Novembre 2004

iotc ctoi Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien

SEVENTH SESSION OF THE SCIENTIFIC COMMITTEE

MAHÉ, SEYCHELLES, 8-12 NOVEMBER 2004

EXECUTIVE SUMMARY OF THE STATUS OF THE INDIAN OCEAN SWORDFISH RESOURCE

BIOLOGY

Swordfish (*Xiphius gladius*) is a large oceanic apex predator that inhabits all the world's oceans. They are one of the most widely distributed pelagic fish species and in the Indian Ocean range from the northern coastal state coastal waters to 50°S. The species is known to undertake extensive diel vertical migrations, from surface waters during the night to depths of up to 1000 m during the day, in association with movements of the deep scattering layer and cephalopods, their preferred prey. In contrast to tunas, swordfish is not a gregarious species, although the density of this species increases in areas of oceanic fronts and seamounts.

Genetic studies of the stock structure of swordfish in the Indian Ocean have failed to reveal spatial heterogeneity, and for the purposes of stock assessments one pan-ocean stock has been assumed. However, spatial heterogeneity in stock indicators (CPUE trends), indicate the potential for localized depletion of swordfish in the Indian Ocean, suggesting that mixing across the ocean basin may be limited.

As with many species of billfish, swordfish exhibit sexual dimorphism in maximum size, growth rates and size and age at maturity – females reaching larger sizes, growing faster and maturing later than males. Length and age at 50% maturity in SW Indian Ocean swordfish is 170cm (maxillary-fork length = lmf) for females and 120 cm for males. These sizes correspond to ages of 6-7 years and 1-3 years for females and males, respectively.

Swordfish are highly fecund, batch spawners with large females producing many millions of eggs per spawning event. One estimate for Indian Ocean populations suggests that a female swordfish in equatorial waters may spawn as frequently as once every three days over a period of seven months.

The species is also long lived – reaching maximum ages of more than 30 years. However, the species also exhibits phenomenal growth in the first year of life - by one year of age, a swordfish may reach 90 cm (~15 kg). The average size of swordfish taken in Indian Ocean longline fisheries is between 40kg and 80kg (depending on latitude).

The species life history characteristic of relatively late maturity, long life and sexual dimorphism make it vulnerable to over exploitation.

FISHERIES

Swordfish are taken as a target or by-catch of longline fisheries throughout the Indian Ocean, are rarely caught by purse seines, but are thought to be a component of the "unidentified Billfish" catch by Sri Lankan gill net fisheries in the central northern Indian Ocean.

Exploitation of swordfish in the Indian Ocean was first recorded by the Japanese in the early 1950's as a by-catch in their tuna longline fisheries. Over the next thirty years, catches in the Indian Ocean increased slowly as the level

of coastal state and distant water fishing nation longline effort targeted at tunas increased. In the 1990's, exploitation of swordfish, especially in the western Indian Ocean, increased markedly, peaking in 1998 at around 36,000 tonnes (Figures 1 and 2, Table 1). By 2002, twenty countries were reporting catches of swordfish (Figure 3, Table 1). The total catch in 2003 was a little over 32,000 tonnes.

Since the early 1990's China,Taiwan has been the dominant catcher of swordfish in the Indian Ocean (41-60 % of total catch). Taiwanese longliners, particularly in the south western and equatorial western Indian Ocean, target swordfish using shallow longlines at night. The night sets for swordfish contrast with the daytime sets used by the Japanese and Taiwanese longline fleets when targeting tunas.

During the 1990's a number of coastal and island states, notably Australia, La Reunion/France, Seychelles and South Africa have developed longline fisheries targeting swordfish, using monofilament gear and light sticks set at night. This gear achieves significantly higher catch rates than traditional Japanese and Taiwanese longlines. As a result, coastal and island fisheries have rapidly expanded to take over 10,000 tonnes of swordfish per annum in the late 1990's.

STOCK STATUS

Stock assessments of Indian Ocean swordfish stocks are preliminary, and rely heavily on indicators of abundance and stock status such as trends in CPUE and size composition of the catch.

In 2004, the WPB attempted to fit a spatial production model to the available swordfish data. Unfortunately, trial runs did not lead to sensible parameter estimates and there was insufficient time at the meeting to fully explore the model and alternative assumptions, but it was agreed that this approach is worth further consideration.

