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MORPHOLOGICAL ABNORMALITIES IN TWO BATOID SPECIES (CHONDRICHTHYES) FROM NORTHERN TUNISIAN WATERS (CENTRAL MEDITERRANEAN)

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ABSTRACT

The authors present two cases of abnormalities recorded in two elasmobranch species from northern Tunisian waters. A pregnant common torpedo Torpedo torpedo *captured in the Lagoon of Bizerte in northern Tunisia, carried three embryos, two of which, one female and one male, were abnormal, both having the pectoral fin non-adherent to the head. A juvenile female* Raja polystigma *captured off northern coast of Tunisia presented a morphological abnormality at distal end of tail in the shape of a fork. These two cases of abnormalities are described, commented and discussed.*

Key words: Chondrichthyes, *Torpedo torpedo*, *Raja polystigma*, morphological abnormalities, Lagoon of Bizerte, central Mediterranean

ANOMALIE MORFOLOGICHE IN DUE SPECIE BATOIDI (CHONDRICHTHYES) DI ACQUE SETTENTRIONALI DELLA TUNISIA (MEDITERRANEO CENTRALE)

SINTESI

Gli autori presentano due casi di anomalie riscontrate in due specie di elasmobranchi di acque settentrionali della Tunisia. Una femmina gravida di torpedine ocellata Torpedo torpedo, *catturata nella Laguna di Biserta (Tunisia settentrionale), portava tre embrioni dei quali due, una femmina ed un maschio, presentavano anomalie, ossia la pinna pettorale non aderente alla testa. Una giovane femmina di* Raja polystigma *catturata al largo della costa settentrionale della Tunisia presentava un'anomalia morfologica all'estremità distale della coda, ossia una forca. Nell'articolo questi due casi di anomalie vengono descritti, commentati e discussi.*

Parole chiave: Chondrichthyes, *Torpedo torpedo*, *Raja polystigma*, anomalie morfologiche, Laguna di Biserta, Mediterraneo centrale

INTRODUCTION

Morphological abnormalities also called 'monstrosities' by authors were reported in fish species and listed by Dawson (1964, 1966, 1971) and Dawson & Heal (1971). It appears that such phenomena are more frequently recorded in osteichthyan species than in chondrichthyan species. It is probably due to the low commercial value that has characterized the latter for several years and difficulties to obtain a significant number of specimens to detect abnormalities (Hoenig & Walsh, 1983; Ribeiro-Prado *et al.*, 2008). Additionally, they represent a minor group in term of captures, 0.85% of total world captures (Vannucini, 1988).

Morphological abnormalities were listed in sharks (Barrull *et al.*, 2002; Saïdi *et al.*, 2005; Mancini *et al.*, 2006), but also in skates and rays (Ribeiro-Prado *et al.*, 2008; El Kamel *et al.*, 2009a), for both embryos and free-swimming specimens. Morphological abnormalities concern skeleton, chondrodranium and vertebral column in the former, while in the latter they concern fins, mainly pectoral fins. Investigations conducted from early 2006 to date in northern Tunisian waters to establish elasmobranch monitoring in the area allowed the capture of a pregnant female of the common torpedo *Torpedo torpedo* Linnaeus, 1758 carrying abnormal embryos, and an abnormal female of the speckled ray *Raja polystigma* Regan, 1923. Both specimens are described in the present paper, together with comments and a discussion on morphological abnormalities reported in batoid species.

MATERIAL AND METHODS

Investigations were conducted from June 2006 to October 2010 in northern Tunisian waters, including the northern Tunisian coast from Algerian border (8°37′ E) to Kelibia (11°03′ E), and the Lagoon of Bizerte (Fig. 1). The latter is a brackish water area located in northeastern Tunisia, between 37°8′ and 37°14′ N, and between 9°46′ and 9°56′ E (Fig. 2), where elasmobranch species are regularly caught by gill-nets, longlines or trammel nets (El Kamel *et al.*, 2009b, c).

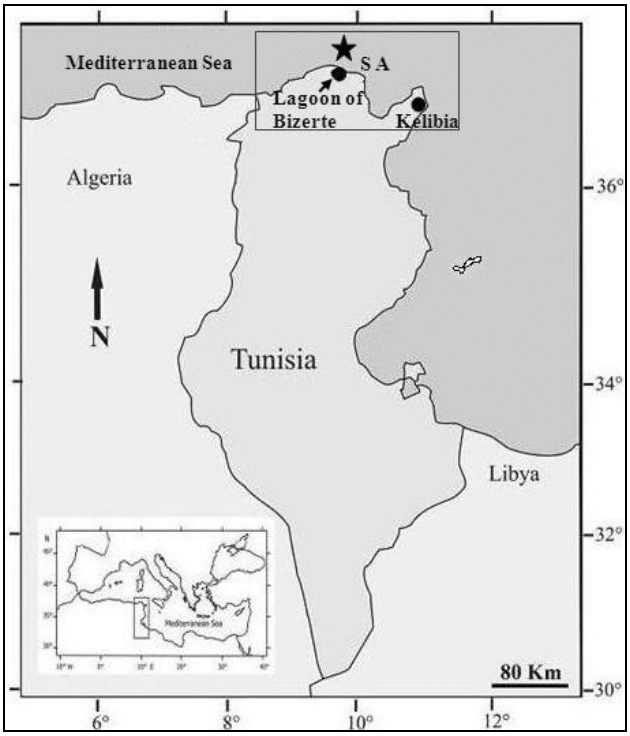

Fig. 1: Map of the Mediterranean showing the Lagoon of Bizerte, the sampling area (SA) off northern Tunisian coast and pointing out the capture site (black star) of the abnormal *Raja polystigma* ***(FSB-Raj-pol-01).***
Sl. 1: Zemljevid Sredozemlja z Laguno Bizerte, območjem vzorčenja (SA) ob severni tunizijski obali in označeno točko ulova (črna zvezda) abnormalnega primerka vrste *Raja polystigma* ***(FSB-Raj-pol-01).***

