

OVERALL FISHING INTENSITY OF ATLANTIC LONGLINE FISHERY FOR BIGEYE TUNA, 1956-76

by

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SUMMARY

This report is to estimate the overall fishing intensity for bigeye tuna caught by the longline fishery in 1976 and update the series of this study. The estimation was made for three areas, whole Atlantic, North, and South Atlantic. The results indicated that both the catch and fishing intensity of the whole longline fleet in 1976 declined remarkably compared with the recent few years. The decrease in hook rate estimated from Japanese and Taiwanese fleet was observed larger in the North Atlantic area.

RESUME

Ce rapport présente des estimations de l'intensité d'ensemble de la pêche correspondant aux captures palangrières de thon obèse en 1976, ainsi qu'une mise à jour des séries étudiées. Les estimations portent sur trois zones: Atlantique entier, nord et sud. Les résultats montrent que, en 1976, la capture et l'intensité de pêche ont toutes deux considérablement diminué par rapport à ces dernières années. On a observé que la baisse du taux par hameçon estimée pour les flottilles japonaise et taiwanaise était plus importante dans le nord de l'Atlantique.

RESUMEN

En este informe se estima la intensidad de pesca global aplicada, referente al patudo capturado por la pesquería de palangre en 1976 y se actualizan las series de este estudio. La estimación se dirige a tres zonas principales: conjunto del Atlántico, Norte y Sur del Atlántico. los resultados señalan que en 1976, tanto la captura como la intensidad de pesca de toda la pesquería palangrera disminuyeron sensiblemente en relación con años precedentes. Se observa que el descenso en la tasa de anzuelos -estimado a partir de datos de las flotas de Japón y Taiwan- fue más acusado en el Atlántico Norte.

1. Longline fishery for bigeye tuna in the Atlantic in 1976.

It is shown from the catch statistics by country that 8 nations participated in catching bigeye tuna by longline fishery (Table 1). The total catch declined from 36 thousand tons in 1975 to 21 thousand tons in 1976. Most of the catch, more than 80%, was achieved by Japanese, Korean and Taiwanese fleet. The catch distribution of longline bigeye is shown by country in Figs. 1-4. It is indicated that Japanese and Taiwanese fleet are taking more bigeye tuna in temperate waters than in tropical waters, whereas catches of Korean and Cuban fleet are centered in low latitudes. These information was used to separate the catch and effort data into north and south Atlantic.

2. Standardization of nominal effort to effective effort.

Distribution of certain fish is generally not uniform, so that fishing effort invested on the area of higher density will be more effective in the catchability than that invested on the area of lower density. If the density of the fish in certain small unit area, 5 degree square in this study, is the same as the average density of the stock, the unit of effort, in terms of number of hooks in this study, invested on such area will take constant rate (q) of amount from the fishable stock. When the density of i -th unit area is r_i times as much as the average density, the catchability in i -th area will become the product of r_i multiplied by q . Thus, nominal fishing effort invested on i -th area (h_i) will take the amount of fish of $h_i \times q \times r_i$, and $h_i \times r_i$ is defined as effective effort. This procedure is also operational to eliminating the effect of the concentration of effort on other species to some extent. Details of the technique for calculation was explained by Honma (1973). The average density distribution for the calculation in this report was taken from eleven years' data of Japanese longline fishery from 1965 to 1975. Japanese and Taiwanese catch and effort data, for which historical statistics are available, were processed up to 1976 data following the above method.

3. Estimation of overall fishing intensity.

The annual fishing intensity defined here is the summation of monthly fishing intensity in terms of effective hooks per 5 degree square which is obtained by taking into account of the monthly change of the range of population area. The overall fishing intensity of the whole longline fleet was estimated by extrapolating 'Basic data', Japanese and Taiwanese data combined, by the ratio of catch of 'Basic data' to the catch of other fleets. The results are tabulated in Table 1. It is noted that Japanese annual catch statistics in weight for the years up to 1970 and those of non-Japanese longline fleet have been expressed by amount of landing, which do not correspond exactly to the effort statistics dealt with in this study. There seems no appropriate way to adjust them.

