TUNA FISHERY IN BRAZIL BY LEASED JAPANESE LONGLINER FLEET FROM 1977 TO 1991.

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SUMMARY

The present paper analyses the fisheries of leased Japanese longliners in Brazil, during 14 years. The main goal of these fisheries was the bigeye (Thunnus obesus), yellowfin (T.albacares) and swordfish (Xiphias gladius), that respectively presented percentages of 24.7%, 20.5% and 15.3% of the total catch in weight. The boats set around 81.2% of the hooks at 25° S parallel off Brazil, where the fisheries are concentrated in the coldest months, the end of autumn and winter. The remaining fishing effort was especially set in Equatorial region: off the Brazilian Northeast, near Ascencao Islands to the African coast, in the hottest months, more intensively in the summer and spring.

RESUME

Le présent document analyse les pêcheries de palangriers japonais en location au Brésil pendant 14 années. L'objectif principal de ces pêcheries était le thon obèse (Thunnus obesus), l'albacore (T. albacares) et l'espadon (Xiphias gladius), dont le pourcentage était respectivement de 24,7 %, 20,5 % et 15,3 % de la prise totale en poids. Les bateaux ont mouillé environ 81,2 % des hameçons le long du parallèle 25°S au large du Brésil, où les pêcheries se concentrent pendant les mois les plus froids, à la fin de l'automne et en hiver. Le reste de l'effort de pêche se situait surtout dans la région équatoriale, au large du nord-est brésilien, près de l'île de l'Ascension au large des côtes africaines, pendant les mois les plus chauds, et de façon plus prononcée pendant l'été et au printemps.

RESUMEN

Este documento analiza las pesquerías de palangreros japoneses en sistema de "leasing" en Brasil, durante un período de 14 años. El objetivo principal de estas pesquerías era el patudo (Thunnus obesus), rabil (Thunnus albacares) y pez espada (Xiphias gladius), que representaban porcentajes del 24.7%, 20.5% y 15.3%, respectivamente, de la captura total en peso. Los barcos calan alrededor de 81.2% de los anzuelos en el paralelo 25°S frente a Brasil, donde las pesquerías se concentran durante los meses mas fríos, a finales del otoño y en el invierno. El esfuerzo de pesca restante se desplegó en la zona Ecuatorial: frente a la costa nordeste de Brasil, cerca de las Islas Ascensión hasta la costa de Africa, en los meses de mayor calor, con mayor intensidad durante el verano y la primavera.

1. INTRODUCTION

The tuna fishery in Rio Grande do Sul State began in September 1977 with the leasing of three Japanese longliners by a fishing industry located in Rio Grande city, Rio Grande do Sul State. The fleet stopped the operations in October 1991, when the two last fishing boats returned to Japan.

The number of operative fishing tuna boats anually ranged from two (in 1991) to six boats (in 1982 and 1986) according to Table 1.

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During this period (1977-1991) 21 boats operated, all of them made in naval steel and equipped with sophisticated gears for fishing and navigation. From those tuna boats, 19 are of great loading capacity (Table 1), with an average of 50.5 m of length, 348 MT, oil capacity of 328 m^3 and an average capacity of storage of 457 m^3 in production. The two longliners of small loading capacity are 24.5 and 28.7 meters long, 82 and 97 t, fuel oil 31 and 66 m^3 and 46 and 83 m^3 of fish storage capacity. The general caracteristics of Japanese longliner fleet was described by Antero Silva, 1986.

2. METHODOLOGY

The tuna fishery was analysed through the project on fisheries biology developed by CEPERG/RS-IBAMA. The data were obtained from log sheets, specific for tuna boats, which described approximately 100% of the fisheries. These log sheets were filled in by the captains, with detailed daily information on fisheries like: weight and number of species, fishing effort, fishing area, period of setting and hauling of the longliners, oceanographic conditions, etc.

