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REPORT ON THE EXPERT CONSULTATION ON THE STOCK ASSESSMENT OF TUNAS IN THE INDIAN OCEAN

Colombo, Sri Lanka
28 November - 2 December 1985

INDO-PACIFIC TUNA DEVELOPMENT & MANAGEMENT PROGRAMME
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EXPERT CONSULTATION ON THE STOCK ASSESSMENT OF TUNAS IN THE INDIAN OCEAN

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1. OPENING OF THE MEETING

The Expert Consultation on the Stock Assessment of Tunas in the Indian Ocean was held at the Hotel Ceylon Inter-Continental in Colombo, Sri Lanka from 28 November to 2 December 1985. On behalf of the staff of the Indo-Pacific Tuna Development and Management Programme (IPTP), Mr. T. Sakurai, Programme Director a.i. welcomed the participants and also extended his sincere thanks to the Government of Sri Lanka for hosting the meeting.

Dr. Hiran Jayewardene, Chairman of the National Aquatic Resources Agency (NARA) opened the meeting with his inaugural address. The address is attached as Appendix 1.

Dr. J. Marcille, Technical Secretary of the IOFC Committee for the Management of Indian Ocean Tuna explained the objectives of the meeting and pointed out that the rapid expansion of purse seining in the Western Indian Ocean and the increasing interest by many coastal states in tuna fishing made it highly desirable to undertake an up to date review of what is known about the tuna resources and their state of exploitation.

A list of participants is attached as Appendix 2.

2. ELECTION OF THE CHAIRMAN

Mr. Richard S. Shomura, Director of the Honolulu Laboratory, Southwest Fisheries Center, Honolulu, USA, was unanimously elected as Chairman of the meeting.

3. ADOPTION OF AGENDA AND ARRANGEMENTS FOR THE MEETING

A provisional agenda and timetable prepared by the Secretariat was presented and adopted without amendment. The agenda and timetable adopted is attached as Appendix 3.

A number of papers giving background information were presented by participants and the Secretariat. A list of documents presented is attached as Appendix 4.

Working groups were established to review the state of exploitation of various species groups. The following participants were appointed Chairmen and rapporteurs of these Groups:

Group	Chairman	Rapporteur
Bigeye, southern bluefin and Albacore (Group 1)	Mr. J. Nageon de Lestang (Seychelles)	Mr. S. Kume (Japan) Mr. T. Lawson (IPTP)
Small tunas & tuna-like fishes (Group 2)	Dr. A. Majid (Pakistan)	Dr.K.Sivasubramaniam (BOBP),Dr. J. Marcille (FAO)
Yellowfin and skipjack (Group 3)	Mr. D.B.L. Joseph (Sri Lanka)	Mr. R. Shomura (USA) Mr. A. Fonteneau (France)
Interaction between fisheries (Group 4)	Mr. J. Joseph (I-ATTC)	Mr. T. Polacheck (SPC) Mr. Z. Suzuki (Japan)
Statistics (Group 5)	Dr. P. Miyake (ICCAT)	Mr. M.A. Robinson (FAO) Mr. T. Sakurai (IPTP)

4. REVIEW OF NATIONAL FISHERIES AND RESEARCH PROGRAMMES

Summaries of Country statements presented by participants are given in Appendix 5.

5. REVIEW OF STATUS OF STOCKS

5.1 BIGEYE

Bigeye tuna (Thunnus obesus) are distributed throughout the Indian Ocean between latitudes 20^0N and 45^0S. They are caught primarily by longliners from Japan, Korea and Taiwan (Province of China), and more recently, by purse seiners from France, Spain and the Ivory Coast.

5.1.1 Review of Fisheries Data

Catch Trends

Catches of bigeye tuna by longliners are summarized by country in Table 1.1 and are illustrated in Figure 1.1. Catches increased from 1952 to 1968, then declined steadily until 1973. Since 1974, catches have remained above 25,000 t, reaching a maximum of 56,000 t in 1978. In 1982 and 1983, the total catch was just over 40,000 t.

Japan was the dominant fishing nation from 1952 until the seventies. In 1974, the catch by Japan had diminished and was exceeded by that of Korea. Korean catches remained dominant until 1983, when Japanese catches increased. The catch by Taiwan (Province of China) longliners has been relatively constant since the late sixties.

Purse seiners began experimental fishing in the Indian Ocean in 1973, one purse seine from Mauritius began operations in 1979. By late 1984, a total of 49 vessels were fishing in the western Indian Ocean. Catches of bigeye by purse seiners in 1984 have been estimated at roughly 1,400 t for French and Ivoirian vessels and 800 t for Spanish vessels. Bigeye caught by purse seiners have been taken mostly from flotsam-associated schools during the inter-monsoon periods, taken in mixed school with skipjack and yellowfin. Those bigeye are usually of small size (40 to 65 cm).

Effort Trends

Nominal longliner fishing effort expressed in number of hooks is shown (by country) in Figure 1.2 for the entire Indian Ocean (north of 50°S). After fishing effort by Japanese longliners reached a peak at 125 million hooks in 1967, it ranged from 60 to 90 million. In 1983, it showed a sudden increase and exceeded 100 million. Taiwan (Province of China) effort has increased to between 30 and 60 million since the late sixties and reached 80 million in 1982. The amount of Korean fishing effort was similar to Japanese effort during the period 1975 to 1980.

Estimates of effective effort on bigeye are illustrated by country in Figure 1.3. Panel B in Figure 1.3 shows effort adjusted for differences in gear efficiency between deep longliners and regular longliners. Effective Japanese effort decreased more substantially than nominal effort, particularly after 1970, and has been about the same or even smaller than that of the fishery of Taiwan (Province of China), whose nominal effort has been much smaller than the Japanese. In contrast, effective effort by Korean longliners has exceeded effort by both Japanese and Taiwan (Province of China), in spite of the fact that the nominal effort by Korean vessels was about the same as for Japanese vessels during the late seventies. The Korean fleet operated principally in the tropical Indian Ocean targeting on bigeye and yellowfin tuna. The fleets of Japan and Taiwan (Province of China) directed a larger part of their effort in the southern Indian Ocean, targeting on southern bluefin and albacore, respectively.

Since 1978, the major part of Japanese operations changed rapidly from regular longline to deep longline in the equatorial Indian Ocean. In areas of the eastern Indian Ocean, it has been shown that the bigeye deep longliners are 70 percent more efficient than regular longline, and in an area of the Western Indian Ocean, they were 30 percent more efficient (Koido TWS/85/25).

Trends in Catch Per Unit Effort (CPUE)

Annual longliner catch per unit of effort was calculated based on effective effort (Table 1.1) and is illustrated in Figure 1.4. After the development of the Japanese fishery, the hook rate of bigeye decreased gradually until 1976. In 1977, it suddenly increased to the level of the early fishery, then decreased again in the following two years. It has since been rather stable, though somewhat higher than pre-1977.

The peak in hook rate observed for the Japanese in 1977 was also observed in Korean data, but not for that of Taiwan (Province of China). It was noted that although there was an appreciable increase in bigeye CPUE during 1977, the reported increase is not well understood. It may have been due to either an increase in stock abundance or catchability, or statistical error, though probably represents a combination of each.

5.1.2 Stock Structure

Based on Japanese longline data, it has been speculated that there is a single stock. At present, no evidence exists to support the hypothesis of genetically-isolated sub-stocks, although isolation by distance may be important.

5.1.3 Population Parameters

Weight-length equation for bigeye sampled from the Spanish purse seiner fleet were estimated to be:

$$(\text{Weight in kg}) = 2.7 \times 10^{-5}\ (\text{fork length})^{2.951}$$

(Cort TWS/85/48)

5.1.4 Production Models

Results of a production model analysis of longliner data for bigeye were reported in Miyabe and Koido (TWS/85/27). Estimates of the generalized stock production model were obtained for three cases:

(1) Fishing effort for all countries was adjusted for differences in gear efficiency between deep and regular longlining for 1975 - 1983, based on data for Japanese vessels;

(2) Only effort for the Japanese fleet was adjusted; and

(3) No adjustment was made.

The shape parameter m was set to values at 0.0, 1.0 and 2.0.

Results are summarized in Table 1.2 and illustrated in Figure 1.5. In all cases, the best fit was obtained for m = 0.0, implying that the equilibrium catch will increase assymptotically as effort is increased, however, other values of m may be equally appropriate; since effective effort has increased to about 250-300,000 hooks since 1982, therefore improved estimates of production model parameters may be possible in the coming years. Any further development of surface fisheries on small bigeye may alter the estimates of this model based on a pure long line fishery on large bigeye.

5.1.5 State of the stock

The bigeye fishery has been operating at high level of effort in recent years, though from data currently available it appears that a further increase in effort will not result in a corresponding substantial increase in catch. The significant increase in longline CPUE since 1977 (fig. 1.4) has been discussed extentively. This increase may be due either to real increase of the adult bio mass (one or several good year classes entering the adult fishery) or to non corrected increase of fishing power. In the latter case the recent figures of longline fishing effort would be under estimated, and the stock would be more heavily exploited than presently estimated.

The increased fishing mortality simultaneously on large size bigeye with development of the longlining and on small bigeye by purse seiners, has recently changed the fishing pattern exerted on this stock. Analytical age specific model are necessary to estimate the possible effect of these changes. Close monitoring is required to clarify the effect of these changes in the future.

5.1.6 Recommendations

Statistics

Catch and effort statistics for longliners have improved in recent years, however it would be useful to increase coverage rates for vessels from Korea and Taiwan (Province of China).

Sampling for species and size composition in the purse seine fishery is being carried out for French and Spanish vessels. In order to monitor possible interactions between the surface and deep-water fisheries, sampling programmes should be strengthened when possible. It was noted that for purse seiners, transshipment records for small bigeye will soon be required by industry, and that this should improve the quality of estimates of bigeye in the surface catch.

Research

The stock structure of bigeye is not well understood and should be investigated.

Efforts should be made where possible to improve the quality of estimates of effective effort for all the longliners.

Close monitoring of both the longline fleet and the surface fleet should be maintained to assess the impact of changes in longline gear efficiency and the introduction of purse seiners. Also analytical model be developed to study interactions and measure possible effects of recent changes of fishing pattern.

Management

No recommendations for management were made.

Table 1.1 Annual catch by countries and estimated total effective effort on bigeye tuna based on three assumptions: 1) all efforts were adjusted for deep longline, 2) only Japanese effort was adjusted for deep longline, 3) no adjustment was conducted. TWS/85/27)

YEAR	CATCH (in 1.000 MT)					Effective Effort (1.000 hooks)		
	JAPAN	TAIWAN	KOREA	OTHERS	TOTAL	1	2	3
1952	1.5				1.5	2.504	2.504	2.504
1953	3.6				3.6	7.111	7.111	7.111
1954	7.9	0.1			8.0	16.808	16.808	16.808
1955	10.1	0.2			10.3	22.895	22.895	22.895
1956	13.4	0.6			14.0	39.179	39.179	39.179
1957	12.4	0.9			13.3	36.025	36.025	36.025
1958	11.3	1.5			12.8	28.985	28.985	28.985
1959	8.9	1.5			10.4	33.140	33.140	33.140
1960	15.7	1.3			17.0	53.587	53.587	53.587
1961	13.6	1.9			15.5	52.711	52.711	52.711
1962	18.7	1.2			19.9	72.023	72.023	72.023
1963	12.4	1.7			14.1	51.010	51.010	51.010
1964	16.8	1.8			18.6	66.564	66.564	66.564
1965	18.2	1.4			19.6	83.311	83.311	83.311
1966	22.6	2.2	0.1		[illegible]	95.310	95.310	95.310
1967	22.3	2.3	[illegible]		24.8	121.589	121.589	121.589
1968	24.6	7.2	5.4		37.2	150.139	150.139	150.139
1969	15.0	8.0	3.1		26.[illegible]	145.616	145.616	145.616
1970	13.6	7.6	1.7		22.9	123.947	123.947	123.947
1971	11.8	5.7	4.1		21.6	141.110	141.110	141.110
1972	8.8	4.1	4.3		17.2	118.863	118.863	118.863
1973	5.7	3.0	5.6		14.3	98.995	98.995	98.995
1974	7.7	4.4	13.4	1.2	26.7	229.905	229.905	229.905
1975	8.5	4.0	24.7	1.5	38.7	207.741	206.696	205.025
1976	2.9	3.2	21.0	1.7	[illegible]	142.02[illegible]	142.024	141.696
1977	5.2	5.2	24.6	1.8	36.[illegible]	155.612	145.982	144.080
1978	16.2	1.9	32.9	1.9	55.9	247.807	215.273	205.714
1979	6.1	6.2	21.2	1.8	35.[illegible]	220.157	197.070	195.007
1980	6.5	6.5	18.[illegible]	1.7	33.4	233.770	197.042	191.867
1981	7.7	5.[illegible]	18.9	1.6	33.[illegible]	255.151	235.992	222.071
1982	12.8	8.3	18.9	1.5	41.[illegible]	292.846	264.729	244.295
1983	17.9	8.3	16.7	0.9	*43.8	*299.719	*274.623	*244.095

Table 1.2 Results of the production model analysis for the bigeye tuna fisheries in the Indian Ocean for 1952-1983 (TWS/85/27)

	m	Ymax (1000 tons)	Fopt (million hooks)	Degree of fit index	Number of significant year class in the catch
	0.0	52.5	Infinite	0.8067	3
Bigeye	1.001	35.5	245.0	0.7557	3
	2.0	38.0	215.0	0.6868	3

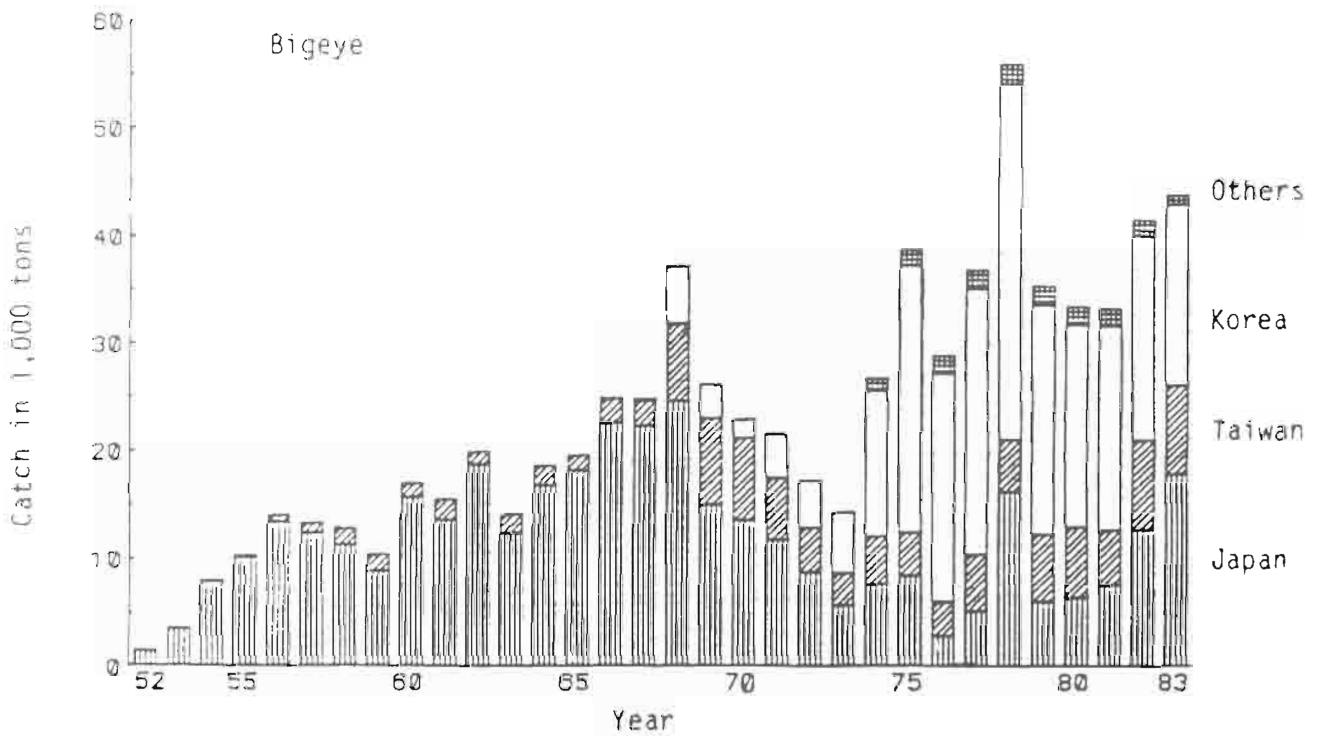

Fig. 1.1 Annual changes of bigeye catch by countries in the Indian Ocean. (TWS/85/27)

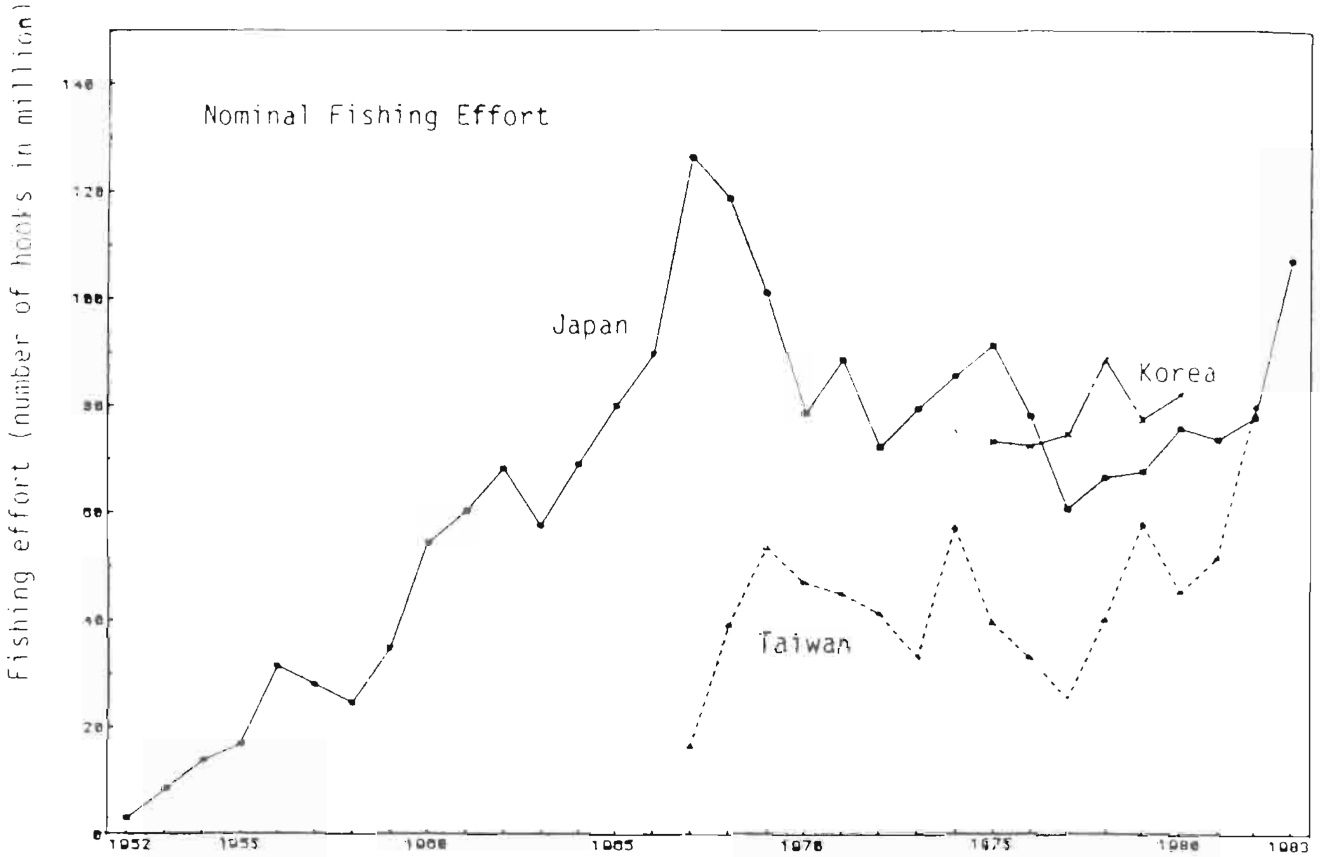

Fig.1.2 Annual changes of the nominal fishing effort by countries in the Indian Ocean (TWS/85/27)

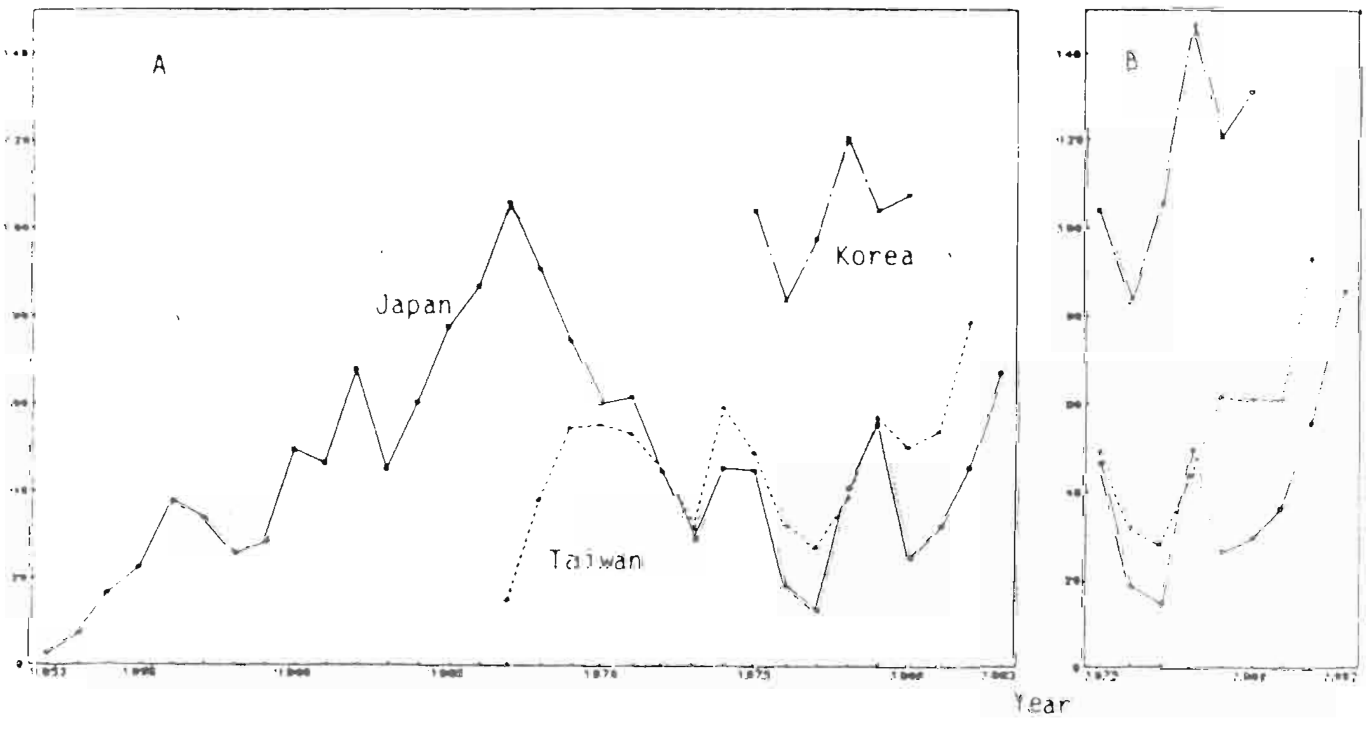

Fig. 1.3 Estimated effective effort by longline countries for bigeye. Panel A and B show those unadjusted and adjusted, respectively. (TWS/85/27)

