

ANALYSIS ON XIPHLAS GLADIUS L. CAUGHT OFF SOUTH AND SOUTHEAST OF BRAZIL (1971-1981)

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SUMMARY

Swordfish represent about 24% of the total catch of Brazilian longliners that operate in the area 20°-33°S and 039°-050°W, being usually the second most caught species. Commonly the values of yield, catch per unit of effort and average weight were higher in the third quarter (winter). The great increase in yield and catch per unit of effort verified in 1980 was due to changes in the bait used and the schedule of the fishery. The analysis of these data suggests a potential to be better studied.

The dressed weight-weight relationship obtained was:

$W = 1.17 W_d$. The catch included specimens between 50 and 290 cm, the sizes of 85 to 185 cm being the most frequent. In this region the spawning of the species occurs from the middle of the fourth to the end of the first quarter (mainly in January-February), in the area 20°-28°S and 039°-047°W.

RESUME

L'espadon constitue environ 24 % de la prise totale des palangriers brésiliens qui pêchent dans le secteur délimité par 20°-33°S de latitude et 039°-050°W de longitude, et se situe au deuxième rang, par ordre d'importance, des espèces capturées. En général, les valeurs les plus élevées de production, CPUE et poids moyen sont atteintes au cours du troisième trimestre (hiver). La forte hausse de la production et de la CPUE observée en 1980 était due à des changements dans le type d'appât utilisé et dans le calendrier des activités de pêche. L'analyse de ces données suggère l'existence d'un potentiel qu'il conviendrait d'étudier.

La relation poids manipulé/poids obtenue est: $W = 1,17 W_d$. La prise comprend des spécimens de 50 à 290 cm, ceux de 85 à 185 cm étant plus fréquents. Dans cette région, la ponte de l'espèce a lieu du milieu du quatrième trimestre à la fin du premier (surtout en janvier-février), dans le secteur délimité par 20°-28°S de latitude et 039°-047°W de longitude.

RESUMEN

El pez espada representa un 24% de la captura total de los palangreros brasileños que faenan en la zona 20°-33° S y 039°-050° W, y suele ser la segunda especie en orden de importancia en las capturas. Normalmente, las cifras de producción, CPUE y peso medio fueron mas altas en el tercer trimestre (invierno). El gran incremento del rendimiento y de la CPUE experimentados en 1980 se debió a cambios en el cebo empleado y en el plan de la pesquería. El análisis de estos datos sugiere un potencial que ha de ser mejor estudiado.

La relación peso/peso eviscerado que se obtuvo, fue:
 $W = 1.17 W_d$. La captura incluía peces entre 50 y 290 cm, siendo mas frecuentes las tallas entre 85-185 cm. En esta región, el desove tiene lugar desde mediados del cuarto trimestre hasta finales del primero (en especial Enero-Febrero) en la zona 20°-28° S y 039-047° W.

1. INTRODUCTION

The catch of swordfish off the South and Southeast of Brasil is realized all the year round by Brazilian and leased longliners.

The Brazilian longliners are settled in Santos-SP and operate at 20°-33° S and 039°-050° W (Figure 1). Aiming at more productivity, these longliners directed their fisheries to determined areas, according to the season of the year. So, from the beginning of May to the middle of October they fished to the South of parallel 25° S and during the rest of the year to the North of parallel 27° S (ARFELLI & AMORIM, 1981). However, since 1979, the fishing areas, according to season, have suffered some changes: the longliners basically follow the mentioned scheme, but sometimes fish in an area not very usual for the season.

The main aim of the Brazilian longliners' fishery are chiefly three species of tuna; nevertheless, the swordfish has been the second, and sometimes the first species in annual catch (in weight). The highest catches of swordfish occurred from July to September when they represented 26%, 38% and 41% (1971-81), respectively.

In Brazil most of the publications, such as MO RAES (1962), MORAIS (1963) and PAIVA (1972 and 1975) just report data of catch and distribution. Recently published papers, as AMORIM (1977), AMORIM & ARFELLI (1977 and 1980), and AMORIM et alii (1979), include biology studies of this species.

The present paper contains results and analysis of dressed weight-weight relationship; season and area of spawning; size-frequency; yield (number of fishes), catch per unit of effort; and average weight of swordfish caught by Brazilian longliners.

2. MATERIAL AND METHODS

The samples analyzed in this paper were obtained through sampling in the sea, during seven research trips on

board Brazilian longliners, from January 1974 to July 1977; and on land, during the longliners' unloading at the Fishing Terminal of Santos - SP, from 1974 to 1981. The data of the catch of the period 1971-81, related to these longliners were obtained from the fisheries companies and "Instituto de Pesca".

