

OVERALL FISHING EFFORT AND CATCH WITH A COMMENT ON THE STATUS OF STOCK FOR THE SWORDFISH,
XIPHIAS GLADIUS, IN THE ATLANTIC OCEAN

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SUMMARY

The trend in the Japanese longline fishery for swordfish for the period 1956-1978 is reviewed. Generally, the CPUE is very low and remains still level or slightly upward. The concentration index, ratio of the effective number of hooks to the nominal hooks, rarely exceeds 1.0 on the average, though there is a considerable quarterly change. It seems that the fishery does not cover sufficiently the swordfish stock(s) both in area and season. The overall fishing intensity corresponding to the yearly total Atlantic catch is obtained simply from the assumption that the whole Atlantic fisheries would be represented by the Japanese longline fishery in terms of the effort distribution and their plots are presented. This assumption, however, is far from the actual situation and necessarily introduces much uncertainty in estimation.

RESUME

On examine la tendance de la pêche palangrière japonaise à l'espadon pour la période 1956-78. La CPUE est en général très faible et demeure stable ou en hausse légère. L'indice de concentration, rapport entre le nombre d'hameçons effectifs et nominaux, dépasse rarement 1,0 en moyenne, bien qu'il se produise des changements trimestriels considérables. Il semble que la pêcherie n'exploite pas suffisamment le stock d'espadon, ni dans le temps ni dans l'espace. L'intensité globale de pêche qui correspond à la prise annuelle totale dans l'Atlantique est obtenue simplement en supposant que la pêche palangrière japonaise illustre l'ensemble des pêcheries de l'Atlantique en termes de la distribution de l'effort, ce qui est représenté graphiquement. Cette hypothèse est néanmoins loin de correspondre à la réalité, et introduit forcément des incertitudes dans les estimations.

RESUMEN

Se examinan las tendencias de la pesquería palangrera japonesa de pez espada, para el período 1956-1978. En términos generales, la CPUE era muy baja y ha permanecido al mismo nivel, o ha experimentado un ligero aumento. El índice de concentración, la relación entre el número de anzuelos efectivos y el de anzuelos nominales, muy rara vez excedió del 1,0 de promedio, si bien existen cambios trimestrales notables. Se tiene la impresión de que la pesquería no cubre suficientemente ni por zonas ni por temporadas, el

stock o stocks de pez espada. La mayor intensidad de pesca global correspondiente al total de capturas anuales en el Atlántico, se obtiene partiendo del supuesto de que todas las pesquerías del Atlántico estarían representadas por la pesquería japonesa de palangre en términos de distribución del esfuerzo y representación gráfica. Esta presunción, sin embargo, no se aproxima a la situación real y, lógicamente, la estimación resulta poco precisa.

Introduction

Swordfish are widely scattered over the Atlantic as in other oceans and often harvested in commercial quantities in coastal areas. They are apparently of the tropical and subtropical spawning and appear to make a large scale movement associated with growth. Among fisheries, the primary gear is the longline, although there is an increasing share by surface gears and sports fishery very recently (ICCAT 1978).

In the Japanese longline fishery, swordfish have been the occasional visitors from the beginning in 1956. Prior to 1962, longline vessels mainly fished large tunas such as yellowfin tuna and albacore of highly economical value and ship's log book records were often lacking billfish catches (Shiohama et al. 1965). From the statistical data available today (ICCAT Stat. Bull. Vols.1-9), the Japanese swordfish catch increased as areas fished increased and amounted to 2,900 tons in 1965. Once reduced, it again reached the peak of 3,200 tons in 1970. After the 1970 high, it decreased until at least 1977.

The swordfish catch from the whole Atlantic fisheries (including the Mediterranean fisheries) rose to the recent level as early as in 1963 and since then fluctuated with the average of 13,000 tons. In this manuscript, trends in the total swordfish catch and overall fishing intensity during the recent years is briefly reviewed using data from the Japanese longline fishery under the hypothesis of the Atlantic-wide stock structure.