4. North-south separation of catch-effort statistics.

Considering the possibility of two separate stocks in the Atlantic (Kume and Morita 1977), catch and effort data of the whole Atlantic were divided into two general areas, north Atlantic (ICCAT bigeye sampling area 1-4) and south Atlantic (ICCAT area 5-8). The procedure for the data prior to 1975 can be referred to the previous report, SCRS/77/58 (Kume 1978).

Yield in weight for the year 1976 (Table 1).

Japan, Taiwan and Korea.....from ICCAT Statistical Bulletin (1977a).

Panama.....the same ratio of Korean data was applied.

Cuba.....partitioned by 1976 ratio in number between north and south which was obtained from Cuban catch and effort statistics (ICCAT, Data Record Vol. 10 (1977b)).

Argentine and Brazil.....assigned to south Atlantic.

Venezuela.....assigned to north Atlantic.

Effective effort and fishing intensity in 1976 (Tables 3 and 4)

To calculate effective effort, the same procedure given to the whole Atlantic was applied for north and south Atlantic separately. Then overall fishing intensity and relevant data were estimated based on 'Basic data'

5. Concentration Index, hook rate and catch-effort relation.

'Concentration Index', annual number of effective hooks divided by the corresponding number of nominal hooks, will indicate the extent of relative convergence of effort on bigeye fishing grounds by the fleet. The Index of Japanese longline fleet has increased remarkably since 1971 and remained at high level, though a little decline was recorded in 1976 (Fig. 5). Such trend is attributed to the continuous great concern of recent Japanese longline fleet on bigeye tuna. On the other hand, the trend of the Index of Taiwanese fleet has been always on low level less than 1.0.

Hook rate, catch in number per 100 effective hooks, was calculated based on Japanese and Taiwanese data combined. Since 1961 when longline fishery expanded to cover nearly entire bigeye distribution, the annual hook rate of the whole Atlantic has been on the decreasing trend, and in 1976 downed to about one third of those in best years (Fig. 6). Annual changes in both hook rates in the north and south Atlantic indicate almost similar trend. It is obvious that the decline of hook rates of 1975 and 1976 are more marked in the north Atlantic.

In Figs. 7 and 8, shown are relations between catch and effort of bigeye tuna for entire Atlantic and north and south sub-areas. In the whole Atlantic, both the catch and effort in 1976 decreased remarkably, following the level of 1975. It is noted that the effort in 1976 was almost the same as those in 1971-74 but the 1976 catch was far less than those of the above years, and that the shape of the recent relation of the whole Atlantic is mainly reflected by that of the north.

References.

- Honma, M. 1973: Overall fishing intensity and catch by length class of yellowfin tuna in Japanese Atlantic longline fishery, 1956-1971. Col. Vol. Sci. Pap., Vol. 1; 59-77.
- ICCAT 1977a: Statistical Bulletin Vol. 7 (Final).
1977b: Data Record Vol. 10.
- Kume, S. and Y. Morita 1977: On the stock structure of bigeye tuna in the Atlantic Ocean. Col. Vol. Sci. Pap., Vol. VI (SCRS-1976); 149-155.

Table 1. Catch statistics of Atlantic bigeye tuna by country and north and south Atlantic, 1957-1976 (in M/T).

Year	North Atlantic				Total	South Atlantic						Total	Grand Total
	Japan	Taiwan	Korea*	Cuba		Japan	Taiwan	Korea*	Cuba	Argentine	Brazil		
1957	381				381	73						73	454
1958	399				399	54						54	453
1959	1,316				1,316	162						162	1,478
1960	2,061				2,061	843						843	3,004
1961	3,065				3,065	7,979					100	8,179	11,235
1962	8,506	3			8,509	7,214	15			200		7,429	15,938
1963	8,430	6			8,436	6,060	35			200		6,295	14,731
1964	10,904	6			10,910	6,432	35			200		6,667	17,577
1965	14,669				14,669	13,869				400		14,269	28,938
1966	8,753	88	72		8,913	8,823	507	217		200		9,747	18,660
1967	3,394	330	80		3,804	5,155	1,901	240		100		7,396	11,200
1968	4,042	1,529	66		5,637	6,244	3,815	197		300		10,556	16,193
1969	2,402	2,969	464		5,835	7,864	4,514	1,393		200		13,971	19,806
1970	4,703	5,117	1,183		11,003	4,290	2,438	3,549		100		10,377	21,380
1971	13,149	2,365	1,838	1,248	18,600	7,623	3,114	5,515	1,952			18,204	36,804
1972	11,263	792	1,449	780	14,284	6,762	4,198	4,345	1,220			16,525	30,809
1973	11,113	1,270	5,704	1,014	19,101	9,130	2,548	2,809	1,586	25	68	16,166	35,267
1974	17,640	1,107	5,868	936	25,510	3,716	1,990	3,300	1,464	17	175	10,662	36,172
1975	12,376	1,474	8,504	741	23,095	5,288	2,476	3,645	1,159	100	129	12,797	35,892
1976	5,860	806	5,003	788	12,478**	1,438	2,468	3,627	512	176	161	8,382	20,860