Swordfish was measured and weighed in the Fishing Terminal of Santos and on board the longliners: the eye-fork length (EFL) was obtained with a metallic tape of 1 cm approximation, and the round weight (obtained only on board) and the dressed weight (without gut, gill, bill and fins) were obtained with scales of 1 kg approximation.

In order to establish the dressed weight-weight relationship, data of 155 specimens were collected, during six research trips from June 1974 to July 1977. They were computed individually, and show that the relationship is linear and results in an expression as follows:

$$W = b W_d$$

were:

W = round weight in kilogram

W_d = dressed weight in kilogram

b = constant

The constant b was estimated by the chi-square method.

The gonadal analysis based on OVCHINNIKOV (1971) was obtained from 354 female gonads, collected from January 1974 to December 1980. Some gonads were examined immediately after the catch on board the longliners, and others were received for analysis in the laboratory, preserved on ice.

The criterion of considering the arrivals of boats in the beginning of a month, was adopted as belonging to the previous month, when most of the catch had really occurred.

Data of 59,000 specimens were utilized for the size-frequency, obtained from log commercial sheets of fisheries companies (Cooperativa Vista de Pesca Vipo-Brasileira, and Companhia Irmãos Jno, Akama Comércio de Pescados Ltda. and Inaipesca Indústria e Comércio de Pescados Ltda). These sheets contain the dressed weight, of the specimens commercialized per each trip. Through the length-weight

relationship $W_d = 1.24 \times 10^{-5} EFL^{3.104}$ (AMORIM & ARFELLI, 1977) the weight was converted into length, gathered in 5 cm classes, expressing the quarterly and yearly size-frequencies for 1971-81. In order to simplify the analysis of size-frequency, the fish of 135 cm or less were considered small (S), the ones of more than 135 cm to 210 cm were medium (M), and lengthy (L), those of more than 210 cm ($S \leq 135 \text{ cm} < M \leq 210 \text{ cm} < L$).

The yield, CPUE (per 1,000 hooks), fishing effort and average weight are expressed by quarter and year, from 1971 to 1981.

The number of fishes used for the analysis of yield, catch per unit of effort (CPUE) and average weight were also obtained from log commercial sheets of the mentioned fisheries companies.

The average weight is the summation of the individual dressed weight, converted to live round by the mathematical expression presented in this paper, and divided by the number of fishes.

The fishing effort (number of hooks) was obtained from "Seção de Controle da Produção Pesqueira - Divisão de Pesca Marítima - Instituto de Pesca", except for the period from 1971 to 1973, which was estimated on the basis of the effective fishing days to an average of 1,200 hooks per day.

3. RESULTS AND DISCUSSION

The main aim of the longliners' fishery are chiefly three species of tuna; nevertheless, the swordfish has usually been the second most caught species. These boats used to set the longline around midnight to 01:00 a.m. and to use sardine, Sardinella brasiliensis, as bait. However, from the middle of 1980 to the beginning of 1981, this fleet aimed its fishery towards the catch of swordfish, starting to set the longline around 9:00 p.m., and changing the bait to squid,

Loligo spp. So, in 1980 the proportion of the 2,100 t caught, was: 46.4% of swordfish; 26.1% of tunas (4 species); 21.4% of sharks (about 20 species); 2.6% of sailfish; 1.1% of white marlin; 0.5% of blue marlin; and 1.9% of others (dolphin, opah, escolar, oilfish, wahoo and skipjack tuna). In 1981 they fished with squid and sardine, but when they tried to catch swordfish (setting the longline around 9:00 p.m.), it was usually preyed by the killer whale, Orcinus orca. It obliged the pilots to operate in the former schedule and/or to change the fishing area. So, the swordfish again became the second most caught species (22%).

Killer whale and sharks sometimes prey a large amount of the swordfish hooked, reaching even 50% on some trips.

a. Dressed Weight-Weight (Figure 2)

$$W = 1.17 W_d$$

$$r = 0.998$$

$$N = 155$$

The variation amplitudes of weight and dressed weight were 6 to 125 kg 5 to 103 kg, respectively.

b. Gonadal Analysis (Figure 3)

The 354 female gonads were examined in different periods of the year, and classified as follow:

- first quarter - 35 gonads: 14% in stage I of maturity, 23% in II, 28% in III, 9% in IV, 20% in V, and 6% in stage VI.

- second quarter - 110 gonads: 2% in stage I, 72% in II, and 26% in stage III.

