REVIEW OF JAPANESE TUNA FISHERIES IN THE INDIAN OCEAN

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INTRODUCTION

Two types of fishery, longline and purse seine, are currently operated by Japan in the Indian Ocean. The longline fishery has a long history, having started in 1952 when the limitations on operational area were removed. The commercial purse-seine fleet, on the other hand, only commenced fishing in the Indian Ocean in 1991 after several years of experimental fishing.

This paper reviews the history of these two tuna fisheries and describes the current situation regarding the amount of catch, the fishing area, size of the fish, *etc*.

THE LONGLINE FISHERY

Fishing effort

The geographical distribution of fishing effort for each decade is shown in Figure 1. In the 1950s, the fishing area of Japanese longliners in the Indian Ocean was limited to waters north of 30°S. During the next decade the fleet extended its operations to waters between 30°S and 50°S, where they found a good fishing ground for southern bluefin tuna. This period corresponds to the time when this fishery covered almost all the Indian Ocean and fishing effort was exerted more or less evenly. Subsequently, the area of operation was divided into two main parts, with the boundary located at around 20°S. This shift seems to reflect the change in demand from fish for canning (yellowfin and albacore) to *sashimi* (bigeye and southern bluefin). The introduction of super-cold freezers also accompanied this change. In tropical to subtropical waters the main target species changed to bigeye, while in temperate waters targeting on southern bluefin tuna intensified. This pattern of effort distribution has persisted.

The distribution of longline effort in the Indian Ocean changes seasonally (Figure 2). Concentrations of fishing effort are apparent in the second and the third quarters in waters off South Africa and southwest Australia, while effort is relatively sparse in the western and southern offshore areas of Indonesia north of 20°S. In the other quarters the opposite is the case, with less fishing effort in the former areas and significant effort in the latter.

Historical changes in total fishing effort are shown in Figure 3. Since the beginning of the fishery, the fishing effort increased year by year, and reached a first peak of 126 million hooks in 1967. It then fell, and from 1970 to 1982 fluctuated around 80 million hooks. From 1982 it rose to a second peak of 127 million hooks in 1985, then dropped to about 60 million hooks, below the previous low level. By 1994 it recovered to 76 million. About 12% of the total Japanese longline effort was expended in the Indian Ocean in the last five years.

The longliners operating in the Indian Ocean are large boat of between 300 and 500 t gross tonnage (GRT). The numbers of Japanese boats operating in the Indian Ocean in 1989-1994 are shown in Table 1. Since slightly over 700 distant-water longline licenses are issued, Japanese longliners account for about one-third of the total number of longliners of that category operating in that Ocean.

Catches

The total catch of four tuna species (southern bluefin, albacore, bigeye, and yellowfin) caught by longline gear increased to over 2 million fish during 1959-69, with the highest peak of about 3.5 million in 1968 (Figure 4). After this period, catches dropped steeply to less than 1.5 million, and the average catch in the last five years (1990-1994)

Table 1. *Number of Japanese boats operating in the Indian Ocean, 1989-1994.*

Fleet/Year	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*
Longliner	228	207	179	180	189	181
Purse seiner	4	5	13	12	11	8

Table 2. *Catch and effort statistics for the Japanese purse-seine fishery in the Indian Ocean, 1985-1994. 1994 data are preliminary.*

Year	*Days F.*	*Total*	*YFT*	*BET*	*SKJ*
1985	45	558	75	168	315
1986	84	864	160	142	562
1987	170	1,319	260	122	937
1988	175	2,917	389	277	2,250
1989	349	4,913	883	581	3,449
1990	813	15,634	3,222	1,225	11,187
1991	1,343	22,207	5,061	1,269	15,877
1992	2,393	45,212	11,882	1,757	31,573
1993	2,161	44,213	10,946	1,959	31,309
1994	1,402	24,673	4,738	3,093	16,842

was about 0.6 million individuals. Except for bigeye, the catch declined steeply from the peak of the 1960s to the recent low levels: from 1.0 million fish to 0.1 million for southern bluefin, from 1.8 million to 0.1-0.2 million for yellowfin, and from 1.0 million to 0.06-0.1 million for albacore. In the case of bigeye, however, the declining trend is moderate (from 0.4-0.6 million to 0.1-0.4 million) and relatively stable. Total catch in weight stayed high during 1983-1988, with a peak of about 46000 t in 1985, after which it declined continuously to about 14000 t in 1993 (Table 2). In this period, the above four tuna species accounted for about 90% of the total catch. All species showed a declining trend except in the most recent year. While the proportion of southern bluefin in the catch shows a steady decline in these 17 years, from about 70% to 10%, the proportions of albacore, bigeye and yellowfin increased, from 3% to 6%, 20% to 40%, and 20% to 30% respectively (Figure 5).