* Panamanian catch is included.

** Venezuelan catch, 21 tons, is included.

Table 2. Catch, effective effort and fishing intensity of bigeye tuna caught by the longline fleet in the whole Atlantic Ocean, 1956-1976.

Year	Basic data (Japan and Taiwan combined)*					Whole longline fleet		
	Catch in number (10 ³) (A)	Yield in weight (10 ³ tons) (B)	Effective hooks (10 ⁶) (C)	Intensity per 5 ^o square (10 ³ hooks) (D)	Hook rate 100x(A)/(C)	Yield in weight (10 ³ tons) (E)	Effective hooks (10 ⁶) (C)x(E)/(B)	Intensity per 5 ^o square (10 ³ hooks) (D)x(E)/(B)
1956	0.2	0.0	0.1	0.5	0.228	0.0	0.1	0.5
1957	8.7	0.5	2.7	17.5	0.320	0.5	2.7	17.5
1958	14.8	0.5	5.9	38.2	0.251	0.5	5.9	38.2
1959	44.8	1.5	11.4	74.0	0.394	1.5	11.4	74.0
1960	70.6	2.9	15.5	102.3	0.454	3.0	16.0	105.8
1961	243.7	11.0	29.8	196.2	0.818	11.2	30.3	199.8
1962	367.9	15.7	54.0	357.3	0.682	15.9	54.7	361.9
1963	285.3	14.5	47.4	316.3	0.602	14.7	48.1	320.7
1964	343.7	17.3	61.1	406.0	0.563	17.6	62.2	413.0
1965	648.3	28.5	117.9	787.8	0.550	28.9	119.6	798.9
1966	232.1	17.6	48.1	323.9	0.482	18.7	51.1	344.1
1967	188.3	10.8	33.1	217.7	0.569	11.2	34.3	225.8
1968	341.4	15.6	63.1	414.6	0.541	16.2	65.5	430.5
1969	430.2	17.7	71.6	473.1	0.601	19.8	80.1	529.2
1970	332.2	16.5	65.9	436.5	0.504	21.4	85.5	566.1
1971	533.2	26.3	128.1	850.9	0.416	36.8	179.2	1190.6
1972	430.4	23.5	115.6	772.2	0.372	31.3	154.0	1028.5
1973	475.6	24.1	117.1	769.6	0.406	35.3	171.5	1127.3
1974	551.2	24.4	103.2	679.8	0.534	36.2	153.1	1008.6
1975	556.5	21.6	151.0	1009.9	0.369	35.9	251.0	1678.5
1976	259.2	10.6	89.3	594.0	0.290	20.8	176.1	1171.2

* Taiwanese data are included since 1967.

Table 3. Catch, effective effort and fishing intensity of bigeye tuna caught by the longline fleet in the north Atlantic Ocean, 1956-1976.

