

CATCHES AND FISHING INTENSITY OF BILLFISH SPECIES
CAUGHT BY THE ATLANTIC LONGLINE FISHERIES
1956-1973

by

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SUMMARY

Annual billfish catches by species for the whole Atlantic longline fleets from 1956 to 1973 were estimated. Recent Taiwanese catch statistics, as well as Japanese historic data from the fishery, were used to figure out these estimates. Annual fishing intensity in terms of the number of hooks per unit area that fished white marlin and blue marlin was calculated based on data from the Japanese fleet and expanded to the whole Atlantic fleets with the rate giving the same density index.

Longline effort directed at the white marlin in the entire Atlantic fishing grounds has remained at a low level, since it decreased considerably in 1967. With this level of effort, there is also the tendency of decreasing hook rate in recent years. In the waters off Brazil, the hook rate dropped suddenly in 1971-1973, while in the Caribbean Sea area, it has remained relatively high and level, as far as the Japanese historic data are concerned.

Unexpectedly, a low hook rate of the blue marlin relative to the effort level is indicated for the entire Atlantic fishing grounds after 1965. The hook rate in the above main areas in the North and South Atlantic has decreased since 1964 with the value much lower for the waters off Brazil up to 1973.

RESUME

La prise annuelle de marlins a été estimée pour l'ensemble des flottilles palangrières de l'Atlantique de 1956 à 1973. Les statistiques récentes de capture de Taiwan, ainsi que les données historiques japonaises sur cette pêcherie, ont servi à calculer ces estimations. L'intensité annuelle en termes du nombre d'hameçons par unité de secteur de pêche au makaire blanc et au makaire bleu a été calculée à partir de données sur la flottille japonaise et étendue à l'ensemble des flottilles atlantiques, le taux indiquant le même indice de densité.

L'effort palangrier portant sur le makaire blanc dans l'ensemble des secteurs de pêche de l'Atlantique est demeuré médiocre depuis son déclin considérable de 1967. Ce niveau de l'effort s'accompagnait également ces dernières années d'une tendance à la baisse du taux par hameçon. Ce taux a baissé soudainement en 1971-1973 au large des côtes brésiliennes, alors qu'il est demeuré relativement élevé et stable dans le secteur des Caraïbes d'après les données historiques japonaises.

Depuis 1965, les secteurs de pêche de l'Atlantique présentent dans leur ensemble pour le makaire bleu un taux par hameçon étonnamment médiocre par rapport à l'effort. Le taux par hameçon dans les principaux secteurs de l'Atlantique Nord et Sud a diminué depuis 1964, donnant une valeur bien plus faible pour les eaux brésiliennes jusqu'en 1973.

RESUMEN

Se hizo una estimación de las capturas anuales de marlín, por especies, realizadas por toda la flota palangrera del Atlántico, de 1956 a 1973. Estos cálculos se basaron en las recientes estadísticas presentadas por Taiwan, y en los datos históricos japoneses sobre la pesquería. La intensidad anual de pesca, en términos de número de anzuelos por unidad de zona, de aguja blanca y aguja azul, se calculó sobre los datos de la flota japonesa, y se extendió a todas las flotas del Atlántico, indicando la tasa el mismo índice de densidad.

El esfuerzo palangrero dirigido hacia la pesca de la aguja blanca en todas las zonas de pesca del Atlántico ha permanecido bajo, desde su considerable reducción en 1967.

A este nivel de esfuerzo acompaña una tendencia descendente de tasa por anzuelo en los últimos años. A la altura de las costas brasileñas, la tasa por anzuelo bajó repentinamente en 1971-73, mientras que en la zona del Mar Caribe se ha mantenido relativamente alta y uniforme, según los datos históricos japoneses.