***Table 3**. Fishing effort and catch in weight (t) by the Japanese longline fishery in the Indian Ocean, 1971-1994. 1994 data are preliminary. Sets and hooks are in thousands and millions, respectively.*

Year	*Sets*	*Hooks*	*Total*	*SBT*	*ALB*	*BET*	*YFT*	*SWO*	*BILL*
1971	41	103	64,446	22,585	3,659	13,969	18,271	1,126	4,836
1972	29	78	46,219	19,657	1,047	11,401	9,373	970	3,771
1973	36	70	32,622	18,645	1,647	5,740	4,070	679	1,841
1974	35	75	40,144	22,310	2,513	7,192	4,402	701	3,026
1975	40	81	30,935	17,470	1,127	5,304	4,301	658	2,075
1976	29	67	26,781	20,548	778	1,851	2,180	291	1,133
1977	23	54	23,092	17,229	244	2,879	1,640	190	910
1978	21	52	28,499	10,241	264	10,426	3,720	765	3,083
1979	20	49	16,183	9,214	185	3,254	1,517	353	1,660
1980	28	70	24,331	13,604	402	4,856	3,035	407	2,027
1981	27	68	24,660	11,037	876	6,355	3,879	524	1,989
1982	27	67	28,971	9,090	759	10,413	5,936	739	2,034
1983	39	100	43,883	15,392	1,152	17,184	6,567	950	2,638
1984	36	95	38,226	12,842	1,412	12,830	7,056	947	3,139
1985	42	112	45,925	13,758	1,968	16,539	9,036	1,638	2,986
1986	39	106	40,318	9,134	1,828	15,075	10,544	1,100	2,637
1987	34	94	35,374	8,396	1,642	14,747	7,551	1,116	1,922
1988	29	79	31,653	8,242	1,024	11,679	8,382	1,066	1,260
1989	24	67	20,538	8,330	634	6,796	3,536	654	588
1990	15	42	20,131	5,324	740	7,638	5,122	785	522
1991	17	48	15,597	2,707	830	7,139	3,847	630	444
1992	15	42	14,326	2,949	1,040	4,786	3,844	1,151	556
1993	14	39	14,288	1,825	896	6,911	3,377	882	397
1994	23	66	26,839	2,540	1,429	13,780	6,982	1,293	815

THE PURSE-SEINE FISHERY

Fishing effort

The history of the Japanese purse seine fishery in the Indian Ocean is relatively short. It was initiated in the mid-1980s on an experimental basis, and shifted to a commercial basis with 10 commercial licenses (with a total of 13 vessels, including one experimental research vessel) in 1991. The number of licenses has remained at that level. Japanese purse-seine vessels in the Indian Ocean are of the 350-500 GRT class (700-800 t carrying capacity).

Before 1991, the area of fishing was limited to the western Indian Ocean (Figure 6). From 1991 fishing took place in the eastern Indian Ocean as well, and in fact since late 1993 the fleet almost completely withdrawn from the western Indian Ocean. According to one purse seiner, this dramatic change is not due to problems with the resource but to economic problems arising from the recent rise in value of the Japanese yen. Because of the low price of tuna, the fishermen needed to eliminate the cost of transshipment, and in the eastern Indian Ocean they do not need to transship because catches are unloaded at ports near canneries. There are two distinct areas of fishing in the western Indian Ocean, one located in the tropical area, north of the Seychelles, at 10°N-10°S and 45°E-70°E, and the other to the northeast of Madagascar. The effort exerted in the tropical area accounted for most of fishing effort in the western Indian Ocean. The area of fishing in the eastern Indian Ocean lies roughly between 3°N-10°S and 80°E-100°E. Total fishing effort (operation days + searching days) increased from 349 days in 1989 to 2393 days in 1992, and decreased to 1402 days in 1994 (Table 3, Figure 7). The number of boats engaged in the Indian Ocean has also fallen, to 8 in 1994 (Table 1).

