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ASPECTS OF THE BIOLOGY AND OF THE FINETOOTH SHARK, *CARCHARHINUS ISODON*, IN LOUISIANA WATERS.—The finetooth shark, *Carcharhinus isodon*, is a moderately sized shark of the Family Carcharhinidae. It is found in the coastal waters of the northwestern Atlantic Ocean from North Carolina to Florida, as well as throughout the Gulf of Mexico and the Caribbean Sea (Compagno, 1984; Garrick, 1985; Castro, 1993a). This species belongs to the small coastal shark management group under the *Fishery Management Plan of the Atlantic Tunas, Swordfish and Sharks* (NMFS, 1999) and is a common component of the catch in the directed shark drift gillnet fishery off the southeast coast of the United States (Trent et al., 1997; Carlson et al., 2003). In addition, this species is taken as bycatch in the gulf menhaden (*Brevoortia patronus*) purse seine fishery (de Silva et al., 2001). The current status of the Gulf of Mexico finetooth stock, as reported by Cortés (2002), is that it is not overfished but overfishing is occurring, where F is higher than F_{MSY}.

The occurrence of the finetooth shark is well documented for the coastal areas off the southeastern United States. Castro (1993a) reported on the specimens collected off South Carolina and Florida. Springer (1950) also reported on catches of finetooth sharks off Salerno, FL. Records of finetooth sharks from Georgia were reported by Dahlberg and Heard (1969). Gulf of Mexico records include reports from Dauphin Island, AL (Branstetter and Shipp, 1980), Biloxi, MS (Garrick, 1985), and Galveston, TX (Baughman and Springer, 1950). Life-history information for this species, including age, growth estimates, and aspects of its reproduction, is available for portions of the species range (Branstetter, 1981; Garrick, 1985; Castro, 1993a; Carlson et al., 2003).

A complete understanding of a species range is necessary for effective conservation and management for that species. de Silva et al. (2001) stated that they encountered six finetooth sharks of the 726 sharks observed during their study examining the shark bycatch in the gulf menhaden fishery. The authors gave no details as to the capture location; thus, additional documentation of the occurrence of finetooth sharks off Louisiana could affect future management decisions. We conducted a search for historic information on finetooth sharks in Louisiana waters. The most extensive collection of elasmobranch specimens from Louisiana waters (1952–73) was contained at the Tulane Museum of Natural History. Eight species of sharks were identified, but no finetooth shark specimens were found. In addition, we electronically examined 14 other natural history museums for records of sharks collected in Louisiana. No museum records of the finetooth shark could be located. Finally, we examined two research reports produced by university personnel and three data sets provided by state and federal agencies. The occurrence of the finetooth shark in Louisiana was not documented in either the research reports or the data sets. In this article we report on the occurrence and aspects of the biology of finetooth sharks in coastal Louisiana waters.

Study area.—Sampling was conducted in the Terrebonne–Timbalier Bay system in eastern Louisiana (Fig. 1). This system is typical of most Louisiana nearshore coastal zones, consisting mainly of shallow, turbid waters protected from the Gulf of Mexico on its southernmost edge by the barrier islands of Timbalier Island, East Timbalier Island, and the Isles Dernieres barrier island chain. The bottom type of the region is predominantly mud or a mud–shell composite. It is a microtidal habitat (<50 cm), with local predominant winds often having more dominant effects than the tidal cycle because of the shallowness (<2 m) of most of the region (Marmer, 1954).

Materials and methods.—Finetooth sharks were collected from May 1999 through Sep. 2001 as part of a nursery ground delineation study. Sampling occurred between 4 and 12 d/mo during the summer season (May–Sep.) for the 3-yr study period. An anchored, 186 m-long gillnet consisting of six panels was used for sampling. Stretched mesh sizes ranged from 10.18 cm (4 inches) to 15.27 cm (6.0 inches) in steps of 1.27 cm (0.5 inches), with an additional size of 20.3 cm (8.0 inches). Location (latitude and longitude) and several environmental parameters (depth, water temperature, salinity, dissolved oxygen, and bottom type) were recorded for each set. Sampling occurred during the entire 24-hr period of the study, although not all hours of the day were sampled during a single sampling trip. The net was