From the content of the log book, the data are manipulated and stratified, making possible the calculation of the CPUE in weight and number of fish (per thousand hooks).

In order to better show the seasonal fisheries of the Japanese fleet, we divided the Atlantic in two big areas (Figure 1):
Area I - from 25° 00' parallel to the South;
Area II - to the North of that parallel.

The Japanese tuna boats settled in Rio Grande city, Rio Grande do Sul State, used longline. This longline presents a great extent, whith a main line, made of kuremona, with twisted multifilaments. The length is varied, reaching approximately 135 km. The smallest is used in the South oif Brazil in winter, and the longest is used in summer, either in Southern or in Equatorial regions of the Atlantic Ocean.

The main line is attached to a buoy cable also made of kuremona, with size ranging from 15 to 60 m. The float cables are attached to a plastic buoy system (40 to 45 cm of diameter). Usually, to each 20 buoys, other light buoys, radio buoys or buoys are intercalated with marked signs. The set of fishing material. situated among the buoys, is denominated fishing unit. It has among 5 as 16 secondary lines (changing according to seasonal periods and aimed species), featuring 3 segments:

- "bura", in the superior part, of kuremona, attached to a main line through a snap, with or without untwist;
- "sekyama", in the median part, that is a nylon monofilament or a bifilament of twisted nylon, with untwist in the extremities;
- "estropo" of twisted steel, with a hook in the lower part, attached to an untwist.

In this period the longliners suffered frequent modifications, improving the fishing technics. In 1977 the standard longline utilized by the Japanese comprised units with 5 secondary lines of 22 m of length and cable buoy with 20 to 22 m. Lately the secondary lines reached up to 55 m, while the cable buoys ranged from 15 to 60 m.

The distribution of buoys, light and radio were changed according to the fisheries goals, seasonal periods and fishing areas. The total number of buoys may reach 500 units, usually 11 radio buoys, 10 light buoys and the other buoys are used.

The fisheries in Equatorial region near Ascencao Islands caused major changes in the longliner structure. In this zone, a fishing unit had from 11 to 16 secondary lines, attached to the main line, that is held by double buoys in each extremity of the fishing unit. The length of the main line unit in the spring of 1989 was 705 m, and the hooks near the median part reached around 300 m of depth. The main line used in this region was of high resistance and presented 8 mm of diameter. The goal of going deeper

is to reach colder waters, more abundant in fish, where we registered great differences of temperature from the surface to 100 m of depth, with variations higher than 13º centigrade.

3. RESULTS

3.1. Fishing Areas

The fleet started the operations in Brazil in September 1977, operating in the South region until November, when they moved to East around 20° S latitude and to the Northeast region, returning to the Shouth in mid April 1978.

In the following years, the fleet operated practically in the South coast until the end of December 1983, when they went on a long cruise to the Northeast region until the beginning of April 1984.

From then on, the great longliners systematically operated in the coldest months (from April to October) in the South. In the spring and summer (from november to March) they moved to Atlantic Equatorial region, off the Brazilian Northeast coast, near Ascencao Islands to the African coast, with less intensive fisheries in the South of Brazil.

The fishing ground in the North was 10° 28' and in the South 42° 55' S latitude, in international waters off Argentine.

The two small tuna boats operated only in area I, off Rio Grande do Sul and South of Santa Catarina States.

The Figure 1 shows the sub-area or fishing blocks with 5° square, where the fleet operated in the Atlantic Ocean.

3.2. Fishing Effort

From 1977 to 1991 around 23,876,158 hooks (Table 2) were set in the Atlantic Ocean by these leased tuna boats. The higher effort occured in Area 1, where 19,400,844 hooks (81%) where set. The sub-area or fishing block with 5° square, that received the highest effort was the 30 050 with 12,758,823 hooks, i.e. 53.4% of the total effort set by the fleet in the whole period (Figure 1). Figure 2 shows with details the Brazilian South region where the fishery is more intensive, and the percentage of effort is marked in each sub-area of 5° square.

