

TREND IN HOOK RATE OF ATLANTIC SWORDFISH

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SUMMARY

Based on Japanese longline data during 1970 to 1984, trends in the hook rate of swordfish were examined for major fishing grounds in the Atlantic Ocean.

RESUME

La tendance du taux par hameçon de l'espadaon est examiné, à partir de données palangrières japonaise pour les années 1970 à 1984, pour les principaux lieux de pêche de l'Atlantique.

RESUMEN

En base a los datos palangreros japoneses del periodo 1970-1984, se examinó la tendencia de la tasa de anzuelos del pez espada en los principales caladeros del Atlántico.

Introduction

Deep longline operations (DL) were introduced by Japanese longline boats in the equatorial Pacific and Indian Oceans from the late 1970s. In the Atlantic, the DL has been practiced by the Japanese longliners since 1977 and at present, spreads all over the lower latitudes of the three oceans. This type of operations primarily aims at bigeye tuna inhabiting mainly in deeper waters below thermocline. The longline hooks are being set in much deeper layer for the DL than for the regular longline operations (RL).

Comparison of hook rates between the RL and DL has already been made for central western Pacific (Suzuki et al. 1977) and for Indian Ocean (Koido 1985). In the present study, hook rate of the Atlantic swordfish between the two types of operations was compared in model areas using the Japanese longline data. After correcting the difference in fishing efficiency of the DL to the RL, if any, on swordfish during 1977 to 1984, long term trend of hook rate for the Atlantic swordfish caught by the Japanese longliners from 1956 to 1984 was analyzed.

1. Division of model areas

The Japanese longline fishery started its operation in the Atlantic in 1956 and covered most of the presently established fishing grounds by the late 1960s. To obtain general image of distribution of the swordfish catch rate in the longline fishing grounds, average hook rates (catch in number of swordfish/1000 hooks) was computed by five-degree square by quarter from the data during 1967-1972 (Fig. 1). Swordfish appear widely distributed and are captured in almost entire part of the Atlantic with some seasonal difference in distribution.

Since the stock structure of the Atlantic swordfish is not clear, four model areas as shown in Figure 2 were somewhat arbitrarily divided taking into account of the information from Figure 1 and the operational activities

of the Japanese longline boats. In the north Atlantic, Areas 1 represents fishing ground for bigeye and bluefin, Area 2 for yellowfin tuna and Area 3 for bigeye. In the south Atlantic, Area 4 for bigeye tuna fishing ground was chosen. No model area was set up for the areas off south America since the Japanese longliners hardly operate there in the recent years. Incidentally, EEZ of the U.S. was excluded from Areas 1 and 2 to keep consistency in comparison before and after 1977 when it was enforced to release swordfish captured by the foreign longliners within the U.S. EEZ.

2. Comparison of hook rate between the RL and DL by quarter of the year and model area

The definition of the RL and DL used in this document are the same with those by Koido (1985). The hook rate of swordfish was calculated by the two types of the operations, quarter of the year and by model area. Figure 3 appears to indicate the hook rate fluctuates randomly regardless seasonal, year and the two types of the operations for all model areas.

From the data shown in Figure 3, the data in which both the RL and DL with the use of more than 20,000 hooks (about 10 operations) were selected as effective data and mean of hook rates and its 95 percent confidence interval were calculated for each type of the operations (Table 1). Mean hook rate is higher in the DL than in the RL in all model areas. However, the confidence interval of the mean of hook rates by the RL and DL overlaps for Areas 1, 2 and 3 thus indicates no significant difference in the fishing efficiency between them. For Area 4, the confidence limit for the DL is significantly higher than that for the RL, indicating statistically significant difference between the two. No correction for the fishing efficiency between the two types of operations was made for Areas 1 to 3 since the efficiency did not differ statistically. For Area 4 since 1977 hook rate was corrected with the ratio of average hook rate by the DL to that by the RL i.e., 1.5 and rate of the number of the DL to the total hooks shown in Table 2.

3. Trends of catch, fishing effort and hook rate by quarter of the year

Trend of nominal number of hooks by the Japanese longliners shows most of the fishing effort in the 1960s was exerted in Areas 2, 3 and 4 aiming at tropical tuna species such as yellowfin and bigeye (Fig. 4). Areas 3 and 4 received substantial amount of the fishing effort in the 1970s. In the 1980s, the fishing effort has increased in Areas 1 and 4. The fishing effort in Area 2 has been low since 1972. Swordfish catch in number remarkably increased in recent years in Area 4 (Fig. 5). Area 3 has secondary large catch. Area 2 produces the smallest catch compared with the rest of the areas.