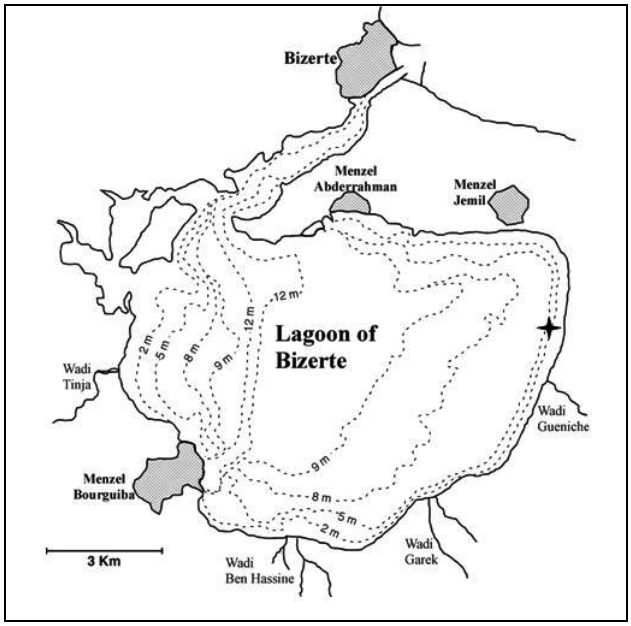

Fig. 2: Map of the Lagoon of Bizerte showing the capture site (black star) of the pregnant common torpedo, *Torpedo torpedo*, ***(FSB T-torp.04).***
Sl. 2: Zemljevid Lagune Bizerte z označeno točko ulova (črna zvezda) breje samice navadnega električnega ската, *Torpedo torpedo*, ***(FSB T-torp.04).***

Soon after captures and identification, both specimens were photographed and measured. Morphometric measurements were recorded to the nearest millimetre following Mejri *et al.* (2004) and masses to the nearest decigram. They were preserved in 5% buffered formalin, deposited in the Ichtyological Collection of the Faculté des Sciences de Bizerte and received catalogue number.

RESULTS AND DISCUSSION

Torpedo torpedo

Torpedo torpedo is known off the eastern Atlantic from the Bay of Biscaye (Quéro *et al.*, 2003) to the Gulf of Guinea (Blache *et al.*, 1970), and southward to South African waters (Smith & Heemstra, 1986). *T. torpedo* is reported throughout the Mediterranean Sea, but it is more common in southern areas (Capapé, 1989). The species is reported off the Tunisian coast (Bradaï *et al.*, 2004), but it was also recorded in Tunisian brackish areas such as the Bahiret El Biban (Capapé *et al.*, 2004), Tunis Southern Lagoon (Mejri *et al.*, 2004) and the Lagoon of Bizerte where a sustainable population has probably found favourable environmental conditions to develop and reproduce (El Kamel *et al.*, 2009b, c).

On 21 July 2010, a female *T. torpedo* was captured by commercial gill-nets at 1.5–2.5 m, on sandy-muddy bottom in the Lagoon of Bizerte, at 37°12′23" N and 9°56′86" E. It was 275 mm in total length and weighed 361.8 g in total mass, while the eviscerated body mass reached 313.4 g. The female was dissected soon after its capture and the uteri contained 3 embryos which were removed and analysed; two of them presented morphological abnormalities, one was normal. The pregnant female was referenced FSB T-torp.04, while the 3 embryos FSB T-torp.05, FSB T-torp.06 and FSB T-torp.07. Morphometric measurements were carried out in the 4 specimens and are presented in Table 1.

The first abnormal embryo (FSB T-torp.05) was a male having 70 mm in total length and weighting 4.69 g. The left pectoral fin was non-adherent to the head and a large region of the fin was missing. The pectoral fin was constituted by a short curve ending by a distal point. Additionally, a large region of the left pelvic fin was also missing and less developed that the right pelvic fin (Fig. 3). The second abnormal embryo (FSB T-torp.06) was a female smaller than the abnormal male; its total length was 52.16 mm and it weighed 1.96 g. The right pectoral fin of this embryo presented a slight non-adherence to the head while the right pelvic fin was not completely formed and smaller than the left pectoral fin (Fig. 4).

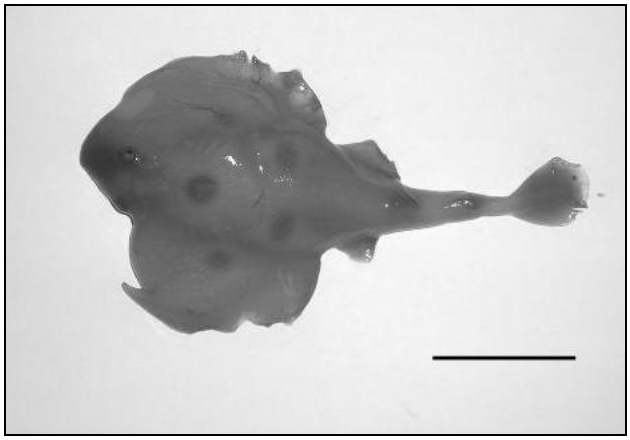

Fig. 3: Abnormal embryo (FSB T-torp.05), removed from a pregnant female *T. torpedo****, scale bar = 20 mm.***
Sl. 3: Abnormalni zarodek (FSB T-torp.05), odstranjen iz breje samice vrste *T. torpedo****, merilo = 20 mm.***