The highest effort was between 1986 and 1990, with annual average superior to 2,2 million of hooks. The year of the highest effort was 1988 with 2,426,915 hooks (Figure 3).

The tuna boats operated in four quadrants of Atlantic: 98.3% of effort was set in quadrant 3 (Southwest), 1.3% in quadrant 4 (Northwest), 0.3% in quadrant 2 (Southeast) and less than 0.1% in quadrant 1 (Northeast).

3.3. Catches

In the studied period the Japanese fleet caught around 994,837 fish with 28,428,145 kg in total weight (Table 3). The main species of the tunas in Brazil was described by Zavala-Camin & Antero Silv, 1991 and Zavala-Camin, 1978 The main goal of the fisheries were: the bigeye tuna (*Thunnus obesus*), followed by yellowfin tuna (*T.albacares*) and swordfish (*Xiphias gladius*).

The most caught species in total weight were bigeye tuna with 24.7% of the catches, yellowfin tuna 20.5%, albacore (*T.alalunga*) 15.8%, swordfish 15.3%, white marlin (*Tetrapturus albidus*) 2.9%, blue marlin (*Makaira nigricans*), 1.0%, sailfish (*Istiophorus albicans*) 0.4%. Bluefin tuna or Southern bluefin tuna (*T.thynnus or T.maccoyii*) 0.2% and other fish (19.2%), as sharks (*Isurus oxyrinchus, Prionace glauca, Sphyrna spp.*) and others, wahoo (*Acanthocybium solandri*), dolphin (*Coriphaena hippurus*), sunfish (*lampris regis*), skipjack (*Katsuwonus pelamis*) and others species.

3.4. Catch per unit of effort

The CPUE, expressed in total weight was in average 1,190 kg per 1,000 hooks, in the Atlantic Ocean, where the tunas contributed with 728 kg/1,000 hooks and the marlins 51 kg/1,000 hooks.

The higheast tunas CPUE occured in 1981 with 1,068 kg/1,000 hooks. Until 1986, the average was 811 kg/1,000 hooks. From 1987 to 1991 this CPUE declined to around 614 kg/1,000 hooks.

Figure 2 shows the CPUE of tunas by quarter in the three main fishing sub-areas in the South of Brazil. Figure 4 shows the trend of CPUE in total weight for tunas, swordfish, billfish and sharks obtained by the leased fleet.

The annual trend of CPUE from the main species is showed in Figure 5, and Figure 6 shows the trend of CPUE by quarters, by groups of species: tunas, swordfish, marlins, sharks and others

4. OBSERVATIONS AND CONCLUSIONS

The leased Japonese longliners basically operated in the South coast of Brazil, more especifically off Rio Grande do Sul State, between 30° to 35° S. In this area 73.1% of the total effort of fleet fishing was set.

The hightest occurrence of tunas in this region happens from May to October, when the waters suffer great influence of Malvinas current, originated from Antartic region. The most abundant species in winter are: the bigeye tuna, albacore and yellowfin tuna. Swordfish presented the hightest catches in July and August.

The presence of large tunas in the South coast, may be related to trophic characteristics, especially by the presence of squids found in great quantity in the stomach contens of the studied species, Antero Silva, 1982.

Tuna is the main goal of Japanese fisheries, especially the bigeye tuna and yellowfin tuna. The fisheries in the farther South Coast of Brazil, presents a high CPUE, and also, according to the Japanese, fish specimens with high fat meat, what increases the price of the product.

Due to the low CPUE in spring and summer, the longliners have moved to others areas, usually in equatorial region, from Brazilian Northeast coast, Ascencao Islands to surroundings of Africa.

In Brazil, in Espirito Santo and Rio de Janeiro State coast, around of 20° South latitude, high catches of white marlin and sailfish were registered, in spring of 1977 and summer of 1978, when tuna boats caught the major part of their production. Therefore, due to the low price of fish in the market that alternative fishing area was not used in the following years.