- third quarter - 96 gonads: 1% in stage I, 71% in II, and 28% in stage III.

- fourth quarter - 113 gonads: 21% in stage I, 59% in II, 15% in III, 1% in IV, and 4% in stage V.

All the gonads in stages IV and V were collected in the first and fourth quarter, mainly in the first quarter; and only in this quarter were observed gonads in the

stage VI. The gonads in stages IV, V and VI were collected in the area 20°-28° S and 039°-048° W. Nevertheless, the spawning area might be larger for several reasons: a) the samples come from Brazilian longliners fishing in a limited area (Figure 1); b) UEYAMAGY et alii (1970) observed maturing female in the first quarter (some also in the fourth quarter) in the area 20°-30° S and 040°-050° W, and larvae in the area 15°-25° S and 015°-030° W (from November to April); and c) Lutken (1980) in GORBUNOVA (1969) found larvae in the area 20°-30° S and 030°-040° W.

The analysis of these data indicates that the swordfish spawning occurs from the middle of the fourth quarter to the end of the first quarter (mainly in January-February). During this period the fleet operated in the area 20°-23° S and 039°-043° W.

These results agree with the previous paper presented by AMORIM & ARFELLI (1980).

c. Size-frequency

The analysis of the annual size-frequency (Figure 4) shows that: the proportion of small fish ($S \leq 135$ cm) caught from 1971 to 1976 presented a decreasing trend, but from 1977 to 1981 it was verified an increasing trend in this proportion; the fluctuation in the proportion of the medium fish ($135 \text{ cm} < M \leq 210$ cm) did not present a definite trend; and the proportion of the lengthy fish ($L > 210$ cm) was almost the same for the whole period. According to the annual size-frequencies of 1971-73, 1978, 1979 and 1981, the largest proportion of the catch were distributed from 85-90 cm to 170-175 cm classes; while in the period of 1974-77 and 1980, the largest proportion of the caught specimens were concentrated from 115-120 cm to 180-185 cm. In the whole period, the caught specimens ranged from 50-55 cm to 285-290 cm.

During the ICCAT Inter-Sessional Workshop on Billfish, Berkeley, Houde and Irby Jr. reported on the results of examining the second anal spine for annuli with results that suit well to the von Bertalanffy growth curve. Analyzing

the size-frequency data presented here (1971-80) that workshop suggested that size modes might be detected passing through the fishery which are compatible with the sizes at age proposed by Berkeley, Houde and Irby Jr. (ICCAT, 1981).

By the annual analysis of monthly size-frequency of the period 1971-81 (Figures 5 to 15) it is possible to state that:

- the widest distributions usually occurred from November to January;

- the distributions of the smallest size range did not have a determined period of occurrence; they were more frequent in May, occurring also sporadically from February to October, except in July;

- the small fish were usually caught in the highest proportion from October to January;

- the medium fish were mostly caught in the highest proportion from July to September;

- the lengthy fish were mostly caught from November to January.

d. Yield, Catch Per Unit of Effort (CPUE) and Average Weight.

- Yield

Analyzing the annual catch of this species, per number of fishes, in the period 1971-81 (Figure 16), there is a noticeable fluctuation with increasing trend: from 1971 to 1973 the average annual was 2,400 fishes, increasing about 3 times in the period 1974-75, totalizing an average catch of 6,100 specimens; it decreased to 4,200 specimens (annual average) in the period 1976-79; and, in 1980 it increased about 4 times, totalizing 15,610 specimens, decreasing to 7,081 in 1981 (although this decrease, the catch of 1981 was higher than in the previous years, except in 1980).

The quarterly catches (Figure 17) were always higher in the third quarter, except in 1973. In this year the

highest number of fishes occurred in the second quarter, but the highest catch in weight occurred in the third quarter.

- Fishing effort

The annual fishing effort has shown an increasing trend in the analyzed period ranging from 432,000 to 1,100,000 hooks (Figure 13).

- CPUE

By the analysis of the annual CPUE of the studied period (Figure 16), fluctuations were observed: / from 1971 to 1973 the average CPUE was almost 3 fishes per thousand hooks, increasing to 5 in 1974-75, and decreasing to 4 in the period of 1976-78; in 1980, due to the mentioned changes on fisheries, the CPUE increased to 13.3, / decreasing again to 5.9 in 1981.

The quarterly CPUE (Figure 17) were usually higher in the third quarter, except in 1971 (first quarter) and 1973 (second quarter).

