

First cases of albinism recorded in the marble electric ray *Torpedo marmorata* (Chondrichthyes: Torpedinidae)

Lovrenc LIPEJ¹, Borut MAVRIC¹, Valter ZIZA² and Christian CAPAPÉ³

(¹) Marine Biology Station Piran, National Institute of Biology, Piran, Slovenia.

E-mail: Lovrenc.Lipej@mbss.org

(²) Piran Aquarium, Piran, Slovenia

(³) Laboratoire d'Ichtyologie, case 104, Université Montpellier II, Sciences et Techniques du Languedoc, 34095 Montpellier cedex 5, France

Abstract: Two albinos specimens, one male and one female, of the electric marbled ray *Torpedo marmorata* Risso, 1810 were captured in the Slovenian marine waters, off Piran (northern Adriatic). Both specimens were juvenile, completely unpigmented on both body surfaces, with red eyes, constituting a case of total albinism. These are the first records on albinism observed to date in *T. marmorata*.

Résumé : Premiers cas d'albinisme signalés chez la torpille marbrée *Torpedo marmorata* (Chondrichthyes: Torpedinidae). Deux spécimens albinos, un mâle et une femelle, de la torpille marbrée *Torpedo marmorata* Risso, 1810 ont été capturés dans les eaux marines de Slovénie, devant Piran (Adriatique septentrionale). Les deux spécimens étaient juvéniles et non pigmentés, avec les yeux rouges, constituant un cas d'albinisme total. Ce sont les premiers signalements d'albinisme observés à ce jour chez *T. marmorata*.

Keywords: Chondrichthyes • Torpedinidae • *Torpedo marmorata* • Albinism • Northern Adriatic

Introduction

The marble electric ray *Torpedo marmorata* Risso, 1810 is a typical atlanto-mediterranean species continuously reported in the eastern Atlantic, from Scandinavia (Katttegat, Skagerrak) to Portugal (Quéro et al., 2003), and south Strait of Gibraltar, from Morocco (Lloris &

Rucabado, 1998) to South African waters (Smith & Heemstra, 1986). *Torpedo marmorata* is known throughout the Mediterranean Sea (Quignard & Tomasini, 2000). Additionally, *T. marmorata* was also recorded in peri-mediterranean lagoons (*sensu* Quignard & Zaouali, 1980), such as Thau Lagoon, located in southern France (Paris & Quignard, 1971), Tunis Southern Lagoon (Mejri et al., 2004) and the Lagoon of Bizerte (El Kamel et al., 2009a), both areas in northern Tunisia. *T. marmorata* is distributed in the eastern part of the Adriatic Sea, especially in channels and open sea, while in the western part, the

Reçu le 4 août 2010 ; accepté après révision le 23 février 2011.

Received 4 August 2010; accepted in revised form 23 February 2011.

population was almost extirpated by fishermen (Jardas et al., 2008).

Investigations which were conducted in the Slovenian part of the Adriatic since 1999, in order to establish elasmobranch species monitoring in the area, allow us to capture two albinos *T. marmorata*, constituting the first records known to date for such anomaly in this species. The aim of this paper is to describe both specimens and to comment on albinism in elasmobranchs and especially in torpedinids.

Material and Methods

A male and a female albino specimens were collected at two different catches by professional trawler on 10 and 11 September 2009, respectively, in front of the pipeline of sewage outfall (45°32.050'N-13°31.900'E) at approximately 1.3 km off the city of Piran (Fig. 1). Soon after landing, both specimens were delivered in tanks, in the Piran Aquarium. In the laboratory, they were photographed and measured with a hand meter and a calliper to the nearest millimetre. After the measurements the specimens were released back in the aquarium tanks (Fig. 2).

Guide fields were used to identify both specimens as *T. marmorata*, such as Tortonese (1956), Bini (1967), Cadenat et al. (1978), Fischer et al. (1987), Quéro et al. (2003) and Mejri et al. (2004). Assessment of sexual stage of both specimens was made following observations of other marine areas.

Results and Discussion

Both specimens of *Torpedo marmorata* presented the main following characters: body entirely smooth, disc rather rounded and subcircular, short thick tail, with two dorsal fins almost equal and close together, large dorsal caudal fin, distal end of pelvic fin at level of second dorsal origin, seven papillae like processes around inner edge one tentacle on posterior edge being the largest. The data of biometric measurements are presented in Table 1.