Trend of swordfish hook rate by the Japanese longliners is shown in Figure 6 for the period 1956 to 1984. Hook rates from 1972 to 1978 are high in Area 1. However, before and after this periods, i.e., the period from the late 1960s to 1971 and after 1979, no trend is apparent, although both periods show lower average hook rate. In Area 2, although data are limited because of small number of the catch and fishing effort as previously shown in Figures 4 and 5, the trend of hook rate is similar to that in Area 1. High hook rate was observed from 1977 to 1980 but in the period before and after this, hook rate is low without any appreciable trend. In Areas 3 and 4, there seems to be slight increasing trend of the hook rate from the commencement of the fishery. Therefore, it is concluded that the stock level of the Atlantic swordfish shows no appreciable decreasing trend in the all major longline fishing grounds examined and it seems increasing for Areas 3 and 4.

4. Discussion

Biological information on the Atlantic swordfish is very limited, especially for stock structure and it is impossible at the present moment to conclude whether or not the Atlantic swordfish is composed of single stock. For example, larval swordfish occurred not only in the Caribbean Sea and the Mediterranean but also in the central Atlantic (Nishikawa et al. 1978). As previously mentioned, the areas with high swordfish catch are not

limited in specific regions of the Atlantic. Therefore, there is no guarantee that each model area corresponds to a specific unit stock.

The present result suggesting no significant difference in fishing efficiency for swordfish between the two types of the operation in the north Atlantic (Areas 1, 2 and 3) seems to be in accordance with the results of sonic tag experiments which revealed the fish moved vertically in a wide range from 20 to 600 m (Carey et al. 1981), thus suggesting that for swordfish the chance of encountering to the hooks set, deeper or shallower, does not change appreciably. Suzuki et al. (1977) showed a slightly lower fishing efficiency of the DL over RL for swordfish in the central western Pacific. Results of experimental fishing using various construction of the longline show swordfish tend to be captured with the hooks set in shallower waters in the central western Pacific (Fisheries Agency of Japan 1980, 1981, 1983a, 1983b).

These observations imply fishing efficiency of the RL over DL changes depending on areas as well as seasons since oceanographic characteristics such as the thermocline sometimes changes remarkably even in the same areas. It is not certain to conclude that the difference in the hook rates between the two types of operations here shown reflects real difference specific to the gear efficiency alone. Therefore, the result obtained in this paper should be regarded as preliminary one.

References

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Table 1. Comparison of the hook rate between the regular (RL) and deep (DL) longline gears in the model areas.

MODEL AREA		1	2	3	4
Number of available hook rates (pairs of RL and DL)		8	11	24	18
Mean of hook rates	RL	0.60	0.39	0.75	1.07
	DL	0.69	0.56	0.67	1.59
95% confidence interval	RL	0.45 - 0.75	0.26 - 0.53	0.53 - 0.96	0.64 - 1.29
	DL	0.39 - 0.98	0.43 - 0.68	0.73 - 1.02	1.33 - 1.85

Table 2. Percentage of hooks with the use of the deep longline (DL) for the model area 4.

YEAR	1977				1978				1979				1980			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
DL (%)	0	0	0	0	0	0	0.1	0	0	0	0	1.7	55.9	64.5	65.0	45.1
YEAR	1981				1982				1983				1984			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
DL (%)	66.9	60.4	37.8	26.5	85.5	32.6	57.3	51.4	94.1	100	20.5	45.6	69.9	58.0	64.4	90.5

