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MORPHOLOGICAL DEFORMITIES IN A STRIPED SEA BREAM *LITHOGNATHUS MORMYRUS* (OSTEICHTHYES: SPARIDAE) FROM NORTHERN TUNISIAN WATERS (CENTRAL MEDITERRANEAN SEA)

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ABSTRACT

Abnormalities of the lateral line and the vertebral column are described in a specimen of striped sea bream Lithognathus mormyrus *(Linnaeus, 1758) collected from the northern coast of Tunisia. Despite these deformities, the specimen was able to live in the wild together with normal specimens. The origin of these abnormalities are commented and discussed.*

Key words: *Lithognathus mormyrus*, hyperkyphosis, lordosis, environmental pollution, length-weight relationship

DEFORMAZIONI MORFOLOGICHE IN UNA MORMORA, *LITHOGNATHUS MORMYRUS* (OSTEICHTHYES: SPARIDAE), IN ACQUE DELLA TUNISIA SETTENTRIONALE (MEDITERRANEO CENTRALE)

SINTESI

L'articolo riporta anomalie della linea laterale e della colonna vertebrale in un esemplare di mormora, Lithognathus mormyrus *(Linnaeus, 1758), proveniente dalle acque al largo della costa settentrionale della Tunisia. Nonostante queste deformità, l'esemplare è stato in grado di vivere allo stato libero insieme ad individui normali. Gli autori commentano e discutono l'origine di queste anomalie.*

Parole chiave: *Lithognathus mormyrus,* ipercifosi, lordosi, inquinamento ambientale, relazione lunghezza-peso

INTRODUCTION

The striped sea bream *Lithognathus mormyrus* (Linnaeus, 1758) is a sparid species inhabiting shallow coastal waters of the eastern Atlantic from the Bay of Biscay to South Africa, and from the south-western areas of the Indian Ocean to the Red Sea (Bauchot & Hureau, 1986). *L. mormyrus* occurs throughout the Mediterranean Sea, where it is abundantly captured by anglers for local consumption especially in the Strait of Sicily (Vitale *et al*., 2011). Additionally, the species has been recently found in the Black Sea (Aydin, 2018). It lives on sandy and rocky bottoms partially covered by seagrass and algae, to a maximum depth of 80 m (Bauchot & Hureau, 1986), and feeds on crustaceans, small teleosts and molluscs (Chessa *et al*., 2005).

L. mormyrus is one of the 21 sparid species, all having economic importance, that are commonly caught throughout the Tunisian coast. Populations of this species can also be found in brackish areas, such as Bahiret el Bibane, in the southern region, and the Lagoon of Bizerte, in the northern region, where they live and reproduce (Hammami *et al*., 2013). Additionally, the species is rather abundant in southern Tunisia, where it is targeted by fishermen, as its flesh is appreciated by the local population (Bradaï, 2000). During investigations conducted in the northern Tunisian area since 2006, focusing primarily on elasmobranch species (El Kamel *et al.,* 2009a, b) and then on all fish species (Rafrafi-Nouira, 2016), several *L. mormyrus* have been collected, among them a specimen displaying morphological deformities. Comprehensive published scientific references of recorded abnormalities in teleost species do not report any case in *L. mormyrus* (see Dawson, 1964, 1966, 1971; Dawson & Heal 1971; Jawad & Hosie, 2007; Jawad *et al.*, 2010; Jawad & Ibrahim, 2018). The aim of this note is to describe this abnormal specimen and comment on similar abnormalities previously observed in teleost species.

