	10790	7939	12232	26052	16866	15045	15902	17279

SPAIN

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
0	378	333	928	1625	585	1851	2201	1996	7979	13319	10591	3815	7571	1072	2337	2335
1	2725	2959	6072	6610	4270	11261	9819	12965	20974	33292	49111	28694	17967	14960	18784	24863
2	7098	6061	10567	11869	7955	26093	18300	27348	44695	61954	61862	42301	51737	38535	38835	42657
3	9500	7289	12446	14000	12155	28813	26839	32961	45587	61334	52234	34224	39494	46485	39317	39428
4	10423	7834	11998	14217	16263	26659	24909	28688	36388	43925	33385	24953	21196	25642	25569	23714
5+	20478	13531	18658	18629	24757	30944	27161	28861	38331	41802	27133	19841	16599	18851	21486	19446
Total	50603	38006	60668	66951	65985	125621	109229	132620	193955	255629	234314	153830	154565	145545	146327	152444

USA

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
0	83	576	1994	1222	3017	2106	3104	2802	4056	3229	8762	2990	5296	2474	2754	3891
1	2248	5000	15410	7044	15750	16360	18314	18437	22089	33133	31702	39640	22895	16528	9857	11816
2	7069	13943	25968	17582	20034	23265	29833	25112	37779	40806	57235	55096	46602	35879	37170	35359
3	13470	14019	22968	18262	22985	16938	22332	24340	27716	29861	36007	37143	32653	29472	24842	27192
4	11061	11258	15508	11231	15685	11799	13145	14822	18353	15054	18483	18860	16467	14266	13102	12811
5+	19296	25365	27121	22939	25133	23894	19156	19310	18788	17413	18884	21159	19214	15565	15380	14657
Total	53226	70161	108969	78280	102605	94363	105884	104822	128782	139496	171072	174888	143127	114184	103105	104727

CANADA

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
0	15	62	65	4	102	112	95	121	275	337	82	106	6	15	24	69
1	918	223	2549	33	399	806	356	466	1379	3419	1455	2114	693	1280	1778	3369
2	3213	2771	4846	458	1368	2611	1587	1514	4841	5962	5590	5337	3373	2634	8213	9506
3	9061	7015	7426	1495	2948	3479	2271	3069	5583	6331	3983	4808	2749	4127	5475	10467
4	7744	8265	6847	1872	2276	3661	1772	2346	4129	3040	3005	2920	2029	2857	3927	5657
5+	12836	18223	9546	3306	2453	5946	2420	2546	4239	3224	3682	5695	4673	5077	7046	9712
Total	33788	36556	31280	7167	9544	16614	8501	10062	20446	22313	17798	20980	13525	15988	26465	38781

PORTUGAL

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
0	2	4	4	6	1	2	4	6	1116	2850	1777	210	542	4150	5081	582
1	13	33	24	23	10	14	20	34	1291	2970	1858	1412	2976	4587	5569	5395
2	33	68	42	42	20	35	35	66	1888	5640	3495	2067	4310	4178	3596	9303
3	45	82	50	50	33	38	47	71	1453	5039	3123	1436	3201	4421	2329	8157
4	48	88	48	50	43	37	48	60	1148	3087	1911	1115	1267	2337	1482	4910
5+	97	151	73	66	63	39	54	62	2701	4646	2896	917	752	1607	823	4199
Total	239	425	241	236	170	164	206	299	9597	24233	15059	7157	13048	21280	18881	32546

OTHERS

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
0	56	135	148	68	40	57	87	81	239	629	1226	457	4457	323	446	529
1	320	1490	1010	530	324	559	548	485	771	2086	4583	3478	5128	2251	1817	4662
2	1195	3200	2487	1867	1189	1825	1209	1830	2402	2731	5435	5635	14696	4546	8384	7661
3	2374	3427	3316	2365	2231	3752	1886	2331	3866	4896	6021	6080	10978	5131	9589	7781
4	3441	3065	2350	2573	2422	3741	1819	2435	3903	7154	5002	4573	6207	5075	7327	5605
5+	7611	5960	5631	3500	5111	4810	2728	3273	6339	8696	7151	4026	6220	6429	7932	6338
Total	14997	17277	14942	10902	11317	14743	8277	10434	17521	26183	29419	24248	47685	23754	35495	32576

SWO-Table 3. Continued.

NORTH ALL COUNTRIES COMBINED

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
0	580	1178	3306	2956	3809	4135	5587	5112	13685	20420	22570	7655	17880	8143	10898	6460
1	6408	10406	25881	14778	21063	29075	29690	32794	46677	75375	89248	76270	49827	40180	38500	50589
2	19301	27379	46023	34879	32431	54488	52430	58335	92664	117971	135274	114490	122321	87309	98430	106184
3	36235	33384	49655	40470	44624	55271	55793	66026	86602	108990	104100	91101	92715	92798	84841	97364
4	35458	32012	39174	34802	41134	48192	44103	51917	66530	74066	64638	58643	52124	53925	54885	57084
5+	66360	66156	67714	54908	67746	68504	55388	59042	74933	78974	64065	58996	53949	53442	58620	60672
Total	164342	170515	231754	182794	210808	259666	242992	273226	381090	475795	479895	407155	388815	335796	346175	378352

(B) SOUTH ATLANTIC

JAPAN

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
0	0	4	0	8	119	0	0	26	0	0	0	390	53	0	36	0
1	10	21	64	92	1033	296	410	630	91	210	1186	1339	287	330	273	124
2	18	593	535	294	3933	1117	3703	2996	541	1561	4032	6901	2012	2725	3654	1032
3	37	1689	2422	1289	9320	3761	9051	8784	2015	4830	13258	14468	11389	10492	10960	3108
4	191	1187	4659	2841	8481	4386	11191	16096	6744	5591	13620	15019	32238	14805	9132	7406
5+	3609	4854	14209	15420	21802	14244	27700	29706	24064	18181	24848	24375	38037	25352	14059	42903
Total	3864	8349	21888	19943	44688	23804	52055	58237	33456	30371	56943	62490	84017	53704	38111	54572

SPAIN

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
0	0	0	0	0	0	0	0	0	0	0	2847	1550	1898	1663	2127	3610
1	0	0	0	0	0	0	0	0	118	0	10285	18419	7342	7707	6349	10364
2	0	0	0	0	0	0	0	0	347	0	13510	24666	18951	17559	17090	15208
3	0	0	0	0	0	0	0	0	370	0	18217	36548	36597	35364	31073	28961
4	0	0	0	0	0	0	0	0	265	0	11845	31593	25844	25164	26690	29403
5+	0	0	0	0	0	0	0	0	357	0	19766	27600	28163	24018	26172	34508
Total	0	0	0	0	0	0	0	0	1459	0	76471	140377	118797	111476	109500	122053

BRAZIL+BRAS.JPN+URUGUAY

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
0	34	39	132	83	101	55	1182	453	181	54	64	396	0	0	16	0
1	205	381	616	841	1333	1119	5543	3938	2153	1483	1167	1182	2	6	125	35
2	695	1284	2317	2330	5703	7758	13681	10782	5254	6069	6159	4606	724	423	1584	337
3	602	1463	3861	2254	5382	7785	14607	8070	7839	6851	9198	9355	3618	1639	3931	685
4	677	1370	4243	1918	4695	5167	8227	6189	5263	4911	5924	7004	8063	4825	3505	1763
5+	1385	3072	10561	4511	8812	10325	8775	6292	5177	9393	7175	5081	12191	6395	5217	7385
Total	3599	7608	21730	11937	26027	32210	52012	35722	25866	28760	29686	27623	24597	13288	14376	10204

OTHERS

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
0	1	10	0	3	50	0	0	151	6	62	225	435	66	129	163	347
1	41	45	220	62	545	335	399	2012	1717	1054	1066	3724	352	556	718	946
2	81	1282	902	202	1980	1181	2578	6435	5052	3416	3476	9196	1387	1790	5723	1362
3	151	3657	2088	589	4100	3153	5222	8905	5742	4073	14580	15048	4852	4261	14120	2389
4	685	2570	3833	1263	3844	3742	7116	14095	5245	4457	7305	14993	7791	8262	12139	4160
5+	12565	10515	10914	6594	9512	11569	14925	17785	10291	13414	10336	17802	9298	12515	18201	16521
Total	13522	18078	17955	8711	20031	19980	30239	49382	28055	26477	36987	61200	23748	27514	51163	25727

SOUTH - ALL COUNTRIES COMBINED

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
0	34	53	132	94	270	55	1182	630	187	116	3136	2771	2017	1792	2342	3957
1	256	447	899	995	2911	1750	6351	6579	4078	2746	13704	24665	7984	8599	7465	11469
2	794	3159	3754	2826	11616	10057	19961	20213	11194	11046	27178	45369	23074	22496	28051	17940
3	790	6809	8370	4132	18802	14699	28880	25759	15966	15753	55253	75420	56456	51756	60184	35143
4	1553	5126	32735	6021	17020	13294	26534	36380	17518	14959	38694	68609	73936	53056	51466	42731
5+	17557	18440	35681	26522	40127	36139	51398	53778	39890	40986	62122	74856	87691	68283	63644	101317
Total	20986	34035	61572	40590	90747	75994	134306	143340	88835	85607	200088	291690	251159	205982	213151	212556

SWO-Table 6. **Estimates from production model analyses. Base case (best estimate) and sensitivity runs are shown. As in the 1992 report, estimates are bias-corrected; approximate 80% confidence intervals are given in parentheses. Where time did not allow computation of bias-corrected estimates and intervals, conventional point estimates are shown. Where estimated, median bias was generally less than ±4%.**

Difference(s) from base case	Sens Run	MSY, MT/yr	f_{MSY}, 10^6 hooks/yr	F_{1993}/F_{MSY}	B_{1994}/B_{MSY}	Equilibrium yield in 1994, MT
None (base case)		12,800 (5,200-17,100)	56.8 (19.5-77.1)	1.82 (0.962-4.69)	0.68 (0.50-1.17)	12,000 (5,200-16,600)
Assumes B_{1950}/B_{MSY} = 1.5	1	13,300 (5,700-17,400)	58.7 (20.8-79.3)	1.66 (0.79-3.99)	0.68 (0.48-1.19)	12,700 (6,000-16,800)
Assumes B_{1950}/B_{MSY} = 2.0	2	12,700 (5,200-17,100)	54.7 (21.1-75.8)	1.87 (1.03-4.37)	0.67 (0.50-1.09)	11,600 (5,400-16,500)
Uses catch data from 1962-93; assumes B_{1962}/B_{MSY} = 1.5	3	8,100 (5,200-14,800)	29.2 (16.8-61.5)	3.65 (1.67-7.16)	0.54 (0.390.81)	10,200 (4,400-15,700)
Uses catch data from 1962-93; assumes B_{1962}/B_{MSY} = 1.75	4	11,300 (5,000-16,400)	48.5 (19.2-75.1)	2.15 (1.22-5.24)	0.64 (4.62-1.03)	11,700 (5,300-16,300)
Uses catch data from 1962-93; assumes B_{1962}/B_{MSY} = 2.0	5	12,400 (4,800-16,600)	54.9 (20.2-75.3)	1.81 (0.99-3.89)	0.67 (0.48-0.99)	6,500 (3,500-13,300)
No constraint on B_{1962}/B_{MSY}	6[a]	11,300	49.5	2.17	0.65	9,900
Data from 1964-93; no constraint needed on B_{1964}	7[a]	11,800	50.9	2.11	0.64	10,300
Assumes a different catchability coefficient in 1963 and 1978	8[a]	13,500	66.5[b] 25.7[c]	1.50	0.81	13,000

[a] Conventional estimates shown (not bias-corrected); bias corrections and confidence intervals not available.
[b] Optimum effort when catchability is as observed in past years except 1963 and 1975.
[c] Optimum effort when catchability is as observed in 1963 and 1975.

SWO-Table 7. North Atlantic swordfish estimates of stock size from the base case assessment.

								STOCK AT AGE AT BEGINNING OF YEAR								
AGE	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94
1	476029	504086	434202	436856	492281	511049	529138	648897	673606	693979	700451	688870	597376	551419	564534	592877	0
2	331061	383952	403314	332142	344327	384034	392175	406430	501676	509393	500242	493063	495251	444179	415218	427468	439783
3	231187	253634	289655	288725	240492	252668	265339	273849	280211	327347	311019	288078	300767	295731	285112	251481	254567
4	175490	156651	177580	192450	199932	156740	157167	167061	164869	151722	170301	161312	154142	163238	158880	157291	118740
5+	311861	307431	291667	288092	312704	321790	286941	274171	261579	222354	169440	162919	160076	162429	170362	167829	160698
4-5+	487352	464082	469247	480542	512636	478530	444107	441232	426448	374075	339741	324231	314217	325667	329241	325120	279437
2-4	737739	794237	870549	813316	784750	793443	814681	847340	946757	988461	981562	942452	950160	903147	859210	836240	813090
2-5+	1049600	1101668	1162216	1101409	1097455	1115233	1101621	1121512	1208336	1210815	1151002	1105371	1110235	1065576	1029572	1004069	973788
1-5+	1525629	1605755	1596418	1538266	1589736	1626281	1630759	1770409	1881941	1904793	1851453	1794241	1707611	1616995	1594105	1596946	0

SWO-Table 8. North Atlantic swordfish estimates of fishing mortality rate from the base case assessment.

								F AT AGE DURING YEAR								
AGE	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93
1	0.0150	0.0230	0.0679	0.0380	0.0483	0.0648	0.0638	0.0573	0.0794	0.1273	0.1511	0.1300	0.0963	0.0837	0.0781	0.0987
2	0.0664	0.0818	0.1342	0.1229	0.1095	0.1697	0.1591	0.1719	0.2269	0.2934	0.3519	0.2943	0.3156	0.2433	0.3014	0.3183
3	0.1892	0.1565	0.2089	0.1675	0.2281	0.2748	0.2626	0.3074	0.4135	0.4535	0.4565	0.4254	0.4111	0.4213	0.3948	0.5504
4	0.2510	0.2543	0.2774	0.2216	0.2562	0.4109	0.3678	0.4163	0.5816	0.7591	0.5363	0.5071	0.4610	0.4491	0.4751	0.5060
5+	0.2662	0.2697	0.2942	0.2351	0.2717	0.2664	0.2384	0.2699	0.3770	0.4921	0.5336	0.5045	0.4587	0.4468	0.4727	0.5034
4-5+	0.2607	0.2644	0.2878	0.2297	0.2657	0.3114	0.2823	0.3228	0.4512	0.5920	0.5349	0.5058	0.4598	0.4480	0.4738	0.5047
2-4	0.1458	0.1376	0.1867	0.1614	0.1810	0.2467	0.2299	0.2593	0.3349	0.4056	0.4145	0.3672	0.3677	0.3344	0.3623	0.4176
2-5+	0.1801	0.1727	0.2126	0.1801	0.2061	0.2523	0.2321	0.2619	0.3439	0.4209	0.4312	0.3863	0.3804	0.3507	0.3797	0.4314
1-5+	0.1256	0.1233	0.1712	0.1377	0.1545	0.1895	0.1744	0.1820	0.2410	0.3037	0.3158	0.2800	0.2716	0.2514	0.2623	0.2947
F5+/F4	1.0606	1.0606	1.0606	1.0606	1.0606	0.6483	0.6483	0.6483	0.6483	0.6483	0.9950	0.9950	0.9950	0.9950	0.9950	0.9950

SWO-Table 9. North Atlantic swordfish estimates of biomass from the base case assessment.

								MID-YEAR BIOMASS AT AGE (KG)								
AGE	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93
1	6253800	6641883	5637258	5792496	6582393	6824683	7115866	8696427	8815203	8759155	8387961	8507812	7858397	6577413	7047443	7380359
2	7847031	8498634	8982241	7437006	7729183	8346980	8698239	8892763	10453198	10494359	9688184	9725651	9944756	9149090	8391983	8573079
3	8215663	8982133	9985491	10027018	8236333	8730051	9028028	9063327	8712640	10093964	9394979	8759748	9226716	9118965	8896978	7270027
4	8686872	7742676	8641474	9641452	9856912	7225086	7303070	7557355	6852533	5873591	7316329	6961971	6733391	7180837	6885571	6724030
5+	28055936	27867456	25507738	26204932	28335834	27006100	24188902	22787640	20758868	16493466	12271875	12017330	11837787	12181276	12755056	12370384
Total	59059300	59732784	58754200	59102904	60740656	58132896	56334104	56997512	55592440	51714536	47059328	45972512	45601048	44207580	43977032	42317880
4-5+	36742808	35610132	34149212	35846384	38192744	34231188	31491972	30344994	27611400	22367056	19588204	18979302	18571178	19362112	19640628	19094414
2-4	24749566	25223444	27609206	27105476	25822428	24302116	25029336	25513444	26018370	26461914	26399492	25447370	25904862	25448892	24174534	22567136
2-5+	52805500	53090900	53116944	53310408	54158260	51308216	49218240	48301084	46777240	42955380	38671368	37464700	37742648	37630168	36929592	34937520
1-5+	59059300	59732784	58754200	59102904	60740652	58132900	56334104	56997508	55592444	51714536	47059328	45972512	45601048	44207580	43977032	42317880

SWO-Table 10. Summary of retrospective analysis of north Atlantic swordfish.

Years in VPA	89	90	91	92	93	94
N at Age 1						
78-88	0	0	0	0	0	0
78-89	700628	0	0	0	0	0
78-90	735780	538023	0	0	0	0
78-91	731401	577204	460758	0	0	0
78-92	722952	585266	584315	519634	0	0
78-93	688870	597376	551419	564534	592877	0
Ratio	1.017	0.901	0.836	0.92	0	0
N at Age 2						
78-88	585621	0	0	0	0	0
78-89	566145	504875	0	0	0	0
78-90	521925	533647	395594	0	0	0
78-91	508257	530063	427667	341002	0	0
78-92	511439	523148	434266	442148	390711	0
78-93	493063	495251	444179	415218	427468	439783
Ratio	1.088	1.019	0.891	0.821	0.914	0
N at Age 3						
78-88	312780	0	0	0	0	0
78-89	238579	360529	0	0	0	0
78-90	250420	324366	327119	0	0	0
78-91	295515	313191	324189	271607	0	0
78-92	297072	315792	318535	277004	273499	0
78-93	288078	300767	295731	285112	251481	254567
Ratio	1.086	1.199	1.106	0.953	1.088	0
N at Age 4						
78-88	117658	0	0	0	0	0
78-89	120141	113770	0	0	0	0
78-90	141817	123421	182509	0	0	0
78-91	165162	160213	173382	182118	0	0
78-92	165968	161484	175507	177501	150670	0
78-93	161312	154142	163238	158880	157291	118740
Ratio	0.729	0.738	1.118	1.146	0.958	0
N at Age 5+						
78-88	100530	0	0	0	0	0
78-89	121280	92705	0	0	0	0
78-90	143203	128133	111364	0	0	0
78-91	166812	166388	172534	186890	0	0
78-92	167627	167710	174651	190352	199340	0
78-93	162919	160076	162429	170362	167829	160698
Ratio	0.617	0.579	0.686	1.097	1.188	0

* Ratio represents the ratio of the number at age in 1993 from the base case VPA (data from 1978-93) to the corresponding terminal year number at age for each retrospective VPA.

SWO-Table 11. Inputs to yield per recruit and biomass per recruit analyses.

AGE	Average partial recruitement 1988-89	Average partial recruitement 1992-93	Average weight Stock	Average weight Catch
1	0.269	0.179	6.16	9.98
2	0.618	0.632	15.11	21.55
3	0.845	0.954	29.23	37.97
4	1.000	1.000	47.53	57.63
5	0.995	0.995	67.98	78.35
6	0.995	0.995	88.49	98.24
7	0.995	0.995	107.45	116.04
8	0.995	0.995	123.96	131.19
9	0.995	0.995	137.72	143.59
10	0.995	0.995	148.82	153.46
11	0.995	0.995	157.56	161.17
12	0.995	0.995	164.33	167.09
13	0.995	0.995	169.49	171.58
14	0.995	0.995	173.40	174.97
15	0.995	0.995	176.34	177.51
16	0.995	0.995	178.53	179.41
17	0.995	0.995	180.16	180.81
18	0.995	0.995	181.37	181.86
19	0.995	0.995	182.87	182.63
20+	0.995	0.995	182.93	183.20

Average weights (kg round) were calculated from a Gompertz growth function with Winf=184.8 kg, g=0.306, to=5.0. Stock weights are beginning of year; catch weights are mid-year (t+0.5). M=0.2 for all ages.

SWO-Table 12. Results from yield per recruit (YPR) and biomass per recruit (BPR) analyses.

	F	YPR	BPR	BPR as % maximum	MSY	Bmsy
1) Partial recruitment (PR) given by average of 1988 and 1989 PR's.						
F0.1	0.163	22.2	98.6	32.2	13700	60880
Fmax	0.293	23.9	49.4	16.1	14760	30500
F1993	0.506	22.6	19.3	6.3		
2) Partial recruitment (PR) given by average of 1992 and 1993 PR's.						
F0.1	0.164	22.4	97.5	31.8	13830	60200
Fmax	0.300	24.2	47.4	15.4	14940	29260
F1993	0.506	23.0	19.0	6.2		
3) Partial recruitment (PR) as for (2), except ages 1 and 2 = 0.						
F0.1	0.195	24.8	95.7	31.2	15320	59090
Fmax	0.445	27.5	35.0	11.4	16980	21610
F1993	0.506	27.4	28.6	9.3		

Fishing mortalities refer to the fully-recruited fishing mortality applying to age 4; the corresponding Age 5+ fishing mortality is 0.995 of the age 4 fishing mortality. Biomass values represent beginning of year 5+ biomass. The maximum BPR is 306.8 kg per recruit, which is attained at a fishing mortality rate of 0. MSY and Bmsy were estimated by multiplying the base case VPA geometric mean of recruitment from 1983-91 (617,400) by the YPR and BPR estimates, respectively.

SWO-Table 13. Production-model projections for north Atlantic swordfish. All projections assumed that removals in 1994 would equal reported removals in 1993 (16,980 MT). Then, a management scheme was projected for the five years 1995-1999. All projections were based on boostrap results (700 realizations) from the base case production model. All projections assume that the hypothesized managment controls can be enforced effectively. Projected catch or effort levels use the base-case estimates of MSY, etc., as standards.

Projected management technique	Figure	Expected outcome
Management based on catch targets		
Yield of zero for five years	18a,b	Rapid stock rebuilding. B_{1997}= 0.95 B_{MSY}. B_{2000}= 1.5 B_{MSY}.
Yield of 6,410 MT/yr (MSY/2) for five years	18c,d	Stock rebuilding. B= B_{MSY} by year 2000.
Yield of 12,820 MT/yr (MSY) for five years	18e,f	Severe stock decline. B_{2000} = 0.14 B_{MSY}
Yield of 16,980 MT/yr (as in 1993) for five years	18g,h	Severe stock decline. B_{1997} = 0.12 B_{MSY}.
Yield decreasing by 1250 MT/yr/yr. (Y_{1995}= 15,730 MT; Y_{1996}= 14,480 MT; etc.)	---	Severe stock decline. B_{1999} = 0.06 B_{MSY}.
Management based on F targets		
F = zero for five years	18a,b	(Identical to first entry in table)
F = 27.4% of F_{1993} value (equivalent to 50% of F_{MSY})	19a,b	Rapid stock rebuilding. Y_{1995} = 4,200 MT; Y_{1999}= 7,700 MT; stock at B_{MSY} by 1999.
F = 55% of F_{1993} (equivalent to F_{MSY})	19c,d	Gradual stock rebuilding. Y_{1995} = 7,900 MT; Y_{1999} = 10,700 MT; stock at 79% of B_{MSY} by year 2000.
F = F_{1993}	19e,f	Stock decline. Y_{1995} = 12,980 MT; Y_{1999} = 9,900 MT; stock at 41% of B_{MSY} in year 2000.

SWO-Table 14. VPA-based projections for north Atlantic swordfish.

Case	*Scenario*	*Expected recovery to maximum biomass of* $F_{0.1}$
A	Yield of zero (F of zero)	Between 1978 and 1999.
B	Yield of 16,980 MT annually (as in 1993)	Not expected.
C	Annual F as in 1993	Not expected.
D	Annual F = $F_{0.1}$	Expected beyond 10-year projected time horizon
E	Annual yield = Maximum equilibrium yield at $F_{0.1}$ (14,000 MT)	Not expected.
F	Annual F = F_{max}	Not expected.
G	Annual F = $F_{0.1}$ with annual reductions in yield of not more than 1,250 MT.	Expected beyond 10-year projected time horizon.

Notes: All projections assumed that removals in 1994 would equal reported removals in 1993. Then, a simulated management scheme was applied until the year 2005. All were based on 500 bootstrap realizations from the base case VPA. Note that all projections assume that the management controls can be implemented exactly, except that fishing mortality was not allowed to be greater than 3. Recruitment is stochastic, with no trend and independent of stock size.

SWO-Table 15. Estimated landing weight (converted to live weight) of swordfish equal to or above 125 cm in L-JFL, by nation for north Atlantic. Index is to 1988 landings and U.S. catch excludes discards.

	CANADA		U.S.A.		SPAIN		PORTUGAL		JAPAN		OTHERS		ALL COMBINED	
Yea	Kg	Index	Kg	Index	Kg	Index	Kg	Index	Kg	Index	Kg	Index	Kg	Index
78	2297816	2.727	3592272	0.653	3530228	0.437	16624	0.025	1016642	1.172	1284245	0.897	10453582	0.655
79	2933643	3.481	4413847	0.803	2503065	0.310	27912	0.041	539846	0.622	1095767	0.765	10418313	0.653
80	1846103	2.191	5278653	0.960	3659798	0.453	14348	0.021	1226899	1.414	1042352	0.728	12025801	0.753
81	555350	0.659	4313523	0.785	3829897	0.474	13197	0.019	1357448	1.565	719560	0.503	10069415	0.631
82	551598	0.655	5067145	0.922	4440076	0.549	11325	0.017	1876680	2.163	934735	0.653	11946824	0.748
83	1063683	1.262	4419779	0.804	6752735	0.836	8713	0.013	567059	0.654	949909	0.663	12811969	0.802
84	492006	0.584	4310476	0.784	6018970	0.745	11474	0.017	694772	0.801	510851	0.357	11527698	0.722
85	578888	0.687	4349436	0.791	6838580	0.846	15011	0.022	964201	1.111	644737	0.450	12746116	0.798
86	1031293	1.224	4727725	0.860	9035883	1.118	511327	0.756	839518	0.968	1190081	0.831	16145746	1.011
87	909495	1.079	4639287	0.844	10923905	1.352	1086960	1.606	596148	0.687	1546942	1.080	18155795	1.137
88	842721	1.000	5497017	1.000	8081104	1.000	676779	1.000	867557	1.000	1431956	1.000	15965178	1.000
89	1189037	1.411	5626264	1.024	5766034	0.714	262453	0.388	1620093	1.867	1033192	0.722	14463881	0.906
90	885261	1.050	4994903	0.909	5646340	0.699	416506	0.615	1145921	1.321	1732897	1.210	13088931	0.820
91	994412	1.180	4107437	0.747	6233071	0.771	601946	0.889	1038370	1.197	1277754	0.892	12975236	0.813
92	1468533	1.743	3847267	0.700	6216834	0.769	374450	0.553	1114864	1.285	1735730	1.212	13021948	0.816
93	2132006	2.530	3791848	0.690	5971474	0.739	1269084	1.875	1177983	1.358	1385493	0.968	14342395	0.898

Conversion factors (length-weight) used are as follows:

NW ATL.	DWT = 4.592 E-06 * LJ-F ** 3.1370 (Turner, 1987)	RWT = 1.3333 * DWT
CENT. N. ATL.	RWT = 4.203 E-06 * LJ-F ** 3.2134 (Mejuto et al, 1988)	
NE ALT.	RWT = 3.4333 E-06 * LF-J ** 3.2623 (Mejuto et al., 1988)	
MED.	DWT = 5.701 E-06 * LJ-F ** 3.16 (De Metrio, 1987)	
SW ATL.	GWT = 1.24 E-05 * E-F ** 3.04 (Amorin et al., 1979	GWT = 0.8009 * RWT ** 1.015
SE ATL.	GWT = 4.3491 E-06 * LJ-F ** 3.188 (Mejuto, et al.,	RWT = 1.140 * GWT

RWT = Round weight
DWT = Dressed weight (gilled, gutted, part of head off, fins off)
GWT = Gilled and gutted weight
FL = Fork length
LJ-F = Lower jaw - fork length
E-F = Eye - fork length

SWO-Table 16. Swordfish partial F's for Japan, Spain, U.S., Canada, Portugal and others, 1978-1986.

AGE	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	F93/F88	F93/F91
Partial F's for JAPAN																		
1	0.000	0.002	0.002	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.002	0.000	0.001	0.001	0.001	1.037	0.790
2	0.002	0.004	0.006	0.011	0.006	0.002	0.004	0.007	0.003	0.002	0.004	0.010	0.004	0.004	0.007	0.005	1.179	1.188
3	0.009	0.007	0.015	0.018	0.022	0.011	0.011	0.015	0.011	0.006	0.012	0.035	0.016	0.014	0.015	0.025	2.047	1.708
4	0.019	0.012	0.017	0.031	0.028	0.020	0.020	0.029	0.023	0.018	0.024	0.054	0.044	0.031	0.030	0.039	1.644	1.246
5+	0.024	0.012	0.029	0.028	0.041	0.011	0.017	0.023	0.023	0.020	0.036	0.063	0.055	0.049	0.048	0.052	1.457	1.060
4+	0.022	0.012	0.025	0.029	0.036	0.014	0.018	0.025	0.023	0.019	0.030	0.058	0.050	0.040	0.039	0.046	1.540	1.138
2-4	0.008	0.007	0.011	0.018	0.016	0.008	0.010	0.014	0.008	0.006	0.010	0.025	0.014	0.012	0.014	0.017	1.691	1.384
2+	0.013	0.008	0.015	0.020	0.023	0.009	0.011	0.016	0.011	0.008	0.014	0.030	0.020	0.018	0.019	0.022	1.660	1.283
1+	0.009	0.006	0.012	0.015	0.016	0.006	0.008	0.010	0.007	0.005	0.008	0.018	0.012	0.011	0.012	0.014	1.634	1.191
3+	0.020	0.010	0.022	0.026	0.034	0.013	0.017	0.024	0.022	0.017	0.028	0.054	0.047	0.039	0.036	0.048	1.723	1.217
1-2	0.001	0.003	0.004	0.005	0.003	0.001	0.003	0.003	0.001	0.001	0.002	0.005	0.002	0.003	0.004	0.003	1.144	1.024
Partial F's for SPAIN																		
1	0.006	0.007	0.016	0.017	0.010	0.025	0.021	0.023	0.036	0.056	0.083	0.049	0.035	0.031	0.038	0.049	0.583	1.557
2	0.024	0.018	0.031	0.042	0.027	0.081	0.056	0.081	0.109	0.154	0.161	0.109	0.133	0.107	0.119	0.128	0.795	1.191
3	0.050	0.034	0.052	0.058	0.062	0.143	0.126	0.153	0.218	0.255	0.229	0.160	0.175	0.211	0.183	0.223	0.973	1.056
4	0.074	0.062	0.085	0.091	0.101	0.227	0.208	0.230	0.318	0.450	0.277	0.216	0.187	0.214	0.221	0.210	0.759	0.984
5+	0.082	0.055	0.081	0.080	0.099	0.120	0.117	0.132	0.193	0.260	0.226	0.170	0.141	0.158	0.173	0.161	0.714	1.024
4+	0.079	0.058	0.083	0.084	0.100	0.154	0.148	0.167	0.238	0.332	0.252	0.193	0.164	0.186	0.196	0.185	0.735	0.996
2-4	0.043	0.031	0.048	0.059	0.056	0.127	0.106	0.131	0.173	0.225	0.201	0.141	0.155	0.158	0.158	0.170	0.843	1.072
2+	0.054	0.038	0.056	0.064	0.068	0.125	0.109	0.131	0.177	0.232	0.205	0.145	0.153	0.158	0.160	0.168	0.822	1.064
1+	0.039	0.027	0.045	0.050	0.049	0.092	0.079	0.089	0.122	0.162	0.154	0.105	0.108	0.111	0.113	0.119	0.770	1.073
3+	0.072	0.049	0.074	0.075	0.096	0.147	0.144	0.164	0.230	0.294	0.234	0.178	0.155	0.180	0.181	0.192	0.823	1.066
1-2	0.014	0.011	0.023	0.027	0.017	0.049	0.035	0.044	0.066	0.096	0.114	0.073	0.077	0.064	0.070	0.080	0.701	1.250
Partial F's for U.S.A.																		
1	0.005	0.011	0.040	0.018	0.036	0.036	0.039	0.032	0.038	0.056	0.054	0.068	0.044	0.034	0.020	0.023	0.430	0.670
2	0.024	0.042	0.076	0.062	0.068	0.072	0.091	0.074	0.093	0.101	0.149	0.142	0.120	0.100	0.114	0.106	0.712	1.060
3	0.070	0.066	0.097	0.076	0.117	0.084	0.105	0.113	0.132	0.124	0.158	0.173	0.145	0.134	0.116	0.154	0.974	1.149
4	0.078	0.089	0.110	0.072	0.098	0.101	0.110	0.119	0.160	0.154	0.153	0.163	0.146	0.119	0.113	0.114	0.740	0.956
5+	0.077	0.103	0.118	0.098	0.101	0.093	0.082	0.088	0.095	0.109	0.157	0.181	0.163	0.130	0.124	0.122	0.773	0.935
4+	0.078	0.099	0.115	0.087	0.100	0.095	0.092	0.099	0.118	0.126	0.155	0.172	0.155	0.124	0.119	0.118	0.758	0.946
2-4	0.051	0.058	0.089	0.069	0.090	0.081	0.099	0.095	0.114	0.116	0.152	0.154	0.132	0.114	0.114	0.121	0.793	1.061
2+	0.058	0.070	0.096	0.076	0.093	0.085	0.094	0.093	0.110	0.114	0.153	0.158	0.136	0.116	0.116	0.121	0.790	1.041
1+	0.041	0.051	0.080	0.059	0.074	0.068	0.076	0.069	0.082	0.091	0.112	0.120	0.101	0.086	0.079	0.081	0.720	0.942
3+	0.071	0.084	0.102	0.078	0.095	0.091	0.089	0.097	0.115	0.111	0.144	0.159	0.147	0.121	0.110	0.122	0.848	1.012
1-2	0.013	0.024	0.057	0.037	0.049	0.051	0.061	0.048	0.060	0.074	0.091	0.097	0.077	0.062	0.057	0.056	0.611	0.892

SWO-Table 16. Continued.

AGE	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	F93/F88	F93/F91
Partial F's for CANADA																		
1	0.002	0.000	0.007	0.000	0.001	0.002	0.001	0.001	0.002	0.006	0.002	0.004	0.001	0.003	0.004	0.007	2.668	2.465
2	0.011	0.008	0.014	0.002	0.005	0.008	0.005	0.004	0.012	0.015	0.015	0.014	0.009	0.007	0.025	0.028	1.960	3.882
3	0.047	0.033	0.031	0.006	0.015	0.017	0.011	0.014	0.027	0.026	0.017	0.022	0.012	0.019	0.025	0.059	3.388	3.158
4	0.055	0.066	0.048	0.012	0.014	0.031	0.015	0.019	0.036	0.031	0.025	0.025	0.018	0.024	0.034	0.050	2.011	2.107
5+	0.051	0.074	0.041	0.014	0.010	0.023	0.010	0.012	0.021	0.020	0.031	0.049	0.040	0.042	0.057	0.081	2.628	1.899
4+	0.053	0.071	0.044	0.013	0.012	0.026	0.012	0.014	0.027	0.024	0.028	0.037	0.029	0.033	0.046	0.066	2.370	1.990
2-4	0.032	0.027	0.026	0.006	0.010	0.015	0.008	0.010	0.020	0.021	0.017	0.018	0.011	0.014	0.027	0.041	2.395	2.988
2+	0.038	0.039	0.030	0.008	0.010	0.017	0.009	0.011	0.020	0.021	0.019	0.022	0.015	0.018	0.032	0.047	2.491	2.647
1+	0.026	0.027	0.023	0.005	0.007	0.012	0.006	0.007	0.013	0.015	0.012	0.015	0.010	0.012	0.021	0.031	2.508	2.503
3+	0.048	0.061	0.039	0.012	0.011	0.025	0.012	0.014	0.026	0.021	0.026	0.034	0.028	0.032	0.042	0.068	2.652	2.128
1-2	0.006	0.004	0.010	0.001	0.002	0.004	0.002	0.002	0.006	0.009	0.007	0.008	0.004	0.005	0.012	0.015	2.105	3.258
Partial F's for PORTUGAL																		
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.005	0.003	0.002	0.006	0.010	0.011	0.011	3.346	1.102
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.014	0.009	0.005	0.011	0.012	0.011	0.028	3.067	2.395
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.021	0.014	0.007	0.014	0.020	0.011	0.046	3.367	2.297
4	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.032	0.016	0.010	0.011	0.019	0.013	0.044	2.745	2.236
5+	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.014	0.029	0.024	0.008	0.006	0.013	0.007	0.035	1.444	2.594
4+	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.012	0.030	0.020	0.009	0.009	0.016	0.010	0.039	1.954	2.373
2-4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.019	0.012	0.006	0.012	0.016	0.011	0.036	3.082	2.294
2+	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.020	0.013	0.007	0.011	0.015	0.011	0.036	2.665	2.331
1+	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.014	0.009	0.005	0.009	0.013	0.011	0.025	2.761	1.927
3+	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.012	0.027	0.019	0.008	0.008	0.016	0.009	0.041	2.186	2.538
1-2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.009	0.005	0.004	0.008	0.010	0.011	0.017	3.163	1.661
Partial F's for OTHERS																		
1	0.001	0.003	0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.004	0.008	0.006	0.010	0.005	0.004	0.009	1.172	1.940
2	0.004	0.010	0.007	0.007	0.004	0.006	0.004	0.005	0.006	0.007	0.014	0.014	0.038	0.013	0.026	0.023	1.624	1.813
3	0.012	0.016	0.014	0.010	0.011	0.019	0.009	0.011	0.018	0.020	0.026	0.028	0.049	0.023	0.045	0.044	1.666	1.888
4	0.024	0.024	0.017	0.016	0.015	0.032	0.015	0.020	0.034	0.073	0.042	0.040	0.055	0.042	0.063	0.050	1.197	1.175
5+	0.031	0.024	0.024	0.015	0.020	0.019	0.012	0.015	0.032	0.054	0.060	0.034	0.053	0.054	0.064	0.053	0.883	0.978
4+	0.028	0.024	0.021	0.016	0.018	0.023	0.013	0.017	0.033	0.061	0.051	0.037	0.054	0.048	0.064	0.051	1.013	1.066
2-4	0.011	0.014	0.011	0.010	0.009	0.015	0.007	0.010	0.014	0.020	0.022	0.023	0.044	0.021	0.038	0.034	1.503	1.600
2+	0.017	0.017	0.014	0.011	0.012	0.016	0.009	0.011	0.018	0.026	0.028	0.024	0.045	0.026	0.043	0.037	1.329	1.423
1+	0.011	0.012	0.011	0.008	0.008	0.011	0.006	0.007	0.011	0.017	0.019	0.017	0.032	0.018	0.027	0.025	1.304	1.412
3+	0.026	0.021	0.019	0.014	0.018	0.022	0.013	0.016	0.032	0.054	0.047	0.034	0.051	0.047	0.059	0.053	1.134	1.140
1-2	0.002	0.006	0.005	0.004	0.002	0.003	0.002	0.003	0.003	0.005	0.010	0.009	0.022	0.008	0.012	0.015	1.417	1.796

SWO-Table 17. Estimated landings of swordfish in number less than 125 cm and equal or greater than 125 cm in lower-jaw fork length for the north and south Atlantic Ocean.

NORTH ATLANTIC

YEAR	<125 No.	>125 No.	TOTAL No.	<125 %	<125 No.	>125 No.	TOTAL No.	<125 %	<125 No.	>125 No.	TOTAL No.	<125 %	<125 No.	>125 No.	TOTAL No.	<125 %
	CANADA				**JAPAN**				**SPAIN**				**USA (Excluding discards)**			
78	1585	32204	33788	4.69	317	11173	11490	2.76	5841	44762	50603	11.54	3644	49582	53226	6.85
79	779	35777	36556	2.13	1132	6958	8090	13.99	5080	32926	38006	13.37	11057	59104	70161	15.76
80	3614	27666	31280	11.55	1410	14245	15654	9.00	9563	51105	60668	15.76	25839	83130	108969	23.71
81	113	7054	7167	1.58	1094	18165	19259	5.68	11299	55651	66950	16.88	14494	63786	78281	18.52
82	741	8803	9544	7.76	703	20484	21187	3.32	7112	58873	65985	10.78	25611	76995	102606	24.96
83	1617	14997	16614	9.73	168	7993	8161	2.06	20152	105469	125621	16.04	28208	66155	94363	29.89
84	788	7714	8501	9.26	1040	9854	10894	9.55	15633	93596	109229	14.31	31776	74109	105885	30.01
85	881	9181	10062	8.76	743	14046	14790	5.03	22198	110623	132821	16.71	31007	73815	104822	29.58
86	3089	17357	20446	15.11	338	10452	10790	3.13	41856	152097	193953	21.58	42492	86290	128783	33.00
87	5352	16962	22313	23.98	644	7295	7940	8.12	64539	191085	255624	25.25	51619	87877	139496	37.00
88	2923	14876	17798	16.42	928	11305	12232	7.58	83861	150451	234312	35.79	61997	109075	171072	36.24
89	3445	17536	20981	16.42	1865	24187	26052	7.16	47994	105836	153830	31.20	66010	108878	174888	37.74
90	1445	12080	13525	10.68	810	16055	16866	4.80	42745	111820	154564	27.65	46316	96811	143127	32.36
91	1824	14164	15988	11.41	717	14328	15045	4.77	27213	118336	145549	18.70	21518	77173	98691	21.80
92	4092	22373	26466	15.46	1264	14638	15902	7.95	32663	113666	146329	22.32	5437	72316	77753	6.99
93	5616	33165	38781	14.48	955	16324	17279	5.53	40462	111987	152449	26.54	4326	72336	76662	5.64
	PORTUGAL				**OTHERS**								**TOTAL - NORTH ATLANTI**			
78	29	210	239	12.15	623	14375	14997	4.15					12038	137929	164342	7.32
79	58	368	425	13.52	2741	14536	17277	15.86					20847	135133	170515	12.23
80	38	202	241	15.92	1890	13052	14942	12.65					42355	176347	231754	18.28
81	41	195	236	17.26	993	9909	10902	9.11					28034	144851	182794	15.34
82	16	154	170	9.29	635	10682	11317	5.61					34817	165310	210808	16.52
83	25	139	164	15.16	1040	13703	14743	7.05					51210	194753	259666	19.72
84	30	176	206	14.73	877	7400	8277	10.60					50145	185448	242993	20.64
85	56	242	299	18.79	852	9582	10434	8.17					55738	207907	273227	20.40
86	2772	6825	9597	28.88	1633	15888	17521	9.32					92180	273021	381089	24.19
87	7021	17213	24233	28.97	3507	22676	26183	13.40					132681	320432	475788	27.89
88	4375	10684	15059	29.05	7661	21754	29415	26.05					161745	296390	479889	33.70
89	2402	4756	7157	33.56	6090	18158	24248	25.12					127805	261192	407155	31.39
90	4151	8897	13048	31.82	14688	32998	47686	30.80					110155	245663	388816	28.33
91	9875	11402	21277	46.41	4155	19599	23754	17.49					65302	235403	320305	20.39
92	11855	7027	18881	62.79	5234	30258	35492	14.75					60545	230020	320823	18.87
93	8943	23600	32543	27.48	8396	24178	32574	25.78					68698	257412	350288	19.61

SOUTH ATLANTIC

YEAR	<125 No.	>125 No.	TOTAL No.	<125 %	<125 No.	>125 No.	TOTAL No.	<125 %	<125 No.	>125 No.	TOTAL No.	<125 %	<125 No.	>125 No.	TOTAL No.	<125 %
	JAPAN				**SPAIN**				**OTHERS**				**TOTAL - SOUTH ATLANTIC**			
78	15	3850	3865	0.39					622	16499	17121	3.63	637	20349	20986	3.04
79	43	8306	8349	0.51					927	24759	25686	3.61	970	33065	34035	2.85
80	113	21775	21888	0.51					1800	37885	39685	4.53	1912	59660	61573	3.11
81	176	19767	19943	0.88					1928	18720	20648	9.34	2103	38487	40590	5.18
82	1911	42778	44688	4.28					4647	41412	46059	10.09	6557	84189	90747	7.23
83	412	23392	23804	1.73					4783	47408	52190	9.16	5194	70800	75994	6.83
84	797	51258	52055	1.53					12001	70251	82251	14.59	12798	121508	134306	9.53
85	1005	57231	58237	1.73					10203	74901	85104	11.99	11208	132132	143340	7.82
86	170	33286	33456	0.51	252	1207	1459	17.27	7534	46386	53920	13.97	7956	80879	88835	8.96
87	368	30003	30371	1.21					5830	49406	55236	10.55	6198	79409	85607	7.24
88	2068	54875	56943	3.63	13389	63082	76471	17.51	4636	62037	66673	6.95	20094	179994	200088	10.04
89	3094	59396	62490	4.95	27504	112873	140377	19.59	10001	78821	88823	11.26	40599	251091	291690	13.92
90	759	83258	84017	0.90	14814	103983	118797	12.47	802	47543	48345	1.66	16376	234784	251159	6.52
91	600	53104	53704	1.12	12262	99214	111476	11.00	835	39967	40802	2.05	13697	192285	205982	6.65
92	757	37354	38111	1.99	13334	96166	109500	12.18	2366	63173	65539	3.61	16457	196694	213151	7.72
93	346	54226	54572	0.63	18037	104016	122053	14.78	1845	34086	35931	5.13	20228	192328	212556	9.52

SWO-Table 17. Continued...

ENTIRE ATLANTIC

YEAR	<125 No.	>125 No.	TOTAL No.	<125 %	<125 No.	>125 No.	TOTAL No.	<125 %	<125 No.	>125 No.	TOTAL No.	<125 %	<125 No.	>125 No.	TOTAL No.	<125 %
	CANADA				**JAPAN**				**SPAIN**				**USA (Excluding discards)**			
78	1585	32204	33788	4.69	332	15022	15354	2.16	5841	44762	50603	11.54	3644	49582	53226	6.85
79	779	35777	36556	2.13	1175	15264	16439	7.15	5080	32926	38006	13.37	11057	59104	70161	15.76
80	3614	27666	31280	11.55	1522	36020	37542	4.05	9563	51105	60668	15.76	25839	83130	108969	23.71
81	113	7054	7167	1.58	1269	37932	39201	3.24	11299	55651	66950	16.88	14494	63786	78281	18.52
82	741	8803	9544	7.76	2613	63262	65875	3.97	7112	58873	65985	10.78	25611	76995	102606	24.96
83	1617	14997	16614	9.73	580	31385	31965	1.81	20152	105469	125621	16.04	28208	66155	94363	29.89
84	788	7714	8501	9.26	1838	61111	62949	2.92	15633	93596	109229	14.31	31776	74109	105885	30.01
85	881	9181	10062	8.76	1749	71277	73026	2.39	22198	110623	132821	16.71	31007	73815	104822	29.58
86	3089	17357	20446	15.11	507	43739	44246	1.15	42108	153304	195412	21.55	42492	86290	128783	33.00
87	5352	16962	22313	23.98	1012	37298	38310	2.64	64539	191085	255624	25.25	51619	87877	139496	37.00
88	2923	14876	17798	16.42	2996	66180	69176	4.33	97250	213533	310783	31.29	61997	109075	171072	36.24
89	3445	17536	20981	16.42	4959	83583	88542	5.60	75498	218709	294207	25.66	66010	108878	174888	37.74
90	1445	12080	13525	10.68	1570	99313	100883	1.56	57559	215803	273361	21.06	46316	96811	143127	32.36
91	1824	14164	15988	11.41	1317	67432	68749	1.92	39475	217550	257025	15.36	21518	77173	98691	21.80
92	4092	22373	26466	15.46	2022	51992	54013	3.74	45997	209832	255830	17.98	5437	72316	77753	6.99
93	5616	33165	38781	14.48	1302	70550	71851	1.81	58499	216003	274502	21.31	4326	72336	76662	5.64

YEAR	<125 No.	>125 No.	TOTAL No.	<125 %	<125 No.	>125 No.	TOTAL No.	<125 %	<125 No.	>125 No.	TOTAL No.	<125 %	<125 No.	>125 No.	TOTAL No.	<125 %
	PORTUGAL				**OTHERS**								**TOTAL - ENTIRE ATLANTI**			
78	29	210	239	12.15	1245	30874	32119	3.88					12675	141779	185328	6.84
79	58	368	425	13.52	3667	39295	42962	8.54					21816	143439	204550	10.67
80	38	202	241	15.92	3690	50937	54627	6.75					44267	198122	293326	15.09
81	41	195	236	17.26	2921	28629	31550	9.26					30137	164618	223384	13.49
82	16	154	170	9.29	5282	52093	57375	9.21					41374	208087	301555	13.72
83	25	139	164	15.16	5823	61110	66933	8.70					56404	218146	335660	16.80
84	30	176	206	14.73	12878	77651	90528	14.23					62943	236706	377299	16.68
85	56	242	299	18.79	11056	84482	95538	11.57					66947	265139	416567	16.07
86	2772	6825	9597	28.88	9167	62274	71441	12.83					100136	307515	469925	21.31
87	7021	17213	24233	28.97	9338	72082	81419	11.47					138879	350435	561396	24.74
88	4375	10684	15059	29.05	12298	83791	96089	12.80					181838	414348	679977	26.74
89	2402	4756	7157	33.56	16092	96979	113071	14.23					168405	433461	698845	24.10
90	4151	8897	13048	31.82	15490	80541	96031	16.13					126530	432904	639975	19.77
91	9875	11402	21277	46.41	4989	59567	64556	7.73					79000	387721	526287	15.01
92	11855	7027	18881	62.79	7600	93432	101032	7.52					77003	363540	533974	14.42
93	8943	23600	32543	27.48	10241	58264	68504	14.95					88926	415654	562843	15.80

<125 = Number of fish in the catch less than 125 cm in lower-jaw fork length.
>125 = Number of fish in the catch equal or more than 125 cm in lower-jaw fork length.

SWO-Table 18. Estimated discards of swordfish in number less than 125 cm and 125 cm in L-JFL.

YEAR	<125 No.	>125 No.	TOTAL No.	<125 %
NORTH ATLANTIC				
U.S. DISCARDS				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				
88				
89				
90				
91	14055	1440	15494	90.7
92	21647	3705	25352	85.4
93	24716	3349	28065	88.1

<125 = Number of fish in the catch less than 125 cm in lower-jaw fork length.
>125 = Number of fish in the catch equal or more than 125 cm in lower-jaw fork length.

SWO-Table 19. Estimated incidental swordfish catch (in MT and %) in major north Atlantic longline fisheries which does not have direct effort to swordfish.

YEAR	CHINA-TAIWAN SWO	CHINA-TAIWAN TOTAL	CHINA-TAIWAN SWO(%)	JAPAN SWO	JAPAN TOTAL	JAPAN SWO(%)	KOREA SWO	KOREA TOTAL	KOREA SWO(%)
1978	126	10331	1.22	946	12902	7.33	634	16583	3.82
1979	260	8384	3.10	542	13084	4.14	303	11493	2.64
1980	103	8229	1.25	1167	20990	5.56	284	8742	3.25
1981	140	7967	1.76	1315	22977	5.72	136	10926	1.24
1982	200	11791	1.70	1755	25451	6.90	198	8302	2.38
1983	209	15635	1.34	537	12316	4.36	53	4483	1.18
1984	126	15920	0.79	665	13086	5.08	32	6800	0.47
1985	117	16125	0.73	921	17491	5.27	160	5757	2.78
1986	121	21454	0.56	807	12534	6.44	68	3250	2.09
1987	40	7304	0.55	413	9981	4.14	60	797	7.52
1988	18	2184	0.82	621	14892	4.17	30	602	4.98
1989	13	1376	0.94	1572	26274	5.98	320	5155	6.21
1990	207	6151	3.37	1051	17240	6.10	51	2564	1.99
1991	574	2370	24.22	992	17132	5.79	3	429	0.70
1992	132	5520	2.39	1044	22981	4.54	3	836	0.36
1993	108			1126	16717	6.74	0		

The unclassified catches (mostly sharks) are excluded from the total.
Sailfish and yellowfin catches are separated into north and south using number of fish in the Task II catch data.
For recent years when Task II data are not available, the north-south proportion for the latest year available was used.

SBF-Table 1. Atlantic and world southern bluefin catch (MT) by gear, area and country.

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
ATLANTIC TOTAL	4677	6203	2823	2569	1138	522	1636	1493	426	1193	613	699	1257	1344	537	1983
-CATCH BY GEAR																
Longline	4677	6203	2810	2563	1138	522	1636	1493	426	1189	610	694	1257	1344	537	1983
Baitboat	0	0	13	6	0	0	0	0	0	0	0	1	0	0	0	0
Sport	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	4	2	5	0	0	0	0
-CATCH BY COUNTRY																
China-Taiwan	26	11	22	57	3	17	0	25	37	69	62	69	55	13	12	407
Japan	4651	6192	2788	2506	1135	505	1636	1468	389	1120	548	625	1202	1331	525	1576
South Africa	0	0	13	6	0	0	0	0	0	0	1	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	4	2	5	0	0	0	0
World Catches (all oceans)	35848	38673	45054	45191	42764	42838	37089	33199	27875	25033	22402	17368	13483	12833	12736	12851
Japan (Longline)	23632	27828	33653	27981	20789	24881	23328	20396	15182	13964	11422	9222	7056	6774	6937	6965
Australia (Surface, Longline)	12190	10783	11195	16843	21501	17695	13411	12589	12531	10821	10591	6118	4719	4162	4095	4715
New Zealand (Longline, etc.)			130	173	305	132	93	94	82	59	93	424	480	129	244	141
Other (Longline, etc.)	26	62	76	194	169	130	257	120	80	189	296	1604	1228	1768	1460	1030

* Preliminary

++ Catch < 0.5 MT

Source for "world" section: Report of the Thirteenth Meeting of Australian, Japanese and New Zealand Scientists on Southern Bluefin Tuna (Wellington, New Zealand - April, 1994).

SMT-Table 1. Reported landings of small tunas (1000 mt) by major gears, in Atlantic and Mediterraean (as of November 22, 1994).