From 1986 to 1990 a remarkable increase in fishing effort occured. However it did not result in a proportional increase in yield (Table 4), due to the decline in CPUE (Table 5).

The high CPUE in 1981 was influenced by a higher proportion on the fishing effort set in the winter. This year all the fishery was operated in the South coast of Brazil.

The lowest CPUE in the whole period occurred in the last three years, in 1990 with a minimum of 30.1 fish/1,000 hooks.

The trend of catches obtained through CPUE, expressed in kg/1,000 hooks, showed an annual decrease, according to Figure 4. The tunas showed declining oscillation in the CPUE.

In the whole period (from 1977 to 91) the average CPUE for tunas was 728 kg/thousand hooks. From 1977 to 1986 the CPUE was 811 kg/1,000 hooks, and in the last five years (from 1987 to 91) the CPUE was reduced to 614 kg/1,000 hooks.

In this period the yellowfin presented an average of 244 kg/1,000 hooks. In the last five years the CPUE was below average, 183 kg/1,000 hooks, except in 1989. This is the specie with largest occurence in the Southwestern Atlantic. The highest catches in this region occurs from June to December, with a highest occurence in October, when it presented an average of 26,7% specimens with 262 kg/1,000 hooks.

The CPUE for albacore has fluctuated below average of longliners catch (188 kg/1,000 hooks) from 1987 to 1990, when reached only 150 kg/1,000 hooks.

The CPUE for bigeye was maintained, because the fleet especially aimed their fisheries to this species. Nevertheless in the last three years the CPUE was below average.

The trend of swordfish was characterized by remarkable annual oscillations, with an average of 182 kg/1,000 hooks in the period from 1977 to 1991. In the last five years there was an increase in yield, with 201 kg/1,000 hooks, influenced by the year of 1990, that presented a high CPUE. This oscillations was remarked for Mora et all, 1990.

The fourteen years of leased Japanese fleet operations in Brazil contributed in a fundamental way to the knowledge of the main tunas species and alike in the Brazilian coast. The data obtained during this study enabled to determine the seasonal and monthly distribution, stratified in fishing sub-areas. Besides this aspect, the oceanographic information, associating temperature to the catches, help the study of these species in the fisheries. The modifications in the fishing technics, schedules of setting and hauling the longline, show how to aim the fisheries to a species, or a group of species.

5. REFERENCES

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Table 1. Characteristics of Japanese Longliner fleet.

Boat	Nr	Length			Gross tonnage			Oil			Fish		
		Min	Max	Aver	Min	Max	Ave	Min	Max	Ave	Min	Max	Aver
Big	19	42	60.5	50.5	282	474	348	203	554	328	350	676	457
Small	2	24.5	28.7	26.6	82	97	89	31	66	48	46	83	64
Total	21	24.5	60.5	48.2	82	474	324	31	554	301	46	676	420

Table 2. Fishing Effort in Hooks, set for Japanese Longliners in Atlantic from 1977 to 1991.

Year	Boats	Area I	Area II	Total
1977	3	80880	192945	273825
1978	3	918283	535785	1454068
1979	5	1047002	130815	1177817
1980	5	1225202	53340	1278542
1981	4	1178950	0	1178950
1982	6	2179716	61200	2240916
1983	4	1725139	56450	1781589
1984	3	656810	425321	1082131
1985	3	785459	296020	1081479
1986	6	1565167	684219	2249386
1987	5	1813252	416489	2229741
1988	5	1878430	548485	2426915
1989	5	1871264	348385	2219649
1990	5	1716775	475935	2192710
1991	2	758515	249925	1008440
Total	0	19400844	4475314	23876158

SOURCE: CEPERG - IBAMA, Rio Grande - RS - Brazil
Coverage: 100%

Table 3. Number of Tuna Fishing and others catched in Atlantic by leased longliner fleet.