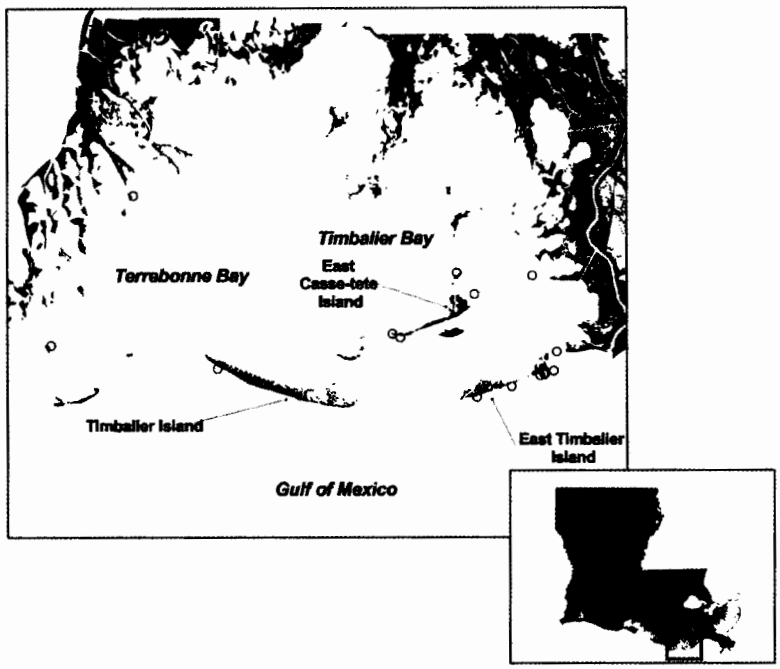

Fig. 1. Collection locations of finetooth sharks, May 1999–Sep. 2001.

checked approximately every hour, and sharks and bycatch encountered were removed from the net. Once caught, sharks were sexed and measured [precaudal length (PCL): straight line measurement from the tip of the snout to the precaudal pit; total length (TL): straight line measurement from the tip of the snout to the end of the tail, with the tail held in the natural position] to the nearest millimeter. Sharks in good condition were tagged using a nylon streamer tag and released; those in poor condition were euthanized for life-history information.

The maturity of euthanized sharks was assessed according to Castro (1993a). Females were determined mature if they contained oocytes larger than 26 mm in diameter, when the nidamental gland width was greater than 20 mm, or if they were gravid. Males were considered mature if they possessed calcified claspers and the rhipidion opened freely.

Vertebrae for age determination were collected from under the first dorsal fin. Vertebrae were prepared for sectioning according to techniques outlined in Neer and Cailliet (2001). According to the methods of Carlson et al. (2003), 0.3-mm sagittal sections were cut from the vertebrae using a Buhler Isomet low-speed saw and stained with a 0.01% crystal violet solution. Band counts were determined by examining the sections under a dissecting microscope with transmitted light. The senior author counted each specimen twice and the junior author once, without knowledge of its sex or length. If the estimates did not agree, the specimen was counted an additional time to reach a consensus with one of the previous band estimates. The index of average percent error (APE; Beamish and Fournier, 1981) and the percentage of agreement ± number of bands (Cailliet, 1990) between authors were computed for the first set of band counts. Bands were assumed to form once a year (Carlson et al., 2003).

Age estimates were calculated using a modified version of the algorithm presented in Carlson et al. (2003): age = the birthmark + number of winter marks − 1.5. If only the birthmark was present, age was calculated as the time between birth and month of capture. We used an arbitrary birth date of 1 May, differing from Carlson et al. (2003) who proposed a 1 June birth date, because we have evidence that the parturition season may occur earlier off Louisiana. The von Bertalanffy growth model was fitted to the observed size at age data for each sex separately using the statistical software package Systat 9.0. Models were run for both PCL and TL to compare with Carlson et al. (2003). For specimens where no TL measurement was available, TL was calculated using the following morpho-

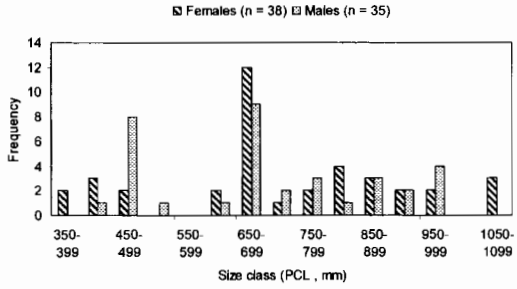

Fig. 2. Length frequency distribution of male and female finetooth sharks (n = 73) collected during our study.

metric relationship determined from our data: TL = 1.3265(PCL) − 0.9584 (R^2 = 0.9794; n = 50).

