Data collection and statistics of Japanese tuna fisheries in the Indian Ocean

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Introduction

Japanese fisheries currently operating in the Indian Ocean include longline and purse seine fisheries. The longline fishery started its operation in this Ocean after 1952 when limitations were removed on operational areas. The commercial purse seine fleet commenced fishing in the Indian Ocean in 1991 after several years of experimental fishing.

In this paper, the data collection system and fisheries statistics of these Japanese tuna fisheries are summarized. Most of this information was already reported in the country report submitted at the 7th Expert Consultation (Okamoto *et. al.*, 1998). This paper is an update, with some additional information.

Longline fishery

Fishing vessels

The Japanese longline fishery is classified into three categories (coastal, offshore and distant water) according to the license and boat size (coastal: less than 20 gross registered tons {GRT}, offshore: 20-120 GRT, and distant 120-500 GRT). Only the distant water category is allowed to fish in this Ocean. Large-sized distant water vessels between 300 and 500 GRT are operating in the Indian Ocean. In the latest decade, 180-250 vessels operated in this ocean per year. Though they decreased in number from 245 vessels in 1987 to 181 in 1993, they increased thereafter to 251 vessels in 1996 and 243 in 1997 (Table 1). This recent increase in the number of vessels in the Indian Ocean seems to be attributable to the lower catch of tunas, bigeye tuna in particular, in the Pacific Ocean.

Fishing Effort

The geographical distribution of fishing effort is shown in Fig. 1 for each decade. In the 1950s, the fishing area of the Japanese longliners in the Indian Ocean, was limited in area north of 30°S. During the next decade, the fleet extended its fishing to waters between 30°S and 50°S where they found good fishing grounds for southern bluefin tuna. This period corresponds to the time when almost all the Indian Ocean was covered by this fishery and fishing effort was exerted more or less evenly. After that, the operational areas were divided into two main parts with a boundary located at around 20°S. This shift seems to reflect the change of demand for fish material from canning (yellowfin and albacore) to sashimi (bigeye and southern bluefin tunas). The introduction of super cold freezers also accompanied this change. In the tropical to subtropical waters, the main target species has shifted to bigeye, whilst in the temperate waters targeting on southern bluefin tuna has been further strengthened. This pattern of effort distribution has been maintained thereafter.

There is a seasonal change in the distribution of the longline effort in Indian Ocean (Fig. 2). In the second and the third quarters, concentrations of fishing effort in the waters off South Africa and southwest Australia become apparent, while fishing effort exerted is relatively sparse to the west and south of Indonesia offshore north of 20°S. In the other quarters, the pattern reverses. These seasonal changes in fishing ground have relation to the national regulation on the fishing period in each fishing ground targeting southern bluefin tuna. Japanese longliners are allowed catch southern bluefin from April (or May) to July (or August) at the fishing area off Africa and Tasmania, and from September to the time when their catches fill the Japanese quota for this species (normally, November or December). This regulation started in 1989 when the quota for southern bluefin was fixed by three countries, Australia, New Zealand and Japan.

The total fishing effort in the Indian Ocean increased year by year from the beginning of the fishery and reached a first peak in 1967 (126 million hooks, Table 2). It went down a bit until 1970 and fluctuated at that level (80 million) thereafter. Then it rose once again from 1982 to 1985. After the second peak in 1985 (112 million hooks), it dropped to less than the previous low level, reaching about 50-60 million hooks in the early 90s. After 1995, it increased steeply, attaining 116 million hooks in 1997. About 23 % of the total effort of the Japanese longline fishery was exerted in the Indian Ocean in the most recent five years.

Catch

The total catch in weight from 1971 to 1997 of Japanese longliners in the Indian Ocean (FAO Areas 51 and 57) is shown in Table 2 (1997 is preliminary data). Although the catch and effort FAO 58 is not negligible, they are not included in this table. Total catch figures include the catch of southern bluefin tuna, albacore, bigeye, yellowfin, swordfish, striped marlin, blue marlin, black marlin, sailfish, and spearfish. The total catch remained high during 1983 to 1988 with a peak

