Executive Summary Of The Status Of The Skipjack Tuna Resource

(from IOTC-2004-SC-R [EN])

BIOLOGY

Skipjack tuna (*Katsuwonus pelamis*) is a cosmopolitan species forming schools in the tropical and subtropical waters of the three oceans. It generally makes large mixed schools in association with other tunas having a similar size as juveniles of yellowfin and bigeye. This is specially the case with FADs associated schools exploited by the purse seine fishery where skipjack is largely dominant (60-70% of the total catch).

The skipjack tuna resource exhibits characteristics that result in a higher productivity when compared to other tuna species. This species has a short lifespan, and they are exploited during a short period (probably less than 3 years). The species shows high fecundity and spawns opportunistically throughout the year in the whole interequatorial Indian Ocean (north of 20°S, with surface temperature greater than 24°C) when conditions are favorable. As the size at first maturity is about 41-43 cm for both males and females for skipjack, the bulk of their catch is made on fishes that have already spawn.

Although three documents were presented on the skipjack growth, it is still uncertain, mainly because its apparent seasonal and geographical variability . However it seems to be closer to the Atlantic estimates than those from the Pacific Ocean. Consequently, it is still a priority to gain more knowledge on the skipjack time-and-space variability in growth patterns.

In the absence of any stock structure estimate, a single Indian Ocean stock is assumed. However, it appears to be less migratory than the other tunas; taking into account the biological characteristics of this species and the different areas where fishing takes place, smaller management units could be considered.

Because of these characteristics, skipjack tuna resources are considered to be resilient stocks which are not easily over fished.

FISHERIES

Catches increased slowly from the 1950s, reaching some 50,000 t at the end of the 1970s, mainly caught by baitboats and gillnets. The catches increased rapidly with the arrival of the purse seiners in the early 1980s, to become the most important tuna species in the Indian Ocean catches since 1999 with catches exceeding 400,000 t yearly (*Figure 1 and Table 1*).

Skipjack catches peaked in 2002 at 563,000 t: 246,000 t from the main purse-seine fishery, 114,000 t for the Maldivian baitboat fishery and 203,000 t for the other fisheries. The increase in 2002, relative to the previous year, was observed at least for both the purse seine (mainly due to a larger catch on FADs) and the Maldivian baitboat (essentially from an increase in CPUE) fisheries. Catches in 2003 (548,000 t) were similar to those in 2002

In recent years, skipjack catches were shared in similar proportions between the industrial purse seine fishery and the different artisanal ones (baitboat, gillnets and others), the majority of this catch originating in the western Indian Ocean (*Figure 1*). In general, there is low inter-annual variability when compared with similar fisheries in other oceans.

The increase of skipjack catches by purse seine fisheries is related to the development of a fishery in association with Fish Aggregating Devices (FAD); currently, 80% of the skipjack tuna caught by purse-seine is taken under FADs. Catch rates by purse seiners show an increasing trend (*Figure 3 and 5*) possibly due to an increase in fishing power and to an increase in the number of FADs (and the technology associated with them) in the fishery.

The Maldivian fishery has increased regularly its effort with the mechanization of its pole and line since 1974, and then the use of anchored FADs since 1981. Skipjack represents some 75% of its total catch, and catch rates have regularly increased since the beginning of the 80s (*Figure 4*).

Little information is available on the gillnet fisheries (mainly from Sri Lanka, Iran, Pakistan, India and Indonesia) which take around 30 to 40 % of the total catch of skipjack .

The average size of skipjack caught in the Indian Ocean remains relatively large (greater than in the Atlantic, but lower than in the Pacific) with 2.5 kg for purse-seine, 3.0 kg for the Maldivian baitboats and 4-5 kg for the gillnet (Figure 5).

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

No new assessment of skipjack was undertaken during 2004 therefore the current stock status is based on the assessment undertaken in 2003.

The assessment of skipjack tuna was a priority for the WPTT in 2003. The group analyzed the information available for stock assessment and considered that there were large uncertainties in the information needed to conduct a complete assessment of the Indian Ocean skipjack tuna. As an alternative, the group decided to analyze different fishery indicators that provide a general understanding of the estate of the stock.

