FIRST OBSERVATIONS ON REPRODUCTIVE BIOLOGY OF BILLFISHES (*TETRAPTURUS ALBIDUS*, *ISTIOPHORUS ALBICANS* AND *TETRAPTURUS PFLUEGERI*) IN SOUTHWESTERN EQUATORIAL ATLANTIC (BRAZIL)

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SUMMARY

From November, 1991, to July, 1993, gonads of *Tetrapturus albidus*, *Tetrapturus pfluegeri*, and *Tetrapturus albicans* were collected from the longline fishery carried out between 1°-9°S latitude and 30° to 40°W longitude. All 109 specimens, represented by 68 females and 41 males, were measured and weighted; this procedure allowed the establishment of the monthly GI. In order to identify microscopic maturational stages, histological sections of female gonads were prepared. Ovaries were evaluated according to Jolley (1977) scales which consider the following stages: I-immature, II-resting, III-active, IV-ripe, and V-spent. Three of these stages were observed in the sample. Specimens in the spawning stage were not recorded.

RESUME

Entre novembre 1991 et juillet 1993, des prélèvements d'échantillons de gonades de *Tetrapturus albidus*, *Istiophorus albicans* et *Tetrapturus pfluegeri* ont été effectués. Les palangriers ont pêché dans la zone comprise entre 1º à 9ºS et 30º à 40ºW.

Cent-neuf individus dont 68 femelles et 41 mâles ont été mesurés et pesés, ce qui a permis le calcul de l'IG mensuel. Les femelles ont été soumises à des coupes histologiques pour l'identification des stades microscopiques de maturation sexuelle, ce qui a été fait en utilisant les échelles établies par Jolley (1977) qui tiennent compte de cinq stades: I- immature, II- repos sexuel, III- active, IV- mûr, V- épuisé.

Trois stades ont été observés dans l'échantillon. Aucun individu en état de ponte n'a été observé.

RESUMEN

Entre noviembre de 1991 y julio de 1993, se efectuaron recolecciones de muestras de gónadas de *Tetrapturus albidus*, *Istiophorus albicans* y *Tetrapturus pfluegeri*. Los palangreros faenaron en la zona comprendida entre 1° a 9°S y 30° a 40°W.

Se pesaron y midieron todos los especímenes, 109 individuos, de los cuales 68 eran hembras y 41 eran machos, lo que ha permitido calcular el IGS mensual. En las hembras se practicaron cortes histológicos para identificar las fases microscópicas de madurez sexual. Esto se llevó a cabo utilizando las escalas establecidas por Ueyanagi (1970) y Jolley (1977), que consideran cinco fases: I - de inmadurez, II - de reposo sexual, III- de actividad, IV - de madurez, V - de agotamiento. Se observaron tres fases en la muestra. No se observó ningún individuo en fase de desove.

Introduction

Fisheries for Billfishes in the Northeast Brazil is conducted by vessels which operate from Natal. The group represents 29% of the total catch which includes sharks and tunas. Among billfishes *Istiophorus albicans*, *Tetrapturus albidus*, and *Tetrapturus pfluegeri* correspond to 47%, 29% and 24% of the catch respectively.

Billfishes (Istiophoridae family) are pelagic species captured in tropical, subtropical and temperate waters.
The present study intends to contribute for elucidating their reproductive process due to the scarce literature on billfishes from Equatorial Southwestern Atlantic.

Material and Methods

Longliners vessels based in Northeastern Region operate in the area laid between 1° - 9° S latitude and 30°-40° W longitude, from november 1991 to July 1993. Billfishes species captured were Sailfish (*Istiophorus albicans*), White Marlin (*Tetrapturus albidus*) and the Longbill Spearfish (*Tetrapturus pfluegeri*).
During landings, the fork length (cm) and the weight (g) were recorded; gonads were stored in formalin . A macroscopic analysis was performed according to Ovichinnikov (1971). The weighting of gonads allowed the gonadal index establishment- GI , that was used as a numeric index to show the ovary maturity, being described by the expression presented by Kume and Joseph (1969), Eldridge and Wares (1974) and Arocha and Lee (1992).

$$GI = (W/L^3)x10^4$$

W = total weight of gonads in grams, and
L = eye-fork length in cm.