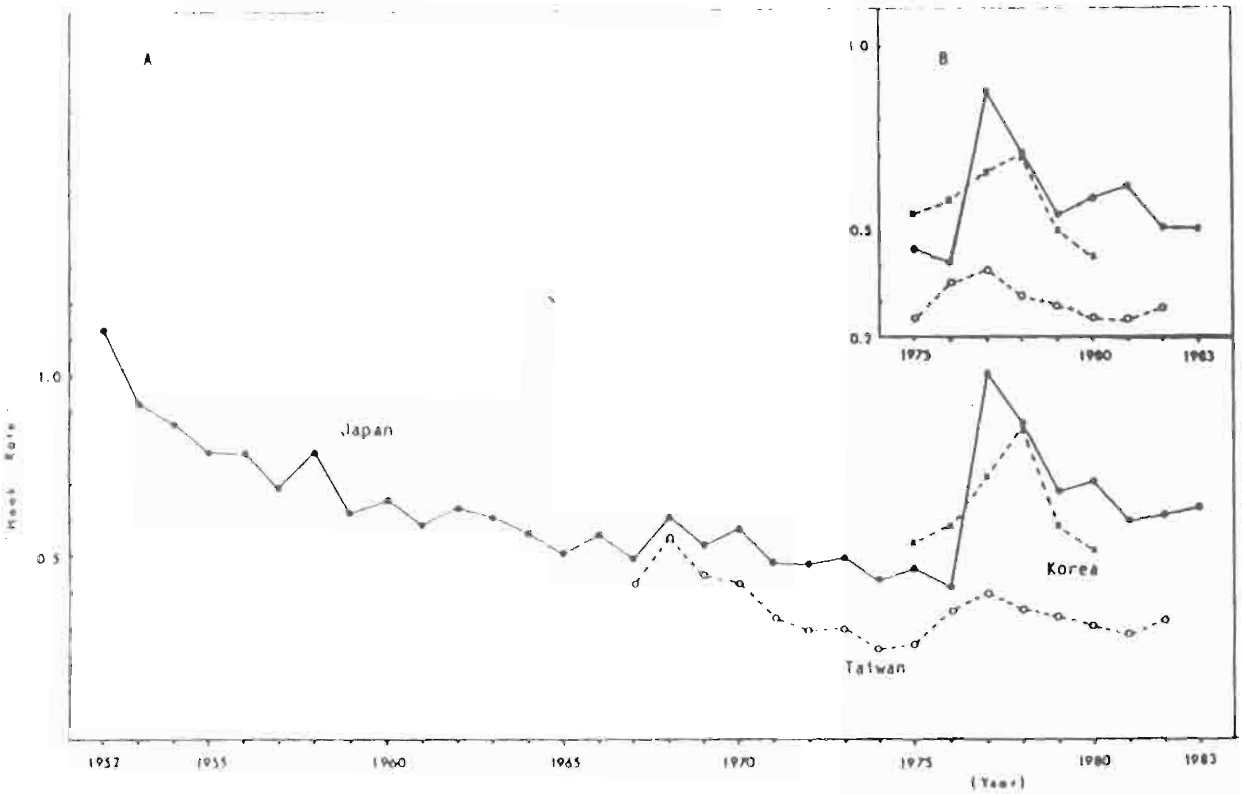

Fig. 1.4 - Annual changes of bigeye hook rate by each longline fishery (TWS/85/27)
A = unadjusted for deep longline
B = adjusted for deep longline

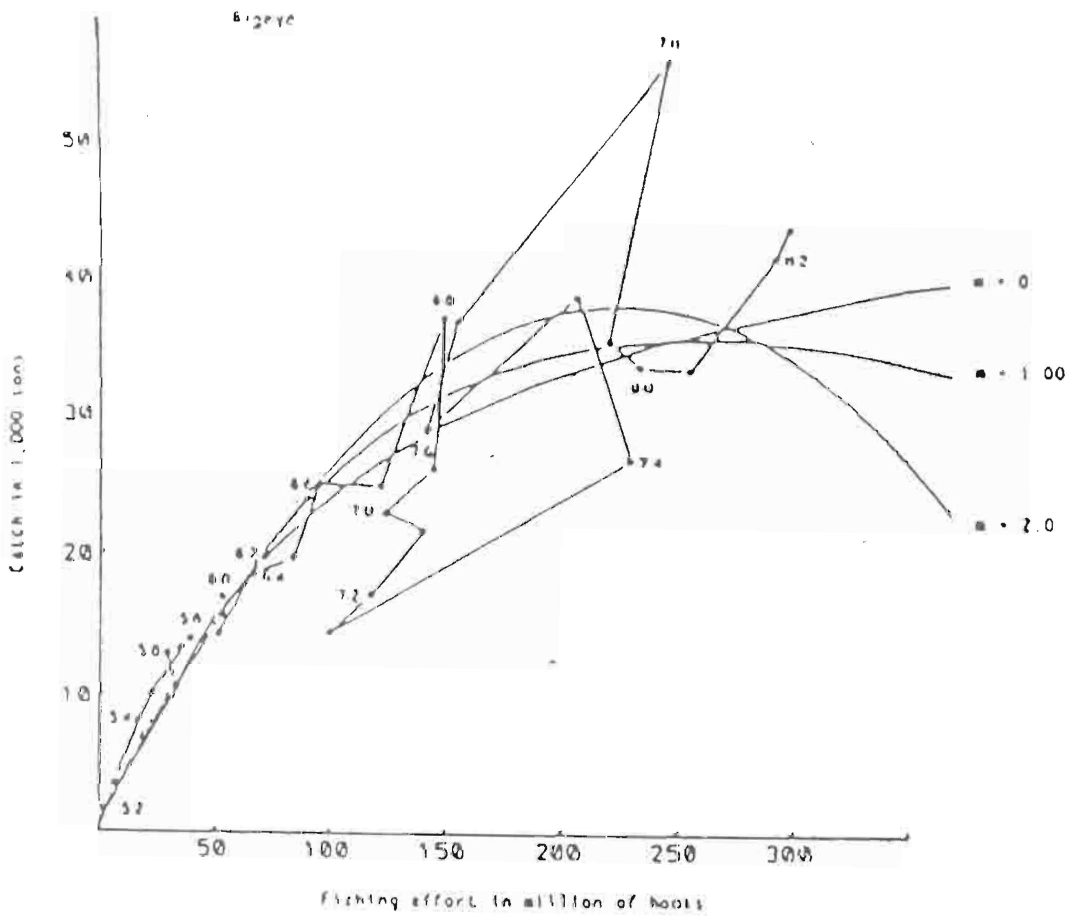

Fig. 1.5 - Relationship between observed annual catch and effort on Indian Ocean bigeye and the fitted equilibrium production curve (TWS/85/27).

5.2 ALBACORE

Albacore (Thunnus alalunga) are distributed across the Indian Ocean between about latitudes 20°N and 40°S. However, they appear to be more abundant south of the equator and most abundant between latitudes 15°S and 35°S. Albacore are taken primarily by longliners, from Taiwan (Province of China), Japan and Korea and, more recently, by purse seines.

5.2.1 Review of Fisheries Data

Catch Trends

Annual catches of albacore by longliners in the Indian Ocean are shown by country in Table 2.1. Total catch increased steadily from 1952 reaching 18,000 t in 1964. Thereafter, catches have fluctuated from year to year, ranging from 10,000 t to 22,000 t except for 1974. The total catch is expected to continue to fluctuate about an average value of 15,000 t.

The Japanese catch was dominant until 1968; since 1969, catches by Taiwan (Province of China) have been much greater than either Japanese or Korean catches. During this time, the Japanese began to target on southern bluefin south of 40°S while the Koreans have generally targetted on bigeye and yellowfin in the equatorial areas.

The catch of albacore in the purse seine fishery in the Western Indian Ocean in 1984 has been estimated at 200 t for the French and Ivorian vessels, and 300 t for Spanish vessels.

Effort Trends

Effective longliner effort on Indian Ocean albacore has fluctuated between 80 million and 190 million hooks since 1973. (Table 2.2, Fig. 2.1). Japanese and Korean effort has declined considerably from their maximum periods, whereas the fishing effort of Taiwan (Province of China) still appears to be increasing.

Trends in Catch Per Unit Effort (CPUE)

Longliner catch per unit effort for albacore has been stable since 1970, varying from 0.54 to 0.88 fish per 100 hooks (Fig. 2.2). This level represents a substantial decrease from the 1960 level, when fishing of immature fish began. Total catch has tended to increase with an increase in fishing effort, but annual fluctuations are high. A strong inverse relationship between CPUE and effort as shown in Figure 2.3 has been observed in the first years of exploitation while catch per unit effort seems to have been rather stable since year 1970.

5.2.2 Stock Structure

The distribution of albacore in the Indian Ocean appears to be continuous with albacore in the Atlantic Ocean, and distinct from albacore in the Pacific Ocean.

According to the distribution of larval fish, the main spawning area is thought to be between latitudes 10°S and 25°S. Length frequencies indicate that immature fish are found primarily between 30°S to 40°S.

5.2.3 Population Parameters

No estimates were available

5.2.4 Production Model

Estimates of the generalized stock production model were reported for bigeye in Shiohama (TWS/85/23). Input data included catch and effort statistics vessels from Japan, Korea and Taiwan (Province of China). The model is basically a longline model as most of the catch is taken by longline and because the effort is based on longline CPUE. Any possible development of surface fisheries on this stock could alter this model to an unknown degree.

Results for different values of the shape parameter are given in Table 2.3 and Figure 2.4. Maximum sustained yield was estimated at 15-20,000 t. However, it was noted that the relationship between expected yield and effort was not clear due to scatter in the data. It was also noted that effective effort was estimated using indices of efficiency determined only from Japanese data. Including data from Taiwan (Province of China) should increase the reliability of indices of efficiency for certain areas, as well as account for the effect of targeting on albacore by the Taiwan (Province of China).

5.2.5 Recommendations

Statistics

It was recommended that ongoing sampling programmes for the surface fleet be maintained to insure reliable estimates of the catch and size composition of albacore.

Research

It was suggested that in the presentation of catch and CPUE data, in general, maps with proportional representation would provide a more accurate picture.

It was recommended that the effect on production model analyses of estimating effective effort using indices of efficiency determined only from Japanese data, rather than data for all longliners, be investigated.

Management

No management recommendations were made.

Table 2.1.- Annual catch of albacore by longlining countries in the Indian Ocean, 1952-1983. (TWS/85/23)

(Unit: tons)

Year	Japan	Taiwan	Korea	Total
1952	67			67
1953	1,099			1,099
1954	2,759			2,759
1955	3,098			3,098
1956	5,118			5,118
1957	4,664			4,664
1958	6,285			6,285
1959	10,412			10,412
1960	11,066			11,066
1961	15,438			15,438
1962	17,668			17,668
1963	12,546	74		12,620
1964	17,874	210		18,084
1965	11,375	22	500	11,897
1966	13,130	2,646	500	16,276
1967	14,098	5,205	2,900	22,203
1968	10,034	6,135	600	16,769
1969	8,546	9,427	3,000	20,973
1970	4,684	6,436	3,000	14,120
1971	3,140	4,346	2,100	9,586
1972	1,257	6,278	3,600	11,135
1973	1,835	10,570	9,000	21,405
1974	2,606	15,438	9,206	27,250
1975	1,168	5,793	3,243	10,204
1976	1,166	8,820	3,847	13,833
1977	404	9,352	1,505	11,261
1978	418	12,873	4,103	17,394
1979	396	12,746	1,922	15,064
1980	577	9,566	1,582	11,725
1981	1,174	11,129	709	13,012
1982	1,184	19,803	399	21,386
1983	1,592	–	274	–

Table 2.2 Annual trend of effective effort, total catch in number, total catch in tons and CPUE for Indian albacore exploited by longlining countries, 1952-1982. (TWS/85/22; TWS/85/23)

Year	Number of hooks (A)	Effective effort (B)	Catch in number (C)	Yield in tons (D)	Concentration index (B/A)	Intensity per 5° square (B/ΣA (149.88))	CPUE, A Hook rate (C×100/A)	CPUE, B (C×100/B)	CPUE, C (D×10 /B)
1952	994,581	153,177	3,244	67	0.15	1,022	0.33	2.12	4.37
1953	4,479,768	2,518,387	57,177	1,099	0.56	16,803	1.28	2.27	4.36
1954	9,234,666	5,452,164	141,379	2,759	0.59	36,377	1.53	2.59	5.06
1955	14,846,570	5,653,576	154,875	3,098	0.38	37,721	1.04	2.74	5.48
1956	27,403,537	11,960,263	258,287	5,118	0.44	79,799	0.94	2.16	4.28
1957	21,855,257	12,395,456	231,492	4,664	0.57	82,703	1.06	1.87	3.76
1958	16,332,813	15,006,781	301,212	6,285	0.92	100,125	1.84	2.01	4.19
1959	28,910,863	28,000,459	523,982	10,412	0.97	186,819	1.81	1.87	3.72
1960	48,411,389	37,825,380	574,060	11,066	0.78	252,371	1.19	1.52	2.93
1961	55,551,265	56,141,307	775,986	15,438	1.01	374,575	1.40	1.38	2.75
1962	61,805,822	75,999,390	1,008,159	17,668	1.23	507,068	1.63	1.33	2.32
1963	52,365,797	57,025,291	721,791	12,620	1.09	380,473	1.38	1.27	2.21
1964	65,097,846	82,790,392	1,019,748	18,084	1.27	552,378	1.57	1.23	2.18
1965	74,266,965	59,382,890	656,348	11,897	0.80	396,203	0.88	1.11	2.00
1966	89,366,892	83,890,505	928,925	16,276	0.94	559,718	1.04	1.11	1.94
1967	134,212,004	128,326,183	1,341,734	22,203	0.96	856,193	1.00	1.05	1.73
1968	139,801,980	103,784,398	1,050,685	16,769	0.74	692,450	0.75	1.01	1.62
1969	144,171,756	127,270,017	1,324,646	20,973	0.88	849,150	0.92	1.04	1.65
1970	130,565,100	106,554,900	859,641	14,120	0.82	710,935	0.66	0.81	1.33
1971	129,039,851	85,742,409	594,662	9,586	0.66	572,074	0.46	0.69	1.12
1972	121,394,085	101,174,283	705,729	11,135	0.83	675,035	0.58	0.70	1.10
1973	152,430,860	170,374,854	1,507,343	21,405	1.12	1,136,742	0.99	0.88	1.26
1974	179,209,115	189,937,558	1,680,267	27,250	1.06	1,267,264	0.94	0.88	1.43
1975	163,577,326	91,053,860	541,591	10,204	0.56	607,512	0.33	0.59	1.12
1976	156,606,989	174,271,739	946,931	13,833	1.11	1,162,742	0.60	0.54	0.79
1977	143,694,617	79,054,582	507,078	11,261	0.55	527,453	0.35	0.64	1.42
1978	163,384,627	135,715,703	1,076,722	17,394	0.83	905,496	0.66	0.79	1.28
1979	172,935,924	155,183,005	1,056,660	15,064	0.90	1,035,382	0.61	0.68	0.97
1980	186,531,100	128,775,771	791,104	11,725	0.69	859,192	0.42	0.61	0.91
1981	117,584,349	112,297,255	898,807	13,012	0.96	749,248	0.76	0.80	1.16
1982	149,855,203	170,853,743	1,511,786	21,386	1.14	1,139,937	1.01	0.88	1.25

Table 2.[illegible] Calculed parameters of production model analysis for the Indan Ocean albacore, 1952-1982. (TWS/[illegible]/23)

m	Degree of fit index	Optimum cpue	Optimum effective effort (10^6 hooks)	MSY (10^3 tons)
Variable (0.0)	0.9556	–	–	20.5
0.0	0.9556	–	–	20.5
1.001	0.9308	0.17	88.7	15.4
2.0	0.8455	0.20	89.0	18.0

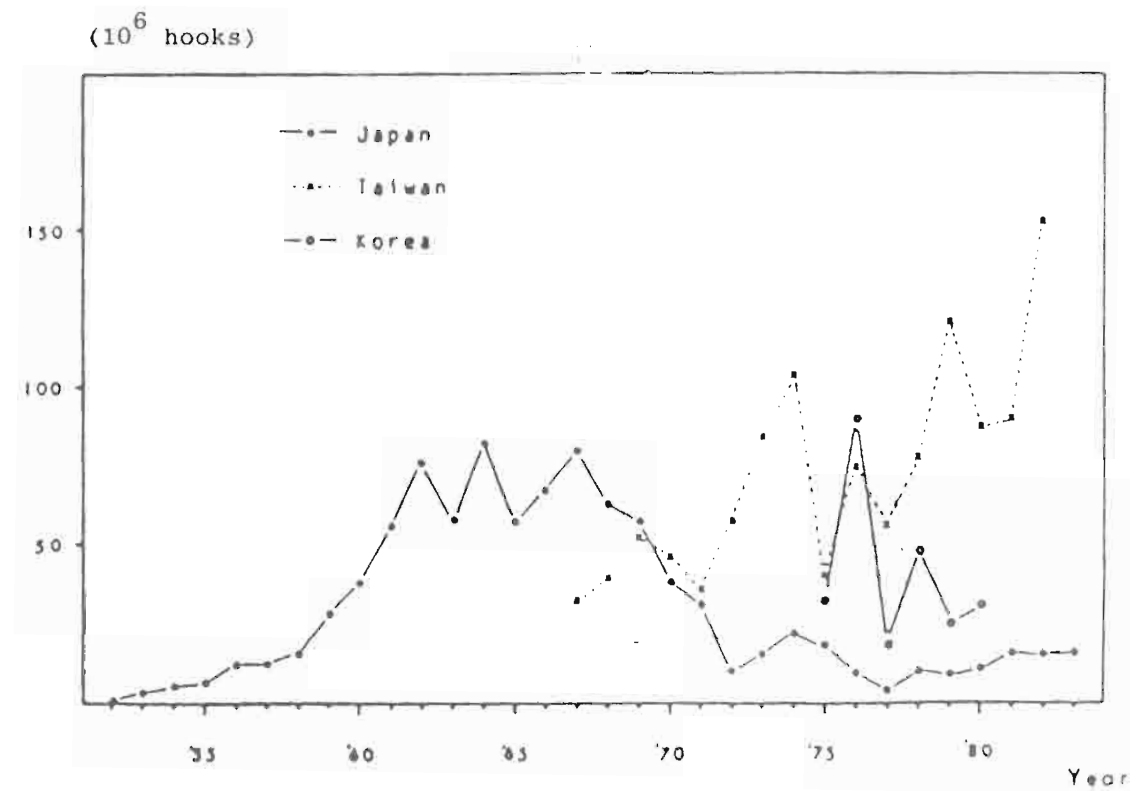

Fig.2.1.- Annual trend of effective effort by countries on whole Indian albacore stock, 1952-1982. (TWS/85/23)

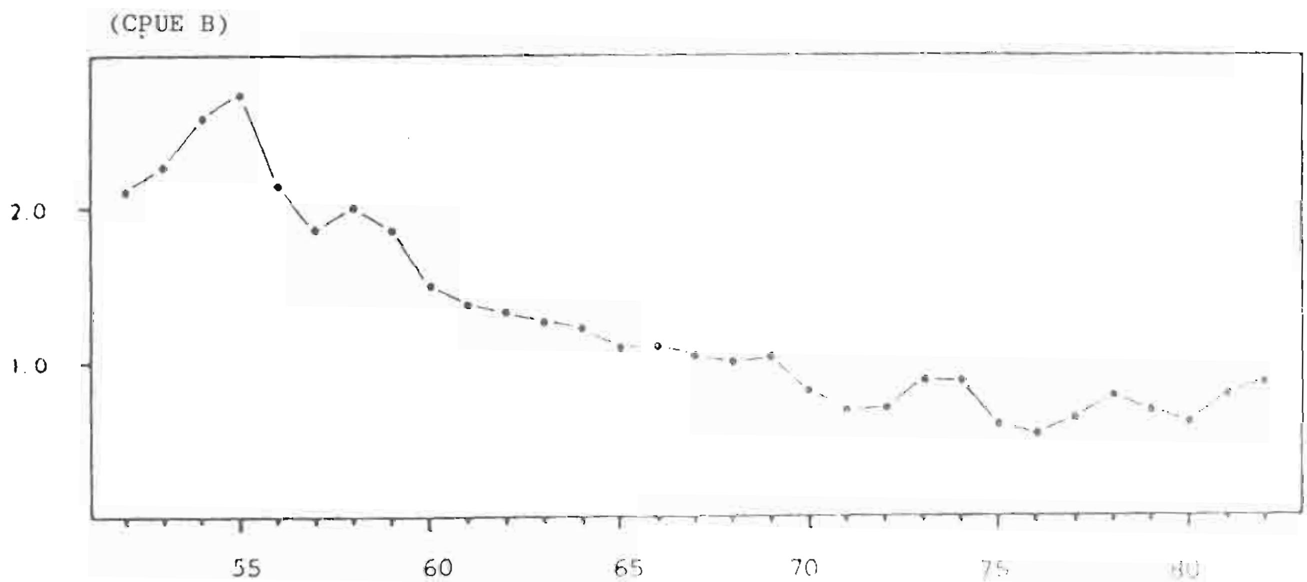

Fig. 2.2. - Annual catch per unit effort for Indian Ocean albacore, 1952-1983. (TWS/85/23)

