



## Observations on female's reproductive tract of *Chimaera cubana* (Chondrichthyes: Holocephali) caught in Matanzas Bay, Cuba

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**Abstract.** In the present study, we confirm the presence of the *Chimaera cubana* (Howell Rivero 1936) in Matanzas Bay, north Cuba. Condition of the reproductive tract suggests the specimen was sexually mature female of 82.5 cm total length. Systematic monitoring of these deep-sea fishes is necessary to understand the life history of this primitive fish.

**Key words:** Chondrichthyans, Holocephalans, chimaeras, deep water, Cuba.

**Resumen:** Observaciones del tracto reproductivo de una hembra de *Chimaera cubana* (Chondrichthyes: Holocephali) capturada en la bahía de Matanzas, Cuba. Se confirma la presencia de *Chimaera cubana* (Howell Rivero 1936) en la bahía de Matanzas Bay al norte de Cuba. La condición del aparato reproductor sugiere que se trata de una hembra madura de 82.5 cm de largo total. El monitoreo sistemático de especies de profundidad es necesario para comprender la historia natural de estos peces primitivos.

**Palabras clave:** Chondrichthyans, Holocephalans, chimaeras, aguas profundas, Cuba.

Chimeras are cartilaginous fish that emerged 400 million years ago (Carrier *et al.* 2012) and are divided into three families Callorhynchidae, Rhinochimaeridae and Chimaeridae (Márquez-Farías & Lara-Mendoza 2014). Chimaeridae is represented by 36 species, of which 14 belong to the genus *Chimaera* and the others to the genus *Hydrolagus* (Didier *et al.* 2012). According to Caldas *et al.* (2009), the only species present in the Western Atlantic is Cuban *Chimaera* which has been reported for Cuba, Puerto Rico, the Lesser Antilles and Colombia (Dagit & Caldas 2006). The Cuban *Chimaera* was first recorded as *C. monstrosa* by Poey (1866) and later identified as *C. cubana* by Howell Rivero (1936). It is a species found at depths <500 m. It has been documented that in the Colombian Caribbean region, this species prefers

rocky bottoms (Caldas *et al.* 2009). The few studies of this species suggest that individuals can reach 80 cm total length (TL) and that both sexes can grow up to ~ 40 cm body length (BDL). Reproduction is oviparous (Conrath & Musick 2012) and embryos take 6 to 12 months to develop (Didier 2002). The species can have oocytes of various developmental stages, suggesting that it is active during a relatively long period (Driggers *et al.* 2009).

Cuban *Chimaera* is considered without commercial value (Dagit & Caldas 2006), but they are caught as a by-catch with longline and bottom trawling gears principally due to the depth at which these fisheries operate (Didier 2002). This situation could represent a risk for deep-water chondrichthyans if the by-catch of this species is not systematically monitored (Didier *et al.* 2012). Due to

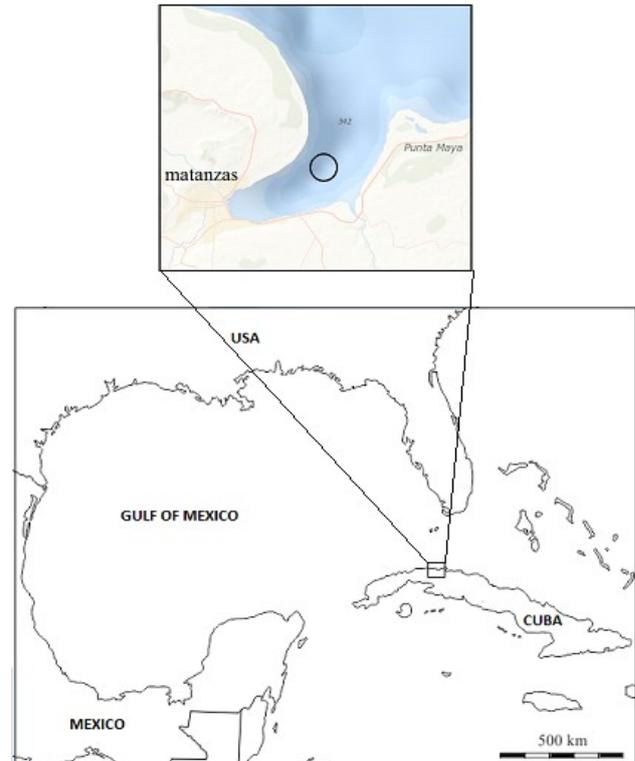
limited information on biology, ecology and ethology, the species has recently been labeled "Data Deficient" in the IUCN Red List (IUCN 2015). Although deep-sea chondrichthyans are rarely a target species, there is evidence that their populations may be depleting more rapidly than commercially important species. The trend for deep-sea fisheries to affect populations of non-target species is worrisome because many species of these habitats are vulnerable even at moderate and low levels of exploitation. Given these circumstances, the recovery of their populations may be remarkably slow (Simpfendorfer & Kyne 2009).