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	
TOTAL																																
ATL+MED	65.4	49.9	71.5	66.3	91.0	74.5	115.4	88.9	97.7	87.9	66.3	91.2	79.4	73.7	91.1	83.9	88.0	124.6	126.6	144.7	135.9	118.0	98.9	99.6	118.0	139.8	124.9	128.5	121.7	108.3	101.0	
MEDITERRANE	29.2	18.5	31.0	26.0	46.3	30.4	60.6	25.6	33.7	21.2	11.1	13.8	10.7	12.1	15.0	15.9	20.2	27.8	35.7	41.8	44.8	25.1	27.8	25.5	31.1	36.3	23.0	36.5	35.9	22.8	21.6	
ATLANTIC	36.2	31.4	40.5	40.3	44.7	44.1	54.8	63.3	64.0	66.7	55.2	77.4	68.7	61.6	76.1	68.0	67.8	96.8	90.9	102.9	91.1	92.9	71.1	74.1	86.9	103.5	101.9	92.0	85.8	85.5	79.4	
ATLANTIC BONITO (S SARDA)																																
ATL+MED	28.2	16.8	31.3	29.1	49.0	31.9	61.6	28.8	44.0	25.1	12.2	21.4	15.4	15.7	20.7	17.1	19.9	31.7	40.0	44.9	42.9	22.4	25.6	21.8	30.1	40.8	26.1	27.9	33.6	21.8	21.0	
MEDITERRANE	22.8	13.5	27.0	22.1	41.2	26.2	55.6	20.7	28.3	16.3	6.2	7.7	6.0	6.4	8.7	9.3	13.5	19.2	29.3	31.6	36.1	15.5	18.5	16.0	22.7	24.5	12.2	21.9	26.0	15.3	15.3	
-PURSE SEINE	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	1.5	2.4	2.3	14.7	12.8	19.2	19.4	7.6	17.3	22.4	11.8	11.8	
GREECE		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	1.4	1.7	1.3	1.0	1.8	1.3	2.5	2.5	2.7	2.7	2.7	*
ESPANA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.6	0.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TURKEY		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.8	11.4	17.3	18.1	5.0	14.7	19.6	8.9	8.9	*
OTHERS	++	++	++	0.1	0.1	++	++	++	++	++	++	++	++	++	++	++	++	0.1	++	0.1	++	++	++	++	0.1	++	0.1	0.1	0.1	0.2	0.2	*
-OTHER SURF	0.5	0.4	0.6	0.9	1.0	0.5	0.4	0.7	1.0	0.6	0.9	0.6	0.5	1.1	1.3	1.0	1.4	1.2	1.7	2.0	1.3	1.3	1.4	0.8	0.4	1.7	2.1	2.0	1.3	0.8	0.8	*
ALGERIE		0.1	0.2	0.3	0.2	0.1	0.1	0.0	++	0.2	0.3	0.2	0.1	0.1	0.2	0.2	0.5	0.6	0.7	0.9	0.9	0.9	0.9	0.5	0.2	0.6	1.5	1.3	0.6	0.6	0.6	*
MAROC		0.0	++	++	0.1	++	++	++	0.1	0.1	0.3	0.1	0.1	0.6	0.5	0.1	0.2	0.1	0.3	0.1	0.1	0.1	0.1	++	0.1	0.1	++	++	++	++	++	
ESPANA	0.5	0.3	0.4	0.6	0.7	0.4	0.3	0.7	0.9	0.3	0.3	0.3	0.3	0.4	0.6	0.7	0.7	0.5	0.7	1.0	0.3	0.3	0.4	0.3	0.1	1.0	0.6	0.7	0.7	0.2	0.2	
OTHERS		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	
-UNCL+ LL +	22.3	13.1	26.4	21.1	40.1	25.7	55.2	20.0	27.3	15.7	5.3	7.1	5.5	5.3	7.4	8.3	12.1	17.9	27.6	28.1	32.4	11.9	2.4	2.4	3.1	3.4	2.5	2.6	2.3	2.7	2.7	
BULGARIA		0.0	1.7	1.5	2.3	1.8	2.1	0.0	0.1	0.0	0.0	0.0	0.0	++	++	++	++	++	0.2	++	++	++	++	0.0	++	0.0	0.0	++	++	++	++	
EGYPT		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	0.0	++	++	++	++	++	++	++	++	0.1	0.1	++	++	0.4	0.6	0.6	0.5	0.5	*
GREECE	2.2	0.9	3.2	2.3	1.8	1.7	2.0	0.9	0.6	0.6	0.5	0.5	0.7	0.5	0.6	0.6	0.7	0.8	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
ITALY	1.0	1.0	0.9	1.0	1.4	0.8	1.0	0.9	1.1	1.0	0.7	0.8	1.0	1.0	1.5	1.4	1.4	1.2	1.1	1.1	1.8	2.8	1.4	1.4	2.1	2.2	1.4	1.2	1.1	1.3	1.3	*
TUNISIE		0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.2	0.2	0.5	0.4	0.6	0.8	0.8	0.9	0.7	0.4	0.7	0.6	0.6	0.5	0.5	0.5	0.6	0.4	0.5	0.3	0.6	0.6	*
TURKEY	19.1	11.2	20.6	16.1	34.5	21.3	50.1	18.1	25.2	13.9	3.9	5.3	3.4	3.2	4.5	5.5	9.1	14.9	24.3	26.0	29.5	7.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
NEI_2		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.5	0.7	0.4	0.4	0.5	0.6	0.3	0.3	0.3	0.3	0.3	*
OTHERS		0.0	0.0	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	++	++	++	++	++	++	++	0.0	0.0	++	++	0.0	0.0	0.0	0.0	0.0	++	++	0.0	0.0	
ATLANTIC	5.4	3.3	4.3	7.0	7.8	5.7	6.0	8.1	15.7	8.8	6.0	13.7	9.4	9.3	12.0	7.8	6.4	12.5	10.7	13.3	6.8	6.9	7.1	5.8	7.4	16.3	13.9	6.0	7.6	6.5	5.7	
-PURSE SEINE	0.6	0.0	0.1	0.5	0.3	0.5	2.4	4.2	3.2	2.9	1.2	2.3	0.2	0.3	2.0	2.5	1.3	2.7	0.9	0.0	0.3	0.1	0.5	0.5	0.2	0.2	0.0	0.3	0.2	0.2	0.1	
ARGENTIN	0.6	0.0	0.1	0.5	0.3	0.5	2.4	4.2	3.2	2.9	1.2	2.3	0.2	0.3	2.0	1.7	1.3	2.6	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
USSR		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
OTHERS	0.0	0.0	0.0	++	0.0	0.0	0.0	0.0	0.0	0.0	++	0.0	++	0.0	0.0	++	++	0.1	0.1	++	0.3	0.1	0.5	0.5	0.2	0.2	++	0.3	0.2	0.2	0.1	
-TROLLING	++	++	0.0	++	++	++	++	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	0.1	++	0.0	0.2	0.1	0.0	0.2	0.2	0.1	0.4	0.4	0.2	0.1	0.1	
OTHERS	++	++	0.0	++	++	++	++	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	0.1	++	0.0	0.2	0.1	0.0	0.2	0.2	0.1	0.4	0.4	0.2	0.1	0.1	*
-TRAP	1.0	1.0	0.6	1.6	1.2	0.5	1.0	0.8	0.9	0.5	0.3	0.2	0.0	0.0	0.1	0.1	0.2	0.3	0.5	0.3	0.2	0.3	0.3	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.0	
ANGOLA	0.5	0.7	0.3	1.2	0.8	0.4	0.6	0.7	0.8	0.4	0.3	0.2	++	++	0.1	0.1	0.1	0.2	0.1	0.2	++	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.0	++	

SMT-Table 1. Continued.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	
OTHERS	0.5	0.3	0.3	0.4	0.4	0.1	0.4	0.1	0.1	0.1	++	++	++	++	++	++	0.1	0.1	0.4	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1	++	++	0.1	++	
-OTHER SURF	3.6	2.0	3.3	4.5	5.6	4.3	1.9	2.4	11.0	4.6	3.8	8.8	6.5	7.2	4.8	3.9	2.0	8.6	8.1	10.2	4.7	3.5	4.4	3.8	4.6	3.0	3.9	2.8	3.5	3.3	3.3	
ANGOLA	++	++	0.1	0.2	0.1	++	0.1	0.2	0.1	0.2	0.2	0.2	++	0.8	0.8	0.5	0.1	0.2	0.1	0.1	0.1	0.1	0.1	++	0.1	++	0.1	++	++	++	++	
BRASIL	1.6	0.8	1.4	1.5	3.4	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.2	0.2	0.5	0.3	0.2	0.3	0.1	0.1	0.1	0.1	
GHANA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	0.0	++	++	0.0	0.1	++	0.1	++	++	++	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	
MARTINIQ		0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.4	0.5	0.4	0.5	0.5	0.4	0.5	0.5	0.5	0.6	0.5	0.6	0.5	0.4	0.3	0.4	0.4	0.4	0.8	0.8	0.8	*
MAROC	0.7	0.4	0.3	0.7	0.3	0.5	0.4	0.2	0.2	0.1	0.1	0.2	0.3	0.3	0.1	0.2	0.2	0.3	0.5	0.5	0.4	0.2	0.0	0.0	0.4	0.6	0.6	0.3	0.5	0.6	0.6	*
SENEGAL	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	0.2	0.6	0.5	0.2	0.1	1.3	1.4	0.5	0.2	0.5	0.3	0.3	0.4	0.5	0.3	0.4	0.3	0.3	*
ESPANA		0.8	1.5	2.1	1.8	0.8	1.0	1.6	10.0	3.5	2.0	7.0	4.8	4.3	2.0	1.9	0.6	0.1	0.2	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.0	
USSR		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.4	4.6	6.3	2.4	1.3	2.1	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	
VENEZUEL		0.0	0.0	0.0	0.0	0.5	0.4	0.3	0.5	0.5	0.7	0.5	0.6	0.8	0.8	0.4	0.4	0.9	0.8	0.9	0.6	0.7	0.8	1.4	1.0	1.2	1.8	1.5	1.5	1.4	1.4	*
OTHERS	++	++	++	++	++	++	++	0.0	0.0	0.0	0.4	0.4	0.4	0.3	++	++	++	++	0.1	++	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.1	
-UNCL+ LL +	0.2	0.3	0.3	0.4	0.7	0.4	0.7	0.7	0.6	0.8	0.7	2.4	2.7	1.8	5.1	1.3	2.9	0.8	1.2	2.8	1.4	2.9	1.9	1.1	2.3	12.8	9.4	2.4	3.6	2.8	2.2	
ARGENTIN		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.3	2.1	1.4	0.7	1.6	2.8	1.3	1.2	1.8	1.6	0.4	
MEXICO		0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.2	0.4	0.4	0.2	0.1	0.1	0.2	0.3	0.4	0.4	0.6	0.7	0.2	0.2	0.4	0.4	0.3	0.2	0.2	0.7	0.7	*
MAROC		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	++	0.9	
RUSSIA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	++	0.0	
USA		0.0	0.0	++	0.0	0.0	++	0.1	0.1	++	0.3	0.1	0.1	++	0.3	0.2	0.5	++	0.2	0.2	0.0	++	++	++	++	++	++	++	0.3	0.3	++	
USSR		0.0	0.0	0.0	0.0	0.1	0.3	0.3	0.1	0.2	++	1.4	1.5	1.3	4.2	0.8	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.9	7.4	0.7	0.0	0.0	0.0	
OTHERS	0.2	0.3	0.3	0.4	0.7	0.3	0.3	0.2	0.2	0.3	0.2	0.5	0.7	0.3	0.5	0.2	0.1	0.5	0.6	0.4	0.5	0.1	0.3	0.2	0.3	0.7	0.4	0.3	0.4	0.2	0.2	*
ATLANTIC BLACK SKIPJACK (E ALLETERATUS)*																																
ATL+MED	4.0	1.7	4.1	3.3	4.0	3.2	3.6	8.7	5.7	3.2	2.4	5.6	9.3	10.3	8.2	17.6	14.8	19.5	15.2	14.5	20.7	19.9	11.7	13.3	14.4	22.7	24.2	25.2	19.9	16.6	16.5	
MEDITERRANE	0.0	0.0	0.0	0.0	0.0	0.1	0.9	1.0	0.8	0.9	1.0	1.3	1.4	2.0	2.5	2.5	2.9	2.8	1.4	2.4	1.5	1.7	2.1	2.2	2.4	2.4	2.1	2.6	1.8	1.2	0.7	
-SURFACE	0.0	0.0	0.0	0.0	0.0	0.1	0.9	0.7	0.5	0.6	0.7	0.8	0.9	1.2	1.3	1.6	2.2	2.2	1.1	1.7	1.0	1.0	1.2	1.1	1.5	1.6	1.0	1.2	1.1	0.6	0.6	
ESPANA		++	++	++	++	0.1	0.9	0.6	0.4	0.6	0.7	0.7	0.7	1.1	1.1	1.2	1.0	0.8	++	0.7	0.0	++	++	++	0.0	++	0.0	0.0	0.0	0.0	0.0	
TUNISIE		0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	++	++	0.1	0.1	0.1	0.2	0.4	1.2	1.4	1.0	1.0	1.0	1.0	1.2	1.1	1.5	1.6	1.0	1.2	1.1	0.6	0.6	*
OTHERS	++	++	++	++	++	++	++	++	++	++	++	++	0.1	++	++	0.0	++	0.0	0.1	++	++	++	++	++	++	++	++	++	++	++	0.0	
-UNCL+ LL +	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.5	0.5	0.8	1.2	0.9	0.7	0.6	0.3	0.7	0.5	0.7	0.9	1.1	0.9	0.8	1.1	1.4	0.7	0.6	0.1	
TUNISIE		0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.8	0.6	0.4	0.4	0.2	0.3	0.2	0.3	0.3	0.5	0.3	0.3	0.6	0.9	0.2	0.1	0.1	*
OTHERS		0.0	++	++	++	++	++	0.1	0.1	0.1	0.1	0.2	0.2	0.4	0.4	0.3	0.3	0.2	0.1	0.4	0.3	0.4	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5	++	
ATLANTIC	4.0	1.7	4.1	3.3	4.0	3.1	2.7	7.7	4.9	2.3	1.4	4.3	7.9	8.3	5.7	15.1	11.9	16.7	13.8	12.1	19.2	18.2	9.6	11.1	12.0	20.3	22.1	22.6	18.1	15.4	15.8	
-BAITBOAT	0.0	0.0	0.0	0.1	0.7	0.3	0.6	1.9	1.1	0.6	0.2	0.5	0.5	0.2	0.7	0.4	0.6	1.3	1.0	1.4	1.2	1.7	2.1	1.7	1.7	0.9	1.7	3.7	0.9	0.8	0.9	
ANGOLA		++	++	0.1	0.7	0.3	0.6	1.2	0.7	0.3	0.2	0.4	0.4	++	0.6	0.3	0.5	0.8	0.7	1.1	1.2	1.3	1.3	1.1	1.3	0.5	0.4	0.1	++	++	++	
GHANA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.1	0.1	0.1	0.1	0.1	0.1	++	++	++	0.0	0.3	0.7	0.5	0.3	0.3	1.2	3.5	0.2	0.3	0.3	
ESPANA		0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.4	0.3	++	0.0	0.0	0.0	0.0	0.0	0.0	++	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.0	0.0	0.0	0.0	0.0	
VENEZUEL		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.5	0.5	*
OTHERS	++	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	++	++	0.5	0.3	0.3	++	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	++	0.1	*

SMT-Table 1. Continued.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
-PURSE SEINE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.1	0.1	0.0	0.0	5.6	0.0	0.8	1.6	2.1	1.6	0.7	1.6	0.5	0.1	0.8	0.7	0.8	1.9	1.4	1.8
FRANCE		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
GHANA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	0.0	0.0	0.0	0.0	0.4	0.6	0.0	0.3	0.2	0.1	++	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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.3	0.3
SENEGAL		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESPANA																															0.3
USSR		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.0	5.5	0.0	0.0	0.0	0.4	1.6	0.4	0.9	0.3	0.1	0.8	0.5	0.7	0.0	0.0	0.0
VENEZUEL		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	1.0	1.0 *
OTHERS		0.0	0.0	++	0.0	0.0	0.0	0.0	0.4	0.0	++	0.1	0.1	0.0	++	0.1	++	0.3	0.1	++	++	++	0.5	0.1	++	++	++	0.1	++	0.1	0.2
-TROLLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	++	0.0	++	0.0	0.0	0.5	0.4	0.7	0.7	0.6	0.4	0.1	++
SENEGAL		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.4	0.7	0.7	0.6	0.4	0.1	0.0
OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	++	0.0	++	0.0	0.0	0.0	0.0	0.0	0.0	++	++	++	++
-TRAP	3.7	1.4	2.9	2.7	3.1	2.4	1.5	1.7	1.1	0.5	0.6	0.7	0.1	0.0	0.2	0.0	0.2	0.4	0.4	0.6	0.5	0.3	0.2	0.0	0.1	0.6	0.7	0.3	0.4	0.0	0.2
ANGOLA	3.7	1.4	2.7	2.7	3.1	2.4	1.4	1.7	1.1	0.5	0.6	0.7	0.1	++	0.2	++	0.2	0.4	0.4	0.6	0.4	0.3	0.1	++	0.1	0.6	0.7	0.2	0.3	0.0	0.2
OTHERS	++	++	0.2	++	++	++	0.1	++	++	++	++	++	0.0	0.0	0.0	++	0.0	++	++	0.0	0.1	++	0.1	++	++	++	++	0.1	0.1	++	0.0
-OTHER SURF	0.3	0.3	1.2	0.5	0.2	0.4	0.6	3.9	2.3	0.9	0.5	1.1	6.2	7.7	4.3	9.1	11.0	13.7	10.6	6.6	14.9	14.8	5.5	8.3	9.7	16.2	18.3	17.1	14.4	12.6	12.6
ANGOLA	0.2	0.3	0.8	0.4	0.2	0.1	0.1	3.2	0.6	0.5	0.1	0.2	++	0.0	0.5	0.5	++	0.1	++	++	++	++	++	++	++	++	0.1	0.0	0.0	0.0	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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.4	0.1	0.1	0.1	0.1	0.3	0.2	0.4
GHANA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	6.0	1.1	6.0	5.4	4.1	2.9	1.5	5.0	5.4	0.0	++	5.2	11.3	11.3	11.3	11.3	11.3	11.3 *
MAROC		0.0	++	0.1	0.0	0.2	0.4	0.3	0.6	0.1	++	++	0.1	++	++	++	0.3	++	++	++	0.0	++	0.0	0.0	0.1	++	++	0.2	++	0.2	0.2 *
SENEGAL		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	0.7	1.5	1.4	1.7	1.9	3.1	4.0	4.3	7.6	3.4	6.5	2.6	3.4	5.1	3.9	2.5	0.5	0.5 *
ESPANA		++	0.4	0.0	0.0	0.0	++	0.1	0.7	++	++	0.0	++	++	++	++	++	0.5	++	++	0.0	++	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
USSR		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.7	0.7	2.2	6.3	3.6	0.6	4.9	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VENEZUEL		0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.2	0.3	0.4	0.4	0.5	0.4	0.4	1.3	0.7	0.8	0.3	0.6	0.6	1.0	1.1	1.5	1.2	1.4	1.3	0.0	0.0	0.0
OTHERS	0.1	0.0	0.0	0.0	++	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.2	0.3	0.3	0.2	0.2	0.3	0.3	0.3	0.4	0.2
-UNCL+ LL +	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.3	0.1	1.9	1.0	0.4	0.5	0.0	0.1	0.4	0.2	1.4	1.0	0.7	0.2	0.1	0.0	1.1	0.0	0.1	0.1	0.5	0.3
CIVOIRE		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.9	0.4	0.4	++	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GERMANY		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	0.1	++	++	++	0.0	++	++	0.0	0.0	0.0
ISRAEL		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.6	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
USA		0.0	0.0	++	0.0	0.0	0.0	0.2	++	0.2	++	0.0	++	++	++	++	++	++	++	0.1	++	++	0.0	++	++	0.1	++	0.1	0.1	0.5	0.3
USSR		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0
OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.1	++	0.1	++	++	++	++	0.3	0.2	0.3	0.1	0.1	++	0.1	++	++	++	++	++
FRIGATE TUNA (A THAZARD)**																															
ATL+MED	8.0	6.9	9.6	7.3	11.4	8.6	16.2	11.4	10.3	13.7	10.0	14.0	10.5	9.8	19.9	8.2	12.5	20.8	14.7	24.0	20.1	25.6	22.2	18.0	19.8	20.8	18.3	19.7	12.8	8.5	6.1
MEDITERRANE	4.3	2.9	2.7	2.7	4.6	3.0	2.9	3.3	4.1	3.5	3.5	4.4	2.6	3.2	3.3	3.5	3.6	3.9	3.6	6.0	5.8	6.5	5.1	5.1	3.7	6.0	6.3	7.5	5.8	4.0	3.3
-PURSE SEINE	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2	1.6	1.7	1.5	1.4	0.3	0.3	0.1	0.1	0.1	0.2	0.2
ESPANA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	1.6	1.4	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SMT-Table 1. Continued.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
OTHERS	0.1	0.1	0.1	++	0.1	0.1	0.1	++	++	++	++	++	++	++	++	++	0.1	++	++	0.2	++	0.1	0.1	0.1	0.3	0.3	0.1	0.1	0.1	0.2	0.2
-TRAP	0.5	0.4	0.7	0.7	0.7	0.9	0.6	0.2	0.4	0.4	0.3	0.8	0.1	0.4	0.5	0.3	0.1	0.0	0.1	0.2	0.5	0.7	0.6	0.3	0.6	1.3	2.2	2.3	1.5	0.9	0.3
MAROC		0.0	0.5	0.4	0.4	0.6	0.1	0.1	0.2	0.1	0.1	0.3	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	0.0	0.1	0.2	0.1	0.3	0.1
ESPANA	0.5	0.4	0.2	0.3	0.3	0.3	0.5	0.1	0.2	0.3	0.2	0.5	0.1	0.2	0.4	0.3	0.1	++	0.1	0.2	0.5	0.7	0.6	0.3	0.6	1.3	2.1	2.1	1.4	0.6	0.2
-OTHER SURF	2.8	1.9	1.2	1.1	2.6	0.8	1.1	1.8	1.9	1.2	1.8	2.0	1.3	1.5	0.9	1.4	1.7	2.1	1.6	1.8	0.1	0.1	0.0	0.2	0.2	2.1	1.5	2.1	1.5	1.2	1.1
MAROC	0.7	0.7	++	++	++	++	++	++	++	0.1	0.3	0.1	0.0	0.1	0.1	0.1	0.1	++	++	0.1	0.1	0.1	++	0.2	0.2	0.8	1.1	1.2	0.6	0.6	0.6
ESPANA	2.1	1.2	1.2	1.1	2.6	0.8	1.1	1.8	1.9	1.1	1.5	1.9	1.3	1.4	0.8	1.3	1.6	2.1	1.6	1.7	0.0	++	++	++	0.0	1.3	0.4	0.9	0.9	0.6	0.5
OTHERS		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	++
-UNCL+ LL +	0.9	0.5	0.7	0.9	1.2	1.2	1.1	1.3	1.8	1.9	1.4	1.6	1.2	1.3	1.9	1.8	1.7	1.8	1.9	3.8	3.6	4.0	3.0	3.2	2.6	2.3	2.5	3.0	2.7	1.7	1.7
GREECE		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	2.2	1.9	2.1	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
ITALY	0.8	0.5	0.7	0.9	1.2	1.2	1.1	1.1	1.6	1.7	1.2	1.3	0.9	0.9	1.1	1.2	1.3	1.4	1.2	1.3	1.5	1.6	1.3	1.3	0.9	0.6	0.5	0.5	0.4	0.3	0.3
TUNISIE		0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.8	0.6	0.4	0.4	0.2	0.3	0.2	0.3	0.3	0.5	0.3	0.3	0.6	0.9	0.9	++	0.0
OTHERS	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	0.2	++	++	++
ATLANTIC	3.7	4.0	6.9	4.6	6.8	5.6	13.3	8.1	6.2	10.2	6.5	9.6	7.9	6.6	16.6	4.7	8.9	16.9	11.1	18.0	14.3	19.1	17.1	12.9	16.1	14.8	12.0	12.2	7.0	4.5	2.8
-BAITBOAT	0.1	0.0	0.9	0.4	0.6	1.6	3.2	3.1	0.3	0.2	1.6	0.7	0.1	0.0	0.1	0.1	0.3	0.2	0.3	0.5	0.4	0.4	0.3	0.2	0.5	0.2	0.2	0.2	0.4	0.5	0.3
JAPAN		0.0	0.9	0.4	0.6	1.6	3.2	3.1	0.0	++	1.2	0.5	++	++	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHERS	0.1	0.0	++	++	0.0	++	++	++	0.3	0.2	0.4	0.2	0.1	++	++	0.1	0.3	0.2	0.3	0.5	0.4	0.4	0.3	0.2	0.5	0.2	0.2	0.2	0.4	0.5	0.3
-PURSE SEINE	0.0	0.0	0.0	0.0	0.4	1.3	0.2	0.7	0.7	1.4	0.2	0.0	0.0	0.0	0.0	1.2	0.8	6.0	5.4	4.7	4.7	8.8	5.2	3.6	5.2	4.9	2.6	2.7	2.6	2.5	1.0
FRANCE		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	1.1	0.1	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	0.4	1.3	0.2	0.7	0.6	1.2	0.2	++	++	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAROC		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	1.1	0.5	++	++	0.4	0.2	0.0	0.0	0.1	0.1	++	0.0
ESPANA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.8	5.8	4.7	2.5	2.5	5.5	3.6	3.1	4.4	3.8	1.6	1.7	0.5	0.2	0.1
USSR		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.0	0.6	0.0	0.0	0.0	0.4	0.3	3.1	1.6	0.1	0.2	0.4	0.3	0.7	0.0	0.0	0.0
VENEZUEL		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.0	0.4	0.3	0.5	0.0	0.7	1.8	0.5
NEI_1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	++	0.0	0.0	++	0.4	0.2	0.2	0.9	0.2	0.2
OTHERS		0.0	0.0	0.0	++	++	0.0	0.0	0.0	0.2	++	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	++	++	++	++	++	++	0.4	0.3	0.2
-TRAP	0.9	1.3	2.8	2.2	1.5	0.8	1.0	0.8	0.5	1.0	1.0	0.9	0.4	0.3	0.3	0.3	0.4	0.1	0.2	0.3	0.3	0.2	0.1	0.1	0.2	0.1	0.4	0.8	0.5	0.2	0.2
ANGOLA	0.9	0.8	1.6	1.4	1.1	0.5	0.7	0.3	0.4	0.4	0.5	0.7	0.2	++	0.1	0.1	0.1	++	0.1	0.1	0.1	0.1	++	0.0	0.0	++	++	++	0.0	0.0	++
MAROC	++	0.0	0.8	0.3	0.2	0.1	++	0.4	++	0.3	0.1	0.1	0.0	0.0	++	0.0	0.0	0.1	++	0.0	++	0.0	0.0	0.0	0.0	++	0.1	0.2	0.3	0.1	0.1
ESPANA		0.5	0.4	0.5	0.2	0.2	0.3	0.1	0.1	0.3	0.4	0.1	0.2	0.3	0.2	0.2	0.3	++	0.1	0.2	0.2	0.1	0.1	0.1	0.2	0.1	0.3	0.6	0.2	0.1	0.1
OTHERS	0.0	0.0	0.0	0.0	0.0	++	++	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-OTHER & UN	2.7	2.7	3.2	2.0	4.3	1.9	8.9	3.5	4.7	7.6	3.7	8.0	7.4	6.3	16.2	3.1	7.4	10.6	5.2	12.5	8.9	9.7	11.5	9.0	10.2	9.6	8.8	8.5	3.5	1.3	1.3
ANGOLA	0.3	0.1	0.1	0.1	0.1	0.2	++	0.2	0.5	1.7	0.2	0.6	0.3	0.0	0.1	0.1	++	++	++	++	++	++	0.0	++	++	0.0	++	0.0	0.0	0.0	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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.7	0.9	1.7	0.6	0.4	0.2	0.1	0.1
GHANA		0.0	0.0	0.0	2.2	0.9	8.2	2.0	1.8	5.1	1.6	6.3	6.0	4.3	13.9	1.0	4.3	7.6	2.0	6.1	5.6	4.5	4.5	3.3	4.7	0.0	0.0	0.0	0.0	0.0	0.0
MAROC	1.0	0.8	0.5	0.1	0.5	0.1	0.1	0.5	0.1	++	1.0	0.1	++	0.3	0.7	0.8	0.7	0.7	1.3	0.1	0.7	0.2	0.4	0.0	0.5	0.2	0.5	0.4	0.5	0.1	0.1
RUSSIA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	1.1	1.1

SMT-Table 1. Continued.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	
ESPANA	0.4	0.4	0.8	0.4	0.4	0.3	0.2	0.1	1.8	0.2	0.2	0.1	0.1	0.2	0.4	0.4	0.1	0.4	0.5	0.4	0.0	0.2	++	++	0.0	++	0.0	0.0	0.0	++	0.0	
USSR		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.5	0.7	0.4	5.2	1.3	2.8	4.4	3.3	2.7	5.5	5.5	5.6	0.0	0.0	0.0	
VENEZUEL	1.0	1.4	1.8	1.4	1.1	0.4	0.4	0.7	0.5	0.6	0.7	0.9	1.0	1.3	0.9	0.6	1.8	1.2	0.9	0.5	1.2	1.5	1.7	1.6	1.4	2.2	2.1	2.0	0.0	0.0	0.0	
OTHERS		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	0.1	0.2	0.1	0.1	0.1	0.1	++	++	0.1	0.1	++	0.0	0.0	
SPOTTED SPANISH MACK (S MACULATUS)*																																
ATLANTIC	11.1	10.1	11.9	13.5	12.8	12.8	12.4	15.9	13.9	16.8	20.0	21.0	18.2	14.6	15.5	14.9	14.6	19.5	16.9	19.6	16.2	19.9	15.1	20.7	20.8	19.5	21.9	17.0	17.7	18.2	16.4	
-LONGLINE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.5	0.4	0.1	0.0	0.1	0.2	0.1	0.3	0.1	0.1	0.1	0.5	0.2	0.2	0.1	0.0	0.0	0.0	
CUBA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.5	0.4	0.1	0.0	0.1	0.2	0.1	0.3	0.1	0.1	0.1	0.5	0.2	0.2	0.1	0.0	0.0	0.0	
OTHERS		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
-TROLLING	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.4	0.5	1.2	0.4	0.1	0.2	0.0	0.1	0.4	0.1	0.1	0.5	0.5	0.6	0.6	
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	0.0	0.0	0.5	0.4	0.5	0.4	0.4	0.1	0.1	++	0.1	0.4	0.1	0.1	0.5	0.5	0.6	0.6	*
USA		0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.8	0.0	++	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
OTHERS	0.1																															
-OTHER SURF	7.4	7.8	8.3	9.1	7.8	7.0	7.1	4.5	3.9	5.5	7.9	9.7	5.4	2.6	3.4	3.8	4.1	11.5	8.3	6.4	9.9	13.6	8.9	14.0	13.0	13.6	14.0	7.8	8.5	8.1	4.4	
BRASIL		0.0	0.0	0.0	0.0	0.0	0.0	1.9	1.2	2.8	4.4	6.3	2.7	0.3	1.0	1.5	1.2	2.8	3.5	4.3	4.5	6.3	1.5	5.0	4.7	5.1	5.9	0.0	++	++	0.0	
CUBA	0.7	1.2	1.6	1.3	1.1	0.8	0.8	0.9	0.5	0.5	0.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.4	0.3	0.5	0.7	0.5	0.5	0.0	0.0	0.0	0.0	
DOMINR		0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.3	0.4	0.5	0.5	0.4	0.2	1.1	1.3	1.3	1.3	1.4	1.4	1.3	0.7	0.7	0.7	*
USA	3.4	2.7	3.5	4.2	3.5	5.2	4.8	0.0	0.0	0.0	0.0	0.0	++	0.0	0.0	0.0	0.0	5.4	1.9	0.0	2.8	3.9	3.8	5.7	4.8	4.9	4.2	4.0	5.3	5.2	1.5	
VENEZUEL	3.3	3.9	3.2	3.5	3.0	0.8	1.3	1.5	2.0	2.0	2.5	2.5	2.4	2.0	2.2	2.0	2.5	2.8	2.4	1.7	2.1	1.9	2.0	1.5	1.5	1.7	2.0	2.5	2.5	2.2	2.2	*
-UNCL + TRA	3.6	2.2	3.5	4.3	4.9	5.7	5.2	11.4	10.0	11.3	12.1	11.3	12.2	11.5	11.7	10.5	10.1	7.4	7.2	12.7	5.9	6.0	6.1	6.5	6.9	5.6	7.6	8.6	8.7	9.5	11.4	
COLOMBIA		0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.6	0.1	0.2	0.3	0.4	0.2	0.3	0.2	0.2	0.2	0.4	++	++	0.1	0.1	0.1	0.1	0.2	0.1	0.1	++	0.1	0.1	*
MEXICO	3.6	2.2	3.5	4.3	4.9	5.7	5.2	4.8	3.5	5.3	6.7	5.2	4.8	3.4	4.4	5.1	5.8	5.9	5.9	7.8	5.9	5.8	5.8	6.2	6.5	5.2	7.2	8.2	8.4	9.2	9.2	*
TRINIDAD		0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.2	1.0	0.8	0.8	1.7	1.5	1.5	1.9	1.2	1.3	0.9	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	
USA		++	++	++	++	++	++	5.5	4.7	4.9	4.4	5.0	5.3	6.4	5.5	3.3	2.9	++	++	3.7	++	0.1	0.2	0.2	0.3	0.2	0.3	0.3	0.3	0.2	++	
OTHERS	++	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	0.0	++	++	++	++	++	++	++	0.0	0.0	++	++	0.0	0.0	0.0	
KING MACKEREL (S CAVALLA)																																
ATLANTIC	3.3	2.8	3.2	3.0	3.9	5.3	5.4	6.4	6.4	7.3	9.7	13.6	9.1	8.3	8.7	6.7	11.4	15.6	18.5	18.1	14.6	13.1	9.9	12.1	11.9	13.0	10.8	10.1	10.1	10.4	8.8	
ARGENTIN		++	0.0	0.0	++	++	0.0	0.0	++	0.0	0.0	0.0	0.0	0.5	1.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
BRASIL		0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.9	2.5	3.3	5.2	2.2	0.5	0.8	0.8	0.8	1.6	1.6	1.9	2.7	2.6	0.8	2.9	2.2	2.0	2.1	++	++	++	0.0	
MEXICO	1.0	0.9	1.0	0.9	1.0	0.7	1.1	0.9	1.3	1.5	2.2	1.5	1.4	1.5	1.3	1.5	2.2	1.9	2.7	4.4	2.9	2.2	2.3	2.6	3.1	3.1	2.3	2.7	2.1	3.0	3.0	*
TRINIDAD		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	++	++	0.1	0.8	0.5	0.4	0.7	0.0	1.1	
USA	2.3	1.6	2.1	2.1	2.8	2.8	2.8	3.0	2.6	2.2	2.7	4.7	3.1	4.1	3.8	2.5	6.3	10.7	12.6	9.9	7.1	7.4	6.0	5.7	5.6	5.8	4.4	5.9	6.1	6.1	3.8	
VENEZUEL		0.3	0.1	0.0	0.1	1.8	1.5	1.0	1.6	1.1	1.5	2.2	2.4	1.7	1.6	1.3	2.0	1.4	1.6	1.9	1.9	0.9	0.8	0.9	0.9	1.3	1.5	1.1	1.2	1.3	0.8	
OTHERS	++	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.0	0.2	0.2	0.1	++	++	++	++	++	0.0	0.0	0.0	++	++	++	++	++	0.1	
WEST AFRICAN SPAN MACK (S TRITOR)																																
ATLANTIC	0.0	0.0	0.0	0.0	0.0	1.8	2.7	0.2	1.3	2.1	1.6	4.7	1.1	2.0	2.5	6.8	4.1	4.9	3.1	5.4	4.7	4.4	4.0	3.3	1.8	3.8	2.7	4.2	3.6	1.4	1.4	
GERMANY		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.5	++	++	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

SMT-Table 1. Continued.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	
GHANA		0.0	0.0	0.0	0.0	1.8	2.5	0.0	0.7	1.5	1.0	3.5	0.6	0.6	0.7	0.8	1.6	4.4	2.0	3.0	2.2	3.0	3.0	1.5	0.0	1.5	1.5	1.5	2.8	0.9	0.9	*
SENEGAL		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	1.3	1.2	1.1	1.1	0.4	1.0	0.7	0.8	1.2	0.7	1.5	1.8	2.2	0.7	1.3	0.6	0.3	0.3	*
USSR		0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.6	0.6	0.6	0.8	0.2	0.1	0.6	4.8	1.4	0.0	0.0	0.6	1.2	0.2	0.2	0.2	++	0.1	0.2	1.2	0.0	0.0	0.0	
OTHERS		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	++	0.1	++	0.1	0.1	0.2	++	++	0.1	0.1	++	++	0.3	0.2	0.2	0.2	0.2	*
BLACKFIN TUNA (T ATLANTICUS)																																
ATLANTIC	0.8	0.8	0.7	0.7	0.9	0.7	0.8	2.0	1.9	1.9	0.9	1.0	0.8	1.1	1.3	1.3	1.1	1.1	2.1	1.9	1.7	1.9	1.5	1.9	2.1	3.2	3.0	3.9	3.7	2.4	3.6	
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	0.0	0.0	0.0	0.0	0.0	0.7	0.6	0.6	0.5	0.2	0.5	0.6	0.3	0.3	0.5	0.3	0.2	0.2	*
DOMINR		0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	++	0.6	0.5	0.5	0.1	0.1	*
GRENADA																	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.1	0.2	0.1	0.3	0.2	0.2	0.3	
GUADELOU		0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.1	1.1	0.2	0.2	0.2	0.2	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.5	1.0	
MARTINIQ	0.7	0.7	0.6	0.6	0.8	0.5	0.6	0.6	0.5	0.3	0.1	0.4	0.3	0.6	0.3	0.4	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.2	0.4	0.4	0.4	0.8	0.7	0.7	
VENEZUEL		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.1	0.7	1.3	1.0	++	0.7	
OTHERS	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.4	0.4	0.3	0.2	0.2	0.4	0.3	0.1	0.2	0.4	0.2	0.1	0.3	0.2	0.2	0.4	0.8	0.4	0.4	0.4	0.7	0.6	
WAHOO (A SOLANDRI)																																
ATLANTIC	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.4	0.4	0.4	0.3	0.4	0.3	0.4	0.4	0.5	0.8	0.6	2.9	2.3	2.4	2.2	0.9	1.1	1.3	1.5	1.5	1.5	1.3	1.8	1.9	
CAP VERT		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	2.3	1.5	1.6	1.4	0.1	0.2	0.3	0.3	0.6	0.5	0.4	0.5	0.5	*
USA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	0.1	0.1	0.1	0.1	0.1	0.2	0.6	
OTHERS		0.0	0.0	0.0	0.0	0.1	0.0	0.4	0.4	0.4	0.3	0.4	0.3	0.4	0.4	0.5	0.8	0.6	0.6	0.8	0.8	0.8	0.8	0.9	0.9	1.1	0.8	0.9	0.8	1.1	0.8	
CERRO (S REGALIS)																																
ATLANTIC	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.5	0.8	0.8	0.8	0.6	0.7	0.5	0.6	0.7	0.6	0.6	0.6	0.7	0.7	0.7	0.6	0.5	0.3	0.3	0.3	0.3	0.3	0.4	0.3	
MARTINIQ		0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.5	0.5	0.4	0.2	0.3	0.2	0.5	0.6	0.5	0.5	0.5	0.6	0.6	0.6	0.5	0.4	0.3	0.2	0.2	0.2	0.3	0.3	0.3	*
OTHERS		0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.3	0.3	0.4	0.4	0.4	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	++	0.1	0.1	0.1	++	0.1	0.0	
SCOMBEROMORUS UNCLASSIFIED (S SPP)																																
ATLANTIC	1.5	1.8	1.8	1.9	2.1	2.1	3.4	0.5	0.4	0.3	0.5	0.6	0.8	0.5	0.5	0.4	0.2	0.2	0.4	0.3	0.0	0.5	0.0	0.0	0.1	0.2	0.0	0.0	0.1	0.2	0.2	
BRASIL	1.0	1.1	1.1	1.3	1.5	1.6	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	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	0.3	0.2	0.1	0.2	0.3	0.4	0.1	0.1	0.1	0.1	0.1	0.2	0.1	++	0.5	++	++	0.1	0.2	++	++	++	++	0.0	
MEXICO	0.0																															
OTHERS	0.5	0.7	0.7	0.6	0.6	0.5	0.4	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.4	0.3	0.1	0.1	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.1	0.2	0.2	
PLAIN BONITO (O UNICOLOR)																																
ATL+MED	3.1	2.3	0.2	0.3	0.7	0.2	1.3	0.8	0.7	0.3	0.1	0.1	0.1	0.2	0.4	1.0	0.5	0.7	1.5	0.6	0.0	0.0	0.1	0.1	0.6	1.5	1.2	0.4	0.4	0.4	0.4	
MEDITERRANE	0.0	0.0	++	++	++	++	++	++	++	++	++	++	0.0	0.0	0.1	0.2	++	0.0	0.0	0.0	0.0	0.0	++	++	0.0	++	++	++	++	++	0.0	
OTHERS		0.0	++	++	++	++	++	++	++	++	++	++	0.0	0.0	0.1	0.2	++	0.0	0.0	0.0	0.0	0.0	++	++	0.0	++	++	++	++	++	0.0	
ATLANTIC	3.1	2.3	0.2	0.3	0.7	0.2	1.3	0.8	0.7	0.3	0.1	0.1	0.1	0.2	0.3	0.8	0.5	0.7	1.5	0.6	0.0	0.0	0.1	0.1	0.6	1.5	1.2	0.4	0.4	0.4	0.4	
MAURITAN		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.1	++	++	++	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	*
MAROC	3.1	2.3	0.2	0.3	0.7	0.2	1.3	0.8	0.6	0.2	++	++	++	0.1	0.2	0.7	0.4	0.6	1.0	0.5	0.0	0.0	0.1	++	0.5	1.4	1.1	0.3	0.3	0.3	0.3	
OTHERS		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	++	++	++	++	++	++	++	++	++	++	++	++	++	0.0	

SMT-Table 1. Continued.

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	
MIXED OR UNKNOWN TUNA-LIKE SPECIES																																
ATL+MED	5.4	6.7	8.7	7.2	6.2	7.7	7.9	13.3	11.9	16.0	7.8	8.2	13.1	10.3	12.4	8.7	7.5	9.4	10.7	12.4	11.9	7.4	7.3	6.8	14.8	12.5	14.9	18.3	18.2	26.2	24.4	
MEDITERRANE	2.1	2.1	1.3	1.2	0.5	1.1	1.2	0.6	0.5	0.5	0.4	0.4	0.7	0.5	0.4	0.4	0.2	1.9	1.4	1.8	1.4	1.4	2.1	2.2	2.3	3.4	2.4	4.5	2.3	2.3	2.3	
GREECE		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	++	0.1	0.1	0.1	0.1	0.5	0.5	0.5	0.5	0.5	*
ISRAEL	0.9	1.1	0.2	0.3	0.0	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
LEBANON	0.5	0.5	0.5	0.3	0.2	0.3	0.8	0.2	0.2	0.2	0.2	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.2	0.2	0.2	*
ESPANA	0.7	0.5	0.6	0.6	0.3	0.5	0.2	0.3	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TUNISIE		0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.3	0.1	0.1	0.2	0.4	0.3	0.3	0.1	1.8	1.3	1.5	1.2	1.3	1.8	1.9	1.9	3.0	1.7	3.9	1.6	1.6	1.6	*
OTHERS		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	++	++	++	++	++	++	++	++	++	++	++	0.1	0.1	0.1	0.1	++	++	++	0.0	++	
ATLANTIC	3.3	4.6	7.4	6.0	5.7	6.6	6.7	12.7	11.4	15.5	7.4	7.8	12.4	9.8	12.0	8.3	7.3	7.5	9.3	10.6	10.5	6.0	5.2	4.6	12.5	9.1	12.5	13.8	15.9	23.9	22.1	
BRASIL		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.3	0.7	0.4	0.6	++	0.7	0.4	++	++	++	0.3	0.1	++	++	0.1	++	0.2	
CHITAIW		0.0	++	++	0.2	0.4	1.1	0.8	0.7	0.9	1.0	0.9	0.4	1.0	++	0.5	1.3	0.8	0.8	1.1	0.8	++	++	0.1	0.3	0.1	1.1	0.2	2.0	0.0	0.0	
COLOMBIA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.1	++	++	++	++	++	++	0.3	++	0.3	1.0	0.7	0.9	0.8	1.2	0.3	0.1	3.9	3.9	*
CIVOIRE		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	3.1	4.4	1.0	0.6	++	5.3	5.3	4.7	6.1	10.1	11.1	11.1	*
CUBA		0.0	0.0	0.0	++	++	0.0	0.0	0.4	0.6	1.1	0.3	1.0	0.4	0.1	0.1	0.1	++	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
EGUINEA		0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.4	0.4	0.5	0.4	0.4	0.4	0.4	0.3	0.4	0.4	*
GHANA		0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.9	0.0	0.0	0.9	0.5	0.7	1.0	0.4	0.1	0.2	0.2	0.6	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
GUADELOU	1.0	1.0	1.0	0.8	1.0	1.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
ISRAEL		0.0	0.5	0.1	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	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	1.5	2.7	5.2	4.8	3.3	1.5	1.1	1.6	1.5	1.0	0.5	0.6	0.4	1.0	0.8	1.0	1.6	1.3	0.8	0.7	0.1	0.3	0.5	0.4	0.3	0.4	0.4	2.2	2.2	2.2	0.3	
KOREA		0.0	0.0	0.0	0.0	2.4	1.0	7.0	5.7	3.1	2.4	3.5	5.8	2.9	4.2	2.5	1.7	2.1	2.0	1.9	1.2	1.0	1.0	0.7	0.4	0.0	0.5	0.2	++	++	++	
LIBERIA		0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.5	0.2	0.4	0.4	0.4	0.3	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.0	
LIBYA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.1	
PANAMA		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.8	1.4	2.6	0.8	0.2	0.7	1.1	0.6	0.7	0.0	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	
PORTUGAL	0.7	0.8	0.4	0.1	0.1	0.3	0.5	0.3	0.5	0.2	++	++	0.2	0.3	0.3	0.5	0.2	0.2	0.2	0.1	0.0	0.0	++	0.4	0.0	++	0.0	0.0	0.0	0.0	0.0	
SILEONE		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	++	0.0	0.5	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.1	++	0.1	0.1	*
ESPANA		0.0	0.0	0.0	1.0	0.8	0.7	0.1	0.0	6.6	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	++	++	++	0.0	
TOGO		0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	0.5	0.6	0.6	0.8	0.7	0.5	0.5	++	0.4	0.3	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TRINIDAD		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	++	++	0.0	3.1	1.2	3.1	3.5	0.1	4.4	4.4	*
USA		0.1	0.1	++	++	++	++	0.0	0.1	0.0	0.0	++	++	++	0.1	++	++	0.5	0.1	0.2	0.4	0.9	0.2	0.3	0.3	0.1	0.1	0.2	0.1	0.2	0.2	
USSR		0.0	0.2	0.2	0.0	++	0.2	0.3	0.3	0.2	0.2	0.3	0.4	++	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
VENEZUEL	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.2	0.2	0.8	0.0	0.0	++	0.7	0.0	0.1	++	0.0	0.0	0.0	0.9	0.9	0.4	0.4	++	0.0	0.0	0.0	0.2	0.1	0.1	*
OTHERS	0.1	0.0	0.0	0.0	0.1	0.1	0.4	0.5	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.2	0.4	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.8	0.3	

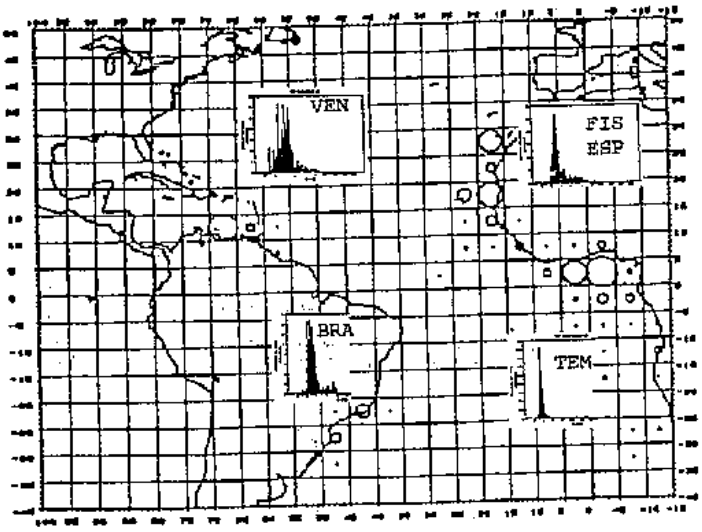
"++" CATCHES: < 50 MT AND >= 1 MT

* INCLUDES FRIGATE TUNA FOR COTE D'IVOIRE

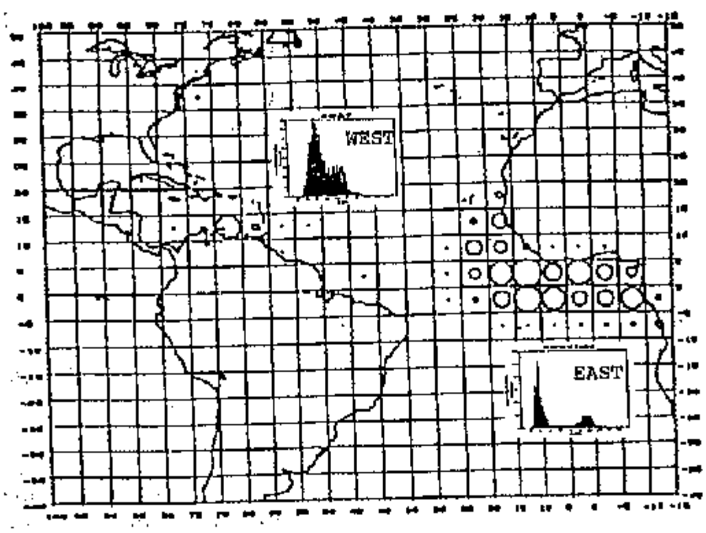
** INCLUDES BULLET TUNA (A. ROCHEI)

& INCLUDES ATL. BLACK SKIPJACK FOR ATLANTIC PS ESPANA BEGINNING IN 1978

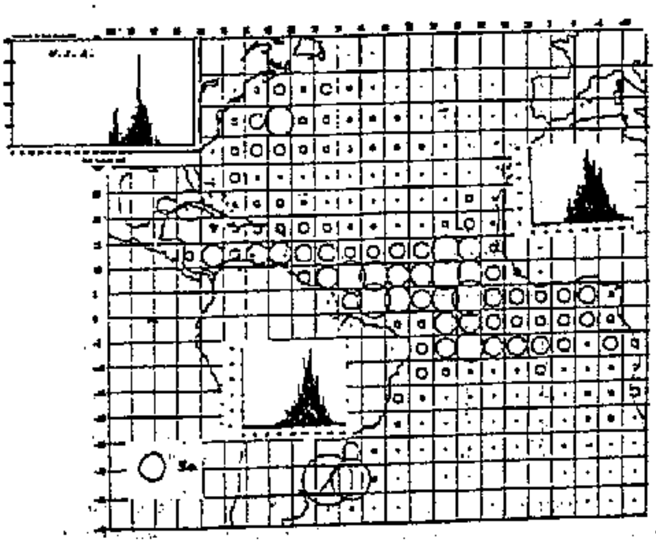
*** INCLUDES SERRA SPANISH MACKEREL (S. BRASILIENSIS)



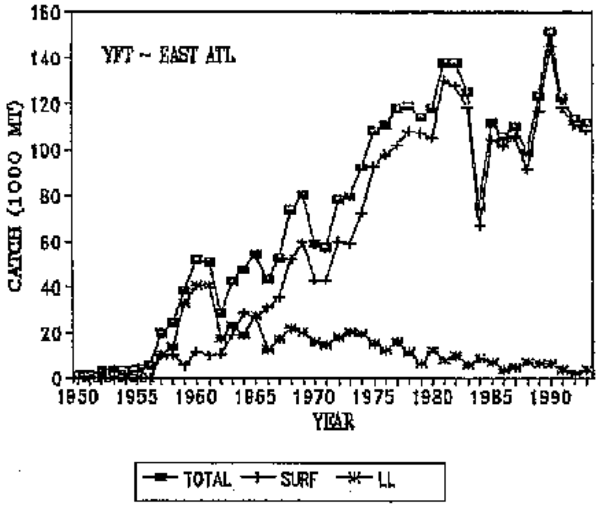
YFT-Figure 1.
Geographical distribution of annual yellowfin catches by baitboat fisheries and average size frequencies of the catches in the Atlantic Ocean, average for 1987 through 1991.



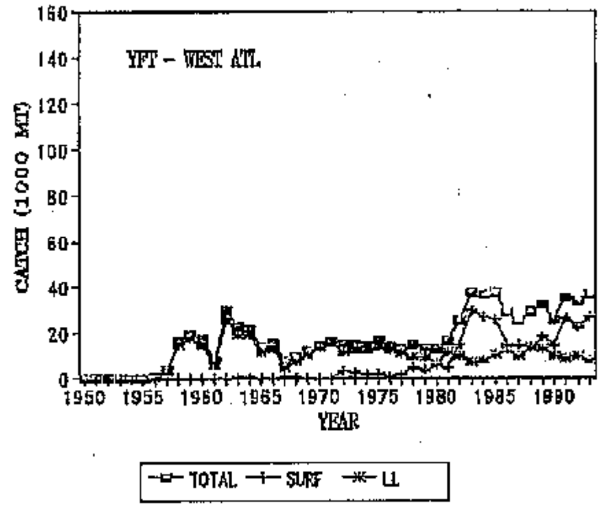
YFT-Figure 2.
Geographical distribution of annual yellowfin catches by purse seine fisheries and average size frequencies of the catches in the Atlantic Ocean, average for 1987 through 1991.



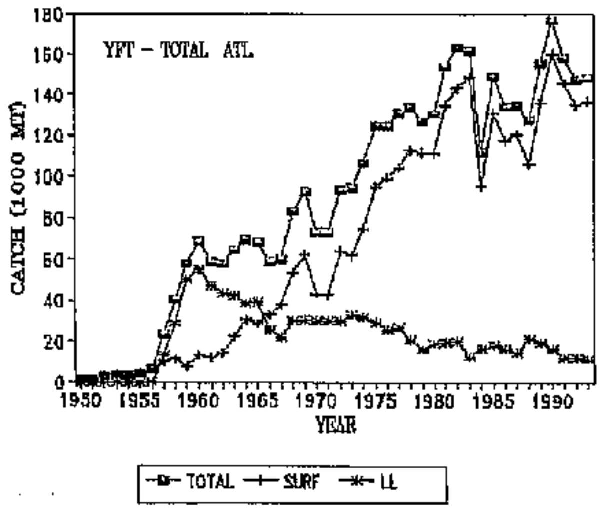
YFT-Figure 3.
Geographical distribution of annual yellowfin catches by longline fishery and average size composition of the catches, for the east and west Atlantic Ocean, average for 1983 through 1986. The size distribution of the U.S. longline fishery is for 1987.



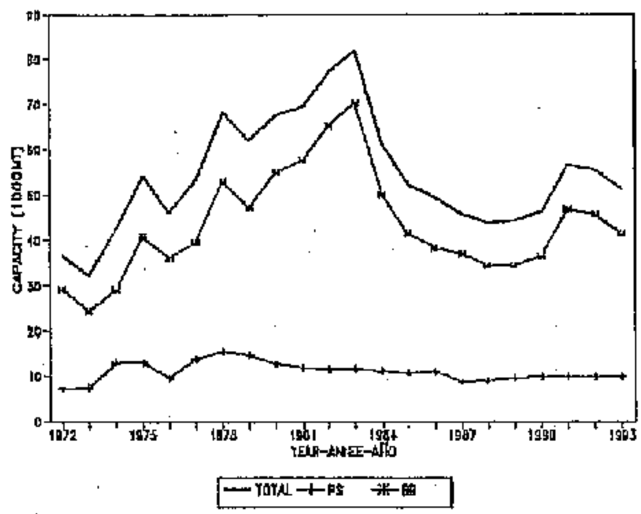
YFT-Fig. 4. Total catches of surface (SURF) and longline (LL) fisheries in the east Atlantic.



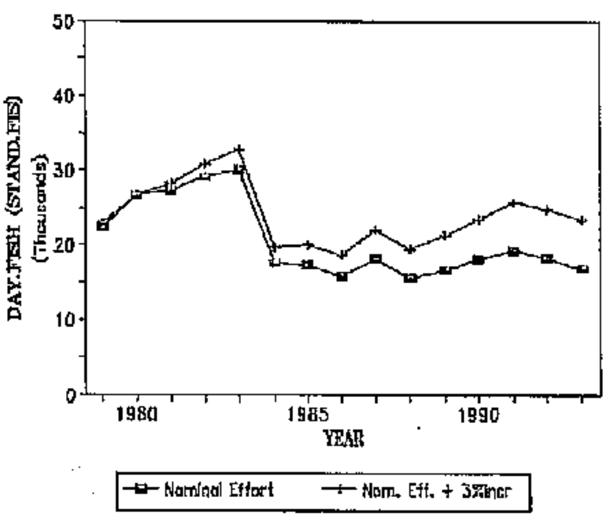
YFT-Fig. 5. Total catches of surface (SURF) and longline (LL) fisheries in the west Atlantic.



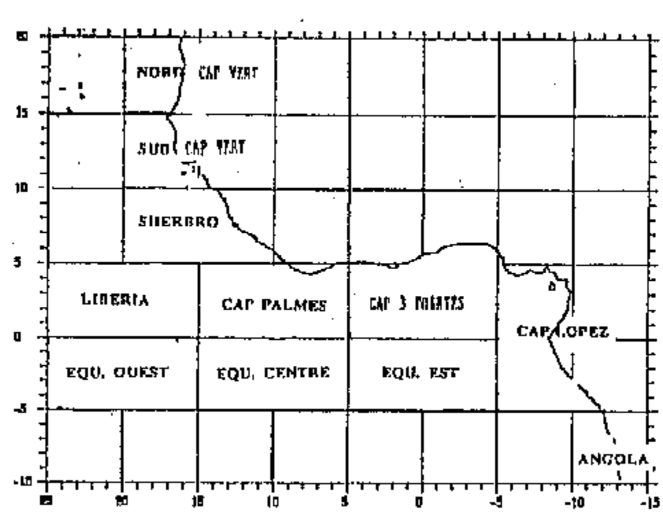
YFT-Fig. 6. Total catches of surface (SURF) and longline (LL) fisheries in the entire Atlantic.



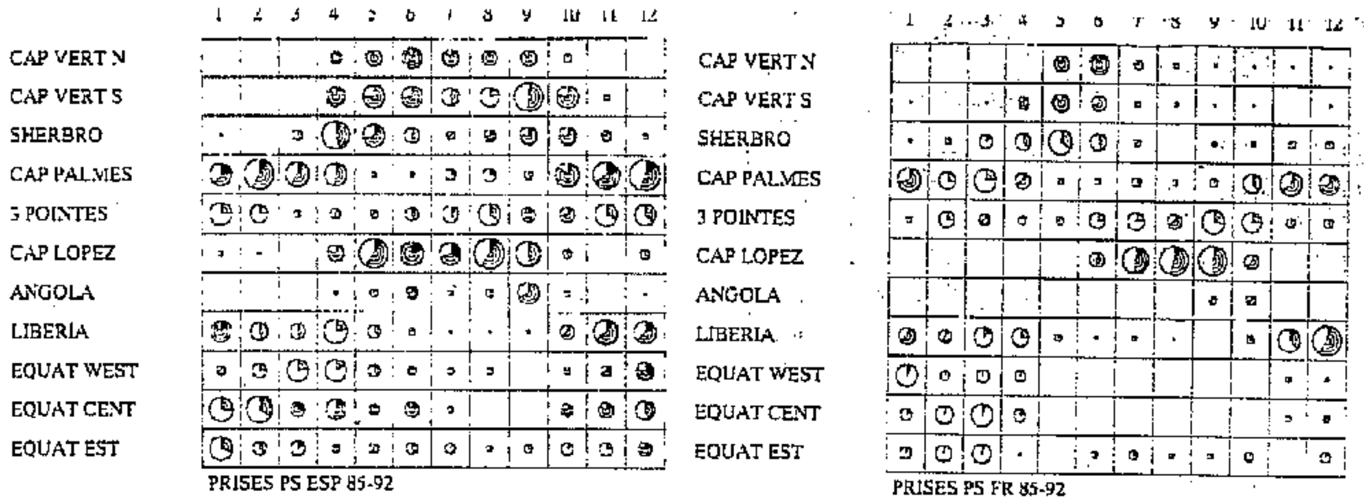
YFT-Fig. 7. Carrying capacity (in 1000 MT) of the total surface, purse seine and baitboat fishing fleets in the east tropical Atlantic, 1972-1993.



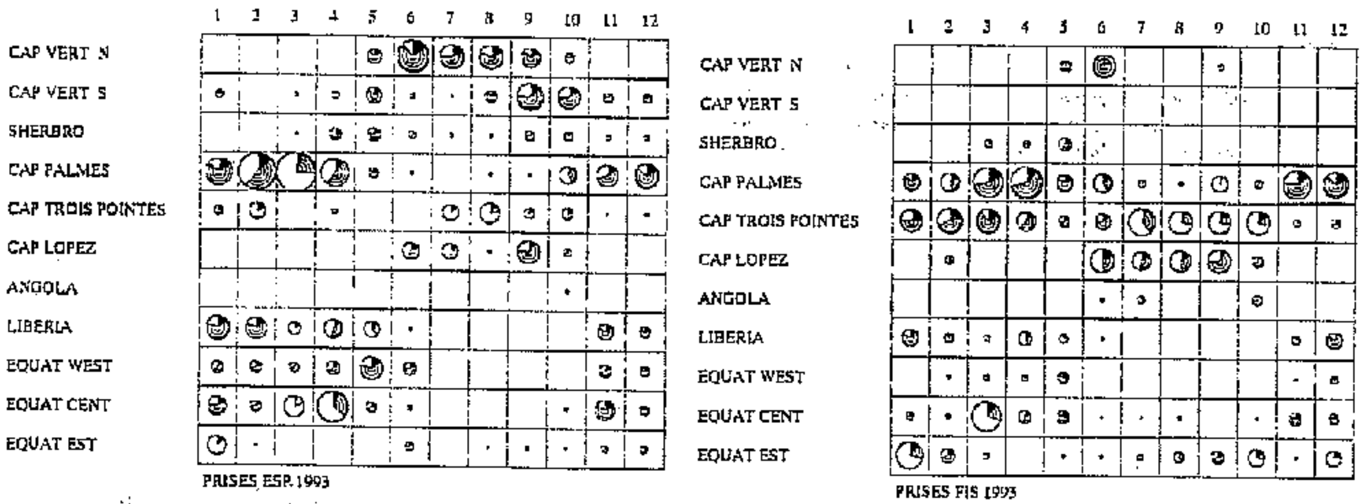
YFT-Fig. 8. Nominal effort, standardized to FIS category 5 purse seiners fishing days, with a 3% annual increase, for the entire Atlantic, 1979-1993.



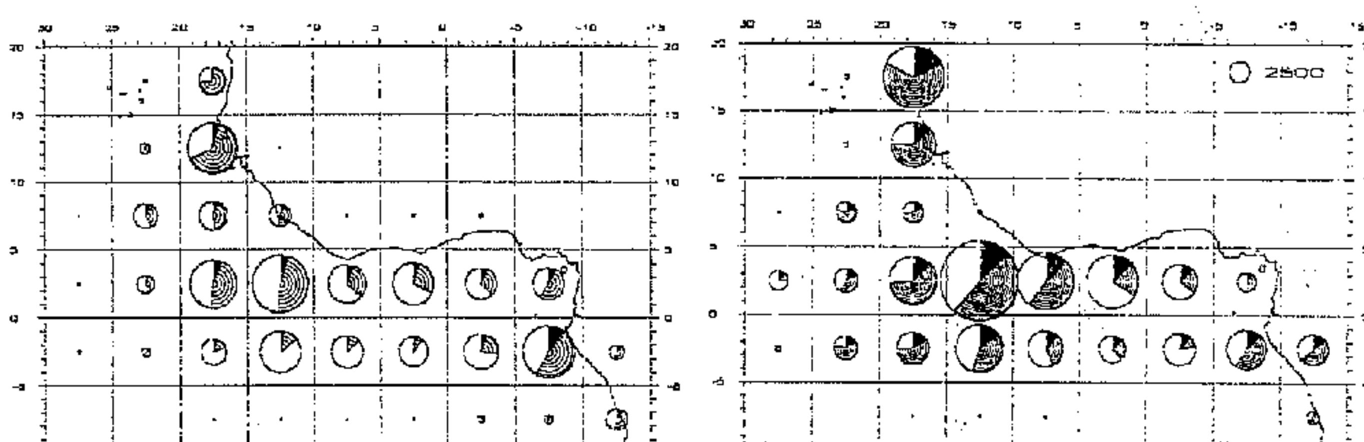
YFT-Fig. 9. Area in which the fishery is developed and the 13 areas established by the working Group on Juvenile Tropical Tunas (Brest, 1984).



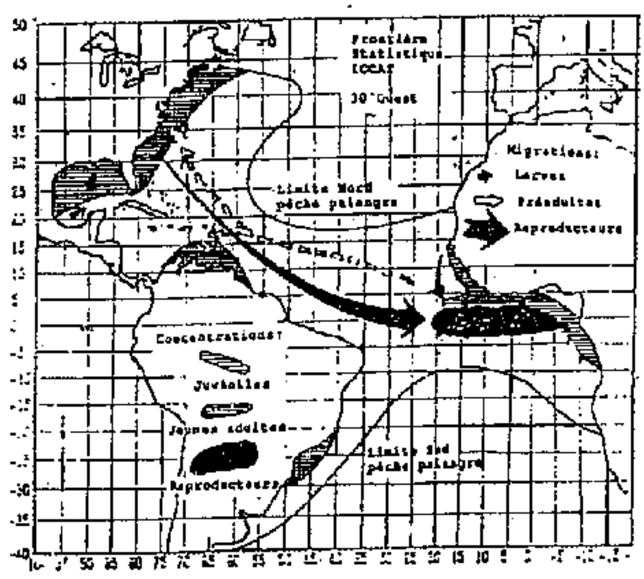
YFT-Fig. 10. Average seasonal catches of yellowfin, skipjack and bigeye of the Spanish and FIS purse seine fleets for the period 1985-1992 (Blank area represents yellowfin; solid area represents bigeye; and striped area represents skipjack.)



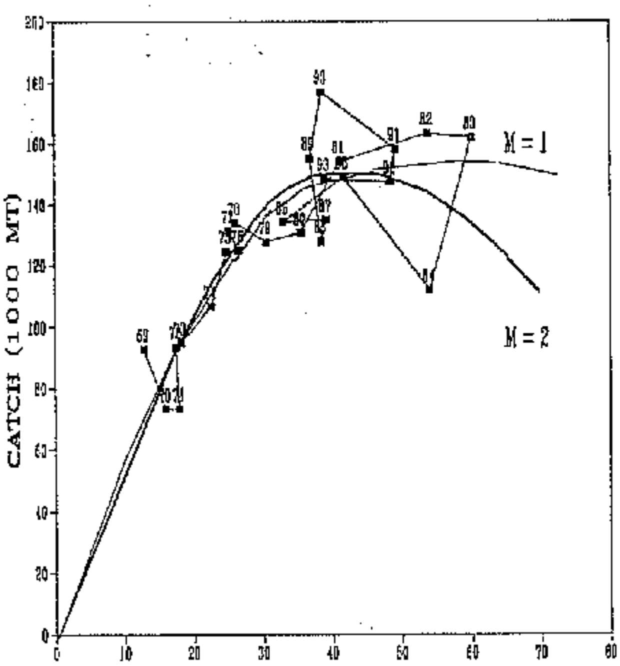
YFT-Fig. 11. Average seasonal catches of yellowfin, skipjack and bigeye of the Spanish and FIS purse seine fleets for 1993. (Blank area represents yellowfin; solid area represents bigeye; and striped area represents skipjack.)



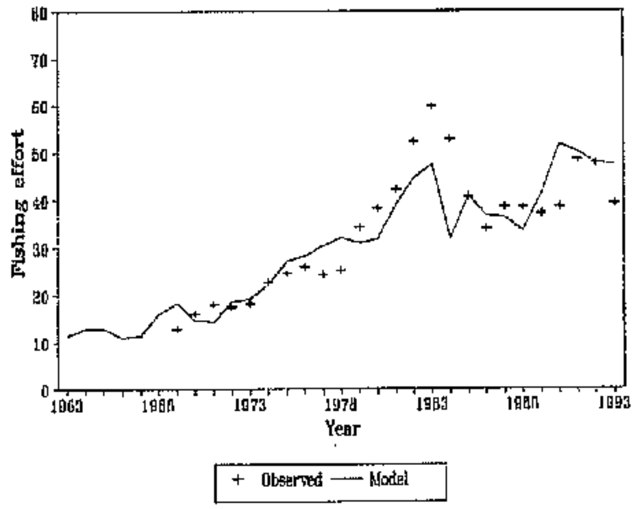
YFT-Fig. 12. Geographical distribution of catches of three main species (yellowfin, skipjack and bigeye) targeted by the Spanish and FIS purse seine fleets in the east Atlantic, for the historic period of 1980-91 and for 1993. (Blank area represents yellowfin; filled area represents bigeye; and striped area represents skipjack.)



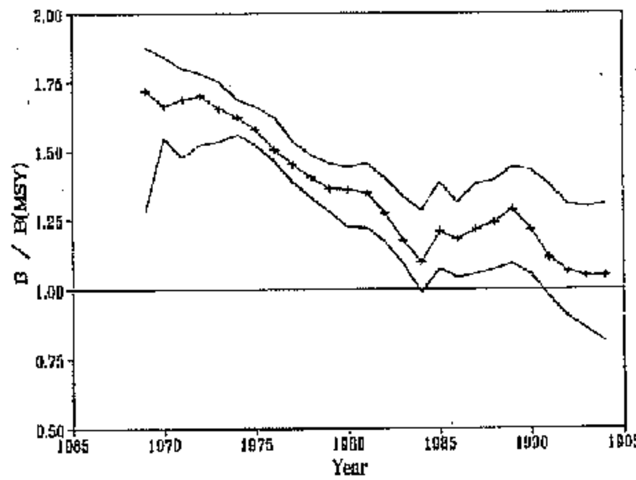
YFT-Fig. 13. Hypothetical migration model for a single Atlantic stock of yellowfin tuna. Movements indicated by a solid line (northwest to east) have been proven by tagging, whereas the migrations indicated by a broken line are for hypothetical, non-verified migrations.



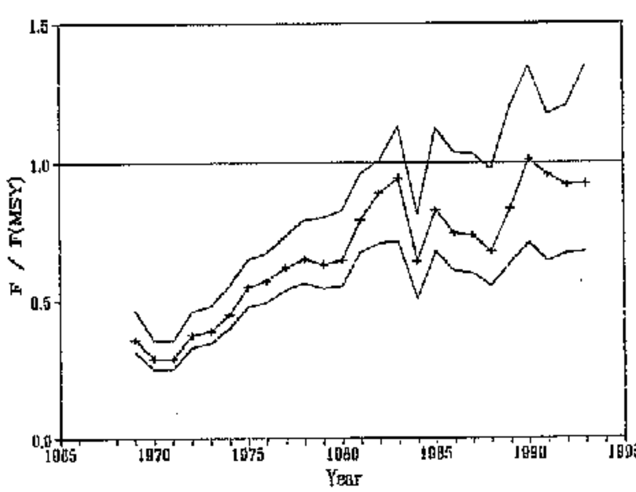
YFT-Fig. 14. Equilibrium production model curve for total Atlantic yellowfin (m=1, k=4). The model is fit to the nominal catch (in 1000 MT) and nominal effort (in fishing days) calculated from FIS and Spanish purse seiners (standardized to category 5 FIS purse seiners), considering an annual increase of 3% since 1981 in fishing power.



