

OVERALL FISHING INTENSITY OF JAPANESE LONGLINE FISHERY  
FOR BIGEYE TUNA IN THE ATLANTIC OCEAN, 1956-1970

by  
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SUMMARY

Catch statistics of Japanese longline fishery in the Atlantic Ocean were processed through Honma's methods to calculate overall fishing intensity on bigeye tuna during 1956 through 1970. The Japanese fishing intensity showed a gradual increase up to 1965, and then fluctuated at a fairly low level, about 30 to 40 percent of the peak reached in 1965. After a rapid increase over the first five years, the hook rate stayed at a fairly stable level, that is, about one tenth of that of yellowfin tuna or albacore during the early years of exploitation. The low density, together with the fairly stable hook rate, suggests that the species has not been fully exploited by the longline fishery.

INTENSITE DE LA PECHE DANS SON ENSEMBLE DE LA PECHERIE PALANGRIERE JAPONAISE  
DE THON OBESE DANS L'ATLANTIQUE, 1956-1970

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RESUME

Les statistiques de captures de la pêcherie palangrière japonaise dans l'Atlantique ont été traitées selon la méthode de Honma pour calculer l'intensité de la pêche dans son ensemble portant sur le thon obèse de 1956 à 1970. L'intensité de la pêche japonaise s'est graduellement accrue jusqu'en 1965, et a ensuite oscillé à un niveau assez faible, environ 30 % à 40 % du maximum atteint en 1965. Après une rapide augmentation au cours des premières années, le taux de prises par hameçon est demeuré à un niveau à peu près constant, environ un dixième de celui de l'albacore ou du germon au cours des premières années d'exploitation. La faible densité, associée à un taux de prises par hameçon relativement stable, semble indiquer que l'espèce n'a pas été exploitée à fond par la pêcherie palangrière.

INTENSIDAD PESQUERA TOTAL DE LA PESQUERIA JAPONESA CON PALANGRE  
DE PATUDO EN EL OCEANO ATLANTICO, 1956-1970

por  
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RESUMEN

Se procesaron las estadísticas de capturas de la pesquería japonesa con palangre en el Océano Atlántico por los métodos de Honma para calcular la intensidad total pesquera sobre patudo durante el periodo 1956 a 1970. La intensidad pesquera de Japón reveló un aumento gradual hasta 1965, y después fluctuó hasta un nivel bastante bajo, que representa alrededor

de un 30-40 % de la cota más alta alcanzada en 1965. Después de un rápido incremento durante los cinco primeros años, el índice de capturas por anzuelo se mantuvo a un nivel bastante estable, es decir aproximadamente una décima parte del nivel de rabil o albacora durante los primeros años de la explotación. La densidad escasa, junto con el índice de capturas por anzuelo relativamente bajo, sugiere que la especie no ha sido plenamente explotada por la pesquería con palangre.

Overall fishing intensity of Japanese longline fishery for bigeye tuna in the Atlantic Ocean, 1956-1970.

Koichi Hisada

Studies of stock assessment have been less advanced for bigeye tuna in the Atlantic Ocean than the same species in the other oceans (Kamimura *et al.* 1966, Suda and Kume 1967, Suda 1970a, b), or for yellowfin tuna in the same ocean (Hayasi *et al.* 1970, ICCAT 1972). Recently some large-sized Japanese longliners are interested in exploiting bigeye tuna in the Atlantic Ocean for domestic consumption (Shiohama 1971, Hayasi *ms*). Such industrial activity stimulates studies to define appropriate level of fishing effort for the stock under discussion. At the same time, French scientists commence investigations of the stock in the eastern Atlantic surface fishery (personal communication of 19 August 1972 from Dr. C. Champagnat, ORSTOM, to Dr. Sigeiti Hayasi of our laboratory).

1. Data and methods of calculation

The present study is essentially a continuation of researches on yellowfin tuna (Honma *ms*) and albacore (Shiohama *ms*), and based on the almost same data and methods except the following three points.