Year	Basic data (Japan and Taiwan combined)*					Whole longline fleet		
	Catch in number (10 ³) (A)	Yield in weight (10 ³ tons) (B)	Effective hooks (10 ⁶) (C)	Intensity per 5° square (10 ³ hooks) (D)	Hook rate 100x(A)/(C)	Yield in weight (10 ³ tons) (E)	Effective hooks (10 ⁶) (C)x(E)/(B)	Intensity per 5° square (10 ³ hooks) (D)x(E)/(B)
1956	0.1	0.0	0.1	0.8	0.366	0.0	0.1	0.8
1957	7.3	0.4	2.0	24.0	0.369	0.4	2.0	24.0
1958	13.0	0.4	5.1	60.0	0.256	0.4	5.1	60.0
1959	39.9	1.3	9.6	112.7	0.417	1.3	9.6	112.7
1960	50.1	2.1	10.3	115.6	0.488	2.1	10.3	115.6
1961	67.6	3.1	9.1	100.5	0.742	3.1	9.1	100.5
1962	199.1	8.5	29.1	325.5	0.684	8.5	29.1	325.5
1963	166.0	8.4	26.2	299.4	0.635	8.4	26.2	299.4
1964	219.2	10.9	37.4	453.8	0.586	10.9	37.4	453.8
1965	339.1	14.7	56.5	683.9	0.601	14.7	56.5	683.9
1966	121.6	8.8	25.0	304.4	0.486	8.9	25.3	307.9
1967	76.4	3.7	15.1	179.7	0.507	3.8	15.5	184.8
1968	125.2	5.6	23.4	268.0	0.536	5.6	23.4	268.0
1969	131.3	5.4	24.9	287.8	0.528	5.8	26.7	309.1
1970	202.1	9.8	37.1	443.8	0.545	11.0	41.6	498.1
1971	318.1	15.5	81.5	969.6	0.390	18.6	97.8	1163.5
1972	241.2	12.1	64.0	794.2	0.377	14.3	75.6	938.6
1973	247.4	12.4	52.7	654.9	0.469	19.1	81.2	1008.8
1974	422.5	18.7	67.8	836.4	0.623	25.5	92.5	1140.5
1975	360.1	13.9	99.2	1236.7	0.363	23.1	164.9	2055.2
1976	147.3	6.7	57.7	721.4	0.255	12.5	107.6	1345.9

* Taiwanese data are included since 1967.

Table 4. Catch, effective effort and fishing intensity of bigeye tuna caught by the longline fleet in the south Atlantic Ocean, 1956-1976.

Year	Basic data (Japan and Taiwan combined)*					Whole longline fleet		
	Catch in number (10 ³) (A)	Yield in weight (10 ³ tons) (B)	Effective hooks (10 ⁶) (C)	Intensity per 5° square (10 ³ hooks) (D)	Hook rate 100x(A)/(C)	Yield in weight (10 ³ tons) (E)	Effective hooks (10 ⁶) (C)x(E)/(B)	Intensity per 5° square (10 ³ hooks) (D)x(E)/(B)
1956	0.0	0.0	0.0	0.2	0.364	0.0	0.0	0.2
1957	1.4	0.1	0.6	10.0	0.218	0.1	0.6	10.0
1958	1.8	0.1	0.8	12.9	0.219	0.1	0.8	12.9
1959	4.9	0.2	1.8	29.1	0.266	0.2	1.8	29.1
1960	20.5	0.8	6.2	86.8	0.333	0.9	7.0	97.7
1961	176.0	8.0	21.1	307.4	0.833	8.2	21.6	315.1
1962	168.8	7.2	26.9	394.2	0.627	7.4	27.6	405.1
1963	119.3	6.1	23.0	335.9	0.519	6.3	23.8	346.9
1964	124.6	6.4	25.0	350.6	0.498	6.7	26.2	367.0
1965	309.2	13.9	61.6	908.4	0.502	14.3	63.4	934.5
1966	110.5	8.8	23.0	346.6	0.480	9.7	25.4	382.0
1967	111.8	7.1	18.7	261.7	0.598	7.4	19.5	272.8
1968	216.2	10.1	39.9	584.8	0.541	10.6	41.9	613.8
1969	298.9	12.4	46.4	688.3	0.644	14.0	52.4	777.1
1970	130.2	6.7	29.1	428.1	0.447	10.4	45.2	664.5
1971	215.1	10.7	48.6	713.0	0.442	18.2	82.7	1212.8
1972	189.2	11.0	51.2	746.7	0.369	16.5	76.8	1120.1
1973	228.2	11.7	61.6	902.7	0.370	16.2	85.3	1249.9
1974	128.7	5.7	33.8	497.8	0.380	10.7	63.4	934.5
1975	196.4	7.8	51.9	746.4	0.379	12.8	85.2	1224.9
1976	111.9	3.9	30.1	446.0	0.372	8.4	64.8	960.6

* Taiwanese data are included since 1967.

