Notes on the biology of *Cephalurus cephalus* and *Parmaturus xaniurus* (Chondrichthyes: Scyliorhinidae) from the west coast of Baja California Sur, México

Eduardo F. Balart
División de Biología Marina, Centro de Investigaciones Biológicas del Noroeste, S.C.
Apdo. Postal 128, La Paz, B.C.S., México 23000
E-mail address: ebalart@cibnor.mx

Jeanette González-García
Carlos Villavicencio-Garayzar
Laboratorio de Elasmobranquios, Universidad Autónoma de Baja California Sur
Apdo. Postal 19-B, La Paz, B.C.S., México 23000

The head, or lollipop, shark *(Cephalurus cephalus)* and filetail catshark *(Parmaturus xaniurus)* are found in the eastern Pacific in waters ranging from 245 to 828 m and from 91 to 1251 m depth, respectively (Castro, 1983). Little is known of their biology because they are rarely captured. *Cephalurus cephalus* is a benthic catshark and has been recorded from southern California, Gulf of California, the Revillagigedo Archipelago, and off the coasts of Peru and Chile (Kato et al., 1967; Meléndez and Meneses, 1989; Pequeño, 1989). Mathews and Ruíz (1974) reported it from the upper Gulf of California, México, and Castro-Aguirre (1981) gave basic information about its morphology, taxonomy, and ecology based on 11 specimens from this locale.

Parmaturus xaniurus is distributed from central California to the Gulf of California (Castro, 1983). Cross (1988) has described its general biology and Lee (1969) reported that, in the Santa Barbara basin, it consumed myctophids. Cailliet[1] concluded that juveniles were mesopelagic, adults demersal, and noted that efforts to determine their age have failed because of the absence of annual rings on the vertebrae.

The objective of this study was to provide additional data on the biology of *C. cephalus* and *P. xaniurus,* with information on length-weight relationships, and notes on reproductive biology, including the sizes of oocytes and embryos, the sex ratio of embryos, and clasper length, for specimens from the west coast of Baja California Sur, México.

Materials and methods

Fish were sampled by bottom trawling with commercial shrimp nets (20-m mouth, 30-mm mesh size) during the oceanographic expedition EP9505 along the Pacific coast of Baja California Sur, México. Trawls were made at depths of 50–280 m from the RV *El Puma* during May 1995. On 5 May two scyliorhinid species (*C. cephalus* and *P. xaniurus*) were collected and whole specimens were frozen. All specimens were captured at the following three stations: 26˚01.9' N, 113˚26.9'W (280 m); 25˚59.6'N, 113˚20.5'W (260 m); 26˚00.7'N, 113˚18.3'W (230 m). Bottom temperature at the collection sites was 10.0˚C. Total weight (W, g), and total length (TL, mm) were recorded. Females were dissected, the diameter of all visible oocytes were recorded, and embryos were removed. For the subsequent analysis of *C. cephalus*, previously published data were also used. The length-weight relationship was determined with STATISTICA software (StatSoft, Inc., 1995) by using the exponential function of the form

$$W = aTL^b,$$

as used by Cross (1988) for the filetail catshark. Length-weight relationships were compared between males and females by using an analysis of covariance.

Results and discussion

Seventy-five catsharks were obtained: 51 *P. xaniurus* and 24 *C. cephalus*. The latter species is recorded for the first time along the west coast of the Baja California peninsula. At one station, *C. cephalus* was captured together with *P. xaniurus,* as reported by Mathews and Ruiz (1974). Other organisms collected at the three stations were the fishes *Merluccius angustimanus*, *Physiculus rastrelliger*, *Kathetostoma averruncus*, *Synodus lucioceps*, *Hippoglossina stomata,* and *Lepophidium* spp., and the crustaceans *Pleuroncodes planipes* and *Cancer johngarthii*.

Cephalurus cephalus

Of the 24 specimens, 23 were female, with a range of 224 and 295 mm TL ($\bar{x}$=249 mm TL). The single male specimen was 298 mm TL. Previously reported maximum total

[1] Cailliet, G. 1981. Ontogenetic changes in the depth distribution and feeding habits of two deep-dwelling demersal fishes of California: sablefish and filetail cat sharks. Paper presented at the sixty-first annual meeting of the Am. Soc. Ichtyol. Herpetol.

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lengths for females and males were 295 and 245 mm TL respectively (Castro-Aguirre, 1981). The length-weight relationship suggested allometric growth and was described by the following equation

$$W = 0.000012\ TL^{2.84} \qquad \text{(Fig. 1A)}.$$

The b coefficient was not significantly different ($F_{1, 36}$= 2.15) between the sexes.

Females of this species have two functional ovaries and oviducts. Sixteen (70%) of the females had mature oocytes in their ovaries and a mean oocyte diameter of 10.5 mm (range 2.0–21.8 mm). The relationship of mean oocyte diameter with TL indicated that all females were mature (Fig. 1B). The size at first maturity has previously been estimated to be 190 mm TL (Compagno, 1984). The large diameter of the oocytes suggested that spawning occurs in early summer.