Results.—Seventy-six finetooth sharks were encountered during our sampling, with two additional specimens provided by the Louisiana Department of Wildlife and Fisheries. Captured sharks ranged in length from 365- to 1,068-mm PCL (Fig. 2). Five sharks escaped from the net before we were able to measure them. Finetooth sharks were collected in water temperatures ranging from 25.3 C to 32.1 C, with salinities ranging from 19.0 to 34.7 ppt.

Finetooth sharks were the fourth most abundant species observed in our 3-yr study. They constituted 6.5% of the shark catch, with catch per unit effort (CPUE) for the species ranging from 0.03 to 0.41 sharks/net hr over three years of the study. No overall monthly trends were observed, with at least one finetooth shark being observed each of the months of May through Sep. for the 3-yr survey. Specimens were collected during all three years of the study, although the months of capture varied by year.

A total of 19 finetooth sharks were tagged and released during our study. One shark was recaptured dead the same day. To date, there are 18 tagged animals at large, and there have been no recaptures reported.

One neonate finetooth (defined as having an open umbilical scar) was collected on 10 May 2000. It was a female measuring 365-mm PCL. Three gravid females were collected in Sep. of 1999 with litters of three, four, and five pups. Twelve additional adult finetooth sharks were captured, with the remaining specimens being juveniles and young-of-the-year individuals.

Age estimates were determined for all 54 specimens processed for age determination. Age estimates ranged from 0+ to 6+ yr for females (n = 30) and from 0+ to 5+ yr for males (n = 24). The precision of band counts was high between readers, resulting in an APE of 8.5%. Percent agreement between readers was 88.9% within ±1 band and 100% within ±2 bands. Parameters derived from the von Bertalanffy growth model indicate that females reach a larger predicted size than males (L_∞: 1,258.2- vs 1,084.7-mm PCL), although males grow at a faster rate (K: 0.300 vs 0.254; Table 1). Parameters derived using TL were similar to those reported by Carlson et al. (2003; Table 1).

Discussion.—Despite the little documentation of finetooth sharks occurring in Louisiana waters, specimens representing all life stages (neonates, young-of-the-year individuals, juveniles, and adults) were collected in our sampling. This indicates that this area may serve as an important habitat for this species and aids our understanding of the finetooth shark in the northcentral Gulf of Mexico. In addition, the presence of gravid females and neonate and young-of-the-year individuals may indicate that coastal Louisiana waters function as nursery areas for the finetooth shark, as defined by Castro (1993b).

Movement patterns of the finetooth shark within the Gulf of Mexico are not known. We have not had any reported tag recaptures, and little recapture data exist for other portions of the northern Gulf of Mexico (n = 3; J. Carlson, pers. comm.). Finetooth sharks in the western Atlantic Ocean appear to occupy nearshore waters and bays in the summer months and migrate south to Florida where they are found in deeper water during the winter (Castro, 1993a). Finetooth sharks seem to follow the general pattern of occurrence of most shark species in the northern Gulf of Mexico: occupying nearshore waters and bays during the summer months and leaving the area when the water temperatures decrease (Carlson and Brusher, 1999). Exactly where the sharks move to during the winter months is currently unknown. Although our sampling was limited to the spring–summer season (April through Sep.), our data support this hypothesis, with the greatest numbers of finetooth sharks being collected in Aug. and Sep.

The neonate finetooth shark collected in our study (365-mm PCL; 490-mm TL) was smaller than the estimated size at birth reported by Carlson et al. (2003; 520-mm TL); however, it fits within the size range presented by Castro (1993a) of 320- to 397-mm PCL for specimens in the western Atlantic. Although

TABLE 1. Von Bertalanffy growth model parameters for male and female finetooth sharks. Parameters are provided for precaudal length (PCL) and total length (TL) measurements. The asymptotic standard error (ASE) and lower and upper 95% confidence limits (CL) are also provided. Parameters determined by Carlson et al. (2003) are included for comparison.