Annual estimates for Japanese and whole Atlantic fisheries

For the period 1957-1978, the annual number of swordfish caught and the corresponding effective number of hooks and fishing intensity per 5-degree square are calculated using the Honma's method (1974) as in our previous reports (1977, 1978). The Japanese 1978 catch are obtained from two sources; one is the longline statistical report compiled by the Fisheries Agency (Fisheries Agency of Japan, 1980) and the other is the unpublished records available to us. The latter contains the number of all billfishes caught and released by Japanese longline vessels within the U.S. 200-mile zone under the U.S. Act of Regulation that came into effect in 1978. The Japanese 1978 fishing effort was expended also for those fish released. If fish recorded alive at time of release continued to survive and never came back again into the fishery during the year, then a portion of fishing effort equivalent to survivors could be deleted from the total effort.

In 1978, 5,110 swordfish were caught and released, which is one third the published total catch. Of these, 2,260 fish or 44.2 % were recorded alive when released. Our corrected 1978 catch and fishing intensity correspond to C_3 and f_3 in Fig.1. This procedure generally results in a significant decrease in the estimated overall fishing intensity for the whole Atlantic fisheries, though the increase in the total catch is small. For swordfish, the overall fishing intensity decreases 23 % and the total catch increases 0.8 %, comparing to where no correction is made.

The annual catch and fishing intensity both for the Japanese and the whole Atlantic fisheries for the period 1957-1978 are presented in Table 1 together with the expanding factor. The basic catch data in metric tons are provided from the ICCAT (Stat. Bull. Vols.1-9).

Trend in Japanese longline fishery

In Fig.2, the annual change in CPUE for the Japanese longline fishery from 1956 to 1978 is shown by quarter of the year on the Atlantic-wide basis. Except for years prior to 1962 where the catch data are inadequate, the change in CPUE appears to nearly level off or to be slightly in an upward trend. CPUE's, however, are very low, ranging on the average from 0.5 to 0.9 fish per 1000 effective hooks. In Fig.3, the annual change in the concentration index, ratio of the effective number of hooks to the nominal hooks, is presented in the same way. Prior to 1968, the concentration index is consistently below 1.0 and after 1969, large seasonal change is seen. A prominent peak occurs in the third quarter from 1969 to 1972, shifting to the fourth quarter after 1973 though in lesser degree. The prominent quarterly peak in the former period apparently mirrors the effort concentration in the South-west Atlantic Ocean off southern Brazil with the extraordinary high hook rate for this fish, as shown in Fig.4. This is the only period during which the concentration index for swordfish was above 1.0 on the annual average. Except for the period above, it seems that the fishery has not covered sufficiently the swordfish stock both in area and time.

Trends in total catch and overall fishing intensity

We here review the trends in the whole Atlantic fisheries for the swordfish catch, using historical data and estimates. The total swordfish catch, which fluctuated with an average of about 13,000 tons, was up to 19,000 tons in 1978, the highest ever. A 49 % increase in the catch from

the previous year was made with a 39 % increase in fishing intensity, as given in Table 1. The ICCAT Statistical Bulletin provides the breakdown of the total catch by gears, that is, catches by the longline and aggregate surface gears. Unspecified gears are assumed to contribute to the catch by the latter. From 1968 to 1977, the surface catch changed between 12 % and 31 % to the total catch and in 1978 was up to 40 %. The sports fishery, according to the published record, contributed nothing to the total catch until 1978 when it took 3,000 tons suddenly. A possible answer to this would be either perfect dropping of the catch or its inclusion in the "Unspecified" prior to 1977.

The expanding factor to represent the overall fishing intensity, shown as T/J in Table 1, changes between 1.6 and 19.0 from 1963 to 1978. Six times after 1963, we have the years each with particularly large values exceeding 10. In three most recent years, for instance, the expanding factor ranges from 14 to 19 and the Japanese longline catch is as small as 5 to 7 % to the total Atlantic catch. This will give rise to much uncertainty for the total estimates.

Fig.5 shows the catch and fishing intensity plots for the whole Atlantic fisheries. The relation between both is indicated by the solid circles. The open circles show the ratio of the catch to the fishing intensity for individual years corresponding to the solid circles. The open circles scatter apparently in a downward trend, which seems to suggest more yield with the further increase in the fishing intensity. However, lack of reliable data from the fisheries makes the analysis difficult for this fish. At least for the longline fisheries that still contribute much to the total landing, examining in detail their data in the scope of available sources is required.