1. **Trends in catches**: The trend in catches indicate a large and continuous increase in the catches of skipjack tuna since the mid-1980's (*Figure 1*), particularly due to an expansion of the FAD-associated fishery in the western Indian Ocean. There is no sign that the rate of increase is diminishing in recent years.
2. **Nominal CPUE Trends:** *Figure 3* shows the nominal CPUE trends of the purse seine fishery for three major areas: Somalia area, Western Seychelles area and Mozambique Channel. In the Somalia and Western Seychelles area catches have been increasing recently. In each of these areas, with the exception of west Seychelles in 2002 the nominal CPUE has been relatively stable since the late 1980's. Since this is a period during which is believed that effective purse-seine effort has increased substantially it is likely that the true abundance in these areas has decreased. In itself, this is not unexpected given the large increase in catches over that period. However, as these areas may be source of skipjack recruitment to the Maldives artisanal fishery, there is the potential for an interaction to be occurring between these fisheries.
3. **Average weight in the catch by fisheries:** The Working Party noted that the average weights of the skipjack taken from various areas have been more or less the same since 1991 (*Figure 6*). Figure 5 shows catches at size expressed as average weight from three major gears; purse seine, baitboat and gillnet. The purse seine and the baitboat fisheries take the greatest catch around 40-50 cm while catches taken from gillnet fisheries ranges from 70-80 cm.
4. **Number of squares fished:** The trend in the number of one-degree squares visited and with catches of skipjack tuna by the main purse-seine fleets suggests that, after the late 1990's, the spatial distribution of the main purse-seine has remained at the same average level. In 1998, a particularly strong El Niño episode resulted in a much wider spatial distribution of the catches.

Length-based cohort analyses. The WPTT did not develop a formal stock assessment for skipjack tuna. However, a length-based cohort analysis was carried during the meeting to analyze skipjack catches and length frequencies (*Figure 7*). The recent period is characterized by a dramatic increase of catches of smaller size fish due to the development of the purse seine FAD fishery and the largest mode reflects the artisanal (essentially Maldives's pole-and-line) fishery.

The fishing pattern is shown in *Figure 8*. They reflect the evolution of the fishery and in particular the increased mortality on both purse seine and the artisanal components. In particular they represent increase of purse seine fishery in the eighties and of the FAD fishery in the nineties.

Interaction between fisheries and species. A potential problem in the skipjack fisheries is the interaction between industrial and artisanal fisheries, and more particularly between the western Indian Ocean purse-seine fishery and the Maldivian baitboat fishery.

Large numbers of juvenile bigeye and yellowfin tuna are caught in the course of purse-seine sets on FADs that target skipjack tuna.

SKIPJACK TAGGING AND IOTTP

The analysis of skipjack tuna stock status conducted by the WPTT reinforce the previous recommendation that only the results of the large scale tagging programme planned by the IOTC will allow to estimate for skipjack tuna:

- stock structure,
- variability of growth in time and space,
- natural mortality at age,
- stock size,
- as well as the potential interactions between skipjack tuna fisheries.

Subsequently, the Scientific Committee recommended to fully incorporate skipjack tuna in the tagging operations that will be planned for the incoming large scale IOTTP tagging programme

STOCK ASSESSMENT

The Scientific Committee recognized that, in spite of not having a full stock assessment for skipjack, the analysis of the stock status indicators provided by the WPTT does not show reasons for immediate concern.

The SC noted two additional arguments in favour of this conclusion. First, in most fisheries, declining catches combined with increasing effort are usually indicators that a stock is being exploited close or above its MSY. In the case of skipjack tuna, catches have continued to increase as effort increased. Second, the majority of the catch comes from fish that is already sexually mature (greater than 40 cm), as the fishing pattern by size indicates.

The SC noted that, although there might be no reason for immediate concern, it is clear that the catches cannot be increased at the current rate indefinitely. Therefore, it recommends that the situation be monitored closely and be reviewed in the WPTT.

MANAGEMENT ADVICE

The Working Party on Tropical Tunas has not made any specific management recommendations for the skipjack stock. However, the life history characteristics of skipjack tuna, the information presented in the documents reviewed, and the information in the stock status indicators prepared during the meeting suggests that there is no need for immediate concern about the status of skipjack tuna.