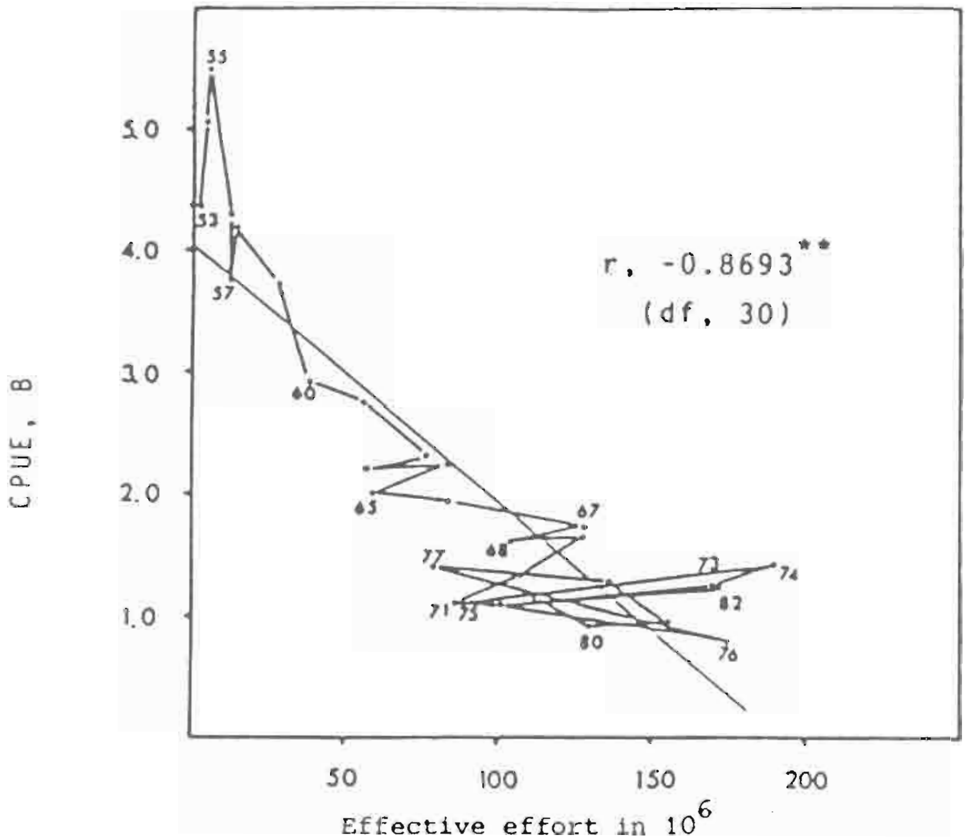

Fig. 2.3. Relationship between effective effort and catch in weight per unit effort (CPUE, B) for albacore during 1951-1982. (TWS/85/23)

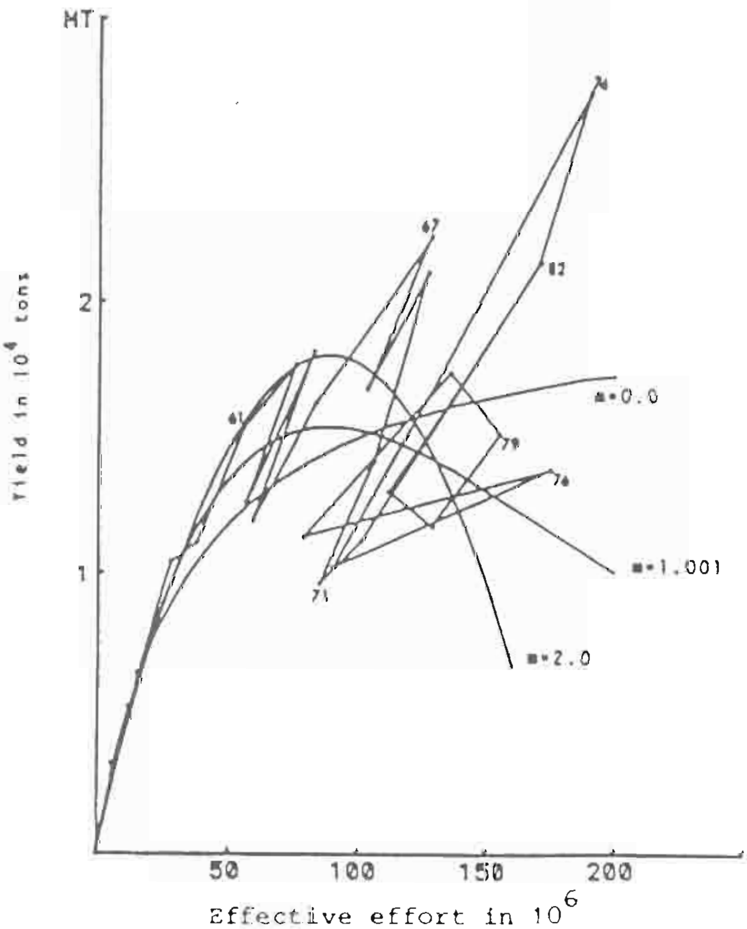

Fig. 2.4. Equilibrium yield curves and observed data for the Indian Ocean albacore, 1952-1982. (TWS/85/23)

5.3 SOUTHERN BLUEFIN TUNA

Southern bluefin tuna (Thunnus maccoyii) are distributed in the western Indian Ocean south of 35^0S and in the eastern Indian Ocean south of 10^0S. They are fished primarily by Japanese longliners and Australian pole-and-line boats and purse seiners and to a small extent, by New Zealand handline boat in the Western Pacific.

5.3.1 Review of Fisheries Data:

Catch Trends

Catch statistics for the entire range of southern bluefin, which include the Atlantic and the Pacific, are summarized in Table 3.1. Total catch increased from 15,000 t in 1958 to 66,000 t in 1959, and reached a maximum of 81,000 t in 1961. Thereafter, catches fluctuated within a range of 45,000-65,000 t until 1975, when total catch dropped to 33,000 t. Since then catches have ranged between 35,000 t and 45,000 t, with catches of 43,000 tons, in 1982 and 1983.

Effort Trends

Before the early fifties, only small incidental catches of southern bluefin were taken by Australian troll fishermen. By the end of that decade, a pole-and-line fishery for southern bluefin had developed off the New South Wales and South Australian coasts. During the sixties and seventies, this fishery expanded considerably and purse seiners were introduced in the early seventies. By the late seventies operations by the purse seiners had become successful. At about the same time, an Australian pole-and-line fishery was established off Western Australia. In the late seventies and early eighties, the Australian southern bluefin fleet was significantly upgraded. The Japanese longline fishery has been concentrating fishing effort on Southern bluefin tuna in the area south of about 35^o in the Indian Ocean.

Trends in Catch Per Unit Effort

No Australian CPUE information was presented at this meeting. CPUE expressed as the number of fish caught per 100 hooks of the Japanese longline fishery based on nominal fishing effort showed a marked decline from 4.0 in the early period of the fishery (in the late 1950s) to about 0.6 in the middle of the 1970s. Since then the CPUE has been stable ranging between 0.4 and 0.6 (except for a low CPUE of 0.3 in 1982).

5.3.2 Stock Structure

Southern bluefin tuna are a highly migratory species. Spawned in an area between north western Australia and Indonesia, juveniles (aged 1 to 8 years) inhabit, at least for part of the time, the continental shelf waters of southern and south eastern Australia, they form large surface schools. From an early age there is a gradual diffusion of fish to the waters of the southern ocean, such that by maturity (8 years of age), most lead an oceanic, pelagic existence and have an almost circumpolar distribution between 30^0 S and 50^0S. This is disturbed only by a regular spawning migration during the southern summer (September - March). Although the surface and longline fisheries are essentially geographically distinct, there is an overlap in the age composition of the catches.

5.3.3 Population Parameters

Length-weight, length-age and age-length relationships have been determined. The natural mortality rate of 0.2 yr^{-1} is regarded as uncertain and consequently all analyses were repeated using values ranging from 0.1 to 0.3 yr^{-1}.

5.3.4 Analytic Models

Length frequency data were the basic input data for stock assessment. These data were converted into age frequencies, using an age-length relationship. This conversion appears to be reasonably accurate for fish aged between 3 and 13 years. The age frequencies was used as input data for cohort analysis and a comulative age class of fish older than 10 years was used as a starting point for this analysis. The rate of fishing mortality used for this age class has been adjusted for different levels of fishing mortality. This rate, and the rate of natural mortality, were uncertain and consequently results of cohort and other analyses were extensively examined using sensitivity analysis.

A mathematical procedure using linear programming methods was developed for estimating catch levels which might lead to a stable parental biomass. This estimation assumed a steady state of the population.

To assess the impact of different catch levels upon the parental biomass, a stochastic simulation model was developed. Also, yield per recruit analyses, both analytical and experimental (a new approach based on tag release-recapture experiments) have been carried out. Interactions among various sub-fisheries have been examined using a new method based on tag release-recapture experiments.

5.3.5 State of the Stock

The biological state of the southern bluefin tuna stock was assessed using different methods and mortality rates, by Australian, Japanese and New Zealand scientists in Wellington, New Zealand in July 1985. These different methods and rates gave different absolute estimates of the parental biomass and the number of new recruits to the fishable stock.

The level of parental biomass was determined to have been reduced to about 25% of the pre-exploitation level. Nonetheless, the level of recruitment seemed to have been relatively stable.

The scientists recognized that the only way of precisely determining the level to which the parental biomass can decline before recruitment declines is by trial and error. However, because the stock might take a long time to recover after such a recruitment reduction - which would put the fishery at risk - the scientists agreed that it would be imprudent to allow this to happen. Therefore, they recommended that the parental biomass should be maintained at no less than its present level.

Figure 3.1 shows the estimated combinations of Autralian and Japanese catches that would, with time, stabilize the parental biomass at its present level. The calculations were carried out for Japanese catches ranging between 20,000 to 30,000 tonnes but they can be produced for a winder range. The stabilizing catches were estimated optimistically, assuming constant recruitment. The age compositions of catches were assumed to be the same in the future as those for the estimated 1985 Australian catch and the average of the Japanese catches from 1980 to 1983. The stabilizing catches on the line in Figure 3.1 are greater than the equivalent values calculated in the past. This is because of the increase in the average size of fish in catches.

As mentioned above, the catch combinations from the line in Figure 3.1 might stablize the parental biomass with time. To examine the immediate implications of these and other catch combinations upon the parental biomass, the scientists adopted a simulation method. Constant recruitment was optimistically assumed in the simulations. Examples of their results are presented in Figure 3.2. By comparing these results the scientists concluded that catch combination to the right on the line in Figure 3.1 generate a greater short-term decline in the parental biomass than those on the left. This has a cimple explanation because year classes that were subject to very intensive Australian fishing (mainly directed at juveniles) between 1981 and 1984 are likely to be considerably reduced. By 1985 they became subject to Japanese harvesting and will soon contribute to the parental biomass.

3.3.6 Recommendations

The meeting recommends:

(1) That the global catch of southern bluefin tuna should be at or below the line shown in Figure 3.1

(2) The southern bluefin tuna fishery and the biological state of the population should be closely monitored to identify further potential changes in the population and any consequential management adjustments required.

(3) That research on southern bluefin tuna should be further intensified to facilitate the rational exploitation of the population.

Table 3.1 - Southern bluefin tuna catches by calendar year. Preliminary estimates are enclosed in parentheses. Weight is in tonnes and number is in thousands.

Year	Australia Weight	Australia No	Japan Weight	Japan No	New Zealand Weight	New Zealand No	Total Weight	Total No
1952	264	22	556	6			820	28
1953	509	43	3809	49			4318	92
1954	424	35	2183	27			2607	62
1955	322	28	2915	36			3237	64
1956	964	79	14948	186			15912	265
1957	1264	100	21878	400			23142	500
1958	2322	180	12417	225			14739	405
1959	2486	198	63896	1032			66382	1230
1960	3545	274	75672	1188			79217	1462
1961	3678	267	77491	1209			81169	1476
1962	4636	621	40852	675			45488	1296
1963	6199	438	59200	1009			65399	1447
1964	6832	693	42718	743			49550	1436
1965	6876	448	40627	721			47503	1169
1966	8008	588	39607	683			47615	1271
1967	6357	546	59086	931			65443	1477
1968	8737	917	49482	828			58219	1745
1969	8679	1151	49644	844			58323	1995
1970	7097	956	40622	699			47719	1655
1971	6969	846	38120	697			45089	1543
1972	12397	1010	39604	806			52001	1816
1973	9890	847	31205	651			41095	1498
1974	12672	1193	33924	672			46596	1865
1975	8833	1132	24118	441			32951	1573
1976	8383	996	33714	634			42097	1630
1977	12569	1352	29595	536			42164	1888
1978	12190	1293	22974	451			35164	1744
1979	10783	1384	27715	520			38498	1904
1980	11195	1619	33364	586	130	1	44689	2206
1981	16843	1482	28056	477	173	2	45072	1961
1982	21501	2368	20809	331	208	4	42518	2703
1983	17695	2110	24735	424	112	2	42542	2536
1984*	15834	1598			86	1		
1985*	(13000)							

* Australian catches refer to quota year, i.e., 1 Oct - 30 Sept of the year indicated.(TWS/85/34)

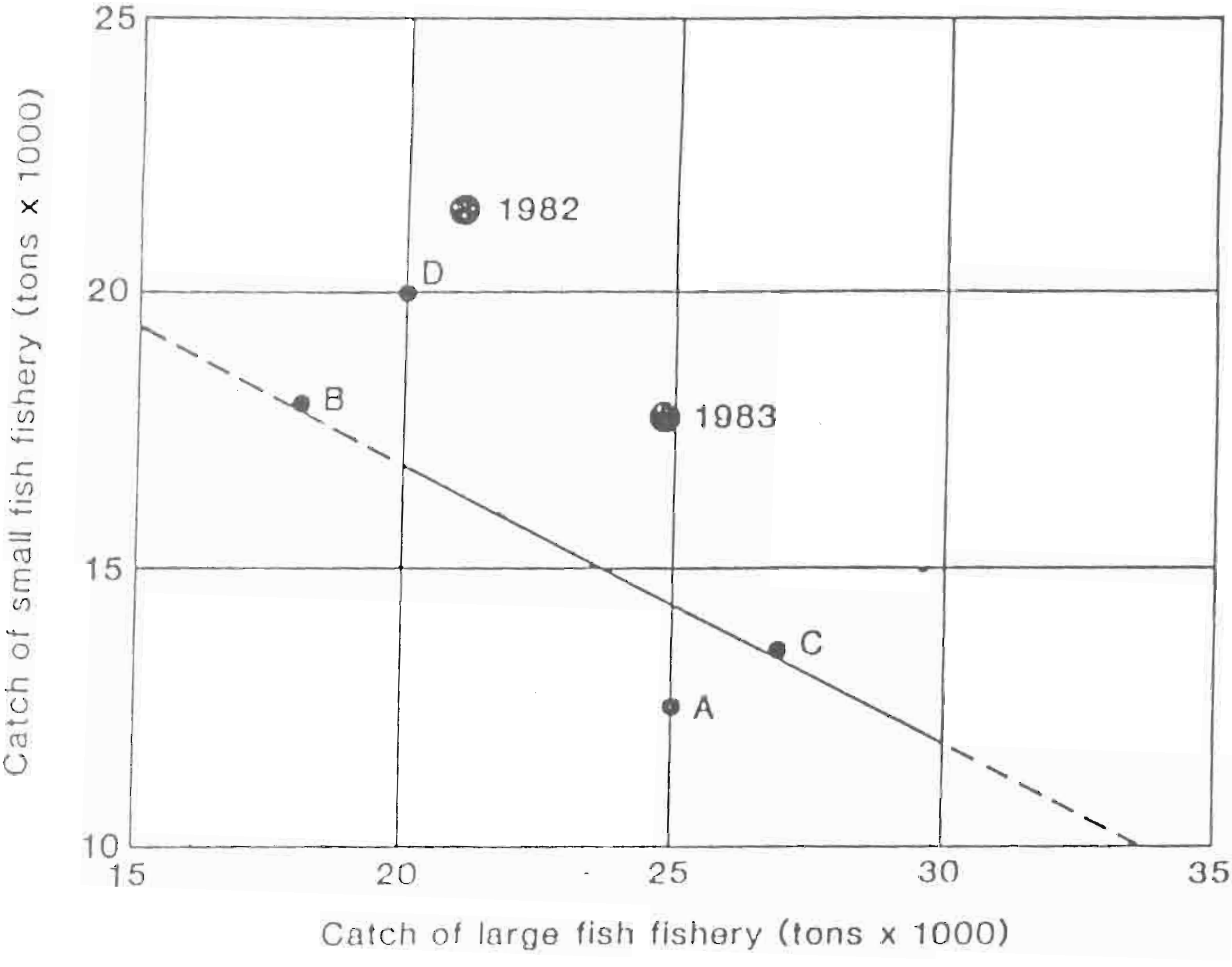

Fig. 3.1 Large fish and small fish catch combinations which stabilize parental biomass at the 1980 level (solid line). Solid circles denote catch combinations in recent years and four hypothetical catch combinations from Figure 2. Based on the estimated age composition of 1985 Australian southern bluefin tuna catch. (TWS/85/34)

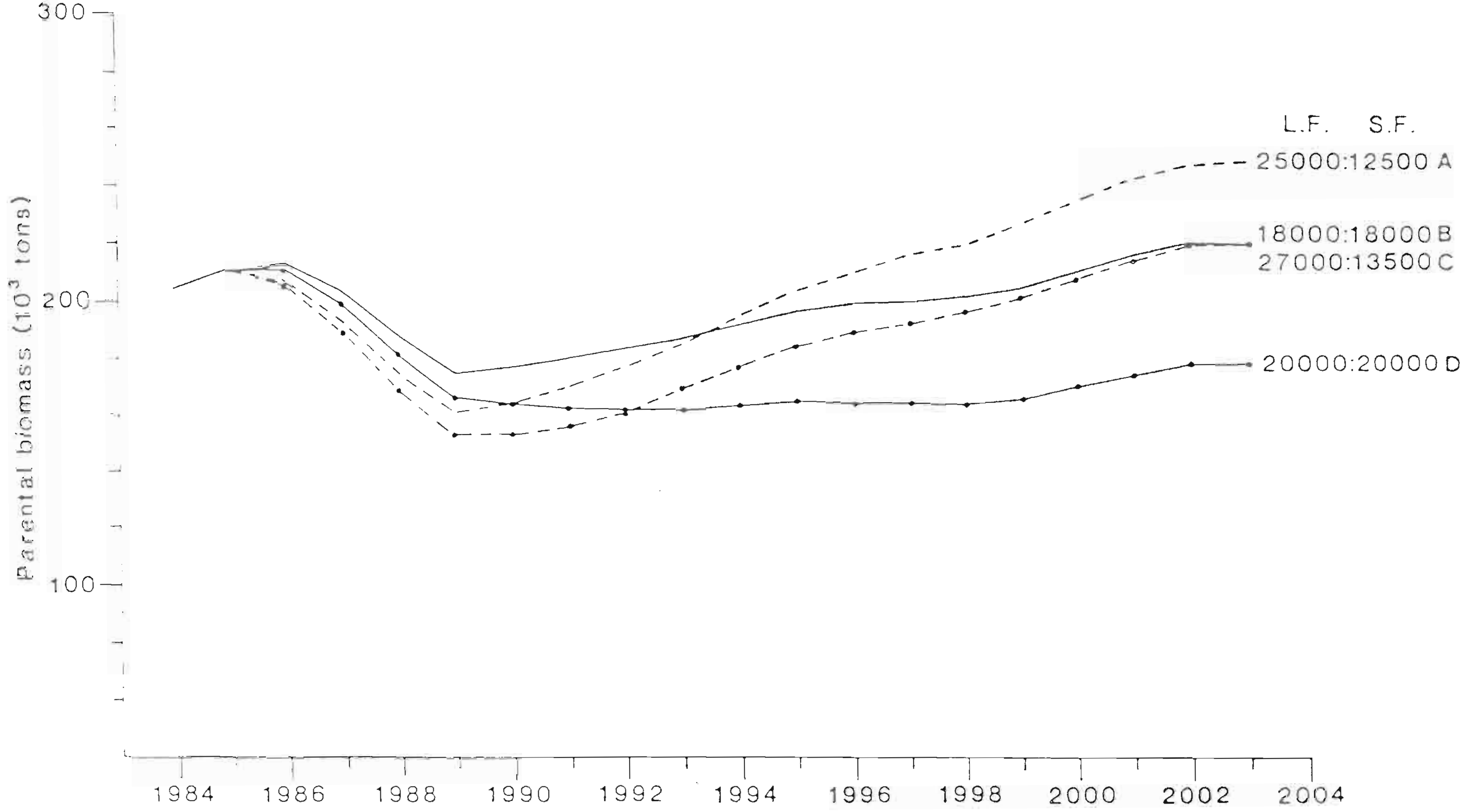

Fig. 3.2 Projections based on 1985 Australian catch age composition pattern, M = 0.2, F = 0.1 (TWS/85/34)

5.4. SMALL TUNAS AND TUNA-LIKE SPECIES

5.4.1 Brief Description of Fisheries

Small tunas are a very complex group which include more than a dozen species occupying widely varying ecological niches. Some are very coastal while others are more oceanic. The main species are the frigate and bullet tuna (Auxis thazard & Auxis rochei), longtail tuna (Thunnus tonggol), kawakawa (Euthynus affinis) and seerfishes including the narrow barred king mackerel (Scomberomorus commerson), the Indo-pacific king mackerel (S. guttatus) and wahoo (Acanthocybium solandri).

Recorded catches as indicated in Table 1 reached at least 163,000 t including 47,000 t of unclassified species taken mainly by Indian and Sri Lankan fishermen. Thus these species presently account for a little less than half the total tuna and tuna like fish catches of the Indian Ocean. The present level of catches represents a significant increase on those in the period 1971-1979 which averaged 70,000 t some of this increase however is due to improved reporting.