Considering the data in item "d", it was observed that the annual and quarterly fluctuations of yield, followed the CPUE fluctuations, but did not follow the fishing effort fluctuations (Figures 16 and 17). The annual data showed that from 1971 to 1975, the increase in the fishing effort usually resulted in increase in the yield and CPUE; however, the opposite happened after this period. Nevertheless, it must be considered that this effort is not normally directed to swordfish, and is even more intense in the period of low occurrence of the species. The great increase of yield and CPUE, verified in 1980, was probably due to the mentioned changes in the fishery, that started to aim at the catch of swordfish. In this year the number of hooks was diminished.

The analysis of these data suggest the existence of a potential, that should be better studied.

a. Average Weight

The highest values of average weight (live round) occurred in the third quarter, except in 1971 and 1979 (fourth quarter) and in 1979 (first quarter). The annual average weight fluctuated from 49.9 to 72.5 kg in the period 1971-81 (Figure 16).

4. CONCLUSIONS

The swordfish is caught in the area 20°-33°S and 039°-050°W, South and Southeast of Brazil, by longliners. It occurs all the year round, although, with more intensity in the third quarter. It represented about 24% of the Brazilian longliners' catch, being the second species in weight, in the period 1971-81.

The dressed weight-weight relationship is represented by the equation:

$$W = 1.17 W_d$$

In the area 20°-26° S and 033°-043° W, the spawning occurs from the middle of the fourth quarter to the end of the first quarter (mainly in January-February).

In the period 1971-81, the catch was composed / by specimens ranging from 50-55 cm to 285-290 cm size classes, and the intervals from 85-90 cm to 180-185 cm being the most frequent. The largest proportion of small fish ($L \leq 135$ cm) usually occurred from October to January. The largest proportion of lengthy fish ($L > 210$ cm) always happened from November to January.

The fluctuation in the yield and CPUE did not follow the fishing effort, as happened until 1975. The great increase in the yield and CPUE, verified in 1980, was probably due to the changes in the fishery. The highest values of yield, CPUE and average weight were verified in the third quarter.

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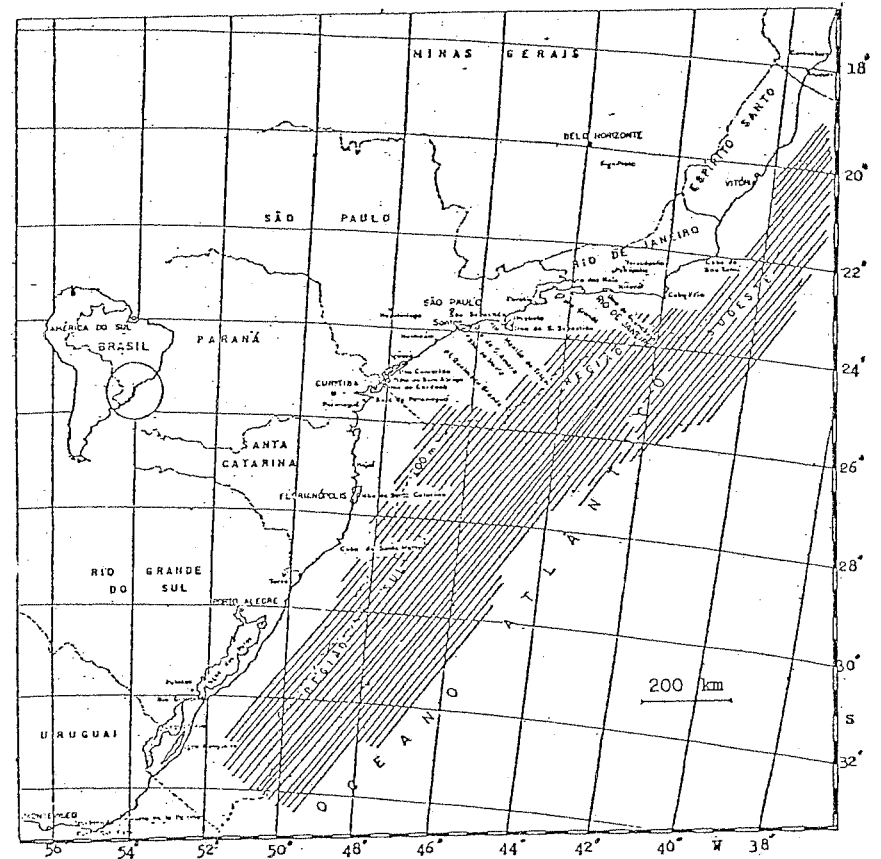


Figure 1 - Brazilian longliners fishing area.