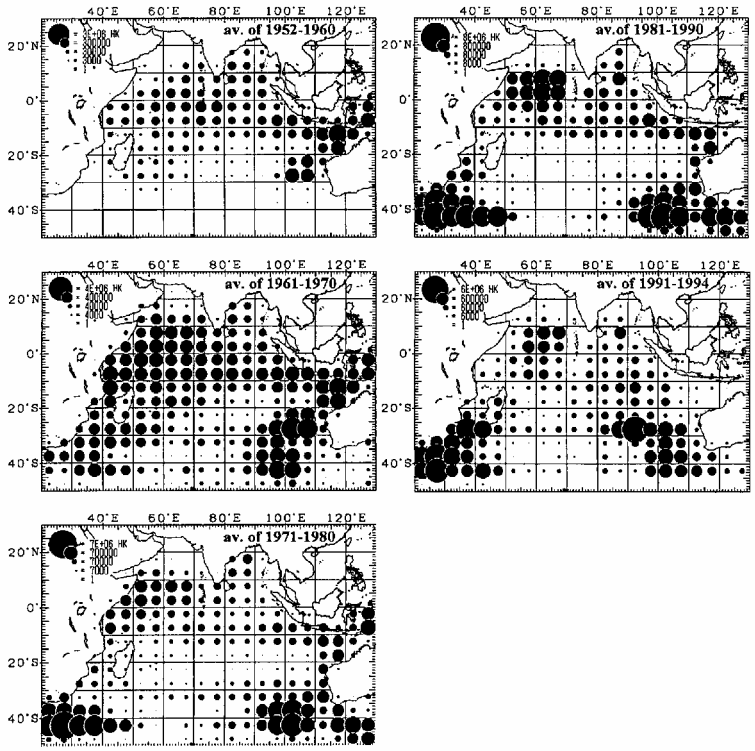
Japanese purse seiners have traditionally targeted fish associated with floating objects, especially log-associated schools. In the Indian Ocean, however, logs are few, so purse seiners use fish-aggregating devices (FADs) extensively. As can be seen in Figure 8, sets on FAD-associated schools accounted for more than 75% of total sets, and if log sets are added to this, the percentage of sets on associated schools reaches nearly 100%.

Catches

The trend in total catch in weight is similar to that of effort, increasing from about 5000 t in 1989 to 45000 t in 1992, and decreasing to 25000 t in 1994 (Table 3). The percentages of catch by species in 1992 were 26.1% yellowfin, 69.2% skipjack, and 3.9% bigeye (Figure 9). Although the proportion of yellowfin and skipjack decreased to 19.2% and 68.3%, respectively, in 1994, that of bigeye increased to 12.5%. The catch in weight of

bigeye about doubled, from 1760 t in 1992 to 3090 t in 1994, in spite of the decline of total catch to about half. This increase in the catch of bigeye is probably caused by the change of fishing ground. Since the catch of bigeye in the western Indian Ocean appears to be distributed in almost all areas irrespective of season, bigeye may be more abundant or more vulnerable to the purse-seine fishery there than in the eastern Indian Ocean.