Both specimens were easily identified as *Torpedo marmorata* basing on these morphological characters, although they were uniformly white on the dorsal surface and belly, with red eyes, considered as the main characteristic for total albinos. In Tunisian marine waters (Capapé, 1979) and off Senegalese coast (Capapé et al., 2004), males and females were sexually matured when they reached 290 and 395 mm in total length, respectively, while off the southern Italian coast (Consalvo et al., 2007), they were adult at 251 and 312 mm, respectively. Consequently, the small sizes of the male, 235 mm, and the female, 278 mm, suggest they were still juveniles when caught (Table 1). Additionally, both specimens died in the first days of

July 2010. One specimen is kept in the collection of the Marine Biology Station NIB in Piran.

Dawson (1964, 1966 & 1971) and Dawson & Heal (1971) listed abnormalities in fish species. According to Ribeira-Prado et al. (2008), they concerned morphological deformities or teratological cases, also called 'monstrosities' in ichthyological literature, malformation of genital apparatus (total, semi or pseudo-hermaphroditism) and full or partial albinism. These three cases of abnormalities were more frequently recorded in osteichthyan species than in chondrichthyan ones, probably because the latter present a low economical interest in fisheries, rather considered as by-catch species and mainly discarded at sea by fishermen. So, it was difficult to obtain a significant number of specimens in order to report such abnormalities (Hoenig & Walsh, 1983).

Moreover, chondrichthyan species are qualitatively less represented throughout the world, only 854 species, versus 50,000 osteichthyan species according to Lecointre & Le Guyader (2001) and Compagno (2005), and they represent in terms of catches 0.65 % of total catches in fisheries. Additionally, during the last decades a drastic decline of chondrichthyan species was observed due to both overfishing and to their K-selective characteristics (*sensu* McAuley et al., 2007). Similar patterns were also observed in Adriatic Sea (Jardas et al., 2008).

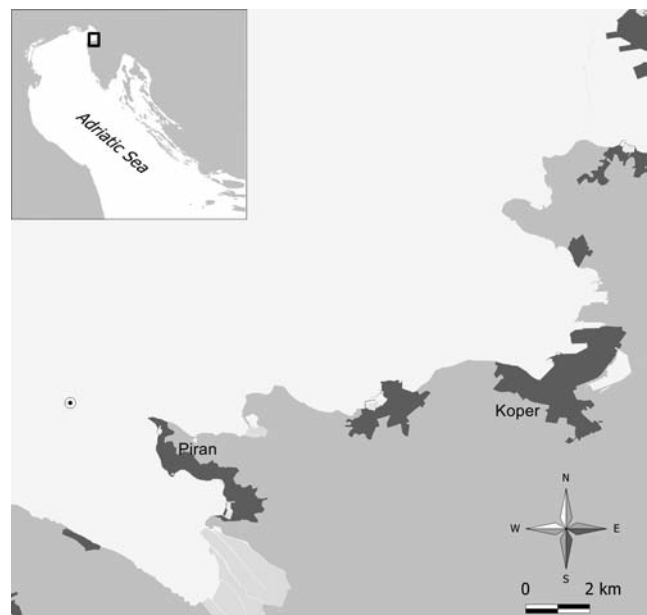


Figure 1. *Torpedo marmorata*. Map of the studied area in the northern Adriatic Sea showing the capture site of the two albino specimens (black circle).

Figure 1. *Torpedo marmorata*. Carte de la région étudiée de la Mer Adriatique septentrionale montrant le site de capture des deux spécimens albinos (cercle noir).

Table 1. *Torpedo marmorata*. Morphometric measurements with percents of total length (% TL) carried out in the two albinos specimens.**Tableau 1.** *Torpedo marmorata*. Mensurations morphométriques et pourcentages de la longueur totale (% TL) chez les deux spécimens albinos.