References

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(Note: Part of description and a table on the production model analysis in the original manuscript is deleted in this version because of much uncertainty of the data base.)

Table 1 Catch and fishing intensity for swordfish under the Atlantic-wide stock hypothesis, as estimated from Japanese longline data, 1957-1978.

Year	Catch (M/T) 1/		T/J	Fishing intensity 2/	
	Japan (J)	Total Atlantic (T)		Japan	Total Atlantic
1957	70 3/	4600	65.71	17	1132
1958	100	5700	57.00	38	2173
1959	100	6200	62.00	81	5046
1960	100	4600	46.00	120	5521
1961	300	5700	19.00	162	3087
1962	400	6300	15.75	282	4443
1963	1100	12000	10.91	291	3170
1964	2000	13800	6.90	398	2748
1965	2870	13000	4.53	540	2446
1966	1960	12810	6.54	269	1758
1967	750	13000	17.33	172	2979
1968	1120	13110	11.71	176	2060
1969	2270	15290	6.74	481	3241
1970	3180	15660	4.92	479	2358
1971	1580	10230	6.47	350	2264
1972	1810	12150	6.71	364	2441
1973	1000	11570	1.57	204	2360
1974	1370	10760	7.85	258	2024
1975	1500	11420	7.61	365	2779
1976	810	11840	14.62	206	3018
1977	800	12810	16.01	143	2287
1978	1000 3/	19040 3/	19.04	167	3176

1/ From ICCAT Statistical Bulletin, Vols.1-9.

2/ Fishing intensity in 1000 hooks per 5° sq. (rounded values).

3/ Estimates in this m.s.

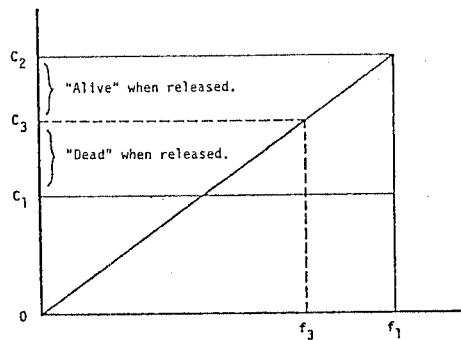


Fig. 1 Correction of Japanese 1978 estimates of catch and fishing intensity.

- f_1 ... 1978 fishing intensity based on average standard year pattern (1965-1975) of fish distribution.
- C_1 ... 1978 catch from published statistical report.
- C_2 ... C_1 + (Total number of fish caught and released within U.S. 200-mile FCZ).
- C_3 ... C_2 - (Number of fish "alive" when released).
- f_3 ... Fishing intensity corresponding to C_3 .

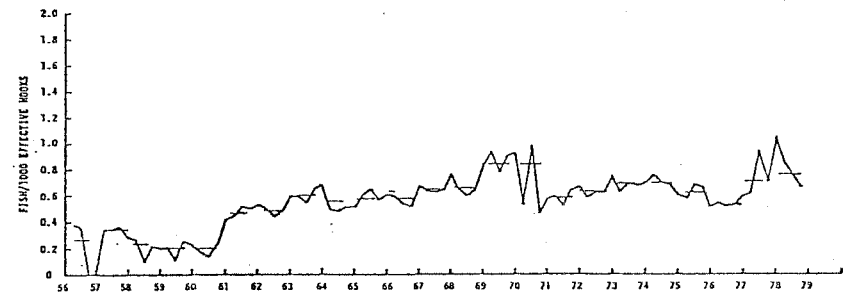


Fig.2 Annual change in CPUE (fish/1000 effective hooks) of swordfish in the whole Atlantic Ocean, 1956-1978.