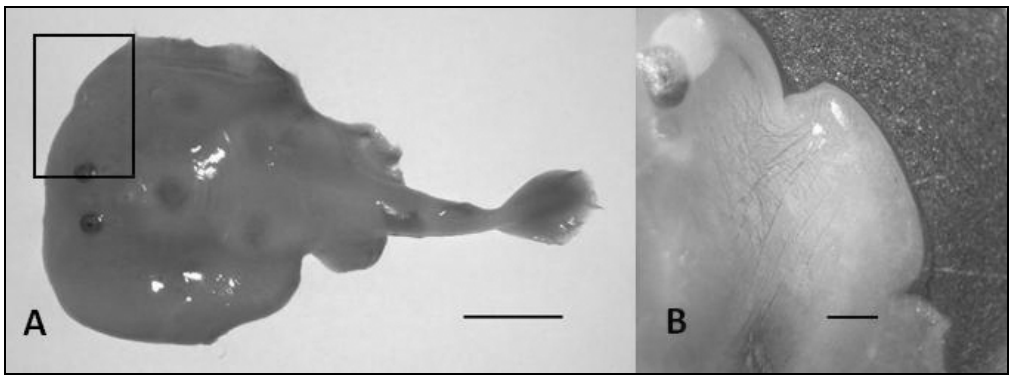

Fig. 4: A. Abnormal embryo (FSB T-torp.06), removed from a pregnant female *T. torpedo* ***scale bar= 10 mm. B. Insert showing the pectoral non-adherent to the head, scale bar = 2 mm.***
Sl. 4: A. Abnormalni zarodek (FSB T-torp.06), odstranjen iz breje samice vrste *T. torpedo****, merilo = 10 mm. B. Izsek prikazuje prsno plavut, ki se ne stika z glavo, merilo = 2 mm.***

Tab. 1: Morphometric measurements and meristic counts recorded in the pregnant common torpedo (FSB T-torp.04), and its uterine content: two abnormal embryos (FSB T-torp.05 and FSB T-torp.06) and a normal embryo (FSB T-torp.07).

Tab. 1: Morfometrični in meristični podatki za brejo samico navadnega električnega skata (FSB T-torp.04) in tri zarodke: dva abnormalna (FSB T-torp.05 and FSB T-torp.06) in en normalen zarodek (FSB T-torp.07).

Reference	**FSB T-torp.04**		**FSB T-torp.05**		**FSB T-torp.06**		**FSB T-torp.07**	
Sex	**F**		**M**		**F**		**F**	
Total mass (g)	361.80		4.69		1.96		5.07	
Measurements	mm	% TL	mm	% TL	mm	% TL	mm	% TL
Total length (TL)	275.00		70.76		52.16		68.58	
Disc length	140.00	50.91	36.72	51.89	25.42	48.73	32.39	47.23
Disc width	175.00	63.64	39.35	55.61	28.76	55.14	39.31	57.32
Disc depth	22.98	8.36	5.43	7.67	4.58	8.78	5.14	7.49
Eyeball length	7.65	2.78	3.24	4.58	2.36	4.52	3.00	4.37
Cornea	3.98	1.45	2.09	2.95	1.72	3.30	1.67	2.44
Pre-orbital length	20.52	7.46	5.64	7.97	4.44	8.51	5.89	8.59
Inter-orbital width	11.90	4.33	5.49	7.76	2.47	4.74	3.10	4.52
Nasal curtain	15.58	5.67	3.95	5.58	4.36	8.36	5.05	7.36
Spiracle diameter	5.92	2.15	2.29	3.24	1.39	2.66	1.53	2.23
Inter-nasal width	12.89	4.69	3.56	5.03	3.58	6.86	3.68	5.37
Space between eye and spiracle	7.36	2.68	2.30	3.25	1.92	3.68	1.11	1.62
Inter-spiracular width	13.93	5.07	6.91	9.77	4.72	9.05	4.99	7.28
Pre-oral length	24.73	8.99	7.95	11.24	3.51	6.73	6.17	9.00
Mouth width	17.03	6.19	5.07	7.17	4.23	8.11	4.56	6.65
First gill slit	5.99	2.18	1.27	1.79	1.14	2.19	1.52	2.22
Second gill slit	6.45	2.35	1.56	2.20	1.45	2.78	1.52	2.22
Third gill slit	7.14	2.60	2.01	2.84	1.90	3.64	1.83	2.67
Fourth gill slit	7.38	2.68	1.82	2.57	0.45	0.86	1.90	2.77
Fifth gill slit	4.81	1.75	1.03	1.46	1.52	2.91	0.98	1.43
Width between first gill slit	41.74	15.18	11.35	16.04	5.31	10.18	9.39	13.69
Width between first gill slit	36.98	13.45	10.16	14.36	4.49	8.61	9.58	13.97
Snout tip to eye	21.59	7.85	7.05	9.96	5.67	10.87	7.21	10.51
Snout tip to mouth	26.83	9.76	8.11	11.46	5.44	10.43	7.02	10.24
Snout tip to first gill slit	59.18	21.52	12.94	18.29	7.22	13.84	10.07	14.68
Snout tip to fifth gill slit	83.22	30.26	18.84	26.63	16.37	31.38	17.48	25.49
Snout tip pelvic fin	143.00	52.00	36.91	52.16	24.66	47.28	32.03	46.70
Snout tip to vent	162.00	58.91	38.86	54.92	27.38	52.49	37.15	54.17
Pectoral fin anterior margin	70.28	25.56	25.04	35.39	16.52	31.67	16.81	24.51
Pectoral fin posterior margin	91.53	33.28	17.77	25.11	15.52	29.75	18.91	27.57
Pectoral fin inner margin	11.24	4.09	2.03	2.87	3.25	6.23	1.70	2.48
Pelvic fin anterior margin	36.15	13.15	10.14	14.33	5.60	10.74	6.79	9.90
Pelvic fin posterior margin	54.55	19.84	10.77	15.22	7.07	13.55	12.51	18.24
Pelvic fin inner margin	10.69	3.89	3.13	4.42	2.21	4.24	2.39	3.48
Span of pelvic fins	85.67	31.15	19.03	26.89	13.88	26.61	17.47	25.47
Tail base width	25.57	9.30	7.15	10.10	4.26	8.17	6.02	8.78
Tail base depth	15.26	5.55	3.25	4.59	2.27	4.35	3.47	5.06
Tail length	101.35	36.85	24.87	35.15	19.68	37.73	24.82	36.19
Snout tip to first dorsal	178.00	64.73	43.65	61.69	29.37	56.31	41.50	60.51
Snout tip to second dorsal	215.00	78.18	52.34	73.97	34.66	66.45	49.31	71.90
Snout tip to birth of dorsal ca udal	245.00	89.09	60.53	85.54	43.13	82.69	55.12	80.37
Snout tip to birth of ventral ca udal	240.00	87.27	59.41	83.96	42.31	81.12	55.48	80.90
Caudal superior	44.58	16.21	12.68	17.92	7.20	13.80	12.98	18.93
Caudal inferior edge	37.03	13.47	11.63	16.44	7.43	14.24	8.69	12.67
Caudal posterior edge	47.48	17.27	10.55	14.91	5.96	11.43	9.52	13.88
First dorsal anterior edge	35.57	12.93	6.78	9.58	2.98	5.71	3.20	4.67
First dorsal posterior edge	23.33	8.48	4.40	6.22	3.36	6.44	4.82	7.03
First dorsal inner edge	6.59	2.40	4.31	6.09	2.28	4.37	2.77	4.04
First dorsal base	18.80	6.84	4.17	5.89	3.93	7.53	4.00	5.83
Second dorsal anterior edge	25.14	9.14	4.20	5.94	42.87	82.19	3.93	5.73
Second dorsal posterior edge	16.40	5.96	4.00	5.65	2.78	5.33	3.40	4.96
Second dorsal inner edge	5.87	2.13	2.73	3.86	2.12	4.06	2.25	3.28
Second base	12.76	4.64	3.84	5.43	3.06	5.87	3.53	5.15
Inter-dorsal distance	14.60	5.31	3.60	5.09	2.69	5.16	3.95	5.76
Second dorsal to caudal birth	13.65	4.96	3.64	5.14	3.13	6.00	4.20	6.12
Caudal careen	40.48	14.72	11.36	16.05	7.48	14.34	11.83	17.25
Clasper length	-		5.82	8.22	-		-	