(1). Extent of area for calculation. Distribution range of bigeye tuna in the Atlantic Ocean extends from Lat. 50°N and Lat. 50°S (Hayasi *et al.* 1970, Fisheries Agency 1972). The fish seems to spawn mainly in the tropical waters, and move toward higher latitude waters at the immature stage (Sakamoto 1967, 1969). It is not confirmed whether or not the southern and northern immatures belong to different stocks.

The "Atlantic Ocean" in the present study is defined as in the comparable work on albacore by Shiohama (*ms*). Namely it covers an area delineated by Lat. 50°N and 50°S lines, by Long. 20°E and coast lines of Africa and Europe, and by coast lines of South and North America.

(2). Definition of average years. It seems possible to presume that the bigeye tuna stock in the Atlantic Ocean did not remarkably decrease for the last 15 years because the fish might have not been intensively exploited (Hayasi *ms*). The "average years" are defined simply as the five years between 1966 and 1970.

(3). Amount of yield in weight. Most data are taken from the ICCAT Statistics (1971). Provisional figures of Japan's yield for 1969 and 1970 in the Bulletin are replaced by final figures reported to the ICCAT Headquarter by national correspondences of 22 May and 14 September 1972. Yields in 1970 from most countries are those presented at the meeting of the ICCAT Special Working Group on Stock Assessment of Yellowfin Tuna held in Abidjan, 12-16 June 1972. FAO statistics (1971) provides minor catch which were not included in the ICCAT Statistics". Sources of these data are given in footnotes of Table 1.

2. Amount of effective fishing effort and overall fishing intensity on bigeye tuna of Japanese longline fishery, 1956-1970.

(1). Table 2 presents monthly extent of fishing ground in the average years, and amount of effective fishing effort and overall fishing intensity in the fifteen years from 1956 to 1970. The fishing ground widens in later half of the year. The area in October reaches 1.4 times as wide as that in March.

(2). Resultant fishing intensity shows very close year-to-year fluctuation with that in fishing effort by Shiohama (1971), at a correlation coefficient of 0.9943, for 14 years up to 1969 (Fig. 1).

(3). The fishing intensity increases gradually from 500 hooks per 5° square in 1956 to 845,700 hooks in 1965 as in the cases of yellowfin tuna and albacore. In the following five years the intensity has fluctuated between 219,800 and 320,000 hooks per 5° square.

3. Relations between overall fishing intensity for bigeye tuna and either the hook rate, catch or yield in the whole Atlantic longline fishery, 1956-1970.

Japanese yield did not always occupy major portion of bigeye tuna taken by longline fishery in the Atlantic Ocean. Especially, the former hardly reaches a half of the latter in the recent two years (Table 1). Nevertheless, it is assumed that abundance of bigeye tuna in a year is represented in the annual average hook rate, or catch divided by yearly total of effective effort, in Japanese fishery, because Task 2 data have been continuously obtained only from that fleet. Catch in number of and fishing intensity for the species in the whole fleet are conjectured by multiplying the estimates for Japanese fishery and ratio of the whole yield to the Japanese yield (Table 3).

The hook rate increased from 0.25-0.48 percent in early five years of exploitation to over 0.5 percent in the later ten years, against increase of fishing intensity. This apparently contradictory relation reflects that the Japanese longline fleet has not yet intensively exploited the bigeye tuna stock. Furthermore, it is noted that these density indices of bigeye tuna are about one-tenth of those found in yellowfin tuna or albacore during the beginning years of exploitation. The low density also implies under-exploitation of bigeye tuna in the Atlantic longline fishery unless the stock is much smaller than the other two fishes. (Fig. 2).

#### 4. Future researches.

Up to 1970, at least, the bigeye tuna in the Atlantic Ocean have not been fully exploited, and then the available data may not be sufficient to represent abundance of the stock. It is now planned to incorporate the catch statistics in the following years and length data in the present calculation systems for better understanding of distribution and abundance of the stock.