Es sorprendente la baja tasa por anzuelo de la aguja azul en relación con el nivel de esfuerzo, que presenta toda la zona de pesca del Atlántico desde 1965. La tasa por anzuelo en las principales áreas del Atlántico norte y sur, ha disminuido desde 1964, con un valor mucho más bajo a la altura de las costas brasileñas hasta 1973.

Tables reproduced in Data Record in Vol. 7.

Tableaux reproduits dans le Vol. 7 du Recueil de Données.

Cuadros reproducidos en Vol. 7 de la Colección de Datos Estadísticos.

Estimates of annual billfish catches by species and their effective effort for the whole Atlantic longline fleets of different nationalities could be obtained through a set of assumptions. Related to this and of particular concern are catches from fleets other than Japan, for the statistics on these fisheries are in most cases imperfect and fragmental. This inadequacy requires such bold procedures for estimation to figure out catches throughout the period under study. The major assumptions, however, which are first considered in the procedures should be those which are as near to the actual status of the fisheries as possible. In this respect, the estimates for the blue marlin given in our previous report (SCRS/74/39) need re-examination.

Biases in estimates based on Japanese data

Billfish yields in weight by Japanese fleets, which in earlier years represented all, were down to 50 per cent in 1967 and to as low as 17 per cent in 1973. The remaining majority is shared by Taiwanese and Korean fleets. This means the reduced validity of having estimates for the whole longline fisheries in the light of Japanese fleet of late.

In our previous report, the Japanese blue marlin catches were simply expanded using yearly rates of yellowfin tuna catches for the whole fisheries to those by Japanese fleet. This was made on the fact that empirically a high correlation between yearly catches in number of some of the longline-caught species was noted in Japanese statistical data, namely between blue marlin and yellowfin tuna and between white marlin and albacore. Estimates thus given, however, would be much biased since such a high correlation happens to be valid for Japanese fleet with the pattern of its effort distribution. If the same procedures are applied to white marlin, we would have the estimated yield of approximately 5,200 tons of this fish alone for 1973, while the total billfish yields of 5,300 tons from whole longline fisheries are reported (ICCAT Stat. Bul., vol. 5, 1975). A very high rate of albacore yields for the whole to those by Japanese fleet, which is as high as 21.2, is responsible for this discrepancy. The fishing grounds for Taiwanese and Korean fleets in 1973, as shown in Figure 1, may in some degree explain the biases occurring in the above procedures.

Estimates for longline fleets other than Japan

Statistics used: The recent publications of Taiwanese catch and effort statistics were used. The main fishing grounds, or in other word, the effort distribution for Taiwanese and Korean fleets appear to have been nearly identical. The yearly changes in the species composition and average size of fish in the catches by these two countries do not seem to differ considerably.

Procedures: Catches in number and yields in weight by species were estimated based on those of all fishes. Yields in weight (w_i) of all billfishes by fleets other than Japan can be obtained from the ICCAT Statistical Bulletin. Yearly catches in number (C_i) were estimated by:

$$C_i = 1,000 \cdot W / \bar{w}$$

$$\bar{w} = r_{m1} \frac{1}{3} \sum \frac{w_{mi}}{n_{mi}} + r_{b1} \frac{1}{3} \sum \frac{w_{bi}}{n_{bi}} + r_{k1} \frac{1}{3} \sum \frac{w_{ki}}{n_{ki}} + r_{s1} \frac{1}{3} \sum \frac{w_{si}}{n_{si}} = 24.85 \text{ (kg)}$$

The \bar{w} is the average body weight of combined billfishes from the Taiwanese statistics 1971-1973. The w_i and n_i are yearly yields in weight and catches in number of each species from 1971 to 1973. The subscripts m, b, k and s mean the white marlin, blue marlin, black marlin and sailfish, respectively. The r_i , the rate of catches in number of each species to those of combined billfishes and r_{2i} , the rate of yields in weight of each to those of combined one were obtained by:

$$r_1 = \frac{1}{3} \sum \frac{n_i}{N_i}$$

$$r_2 = \frac{1}{3} \sum \frac{w_i}{Y_i}$$

The N_i and Y_i are yearly catches in number and yields in weight of combined billfishes. The r_{m1} , r_{b1} , r_{k1} and r_{s1} were calculated as 0.2975, 0.1213, 0.0012 and 0.5800 and the r_{m2} , r_{b2} , r_{k2} and r_{s2} as 0.2653, 0.3561, 0.0015 and 0.3771. The yearly estimates for the longline fleets other than Japan are shown in Table 1.

