Turkish Journal of Zoology
http://journals.tubitak.gov.tr/zoology/
Short Communication
Turk J Zool
(2020) 44: 538-541
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doi:10.3906/zoo-2005-47

The occurrence of xanthochroism in the thinlip grey mullet, *Chelon ramada* (Teleostei: Mugilidae), from the Aegean Sea

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Received: 27.05.2020 • **Accepted/Published Online:** 23.09.2020 • **Final Version:** 20.11.2020

Abstract: In this study, the first case of aberrant coloration, namely xanthochroism or xanthism, in the thinlip grey mullet, *Chelon ramada* (Teleostei: Mugilidae), was reported. The specimen was caught by a purse seiner in November 2019, in İzmir Bay, in the Aegean Sea, and was a female, with mature ovaries, which indicated that it had been in spawning migration or activity on the sampling date.

Keywords: Xanthism, aberrant coloration, Mugilidae, *Chelon ramada*, İzmir Bay

Like other living forms, fish have evolved to gain a perfect phenotype to survive as long as life permits. One of the main phenotypical characters of a fish is surely its coloration pattern, which is a result of the density and distribution of its pigment cells, known as chromatophores. To date, 6types of chromatophores have been determined in fish, comprising melanophores (brown/black), xanthophores (yellow), erythrophores (red), cyanophores (blue), iridophores (iridescence), and leucophores (white). They originated from the neural crest and are located in the integument, eye, and internal organs (Fujii, 2000; Mills and Patterson, 2009). In any given development stage, a stage of cellular, genetic, and physiological factors work together in a complex process for skin color in fish (Colihueque, 2010). While ontogenetic changes in fish coloration are usual, fish can also undergo morphological and physiological color changes under specific circumstances, such as camouflage and reproduction (Sköld et al., 2016).

In addition to all the inevitable color differentiations in the life of a fish, some individuals that belong to a species in an area or a population could have more unpredictable colors than others. These color anomalies in fish are seen as albinism, partial albinism, xanthochroism, melanism and leucism; however, in most cases, especially in wild populations, their causes are unclear. They may stem from skin pathologies, diet, hormonal imbalances, interspecific hybrids, and particularly, from nonlethal genetic mutations (Quigley et al., 2017).

Xanthochroism or xanthism is described as the clear yellow-orange appearance of a species as the result of the high xanthophore density in the skin and the lack of the melanophores to hide them. In fish, the species in some families, commonly living in tropical reefs, exhibit this coloration pattern for either part or all of their life, and similar to the male haplochromic cichlids of the African Great Lakes, in particular, under conditions such as reproduction (Salzburger et al., 2007; Marshall et al., 2018).

In this study, xanthochroism was reported for thinlip grey mullet, *Chelon ramada* (Risso, 1827), from İzmir Bay, in the Aegean Sea, and because no similar case been reported for the species in its native distribution area, this comprises the first such report.

The grey mullet (Mugilidae) is an economically important fish species living in coastal marine, brackish, and freshwater ecosystems, some of which are catadromous. A total of 9 Mugilidae species have been found in the seas, estuaries, and inland waters of Turkey (Turan et al., 2011). Of these, the thin lip grey mullet, *C. ramada*, is distributed along the Atlantic coasts, from Cape Verde and Senegal in the southern and to the British Isles, North Sea, and southern part of Baltic Sea in the northern. Moreover, this Atlanto-Mediterranean species inhabits the Mediterranean, Marmara, and Black seas (Ben-Tuvia, 1986; Bilecenoğlu et al., 2014).

A specimen of xanthochroic *C. ramada* was found in a commercial purse seine operation conducted by F/V AFALA in İzmir Bay, at 38°32′52.0″N, 26°43′20.0″E, on November 25th, 2019. It was the only specimen in the whole catch, which comprised approximately 43,600 kg of thin lip grey mullet, to exhibit this remarkable color

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anomaly. The specimen was identified according to the classification of Šoljan (1963) and Thomson (1981), wherein *C. ramada* differs from other grey mullets by the following characteristics: head large, slightly depressed and pointed anteriorly, upper lip is narrower than the eye diameter in height, short and slightly rounded pectoral fins do not reach the eyes when turned back and propped to the head, and scales on the head reach the nostrils and the adipose tissue around the eyes are not covered by the pupil. Apart from the distinctive morphological features, the number and size of pyloric caecum are significant anatomical references for the Mediterranean grey mullets. From this description, the 7 approximately equal-sized pyloric caeca of the xanthochroic specimen confirmed the species identification again. The only difference in the specimen from its conspecifics was the yellowish skin color, related to the xanthochroism. For instance, a black spot at the base of the pectoral fins is generally used for the identification of *C. ramada*, but due to the lack of melanophores on the skin of the specimen, this character could not be seen. The lateral black/grey stripes were seen as yellowish to olive green. The back and the top of the head were mustard yellow, and towards the flanks, the color became lighter. The paired and single fins were darker than the body and seen as orange-red. Only the pupil was black, as in typical individuals (Figure 1). By contrast, the morphological color differentiation was not observed in the internal organs and peritoneum. The total length and weight of the specimen were 48.5 cm and 831 g, respectively. The specimen was female, with a gonad weight of 24.84 g, and the mature ovaries suggested that it had been reproductively active when caught (Figure 2). The detailed morphometric and meristic characters of the specimen are given in the Table.