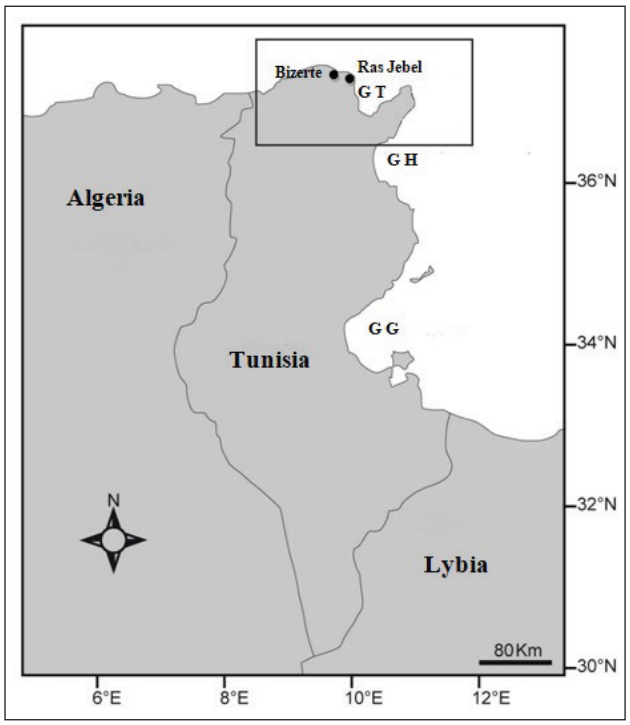

Fig. 1: Map of Tunisia indicating the capture area (rectangle) of** Lithognathus mormyrus **from the northern Tunisian coast. GT, Gulf of Tunis; GH, Gulf of Hammamet; GG, Gulf of Gabès.
Sl. 1: Zemljevid Tunizije z označenim predelom (pravokotnik), kjer je bil ujet primerek ovčice na severni obali. Legenda: GT, Tuniški zaliv; GH, Hamameški zaliv; GG, Gabeški zaliv.

MATERIAL AND METHODS

A total of 32 specimens of *L. mormyrus* were collected during years 2013 and 2014, off Ras Jebel, located on the northern Tunisian coast, among them a specimen found on 23 June 2014 presenting abnormalities on the body. All specimens were caught by commercial gillnet with a stretched mesh size of 26 mm, at 37° 14′ 57.53″ N and 10°11′ 52. 85″ E, on sandy bottom, together with other sparid and labrid species (Fig. 1).

The fresh specimens were measured for total length (TL) recorded to the nearest centimetre and weighed for total body weight (TBW) to the nearest gram. Morphometric measurements and meristic counts followed Bauchot & Hureau (1986) and Aydin (2018); they were recorded in the abnormal specimen and compared with those recorded in 2 of the normal specimens (see Tab. 1). The 3 specimens were fixed in 10% buffered formalin, preserved in 75 % formaldehyde and deposited in the Ichthyological Collection of the Institut Superieur de Pêche et d'Aquaculture de Bizerte (Tunisia), under catalogue numbers ISPAB-Lith mor 01 for the abnormal specimen, and ISPAB-Lith mor 02 ISPAB-Lith mor 03, for the 2 normal specimens, respectively. The abnormalities of the vertebral column, such as scoliosis (lateral curvature), lordosis (ventral curvature), kyphosis (dorsal curvature) and ankylosis (fusion of vertebrae), reported in many species, cultured and from the wild, were described following the Elie & Girard (2014) and Jawad & Ibrahim (2018) definitions. Additionally, three regions were taken into consideration, partially following Louiz *et al.* (2007): the anterior or cephalic region, the intermediate or abdominal region and the terminal or caudal region.

A *t*-test was performed to point out the differences in the number of line scales and vertebrae between the abnormal *L. mormyrus* and 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), including all specimens, normal and

Tab. 1: Morphometric measurements in millimeters (mm), with percentages of standard length (% SL), meristic counts and total body weight in grams (g), recorded in an abnormal and 2 normal specimens of *Lithognathus mormyrus* ***from northern Tunisian waters.***
Tab. 1: Morfometrične meritve v milimetrih (mm), z odstotki standardne dolžine (% SL), merističnim štetjem in skupno telesno maso v gramih (g), zabeležene v neobičajnem in dveh normalnih primerkih vrste *Lithognathus mormyrus* ***iz severno tunizijskih voda.***