Frigate tuna, kawakawa and bullet tuna contributed about 28 to 37 percent of the tuna production in Sri Lanka - mainly taken by inboard engine craft operating troll lines and gillnets, nearly 80 percent of the catches are made on the western side of the island. Small tunas accounted for 65 percent, 9.2 percent and 6 percent of all fish landed in the troll fishery, pole-and-line fishery and gillnet fishery respectively. During the five years 1979 - 1983 production of small tunas has increased by 15 percent from 8141 t in 1979 to 9358 t in 1983. However, there was a peak production of 12,500 t in 1982. Frigate tuna is dominant in the troll fishery while kawakawa production slightly exceeds that of frigate tuna in the pole-and-line fishery. In the gill net fishery the order of species is reversed, catches of frigate tuna being somewhat greater than kawakawa. There is no information on trends in catch per unit effort in the troll line fishery, of which the sole target is small tunas.

On the Western side of Indonesia small tuna and tuna like fish account for 86.7 percent of total tuna production. King mackerel production may be substantial although little detailed information is available. Production of longtail tuna is estimated at about 15,000 t and other species taken in commercial quantities include kawakawa and frigate tuna.

Frigate tuna is the third most important species in the Maldivian fishery after skipjack and yellowfin. Between 1970 and 1984 frigate tuna accounted for an average of nearly 10 percent by weight of the recorded catch. The large fluctuation of catches which has been observed in some years and in particular the high catch recorded from 1973 to 1974 is difficult to interpret but could be due to unusual oceanographic conditions affecting catchability.

During 1980-1983 average catch rates by mechanized masdhonis averaged 17-18 kg/day while those by vadhu adhonis were 2.0 to 2.5 kg/day without clear change over this period. For both vessel types the highest catch rates were recorded in the north of the Islands and the lowest in the south.

Catches of Kawakawa have increased to 1,600 t in 1980-1984 from some 740 t in 1970-1971 and represent presently 3 percent by weight of the Maldivian catch.

Tuna catches on the west coast of Thailand are made by various types of purse seine and gillnet which target mostly on species other than tuna but catch incidenaltly a substantial amount of longtail tuna.

Annual catches of longtail increased from 1,920 t in 1979 to 7,110 t in 1982 and then declined sharply to 3,356 t in 1983 while fishing effort was still increasing substantially. It is not clear whether the apparent decline in catches and catch rates in recent years is related to a declining abundance of the stock, a change in target species or a lower catchability of the fish during the fishing season. However, it is clear that greater attention should be paid to this particular stock in future. It was also suggested that data obtained from national statistics and those collected from selected sampling sites should be cross checked.

5.4.2 Recommendations

(1) Statistics and research:

The data on small tunas are far from satisfactory and it is certain that in a number of IPTP countries recording is incomplete. In a number of cases there is no clear identification of the area where fishing occurs and where resources might be available. The fisheries are however of considerable importance to the food supply in many coastal countries and it is important that the state of these stocks be monitored with some precision. It is therefore recommended that:

- collection of catch and effort data by species and gear be improved and submitted regularly to the IPTP data base.

- species should be better identified and distinguished and catches designated as 'other' be reduced to a minimum.

- IPTP should make the necessary effort to secure the required data from the countries with major artisanal fisheries and which do not currently provide any data.

- a mapping of tuna and tuna-like fish resources including seerfishes be conducted in the countries having major artisanal fisheries. This mapping should focus on the distribution of fishing effort and the major fishing grounds for the different species, and be made on a standardized form.

  (i) FAO in early 1986 should prepare a draft outlining all aspects of the mapping procedure (information required, standardization of the presentation, scale of the map etc.).

  (ii) Each country should prepare its own map.

  (iii) The FAO outposted officer to be appointed in early 1986 in Colombo will coordinate the work and if necessary participate in its elaboration.

A first draft of this map should be available for the next expert consultation

Latest information on the biology of longtail tuna kawakawa and frigate tuna be summarized and made available for the next consultation including any information available on their migration pattern.

(2) Management

The general lack of detailed information on small tunas and tuna-like fishes makes it impossible to formulate any recommendation for management. There is however evidence that for some species in some areas management action may be desirable. There is therefore an increasingly urgent need for improved catch and effort data for this group of species.

Table 4.1

CATCHES OF SMALL TUNA AND SEERFISHES FROM 1971 - 1983

SPECIES	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
LOT	114	665	858	886	958	1396	1555	1930	2785	1683	4273	14077	8900
KAW	12052	14204	12264	15832	16756	16525	15019	9660	14480	8282	23113	25347	12263
FRZ	3015	3186	6626	6006	4057	2692	3086	1661	1701	1595	2908	4946	4040
TOTAL	15181	18055	19748	22724	21771	20613	19660	13251	18966	11560	30294	44370	25203
TUN	17224	19763	47579	38027	26609	36775	39348	36189	41716	55578	33745	44542	73031
COM	10688	14621	11866	13882	12707	16057	18934	19569	21434	18168	37946	43378	23968
GUT	500	600	600	759	498	315	100	157	245	182	13661	15570	2308
STS	0	0	0	0	0	0	0	0	0	0	279	165	0
WAH	0	0	0	0	0	0	0	0	0	0	0	1	0
KGX	19031	21796	18988	26833	22612	26086	20841	20194	29785	33216	3213	5547	38789
TOTAL	30219	37017	31454	41474	35817	42458	39875	39920	51464	51566	55099	64661	65065
G. TOTAL	62624	74835	98781	102225	84197	99846	98883	89360	112146	118704	119138	153573	163299

Table 4.2 Catches of Small Tunas and Seerfishes by Country in 1983 (Indian Ocean) (metric tons)

COUNTRIES	LOT	KAW	FRZ	SPECIES TUN	COM	GUT	KGX	TOTAL GENERAL
Australia	6			1			186	193
Bahrain					403			403
Comoros		1000		100			300	1400
Egypt				300				300
India	0	2620		23432			32978	59030
Indonesia					4785	366		5151
Irak							100	100
Iran	5894				1429	1668		8,991
Israel				45				45
Kenya							47	47
Korea				252				252
Kuwait					64			64
Maldives		2087	3540				400	6027
Mauritius				415				415
Pakistan		2925			8243			11168
Qatar				12	158			170

Table 4.2 (Cont'd) Catches of Small Tunas and Seerfishes by Country in 1983 (Indian Ocean)
(metric tons)

	SPECIES							
COUNTRIES	LOT	KAW	FRZ	TUN	COM	GUT	KGX	TOTAL GENERAL
France (Reunion)				309				309
Saudi Arabia				1596			3250	4846
Seychelles		314						314
Somalia				1000				1000
South Africa				32	1085			1117
Sri Lanka				9383	3455			12838
Tanzania							1760	1760
Thailand	3356			472			1984	5812
United Arab Emirates	3000	1045	500		5000		1292	10837
USSR				577				577
Yemen Arab Rep.		272		452	2788			3512
Yemen Dem.		2000		584			6418	9002
Total	12256	12263	4040	38962	27410	2034	48715	145680

Data Source: IPTP Data Summary No.3 and available information at the meeting

5.5 YELLOWFIN

The yellowfin tuna (Thunnus albacares), is distributed in the Indian Ocean from 20°N to 40°S latitude. Prior to 1980 the longline gear was the dominant fishing gear used in the capture of yellowfin tuna. From 1966-1970 the longline catch averaged 89 percent of the total annual yellowfin tuna catch; the annual catch averaged 50,000 t. In 1983 the total yellowfin tuna catch was 58,500 t; however, the longline share was only 45.4 percent (26,600 t). Beginning in 1979 some exploratory purse seine fishing was carried out in the western Indian Ocean and by 1984 this method of fishing was well established with approximately 13 - 49 purse seiners operating in the western Indian Ocean. In 1984 the estimated purse seine catch of yellowfin tuna was 54,500 t.

Other methods of fishing for yellowfin tuna includes pole-and-line fishing in the Maldives and gill net fishing in Sri Lanka. Net fishing, trolling and handline fishing are methods used by artisanal fishermen from throughout the Indian Ocean region. Figure 5.1 shows the general location of the several industrial, small scale and artisanal fisheries in the Indian Ocean region.

5.5.1 Catch Trends

Table 1 provided the annual catch figures for yellowfin tuna for the period 1971-1984. The shift in dominance of fishing gear from longline to purse seine is shown in Figure 5.2. In 1984 the longline catch only represented about 22 percent of the total estimated yellowfin catch of 94,500 t.

The importance of the yellowfin tuna fishing grounds in the western Indian Ocean is shown in Figure 5.3. In the seventies the western Indian Ocean (Area 51) catches made up about 70 percent of the total yellowfin catch. By 1983 the western Indian Ocean share had increased to about 83 percent. As noted earlier the increase was due to the introduction of purse seine fishing in the western Indian Ocean region.

5.5.2 Longline Fishery

Until the early seventies the major share of the yellowfin catch was landed by the Japanese longline fleet. Since about 1974 the Korean longline fleet has dominated the longline catch of yellowfin. The Japanese longliners were reported to shift their fishing effort to the southern bluefin tuna while the Taiwan longline fleet focussed on albacore.

There has been a marked decline in catch rate of yellowfin tuna since the start of longline fishing in the Indian Ocean in the early 1950's. In the western Indian Ocean the decline has been from about 4 yellowfin tuna per one hundred hooks in 1953 to about 0.5 yellowfin per one hundred hooks in recent years (Figure 5.4). A similar pattern is noted for the eastern Indian Ocean except the initial catch rate 3 yellowfin per 100 hooks was lower at the start of the fishery in 1952 than for the Western Indian Ocean.

5.5.3 Surface Fisheries

Until the early eighties the longline gear was the principal method of catching yellowfin tuna. Beginning in 1979 purse seine fishing trials were conducted in the western Indian Ocean by a French purse seiners and by 1984 the purse seine method had become well established as a principal tuna fishing gear in the Indian Ocean. In 1984 the yellowfin catch by purse seiners was estimated to be 54,500 t. The purse seiner fleet in 1984-1985 period consisted of up to 49 purse seiners; the vessels were from France, Spain and Ivory Coast (Table). Initially much of the purse seine fishing effort was directed to setting around flotsam; however, in recent months more effort has been directed to free swimming tuna schools composed of yellowfin, a more valuable species.

Significant catches of yellowfin are landed by the pole-and-line fishery of the Maldives and the gill net fishery of Sri Lanka. In 1984 the yellowfin catch was estimated to be 7000 t and 6400 t for the two fisheries respectively. The Indonesia catch of 3000 t of yellowfin was taken with a variety of fishing methods, including troll, gilnett and longline gears. it was noted that yellowfin tuna are taken in some quantities by surface fishing methods off the coast of South Africa. While exact catch records were not available it was estimated that the catch was less than 4,000 t. Finally, it was reported that about 400 tons of tuna and bill fish are taken by the sport fishery based in Mauritius; yellowfin tuna represented a significant share of this catch.

5.5.4 Stock Structure

There are no definitive studies on the stock structure of yellowfin tuna in the Indian Ocean. Based on the distribution of longline caught yellowfin tuna in the Indian Ocean, Morita and Koto (1971) suggested that two stocks were present; however, the eastern stock was reported to exist east of 100^{o}E longitude and including the Banda Sea.

5.5.5 Stock Assessment

At the Shimizu tuna stock assessment workshop (FAO 1980) an MSY for the yellowfin tuna resource was estimated to be from 40,000 t to 60,000 t. The estimate was based on a production model study. A recent re-analysis of the longline data (Miyabe and Koido WS/85/27) showed that the data points did not confirm well to a production model (Figure 5.5). It was emphasized at the workshop that production models utilizing longline data reflect MSY estimates for longline fishing conditions only. In the case of the Atlantic the development of a purse seine fishing in the region of the longline fishery resulted in a combined total catch that exceeded the MSY figure computed with longline gear by a substantial margin (Figure 5.6) (Fonteneau TWS/85/28). This same situation may exist in the western Indian Ocean.

5.5.6 Biological Parameters

Several papers were presented covering the biology and life history parameters of yellowfin tuna in the Indian Ocean. Principal papers included

Anderson (TWS/85/16), Maldeniya and Joseph (TWS/85/21), Marsac and Lablache (TWS/85/31) and Cort (TWS/85/48).

Growth parameters based on the von Bertalanffy equation were presented for the yellowfin tuna taken in Sri Lanka fishery. It was noted that while growth parameters were computed using length frequency data with the ELEFAN I programme the computed data points did not fit the size frequency distribution very well. There was a general view expressed that caution should be exercised when using ELEFAN I for growth parameters since the method tended to overestimate L and underestimate K values. Also it was stressed that unreliable results could be generated for a fishery which captures a narrow size range. Growth parameters were also determined for yellowfin tuna taken by the purse seine fishery operating in the western Indian Ocean. (TWS/85/31). The asymptotic growth was estimated at 160.2 cm and a K value of 1.16. The study suggested that the yellowfin in this region had a relatively slow growth rate in the juvenile stage followed by a period of rapid growth. There was a general view that considerable more information is needed covering the biology, behaviour and life history of yellowfin tuna in the Indian Ocean in order to undertake some management of this valuable resource.

5.5.7 Recommendations:

1. Further analyses of longline statistics for stock assessment purposes should include data from all longline fishing nations.

2. Also effort should be directed to improving the collection of tuna statistics from artisanal fisheries.

3. Research should be directed toward understanding the stock structure of the yellowfin tuna resource in the Indian Ocean.

4. Conduct a yellowfin tuna tagging programme to obtain information on migratory routes, age and growth rates, mortality rates and population assessment values and interactions.

5. Conduct stock assessment studies using available standard assessment techniques and yield per recruit. Also effort should be directoed toward developing new analytical techniques for stock assessment.

Table 5.1 Catch of Yellowfin Tuna by Cou

COUNTRY	GEAR	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Australia	UNCL	0	0	0	0	0	0	3	15	28	34	20	0	25	-
China (Taiwan)	LL	13100	15000	10000	3876	7074	4120	3420	3070	3420	3878	2369	3526	2411	1369
Comoros	UNCL	100	100	100	100	100	100	100	100	100	100	100	100	100	100
France [1]	PS	0	0	0	0	0	0	0	0	0	0	260	1224	10773	39305
Indonesia	LL	0	0	0	0	0	0	0	0	0	0	0	515	0	
	PS	0	0	0	0	0	0	0	0	0	0	0	17	0	
	UNCL	600	1000	1100	1071	869	1317	2345	2811	3236	3348	3350	3208	5888	5366
Country Total		600	1000	1100	1071	869	1317	2345	2811	3236	3348	3350	3740	5888	5366
Iran	LL	0	0	0	0	0	800	625	0	341	322	0	0	0	0
Japan	LL	12900	7800	3400	4415	4719	2744	2061	4024	2023	3304	4281	6355	5793	7467
	PS	0	0	0	0	0	0	0	239	0	136	0	0	0	109
	UNCL	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Country Total		12900	7800	3400	4415	4719	2744	2061	4263	2023	3440	4283	6355	5793	7576
Kenya	LL	0	0	0	0	0	0	0	0	0	67	171	204	322	
Korea	LL	6500	9600	9200	11563	11694	12848	31383	25165	17788	12537	11777	18654	15337	9900
Maldives	BB	1081	1940	5234	3868	3512	4393	4123	3214	3692	3647	4740	3770	5984	6893
	UNCL	146	136	241	260	262	410	350	370	597	582	544	234	257	229
Country Total		1227	2076	5475	4128	3774	4803	4473	3584	4289	4229	5284	4004	6241	7124
Mauritius	PS	0	0	0	0	0	0	0	0	0	0	0	1323	0	1274
	UNCL	0	0	0	0	0	0	0	15	5	1	1	0	0	50
Country Total		0	0	0	0	0	0	0	15	5	1	1	1323	0	1324
Mozambique	BB	0	0	0	0	0	0	0	0	0	0	0	0	15	11
	LL	0	0	0	0	0	0	0	0	0	0	0	0	0	178
Country Total		0	0	0	0	0	0	0	0	0	0	0	0	15	189
Seychelles	UNCL	100	100	100	150	100	50	80	100	128	357	949	518	114	198
Spain	BB	0	0	0	0	0	0	0	0	0	0	363	55	0	0
	PS	0	0	0	0	0	0	0	0	0	0	0	0	0	13796
Country Total		0	0	0	0	0	0	0	0	0	0	363	55	0	13796
Sri Lanka	LL	0	0	0	0	0	0	0	0	0	0	0	834	905	(900)
	BB	0	0	0	0	0	0	0	0	0	0	0	418	452	(400)
	UNCL	4700	6500	5100	6070	6611	6915	5720	5369	6166	6906	7662	7098	7689	6700
Country Total		4700	6500	5100	6070	6611	6915	5720	5369	6166	6906	7662	8350	9046	(8000)
Tanzania	UNCL	0	0	0	0	0	0	0	0	0	0	0	0	600	-
Yemen Dem	UNCL	0	0	0	0	0	0	0	0	0	0	0	80	80	80
Gear Total for	LL	32500	32400	22600	19854	23487	20512	37489	32259	23572	20108	18598	30088	26568	21069
Gear Total for	BB	1081	1940	5234	3868	3512	4393	4123	3214	3692	3647	5103	4243	6451	7481
Gear Total for	PS	0	0	0	0	0	0	0	239	0	136	260	2564	10773	54484
Gear Total for	UNCL	5646	7836	6641	7651	7942	8792	8598	8780	10260	11328	12628	11238	12935	12725
Species total		39227	42176	34475	31373	34941	33697	50210	44492	37524	35219	36589	48133	58545	94436

1/ Catch of Ivory Coast are included

Table 5.2 - Purse Seines Fishing in the Western Indian Ocean (TWS/85/4)

Number of purse seiners operated

Month	France	Spain	Ivory Coast	Panama	United Kingdom	Mauritius	Total
Jan/84	11	-	2	-	-	-	13
Feb	13	1	2	-	-	-	16
Mar	15	4	2	-	-	-	21
Apr	18	5	2	1	-	-	26
May	19	6	5	1	-	-	31
Jun	19	6	5	1	-	-	31
Jul	14	6	5	1	-	-	26
Aug	16	6	5	1	-	-	28
Sep	24	6	5	1	-	-	36
Oct	26	8	5	1	-	-	40
Nov	26	13	5	1	-	1	46
Dec	27	14	5	1	1	1	49
Jan/85	27	14	5	1	1	1	49
Feb	26	15	5	1	1	1	49
Mar	23	15	5	1	1	1	46
Apr	23	15	4	1	1	-	44
May	22	8	2	1	1	-	34
Jun	22	8	1	1	1	-	33
Jul	19	5	1	1	1	1	28
Aug	21	5	1	1	1	1	30
Sep	22	7	1	1	1	1	33

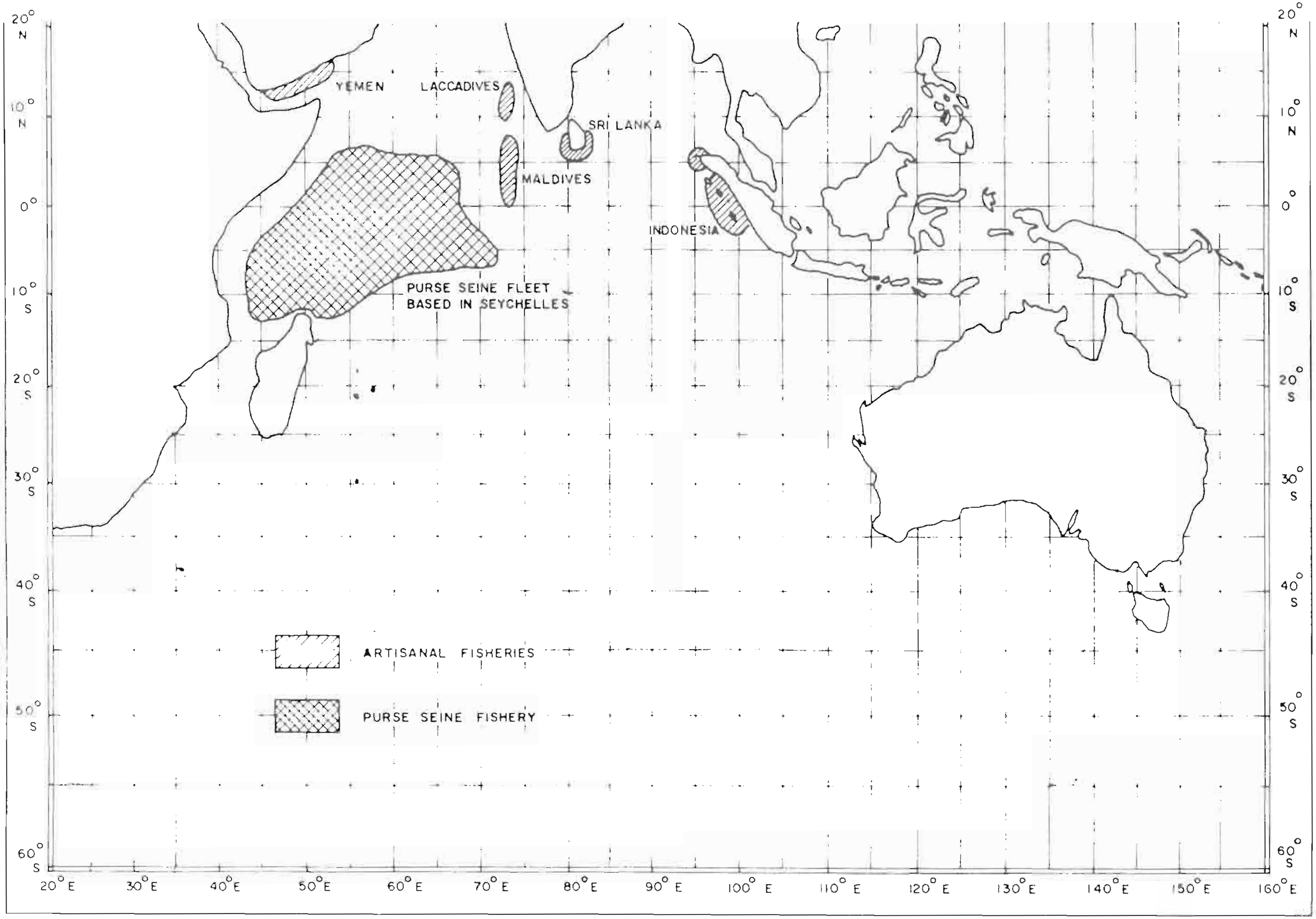

Fig. 5.1 Fishing grounds of the major artisanal and industrial fisheries for yellowfin and skipjack

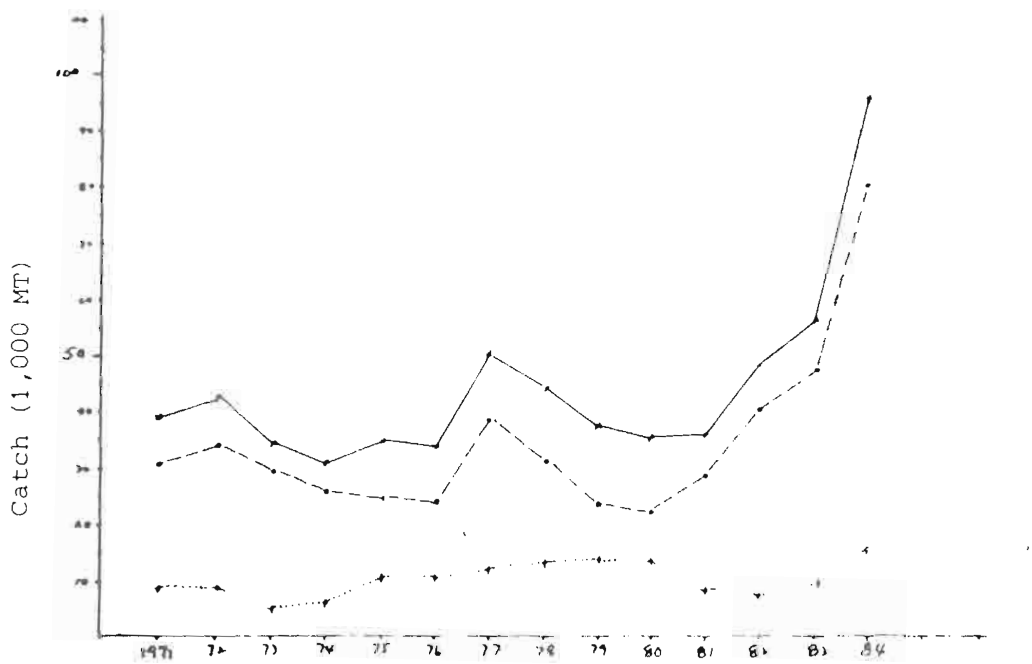

Fig. 5.2 - Trends in yellowfin catches, 1971-1984.