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TABLE 1 - Estimated amount of catch of bigeye tuna in the Atlantic Ocean, 1957-1970.

Country	Fishing gear	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Grand total	Total	454	453	1,478	3,004	11,244	15,964	14,946	20,407	31,263	21,340	21,111	19,079	27,673	23,120
	Longline	454	453	1,478	3,004	11,244	15,938	14,731	17,577	29,038	18,838	11,048	16,420	20,252	18,496
	Surface	..	..	..	..	..	26	215	2,830	2,225	2,502	10,063	2,659	7,421	4,624
Argentine	Longline	..	..	..	100	200	200	200	200 <sub>c</sub>	400 <sub>c</sub>	200 <sub>c</sub>	0 <sub>c</sub>	400 <sub>c</sub>	200 <sub>b</sub>	100 <sub>c</sub>
Côte d'Ivoire	Surface	..	..	..	..	..	..	..	-	-	-	-	..	200 <sub>b</sub>	
Cuba	Longline	..	..	..	..	..	..	..	-	100	300	300	900	1,000	0 <sub>b</sub>
France	Surface	..	..	..	..	..	..	..	.. <sub>c</sub>	.. <sub>c</sub>	300 <sub>c</sub>	7,200 <sub>c</sub>	500 <sub>c</sub>	3,600 <sub>c</sub>	900 <sub>c</sub>
Ghana	Surface	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Japan	Subtotal	454	453	1,478	2,904	11,044	15,746	14,505	17,366	28,663	17,578	9,012	11,345	10,739 <sup>a</sup>	9,117 <sup>a</sup>
	Longline	454	453	1,478	2,904	11,044	15,720	14,490	17,336	28,538	17,576	8,549	10,286	10,266	8,993 <sup>a</sup>
	Purse seine	-	-	-	-	-	-	-	-	-	-	82	413	161 <sup>a</sup>	92 <sup>a</sup>
	Pole-and-line	-	-	-	-	-	26	15	30	125	2	381	646	312	32 <sup>a</sup>
Korea	Longline	-	-	-	-	-	-	..	..	..	249	276	227	1,601	4,079 <sub>c</sub>
Portugal	Bait boat	..	..	..	..	..	..	..	2,600	2,100	2,200	2,200	1,100	2,000	2,000 <sub>c</sub>
Senegal	Surface	..	..	..	..	..	..	..	.. <sub>c</sub>	.. <sub>c</sub>	0 <sub>c</sub>	400 <sub>c</sub>	0	100 <sub>b</sub>	200 <sub>b</sub>
Spain	Surface	..	..	..	..	..	..	..	.. <sub>c</sub>	.. <sub>c</sub>	.. <sub>c</sub>	.. <sub>c</sub>	.. <sub>c</sub>	1,100 <sub>b</sub>	1,200 <sub>b</sub>
South Africa	Trolling	..	..	..	..	0	0	200	200	..	..	..	..	..	.. <sub>b</sub>
Taiwan	Longline	-	-	-	-	-	18	41	41	..	513	1,923	4,607	7,185	5,324 <sub>b</sub>
United States	Purse seine	-	-	-	-	-	-	-	-	-	-	-	-	148	- <sub>c</sub>
Venezuela	Longline	..	..	..	..	..	..	..	..	..	..	..	0	0	..

Notes.

- (1) Remarks for minor catch. No figure=no information, .. = No data inspite of presence of fishery, - = No catch, and 0 = minor amount of catch.
- (2) Source of data. No sign: Data from ICCAT Statistical Bulletin, vol. 1 (1971), given in tons except those for Argentine, Cuba, France, Portugal, Senegal, South Africa and Venezuela in 100 tons and for United States in 100 kg.
  - (a): Japanese correspondences of 22 May 1972 and 14 September 1972 to ICCAT Secretariat.
  - (b): Data presented at the Meeting of the ICCAT Special Working Group on Stock Assessment of Yellowfin Tuna, Abidjan, June 12-16 1972, given in tons except those for Argentine, Côte d'Ivoire, France, Korea, Senegal, Spain and Taiwan in 100 tons, and,
  - (c): Data cited from FAO (1971, p. 336-337), given in 100 tons.