References	**ISPAB-Lit-mor01**		**ISPAB-Lit-mor02**		**ISPAB-Lit-mor03**	
Condition	Abnormal		Normal		Normal	
Morphometric measurements	mm	%SL	mm	%SL	mm	%SL
Total length	168	124.4	160	125.0	163	125.4
Fork length	149	110.4	142	110.9	144	110.4
Standard length	135	100.0	128	100.0	130	100.0
Head length	47	35.1	44	34.3	43	33.1
Eye diameter	10	7.5	11	8.3	10	7.7
Pre-orbitary length	20	14.7	19	14.5	17	13.2
Post-orbitary length	19	13.7	17	13.6	17	13.4
Dorsal fin length	68	50.5	61	47.6	61	47.2
Pectoral fin length	8	5.9	6	4.6	7	5.3
Pelvic fin length	11	8.2	9	6.9	9	7.0
Anal fin length	29	21.4	23	18.1	22	17.2
Caudal fin length	15	11.3	14	11.3	14	10.5
Snout length	18	13.2	18	13.7	17	12.8
Body height	53	39.5	40	31.1	40	31.0
Pre-dorsal fin length	56	41.8	53	41.2	53	41.0
Pre-pectoral fin length	47	34.7	43	33.4	43	33.2
Pre-pelvic fin length	51	37.4	51	39.5	49	37.8
Pre-anal fin length	89	65.8	87	67.9	88	67.9
Length of the largest spine of the pectoral fin	34	25.3	30	23.5	30	23.4
Thickness	23	17.2	19	14.7	19	14.9
Meristic counts						
Lateral line scales	68		60		60	
Total number of vertebrae	27		24		24	
Dorsal fin rays	XI+12		XI+12		XIII+10	
Pectoral fin rays	14		13		13	
Pelvic fin rays	II+10		II+10		II+10	
Anal fin rays	III+10		III+10		III+10	
Caudal fin rays	19		20		20	
Total body weight (g)	68.6		48.3		48.4	

abnormal, to show if this latter was able to develop in the wild like other normal specimens. This LWR is TBW = aTL^b, and was converted into its linear regression, expressed in decimal logarithmic coordinates, correlations were assessed by least-squares regression as log TBW = log a + b log TL. The 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). These two latter tests were performed by using the logistic model STAT VIEW 5.0.

Fig. 2: *Lithognathus mormyrus* ***specimens from the northern Tunisian coast. A: Abnormal specimen. B: Normal specimen, scale bar = 40 mm.***
Sl. 2: Primerki ovčice iz severne tunizijske obale. A: Deformirani primerek. B: normalni primerek, merilo = 40 mm.

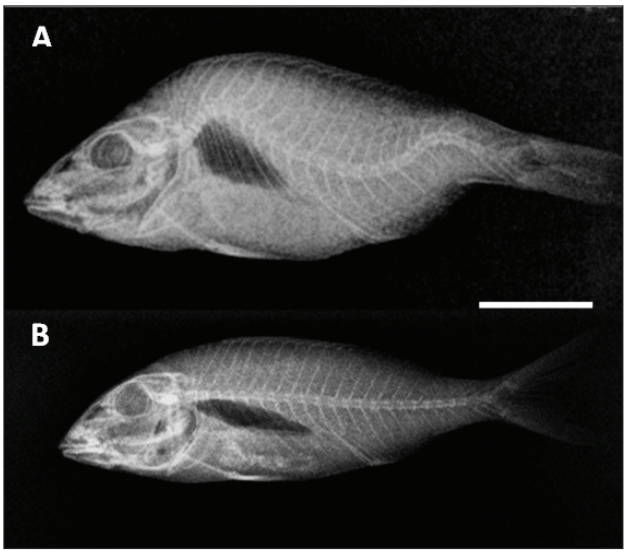

Fig. 3: An X-ray photograph of *Lithognathus mormyrus* ***from the northern Tunisian coast. A: Abnormal specimen. B: Normal specimen, scale bar = 30 mm.***
Sl. 3: Rentgenski posnetek ovčice iz severne tunizijske obale. A: Deformirani primerek. B: Normalni primerek, merilo = 30 mm.

RESULTS AND DISCUSSION

All collected specimens were identified as *L. mormyrus* following the combination of main morphological characters from Bauchot & Hureau (1986) and Engin *et al.* (2015), such as: body elongated, ovoid and compressed, snout elongate and pointed, posterior nostril an oblique slit, in front the of eyes, scales on check and opercle, preopercle broad, scaleless, livery with a fundamental silver-grey colouration, more or less dark, broken by a dozen of blackish or grey vertical lines. The abnormal specimen exhibited an upper margin developed and arched, forming a hump, and the upper profile of the head was strongly curved, the lateral obviously sinuous, while it was only slightly curved in the normal specimens, mainly in the caudal region (Fig. 2).