From each specimen samples for microscopic analysis were taken from the central part of ovary. Histological sections (8 μm), were obtained. After being stained by Hematoxylin/Eosin, these sections were examined and classified according to Jolley's (1977) maturity scale.

The sex ratio was assumed as the number of females in relation to the number of males.

Results

Concerning *Tetrapturus albidus*, the fork length in the whole sample ranged from 90 to 180 cm. Nineteen females ranged from 90 to 160 and thirteen males ranged from 110 to 180 cm (Fig.01) The sex ratio , shows the dominance of females: 1.5:1.

The average gonadal indexes (GI) per month are higher for females in the second (1,47) and fourth (0,65) quarters . The highest IG (0.4) for a males in the length class 160-170 cm was found in the first quarter (Fig.02)

All females in the sample corresponded to Jolley's (1977) I (immature) and II (resting) stages. Fifty seven per cent of females were classified in stage I and the remaining twenty nine per cent corresponded to stage II (Fig.03-A). Measurements of largest oocytes diameter, ranged from 15 to 20 um for stage I and 35 to 40 μm for stage II (Fig.04).

Referring to *Tetrapturus pfluegeri*, twenty six specimens, seventeen females and nine males, ranged from 100 and 180 cm (Fig.05). The sex ratio here was 1,9:1 , showing, again, the dominance of females.

The average gonadal indexes (GI) per month are higher for females in the third (1,62) and fourth (0,92) quarters. The highest GI for males in the fourth (0,13) quarters. (Fig.06).

Three out five stages described by Jolley (1977) were found in the sample. Immatures specimens were dominant (Fig.03-B). Here the diameters of the oocytes varied from 35 to 40 μm at the stage I and stage II; and 290 to 410 μm at stage III.

The whole sample can be divided in the following stages: stage I and stage II: 57%, and stage III: 14%.

Finally considering *Istiophorus albicans*, fifty-one specimens, ranged from 100 to 230 cm. Thirty-two females ranged from 100 to 230 cm and nineteen males ranged from 130 to 210 cm (Fig.07), leading to a sex ratio of 1,7:1 favorable to females.

The highest IG obtained was 1,28 for females and 0,42 for males (Fig.8).

Three out five of Jolley's (1977) maturational stages were observed in females. Immature specimens, corresponding to stage I were the most abundant (Fig. 03-C).

The sample, according to maturational stages was divided as follows: Stage I: 38%, Stage II: 39%, stage III: 24%.

Oocytes diameter ranged in stage I from 10 μm to 20 μm; in stage II from 70 μm to 80 μm and in stage III they ranged from 310 to 350 μm (Fig. 9).

Discussion

As far as *Tetrapturus albidus* is concerned , Ueyanagi (1970) has demonstrated that the species reaches maturity at 130 cm. The small number of individuals larger than 130 cm in the sample can be explained by the species life cycle strategy which, certainly, spends in the area phases not related to reproduction. As a result, the most of the sample is represented by immature individuals.

The IG was not high enough as consider the area as a spawning site for the species. IG values were always smaller than 9,1. After Ueyanagi's (1970) scale all individuals in the present

study correspond to immature or resting stages.

The author suggests that the species migrates to temperate waters for feeding and to subtropical areas for spawning.

He observed the highest abundance of spawning females during the summer and a very important assemblage of mature females in South Atlantic in the area laid between 20° S and 30°S of latitude and 20° W of longitude.

Nayasi (1977) remarks that the highest CPUE in Southern Brazil were obtained from November to April. In this moment large fishes, post-larvae and juveniles appear, confirming the migration of adults for spawning. Individuals in stage II may have already spawned before. In general these results agree with those presented by Ueyanagi and Nayasi who does not consider the area as a spawning site.

Taking into account the Atlantic *Istiophorus albicans*, larger individuals than those caught by Ueyanagi (1970) and Arfelli (1981) were observed. They were also larger than those captured by Eldridge (1970) in Pacific.

The IG was far below those considered as maturing females (0,01 - 1,23) leading to the idea that this area is not a spawning ground.

Merrett (1971) states that first maturity takes place at 140 - 160 cm class (eye-fork length), in spite of that no mature individuals were observed in a sample ranging from 110 to 230 cm.

Concerning *Tetrapturus pfluegeri*, larger individuals than those caught in the study area were previously captured by Ueyanagi in the Atlantic.