***Tab. 2: Morphological abnormalities recorded in the ichthyological literature in specimens of the genus** Torpedo.*
***Tab. 2: Morfološke nepravilnosti, zabeležene v ihtiološki literaturi pri primerkih iz rodu** Torpedo.*

Species	Case of abnormality	Marine region	Authors
T. marmorata	Pectoral non adherent to the head	Adriatic Sea	Valle (1931)
T. marmorata	Pectoral non adherent to the head	Adriatic Sea	Jardas & Homen (1977)
T. nobiliana	Pectoral non adherent to the head	Atlantic Ocean	Palmer & Wheeler (1958)
T. torpedo	Surnumerary dorsal fin	Lagoon of Bizerte	Ben Brahim & Capapé (1997)
T. torpedo	Lack of gill-slit	Lagoon of Bizerte	El Kamel *et al.* (2009a)
T. torpedo	Pectoral non adherent to the head	Lagoon of Bizerte	This study
T. torpedo	Pectoral non adherent to the head	Lagoon of Bizerte	This study

The atypical morphological characteristics observed in the embryos carried by the pregnant female *T. torpedo* were pectoral fins non-adherent to the head, rarely recorded in torpedinid species (Ribeiro-Prado *et al.*, 2008). Three cases were recorded to date in free swimming specimens (Tab. 2), two for the marbled electric ray *Torpedo marmorata* Risso, 1810 and a single case for the black torpedo *Torpedo nobiliana* Bonaparte, 1835. Consequently, such abnormality was reported herein for the first time in the common torpedo. However, it was found in developing embryos; the question is whether their development would complete and if they would be able to live in the wild after birth. It could explain why no free swimming common torpedos presenting similar abnormality were found to date. In contrast Ribeiro-Prado *et al.* (2008) listed 24 similar cases in rajid species and 11 cases in stingrays. This relatively frequent occurrence of abnormalities in this species rather than in torpedinids appears difficult to explain. It may be due to sampling, but also to disk shape, rectangular in skates and rays, rounded in torpedos; it could mean that it is more difficult for pectoral fins to develop adherent to the head in the former than in the latter.

According to Bigelow & Schroeder (1953), such morphological abnormality occurs when the pectoral fins fail to fuse together in front of the head in early development. Additionally, Thorson *et al.* (1983) described embryonic development in the two freshwater stingrays *Potamotrygon constellata* (Vaillant, 1880) and *P. motoro* (Müller & Henle, 1841) as follows: in early embryos, the stingray's pectoral fins begin to separate, then fuse in medium embryos and finally form the complete disc in near term embryos.

Three common torpedos presenting abnormalities were reported from the Lagoon of Bizerte (see Table 2, Ben Brahim & Capapé, 1997; Ben Brahim *et al.*, 1998). This relatively high frequency could be explained by the pollution, affecting a restricted brackish area such as the Lagoon of Bizerte, polluted by both inorganic and organic nutriments and heavy metals. The common torpedo lives buried in sandy bottoms (El Kamel *et al.*, 2009a, b, c), where pollutants are collected (Mzoughi *et al.*, 2002; Harzallah, 2003). However, this hypothesis needs further confirmation.