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of about 46,000 t in 1985. It then declined continuously to about 14,000 t in 1992 (Table 2). The total catch increased thereafter in relation to the increase in effort and reached 34,000-42,000 t in the two most recent years. The catch for each species in 1996 (1997) was 3,591 t (4,543 t) for southern bluefin, 2,161 t (2,799 t) for albacore, 14,741 t (16,756 t) for bigeye and 10,444 t (13,248 t) for yellowfin, respectively. Because southern bluefin catch is regulated by quota, and because the above catch of southern bluefin tuna is based on aggregated catch data raised from logbook data submitted by longliners including operations targeting on other species, it may be to some extent different from the actual catch. Recently, 4 major tuna species (southern bluefin, albacore, bigeye and yellowfin) accounted for about 85-87 % of the total catch (Fig. 3). The proportion of southern bluefin tuna in the total catch weight was about 50 % or more (77 % in 1976) in the 1970s and about 30 % in the 1980s, coming down to about 10 % in the last five years. In contrast, the rates of bigeye and yellowfin became higher, 40-50 % and 20-30 %, respectively in recent years.

Recent changes in longline fishing gear and techniques

In this decade, there is no remarkable change in longline fishing strategy except for the material of main and branch line. In the Indian Ocean, nylon monofilament line or braided nylon line were introduced, first to the southern bluefin tuna fishery in the early 1990s, spreading then to other fisheries. At the same time, nylon monofilament line came to be used for the main part of for the branch line. Since 1994, data on the materials of main and branch lines have been collected through logbooks. However, because there are several combinations of materials for branch lines, and several kinds of branch lines are often used in one operation, it is difficult to collect accurate data.

The Purse Seine Fishery

Fishing vessels

The Japanese purse seine fishery started operating in the Indian Ocean in the mid 1980s on an experimental basis, and shifted to a commercial basis with 10 commercial licenses (a total of 13 vessels, including one experimental research vessel) in 1991. Japanese purse seine vessels in the Indian Ocean are 350-500 GRT class (700-800 t carrying capacity). The historical change in the number of vessel is shown in Table 1. Although more than 10 Japanese purse seiners operated in 1991-1993, they decreased year by year to only 3 vessels in 1997 and 1998. As described in the purse seine effort section, this decrease in vessel numbers seems to be due to economic reason (high operating cost, low price of catch, loss in foreign currency exchange rates).

Fishing Effort

Two distinct fishing areas were seen in the western Indian Ocean. One of them is located in the tropical area (north of Seychelles, 10°N-10°S and 45°E-70°E) and the other to the northwest of Madagascar. The fishery in the tropical area accounted for most of the fishing effort in the western Indian Ocean. The fishing area in the eastern Indian Ocean is roughly between 3°N-10°S and 80°E-100°E. Before 1991, fishing was limited to the western Indian Ocean (Fig. 4). As from 1991, fishing took place in the eastern Indian Ocean as well, and the fleet withdrew almost completely from the western Indian Ocean starting in late 1993. According to the explanations given by one purse seiner, this dramatic change is not due to decline of catch but to economic problems stemming from the rise of the Japanese Yen against the U.S.$ during that time. Because of the low price of tuna, the fleet had to choose either to reduce the cost of transhipment or to shift their fishing grounds to the Pacific Ocean. In the eastern Indian Ocean, transhipment is not needed because catches are unloaded at ports which are close to the cannery. The total fishing effort (operation days + searching days) increased from 349 days in 1989 to 2,393 days in 1992, and decreased drastically to 623 days in 1997 and 696 in 1998 (Table 3, Fig. 6).

Japanese purse seiners have traditionally targeted fish associated with floating objects, especially on log-associated schools. In the Indian Ocean, however, logs are few that purse seiners utilize fish aggregating devices (FADs) extensively. As seen in Fig. 5, sets on FAD-associated schools accounted for more than 75 % of total sets and, if natural log sets are added, the total of sets on associated school reaches nearly 100 %.

Catch

The total catch in weight shows a similar trend to that of effort. It increased from about 5,000 t in 1989 to 45,560 t in 1992, and decreased steeply to 9,308 t in 1998 (Table 3, Fig. 6). The catch weight of each species in 1997(1998) was 6,713 t (5,748 t), 2,612 t (1,949) and 1,251 t (915 t) for skipjack, yellowfin and bigeye, respectively. Historical change in species composition in total catch weight is shown in Fig. 7. The catch by species was 62 % for skipjack, 21 % for yellowfin tuna, and 10 % for bigeye tuna in 1998. In recent four years, bigeye catch remained higher, 10-15 %, compared to 4-8 % in 1990 through 1993. This increase in percentage of bigeye is probably caused by a shift of fishing grounds.