The yearly estimates of catches in number by species were obtained from the C_i and the r_i , the conversion rate to number, and those estimates of yields in weight by species from W_i and r_2 , the conversion rate to weight. The resultant estimates by species are given in Table 2.

Fishing intensity for whole Atlantic longline fisheries

Table 3 shows catches in number and yields in weight of two major species, white marlin and blue marlin, based on Japanese longline catch and effort statistics. It also indicates the fishing intensity calculated therefrom. The total catches and yields of the two species for the whole longline fleets were obtained from Tables 2 and 3. The fishing intensity in terms of effective number of hooks exerted on each species per unit area was first calculated on data from Japanese fleets by the procedures described previously (Honma 1974a). It was then expanded for the whole fleets with the rate giving the same density index. These estimates eventuate as shown in Table 4.

White marlin: Figure 2 shows yearly estimates of catches in number or yields in weight plotted against effort from 1958 to 1973. In the uppermost panel are the plots of density index in terms of hook rate against effort. Effort exerted on this species has remained at a low level as seen in earlier years since it reduced considerably in 1967. The plots of catches against effort give somewhat linear relation within the range of effort ever stretched. A gradually descending change in hook rate without the increasing level of effort is pointed out, however.

Blue marlin: Figure 3 shows an amended relation between catches in number or yields in weight and effort given in the previous report (SCRS/74/39). Unexpectedly low hook rate relative to the effort level are noted during the recent several years. Two equilibrium curves under the different conditions, as fitted to the relation between yields in weight and effort, are indicated in the figure. One of the curves refers to five year classes under exploitation and the other to six year classes. Necessary calculations were done according to Fox (1975), using yearly estimates from 1958 to 1973. It seems more likely to assume five year classes under exploitation than to take six year classes.

Change in effort directed at billfishes for Japanese fleet

The change in hook rate for white marlin and blue marlin in two main fishing grounds is indicated in Figures 4 and 5. The northern area includes the Caribbean Sea and the West Indies and the southern area is off Brazil. The change in number of hooks (not standardized) in these two areas is shown in Figure 6.

Hook rate for white marlin in the southern area has dropped suddenly in a recent few years, while it has been relatively high and remained level in the northern area. For blue marlin too, hook rate in the southern area has been considerably low comparing to that in the northern area. There is an outstanding tendency of diminution of Japanese fishing operations in the southern area after 1967. Very few longline effort made in this area in 1973 may have provided the calculated hook rate especially for white marlin with such biases.

Figure 7 shows the change in hook rate for both species in the entire Japanese longline fishing grounds in the Atlantic Ocean. Data before 1961 do not seem valid for white marlin. The figure indicates a clear difference in the level of hook rate (density index in this case) for both species. Figure 8 shows a conspicuous decrease in Japanese longline effort directed at white marlin and blue marlin for the last two years, 1972 and 1973. As given in Tables 1-3, the percentage of Japanese billfish catches has decreased year by year. In 1973, 19 per cent of total white marlin catches and 16 per cent of total blue marlin catches by the whole Atlantic longline fisheries are estimated to be shared by Japanese fleet.