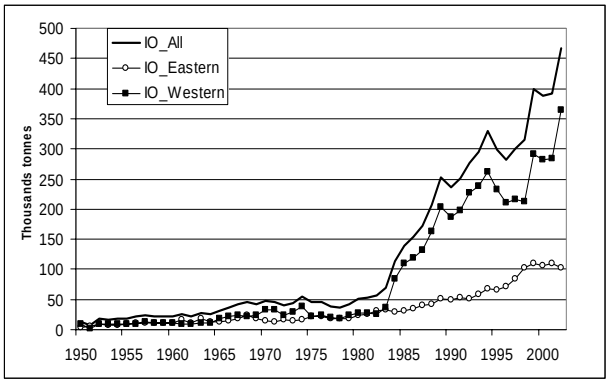
SKIPJACK TUNA SUMMARY

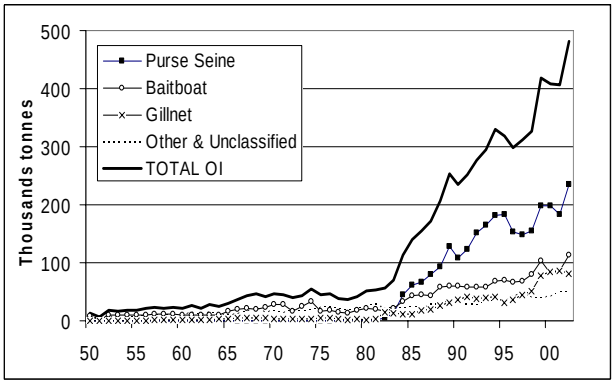
Maximum Sustainable Yield :	unknown
Current (2003) Catch:	548,000 t
Mean catch over the last 5 years	523,000 t
Current Replacement Yield :	-
Relative Biomass (B_{cur}/B_{MSY}) :	unknown
Relative Fishing Mortality (F_{cur}/F_{MSY}):	unknown
Management Measures in Effect :	none

Table 1. Catches of skipjack tuna by gear and main fleets for the period 1954-2003 (in thousands of tonnes). Data as of 20 November 2004.

Gear	Fleet	Av99/03	Av54/03	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78
Purse seine	Indonesia	8.6	2.4																					0.3	0.5	0.7	0.9	0.9
	Japan	2.4	3.4																								0.1	0.9
	Other Fleets	5.1	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	215.0	60.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.7	1.0	1.8
Baitboat	Maldives	97.1	36.1	9.0	9.0	9.0	10.0	10.0	10.0	9.0	8.0	8.0	8.0	8.0	14.1	16.9	18.9	17.5	19.6	27.6	28.0	17.5	19.5	22.5	14.9	18.6	13.7	13.2
	Other Fleets	4.8	3.1	1.6	1.6	1.7	1.6	1.7	1.6	1.6	2.1	2.1	2.2	2.3	2.6	2.8	2.7	2.9	3.1	0.3	0.0	0.4	5.0	10.9	2.2	0.1	0.6	0.8
	Total	101.9	39.1	10.6	10.6	10.7	11.6	11.7	11.6	10.6	10.1	10.1	10.2	10.3	16.7	19.7	21.6	20.4	22.7	27.9	28.0	17.9	24.6	33.4	17.1	18.7	14.3	14.0
Longline	Total	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Gillnet	Sri Lanka	71.4	20.4	1.1	1.0	1.3	1.6	1.7	1.9	2.4	2.9	4.5	6.0	5.8	5.5	6.3	7.0	7.9	8.8	6.9	5.0	8.8	10.5	9.3	7.2	12.6	12.5	14.7
	Indonesia	67.5	25.5	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.4	1.4	1.5	1.6	1.8	1.9	1.8	1.9	2.1	3.8	4.0	6.3	6.9	8.9	16.4	20.8	28.2	22.0
	Pakistan	3.9	3.6	0.8	0.8	0.7	1.9	0.9	0.9	1.2	1.0	1.6	2.4	3.4	3.6	4.9	4.7	4.7	4.3	3.9	3.2	3.8	3.0	4.1	4.5	4.2	3.8	2.2
	Other Fleets	0.7	1.7	0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.4	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.8	0.8	3.2	1.0	1.3	2.5	1.5	2.1
	Total	166.5	54.3	3.0	3.0	3.3	4.7	4.0	4.1	4.9	5.8	7.7	10.1	10.9	11.1	13.2	13.8	14.8	15.3	15.0	12.9	19.6	23.5	23.3	29.4	40.3	46.1	40.9
Line	Indonesia	35.8	12.6	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	1.1	1.2	1.7	1.9	2.6	5.2	6.6	1.1	0.9
	Other Fleets	4.0	3.1	0.3	0.4	0.4	0.4	0.4	0.5	0.6	0.7	1.0	1.3	1.2	1.2	1.4	1.5	1.8	1.9	3.1	2.7	3.0	3.5	3.4	3.4	4.6	4.1	4.1
	Total	39.8	15.7	0.5	0.6	0.6	0.6	0.6	0.7	0.8	0.9	1.2	1.5	1.5	1.5	1.7	1.9	2.1	2.3	4.2	3.9	4.7	5.4	6.0	8.6	11.2	5.3	5.0
All	Total	523.2	169.1	14.1	14.2	14.7	16.9	16.3	16.3	16.3	16.8	19.0	21.9	22.9	29.3	34.6	37.3	37.3	40.4	47.2	45.0	42.5	53.5	63.1	55.6	70.8	66.6	61.8