Year	BFT	YFT	ALB	BET	SWO	SAI	WHM	BUM	OTH	TOTAL
77	27	1200	2088	1446	144	*	6656	*	4075	15636
78	1033	15128	17095	10040	2464	1452	5223	198	8233	60866
79	1336	16578	11068	8963	2883	1190	4061	29	7872	53980
80	232	13193	9598	7642	5740	440	941	52	10715	48553
81	386	37773	11512	10568	3412	11	187	26	13995	77870
82	331	32075	26781	8973	7368	580	2778	77	27027	105990
83	53	27146	27296	8651	5412	425	952	79	20263	90277
84	1	4528	14322	12512	2512	48	270	153	8269	42615
85	8	10132	11366	9930	4587	96	1548	216	11550	49433
86	75	26273	23369	21329	5641	76	1576	186	15449	93974
87	135	20816	14012	16129	7988	147	1119	168	21042	81556
88	19	33052	17912	18483	8282	275	1324	288	19699	99334
89	271	28180	19851	10200	4870	51	1198	208	8609	73438
90	62	4680	18952	12972	11489	58	1433	209	16269	66124
91	37	8700	10424	5276	2341	18	785	113	7497	35191
TOT	4006	279454	235646	163114	75133	4867	30051	2002	200564	994837

* Included in WHM catch.
SOURCE: CEPERG - IBAMA, Rio Grande - RS - Brazil.

Table 4 - Catch, CPUE per 1000 hooks in the Atlantic Ocean from 1977 to 1991

	Area	W Total	BFT	YFT	ALB	BET	SWO	SAI	WHM	BUM	SKJ
Catch kg	I	23654598	38674	5080939	4282091	4764238	4019949	15846	328510	110734	5013617
	II	4773547	2735	755040	211065	2242398	329245	85087	510687	182251	455039
	Atlant	28428145	41409	5835979	4493156	7006636	4349194	100933	839197	292985	5468656
Catch No	I	868820	3825	260954	227250	110491	69145	736	12464	499	183456
	II	126017	181	18500	8396	52623	5988	4131	17587	1503	17108
	Atlant	994837	4006	279454	235646	163114	75133	4867	30051	2002	200564
CPUE kg	I	1219	2	262	221	245	207	1	17	6	258
	II	1067	1	169	47	501	73	19	114	41	102
	Atlant	1190	2	244	188	294	182	4	35	12	229
CPUE No	I	44.8	0.2	13.5	11.7	5.7	3.6	0.0	0.6	0.0	9.5
	II	28.1	0.1	4.1	1.9	11.8	1.3	0.9	3.9	0.3	3.8
	Atlant	41.7	0.2	11.7	9.9	6.8	3.1	0.2	1.3	0.1	8.4

SOURCE: IBAMA - CEPERG
Rio Grande - RS - Brazil
live weight in kilogram
CPUE KG = KG / 1000HOOKS
CPUE NR = NR / 1000HOOKS