References

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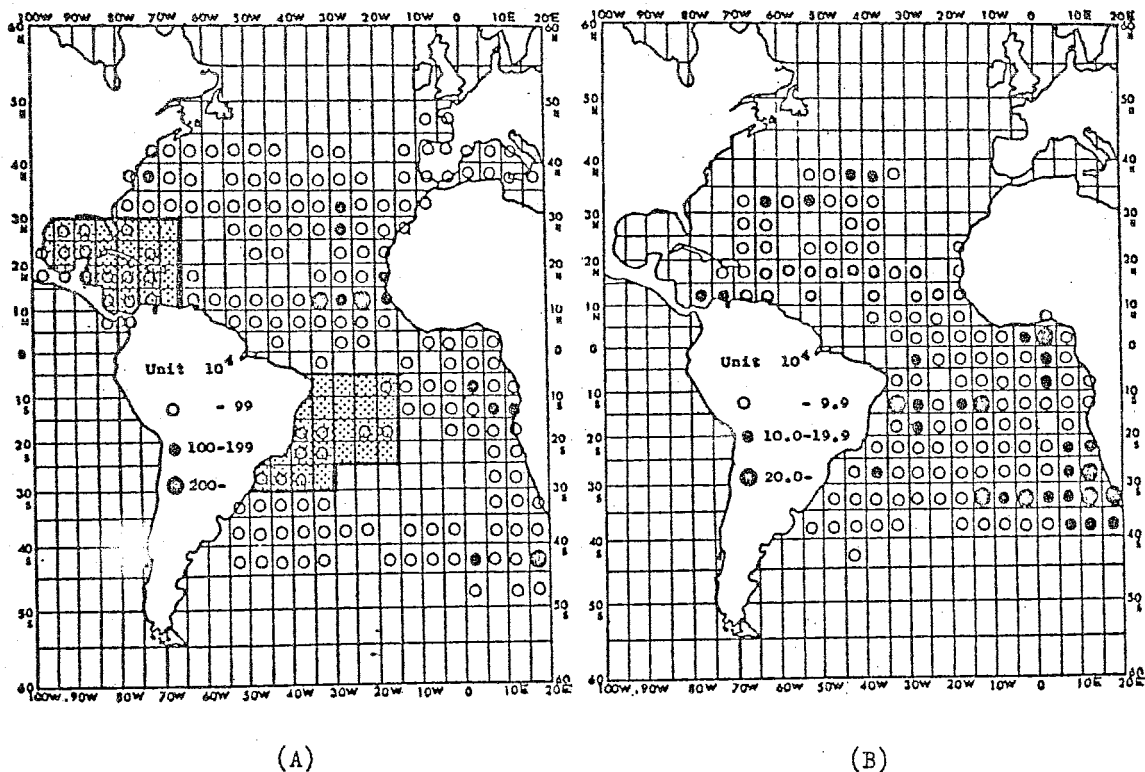


Figure 1 Longline effort distribution in terms of hooks in the Atlantic Ocean, 1973

(A) Japanese fleet (B) Taiwanese fleet

Areas specified in this report as main fishing grounds for white marlin and blue marlin are shown shaded in Figure A.