On an X-ray photograph, the abnormal specimen appeared to display three visible deformities. At the level of cephalic and caudal regions, the vertebral column was strongly arched, forming hyperkyphosis. The abdominal region displayed lordosis with a somewhat smaller arch than the other two deformities (Fig. 3). No scoliosis was observed in the abnormal specimen. The number of lateral line scales in the abnormal specimen was 68, significantly outnumbering those of the normal specimens, 60 (*t*-test = 16, df = 1, p = 0.03). Following Bauchot & Hureau (1986) the normal range is from 59 to 65. Similarly, the number of vertebrae in the abnormal specimen, 27, significantly outnumbered those of the normal specimens, 24, (*t*-test = 17, df = 1, p = 0.03). Such increased numbers are probably due to the curves of the lateral line and the deformities of the vertebral column. This also means that the vertebrae were not fused and the specimen did not display any signs of ankylosis.

Lateral line deformation is the main consequence of vertebral column malformation, as observed in the present specimen exhibiting hyperkyphosis. Similar patterns were reported by Jardas & Homen (1977) in the whiting *Merlangius merlangus* (Linnaeus, 1758) and the bogue *Boops boops* (Linnaeus, 1758). The same authors considered such anomalies not to be that rare in teleost species from the Adriatic, and suggested that parasitic infection could also be the cause of skeletal deformations.

Jawad *et al.* (2010) noted that anomaly in fins could hinder the performance of the specimen, especially affecting its capacity to obtain food and avoid predators. In the case presented herein, the deformities observed did not affect the life of the abnormal specimen in the wild, it functioned as well as other normal specimens from the same size class, as shown by the relation between total length *versus* total body weight (TM, in g) plotted in Fig. 4, with: log TBW = 3.150 * log TL +5.161; r = 0.973, n = 32, displaying a positive allometry. Similar patterns were observed by Khenfech *et al.* (2011) in the annular sea bream *Diplodus annularis* (Linnaeus, 1758). Conversely, Matsuoaka (1987) and Boglione *et al.* (2006) noted a

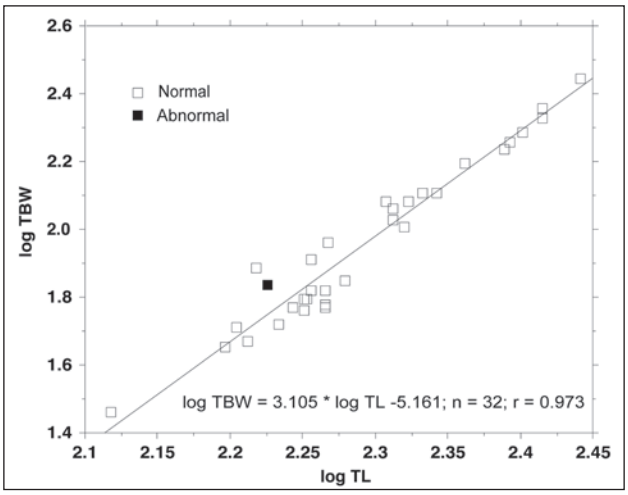

Fig. 4: The relation between total length (TL) and total body weight (TBM) in specimens of *Lithognathus mormyrus* ***from the northern Tunisian coast.***
Sl. 4: Odnos med totalno dolžino telesa (TL) in telesno težo (TBM) pri primerkih ovčice iz severne obale Tunizije.

lethal effect caused by severe skeletal deformities in teleost species living in natural conditions.

Abnormalities in fish species occur during the early stages of development and could have a genetic origin. A mechanical origin cannot be totally ruled out either. For instance, when specimens entangled in gillnets successfully escape, they can suffer morphological deformations and distortions of the normal vertebral shape, essentially a remodelling of the vertebral column, as a consequence of extrinsic forces (Jawad & Ibrahim, 2018). On the other hand, these deformities could constitute an important indicator of adverse environmental conditions and pollutants, and stress in the wild induced in other ways (Sfakianakis *et al.*, 2004). Several cases of abnormalities were described among the animal species collected in the Lagoon of Bizerte, a restricted brackish area polluted by both inorganic and organic nutriments and heavy metals (Mzoughi *et al.*, 2002).