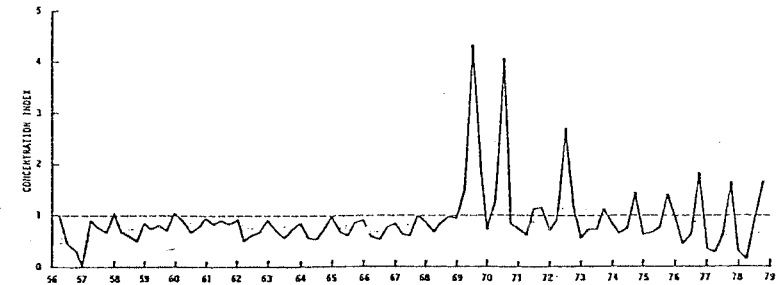


Fig.3 Annual change in concentration index (ratio of effective number of hooks to nominal hooks) of swordfish in the whole Atlantic Ocean, 1956-1978.

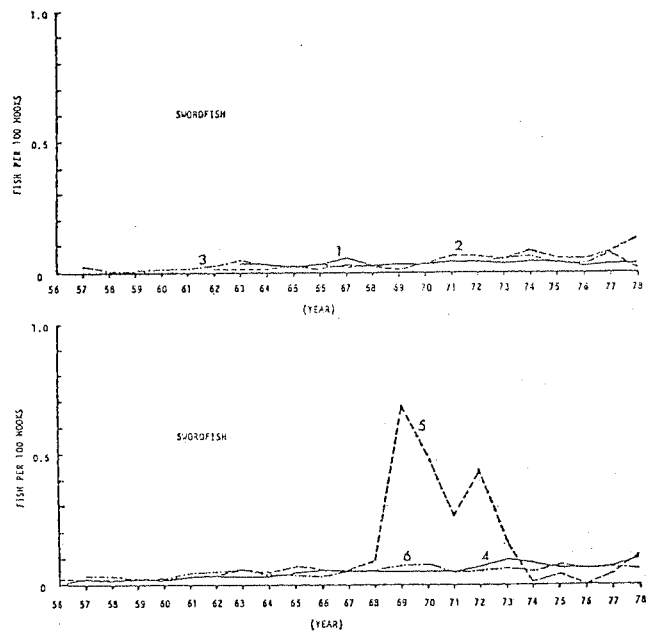


Fig.4 Annual change in hook rate of swordfish by ICCAT billfish sampling area, 1956-1978.

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|---------------------------|---------------------------------------|
| 1 Gulf of Mexico area. | 4 Central and Eastern North Atlantic. |
| 2 Western North Atlantic. | 5 Western South Atlantic. |
| 3 Caribbean Sea area. | 6 Eastern South Atlantic. |

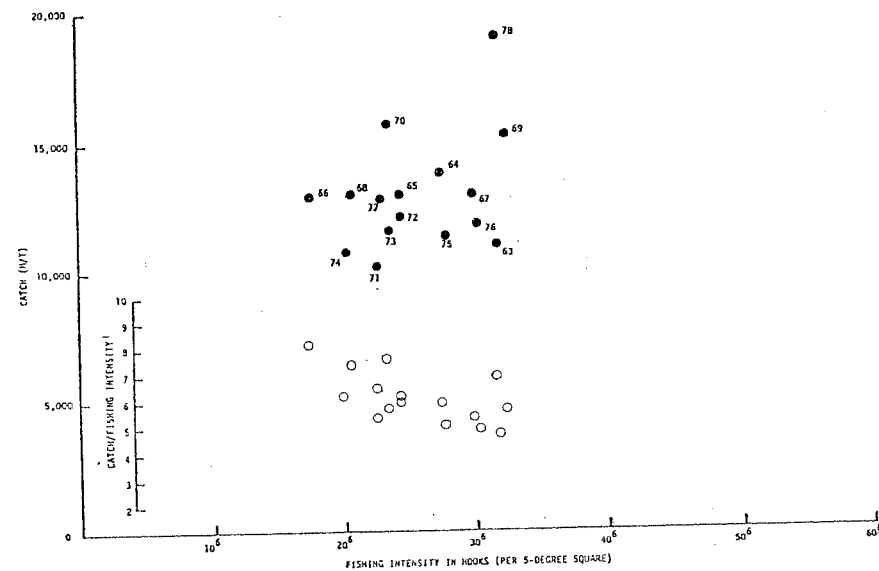


Fig.5 Catch/fishing intensity plots under the Atlantic-wide stock hypothesis.