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OCCURRENCE AND BIOLOGY OF THE DAGGERNOSE SHARK *ISOGOMPHODON OXYRHYNCHUS* (CHONDRICHTHYES: CARCHARHINIDAE) OFF THE MARANHÃO COAST (BRAZIL)

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ABSTRACT

The daggernose shark, *Isogomphodon oxyrhynchus* (Müller and Henle, 1839) inhabits shallow waters of the western Atlantic from Trinidad to northern Brazil where it is abundant off the coast of the state of Maranhão, in the São Marcos and Cumã Bays and on shallow coastal banks. The distribution of the species has been associated with hot, humid climates and highly turbid waters where mangroves are the dominant system. The species enters bays during the dry season and moves to the shallow banks off the coast during the rainy season. This is probably due to the decreasing salinity. Both juveniles and adults were caught throughout the year. Males are mature at 103 cm TL and females at 115 cm TL. The females outnumbered males in the overall sample. Female length varied between 55 to 145 cm TL and male from 60 to 125 cm TL. Pregnant females accounted for 70% of samples collected in January (rainy season). They bore recently fertilized eggs or very small embryos. Non-pregnant adult females in this period showed heavy ovaries, indicating imminent mating. Pregnant females containing embryos as large as 37 cm TL were collected in November (dry season), suggesting that birth may occur at the beginning of the year, when rainfall starts. Gestation seems to develop from January to December. Variations in several organs related to both the rainy and dry seasons indicate a fairly defined cycle for the species. The maximum size of the litter was found to be seven embryos. Fecundity could not be related to female size. A resting break may take place between two successive cycles. Both the absence of migration and general traits of the whole shark community confirm that the study area has important conservation value.

The daggernose shark, *Isogomphodon oxyrhynchus* (Muller and Henle, 1839) is a moderate-sized, placentally viviparous, inshore tropical species (Compagno, 1984). Little known, it is found in a rather narrow area in the western Atlantic, including Trinidad, Venezuela, Surinam, Guyana and French Guyana (Bigelow and Schroeder, 1948; Cervigón, 1968; Uyeno et al., 1983, Compagno, 1984 and 1988). The occurrence of the species in Brazil was reported along the eastern Brazil coast (Valença, Bahia) (Compagno, 1984, 1988). However, despite its abundance, the species was not reported by any of the aforementioned authors for the northern coast of Brazil.

It is caught in shallow waters, near the bottom up to 40 m depth (Lessa, 1986; Lessa and Menni, 1994). The presence of this species is strongly associated with muddy bottoms in low-lying and indented coasts with hot, humid climates and a large number of rivers and estuaries, where mangroves are the main component and the waters are highly turbid.

Information on *I. oxyrhynchus* is scarce and only refers to some taxonomy (Bigelow and Schroeder, 1948; Compagno, 1984), male sexual development (Lessa, 1987), biological and fishery traits (Stride et al., 1992), studies on community structure (Lessa and Menni, 1994).

The elasmobranch fauna in the study area is made up of two “dominant-permanent” species, *Carcharhinus porosus* (Ranzani, 1839) and *Sphyrna tiburo* (Linnaeus, 1758) and

11 "common" species, among them *I. oxyrhynchus*, which spend all, or most, of their life-cycles within the area. Thus, pregnant females, adult males and new-borns were observed, as well as a variable degree of sexual segregation (Lessa and Menni, 1994).

The daggernose shark is caught incidentally in floating gill nets targeting both for the Brazilian Spanish mackerel, *Scomberomorus brasiliensis* (Colette, Russo and Zavala-Camin, 1978) and the king weakfish *Cynoscium acoupa* (Block and Schneider, 1801) inside or near the estuary mouths during the dry season. Here, *I. oxyrhynchus* represents about 10% of the catch (Lessa, 1986). Additionally, the species can be caught in abundance along the outer part of islands and banks, throughout the year, when gill nets with bigger meshes (>20 cm) targeting sharks are used.

A shark collection was conducted along the Maranhão coast during the periods 1985–1987 and 1989–1990 with the aim of supplying information on general aspects required for management of shark fisheries. Data from these studies analyzed here refer to sexual development aspects of *I. oxyrhynchus* in northern Brazil.

Material and Methods

Sampling.—The whole sample is composed of 201 specimens collected from June 1985 to January 1987 and from December 1989 to February 1990 in the study area (Fig. 1). During the first part of the collection, sail boats and floating gill nets measuring up to 900 m long, 7.5 m in height and 8.0 cm mesh size were used. During the second part, which corresponded to a preliminary attempt at a gill net selectivity study, 1200 m long nets with different mesh sizes ranging from 20 to 30 cm were deployed from motorized boats. Fishing operations in both cases were carried out in the same area although in the second operation reached deeper waters along the outer part of shallow banks and islands located along the external rim of bays and estuaries. Overall, samples were obtained at between 6 and 40 m in depth in seven-day trips.