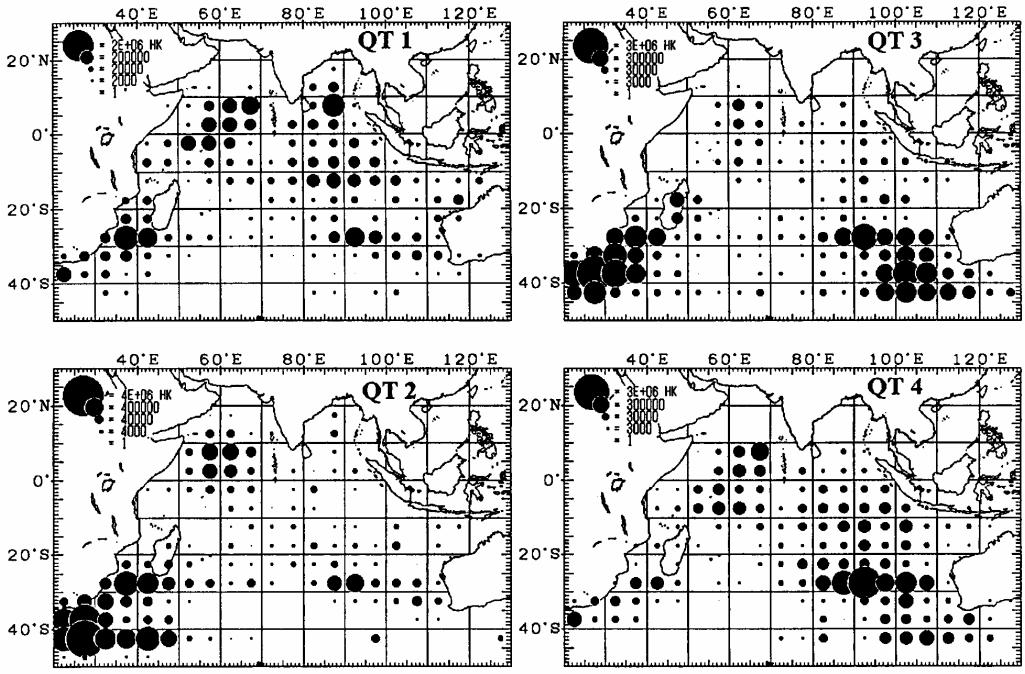
***Figure 1**. Geographical distribution of longline effort for each decade.*



Size of fish

Length-frequency distributions are available from on-board measurements. Figure 10 shows annual length frequencies for three main tuna species. The majority of tunas caught are small, between 40 and 70 cm in fork length (FL). Some larger yellowfin were caught. Most of the catch of bigeye and yellowfin are young individuals, so there is some concern about the effect of large catches of small fish on the adult stock which is exploited by the longline fishery. In order to investigate the situation of the catches of these small individuals by Japanese purse seiners, a research project to determine the size of fish caught through port sampling was started last year. For example, catch-at-length histograms were constructed for skipjack, yellowfin and bigeye, caught by the N*ippon Maru*, an experimental purse seiner which fished in the Indian Ocean from March to June 1995 and unloaded in Makurazaki, Japan (Figure 11). However, nearly all

***Figure 2**. Seasonal change in longline effort distribution in the Indian Ocean.*



catches were unloaded at ports in southeast Asian countries, and catches unloaded at foreign ports cannot be sampled.

Figure 3. *Annual trend of fishing effort by Japanese longliners from 1952 to 1994 in the Indian Ocean.*

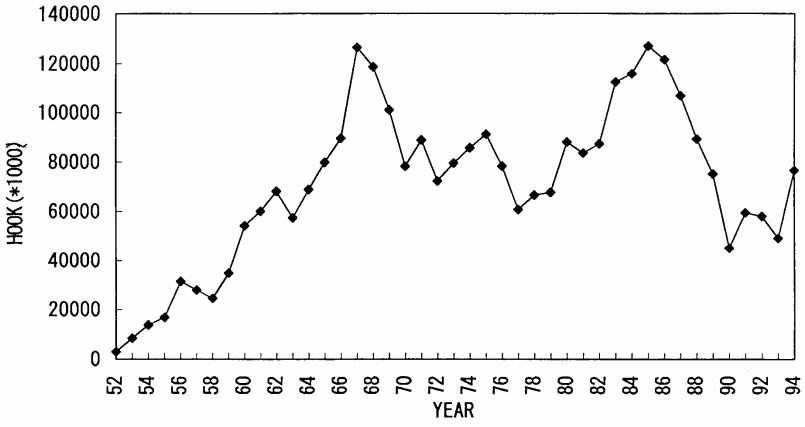


Figure 4.*Historical change in the number of four tuna species (YF: Yellowfin, BE: Bigeye, ALB:Albacore, SBT: Southern bluefin tuna) caught by Japanese longliners in the Indian Ocean.*