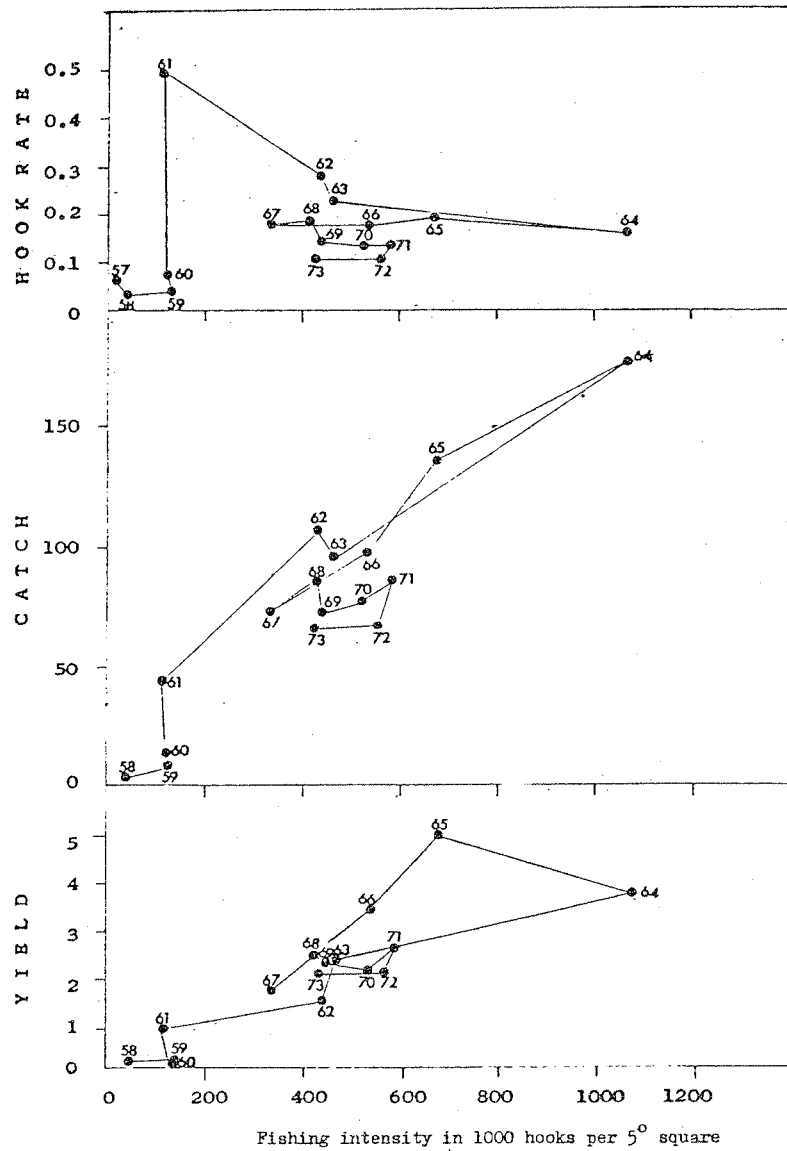


Figure 2 Hook rate in percentage (upper), catch in 1000 fish (middle) and yield in 1000 tons (lower) plotted against fishing intensity in 1000 hooks per 5° square for white marlin caught by whole Atlantic longline fisheries, 1957-1973.