Raja polystigma

The speckled ray *Raja polystigma* Regan, 1923 is probably endemic to the Mediterranean Sea (Capapé, 1989), and up to date, unknown off the eastern side of the Atlantic (Quéro *et al.*, 2003). The species was reported in northern Mediterranean areas, such as the Catalan Sea (Matallanas, 1977), southern France (Capapé *et al.*, 2006a, b), the Italian Seas (Tortonese, 1956; Arbocco, 1966), off Greece (Kaspiris, 1974). Southward, *R. polystigma* is known off the Maghreb shore, Morocco (Lloris & Rucabado, 1998), Algeria (Hemida *et al.*, 2007), Tunisia, where the species is rather common in northern areas (Capapé *et al.*, 1980; Bradaï *et al.*, 2004).

On 25 May 2010, a speckled ray was captured off northern coast of Tunisia by trawler (37°31'9.36" N; 9°51'26.71" E), at depth between cca. 150 and 200 m, on sandy-muddy bottom (Fig. 5). The specimen of *R. polystigma* was identified following Clark (1926), Tortonese (1956) and Capapé *et al.* (1980, 2006b), as follows: disc sub-quadrangular, obtuse in front, with snout rounded, anterior margin slightly concave at level of eyes and outer corners; outer angles broadly rounded; posterior margins convex; first dorsal larger than second dorsal. Disc depth 11%, disc length 77.8%, pre-oral length 15.9%, pelvic span 37%, pelvic fin anterior margin all in disc width (DW). Dorsal surface greyish--brownish with dark and yellowish spots, belly beige with the outer margin of disc slightly brownish. Additional morphological measurements and meristic counts (see Table 3) are in agreement with those reported by these authors.

The specimen was 374 mm DW, 541 mm total length, the total body mass and the eviscerated body mass were 1104.3 g and 921 g, respectively, while the liver mass was 38.7 g. The gonads were thread-like and both weighed 5.2 g, the oviducal glands were inconspicuously developed and both weighed 0.94 g. The specimen was still juvenile, in agreement with Capapé & Quignard (1978) who noted that females over 400 mm DW were mature. The gut was empty, with no food or remains of food.

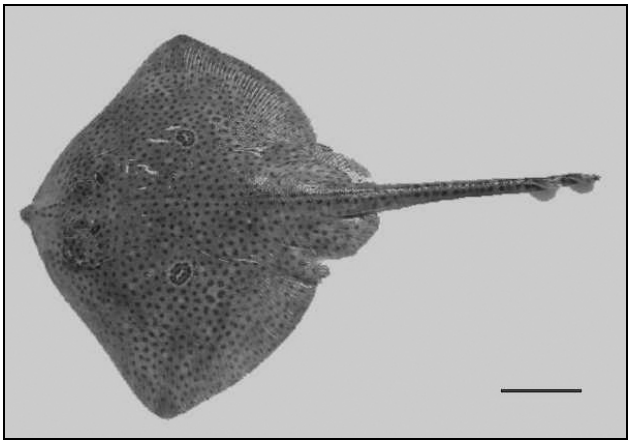

Fig. 5: Abnormal** R. polystigma **caught off northern Tunisian coast, scale bar = 50 mm.
Sl. 5: Abnormalni primerek vrste** R. polystigma**, ujet ob severni tunizijski obali, merilo = 50 mm.

However, the specimen presented a morphological abnormality at distal end of tail in the shape of a fork (Fig. 6). This morphological abnormality in tail is not due to an injury as it is generally the case in skates (see Mnasri *et al.*, 2009). No scar was visible in this fork which is also covered by pigmented skin. To our knowledge, it is the first time that such abnormality was recorded to date in skates. Ribeiro-Prado *et al.* (2008) listed all morphological abnormalities recorded to date in skates and rays, and noted that abnormalities occurred in disc, with pectoral fins non-adherent to the head being the most recorded one. The latter not only concerned skates but also rays and rarely torpedinids. A single case of abnormality reported to date was in a rough ray *Raja radula* Delaroche, 1809 by Capapé & Pantoustier (1975). Another case of morphological abnormality in tail was observed in a common torpedo *T. torpedo* in Tunisian waters, the specimen exhibiting a surnumerary dorsal fin (Ben Brahim & Capapé, 1997).

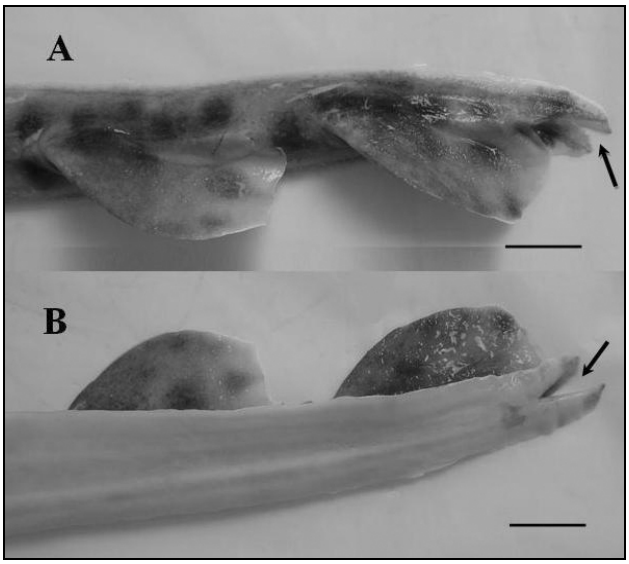

Fig. 6: Tail of abnormal** R. polystigma **with black arrow pointing out the morphological abnormality or fork, scale bar = 10 mm. (A) Dorsal surface, (B) ventral surface.
Sl. 6: Rep abnormalnega primerka vrste** R. polystigma **s črno puščico, ki kaže na morfološko deformacijo v obliki škarjastega repa, merilo = 10 mm. (A) Hrbtna stran, (B) trebušna stran.