References	1		2	
	mm	%TL	mm	%TL
Total length	235	100.00	278	100.00
Disk width	150	63.83	185	66.55
Disk length	120	51.06	140	50.36
Snout tip to mouth	24	10.21	29	10.43
Mouth to fifth gill	50	21.28	63	22.66
Snout tip to fifth gill	74	31.49	88	31.65
Fifth gill to anal opening	61	25.96	71	25.54
Snout to anal opening	135	57.45	159	57.19
Tail length	92	39.15	94	33.81
Mouth width	12	5.11	14	5.04
Internasal width	9	3.83	11	3.96
Pelvic fin length	64	27.23	71	25.54
Caudal fin width	34	14.47	34	12.23
Caudal fin anterior edge	40	17.02	44	15.83
Caudal trunk width	6	2.55	7	2.52
Snout tip to eye	17	7.23	19	6.83
Eye length	6	2.55	7	2.52
Spiracle length	3	1.28	4	1.44
Head width	42	17.87	53	19.06
1st gill slit	4.5	1.91	nd	nd
2nd gill slit	5	2.13	nd	nd
3rd gill slit	5.5	2.34	nd	nd
4th gill slit	6	2.55	nd	nd
5th gill slit	4.5	1.91	nd	nd
Width between first gill slit	26	11.06	nd	nd
Width between fifth gill slit	26	11.06	nd	nd
First dorsal length	14	5.96	14	5.04
First dorsal posterior edge	21	8.94	19	6.83
First dorsal anterior edge	14	5.96	15	5.40
Second dorsal length	10	4.26	13	4.68
Second dorsal posterior edge	13	5.53	19	6.83
Second dorsal anterior edge	9.50	4.04	10	3.60
Interdorsal distance	12	5.11	13.50	4.86
Snout tip to first dorsal	165	70.21	200	71.94
Snout tip to second dorsal	187	79.57	222	79.86
Snout tip to pelvic fin	142	60.43	167	60.07
interspiracular with	14	5.96	15.50	5.58
Interorbital width	13	5.53	14.50	5.22
Precaudal length	208	88.51	245.5	88.31
Clasper length	47	20.00	nd	nd

Of the three cases of abnormalities cited in chondrichthyan species, albinism is the less frequently recorded according to Ribeiro-Prado et al. (2008 & 2009) who carried out surveys of abnormalities in chondrichthyan species. Two cases of albinism are considered in chondrichthyan species: total or partial. In total albinism, specimens are completely unpigmented and the eyes are red, while in partial albinism, specimens present a partial

pigmentation and a normal retinal pigmentation. According to Bottaro et al. (2005), this definition is more accurate than leucism applied by Bechtel (1995). On the other hand, Sandoval-Castillo et al. (2006) and Ben Souissi et al. (2007) listed all cases of both total and partial albinism recorded in elasmobranch species. Twenty-four cases were reported in sharks. Additionally, a specimen of whale shark *Rhincodon typus* Smith, 1828 has been observed and documented in the archipelago of Galapagos in 2008 (Shark Research Institute, 2008), while Mnasri et al. (2010a) described recently a first case of partial albinism in the small-spotted catchark *Scyliorhinus canicula* (Linnaeus, 1758) caught of the northern Tunisian coast.

We have listed in Table 2 all cases of total and partial albinism recorded to date in skates and rays in literature by authors, including both cases presented in this paper. Of these 14 records, 4 concerned electric rays (approximately 29% of records observed). However, the electric rays represent 66% of total albinos, so it seems that these species are more concerned than others by such phenomenon. On the other hand, this hypothesis is difficult to confirm due to low number of records. Additionally, in Table 3, all cases of abnormalities reported in electric rays were summarized. Of the 13 cases recorded, 4 (30.7%) concerned albinism.

Formerly, Vilter (1937) noted that the lack of pigmentation represented a disadvantage for sharks and rays, as predators or preys, such phenomenon advertising their presence in biological environment. However, the sizes of observed albino specimens, in this paper, as the great size in other papers (see Ben Souissi et al., 2007), showed that total or partial albinism or more generally aberrant colorations did not compromise normal development of species presenting such phenomenon.

Dingerkus et al. (1991) reported a relative abundance of albino specimens of the Channel catfish *Ictalurus punctatus* (Rafinesque, 1818), placed in tanks containing water polluted by heavy metals. Similar patterns were reported by Oliveira & Foresti (1996) who noted that albinism increased in fish species by exposing eggs to heavy metals. Although, both *T. marmorata* were caught in front of the pipeline of sewage outfall, we are lacking any

Table 2. *Torpedo marmorata*. Cases of partial and total albinism recorded to date in batoid species.**Tableau 2.** *Torpedo marmorata*. Cas d'albinisme partiel ou total signalés à ce jour chez des espèces de batoides.