The evolution of the life history of this primitive Group of fish has resulted in demographic aspects, which lead to low biological productivity; render the species highly susceptible to commercial exploitation. These low levels of productivity are partly due to deep water environments, where low temperatures prevail and where food is limited, resulting in metabolic rates that incur slow growth (Cailli *et al.* 2001).

The species' biological characteristics limit the commercial exploitation of chondrichthyes. These characteristics include a low growth rate and high longevity resulting in late maturity. The species is also characterized by low fertility and long gestation periods (Camhi *et al.* 1998). This is particularly true of deep-sea chondrichthyes which are more vulnerable than species that thrive in shallower waters and support various fisheries around the world (Kyne & Simpfendorfer 2010).

In the present study, a female Cuban Chimaera, captured in the Bay of Matanzas in northern Cuba, is reported. Morphometric information is presented following conventional measures as well as a basic description of the reproductive system. During July 2014, in the Pelagic fishery (with hook and line), an adult female Cuban Chimaera was caught at a depth of between 200-300 m in Matanzas Bay, Cuba (Fig 1).

The specimen was identified at the species level, according to Didier (2002) and Guitart (1979). Subsequently, the fish was frozen for a year and then dissected. The following morphometric measurements were taken using a tape measure, following the criteria proposed by Didier & Séret (2002): total length (TL); preorbital length (POB); length to the first dorsal fin (PD1); base of the first dorsal fin (D1B); interdorsal space (IDS); length to the second dorsal fin (PD2); base of the second dorsal fin (D2B); length of the first spine (DSA); maximum height of the first dorsal fin (D1H); eye



**Figure 1.** Capture zone of *Chimaera cubana* in Bahía de Matanzas, Cuba. Capture zone (circle).

length (EyL); eye height (EyH); precaudal length (LPC); anterior margin of the pectoral fin (P1A); anterior margin of the pelvic fin (P2A); margin of the dorsum of the caudal fin (MDC); ventral margin of the caudal fin (MVC); total length of the caudal fin (LAC). These measures are useful for comparisons with other investigations. The absence of claspers identified the sex of the specimen. The reproductive system was extracted for examination, to determine its phase of sexual maturation and to be photographed. The specimen was donated to the fish collection of the Marine Research Center of the University of Havana.

The specimen was a female of 82.5 cm TL which is slightly greater than previously reported in the literature (80 cm TL) (Fig. 2). A TL of 75 cm has been previously reported for this species in Cuba, Puerto Rico and in the northern islands of the Lesser Antilles (Didier *et al.* 2012), and a TL of 80.3 cm has been reported in Colombia (Caldas 2011). In other studies, females of this species range from 71.9-74.5 cm TL in the Colombian Caribbean (Caldas *et al.* 2009) and 68.5 cm TL in Puerto Rico (Bunkley-Williams & Williams 2004). However, males of *C. cubana* have been reported to grow to 78.5 cm TL (Suárez *et al.* 2001), 72.8 cm TL and 66.4 cm TL (Kemper *et al.* 2010) in Cuba.



**Figure 2.** Female *Chimaera cubana* captured in Bahía de Matanzas, Cuba .

**Table I.** Measurements of the specimen of *C. cubana* captured in Bahía de Matanzas, Cuba. TL= total length; PCL= precaudal length; BDL= body length; POB= preorbital length; PD1= length to the first dorsal fin; PD2= length to the second dorsal fin; D1B= base of the first dorsal fin; D2B= base of the second dorsal fin; IDS= interdorsal space; DSA= length of the first spine; D1H= maximum height of the first dorsal fin; EyL= eye length; EyH= eye height; P1A= anterior margin of the pectoral fin; P2A= anterior margin of the pelvic fin; MDC= margin of the dorsum of the caudal fin; MVC= ventral margin of the caudal fin; CTL= total length of the caudal fin.