Table 5 - Anual catch and effort per leased fleet in Atlantic Ocean

Year	Boats	FED	Hooks	W Total	BFT	YFT	ALB	BET	SWO	SAI	WHM	BUM	SKJ
1977	3	136	273825	497884	182	45712	55287	65280	11985		226741		92697
1978	3	729	1454068	1803594	13892	378390	362991	465748	154140	31543	145582	24633	226675
1979	5	637	1177817	1584403	9869	381422	216548	405417	200332	26006	111707	4122	228980
1980	5	730	1278542	1667333	1611	283351	204086	392613	409522	11873	26051	9079	329147
1981	4	665	1178950	1901698	2845	727192	187140	341417	222804	223	4277	5026	410774
1982	6	1156	2240916	2816269	2524	582100	537120	464013	390823	7967	56108	14185	761429
1983	4	790	1781589	2361029	1286	504674	472184	378231	282827	6670	25198	15298	674661
1984	3	474	1082131	1310944	52	131753	280078	521707	121771	744	7739	20142	226958
1985	3	472	1081479	1489177	560	276353	225884	363783	227307	1919	36713	24123	332535
1986	6	1121	2249386	2662482	2462	676007	435721	788991	304135	1625	38653	28076	386812
1987	5	1038	2229741	2422173	2053	409274	262191	691274	511158	3686	31216	26065	485256
1988	5	1115	2426915	2730128	892	476496	327689	885248	470085	5872	35009	44598	484239
1989	5	888	2219649	1998266	1894	634123	372211	471250	241476	986	31352	28726	216248
1990	5	946	2192710	2166221	1080	121938	355532	534452	679280	1458	40946	30870	400665
1991	2	420	1008440	1016543	204	207193	198494	237213	121549	361	21906	18042	211581
Total		11317	23876158	28428144	41406	5835978	4493156	7006637	4349194	100933	839198	292985	5468657

SOURC IBAMA - CEPERG
Rio Grande - RS - Brazil
live weight in kilogram
IN 1977 they are all Marlins in WM

Table 6. Catch per unit of effective effort in kilogram per 1000 hooks.

Year	Tuna	Sworfish	Marlins	Others	Total
1977	608	44	828	338	1818
1978	839	106	139	156	1240
1979	840	170	120	195	1345
1980	691	320	36	257	1304
1981	1068	189	8	348	1613
1982	708	174	35	340	1257
1983	761	159	26	379	1325
1984	863	112	26	210	1211
1985	802	210	58	307	1377
1986	847	135	30	172	1184
1987	612	229	28	217	1086
1988	696	194	36	199	1125
1989	667	109	27	97	900
1990	462	310	33	183	988
1991	637	121	40	210	1008
Aver	828	182	51	229	1190

SOURCE: IBAMA - CEPERG, Rio Grande - RS - Brazil

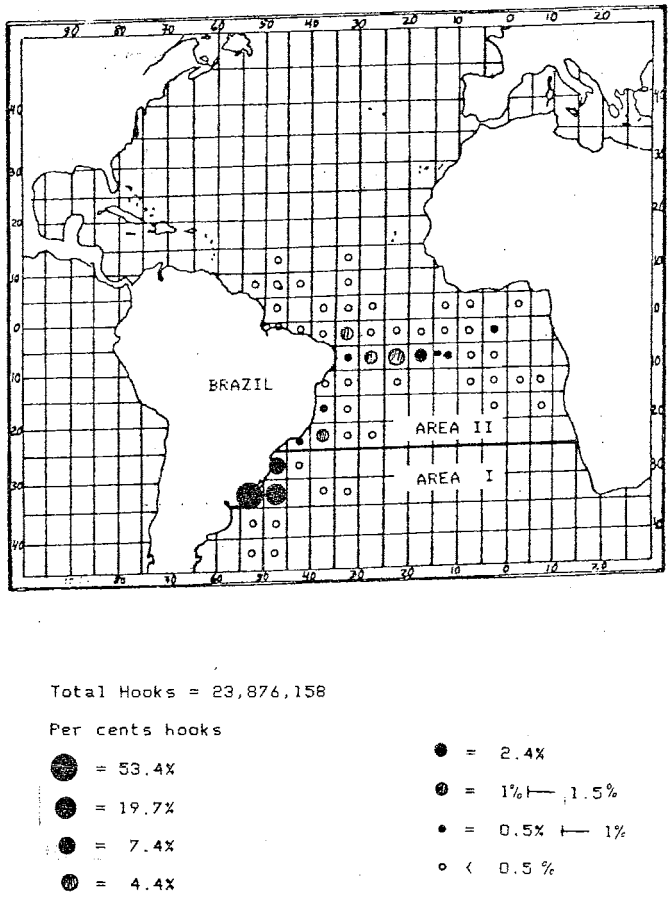

Figure 1. Relative effort in number of hooks used by the leased Japanese longline fleet in the Atlantic Ocean, 1977-1991.