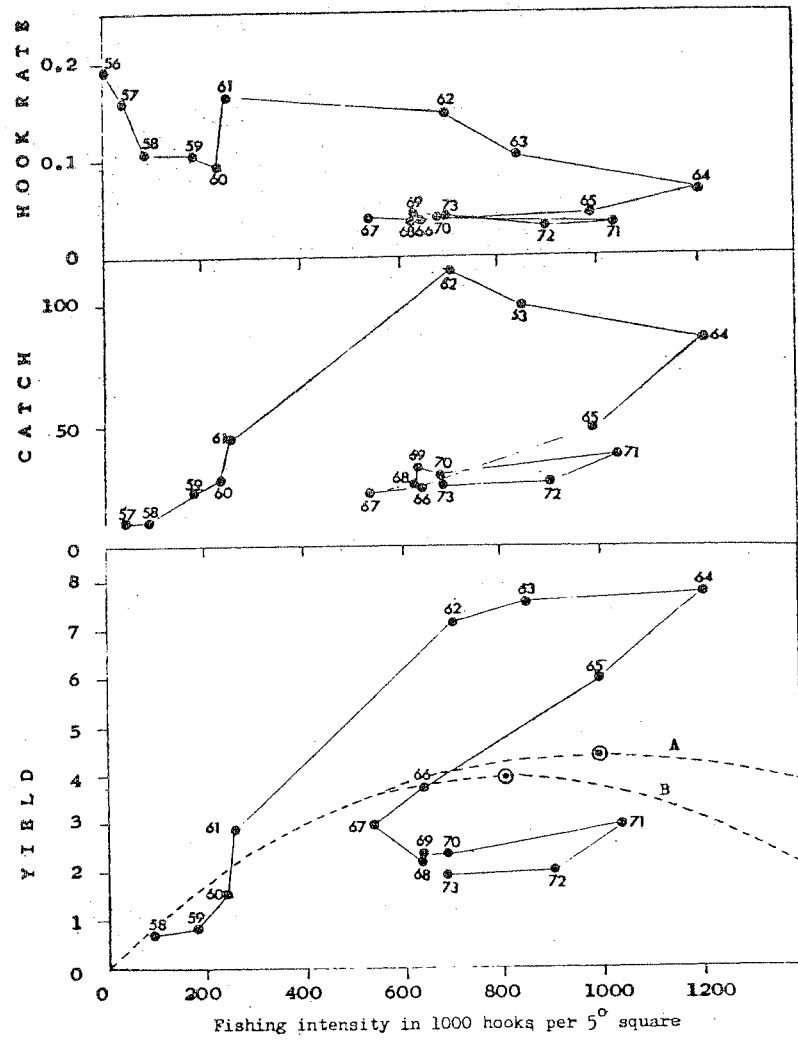


Figure 3 Hook rate in percentage (upper), catch in 1000 fish (middle) and yield in 1000 tons (lower) plotted against fishing intensity in 1000 hooks per 5° square for blue marlin caught by whole Atlantic longline fisheries, 1956-1973. Estimated production curve A and B refer to 5 and 6 year classes under exploitation, respectively. Double circles denote positions of MSY.

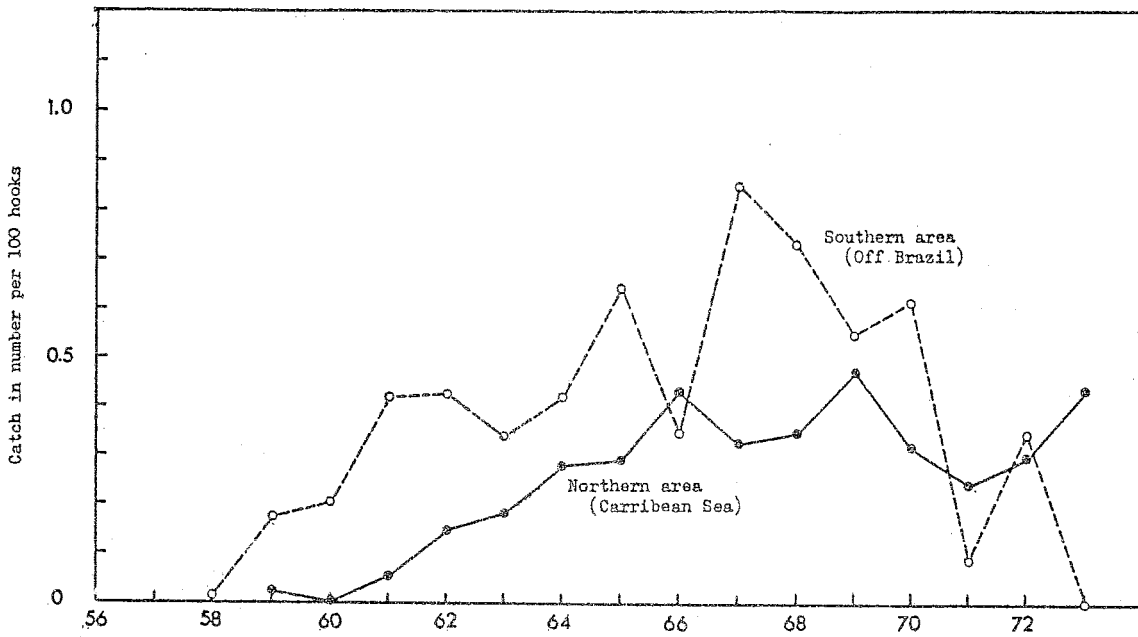


Figure 4 Yearly change in hook rate of white marlin in two main fishing grounds, 1956-1973. (For area specification, see Figure 1)