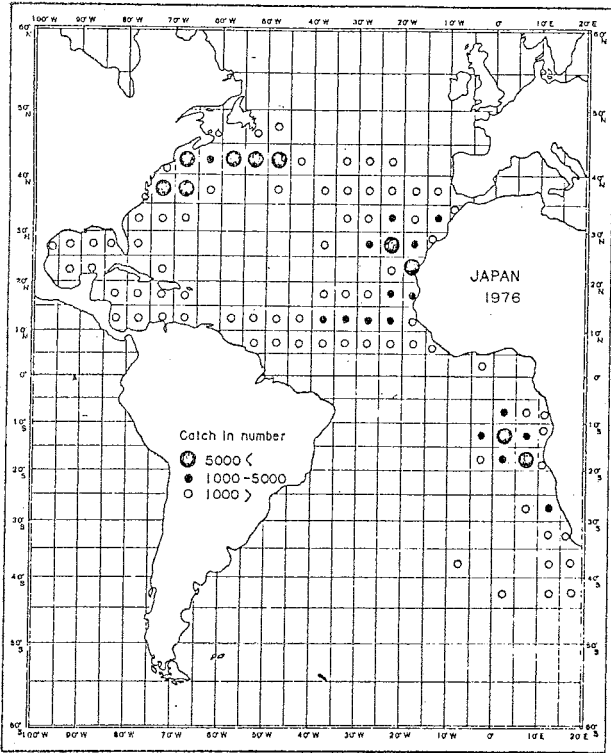


Fig. 1. Distribution of bigeye catch by Japanese longline fleet in the Atlantic, in 1976.

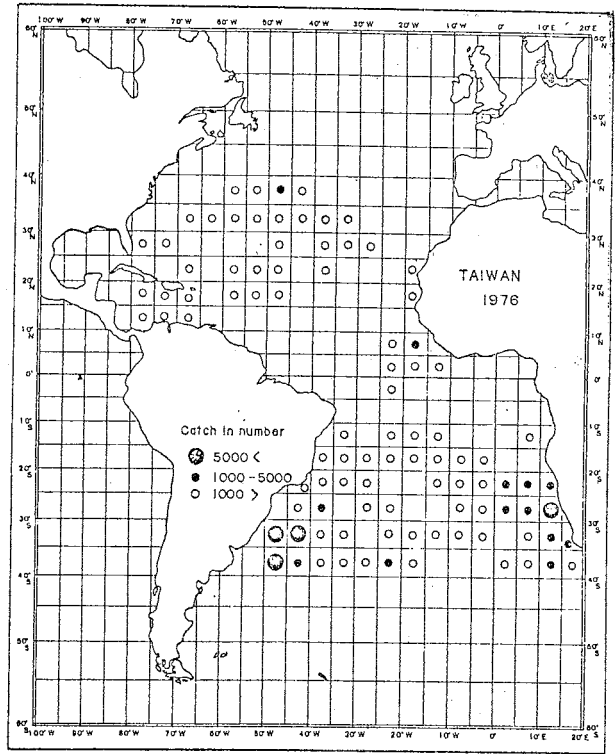


Fig. 2. Distribution of bigeye catch by Taiwanese longline fleet in the Atlantic, in 1976.

