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ATYPICAL CHARACTERISTICS IN BLACKMOUTH CATSHARK, *GALEUS MELASTOMUS* (CHONDRICHTHYES: SCYLIORHINIDAE) FROM THE ALGERIAN COAST (SOUTHERN MEDITERRANEAN SEA)

SUMMARY

The authors report in the present paper the capture of an abnormal specimen of the blackmouth catshark *Galeus melastomus* Rafinesque, 1810 from the central coast of Algeria (southern Mediterranean Sea). The specimen was a sub–mature female having 478 mm in total length (TL) and weighing 265 g in total body weight (TBW). The specimen displayed a severe atrophy of the right clasper and a poor development of the right pelvic fin. These abnomalities are compared with other similar patterns reported in elasmobranch. The origin of the abnormalities remains questionnable, due to unfavourable environmental conditions (action of pollutants) or to endogenous origin or genetic during embryonic development.

INTRODUCTION

Blackmouth catshark, *Galeus melastomus* Rafinesque, 1810 is a small shark species know from the north-eastern Atlantic, the Bay of Biscay to the coast of Portugal (Quéro *et al*., 2003). South the Strait of Gibraltar, it occurs off Morocco (Lloris and Rucabado, 1998), but it is replaced by its close relative species *G. polli* Cadenat, 1959 from the coast of Mauritania (Maurin and Bonnet, 1970), to the Gulf of Guinea (Blache *et al*., 1970).

Galeus melastomus is known in the entire Mediterranean Sea (Capapé, 1989; Serena, 2005), including the Adriatic Sea (Lipej and Dulcic, 2010) and the eastern Levant Basin (Golani, 2005). The species occurs off the Maghreb shore, where it is rather captured at depths over 100-350 m approximatively, Morocco (Lloris and Rucabado, 1998), Algeria (Hemida, 2005; Aït Darna *et al*., 2018), Tunisia (Bradai *et al*., 2004). Following Capapé *et al*. (2008), *G. melastomus* formed the object of various studies concerning some traits of its distribution, size-structure, reproductive biology, and food and feeding habits from the Mediterranean and outside this sea.

Investigations regularly conducted in the central region of the Algerian coast offered us the opportunity to collect several specimens of *Galeus melastomus*, and among these specimens we have found a male displaying and abnormality of pelvic fins and claspers. This abnormality is described and commented in the present paper.

MATERIALS AND METHODS

A total of 211 specimens of *Galeus melastomus* were collected during trawl surveys from the central region of the Algerian coast. Of the 102 males, a single specimen exhibiting an abnormality was captured off Aïn Baniane (Fig. 1), on 14 July 2015, by 36° 48′ 39′′and 2° 51′ 32′′ E, at a depth of 350 m approximately, on sandy-muddy bottom, together with teleost species such as bluemouth rockfish *Helicolenus dactylopterus* (Delaroche, 1809), black anglerfish *Lophius budegassa* (Spinola, 1807) and greater fork-beared *Phycis blennoides* (Brünnich, 1768).

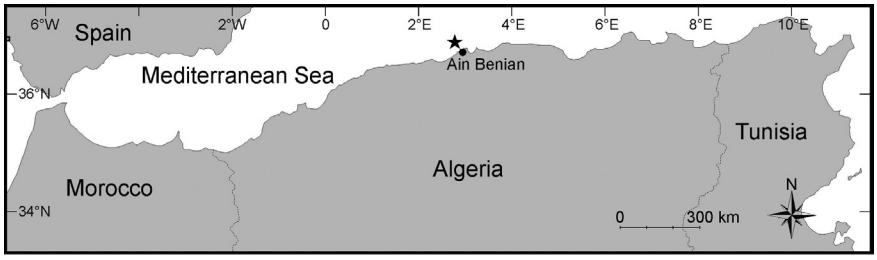

Fig. 1. Map of the Algerian coast indicating the capture site of the abnormal specimen of *Galeus melastomus* (black star).

The collected specimens were measured for total length (TL) recorded to the nearest millimetre and weighed for total body weight (TBW), recorded to the neasrest gram. The 102 sampled males ranged between 252 and 562 mm TL and weighed between 44 and 480 g (TWB). All fresh specimens were

measured to nearest millimetre and weighed to nearest gram. However, a sub-sample of 58 normal specimens was used in order to obtain a more visible view, allowing to clearly distinguish the abnormal specimen from the normal specimens.