The Maranhão coast is located in the northern Brazil between the Gurupi (1°35′S, 46°W) and Parnaíba (3°S, 42°W) rivers (Fig.1). The study area is the western part of the Maranhão coast, from the Turiaçu to Tubarão Bays, whose low-lying mangrove coastline is deeply indented with a large

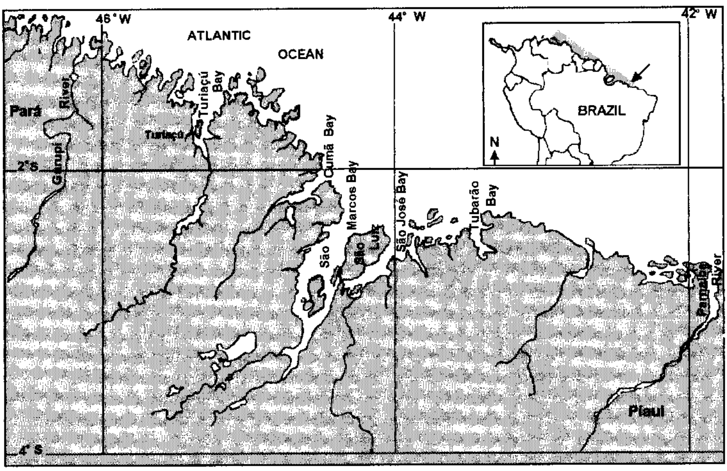

Figure 1. The distribution area of *Isogomphodon oxyrhynchus* in South America (small map) and the collection site in northern Brazil. The area slightly enhanced in the small map was based on the map by Compagno (1984), adding the area of occurrence in northern Brazil. The study area is indicated by a black arrow.

Table 1. Variation of length (cm), weight (g), liver weight (g), nidamental gland diameter (cm), size of embryos (cm) in mature females (non-pregnant and pregnant) *Isogomphodon oxyrhynchus* off the Maranhão coast (northern Brazil), for dry and rainy seasons.

	Dry season					
	Non-pregnant adult			Pregnant		
	Mean	Range	N	Mean	Range	N
Total length	127.10	111–132	7	132.00	122–132	11
Total weight	9,269.00	6,157–16,105	7	10,407.00	8,136–10,542	11
Ovary weight	9.01	2.2–69	7	7.18	2.5–18	11
Liver weight	197.10	117.2–2,200	7	578.40	360–1161	11
Nidamental gland	2.07	1.3–2.8	7	2.15	1.5–2.6	11
Litter size			7	5.00	2–6	11
Embryo size				37.20	32.9–43.2	54
	Rainy season					
	Non-pregnant adult			Pregnant		
	Mean	Range	N	Mean	Range	N
Total length	121.70	113.5–136	10	130.00	123.5–141	20
Total weight	6,655.00	6,900–12,500	10	11,323.00	8,500–13,700	19
Ovary weight	25.50	3–62.4	10	30.60	12–61	20
Liver weight	445.00	250–850	10	768.00	300–1350	20
Nidamental gland	1.90	1.5–3	10	2.40	1.9–3.7	20
Litter size				5.35	3–7	20
Embryo size				3.14	eggs~10	119

number of rivers, islands, estuaries and sandy beaches. Tidal amplitude reaches 7 m. The climate is under amazonian influence with a rainy season from January to June and a dry season from July to December. Salinity ranges from about 20‰ in the first half of the year to 34‰ in the second.

REPRODUCTION.—The following data were recorded for each specimen: Total length (TL-cm), measured on a horizontal line between perpendiculars, from the tip of the nose to the tip of the tail, with the tail at its maximum extension, avoiding uncertainties from having the tail in different angles when taking measurements (Castro, 1996), pre-caudal length (PCL-cm), total weight (g), gutted weight (g), and liver weight (g) for both sexes; diameter (cm) and color of major ovarian follicles, uterus contents (eggs/embryos), diameter of nidamental glands (cm) in females, and testis weight (g) and clasper length (cm) in males (measured from the point of insertion at the cloaca to the tip of the clasper).

Length data from both sexes were combined to generate a linear relationship between PCL and TL: Y= ax + b, where Y is the total length and x corresponds to PCL.

Males were considered to be mature based on length and calcification of claspers combined with criteria presented by Lessa (1987), including testis weight and normal sperm in different organs. Inferences on females maturity were based on: (1) nidamental glands larger than 1.5 cm in diameter, (2) presence of vitellogenic follicles in ovaries, and (3) pregnancy: embryos or eggs present in uterus.

The length/weight relationship was calculated using the least squares fitting method to estimate the a and b parameters of the function $EW= aTL^b$, where EW is the eviscerated weight and TL is the total length.