Consideration of the stock indicators suggest that there has been a marked decline in the stocks of Indian Ocean swordfish since targeting of the species began in the early 1990's. Although there is uncertainty, the indicators and previous assessments suggest that the situation may be more serious in the western Indian Ocean than the eastern Indian Ocean.

The total catches have decreased slightly over the recent five years after reaching a peak of 36,000t in 1998. However, the effective effort (estimated as the catch divided by the standardised Japanese CPUE) has continued to increase over this period. This suggests that the decrease in the catch is not as a result of a reduction in effective effort, but more likely to be as a result of a decrease in the swordfish biomass.

There is a consistent pattern of declines in catch rates in all areas that have been exploited. While the Japanese CPUE indices show more pronounced declines compared to the Taiwanese indices, the severity of the declines appears to be correlated with the magnitude of the catches in the most heavily exploited areas (Figure 5). This pattern is clear when the CPUE's for the eastern Indian Ocean and the western Indian Ocean (which is relatively heavily exploited) are compared (Figure 6)

The standardized CPUE series for the Japanese fleet show relatively large declines since 1990 in several areas: 50% decline in the equatorial western Indian Ocean (Area 3), 90% decline in the south western Indian Ocean (Area 7). There is also evidence of recent declines in Area 4 in the north eastern Indian Ocean (Figure 5). The declines in CPUE in the Japanese series coincide with the timing of large increases in swordfish catches by the Taiwanese and other fleets in the west Indian Ocean areas.

Currently, there is no evidence of any declines in the size-based indices (Figure 7), but the SC recommends that these indices be carefully monitored. Since females mature at a relatively large size, a reduction in the biomass of large animals could potentially have a strong effect on the spawning biomass.

The apparent fidelity of swordfish to particular areas is a matter for concern as this can lead to localised depletion. The spatial structure of the CPUE suggests that there may already be localised depletion of swordfish in the south-west Indian Ocean.

MANAGEMENT ADVICE

On the basis of the stock indicators the SC concluded that the current level of catch (about 32,000 t) is unlikely to be sustainable. Of particular concern are the trends in abundance of swordfish in the western Indian Ocean, where the highest catches are currently taken. The spatial structure of the CPUE suggests that there may already be overfishing of swordfish in the southwest Indian Ocean. However, these reductions in catch rates have not been accompanied by reductions in average size of the fish in the catch, as has been the case in other oceans. The SC expressed concern regarding the very rapid increase in effort targeting swordfish in other areas of the Indian Ocean and the relatively large incidental catch of swordfish in fisheries targeting bigeye. These increases in effort exploiting swordfish have continued since 2000.

The fact that large, rapid increases in fishing effort followed by a reduction in catch rates have been seen in the southwest Indian Ocean indicates that this might also occur in other areas where fishing effort directed to swordfish is increasing rapidly.

The SC recommends that management measures focussed on controlling and/or reducing effort in the fishery targeting swordfish in the southwest Indian Ocean be implemented. Similar measures may be needed in the future if reductions in catch rates are detected in other areas of the Indian Ocean.

SWORDFISH SUMMARY

Maximum Sustainable Yield :	unknown
Current (2003) Catch:	32,000 t
Mean catch over the last 5 years	32,000 t
Current Replacement Yield	-
Relative Biomass (B_{2000}/B_{MSY})	unknown
Relative Fishing Mortality (F_{2000}/F_{MSY})	unknown
Management Measures in Effect	None

Table 1. Catches of swordfish 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
Baitboat	Total	0.0	0.0																	0.0		0.0		0.0	0.0	0.0	0.0	0.0
Longline	China																											
	Taiwan,China	13.7	4.4	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.2	0.2	0.2	0.6	0.8	1.2	0.9	0.9	0.6	1.0	0.9	0.9	0.9	0.6
	Japan	1.4	1.2	0.3	0.5	0.9	0.6	0.7	0.9	1.2	1.3	1.4	1.1	1.3	1.5	1.7	2.2	1.7	1.6	1.2	1.1	0.9	0.8	0.8	0.8	0.4	0.3	0.9
	Indonesia	1.1	0.2																					0.0	0.0	0.0	0.0	0.0
	Republic of Korea	0.0	0.1												0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.1	0.1	0.3	0.5	0.6	0.7	0.8
	Other Fleets	1.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	29.5	8.7	0.3	0.5	1.0	0.7	0.8	1.0	1.3	1.5	1.6	1.4	1.7	1.9	1.9	2.5	2.6	2.6	2.7	2.1	2.0	1.6	2.0	2.3	1.9	1.9	2.4
Gillnet	Sri Lanka	2.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	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	2.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Line	Total	0.0	0.0																	0.0		0.0		0.0	0.0	0.0	0.0	0.0
All	Total	31.7	9.1	0.3	0.5	1.0	0.7	0.8	1.1	1.3	1.5	1.6	1.4	1.7	1.9	2.0	2.5	2.6	2.7	2.7	2.2	2.0	1.6	2.0	2.3	1.9	2.0	2.4