Continious line...... whole ocean
Broken line .... area 51
Dotted line .... area 57

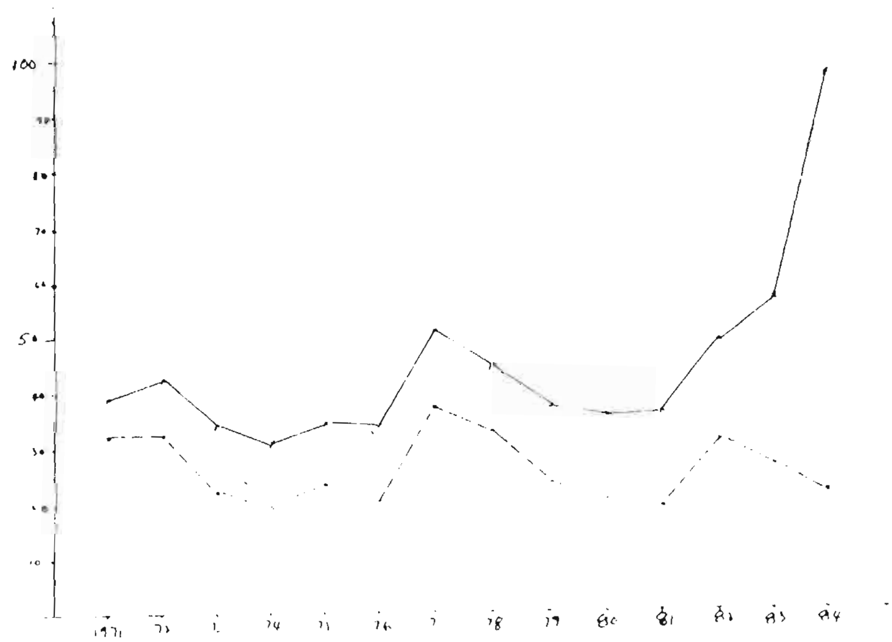

Fig. 5.3 - Trends in yellowfin total catch (continious line) and longline catches (broken line) 1971 1984.

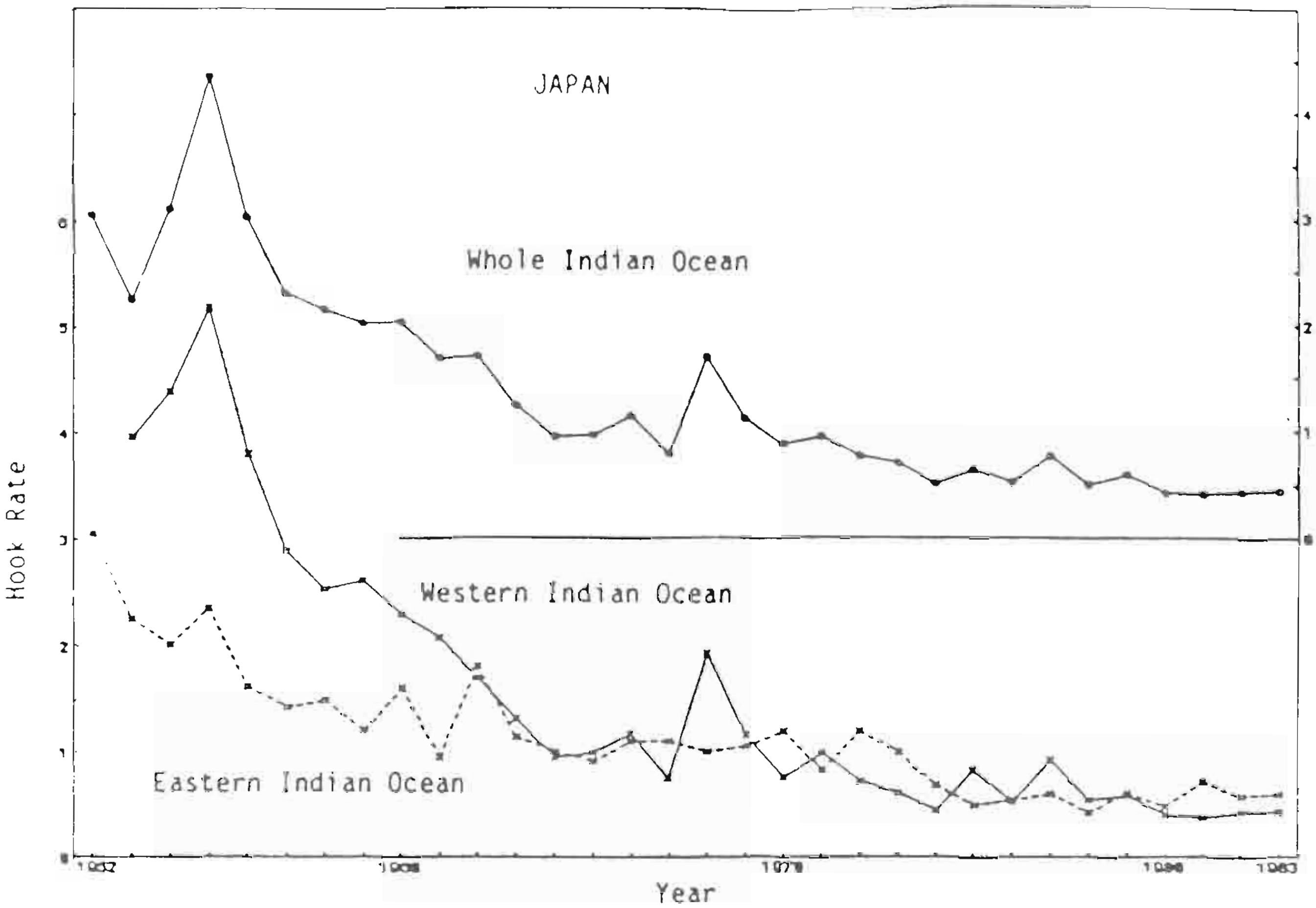

Fig. 5.4 Annual changes of yellowfin hook rate by each longline fishery for the whole, western and eastern Indian Ocean stock (TWS/85/27)

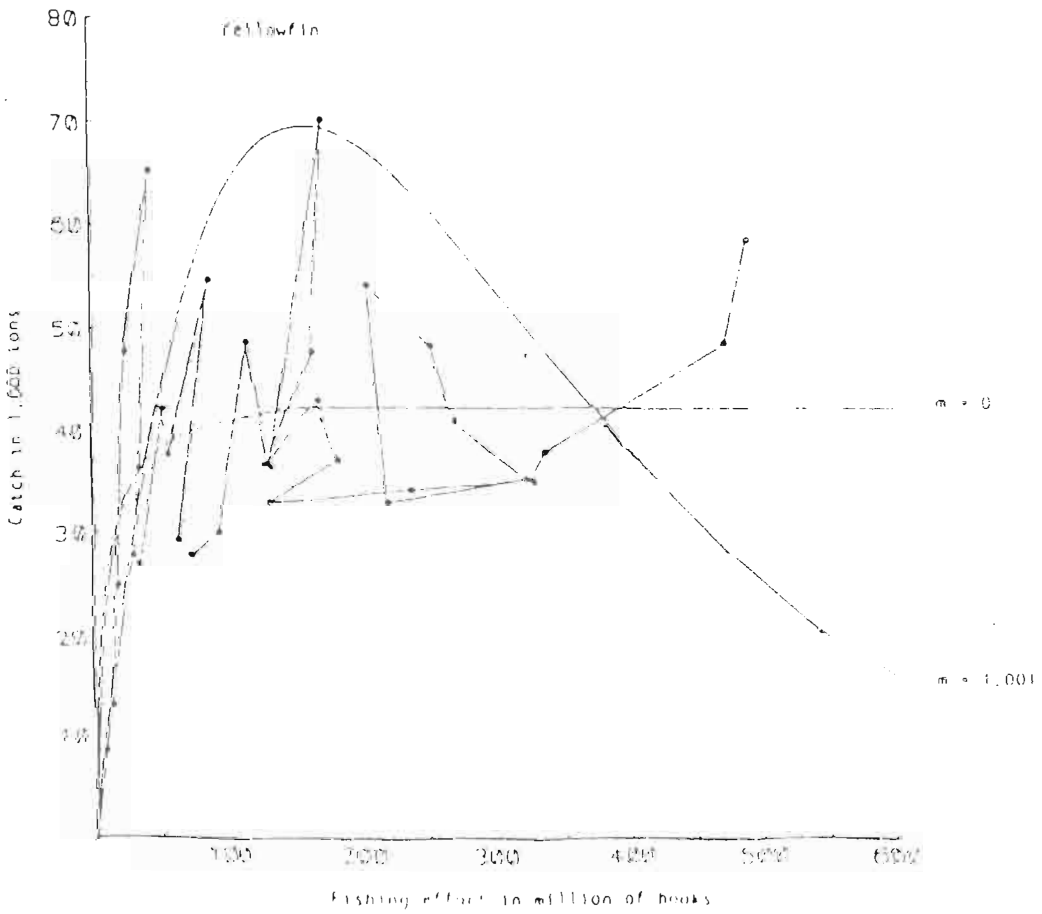

Fig. 5.5 Relationship between observed annual catch and effort on Indian yellowfin and the fitted equilibrium production curve. (TWS/85/27)

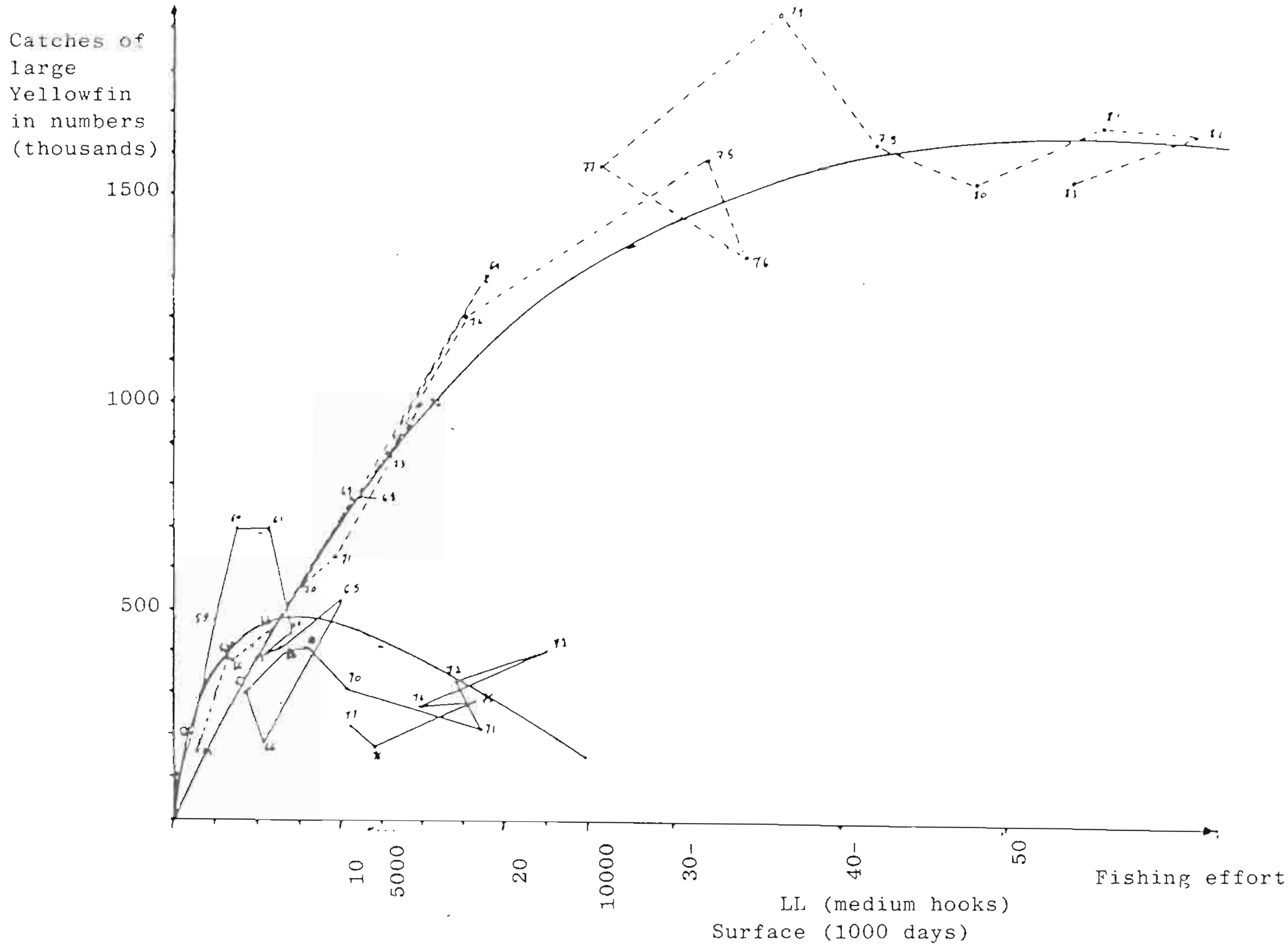

Fig. 5.6 Yearly catches of large yellowfin (in numbers) by surface and by longline fishery and effort of each fleet (TWS/85/28)

5.6. SKIPJACK

Similar to other oceans the skipjack tuna Katsuwonus pelamis catch in the Indian Ocean is taken by surface fishing gears, e.g. pole-and-line, purse seine, troll and gillnetts. Only very small amounts of skipjack are taken by the deep fishing longliner gear. Table 6.1 gives the skipjack catch for the Indian Ocean for the period 1971 - 1984. Figure 5.1 shows the location of the industrial and the artisanal fisheries for skipjack tuna.

5.6.1 Trends

From 1971 to 1979 the skipjack tuna catch remained relatively stable around 30,000 to 40,000 t (Figure 6.1). Subsequently the catch increased slightly to 51,000 t by 1982 and increased dramatically in 1983 and 1984. The 1983 catch was 61,200 t and the 1984 catch has been estimated at 100,400 t. Similar the yellowfin tuna catches the marked increase in 1983/1984 catches resulted from the rapid development of the purse seine fishery in the western Indian Ocean. Figure 6.1 also shows the skipjack catch by area. During the period 1971-1984 the catch from the western Indian Ocean (Area 51) exceeded 75 percent of the total skipjack catch; for 1984 the difference was a dramatic 89 percent. As noted earlier the sharp increase in catch has been due to the development of the purse seine fishery in the western Indian Ocean.

5.6.2 Fisheries

The three principal methods of catching skipjack tuna in the Indian Ocean is the pole-and-line gear, gillnet and the purse seine gear. The most prominent pole-and-line fishery occurs in the Maldives where an estimated 32,000 t of skipjack were landed in 1984. The Maldives fishery has been mechanized in recent years and the bulk of the skipjack catch is taken by this mechanized fleet.

In Sri Lanka the principal gear used to catch skipjack tuna is the gillnet. In 1984 the skipjack tuna catch was estimated to be 11,600 t. In Indonesia several types of fishing gear are employed to catch skipjack tuna, e.g. troll, gillnet and purse seine gear. The 1984 Indonesian skipjack catch from the Indian ocean region was estimated to be 14,000 t.

Experimental purse seine fishing for tunas in the western Indian ocean was carried out in 1980 by a French purse seiner. By 1983 the gear proved to be effective in catching commercial quantities of tuna and 10,000 MT of skipjack were caught with this gear. The 1984 catch by purse seiners was 43,000 t; the catch was made by fleets from France, Spain, Ivory Coast and Mauritius. In the eastern Indian cean a Japanese purse seiner has been reported to have conducted purse seine trials for tuna in the region from 1973 to 1985 (TWS/85/24). The catch was predominantly skipjack tuna.

5.6.3 Stock Assessment

Presently no estimates of the size of the skipjack tuna resource in the Indian ocean are available. Several papers presented at the workshop described preliminary attempts at stock assessment estimates for the Maldive and Sri Lanka resources. Evaluation of the papers resulted in words of caution in developing production model studies of restricted fishing areas and narrow ranges in fishing effort.

5.6.4 Biological Parameters

Several papers provided some information on biological parameters of the skipjack tuna in the Indian ocean (TWS/85/20, TWS/85/13, TWS/85/15). A study of growth by the ELEFAN I technique and of mortality rates determined by the ELEFAN II technique drew some discussion by the participants. It was suggested that some care needed to be exercised in drawing conclusions from this method since in and out migration of fish could represent major components of the calculated mortality rates; specially with size selective fisheries.

There was a general consensus that a review of the various techniques used to determine life history parameters for tunas in the Indian ocean was highly desirable at this time. Scientists who are collecting data from the several skipjack tuna fisheries in the region would benefit from such a review. One mechanism of this review was to carry out a workshop on the topic.

5.6.5 Recommendations

1. There is a need to improve the collection of statistics from the region; especially those related to the artisanal fisheries.

2. A workshop should be held to review the various techniques used to determine life history parameters, e.g. growth, mortality rates and movements.

3. Efforts should be directed to understand the stock structure of skipjack tuna in the Indian Ocean.

4. A comprehensive tagging program should be developed to obtain information on age and growth, mortality rates, migration patterns, stock structure, stock assessment and interactions.

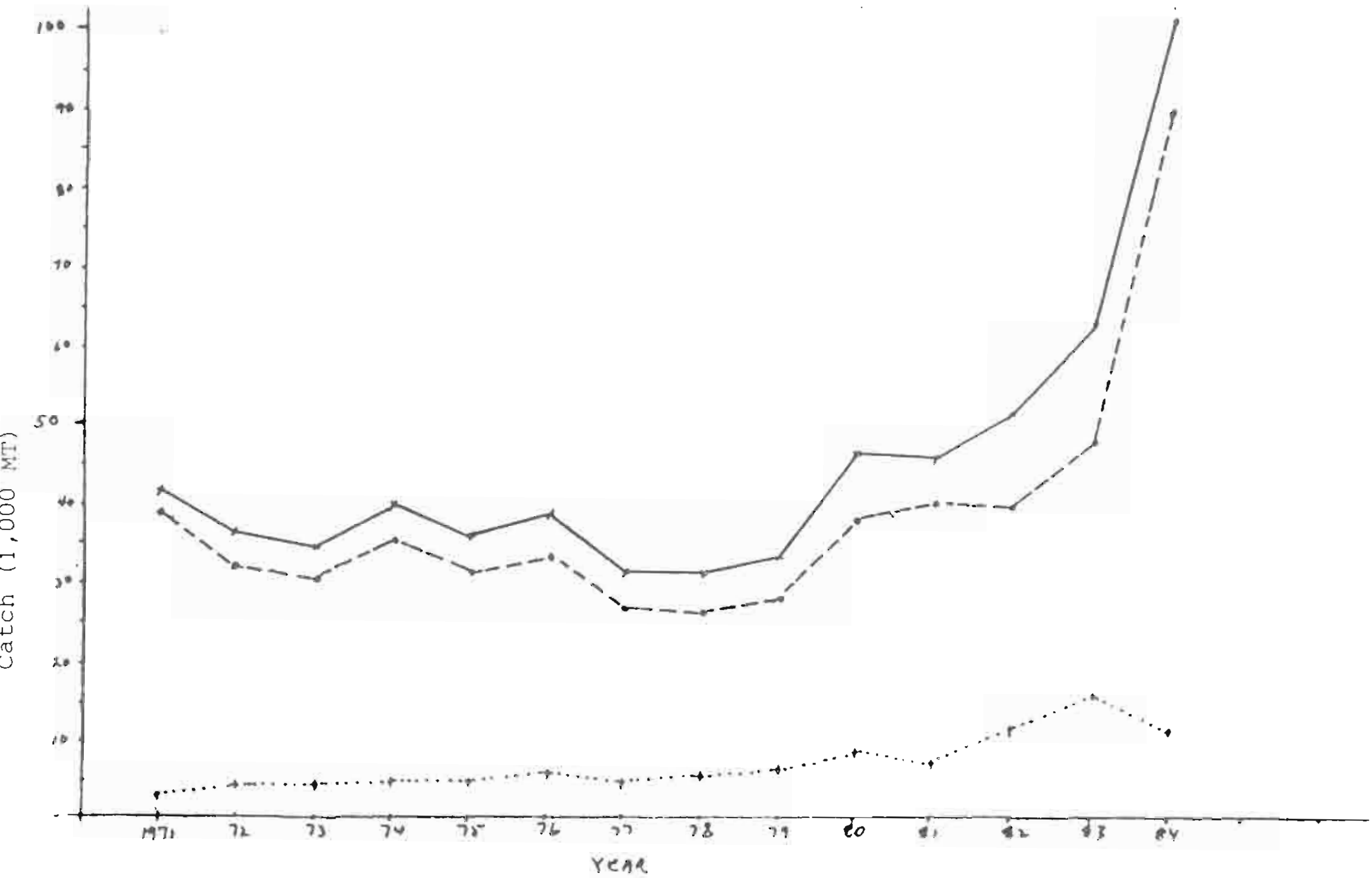

Fig. 5.6.1 -Trends in skipjack tuna catch in FAO areas 51 and 57 for the years 1971-1984.