For inferences on seasonal aspects of reproduction (Tables 1,2) variations in gonad weight, liver weight and individual weight were taken into account in both sexes; nidamental glands diameter, embryo length and litter size were considered in females, divided in two categories: pregnant and non-pregnant adults. In adult males, variations in clasper length were also analysed. Values were compared between seasons (rainy and dry), for both males and females.

Table 2. Variation of length (cm), weight (g), testis weight (g), liver weight (g) and clasper length (cm), for mature males of *Isogomphodon oxyrhynchus* off Maranhão coast (northern Brazil) for dry and rainy seasons.

	Adult males					
	Dry season			Rainy season		
	Mean	Range	N	Mean	Range	N
Total length	109.00	101–125	18	114.00	110–115	14
Total weight	5,948.00	4,460–9,160	18	6,310.00	5,140–9,400	14
Testis weight	5.70	1.6–16.8	18	20.70	8.7–39	14
Liver weight	383.40	208–600	17	158.40	77.2–300	14
Clasper length	7.40	2.5–9.6	18	10.40	9.3–12.6	14

The Separation-Index for fish length frequency distinction into normally distributed components followed Hasselblad (1966 *in* Sparre et al., 1992). Mann-Whitney U-test and Kolmogorov-Smirnov tests were performed to detect differences between distributions, considering both sexes and seasons (Siegel, 1981). Differences in frequency data between sexes were tested using χ^2 with Yate's correction (Browner and Zar, 1984), whereas differences between regressions were tested using ANCOVA. In all statistical analysis, a significance level of $P < 0.05$ was required for rejection of the null hypothesis (Sokal and Rohlf, 1981). Throughout this study, unless otherwise specified, size is always expressed as total length (TL).

Results

Length and Sex Composition.—An overall sample consisting of 201 specimens, of which 88 were males (60.6 to 125 cm) and 113 were females (55 to 145 cm) was collected (Fig. 2). The sex ratio of 0.78:1 was favorable to females; differences from a 1:1 ratio were found to be significant (χ^2 with Yate's correction = 3.879; df = 1, $P < 0.05$). Additionally, length frequency distributions by sex were compared using the Kolmogorov-Smirnov test indicated also significant differences ($\chi^2 = 63.811$; df = 2, $P < 0.05$).

The separation index confirmed the polimodal character of the sample obtained for females, where three modes were distinguished (S.I. > 2.0). However, two modes were discerned when male distribution was concerned.

The relationship established between PCL and TL was expressed by the following equation: TL = 1.28 PCL + 4.19, ($r^2 = 0.989$; n = 170). To facilitate comparisons with previous studies, TL is used hereafter.

Concerning the whole male sample, 50 specimens were collected during the dry season and 38 individuals during the rainy season. Sizes ranged from 60.6 cm to 115 cm and from 65 to 125 cm, respectively. Males were considered to occur in different frequencies among samples (χ^2 with Yate's correction = 4.6533, df = 1, $P < 0.05$). In the case of females, 46 specimens ranging from 55 to 135 cm were caught during the dry season while 67 individuals from 65 to 145 cm were collected during the rainy period. In contrast to males, differences in frequency of females were not found (χ^2 with Yate's correction = 2.6784; df =1; $P < 0.05$).

Length/gutted weight relationships were established for each sex separately. Differences were again found to be significant (ANCOVA: P = 0.05) (Figs. 3A,B).

Reproduction in Females.—The relationship between ovary weight and total length shows that the organ increases with individual size (Fig. 4A). Two phases can be detected