Literature review shows that cases of abnormalities are relatively rare in elasmobranch species (see Dawson, 1964, 1966, 1971; Dawson & Heal, 1971; Hoenig & Walsh, 1983; Ribeiro-Prado *et al.*, 2008). However, the percentage of abnormalities recorded is not representative of the real number of cases, because all specimens came from fisheries. So, in order to obtain a more accurate percentage, samples from scientific surveys should be considered.

The causes of such abnormalities remain doubtful and still hypothetical. Unfavourable environmental conditions, such as large exposures to pollutants for instance, probably play a role in occurrence of abnormalities (Ribeiro-Prado *et al.*, 2008). It could explain why abnormalities are more often observed in oviparous species than in viviparous species; in the former, embryos develop in egg cases directly deposited in water, while in the latter embryos are protected in the mother's uteri (Casarini *et al.*, 1996). However, we cannot totally exclude the role of the polluted environment in abnormalities observed in viviparous elasmobranch species. Some instances were reported herein concerning the common torpedo from the Lagoon of Bizerte. Bensam (1965) noted that embryonic deformities could be caused by intrauterine pressure exerted by other embryos in a same litter. In contrast, Bonfil (1989) argues that in a litter, embryos are exposed to the same space and growth conditions, so the origin of pre-natal abnormalities would be related to mutation or other developmental irregularities. Rosa *et al.* (1996) noted that abnormalities could be due to disturbance in the initial stages of ontogeny known as shark stage, where embryos have fins separated from the head, resembling shark embryos.

According to Rosa *et al.* (1996) the fact that adult skates exhibiting abnormalities occur alive and in good condition, means that these deformities do not interfere with the biological activities, mainly feeding. Additionally, an interesting instance was described by Oldfield (2005) of a female ocellated freshwater stingray *P. motoro* placed in captivity, which gave birth to a couple of abnormal specimens. Oldfield (2005) noted that the first specimen died two days after birth, while the second specimen born as a 'Batman ray' did fantastic, eating

Tab. 3: Morphometric measurements and meristic counts recorded in the abnormal** Raja polystigma **(FSB-Raj-pol-01).
Tab. 3: Morfometrični in meristični podatki za abnormalnem primerek vrste** Raja polystigma **(FSB-Raj-pol-01).

Reference	**FSB-Raj-pol-01**	
Morphometric measurments	mm	% DW
Total length	541	144.6
Disc length	291	77.8
Disc width (DW)	374	
Disc depth	41.4	11.1
Eyeball length	18.2	4.9
Cornea	13.1	3.5
Pre-orbital length	59.1	15.8
Inter-orbital width	24.5	6.6
Spiracle length	14.7	3.9
Spiracle width	6.15	1.6
Inter-nasal width	37.2	9.9
Nasal curtain	47.9	12.8
Interspiracular width	35.4	9.5
Pre-oral length	59.6	15.9
Mouth width	47.9	12.8
First gill slit	14.1	3.8
Second gill slit	14.5	3.9
Third gill slit	13.6	3.6
Forth gill slit	13.6	3.7
Fifth gill slit	8.5	2.3
Width between first gill slit	76.5	20.4
Width between fifth gill slit	38.9	10.4
Snout tip to eye	71.3	19.1
Snout tip to mouth	66.1	17.7
Snout tip to first gill slit	103	27.5
Snout tip to fifth gill slit	146	39.1
Snout tip to pelvic fin	230	61.5
Snout tip to vent	254	67.9
Pectoral fin anterior margin	250	66.8
Pectoral fin posterior margin	195	52.1
Pectoral fin inner margin	37.9	10.2
Pelvic fin anterior margin	57.3	15.3
Pelvic fin posterior margin	84.6	22.6
Pelvic fin inner margin	31.7	8.5
Span of pelvic fin	142	37.97
Tail base width	28.7	7.6
Tail base depth	17.4	4.7
Tail length	255	68.2
Snout tip to first dorsal	472	126.2
Snout tip to second dorsal	510	136.4
Superior caudal edge	8.8	2.4
Inferior caudal edge	5.9	1.6
First dorsal anterior edge	26	6.9
First dorsal posterior edge	11.8	3.1
First dorsal base	27.9	7.5
Second dorsal anterior edge	25.7	6.8
Second dorsal posterior edge	13.8	3.7
Second dorsal base	25.6	6.8
Inter-dorsal distance d1-d2	9.1	2.4
Third dorsal anterior edge	7.8	2.1
Third dorsal posterior edge	2.1	0.6
Third dorsal base	5.1	1.4
Inter-dorsal distance d2-d3	3.9	1.1
Third dorsal caudal birth	0.8	0.2
Tooth rows upper jaw	54	
Tooth rows lower jaw	57	
Pseudo-branchial lamellae	16/16	
Nictitating lamellae	13/13	
Pectoral rays	75/75	
Truncal vertebrae	28	

healthily, growing rapidly, and developing a nice colour pattern. These observations confirm that such morphological abnormalities do not necessarily play a negative role in embryonic development and beyond, during life in the wild of specimens having the pectoral fin non-adherent to the head.