Continious line......... whole ocean
Broken line .... area 51
Dotted line .... area 57

Table 5.6.1 Catch of Skipjack Tuna by Country and Type of Gear from 1971 - 1984

COUNTRY	GEAR	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Australia	UNCL	0	100	0	133	523	404	26	49	58	37	44	0	54	-
China (Taiwan)	LL	0	0	0	0	0	0	0	0	0	0	0	11	9	22
Comoros	UNCL	300	300	300	250	300	250	300	300	300	300	300	300	300	300
France 1/	PS	0	0	0	0	0	0	0	0	0	0	210	771	10075	31550
India	UNCL	0	0	0	0	0	0	0	0	0	0	1803	2399	0	3395
Indonesia	PS	0	0	0	0	0	0	0	0	0	0	0	284	0	328
	UNCL	2400	3700	4100	4447	3925	5513	4034	4093	6524	7573	6579	11548	12458	13323
Country Total		2400	3700	4100	4447	3925	5513	4034	4093	6524	7573	6579	11832	12458	13651
Japan	LL	100	300	0	31	23	16	4	11	3	6	10	5	2	-
	BB	0	0	0	0	0	0	0	0	0	0	7	0	0	-
	PS	0	0	0	0	0	0	0	908	0	478	0	0	790	548
	UNCL	0	0	0	0	0	0	0	0	0	0	10	0	0	-
Country Total		100	300	0	31	23	16	4	919	3	484	27	5	792	548
Kenya	LL	0	0	0	0	0	0	0	0	0	0	3	1	2	-
	UNCL	0	0	0	0	0	0	0	0	0	0	68	96	31	-
Country Total		0	0	0	0	0	0	0	0	0	0	71	97	33	-
Korea	LL	0	0	0	72	200	63	151	253	65	43	48	57	8	-
Maldives	BB	28200	17634	18761	21760	14601	19287	14032	13549	17798	23074	20198	15694	19491	31714
	UNCL	509	337	434	400	257	489	310	275	338	487	419	187	210	333
Country Total		28709	17971	19195	22160	14858	19776	14342	13824	18136	23561	20617	15881	19701	32049
Mauritius 2/	PS	0	0	0	0	0	0	0	0	44	1025	1726	882	2597	2558
	UNCL	0	0	0	0	0	0	0	14	10	4	5	3	0	350
Country Total		0	0	0	0	0	0	0	14	54	1029	1731	885	2597	2908
Mozambique	BB	0	0	0	0	0	0	0	0	0	0	0	0	60	154
Pakistan	UNCL	0	0	0	0	0	0	0	0	449	134	446	5156	733	(700)
Seychelles	UNCL	0	0	100	50	10	10	20	10	10	0	0	0	0	0
Spain	BB	0	0	0	0	0	0	0	0	0	0	179	14	0	0
	PS	0	0	0	0	0	0	0	0	0	0	0	0	0	8079
Country Total		0	0	0	0	0	0	0	0	0	0	179	14	0	8079
Sri Lanka	BB	0	0	0	0	0	0	0	0	0	0	0	1987	2095	(2000)
	UNCL	9500	13200	10400	12321	15243	12222	11399	10994	8309	12700	13758	11263	11877	(9000)
Country Total		9500	13200	10400	12321	15243	12222	11399	10994	8309	12700	13758	13250	13972	(11000)
Yemen Dem	UNCL	0	0	0	0	0	0	0	0	0	0	0	400	400	-
Gear Total for	LL	100	300	0	103	223	79	155	264	68	49	61	74	21	22
Gear Total for	BB	28200	17634	18761	21760	14601	19287	14032	13549	17798	23074	2384	17695	21646	33868
Gear Total for	PS	0	0	0	(	0	0	0	908	44	1503	1936	1937	13462	43063
Gear Total for	UNCL	12709	17637	15334	17601	2258	18668	16089	15735	15998	21235	23432	31352	28620	27403
Species Total		41009	35571	34095	39464	35082	38254	30276	30456	33906	45661	45813	51058	611[illegible]	104356

1/ Including Ivory Coast

2/ Including some amount of yellowfin tuna for 1979 - 1981 and 19

6. INTERACTION BETWEEN FISHERIES

The workshop began with the presentation of five working papers concerned with problems of interactions in tuna fisheries.

Dr. J. Marcille presented working paper TWS/85/35 entitled 'Interactions Between Longline and Surface Fisheries for Yellowfin Tuna'. This paper had been prepared for an earlier meeting in Mombasa in response to countries concerned with the sudden increase in purse seine catches in the Western Indian ocean. Two potentially important types of interactions for the Indian ocean are identified in the paper.

1) the interaction between purse seine and longline fisheries and
2) the interaction between purse seine catches and artisanal fisheries.

He noted that the existing literature on interactions among tuna fisheries is limited and that this lack of information prompted FAO to request Dr. Suzuki and Dr. Fonteneau to prepare papers on this question to be presented at this workshop.

Dr. Suzuki then presented working paper 26 entitled 'Interaction study on yellowfin stock between longline and purse seine fisheries in the western Pacific'.

Interaction between longline and the rapidly expanding purse seine fisheries for yellowfin tuna were analyzed for the western Pacific stock. Since basic biological information on the stock is lacking from major fishing countries except for Japan, relevant Japanese data were extensively used for comparison between the two fisheries.

The longline catch increased with increasing fishing effort but levelled off at about 100,000 t in recent years. Correspondingly, the longline CPUE in recent years has decreased to about one half of that in the early period of the fishery. Average weight of fish in the catch showed a clear decreasing trend throughout the period studied. The purse seine catch has been increasing in proportion to the increase in fishing effort and the CPUE has remained stable. Longline boats mainly capture yellowfin larger than about 90 cm in fork length while purse seiners capture fish smaller than 70 cm.

Yield per recruit (Y/R) analysis was attempted for the data obtained from major yellowfin fisheries in the western Pacific, i.e., Japanese longline, Japanese equatorial purse seine, all Philippine and the U.S. purse seine fisheries. The results suggested theoretically that, 1) further increase of the present level of fishing effort by the three fisheries will not be accompanied by increased catch unless the size of fish at entry to the fisheries is simultaneously increased, and 2) increased catch by the purse seine fishery reduced the longline catch significantly although the total catch from the stock will not change much from present levels.

Local interaction was investigated examining CPUE trends of the longline boats operating on the purse seine fishing grounds of the western equatorial Pacific. It was not possible to demonstrate that the recent decrease of longline CPUE was related to the increased catch by the purse seiners, possibly due to the short time series for the purse seine data.

The possibility was raised that the decrease in longline catch rates suggested by the theoretical Y/R analysis may be masked in the observed CPUE by environmental conditions related to El Nino.

Following the presentation by Dr. Suzuki, working paper TWS/85/28, entitled 'Surface versus longline tropical fisheries in the Atlantic ocean : What Interaction?' was presented by Dr. Fonteneau.

The analysis of the interaction presented by Dr. Fonteneau showed that the major share of the yellowfin catch in recent years has been made by surfaces fishing vessels, whereas for bigeye the reverse is true, the major catches are made by longliners. Respecting yeild per recruitment analysis longliners seem to in the case of both yellowfin and bigeye operating nearer to the optimum size. However for yellowfin they seem to operate on only a portion of the stock. In fact analysis of yeild of yellowfin versus effort for both the longline and surfact fishery suggest that the stocks supporting the two fisheries are not homogenous. Final conclusion concerning these matters are unclear and require further research.

Dr. Polacheck then presented working paper TWS/85/51, 'Yellowfin tuna catch rates in the western Pacific'. This paper is a general review of trends in yellowfin catch rates covering the period of rapid expansion of purse seine fishing in the western Pacific. Longline catch rates in 1984 and 1985 are substantially lower than in 1979. Whether this represents a general decline is not clear because of the short time series of data and high catch rates observed in 1983 (which may have been the effect of El Nino). No relationship was found between longline and purse seine catch rates within relatively fine geographical and temporal strata. This suggests that the fishery is not homogenous with respect to the two different gears. The observed changes in longline catch rates within areas of the western Pacific do not appear to be related to the purse seine catches taken from those areas. The areas exhibiting the greatest decline in longline catch rates partially overlap but do not coincide with the major area of the purse seine fishery. Reasons for lack of any relationship are discussed and the problem of incomplete catch and effort statistics was noted.

Dr. Majkowski then presented a paper number TWS/85/35 entitled 'An experimental determination of the effect of changing the catch of one component of a fishery upon the remaining components'(by J. Majkowski, W. S Hearn and R. L. Sandland, to be published in the Can. J. Fish. Aquat. Sci). The objective of this technique is (i) to outline a scientifically novel method for quantitatively determining the extent of interactions among fishery components associated with different fishing methods, classes of fishing vessels, geographical areas and temporal patterns, and (ii) to illustrate the application of the method to the southern bluefin tuna fisheries. The technique discussed by Majkowski employs a specifically designed tag release - recapture experiment was proposed along with a new method of analysing the resulting data. The approach proposed does not involve any mathematical model and requires almost no knowledge of the system being studied. The methodolgy suggested can be applied even if catch and fishing effort statistics are not available. In addition the method is as applicable to both simple fisheries systems and complex ones for which other methods may not be suitable.

Dr. Majkowski's presentation covered aspects such as experimental design including the assessment of the number of tagged fish required to achieve a specific accuracy of results and the method of analysing tag release and recapture data including the estimation of errors in the results of the analysis.

After the presentation of each working paper, technical comments and discussions occured. An important point noted for the two papers concerning the western Pacific, was that in both studies lack of complete catch and effort statistics hampered the interpretation of the results. Based on the documents presented, there is no clear picture as to whether interactions are occuring or how significant they may be.

During the discussion two types of interactions were identified as potentially important for the Indian ocean; 1) the interaction between longline and surface fisheries and 2) the interaction between surface fisheries operating in different areas. The question of interations between species was considered to be outside the scope of the present workshop.

Sri Lanka noted that for the Indian ocean the question of interactions between surface fisheries is of critical importances and expressed concern about the possible effect of increased surface catches in the west Indian Ocean on its developing fishery.

Similar concern was expressed regarding the effects of the increasing surface catches in the western Indian Ocean on the local fisheries of the Maldives.

There was a general concensus that there is an immediate need for additional research on the question of interactions. Tagging experiments are among the most direct methods for obtaining answers to questions about interactions in a timely fashion. The importance of good catch and effort statistics for interaction studies was also noted.

The workshop also noted that studies are needed not just to establish the occurrence of interactions, but to be able to quantify the degree of interaction. For example, there is a need to be able to predict, quantitatively the effect that changes in fishing effort in one fishery will have on another fishery. Answers to these types of questions will require the development of appropriate models, well as the acquisition of data for estimating the parameters for such models.

Examples of possible interations in other oceans besides those presented in the working papers were briefly noted. It was noted that the collapse in the local Hawaiian bait boat fishery over the last ten years may be the result of large purse seiner catches in the eastern tropical Pacific. It was noted that I-ATTC has been studying the possible effect of the yellowfin purse seine catches on the longline fishery in the eastern tropical Pacific but that after examining the data on catch rates there is not a clear explanation of what interaction, if any, have occurred. In the western Pacific the SPC has a time series of data on artisanal tuna catch rates in Tuvalu covering the period of rapid expansion in the purse seine fishery. These data do not suggest any trend. However, the data are limited and this artisanal fishery is a long distance from the major purse seine fishing areas.

It was reported that longline catches in the Seychelles have declined dramatically since 1982 and noted that fishermen ascribe the decline to the increased surface catches. No analysis has been performed to evaluate these claims.

It was noted that a number of other research organizations hope to conduct tagging experiments involving yellowfin and skipjack tuna in the near future. These include ICCAT, IATTC, SPC and Australia. In addition the regional tuna project for the southwest Indian Ocean hopes to commence tagging experiments in the southwest Indian Ocean in early 1986. A major purpose of the tagging studies planned by SPC and Australia is to collect information with respect to interactions, and indeed all the planned tagging studies should provide interesting data with respect to questions of interactions.

There was a general agreement that the next couple of years may be critical with respect to interactions both in the Indian and western Pacific Oceans. The situations in these oceans requires careful study and monitoring.

The Maldives expressed particular concern that this is a critical period for their local fishery and hoped that necessary research would be commenced without delay.

The question of what data requirements are necessary for studies of interactions was discussed. The importance of complete and adequate catch and effort statistics was emphasized. In addition, there is a critical need for size frequency data in order to be able to conduct cohort and yield per recruit analyses in relation to interactions. There was a general agreement that the data requirements for interactions studies, particularly in reference to the details of temporal and spatial scales, need to be defined. It was pointed out that for longline catch and effort statistics, a meeting held in June 1985 in Pusan, Korea had gone a long way to resolving this problem. The question of catch on changes in sex ratios with sizes and its relevance to interactions studies was raised and it was concluded that such data has not been useful in studying interactions. The difficulties in obtaining adequate and accurate data from local fisheries at the level of detail needed for interaction studies was recognized, but never the less the importance of obtaining such information was stressed.

Having considered the exchange of views and information concerning the problems of fisheries interactions, the workshop recommends:

(1) Research into the investigation of fisheries interaction problems in the Indian Ocean, and elsewhere, with special emphasis on (a) surface and sub-surface fisheries, particularly purse seine and longline and (b) surface fisheries in the western Indian Ocean, particularly among the large commercial surface fisheries and the local fisheries of the Maldives and Sri Lanka.

Such research should include a continuation of the present classical types of investigations employing fishery catch, effort and size composition data as well as the use of tagging techniques to quantify directly rates of interaction.

(2) The establishment of a small group of experts to provide guidance in the formulation of tagging experiments to study interaction, giving spescial attention to the matter of experimental design. This group should also define the requirements of catch, effort and size frequency data necessary for in-depth studies of interactions. This group of experts should be convened as soon as practicable and particularly before any major tagging programmes are undertaken in the Indian Ocean.

(3) That consideration be given to the possibility of establishing a broader based and more formal workshop to exchange information, analytical techniques and results of the research and field programmes carried out respecting the interaction problems discussed above.

7. INDIAN OCEAN TAGGING PROGRAMME

A small working group was established to write a first preliminary project for a tagging programme to be realized in the Indian Ocean. This is the report of this working group.

7.1 OBJECTIVES OF THE PROGRAMME

Tuna tagging has provided, during the last 30 years, a considerable amount of information on tuna biology and stock structure. This tagging has been conducted in all areas, except in the Indian ocean. In general, tagging is very useful and complementary to detailed fishing statistics, to provide the base for national development and management of tuna fisheries. Tagging has also the great advantage that its results are more rapidly usable than the basic fishery statistics, for which longtime series are mostly necessary.

The goals of the Indian Ocean tagging programme would be quite general:

- growth
- stock structure and transfer rates between fisheries
- population size and mortality rates

The species yellowfin, skipjack and bigeye would be the major target species to be tagged during the programme, however other tuna species could be tagged in some areas depending on their importance in local fisheries.

7.2 OPERATIONS

Tagging areas

The entire Indian ocean should be covered by tagging. Intensive tagging should be conducted primarily in well identified fisheries (Mauritius, Seychelles Islands, Maldives, Sri Lanka, Indonesia etc.) but also in other areas.

The programme should be coordinated in some areas with existing tagging programmes, such as the proposed EEC regional tagging programme, to be conducted under the responsibility of Mauritius.

Duration of tagging operations

The tagging activities should be conducted for one year (minimum) or two years, depending on available funds.

The advantage of doing tagging with one or several bait boats on a full times basis during this period should, among other options, be considered.

Organization of the programme

Several phases can be distinguished:

(1) Planning of the programme (1986): a working group should be set up to build a detailed programme, taking into account the general guideline made in this recommendation but not necessarily being bound by them (activities, organization, data processing, publication, budget). Special attention should be given as to how to share the responsibilities between the partners acting in the programme.

(2) Searching for funding and practical organization of the programme: end of 1986 and 1987.

(3) Tagging activities: 1988 (and possibly 1989)

(4) Returns of tags : 1989 to 1990

(5) Data processing analysis and publication

7.3 BUDGET

The budget will depend on the national participation of countries in the area. As a preliminary order of magnitude, the budget of the tagging programme should be between 1 to 2 million dollars, depending on the duration of the programme and of national participation (specially in providing scientists to the programme).

8. STATISTICS

Reference was made to Table 1 of document IOFC:TM/85/4 indicating the status of IPTP data collection as at 30 June 1985. Participants were requested to provide information of any improvements in data availability since that data on the basis of which an updated table appearing as annex 1 to this section was prepared.

The group considered also paper TWS/85/7 which included forms proposed for us by the IPTP for the collection of data. These forms were found adequate to meet the data needs of the programme with an understanding that some improvements can be made in the explanatory notes. There was some discussion concerning form 2 requesting data on fishing vessels. As a result of which the IPTP was requested to clarify the instructions for completion. With this minor amendment the forms were approved for circulation to member governments.

It was noted that the work of the groups undertaking stock assessment of species had been limited by the lack of statistics and among other suggestions for improving the situation was a proposal to produce a field manual. While recognizing that the issue of a manual would not solve the problems without training of field staff followed up by constant monitoring of the system, the group approved the proposal and invited the assistance of experts to the IPTP in developing the manual.

Several delegations commented on the difficulties faced in statistics collection in their countries. While training of personnel was noted to be a problem it was also clear that a lack of means i.e. finance and the required personnel as well as frequent lack of priority accorded by governments to this activity were more fundemental problems.

It was noted that Japanese government has agreed for a further extension of the Japan founded tuna project which include two outposted experts which were helping the IPTP in statistical improvement. The expert in Indonesia has been assisting the tuna scientists of the Research Institute for Marine Fisheries in tuna sampling, data analysis and in the organization of a tagging programme. The expert in the Seychelles has concentrated on the development of the monitoring system at the Seychelles Fishing Authority. The system has been installed and almost completed.

The data processing systems and the dissemination of data practised by IPTP were reviewed. The group recognized that all the data received by IPTP had been or would be entered into the data base and will become available, as far as confidentiality criteria allowed, either hard copy or on magnetic tape.

The secretariat raised the question of boundaries. At the outset the IPTP had covered the western Pacific area as well as the Indian ocean but as it was not restricted to the Indian ocean and the southeast asian region it was necessary to define its area of responsibility for statistical purposes and it was questioned whether the existing FAO marine boundaries were satisfactory. To consider the question in greater detail, a small ad hoc group was established consisting of Autralia, Indonesia, Japan, Thailand and FAO. Concerning the western boundary the group approved the procedure practised by IPTP in collecting statistics i.e. the boundary should extend as far as west 20°E even though this does not coincide with the FAO major marine areas for statistical purposes. The eastern boundary based on the existing FAO areas was considered by the group to be satisfactory with the exception of the division between the Indian and Pacific oceans at the northern entrance to the Malacca straits. It was recommended that this should be changed to coincide with the boundary currently in use by the Thai authorities.

8.1 RECOMMENDATIONS

While there has recently been a significant improvement in statistics provided to IPTP from some of the major coastal countries having important artisanal fisheries (e.g. Maldives, Sri Lanka, Thailand and Indonesia). In others there is still a lack of basic information on total catches, catch composition by species length frequency, gear used and other relevant data.

- It is recommended therefore, that, countries make a special effort to report their catches.

- Programmes for the collection of fishing effort and catch by species should be developed and later submitted to IPTP data base.

- That IPTP secretariat and/or FAO should provide financial and technical assistance to improve tuna statistics in those countries with substantial tuna fisheries especially those boardering the north Arabian sea and the gulf area.

Collection of data from the distant water fishing nations has been improved especially in the case of the recently introduced purse seine fishery and in the longline fishery by Taiwan (Province of China). However, recent longline data from the other major longline fleets is still lacking.

Therefore, it is recommended that:

- the data on those fisheries which are currently being collected by the respective national institutes be provided in due time to IPTP.

Considering that very little length frequency data for either industrial or artisanal fisheries is submitted to IPTP although in some cases such data are collected.

It is recommended that:

- when available such information should be provided to IPTP

Where such information is not presently available, programmes should be implemented to organize its collection.