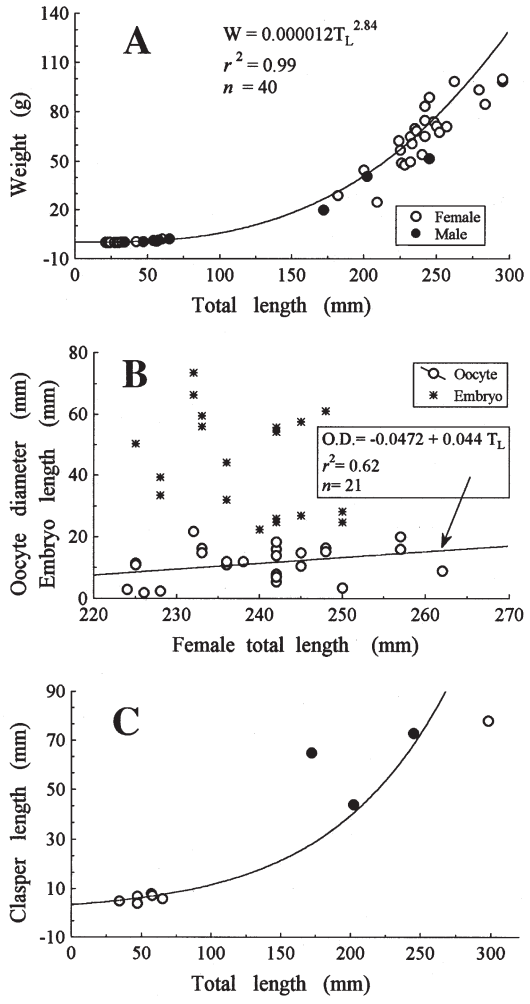

Figure 1

Cephalurus cephalus. (**A**) Length-weight relationship. (**B**) Relationships between oocyte diameter and embryo total length with female total lengths. (**C**) Relationship between total length and clasper length. Data less than 75 mm TL are from embryonic material. Data from Castro-Aguirre (1981) are denoted by solid circles.

Embryonic development of *C. cephalus* occurs in the uterine tract and is described as aplacental viviparity or ovoviviparity (Wourms, 1977, 1981; Compagno, 1984). The thin-walled egg cases of *C. cephalus*, which are retained in the oviducts, were observed in 11 individuals. The three largest females had neither eggs in the oviducts nor large oocytes in their ovaries and may have finished their reproductive cycle.

The mean size of the 19 embryos was 43 mm TL (size range 21 to 65 mm TL), which is less than the estimated size at birth (100 mm; Compagno, 1984), and the sex ratio of embryos (9 males, 10 females) was aproximately equal. The relation between clasper length and total length of adults and embryos is illustrated in Figure 1C.

Parmaturus xaniurus

Of 51 specimens captured, 22 were female and 29 were male. Females measured 108 to 350 mm TL ($\bar{x}$=184 mm TL), males 117 to 380 mm TL ($\bar{x}$=233 mm TL). The largest recorded lengths are 574 mm TL for females and 600 mm TL for males (Springer, 1979). The length-weight relationship of *P. xaniurus* indicated allometric growth (Fig. 2A) and was described by the following equation:

$$W = 5.5 \times 10^{-7}\ TL^{3.34}.$$

The analysis by sex (males: $W = 6.76 \times 10^{-7}\ TL^{3.31}$; females: $W = 9.53 \times 10^{-7}\ TL^{3.22}$) did not reveal significant differences in the b coefficient ($F_{1, 45}$=0.14) as reported by Cross (1988) for specimens from the upper continental slope off southern California.

All females examined were immature and did not contain mature oocytes. Cross (1988) noted that females first reached maturity at 425–475 mm TL in southern California waters. *Parmaturus xaniurus* is oviparous, and the egg cases of this species have been described by Cox (1963). Embryonic development lasts approximately one year (Compagno, 1984; Cross, 1988). The relationship between total length and clasper length suggested that males matured at 340 mm TL (Fig. 2B), and this size at first maturity was smaller than that previously recorded (375 to 425 mm TL; Cross, 1988). This may reflect latitudinal differences in the reproductive biology of *P. xaniurus*.

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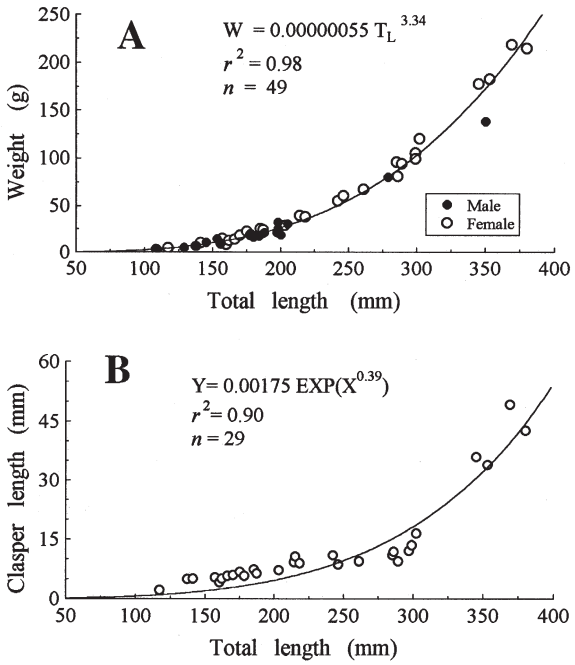

Figure 2

Parmaturus xaniurus. (**A**) Length-weight relationship. (**B**) Relationship between total length and clasper length.

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