MORFOLOŠKE NEPRAVILNOSTI PRI DVEH VRSTAH SKATOV (CHONDRICHTHYES) IZ SEVERNIH TUNIZIJSKIH VODA (OSREDNJE SREDOZEMLJE)

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POVZETEK

Avtorji članka predstavljajo dva primera nepravilnosti, zabeležena pri dveh vrstah skatov iz severnih tunizijskih voda. Breja samica navadnega električnega skata Torpedo torpedo*, ujeta v Laguni Bizerte v severni Tuniziji, je nosila tri zarodke, od katerih sta bila dva, en ženski in en moški, abnormalna, s prsno plavutjo, ki se ni stikala z glavo. Mladostna samica vrste* Raja polystigma*, ujeta ob severni tunizijski obali, pa je imela abnormalen rep škarjaste oblike. Primera nepravilnosti sta opisana, komentirana in diskutirana.*

Ključne besede: Chondrichthyes, *Torpedo torpedo*, *Raja polystigma*, morfološke abnormalnosti, Laguna Bizerte, osrednje Sredozemlje

REFERENCES

Arbocco, G. (1966): Primo riperto di *Raja polystigma* Reg. nel Golfo di Genova. Doriana, 3(116), 1–6.

Barrull, J. L. M., I. Mate & M. Bueno (2002): Presence of atypical characteristics in a specimen of small-spoted catshark *Scyliorhinus canicula* (Linnaeus, 1758) caught in the Mediterranean. Annales, Ser. Hist. Nat., 12(1), 23–26.

Ben Brahim, R. & C. Capapé (1997): Nageoire dorsale supplémentaire chez une torpille ocellée, *Torpedo (Torpedo) torpedo* des eaux tunisiennes (Méditerranée Centrale). Cybium, 21(2), 223–225.

Ben Brahim, R., A. A. Seck & C. Capapé (1998): Albinisme chez la torpille ocellée, *Torpedo (Torpedo) torpedo* (Linnaeus, 1758). Cybium, 22(1), 83–86.

Bensam, P. (1965): On a freak embryo of the grey shark *Carcharhinus limbatus* M. & H. J. Mar. Biol. Assoc. India, 7(1), 206–207.

Bigelow, H. B. & W. C. Schroeder (1953): Fishes of the western north Atlantic. Part 2. Sawfishes, guitarfishes, skates, rays and chimaeroids. Mem. Sears Found. Mar. Res., No. 1, part 2, pp. 1–577.

Blache, J., J. Cadenat & J. Stauch (1970): Clés de détermination des poissons de mer signalés dans l'Atlantique oriental tropical (entre le 20ème parallèle N. et le 15ème parallèle S.). Faune. Trop., ORSTOM, 18, 1–479.

Bonfil, R. (1989): An abnormal embryo of the reef shark *Carcharhinus perezi* (Poey) from Yucatan, Mexico. Northeast Gulf Sci., 10(2), 153–155.

Bradaï, M. N., J.-P. Quignard, A. Bouaïn, O. Jarboui, A. Ouannes-Ghorbel, L. Ben Abdallah, J. Zaouali & S. Ben Salem (2004): Ichtyofaune autochtone et exotique des côtes tunisiennes: recensement et biogéographie. Cybium, 28(4), 315–328.

Capapé, C. (1989): Les Sélaciens des côtes méditerranéennes: aspects généraux de leur écologie et exemples de peuplements. Océanis, 15, 309–331.

Capapé, C. & G. Pantoustier (1975): Anomalies chez quelques Sélaciens des côtes tunisiennes. Arch. Inst. Pasteur Tunis., 52(3), 251–260.

Capapé, C. & J.-P. Quignard (1978): Contribution à la biologie des Rajidæ des côtes tunisiennes. XIV. *Raja polystigma* Regan, 1923: répartition géographique et bathymétrique, sexualité, reproduction, fécondité. Cah. Biol. Mar., 19, 233–244.

Capapé, C., J.-P. Quignard. & F. Kartas (1980): Nouvelle descripition de *Raja polystigma* Regan, 1923 (Pisces, Rajiformes). Bull. Off. natn Pêch Tunis., 4(1), 27–45.

Capapé, C., O. Guélorget, J.-P. Quignard, A. El Abed, J. Zaouali & J. Ben Souissi (2004): The Elasmobranch species from the Bahiret El Biban (Southern Tunisia, Central Mediterranean): a survey. Annales, Ser. Hist. Nat., 14(1), 19–28.

Capapé, C., O. Guélorget, Y. Vergne & J.-P. Quignard (2006a): On a rare skate, the speckled ray, *Raja polystigma* Regan, 1923 (Chondrichthyes: Rajidae) captured off the coast of Languedoc (Southern France, Northern Mediterranean). Annales, Ser. Hist. Nat., 16(1), 37–42.

Capapé, C., O. Guélorget, Y. Vergne, A. Marquès & J.-P. Quignard (2006b): Skates and rays (Chondrichthyes) from waters off the Languedocian coast (southern France, northern Mediterranean). Annales, Ser. Hist. Nat., 16(2), 166–178.

Casarini, L. M., U. L. Gomès & O. B. G. Gadig (1996): Would be Santos habour dredged material dumping a reason of teratogeny on *Raja agassizi*. In: Congresso Latino-Americano sobre Ciências do Mar Colacmar.

Clark, R. S. (1926): Rays and Skates, a revision of the european species. Fish., Scotl., Scient. Invest., 1, 1–66.

Dawson, C. (1964): A bibliography of anomalies of fishes. Gulf Res. Rep., 1, 308–399.

Dawson, C. (1966): A bibliography of anomalies of fishes. Gulf Res. Rep., 2, 169–176.

Dawson, C. (1971): A bibliography of anomalies of fishes. Gulf Res. Rep., 3, 215–239.

Dawson, C. & E. Heal (1971): A bibliography of anomalies of fishes. Gulf Res. Rep., 3 (suppl.), 215–239.

El Kamel, O., N. Mnasri, M. Boumaïza & C. Capapé (2009a): Atypical abnormality in a common torpedo, *Torpedo torpedo* (Chondrichthyes: Torpedinidae) from the Lagoon of Bizerte (northern Tunisia, central Mediterranean). Cah. Biol. Mar., 50(1), 97–101.