The global warming of marine waters in the various seas throughout the world could also play a role in skeletal deformities (Jawad & Ibrahim, 2018). The entire Mediterranean has been facing this major problem for several decades (Francour *et al.*, 1994), including the Tunisian coast with the spread of alien species incoming from the Red Sea through the Suez Canal and/or from the eastern tropical Atlantic through the Strait of Gibraltar (Ounifi-Ben Amor *et al.*, 2016). The northern coast of Tunisia is progressively invaded by such species and cases of abnormalities in fish are more frequent than previously recorded in the area (Rafrafi-Nouira, 2016). However, thorough investigations are needed and should be conducted together with environmental monitoring to locally delineate the role of temperature in deformities among fish species.

MORFIOLOŠKE DEFORMACIJE PRI OVČICI *LITHOGNATHUS MORMYRUS* (OSTEICHTHYES: SPARIDAE) IZ SEVERNO TUNIZIJSKIH VOD (OSREDNJE SREDOZEMSKO MORJE)

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POVZETEK

Avtorji opisujejo anomalije v pobočnici in na hrbtenici, opažene na primerku ovčice Lithognathus mormyrus *(Linnaeus, 1758), ujete ob severni obali Tunizije. Kljub tem deformacijam je primerek uspel živeti v naravi skupaj z drugimi, normalnimi primerki. Avtorji nadalje razpravljajo o izvoru teh anomalij.*

Ključne besede: *Lithognathus mormyrus*, hiperkifoza, lordoza, onesnaževanje okolja, odnos med dolžino in težo

REFERENCES

Aydin, M. (2018): The new maximum length of the striped sea bream (*Lithognathus mormyrus* L., 1758) in the Black Sea region. Aquat. Sci. Eng, 32(2), 50-52.

Boglione, C., C. Costa, M. Giganti, M. Cecchenetti, P. Di Dato, M. Scardi & S. Cataudella (2006): Biological monitoring of wild thicklip grey mullet (*Chelon labrosus*), golden grey mullet (*Liza aurata*) and fathead mullet (*Mugil cephalus*) (Pisces: Mugilidae) from different Adriatic sites: meristic counts and skeletal anomalies. Ecol. Indic., 6, 712-732.

Bradaï, M.N. (2000): Diversité du peuplement ichtyque et contribution à la connaissance des sparidés du golfe de Gabès. PhD Thesis, University of Sfax (Tunisia), 600 pp.

Bauchot, M.-L. & C. Hureau (1986): Sparidae. In: J.P. Whitehead, M.L. Bauchot, J.C. Hureau, J. Nielsen and E. Tortonese. (Editors.), Fishes of the North-western Atlantic and the Mediterranean. Vol. II, UNESCO, Paris, pp. 883-907. Paris: UNESCO.

Chessa, L.A., P. Lanera, A. Pais, N. Plastina, M. Scardi, S. Serra, M.L. Valiante & D. Vinci (2005): Aspetti del regime alimentare di *Lithognathus mormyrus* (Linnaeus, 1758) nello stagno di calich (Sardegna Nord Occidentale). Biol. Mar. Medit., 12, 492-495.

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. & F. Heal (1971): A bibliography of anomalies of fishes. Gulf Res. Rep., suppl. 3, 215-239.

Elie, P. & P. Girard (2014): L'état de santé des poisons sauvages: les codes pathologie, un outil d'évaluation. Editions Association Santé Poissons Sauvages, Montpellier, France, 286 pp.

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

El Kamel, O., N. Mnasri, M. Boumaïza & C. Capapé (2009b): 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.

Engin S., K. Arif Can., A. Tolga & S. Dilruba (2015): Occurrence and new geographical record of striped seabream *Lithognathus mormyrus*(Linnaeus, 1758) in the Turkish coast of Black Sea. Turk. J. Aquatic Sci. Fish., 15(4), 937-940.

Francour, P., C.F. Boudouresque, J.G. Harmelin., M.L Harmelin-Vivien. & J.-P. Quignard (1994): Are the Mediterranean waters becoming warmer? Mar. Poll. Bull., 28(9), 523-526.