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
Baitboat	Total	0.0	0.0	0.0	0.0																							
Longline	China	0.4	0.1																	0.1	0.2	0.3	0.1	0.4	0.4	0.3	0.4	0.8
	Taiwan,China	13.7	4.4	1.1	1.3	1.1	1.5	1.9	1.7	2.0	3.2	3.8	5.4	4.1	3.8	4.7	9.0	15.3	12.5	18.3	17.6	17.3	16.8	14.7	15.2	12.3	12.9	13.5
	NEI-Deep-freezing	4.0	1.2							0.0	0.2	0.2	0.8	0.6	0.8	0.9	1.5	4.1	3.5	5.3	7.3	5.2	7.8	7.1	6.2	2.9	1.9	1.9
	Spain	2.4	0.3															0.2	0.7	0.0	0.0	0.5	1.4	2.0	1.0	1.9	3.5	3.6
	Australia	1.7	0.2											0.0		0.0	0.0	0.2	0.1	0.1	0.0	0.0	0.3	1.4	1.8	2.9	1.3	1.2
	France-Reunion	1.4	0.3													0.0	0.1	0.3	0.7	0.8	1.3	1.6	2.1	1.9	1.7	1.6	0.8	0.8
	Japan	1.4	1.2	0.6	0.6	0.8	1.0	1.2	1.3	2.2	1.3	1.4	1.5	1.0	1.0	0.9	1.7	1.4	2.6	1.7	2.1	2.8	2.2	1.5	1.6	1.2	1.2	1.2
	Indonesia	1.1	0.2	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.5	0.5	1.0	1.2	1.1	1.3	0.7	0.6	1.3	1.3
	NEI-Fresh Tuna	0.7	0.2											0.5	0.7	0.6	0.7	0.7	1.1	0.8	0.9	1.2	0.9	0.8	0.8	0.4	0.9	0.8
	Seychelles	0.7	0.1																	0.0	0.1	0.2	0.2	0.3	0.5	0.7	0.6	1.4
	Portugal	0.7	0.1																				0.1	0.2	0.2	0.6	0.8	1.6
	Republic of Korea	0.0	0.1	0.6	0.3	0.4	0.3	0.3	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.2	0.1	0.0	0.1	0.0	0.0	0.1
	Other Fleets	1.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.4	0.4	0.5	0.4	0.5	0.3	0.2	0.2	1.2	0.7	0.3	0.6	2.0	2.7
	Total	29.5	8.7	2.3	2.2	2.3	2.8	3.4	3.2	4.2	4.9	5.6	7.9	6.7	7.0	7.8	13.9	23.0	22.2	27.9	30.9	30.7	34.5	32.5	30.3	25.9	27.6	30.9
Gillnet	Sri Lanka	2.3	0.4	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.4	2.0	1.0	1.0	1.1	1.4	1.1	1.2	3.0	2.6	2.9	1.5
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	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	2.3	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.4	2.0	1.0	1.0	1.1	1.4	1.1	1.2	3.0	2.6	2.9	1.5
Line	Total	0.0	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0
All	Total	31.7	9.1	2.4	2.3	2.4	2.9	3.5	3.3	4.3	5.0	5.7	8.0	6.8	7.2	8.0	14.2	25.1	23.2	28.9	32.1	32.2	35.6	33.7	33.4	28.6	30.6	32.4

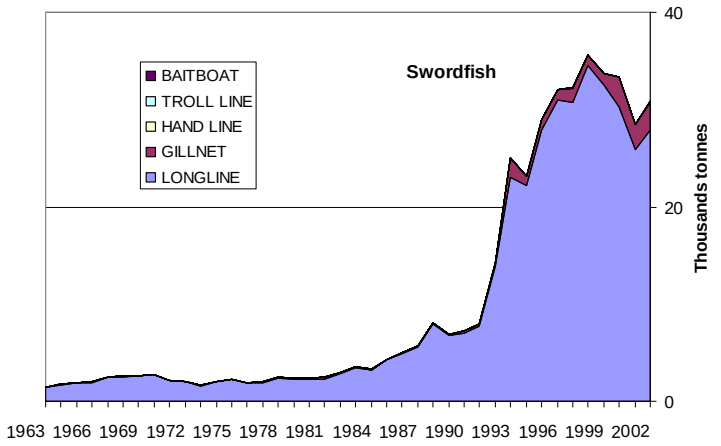

Figure 1: Catches of Swordfish per gear and year recorded in the IOTC Database (1963-2002).