El Kamel, O., N. Mnasri, J. Ben Souissi, M. Boumaïza, M. M. Ben Amor & C. Capapé (2009b): Inventory of elasmobranch species caught in the Lagoon of Bizerte (north-eastern Tunisia, central Mediterranean). Panam JAS, 4(4), 383–412.

El Kamel, O., N. Mnasri, J. Ben Souissi, M. Boumaïza, M. M. Ben Amor & C. Capapé (2009c): Production of elasmobranch species in the Lagoon of Bizerte (northern Tunisia, central Mediterranean). Elasmovisor, 4, 8–11.

Harzallah, A. (2003): Transports de polluants dans la lagune de Bizerte simulé par un modèle de circulation de l'eau. Bull. Inst. Natl. Sci. Tech. Oceanogr. Peche Salammbo, 30, 121–133.

Hemida, F., W. Sergoua & R. Seridji (2007): Analyse des données morphométriques de quelques espèces du genre *Raja* Linnaeus, 1758, dans le bassin algérien. Rapp. P. V. Réun. Comm. Int. Explor. Scient. Mer Médit., 38, pp. 497.

Hoenig, J. M. & A. H. Walsh (1983): Skeletal lesions and deformities in large sharks. J. Wildl. Dis., 19, 27–33.

Jardas, I. & Z. Homen (1977): Nouvelles trouvailles sur les anomalies anatomiques des exemplaires tératologiques des poissons adriatiques. Biljeske-Notes, 34, 1–10.

Kaspiris, P. (1974): Primi riperti di *Mustelus mediterraneus* Quign. Cap. e *Raja polystigma* Reg. (Selachii) nel Mar Jonio (golfo di Patrasso e dintorno). Doriana, 5(218), 1–3.

Lloris, D. & J. Rucabado (1998): Guide FAO d'identification des espèces pour les besoins de la pêche. Guide d'identification des ressources marines vivantes pour le Maroc. FAO, Rome, 263 p.

Mancini, P. L., A. L. Casas & A. F. Amorim (2006): Morphological abnormalities in a blue shark *Prionace glauca* (Chondrichthyes: Carcharhinidae) foetus from southern Brazil. J. Fish Biol., 69, 1881–1884.

Matallanas, J. (1977): Algunas consideraciones sobre *Raja polystigma* Regan 1923 (Rajiformes, Rajidae) de la Mar Catalana. Vie Milieu, 27(1), 101–110.

Mejri, H., J. Ben Souissi, J. Zaouali, A. El Abed, Y. Vergne, O. Guélorget & C. Capapé (2004): On the recent occurrence of elasmobranch species in a perimediterranean lagoon: the Tunis Southern Lagoon (Northern Tunisia). Annales, Ser. Hist. Nat., 14(2), 143–158.

Mnasri, N., M. Boumaïza & C. Capapé (2009): Morpological data, observations and occurrence of a rare skate, *Leucoraja circularis* (Chondrichthyes: Rajidae), off the northern coast of Tunisia (central Mediterranean). PanamJAS, 4(1), 70–78.

Mzoughi, N., F. Hellal, M. Dachraoui, J.-P. Villeneuve, C. Cattini, S. de Mora S. & A. El Abed (2002): Méthodologie de l'extraction des hydrocarbures polycycliques. Application à des sédiments de la lagune de Bizerte (Tunisie). C. R. Geoscience, 334, 893–901.

Oldfield, R. (2005): Biology, husbandry, and reproduction of freshwater stingrays. http://deepblue.lib.umich.edu/index.jsp

Palmer, G. & A. C. Wheeler (1958): Teratological example of an electric ray, *Torpedo nobiliana* Bonaparte. Proc. Zool. Soc. London, 130, 449–454.

Quéro, J. C., P. Porché & J. J. Vayne (2003): Guide des poissons de l'Atlantique européen. Les Guides du naturaliste. Delachaux & Niestlé, Lonay (Switzerland)-Paris, 465 p.

Ribeiro-Prado, C. C., M. C. Oddone, M. M. B. Gonzalez, A. Ferreira de Amorim & C. Capapé (2008): Morphological abnormalities in skates and rays (Chondrichthyes) from off Southeastern Brazil. Arq. Cien. Mar. Fortaleza, 41(2), 21–28.

Rosa, R. S., U. L. Gomès & O. B. G. Gadig (1996): Um caso de teratogeniana raia de água doce *Potamotrygon motoro* (Natterer *in* Müller e Henle, 1841) (Chondrichthyes: Potamotrygonidae). Rev. Nord. Biol., 11(2), 125–132.

Saïdi, B., M. N. Bradaï, S. Marouani, O. Guélorget & C. Capapé (2006): Atypical characteristics in a partial albinos embryo *Carcharhinus plumbeus* (Chondrichthyes: Carcharhinidae) from the Gulf of Gabès. Acta Adriat., 47(2), 167–174.

Smith, M. C. & P. C. Heemstra (1986): Smiths'sea fishes. Springer-Verlag editor, Berlin, Heidelberg, New York, London, Paris, Tokyo, 1047 p.

Thorson, T. B., J. K. Langhammer & M. I. Oetinger (1983): Reproduction and development of the South American freshwater stingrays, *Potamotrygon circularis* and *P. motoro*. Environ. Biol. Fish, 9(1), 3–24.

Tortonese, E. (1956): Fauna d'Italia. Leptocardia, Ciclostomati, Selachii. Calderini, Bologna, 334 p.

Valle, A. (1931): Contributo alla teratologia dei Crostacei e dei Pesci Adriatici. Atti Mus. Civ. Stor. Nat. Trieste, 11(2), 360–363.

Vannucinni, S. (1988): Shark, utilization, marketing and trade. FAO Fisheries Technical Paper, No. 389. FAO, Rome, 470 p.