TABLE 2 - Extent of fishing ground in 5<sup>o</sup> square in "average years from 1966 to 1970", and amount of effective effort in thousand hooks and overall fishing intensity in thousand hooks per 5<sup>o</sup> square of Japanese longline fishery for bigeye tuna in the Atlantic Ocean, 1956-1970.

Month	Area	1956		1957		1958		1959		1960	
		X	f	X	f	X	f	X	f	X	f
Total	(1,639.75)	(70)	(0.5)	(2,489)	17.5	(5,901)	441.9	(10,826)	77.2	(14,609) <sup>3</sup>	104.9
1	132.06	-	-	-	-	446	3.4	706	5.3	540	4.1
2	128.56	-	-	9	0.1	132	1.0	311	2.4	543	4.2
3	109.86	-	-	8	0.1	189	1.7	249	2.3	451	4.1
4	150.95	-	-	45	0.3	160	1.2	477	3.6	800	6.1
5	155.32	-	-	188	1.4	343	2.6	755	5.7	929	7.0
6	148.36	8	0.1	189	1.3	684	4.6	947	6.4	1,821	12.3
7	154.76	2	0.0	326	2.4	537	4.0	1,514	11.2	1,987	14.7
8	158.46	15	0.1	214	1.5	188	1.4	1,008	7.3	1,509	10.9
9	144.25	17	0.1	354	2.5	766	5.3	1,039	7.2	1,954	13.5
10	156.68	22	0.1	401	2.6	1,028	6.6	1,722	11.0	1,255	8.0
11	142.08	2	0.0	255	1.8	581	4.1	1,535	10.8	1,716	12.1
12	140.45	5	0.0	499	3.6	847	6.0	563	4.0	1,099	7.8

Table 2. Continued.

Month	1961		1962		1963		1964		1965	
	X	f	X	f	X	f	X	f	X	f
Total	(31,929)	230.0	(50,852)	369.3	(46,114)	337.9	(57,853)	418.9	(114,636)	845.7
1	1,226	9.3	1,107	8.4	1,290	9.8	1,299	9.8	6,594	48.4
2	1,150	8.9	3,486	27.1	3,728	29.0	3,410	26.5	6,515	50.7
3	955	8.7	2,815	25.6	2,973	27.1	4,183	38.1	10,559	96.1
4	1,124	8.6	2,892	22.1	5,034	38.4	4,018	30.7	10,905	83.3
5	2,025	15.2	6,633	49.8	6,840	51.3	3,449	25.9	8,170	61.3
6	2,821	19.0	3,449	23.2	1,149	7.7	1,107	7.5	7,791	52.5
7	5,645	41.9	5,383	39.9	2,149	15.9	3,523	26.1	16,849	125.0
8	6,760	48.8	7,103	51.3	7,004	50.6	8,116	58.6	13,540	97.8
9	1,179	8.2	6,409	44.4	6,603	45.8	8,671	60.1	11,175	77.5
10	3,643	23.3	6,370	40.7	5,507	35.1	9,305	59.4	11,010	70.3
11	3,971	28.0	3,559	25.0	2,938	20.7	5,793	40.8	7,787	54.8
12	1,431	10.2	1,645	11.7	900	6.4	4,975	35.4	3,942	28.1