Recent change in the purse seine fishing gear and technique

As it is well known, in this fishery, several technical advances have been introduced. These have included progress in vessel size and power, in net size, introduction of bird radar, ARGOS FAD locaters, sonar, etc. Detail data on these innovations, which may affect fishery efficiency, have not been collected routinely except for the data on net size which was included in logbooks since 1995.

Data collection and statistics

Data collection systems

The owners of fishing vessels are obliged to submit log sheets on their operations and catch information to the Japanese government. In the log sheets for longline, set by set data on catch numbers and weight of each species and operational data such as fishing date and location, fishing effort (the number of baskets and hooks) and water temperature are included. Catch weight information was not included in the logbook until 1993. The number of hooks per basket is important as it suggests the depth of the gear and target species. Six tunas (bluefin, southern bluefin, albacore, bigeye, yellowfin and skipjack), swordfish and five billfishes (striped marlin, blue marlin, black marlin, sailfish and shortbill spearfish) are included individually in the catch categories. Additionally, information on the cruise (date and port of starting and finishing of the cruise), vessel (name, size, license number and callsign), the number of crew and the configuration of the fishing gear (material of main line and branch line) are to be entered on the top part of the sheet for each cruise.

Although the data sheet format for purse seines is similar to that of longlines, there are several points of difference between them. The purse seine logbook was modified to a new format in 1994. Explanations on the new logbook format follow. In the purse seine logbook, catch data is only weight for each species. All sets are recorded and if activity is limited to searching with no sets made, this is also recorded. School types are recorded in set by set data by codes. Six school types are categorized associated to floating objects (log, artificial floating object, vessel, shark and whale) and four free-swimming schools (dolphin associated, free, boiling, jumping). Start and finish times of each operation are also recorded in set by set data. The species included in purse seine log sheets are skipjack, frigate tunas, yellowfin, bigeye, bluefin, albacore and others. Moreover, yellowfin and bluefin are divided into two categories, large (larger than 10 kg) and middle-small (smaller than 10 kg). The fishing gear configuration, length and depth of fishing net are also recorded. Gear configurations are very important information to know the change of fishing efficiency in these fisheries. In both fisheries, the log sheets are submitted for each cruise.

Data compilation for statistics

The NRIFSF (National Research Institute of Far Seas Fisheries) compiles statistics for Japanese longliners and purse seiners using the log sheets submitted by them. This institute also prepares and sends the statistics in the required format to each international organization for fisheries resource management (SPC, ICCAT, IATTC, IOTC, etc).

Because the submission rate of logbook is not 100 % for the longline fishery, it is necessary to raise the sampled value to the real catch. In the case of the distant water longline fishery, the submission rate is about 90 % or more of total operations. Total numbers of operations in each raising sub-area by month are given by the fishermen’s association (Federation of Japan Tuna Fisheries Cooperative Associations). Sampled catch and effort data is raised and aggregated for each stratum (for example, 5 degree square by month). By summing up the stratified catch and effort data, nominal total catch data is estimated for each area such as FAO areas and statistical areas of each international organization. Since the sampled catch weight data is processed weight, for example gutted weight for bigeye, yellowfin and southern bluefin tuna, the processed weight is converted to whole live weight using conversion factors for each species.

Since the submission rate of purse seine logbook is 100 % in the Indian Ocean, nominal total catch and stratified catch and effort statistics are simply made by summing up logbook data.

Size data

Size data and other biological data for tunas and billfishes caught by the Japanese tuna fisheries are obtained from port sampling, on-board measurement on fishing, training and research vessels, and observer programmes. For the size information on longline-caught fish, onboard measurements conducted by commercial fishing vessels are very important. Recently, however, the coverage of size measurement in the total catch is not high, except for that on southern bluefin tuna, for which fishermen or RTMP observer in recent years are obliged to measure length (about 100 % coverage since 1995).

In the case of the purse seine fishery, since nearly all catches in the Indian Ocean are unloaded at ports in Southeast Asian countries, it is not possible to conduct port sampling for those catches unloaded at foreign ports. Although purse seine vessels also conduct onboard measurement, the data reliability is considered not to be high, in part because it is very difficult to measure enough fish to grasp size frequency and species composition without bias in purse seine operations.