Annex 1

STATUS OF IPTP HISTORICAL DATA COLLECTION AS AT 30 NOVEMBER 1985

	COUNTRIES	CATCH STATISTICS (1)	FISHING BOAT STATISTICS (2)	CATCH AND EFFORT STATISTICS BY MONTH/FISHING GROUND (3)	SIZE FREQUENCY (4)
1.	AUSTRALIA	Catch by species and gear (1981-1984) catch by species (1970-1980)	Number of boats for southern bluefin tuna fishery by type of gear (1976-1984)	No data provided	Catch by age for southern bluefin tuna (1980-1982)
2.	CHINA PROVINCE OF (TAIWAN)	Catch by species and gear (1970-1984)	Tuna longline by size class of boat (1970-1984)	Tuna Longline (1971-1983)	No data provided
3.	FRANCE	Catch by species and gear (1981-1984)	Number of boats by gear (1981 - 1984)	Data provided by $5^0 x 5^0$ (1982-1984)	Skipjack, Yellowfin and Bigeye (1982-1984)
4.	INDIA	Catch by species (1970-1984)	No data available	Gillnet at Tuticorin (1979 - 1982) Gillnet and handline at Vizhinzam (1970 - 1979)	No data provided
5.	INDONESIA	Catch by species (1970-1978, 1980-1981 and 1983)	Number of boats by gear (1984)	Pole and line (1976-1984) Purse seine (1981 - 1984) Trolling (1981 - 1984)	Gillnet (1981 - 1982 & 1984) Seine net (1981- 1982 & 1984) Trolling (1981 - 1982 & 1984)
		Catch by species and gear (1979, 1982,1984)		Gill net (1980 - 1984) Seine net (1980 - 1984) Longline (yearly data) (1973 - 1984)	
6.	IVORY COAST	Catch by species and gear (1983-1984)	Number of boats by gear (1983-1984)	Data provided by $5^0 x 5^0$ (1983-1984)	Skipjack, Yellowfin and Bigeye (1982-1984)

STATUS OF IPTP HISTORICAL DATA COLLECTION AS AT 30 NOVEMBER 1985 Cont'd

	COUNTRIES	CATCH STATISTICS (1)	FISHING BOAT STATISTICS (2)	CATCH AND EFFORT STATISTICS BY MONTH/FISHING GROUND (3)	SIZE FREQUENCY (4)
7.	IRAN	Catch by species (1965 - 1984)	Number of boats by gear and size class of boats (1982-1984)	No data available	No data available
8.	JAPAN	Catch by species and gear (1969 - 1983) Preliminary 1984, catches of Bigeye, Yellowfin & Albarore	Number of boats by gear and size of boat (1969 - 1983)	Tuna longline (1962 - 1980)	No Data provided
9.	KOREA (REPUBLIC OF)	Tuna longline catch by species (1970-1984)	Tuna longline (1971 - 1983)	Tuna longline (1966 - 1970)* (1975 - 1980)	No data provided*
10.	KENYA	Catch by species and (1980 - 1983)	Tuna Longline (1980 - 1983)	Data not available	Data not available
11.	MALAYSIA	Catch by species and (1970-1983) Catch by species and gear (1976-1983)	Data not available	Trolling at a landing center (Aug. 1982 - July 1983)	Trolling at a landing center (Jan.-June 1983)
12.	MALDIVES	Catch by species and gear (1970 - 1984)	Number of boats by gear and type of boat (1970 - 1984)	Skipjack pole and line (1970 - 1983) Trolling (1970 - 1983)	Skipjack, Yellowfin Little tuna and Frigate tuna provided for 1983 and 1984 for one landing centre
13.	MAURITIUS	Catch by species and gear (1979-1984)	Number of boats by gear (1982-1984)	Purse seine (Dec. 1979 - Nov. 1985)	No data available

STATUS OF IPTP HISTORICAL DATA COLLECTION AS AT 30 NOVEMBER 1985 Cont'd

COUNTRIES	CATCH STATISTICS (1)	FISHING BOAT STATISTICS (2)	CATCH AND EFFORT STATISTICS BY MONTH/FISHING GROUND (3)	SIZE FREQUENCY (4)
14. MOZAMBIQUE	Catch by species and gear (1983 - 1984)	Number of boats (1983 - 1984)	No data available*	No data available*
15. PAKISTAN	Catch by species (1970 - 1984)	Number of boats by gear (1983 - 1984)	No data available	No data available
16. REUNION	Landings of Taiwanese Longliners by species (1971 - 1983)	No data provided	No data provided	Albacore (Dec. 1983)
17. SAUDI ARABIA	Catch of species (1982)	Number of boats (1982)	No data available	No data available
18. SEYCHELLES	Korean longliners and French purse-seiner Landings (1980-1983) Landings of species for purse seiners (1984)	Number of purse seiners based in Seychelles (1984)	Seykor (National Liner) (1984)	No data available
19. SPAIN	Catch by species and gear (1981,1982, 1984))	Number of boats by gear (1981,1982, 1984)	No data provided*	No data provided*
20. SRI LANKA	Catch by species (1970 - 1981)			
	Catch by species and gear (1982 and 1983)	Number of boats by gear (1982 and 1983)	Skipjack and yellowfin for drift gillnet (1982 and 1983)	Skipjack and yellowfin (1982 - 1984)
21. SOUTH AFRICA	Catch by species and gear (1983)	Number of boats by gear (1983)	No data provided	No data available

STATUS OF IPTP HISTORICAL DATA COLLECTION AS AT 30 NOVEMBER 1985 Cont'd

COUNTRIES	CATCH STATISTICS (1)	FISHING BOAT STATISTICS (2)	CATCH AND EFFORT STATISTICS BY MONTH/FISHING GROUND (3)	SIZE FREQUENCY (4)
22. TANZANIA	Catch by species and (1970 - 1984)	Number of boats by gear (1982 and 1984)	No data available*	No data available*
23. THAILAND	Catch by species and gear (1970 - 1984)	Number of boats by gear registered (1970 - 1983)	Luring purse seine and Mackerel encircling gillnet (1971-1983)	Thunnus tongol, Euthynnus affinis and Auxis thazard (1976-1978) Scomberormous commerson (1974 - 1976)
24. YEMEN (PEOPLES DEM. REPUBLIC OF)	Catch by species (1982-1983)	No data provided	No data available	No data available

*Data or Revised and up-dated data to be provided in 1986

9. OTHER MATTERS

A suggestion was made on the suitability of publishing in a very simple form a collective volume of the working documents presented at the Expert Consultation. Authors will be requested to indicate if for any reason they do not wish their documents to be included in the collective reprint.

- It was therefore recommended that IPTP publish a collective volume of the working documents presented at the Expert Consultation.

10. ADOPTION OF THE REPORT

The report of the expert consultation was adopted on 12 December 1985.

APPENDIX 1

INAUGURAL ADDRESS BY DR. HIRAN W. JAYAWARDENA, CHAIRMAN
NATIONAL AQUATIC RESOURCES AGENCY (NARA) AT THE
'EXPERT CONSULTATION ON THE STOCK ASSESSMENT ON TUNA IN THE INDIAN OCEAN'
IN COLOMBO ON 28TH NOVEMBER 1985

Distinguised Participants and Guests,

I wish to express my appreciation for the invitation extended to me to address you at the inauguration of the Expert Consultation on Stock Assessment of Tunas in the Indian Ocean.

This morning, before we proceed, we have a solemn task to perform. This week, we received the sad news of the passing of the Assistant Director General of Fisheries of the FAO, Jean Carroz. The late Dr. Carroz, for long years on the staff of the FAO, as an eminent jurist, has contributed greatly not only to the international jurisprudence concerning fisheries, but has been the driving force behind significant international fisheries programmes. Of these, one of the most outstanding was the Exclusive Economic Zones programme of the FAO which was already in operation prior to the conclusion of the Third United Nations Conference on the Law of the Sea. It is a programme which brought home to many developing coastal states, the significance of the new ocean regime, its opportunities, challenges and difficulties and the basic elements of appropriate national responses. I can speak from personal experience of the untiring efforts of Dr. Carroz in this respect which characterised FAO's foresight and dynamism in dealing with current problems. We would recall the initiation of the 'modular programme' of sub-regional decentralization of FAO subsidiary fishery management bodies in the Indian Ocean, which gave rise to the present management framework, and again, the contribution of Dr. Carroz to the implementation and consolidation of that regime. In the present context of Tuna, I recall his role in the consultations in Manila many years ago, which led, to the establishment of the Indo-Pacific Tuna Management and Development Programme which now provides in Colombo the nucleus for future Tuna Management in the Indian Ocean. These are but elements in an outstanding and exceptionally productive career, that extended its dynamism throught many regions of the world, with unflagging interest and dedication to the task to which he had committed his life's endeavour and the institution that he served unwillingly to the end. It was indeed appropriate that Dr. Carroz in time took on the responsibilities of the Assistant Director General of Fisheries in Rome. To those of us who have had the pleasure of having worked with him and knowing him personally, his untimely passing will no doubt leave a great void in the ranks of those who will continue to strive for the international development of Fisheries. Jean Carroz, also represented to us an international civil servant in the highest standards of ability, efficiency and integrity. We will remember his professionalism and quiet disposition. He will always have a special place here in Sri Lanka. We remember him well as the leader of the high level inter-agency team associated with the formation of the National Aquatic Resource Agency (NARA) in 1981.

I know you would join me in sharing these sentiments on the occasion of his passing, and I would request the Secretariat to convey our deepest sympathy to the Director General and his collegues at the FAO and to his family.

It is indeed timely, that we meet to review the state of Indian Ocean Tuna, and to assess the prospescts for development and management. Before I proceed, I would like to take this opportunity to welcome all of you, particularly those of you who have come to Sri Lanka for this meeting. At the outset, I would like to touch briefly on the Indian Ocean - which is the context for our deliberations. In terms of fisheries potential the ocean has certain exceptional natural characteristics which would set it apart from other oceans. We have a characteristically narrow continental shelf skirting the main continental land masses and have relatively smaller extents of interstitial waters adjacent to archipelagos and islands. In contrast, we have the broad shelf areas of the Atlantic and the island studded South Pacific. In geo-political terms, with limited exceptions, we have the largest concentration of the World's population living in the developing countries that border the Indian Ocean. Many of these are coastal developing states with a growing dependence on fisheries. Narrow shelf areas and rapidly developing fisheries, combined with limited options in terms of other fishing grounds, places a heavy emphasis on oceanic fisheries, of which Tuna is the major fishery. It would not be inappropriate to say that the Indian Ocean Tuna fishery offers the only real prospect for ultimate expansion of Indian Ocean State's marine fisheries. Certainly, that is the case with Sri Lanka and I know it is a case of even greater dependence for certain other States. It is a recognition of the significance of Tuna at the present juncture that endows this meeting with a very great importances.

Many Indian Ocean coastal States which are developing States, emerged from de-colonization only in the post-World War II era. Their immediate development problems and pre-occupations did not permit venturing into what was a distant deep ocean fishery. Hence, the early phases of Indian Ocean Tuna fishing did not see the participation of coastal states in a significant way except as an element of coastal fishing and was essentially dominated by distant water fishing nations. Those patterns, as we know, have now changed. There have been different actors upon the scene - some turned out thorugh forced of economic circumstance, others attracted by it. Today that picture is rapidly changing. We are poised on the threshold of a new phase in the Indian Ocean Tuna fishery.

A combination of the extension of 200 mile zones, and changing economic factors can be said to have produced a climate where we see a tapering off of distant water fishing effort - particularly long lining, and a move towards a resurgence of coastal state interest and new patterns for Tuna development in the Ocean.

The recent developments in the Western Indian Ocean region in particular, signals the further advancement of the Indian Ocean Tuna fishery. As with all fisheries rapid development also brings with it concern regarding sustainability, which is today a ligitimate management concern . As much as we would wish to see widespread development of the fishery, we must bring to mind, the experience of such examples as South American Anchovy and North Sea Herring. This I believe is what underlines the importance of the function of those of you who have assembled here as experts on Indian Ocean Tunas from around the world. It is in your hands that the international community will place the guidance of the further development and management of the Indian Ocean Tuna Fishery which holds some much promise for so many. I hardly need to emphasize the magnitude of that responsibility. In the context of science and resource management, it has been the experience of international fisheries management, that the plea of inadequacy of scientific information is so often taken as a classic subterfuge by those who favour short term commercial gain and unbridled exploitation rather than rational management. Our short experience in the Indian Ocean region - particularly with regard to the Indo-Pacific Tuna Programme (IPTP) has been that the requisite scientific information - though available - regrettably - is not forthcoming. No doubt, individual reasons are cogent, but the overall effect - due to political and economic as well as practical considerations - is that we have a great lacuna due to a lack of broad-based co-operation. It is not a new problem. What is needed is a more co-operative if not pragmatic attitude. The lessons to be learned from the South Pacific are many, and we from developing countries of this region have watched with considerable sympathy, the efforts of our collegues in those countries to grapple with the problems of dealing with more developed distant water fishing interests. As in the development sector, it is imperative that we continue to develop indegenous capabilities in the requisite marine sciences which will give us the independence to act individually and collectively to manage fisheries in keeping with our own national and regional perceptions with regard to development and participation. I can speak for Sri Lanka and say that we are well on the way towards self-relience in this respect and we see these developments spreading at least sub-regionally. We are particularly appreciative of the assistance consistently received from FAO in this regard and would look forward to its continuation on a broader basis within the region.

Earlier this year, Colombo was the venue of the First Conference on Economic, Scientific and Technical Co-operation in the Indian Ocean (IOMAC). One of the underlying themes of that first consultation, was the need to develop national capabilities in the requisite marine sectors. Another - the major theme was the promotion of cooperation not only amongst Indian Ocean States, but also with States from outside the region with activities therein. This is particularly important in the context of the Tuna fishery as we can see from recent developments. It is our expectation that this major parallel development will go some way towards producing a better climate for broader international cooperation in Tuna management which is a prerequisite for the continuing productivity of Indian Ocean Tuna. In the context of science and interaction with resource development, IOMAC also promises to provide a better basis for multideveloping intergrated management where for instance, marine science particularly oceanography can be made more relevant to the immediate goals of oceanic fishery development and management. The new United Nations Convention on the Law of the Sea recongises the need for such co-operation on the basis of which appropriate management regime would be structured as in the case of other oceans.

The expert consultation will lead up to the 8th session of the Committee for Management of Indian Ocean Tuna of the IOFC to be held in Colombo next week. It is our expectation that we will see a clear move towards laying the foundations for appropriate Tuna management measures which could in time be enshrined in the requisite management regime, before events overtake us and bring irreparable harm to the Tuna resouces of the Indian Ocean.

I wish you all success in your deliberations and a very pleasant stay in Sri Lanka for our friends who have come from abroad.

Thank you.

APPENDIX 2

EXPERT CONSULTATION ON THE STOCK ASSESSMENT OF
TUNAS IN THE INDIAN OCEAN
COLOMBO, 28 NOVEMBER - 1 DECEMBER 1985

LIST OF PARTICIPANTS

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	Ms. C. Lagrange-Hall	Secretary FAO, Rome
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APPENDIX 3

EXPERT CONSULTATION ON THE STOCK ASSESSMENT
OF TUNAS IN THE INDIAN OCEAN

Colombo, Sri Lanka
28 November - 2 December 1985

AGENDA AND TIME TABLE

Thursday, 28 November 1985

Morning 10:00 H	1.	Opening of the meeting
	2.	Election of the chairman
	3.	Adoption of agenda and arrangements for the meeting
Afternoon 14:00 H	4.	Review of national fisheries and research programme

Friday, 29 November 1985

Morning 08:00 H	5.	Meeting of Working Groups 1, 2 & 3
		(a) Bigeye, Southern Bluefin, Albacore (Group 1)
		(b) Small tunas and tuna-like fishes (Group 2)
Afternoon 14:00 H	6.	Yellowfin-Skipjack (Group 3)

Saturday, 30 November 1985

Morning 08:00 H	6.	(Continued) Meeting of the Yellowfin-Skipjack Working Group (Group 3)
Afternoon 14:00 H	7.	Meeting of the Working Groups 4 & 5
		(a) Interaction between fisheries (Group 4)
		(b) Statistics (Group 5)

Monday, 2 December 1985 - Plenary Session

Morning 08:00 H	8.	Report by Chairmen of the Working Groups
	9.	Recommendations to the IOFC Committee for the Management of Indian Ocean Tuna
	10.	Future research
	11.	Other matters
Afternoon 17:00 H	12.	Adoption of the report

APPENDIX 4

EXPERT CONSULTATION ON THE STOCK ASSESSMENT
OF TUNA IN THE INDIAN OCEAN

Colombo, Sri Lanka
28 November - 2 December 1985

LIST OF DOCUMENTS

TWS/85/1	Annotated provisional agenda and time table
TWS/85/2	Provisional list of documents
TWS/85/3	List of participants
TWS/85/4	Report on the activities of the Indo-Pacific Tuna Development and Management Programme (IPTP) (INT/81/034) and the Japan Trust Fund Project (GCP/RAS/099/JPN) - Progress Report, January to June 1985.
TWS/85/5	Indian Ocean Tuna Fisheries Data Summary (IPTP Data Summary No. 3)
TWS/85/6	IPTP Date Catalogue
TWS/85/7	IPTP data collection forms with explanatory notes
TWS/85/8	Report on the preparatory expert meeting on tuna longline data for stock assessment in the Indian Ocean (IPTP/85/GEN/7)
TWS/85/9	Major findings from the Indo-Pacific Historical Tuna Fisheries Data Summary (IPTP/85/WP/11)
TWS/85/10	Report on the Ad Hoc Workshop on the Stock Assessment of tuna in the Indo-Pacific Region (IPTP/84/GEN/6)
TWS/85/11	Report of the Workshop on Tuna Fisheries Management and Development in the southwest Indian Ocean, Mombasa, Kenya, 12-13/11/85
TWS/85/12	Report of the 2nd working group meeting on the tunas around the Republic of Maldives and Sri Lanka (BOBP)
TWS/85/13	Report of the first working group meeting on the tunas in the Andaman Sea area (BOBP)
TWS/85/14	Recent trends in Tuna Fisheries in Sri Lanka by L. Joseph and N. M. Moyiadeen
TWS/85/15	Review of tuna fisheries of the Republic of Maldives (by R.C. Anderson and A. Hafiz)
TWS/85/16	Yellowfin tuna in the Maldives by R. C. Anderson

TWS/85/17 Summary of information on the fisheries for billfishes seerfishes and tunas other than skipjack and yellowfin in the Maldives by R. C. Anderson and A. Hafiz

TWS/85/18 Preliminary results of the experimental commercial longline fishery in the Mozambican EEZ in 1984 by F. Simoes

TWS/85/19 Potential tuna purse seine fishing grounds in the Indian Ocean by J. Marcille

TWS/85/20 Skipjack tuna (Katsuwonus pelamis) - Aspects on the biology and relative abundances from the western and southern coastal waters of Sri Lanka by C. Amarasiri and L. Joseph

TWS/85/21 On the distribution and biology of yellowfin tuna from the western and southern coastal waters of Sri Lanka by R. Maldenya and L. Joseph

TWS/85/22 Overall fishing intensity and length composition on albacore caught by Japanese longline fishery in the Indian Ocean, 1952-1982 by T. Shiohama

TWS/85/23 Stock assessment of Indian Ocean albacore by production model analysis by T. Shiohama

TWS/85/24 Review of experimental purse seine operations in the Indian Ocean by Japan Marine Fishery Resource Research Center by Y. Watanabe

TWS/85/25 Comparison of fishing efficiency between regular and deep longline gears on bigeye and yellowfin tunas in the Indian Ocean by T. Koido

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TWS/85/27 Production model analysis of bigeye and yellowfin tunas based on Japanese longline fishery data by N. Miyake and T. Koido

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TWS/85/30 Purse seining on Debris-Associated schools in the Western Indian Ocean by J. P. Hallier

TWS/85/31 Preliminary study of the growth of yellowfin estimated from purse seine data in the Western Indian Ocean by F. Marsac et G. Lablache

TWS/85/32 La flottille thoniere franco-ivoirienne operant dans l'Ocean Indien Occidental by J. P. Hallier et F. Marsac

TWS/85/33 Population dynamics studies on Southern Bluefin Tuna by J. Majkowski

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TWS/85/38	State of Selected Stocks of Tuna and Billfish in the Pacific and Indian Oceans (Report of Shimizu meeting)
TWS/85/39	Notes on Development of the Australian Southern Bluefin Tuna Fishery and its Management by A. Caton
TWS/85/40	Tuna and Billfish Fisheries of the Western Australian Zone by A. Caton
TWS/85/41	Seychelles Fishing Authority: Seychelles Tuna Fishery Bulletin: third quarter 1985
TWS/85/42	A brief summary of the final report of the Monap/FAO experimental pole and line fishing programme GCP/MOZ/006/SWE by Moreira Rato
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TWS/85/46	Korean tuna longline fishery in the Indian Ocean by J. U. Lee
TWS/85/47	The status of tuna fisheries in the Indonesian part of the Indian Ocean, by G. S. Merta
TWS/85/48	Data on tuna fishing by spanish vessels in the Western Indian Ocean
TWS/85/49	A review of the tuna fisheries of the Republic of Maldives
TWS/85/50	Review of national fisheries and research programmes of Tanzania
TWS/85/51	Yellowfin tuna catch rates in the Western Pacific (Report of South Pacific Commission, Seventeenth Regional Technical Meeting on Fisheries
TWS/85/52	Fishery, biology and population dynamics of tunas and seerfishes - An update for India

COUNTRY STATEMENTS

AUSTRALIA

Before the early fifties only small incidental catches of southern bluefin tuna (SBT) were taken by Australian troll fishermen. By the end of that decade a pole and live bait fishery for SBT had developed off the New South Wales and South Australian coasts. During the sixties and seventies this fishery expanded considerably and in the early seventies six purse seiners were introduced. By the late seventies operations by these vessels had become successful and about the same time an Australian SBT pole and bait fishery was established off the Western Australian Coast. In the late seventies and early eighties the Australian SBT fleet was significantly upgraded and the Australian catch increased from 10-12,000 t in the late seventies to a maximum of 21,000 t in 1982/83.

In 1980/81 Australian scientists expressed concern regarding the state of the SBT stock and in 1982 Australian, Japanese and New Zealand fisheries scientists and managers met for discussions. Since then this SBT fishery has been under continuous review on the trilateral basis. Current management involves catch restriction for the fishery of each country. In the 1985/86 fishing year the limit applicable to the Australian fishery will be 14,500 t.

Australian scientists have been involved in SBT research since 1938 and whilst the intensity of research has varied considerably, a substantial body of information has accumulated. Research activities have included tagging programmes (60,000 fish tagged in the fiftees and sixtees with over 10,000 recaptures, and a recent programme involving 10,000 tagged fish and over 3,500 recoveries). The available data have been analysed to determine information on the stock structure, migration, growth, natural and fishing mortalities, abundance, yield per recruit and fishery interactions. Complex age dependent models have been developed and used to assess the biological status of the population, to predict the effect of different fishing regions and to determine optimal way of exploiting the resources regions.

DEMOCRATIC YEMEN

Seerfishes are the major components of the tuna and tuna-like fisheries in Democratic Yemen with an estimated catch of 6,418 t in 1983. Seerfishes are caught by artisanal gill net fisheries. Tunas amount to about 2,500 t and the sailfish and marlin 500 t. Large tuna, which comprise mostly yellowfin, are caught by handline and troll.

FRANCE

French purse seine tuna fishing experiments in the Indian Ocean began in December 1980 with a three month survey in the Seychelles EEZ; it was followed by another survey carried out by one large purse seiner, in a wider area of the western Indian Ocean, from December 1981 to June 1982. Then a small fleet of four seiners began to operate on a commercial basis in November 1982. Another French purse seiner arrived in August 1983 and five more in November. Thus, the fleet increased during the year 1984, peaking at twenty six French seiners in December. Simultaneously, two other industrial purse seine fleets, i.e. Spain and Ivory Coast, appeared in the Indian Ocean. These vessels shifted from the Atlantic Ocean to the Indian Ocean because of a drastic decline in catch rate in the former and the very good results obtained in the latter.