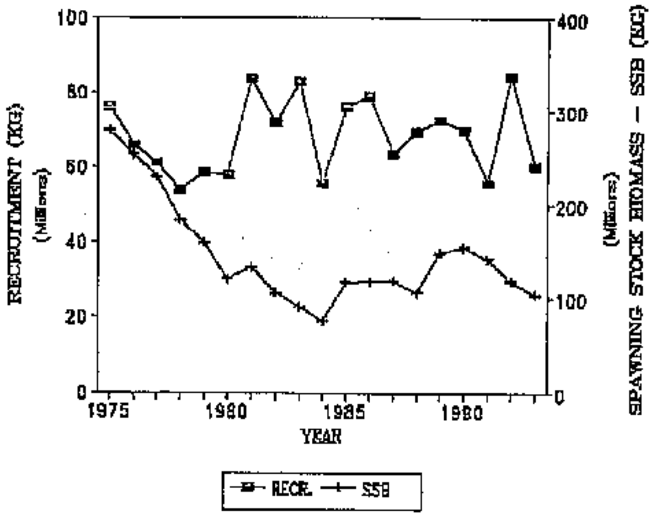
YFT-Fig. 15. Fit of ASPIC production model under the total Atlantic hypothesis. Observed and predicted fishing effort are shown.



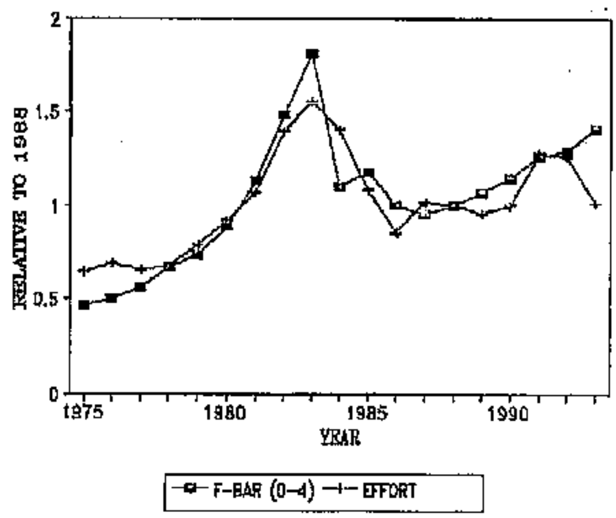
YFT-Fig. 16. Estimated relative biomass (B/B_{MSY}) with approximate 80% confidence intervals. Computed from ASPIC run for total Atlantic hypothesis.



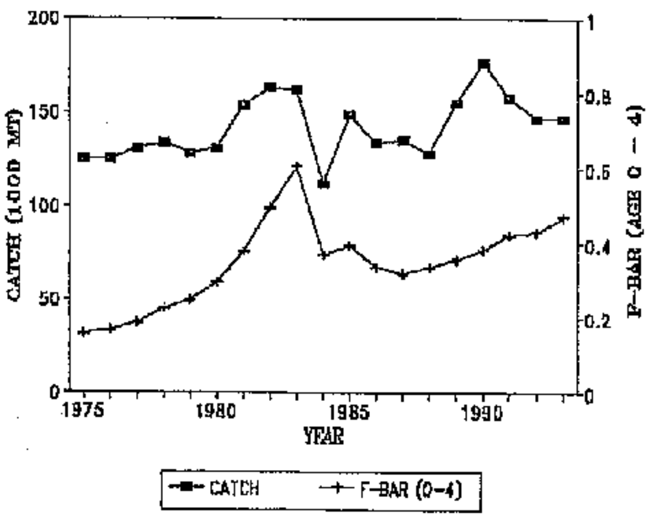
YFT-Fig. 17. Estimated relative fishing mortality rate (F/F_{MSY}) with approximate 80% confidence intervals. Computed from ASPIC run for total Atlantic hypothesis.



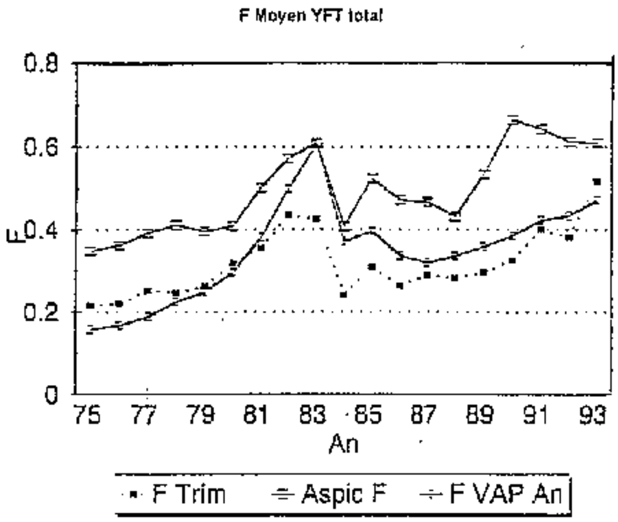
YFT-Fig. 18. Development of recruitment and spawning biomass estimated by VPA from 1975 to 1993.



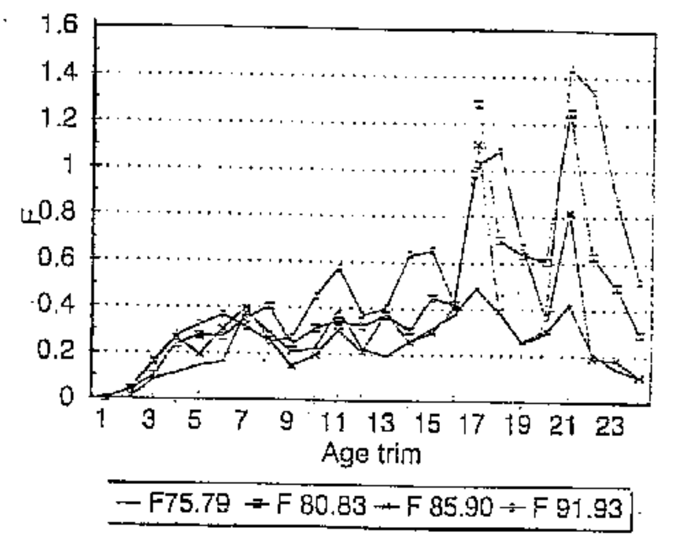
YFT-Fig. 19. Development of average fishing mortality (ages 0-4) and fishing effort (relative to 1988), estimated by VPA for the period of 1975 to 1993.



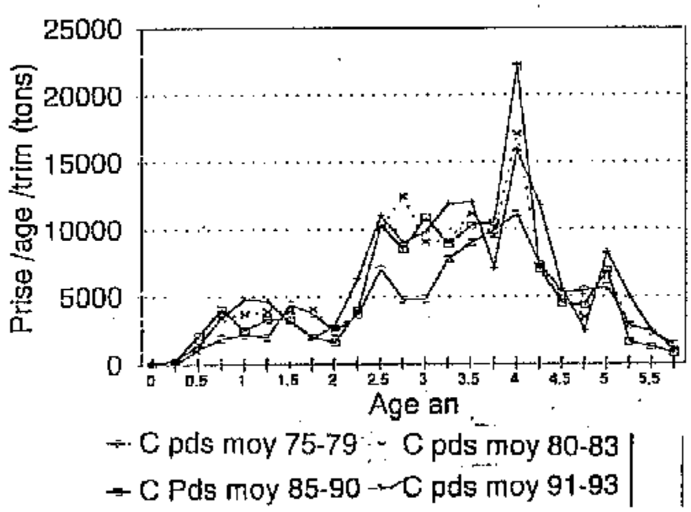
YFT-Fig. 20. Development of catch and average fishing mortality (ages 0-4) estimated by VPA from 1975 to 1993.



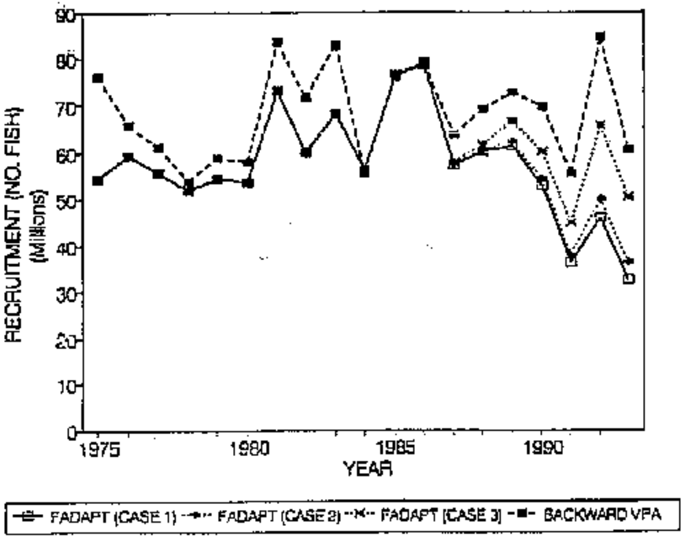
YFT-Fig. 21. Fishing mortality estimated by non-calibrated VPA applied on a quarterly basis; ASPIC and non-calibrated VPA applied on annual basis, 1975 - 1993.



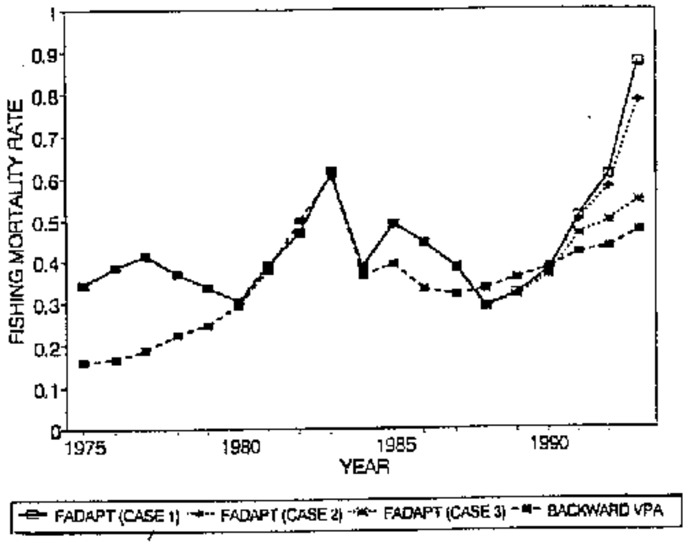
YFT-Fig. 22. Fishing mortality by age class (quarterly basis) for four periods (1975-79, 1980-83, 1985-90, and 1991-93).



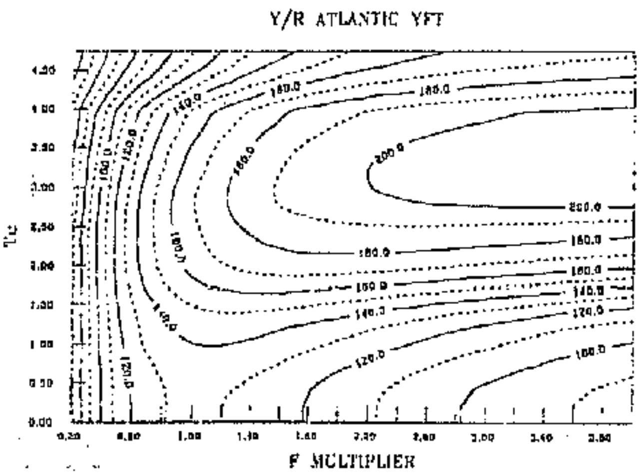
YFT-Fig. 23. Distribution of total biomass by age class (quarterly basis) for four periods of fishing.



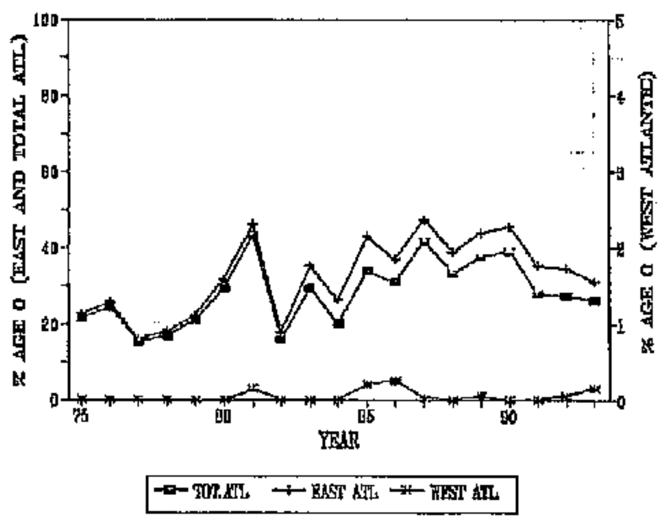
YFT-Fig. 24. Estimates of F (mean of ages 0 through 4) from ADAPT (3 cases) and untuned (backward) VPA. Difference in the final years results from the reliance of all VPA procedures on abundance indices and F assumptions for the final years, which for yellowfin are not well known.



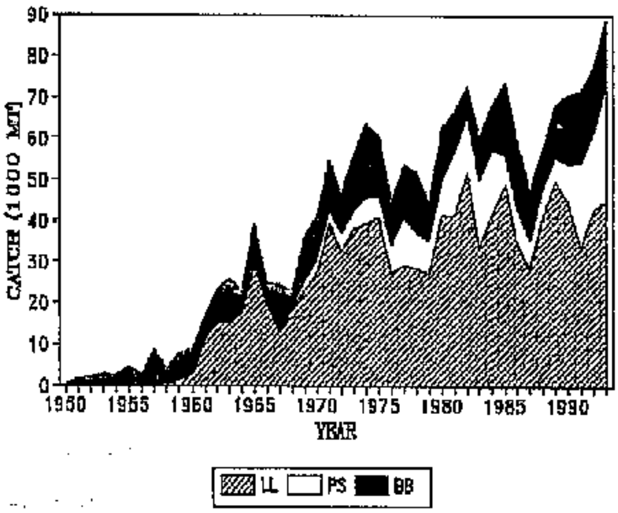
YFT-Fig. 25. Estimates of recruitment from ADAPT (3 cases) and untuned (backward) VPA. Difference in the early years (1975-80) reflects different assumptions about terminal F values in those years. The wide variety of solutions in the final years results from the reliance of all VPA procedures on abundance indices and F assumptions the final years, which for yellowfin are not well known.



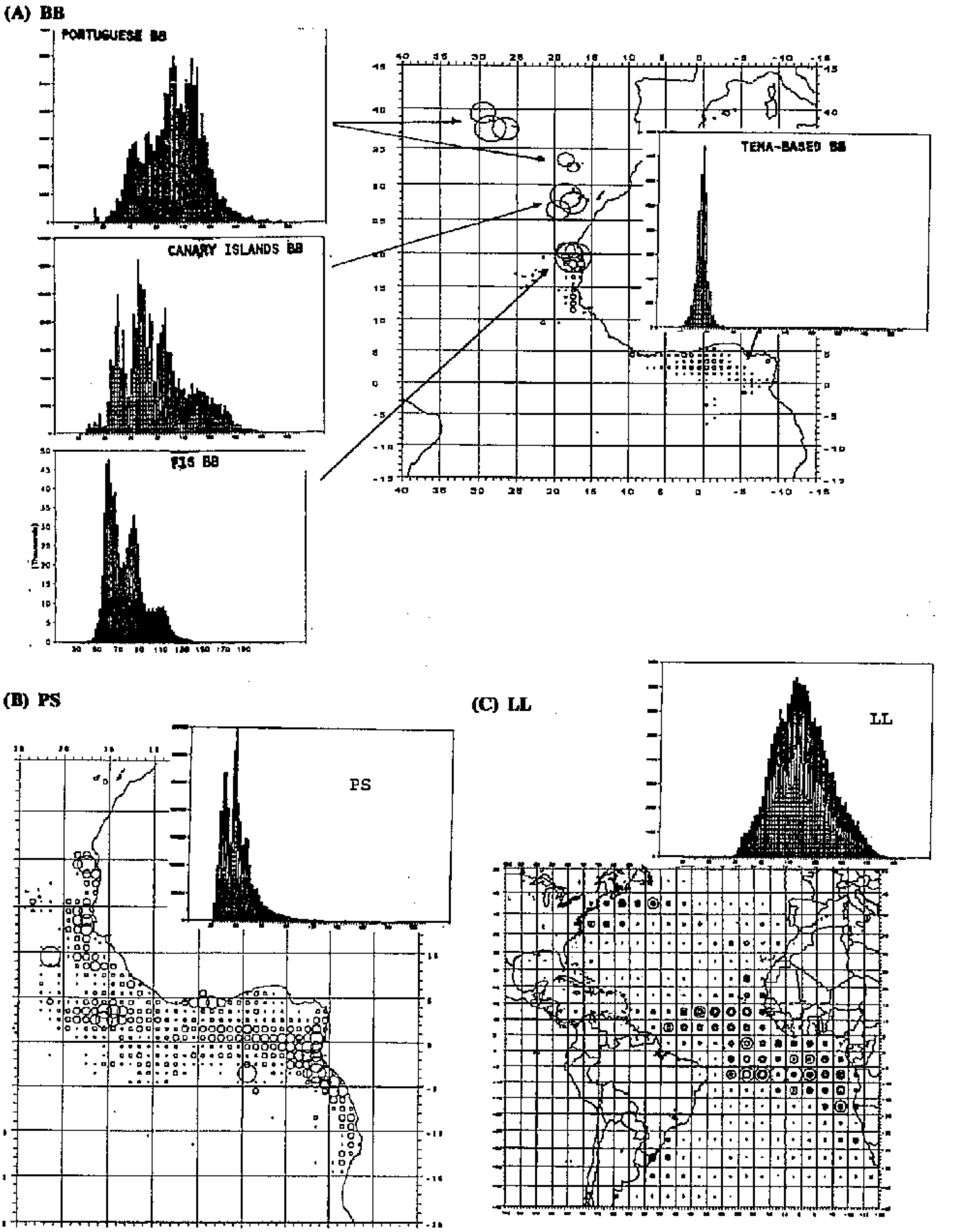
YFT-Fig. 26. Yield per recruitment curves (Ricker model) for the Atlantic yellowfin stock.



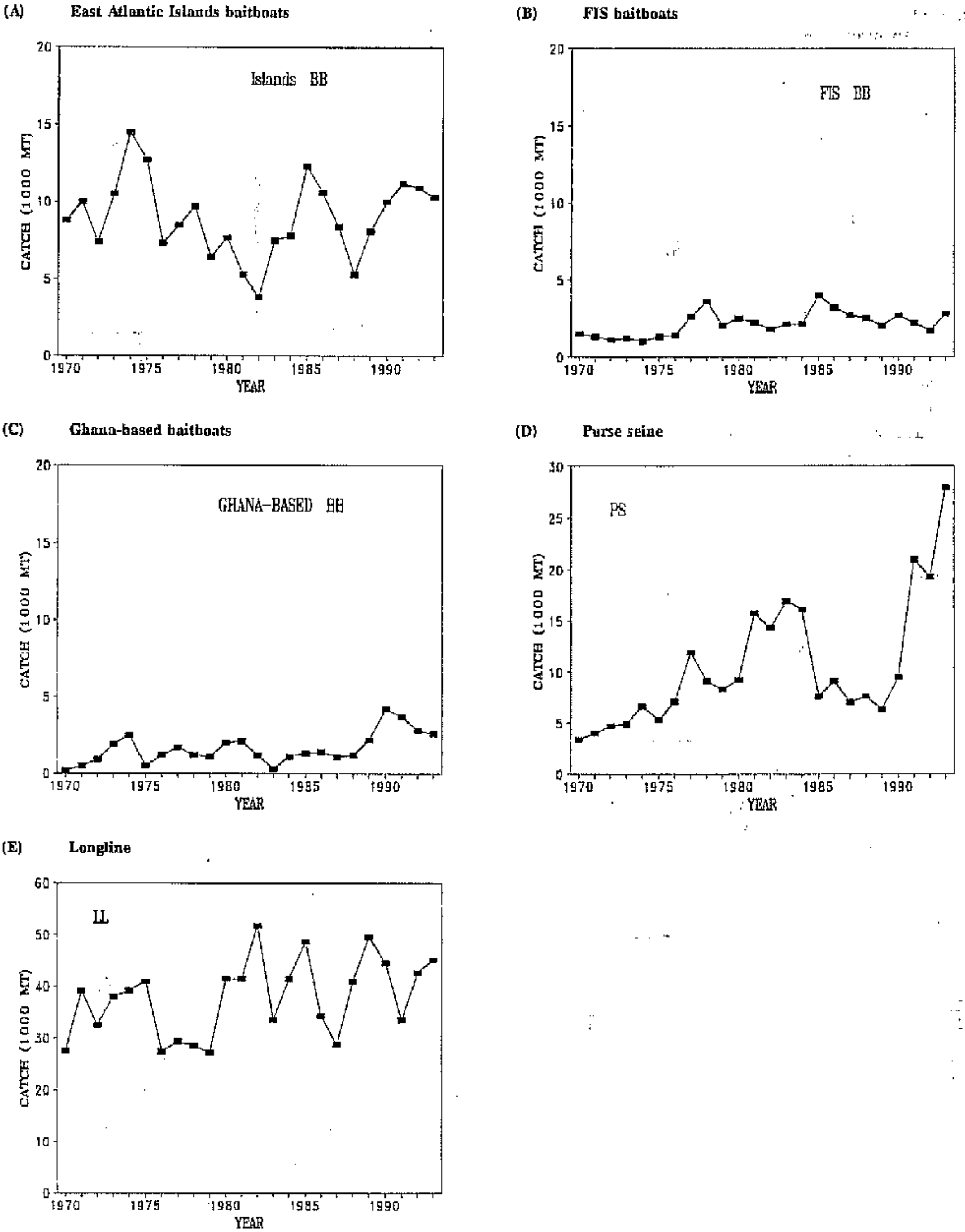
YFT-Fig. 27. Percent of age zero yellowfin tuna in landings, 1975-93. Results for east Atlantic and total Atlantic are plotted on the left hand scale.



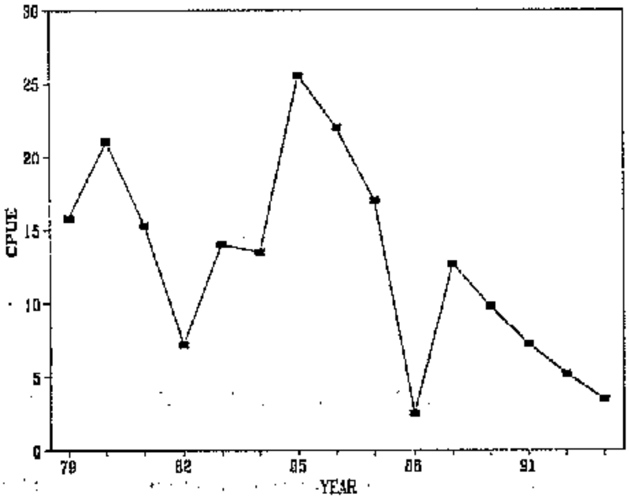
BET-Fig. 1. Reported total landing of bigeye in the Atlantic, by major categories of fishing gears.



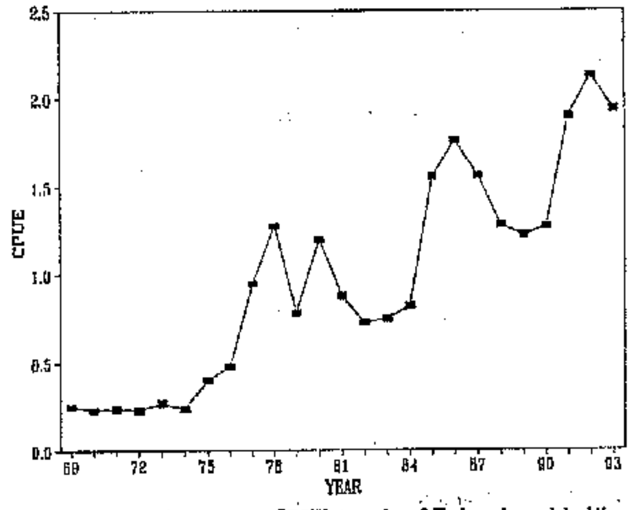
BET-Fig. 2. Areas of opertation and size frequencies of the main bigeye fisheries in the Atlantic (A) baitboats, (B) purse seine, and (C) longline.



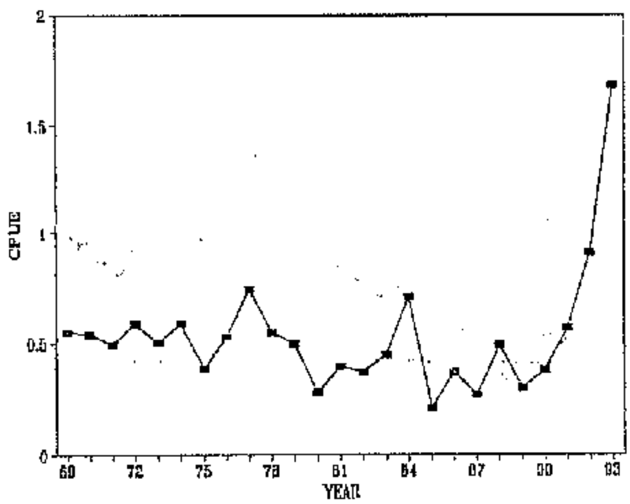
BET-Fig. 3. Reported bigeye catches by major fisheries.



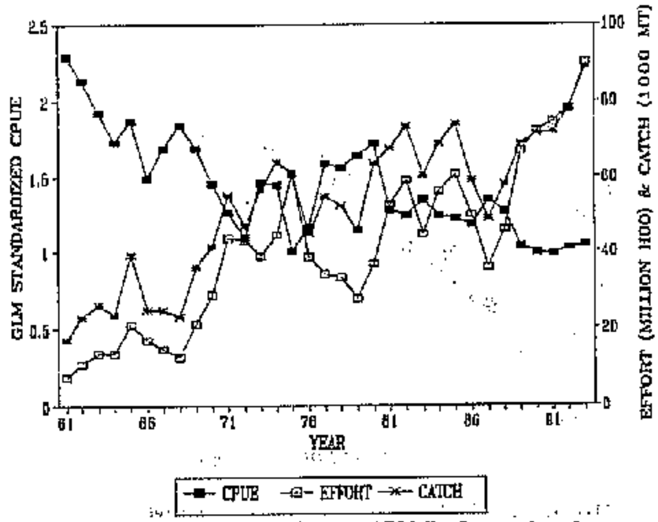
BET-Fig. 4. Bigeye tuna CPUE trends of Azorian baitboats (2nd quarter), 1979-93.



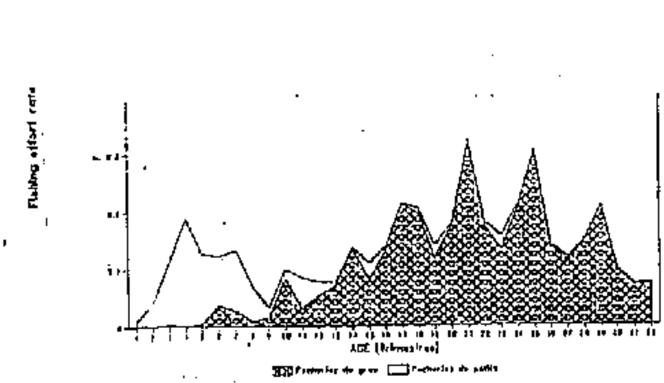
BET-Fig. 5. Bigeye tuna CPUE trends of Dakar-based baitboats, 1969-93.



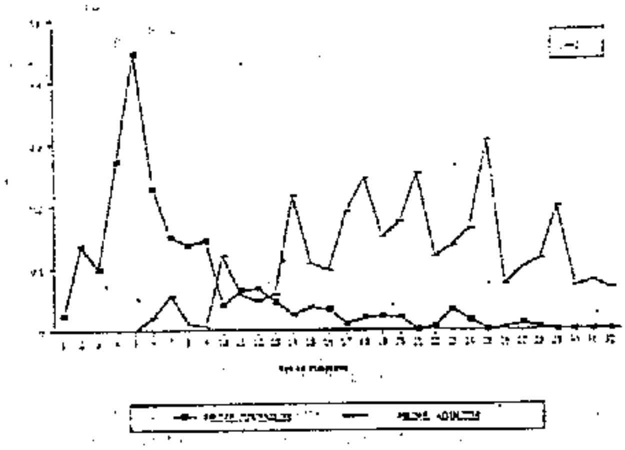
BET-Fig. 6. Bigeye tuna CPUE trends of FIS purse seiners, 1969-93.



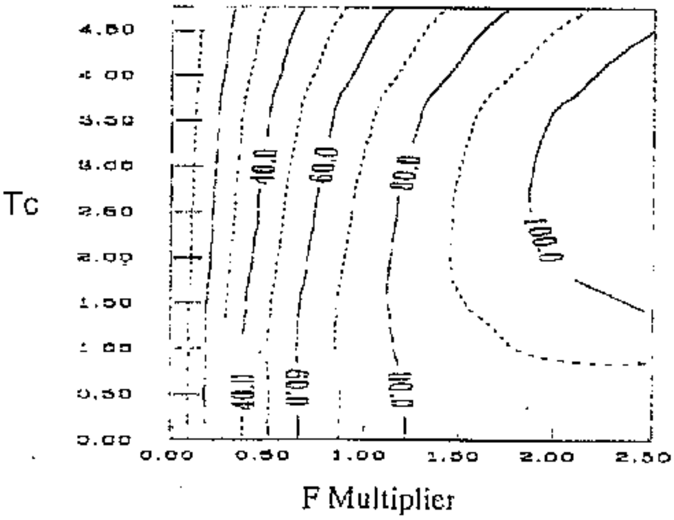
BET-Fig. 7. Standardized CPUE (GLM) from the Japanese longline fishery, total fishing effort (in million hooks) and total catches (1000 MT) of Atlantic bigeye tuna.



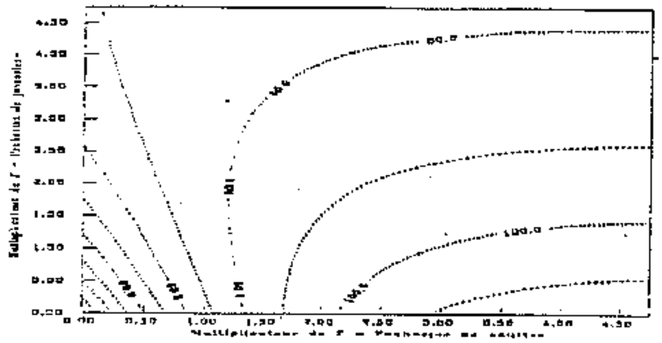
BET-Fig. 8. Non-equilibrium production model of bigeye tuna in the eastern Atlantic. Fit of two models: Model 1 assumes that catchability is constant for the entire period. Model 2 assumes that catchability is constant within each of two periods, 1961-1984 and 1985-1990 Each model fits the data reasonably well, with Model 2 fitting better.



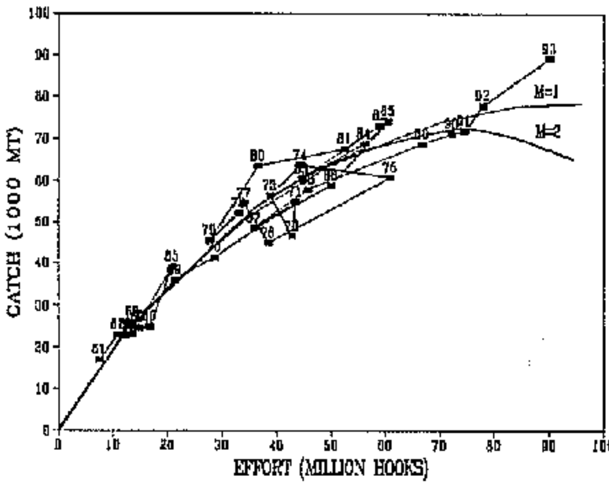
BET-Fig. 9. Fishing mortality (F), by quarterly age, of the fisheries for small and large bigeye, calculated for 1992, using cohort analysis and used for multi-gear yield per recruit in the analysis.



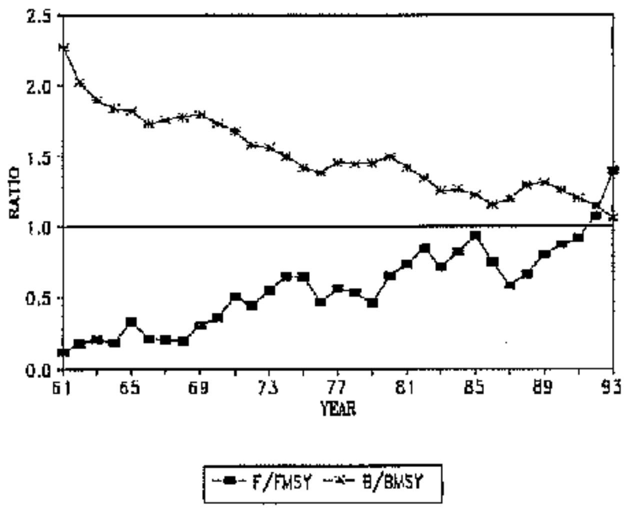
BET-Fig. 10. Yield-per-recruit curves calculated for the bigeye stock for 1992.



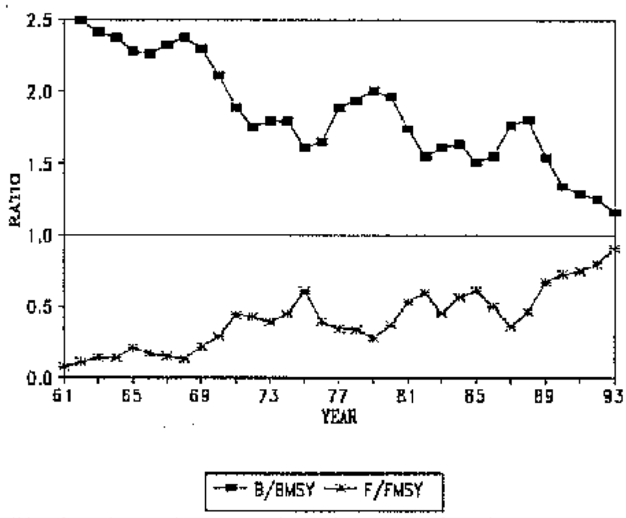
BET-Fig. 11. Overall multi-gear yield-per-recruit curves of the juvenile and adult bigeye fisheries for 1992, with a recruitment vector of 35 million fish.



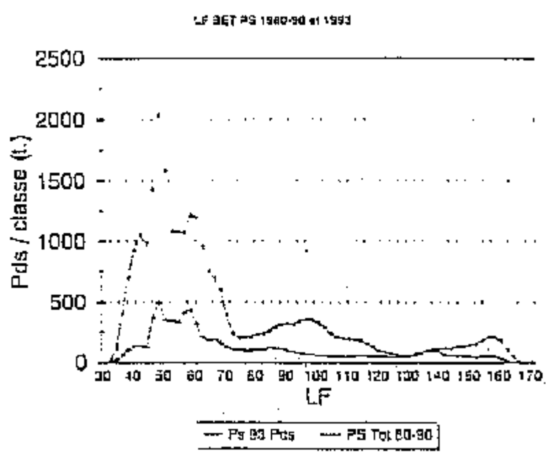
BET-Fig. 12. Yield curves from production model analysis (PRODFIT) for Atlantic bigeye tuna (m=1 and 2, k=4).



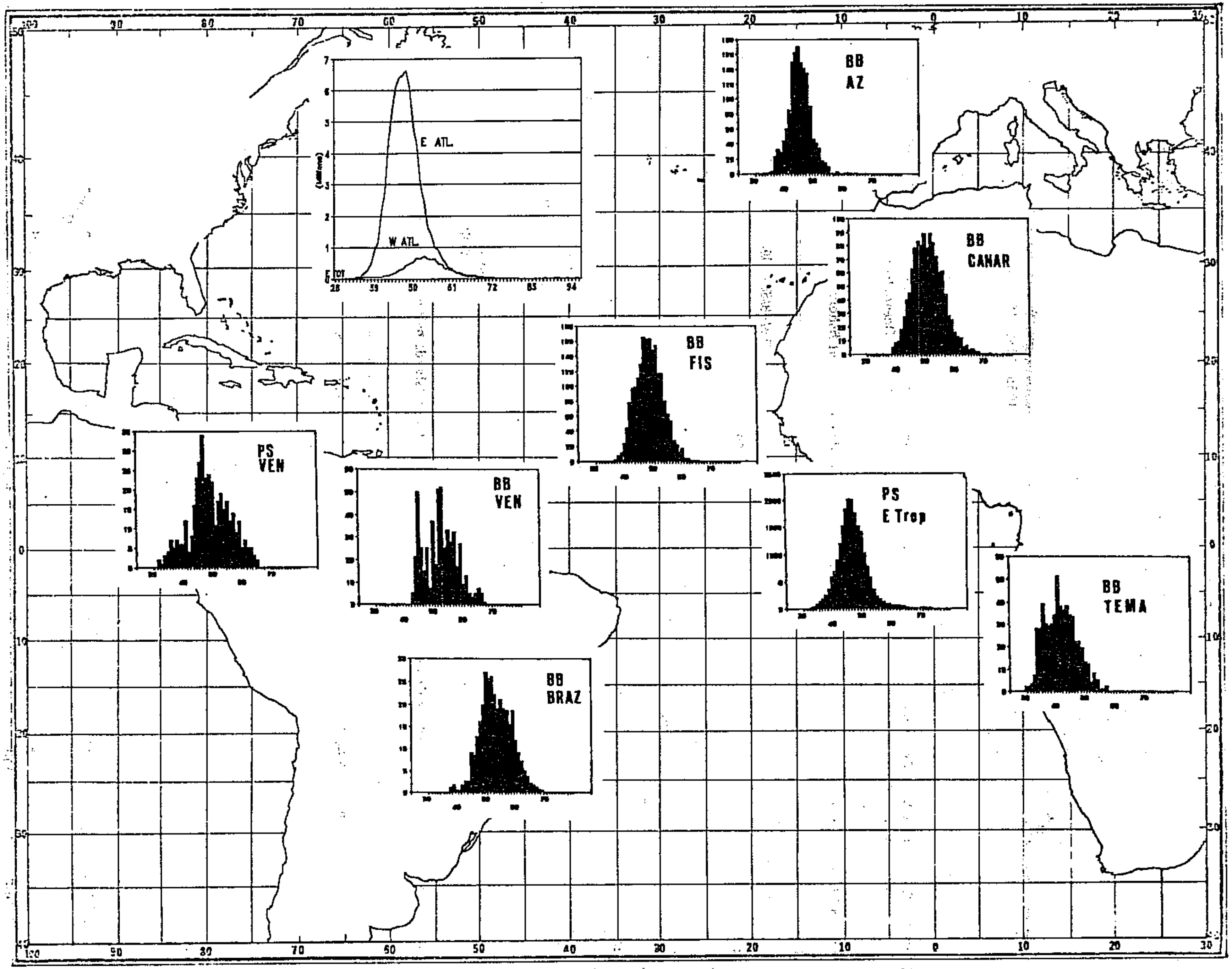
BET-Fig. 13. Estimated trajectories of relative biomass and relative fishing mortality resulted from a non-equilibrium production model (ASPIC) of bigeye under the total Atlantic hypothesis, based on a 1961-93 time series.



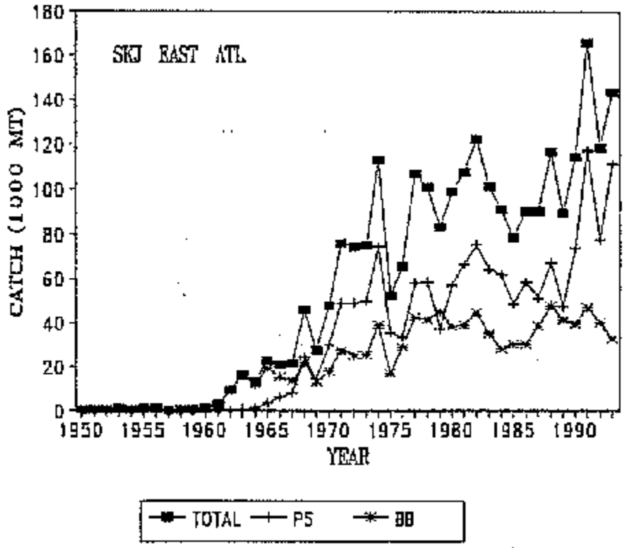
BET-Fig. 14. Estimated trajectories of relative biomass and relative fishing mortality resulted from a non-equilibrium production model (IFOX) of bigeye tuna under the total Atlantic hypothesis, based on a 1961-93 time series.



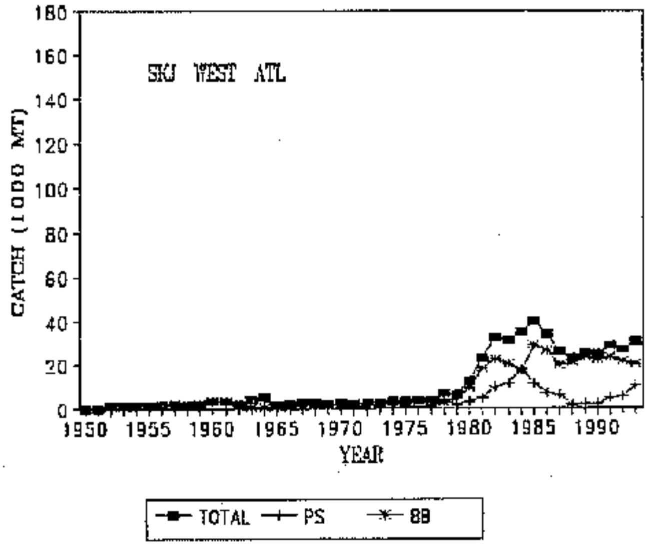
BET-Fig. 15. Bigeye catch (in weight) at size by tropical purse seiners in 1980-90 and 1993.



SKJ-Figure 1. **Size distribution of skipjack catches by the principal Atlantic fisheries.**

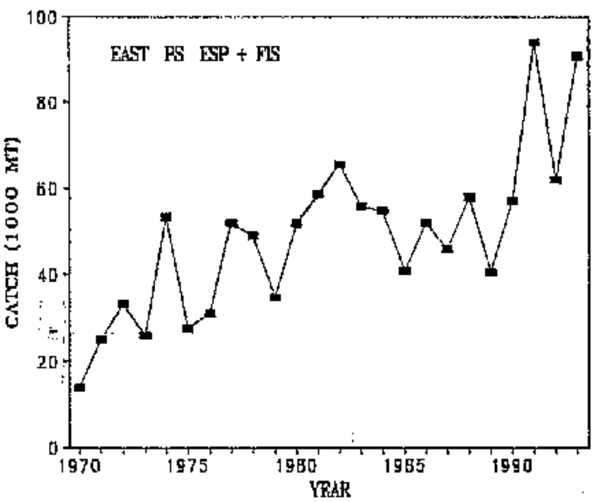


SKJ-Fig. 2. Reported landing of skipjack (in 1000 MT) in the east Atlantic Ocean, by gear.

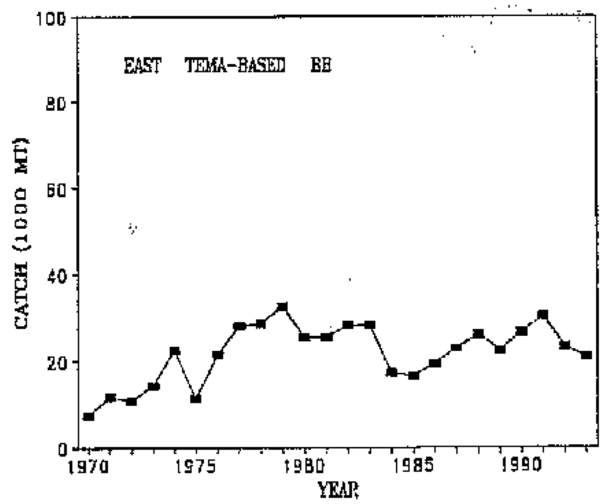


SKJ-Fig. 3. Reported landing of skipjack (in 1000 MT) in the west Atlantic Ocean, by gear.

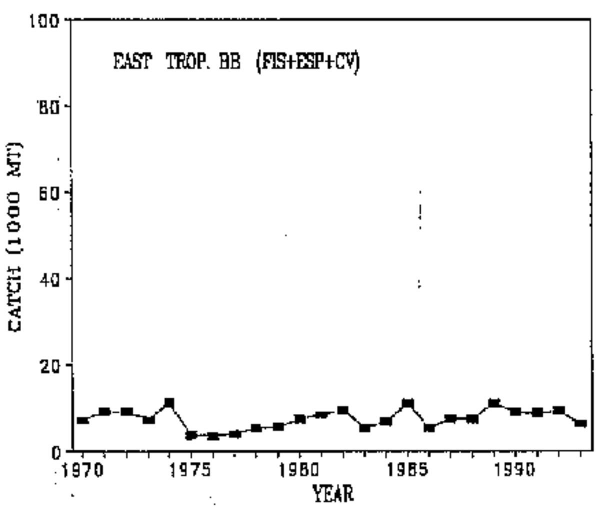
Spanish and FIS purse seine fishery.



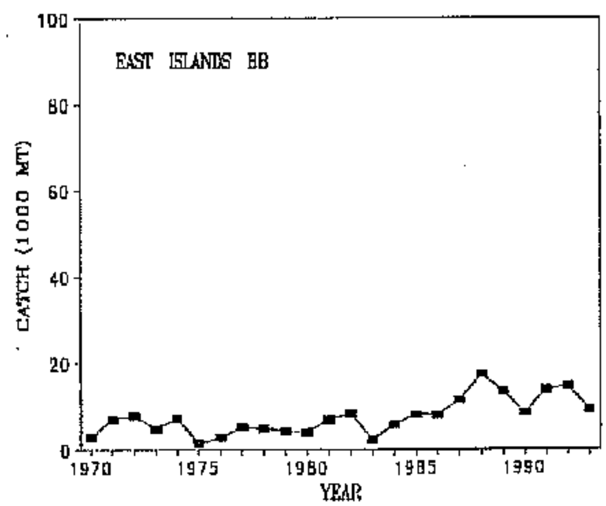
Tema-based baitboat fishery



Tropical (FIS, Spanish and Cape Verde) baitboat fisheries.

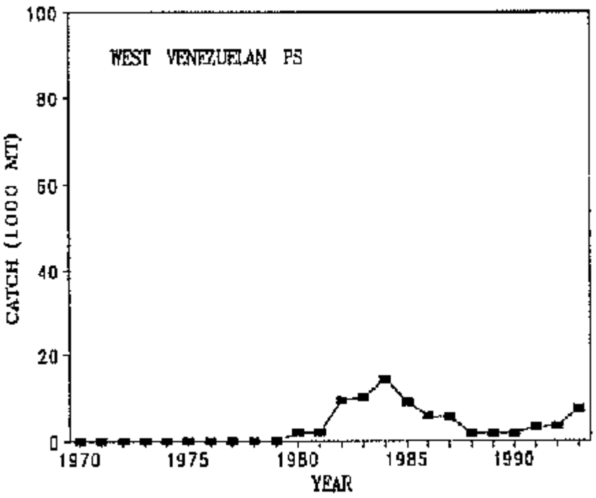


East Atlantic Islands baitboat fisheries

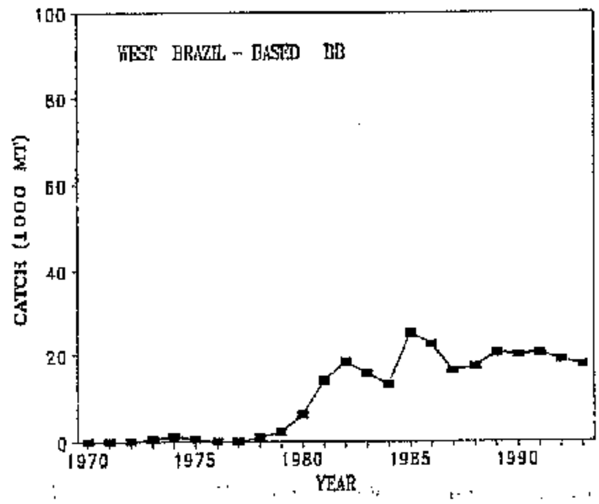


SKJ-Fig. 4. Reported annual landing (in 1000 MT) of skipjack by the principal fisheries in the east Atlantic.

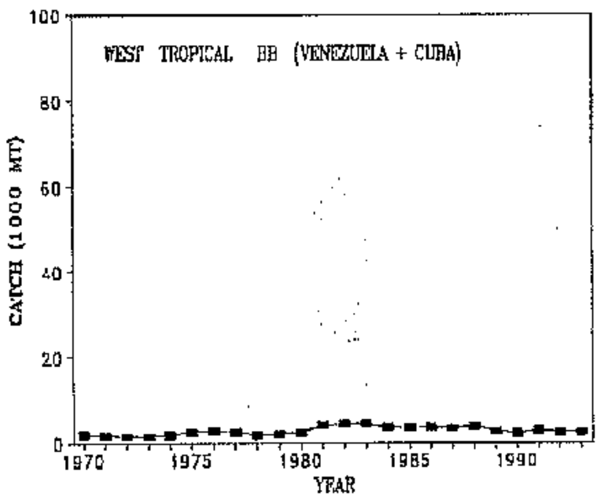
Venezuelan purse seine fishery



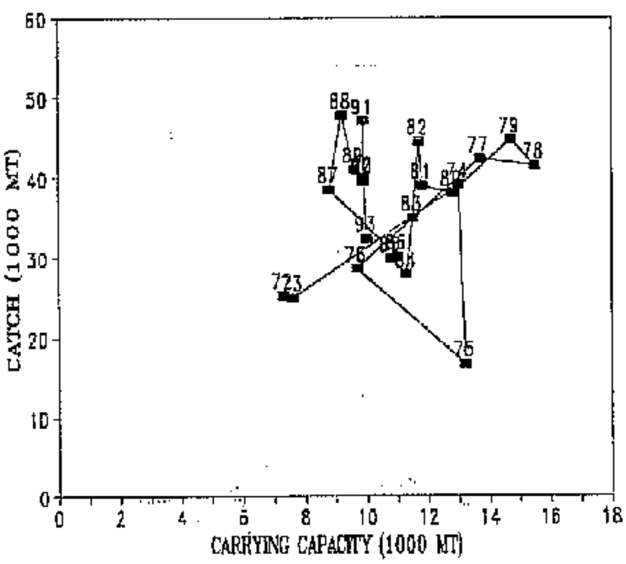
Brazil-based baitboat fishery



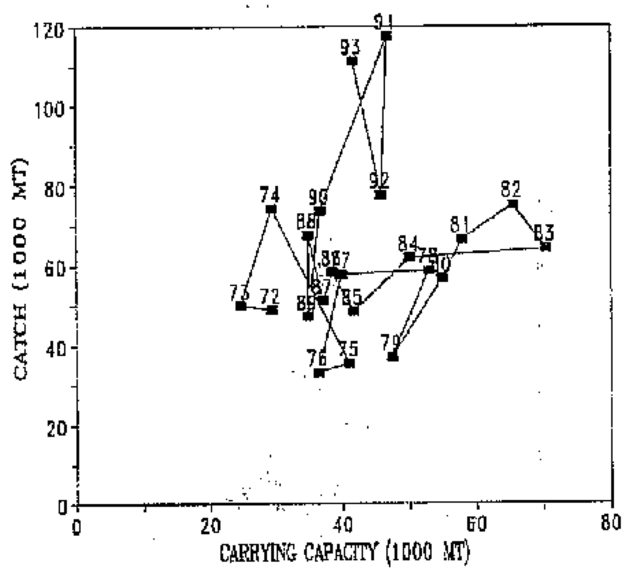
Venezuelan and Cuban baitboat fisheries



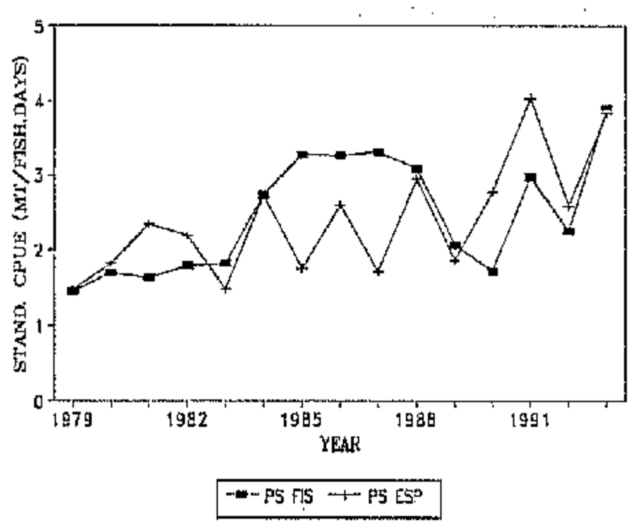
SKJ-Fig. 5. Reported annual landings (in 1000 MT) of skipjack by the principal fisheries in the west Atlantic.



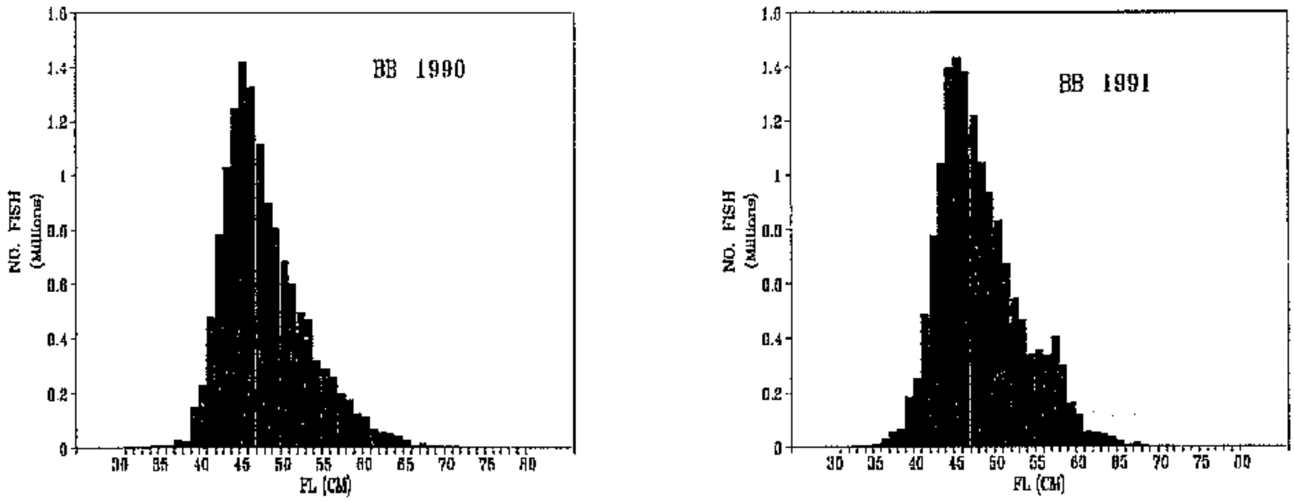
SKJ-Fig. 6. Skipjack catches vs. carrying capacity of the east Atlantic baitboat fleet.



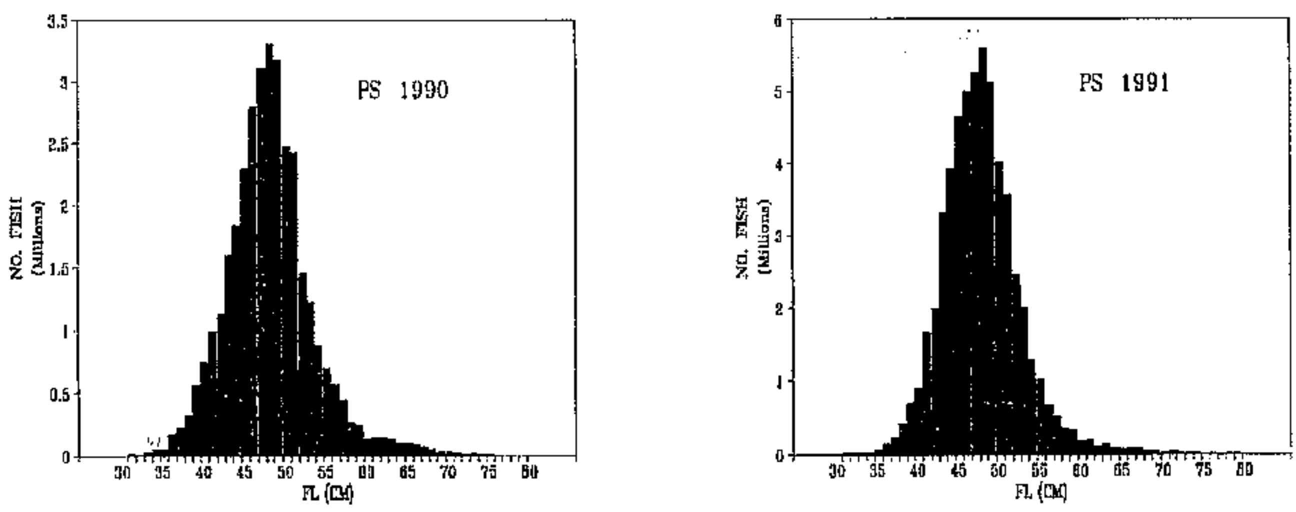
SKJ-Fig. 7. Skipjack catches vs carrying capacity of the east Atlantic purse seine fleet.



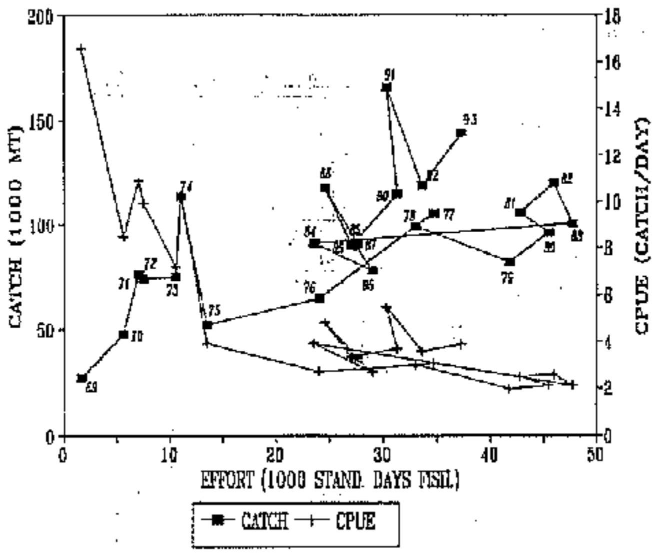
SKJ-Fig. 8. Annual skipjack CPUE (MT/ days fishing) of the FIS and Spanish purse seine fleets in the east Atlantic, 1980-1993.



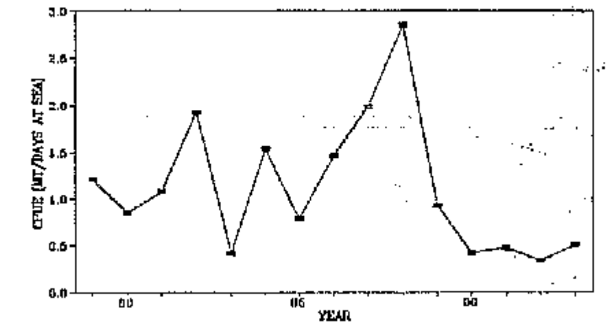
SKJ-Fig. 9. Size distributions of skipjack (1990-1991) caught by baitboat fisheries.



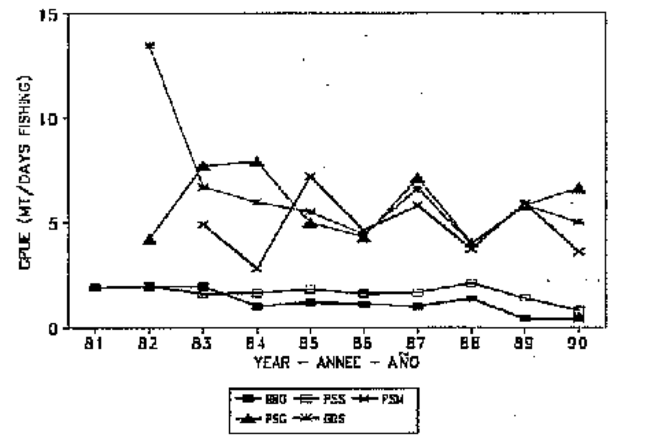
SKJ-Fig. 10. Size distributions of skipjack (1990-1991) caught by purse seine fisheries.



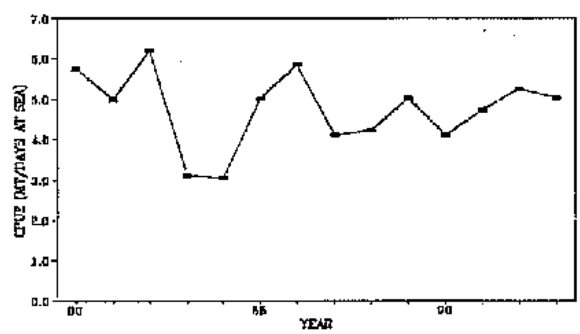
SKJ-Fig. 11. Catches and CPUE vs effort for the east Atlantic (Total effort estimated from purse seine effort extrapolated to the total catch. For the 1969-1979 period, effort has been estimated from Spanish purse seine carrying capacity by 0.34 (average conversion factor calculated as the relation of effective effort/carrying capacity). During the 1980-1993 period, effort is calculated in days fishing of FIS large purse seiners (400 MT), from FIS and Spanish purse seine effort).



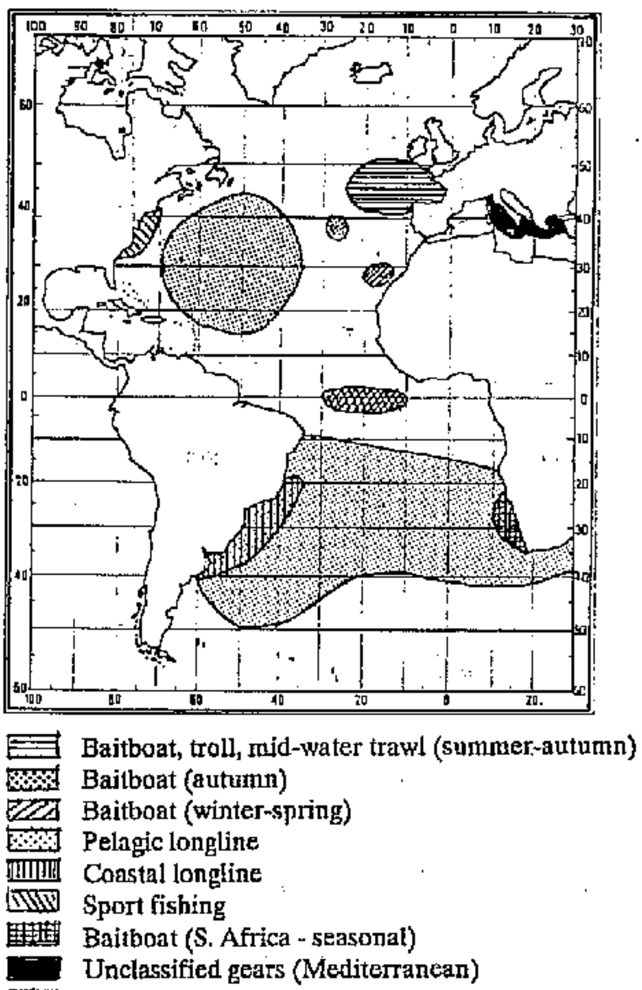
SKJ-Fig. 12. CPUE trends of skipjack by Azorian baitboats (third quarter), from 1979 to 1993.