Robins (1974) remarks that the species reaches the maturity at 160-170 cm length class. The IG values (0,01 to 1,62) may be considered very low when we compare to the that one assumed as the maturing IG (9.1). All microscopically analyzed females were classified in stages I,II and III. The first one being the most abundant in the whole sample. After Jolley's scale all individuals are immature.

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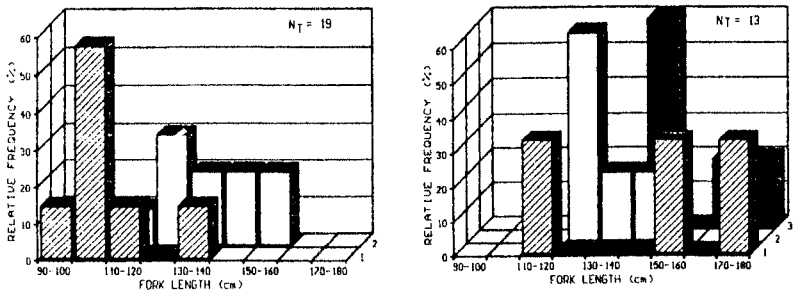


Figure 1. Fork length frequency distribution of White marlin: (A) Female: 1- II Quarter/1992, 2- IV Quarter/1992; (B) Male: 1- II Quarter/1992, 2- IV Quarter/1992, 3- I Quarter/93.

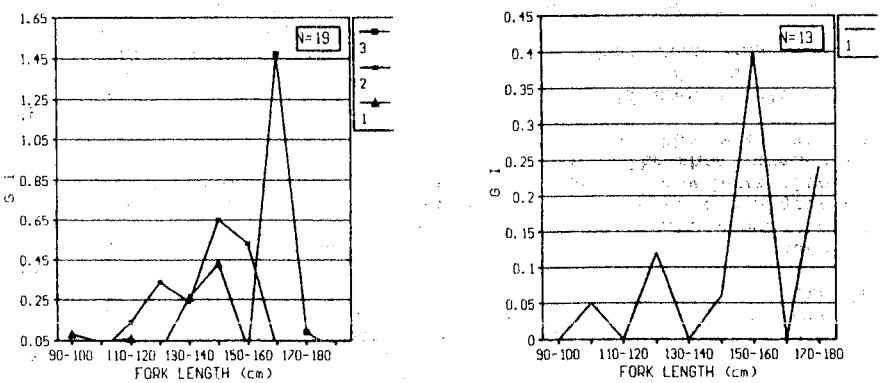
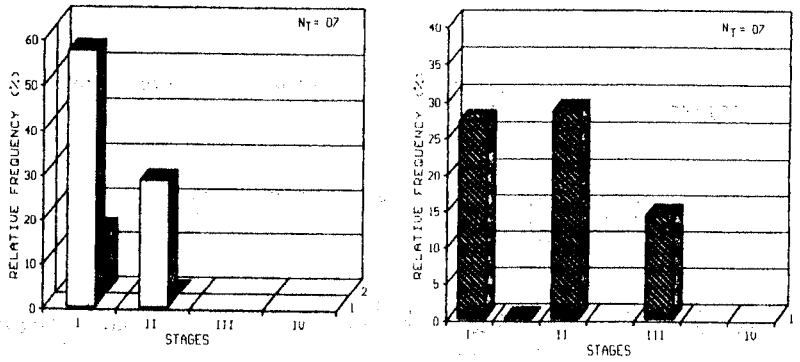


Figure 2. Gonadal index of White marlin: (A) Female: 1- III Quarter/1992, 2- IV Quarter/1992, 3- II Quarter/1993 ; (B) Male: I Quarter /1992.



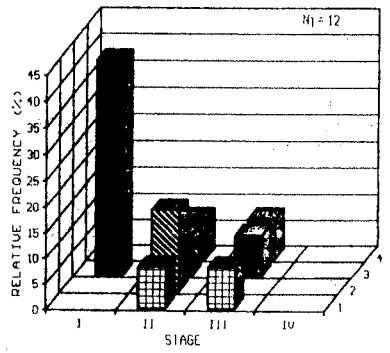
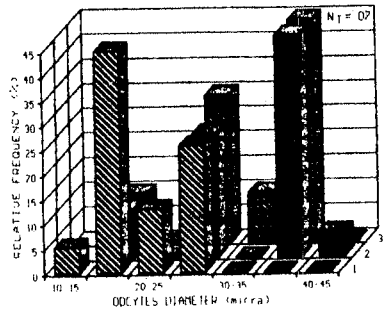
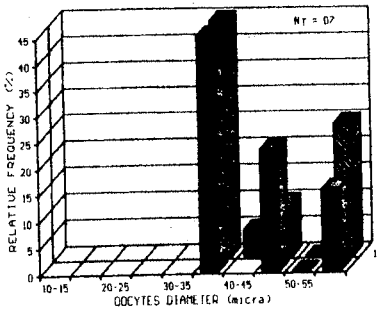