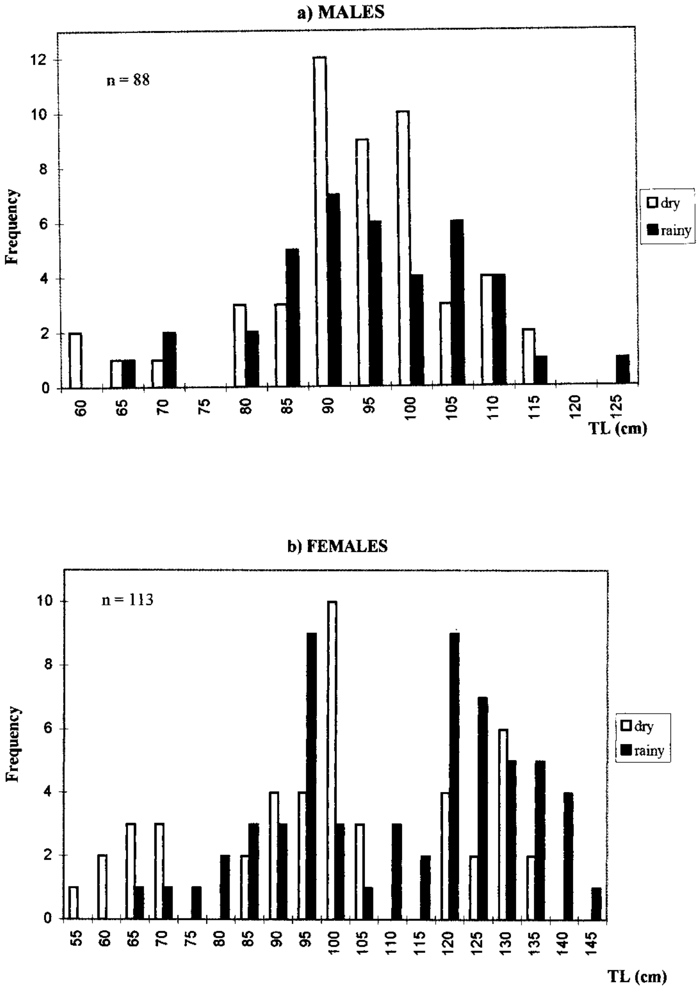

Figure 2. Length frequency of *Isogomphodon oxyrhynchus* collected off the Maranhão coast during 1985/1987 (dry season) and 1990 (rainy season): (a) males and (b) females.

during development: the first comprises very young individuals, from around 60 cm, to juveniles of about 100 cm; the second phase is marked by a strong dispersion of points, as a result of different developmental stages within the same length classes.

Nidamental glands were evaluated during development through the relationship between gland diameter and total length (Fig. 4B). Gland diameter varies from 0.2 to >3.5 cm in the overall sample. On the whole, two phases can be considered. The first one comprises individuals from 55 cm to about 110 cm with glands below 1 cm in diameter. In a second phase, gland diameter varies from about 1.5 to 3.7 cm in 110 to >140 cm specimens.

As in the preceding case, two phases may be discerned in the relationship between liver weight and body weight (Fig. 5A). The first one depicts individuals from birth up to 110 cm or 6000 g with liver weights varying from 15 to 400 g. The second one includes individuals weighing more than 6000 g, or 110 cm, with liver weighing from 300 to 1350 g.

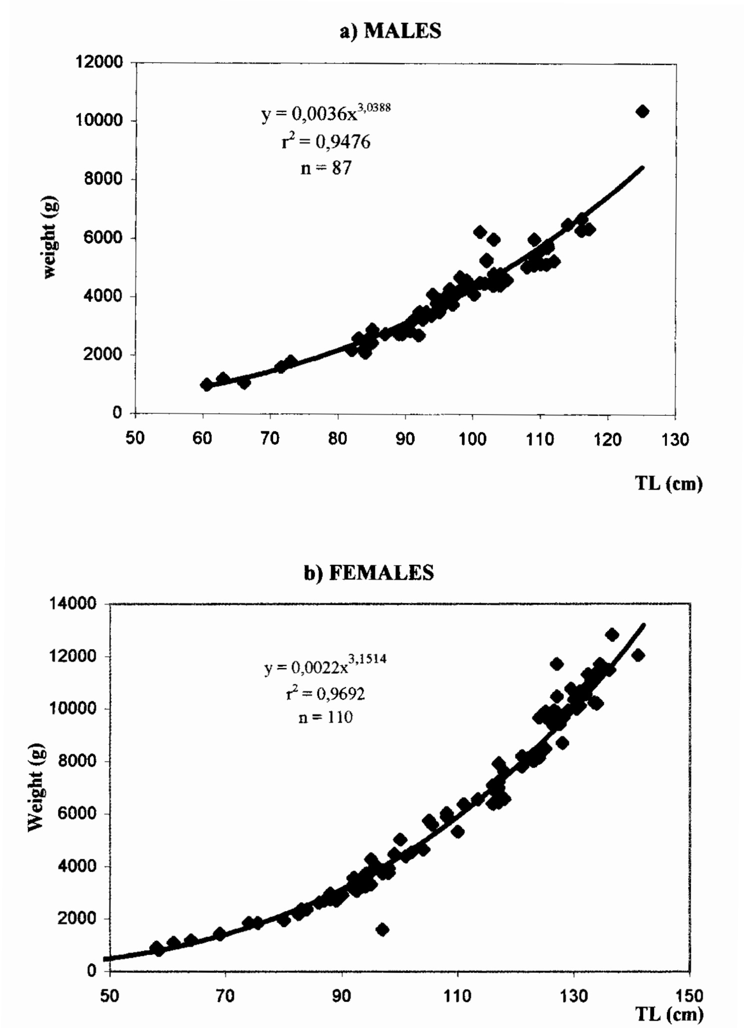

Figure 3. Length/weight relationship for (a) male and (b) female *Isogomphodon oxyrhynchus* collected off the Maranhão coast (northern Brazil).