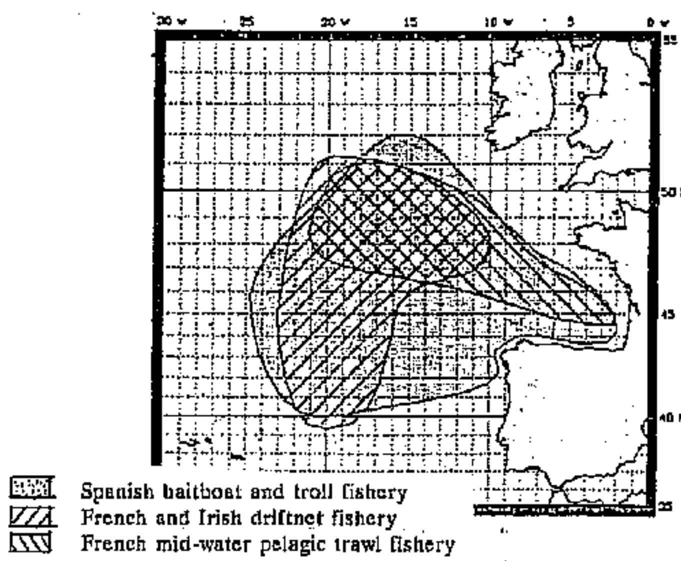
SKJ-Fig. 13. Skipjack CPUE for the different Venezuelan fleets, 1981-1990.



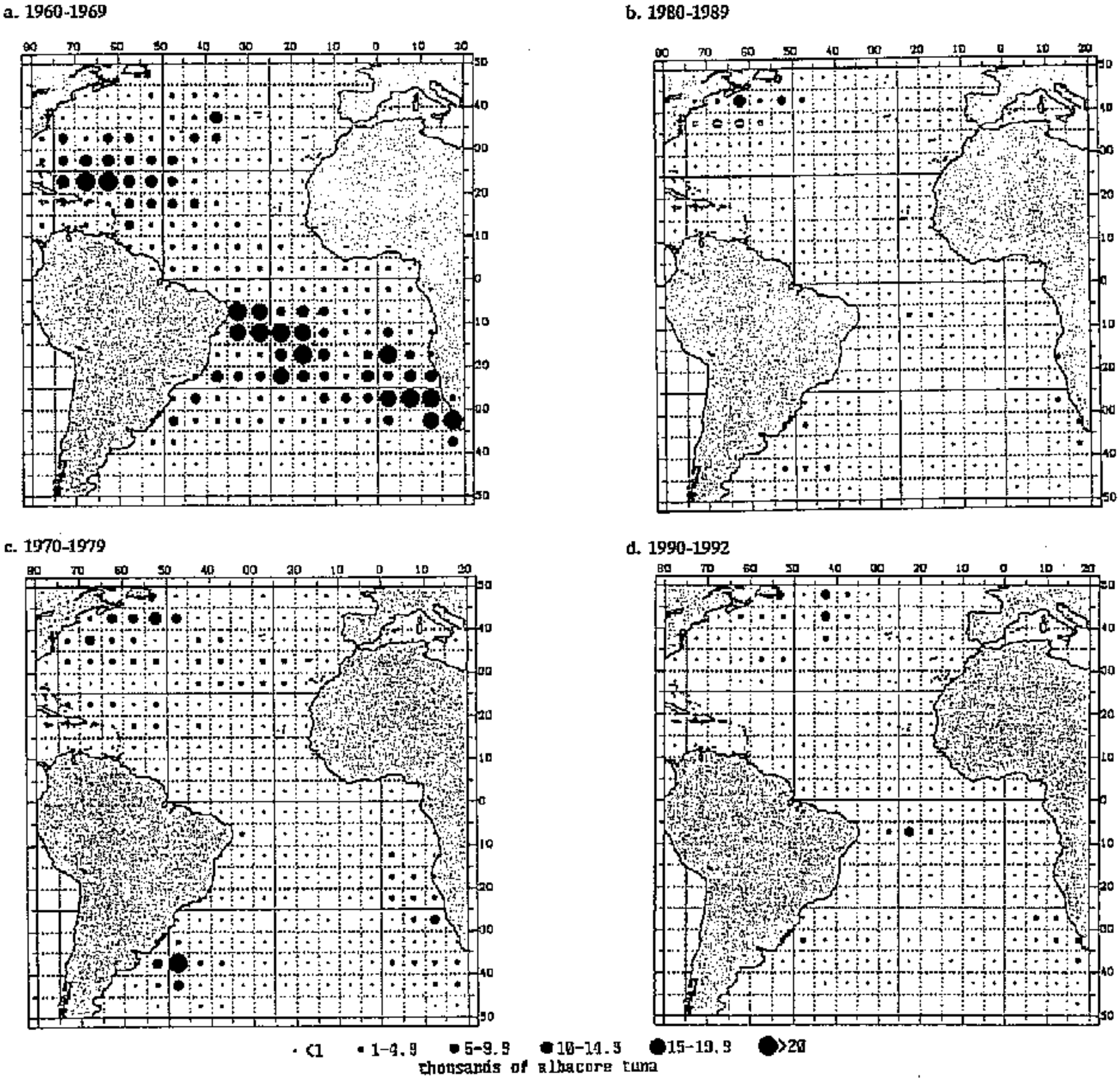
SKJ-Fig. 14. Changes in CPUE (in MT/days fishing) in the Brazilian baitboat fishery, 1980-1993.



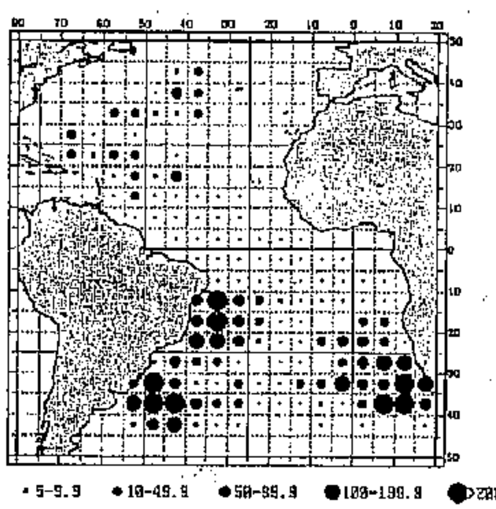
ALB-Fig. 1. General albacore fishing grounds in the Atlantic and Mediterranean, by gears (Source SCRS/94/16).



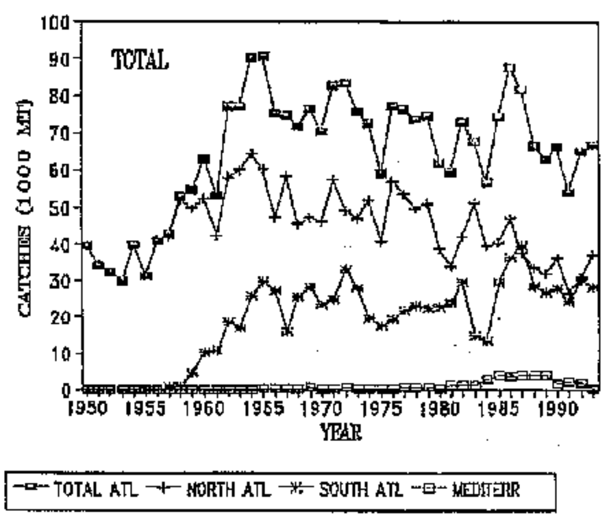
ALB-Fig. 2. Summer surface fishing grounds in the Bay of Biscay and its adjacent waters, by type of surface fishery (Source: SCRS/94/16)



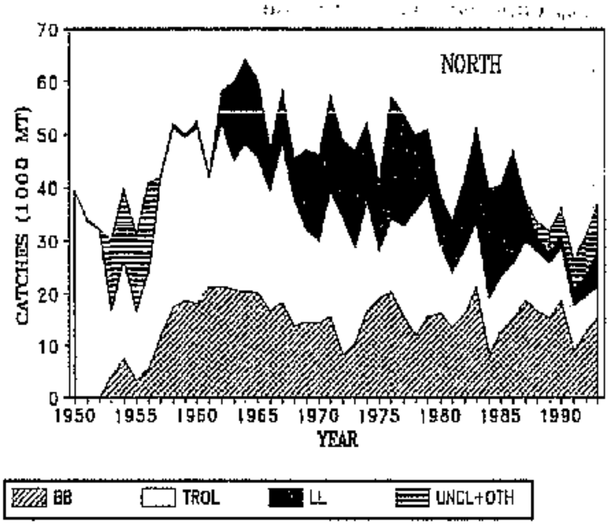
ALB-Fig. 3. Distribution of mean albacore catches (in 1000 fish per year) by the Japanese longline fishery (Source: SCRS/94/16).



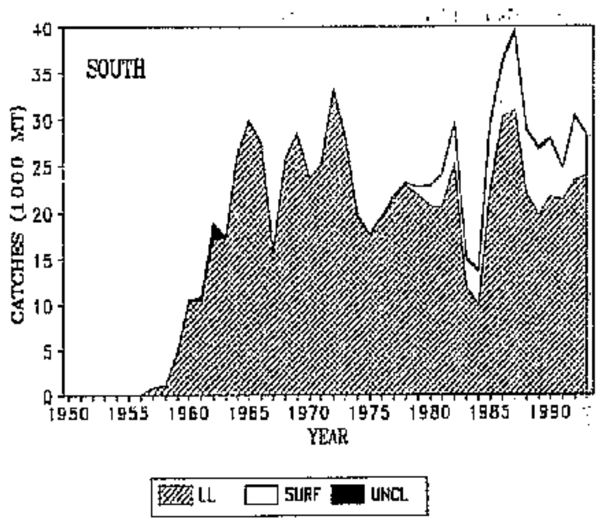
ALB-Fig. 4. Distribution of mean albacore catches (in 1000 fish per year) by the Taiwanese longline fishery (Source: SCRS/94/16)



ALB-Fig. 5. Annual landings, by regions, 1950-1993 (Source: Task I data base - Secretariat).



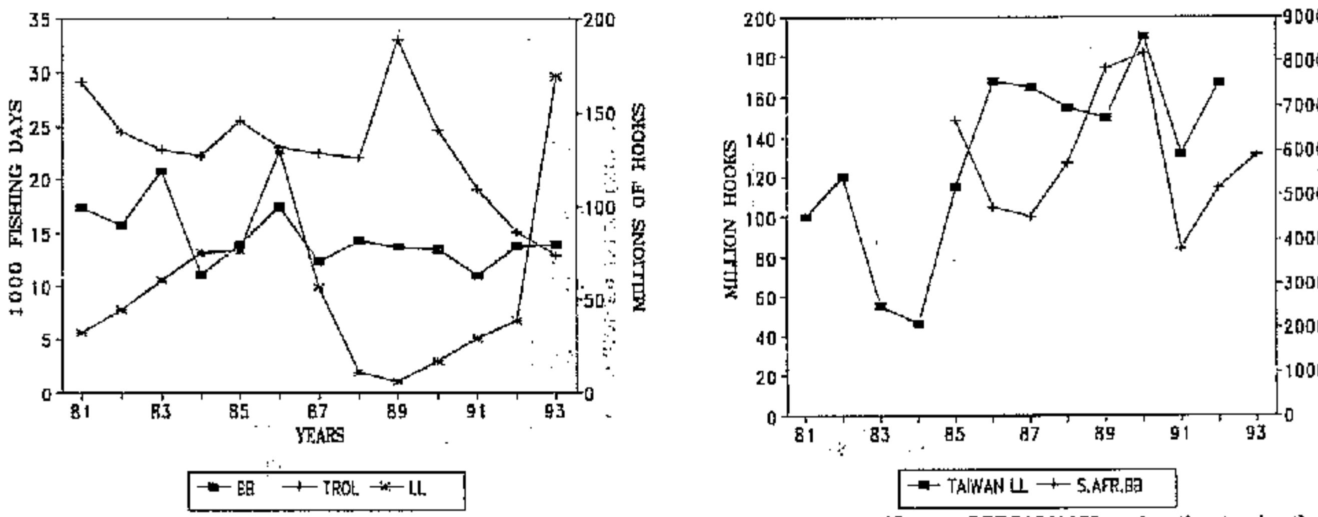
ALB-Fig. 6. Annual catches, 1950-1993, by gear for the north Atlantic (Source: Task I data base - Secretariat).



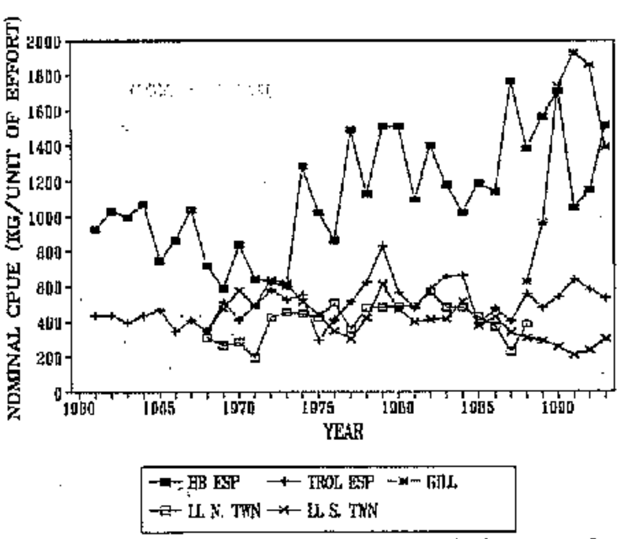
ALB-Fig. 7. Annual catches, 1950-1993, by gear for the south Atlantic (Source: Task I data base - Secretariat).

a. North Atlantic

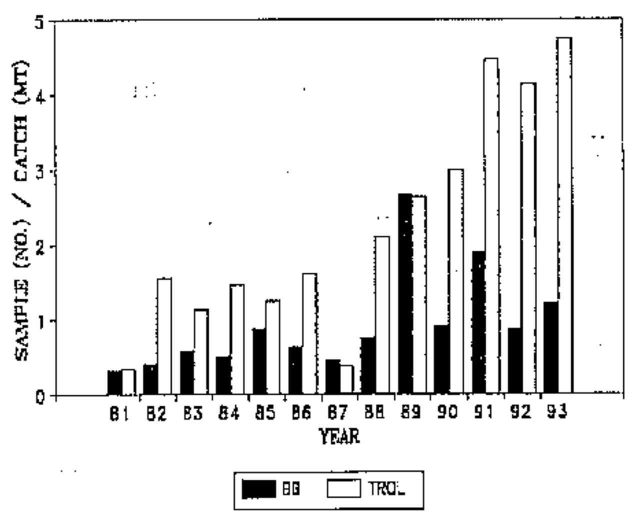
b. South Atlantic



ALB-Fig. 8. Indices of effective effort for the main gears targeting Atlantic albacore (Source SCRS/94/173 and estimates by the scientists present at the meeting of the Committee).

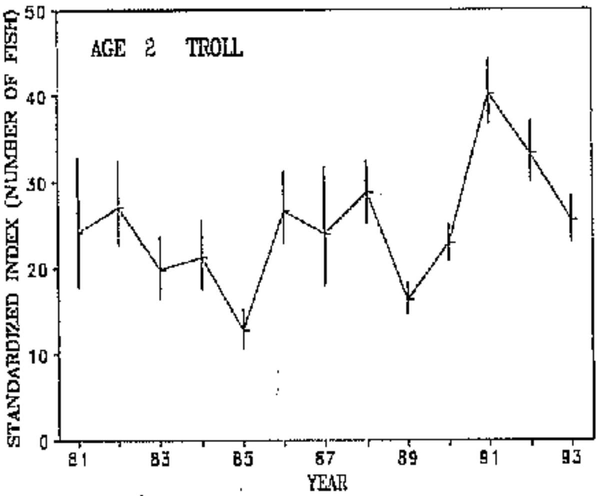


ALB-Fig. 9. Nominal catch rates of main fishing gears for the north and south Atlantic (Source: SCRS/94/35).

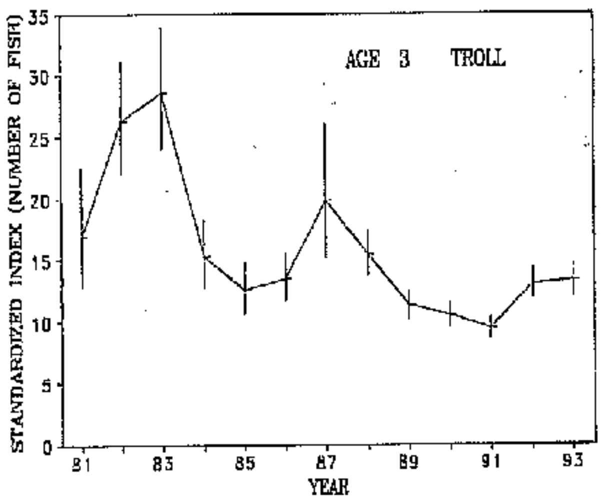


ALB-Fig. 10. Size sampling coverage expressed in number of fish measured per metric ton, for Spanish baitboats and trollers, 1981-93 (Source: SCRS/94/16).

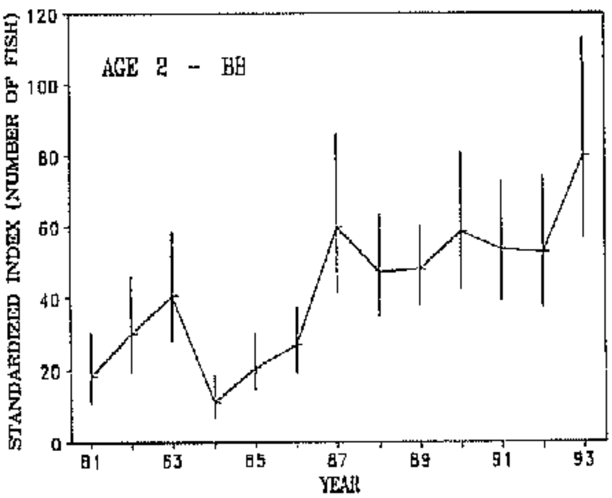
a. Age 2 fish CPUE by Spanish troll



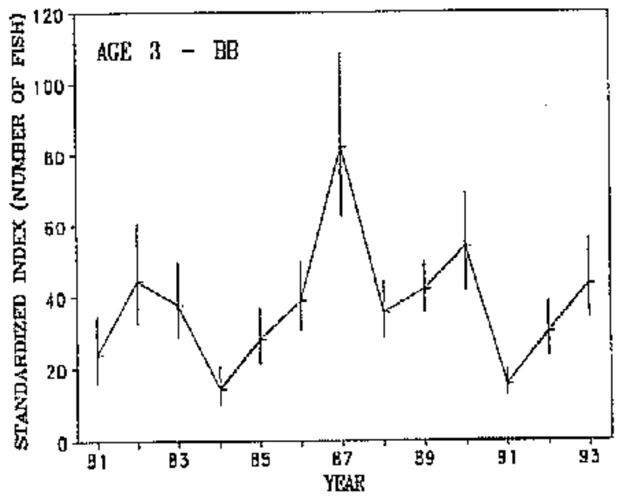
b. Age 3 fish CPUE by Spanish troll



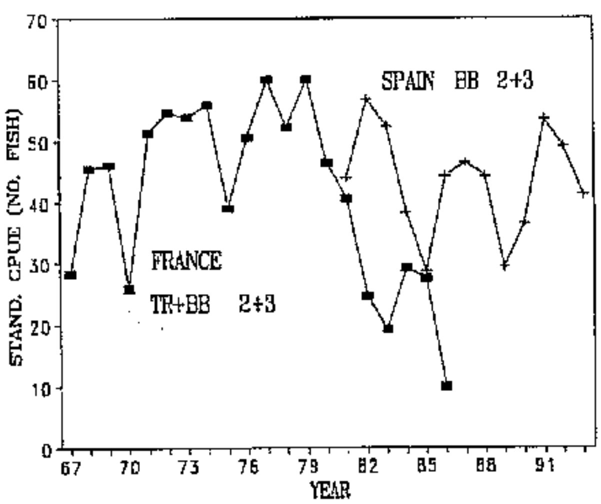
c. Age 2 fish CPUE by Spanish baitboats



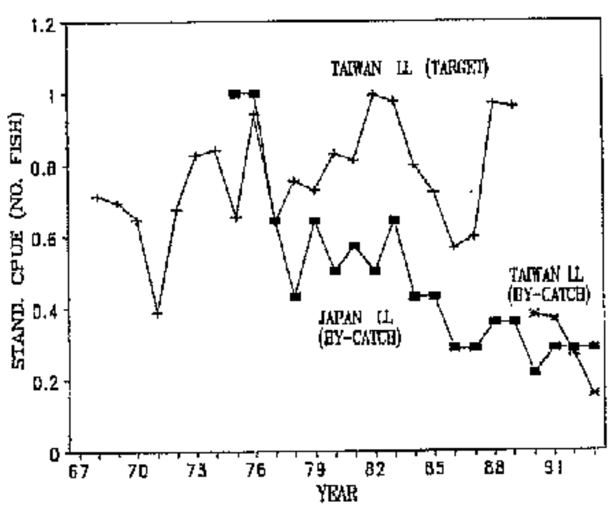
d. Age 3 fish CPUE by Spanish baitboat



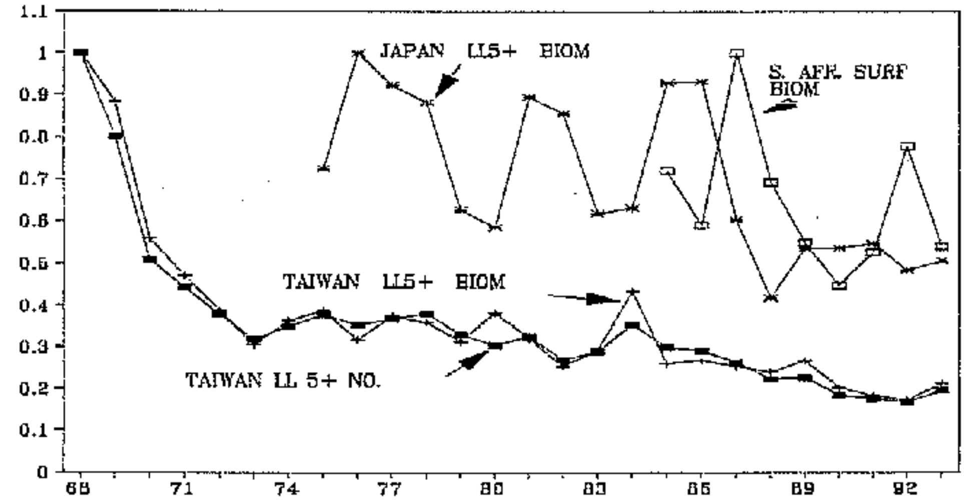
e. Age 2+3 fish CPUE by Spanish troll and French troll & baitboats



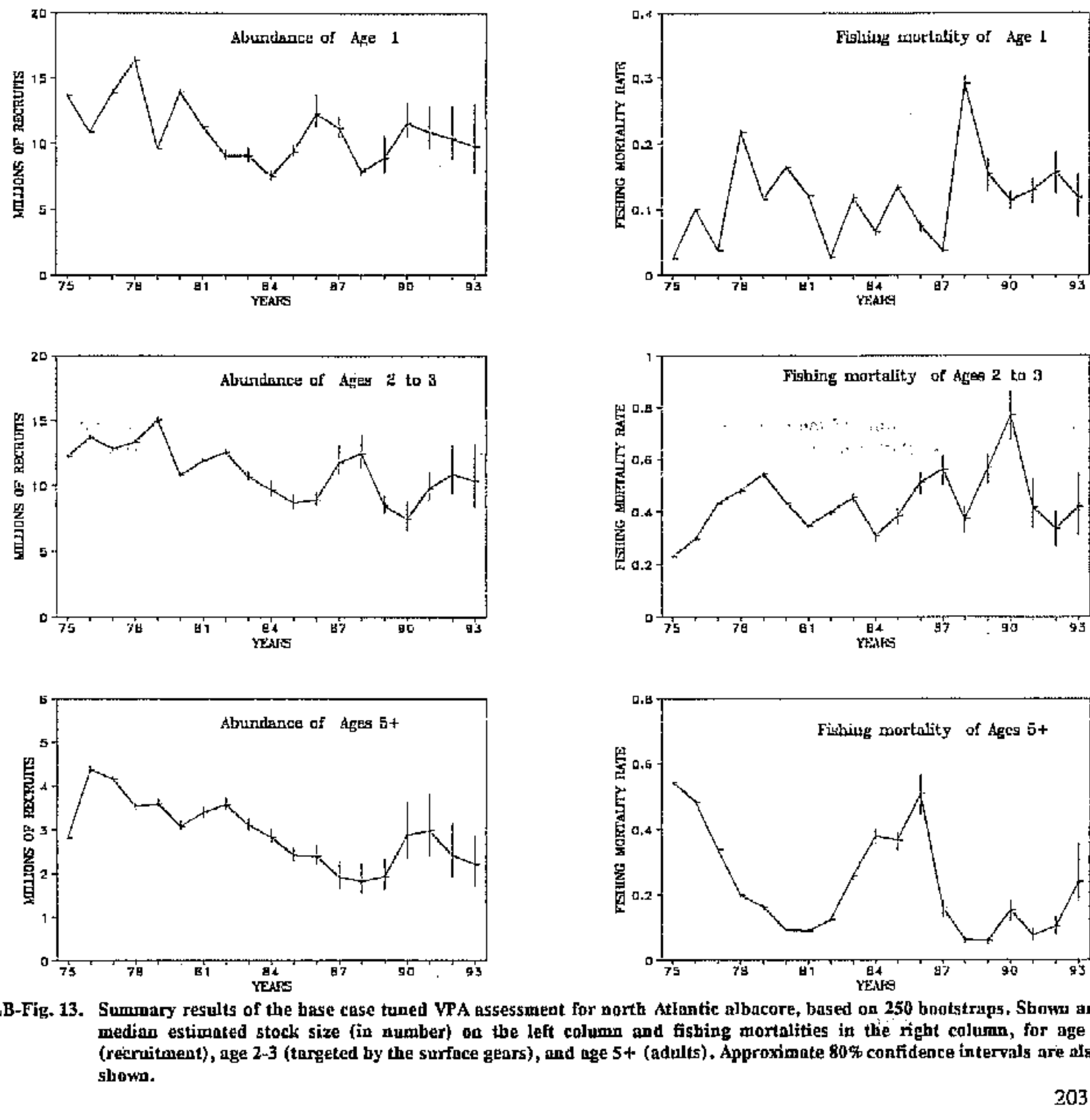
f. Japanese and Taiwanese longline CPUE



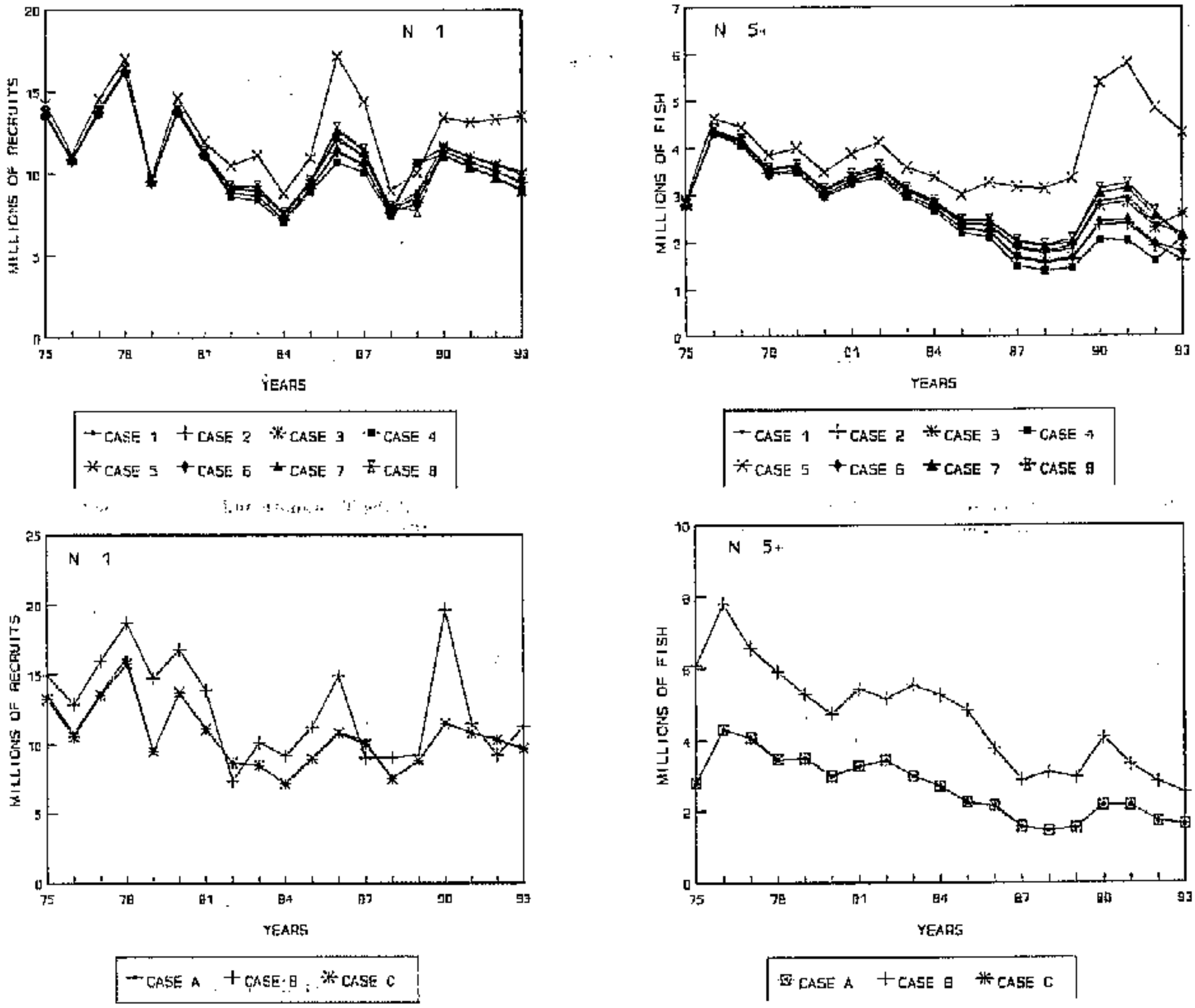
ALB-Fig. 11. Standardized catch rates of the Spanish troll and baitboat fleets (ages 2 and 3); Spanish troll fleet and French troll+baitboat fleets (ages 2+3 combined); and Japanese and Taiwanese longline fleet, north Atlantic (Source: SCRS/94/30).



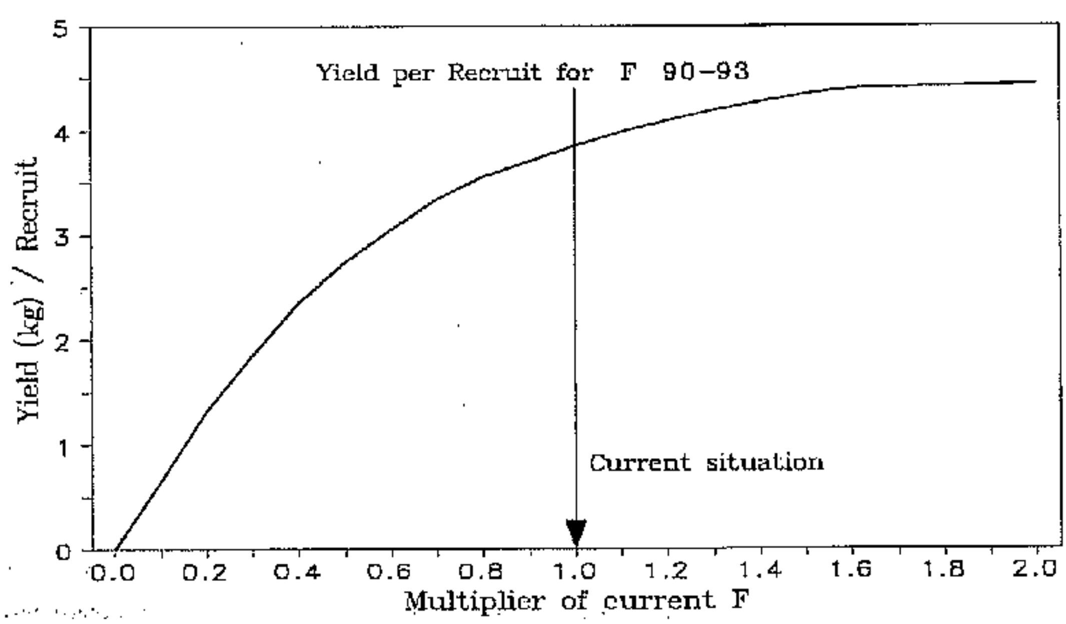
ALB-Fig. 12. South Atlantic standardized catch rates (in number of fish or biomass) of the Taiwanese and Japanese longline fisheries and the South African surface fishery (Source: SCRS, SCRS/94/32 & 154).



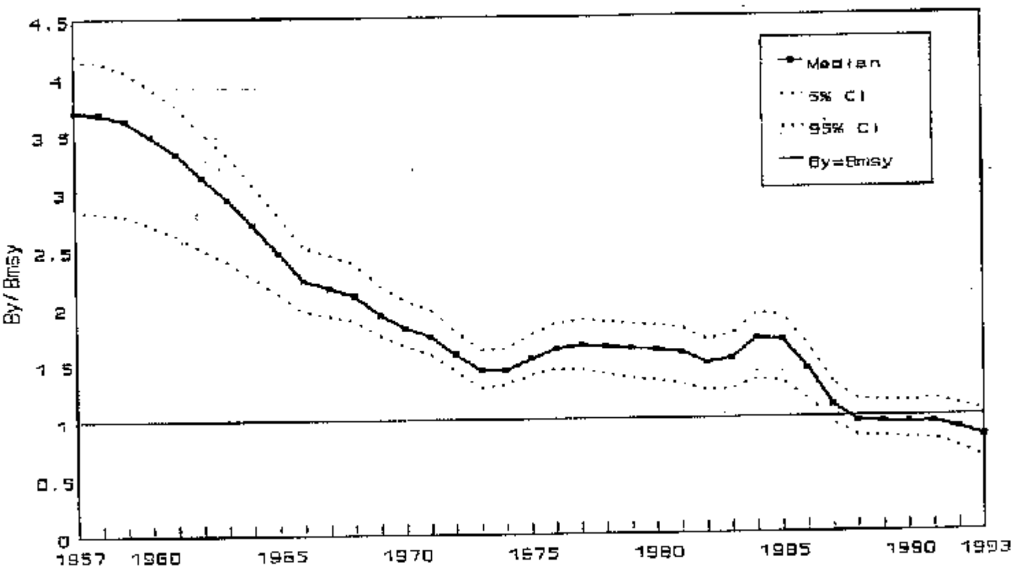
ALB-Fig. 13. Summary results of the base case tuned VPA assessment for north Atlantic albacore, based on 250 bootstraps. Shown are median estimated stock size (in number) on the left column and fishing mortalities in the right column, for age 1 (recruitment), age 2-3 (targeted by the surface gears), and age 5+ (adults). Approximate 80% confidence intervals are also shown.



ALB-Fig. 14. Summary results of the sensitivity analysis conducted for north Atlantic albacore. For each case (see ALB-Table 7.) estimated stock size (in number) for recruits and adults are shown. For comparison, case 1 is the base case.

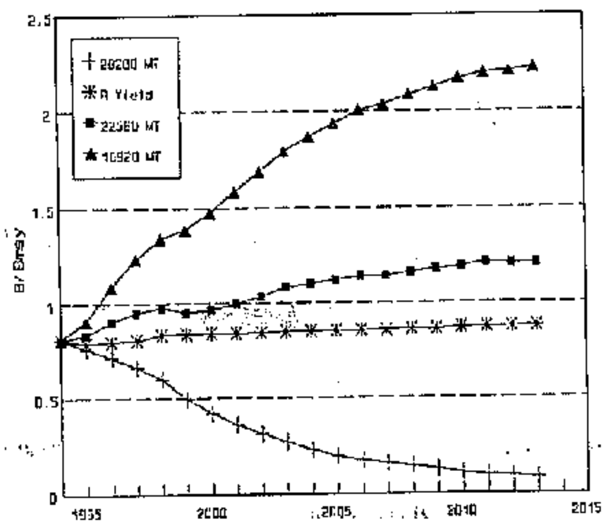


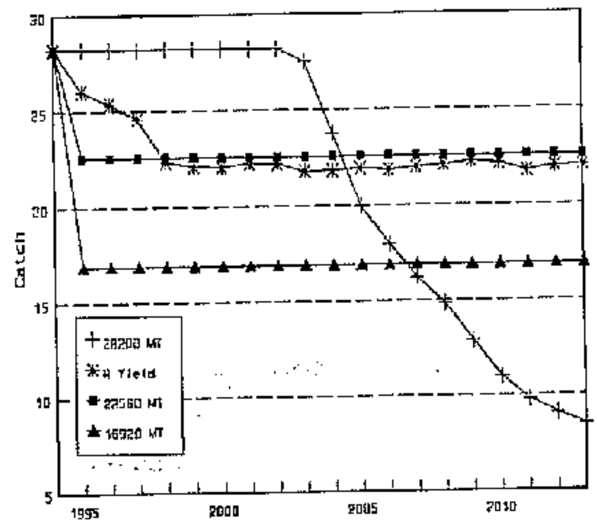
ALB-Fig. 15. Yield per recruit for north Atlantic albacore, computed from the best selection of fishing mortalities from tuned VPA.



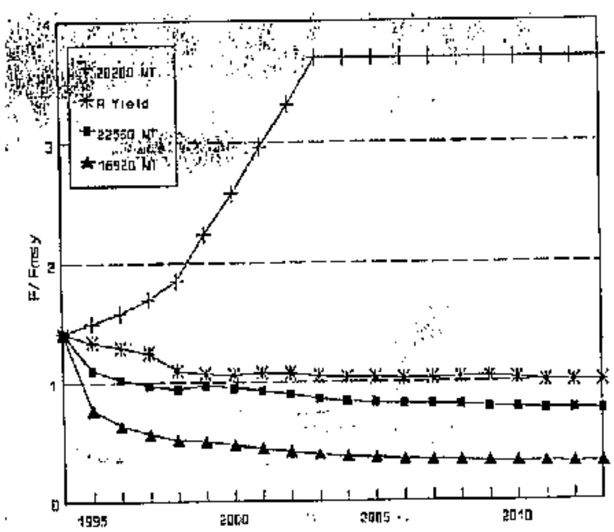
ALB-Fig. 16. Trajectory of B/Bmsy, 1957-1993, for south Atlantic albacore as estimated by the ASPM base case.

A) B/B_{msy}



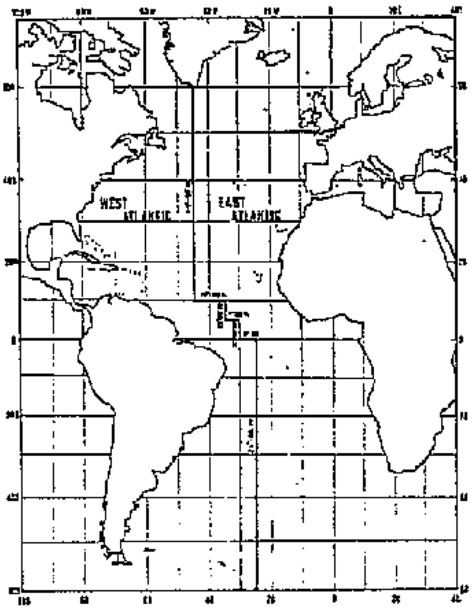


B) F/F_{msy}

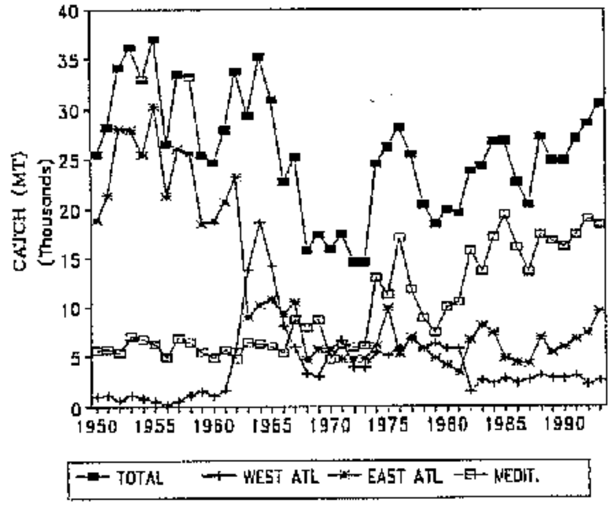


ALB-Fig. 17. Projected trajectories of B/B_{msy}, F/F_{msy} and catch of south Atlantic albacore under various catch strategies from 1994 to 2013.

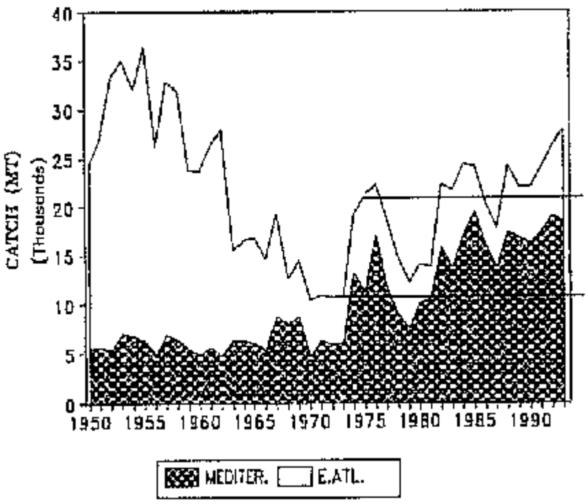
C) Catch



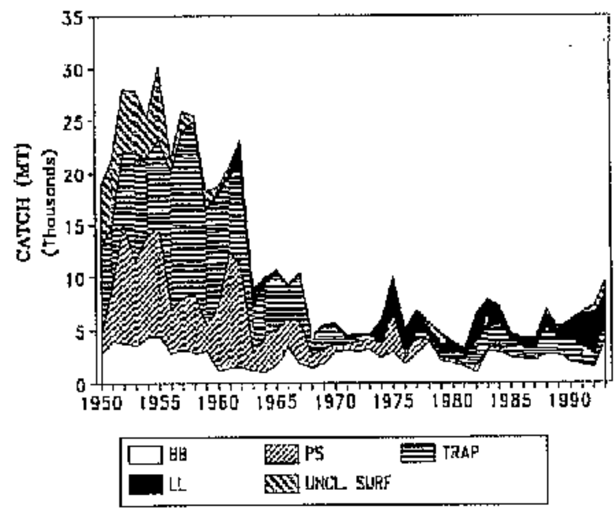
BFT-E-Fig. 1. Map of the Atlantic Ocean showing the line used to separate the eastern and western components of the Atlantic bluefin tuna stock.



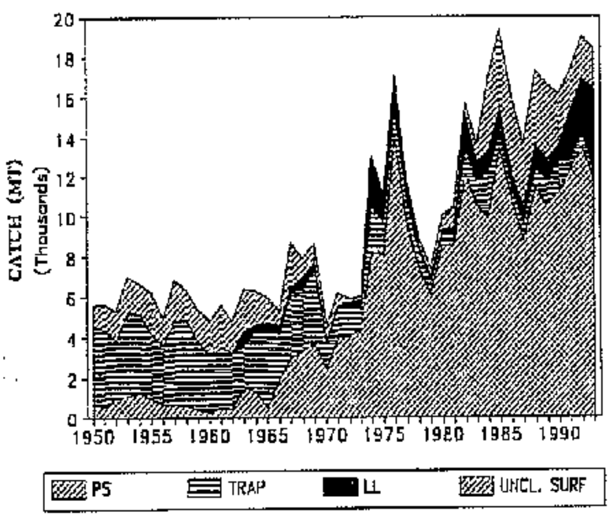
BFT-E-Fig. 2. Total Atlantic bluefin catches (MT) by regions.



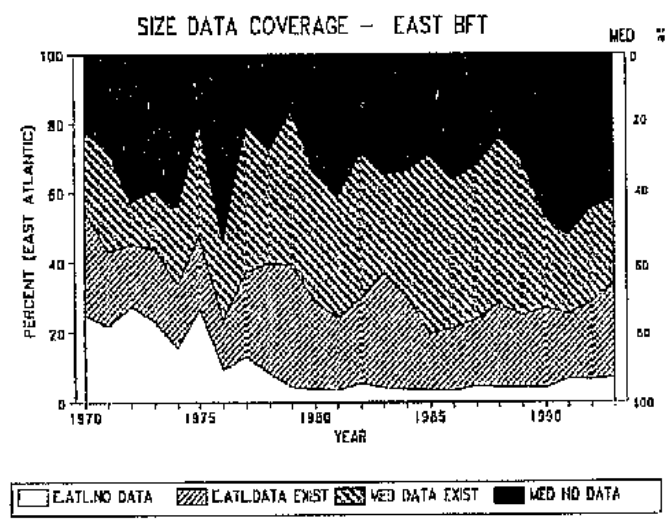
BFT-E-Fig. 3. Accumulative bluefin catches (1000 MT) from the east Atlantic and Mediterranean Sea. Horizontal lines represent maximum and minimum levels of catches during 1970-1975.



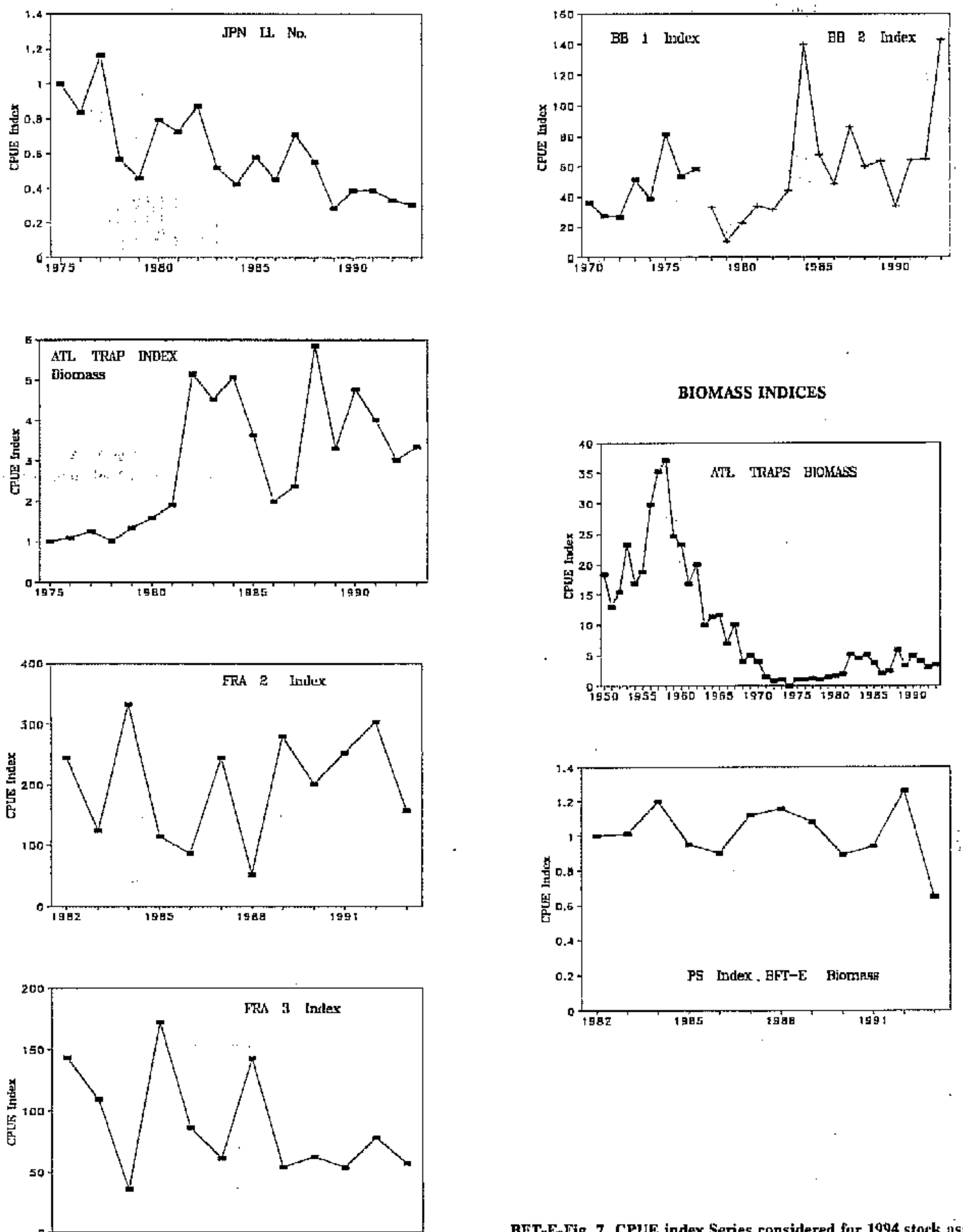
BFT-E-Fig. 4. Total accumulatvie bluefin catches (MT) by gears for the east Atlantic.



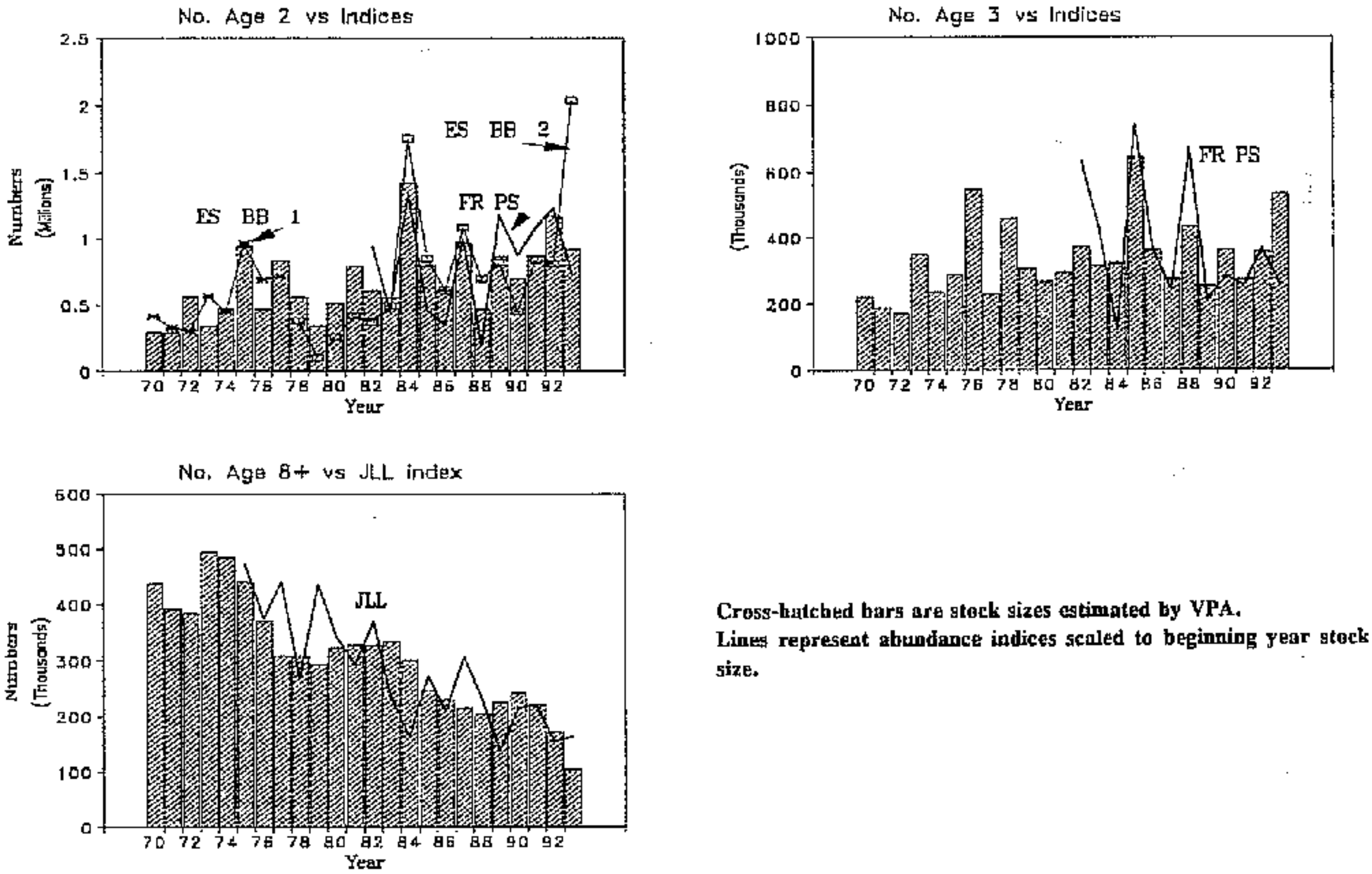
BFT-E-Fig. 5. Total accumulative bluefin catches (MT) by gears for the Mediterranean Sea.



BFT-E-Fig. 6. Proportion of bluefin landings in the east Atlantic and Mediterranean for which no size samples are available.

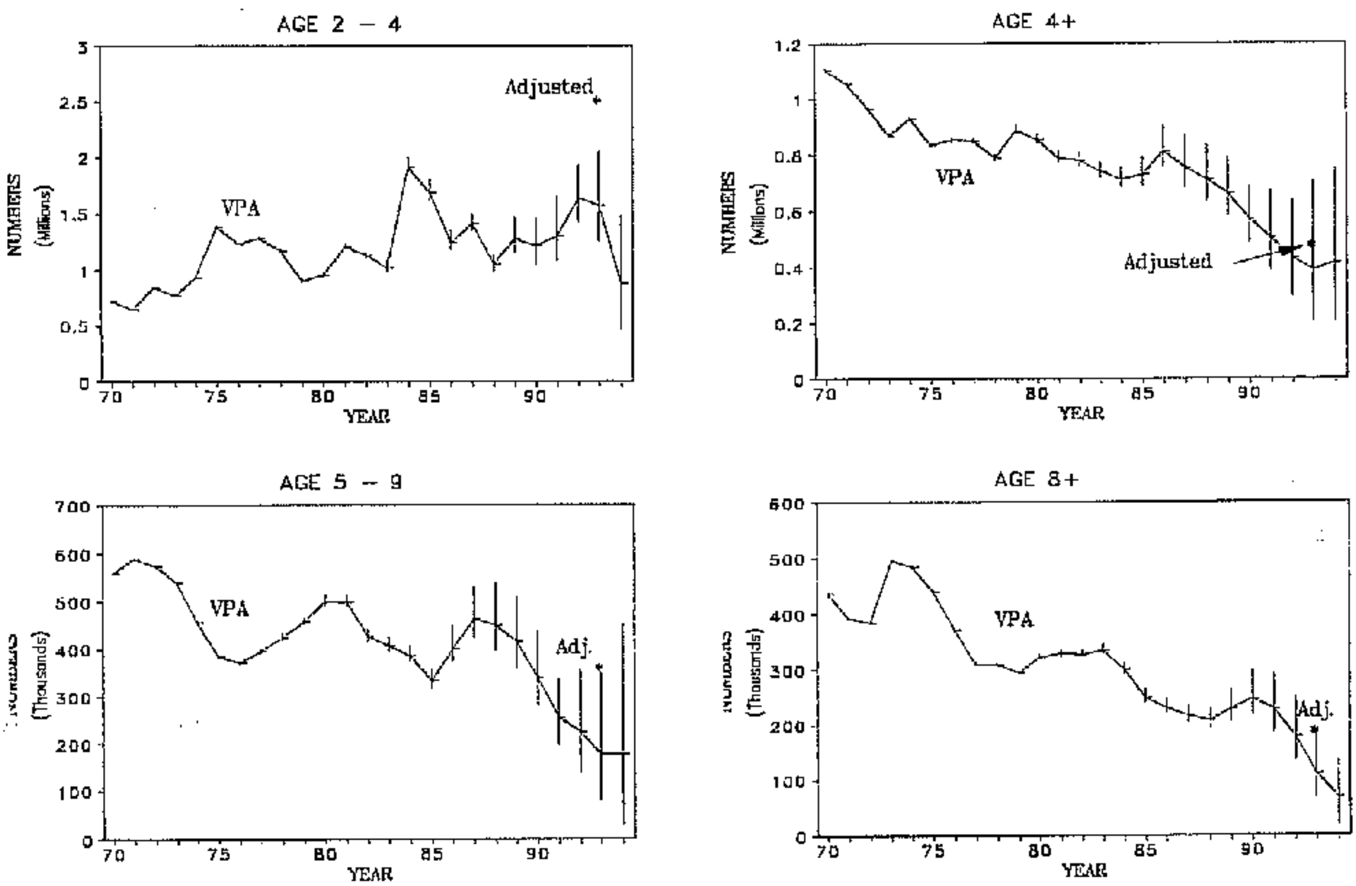


BFT-E-Fig. 7. CPUE index Series considered for 1994 stock assessments of east bluefin tuna.

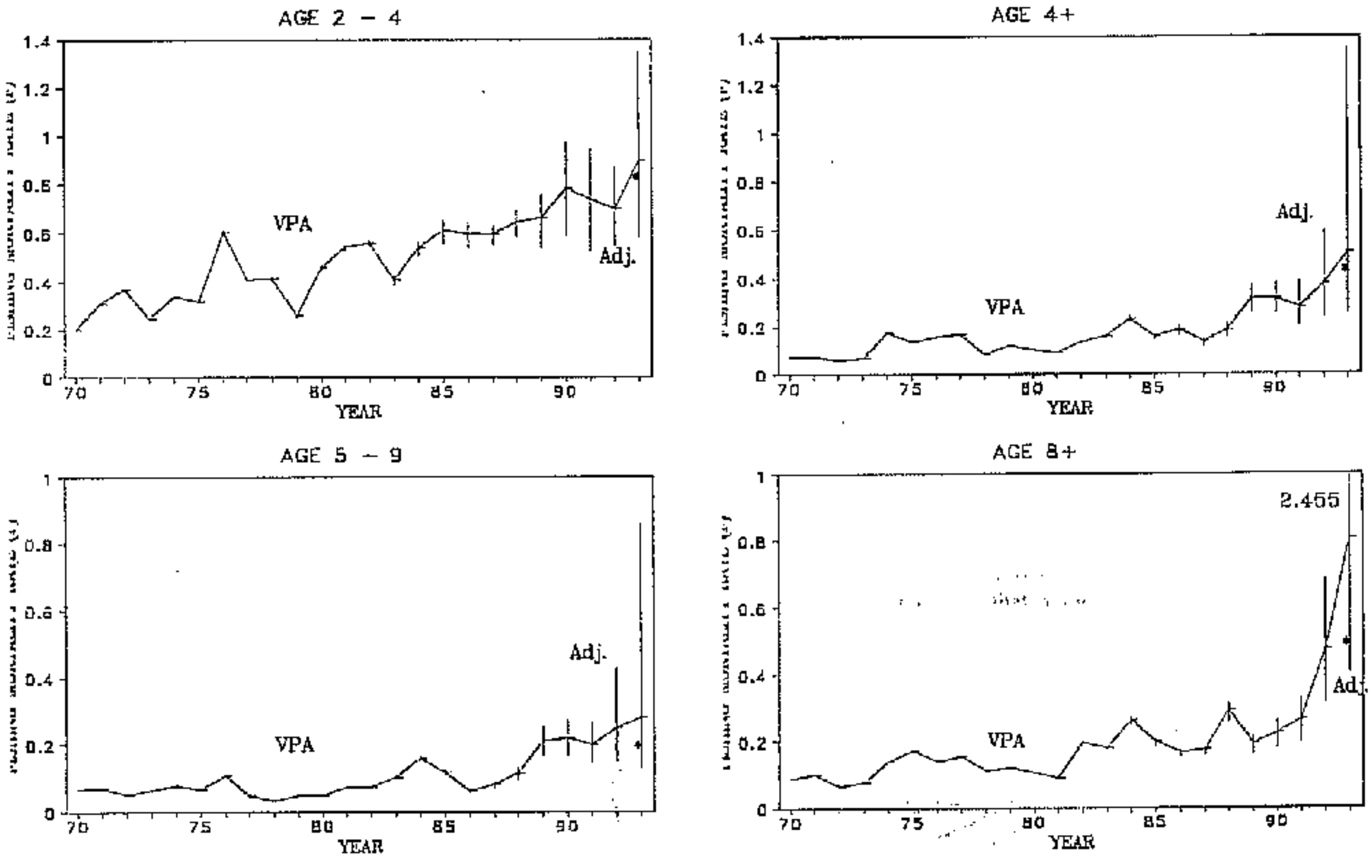


Cross-hatched bars are stock sizes estimated by VPA.
Lines represent abundance indices scaled to beginning year stock size.

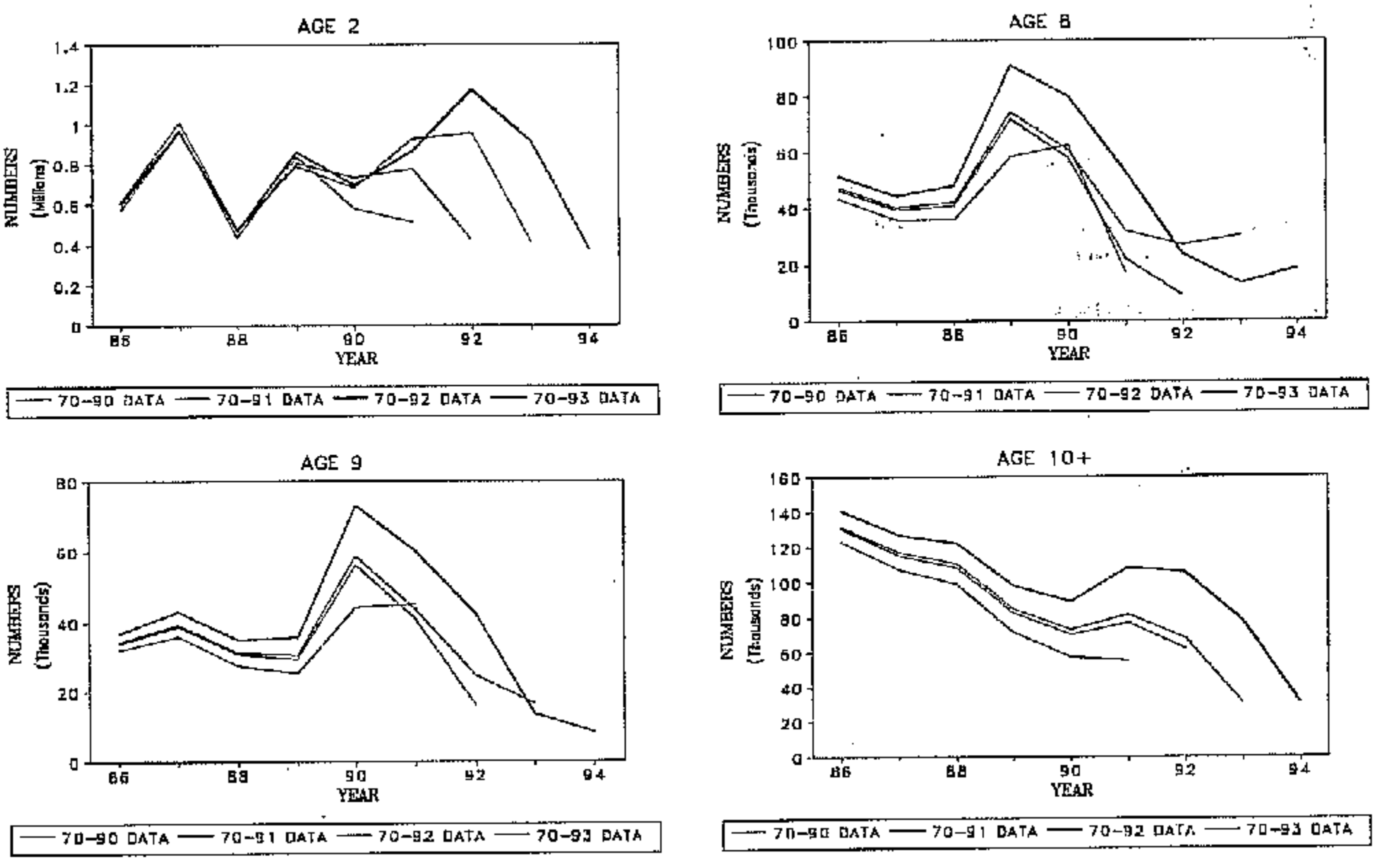
BFT-E-Fig. 8. CPUE series fit to stock size in the base case assessment of east bluefin stock by age group.