Record	Family	Species	Albinism	Capture site	Authors
1	Rhinobatidae	<i>Glaucostegus halavi</i>	total	southern Tunisia	Ben Souissi et al. (2007)
2	Narcinidae	<i>Narcine entemedor</i>	total	Baja California Sur, México	Sandoval-Castillo et al. (2006)
3	Torpedinidae	<i>Torpedo marmorata</i>	total	Trieste Gulf, north Adriatic	This study
4	Torpedinidae	<i>Torpedo marmorata</i>	total	Trieste Gulf, north Adriatic	This study
5	Torpedinidae	<i>Torpedo torpedo</i>	total	Lagoon of Bizerte, Tunisia	Ben Brahim et al. (1998)
6	Rajidae	<i>Dipturus batis</i>	partial	Scotland	Wilson (1951)
7	Rajidae	<i>Leucoraja naevus</i>	partial	Scotland	Wilson (1951)
8	Rajidae	<i>Okamejei kenoei</i>	?	?	Ishihara et al. (2001)
9	Rajidae	<i>Raja clavata</i>	partial	Scotland	Traquair (1893)
10	Dasyatidae	<i>Dasyatis americana</i>	partial	California	Schwartz & Safrit (1977)
11	Dasyatidae	<i>Dasyatis pastinaca</i>	partial	Tunisia	Capapé & Pantoustier (1975)
12	Rhinopteridae	<i>Rhinoptera bonasus</i>	partial	Maryland	Schwartz (1959)
13	Rhinopteridae	<i>Rhinoptera bonasus</i>	partial	Chesapeake Bay	Joseph (1961)
14	Myliobatidae	<i>Myliobatis californica</i>	total	California	Jésus-Roldán (1990)

Table 3. *Torpedo marmorata*. Abnormalities recorded to date in different electric ray species.**Tableau 3.** *Torpedo marmorata*. Anomalies signalées à ce jour chez différentes espèces de torpilles.

Record	Species	Case of abnormalities	Marine region	Authors
1	<i>Narcine entemedor</i>	Total albinism	Baja California Sur, México	Sandoval-Castillo et al. (2006)
2	<i>Torpedo marmorata</i>	Pectoral non adherent to head	Adriatic Sea	Valle (1931)
3	<i>Torpedo marmorata</i>	Abnormal hermaphroditism	Coast of Tunisia	Capapé (1974)
4	<i>Torpedo marmorata</i>	Total albinism	Trieste Gulf, north Adriatic	This study
5	<i>Torpedo marmorata</i>	Total albinism	Trieste Gulf, north Adriatic	This study
6	<i>Torpedo marmorata</i>	Pectoral non adherent to head	Adriatic Sea	Jardas & Homen (1977)
7	<i>Torpedo nobiliana</i>	Pectoral non adherent to head	Atlantic Ocean	Palmer & Wheeler (1958)
8	<i>Torpedo torpedo</i>	Abnormal hermaphroditism	Coast of Tunisia	Quignard & Negla (1971)
9	<i>Torpedo torpedo</i>	Supernumerary dorsal fin	Lagoon of Bizerte	Ben Brahim & Capapé (1997)
10	<i>Torpedo torpedo</i>	Total albinism	Lagoon of Bizerte	Ben Brahim et al. (1998)
11	<i>Torpedo torpedo</i>	Abnormal hermaphroditism	Tyrrhenian Sea	Dalù et al. (2003)
12	<i>Torpedo torpedo</i>	Lack of gill-slit	Lagoon of Bizerte	El Kamel et al. (2009b)
13	<i>Torpedo torpedo</i>	Pectoral non adherent to head	Lagoon of Bizerte	Mnasri et al. (2010b)

evidence of the interrelationship between albinism and polluted waters in our area of investigations. Brito & Caramaschi (2005) recorded an albinos catfish *Schizolecis guntheri* (Miranda-Ribeiro, 1918) in a non-polluted habitat. Ben Souissi et al. (2007) noted that despite the waters of Gulf of Gabès are polluted, investigations conducted in the area during four decades allowed to found a single albino specimen, cited in Table 2.

However, the Lagoon of Bizerte located in northern Tunisia is much polluted and this pollution plays a drastic role on animal species (Harzallah, 2003), especially on gastropods (Lahbib et al., 2007). Additionally, since two decades some abnormal common torpedos were recorded in this brackish area (see Table 3), so the role of polluted waters as a cause of abnormalities in elasmobranch species

cannot be totally neglected and may be the base of future research on this unexplored area.