In a previous study, it was shown that vitellogenesis begins in specimens between 105 and 112 cm. The smallest pregnant female was 118 cm (Lessa, 1987). White follicles were observed in larger females, and even in pregnant ones. The number of embryos ranged from three in a 118 cm female to six in a 140 cm one. The largest litter, borne by a 125 cm female, corresponded to 7 embryos. However, the litter size vs total length relationship did not show a significant correlation ($r^2 = 0.24$, n = 42) (Fig. 5B).

REPRODUCTION IN MALES.—Claspers show three phases during growth. The first one groups individuals up to 90 cm with claspers smaller than 4 cm. The second phase comprises specimens from 90 to 110 cm with claspers varying from 4 to 10.5 cm; a third phase would represent fully adults males larger than 110 cm with claspers measuring from 9 to >12 cm (Fig. 6A)

Testis weight was fairly constant for individuals under 3000 g or 90 cm, remaining below 10 g. In larger specimens, a great dispersion of points is observed due to several

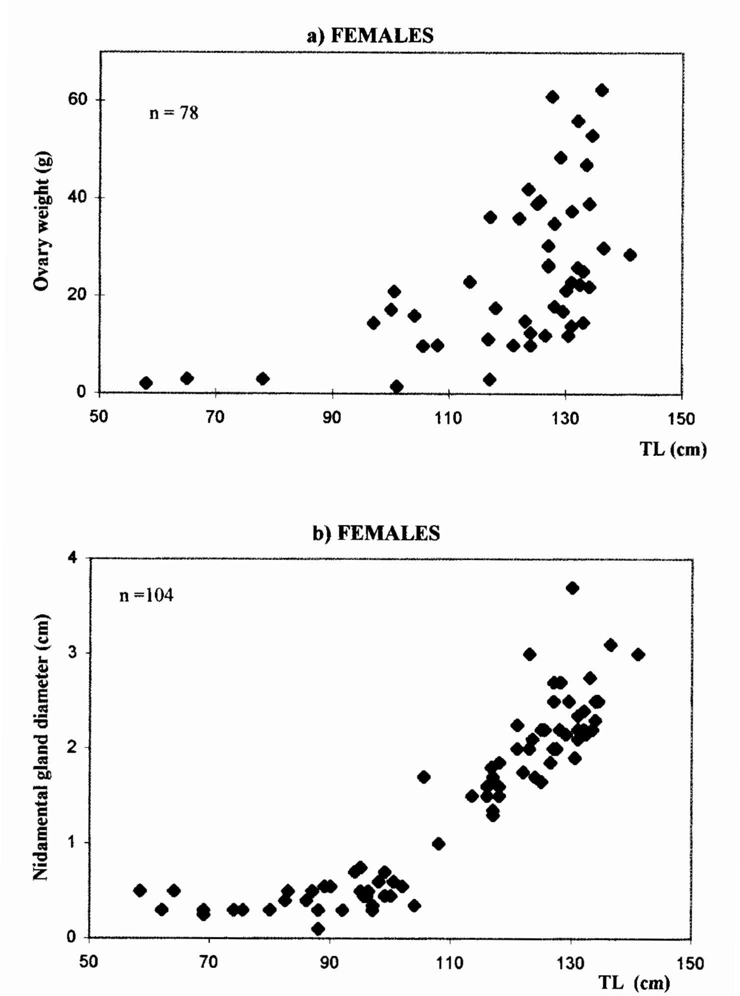

Figure 4. Relationships between: (a) ovary weight and total length and (b) nidamental gland diameter and total length for *Isogomphodon oxyrhynchus* off Maranhão coast (northern Brazil).

different testis weights in the same body weight class. Testis weight for these individuals may reach a maximum of 50 g. (Fig.6B).

Liver weight was also related to body weight; the great dispersion of points prevented any pattern being discerned in this organ during growth. Liver weight varies from 10 to 250 g among individuals from 3000 to >9500, or 90 to > 120 cm (Fig. 6C).

Seasonal Aspects of Reproduction.—Variations in several organs among females are shown for pregnant and non-pregnant adults (Table 1). Significant differences were observed between these two categories for: total length, weight, ovary weight, liver weight and nidamental gland diameter (Mann-Whitney U-test, $P < 0.05$). Also, when non-pregnant adults (rainy season) are compared to the same category in the dry season, total weight, ovary weight and liver weight differed (Mann-Whitney U-test, $P < 0.05$). Finally, significant differences were found for ovary weight, liver weight, nidamental gland diam-