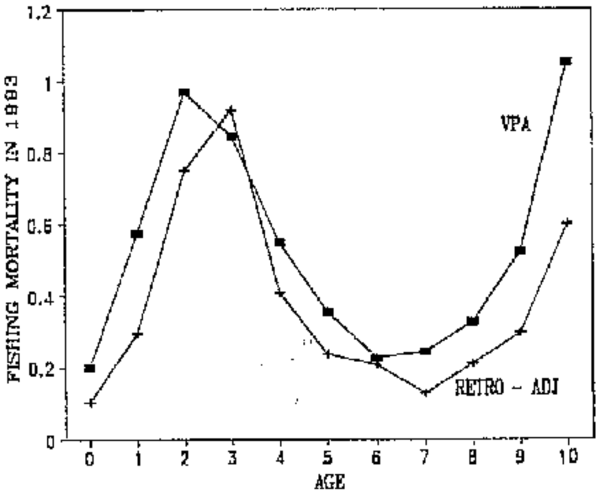
BFT-E-Fig. 9. East bluefin stock size (with 95% confidence intervals) estimated by age group from base-case assessment.



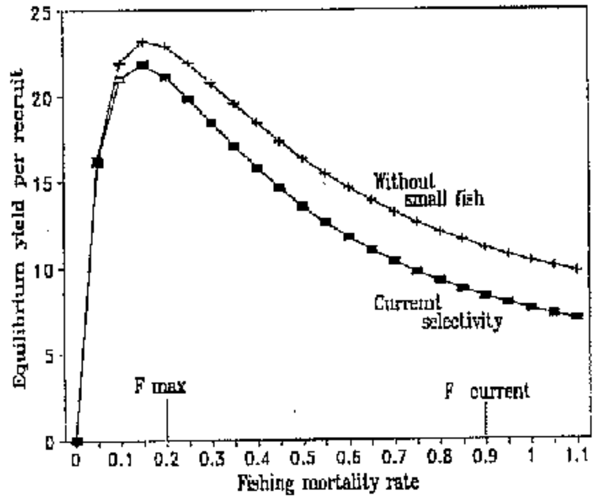
BFT-E-Fig. 10. Fishing mortality rate estimates by age group from the basic-case assessment for east bluefin stock.



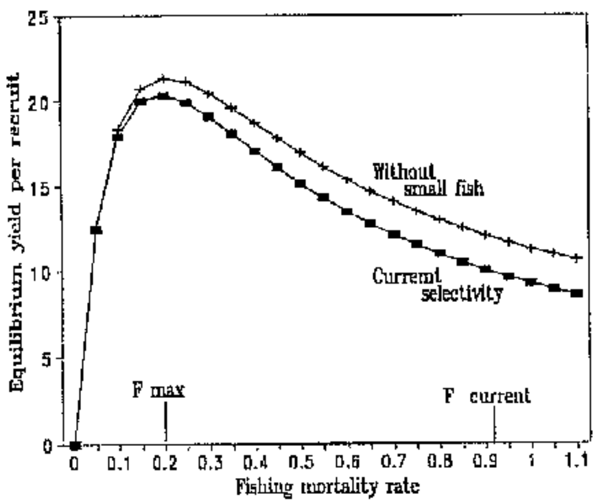
BFT-E-Fig. 11. Estimated stock size (number of fish by age groups) of east bluefin with retrospective VPA using various periods of catch-at-size.



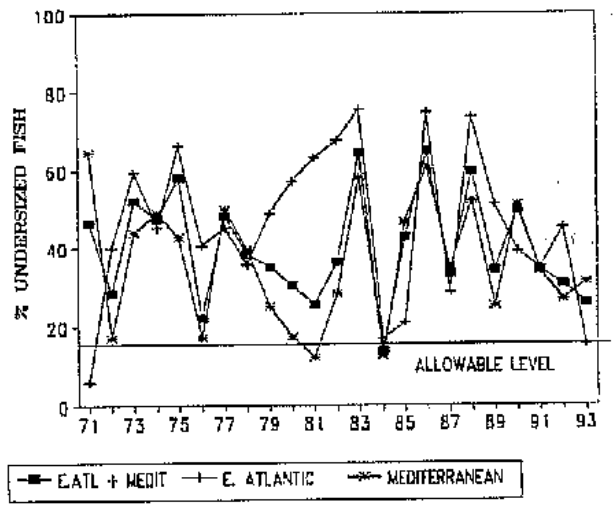
BFT-E-Fig. 12. Estimated (base-case) and retrospectively adjusted fishing mortality at age in 1993.



BFT-E-Fig. 13. Yield per recruit curves without retrospective adjustment (base-case).

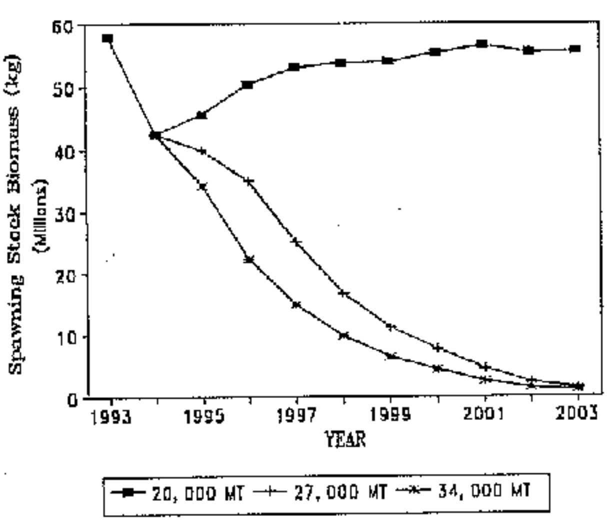


BFT-E-Fig. 14. Yield per recruit curves with retrospective adjustment.

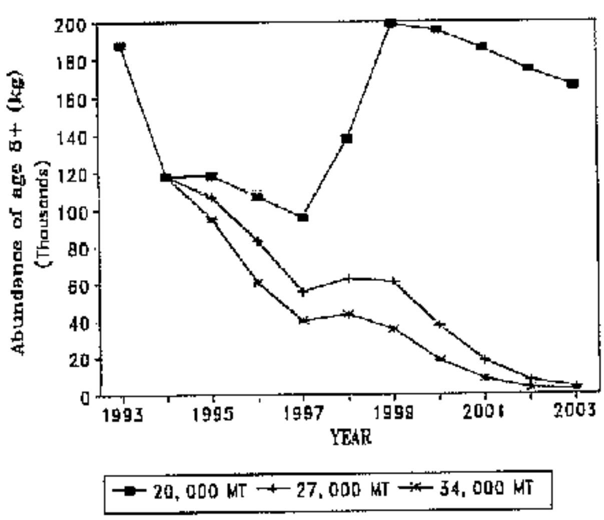


BFT-E-Fig. 15. Percentage of undersized bluefin tuna in the total catches for east Atlantic, Mediterranean and east combined.

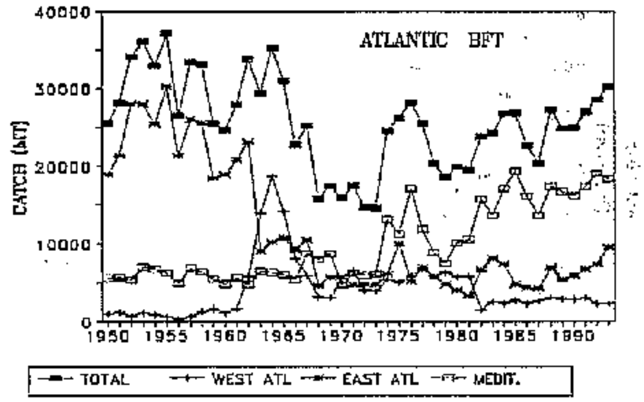
a. SSB (spawning stock biomass)



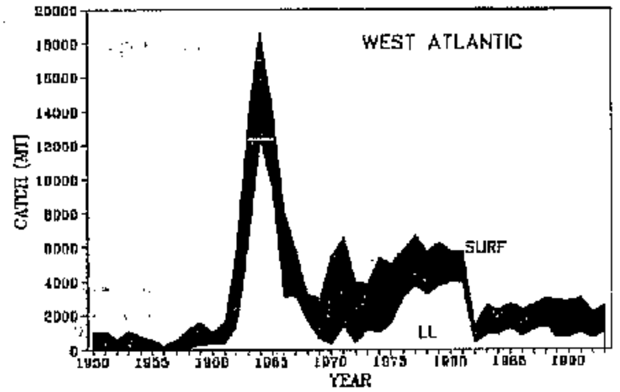
b. Age 8+



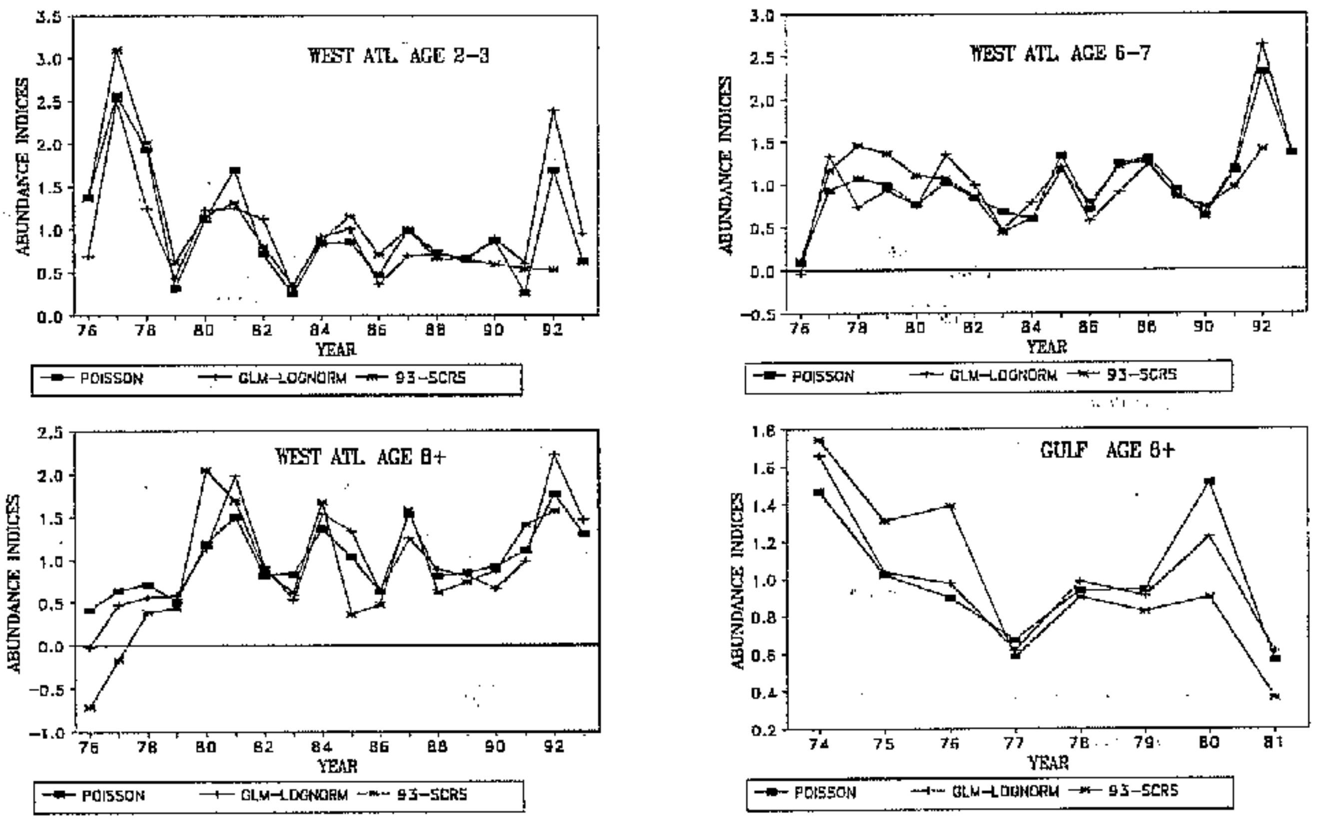
BFT-E-Fig. 16. Deterministic projections of east Atlantic bluefin spawning stock biomass and age 8+ fish, with three levels of constant annual catches.



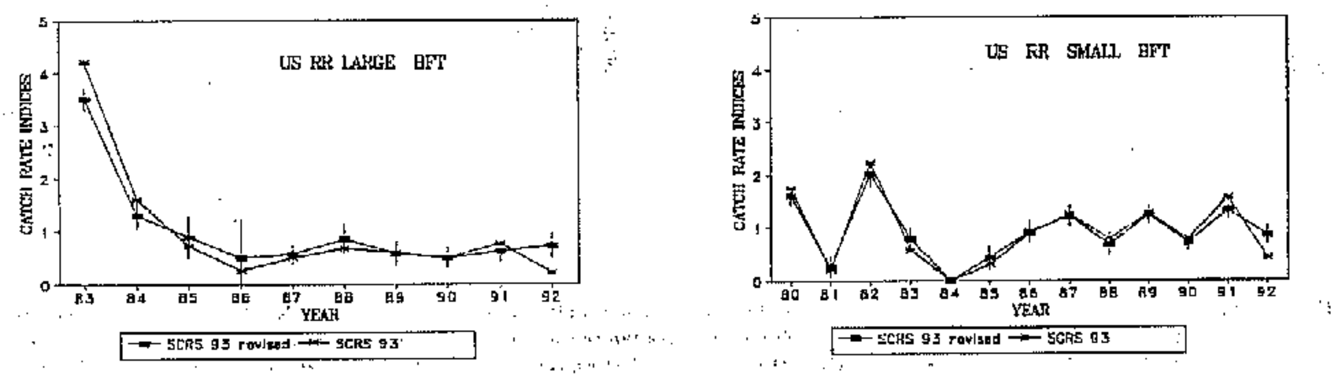
BFT-W-Fig. 1a. Total Atlantic bluefin landings (live weight in MT) by regions.



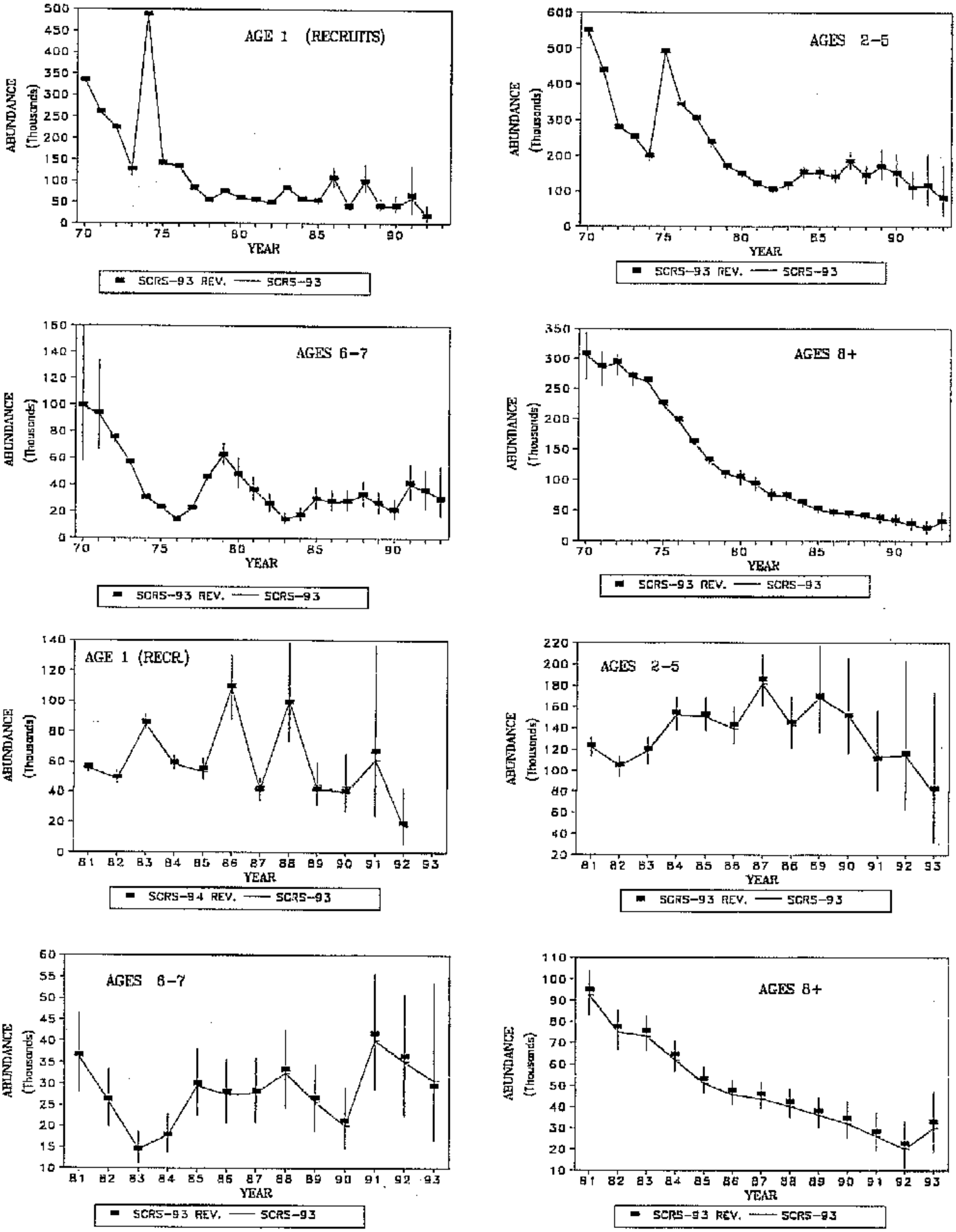
BFT-W-Fig. 1b. Total cumulative bluefin landings (live weight in MT) by gears for the west Atlantic.



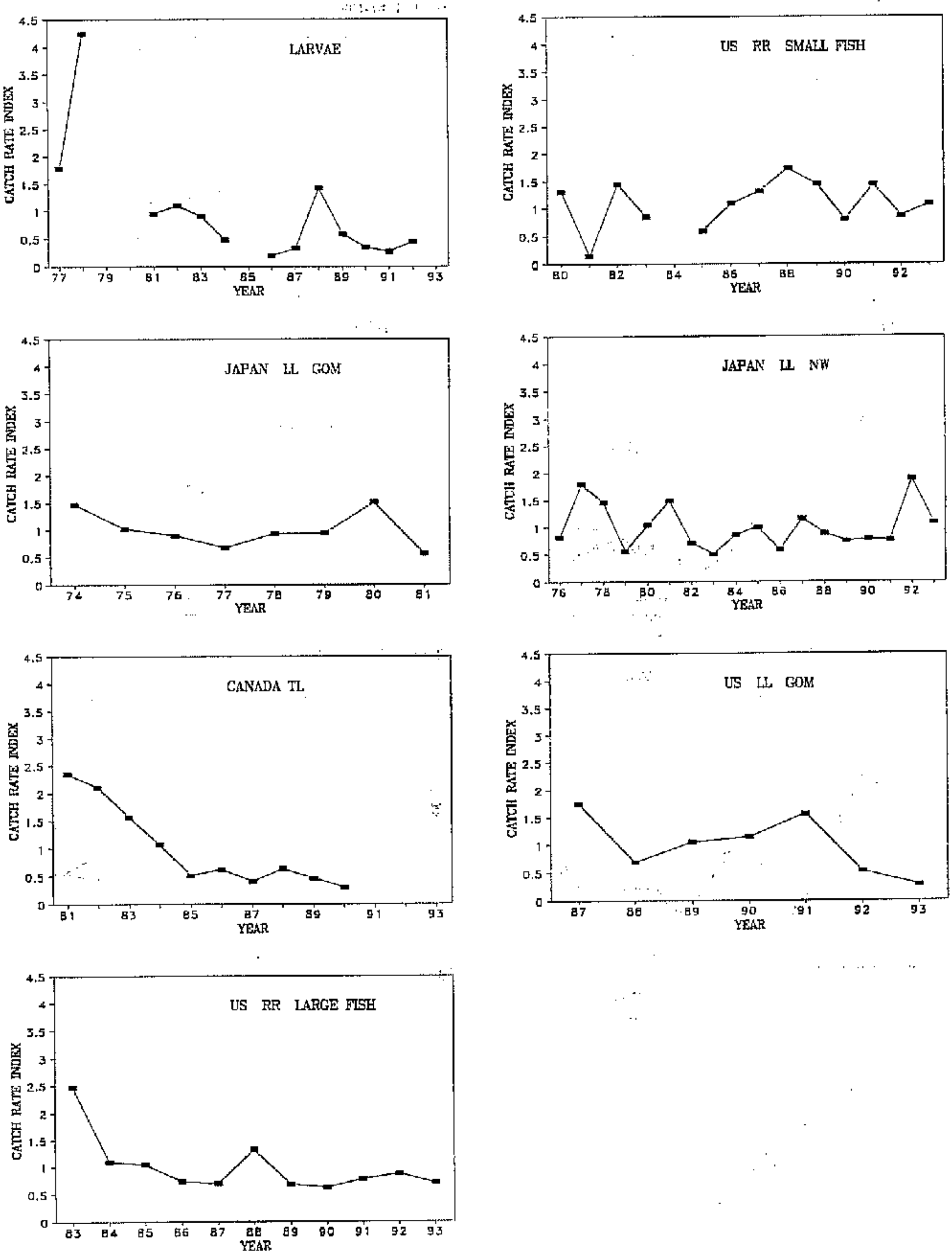
BFT-W-Fig. 2a. Standardized catch rates for west Atlantic bluefin from the Japanese longline fishery using lognormal (GLM) and Poisson distributed error assumptions. Also shown are the CPUE series used in the 1993 SCRS assessment.



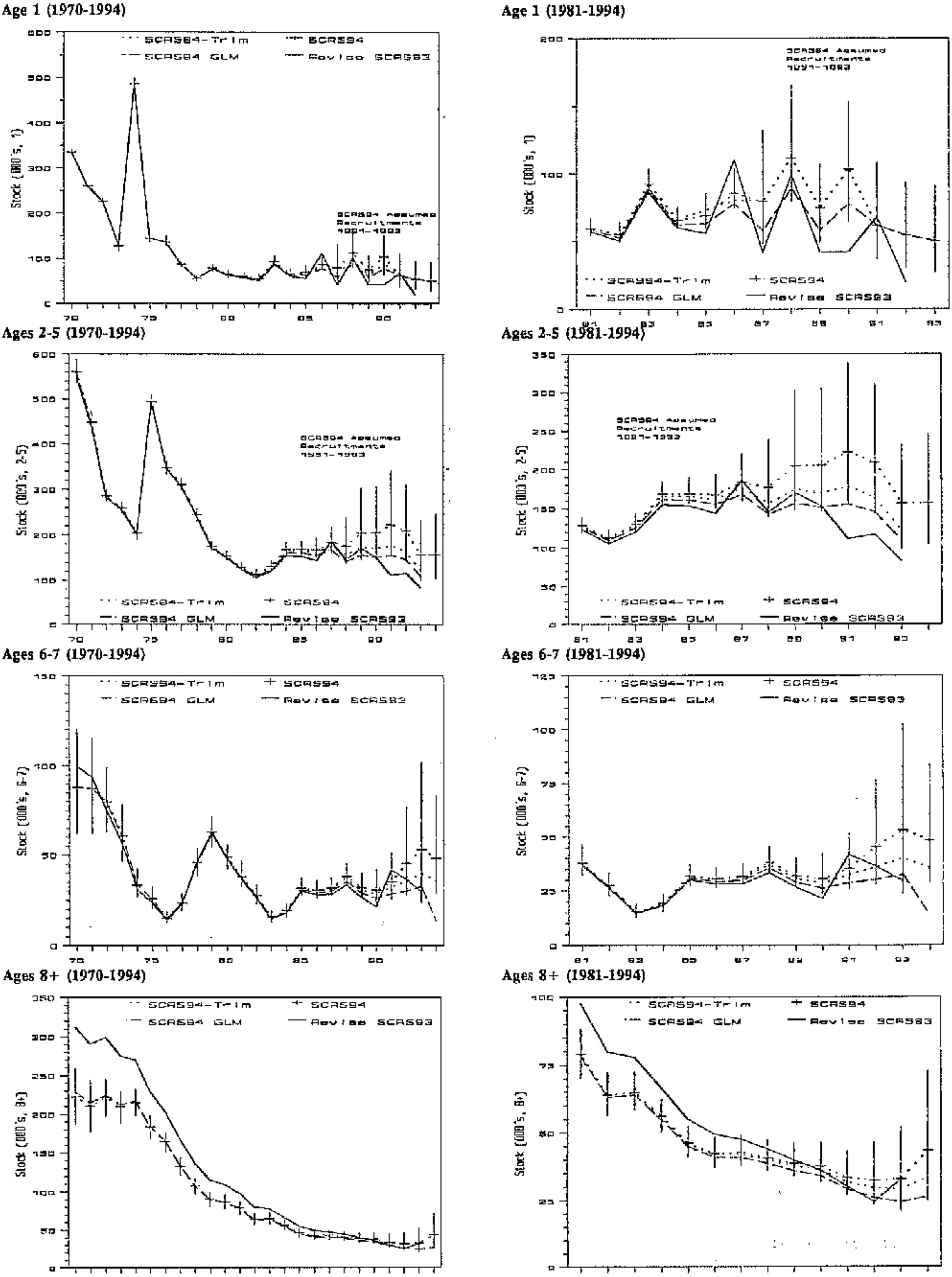
BFT-W-Fig. 2b. The U.S. rod and reel CPUE used in 1993 SCRS assessment compared with the same data after corrections of coding errors for large and small bluefin.



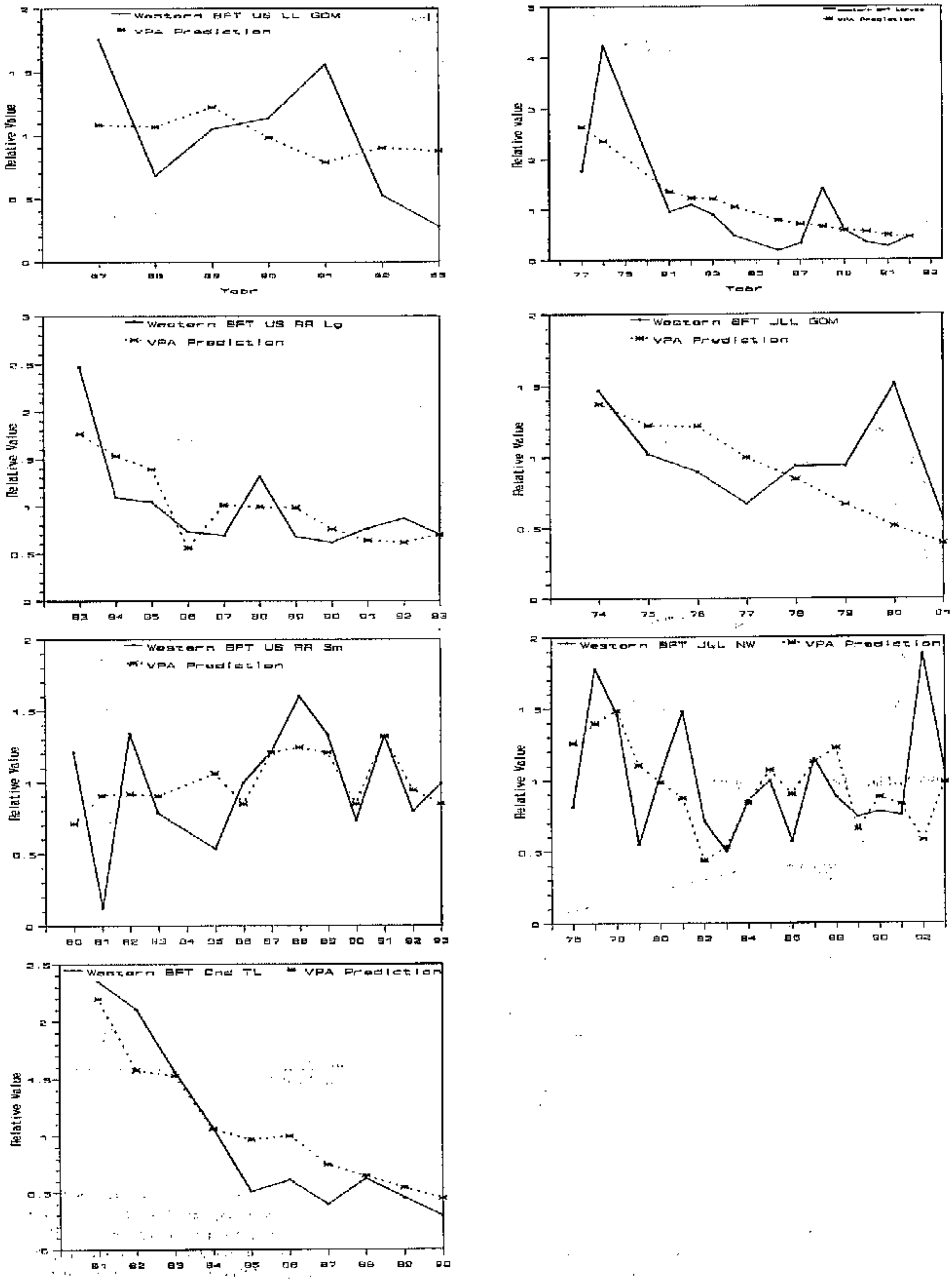
BFT-W-Fig. 3. Comparison of median stock size estimates from 1000 bootstrap iterations of the 1993 analysis (SCRS-93) with the median estimates from the revised analysis which incorporates the corrected U.S. rod and reel index values. Approximate 80% confidence bounds on SCRS-93. (SCRS-93 rev. means 1993 assessment revised using corrected U.S. rod and reel data).



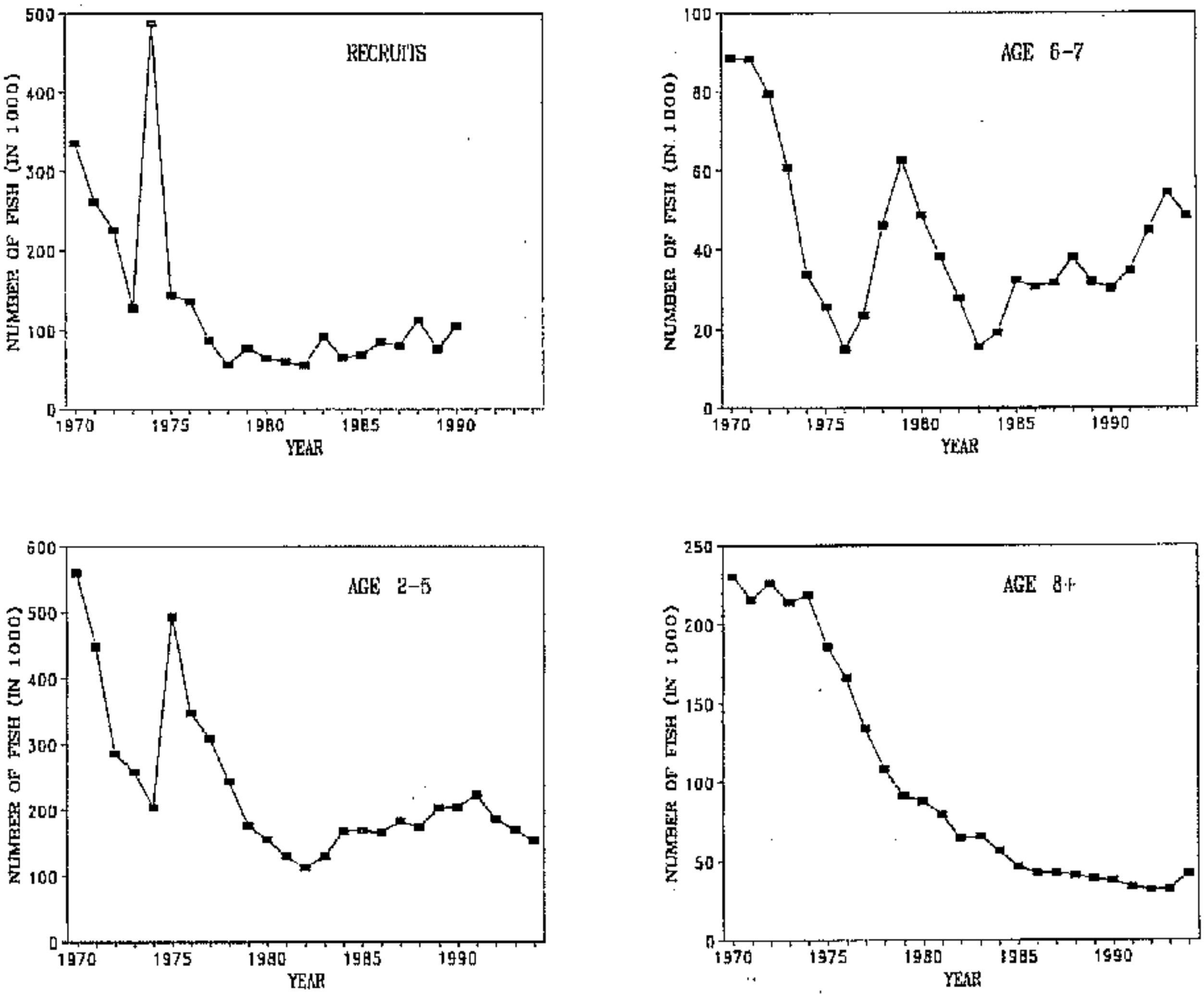
BFT-W-Fig. 4 Catch rate indices used in the calibration of VPA. Each series has been standardized to its own mean.



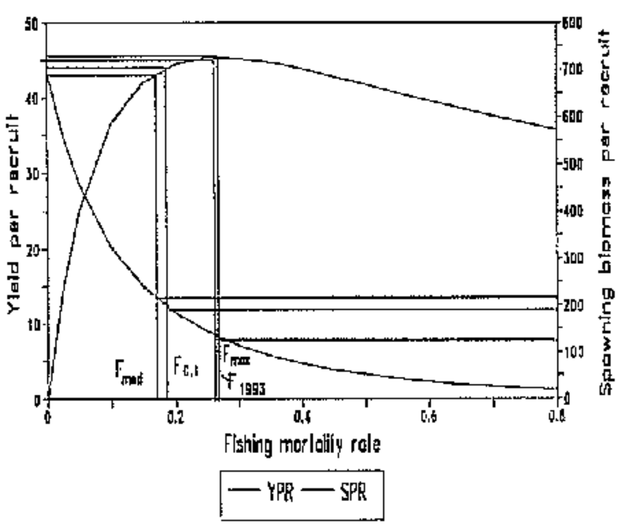
BFT-W-Fig. 5. Comparison of VPA estimates of ages 1, 2-5, 6-7 and 8 and older abundance from various runs. SCRS94 is the base case (with 90% confidence intervals). SCRS94-Trim is the run excluding 5 data points with the highest and 5 data points with the lowest standardized residuals from the analysis. SCRS94 GLM is the run using lognormal error assumptions for index standardization. Revised SCRS93 is the revised 1993 VPA, using corrected CPUE series.



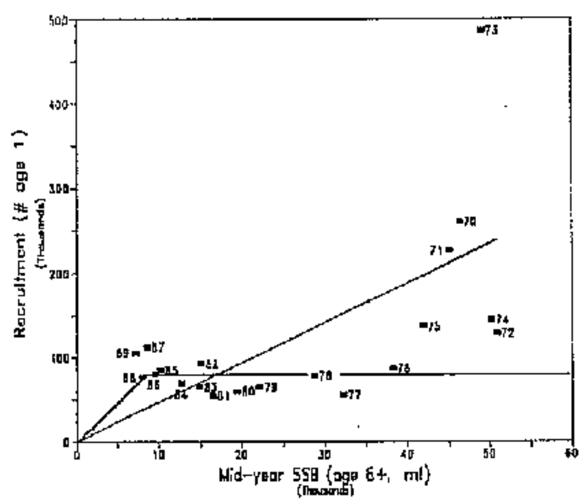
BFT-W-Fig. 6. Fit of the base case. Each series has been standardized to its mean.



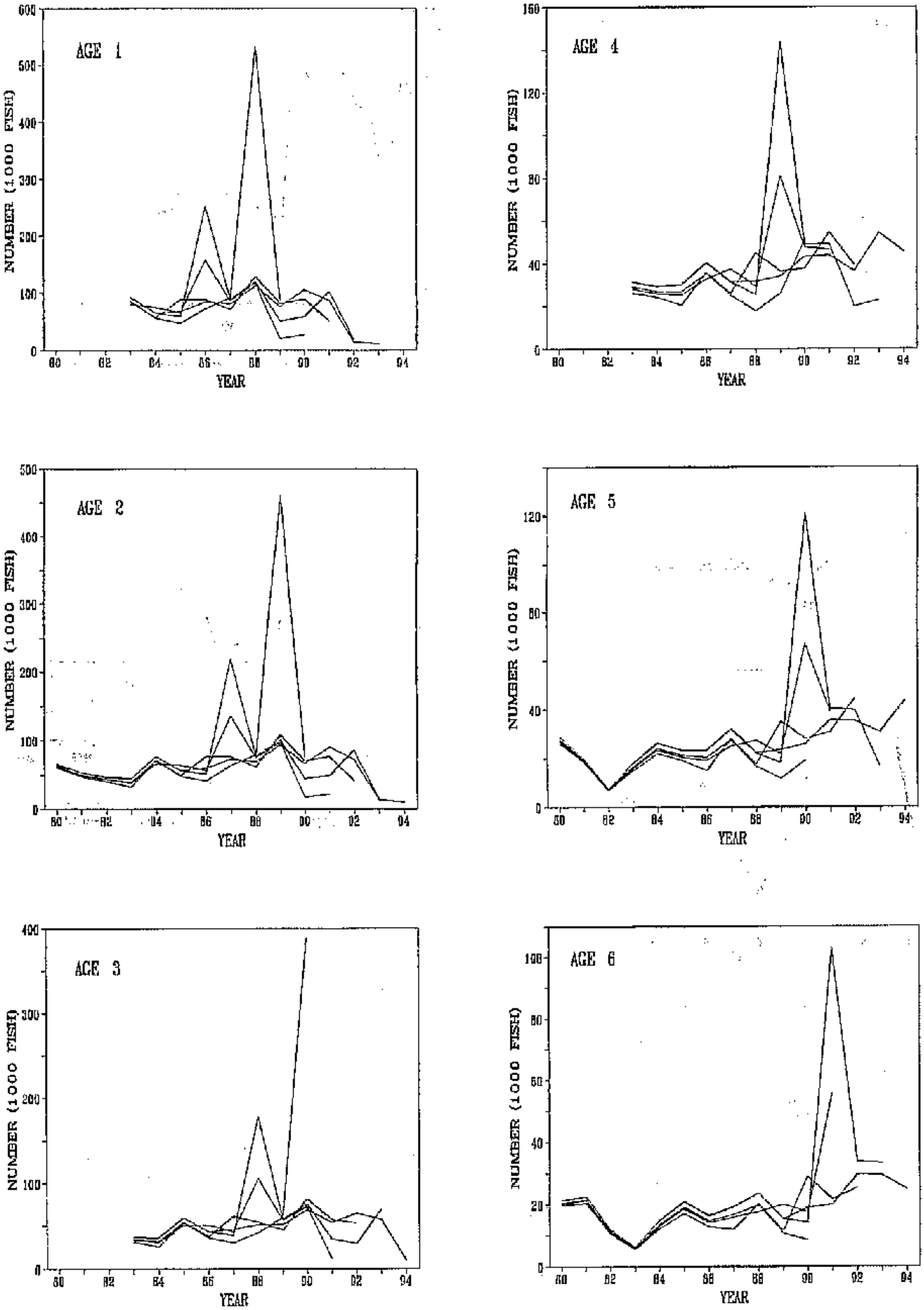
BFT-W-Fig. 7. Deterministic population trends (number) for the base case.



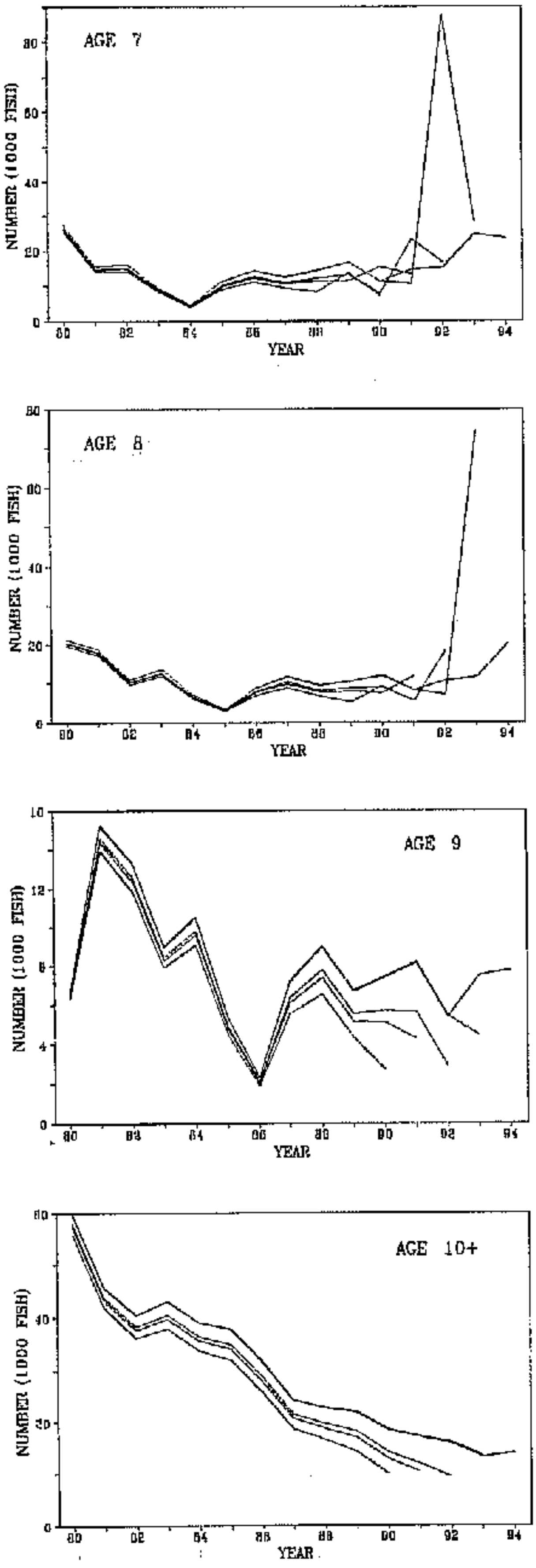
BFT-W-Fig. 8a. Yield per recruit (YPR) and spawning biomass per recruit (SPR, represented as 8+ biomass) for western Atlantic bluefin tuna. Horizontal lines represent the levels of YPR and SPR corresponding to the reference points $F_{0.1}$, F_{max}, F_{med} (F-medium for the period 1970-89), and F_{1993}.



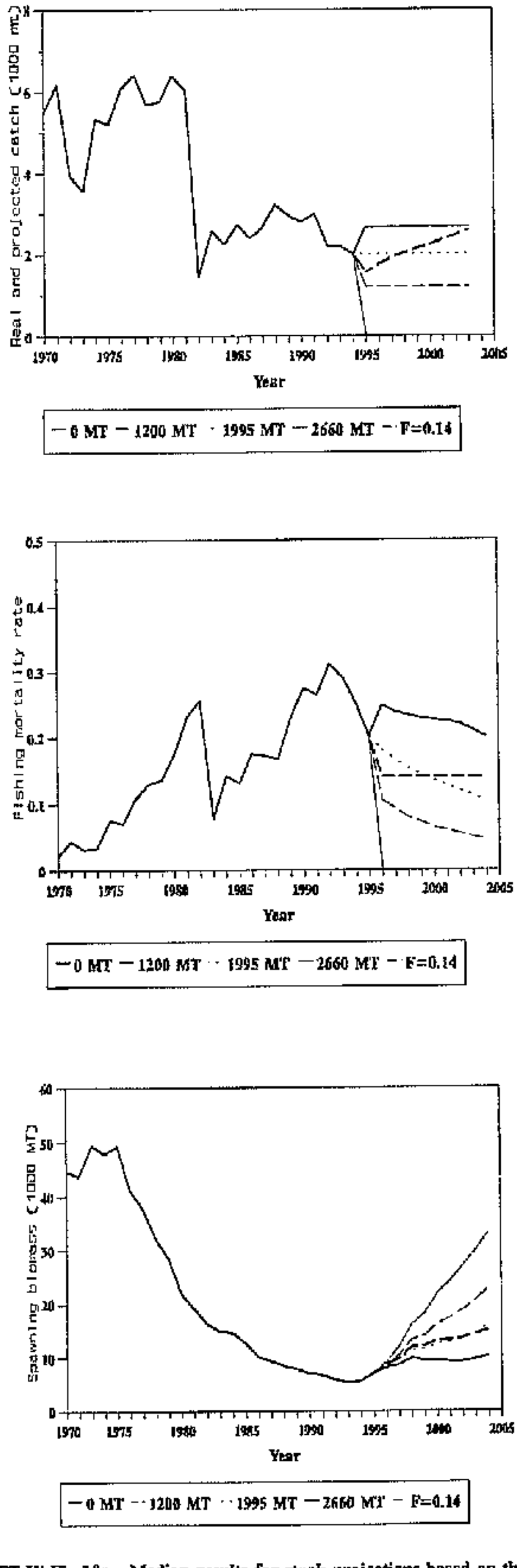
BFT-W-Fig. 8b. Estimated spawning stock biomass (SSB, 8+ biomass) and recruits (numbers at age 1) from the base case VPA. The single straight line through the origin represents the median survival ratio (R/S) for the years 1970-89. The inverse of the slope of this line is the level of SPR corresponding to F_{med} (F-median) in BFT-W-Fig. 8a. The thick line represents the stock-recruitment relationship assumed for the base case VPA projections.



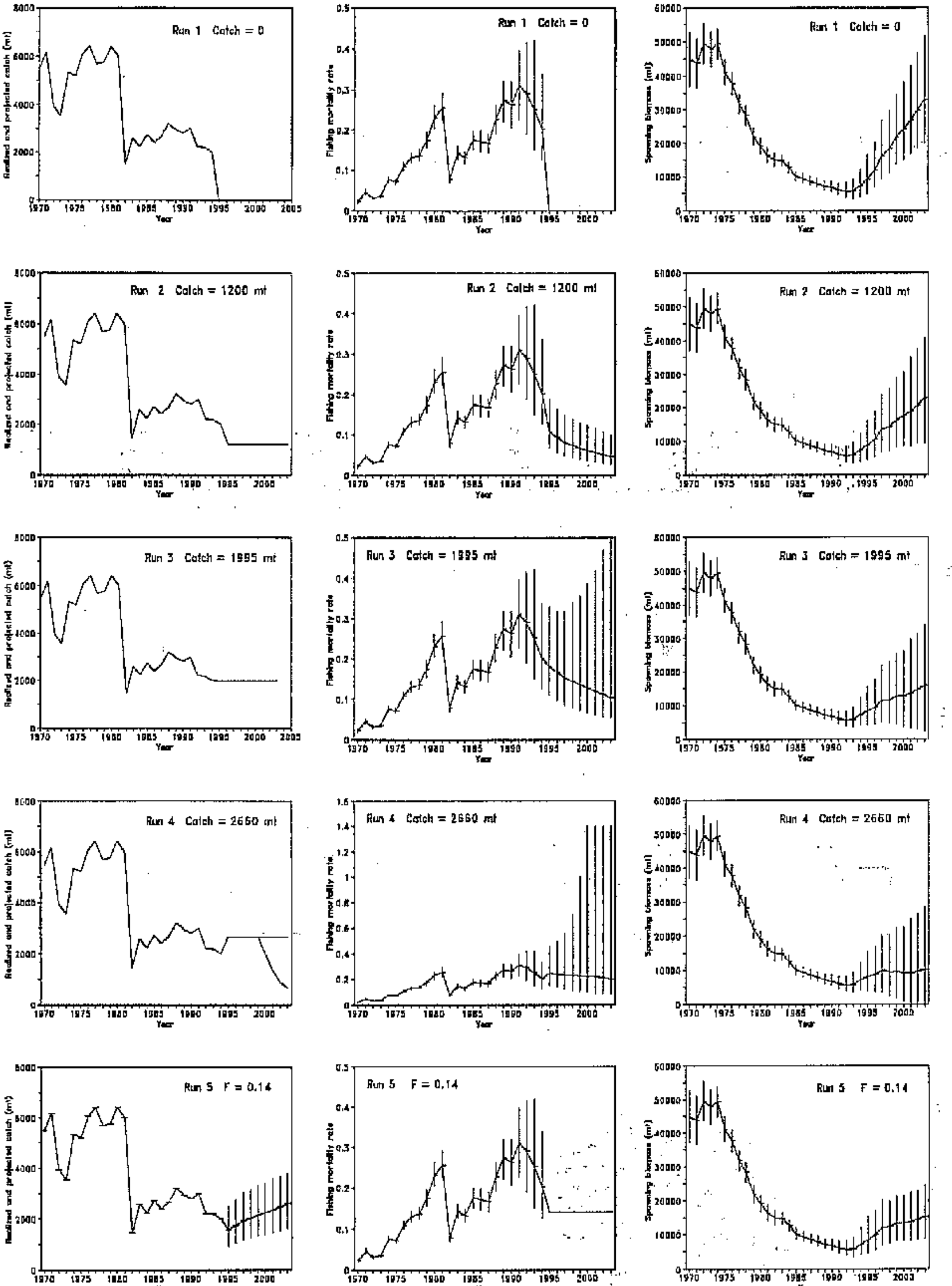
BFT-W-Fig. 9. Retrospective analysis for ages 1 to 10+ from the base case.



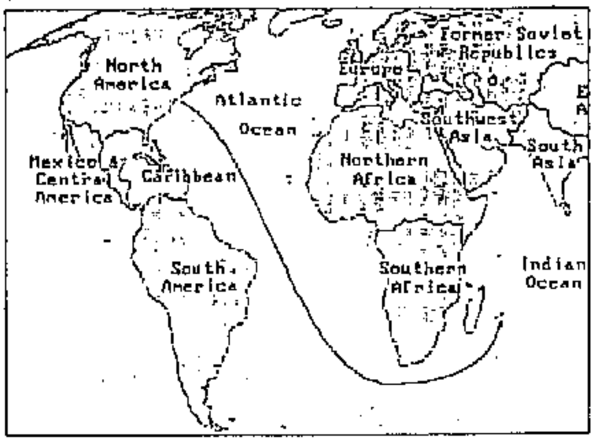
BFT-Fig. 9. Continued.



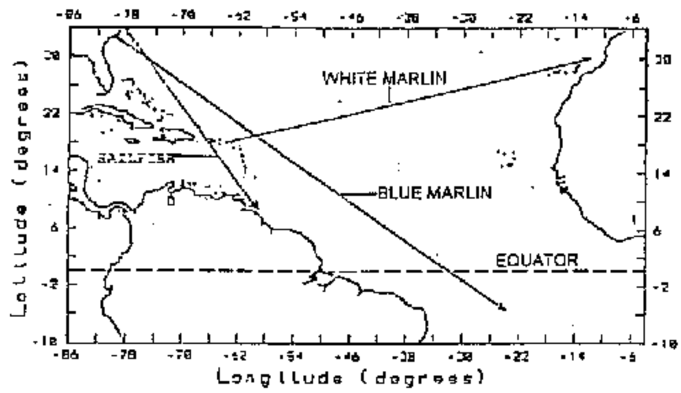
BFT-W-Fig 10a. Median results for stock projections based on the base case VPA. The fishing mortality rate and spawning stock biomass refer to ages 8+.



BFT-W-Fig. 10b. Stock projection results (medians and 90% confidence intervals) for the base case VPA. The fishing mortality rate and spawning stock biomass refer to ages 8+.

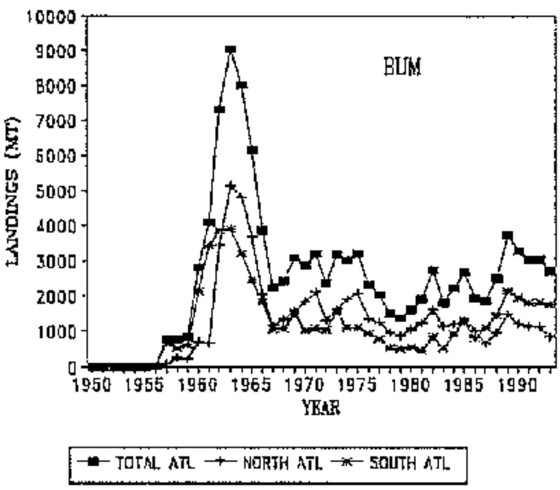


BIL-Fig. 1a. Recent inter-ocean movement for a blue marlin tagged through the Cooperative Tagging Center of the U.S. National Marine Fisheries Service off Delaware along the U.S. East Coast and recaptured 3.5 years later near the island Mauritius in the Indian Ocean. Line represents minimum distance traveled and is not intended to provide insight into route taken. Arrowindicates point of recapture.

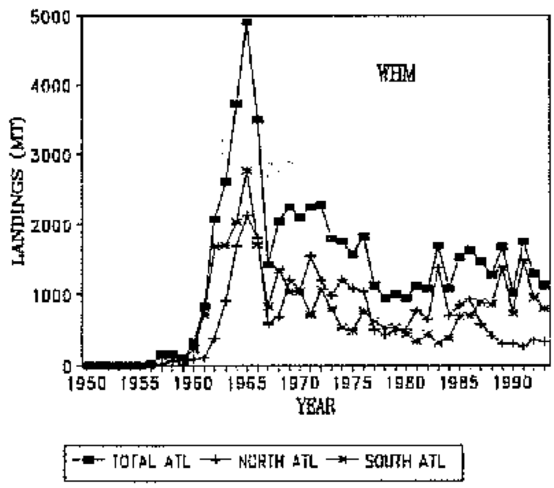


BIL-Fig. 1b. Recent long distance movements based on tag returns for blue marlin, white marlin, and sailfish. Lines represent minimum distance traveled and are not intended to provide insight into routes taken Arrows indicate points of recapture.

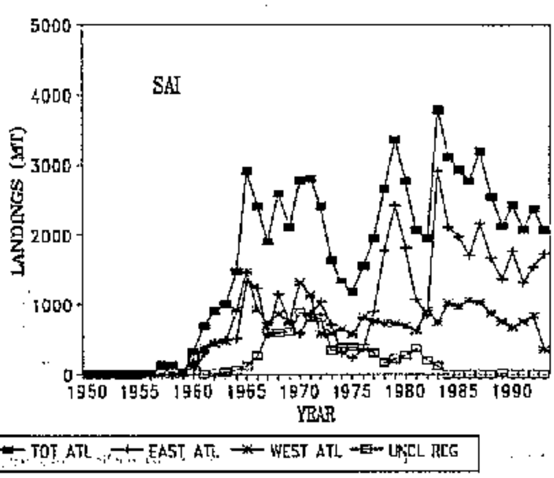
(a) Blue marlin



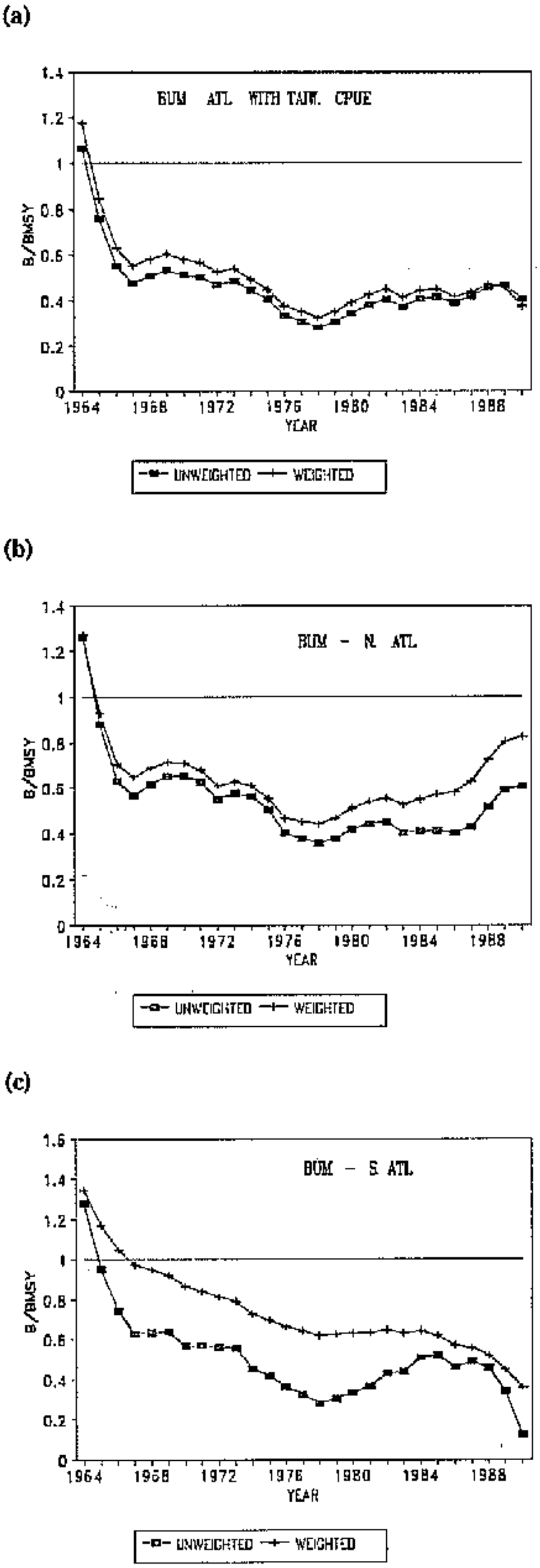
(b) White marlin



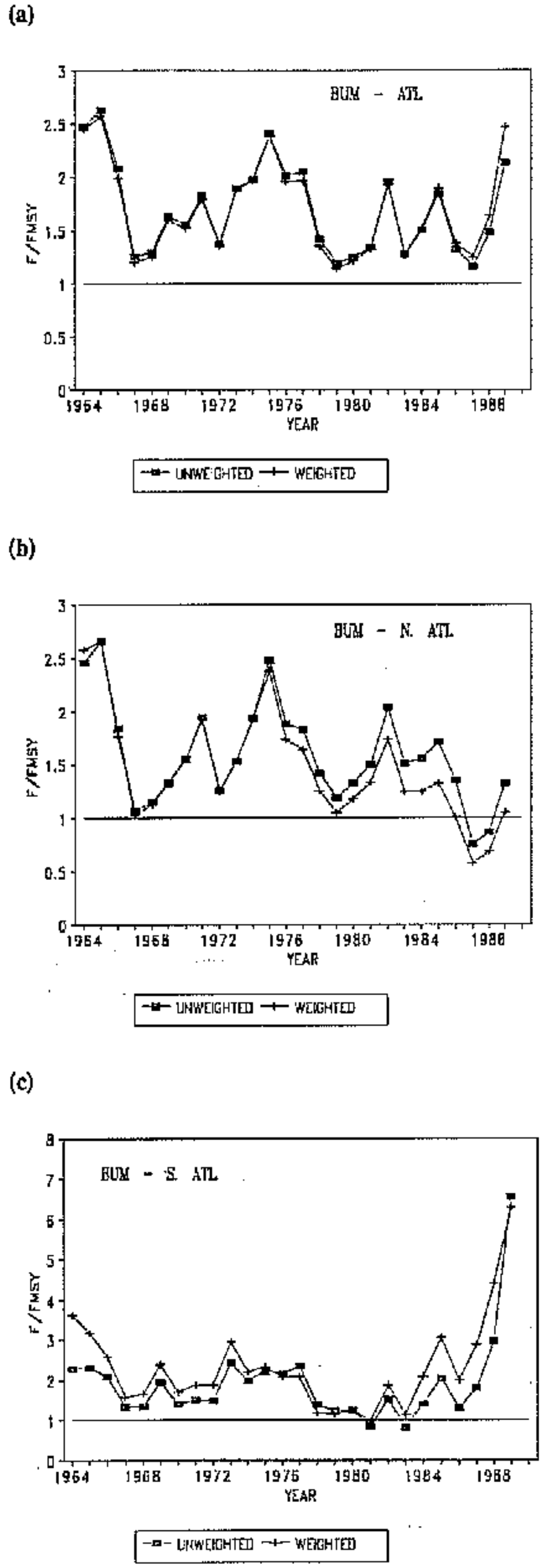
(c) Sailfish



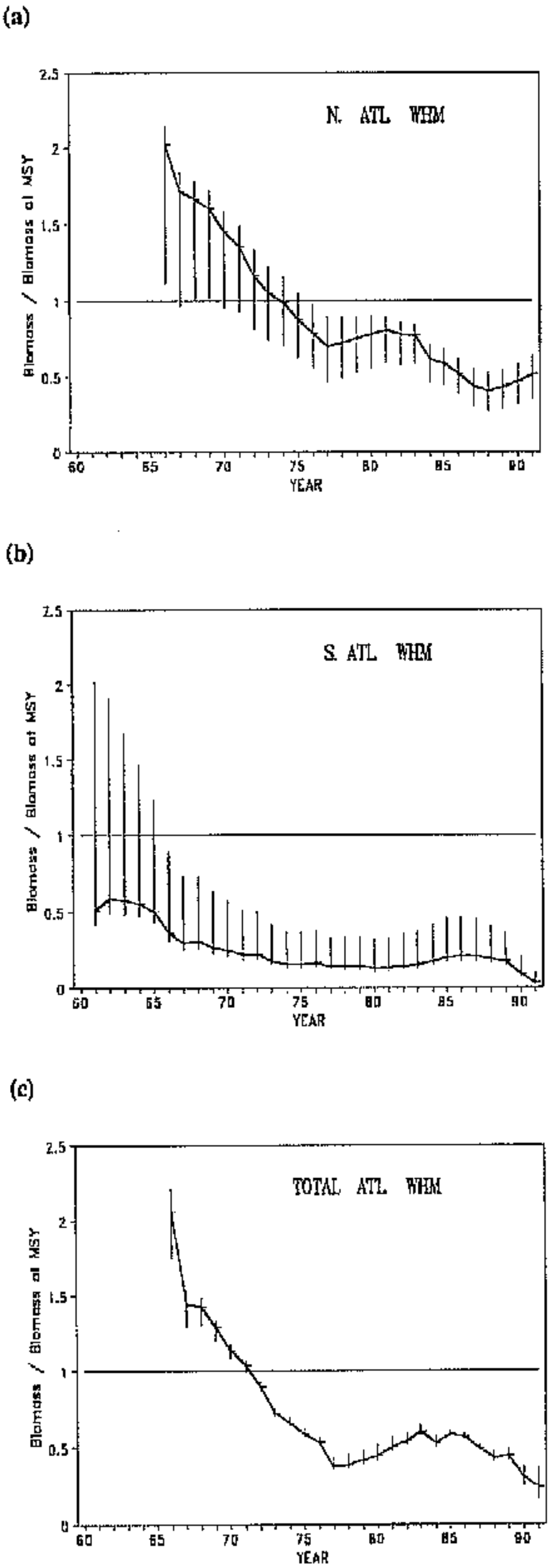
BIL-Fig. 2. Nominal landings of billfish (a - blue marlin; b - white marlin; and c - sailfish including some spearfish) in metric tons.