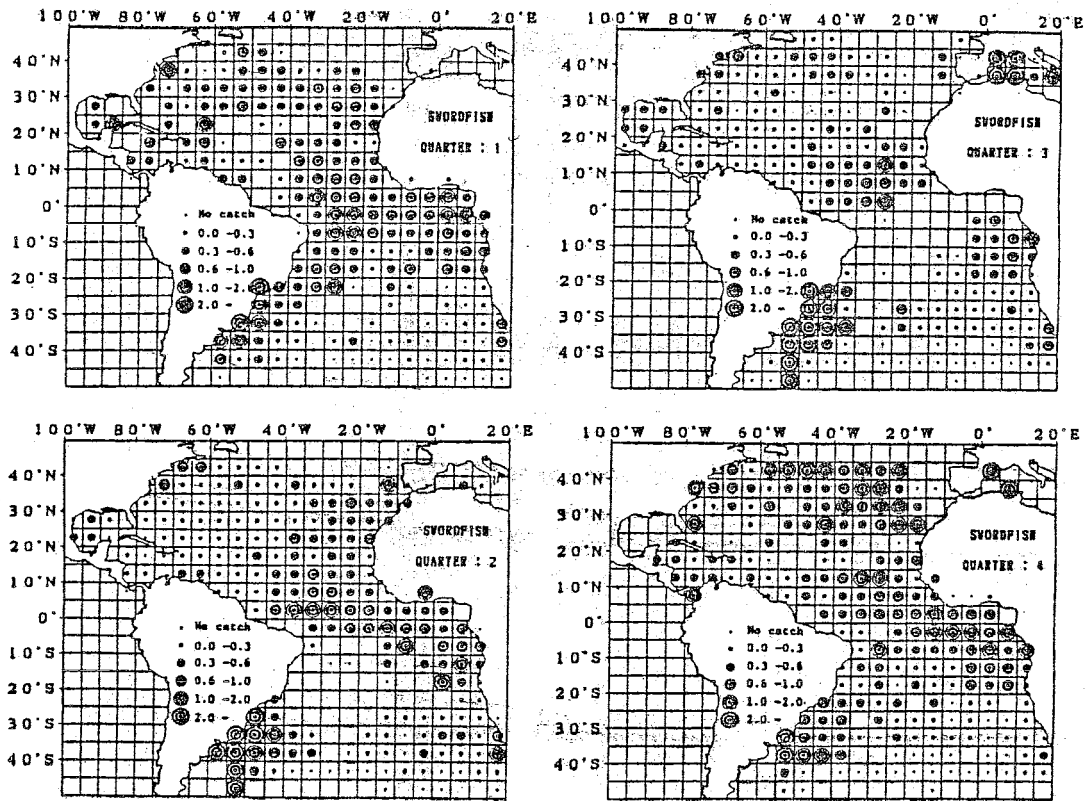


Fig. 1. Quarterly distribution of average hook rates (number of fish/1000 hooks) on Atlantic swordfish caught by Japanese longline boats from 1967 to 1972.

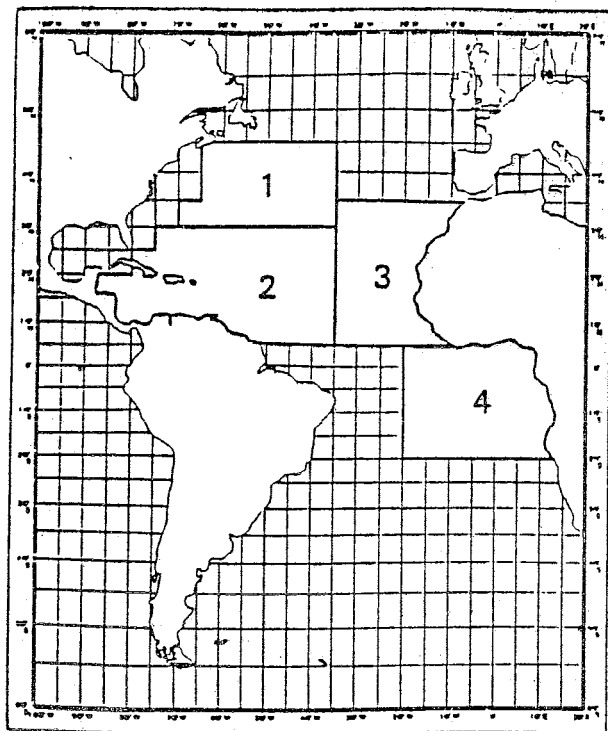


Fig. 2. Division of model areas used for the present study on the Atlantic swordfish.