References

- Ben Brahim R. & Capapé C. 1997.** Nageoire dorsale supplémentaire chez une torpille ocellée, *Torpedo (torpedo) torpedo* des eaux tunisiennes (Méditerranée Centrale). *Cybium*, **21**: 223-225.
- Ben Brahim R., Seck A. & Capapé C. 1998.** Albinisme chez une torpille ocellée, *Torpedo (torpedo) torpedo*. *Cybium*, **22**: 83-86.
- Ben Souissi J., Golani D., Mejri H., Ben Salem M. & Capapé C. 2007.** First confirmed record of the Halave's guitarfish, *Rhinobatos halavi* (Forsskål, 1775) (Chondrichthyes: Rhinobatidae) in the Mediterranean Sea with the description of

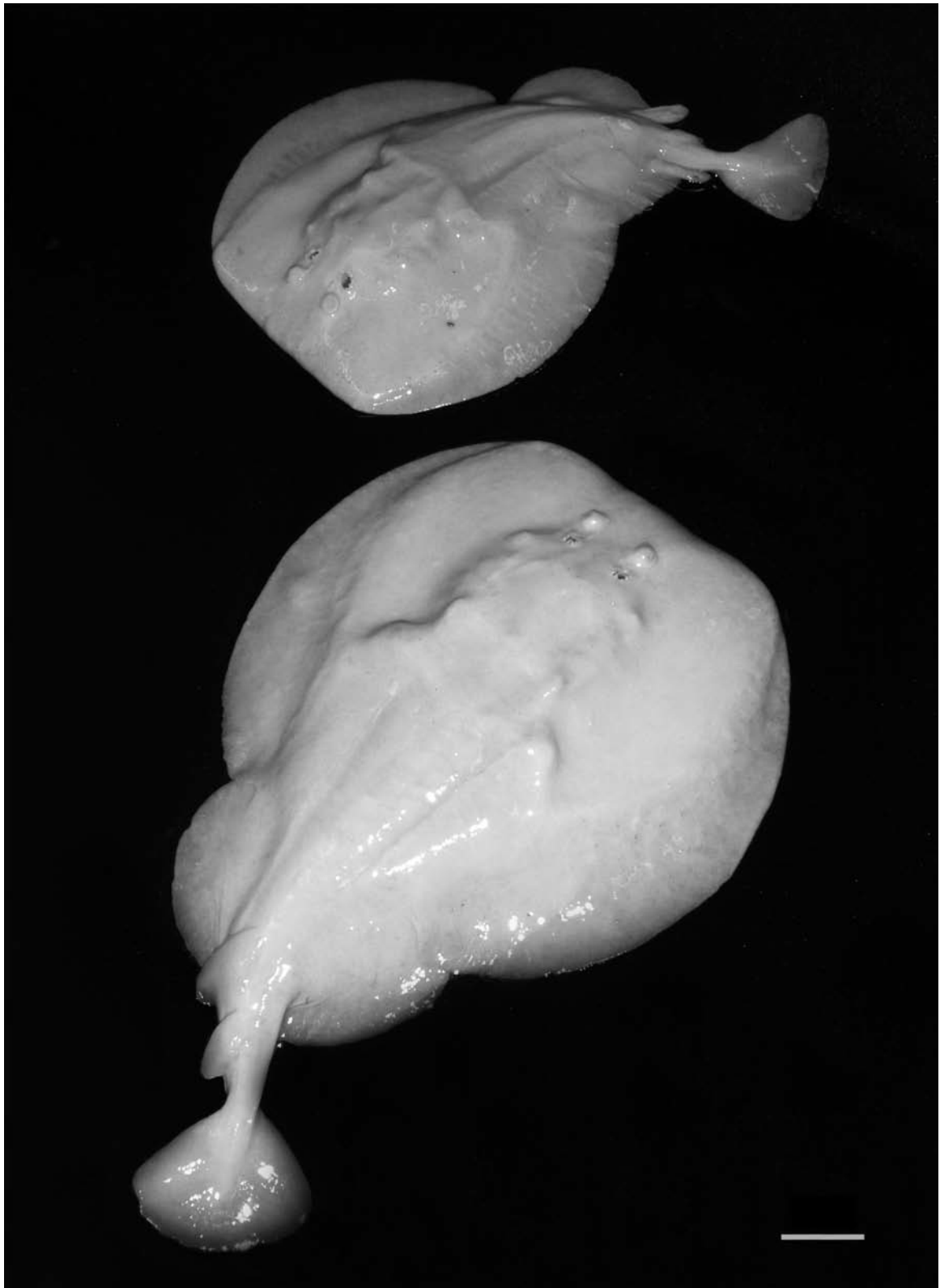


Figure 2. *Torpedo marmorata*. Two albino specimens of the electric marbled ray caught in the Bay of Piran (scale bar = 30 mm). Photo of Borut Mavric.