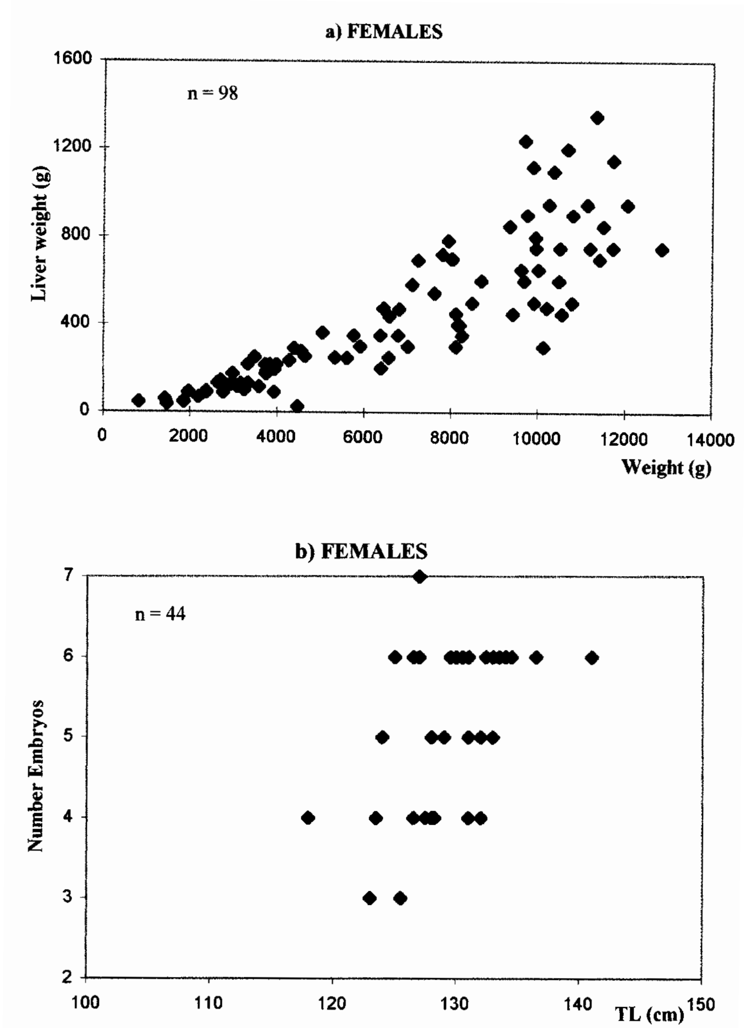

Figure 5. Relationships between: (a) liver weight and body weight and (b) number of embryos and female size for *Isogomphodon oxyrhynchus* off the Maranhão coast (northern Brazil).

eter and embryo size when pregnant females collected in the rainy season were compared to adult females collected during the dry period.

The weight of ovaries in non-pregnant adults suggests that follicles develop throughout the year, resulting in heavy ovaries during the rainy season, when the weight of the organ is greater.

Females classified as non-pregnant adults (rainy season) include specimens in different phases of their reproductive cycle, as is easily discerned from the values range, i.e., recovering females, having just had pups, with white follicles in ovaries and females having just attained the maturity with developed vitellogenic follicles and with expanded, thickened uteri ready for ovulation (Table 1).

Recovering females with flaccid uteri presenting white follicles suggest a break for follicle development between two successive pregnancies. Moreover, recently pregnant

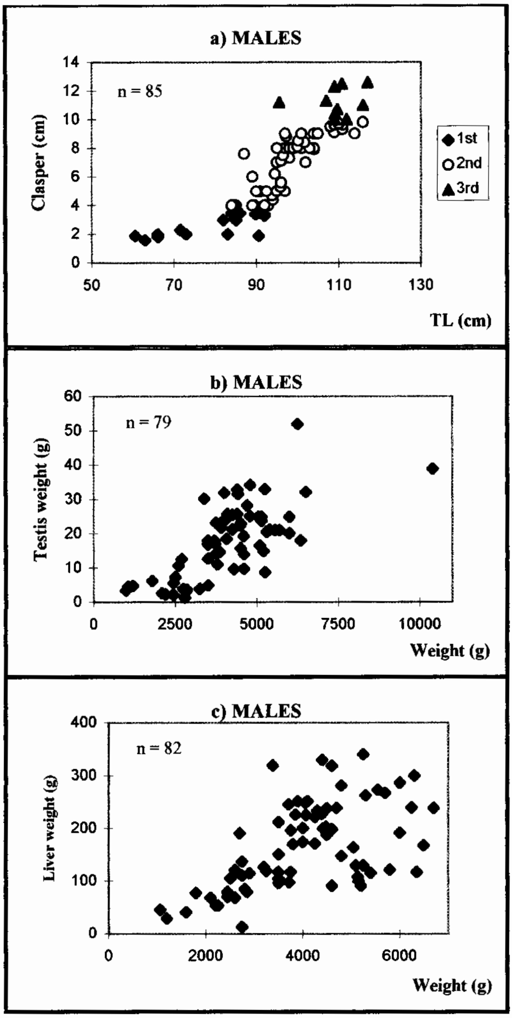

Figure 6. Relationship between: (a) clasper length and total length (b) testis weight and body weight and (c) Liver weight and body weight in male *Isogomphodon oxyrhynchus* off the Maranhão coast (northern Brazil).

females collected in the rainy season may show vitellogenic follicles in ovaries measuring up to 3.0 cm diameter, presumed as the remains of a previous ovulation period not yet removed from ovaries.