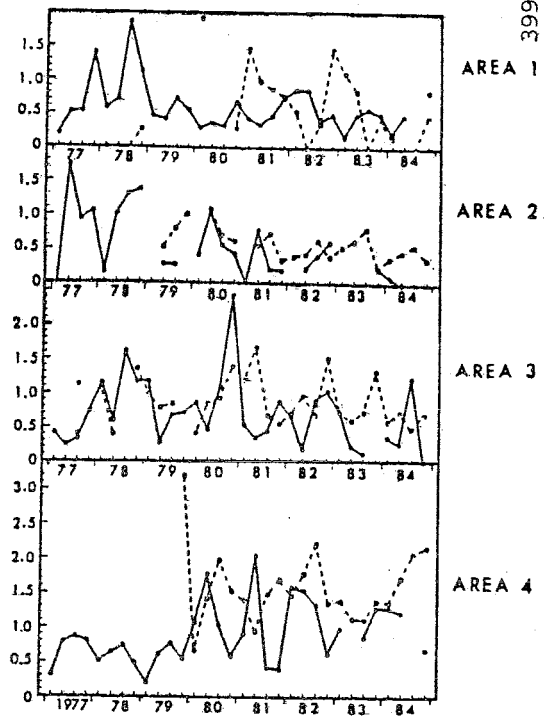


Fig. 3. Hook rates of the Atlantic swordfish by gear type by quarter of the year in the model areas. (— RL, - - - DL)

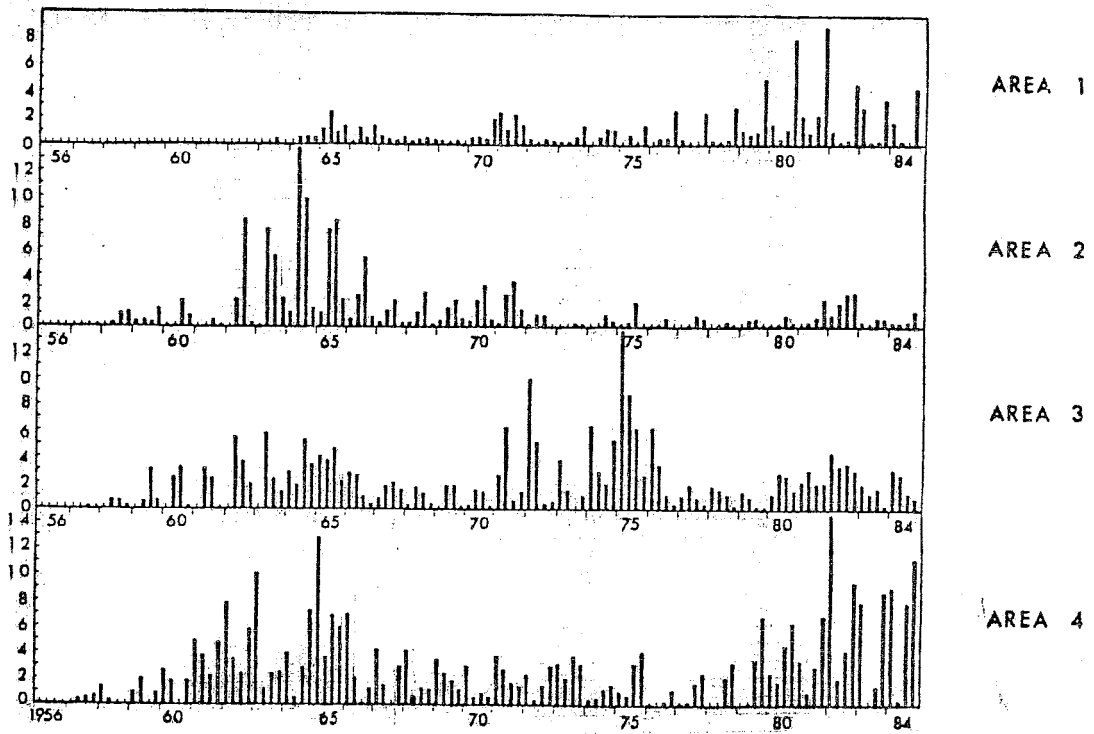


Fig. 4. Number of hooks (million hooks) by quarter of the year used by the Japanese longline boats in the model areas.