The relation between the total length (TL) and the total body weight (TBW) was used as a complement following Froese *et al*. (2011), all specimens, normal and abnormal to show if this latter is able to to develop in the wild as normal specimens. This LWR is $TBW = aTL^b$, and was converted into its linear regression, expressed in decimal logarithmic coordinates and correlations were assessed by least-squares regression. as: log TBW = log a + b log TL: Significance of constant b differences was assessed to the hypothesis of isometric growth if $b = 3$, positive allometry if $b > 3$, negative isometry if $b > 3$ (Pauly, 1983). Comparison of means were carried out by using t-test. These two latter tests were performed by using logistic model STAT VIEW 5.0.

RESULTS AND DISCUSSION

All sampled specimens were identifed as *Galeus melastomus via* the combination of main morphological characters, as follows: snout longer than width across the mouth, nostrils widely separated from mouth, first dorsal fin originating over rear part of pelvic fins, a crest of margin of rmodified denticles on anterior part of caudal, dark-brown blotches along back and sides. These characters are in total accordance with Springer (1979), Quéro (1984) and Quéro *et al*. (2003).

The abnormal specimen was a male which measured 478 mm TL and weighed 265 g TBW. The left pelvic fin was completely developed and slightly larger than the left clasper which was not elongated, rigid, probably not calcified (Fig. 2). The morphology of this clasper is characteristic of a sub-adult stage described by Capapé *et al*. (2008) in *G. melastomus*. The right pelvic fin is obviously smaller than the left pelvic fin and exhibited on its internal margin rather appeared as a roll-shaped structure rather than an inconspicuous clasper (Fig. 3). Therefore, we assume that the clasper is severely atrophied in this specimen male of *G. melastomus*.

Size at first maturity and maximum size reported in *G. melastomus* from some Mediterranean areas are summarized in Table 1. It suggests that the present specimen was probably a sub-adult specimen and such statement is corroborated by the morphology of the left clasper.

Abnormalities of claspers are reported in some elasmobranch species as lack or atrophy of this copulatory organ, and are included in Table 2. It clearly appears all recorded instances concerned batoid species which generally live close or buried in soft bottoms. These habitats faced to a large expo-

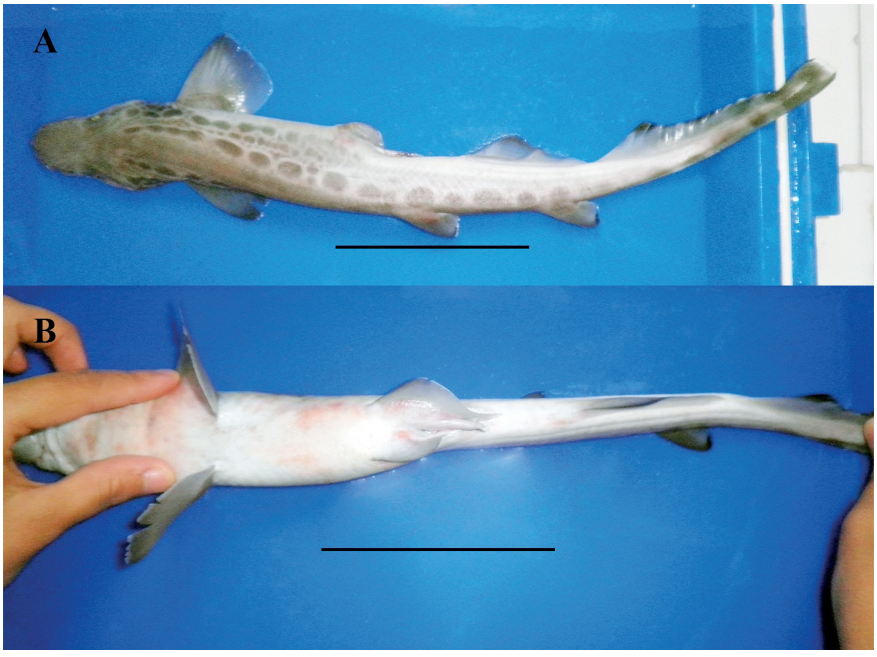

Fig. 2. Abnormal specimen of *Galeus melastomus*. A. Dorsal surface. B. Ventral surface. Scale bar = 100 mm.