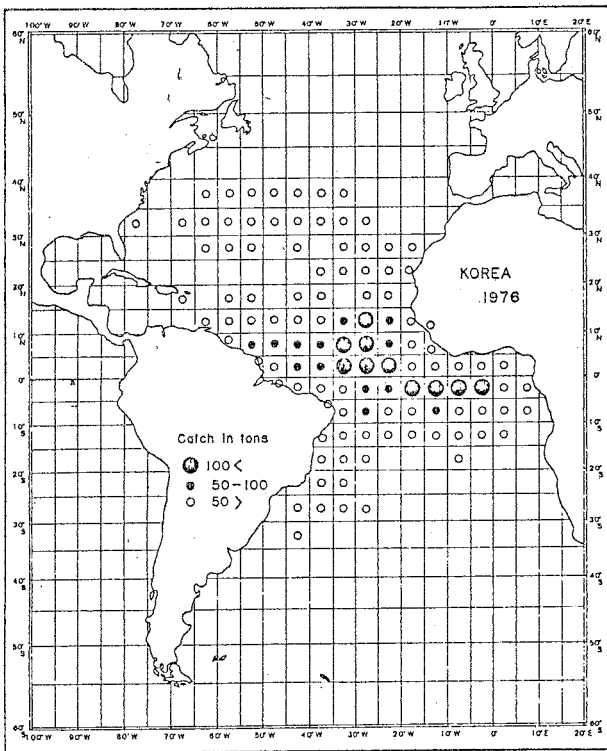


Fig. 3. Distribution of bigeye catch by Korean longline fleet in the Atlantic, in 1976.

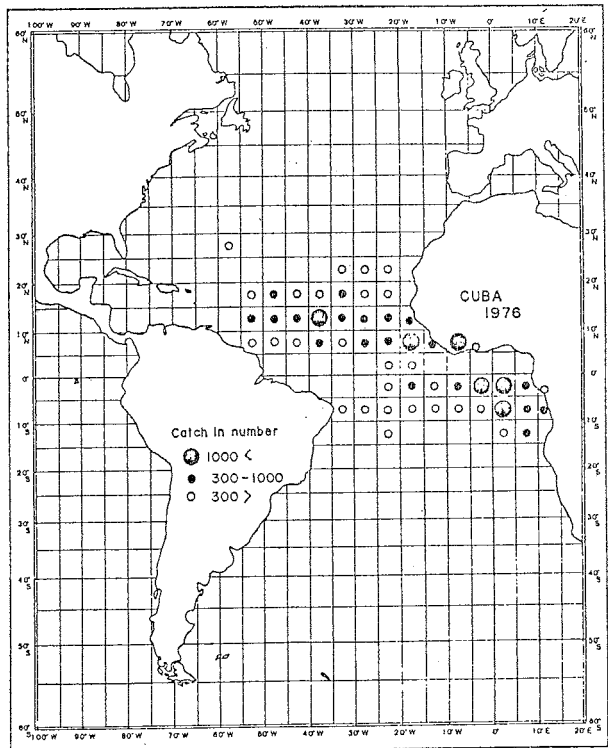


Fig. 4. Distribution of bigeye catch by Cuban longline fleet in the Atlantic, in 1976.

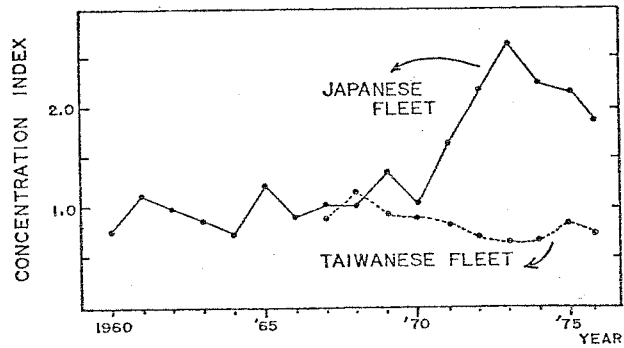


Fig. 5. Annual change in Concentration Index of Japanese and Taiwanese longline fleet on bigeye tuna in the Atlantic Ocean, 1960 - 1976.