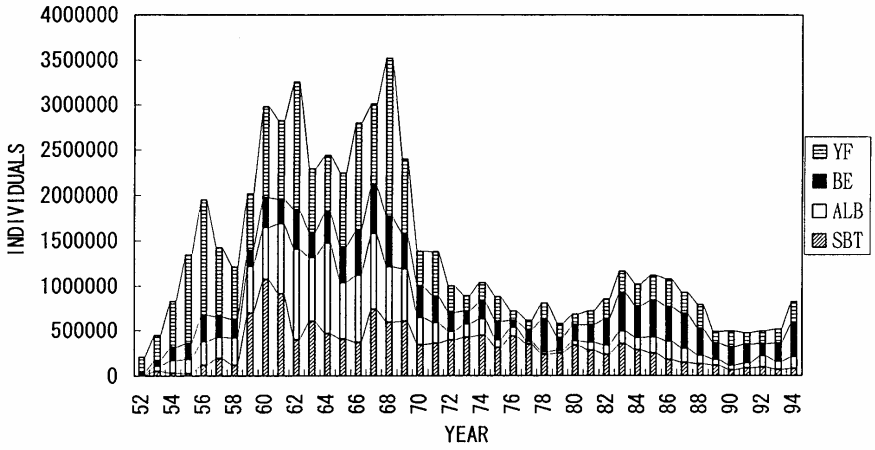


Figure 5. *Proportion of catch in weight of each tuna species relative to total catch in weight by Japanese longliners.*

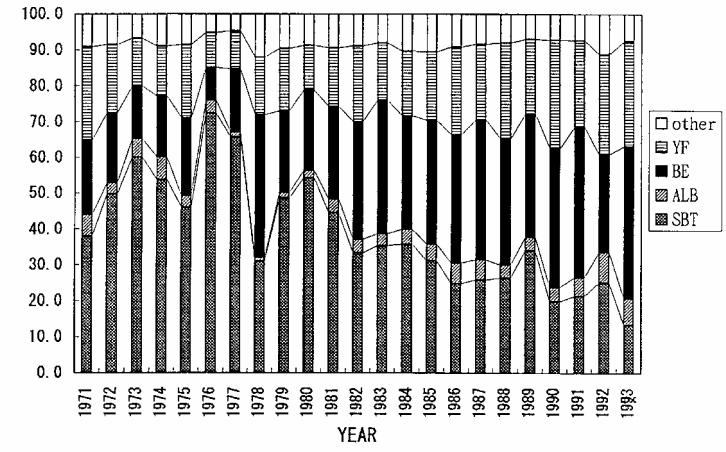


Figure 6*. Distribution of effort (days) by Japanese purse-seiners in the Indian Ocean from 1989 to 1994.*