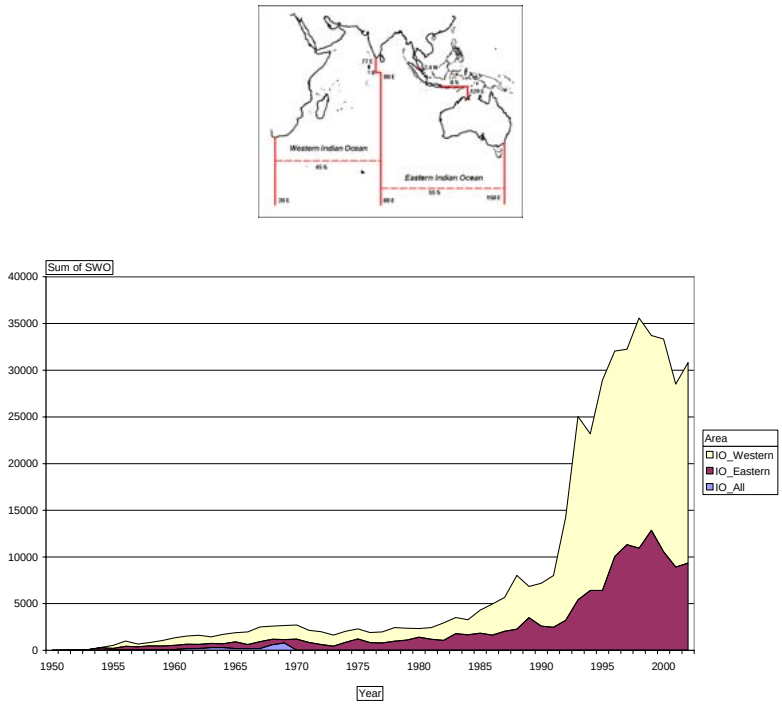

Figure 2: Trends of the swordfish catches in the western and the eastern area of the Indian Ocean between 1970 and 2002.