Figure 2. *Torpedo marmorata*. Deux spécimens albinos de la torpille marbrée capturés dans la Baie de Piran (échelle = 30 mm). Photo de Borut Mavric.

- a case of albinism in elasmobranchs. *Cahiers de Biologie Marine*, **48**: 67-75.
- Bechtel H.B. 1995.** *Reptile and amphibian variants colors, patterns, and scales*. Krieger Publishing Company, Malabar, Florida, 206 pp.
- Bini G. 1967.** *Atlante dei pesci delle coste italiane. Vol. 1. Leptocardi – Ciclostomi – Selaci*. Milano, Edizione Mondo Sommerso, 106 pp.
- Bottaro M., Ferrando S., Gallus L., Giroi L. & Vacchi M. 2005.** First record of albinism in the deep water shark *Dalatias licha*. *JMBA2 - Biodiversity Records*, published online. downloaded on 05 May 2010.
- Brito (de) F.G. & Caramaschi É.P. 2005.** An albino armored catfish *Schizolecis guntheri* (Siluriformes: Locariidae) from an Atlantic Forest coastal basin. *Neotropical Ichthyology*, **3**: 123-125.
- Cadenat J., Capapé C. & Desoutter M. 1978.** Description d'un torpedinidæ nouveau des côtes occidentales d'Afrique *Torpedo (Torpedo) bauchotæ* (Pisces, Torpediniformes). *Cybiurn*, **4**: 29-42.
- Capapé C. 1974.** Anomalie de l'appareil urogénital chez *Torpedo (Torpedo) marmorata* Risso, 1810. *Archives de l'Institut Pasteur de Tunis*, **51**: 321-328.
- Capapé C. 1979.** La torpille marbrée, *Torpedo marmorata* Risso, 1801 (Pisces, Rajiformes) des côtes tunisiennes : nouvelles données sur l'écologie et la biologie de la reproduction de l'espèce avec une comparaison entre les populations méditerranéennes et atlantiques. *Annales des Sciences naturelles, Zoologie, Paris*, 13ème série, **1**: 79-97.
- Capapé C. & Pantoustier G. 1975.** Anomalies chez quelques sélaciens des côtes tunisiennes. *Archives de l'Institut Pasteur de Tunis*, **52**: 251-262.
- Capapé C., Quignard J.-P., Guélorget O., Bradaï M.N., Bouaïn A., Ben Souissi J., Zaouali J. & Hemida F. 2004.** Observations on biometrical parameters in elasmobranch species from the Maghreb shore: a survey. *Annales, Series Historia Naturalis*, **14**: 1-10.
- Compagno L.V.J. 2005.** Check-list of living Chondrichthyes. In: *Reproductive biology and phylogeny of Chondrichthyes. Sharks, Batoids and Chimaeras* (W.C. Hamlett ed), pp. 503-548. Sciences Publishers, Inc.: Enfield.
- Consalvo I., Scacco U., Romanelli M. & Vacchi M. 2007.** Comparative study of the reproductive biology of *Torpedo torpedo* (Linnaeus, 1758) and *T. marmorata* (Risso, 1810) in the Central Mediterranean Sea. *Scientia Marina*, **71**: 213-222.
- Dalù M., Consalvo I., Candi G. & Romanelli M. 2003.** A hermaphrodite specimen of *Torpedo torpedo* (Chondrichthyes, Torpedinidae). *Biologia Marina Mediterranea*, **19**: 792-794.
- Dawson C. 1964.** A bibliography of anomalies of fishes. *Gulf Research Reports*, **1**: 308-399.
- Dawson C. 1966.** A bibliography of anomalies of fishes. *Gulf Research Reports*, **2**: 169-176.
- Dawson C. 1971.** A bibliography of anomalies of fishes. *Gulf Research Reports*, **3**: 215-239.
- Dawson C. & Heal E. 1971.** A bibliography of anomalies of fishes. *Gulf Research Reports*, **5**: 35-41.