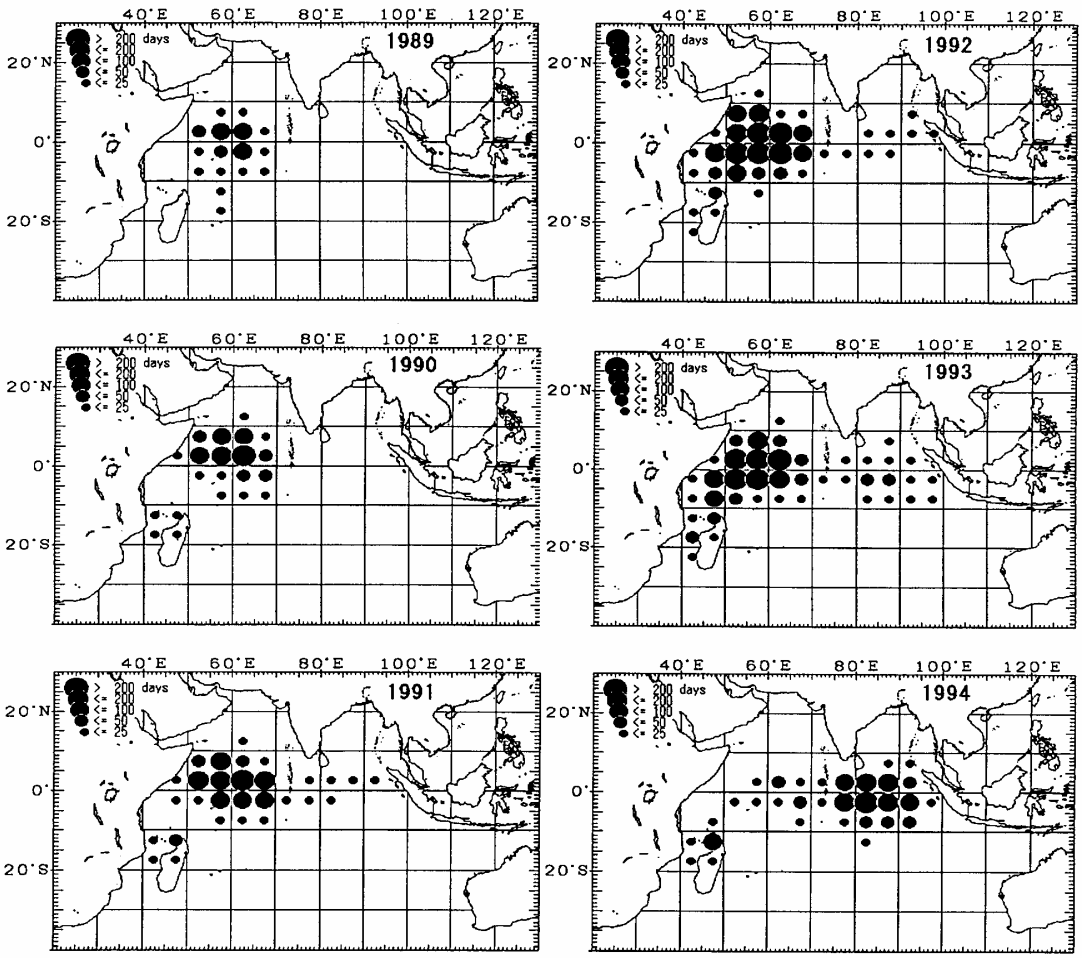


Figure 7. *Change in amount of effort and catch weight of three tuna species (YF: yellowfin, SK: Skipjack, and BE: bigeye) by Japanese purse seiners in the Indian Ocean.*

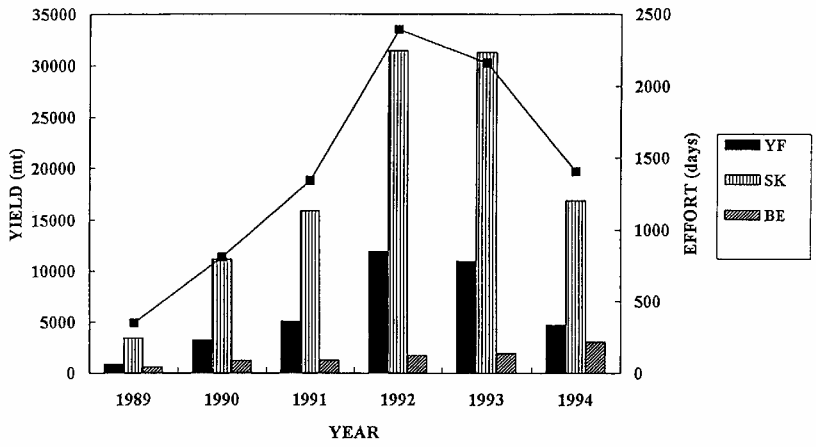


Figure 8. *Proportion of sets by type of school for the Japanese purse-seine fishery. FADs; fish-aggregating-device associated schools, FREE: free-swimming schools, LOG; log-associated school.*

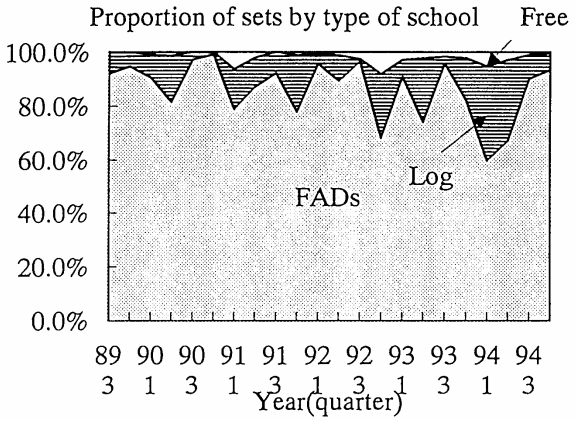


Figure 9. *Proportion in catch weight of each tuna species (BE: bigeye, SK:skipjack, and YF: yellowfin) in total catch weight by Japanese purse seiners.*