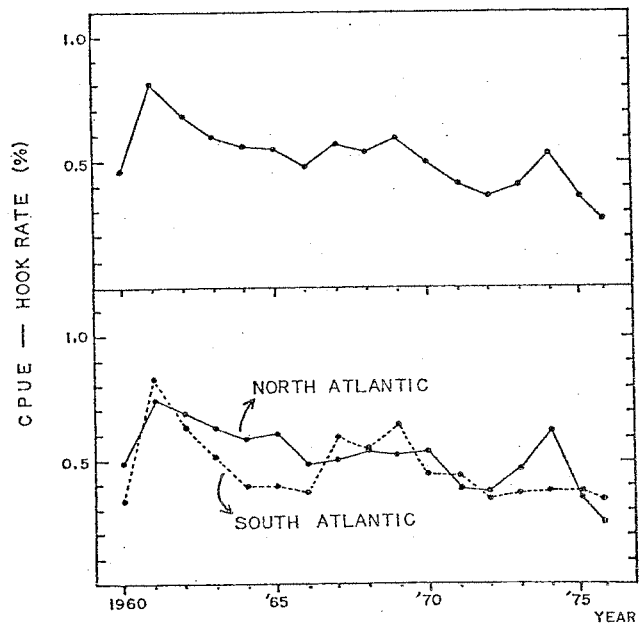


Fig. 6. Annual change in hook rate of bigeye tuna in the whole Atlantic (upper panel) and north and south Atlantic (lower panel), based on data of Japanese and Taiwanese longline fisheries combined, 1960 - 1976.

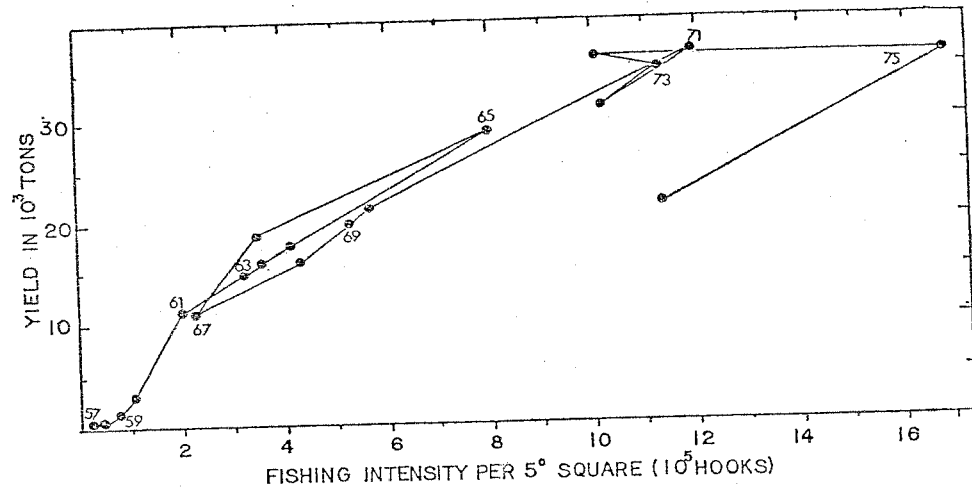


Fig. 7. Annual change in catch in weight of bigeye tuna against overall fishing intensity of the whole longline fleet in the Atlantic Ocean, 1957-1976.

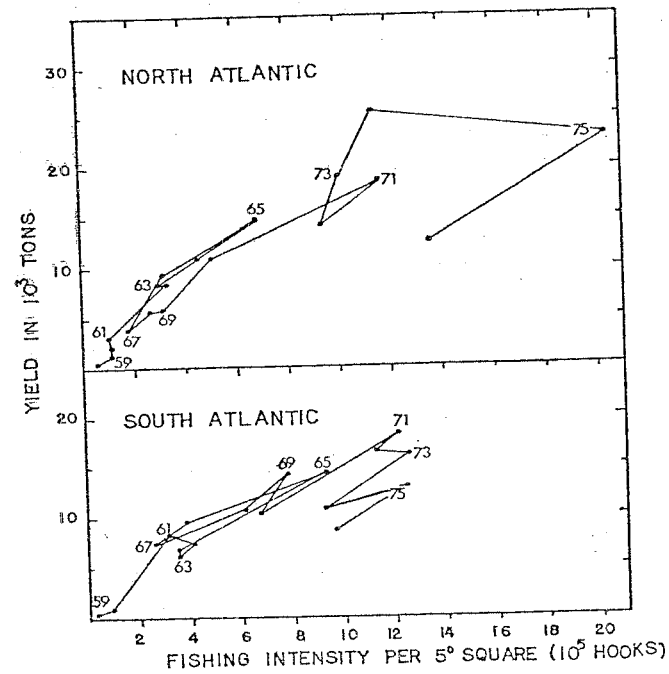


Fig. 8. Relationship between yield and fishing intensity on bigeye tuna caught by longline fishery in the north and south Atlantic, up to 1976.