Froese, R., A.C. Tsikliras & K.I. Stergiou (2011): Editorial note on weight-length relations of fishes. Acta Ichthyol. Piscat., 41(3), 261-263.

Hammami, I., L. Bahri-Sfar, M. Kaoueche, G. Grenouillet, S. Lek, M. Kara & O.K. Ben Hassine (2013): Morphological characterization of striped seabream (*Lithognathus mormyrus*, Sparidae) in some Mediterranean lagoons. Cybium, 37(1-2), 127-139.

Jardas, I. & Z. Homen (1977): Nouvelles trouvailles sur les anomalies anatomiques des poissons adriatiques. Biljeskes-notes, 34, 1-10.

Jawad, L.A. & A. Hosie (2007): On the record of pug-headedness in snapper, *Pagrus auratus* (Forster 1801) (Perciformes, Sparidae) from New Zealand. Acta Adriat., 48(2), 205-210.

Jawad, L.A., S. T. Ahyong, & A. Hosie (2006-2007): Malformation of the lateral line and ambicolouration in the triplefin *Grahamina capito* (Jenyns 1842) (Pisces: Tripterygiidae) from New Zealand. Ann. Mus. Civ. Sto. Nat. Ferrara, 9-10, 89-97.

Jawad, L.A., Z. Sadighzadeh & T. Valinassab (2010): Malformation of the caudal fin in the freshwater mullet, *Liza abu* (Actinopterygii: Mugilidae) collected from Karkhe River, Iran. An. Biol., 32, 11-14.

Jawad, L.A. & M. Ibrahim (2018): Environmental oil pollution: a possible cause for the incidence of ankylosis, kyphosis, lordosis and scoliosis in five fish species collected from the vicinity of Jubail City, Saudi Arabia, Arabian Gulf. Int. J. Environ. Stud., 75(3), 425-442.

Khenfech, N.E.H., M. Boumaïza, C. Reynaud & C. Capapé (2011): Morphological abnormalities in the annular sea bream *Diplodus annularis* (Osteichthyes: Sparidae) from the Lagoon of Bizerte (northeastern Tunisia, central Mediterranean). Annales, Series Historia Naturalis, 21(2), 161-166.

Louiz, I., D. Menif, M. Ben Attia & O.M. Ben Hassine (2007): Incidence des déformations squelettiques chez trois espèces de Gobiidae de la lagune de Bizerte (Tunisie). Cybium, 31(2), 199-206.

Matsuoaka, M. (1987): Development of skeletal tissue and skeletal muscle in the Red Sea bream, *Pagrus major*. Bull. Seikai Reg. Fish. Res. Lab., 65, 1-102.

Mzoughi, N., F. Hellal, M. Dachraoui, J.-P. Villeneuve, C. Cattini, S. de Mora. & A. El Abed (2002): Méthodologie de l'extraction des hydrocarbures polycycliques. Application à des sédiments de la lagune de Bizerte (Tunisie). Comptes-Rend. Geosci., 893-101.

Ounifi-Ben Amor, K., M. Rifi, R. Ghanem, I. Draeif, J. Zaouali & J. Ben Souissi (2016): Update of alien fauna and new records from Tunisian marine waters. Medit. Mar. Sci., 17(1), 124-143.

Pauly, D. (1983): Some simple methods for assessment of tropical fishes. FAO Fish. Tech. Papers, 234, 3-10.

Rafrafi-Nouira, S. (2016): Catalogue raisonné des espèces de poissons capturées devant Ras Jebel et autres régions marines de Tunisie septentrionale: aspects morphologiques, biométriques et bio-écologiques. Thesis, Faculty of Sciences of Bizerte, University of Carthage (Tunisia), 509 pp.

Sfakianakis, D.G., G. Koumoundouros, P. Divanach & M. Kentouri (2004): Osteological development of the vertebral column and of the fins in *Pagellus erythrinus* (L. 1758). Temperature effects on the development plasticity and morphoanatomical abnormalities. Aquacult., 232, 407-424.

Vitale, S., A. Arkhipkin, L. Cannizzaro & M. Scalisi (2011): Life history traits of the striped seabream *Lithognathus mormyrus* (Pisces, Sparidae) from two costal fishing grounds in the Strait of Sicily. J. Appl. Ichthyol., 27(4), 1086-1094.