Gear	Fleet	Av99/03	Av54/03	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03
Purse seine	Spain	80.3	21.7						6.4	18.6	19.1	27.9	39.7	63.9	47.9	41.8	46.7	51.3	61.6	69.6	66.3	62.9	58.6	74.3	79.4	68.5	91.3	88.0
	France	42.4	16.0			0.2	1.0	9.4	27.3	29.8	36.1	35.6	36.1	43.1	29.0	39.4	45.0	48.2	58.4	48.7	40.1	31.3	30.3	42.7	39.9	36.3	54.4	38.9
	NEI-Other	32.0	7.5					0.4	8.2	8.4	6.4	4.8	7.0	7.9	11.0	10.8	10.8	17.4	24.5	22.3	18.4	24.3	31.2	33.4	40.8	26.5	31.9	27.5
	Seychelles	24.1	2.8													1.8	0.6					4.9	10.7	15.8	11.6	26.2	29.9	36.8
	NEI-Ex-Soviet Union	20.1	3.7												0.7		10.1	8.7	8.2	20.6	16.4	11.6	10.2	17.3	19.8	21.1	21.0	21.0
	Indonesia	8.6	2.4	1.0	1.1	1.1	1.4	1.9	1.2	2.5	2.7	2.7	2.9	2.9	3.0	1.5	3.7	6.3	7.3	7.1	8.2	8.8	8.4	8.9	9.2	8.8	7.8	8.1
	Japan	2.4	3.4	0.6	0.4	0.1	0.5	0.6	0.7	0.3	0.6	0.9	2.3	3.4	10.9	15.9	31.7	31.4	20.1	16.1	7.0	6.7	5.7	4.6	2.3	1.8	1.9	1.5
	Other Fleets	5.1	2.5	0.1	1.1	1.8	2.7	1.5	3.1	3.2	4.4	9.9	7.8	8.3	8.8	13.1	6.4	7.1	6.3	3.9	2.7	4.0	3.2	5.1	3.0	9.3	8.1	
	Total	215.0	60.0	1.6	2.5	3.1	5.6	13.7	46.9	62.9	69.3	81.7	95.7	129.6	111.3	124.3	155.1	170.2	186.4	188.2	159.1	154.6	158.4	202.2	206.1	198.4	246.4	221.8
Baitboat	Maldives	97.1	36.1	17.3	22.2	19.6	15.3	19.3	32.3	42.2	45.1	42.6	58.2	57.8	60.7	58.3	57.6	58.0	69.0	69.9	66.2	68.1	77.8	92.3	78.8	86.8	113.9	113.9
	Other Fleets	4.8	3.1	0.4	0.0	0.2	1.3	1.2	1.0	1.0	1.1	1.3	1.8	1.4	1.8	6.9	7.3	14.2	6.8	7.4	7.4	8.7	4.3	7.2	7.5	2.7	3.2	3.2
	Total	101.9	39.1	17.6	22.2	19.9	16.6	20.5	33.3	43.2	46.2	43.9	60.0	59.2	62.5	65.2	64.9	72.2	75.8	77.3	73.6	76.8	82.1	99.5	86.3	89.5	117.0	117.0
Longline	Total	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Gillnet	Sri Lanka	71.4	20.4	12.2	16.2	18.2	17.8	16.2	13.2	14.8	14.5	15.2	15.8	17.3	20.4	23.0	26.9	31.4	38.7	40.3	47.0	55.8	56.7	72.2	73.0	68.1	73.9	69.8
	Indonesia	67.5	25.5	26.7	35.7	40.7	40.9	44.9	49.2	43.9	48.9	27.5	49.1	62.1	44.4	21.1	23.3	25.8	31.5	31.5	37.7	66.6	48.0	51.6	94.5	79.7	60.6	51.1
	Islamic Republic of Iran	22.9	3.0											0.3	0.8	1.1	4.3	4.4	7.4	1.1	2.5	8.3	4.7	13.9	18.5	23.2	23.1	36.0
	Pakistan	3.9	3.6	3.8	1.8	2.7	3.4	1.1	1.2	2.0	1.5	3.7	5.6	7.5	7.6	7.5	6.1	6.9	8.1	7.1	4.4	4.6	4.5	4.9	4.6	3.6	3.3	3.3
	Other Fleets	0.7	1.7	2.8	2.8	2.3	3.3	3.3	4.2	4.4	4.8	6.7	5.6	7.3	6.9	0.6	0.7	1.2	1.2	1.5	1.2	1.6	0.7	0.8	0.9	0.5	0.5	1.0
	Total	166.5	54.3	45.5	56.4	63.9	65.3	65.5	67.8	65.2	69.7	53.2	76.0	94.4	80.1	53.4	61.3	69.6	86.9	81.6	92.8	136.9	114.6	143.3	191.5	175.1	161.4	161.2
Line	Indonesia	35.8	12.6	1.4	1.7	2.5	3.6	3.7	2.8	5.2	1.4	23.6	6.7	4.4	6.2	35.6	26.9	46.4	53.8	49.1	56.6	41.2	50.9	51.6	19.5	30.0	33.8	43.9
	Other Fleets	4.0	3.1	3.8	4.6	5.0	3.3	3.2	3.1	3.2	3.3	3.2	3.4	5.7	6.2	6.3	4.8	4.6	4.5	4.7	4.4	4.8	4.5	3.5	3.9	4.0	4.4	4.2
	Total	39.8	15.7	5.3	6.3	7.5	6.9	6.9	5.9	8.4	4.7	26.8	10.1	10.1	12.4	41.9	31.6	51.0	58.3	53.8	61.0	46.0	55.4	55.1	23.5	34.0	38.1	48.1
Other	Total	0.1	0.0										0.0		0.0	0.0	0.0	0.0	0.0		0.0		0.0		0.0	0.0	0.2	0.2
All	Total	523.2	169.1	70.1	87.5	94.4	94.4	106.7	154.0	179.6	189.9	205.7	241.9	293.4	266.4	284.8	313.0	363.3	407.5	401.0	386.5	414.4	410.6	500.2	507.4	497.0	563.1	548.3