Table 1. Number of Japanese boats operated in the Indian Ocean. The number of longline vessel operated in the Indian Ocean in 1998 is not available now.

Fleet/Year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Longliner	272	235	*245*	216	184	181	206	206	224	251	243	
Purse seiner	1	1	3	4	11	12	11	11	8	5	3	3

Table 2. Fishing effort and catch in weight (t) by the Japanese longline fishery in the Indian Ocean (FAO area 51 and 57), 1971-1998. 1998 is preliminary. Sets and hooks are in thousands and millions, respectively. For the abbreviation of each species, species codes of FAO were used except for SPF (spearfish). SPF and SFA were combined until 1994 when they were separated.

Year	Sets	Hooks	SBF	ALB	BET	YFT	SWO	MLS	BLZ	BLM	SPF	SFA	Total
1971	38	90	22519	2910	10731	12862	941	1028	945	709	823		53468
1972	27	66	19657	930	7768	6231	695	746	906	316	560		37809
1973	36	67	18644	1624	4894	3450	617	530	556	190	251		30756
1974	34	73	22273	2496	6329	3800	647	1315	885	382	247		38374
1975	40	80	17452	1126	5203	4207	653	882	645	385	153		30706
1976	29	67	20540	778	1840	2155	291	483	301	183	164		26735
1977	23	54	17191	244	2749	1554	189	518	248	92	38		22823
1978	21	51	10241	263	9937	3553	746	1710	927	291	81		27749
1979	20	49	9213	182	3154	1459	349	1061	391	126	74		16009
1980	28	70	13600	397	4833	3027	404	1089	636	224	70		24280
1981	27	68	11008	876	6355	3879	524	903	794	247	45		24631
1982	27	67	9089	759	10413	5936	739	609	1079	256	90		28970
1983	39	100	15388	1152	17184	6567	950	605	1595	337	101		43879
1984	36	94	12834	1412	12830	7056	947	977	1472	591	99		38218
1985	42	112	13758	1968	16539	9036	1638	948	1476	431	131		45925
1986	39	106	9130	1828	15075	10544	1100	963	1234	321	119		40314
1987	34	94	8396	1642	14747	7551	1116	664	929	268	61		35374
1988	29	79	8242	1024	11679	8382	1066	269	766	178	47		31653
1989	24	67	8330	634	6795	3536	654	125	346	91	26		20537
1990	15	42	5324	740	7607	5108	785	109	313	78	22		20086
1991	17	48	2707	830	7139	3847	630	152	226	55	11		15597
1992	15	42	2949	1040	4786	3844	1151	180	292	69	15		14326
1993	14	39	1385	937	7353	3826	944	106	290	55	8		14904
1994	24	68	2521	1485	14525	6956	1355	191	593	63	22	2	27713
1995	28	82	2620	1770	14793	6044	1238	214	417	83	36	15	27230
1996	34	99	3591	2161	14741	10444	1679	268	573	62	23	10	33552
1997	40	119	4543	2799	16756	13248	2448	381	1226	113	149	13	41676

Table 3. Catch and effort statistics for the Japanese purse seine fishery in the Indian Ocean. 1998 data are preliminary. The units of catch and effort are tonnes and days (search days and operation days), respectively.

Year	Days F.	Total	SKJ	YFT	BET
1985	45	558	315	75	168
1986	84	864	562	160	142
1987	170	1319	937	260	122
1988	175	2917	2250	389	277
1989	349	4913	3449	883	581
1990	813	15754	11187	3222	1225
1991	1343	22242	15877	5061	1269
1992	2393	45560	31573	11882	1757
1993	2161	44277	31309	10946	1959
1994	1607	29610	20090	5338	4177
1995	1661	24434	16077	4751	3599
1996	780	12281	7024	3917	1330
1997	623	11199	6713	2612	1251
1998	696	9308	5748	1949	915