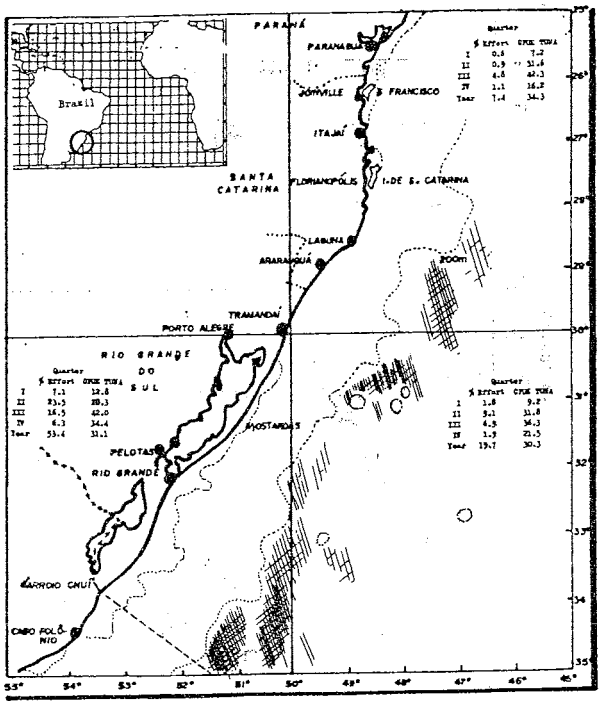

Figure 2. Quarterly catch per unit of effort (in number per 1000 hooks) of tunas and relative effort (in number of hooks) in south Brazil, 1977-1991.

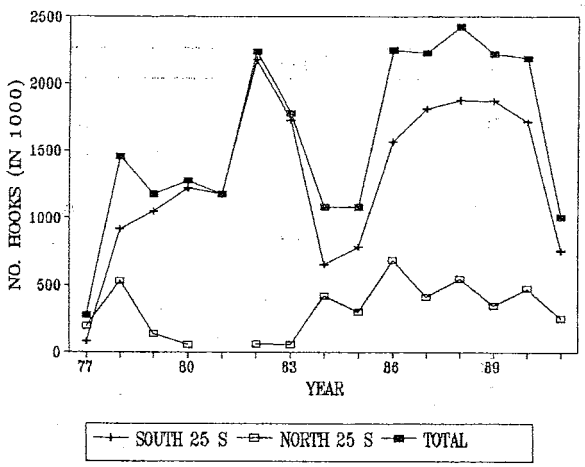

Figure 3. Effective effort (in number of hooks) by leased Japanese longline fleet, in the south and north of 25°S, Atlantic Ocean, 1977-1991.

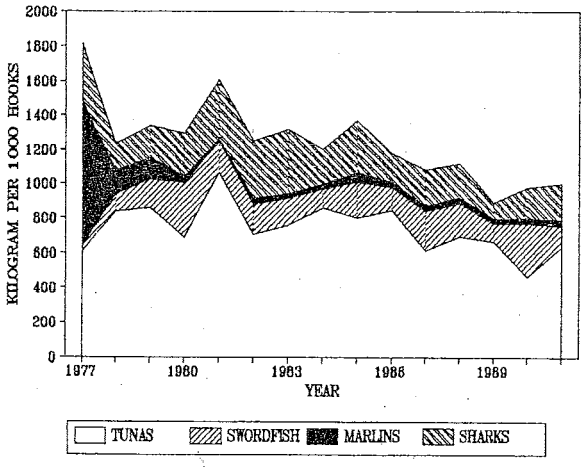

Figure 4. Annual catch per unit of effort, in the Atlantic Ocean, 1977-1991.