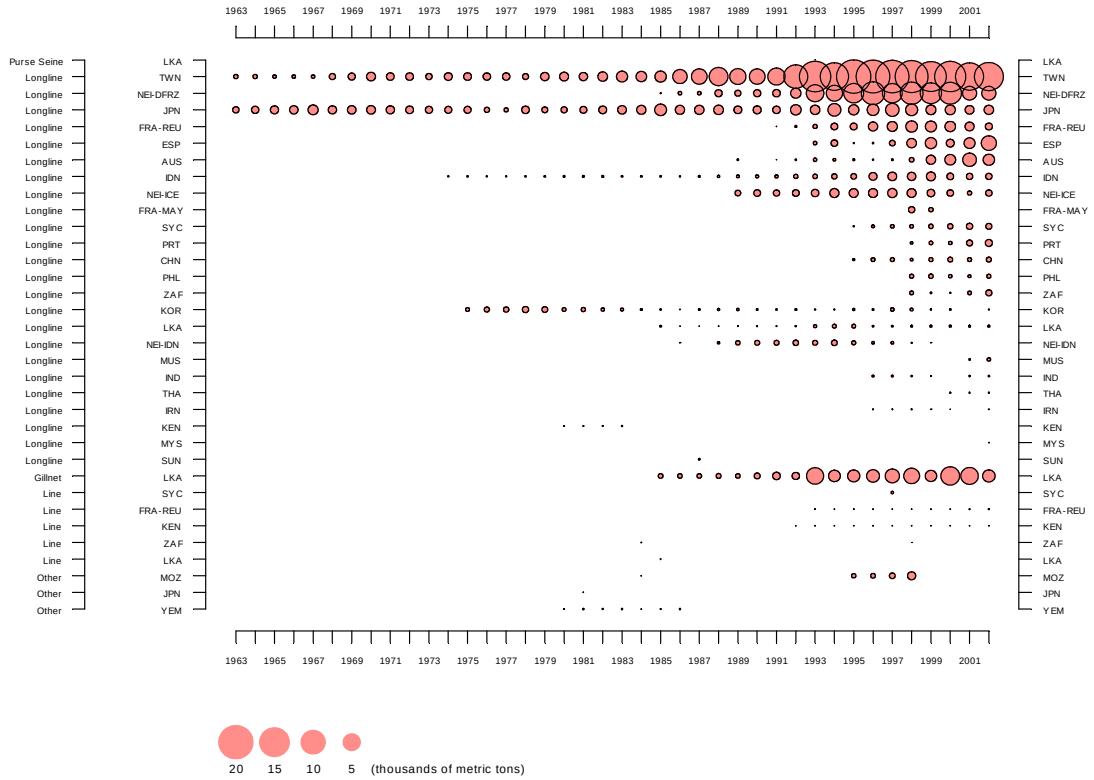

Figure 3: Catches of swordfish in the Indian Ocean for the period 1963-2002, in thousands of metric tons by gear and country/fleet.

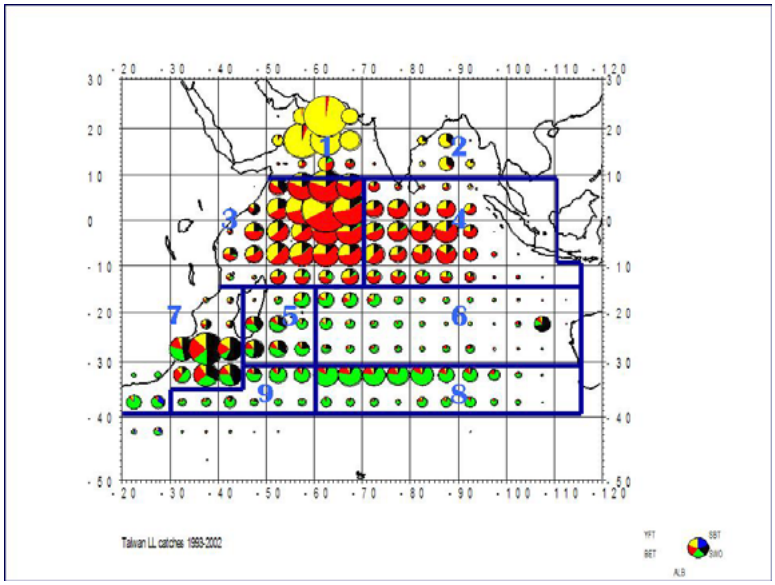

Figure 4: Areas used in the CPUE standardization for the Japanese and Taiwanese fleets.

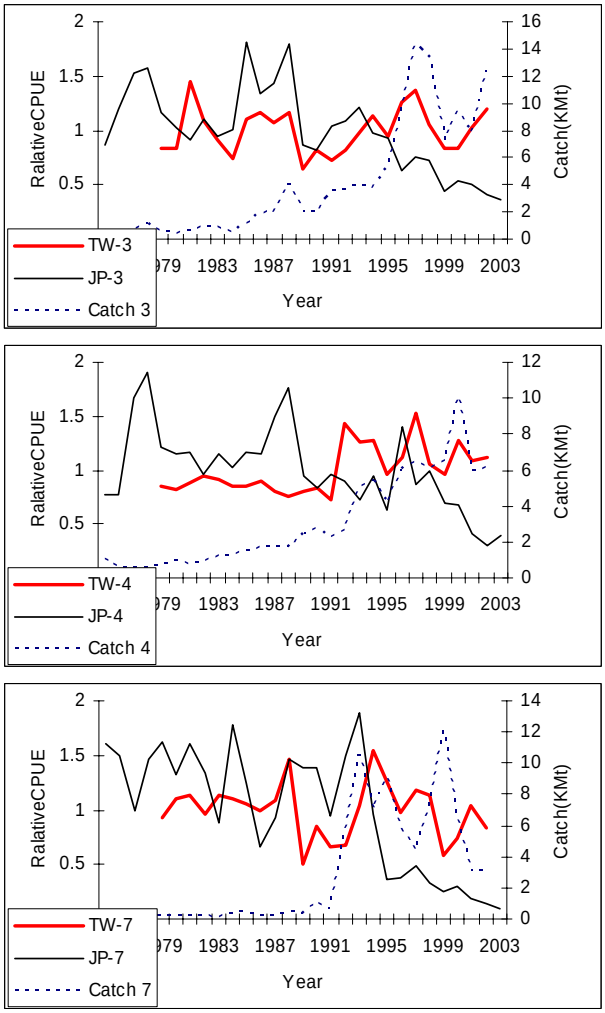

Figure 5: Total catch and standardized CPUE trends (rescaled to their average) for the Japanese and Taiwanese fleets in areas 3 (equatorial western), 7 (south western) and 4 (equatorial eastern). areas are shown in Figure 4.