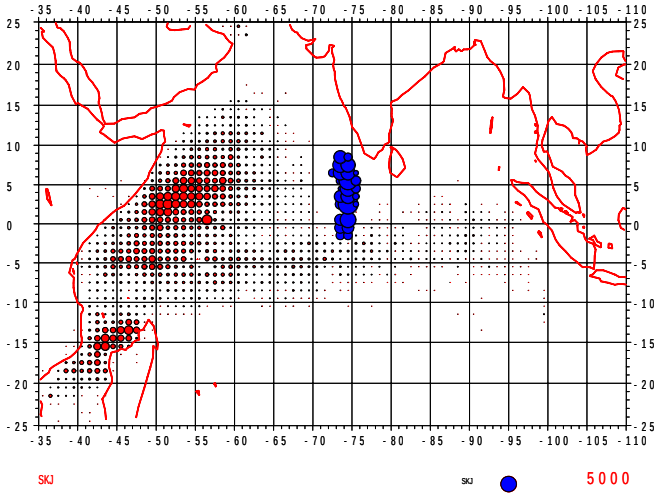


Figure 1. *(a) Yearly catches (thousand of metric tonnes) of skipjack tuna by area (Eastern and Western Indian Ocean, top left) and by gear (top right) from 1950 to 2002 (right). (b) Average spatial distribution of Indian Ocean skipjack catches for 1995—2001 for purse-seine (red/light) and baitboat (blue/dark).*