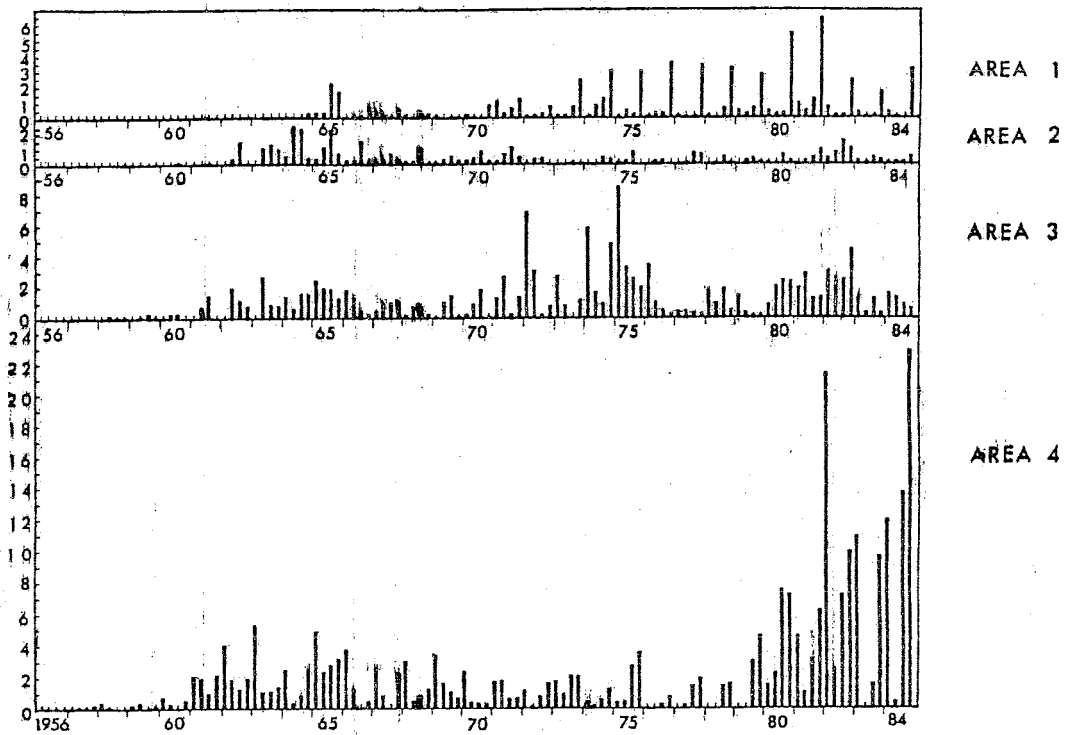


Fig. 5. Number of swordfish (1000 fish) by quarter of the year caught by the Japanese longline boats in the model areas.

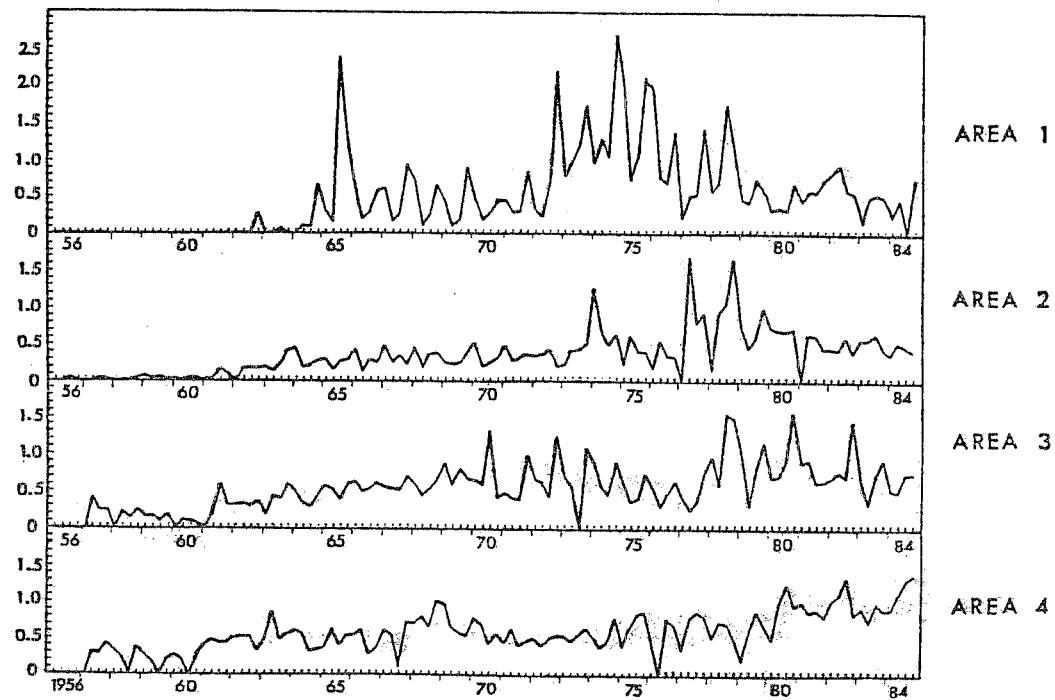


Fig. 6. Trends of hook rates for the Atlantic swordfish by area by quarter of the year.