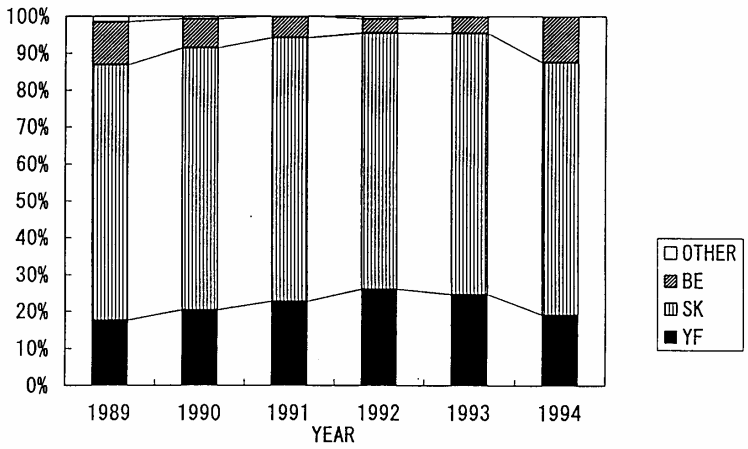


***Figure 10**. Annual length frequencies for yellowfin, bigeye and skipjack caught by the Japanese purse-seine fishery in the Indian Ocean. Data are compiled from sets for FAD-associated schools.*

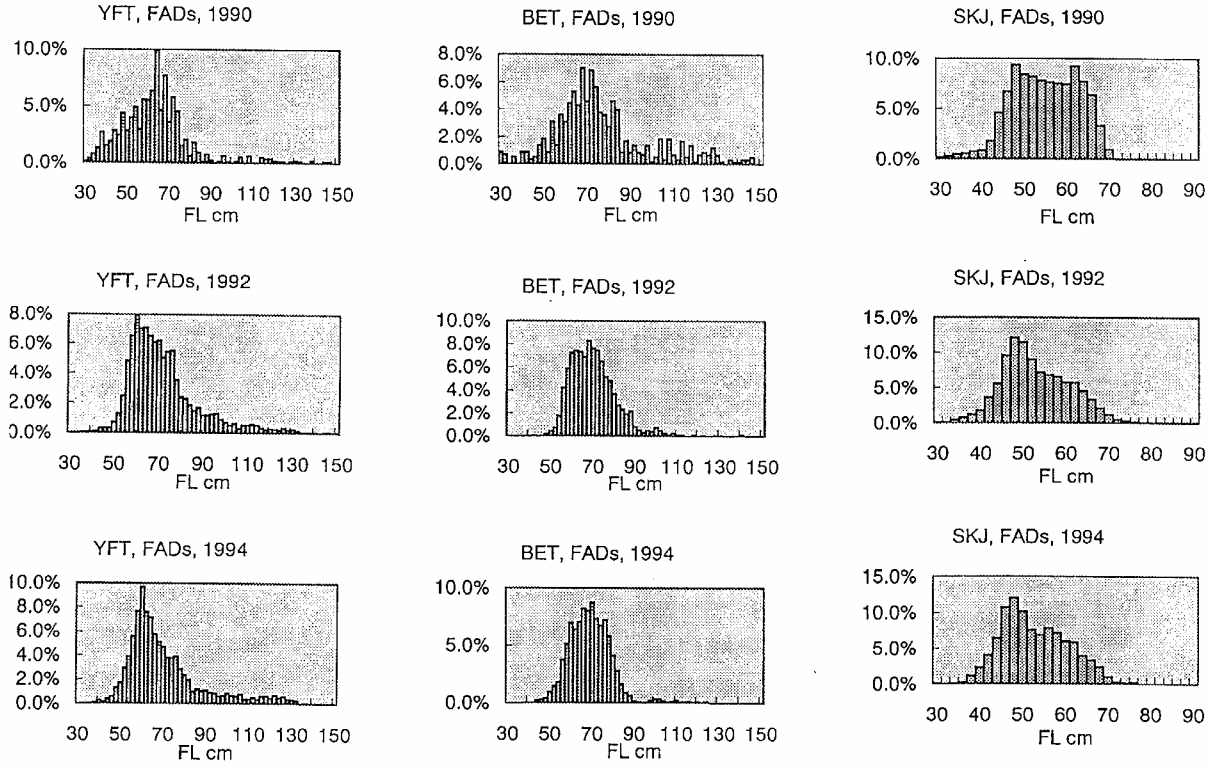


***Figure 11**. Catch-at-size for NIPPON MARU, constructed from port sampling data.*