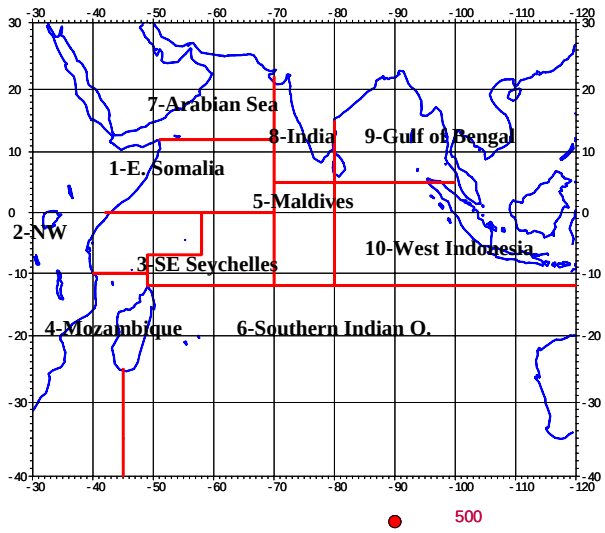
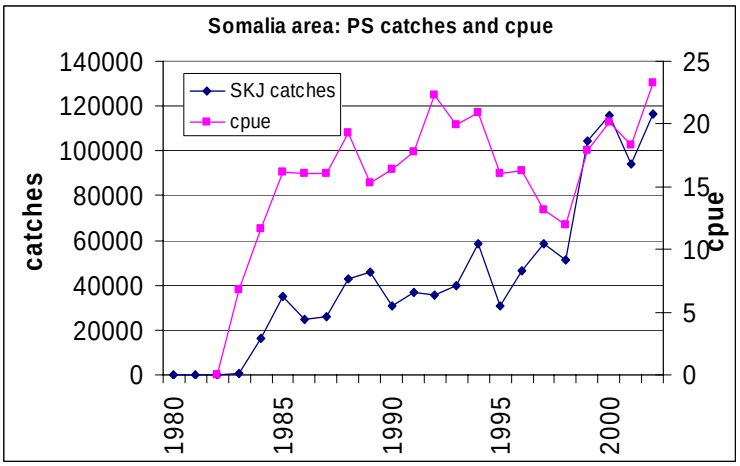
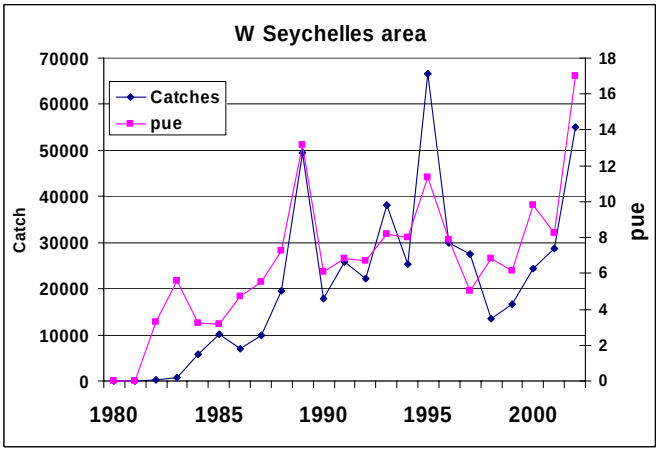