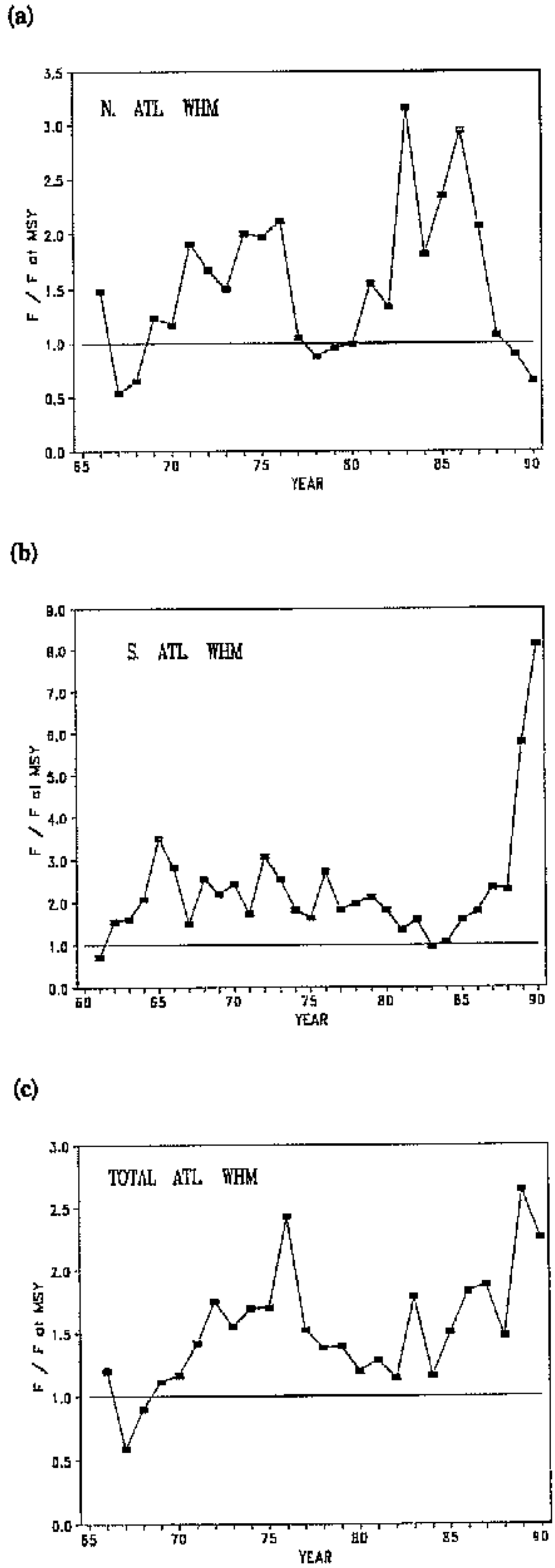
BIL-Fig. 3. Blue marlin estimated trajectory of B/B_{MSY} for the (a) total Atlantic, (b) north Atlantic and (c) south Atlantic. The values for the first three years of the time series have been omitted, as estimates are less precise. Iterative re-weighting mehtods and results are given in Billfish Workshop Report (1992).



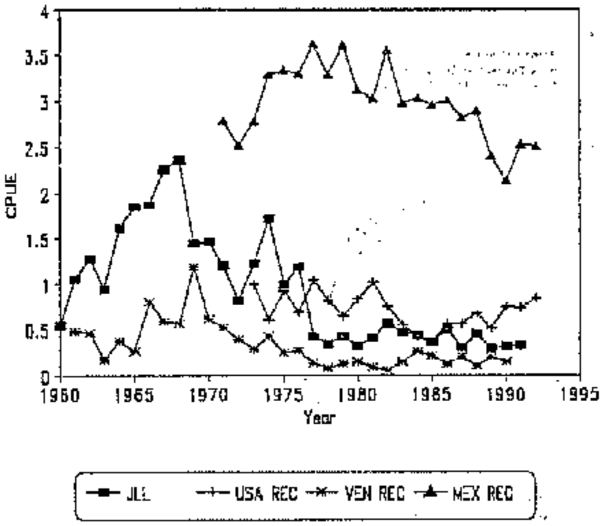
BIL-Fig. 4. Blue marlin estimated trajectory of F/f_{MSY} for the (a) total Atlantic, (b) north Atlantic and (c) south Atlantic. Iterative re-weighting mehtods and results are given in Billfish Workshop Report (1992).



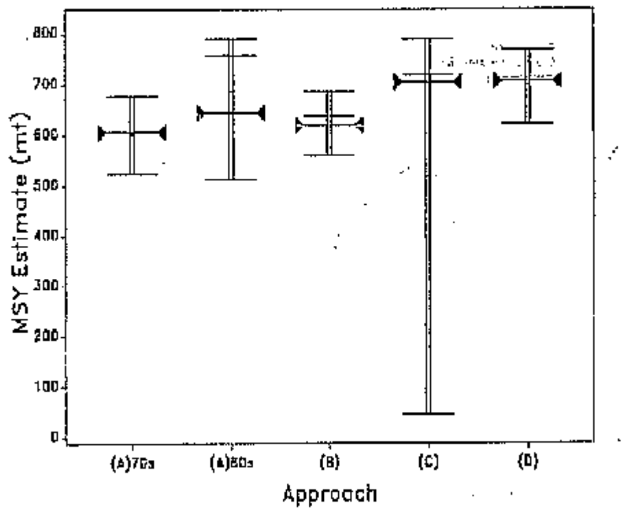
BIL_Fig. 5. Bootstrapped median biomass trajectories with approximate non-parametric 80% intervals for white marlin fisheries from the (a) north Atlantic, (b) south tlantic and (c) total Atlantic. Results are imprecise for the first 3 to 5 years of the time series.



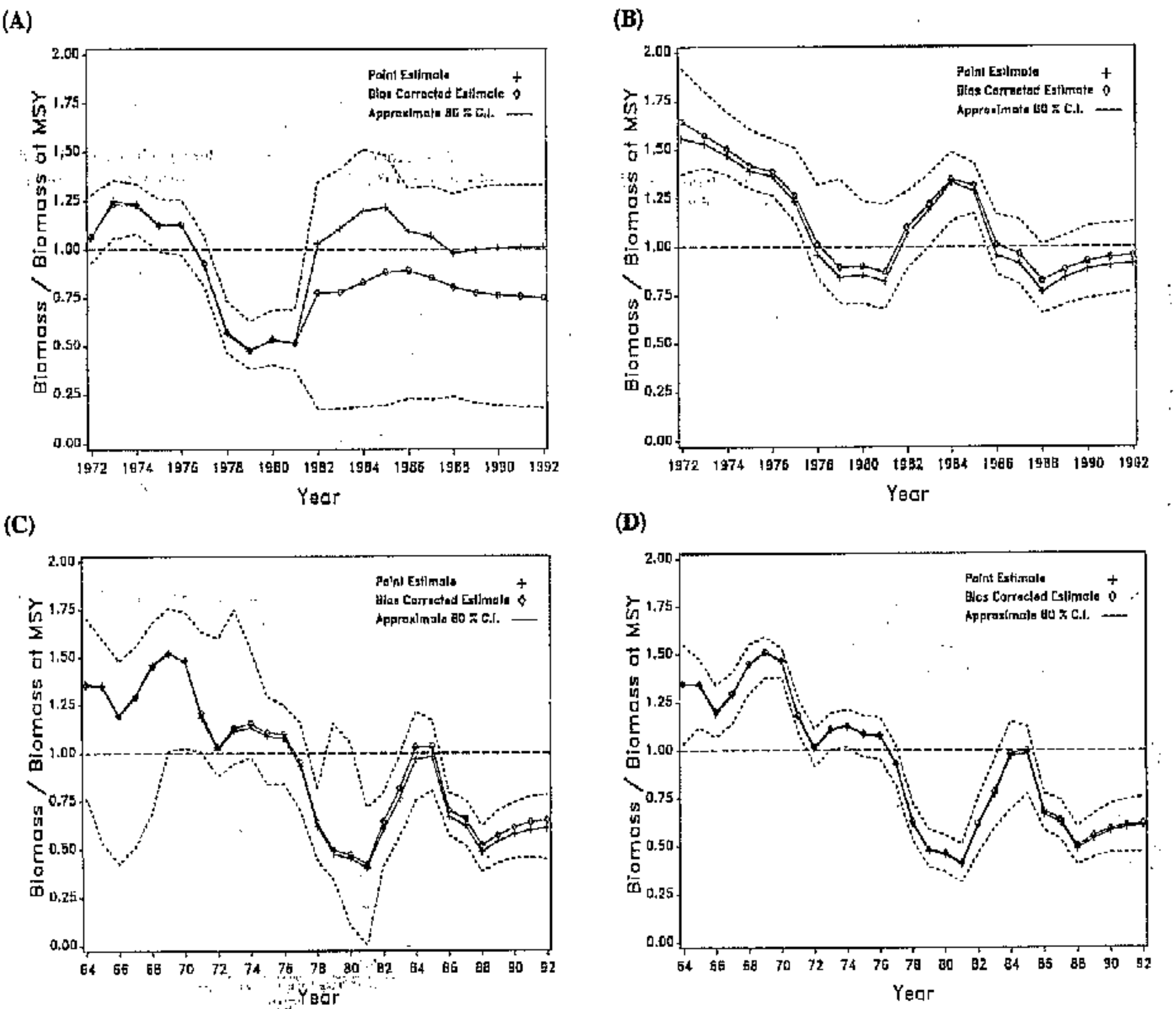
BIL-Fig. 6. Relative fishing mortality trajectories for white marline from the (a) north Atlantic, (b) south Atlantic, and (c) total Atlantic.



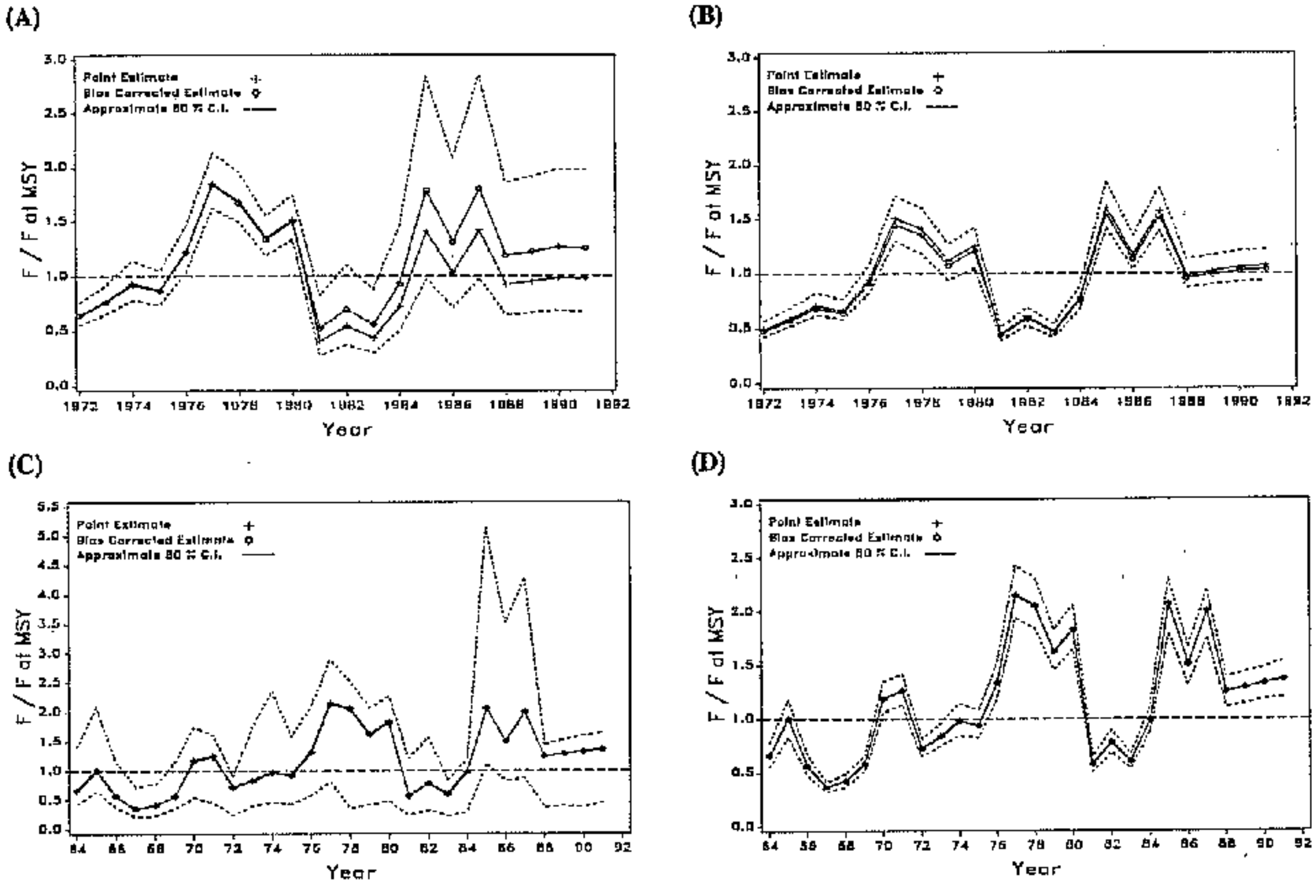
BIL-Fig. 7. Available CPUE trajectories used for west Atlantic sailfish. JLL is Japanese longline standardized CPUE. USA REC is the United States rod and reel fishery standardized CPUE. VEN REC is the Venezuelan recreational fishery standardized CPUE. MEX REC is the Mexican recreational fishery CPUE in nominal units.



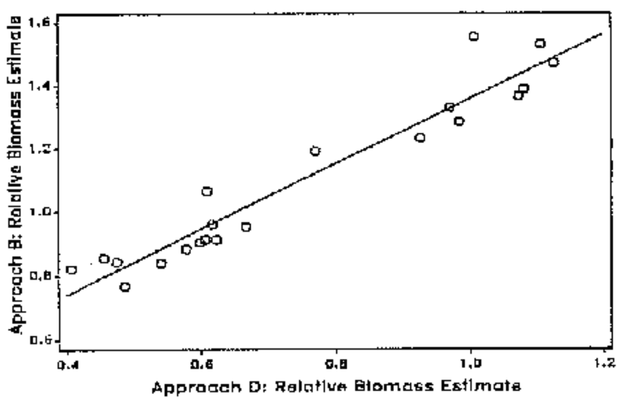
BIL-Fig. 8. Estimated values of west Atlantic sailfish MSY. Horizontal lines are point estimates and approximate 80% nonparametric confidence limits (from 1000 bootstraps). Lines with pointers are bias corrected point estimates. An explanation of the four approaches (A-D) used in these analyses is given in the text.



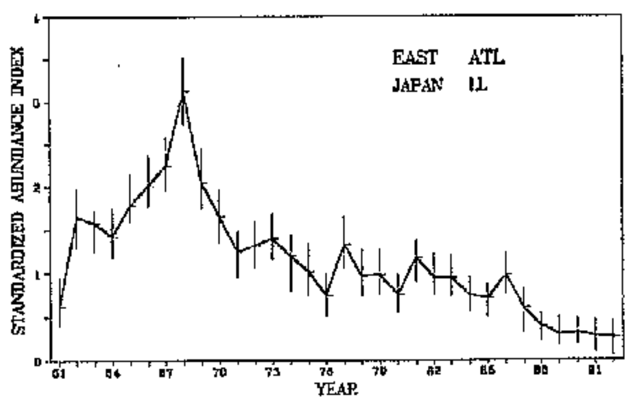
BIL-Fig. 9. Bootstrapped annual relative biomass (= B_t / B_{MSY}) from the ASPIC models fitted to west Atlantic sailfish catch and effort information. Confidence intervals are based on 1000 trials. Annual values for the first two years are omitted due to extreme imprecision. The four approaches (A-D) are described in the text.



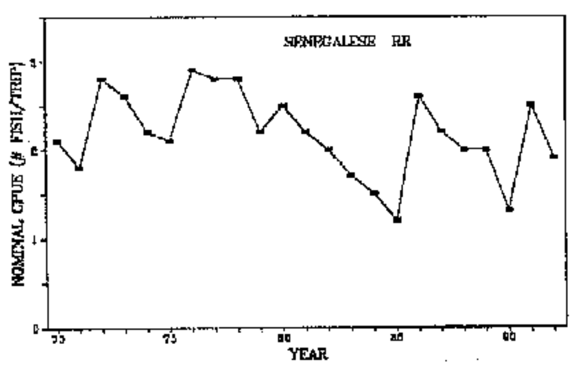
BIL-Fig. 10. Bootstrapped annual relative fishing mortality (= F_t/F_{MSY}) from the ASPIC models fitted to west Atlantic sailfish catch and effort information. Confidence intervals are based on 1000 trials. Annual values for the first two years are omitted due to extreme imprecision. The four approaches (A-D) are described in the text.



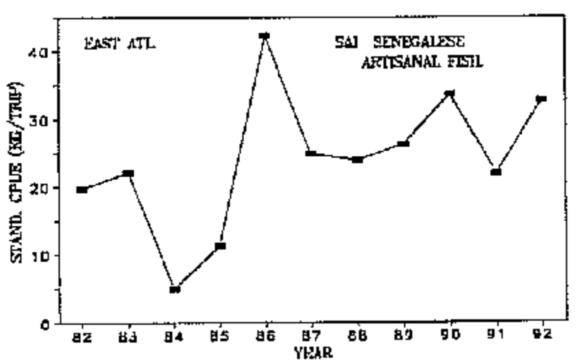
BIL-Fig. 11. Relative west Atlantic sailfish biomass estimates for approaches (B) and (D) (see BIL-Fig. 15) for the years 1972-1992. The correlation coefficient is r = 0.96. Slope of the fitted line is 1.02 with a y-intercept of 0.33.



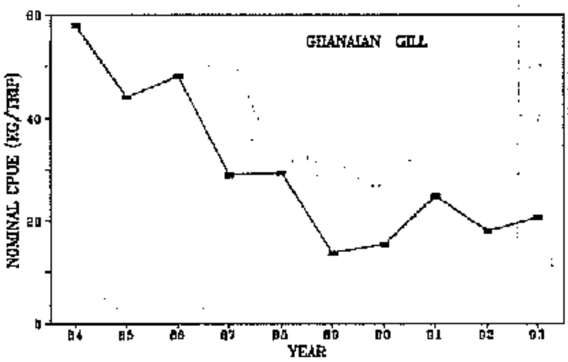
BIL-Fig. 12. Standardized CPUE's for eastern Atlantic sailfish from the Japanese longline fleet.



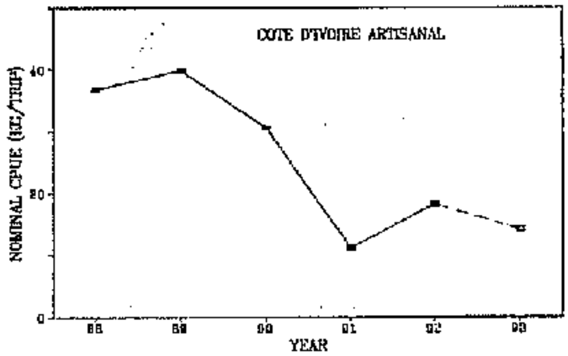
BIL-Fig. 13. Nominal CPUE's for eastern Atlantic sailfish from Senegalese recreational fisheries.



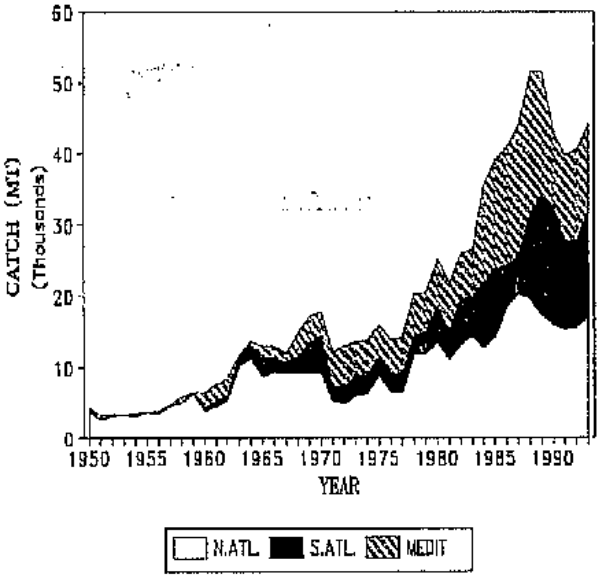
BIL-Fig. 14. Standardized CPUE's for eastern Atlantic sailfish from Senegalese artisanal fisheries (all combined).



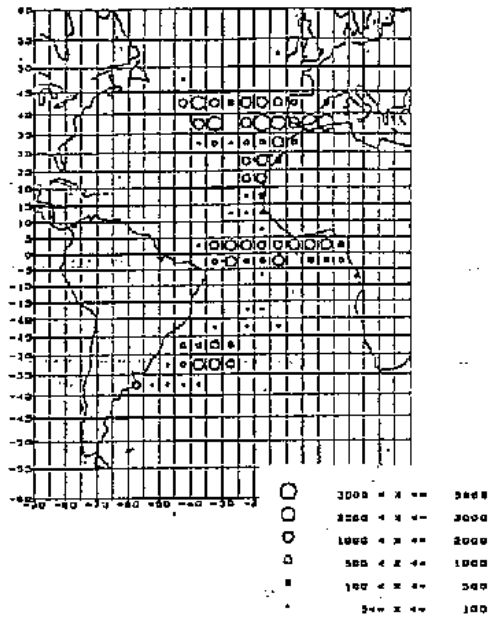
BIL-Fig. 15. Nominal CPUE's for eastern Atlantic sailfish from Ghanaian artisanal gillnet fisheries.



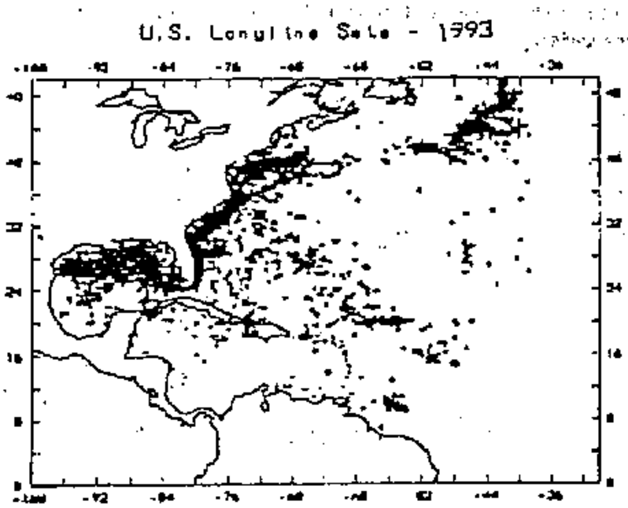
BIL-Fig. 16. Nominal CPUE's for eastern Atlantic sailfish from Cote d'Ivoire artisanal gillnet fisheries. The data for 1993 is partial data through July.



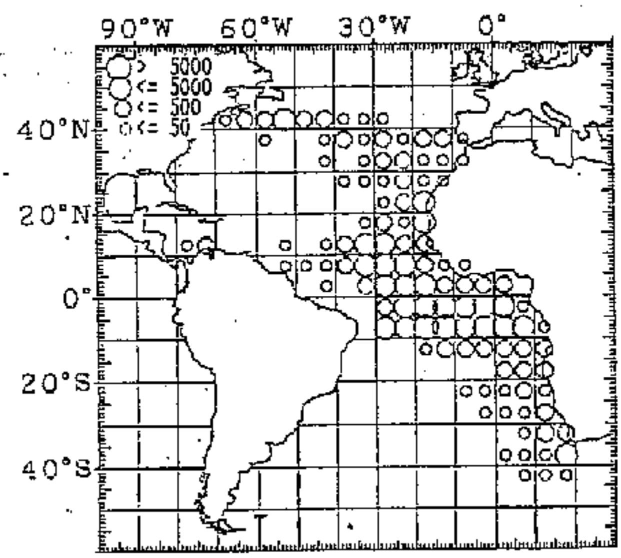
SWO-Fig. 1. Cumulative catches of swordfish (MT) for the north Atlantic, south Atlantic and Mediterranean, 1950-93.



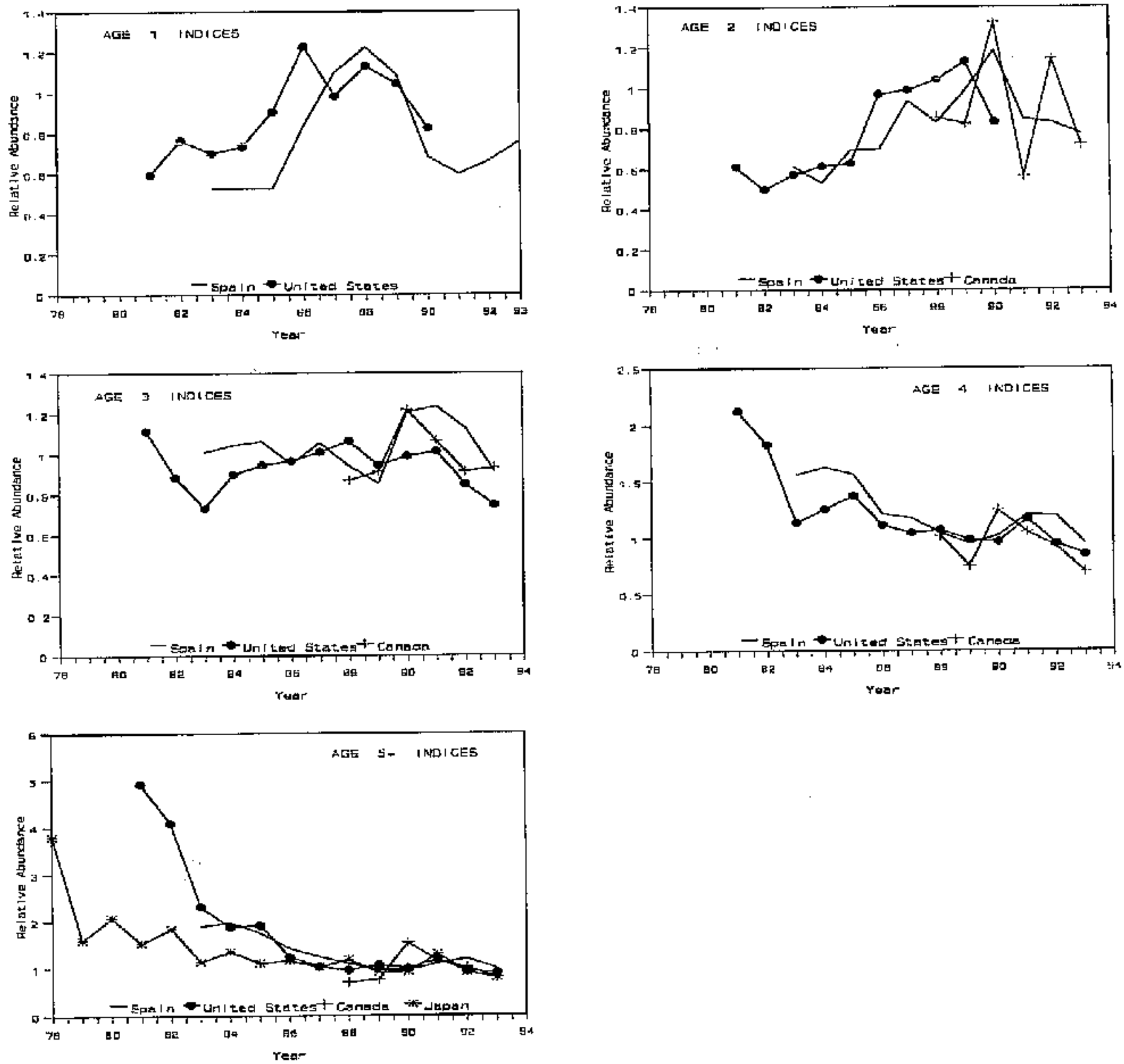
SWO-Fig. 2. Distribution of Spanish longline fishery effort (in 1000 hooks) by 5-degree area for 1993.



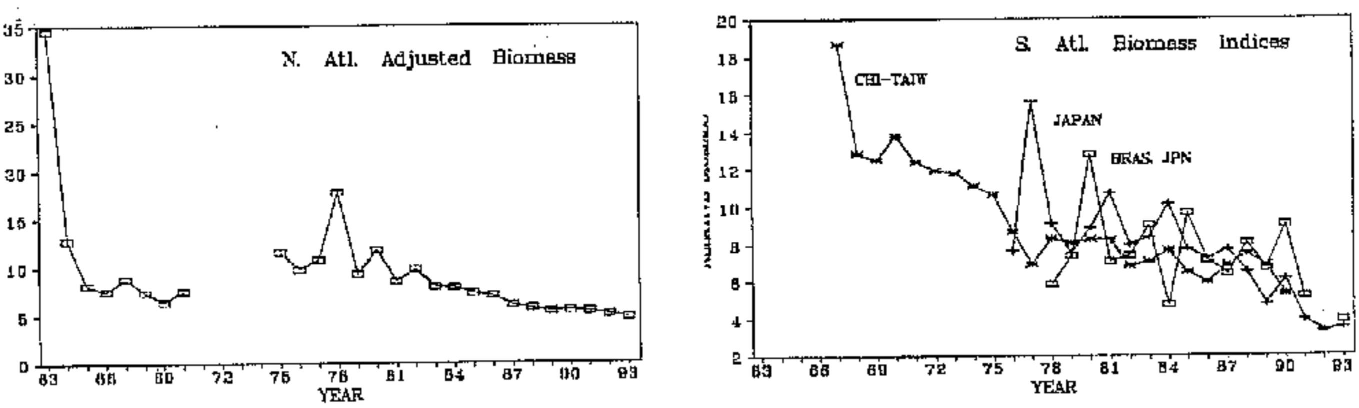
SWO-Fig. 3. U.S. swordfish longline set locations for 1993.



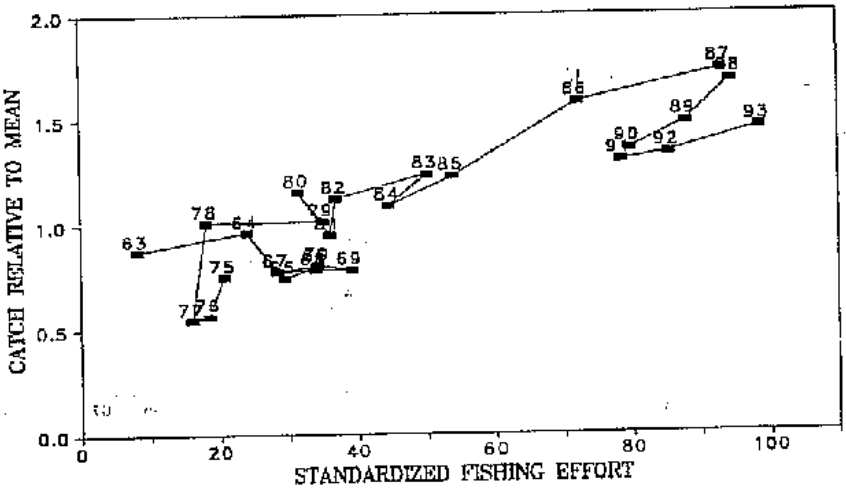
SWO-Fig. 4. Distribution of Japanese longline catch (in number of fish) by 5-degree area in 1993.



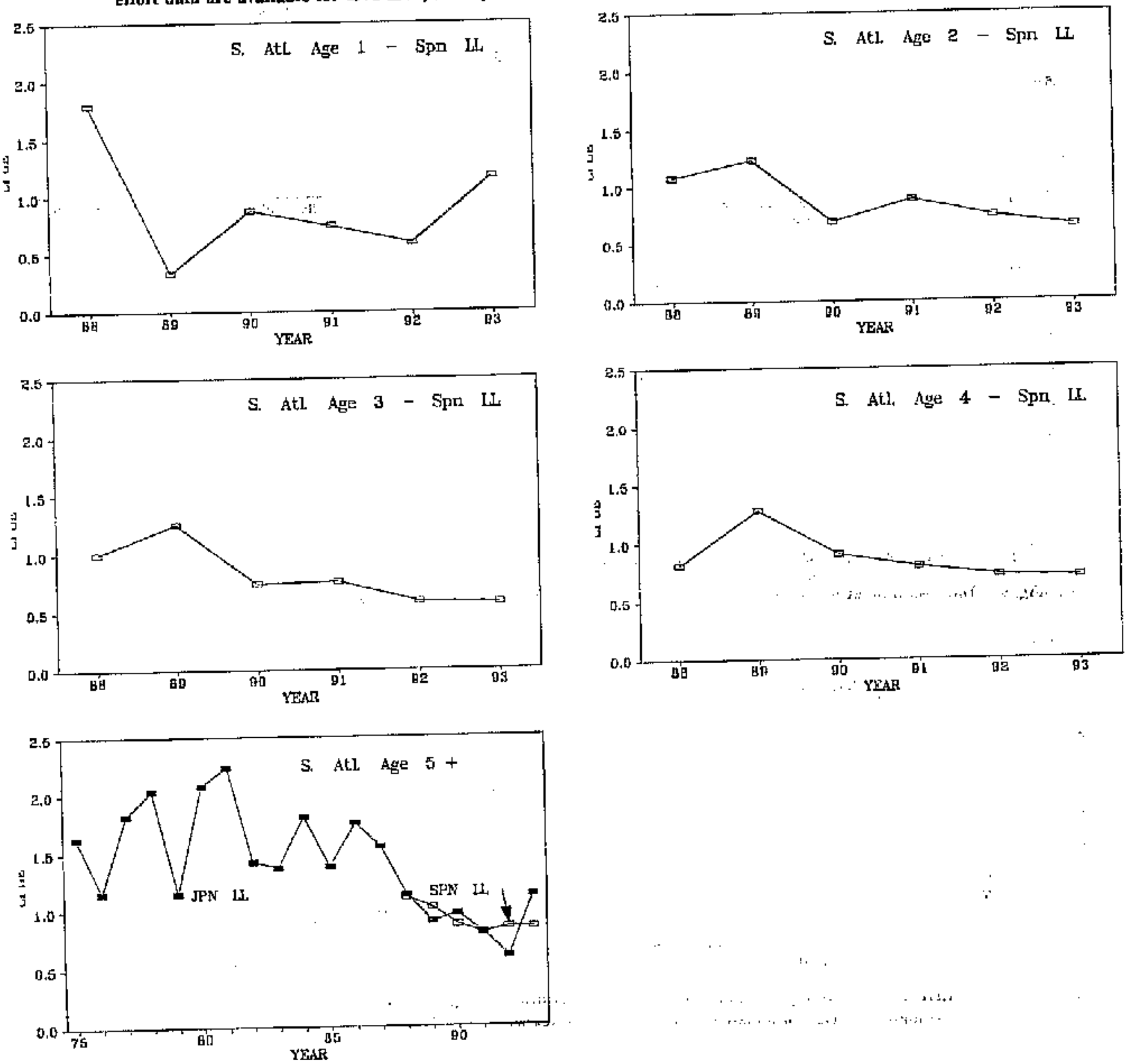
SWO-Fig. 5. North Atlantic age-specific, standardized catch rates from the Spanish, Japanese, U.S. and Canadian longline fisheries. Indices are scaled to the mean of years 1988-1990 for each time series.



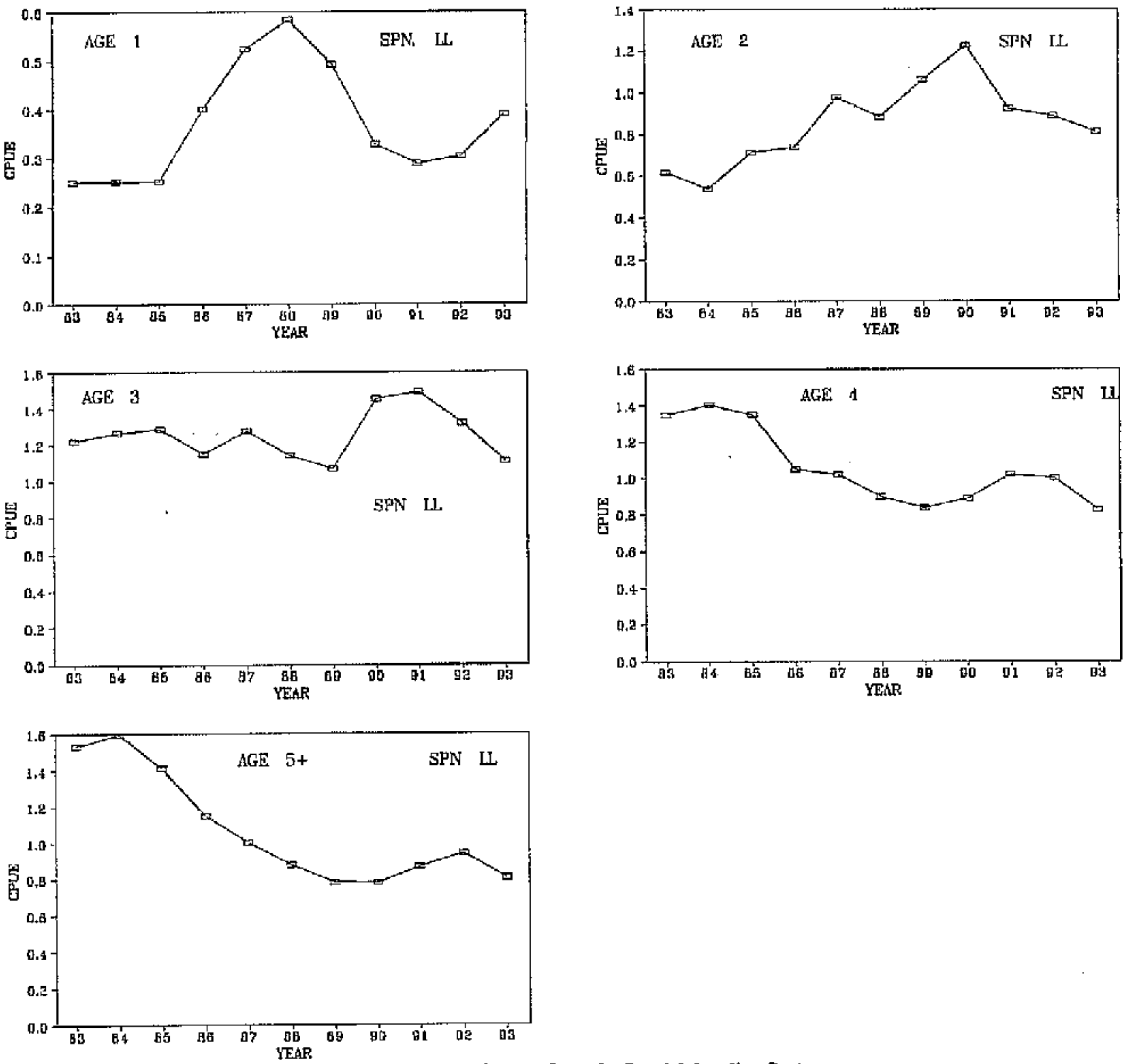
SWO-Fig. 6. North Atlantic (left panel) and South Atlantic (right panel) standardized biomass indices, presented to the 1994 SCRS. Indices have been adjusted to account for differences in scale through GLM analyses. Taiwanese CPUE is considered preliminary.



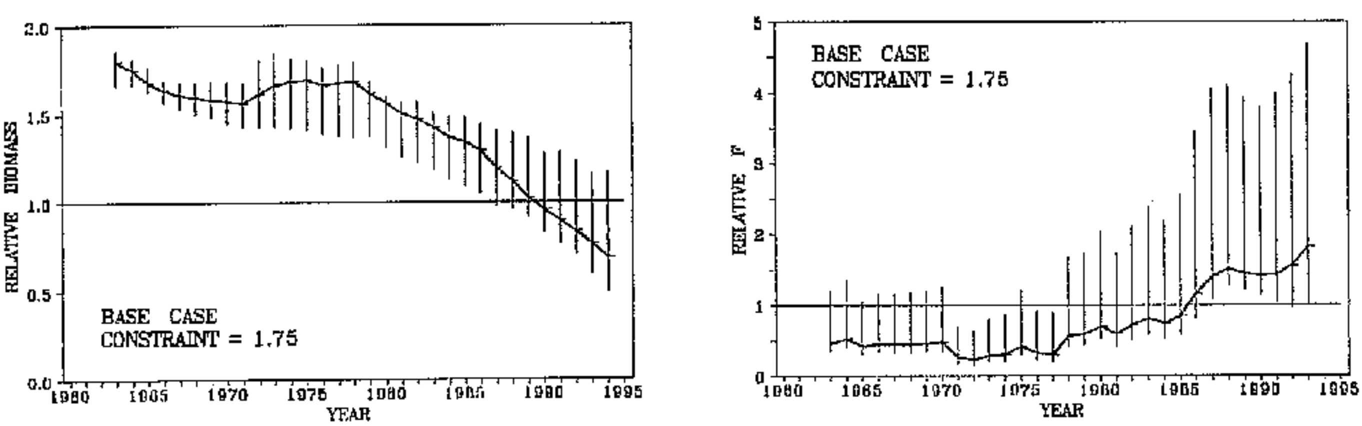
SWO-Fig. 7. Evolution of catch (relative to mean catch, 1963-1993) and standardized fishing effort for north Atlantic swordfish. As no effort data are available for 1971-1974, those years were omitted.



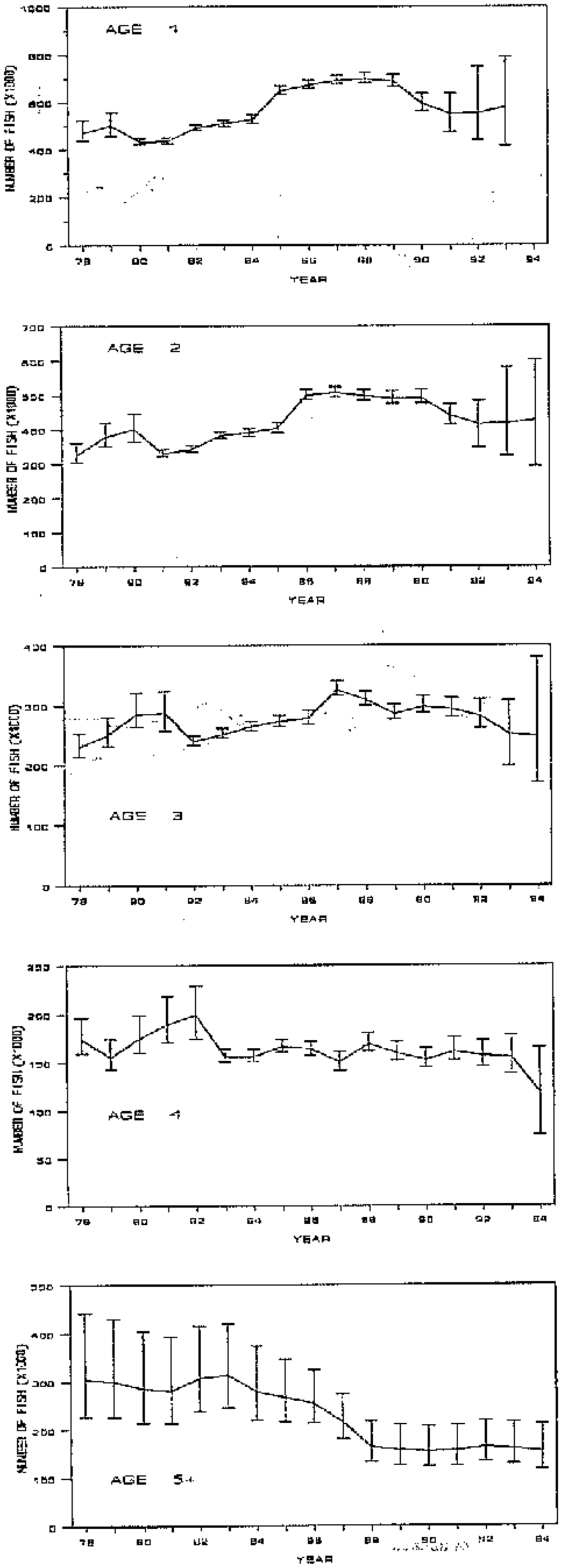
SWO-Fig. 8. South Atlantic age-specific, standardized catch rates from the Spanish and Japanese longline fleets.



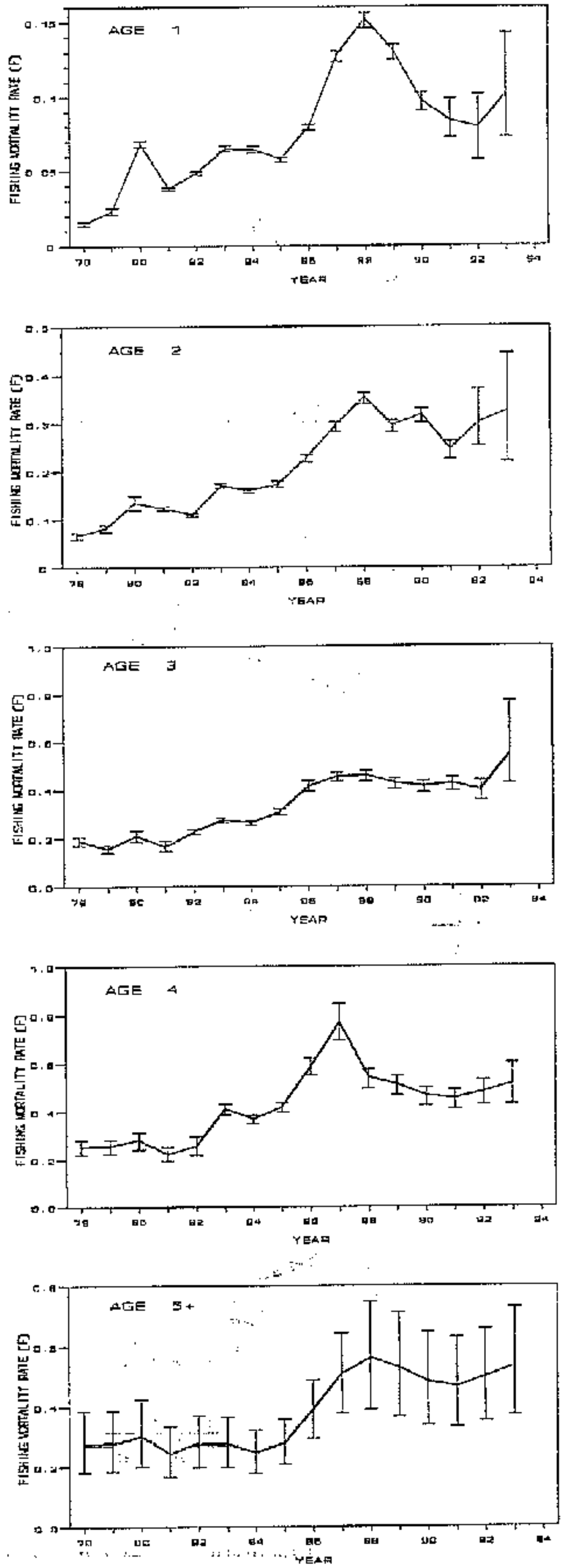
SWO-Fig. 9. Total Atlantic age-specific, standardized catch rates from the Spanish longline fleet.



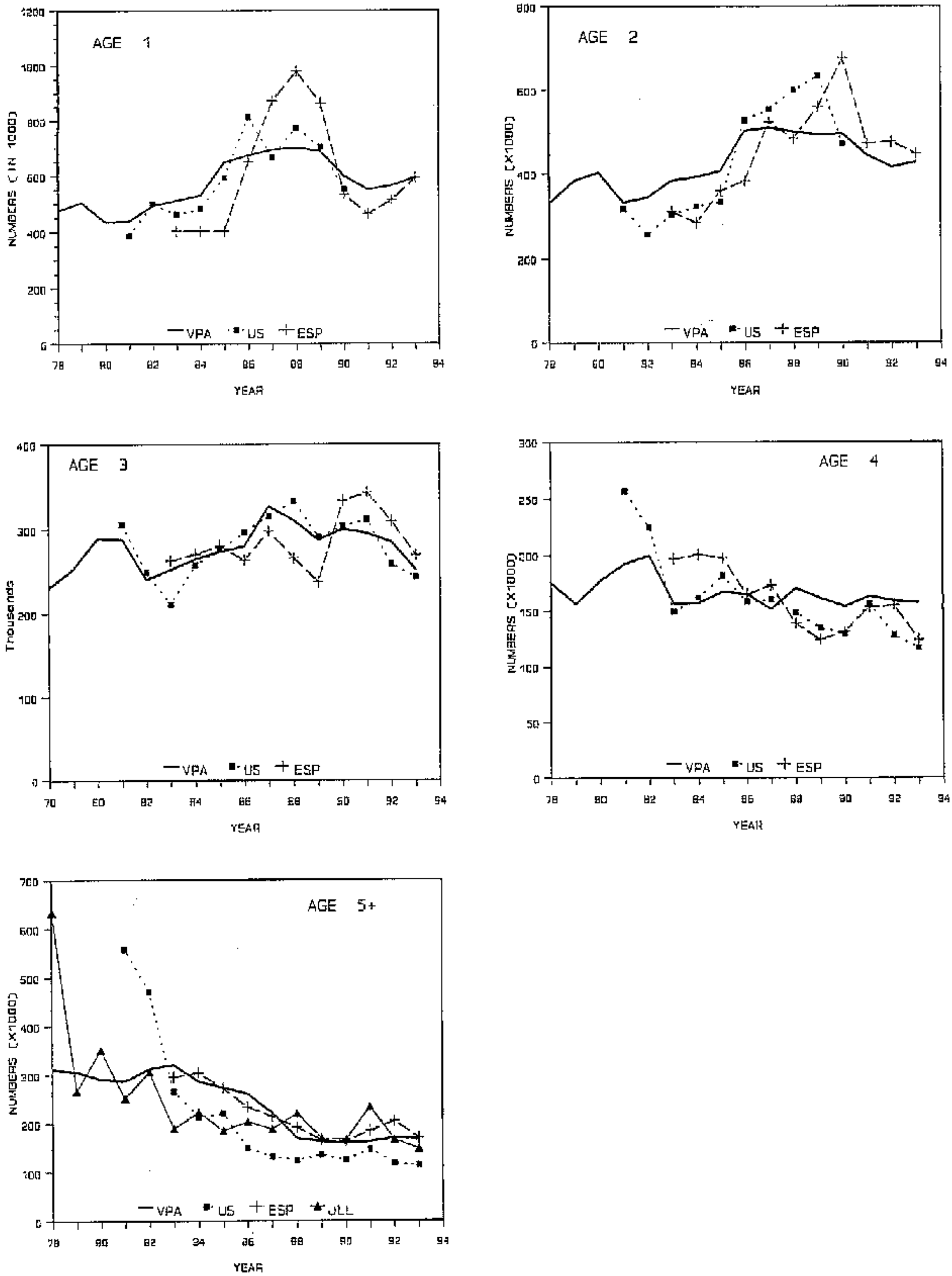
SWO-Fig. 10. Relative biomass (B/B_{MSY}) and relative fishing mortality (F/F_{MSY} estimates, with 80% confidence intervals, from the approximate base-case production model analysis. Reference line is 1.0.



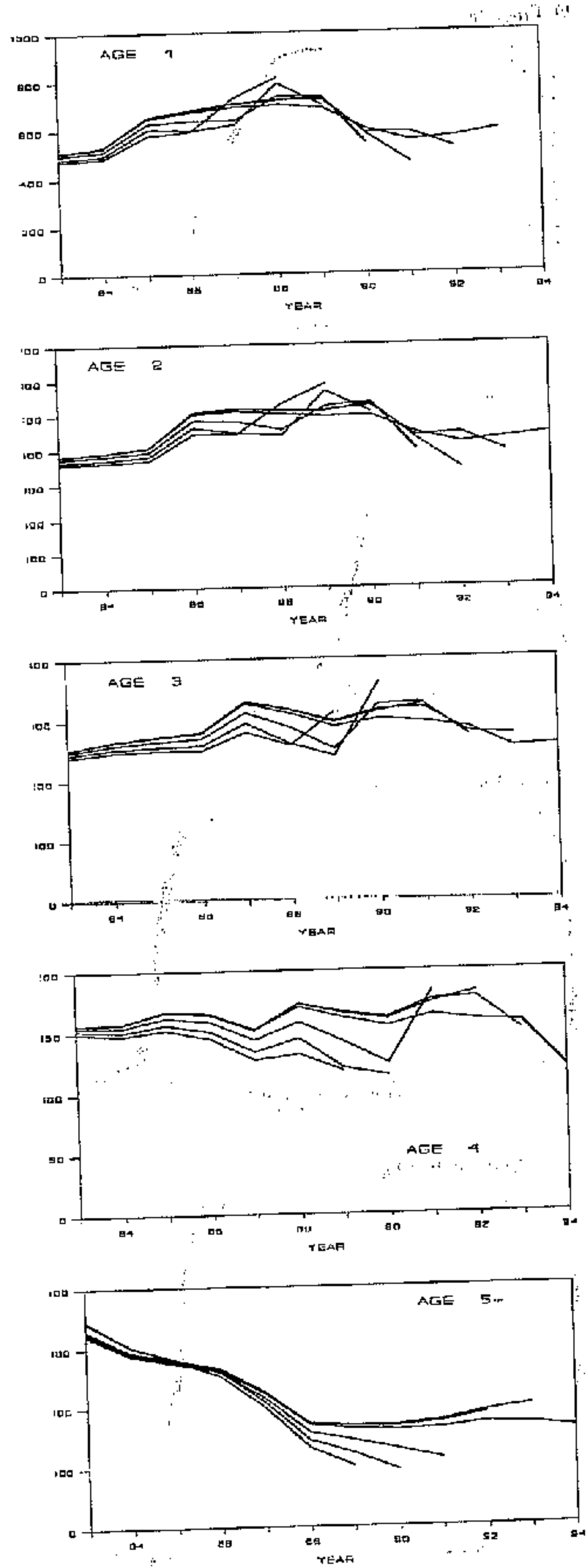
SWO-Fig. 11. Stock size at age from the base case VPA with 90% bootstrap confidence intervals.



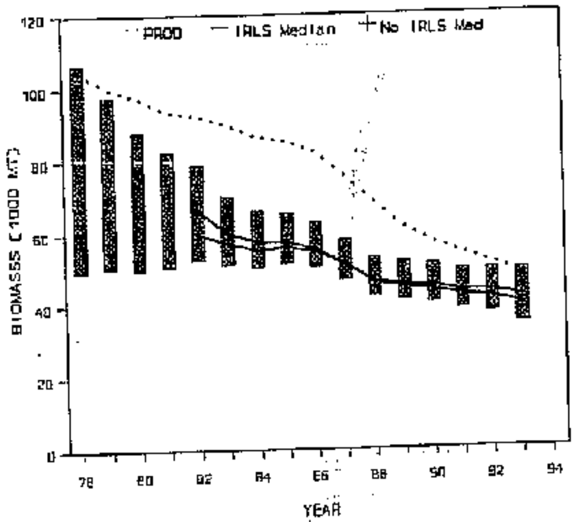
SWO-Fig. 12. Fishing mortality rate at age from the base case VPA with 90% bootstrap confidence intervals.



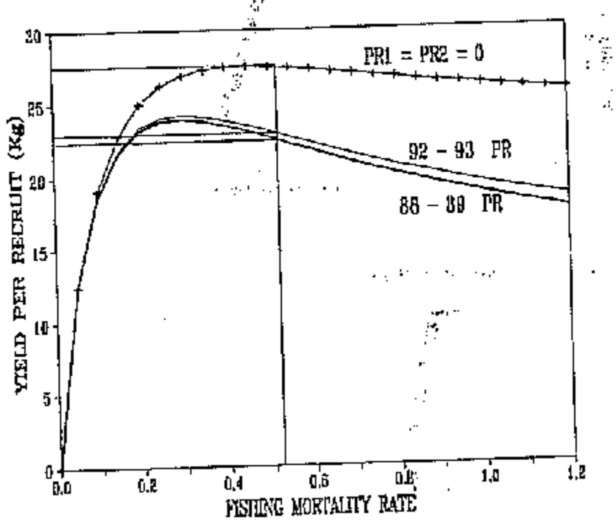
SWO-Fig. 13. Stock size at age from the base case VPA compared to scaled indices of abundance.



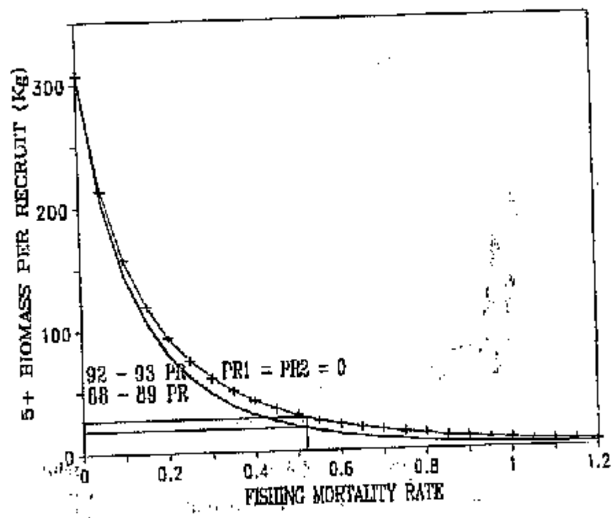
SWO-Fig. 14. Stock size at age from the base case VPA using a retrospective analysis in which the analysis is repeated with data through 1992, through 1991, etc.



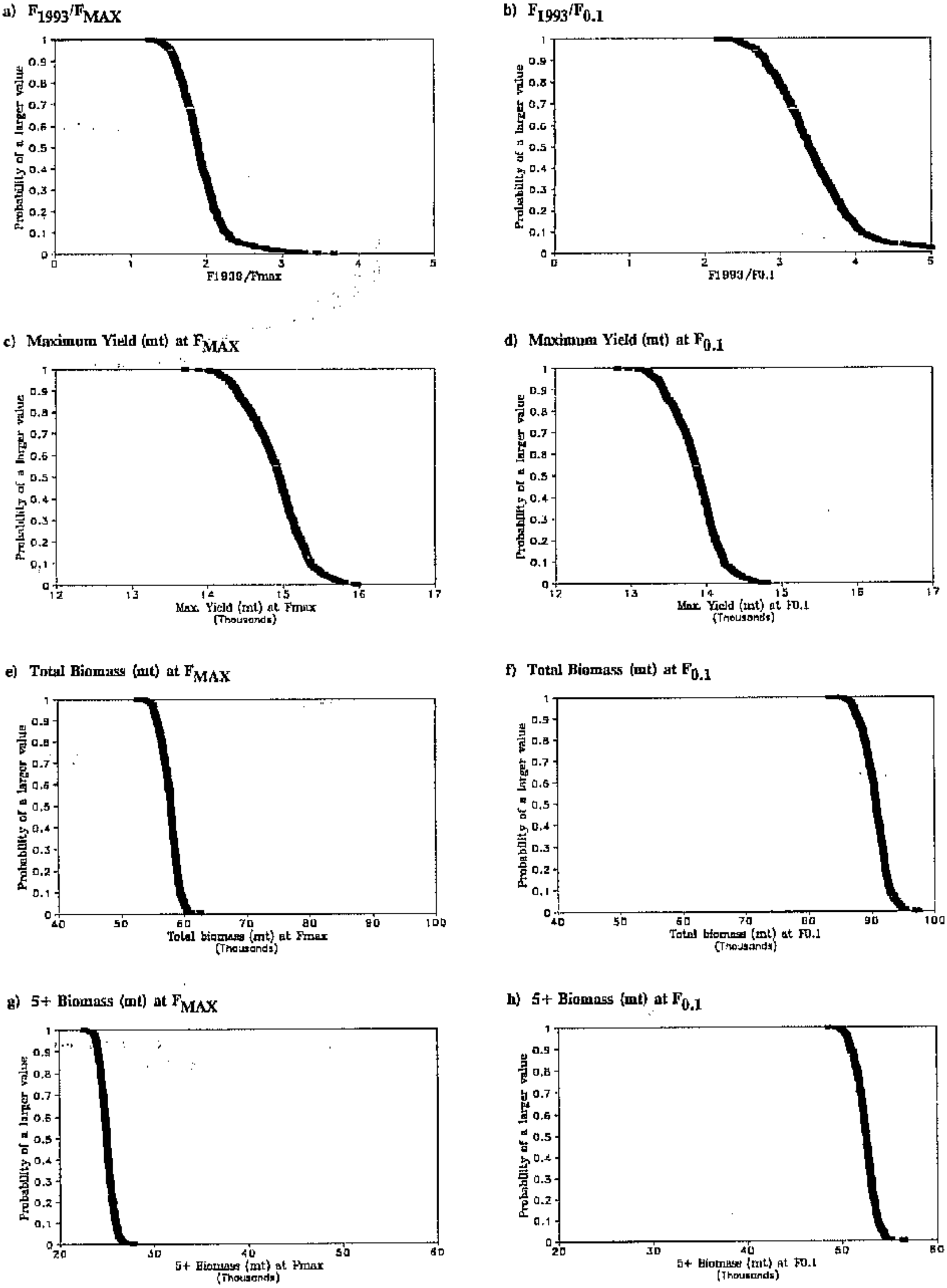
SWO-Fig. 15. Bootstrap 90% CI from IRLS and no IRLS VPA's (dashed line is production model estimate; solid lines are medians from IRLS and no IRLS VPA's).



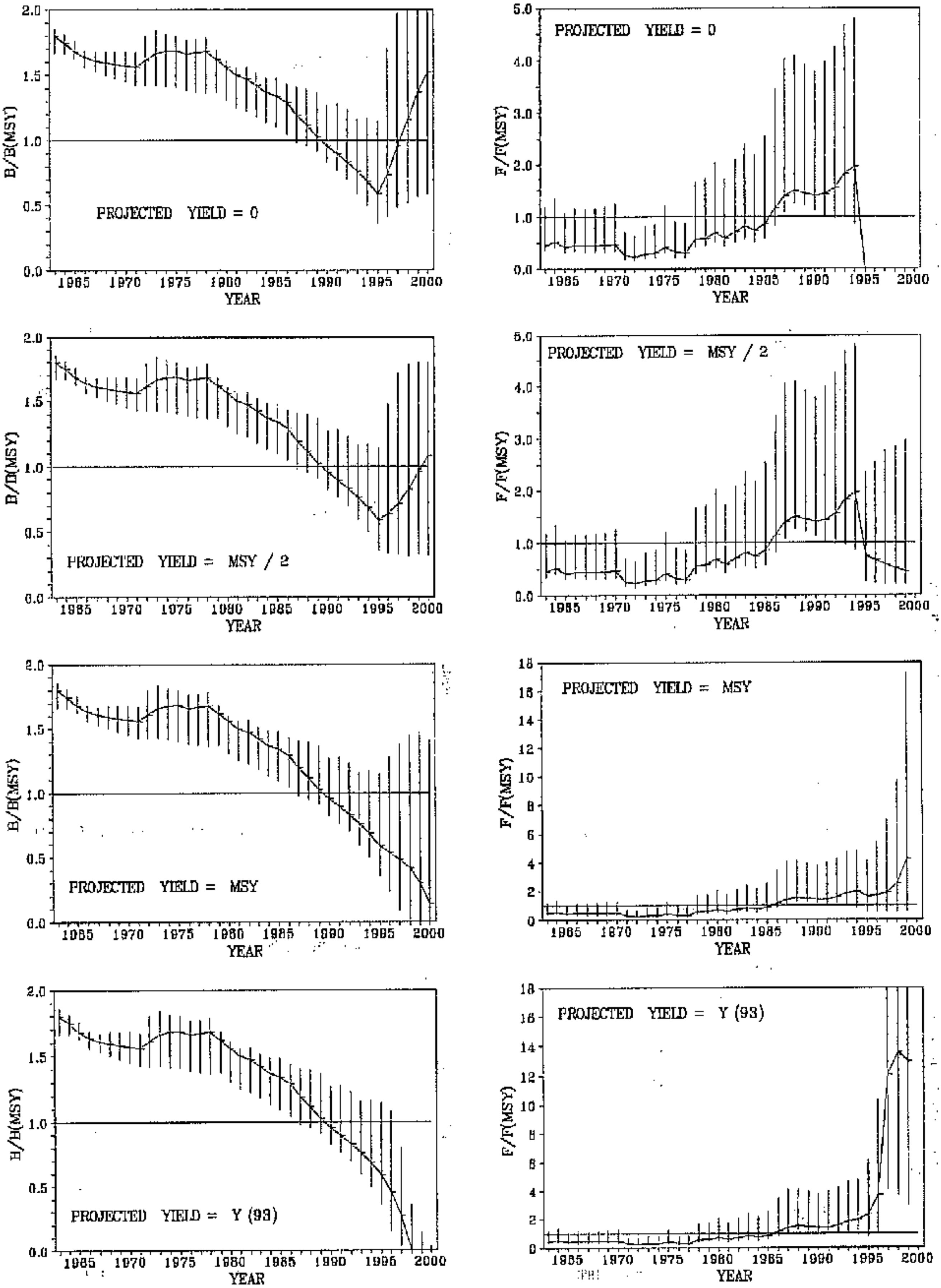
SWO-Fig. 16. Yield per recruit (YPR) results for the three runs summarized in SWO-Table 12. Straight lines indicate the current fully-recruited fishing mortality (0.506) and the corresponding YPR.