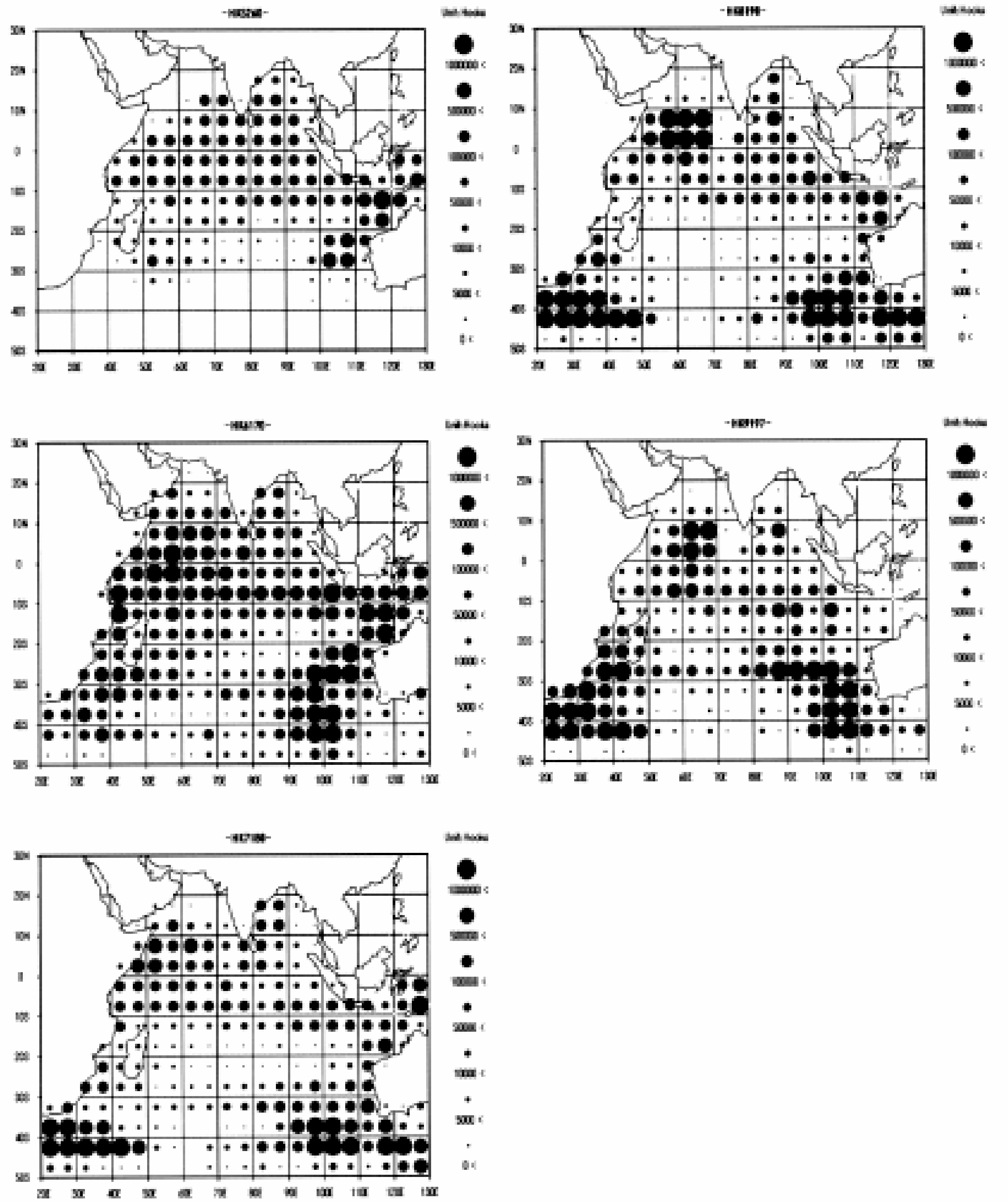

Fig. 1. Geographical distribution of longline fishing effort for each decade. Although the catch in FAO 58 is not negligible, it is not included in this figure.