***Figure 2**. Areas used for the calculation of the CPUE trends shown in Figure 4*





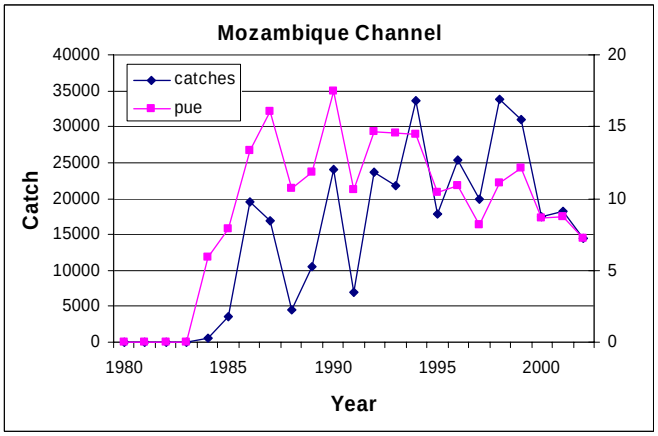


Figure 3. *Nominal CPUEs for three important purse seine fishing ground areas: Somali Basin (top left panel); Mozambique Channel top right panel) and Western Seychelles (bottom panel).*

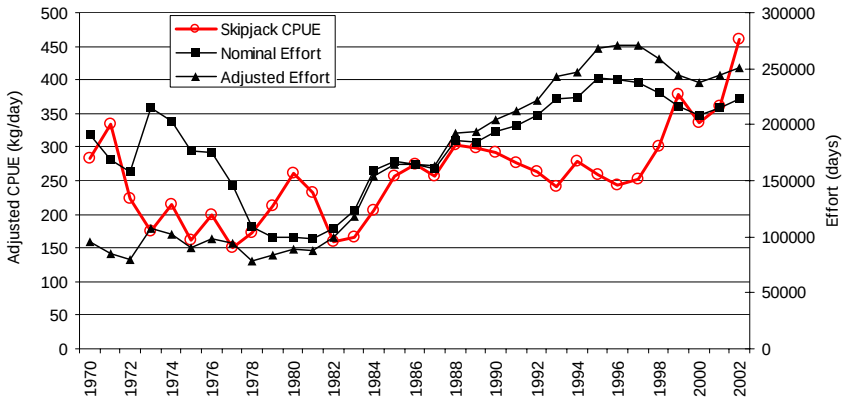


Figure 4. *Time series of Maldives CPUE and the nominal and adjusted effort (WPTT-03-23).*

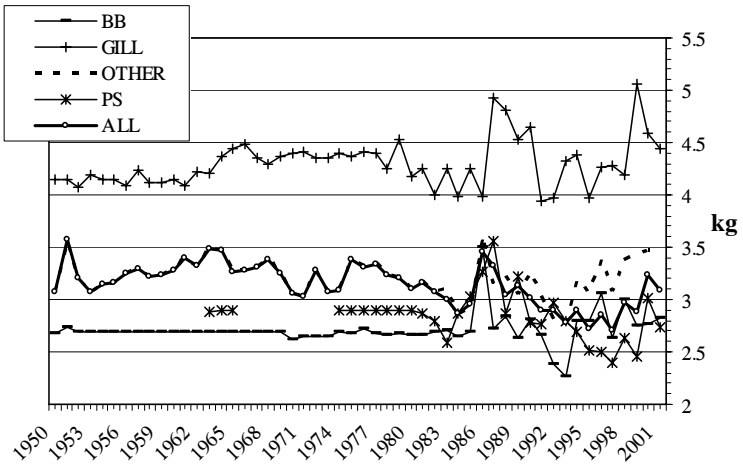


Figure 5. *Skipjack tuna average weight in the catch by gear (from size-frequency data) and for the whole fishery (estimated from the total catch at size).*

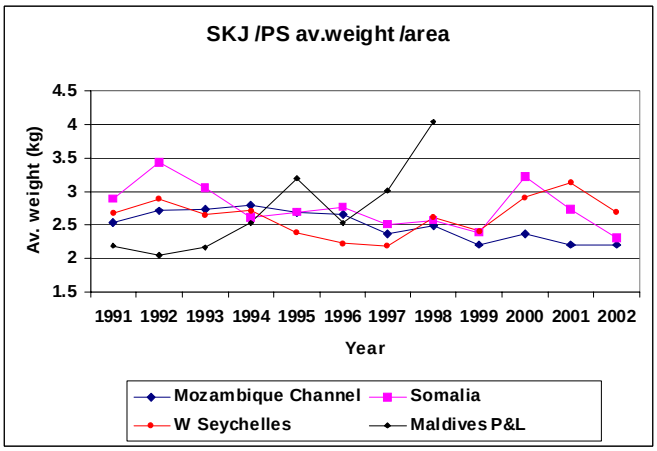


Figure 6. *Time series of average weight of skipjack caught by the purse seine and pole and line by major areas. (1991 - 2002)*