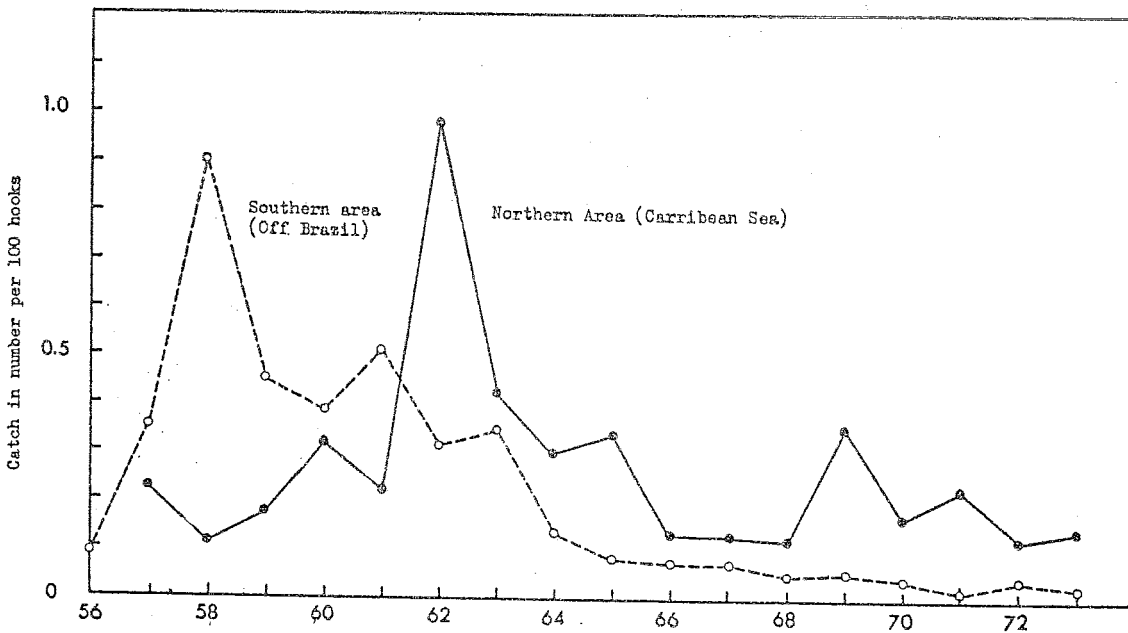


Figure 5 Yearly change in hook rate of blue marlin in two main fishing grounds, 1956-1973.

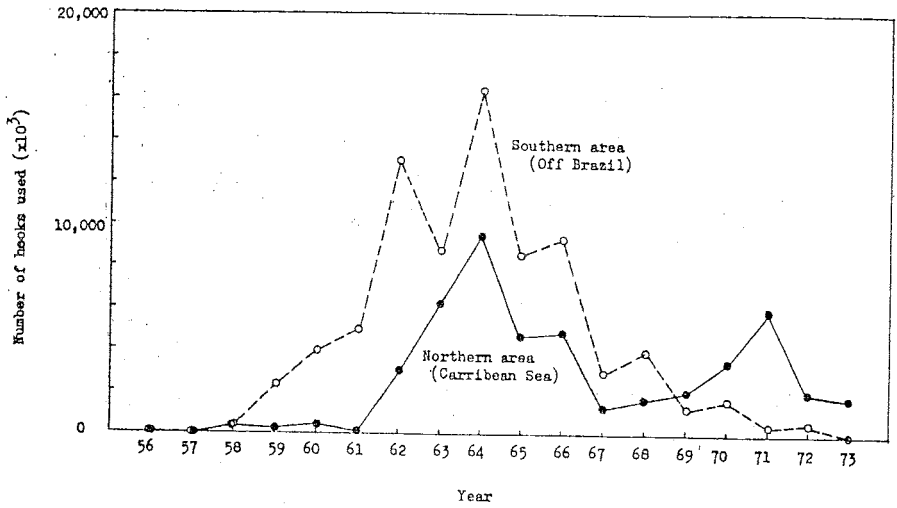


Figure 6 Yearly change in number of hooks used by Japanese fleet in two main fishing grounds, 1956-1973.