Consequently, the catches have been increasing rapidly: 2000 t in 1982, 20,000 t in 1983 and 64,000 t in 1984. From 1982 to 1984, yellowfin represented 50 to 55 percent of the total catch, skipjack 43 to 49 percent, bigeye one to two percent and albacore not more than 0.5 percent. The fishing activity on flotsam declined from 65 percent of the catch in 1982 down to 42 percent in 1984, as well as the proportion of skipjack in the catch since this species is found more in the catch on flotsam than in free swimming schools. The CPUE was stable in 1983 and 1984, by 12 t per fishing day. In 1985 (up to September), 50,000 t were caught by the French fleet, compared with the previous year the proportion of yellowfin increased (57 percent) and skipjack decreased (40 percent). The CPUE was 11.2 t per fishing day. The fleet was reduced by 30 percent during the first four months of 1985 due to the necessity of providing fish to the Western African canneries whose main partners are also ship owners.

The main research tasks carried out by the ORSTOM team based in the Seychelles are (i) tuna stock assessment; (ii) estimation of tuna abundance by analysis of the sightings reported by observers and by aerial surveys, and (iii) the study of the tuna-environment relationships through analysis of historical oceanographic data, environmental parameters collected on board seiners and satellite SST data. An increasing knowledge of these relationships in the Indian ocean would allow the prediction of the best potential tuna fishing grounds for surface gears according to the observed meteo and oceanographic conditions.

INDIA

The fisheries for tuna and seerfishes in India is still an artisanal activity. A major effort in the exploratory surveys as well as the utilization of the resources are within the EEZ of India. Major species caught around the mainland are E. affinis, Auxis thazard, A. rochei, S. orientalis and T. tonggol. Skipjack and yellowfin tuna are regularly taken from the Lakshadweep Sea. The current trend of tuna production stands around 19,400 tonnes and E. affinis and K. pelamis constitute about 60.8% and 14.0% of the total catch respectively. Among the seerfishes landed in 1983, Scomberomorus commersion accounts for about 19,000 tonnes, S. guttatus 14,000 tonnes and S. lineolatus and Acanthocybium solandri together about 190 tonnes.

Both mechanized and non-mechanized crafts are engaged in the tuna and seerfishing fishery employing drift gillnets, purse seines, hook and lines, pole and lines and troll lines. Exploratory longline fishery also land yellowfin tuna taken from the Arabian Sea, south of equator and Bay of Bengal. Recent developments in the artisanal fishery are the introduction of mechanization for propulsion for dug out canoes and large sized boats in the pole and line fishery. Tunas are being canned, smoke-dried and sold as fresh fish whereas seerfishes are sold in fresh condition.

Biology and stock assessment studies carried out on E. affinis, A. thazard, K. pelamis and T. albacares indicate that further expansion of the fishery for these species is possible. Population parameters of seerfishes have also been conducted and the results presented in the Working Paper.

INDONESIA

The annual production of tuna and tuna-like fishes by Indonesian vessels is about 17.8 percent of the total Idonesian production or about 25,856 t with an annual increased of about 13.7 percent during the period 1976-83.

The gears used are mainly small purse seine in Banda Aceh (North Sumatra), with the catch rates for skipjack and tuna-like fishes in 1984 ranging from 41 to 331 and 125 to 768 kg/day respectively. The smaller purse seines are being used in Prigi with annual production of 500.5 tons. Troll line fisheries have developed in West Sumatra with the catch rates ranging from 63.5 to 376 kg/day (May - September 1985). Gill nets are being used in Pelabuhan Ratu with the catch rates ranging from 43.9 to 174.0 kg/day. This fishery has also developed more recently in Prigi with annual catch ranging from 11.6 to 55.7 t. Seine fishing is only practised in Pelabuhan ratu for tuna-like fishes as well as small pelagic fishes, with the catch rates ranging from 128.3 to 322.3 kg/day. A long line fishery operates from Bali exploiting seasonally resources in both the Banda sea and the Indian ocean. This fishery employs 100 GT boats, with the hook rates in 1983 and 1984 being 1.15 and 1.39 by 100 hooks respectively.

IRAN

There are several species of Tuna that have so far been identified in the Coastal water of Iran in the Sea of Oman and part of the Persian Gulf. The most dominant species are longtail tuna and kawakawa. The other species contributing in the catch are: skipjack tuna, seerfish (Scomberomorus spp.) and sail fish. According to the data available about 50 percent of the total tuna catch consist of longtail tuna, 40 percent of kawakawa and the remaining 10 percent includes other related species. Most of the tuna catch are made by artisanal fishermen as an incidental catch of gill net fishery. The method of trolling has also been used to some extent by local fishermen in some fishing areas.

The total annual catches of tuna and related species from Iranian waters accounted for about 11,700 and 12,068 t in 1983 and 1984 respectively. This represented about 26 to 27 percent of the total catches from the Persian Gulf and the Sea of Oman. Tuna catches in 1984 amounted to about 6389 t of longtail tuna, 4135 t of kawakawa and 1544 t of seerfish. As it can be seen from the data the catch effort of tuna from Iranian waters showed a relatively constant trend during the past few years. This may be due to the fact that no industrial tuna fishing activity exists in the country and also the amount of catches that are made by artisanal sections are part of their incidental catch. The minor variation in the annual catch is due to the number of artisanal fishing boats operating in each year.

The fishing period for tuna species in the sea of Oman is from April to the end of September with the landing peak in June, July and August. Seasonal variations in tuna catch indicated that during the summer months tuna fishing is concentrated in the sea of Oman due to the high temperature and salinity of water in the Persian Gulf. By the beginning of winter season some species of tuna start migration in to the Persian Gulf where they are caught in the coastal water of Busher province.

Due to the wide spread of the landing places along the coast line, no precise data collection system has been set up. The present data collection system in Iran consist of sampling from fish market for species identification, length and weight measurement. Data on the amount of tuna landed by species are also collected from statistic division of the State Fisheries Department. In order to obtain more accurate and adequate data on tuna fishery a sufficient system of data collection is needed to be adopted in several landing places. A national research project on the development and management of the palagic resources from the Iranian waters in the sea of Oman and the Persian Gulf has recently been set up through FAO/UNDP assistant. This project that is in the preparatory phase will examin the efficiency of various methods of catching pelagic fishes. It is expected that the result of this project may provide us more information on these resources.

JAPAN

In recent years, the Japanese longline fleet in the Indian Ocean has concentrated in the tropical waters of the western Indian Ocean for bigeye tuna by employing deep longline gear and in the higher latitudes (south of 35°S) targeting exclusively for southern bluefin tuna. The tuna catches in 1984 were 13,500 t for bigeye tuna, 7,500 t for yellowfin tuna and 1,600 t for albacore. The overall catch of southern bluefin tuna, including those of other oceans, was about 25,000 t in 1983. Since 1971, Japanese fishermen have been under a voluntary regulatory measure of seasonal closure of the area where younger fish are abundant. In addition, Japan decided to introduce an annual catch quota of 23,150 t for 1986. Purse seine fishing on an exploratory basis has been conducted by one purse seiner since 1978. In 1984, it operated in the western tropical Indian Ocean.

Catch and effort and size sampling data of longline fishery have been collected continuously, and the Far Seas Fisheries Research Laboratory (FSRFL) has been in charge of processing and compilation of these data. In 1984, the timeliness of the logbook reporting system was improved on by requesting the fishermen to submit catch records at every port of call instead of submitting them after the completion of a trip. The coverage rate of logbook data has been more than 90 percent in recent years. Size sampling has been made at unloading sites and some longline boats have made voluntarily on board size measurement. The FSFRL presented six working documents for this meeting as to research on albacore, yellowfin and bigeye tunas.

KENYA

Kenya's history with tuna fishing dates back to 1971 when Korean longliners began trans-shipping their catch through Kenya Fishing Industries Ltd (KFI), at Mombasa. The number of vessels calling at KFI increased from two in 1972 to five in 1974. The catch was increasing proportionally to the number of vessels, from 3,981 t in 1971 to 7,810 t in 1974.

In 1975, 1,918 t were trans-shipped in Mombasa. The decline was attributed to reduced calling frequency. This is also the time when longliners which had been recently acquired from Japan began effective operations. From 1976 onwards, the catch declined as compared to the early seventies. The Korean fleet made almost no landings. The KFI was left with two vessels with local crew whose experience, unfortunately, did not match the Koreans.

The major species landed from Kenyan waters include bigeye, skipjack, yellowfin, black marlin, sailfish, swordfish, blue marlin and stripped marlin. The yearly landings (in tons) from 1971 to 1983 are given in the Table below.

Yearly landings of tuna at Mombasa 1971 - 84

Year	Landings	Vessels
1971	3 981	2
1972	7 516	4
1973	6 941	4
1974	7 180	5
1975	1 918	5
1976	111	2
1977	155	2
1978	120	2
1979	63	2
1980	378	2
1981	613	2
1982	570	2
1983	688	2
1984		5

In 1984, there was no commercial tuna fishing activity, except from sports fishing clubs, whose contribution to the catch of tuna and tuna-like fish is minimal.

The two Kenyan longliners remained active up to the end of 1983. However, negotiations with donor agencies leading to a resumption of commercial tuna fishing operations are in progress.

REPUBLIC OF KOREA

The Korean deep-sea fishery initiated an experimental tuna longline fishing programme in the eastern part of the Indian Ocean in 1957. From the early seventies the commercial vessels began to extend their fishing grounds to the west for yellowfin and bigeye as main target fishes and most of the vessels have used the deep-longline gear in recent years.

The total catch of tunas and related fishes from the Indian ocean showed a peak of 71,000 t in 1978 and then decreased to 37,000 t in 1983. This is due to the reduction of fishing effort with the economic difficulties and the conversion of the vessels to gill net fishery for squid in the North Pacific.

All the data for scientific purposes have been collected by the Fisheries Research and Development Agency (FRPA). An annual bulletin on catch and effort data by five degree squares for the 1975 - 1980 period has already been published and the FRPA is now preparing the bulletin for 1981 and 1982. The length frequency data for yellowfin and bigeye by the Korean longline fishery from 1978 to 1982 were compiled by FAO major fishing areas. Those data will be available soon for future scientific analysis.

REPUBLIC OF MALDIVES

The tuna fishery in the Maldives has been of major importance for hundreds, if not thousands of years. Tuna accounts for nearly 90 percent of the total fish catch. Most tuna are taken by live bait pole and line vessels, although trolling is also important. The active pole and line fleet has been almost entirely mechanized since the mid seventies. During the period 1970 to 1983 the annual tuna catch varied within the range 20-33,000 t. The total recorded tuna catch in 1984 was 44,000 t. The major tuna species caught are skipjack (average of about 60 percent of total fish catch), yellowfin (13 percent), frigate tuna (10 percent) and little tuna (3 percent). The Republic of Maldives has a total enumeration system for the collection of catch and effort statistics, covering all of the 200 inhabited islands. Research on tuna biology and stock assessment has been started on a small scale by the Marine Research Section of the Ministry of Fisheries.

MAURITIUS

The tuna fishery in Mauritius first started in 1965 by the trans-shipment of tunas by longliners from the far eastern countries. In 1979 a purse seiner was acquired by a Mauritian-Japanese private joint venture and which captures about 4,000 t annually (mainly yellowfin and skipjack). The sport fishery contributes to about 20% of fresh tuna, mainly billfish, landings annually of the total catches of fresh fish. Moreover, fishing around FADS is presently being tried in the waters around Mauritius.

The government is trying to increase incentives to attract more longliners for the trans-shipment of tunas and the private company is seriously contemplating the acquisition of a second purse seiner. Licensing of all vessels operating in the contry's EEZ is also one of the main preoccupations of the government.

MOZAMBIQUE

Seven long-liners operated in Mozambican waters from January to March 1984; two Japanese and five Soviet. These boats were engaged in this activity under licences for experimental long-line tuna fishing in simulated commercial regime. The main objectives for this licencing were to permit foreign ship owners to study with their own fleets the feasibility of this fishery in the Mozambican EEZ, and, to allow the Mozambican fisheries authorities to study the characteristics and rational management of the resource.

An average yield of 2.3 t of total catch per set and 1.9 t of tunas per set was obtained by the Japanese fleet (83 sets), the yellowfin contributed with 75 percent of total catch in weight.

Judging from the results of the Japanese long-liners it is possible to conclude that for the first quarter of the year the operation of long-line fleets with similar characteristics can be very successful.

During the experimental pole and line programme, seventeen trips were conducted (302 days at sea); it began in September 1983 and terminated in April 1985. The whole of the Mozambican coast was covered by the test-fishing carried out. Some important fishing grounds were localized. The mean catch of tuna per kg. of baitfish was 51.3 kg. The main conclusions can be summarized as follows:

- Tuna resources along the Mozambique coast are adequate to support a commercial pole and line fishery.
- In the northern zone, pole and line fishing can be practiced throughout the year. In the southern zone, fishing can be practiced from November to April.
- Along the entire coast, skipjack is the dominant species.
- Baitfishing conditions are sufficient to support a pole and line fishery.

Commercial Licences:

- For pole and line and for long line, the Mozambican fisheries authorities are open to sell licences to foreign fleets on a commercial basis.
- For purse-seining the Mozambique fisheries authorities are open to grant short period experimental commercial fishery licences (up to six months) free of charge. The only condition that shipowners are requested to observe is to submit all the information requested by the Fishery Research Institute.
- In 1986 between two and five Japanese long liners are expected to operate in the Mozambican EEZ during a part of the year at least.

Future Expected Research:

- For 1986, a one year FAO project is proposed for a trial fishery with small boats: ± 8 m in the northern (Pemba coast) and ± 14 m in the southern zone (Maputo coast).
- From 1987 until 1989 another project is proposed to be carried out through FAO. The main objectives of this project are to follow up the experimental fishery with pole and line:

a) in the northern zone - with artisanal boats (± 8m)
in the southern zone - with 1/2 industrial boats (± 22m)

b) introduce new fishing gears

- Concerning purse seine the Mozambican fisheries authorities are quite interested in participating in and/or promoting an experimental fishery programme. At the moment they are looking for founders and suitable counterparts.

OMAN

The major part of the artisanal fishery in Oman is targeting on small tunas and seerfishes. The most common species are longtail tuna and king mackerel followed by yellowfin kawakawa, skipjack and frigate tuna. No precise information on catches by species is available but it is considered that total catches amounted to 9,000 t in the years 1976 - 1978. Fishing is carried out mostly by trolling for the larger species and with gill nets for seerfishes. Fishing is confined largely to coastal areas. A port sampling survey is now being conducted and some details on the composition of tuna catch by species may be available in the near future.

PAKISTAN

In Pakistan no significant headway regarding tuna fisheries development could be made so far. Although no specific boats designed for catching tuna are operating in Pakistani waters, as a result of incidental catch, comprising of a yearly average of 8-10,000 t of tuna the following species are caught by gillnetters meant for shrimping in the coastal waters: Kawakawa (Euthynus affinis), Skipjack (Katsuwonus pelamis), Seerfish (Scomberomorus spp), Swordfish (Xiphias gladius), Billfishes (Istiophoridae)

A U.S. AID technical study report reveals that tuna enter the Persian Gulf mouth area during the cooler part of the year but go out again into the Gulf of Oman when the Persian Gulf warms up, this has been further substantiated by the native fishery for tuna on the southern coast of the straits of Hormuz along the Oman Gulf. The US AID further indicates that substantial stocks of tuna move from equatorial regions into the Arabian Sea and the Gulf of Oman north of 15^0 N, begining in October and increasing in volume through the winter months. The best fishing period is from November through March, although good fishing may continue up to June in some areas which are favourably affected by the process of upwellings. The data further indicated that no tuna will be available during the months of July, August and September at north of 10^0 N. and Karachi based vessels will have to operate in the equatorial region during these months, about 800 - 1,200 miles away from Karachi. According to the report, although oceanographic conditions in the northern area of the Arabian Sea were favourable for purse-seining, in view of the high cost involved in construction and outfitting of purse-seiners, it was considered unwise to adopt this untried method at the initial stage of planning. The report, however, recommended a live bait fishery because of the availability of plenty of sardinella as incidental catch during shrimping. Presently the sardinella have no commercial utility except for reduction to fish meal.

SEYCHELLES

Between 1983 and 1984 the Seychelles Government signed fishing agreements with the European Economic Community (EEC), France, Spain, Ivory Coast and two private companies granting the right for purse seiners in Seychelles waters. In 1984 these purse seiners trans-shipped a total of 97,000 t of tuna in Port Victoria (55 percent yellowfin, 43 percent skipjack).

Some of these vessels have since returned to the Atlantic Ocean and in October 1985 the number of purse seiners still active in Seychelles waters seems to have stabilized at around 38 of which the flags are as follows: 22 French, 12 Spanish, 1 Ivorian, 1 Panama registered, 1 UK registered. The total catch so far this year (to October 1985) stood at slightly over 100,000 t and if present catch rates are sustained (25 t/day) it could reach around 130,000 t.

The Seychelles also granted licences to Republic of Korea longliners although the number of licensed boats declined drastically in recent years. The Seychelles own longliner, the Seykor last year landed a total of 312 t of tuna to be trans-shipped to Japan.

In addition Seychelles has a small artisanal tuna fishery operating mostly with handlines and trolls. Last year about 500 t of tuna and tuna-like species were landed by the artisanal fleet, mostly destined for local consumption.

SOMALIA

Ten Japanese longliners operating along the east coast of Somalia have been licensed. Their total catch for the period February-March 1983 was 1,047 t, of which 723 t consisted of tuna, mainly bigeye, and 314 t of marlin and swordfish. Only six vessels continued operation in January 1984, and reported a catch of 173 t. In February, the catch was 246 t.

During 1983, fishing operations were carried out between latitudes 4°N, fairly close to the coast. During 1984, fishing was done in the area bounded by latitudes 2°N and 3°N and longitudes 49°E and 50°E.

Eighteen licences were granted to Korean vessels in 1983, but only 10 vessels operated in Somali waters. The catch was 1,390 t. Recently, longliners from Singapore and Japan were granted licences, but data on their catches have not yet been made available.

The catch of tuna landed by the artisanal fishermen is minimal.

SPAIN

Spanish industrial tuna fishing in the Indian Ocean started in February 1984. The fleet is composed of 16 freezer purse seiners having a capacity which fluctuates between 800 and 1,200 t.

The fleet caught 22,901 t in 1984 of which the specific composition was as follows: 60.2 percent yellowfin, 35.3 percent skipjack, 3.5 percent bigeye and 1 percent albacore.

October and November were the months when catches were higher, reaching 34.6 t searching day.

During the flotsam fishing season (from September to November) a very high rate of mixing of species (small yellowfin and bigeye of less than 5 kg, mixed with skipjack) was found in the catches.

SRI LANKA

Tuna production in Sri Lanka increased from 21,990 mt in 1979 to 32,370 mt in 1983, with a peak of 34,115 MT in 1982. Recent catches comprised 35 - 45 percent skipjack, 23 - 28 percent yellowfin and 29 - 37 percent of smaller tuna, notably Eastern little tuna and Auxis species. Over 95 percent of the production came from mechanised crafts, with the 9 metre 3.5 GT class of boats, numbering 2,700 to 3,000, constituting the major fishing fleet exploiting tunas. In the multispecies, multigear tuna fisheries, 72 percent, 17 percent, 3 percent, and 8 percent of the effort is applied through gill net (drift-gill net), troll line, pole and line and longline respectively.

Tuna fisheries in Sri Lanka have been generally confined to the coastal zone, an area extending up to 25 miles and to the fringes of the off-shore. Tuna resources within this zone are considered to be heavily fished, although some increases can be expected through increased effort by seasonally effective gear such as pole and line. The most recent attempt to extend tuna fisheries to the off-shore has been through the introduction of 11 metre combination gillnet/longline boats. Forty boats have been introduced during the period 1982 to 1984. Research on tuna fisheries commenced in 1982, after a break of nearly ten years. Although the coverage at present is limited to southern and western coasts, these areas contribute nearly 75 percent of the tuna landed in the country.

TANZANIA

Tuna landings in Tanzania are estimated to contribute four percent to the total catch from marine waters. From 1979 to 1984 tuna landings have shown a decline, the reason being mainly the recession which has resulted in a shortages of gillnets. However, with the improving economic situation the chances of higher catches in the future are brighter. The highest tuna catch recorded so far was 2,728.7 t in 1977. Most of the tuna fisheries are carried out by artisanal fishermen. There have been some surveys undertaken in this region. The early surveys were carried out by Japanese longliners in the early sixties. These were followed by surveys by the East African Marine Fisheries Research Organization. These surveys covered aspects of taxonomy and stock assessment of commercially important species mainly tuna. Also sighting surveys have been conducted in the southern part of Tanzania and have shown encouraging results.

THAILAND

A distinct development of the pelagic fishery in Thai waters has been observed since 1973, the decline in demersal fish stock provided more incentives for Thai fishermen to enter the pelagic fishery. The total marine catch reached 290,000 t in 1973 and declined until 1981, then again rose to over 300,000 tons in 1973 and declined until 1981, then again rose to over 300,000 tons in 1982 and 1983.

In the early period, tunas were a relatively minor fishery in Thailand, the total catch during the period 1971 to 1983 varied from 1,800 to 9,600 tons. It showed an increasing trend with fluctuation in some years and reached the peak of 9,646 tons in 1982. The annual catch of longtail tuna also showed this trend as the total tuna catch, increased from 1,920 tons in 1979 to 7,110 tons in 1982.

Tuna species are caught incidentally all year round, but catches reach a peak during the Northeast monsoon. Purse seines have been found to be the most efficient gear for catching tunas.

The potential yield for longtail tuna and small tuna are roughly estimated to be not less than 5,500 and 1,100 t. respectively.

Since 1965, several exploratory surveys and an experimental longline fishing programme have been launched in the Andaman Sea by the R/V Fishery Research No. 2 under the supervision of the Department of Fisheries of Thailand. The purpose of the survey was to obtain information on the feasibility of tuna fishing in the oceanic area due to the rapid growth of the marine fishing industry. The results showed some promise for the development of a commercial longline fishery for yellowfin as well a fishery for coastal tuna (longtail, kawakawa and frigate tuna) using purse seines.

YEMEN ARAB REPUBLIC

Seerfishes are an important component of the total fishery of this country. Total catches were estimated to be 2,788 t in 1983, mostly caught by gill net fisheries. Catches of tuna estimated at 724 t during the same year are often caught by hand line and troll line with the more common species being kawakawa and longtail tuna.

UNITED ARAB EMIRATES

Catches of small tuna and seerfishes were estimated at 11,000 t in 1983 according to FAO statistics; this included 6,000 t of seerfishes and 5,000 tons of small tunas. The absence of systematic sampling makes difficult any estimate of real catches, however, major species caught are the kawakawa, longtail tuna and king mackerel. Although rather common the Indo-Pacific king mackerel is reported to be less abundant. Troll and gill net are the major gears used.

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