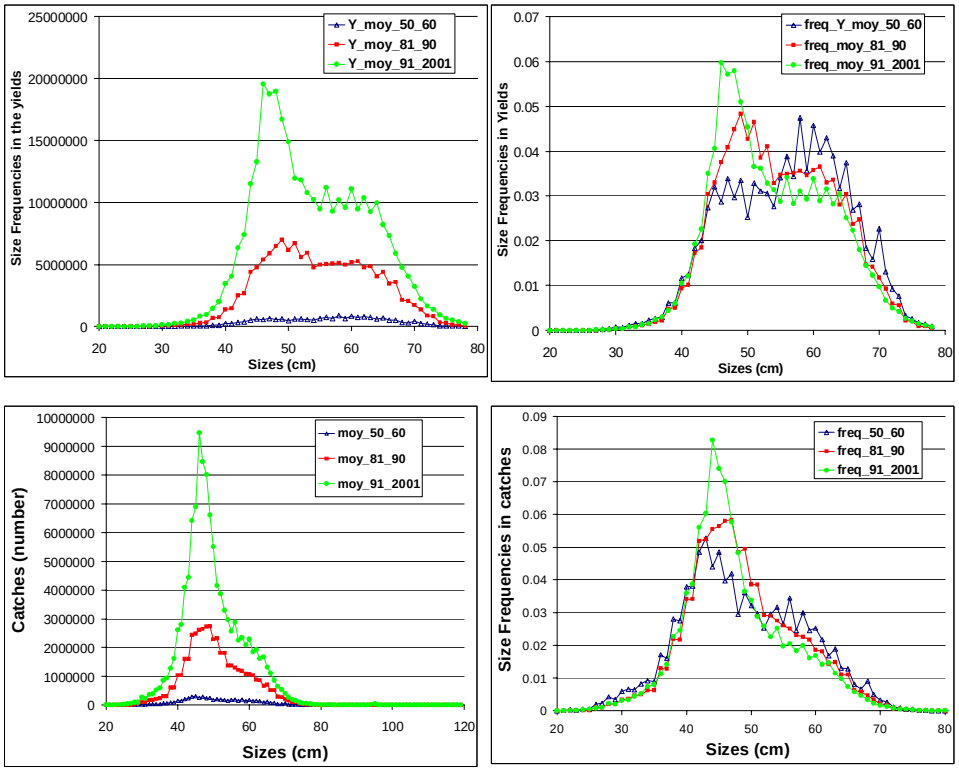


Figure 7. *Size frequencies of the yield (top panels) and catch by numbers (bottom panels) for three time periods: 1950-1960 (green), 1981-1990 (red) and 1991-2001 (blue). Left panels are actual numbers and right panels are in proportions. Note the two modes (40-50 and 55-65 cm) that appear in the yield frequencies but which are less visible in the number frequencies.*

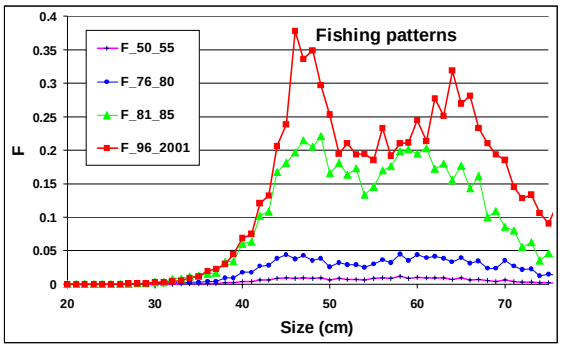


Figure 8*. Estimated fishing mortality by size for four five-year mean periods : (1950-1955, 1976-1980, 1981-1985, and 1996-2001)*