Month	1966		1967		1968		1969		1970	
	X	f	X	f	X	f	X	f	X	f
Total	(42,367)	320.5	(30,158)	219.8	(31,871)	230.2	(41,691)	305.2	(36,908)	269.7
1	3,779	28.6	1,929	14.6	2,146	16.2	913	6.9	2,046	15.5
2	7,573	58.9	4,454	34.6	1,674	13.0	1,712	13.3	2,944	22.9
3	6,106	55.6	1,722	15.7	1,781	16.2	2,162	19.7	2,855	25.8
4	3,801	29.0	2,012	15.4	1,277	9.8	4,596	35.6	2,886	22.0
5	3,165	23.7	1,563	11.7	2,317	17.4	5,958	44.7	2,279	17.1
6	2,463	16.6	1,172	7.9	3,333	22.5	3,443	23.2	2,400	16.2
7	2,763	20.5	2,103	15.6	4,309	32.0	5,433	40.3	3,584	26.6
8	3,050	22.0	1,431	10.3	3,840	27.7	6,578	47.5	2,517	18.2
9	3,356	23.3	2,701	18.7	4,952	34.3	5,523	38.3	4,125	28.6
10	3,432	21.9	4,352	27.8	4,401	28.1	2,503	16.0	4,324	27.6
11	1,680	11.8	4,220	29.7	1,373	9.7	1,737	12.2	4,258	30.0
12	1,197	8.5	2,498	17.8	468	3.3	1,331	9.5	2,711	19.3

Table 3. Hook rate, catch in number of fish, yield in weight, and overall fishing intensity of bigeye tuna in Japanese longline fishery, and catch, yield and overall fishing intensity in the whole longline fishery operated in the Atlantic Ocean, 1956-1970.

Year	Hook rate in percent	Japanese fleet			Whole fleet		
		Catch in number of fish	Yield in tons	Intensity in 1,000 hooks per 5° square	Catch in 1,000 fish	Yield in 1,000 tons	Intensity in 1,000 hooks per 5° square
1956	0.2716	191	..	0.5	0	..	0.5
1957	0.3476	8,650	454	17.5	9	0	17.5
1958	0.2512	14,824	453	41.9	15	0	41.9
1959	0.4141	44,825	1,478	77.2	45	1	77.2
1960	0.4837	70,639	2,904	104.9	73	3	108.5
1961	0.7621	243,349	11,044	230.0	248	11	234.1
1962	0.7234	367,887	15,720	369.3	373	16	374.4
1963	0.6187	285,310	14,490	337.9	290	15	343.5
1964	0.5942	343,732	17,336	418.9	349	18	424.8
1965	0.5669	649,838	28,538	845.7	661	29	860.5
1966	0.5479	232,122	17,576	320.5	249	19	343.5
1967	0.5998	180,893	8,549	219.8	181	11	284.1
1968	0.6420	204,599	10,286	230.2	328	16	369.3
1969	0.6324	263,635	10,266	305.2	520	20	602.0
1970	0.5126	189,203	8,993	269.7	389	18	554.8

Only Japanese data are available for 1956-1959.