Considering that the majority of pregnant females in rainy season were either carrying recently fertilized eggs in the uterus (70%) or very small embryos, it is supposed that the ovulation period takes place at the end of the dry season or at the beginning of the rainy season, when our sample was collected.

Concerning mature males, variations in several organs between the seasons are shown in Table 2. Significant differences between seasons were found for total length, liver weight and testis weight (Mann-Whitney U-test, $P < 0.05$).

Discussion

Occurrence in the Study Area.—Compagno (1984) mentions the occurrence of the daggernose shark off the eastern (central) Brazilian coast (Valença, Bahia, 13°S). Considering the fact that the species has never been collected in fishery surveys and, contrary to what is stated by Compagno (1988), is unknown to local fishermen (pers. observ.), it is unlikely to occur in the area (Gadig, 1994). Still Compagno (1988), mentioned that local fishermen term the species “bico-doce”, however this name refers to the *Rhizoprionodon* species, common in the area (Gadig, 1994).

Concerning the occurrence of the species off the northern coast of Brazil, Barthem (1985) has reported schools at Cape Maguari (Marajó Bay, west of the study area) where pregnant females were obtained, whereas Lessa (1986) reported its presence in Cumã Bay in Maranhão. There is no record of the species anywhere along the Brazilian coast east of the Maranhão State study area.

The geographical area where *I. oxyrhynchus* has effectively been caught corresponds to the South American coast, from Trinidad (Bigelow and Schroeder, 1948), Venezuela (Cervigón, 1968), Guyana (Bigelow and Schroeder, 1948), Surinam (Uyeno et al., 1983) French Guiana (Cadenat and Blache, 1981) to northern Brazil (Barthem, 1985; Lessa, 1986), with Tubarão Bay on the Maranhão Coast as the easternmost limit. The whole area is characterized by a humid, tropical climate, coasts covered by an exuberant mangrove system, wide continental shelves, intense draining by numerous rivers (including the Amazon), muddy bottoms and highly turbid waters.

Environmental conditions change east of Tubarão Bay on the Maranhão coast. The climate is arid. Waters gradually become clear and transparent. Coasts do not have mangroves and continental shelves are narrower.

The adaptation of *Isogomphodon* to hot-humid climates with turbid waters in association with mangroves has been well documented by Bassedick et al. (1984) studying paleontological samples from the Miocene on the French Mediterranean Coast. Studies carried out by these authors showed a humid, tropical climate where *Isogomphodon* occurred in the same strata as *Avicennia* spp., and was a component of an elasmobranch fauna made up of Triakidae, *Aetobatus* and Dasyatidae. This fauna is currently found in the study area, composing the “common” species group (Lessa and Menni, 1994) with climatic conditions similar to those of the Miocene on Mediterranean Coast (Lessa, 1986; Lessa and Menni, 1994). Accordingly, Ekman (1953) has suggested that this area of South America seems to have been a refuge for tropical fauna during the Pliocene and Quaternary periods.

An overall sample made up of 1066 specimens was obtained by Stride (pers. comm.) over one year of monthly trips. The shallow banks close to Guimarães and Cumã bays were the main collection sites in this area. Our rainy season samples came from these same places. Beyond the banks, where the water becomes clearer, the abundance of the species decreases with the increasing transparency. The abundance of this species increases both during the day and with the level of turbidity. Therefore, catches were more abundant when nets drift entirely within turbid waters. Accordingly, Compagno (1984) suggests that the small eyes and long snout of the daggernose shark may represent adaptations that increase feeding efficiency in turbid waters.

In the present study, it was noted that from Tubarão Bay to Turiaçu Bay, the species is especially abundant in a small area lying between the São Marcos and Cumã Bays, where

Alma shallow banks are located. The abundance of the species decreases eastwards of São Jose Bay and westwards to Cumã Bay. The restricted area of distribution would certainly be a handicap for commercial exploitation of the species.

Lessa (1987), using a 8 cm mesh size gill net and targeting *Scomberomorus* within bays, reports that *I. oxyrhynchus* is an abundant species during the Amazonian summer (July-December). Males approach estuary waters earlier than females and the complete population enter bays and low waters during the dry season (summer), with sexes evenly represented in catches. Males appear to be more vulnerable to the fishery than adult females which live in deeper waters during most of gestation period where they can not easily be caught by the local fleet. Data suggested that the harvest takes place for the species starting in October and peaks in January, at the beginning of the rainy season when the highest CPUE in Alma Bank corresponded to 71 kg km^{-1} h^{-1} (Stride, pers. comm.). This peak would correspond to maximum abundance of several other species such as sardines, croakers and catfish which represent important food items for the daggernose shark (pers. observ.). The observations above concerning the seasonal abundance pattern seem to be complementary, indicating movements of the population within the area, perhaps due to salinity.