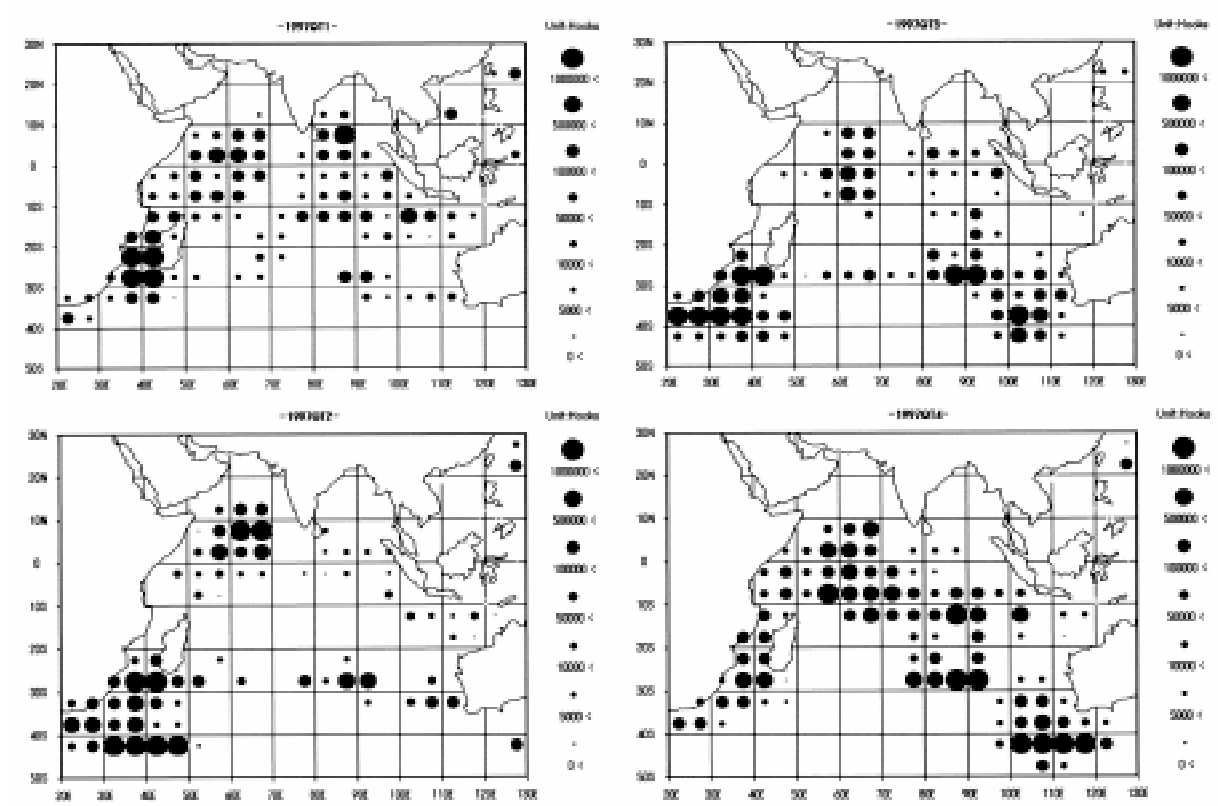

Fig. 2. Seasonal change in longline effort distribution in the Indian Ocean.

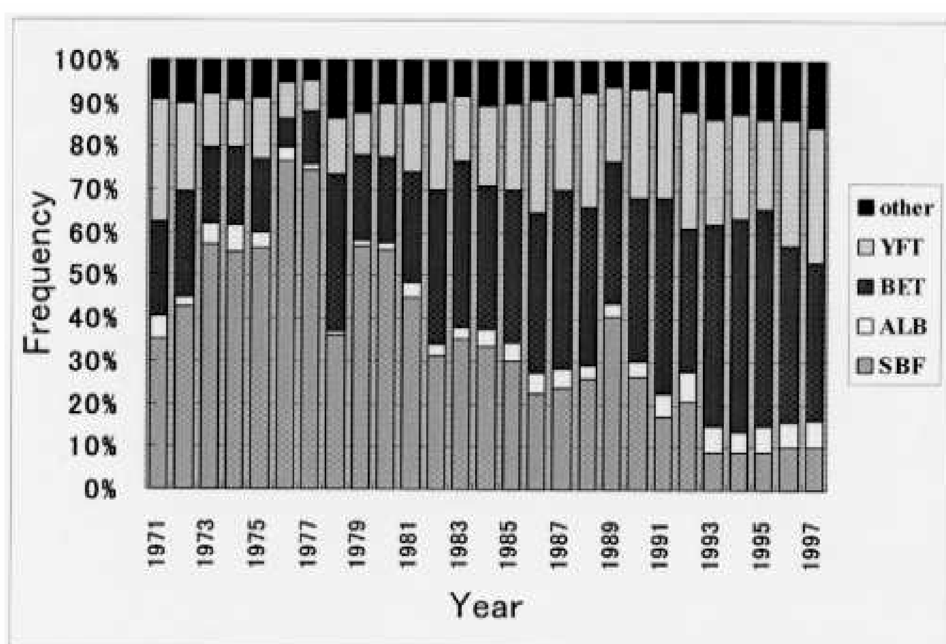

Fig. 3. Species composition (%) in total longline catch by tuna species (YFT: yellowfin, BET: bigeye, ALB: albacore, and SBT: southern bluefin) in total catch weight by Japanese longliners.