Length measurement	Male				Female			
	L_{inf} (mm)	K (yr^{-1})	t_0 (yr)	n	L_{inf} (mm)	K (yr^{-1})	t_0 (yr)	n
Current study								
PCL								
	1,084.7	0.300	−1.806	24	1,258.2	0.254	−1.367	30
ASE	121.9	0.119	0.619		105.2	0.055	0.266	
CL	831.2/1,338.2	0.053/0.547	−3.09/−0.52		1,042.4/1,473.9	0.141/0.368	−1.91/−0.82	
Current study								
TL								
	1,373.7	0.362	−1.568	24	1,637.6	0.266	−1.347	30
ASE	116.7	0.123	0.514		123.9	0.054	0.250	
CL	1,131.1/1,616.3	0.107/0.617	−2.64/−0.50		1,383.3/1,891.8	0.155/0.376	−1.86/−0.83	
Carlson et al. (2003)								
TL								
	1,337.8	0.412	−1.390	123	1,559.6	0.244	−2.067	117
ASE	27.9	0.043	0.178		69.7	0.036	0.274	
CL	1,282.5/1,393.2	0.327/0.496	−1.74/−1.04		1,421.6/1,697.6	0.173/0.315	−2.61/−1.52	

the Louisiana neonate was 30 mm smaller than those reported for the northeast Gulf of Mexico, it is important to remember that only one neonate was observed in this study. In addition, the specimen was collected in May, leading us to set an arbitrary 1 May birth date for this study. The 1-mo difference in birth date between our study and Carlson et al. (2003; 1 May vs 1 June) may account for the difference in size at birth. Castro (1993a) reports that parturition occurs from late May through mid-June for finetooth sharks in the western Atlantic, encompassing the arbitrary 1 June birth date set by Carlson et al. (2003), but slightly later than our proposed date. Further research is needed to gain more insight into the reproductive traits of finetooth sharks in Louisiana.

The von Bertalanffy growth parameters computed for our data are similar to those reported by Carlson et al. (2003; Table 1). One difference can be seen in the greater asymptotic standard errors and wider 95% confidence intervals for our parameter estimates. This is likely due to the smaller sample size in the current study. Despite this discrepancy, finetooth sharks in Louisiana show similar growth patterns to those in the northeastern Gulf of Mexico (Carlson et al., 2003).

The paucity of documented records of the finetooth shark in Louisiana may be due to species misidentification by both recreational anglers and scientific personnel not trained in shark identification. Although the species lacks black fin tips on the pectorals and lower lobe of the caudal fin, its size and body shape could be misidentified as another species of carcharhinid such as the blacktip shark, *Carcharhinus limbatus*, especially to an angler who sees the shark at the end of a fishing line. Alternatively, smaller finetooth sharks may be confused with the Atlantic sharpnose shark, *Rhizoprionodon terraenovae*. This species has similar silver-gray coloration, and the finetooth shark may be identified as an Atlantic sharpnose shark without spots.

Low abundance of the finetooth shark in Louisiana waters may have also contributed to the few documented records. Finetooth sharks constituted only 6.5% of the shark catch during our 3-yr study. CPUE data lead us to believe that finetooth shark abundance decreases as you move west along the northern Gulf of Mexico. The CPUE data for finetooth sharks from a similar fishery-independent survey in the northeastern region of the Gulf of Mexico off Florida ranged from 0.39 to 0.77 sharks/net hr (Carlson, 2001), whereas our CPUE data for Louisiana ranged from 0.03 to 0.41 sharks/net hr for the same survey years. Additional data from a similar survey conducted in Mississippi and Alabama waters support this trend (G. Parsons, pers. comm.). No published CPUE data are available for Texas, but there are only four documented records of the finetooth shark from Texas waters, where Baughman and Springer (1950) reported it as rare.

The additional information on finetooth sharks in Louisiana waters may have conservation and management implications. Our data suggest that the coastal waters off Louisiana may serve as a nursery and pupping ground as well as provide habitat for other life stages of this species. de Silva et al. (2001) documented shark bycatch within the gulf menhaden fishery, including the incidental catch of finetooth sharks. This extensive purse seine fishery operates predominately within Louisiana state waters (Smith et al., 2002). Thus, further research is needed to determine the effect, if any, this fishery may have on finetooth shark populations in the central Gulf of Mexico.

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