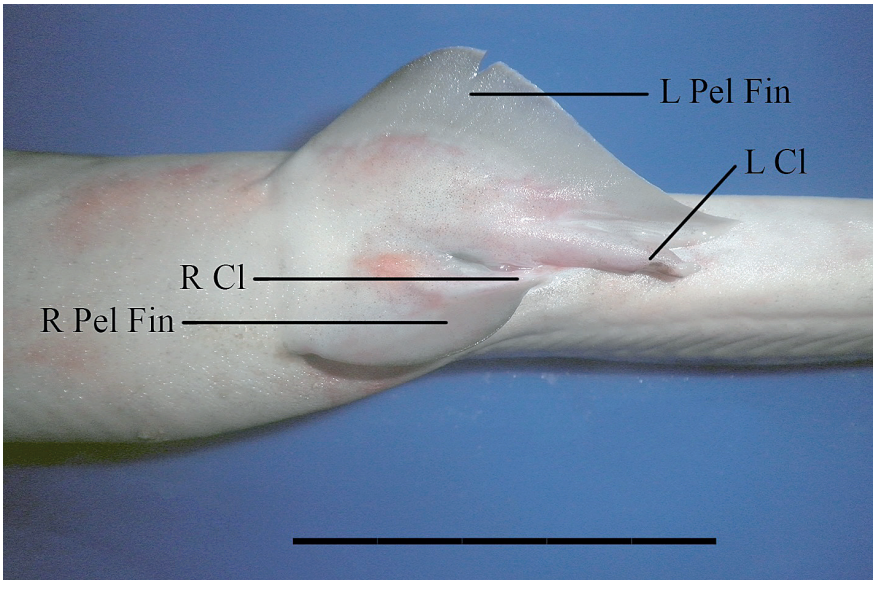

Fig. 3. Abnormal specimen of *Galeus melastomus*. L Cl: left clasper. L Pel Ffin: left pelvic fin. RCL: right clasper. R Pel Fin: right pelvic fin. Scale bar = 50 mm.

Area	Size at sexual maturity (TL, mm)		Maximum size (TL, mm)		Authors
	Males	Females	Males	Females	
Tunisian coast	> 420	390-420	560	550	Capapè and Zaouali (1977)
Ionian Sea	450	490	510	550	Tursi *et al.* (1993)
Adriatic Sea	450	490	-	580	Ungaro *et al.* (1996)
Tyrrhenian Sea	-	-	500	500	Rinelli *et al.* (2005)
Languedoc Coast	510-550	520-610	620	640	Capapè *et al.* (2008)
Eastern Algeria	540	540	560	560	Ait Darna *et al.* (2018)

Table 1. Size at sexual maturity and maximal size of *Galeus melastomus* recorded from some Mediterranean areas.

Species	Region	Condition of claspers	Authors
Raja miraletus (**L**innaeus, 1758)	Tunisian coast	Lack of left clasper	Quignard and Capapè (1972)
Bathyraja interrupta (**G**ill and **T**ownsend, 1897)	Coast of Alaska	Atrophy of both claspers	Haas and Ebert (2008)
Pteroplatytrygon violacea (**B**onaparte, 1832)	Brazilian coast	Lack of left clasper	Ribeiro-Prado *et al.* (2009)
Dasyatis tortonesei **C**apapè, 1975	Tunisian coast	Atrophy of both claspers	Capapè *et al.* (2012)
Urotrygon microphthalmum **D**elsman, 1941	Brazilian coast	Atrophy of left clasper, lack of right clasper	Santander-Neto and Lessa (2013)
Urotrygon chilensis (**G**ünther, 1872)	West coast of Mexico	Lack of left clasper	Torres-Huerta *et al.* (2015)
Zapteryx exasperata (**J**ordan and **G**ilbert, 1880)	West coast of Mexico	Lack of right clasper, atrophy of left pelvic fin	Gonzàlez-Gonzàlez *et al.* (2016)
Myliobatis aquila (**L**innaeus, 1758)	Tunisian coast	Atrophy of both claspers	Rafrafi-*et al.* (2017)
Pseudobathos percellens (**W**albaum, 1792)	Caribbean Sea	Lack of left clasper, atrophy of right pelvic fin	Ehemann and Gonzàlez- Gonzàlez (2018)
Galeus melastomus **R**afinesque, 1810	Algerian coast	Severe atrophy of right clasper and pelvin fin	This study

Table 2. Condition of clasper and pelvic fin (lack and/or atrophy) observed in *Galeus melastomus* collected in some marine regions.