Size Composition, Maturity Length and Fecundity.—Size compositions of both sexes were highly influenced by mesh sizes as was demonstrated by length frequency and modal sizes in samples obtained using different meshes. Thus, samples from the dry season using a 8 cm mesh size gill net captured smaller individuals, from 55 cm and a lower number of adults measuring up to 135 cm. Conversely, in samples obtained using a 20 cm mesh size, 65 cm to 125 cm males and females from 65 to 145 cm were caught. *C. porosus* was the most abundant species caught in the 8 cm mesh, whereas *I. oxyrhynchus* was the most abundant species using the 20 cm mesh (Lessa, 1986; Stride, pers. comm.).

Males were smaller than females, as demonstrated by differences in length/weight relationship. The smallest male presenting sperm in testis and epididymides measured 93 cm (Lessa, 1987). Combining criteria such as claspers rigidity, presence of sperm in smears of seminal ampullae, this author established 103 cm as the first maturity class. It was observed, as mentioned by Mellinger (1966), that the size class where sperm production and sperm storage starts for the daggernose shark does not coincide with the length of completely calcified claspers (Lessa, 1987). From 93 to 103 cm an increasing number of individuals were considered mature as they showed sperm production in testis, storage in epididymides, normal sperm in smears of seminal ampullae and rigid claspers. Individuals were considered fully mature at 110 cm when claspers were longer than 9 cm. The clasper length and its degree of calcification degree seems to be, as for most species, a good indicator of maturity.

Adult males show greater testis weight and clasper length values in the rainy season sample, thus corroborating the pattern presented for females. However, as far as liver weight is concerned, higher values were found during the dry season, suggesting the participation of the organ in the storage of nutrients to be used in sperm production during a subsequent mating period.

Concerning females, specimens smaller than 105 cm were immature, taking into account the absence of vitellogenic activity in ovaries (Lessa, 1987). This activity was observed between 105 and 112 cm, when ovarian follicles reach 1.3 cm in diameter. The smallest pregnant female ever caught in the area measured 115 cm, coinciding with the size at maturity. (Stride, pers. comm.).

Compagno (1984) mentions four embryos per litter as the recorded fecundity for the species. Accordingly, it was shown that daggernose shark fecundity is low, ranging from three to seven in the present study. Lessa (1987) reported fecundity values ranging from three to six embryos and Stride (pers. comm.) working with a wider sample recorded a maximum of eight embryos.

In contrast to many species, among them *Rhizoprionodon terraenovae* (Parsons, 1983), *Galeorhinus australis* (Olsen, 1984), *Sphyrna tiburo* (Lessa, 1992) and *C. porosus* (pers. observation) in the study area, there is no significant relationship between female size and the size of the litter ($r^2 = 0.24$; n = 42).

Lessa (1987) observed 26–28 cm embryos in November. Pregnant females bearing embryos from 22 to 37 cm were also collected in November in Marajó Bay (Barthem, 1985), suggesting an extended birth period that may occur from the start of the rainy season onwards. In the current work the largest embryo collected at the end of the dry season measured 43 cm, thus agreeing with the birth length, 38 to 41 cm, suggested by Compagno (1984) for the species.

Samples collected in January/February (beginning of the rainy season) were made up of 70% pregnant females carrying recently fertilized eggs or very small embryos (Table 1). Some of non-pregnant adults collected at this time showed heavy ovaries with large follicles (>2.5 cm), indicating imminent mating and egg fertilization. Also, recently-pregnant females showed either large vitellogenic follicles, presumed here as remains of the previous ovulation period not yet removed from ovaries or hemorrhagic ovaries with small follicles.

As for most Carcharhinidae, our data suggest that *I. oxyrhynchus* presents a 1-yr gestation period showing a loosely defined cycle. Data also seem to suggest a break between two successive cycles for follicle development. It would imply that the species cycle takes at least 2 yrs, one for gestation and another for follicle development. This pattern, not completely ascertained for the daggernose, due to the smallness of the sample, was verified for several species such as for *Carcharhinus limbatus* in the Gulf of Mexico (Castro, 1996).

Summing up, we have shown that *I. oxyrhynchus*, because its low fecundity and long gestation period, presents, like most elasmobranchs, a life strategy which makes the species highly vulnerable to any increment in fishing efforts in coastal areas of northern Brazil. The present study extends the range of the species about 3°S. The Maranhão Coast is a particularly important nursery area for sharks in the tropical Atlantic, worthy of care and protection.

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