| Mesaurement | Present Study<br>(cm) | Present Study<br>% BDL | Caldas <i>et al.</i> (2009)<br>% BDL | Kemper <i>et al.</i> (2010)<br>% BDL |
|-------------|-----------------------|------------------------|--------------------------------------|--------------------------------------|
| TL          | 82.50                 | 185                    | 150–196                              | 170–260                              |
| PCL         | 56.72                 | 127                    | 76–128                               | 120–138                              |
| BDL         | 44.62                 | 100                    | 14.3–45 (cm)                         | 10.9–42.7(cm)                        |
| POB         | 3.90                  | 9                      | 10–12                                | 10.9–16                              |
| PD1         | 12.10                 | 27                     | 25–30                                | 29–39                                |
| PD2         | 25.20                 | 56                     | 38–56                                | 49–60                                |
| D1B         | 7.70                  | 17                     | 13–20                                | 16–21                                |
| D2B         | 32.26                 | 72                     | 55–76                                | 65–81                                |
| IDS         | 5.4                   | 12                     | 1–10                                 | 1–10                                 |
| DSA         | 10.10                 | 23                     | 18–28                                | 24–29.2                              |
| D1H         | 8.50                  | 19                     | 22–25                                | 13.1–35                              |
| EyL         | 3.50                  | 8                      | 1–10                                 | 8–11                                 |
| EyH         | 2.00                  | 4                      | 5–6                                  | 4.7–8                                |
| P1A         | 21.30                 | 48                     | 29–42                                | 34–44                                |
| P2A         | 9.50                  | 21                     | 14–20                                | 17–20                                |
| MDC         | 7.00                  | 16                     | 14–17                                | 13–25                                |
| MVC         | 17.20                 | 39                     | 32–34                                | 35–59                                |
| CTL         | 25.78                 | 58                     | 31–69                                | 72.6                                 |

In general, it is known that sexual dimorphism is linked to length in most chondrichthans, whereby females reach greater sizes than males. However, the scarcity of reports prevents the characterization of sexual dimorphism in *C. cubana*.

The measurements taken in the present study were within the reported range for the species, except for P1A and P2A which were slightly greater because TL was greater than what has been previously reported for this species. Table I shows the morphometric measurements of the captured individual. It is known that most chimera species reach sexual maturity over 40 cm BDL (Didier *et al.* 2002).

In *Chimaera carophila* the smallest female to exhibit sexual maturity was 82.5 cm TL (Didier *et al.* 2012). To our knowledge, there have been no previous reports that refer to this aspect of the species, which indicates a lack of information and the need for further study of this taxon.

The reproductive system of the specimen was characterized by a yellowish pair of ovaries (O) measuring approximately 50 mm long and 21 mm wide. The ovaries (O) are situated at the level of the middle part of the superior oviduct between the oviducal gland (GO) and the ostium area. Both ovaries contained numerous follicles of 2-7 mm in diameter. Driggers *et al.* (2009) also observed follicles ranging between 1-7 mm for *C. cubana* species. There was no sign of mature follicles. The superior oviduct measured 31 mm in length from the oviducal gland to the ostium zone. The GO measured 42 mm in length and 19 mm in width and was observed to be wider than the lower oviduct (in both), but of the same thickness (19 mm) as the uterus (U). The latter length was 53 mm from the GO to the insertion of the cloaca (C) (Fig. 3).

Based on the observed developmental level of the ovaries, the size of the oviducal gland and the widening and sagging of the uterus, we determined that the specimen was an adult female. There is little published information about the species *C. cubana*, and, to our knowledge, this is the first study to provide details of the species' reproductive tract for Cuba. However, further study of the population dynamics and biology of this species is necessary. The result of this investigation is not only of interest to Cuba but also to the countries of the Caribbean region where the species converge.

Further research should address the life cycle of the species and assess stock which can be used to implement conservation measures necessary for the sustainable management of this species (Bernasconi



**Figure 3.** Reproductive system of the female *Chimaera cubana*. Ovario (O), Oviducal gland (GO), Uterus (U) and Cloaca (C).

*et al.* 2015). By enhancing current knowledge of the biology and ecology of this species, this study hopes that the information presented will be useful to the International Union for the Conservation of Nature (IUCN) and FishBase.

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