Figure 3. Maturing stages distribution of females: (A) - White marlim : 1- IV Quarter/1992, 2- II Quarter/1993; (B) - Longbill spearfish: 1 - IV Quarter/1992; (C) - Sailfish: 1- IV Quarter/1991, 2-II Quarter/1992,3- IV Quarter/1992, 4- II Quarter/1993.





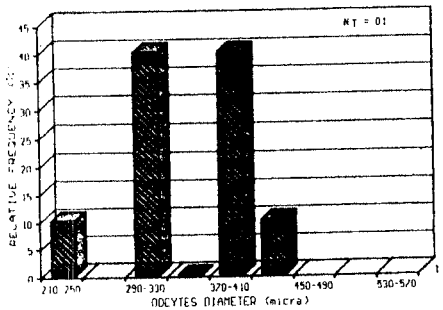
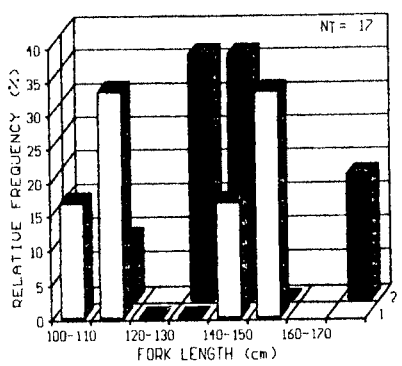


Figure 4. Oocyte diameter frequency:
(A) White marlim: 1- IV Quarter /1992 - I and II stage, 2 - IV Quarter/1992 -II stage, 3- IIQuarter/1993; B) Longbill spearfish: 1 - IV Quarter/1992 - I and II stage;(C)Longbill spearfish: 1-IV Quarter /1992 -III stage.



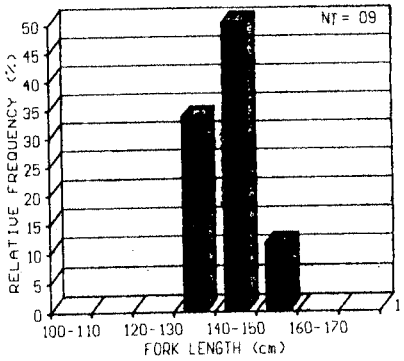
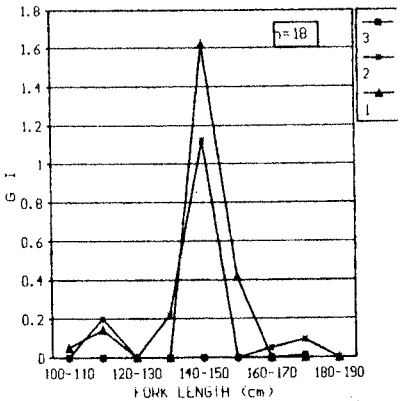


Figure 5. Fork length frequency distribution of Longbill spearfish:
(A) Female: 1 - III Quarter/1992, 2 - IV Quarter/1992;
(B) Male: 1 - IV Quarter/1992.



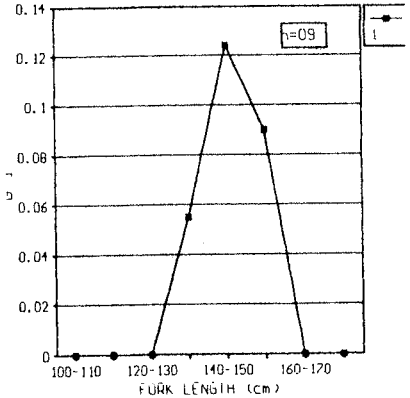


Figure 6. Gonadal index of Longbill spearfish:
(A) Female: 1- III Quarter/1992, 2- IV Quarter/1992, 3- II Quarter/1993 ; (B) Male: IV Quarter /1992.