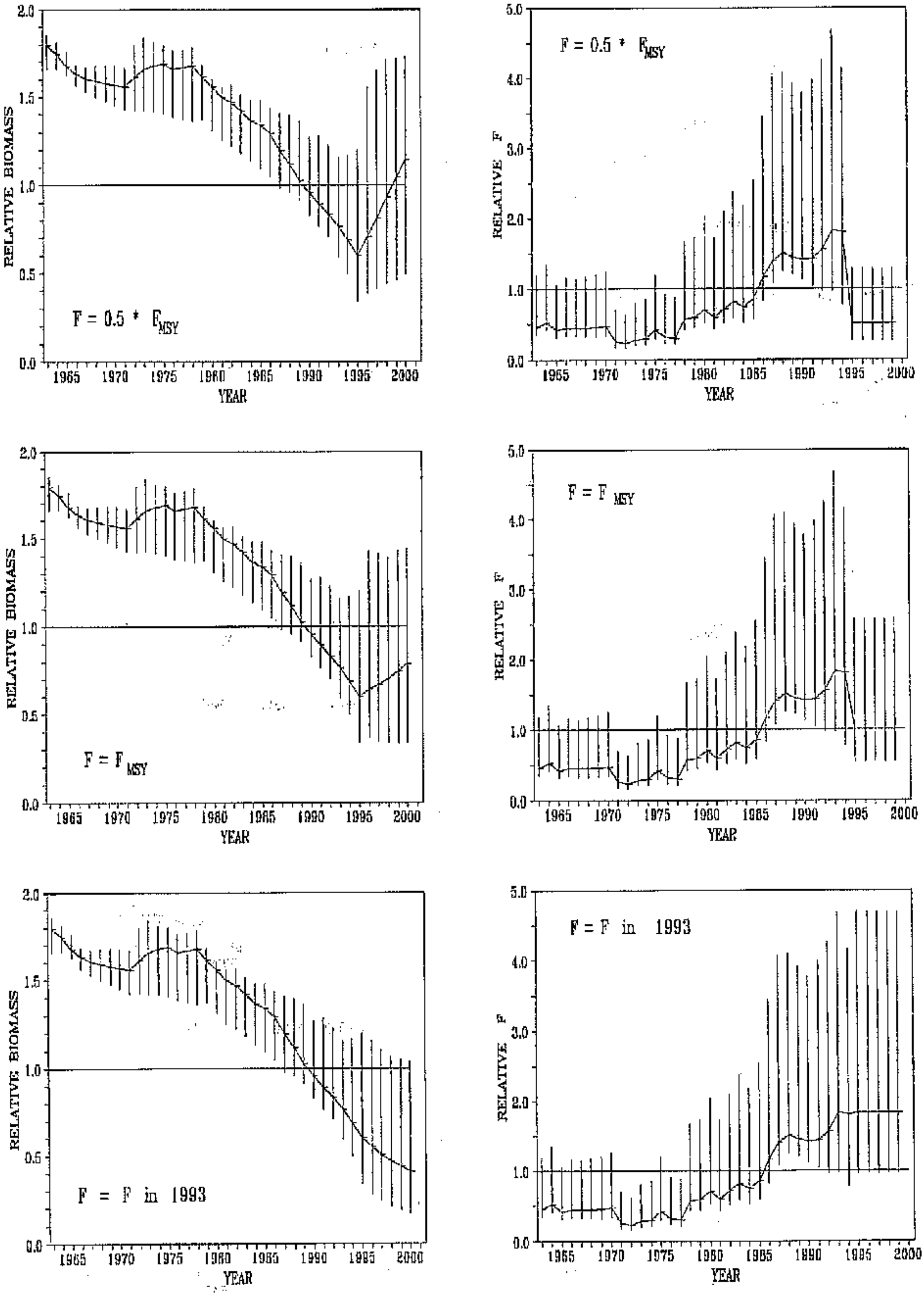
SWO-Fig. 17. 5+ biomass per recruit (BPR) results for the three runs summarized in SWO-Table 12. Straight lines indicate the current fully-recruited fishing mortality (0.506) and the corresponding BPR.



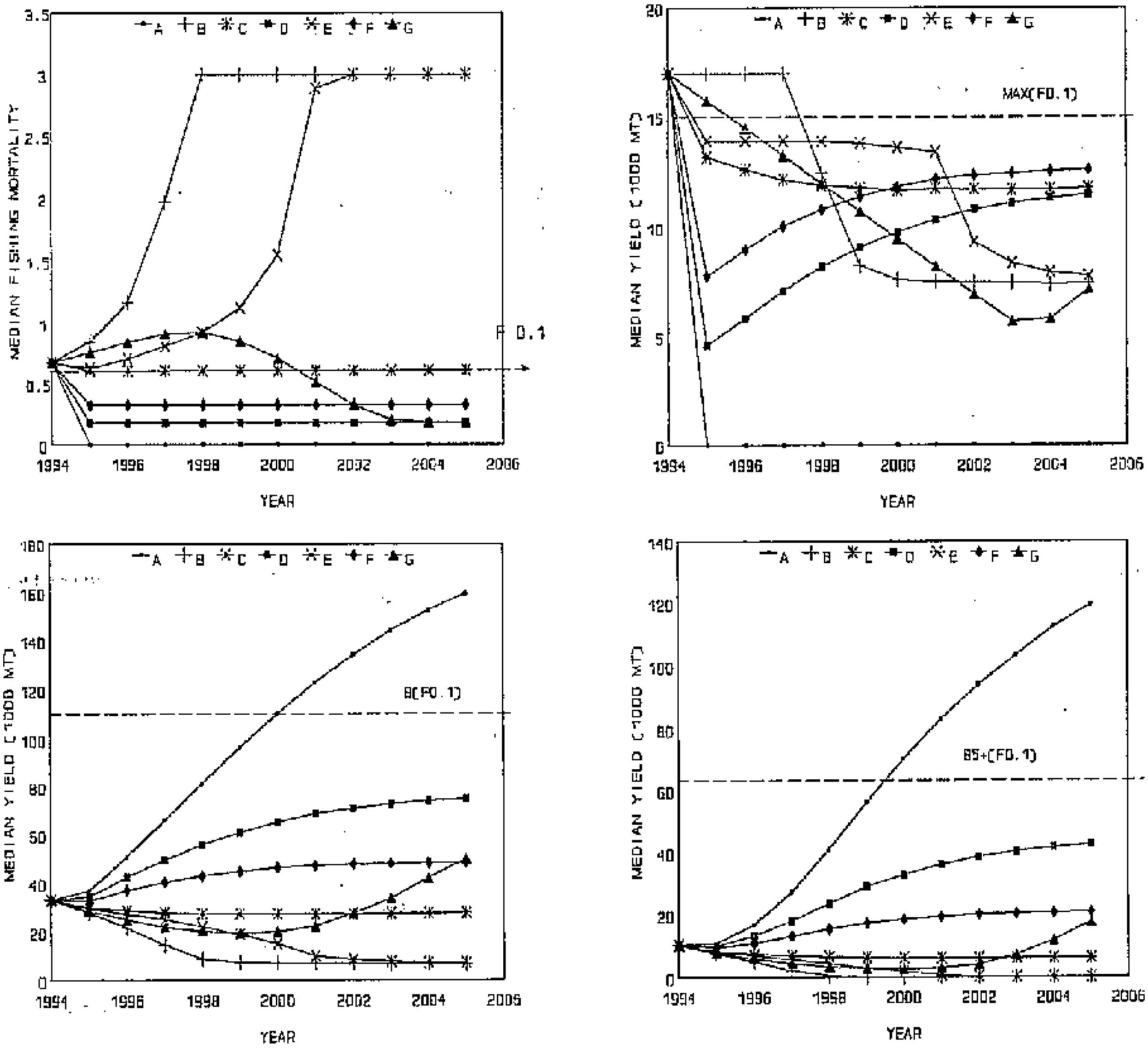
SWO-Fig. 18. Probabilities that fishing mortality rates, yields and biomasses exceed the values given on the abscissa of each graph. For example, the graph in the upper right corner shows that there is about an 80% probability that $F_{1993}/F_{0.1}$ exceeds 3.0. Probabilities were obtained by bootstrapping the base case VPA.



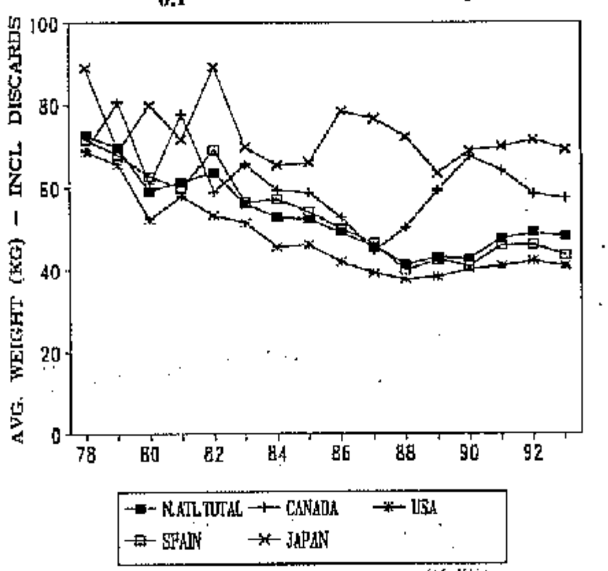
SWO-Fig. 19. Trajectories of relative biomass (B/B_{MSY}; left panels) and relative fishing mortality rate (F/F_{MSY}; right panels) from projections based on base-case production model. In this figure, projections were based on catch targets for 1995-1999. Catches for 1994 were assumed to equal those in 1993.



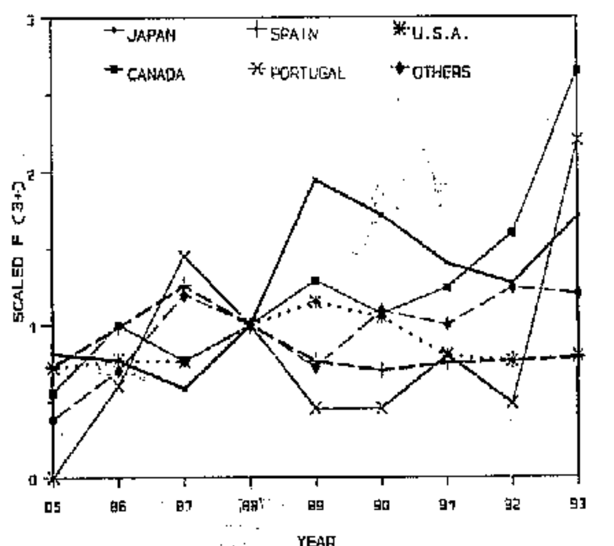
SWO-Fig. 20. Trajectories of relative biomass (B/B_{MSY} ; left panels) and relative fishing mortality rate (F/F_{MSY} ; right panels) from projections based on base-case production model. In this figure, projections were based on F targets for 1995-1999. Catches for 1994 were assumed to equal those in 1993.



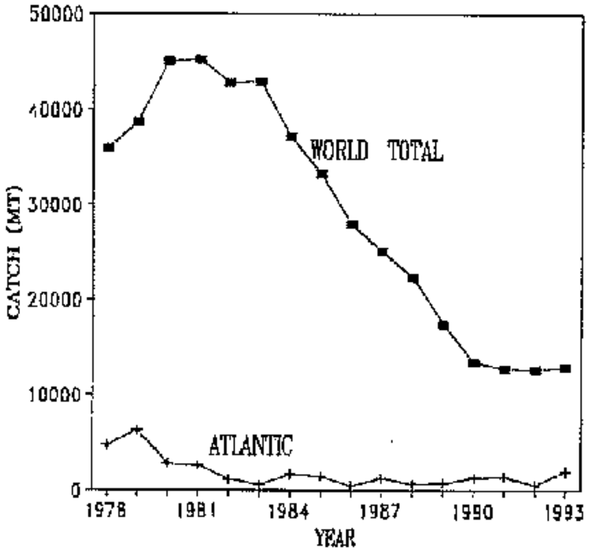
SWO-Fig. 21. Projection results based on VPA analyses for seven scenarios: A = zero catch; B = Annual yield of 17000 MT (as in 1993); C = Annual F as 1993 F; D = Annual F set to $F_{0.1}$; E= Annual yield set to maximum average yield under $F_{0.1}$; F = Annual F set $F_{0.1}$; G = Annual F set to $F_{0.1}$ with annual reductions in yield of not more than 1,250MT. In all cases, F is constrained to be under 3.0 and recruitment was assumed to be independent of stock size. Dashed lines denote equilibrium levels corresponding to $F_{0.1}$ under constant recruitment equal to the mean 1983-1991 estimated levels.



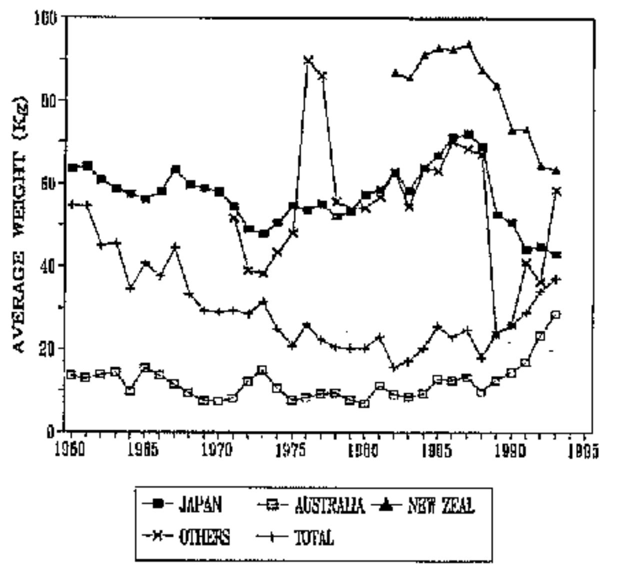
SWO-Fig. 22. Average weight of swordfish in the catch (including discards) in the North Atlantic, by major nations and total North Atlantic.



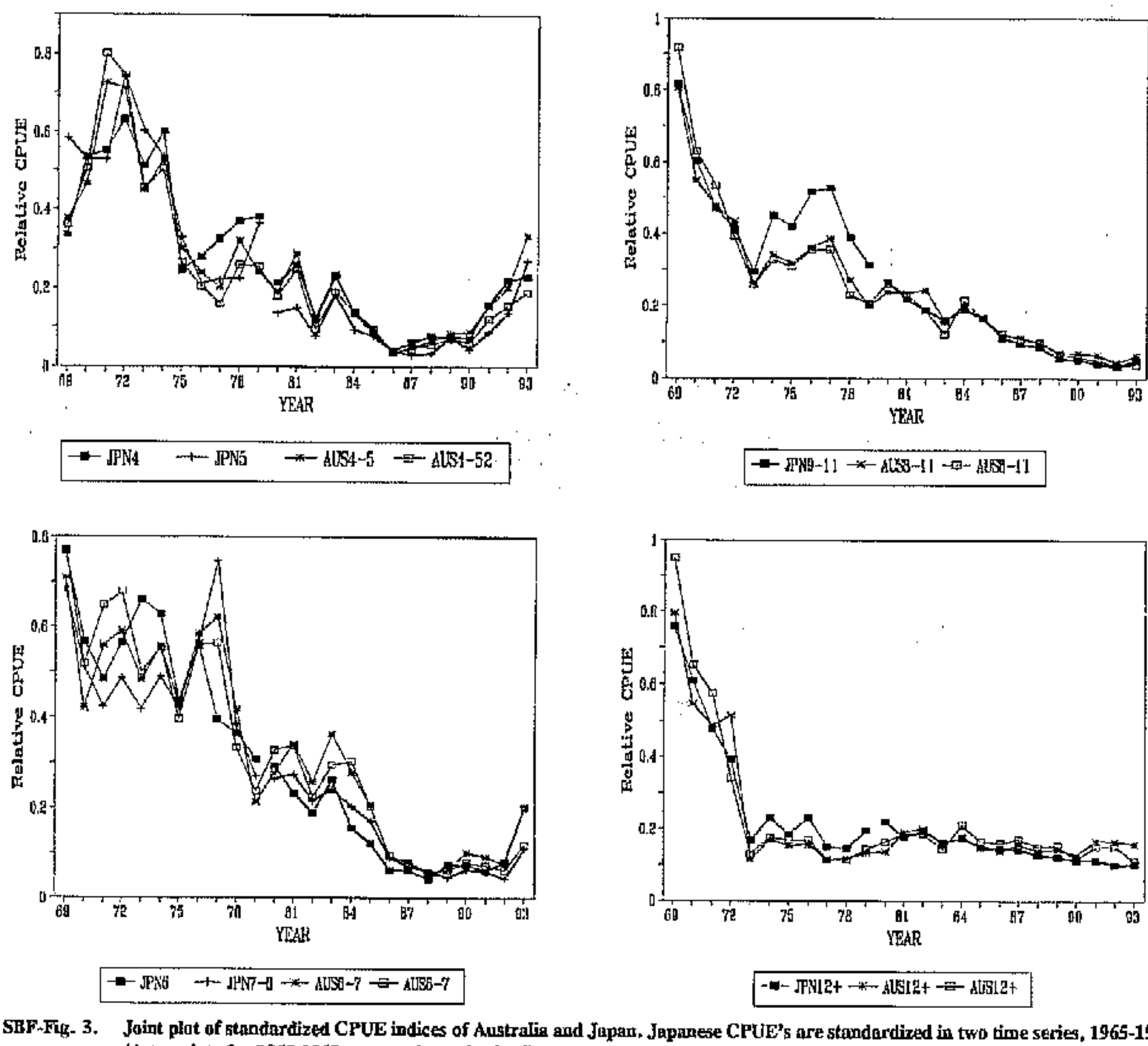
SWO-Fig. 23. Swordfish fishing mortality rates by nation based on the base-case VPA, relative to 1988.



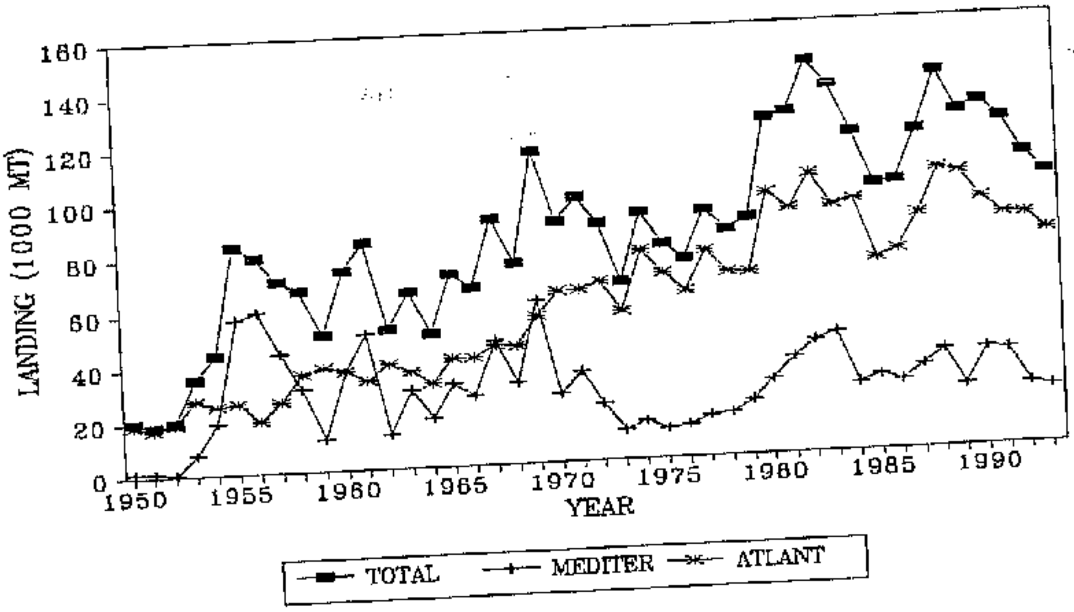
SBF-Fig. 1. World and Atlantic catches (in 1000 MT) of southern bluefin tuna.



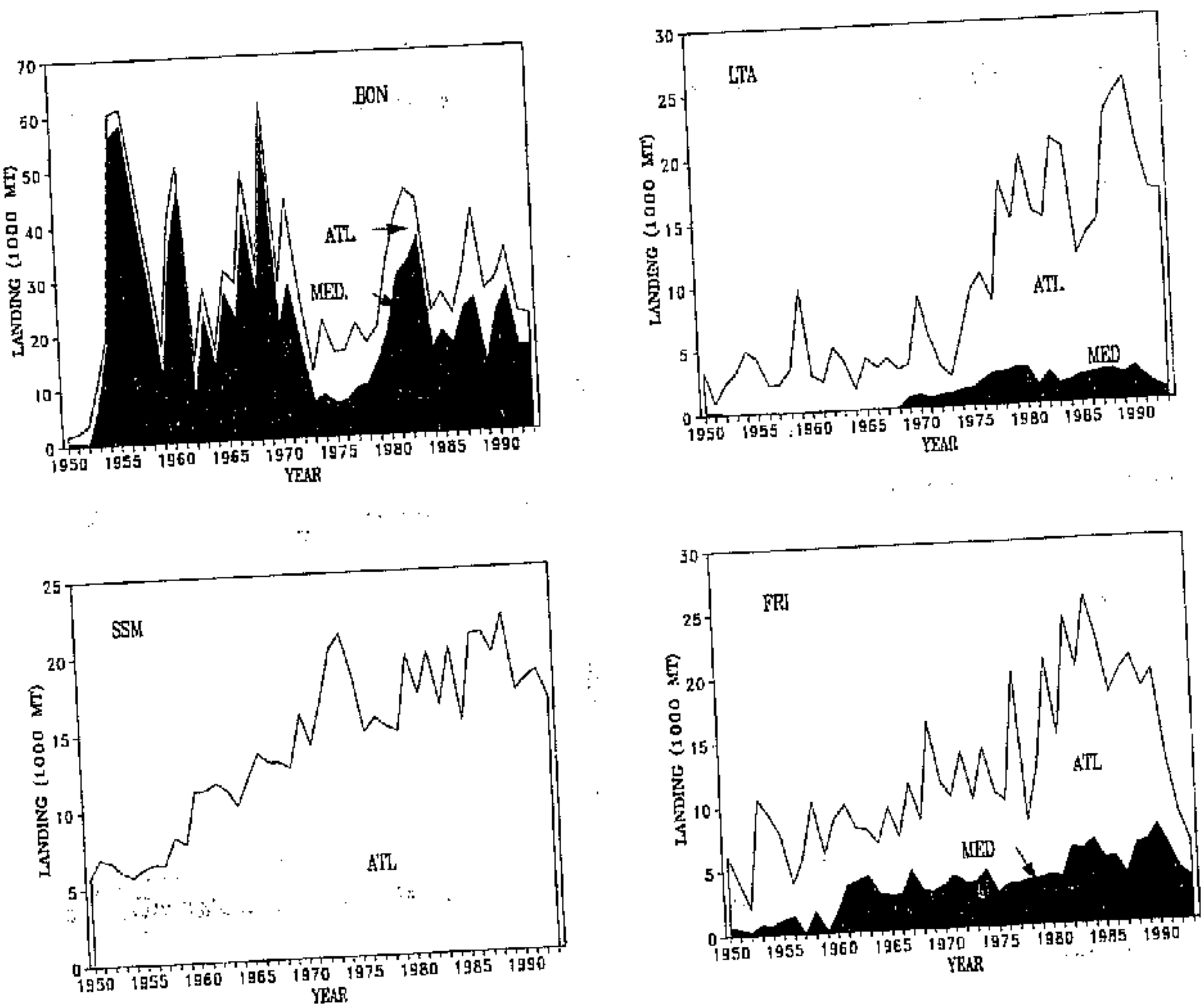
SBF-Fig. 2. Average weight of fish caught in southern bluefin fisheries of various nations.



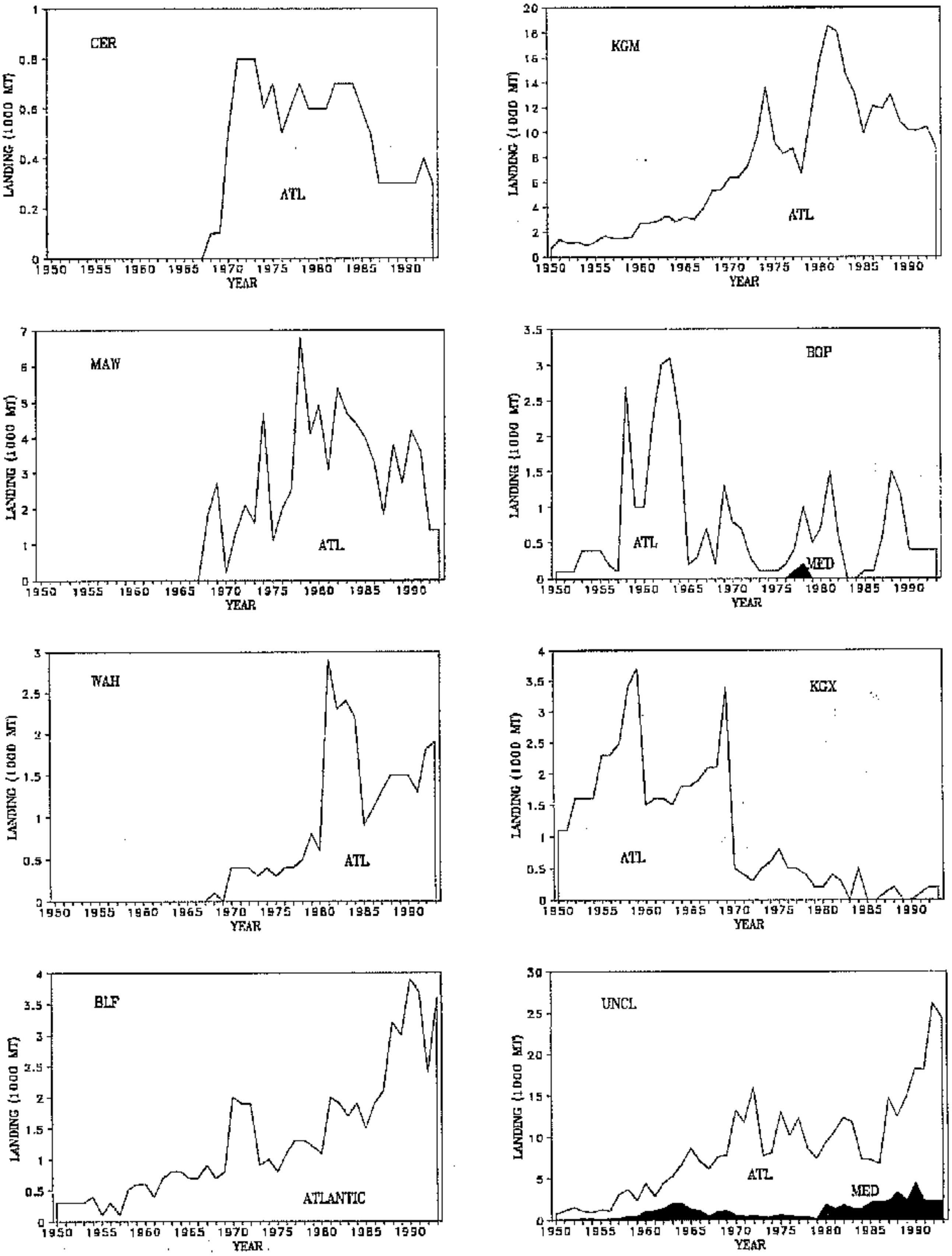
SBF-Fig. 3. Joint plot of standardized CPUE indices of Australia and Japan. Japanese CPUE's are standardized in two time series, 1965-1979 (data points for 1965-1968 are not shown in the figure) and 1980-1993.



SMT-Fig. 1. Reported total landing of small tunas in the Atlantic and the Mediterranean Sea.



SMT-Fig. 2. Reported small tuna landings by species, in the Atlantic and the Mediterranean Sea.



SMT-Fig. 2. Continued.

Appendix 1 to Annex 25

SCRS AGENDA

1. Opening of the meeting
2. Adoption of Agenda and arrangements for the meeting
3. Introduction of delegations
4. Admission of observers
5. Admission of scientific documents
6. Review of national fisheries and research programs
7. Reports of 1994 inter-sessional scientific meetings
   - Second Meeting of the Permanent Working for the Improvement of ICCAT Statistics and Conservation Measures (Tokyo, Japan - April 17-19, 1994)
   - Final Meeting of the ICCAT Albacore Research Program (Sukarrieta, Vizcaya, Spain - June 1-8, 1994)
   - ICCAT Workshop on the Technical Aspects of Methodologies which Account for Individual Growth Variability by Age (Brest, France - June 27-29, 1994)
   - Data Preparatory Meeting for the South Atlantic Abundance Indices (Tamandaré, Pernambuco, Brazil -August 3-9, 1994)
   - Ad Hoc GFCM/ICCAT Joint Working Group on Stocks of Large Pelagic Fishes in the Mediterranean Sea (Fuengirola, Malaga, Spain - September 19-23, 1994)
   - Other meetings
8. Conclusions of the Albacore Research Program
9. Review of the progress made by the Program of Enhanced Research for Billfish
10. Review of the progress made by the Bluefin Year Program
11. Review of conditions of stocks:
    Tropical tunas: YFT-Yellowfin, BET-Bigeye, SKJ-Skipjack
    ALB-Albacore, BFT-Bluefin, BIL-Billfishes, SWO-Swordfish,
    SBF-Southern Bluefin, SMT-Small Tunas
12. Report of Sub-Committee on Environment
    - Anomalies in oceanic conditions in recent years
    - Ecology of tunas (association with floating objects, with other marine animals, gear selectivity, species interactions, by-catches, etc.)
    - Review of studies on the effect of the environment on tuna ecology and the conclusions of various international meetings on the environment
13. Report of the Sub-Committee on Statistics and review of Atlantic tuna statistics and data management system
    - Review of national statistics
    - The Secretariat's statistical work in 1994
    - Problems of unreported catches by non-Contracting Parties
    - Progress made on recommendations for statistics (as contained in the 1993 SCRS Report), and future plans
14. Collection of information on by-catches
15. Review of ICCAT publications
16. Draft of the scientific opinions to be submitted, if necessary, to CITES
17. Review of future SCRS activities
    - Proposal for an ICCAT Tuna Symposium
    - Organization of the SCRS sessions
    - Inter-sessional scientific meetings in 1995
    - Other matters
18. Cooperation with non-Contracting Parties and other organizations
19. Date and place of the next meeting of the SCRS
20. Other matters
21. Adoption of Report
22. Adjournment

Appendix 2 to Annex 25

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Appendix 3 to Annex 25

LIST OF SCRS DOCUMENTS

SCRS/94/1	Tentative Agenda of the SCRS
SCRS/94/2	Annotated Tentative Agenda of the SCRS (COM/94/1)
SCRS/94/3	Tentative Agenda of the Sub-Committee on Statistics
SCRS/94/4	Tentative Agenda of the Sub-Committee on Environment
SCRS/94/5	Organization of the 1994 Meeting of the SCRS
SCRS/94/6	Guidelines for the presentation of Documents to the 1994 SCRS
SCRS/94/7	Updating of the catch-at-size data base for albacore data substitution, and raising to the total catch, presented to two albacore meetings in 1994 - Miyake, P. M., P. Kebe
SCRS/94/8	Updating of the catch-at-size data base for swordfish data substitution, and raising to the total catch, presented to the SCRS stock assessment session - Miyake, P. M., P. Kebe
SCRS/94/9	Statistical analysis of tuna fisheries in eastern Atlantic: A preliminary report - Cuevas,A., J. de la Horra, J. Romo
SCRS/94/10	Compte Rendu de la 53ème Réunion de la Commission Inter-Américaine du Thon Tropical (IATTC) *(Cumana, Venezuela, 7-8 juin 1994)* - Gaertner, D.
SCRS/94/11	Updating of the catch at size data base for Atlantic yellowfin tuna, data substitution, and raising to the total catch, presented to the SCRS - Miyake, P. M., P. Kebe
SCRS/94/12	Report on Statistics and Coordination of Research in 1994 (COM/94/12)
SCRS/94/13	1994 Meeting Report of the Standing Committee on Research and Statistics (SCRS) (COM/94/13)
SCRS/94/14	Report of the Contributions-Expenditures of the ICCAT Enhanced Billfish Research Program in 1994 (COM/94/14)
SCRS/94/15	Review of the Progress made in the Bluefin Year Program (BYP) in 1994 - Suzuki, Z., B. Liorzou (COM/94/15)
SCRS/94/16	Report of the Final Meeting of the ICCAT Albacore Research Program *(Sukarrieta, Vizcaya, Spain, June 1-8, 1994)* (COM/94/16)
SCRS/94/17	Second ICCAT Workshop on the Technical Aspects of Methodologies which Account for Individual Growth Variability by Age *(Brest, France, June 27-29, 1994)* (COM/94/17)
SCRS/94/18	United Nations Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks (COM/94/18)

SCRS/94/19 Second Meeting of the Permanent Working Group for the Improvement of ICCAT Statistics and Conservation Measures *(Tokyo, Japan, April 19-21, 1994)* (COM/94/19)

SCRS/94/20 Information relative to High Seas Driftnet Fishing (COM/94/20)

SCRS/94/21 Report of the First Meeting of the *Ad Hoc* GFCM/ICCAT Working Group on Stocks of Large Pelagic Fishes in the Mediterranean Sea *(Fuengirola, Malaga, Spain, September 19-24, 1994)* (COM/94/21)

SCRS/94/22 Redesigning of the Secretariat computer system (COM/94/22)

SCRS/94/23 Review of the possibilities of access to data bases on the environment (COM/94/23)

SCRS/94/24 Report of the Data Preparatory Meeting for the South Atlantic Abundance Indices *(Tamandare, Pernambuco, Brazil, August 3-9, 1994)* (COM/94/24)

SCRS/94/25 ICCAT Tuna Symposium (COM/94/25)

SCRS/94/26 Report of the *Ad Hoc* Consultation on the Role of Regional Fishery Agencies in Relation to High Seas Fishery Statistics *(La Jolla, California, U.S.A., December 13-16, 1993)* (COM/94/35)

SCRS/94/27 Report of the *Ad Hoc* Inter-Agency Consultation on Atlantic Fishery Statistics *(Madrid, Spain, July 11-15, 1994)* (COM/94/36)

SCRS/94/28 Informe Nacional de Uruguay - Mora, O.

SCRS/94/29 National Report of Korea - NFRDA

SCRS/94/30 Standardized catch rates for albacore *(Thunnus alalunga)* from the Spanish surface fleets in the northeast Atlantic, years 1981-93 - Mejuto, J., B. Garcia

SCRS/94/31 Updated ASPIC analyses for North Atlantic albacore through 1992 - Cummings-Parrack, N.

SCRS/94/32 Abundance indices and stock assessment of south Atlantic albacore *(Thunnus alalunga)* - Punt, A. E., A. J. Penney, R. W. Leslie

SCRS/94/33 Preliminary age validation results from tagged-recaptured fluorochrome label albacore in northeast Atlantic - Ortiz de Zarate, V., P. Megalofonou, G. de Metrio, C. Rodríguez Cabello

SCRS/94/34 Note on updated tag-recapture growth analyses for North Atlantic albacore - Ortiz de Zarate, V., N. Cummings-Parrack

SCRS/94/35 CPUE diaria de la flota vasca de cebo vivo de 1990 a 1993 - Santiago, J.

SCRS/94/36 Final Report of the Data Preparatory Meeting for Atlantic Pelagic Tuna Longline Fisheries *(Taipei, Taiwan, May 11-15, 1994)*

SCRS/94/37 The historical trend of standardized CPUE for albacore caught by Japanese longline fishery in the Atlantic Ocean - Uozumi, Y.

SCRS/94/38 Review of biology and fisheries on albacore in the North Pacific Ocean - Nakano, H.

SCRS/94/39	Review of data collection system for the Japanese longline fishery and problems about standardization of CPUE - Nakano, H.
SCRS/94/40	Comparison of standardized longline CPUE of albacore among the oceans and countries - Nakano, H.
SCRS/94/41	A historical review of Japanese longline fishery and albacore catch in the Atlantic Ocean - Uozumi, Y.
SCRS/94/42	Preliminary analysis on the albacore *(Thunnus alalunga)* stock structure inferred by PCR-RFLP analysis on mtDNA gene - Chow, S., H. Ushiama
SCRS/94/43	The recent catch estimating procedures of Taiwanese longline fisheries - Hsu, C.C., M.C. Lin
SCRS/94/44	Extracting Taiwanese longline catches targeted on Atlantic albacore through daily catch composition - Chang, S. K., C. C. Hsu, H. C. Liu
SCRS/94/45	Adjusted Taiwanese longline CPUE of North Atlantic albacore stock from target species segregated catch data - Chang, S. K., C. C. Hsu
SCRS/94/45bis	New estimates of the adjusted North Atlantic albacore CPUE from Taiwanese longline catch data of 1968-1993 - Chang, S. K., C. C. Hsu
SCRS/94/46	The North Atlantic albacore *(Thunnus alalunga)* assessment problem - Bard, F. X., T. Joanny
SCRS/94/47	Standardization of South Atlantic albacore CPUE by using GLM with area-time-species adjustments on Taiwanese data - Wu, C. L., S. Y. Yeh, H. C. Liu
SCRS/94/48	Trends of abundance indices of albacore tuna *(Thunnus alalunga)* obtained by GLM fitting of the French troll and baitboat catch per unit of effort data for the period 1967 to 1986 - Goujon, M., L. Antoine, D. Gascuel
SCRS/94/49	Swordfish catch and fishery in the south Atlantic and preliminary results of standardized CPUE using the data of major fishing countries - Nakano, H.
SCRS/94/50	Data check of ICCAT Task II for the South Atlantic - Uosaki, K.
SCRS/94/51	A multi-component variant of the ASPM approach for use in the assessment of north Atlantic albacore *(Thunnus alalunga)* - Punt, A. E.
SCRS/94/52	Standardized catch rates by age and length groups for swordfish *(Xiphias gladius)* from the Spanish longline fleet in the Atlantic, 1983-93 - Mejuto, J., J. M. de la Serna
SCRS/94/53	Standardized catch rates in number and weight for the swordfish *(Xiphias gladius)* from the Spanish longline fleet in the Mediterranean Sea, 1988-1993 - Mejuto, J., J. M. de la Serna
SCRS/94/54	Taiwanese longline fishery in the Mediteranean with emphasis on catch and catch-at-size of bluefin tuna - Hsu, C. C.
SCRS/94/55	Catch of bluefin tuna in the Atlantic for Taiwanese longline fishery - Hsu, C. C.
SCRS/94/56	A preliminary report on the investigations of bluefin tuna (*Thunnus thynnus*, L. 1758) caught in the Turkish waters - Karakulak, F. S., I. K. Oray

SCRS/94/57 A preliminary report on the investigations of the bullet tuna (*Auxis rochei*, Risso 1810) caught in the Turkish waters - Bök, T., I. K. Oray

SCRS/94/58 A preliminary report on the investigations of the Atlantic little tuna (*Euthynnus alletteratus*, Rafinesque 1810) in Turkish waters - Kahraman, A. E., I. K. Oray

SCRS/94/59 A preliminary report on the investigation of swordfish (*Xiphias gladius*, L. 1758) caught in the Turkish waters - Aliçli, T. Z., I. K. Oray

SCRS/94/60 Use of a surplus-production model to analyze the standard ICCAT age-structured simulated data sets - Prager, M. H.

SCRS/94/61 Variability of fishing mortality by age: consequences for MSY - Goodyear, C. P.

SCRS/94/62 Red grouper mean size at age: an evaluation of sampling strategies using simulated data - Goodyear, C. P.

SCRS/94/63 Analysis of St. Andrews simulated datasets using length-based separable sequential population analysis - Kimura, D. K.

SCRS/94/64 Application of cohort slicing and tuned VPA to simulated data that includes variability in length at age - Restrepo, V. R.

SCRS/94/65 Progress report on length based methods using the 4 data sets derived at 1993 ICCAT Meeting - Mohn, R.

SCRS/94/66 Estimates of growth and abundance from simulated size composition data using the stock synthesis model - Methot, R. D.

SCRS/94/67 On the age and growth of swordfish in the northwest Atlantic Ocean - Ehrhardt, N. M.

SCRS/94/68 An assessment of Atlantic bluefin tuna - Committee to Review Atlantic Bluefin Tuna

SCRS/94/69 Useful methods for dealing with outliers in stock assessments - Restrepo, V. R., J. E. Powers

SCRS/94/70 Biological assessment of tunas and other prey of sooty terns nesting in the Dry Tortugas, Florida - Miller, R. J., J. A. Browder, J. Cramer, W. B. Robertson Jr., W. J. Richards, S. Kelley

SCRS/94/71 Method of incorporating uncertainty in size composition of catches of east Atlantic bluefin tuna in assessments - Turner, S. C., V. R. Restrepo

SCRS/94/72 Use of tagging data within a VPA formalism to estimate migration rates of bluefin tuna accross the North Atlantic - Punt, A. E., D. S. Butterworth

SCRS/94/73 Virtual population analyses of Atlantic bluefin tuna incorporating movement and tagging data - Porch, C. E., V. R. Restrepo, S. C. Turner, G. P. Scott

SCRS/94/74 Review of information related to Atlantic bluefin tuna east-west movement - Turner, S. C., J. E. Powers

SCRS/94/75 A two-area VPA with discrete mixing: can we discriminate between mixing rates given the present condition of the data? - Porch, C. E.

SCRS/94/76 Genetics of highly migratory oceanic pelagic fishes: bluefin tuna - Dean, J. M., C. Woodley

SCRS/94/77 Materials for the chemical identification of early life stages of bluefin tuna, *Thunnus thynnus* - Richards, W. J., S. Kelley

SCRS/94/78 -

SCRS/94/79 National Report of Japan - National Research Institute of Sea Fisheries -

SCRS/94/80 Una relación talla (LJFL)-peso canal (DW) de pez espada *(Xiphias gladius)* para el Mediterráneo occidental - de la Serna, J. M. D. Ovejero, J. M. Ortíz de Urbina

SCRS/94/81 A review of driftnet catches by the Italian fleet: species composition, observers data and distribution along the net - di Natale, A., A. Mangano, A. Maurizi, L. Montaldo, E. Navarra, S. Pinca, G. Schimmenti, G. Torchia, M. Valastro

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SCRS/94/83 Albacore (*Thunnus alalunga* Bonn.) fishery in the Tyrrhenian Sea: 1990-1992 Report - di Natale, A., A. Mangano, E. Navarra, G. Schimmenti, M. Valastro

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SCRS/94/85 Driftnets impact on protected species: observers data from the Italian fleet and proposal for a model to assess the number of cetaceans in the by-catch - di Natale, A.

SCRS/94/86 Moon phases influence on CPUE: a first analysis of swordfish driftnet catch data from the Italian fleet between 1990 and 1991 - di Natale, A., A. Mangano

SCRS/94/87 -

SCRS/94/88 Croissance du thon rouge à partir des données des senneurs français méditerranéens, Bluefin tuna growth from Mediterranean French purse seiners data - Liorzou, B., J. L. Bigot

SCRS/94/89 Feeding of the swordfish, the bluefin and other pelagic nekton in the western Ligurian Sea - Orsi Relini, L., F. Garibaldi, C. Cima, G. Palandri

SCRS/94/90 Greek swordfish fishery - Tserpes, G.

SCRS/94/91 Datos de la pesquería de atún rojo del Mar Cantábrico - Cort, J. L.

SCRS/94/92 Revisión del marcado/recaptura de atún rojo en el Atlántico Oriental y Mediterráneo - Cort, J. L., B. Liorzou

SCRS/94/93 La croissance de l'espadon pêché près des côtes algériennes - Chalabi, A., I. Cherrak, S. Hamida, M. Sail

SCRS/94/94 Synthesis of the Albacore Research Program in the Frame of the Project "Characterization of Large Pelagic Stocks in the Mediterranean" - Megalofonou, P.

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SCRS/94/96	An attempt to find eggs and larvae of bluefin tuna *(Thunnus thynnus)* in the Black Sea - Piccinetti-Manfrin, G., G. Marano, G. de Metrio, C. Piccinetti
SCRS/94/97	Characterization of Large Pelagic Stocks in the Mediterranean. EEC Project XIV/MED/91-102. Description of the project and synthesis of the research on swordfish - de Metrio, G.
SCRS/94/98	Activités réalisées en Italie en accord au programme "ICCAT BYP Survey of Bluefin Larvae" - Piccinetti, C.
SCRS/94/99	Rapport National du Maroc - Lahlou, A., A. Srour
SCRS/94/100	La pêche des thonidés en Méditerranée marocaine - Srour, A.
SCRS/94/101	Updated standardized CPUE of Atlantic bluefin caught by the Japanese longline fishery in the eastern Atlantic and Mediterranean Sea - Miyabe, N.
SCRS/94/102	A preliminary report on the commencement of bluefin tuna fishing in Cyprus - Economou, E., D. Konteatis
SCRS/94/103	Review of swordfish fishing 1986-1993 - Economou, E., D. Konteatis
SCRS/94/104	Time-area coincidence of year-classes for Atlantic bluefin tuna - Hester, F.
SCRS/94/105	La pêche au thon rouge *(Thunnus thynnus)* à la madrague de Sidi Daoud, 1990-1994 - Hattour, A.
SCRS/94/106	National Report of Libya - El Kebir, N., K. Al Macki, A. Zreigani
SCRS/94/107	Updating of the catch-at-size data base for eastern Atlantic bluefin tuna, data substitution and raising to the total catch, presented to the SCRS East Atlantic Bluefin Tuna Stock Assessment Session - Miyake, P. M., P. Kebe
SCRS/94/108	La pêche aux thons en Tunisie: analyse démographique du thon rouge *(Thunnus thynnus)* et de la thonine *(Euthynnus alletteratus)* capturés par les madragues - Hattour, A.
SCRS/94/109	The swordfish (*Xiphias gladius* L. 1758) fishery in the Azores, from 1987 to 1993 - Simoes, P. R.
SCRS/94/110	Some biometric data from the swordfish (*Xiphias gladius* L.) in the areas off Madeira - Gouveia, L., J. Mejuto
SCRS/94/111	An age-specific CPUE for Canadian swordfish longline, 1988-1993 - Stone, H., J. M. Porter
SCRS/94/112	National Report of Canada, 1993-1994 - Porter, J. M.
SCRS/94/113	-
SCRS/94/114	An evaluation of the effectiveness of the current minimum size for Atlantic swordfish - Mace, P. M.
SCRS/94/115	Estimates of swordfish discarded dead by US longline vessels since 1991 - Cramer, J., A. R. Bertolino, G. P. Scott

SCRS/94/116	Application of tests of a stock-production model on age-structured simulated data: a swordfish-like stock - Prager, M. H., C. P. Goodyear, G. P. Scott
SCRS/94/117	Updated estimates of US landed catch at size of swordfish - Bertolino, A. R., G. P. Scott
SCRS/94/118	Addendum to SCRS/93/51. Modification to the LSSPA stock assessment model - Kimura, D. K.
SCRS/94/119	Standardized catch rates for swordfish *(Xiphias gladius)* from the U.S. longline fleet through 1993 - Scott, G. P., A. R. Bertolino
SCRS/94/120	United States imports of swordfish (1974-June 1994) - Habron, G. B., P. M. Mace, S. Koplin, G. P. Scott
SCRS/94/121	The spawning of swordfish from the northwest Atlantic - Arocha, F., D. Lee
SCRS/94/122	An updated biomass index of abundance for North Atlantic swordfish, 1963-1993 - Hoey, J. J., J. Mejuto, J. M. Porter, H. H. Stone, Y. Uozumi
SCRS/94/123	Recent trends in the US Atlantic longline fishery - Hoey, J. J., A. R. Bertolino, J. Cramer, C. W. Rogers
SCRS/94/124	Revised projections for the western North Atlantic bluefin tuna population - Punt, A. E., D. S. Butterworth
SCRS/94/125	Updated assessments of North Atlantic bluefin tuna taking account of trans-Atlantic migration - Punt, A. E., D. S. Butterworth
SCRS/94/126	An overview of the sex-ratio at size of the swordfish (*Xiphias gladius* L.) around the world: similarity between different strata - Mejuto, J., J. M. de la Serna, B. García
SCRS/94/127	Global population structure of the swordfish *(Xhiphias gladius)* as revealed by the analysis of the mitochondrial control region - Alvarado Bremer, J. R., J. Mejuto, B. Ely
SCRS/94/128	Report of the CARICOM Fisheries Resource Assessment and Management Program (CFRAMP)
SCRS/94/129	National Report of Trinidad and Tobago - Fisheries Div., Min. of Agriculture, Land and Marine Resources
SCRS/94/130	A preliminary examination of the Taiwanese longline catch and effort data (1967 to 1992) for South Atlantic albacore *(Thunnus alalunga)* - Punt, A. E., R. W. Leslie, A. J. Penney
SCRS/94/131	Stock assessment and risk analysis for the South Atlantic population of albacore *(Thunnus alalunga)* for 1994 - Punt, A. E., D. S. Butterworth, A. J. Penney
SCRS/94/132	A numerical evaluation of GLM methods for estimating indices of abundance from west Atlantic small bluefin tuna catch per trip data when the data are aggregated to minimize zero catches - Porch, C. E.
SCRS/94/133	Standardized catch rates of large bluefin tuna, *Thunnus thynnus*, in the rod and reel/handline fishery off the northeast United States - Brown, C. A.
SCRS/94/134	Standardized catch rates of small bluefin tuna, *Thunnus thynnus*, in the Virginia-Rhode Island (U.S.) rod and reel fishery - Brown, C. A., H. Huang

SCRS/94/135	Preliminary examination of size and location data for U.S. tagged and recaptured swordfish - Brown, C. A.
SCRS/94/136	Preliminary observations on bluefin tuna catches in the Ligurian Sea. Catches in 1992. Size/age key for young. Length/weight relationship - Orsi Relini, L., C. Cima, G. Palandri
SCRS/94/137	Informe Nacional de España - Instituto Español de Oceanografía
SCRS/94/138	Report about the work carried out on swordfish *(Xiphias gladius)* along its Mediterranean distribution using protein electrophoresis - Pla, C., J. M. Pujolar, J. Viñas
SCRS/94/139	Agregaciones de atún blanco sobre los giros oceánicos de pequeña escala del Atlántico nororiental y Mediterráneo - Santiago, J., A. G. Ramos, M. Cantón
SCRS/94/140	A review of length data for Atlantic swordfish caught by the Japanese longliners - Uosaki, K., Y. Uozumi
SCRS/94/141	Updated standardized CPUE for swordfish caught by Japanese longline fishery in the Atlantic Ocean - Nakano, H.
SCRS/94/142	Températures de surface de l'océan et déplacements des thons: proposition d'un nouvel outil pour exploiter des données de marquage-recapture - Dagorn, L., J. M. Stretta, M. Petit
SCRS/94/143	Proposition d'un modèle d'étude du comportement grégaire des thons basé sur l'utilisation d'un algorithme génétique - Dagorn, L., J. M. Stretta, M. Petit
SCRS/94/144	Etude théorique du phénomène d'aggrégation des bancs de thons sous les objets flottants à partir d'un modèle de comportement grégaire des thons - Dagorn, L., J. M. Stretta, M. Petit
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SCRS/94/146	Analysis of annual length-frequency changes of billfish in the western Atlantic Ocean 1987-1993 - Jones, C. D., R. L. Carter
SCRS/94/147	Progress of the ICCAT Enhanced Research Program for Billfish in the western Atlantic Ocean during 1994 - Prince, E. D.
SCRS/94/148	National Report of the United States: 1994 - NOAA/NMFS
SCRS/94/149	Progress on catch-at-age analyses of Atlantic bluefin tuna using a two-area mixing model that assumes fish can remember where they came from - Porch, C. E.
SCRS/94/150	A compilation of available catch, effort, and CPUE data needed for assessment of sailfish *(Istiophorus platypterus)* in the eastern Atlantic Ocean - Farber, M. I., T. Diouf, J. B. Amon Kothias, A. Hervé, S. N. K. Quaatey, Y. Uozumi
SCRS/94/151	Interpretation of the U.S. National Research Council's Report on "An Assessment of Atlantic Bluefin Tuna" - Scientific Staff of the NOAA
SCRS/94/152	National Report of Brazil - Meneses de Lima, J. H.
SCRS/94/153	Updated standardized CPUE for albacore caught by Japanese longline fishery in the Atlantic Ocean - Uozaki, K.

SCRS/94/154 Updated biomass CPUE for albacore caught by Japanese longline fishery in the Atlantic Ocean standardized by general linear model - Uozumi, Y.

SCRS/94/155 Standardization of species combined CPUE for sailfish and spearfish caught by Japanese longline fishery in the Atlantic Ocean - Uozumi, Y.

SCRS/94/156 Preliminary analysis on the distribution of sailfish and longbill spearfish in the Atlantic Ocean in 1993 based on the logbook data - Uozumi, Y.

SCRS/94/157 South African National Report - Penney, A. J.

SCRS/94/158 Projections of Atlantic bluefin tuna stock sizes - Turner, S. C., C. E. Porch, V. R. Restrepo

SCRS/94/159 Observed migration of albacore *(Thunnus alalunga)* based on results of Spanish tagging cruises in North East Atlantic (Bay of Biscay, 1988-1993) - Ortíz de Zárate, V., C. Rodríguez-Cabello

SCRS/94/160 Projet de recherche et de développement dans le domaine de l'aquaculture du thon rouge au Royaume du Maroc. Purpose and present status of the project - Fushimi, H.

SCRS/94/161 Nota sobre el marcado de listado en aguas de las Islas Canarias durante 1994 - Delgado de Molina, A., R. Delgado de Molina, J. Ariz, J. C. Santana

SCRS/94/162 Estadisticas españolas de la pesquería atunera tropical en el Océano Atlántico - Delgado de Molina, A., P. Pallarés, J. C. Santana, R. Delgado de Molina, J. Ariz

SCRS/94/163 Datos estadísticos de la pesquería de túnidos de las Islas Canarias durante el período 1975 a 1993 - Ariz, J., R. Delgado de Molina, J. C. Santana, A. Delgado de Molina

SCRS/94/164 Estudio de la modalidad de pesca sobre "manchas" de túnidos en las Islas Canarias - Ariz, J., J. C. Santana, A. Delgado de Molina, R. Delgado de Molina

SCRS/94/165 Pourquoi un Symposium? Why a Symposium? - Fonteneau, A.

SCRS/94/166 Preliminary report on size composition of giant bluefin tuna caught in the Gibraltar Strait by Moroccan handline fishery - Fushimi, H., K. Kami, S. Nakamara, A. Srour

SCRS/94/167 Preliminary report on composition of young bluefin tuna caught by Moroccan Mediterranean trap in 1994 fishing season - Fushimi, H., K. Kami, A. Abrehouch, A. Srour

SCRS/94/168 Algunas consideraciones sobre la evolución de la CPUE de la flota atunera española de cerco que faena en el Océano Atlántico (1980-1993) - Pallarés, P., J. Ariz, J. C. Santana, A. Delgado de Molina, R. Delgado de Molina

SCRS/94/169 Etat d'exploitation du stock de patudo - Pereira, J. A. G.

SCRS/94/170 Application of an integrated version of Fox's model to the yellowfin and bigeye tuna fisheries - Pinho, M. R.

SCRS/94/171 Biochemical genetics characterization of large pelagic stocks (*Thunnus thynnus, Thunnus alalunga* and *Sarda sarda*) in the Mediterranean - Plá, C., J. Viñas, J. M. Pujolar, J. A. Levy

SCRS/94/172	Evolución de la pesca al objeto y sobre bancos libres de la flota de cerco española en el Océano Atlántico (1990-1993) - Pallarés, P., A. Delgado de Molina, J. C. Santana, R. Delgado de Molina, J. Ariz
SCRS/94/173	Assessment of South Atlantic albacore resource by using surplus models on Taiwanese 1968-1993 longline data - Yeh, S. Y., C. L. Wu
SCRS/94/174	Rapport d'activités sur les pêcheries d'istiophoridés au Sénégal (juin à octobre 1994) - Diouf, T.
SCRS/94/175	Statistiques de la pêcherie thonière FIS durant la période de 1969 à 1993 - Hallier, J. P., T. Diouf
SCRS/94/176	Captures de la pêcherie germonière française au filet maillant dérivant dans l'Atlantique nord-est - Goujon, M., L. Antoine, B. Leroy
SCRS/94/177	Atlantic bluefin tuna larval survey by the R/V Shoyo-maru in 1994 - Tsuji, S., K. Segawa, Y. Hiroe, K. Uosaki, T. Itoh
SCRS/94/178	Standardized indices of abundance 1988-1994 for billfish (sailfish, blue marlin) and swordfish *(X. gladius)* off Côte d'Ivoire - Joanny, T., J. B. Amon Kothias, F. X. Bard
SCRS/94/179	Mise à jour des quantités de "faux-poissons" débarquées par les senneurs à Abidjan - Amon Kothias, J. B., F. X. Bard, A. Hervé
SCRS/94/180	Pesquerías artesanales pelágicas del Estado Nueva Esparta. Carite y peces de pico - Marcano, J. S., A. Lárez, L. Marcano, C. Gil, H. Salazar, H. Pino
SCRS/94/181	Informe Nacional de Venezuela, año 1993 - SARPA, FONAIAP
SCRS/94/182	Nota sobre la reproducción del atún Listado *(Katsuwonus pelamis)* en el Mar Caribe - Pagavino, M.
SCRS/94/183	Ajuste de una curva de crecimiento a frecuencias de tallas de atún Listado *(Katsuwonus pelamis)* pescado en el Mar Caribe suroriental - Pagavino, M., D. Gaertner
SCRS/94/184	National Report of Ireland 1994 (Preliminary Data) - Molloy, J.
SCRS/94/185	Note sur l'activité de pêche thonière au Gabon en 1993 -
SCRS/94/186	Note sur la pêcherie marocaine des thons et espèces voisines - Lahlou, A., A. Srour
SCRS/94/187	Résumé sur les pêcheries des thonidés en Angola
SCRS/94/188	Rapport National de la Guinée - Traoré, S., M. Kourouma
SCRS/94/—	Rapport National de la France

Appendix 4 to Annex 25

REPORT OF THE SUB-COMMITTEE ON STATISTICS

1. Opening of the Meeting

1.1 The 1994 meeting of the ICCAT Sub-Committee on Statistics was held in Madrid, Spain, at the Hotel Pintor on November 23 and 25. Dr. S. Turner (U.S.A.), Convener of the Sub-Committee, opened the meeting and welcomed all the participants.

2. Adoption of Agenda and arrangements for the meeting

2.1 The Tentative Agenda was adopted with slight modifications and is attached as **Addendum 1** to this Report. Dr. P. M. Miyake (Secretariat) served as rapporteur.

3. Review of national statistics

3.a Data collection and reporting

3.a.1 The Sub-Committee reviewed the Secretariat Report on Statistics and Coordination of Research (COM-SCRS/94/12), particularly regarding data collection and reporting by the national offices. The attached **Table 1** shows the updated status on the availability of 1993 data at the time of the meeting.

3.a.2 The Sub-Committee noted the increasing problem of fishing vessels unloading at foreign ports in the Mediterranean area. The current EU policy permits fishing vessels of its Member States unrestricted landing of catches at the port of any other EU Member States. The landing of French catches at Spanish ports has been noted. The Sub-Committee pointed out the risk that the same catches may be reported twice or that some catches are not reported at all. The Sub-Committee was informed that the EU has started a program aimed at solving this problem, in which the catches and landings can be cross-checked for the Mediterranean. The representative from EUROSTAT reported that the difficulties have been noted and corrective measures are being taken through bi-lateral contacts between the countries involved.

3.a.3 The ICCAT Bluefin Tuna Statistical Document Program was reviewed with respect to its effect on the science. The Sub-Committee recognized that the Program is now in force and that a considerable quantity of statistics is becoming available for many countries which have not previously reported bluefin catches to ICCAT.

3.a.4 The Sub-Committee noted that caution should be exercised in interpreting these data, since many fish may go through more than one country. There could also be double reporting of the same fish in the import statistics by different nations. While recognizing the usefulness of this Program for scientific purposes, the Sub-Committee recommended that the SCRS scientists collaborate in, and support, this important Program, particularly in designing the program and document format, checking the statistics, and evaluating the effectiveness of the Program.

3.b Improvements to be made

— Timeliness of the submission of data

3.b.1 The Sub-Committee recognized that the timeliness of the submission of data continues to be a major problem, since the scientists tend not to transmit data to the Secretariat, but to bring the data with them to various stock assessment sessions and the SCRS. This delays all the assessment work since the Secretariat has to work on the updating of catch and effort data at the time of the meetings, before it can concentrate on the catch-at-size.

3.b.2 Preparation of a status report (table) on data availability, to be circulated after the deadline for data submission has expired, was suggested to serve as a reminder to the national offices. The Secretariat commented that if countries which had reported data observed that many other countries also had not reported, some might be even less inclined to report as soon as possible. The Secretariat was requested to create such a table and, if it is considered useful as a reminder, to circulate it among the national offices.

3.b.3 The Secretariat reiterated that the updating of the catch-at-size table was also delayed since the data (catch and/or size) often are not transmitted until the meetings have started, with the exception of west bluefin tuna. The preparation of the catch-at-size requires more than a week's time and such late changes cancel out all such efforts spent previously.

3.b.4 The Sub-Committee expressed concern regarding the changes which are sometimes introduced in the basic data. These changes often have repercussions on the stock assessments. However, the Sub-Committee recognized the scientific need that these changes be communicated when deficiencies are detected. Otherwise the credibility of the work of the scientists and the SCRS can be jeopardized. These changes should be documented.

-- Changes made to the data

3.b.5 The Sub-Committee was informed that ICES has also had this problem where significant changes in the historical data have been made. The problem was solved by obliging the people who propose such changes to present the justifications for them.

3.b.6 There is further discussion on this matter under Agenda Item 6.