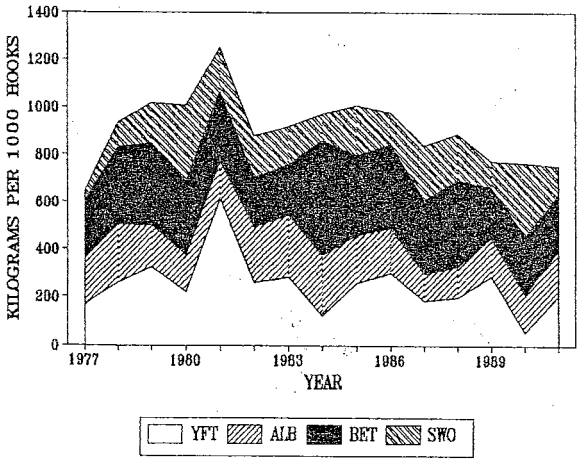

Figure 5. Annual catch per unit of effort for principal tunas and swordfish in the Atlantic Ocean, 1977-1991.

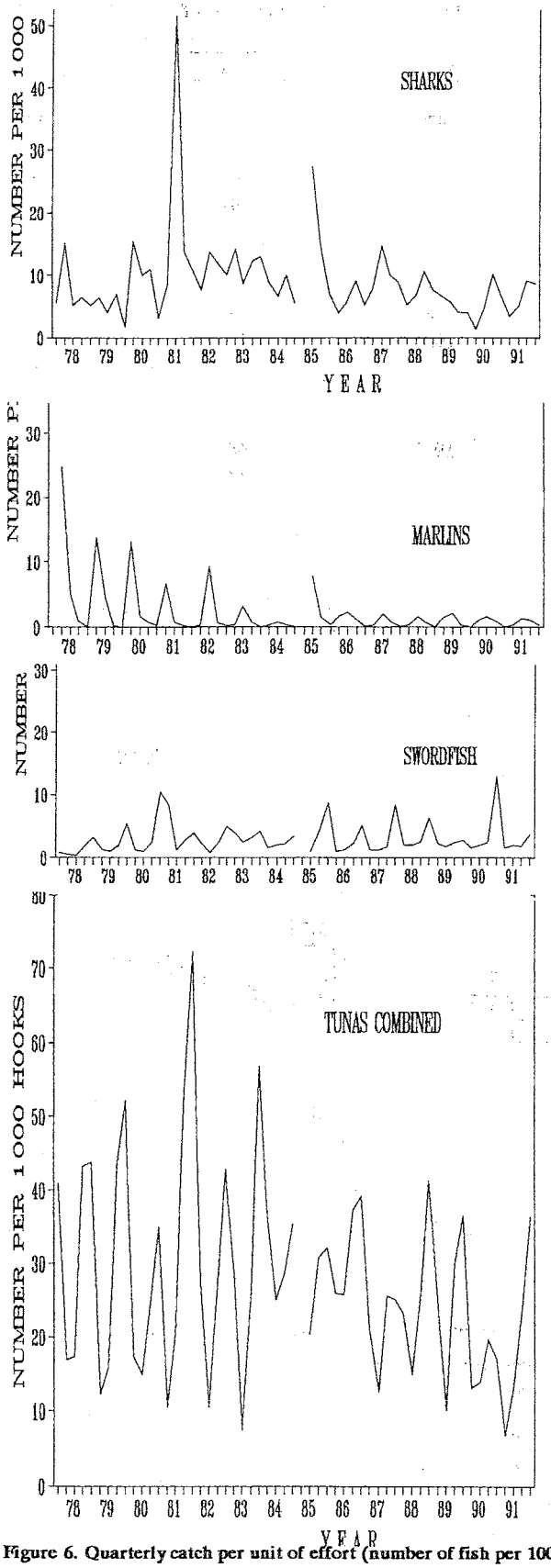

Figure 6. Quarterly catch per unit of effort (number of fish per 1000 hooks) for tunas, swordfish, marlins and other fishes.