- Dingerkus G., Séret B. & Guilbert E. 1991.** The first albino wels *Silurus glanis* Linnaeus, 1758, from France, with a review of albinism in catfishes (Teleostei: Siluriformes). *Cybiurn*, **15**: 185-188.
- El Kamel O., Mnasri N., Ben Souissi J., Boumaïza M., Ben Amor M.M. & Capapé C. 2009a.** Inventory of elasmobranch species caught in the Lagoon of Bizerte (north-eastern Tunisia, central Mediterranean). *Pan-American Journal of Aquatic Sciences*, **4**: 383-412.
- El Kamel O., Mnasri N., Boumaïza M. & Capapé C. 2009b.** Atypical abnormality in a common torpedo, *Torpedo torpedo* (Chondrichthyes: Torpedinidae) from the Lagoon of Bizerte (northern Tunisia, central Mediterranean). *Cahiers de Biologie Marine*, **50**: 97-101.
- Fischer W., Bauchot M.L. & Schneider M. 1987.** Fiches FAO d'identification des espèces pour les besoins de la pêche (Révision 1). Méditerranée et mer Noire. Zone de pêche 37. Vol. I & II FAO, Rome, 1530 pp.
- Harzallah A. 2003.** Transports de polluants dans la lagune de Bizerte simulés par un modèle de circulation de l'eau. *Bulletin de l'Institut national des Sciences et Technologies de la Mer de Salammbô*, **30**: 121-133.
- Hoening J.M. & Walsh A.H. 1983.** Skeletal lesions and deformities in large sharks. *Journal of Wildlife Diseases*, **19**: 27-33.
- Ishihara H., Homma K. & Nakamura R. 2001.** The occurrence of albinism in individuals of the manta ray and Japanese common skate found in the western Pacific. *IOP Diving News*, **12**: 6-20.
- Jardas I. & Homen Z. 1977.** Nouvelles trouvailles sur les anomalies anatomiques des exemplaires tératologiques des poissons adriatiques. *Biljeske-Notes*, **34**: 1-10.
- Jardas I., Pallaoro A., Vrgoc N., Jukic Peladic S. & Dadić V. 2008.** *Red book of sea fishes of Croatia*. Ministry of Culture, State Institute for Nature protection, Republic of Croatia. 396 pp.
- Jésus-Roldán M. de 1990.** An albino bat ray, *Myliobatis californica*, from the Pacific coast of Baja California Sur, Mexico. *California Fish and Game*, **76**: 126-127.
- Joseph E.B. 1961.** An albino cownose ray, *Rhinoptera bonasus*, from Chesapeake Bay. *Copeia*, **4**: 482-483.
- Lahbib Y., Labidli S., Le Pennec M., Flower R. & Trigui El Ménif N. 2007.** Morphological expression and different stages of imposex in *Hexaplex trunculus* (Neogasteropoda: Muricidae) from Tunisian coasts. *Cahiers de Biologie marine*, **48**: 315-328.
- Lecointre G. & Le Guyader H. 2001.** *Classification phylogénétique du vivant*. Paris, Belin, 559 pp.
- Lloris D. & Rucabado J. 1998.** *Guide FAO d'identification des espèces pour les besoins de la pêche. Guide d'identification des ressources marines vivantes pour le Maroc*. Rome. FAO, 263 pp.
- McAuley R.B., Simpfendorfer C.A., Hyndes G.A. & Lenanton R.C.J. 2007.** Distribution and reproductive biology of the sandbar shark, *Carcharhinus plumbeus* (Nardo), in Western Australian waters. *Marine and Freshwater Research*, **58**: 116-126.
- Mejri H., Ben Souissi J., Zaouali J., El Abed A., Guélorget O. & Capapé C. 2004.** On the recent occurrence of elasmobranch species in a perimediterranean lagoon: the Tunis Southern Lagoon (Northern Tunisia). *Annales, séries Historia Naturalis*,