sure to radioactive contamination (Yano and Tanaka, 1989) and to pollutant dumps with high values of heavy metals concentrations (Ribeira-Prado *et al*., 2008) and chemical particulates such as DDT (Torres-Huerta *et al*., 2015). *G.melastomus* is a benthic species but also an oviparous species which lays its egg cases directly in the wild, and embryos are not protected by mother's uteri as for viviparous species and underget the unfavourable environmental parameters (Ribeira-Prado *et al*., 2008). The study area where our sample was collected is located in the central region of Algeria which faced to different categories of pollutants such as heavy metals (Benamar *et al*., 1999) and polychlorinated biphenyls (Fouial-Djebbar *et al*., 2011)

On the other hand, the specimens displaying some abnormalities and reported in the present paper live in tropical and equatrorial seas. The waters of the Algerian coast are becoming warmer as for the entire Mediterranean Sea (Francour *et al*., 1994), and as a consequence they are progressively invaded by non-indigenous species (Hemida *et al*., 2018). However, the role of temperature in the development of such abnomalities remains only a possible hyptothesis which needs adequate studies, but it cannot be totally ruled out. Among the causes of these reproductive abnormalities, lack or atrophy of claspers, Ehemann and Gonzàlez-Gonzàlez (2018) noted the most probable origin is related to the embryonic development. This opinion is in total accordance with Bensam (1965) who emphasized that such deformities are probably caused by intrauterine pressure exerted by other embryos in viviparous species. Conversely, Bonfil (1989) suggested that the pre-natal abnormalities have a genetic origin or related to mutations.

The lack of one clasper probably plays a minor role in reproduction processus due to the fact that male specimens introduce a single clasper during copulation (Chapman *et al*., 2003). Conversely, atrophy of both claspers reduces the success of the reproduction processus. The relationship TBW vs TL including the abnormal specimen and other specimens of similar sizes from our sample of *G.melastomus* is log TWB = -5.429 + 2.94 * log TL; r = 0.97; n = 58, displaying an allometry slightly negative (Fig. 4), all specimens having a regular increase in development. Therefore, both atrophies of right clasper and right pelvic fin did not assume the development of the abnormal specimen in the wild, similar patterns were provided in two other batoid species (Capapé *et al*., 2015a, b)

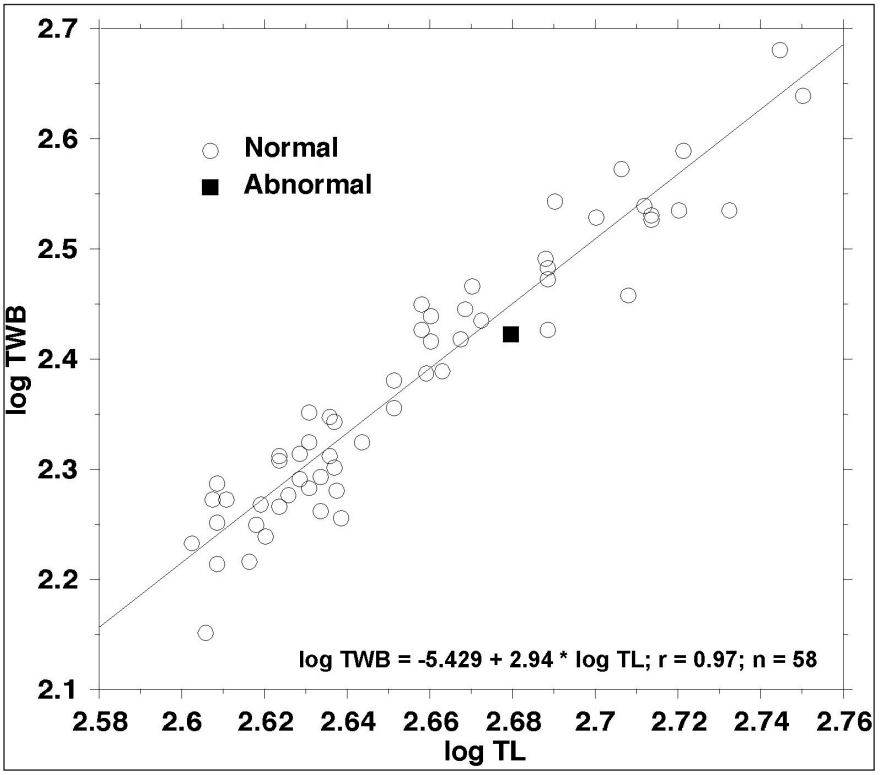

Fig. 4. Relationship total body mass (TBM) *versus* disc width (TL) expressed in logarithmic coordinates for normal and abnormal specimens of *Galeus melastomus* collected from the Algerian waters.

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