4. Secretariat's statistical work in 1994

4.a Data collection and compilation

4.a.1 Details on the data processing carried out by the Secretariat in the course of 1994 are contained in Document COM-SCRS/94/12. The Sub-Committee recognized the progressive increase in the volume of data to be processed by the Secretariat, particularly to comply with the mandate to prepare the data files needed for the various stock assessment sessions and inter-sessional scientific meetings, especially this year due to the extraordinary inter-sessional meeting schedule. In 1994, the Secretariat had to update the catch at size for swordfish, albacore (twice), east and west bluefin and yellowfin.

4.a.2 It was noted that the scientists working on the files found some significant errors during the course of 1994 when updating the east bluefin and yellowfin catch-at-size data file. While the Sub-Committee recognized that extensive updating of the catch-at-size base was done almost simultaneously for many species in a very short time. However, considering the relevance of such work, the Sub-Committee emphasized the importance of avoiding such errors in the future. It therefore reiterated the former recommendation that national scientists submit their data on time, so that the Secretariat has sufficient time to update the base. The Sub-Committee also requested that the Secretariat develop a more comprehensive data checking system for the final data base (i.e., checking the total catches estimated by the size against the total Task I catches).

4.a.3 The ICCAT Assistant Executive Secretary explained the new data format for the tagging file which is a fish-based, rather than a tag-based, system. He informed the Sub-Committee that albacore and bluefin tagging data are now almost completely updated with this new format, inasmuch as the data that are currently available. The Sub-Committee noted that the new format is more user friendly and hence adopted this format for use in the future.

4a.4 There have been repeated requests to the scientists who work on tagging data for yellowfin and skipjack to provide these to the Secretariat, since these data are very incomplete and only fish recovered are included in the present ICCAT file. The Sub-Committee strongly recommended that the data file, particularly those of the Yellowfin Year Program and the International Skipjack Year Program to be provided to the Secretariat as soon as possible. The completion of this tag data file is necessary and should be done within a short period.

4.b Port sampling program

4.b.1 The Secretariat reported that port sampling activities at the transshipment ports were again minimal in 1994, mostly due to the decline in landings by Oriental longliners at Atlantic ports. The Sub-Committee, while recognizing that port sampling can become an important mechanism in the future for the collection of statistics from the fleets of non-Contracting Parties, did not recommend reinforcement of port sampling efforts at this time, for reasons of practicality and funding requirements.

4.b.2 The Sub-Committee expressed its appreciation to South Africa for sampling the transshipments of Asian longliners at Cape Town. The high quality data submitted prove very effective in checking the albacore size data measured by fishermen at sea.

4.c Secretariat data management policy

4.c.1 The Secretariat reported that several requests were received from various scientists (of the same nation and sometimes of other nations) to change catch statistics that were reported by the national offices and/or the statistical correspondent. The Secretariat's policy in this respect is not to accept such changes unless valid justification and basic documentation are also presented. The Sub-Committee endorsed this policy.

4.d. Data dissemination and publication of data

4.d.1 The increase in the requests for data in the ICCAT data base by other regional agencies and scientists from non-member countries was reported. Up to now, the SCRS policy did not allow for providing data to non-Contracting Parties. However, the Sub-Committee approved complying with such requests, on an exchange bases, and provided they do not violate the confidentiality of the data. The Sub-Committee further indicated that such data should only be provided in summarized basic form and that the Secretariat is not responsible for processing the data for the users.

4.d.2 No changes were proposed at this meeting in the Commission's statistical publication policy.

4.e. Other Matters

4.e.1 No other matters were discussed.

5. Examination of the problem of unreported catches by non-Contracting Parties

5.1 The Sub-Committee noted that there are many discrepancies found between data on bluefin tuna to the Japanese market and bluefin tuna catches reported by the country of origin. The Sub-Committee also noted the many discrepancies between data on swordfish imports to the U.S. and reported swordfish catches. Although no such comparison was made for other species, the Sub-Committee believed that many discrepancies could also exist for other species, particularly bigeye tuna.

5.2 It was pointed out that this problem of discrepancies in data has been observed for both the Contracting and non-Contracting Parties. As concerns the Contracting Parties, the Sub-Committee on Statistics strongly recommended that each national office recognize the problem, investigate the cause of such discrepancies, and take appropriate corrective measures.

5.3 The Sub-Committee reiterated its past concern on the catches by tuna fishing vessels of non-Contracting Parties, since such catches have been increasing over the past several years. Many anecdotal and circumstantial evidence has become available which indicates that the unreported catches could be even more significant in scope than the level estimated at present by the SCRS. However, it is difficult to quantify such information.

5.4 At present, the unreported bluefin catches can be investigated through trade data and the ICCAT Bluefin Tuna Statistical Document Program. However, it is known that most of these catches are from those vessels that operate in the Atlantic Ocean, mostly fishing bigeye tuna during the bluefin off-season; the unreported catches of bigeye, swordfish and possibly other species could also be very significant.

5.5 The possibility of estimating unreported bigeye catches through trade statistics was suggested. The scientist from Japan noted that there is a possibility of limited estimation, since statistics often mix species and products in different forms. He indicated, however, that a rough estimate of the quantity of bigeye imports from the Atlantic area, on a country of origin basis, could be obtained from the data available.

5.6 A Commission-sponsored aerial survey program was proposed. The Sub-Committee noted that this would be an effective measure to estimate the number of longliners present in the bluefin spawning grounds during June and July, and recommended that a feasibility study for such a project be conducted.

5.7 In the course of the discussions in the species groups, further unreported catches were discovered (e.g. Taiwanese bigeye catches, FIS tropical purse seine albacore catches). The quantities of these were significant enough to change even the conclusions of the stock assessments. Therefore, the Sub-Committee recommended that all the Contracting Parties investigate these unreported catches. Even unquantified, rough estimates should be presented to the Commission for an evaluation of these catches. Recognizing that most of these unreported catches were of non-targeted species, the Sub-Committee urged that Task II catch and effort data as well as Task I data include these non-targeted species, when reporting to ICCAT.

6. Review of the progress made on recommendations for statistics (as contained in the 1993 SCRS Report), and future plans

6.a Improvement of Mediterranean statistics

6.a.1 The Sub-Committee noted that there were major improvements made on Mediterranean statistics in 1994 as a result of the *Ad Hoc* GFCM/ICCAT Joint Working Group on Stocks of Large Pelagic Fishes in the Mediterranean Sea (Fuengirola, Malaga, Spain - September 1994). The updating of catch statistics to 1993 was done for bluefin, albacore and swordfish; an updating of the catch-at-size data base for east Atlantic bluefin was carried out and some new information on size and CPUE for bluefin, albacore and swordfish was entered to the base.

6.a.2 The Sub-Committee noted that the *Ad Hoc* GFCM/ICCAT Working Group proposed holding another joint meeting to develop swordfish abundance indices in the Mediterranean. The swordfish stock assessment group also considered this an appropriate suggestion. The Sub-Committee reiterated these proposals as presented in the Bluefin-East Report and the Swordfish Report.

6.b Collection of information on by-catches

6.b.1 Since this matter is included on the SCRS Agenda, discussion was deferred to the SCRS Plenary. However, should the SCRS establish basic policy as regards the collection of these data, the Sub-Committee would be ready to formulate that policy into an appropriate and realistic statistical system.

6.c Improvement of computer facilities and software

6.c.1 The Sub-Committee reviewed Document SCRS/94/12 concerning the improvements made in the Secretariat's computer facilities in 1994 and noted that most of the budget allocated for this purpose was still unused. It was explained that this was not due to over-budgeting but rather to a lack of cash flow. The Sub-Committee regretted that the money budgeted was not available for this important budget item.

6.c.2 The Sub-Committee reviewed Document SCRS/94/22, which proposed the redesigning of the Secretariat data processing system and its other computer facilities. The basic proposal is to move from the present outdated, Micro VAX II system to a more powerful work station setup. The Digital Equipment Co. offered the most attractive price for a VAX WS Alpha-2000, which includes the trade-in of the current Micro VAX II.

6.c.3 The Sub-committee recognized that two years' maintenance cost for the present data processing system would amount to more than the purchase price of a new system, including its maintenance. With these observations, the Sub-Committee formed a small group to review the proposed new system, as well as the need to purchase other equipment and software, and asked the group to prioritize the items.

6.c.4 The small group reported the results of its study at a later session. The Committee accepted the recommendations of the Group and forwarded them to the SCRS. The Report is attached as **Addendum 2** to this Report.

6.d International purse seine logbook

6.d.1 The Secretariat presented the final form of the logbook (with captions in English, Japanese and Korean) to be used by the boat captains (mostly Korean or Japanese) of the international purse seiners (often flying a flag of convenience) operating from the ports of Tema and Abidjan. The logbook, which was developed in consultation with the pertinent scientists, was agreed upon. The Sub-Committee thanked the Korean scientists for their assistance in providing the Korean translation of the logbook. The Sub-Committee was informed that the logbook had not yet been given to the printer, pending the insertion of information on the Secretariat's new office address, phone and fax numbers, etc.

6.e Restructuring of the sampling strategy for the surface fisheries

6.e.1 The Sub-Committee was informed that this biostatistical work, as recommended by the Committee in the last two years, have been carried out through a contract between the Commission and the Department of Mathematics of the Autonomous University of Madrid.

6.e.2 Dr. A. Cuevas presented the results of this study (SCRS/94/9). The objectives of the study were to review the size and species compositions and to analyze the sampling strategy, using a partial data set (1991 Spanish and FIS purse seine data). Standard errors between and within samples were evaluated. It was concluded that greater use of the data might be made. The within-sample variance is much smaller than the between-sample variance.

6.e.3 The Sub-Committee congratulated Dr. Cuevas for the work done, although the findings are still preliminary. Since this has been a long-pending item for tropical tuna research, and the work is still in the preliminary stages, the Sub-Committee re-iterated the recommendations made in the tropical species stock assessments, i.e., that this study be further expanded to a more thorough data base and along the lines originally proposed by the Secretariat (attached as **Addendum 3** to this Report). The scientists involved were asked to provide the full data base to the contractee which includes all the information needed to carry out this work.

7. Definition of the parameters for simulated data to be used in evaluating methods of converting such catch at size to catch at age

7.1 The Consultation on the Technical Aspects of Methodologies Which Account for Individual Growth Variability by Age that met in Brest, France, in July, 1994, requested that the Secretariat create a simulated data set with software provided by that group and to ensure that the underlying population parameters be kept secret until the scientists complete their methodologies tests. The Sub-Committee requested the Secretariat to carry out this task and distribute the simulated data to the scientists involved, while maintaining the confidentiality of the parameters used for its creation.

8. Recommendations

8.1 The Sub-Committee reiterated the proposal it has made in the last few years to recruit a high-level biostatistician to the staff, since it recognized that the need for such staff continues. The Sub-Committee recommended that the SCRS propose the Commission to allocate adequate budgetary funding to hire a biostatistician.

9. Date and place of the next meeting of the Sub-Committee on Statistics

9.1 The Sub-Committee decided to meet during the 1995 SCRS Session and at the same place.

10. Other Matters

-- CWP

10.1 In 1993, the Commission agreed to host the next meeting of the Coordinating Working Party on the Atlantic Fisheries Statistics (CWP) in Madrid in 1994. However, for various reasons, the meeting was postponed to the spring of 1995, and instead, a CWP Inter-Agency Consultation was held at the ICCAT Head quarters in July, 1994. The results of this meeting are reported under Agenda Item 7 of the SCRS. The Sub-Committee reviewed the revised draft Statute proposed by the CWP Inter-Agency Consultation and recommended the Commission to approve it.

-- High seas statistics

10.2 The results of the Ad Hoc Consultation on the Role of Regional Fishery Agencies in Relation to High Seas Fishery Statistics was also reported at the SCRS Plenary and forwarded to the Sub-Committee for its review. The Sub-Committee is of the opinion that tuna are definitely highly migratory and straddling stocks and for stock assessment and management purposes, the separation of statistics between the EEZs and high seas area would be difficult and perhaps be of little benefit to ICCAT.

10.3 On the other hand, the global demand for high seas statistics is increasing, for which ICCAT cannot respond at present. The Secretariat has requested that FAO provide a map showing the agreed separation of the EEZs and high seas areas. Up to now, however, this information has not yet been received. The FAO representative was asked to investigate if such a map is available and, if so, to assure that a copy is forwarded to ICCAT. In such information becomes available, the Sub-Committee recommended that the Secretariat circulate it to the national offices and that this be reviewed again at the next meeting of the Sub-Committee from the point of view of feasibility and rationale for ICCAT to take the responsibility of creating this atlas.

-- Fish atlas program

10.4 The FAO representative explained that Organizations's program of a world tuna ATLAS. According to the program, a digital map of tuna catches can be prepared by 5 degree rectangles, by gear, by species and by quarter, for the last few years, which can be then eventually be included in the Atlas. The FAO requested ICCAT to assume responsibility for the Atlantic map and indicated that some funds can be made available to carry out this work by contract.

10.5 The Sub-Committee considered the atlas program very interesting and useful for tuna scientists. Thus, it authorized the Secretariat to undertake the contract with FAO, as long as the work does not interfere with Commission assignments. It indicated, however, that the Commission's assignments should have first priority.

11. Adoption of Report

11.1 The Sub-Committee adopted the Report.

12. Adjournment

12.1 The 1994 meeting of the Sub-Committee on Statistics was adjourned.

Table 1. Progress made in data collection As of 2 November 1994

SPECIES GEAR AND COUNTRY	TASK I CATCH DATE REC'D 1993	TASK I 1994		TASK II CATCH & EFFORT DATE REC'D 1993	TASK II 1994	BIOLOGICAL (SIZE) DATE REC'D 1993	BIOLOGICAL 1994	REMARKS
YFT, BET, SKJ - Surface Fl								
BAITBOAT								
Angola	Mar 9 Sep 1	Aug 31	x	Mar 9	Mar 3			preliminary data 1994
Brazil	Aug 11	Sep 29	x	Sep 14		Sep 14	Sep 29 Oct 17	
Brazil-Japan	Aug 11			Sep 14	May 24	Sep 14		
Cape Verde	Jun 1			Jun 1				
Cuba								
FIS	Apr 23	Apr 18		Apr 23		May 6		
Ghana	Aug 17 Sep 13 Nov 1			Aug 17		Aug 17		
Namibia		Oct 3						Data for 1994
Portugal (Azores)	Jul 16			Jul 16		Jun 9		
(Madeira)	Aug 31	May 16		Aug 31	May 16	Aug 31	Sep 22	
(Mainland)								
South Africa	May 18 Oct 26 Nov 18	Sep 5	x	Aug 25 Oct 26	Sep 5			
Spain (Canary Islands)	May 11	Jul 20		May 11	Jul 20	May 18	Jul 20	
(Tropical)		Jul 20		Mar 1	Jul 20	Mar 1	Jul 20	
	May 4			May 4		May 4		
U.S.A.								
Venezue (incl. For.)				Jun 11		Jun 11		
PURSE SEINE								
Benin								
Cape Verde								
Colombia		Apr 22	x		Apr 22			
Cuba								
FIS	Apr 23 Nov 1			Apr 23 Nov 1		May 6		
Japan				Jun 9		Jun 9		
				Jun 9		Jun 9		
Morocco	May 4							
Portugal (Mainland)	Aug 6	Jul 6		Aug 6	Jul 6			
Russia	Oct 1	Jun 15 Aug 9	x			Sep 14 Oct 5		data 1994
South Africa	Oct 26			Oct 26				
Spain (Tropical)	May 11	Aug 1		May 18 Jul 12 Nov 26	Aug 1	May 18	Aug 1	
U.S.A.	May 31					May 25 May 31		
				Jul 9				
	Jul 22 Aug 9			Jul 22		Jul 22 Aug 9		
Venezue (incl. For.)				Jun 11		Jun 11		
NEI-1	Apr 23 May 12			Nov 1				
UNCL & OTHERS								
Angola	Sep 1							
Argentina		Mar 16						Data for 1988-93
Barbados								
Benin								
Bermuda		Aug 18						
Brazil	Aug 11	Sep 29	x					

Table 1. continued. As of 2 November 1994

SPECIES GEAR AND COUNTRY	TASK I CATCH DATE REC'D 1993	TASK I 1994		TASK II CATCH & EFFORT DATE REC'D 1993	TASK II 1994	BIOLOGICAL (SIZE) DATE REC'D 1993	BIOLOGICAL 1994	REMARKS
Brazil-Japan	Aug 11							
Canada	May 5			May 5				
Cape Verde	Jun 1			Jun 1	Oct 21	Jun 1	Oct 21	
						Nov 2		Data for 1988-92
China (Taiwan)								
Colombia	Apr 6							
Cuba								
Cape Verde								
Ghana								
Mexico								
Morocco	May 4							
Portugal (Madeira)	Aug 6			Aug 6				
(Mainland)		Jul 6		Aug 6	Jul 6			
St. Helena	Nov 3			Nov 3				
St. Lucia								
Senegal	Apr 26							
South Africa	May 18	Sep 5	x	Aug 25	Sep 5			
	Oct 26			Oct 26				
Spain (Peninsula)								
U.S.A.	May 31	Aug 12			Aug 12	May 26	Aug 12	inc 1992 data
						May 31		
				Jul 9				
	Jul 22			Jul 22		Jul 22		
	Aug 9					Aug 9		
Russia								
Venezuela								
Venezuela-Foreign								
ALB - SURF								
BAITBOAT								
Brazil	Aug 11	Sep 29	x					
Brazil-Japan	Aug 11				May 24			
France								
Italy								
Namibia		Oct 3						Data for 1994
Portugal (Azores)	Jul 16			Jul 16		Jun 9		
						Sep 22		
(Madeira)	Aug 31	May 16		Aug 31	May 16	Sep 29	Sep 22	
South Africa	Sep 20	Sep 5	x	Aug 25	Sep 5	Oct 14	Oct 27	Albacore catch at size 93
	Oct 26			Oct 26				
	Nov 18							
Spain (Canary Islands)	May 11	Jul 20		May 11	Jul 20	May 18	Jul 20	
(Peninsula)	Jun 8	Apr 20		Aug 23	May 4	Aug 23	May 4	
(Mediterranean)		Apr 20			May 4		May 4	
Venezuela								
PURSE SEINE								
FIS								
France	Oct 14	Sep 12		Oct 14	Sep 12			
Japan				Jun 9		Jun 9		
Italy								
Portugal (Mainland)								
South Africa	Oct 26			Oct 26				
Spain	May 11							
Venezuela								
NEI-1	May 11							
TROL								
France								
Greece								
Spain (Peninsula)	Jun 8	Apr 20		Jul 6	May 4	Jul 6	May 4	
Spain (Mediterranean)		Apr 20			May 4		May 4	
U.S.A.		Aug 12		Jul 9				
	Jul 22			Jul 22		Jul 22		
	Aug 9					Aug 9		

Table 1. continued. As of 2 November 1994

SPECIES GEAR AND COUNTRY		TASK I CATCH DATE REC'D 1993	TASK I CATCH DATE REC'D 1994		TASK II CATCH & EFFORT DATE REC'D 1993	TASK II CATCH & EFFORT DATE REC'D 1994	BIOLOGICAL (SIZE) DATE REC'D 1993	BIOLOGICAL (SIZE) DATE REC'D 1994	REMARKS
UNCL & OTHERS									
Argentina			Mar 16						Data for 1988-93
Bermuda			Aug 18	x					
Brazil		Aug 11	Sep 29	x					
China (Taiwan)									
France	(Bay of Biscay)	Aug 2			Aug 2	May 19	Aug 2	May 19	Data for 1993
		Oct 29			Oct 29				
	(Mediterranean)	Oct 14	Sep 12			Sep 12			
Greece									
Ireland		Nov 1	Jun 3	x		Jun 3		Jun 3	Data for 1993
Italy		Aug 10							
Portugal	(Azores)								
	(Madeira)								
	(Mainland)	Aug 6	Jul 6		Aug 6	Jul 6			
St Helena		Nov 3			Nov 3				
South Africa		Sep 14	Sep 5	x	Aug 25	Sep 5			
		Oct 26			Oct 26				
Spain	(Peninsula)								
	(Mediterranean)	Sep 21			Sep 21		Sep 21		
U.S.A.			Aug 12		Jul 9	Aug 12		Aug 12	
		Jul 22			Jul 22		Jul 22		
		Aug 9					Aug 9		
Venezuela									
Venezuela-Foreign									
BLUEFIN - SURF									
BAITBOAT									
France	(Bay of Biscay)	Nov 19							
Portugal	(Azores)								
	(Madeira)	Aug 31	May 16		Aug 31	May 16			
	(Mainland)								
Spain	(Canary Islands)	May 11	Jul 20		May 11	Jul 20	May 18		
	(Bay of Biscay)	Mar 22	May 6		May 18		Mar 22	May 6	
		Dec 28			Dec 28		Dec 28		
	(Malaga)	Oct 27					Oct 27		
	(Mediterranean)	Oct 27					Oct 27		
PURSE SEINE									
Croatia		Apr 2	Feb 18		Apr 2	Feb 18			
France	(Mediterranean)	Oct 14	Sep 12		Oct 14	Sep 12	Oct 14	Sep 12	
Italy		Aug 10							
Libya							Nov 6		
Morocco		May 4							
Norway		Jul 20							
Portugal	(Azores)								
	(Mainland)		Jul 6			Jul 6			
Spain		Sep 21	Sep 8		Sep 21	Sep 8	Sep 21		
Tunisie									
U.S.A.		Aug 9	Aug 12		Jul 9	Aug 12		Aug 12	
							Aug 20		
NEI-2									
TRAP									
Canada		May 5	May 11		May 5	May 11	Sep 6	Aug 19	
Italy		Aug 10							
Libya		Nov 6			Nov 6				
Morocco		May 4							
Spain	(Mediterranean)	Sep 21			Sep 21		Sep 21		
	(Peninsula)								
Tunisie									
UNCL & OTHERS									
Argentina			Mar 16						Data for 1988-93
Canada		May 5	May 11		May 5	May 11		Aug 19	
		Jun 16			Jun 16	Jul 5			Data for 1990

As of 2 November 1994

Table 1. continued.

SPECIES GEAR AND COUNTRY	TASK I CATCH DATE REC'D 1993	TASK I CATCH DATE REC'D 1994		TASK II CATCH & EFFORT DATE REC'D 1993	TASK II CATCH & EFFORT DATE REC'D 1994	BIOLOGICAL (SIZE) DATE REC'D 1993	BIOLOGICAL (SIZE) DATE REC'D 1994	REMARKS
						Sep 6		
France (Mediterranean)	Oct 14							
(Bay of Biscay)	Nov 19							
Greece								
Italy	Aug 10							
Morocco								
Portugal (Azores)								
(Madeira)							Sep 22	
(Mainland)	Aug 6	Jul 6		Aug 6	Jul 6			
St. Lucia								
Spain (Mediterranean)	Sep 21	Sep 8		Sep 21	Sep 8	Sep 21	Sep 8	
(Peninsula)								
Tunisie								Data for 1992-93
Turkey		Apr 15						
U.S.A.	Aug 9	Aug 12		Jul 9	Aug 12	Aug 20	Aug 12	
BILLFISH (incl. SWO)								
SURFACE								
Argentina		Mar 16						Data for 1988-93
Benin								
Bermuda		Aug 18	x					
Brazil	Aug 11	Sep 29	x					
Canada	May 5	May 11		May 5	May 11	Aug 3		
China (Taiwan)								
Cyprus								
France (Bay Biscay)								
Ghana								
Ireland					Jun 3			
Italy	Aug 10							
Malta		Apr 4						
Morocco	May 4							
Portugal (Madeira)	Aug 31	May 16		Aug 31	May 16			
(Mainland)	Aug 6	Jul 6		Aug 6	Jul 6			
Senegal	Apr 26			Apr 26		Apr 26		
South Africa	May 18	Jul 20						
	Oct 26							
Spain (Canary Islands)	May 11	Jul 20		May 11	Jul 20			
(Mediterranean)	Sep 21	Sep 8		Sep 21	Sep 8	Sep 21		
(Peninsula)								
Ukraine	Dec 1							
U.S.A.	Jul 9	Aug 12		Jul 9	Aug 12	Jul 9	Aug 12	Including swo 1992 data
		Oct 6			Oct 6		Oct 6	data 1982-93 revised
	Jul 22			Jul 22		Jul 22		
	Aug 9					Aug 9		
Russia								
Venezuela								
SMALL TUNAS - SURF								
Angola	Mar 9	Aug 31	x	Mar 9	Mar 3			preliminary data 1994
	Sep 1							
Argentina		Mar 16						Data for 1988-93
Barbados								
Benin								
Bermuda		Aug 18	x					
Brazil	Aug 11	Sep 29	x	Sep 14				
Cape Verde	Jun 1			Jun 1			Oct 21	
Croatia		Feb 18			Feb 18			
Cuba								
FIS								
France	Oct 14			Oct 14				

Table 1. continued. As of 2 November 1994

SPECIES GEAR AND COUNTRY	TASK I CATCH DATE REC'D 1993	1994		TASK II CATCH & EFFORT DATE REC'D 1993	1994	BIOLOGICAL (SIZE) DATE REC'D 1993	1994	REMARKS
Ghana	Aug 17			Aug 17				
	Sep 13							
	Nov 1							
Greece								
Libya	Nov 6			Nov 6				
Malta	Mar 8	Apr 4						
Libya								
Mexico								
Morocco	May 4							
Portugal (Azores)	Jul 16			Jul 16		Jun 9		
(Madeira)	Aug 31	May 16		Aug 31	May 16			
(Mainland)	Aug 6	Jul 6		Aug 6	Jul 6			
Russia	Oct 1	Jun 15				Sep 14		
		Aug 9						inc 1994 data
Senegal	Apr 26			Apr 26				
South Africa	Oct 26			Oct 26				
St. Lucia								
Spain (Canary Islands)	May 11	Jul 20		May 11	Jul 30			
(Mediterranean)	Sep 21	Sep 8		Sep 21	Sep 8	Sep 21		
(Peninsula)		Sep 8			Sep 8			
(Tropical)	May 11			Jul 12				
Ukraine	Dec 1							
U.S.A.	May 31	Aug 12			Aug 12		Aug 12	inc KGM and SSM for 91 and 92
				Jul 9				
	Jul 22			Jul 22		Jul 22		
	Aug 9					Aug 9		
Venezuela				Jun 11		Jun 11		
NEI-1	May 11							
NEI 2	May 11							
LONGLINE - ALL SPP.								
Algerie				Sep 14				
Bermuda		Aug 18	x					Flag Taiwan
Brazil	Aug 11	Sep 29	x				Oct 17	size data BET,YFT,ALB 78-83
	Sep 23							
Brazil-Japan	Aug 11	Sep 29	x	Sep 14				
Brazil-Honduras	Aug 11	Sep 29	x					Include Brasil-Spain
Brazil-Taiwan	Aug 11	Sep 29	x	Sep 14	May 24	Sep 14		
Canada	May 5	May 11		May 5	May 11	Aug 3	Aug 19	
	Jun 16			Jun 16	Jul 5			Data for 1990
						Sep 6		
China (Taiwan)		Oct 19		May 5		May 5		swo 91,92,93
	Jun 8					May 10		
						May 14		
				Sep 24		Sep 24		
Colombia		Apr 22	x		Apr 22			
Cuba								
Cyprus		Jun 30			Jun 30			Data for 1993
France (Bay of Biscay)	Nov 19							
Greece		Sep 5	x		Sep 5		Sep 5	Including 1992 data
Italy	Aug 10						Sep 20	bft size
Japan				May 21	Sep 12		Oct 19	catch by size alb 92
							Sep 13	catch by size bft 93
							Oct 11	catch at size swo 92,93
							Nov 2	catch at size yft 93
						Sep 14		
						Sep 16		

Table 1. continued. As of 2 November 1994

SPECIES GEAR AND COUNTRY		TASK I CATCH DATE REC'D 1993	TASK I CATCH DATE REC'D 1994		TASK II CATCH & EFFORT DATE REC'D 1993	TASK II CATCH & EFFORT DATE REC'D 1994	BIOLOGICAL (SIZE) DATE REC'D 1993	BIOLOGICAL (SIZE) DATE REC'D 1994	REMARKS
							Oct 1		
							Oct 15		
			Feb 7			Feb 7			Final data for 1991
Japan-Canada-Observer									
Japan-S.Helena-Observer									
Japan-U.S.-Observer									
Korea		Sep 13	Oct 31		Sep 13	Oct 31	Sep 13		
Libya									
Malta		Mar 8	Apr 4						
		Jul 22							
Mexico			Aug 26	x		Aug 26			Data for 1993
			Oct 3						quick estimates for 1994
Morocco		May 4							
Panama									
Portugal	(Azores)	Jul 16			Jul 16		Sep 20		
	(Madeira)	Aug 31	May 16		Aug 31	May 16	Sep 29	Sep 22	
		Sep 29							
	(Mainland)	Aug 6	Jul 6		Aug 6	Jul 6			
St. Helena-Jpn					Nov 3				
St.Helena/Ascension-Jpn					Nov 3				
Ascension-Honduras					Nov 3				
Ascension-Panama					Nov 3				
Ascension-Singapore					Nov 3				
Ascension-Taiwan					Nov 3				
South Africa		Oct 26			Oct 26				
Spain	(Mediterranean)	Sep 21	Sep 8		Sep 21	Sep 8	Sep 21		
	(Peninsula)	Oct 26	Sep 14		Oct 20	Sep 14	Oct 20		data for 91/92
Uruguay									
U.S.A.		May 31	Aug 12			Aug 12	May 26	Aug 12	inc swo 92 and 93 data
		Jul 9			Jul 9		Jul 9		
							May 31		
		Jul 22			Jul 22		Jul 22		
		Aug 9					Aug 9		
							Aug 20		
Russia									
Venezuela									
Venezuela-Foreign									
NEI-1									
NEI-2									
VARIOUS:									
FAO		Aug 3	Mar 21						Updates for 1987-92
		Aug 20							
		Aug 31							
		Sep 6							
		Sep 20							
		Oct 15							
		Oct 27							

Addendum 1 to Appendix 4

Agenda of the Sub-Committee on Statistics

1. Opening of the meeting
2. Adoption of Agenda and arrangements for the meeting
3. Review of national statistics
   - 3.a Data collection and reporting
   - 3.b Improvements to be made
4. Secretariat's statistical work in 1994
   - 4.a Data collection and compilation
   - 4.b Port sampling program
   - 4.c Secretariat data management policy
   - 4.d Dissemination and publication of data
   - 4.e Other matters
5. Examination of the problem of unreported catches by non-Contracting Parties
6. Review of the progress made on recommendations for statistics (as contained in the 1993 SCRS Report), and future plans
   - 6.a Improvement of Mediterranean statistics
   - 6.b Collection of information on by-catches
   - 6.c Improvement of computer facilities and software
   - 6.d International purse seine logbook
   - 6.e Restructuring of the sampling strategy for the surface fisheries
7. Definition of the parameters for simulated data to be used in evaluating methods of converting catch at size to catch at age
8. Recommendations
9. Date and place of the next meeting of the Sub-Committee on Statistics
10. Other matters
11. Adoption of Report
12. Adjournment

Addendum 2 to Appendix 4

Report of the Small Group to Review Secretariat Computer Facilities

A small group was formed to review the Secretariat's proposal (COM-SCRS/94/22) to replace its computer equipment. The group concurred with the Secretariat's report that the existing equipment was outdated, increasingly prone to failure, and in need of replacement.

The Secretariat reported that proposals had been solicited from three prominent vendors of computer workstations for similar configurations, and that the DEC proposal was the least expensive in terms of purchase price and maintenance costs. It was noted that the proposed workstation was not the fastest of the three considered, but the group believed that the Secretariat's needs would be adequately met with the proposed machine. The group further noted two additional benefits of the proposed purchase: (1) the operating system of the DEC machine would be the same as that of the Micro VAX II, thus eliminating substantial investments in time that would be needed if a workstation were purchased from another vendor; and (2) the workstation might be useful to SCRS scientists who are running some jobs at meetings which take multiple hours (to 12 or more) on fast PCs.

The group strongly endorsed the proposal presented by the Secretariat.

The group further recommended that the Secretariat investigate, if feasible, an INTERNET connection to the workstation to facilitate electronic transfers of data and information to and from the Secretariat, member and cooperating nations, and other international organizations.

The small group reviewed the Secretariat's proposals for other computer related office equipment and software (SCRS/94/22). The group agreed that much of the existing equipment (computers, printers, etc.) was obsolete and that breakdowns of the equipment are becoming more frequent. Thus, the group strongly supported the Secretariat's proposals for the purchase of new equipment.

The purchase of five new printers was assigned the highest priority. These printers should be equipped with built-in, scalable fonts, and have the capability of printing 600 dpi (dots per inch), particularly for use in printing documents to be published in ICCAT volumes. At least one of these printers should be a "Post Script" printer, which is necessary for many graphics packages and which can be used to print the graphics files presented to the Secretariat by scientists and organizations, during the meetings and throughout the year.

The group concurred that in 1995 at least three additional portable PCs (Notebooks) should be purchased to replace the current out-dated equipment so that each language department will have at least one portable (in addition to the two Notebooks recently purchased for the Assistant Executive Secretary and the Systems Analyst). These portable PCs (486/SX 33 Mhz, with additional full-sized monitors and expanded keyboards for regular in-office use) should meet the following specifications: a minimum of 8 MB RAM, SVGA monitors with a vertical refresh rate of 72 or more and a resolution of .26 mm or less for a 14 inch monitor (or equivalent resolution on larger monitors).

The group further recommended that such purchases of computer equipment be made as early as possible in the year so that the Secretariat can take full advantage of their use in their work on the ICCAT publications (Biennial Report, Collective Volume, etc.).

In addition to the Secretariat's proposals the following recommendations were made:

A flatbed scanner with 600 dpi capability, and associated software, should be purchased so that the Secretariat can computerize figures sent by scientists, etc. for which original data and/or graphics package files are not available (as was the case for the Billfish Symposium).

The group noted that the purchases of software for the PCs recommended in 1993 had not been made. It strongly recommended that those purchases be made as they impact on the Secretariat's ability to make more efficient use of its equipment and to perform several functions vital to the Commission's work.

The group further noted that PC-based software to sort and compile programs from within an editor was also necessary to assure optimal use of the Systems Analyst's time and strongly urged that this purchase be made.

Since an increasing number of files received by the Secretariat are Windows-based, one of the portables at the Secretariat should be installed with a Windows version of a word processing software and spreadsheet so that those files can be easily converted to DOS files.

If funds are available, the group also recommended the purchase of transportable text to speech equipment and software. This equipment would permit accurate data entry checking by one person rather than two and would simplify checking (and improve accuracy).

The group agreed with the proposed schedule of purchases for 1996 as outlined in Document COM-SCRS/94/22 and asked that the proposal be submitted again to the Committee at the 1995 meeting for purchases to be made in 1996, with revisions as necessary. The group recommended that the remainder of the PCs to be purchased for the Secretariat staff be desk top models, as these are not only less expensive, but more durable and more easily upgraded.

Addendum 3 to Appendix 4

Working Plan to Review the Sampling Scheme for the Eastern Tropical Atlantic Surface Fisheries

Objectives

In accordance with the various recommendations made by the Standing Committee on Research and Statistics of the ICCAT, the present biological (size and species) sampling scheme for the surface tuna fisheries in the eastern tropical Atlantic should be critically reviewed, with a view towards reviewing this scheme. Recommendations should be submitted on improvements which can be introduced to assure the most cost effective, yet adequate, sampling of these catches, particularly in light of recent changes in fishing strategy and fishing efficiency.

Funds available

The funds available in 1994 for this work amount to 1,000,000 pesetas (about US$ 7,100). It is expected that additional funding may be available in subsequent years, depending on the progress made in the first year.

Basic outline of the plan

Step 1: Review and statistical analysis of the current sampling and data treatment (substitution) schemes, and the data base, in terms of stratification. Preliminary recommendations to improve sampling.

Step 2: Convene a Workshop of the pertinent scientists involved.

Step 3: Carry out, if necessary, further comparative analyses of species and size samples between strata and inter-strata, and make final recommendations for the sampling design.

Work to be carried out in the immediate future

1. The current sampling system should be reviewed and its structure and basic procedures should be documented. Particular attention should be given to the sample size, sampling strategy, and stratification (in time, area, gear, specific conditions, such as use of aggregating devices, helicopters, etc, and topographical conditions). Some documentation has been done in the past on the general sampling scheme, but this was not very comprehensive. The work would most likely be of a theoretical nature (i.e., not actually working on the data base itself, but conducting an overall review).

2. Analysis of the current sampling scheme and identification of the main problems that could occur. This work would be more analytical, utilizing actual limited data (e.g., sampling data from one particular year). The analysis should be centered fundamentally on the following:

a) Whether or not multi-species sampling is suitable as the only sampling scheme to cover a double objective:

-- correct the species composition of the reported catches;
-- obtain size distributions of these catches

b) Review of the criteria for stratification which is currently applied to weight the size distributions and definition of new variables, if necessary. In this sense, special attention should be given to the changes that have occurred in the fishery in the most recent period (extension of fishing with floating objects, etc.)

c) Analysis of the current sampling coverage and the sampling allocation among different size categories.

d) Review of the current substitution scheme of unsampled strata and development of a detailed document on this subject.

3. The advantages and disadvantages of the present sampling scheme should be reported, together with preliminary recommendations to improve sampling.

4. The results of all of the above should be reported at the 1995 SCRS meeting and future plans should be discussed at that time.

Logistics

This draft plan will be forwarded to the SCRS Chairman, the Convener of the Sub-Committee on Statistics, and the rapporteurs of the tropical species groups for their comments. Once the plan is finalized, the actual work will be done by an outside contract with a qualified scientist. Due to funding limitations, this work may be carried out by local contract.

The overall work will be under the direct supervision of the Contractor (i.e., the ICCAT Executive Secretary), but the general collaboration of the scientists involved in the research on these fisheries will be essential, and in particular the collaboration of the Spanish and French scientists is solicited. Such collaboration may include providing the Contractee with some original sampling data and perhaps logbook records taken from their tropical surface tuna fleets. In order to protect the privacy of industry, boat names will be deleted from such a data base.

Appendix 5 to Annex 25

REPORT OF THE CONTRIBUTIONS/EXPENDITURES OF THE ICCAT ENHANCED BILLFISH RESEARCH PROGRAM IN 1994

(COM-SCRS/94/14, Revised)

The ICCAT Enhanced Research Program for Billfish, which began in 1987, continued in 1994. The Secretariat served as the coordinator for transferring funds and distributing tags, information, and data. The billfish data base is maintained at the NMFS Southeast Fisheries Center (Miami, Florida) and at the ICCAT Secretariat. This report represents a summary of the contributions and expenditures for the ICCAT Enhanced Research Program for Billfish during 1994.

The General Coordinator of the Program is Dr. B. Brown; the East Atlantic Coordinators are Dr. T. Diouf (Senegal) and Mr. M. Mensah (Ghana), while the West Atlantic Coordinator is Dr. E. Prince.

The Second ICCAT Billfish Workshop, held at the NMFS Southeast Fisheries Center (Miami, Florida, U.S.A.), July 19-22, 1992, resulted in a large amount of information being obtained (27 documents were submitted to the Workshop and another 13 documents were presented to the 1992 SCRS). The Report of the Workshop, the documents submitted at the Workshop, and the documents submitted to the 1992 SCRS, were published in the "Collective Volume of Scientific Papers" series, Vol. XLI (587 pages), in enhanced format, including a hardcover binding. Funds for publishing the book in hard cover binding and mailing expenses were covered by the Billfish Program funds. The Report was distributed by the ICCAT Secretariat during the second quarter of 1994.

Table 1 shows the income received at the Secretariat towards the Billfish Program and the balance of Billfish Program funds (as of November 15, 1994). At the start of Fiscal Year 1994, there was a balance of US$ 44,624.81 in the Billfish Program account. There were contributions received by the ICCAT Secretariat in 1994 towards the Billfish Program from the U.S. National Marine Fisheries Service in April (US$ 30,000) and the National Fish & Wildlife Foundation in October (US$ 37,000). Other income received in 1994 included interest earned on a time-deposit account and the re-deposit of a check issued from the account that was returned. It should also be noted that during the second quarter of 1994, the ICCAT Secretariat, with the authorization of the Billfish Program Coordinator, arranged for a portion of the budget to be deposited in a time deposit account. This was done in order to earn interest on that portion of the funds intended to be used during the 1995 sampling season. The interest earned from this effort is reflected as a deposit of US$ 295.21. These funds are intended to support research activities for the 1994 and 1995 sampling seasons. Overall, the Program Plan for 1994 was successfully carried out in a timely manner.

Table 2 shows the Billfish Budget and expenditures as of November 15, 1994. It should be noted that several expenditures during the first quarter of 1994 were the result of research activities in Venezuela during the last quarter of 1993.

Research carried out during 1994 in the west Atlantic is described in SCRS/94/147, while that for the east Atlantic is described in SCRS/94/174, as provided by the Coordinators of the respective areas. In addition, progress in data compilation and analysis for an assessment of eastern Atlantic sailfish by five cooperating countries (Côte d'Ivoire, Ghana, Japan, Senegal and the U.S.) is described in SCRS/94/150.

Table 1. Funds received in 1994 for Billfish Program (up to Nov. 15, 1994) (US$)

Source	*Amount*
Starting Balance (1994)	44,624.81
Funds received:	30,000.00
National Marine Fisheries Service	
National Fish & Wildlife Foundation	37,000.00
Other income:	
Re-deposit of check	1,496.00
Bank interest	295.21
	113,416.67
TOTAL FUNDS AVAILABLE IN 1994	
	58,010.43
TOTAL EXPENDITURES IN 1994 (see **Table 2**)	
BALANCE IN BILLFISH FUNDS (as of November 15, 1994)	**55,406.84**

Table 2. Budget & Expenditures of the Enhanced Billfish Research Program (as of Nov. 15, 1994) (US$)

	Amount Budgeted	*Expenditures*
SPECIES IDENTIFICATION KITS:	1,000.00	0.00
AGE AND GROWTH: Purchase of hard parts	500.00	0.00
TAGGING:		
Tag rewards	750.00	450.00
Lottery rewards	500.00	500.00
Hard part rewards	500.00	0.00
Printing posters and recapture cards in Japanese/Chinese/Portuguese	2,500.00	0.00
Tags and tagging equipment	3,000.00	3,636.75*
STATISTICS & SAMPLING ENHANCEMENT		
-- *West Atlantic shore-based sampling:*		
Cumaná, Venezuela	300.00	300.00
Puerto La Cruz, Venezuela	240.00	240.00
Juangriego, Venezuela	864.00	864.00
Playa Verde, Venezuela	500.00	500.00
Playa Grande Marina, Venezuela	1,680.00	1,680.00
Venezuela tournaments in Puerto Cabello and Falcon	760.00	760.00
Grenada 1,900.00	1,900.00	
Jamaica 1,000.00	0.00	
Trinidad and Tobago	2,000.00	0.00
St. Maarten Netherlands Antilles	1,500.00	0.00
-- *West Atlantic at-sea sampling:*		
Venezuela (Cumaná, Puerta La Cruz, Carupano, Juangriego)	22,300.00	22,408.00*
Insurance for Venezuelan Observers	1,250.00	1,250.00
St. Vincent and Grenada	2,000.00	460.59
Telemetry/Hook Timer studies (travel)	2,000.00	0.00
Brazil	1,000.00	0.00
-- *East Atlantic shore-based sampling:*		
Dakar, Senegal	1,500.00	1,500.00
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	12,000.00	14,373.52*
Mailing & miscellaneous--East Atlantic	100.00	0.00
Secretariat support (data management, mailing, etc.)	2,000.00	3,858.09*
Bank charges on Billfish account	00.00	429.48*
Repair freezer truck for biological sampling	800.00	800.00
Matching funds for purchase of copy machine	600.00	600.00
GRAND TOTAL	**68,444.00**	**58,010.43**

* Part or all of these expenses were not included in the 1993 Budget, but were approved by the Coordinator.

may travel to the Canary Islands in 1995 to assist Japan Tuna Federation staff in distributing tagging kits to captains of longline vessels and answer questions concerning tagging procedures. Travel expenses for this activity are reflected in the section on Coordination Travel.

c) At-sea sampling

Venezuela. At-sea sampling out of the port of Cumaná, Puerto La Cruz, Carúpano, and Juangriego will be continued in 1995. A total of about 15 tuna trips ($9,000), 15 swordfish trips ($9,000), 2 long-range trips on large Korean-type vessels ($2,300), and 8 trips on smaller longline vessels ($2,000) will be made in 1995. Insurance will be $1,250 and the total funding for 1995 will be $23,550.

Brazil. At-sea sampling on Brazilian and Taiwanese longliners fishing out of Rio Grande do Sul, as well as other ports will be initiated in 1995. Dr. A. Amorim from the Instituto de Pesca and Mr. J. Nelson Antero da Silva from IBAMA will direct these research activities. The Western Atlantic Coordinator may travel to Brazil in 1995 to train observers and give a slide presentation on the tagging program. Requested funding for 1995 will be $1,000.

Telemetry and Hook Timing Studies. Proposals for telemetry studies to evaluate the survival of marlin caught and released off longline vessels were not received in 1994. However, a proposal to evaluate possible avoidance of billfish catches on longline gear, through the use of hook timing devices to document the time and depth of billfish catches, was funded by the U.S Government. This project will be conducted by staff at the Mote Marine Laboratory in Sarasota, Florida, during 1994 and 1995. Data on the short-term survival of billfish caught on longline gear will also be obtained. To insure that this study will have a sufficient sample size of billfish in the longline catch, the Western Atlantic Coordinator has agreed to arrange for at least one longline trip to be made in the winter of 1994/95, from Cumaná, Venezuela, or in association with CARICOM and the Division of Fisheries in St. Vincent and the Grenadines. The by-catch rate of billfish in these locations is sufficiently high for sampling. Most of the funding for this project is already covered but travel costs of $2,000 for a Mote Laboratory scientist will be required for 1994/95 to test the hook timers on a Venezuelan or St. Vincent longline vessel.

d) Billfish Tagging Program

Some tagging supplies may have to be ordered for the 1995 tagging season and the funding required for 1995 will be $2,000. In order to further encourage the return of tagged billfish, two types of tagging posters will be printed in Japanese, Chinese, and Portuguese and distributed to longline vessels from these countries. In addition, the florescent orange tag-recapture cards now distributed by the U.S. National Marine Fisheries Service will be printed in the three ICCAT languages (English, French and Spanish) and distributed to participants of the tagging program. Requested funding for printing the new posters and cards is $3,000 for 1995 and $1,000 are required for various tag rewards for 1995.

Grenada, St. Vincent and the Grenadines. A joint study to intensively tag and release west Atlantic sailfish will be conducted between CARICOM and ICCAT on Grenada and St. Vincent and the Grenadines in 1994/95. New longline vessels obtained from Japan, with live bait holding capabilities, will be used to maximize catch rates on both islands to tag and release sailfish caught by longline gear. The funding allocated for this portion of the study will be $2,000 for 1995 and this amount will likely be matched by CARICOM. This funding could provide from 10 to 20 trips during the year.

e) Age and growth

Requested funding for biological samples from juvenile and very large billfish, as well as tag-recaptured billfish, is $500 for 1995. The Western Atlantic Coordinator may travel to Madeira, Portugal, in order to sample very large blue marlin that are landed in this location. Only travel funds will be required for this activity.

f) Coordination

f-1 Travel/Coordination

Experience in the west Atlantic (SCRS/90/20, SCRS/91/18, SCRS/92/24, SCRS/93/102, and SCRS/94/147) continues to indicate that it will be necessary to make a series of trips in specific Caribbean island locations, and occasionally to west Africa 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 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 1995 will be $14,000. Travel may include the following areas:

- Cumaná, Margarita Island, and La Guaira, Venezuela
- Grenada
- St. Maarten, Netherlands Antilles
- Trinidad and Tobago
- Cancún and Cozumel, Mexico
- Dakar, Senegal
- Abidjan, Côte d'Ivoire
- Santos and Recife, Brazil
- St. Vincent
- Other west African and Caribbean countries

f-2 Miscellaneous/Mailing

The requested funding for 1995 for east Atlantic miscellaneous and mailing is $100. Similar needs for the West Atlantic Coordinator are covered by the U.S. domestic budget.

f-3 Secretariat

Funding for mailing and shipment of materials, data management, and samples ($1,000) and for miscellaneous expenses and contingencies ($1,500) for 1995 are included. Requested funding for 1995 is $2,500. Bank charges for 1995 are estimated at $500.

Because of unforseen changes in the fisheries and opportunities for sampling, it may be necessary for the General Coordinator to make adjustments in budgeted program priorities. These changes, if any, will be duly transmitted to the area Coordinators and to the ICCAT Secretariat. Also, the implementation of the proposed budget (**Table 1**) is contingent upon receipt of sufficient funds. The expansion or reduction of expenses will depend, to a large degree, on the available funds.

Table 1. 1995 Budget of the Enhanced Billfish Research Program (US$)

Budget Chapters	*Amounted budgeted*
SPECIES IDENTIFICATION KIT:	1,000*
AGE AND GROWTH:	
Purchase of hard parts	500*
TAGGING:	
Tag rewards	500
Lottery rewards	500
Hard part rewards	500*
Printing posters and recapture cards in Japanese, Chinese, and Portuguese	3,000*
Tags and tagging equipment	2,000*
STATISTICS & SAMPLING	
-- *West Atlantic shore-based sampling:*	
Cumaná, Venezuela	300
Puerto La Cruz, Venezuela	240
Juangriego, Venezuela	864
Playa Verde, Venezuela	500
Playa Grande Marina, Venezuela	1,680
Venezuela tournaments in Puerto Cabello and Falcon	760
Grenada	1,000*
Jamaica	1,000*
Martinique	1,500*
Trinidad & Tobago	1,000*
St. Maarten, Netherlands Antilles	1,500*
U.S. Virgin Islands	1,000*
-- *West Atlantic at-sea sampling:*	
Venezuela (Cumaná, Puerto La Cruz, Carúpano, Juangriego)	22,300
Insurance for Venezuelan Observers	1,250
St. Vincent and Grenada	2,000
Telemetry / Hook timer studies (Travel only)	2,000
Brazil	1,000*
-- *East Atlantic shore-based sampling:*	
Dakar, Senegal	1,500
Côte d'Ivoire	1,500
Ghana	1,500
Canary Islands	400*
COORDINATION:	
Travel by Coordinators	14,000*
Mailing & miscellaneous-East Atlantic	100
Secretariat support (data management, mailing, etc.)	2,500
Bank charges	500
GRAND TOTAL:	$69,894

* These budgetary expenditures (all or part) will not be authorized unless sufficient funds are available.

Appendix 7 to Annex 25

REVIEW OF THE PROGRESS MADE IN THE BLUEFIN YEAR PROGRAM (BYP) IN 1994
(COM-SCRS/94/15)

1. Background

The year 1994 marked the third year of the ICCAT Bluefin Year Program (BYP) that was initiated in 1992 within the framework of the SCRS. The objectives of this program are to improve statistics and to gain a better understanding of the basic biology, ecology and population dynamics of the Atlantic bluefin tuna stock, in order to meet the need for more accurate and precise management of this heavily exploited stock (ICCAT 1992, Appendix 9 to Annex 16).

This Program depends entirely on the national research activities of the ICCAT member countries. However, international research cooperation has been established recently among ICCAT, GFCM and the EU, especially regarding studies on Mediterranean bluefin tuna. As indicated later in this report, the major BYP activity in 1994 centered on the international joint project for a larval survey of Atlantic bluefin tuna, which was carried out and covered most of the two major spawning areas, the Gulf of Mexico and the Mediterranean Sea.

2. Review of national research activities

A summary of national research activities was submitted to the BYP Coordinators from Canada, Greece, Spain, Italy, the U.S. and Japan. Specific new research and topics of national research activities in 1994 were summarized as follows:

Canada completed sampling, and data analyses continued on reproductive biology through histological analysis, tag/recapture studies to estimate absolute numbers in the Hell Hole areas. Canada also provided ICCAT with the historical tag/recapture data file for the establishment of a common tag/recapture file.

Greece, under EU and BYP research projects, has been conducting plankton surveys in the southern Aegean Sea since 1993. Italy has been conducting a domestic larval survey in its coastal waters for a long time.

Important progress is being made in Spanish research on Atlantic bluefin tuna, especially on fecundity, growth and tagging experiments.

As regards fecundity studies, an additional 63 fish, ranging between 130 cm and 257 cm, were sampled for reproductive biology. Histological studies are underway to obtain improved information on reproductive biology and these studies will be completed in 1995. As mentioned earlier, a validation study of growth based on spines is being carried out using samples collected in the Turkish fall and winter fisheries. A bluefin tuna which had been tagged and injected with oxytetracycline in 1991 in the western Mediterranean was recaptured in the Bay of Biscay in 1994. Samples from this fish will provide useful information for the validation study of growth. Tagging cruises for juvenile tuna (less than 50 cm) were carried out during the September-November period off the Spanish Mediterranean coast. About 1,100 individual small fish were tagged in 1993 and 1994. The relationship between the fisheries in the western Mediterranean and the Bay of Biscay is now being studied, based on these tag/recapture data.

A Spanish scientist took part in the Japanese cruise for the investigation of the distribution of bluefin spawning areas in the Mediterranean in July, 1994. Also, activities carried out within the above mentioned projects, and financed by the EU, included studies on stock structure based on genetic identification.

U.S. activities relative to the BYP during 1993 and 1994 included the improvement of statistics, stock structure, abundance index of large fish and reproductive biology. As to the approach of determining bluefin tuna stock structure from genetic material, samples were obtained from both the west Atlantic and the Mediterranean.

Two feasibility studies, using methods independent of the fisheries, to obtain abundance indices of large fish, were carried out, one based on observations by spotter pilots off the northeast U.S., primarily in the Gulf of Maine, and another based on a line transect larval survey. More feasibility tests are required to determine the utility of these methods. The study of reproductive biology made little progress due to the difficulty in obtaining samples from more southerly waters, but preliminary studies of the samples are underway.

For aging and reproductive biology, Japan collected biological samples from the Japanese longline fishery operating within the Canadian 200 mile zone, as well as adjacent high seas, for the period October, 1992, to January, 1993, with the cooperation of Canadian observers on-board Japanese boats. In total, the gonads of 175 bluefin tuna ranging from 89 to 290 cm FL were sectioned for histological analysis. All of these gonads were immature or in the resting stage, containing mainly peri-nucleous oocytes, less than 0.2 mm in diameter. Some gonads contained a few atretic oocytes but no oocytes with clear vitellogenesis were observed.

In addition, samples taken from various parts of the Atlantic and the Mediterranean are now under genetic analysis for stock structure.

3. Review of international research activities

The EU-funded research project for large pelagic fish in the Mediterranean Sea (Characterization of large pelagic stocks in the Mediterranean) continued in 1994. The primary objective of the project is to collect and analyze data related to the biology and fisheries of bluefin tuna, albacore, bonito and swordfish in the Mediterranean Sea.

A joint international larval survey of the Atlantic and Mediterranean was successfully conducted with the participation of scientists from the U.S., Spain, Italy, Greece, Turkey and Japan. The main objectives of this survey were: (1) to collect bluefin tuna larvae to examine genetic differences between the two spawning grounds; (2) to calibrate and standardize sampling efficiencies on tuna larvae among vessels from the U.S., the EU and Japan; and (3) to examine the distribution of tuna larvae, especially in the Mediterranean.

U.S. and Japanese scientists conducted the survey with their own research vessels from late April to late May during the annual U.S. survey in the Gulf of Mexico in the bluefin spawning season. A total of 67 cooperative stations were covered by a net survey in the Gulf of Mexico. In the Mediterranean, a Japanese boat (SCRS/94/177) and an EU-funded vessel (SCRS/94/94) carried out net surveys on 445 and 302 stations, respectively, from early June to early August. Inter-calibration of catchability of the larvae between two boats was attempted on July 19 and 20, 1994, on a total of 23 stations in the Ionian Sea. The data collected are now being processed and it is expected that the preliminary results will be made available in 1995/1996.

Appendix 8 to Annex 25

REPORT OF THE SUB-COMMITTEE ON ENVIRONMENT

1. Opening

The meeting of the Sub-Committee on Environment was held on November 23, 1994, in the Hotel Pintor, Madrid. Mr. J Pereira (Portugal), Convener of the Sub-Committee, welcomed all the participants.

2. Adoption of Agenda and arrangements for the meeting

The Tentative Agenda was adopted and is attached to this report as **Addendum 1 to Appendix 8.** Dr. J. M. Stretta (France) was designated rapporteur.

This year, the matter of by-catches, usually discussed by the Sub-Committee on Environment, was referred to the SCRS Plenary Sessions.

3. Review of contribution papers

Only five of the documents presented to the SCRS this year dealt with issues related, in a broad sense, to the Sub-Committee on Environment (SCRS/94/78, 139, 142, 143, 144, and 164).

A study on bluefin carried out in 1993 and 1994 in the west Mediterranean on the relationship between the area distribution of catches and the size of bluefin within environmental parameters (temperature and surface currents estimates) is reported in document SCRS/94/78. It appears that the distribution of bluefin is linked to cyclone-like structures.

A study on albacore catches during the fishing seasons in 1990, 1991, and 1992 in the north west Atlantic and the Mediterranean (Alboran Sea) together with oceanographic phenomenon observed by satellite is discussed in document SCRS/94/139. This study shows that thermal fronts, particularly turbulent ones of an anticyclonic type, are structures which favor important concentrations of albacore.

Documents SCRS/94/142, 143 and 144 contain all the latest research into tuna behavior models (in the broad sense) based on techniques used in artificial intelligence and virtual reality. Thus, by using neuron networks and genetic algorithms, it has been possible to make an artificial tuna "navigate" through daily surface temperatures mapped by satellite, between two different fishing areas of about 1,000 miles apart (SCRS/94/142). It has also been possible, with the aid of techniques used in Artificial Intelligence, to reproduce the optimum gregarious behavior of tunas, both in free schools (SCRS/94/143) or under floating objects (SCRS/94/144), depending on the environmental resources.

The Convener of the Sub-Committee noted with regret the reduction in the number of documents presented concerning the environment in its *sensu stricto*. It is hoped that studies will be carried out on the direct and indirect effects of the environment on the fluctuations of the tuna stocks. This problem highlights the need for cooperation between different oceanographic disciplines (physics, biology etc.).

4. Examination of possible access to existing data bases on the environment

The Secretariat carried out a study on the access to data bases on marine environment (document COM-SCRS/94/23). Five institutions currently have environmental data bases that are accessible to interested scientists.

-- The NODC (Washington-USA) sells a CD-ROM (at a cost of about $80) with traditional oceanographic data.

- SADCO (Republic of South Africa) also has oceanographic data available on the southern part of the Atlantic, Indian and Pacific oceans. This organization will allow ICCAT on-line access to its base (at a cost of 50,000 ECU) or off-line access (at 100 ECU per consultation)

- CEOS (ORSTOM-NMFS-ICLARM) has oceanographic data (from 1854 to 1991) and software on several CD-ROMs (one per ocean) which they distribute free of charge (contact: Dr. C. Roy, ORSTOM-Montpelier).

- The TOGA (ORSTOM-IFREMER) data base covers the intertropical area of the world's oceans; these data are free.

- UNEP (Kenya) has an INFOTERRA data base on the environment, in the broad sense.

It was suggested that the Secretariat acquire a CD-ROM in order to be able to read the environmental data available on CD.

The European Union representative drew the attention of the Sub-Committee to the May 1994 meeting of a working group (under the auspices of the EU) which established a data base to assess the biological impact on fisheries. This working group identified the possible interactions between the fisheries and the ecosystem, both overall and on the level of biotas of which it consists (particularly the interactions between the fisheries and birds, fish, mammals and benthos). This working group also examined the problems of quantification of these interactions between the fisheries and the ecosystem, bearing in mind the problems of scale, data compatibility, choice of species to be studied, experimental approaches to adopt, as well as the definition of the notion of "risk" (risk of extinction of a species, or of affecting the vital minimum threshold of a population). The EU working group concluded by highlighting the need for catch data on targeted species and by-catches of the fisheries, as well as the need for biological information on preyed fish (juveniles, short cycle species).

5. Anomalies in oceanographic conditions in 1993

A study being carried out on thermal anomalies (on the order of -8°C), observed in 1988, in the maritime province of the Azores, was brought to the attention of the Sub-Committee. This anomaly could explain the absence of bigeye fishing that year.

Furthermore, in 1993, a particularly high abundance of bigeye (all sizes) was noted along the coast of Senegal and Angola, together with high albacore catches by purse seine. The question is whether this abundance is linked to the cooling of these fishing zones, which increases the vulnerability of certain species. The situation would be inverse to that noted in 1984, where a thickening of the surface layer may have reduced the vulnerability of some species.

6. Ecology of tunas

Document SCRS/94/164 discussed the new Canary Islands fishery which consists of maintaining a tuna school under a baitboat fishing vessel for several weeks. This fishing technique, also used off Senegal, obtains very different results; in the Canary Islands fishery, bigeye and skipjack represent 89% and 9% of the catch respectively, while in Senegal, catches of bigeye, yellowfin and skipjack were the same overall, although there was considerable daily variability in the species composition. Off Senegal, a group of baitboats could maintain a school over a 10-12 month period and over distances of more than 1000 km. In addition, this fishing technique tends to be developed for bluefin fishing in temperate waters. France has set up a national program to study this type of association, its dynamics and the problem involved, particularly with regard to CPUE.

A document (SCRS/94/172) relative to fishing using floating objects was presented to the SCRS but was not discussed in any depth.

It was brought to the attention of the Sub-Committee that IATTC documents relating to the important meeting on floating objects, which took place in 1992, will soon be published.

7. Review of studies on the effect of the environment on tuna ecology and the conclusions of international meetings on the environment

The EU representative informed the Commission's scientific committee of the impact of driftnets, used in Community fisheries, on two species of marine mammals, the common dolphin *(Delphinus delphis)* and the striped dolphin *(Stenella coeruleoalba)*. It was agreed at this meeting that there are no negative effects on the populations of these two dolphin species if the quantities caught are less than the 2% threshold of the population. For the common dolphin, catches are less than that threshold, but this is not the case for striped dolphin.

The Sub-Committee was also informed of a meeting held by the CEOS on the problems of "exploited resources and the environment". Biologists, physicists, and modelling experts attended this meeting and discussed in depth the conceptual problems of methodologies. The report is currently being prepared for publication.

The Delegate of France noted that a research program on the enrichment methods in the very productive area located north of the Equator has been initiated (PICOLO program).

The Delegate of Venezuela reported that an observer program on board the tuna fleet, with 33% coverage, will soon commence.

8. Working plan for the Sub-Committee

The Convener of the Sub-Committee wished to reiterate the recommendations put forward last year, particularly those concerning the development of research on the trophic relations between yellowfin and small tunas under artificial flotsam.

9. Date and place of next meeting of the Sub-Committee on Environment

The next meeting of the Sub-Committee on the Environment will be held in the same time and place as the next SCRS session.

10. Other matters

No other matters were discussed.

11. Adoption of Report

The report was adopted.

12. Adjournment

The meeting was adjourned.

Addendum 1 to Appendix 8

Agenda of the Sub-Committee on Environment

1. Opening of the meeting
2. Adoption of Agenda and arrangements for the meeting
3. Review of contribution papers
4. Examination of possible access to existing data bases on the environment
5. Anomalies in oceanic conditions in recent years
6. Ecology of tunas (association with floating objects, with other marine animals, gear selectivity, species interactions, by-catches, etc.)
7. Review of studies on the effect of the environment on tuna ecology and the conclusions of any international meetings on the environment
8. Working plan for the Sub-Committee
   -- Short-term plan
   -- Long-term plan
9. Date and place of the next meeting of the Sub-Committee on Environment
10. Other matters
11. Adoption of Report
12. Adjournment