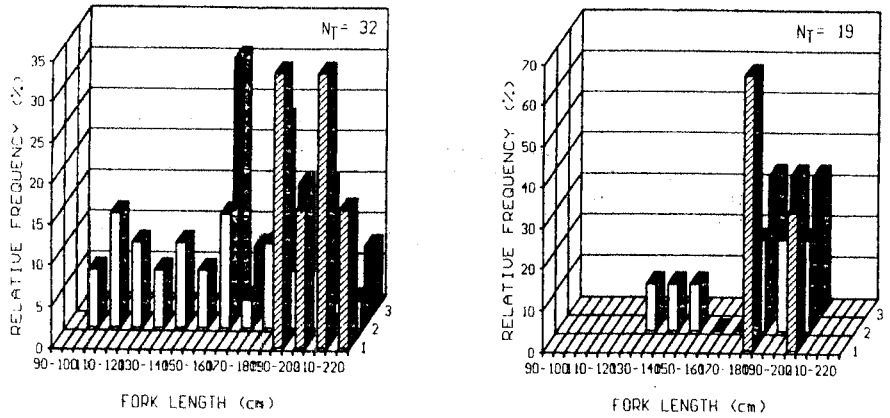


Figure 7. Fork length frequency distribution of Sailfish: (A) Female: 1- IV Quarter/1991, 2- II Quarter/1992, 3- II Quarter/1993; (B) Male: 1- IV Quarter/1991, 2- II Quarter/1992, 3- II Quarter/1993.

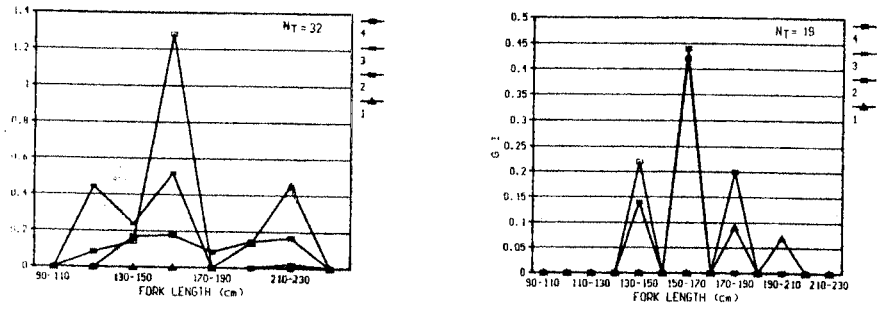


Figure 8. Gonadal index of Sailfish: (A) Female: 1- IV Quarter/1991, 2- II Quarter/1992, 3- IV Quarter/1992 , 4- II Quarter/1993; (B) Male: 1- IV Quarter /1991 , 2- II Quarter /1992, 3- IV Quarter /1992, 4- II Quarter/1993.

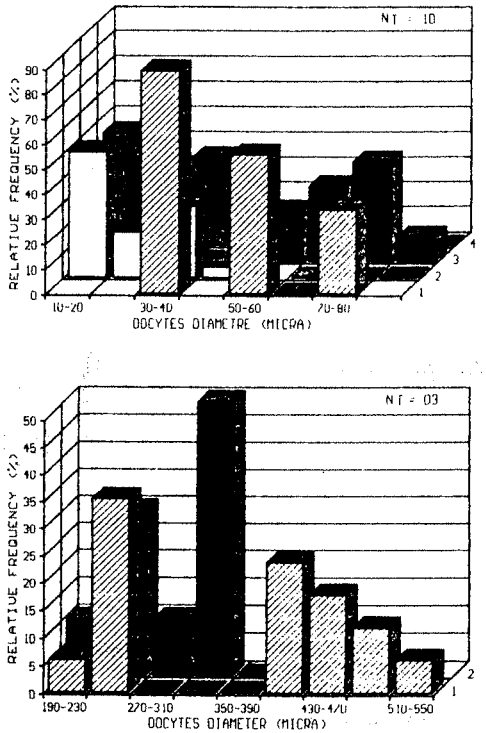


Figure 9. Oocyte diameter frequency of Female of Sailfish: (A) 1- IV Quarter/1991, 2- II Quarter/1992, 3- IV Quarter/1992, 4- II Quarter/1993; (B) 1- IV Quarter/1991, 2- II Quarter/1993.