- 14: 143-158.
- Mnasri N., El Kamel O., Boumaïza M. & Capapé C. 2010a.** Atypical coloration in small-spotted catshark *Scyliorhinus canicula* (Chondrichthyes: Scyliorhinidae) caught off northern Tunisian coast (central Mediterranean). *Annales, séries Historia naturalis*, **20**:47-52.
- Mnasri N., El Kamel O., Boumaïza M., Ben Amor M.M., Reynaud C. & Capapé C. 2010b.** Morphological abnormalities in two batoid species (Chondrichthyes) from northern Tunisian waters (central Mediterranean). *Annales, séries Historia naturalis*, **20**: 181-190.
- Oliveira C. & Foresti F. 1996.** Albinism in the banded knifefish *Gymnotus carapo*. *Tropical Fish Hobbyist*, **44**: 92-96.
- Palmer G. & Wheeler A.C. 1958.** Teratological example of an electric ray, *Torpedo nobiliana* Bonaparte. *Proceedings of the Zoological Society of London*, **130**: 449-454.
- Paris J. & Quignard J.-P. 1971.** La faune ichtyologique des étangs languedociens de Sète à Carnon (écologie, éthologie). *Vie et Milieu*, **22** (supplément): 301-327.
- Quéro J.C., Porché P. & Vayne J.J. 2003.** *Guide des poissons de l'Atlantique européen. Les Guides du naturaliste*. Lonay (Switzerland)-Paris. Delachaux & Niestlé, 465 pp.
- Quignard J.-P. & Negla N. 1971.** Anomalies au niveau du système génital chez les sélaciens rajiformes. *Travaux du Laboratoire de Biologie Halieutique de l'Université de Rennes*, **5**: 121-124.
- Quignard J.-P. & Tomasini J.A. 2000.** Mediterranean fish biodiversity. *Biologia Marina Mediterranea*, **7**: 1-66.
- Quignard J.-P. & Zaouali J. 1980.** Les lagunes péri-méditerranéennes. Bibliographie ichtyologique annotée. Première partie: les étangs français de Canet à Thau. *Bulletin de l'Office national des Pêches de Tunisie*, **4**: 293-360.
- Ribeiro-Prado C.C., Oddone M.C., Bueno Gonzalez M.M., Ferreira de Amorim A. & Capapé C. 2008.** Morphological abnormalities in Skates and Rays (Chondrichthyes) from off Southeastern Brazil. *Arquivos de Ciencias do Mar, Fortaleza*, **41**: 21-28.
- Ribeiro-Prado C.C., Oddone M.C., Ferreira de Amorim A. & Capapé C. 2009.** An abnormal hermaphrodite pelagic stingray *Pteroplatytrygon violacea* (Dasyatidae) captured off southern coast of Brazil. *Cahiers de Biologie Marine*, **50**: 91-96.
- Sandoval-Castillo J., Mariano-Melendez E. & Villavicencio-Garayzar C. 2006.** New records of albinism in two elasmobranchs: the tiger shark *Galeocerdo cuvier* and the giant electric ray *Narcine entemedor*. *Cybium*, **30**: 191-192
- Schwartz F.J. 1959.** White cownose ray, *Rhinoptera bonasus*, from Tangier Sound. *Maryland Tidewater News*, **15**: 12.
- Schwartz F.J. & Safrit Jr G.W. 1977.** A white southern stingray, *Dasyatis americana* (Pisces, Dasyatidae), from Pamlico Sound, North Carolina. *Chesapeake Science*, **18**: 83-84.
- Shark Research Institute 2008.** Albino Whale shark. *Shark Research Institute Newsletter*, **17**: 2.
- Smith M.C. & Heemstra P.C. 1986.** *Smiths' sea fishes*. Springer-Verlag: Berlin. 1047 pp.
- Tortonese E. 1956.** *Fauna d'Italia. Vol.II. Leptocardia, Ciclostomata, Selachii*. Calderini: Bologna. 334 pp.
- Traquair R.H. 1893.** An unusually coloured example of the thornback, (*Raja clavata*, Linn.). *Annales of Scottish Natural History*, **25**, Plate 1..
- Valle A. 1931.** Contributo alla teratologia dei crostacei e dei pesci adriatici. *Atti del Museo civico di Storia naturale di Trieste*, **14**: 112-113.
- Vilter V. 1937.** Recherches histologiques et physiologiques sur la fonction pigmentaire des sélaciens. *Bulletin de la Station biologique d'Arcachon*, **34**: 1-136.
- Wilson E. 1951.** Colour deficiency in skate (Rajidae). *Proceedings of the Zoological Society of London*, **121**: 557- 559.