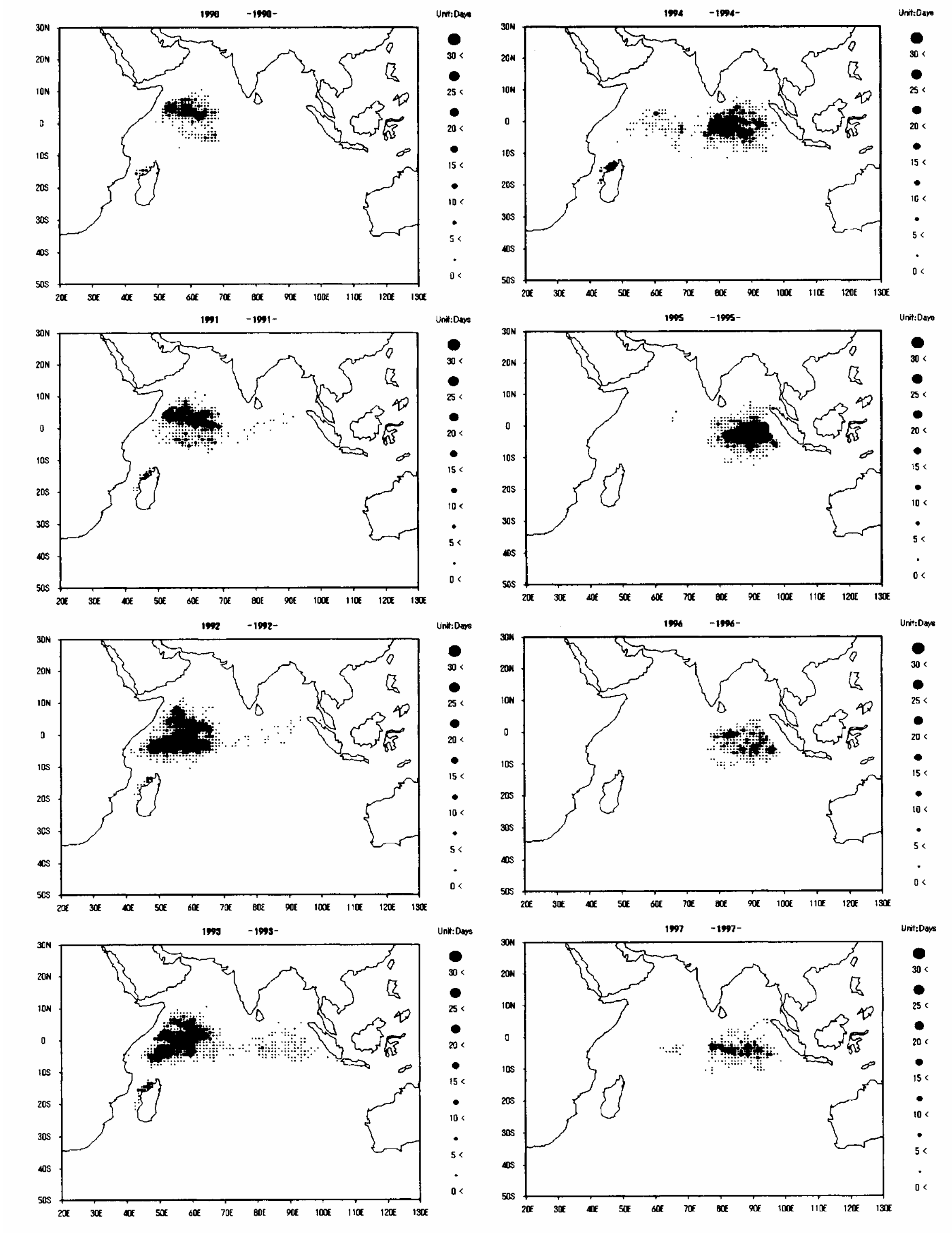

Fig. 4. Annual distribution of effort (days) by Japanese purse seiners in Indian Ocean from 1990 to 1997.