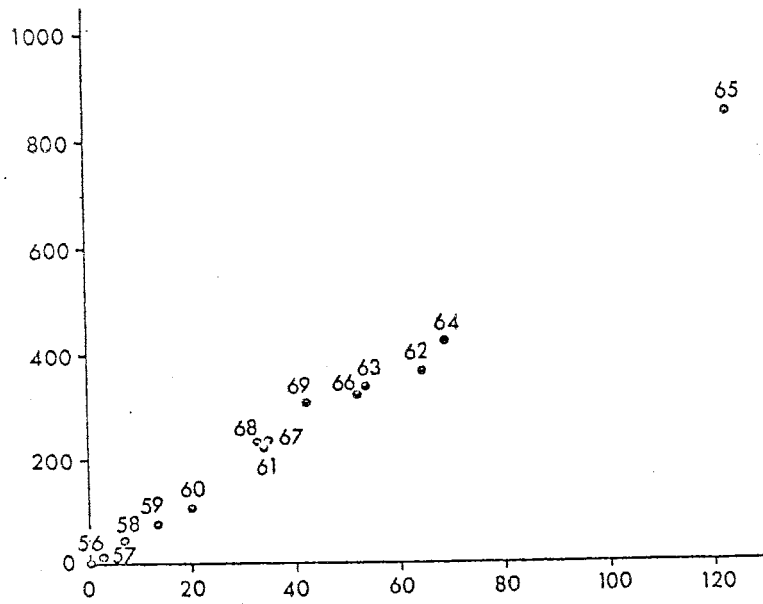


Fig. 1. Relation between amount of fishing effort in million hooks by Shiohama (1971) on ordinate and present estimates of overall fishing intensity in thousand hooks per 5° square on abscissa, of Japanese longline fishery for bigeye tuna in the Atlantic Ocean, 1956-1969.

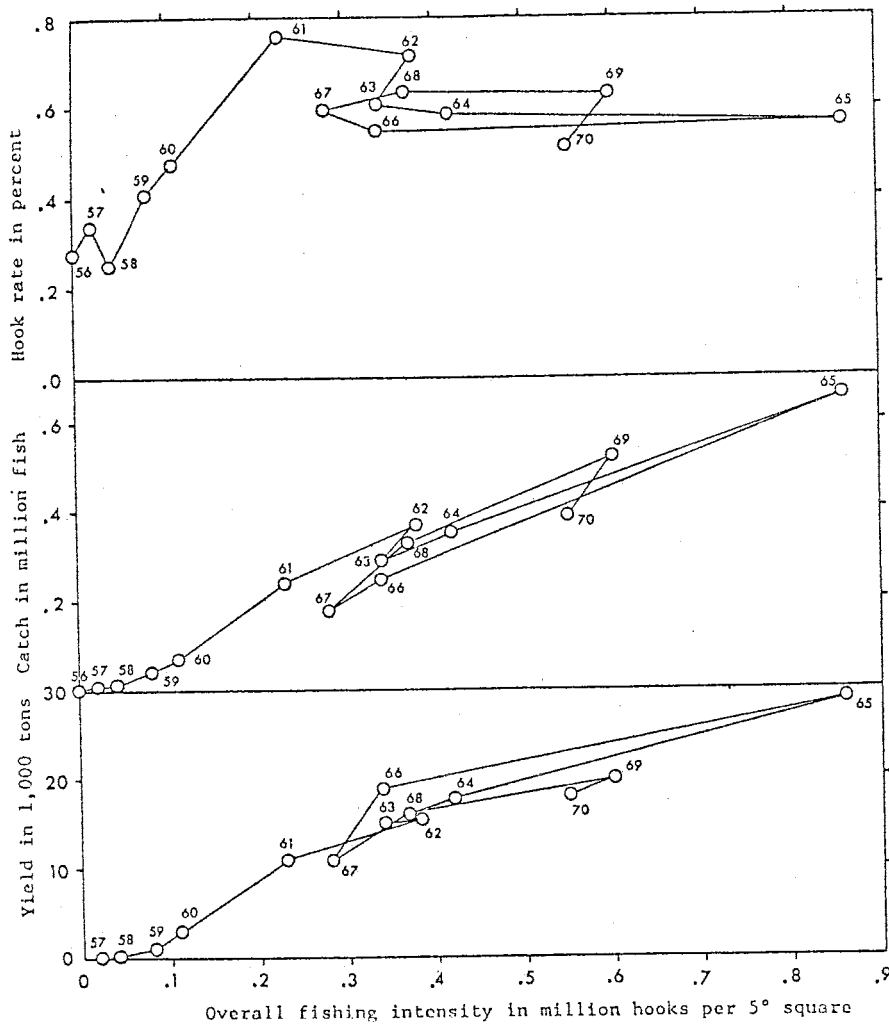


Fig. 2. Density in hook rate, catch in number, and yield in weight of bigeye tuna, against overall fishing intensity in the whole Atlantic longline fishery, 1956-1970.