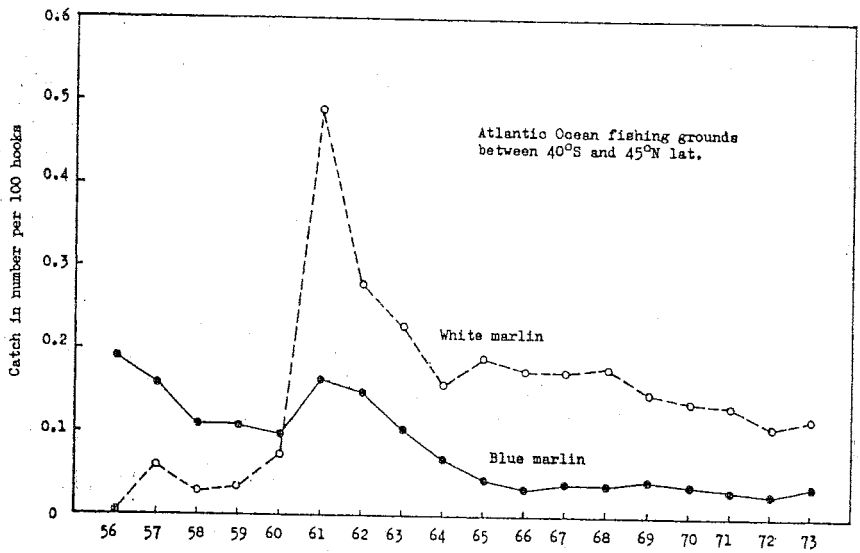


Figure 7 Yearly change in density index (in terms of hook rate) for white marlin and blue marlin caught by Japanese fleet in the Atlantic Ocean fishing grounds, 1956-1973.

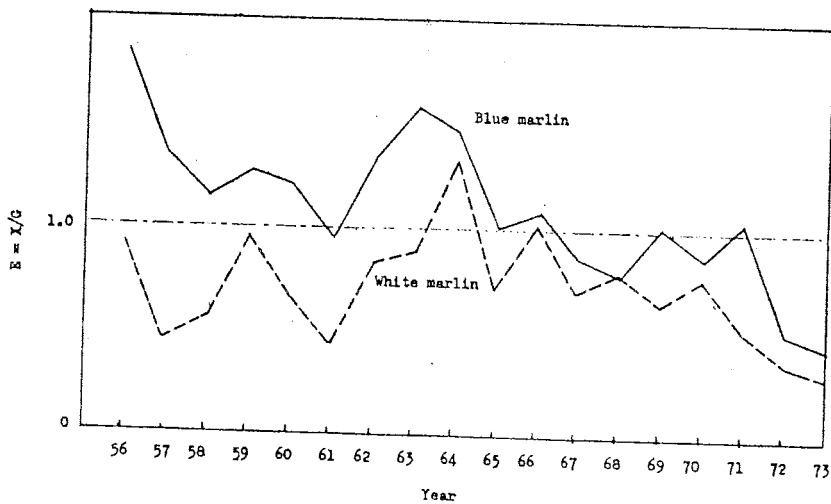


Figure 8 Yearly change in rate of effective effort to crude effort for white marlin and blue marlin, 1956-1973.

X Effective number of hooks exerted on respective species.
G Number of hooks used.