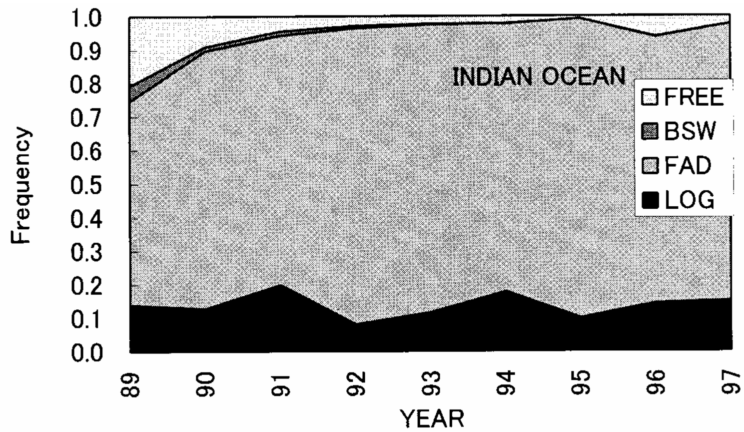

Fig. 5. Change in the proportion of each operation type in the total number of operations. FREE : free school, BSW : boat, shark and whale associated school, FAD: FAD (fish aggregating device) associated school and LOG: log associated school.

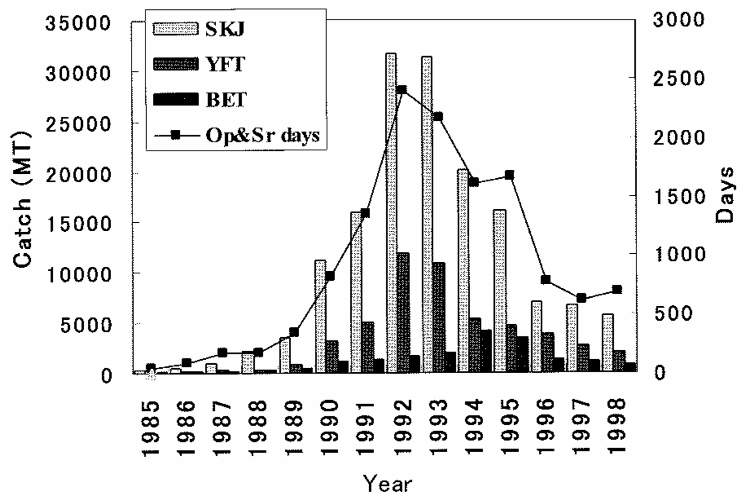

Fig. 6. Change in effort and catch weights of three tuna species (YFT: yellowfin, SKJ: skipjack, and BET: bigeye) by Japanese purse seiners in Indian Ocean.

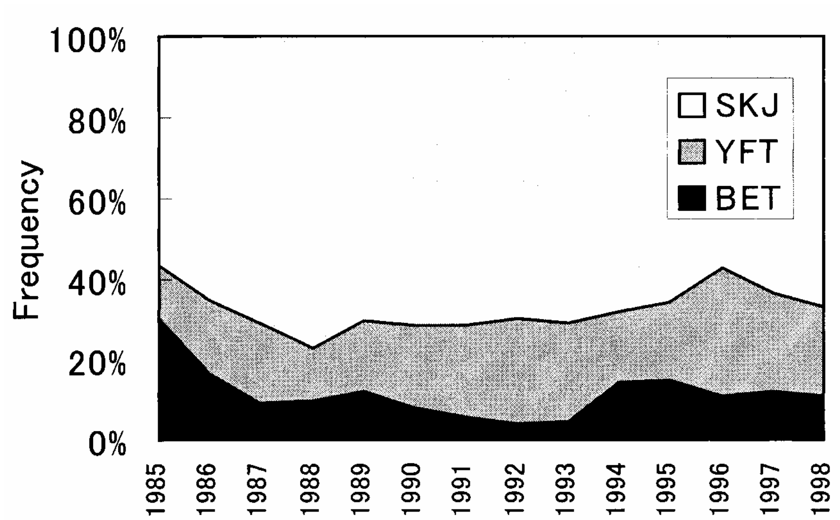

Fig. 7. Historical change in species composition of Bigeye (BET), Yellowfin (YFT) and skipjack (SKJ) in the total catch by Japanese purse seiners in the Indian Ocean.