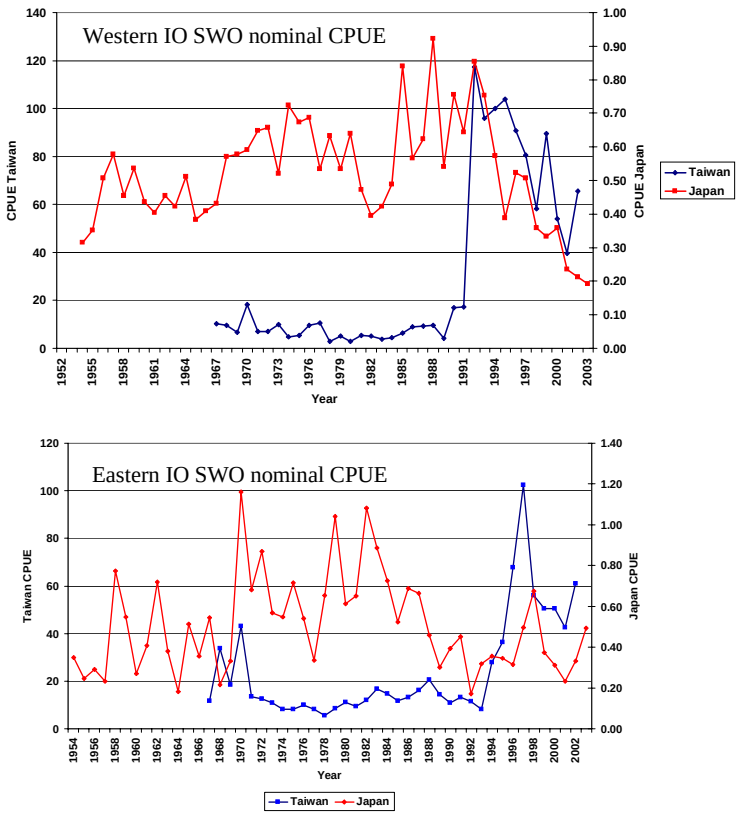

Figure 6: trends of the Taiwanese and Japanese fleets CPUE in the western and eastern areas in Indian Ocean. Areas are shown in Figure 2.

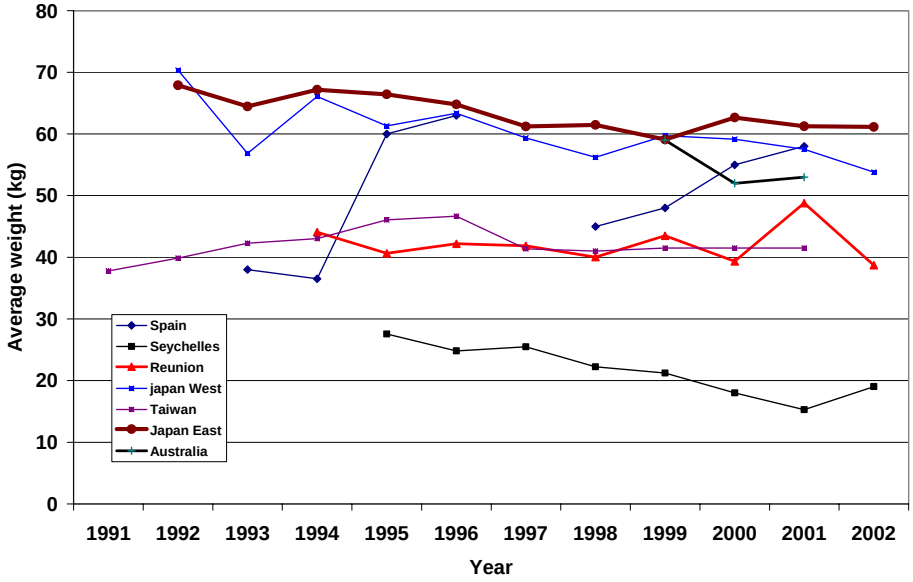

Figure 7: Trends in average size of swordfish in Indian Ocean fisheries.