Abnormal pigmentation has been documented in a few teleosts in the Mediterranean; the first, interestingly, to our knowledge, was of the family Mugilidae and a *C. ramada* specimen in the Adriatic Sea, which was described as partial albinism (Algeria-Hernăndez and Sinovčić, 1987). Unfortunately, due to the lack of the color definition of the specimen, no a clear opinion was formed as to whether it

Figure 1. Xanthochroic specimen (upper) and the typical coloration (below) of the species.

Figure 2. Ovary stage and peritoneum color of the xanthochroic specimen.

Table. Some morphometric and meristic characteristics of the xanthochroic *C. ramada* specimen (D1: 1st dorsal fin; D2: 2nd dorsal fin; A: anal fin; V: ventral fin; P: pectoral fin.Values given in parenthesis show the percentage of the related character in standard length).

Metricmeasurements		Meristiccounts	
Total length	48.5 cm	D1	IV
Fork length	44.6 cm	D2	9
Standard length	41.4 cm	A	III+9
Snout to D1 origin	21.44 cm (51.7)	V	I+5
Snout to D2 origin	30.21 cm (72.9)	P	I+15
Snout to V origin	17.10 cm (41.3)		
Snout to A origin	28.92 cm (69.8)		
Body depth	7.64 cm (18.4)		
Head length	9.88 cm (23.8)		
Snout length	1.40 cm (3.4)		
Eye diameter	1.74 cm (4.2)		
Interorbital distance	4.41 cm (1.06)		

was a xanthochroic specimen or not. Additionally, an adult xanthochroic starry weever, *Trachinus radiatus* Cuvier, 1829, was caught in the Adriatic Sea (Stagličić et al., 2019). Golani et al. (2019) recorded xanthism in 2 demersal species: *Epinephelus marginatus* (Lowe, 1834) (Serranidae) from the Israeli coasts of the Mediterranean Sea and *Diplodus vulgaris* (Geoffroy Saint-Hilaire, 1817) (Sparidae) from the Aegean Sea. The authors also presented a possible xanthism specimen of Mediterranean horse mackerel, *Trachurus mediterraneus* (Steindachner, 1868), in the same study, which was the first recorded specimen of *Trachurus declivis* (Jenyns, 1841) from the Eastern Mediterranean Sea. Furthermore, another xanthochroic sparid, a white seabream, *Diplodus sargus* (Linnaeus, 1758),was identified from a shared photo on a social media platform very recently (Fishing in Greece, 2020) by the current authors. Prior to the current study, signs of malpigmentation and xanthochroism in İzmir Bay were observed in 2 flatfish from Soleidae (*Solea solea* (Linnaeus, 1758), *Dicologlossa cuneata* (Moreau, 1881), and in a surmullet, *Mullus surmuletus* (Mullidae) (Akyol and Şen, 2012; Tokaç et al., 2013; Ulutürk et al., 2015).

It is worth to noting that most of the specimens recorded with unusual coloration herein belonged to the commercial species that were the target of various fishing activities conducted mainly in coastal waters. Hence, it can be considered that the possibility of encountering similar specimens is likely in commercial and coastal fish due to their high availability. Furthermore, some fish species, such as flatfish (Heterosomata), are more prone to color anomalies than others, due to their genetic, physiological, and metabolic characteristics. Environmental influences also play a role in these disparities among species as a result of variability in the habitat choices of fish. On the other hand, the increase of the frequency of similar cases recently could have been related to pollution in the aquatic ecosystem.

In addition to everything mentioned above, through the effective use of visual platforms web-based sources, and especially from citizen science, it is more likely to discover this kind of specimen in nature in the future.

Acknowledgments

This specimen was caught during a field study for TÜBİTAK, under project number 118O317. The authors would like to thank Süleyman Canbaz and Arif Yalılı, the skipper of the purse seiner AFALA and the executive chief of DALKO Fisheries Cooperative, respectively. We also would like to express our sincere appreciation to Aylin Ulman for her assistance in editing and checking of the manuscript language.

Conflict of interest

The authors declare no sources of conflict of interest in the study.

References

Akyol O, Şen H (2012). First record of abnormal pigmentation in a wild common sole, *Solea solea* L., from the Aegean Sea. Turkish Journal of Veterinary and Animal Sciences 36 (6): 727-729. doi: 10.3906/vet-1110-7

Algeria-Hernăndez V, Sinovčić G (1987). A note on a partial albino specimen of the species *Liza (Liza) ramada* (Risso, 1826) caught from the middle Adriatic. Institute of Oceanography and Fisheries, Biljeske- Notes, No: 68, 4p.

Ben-Tuvia A 1986. Mugilidae. In Whitehead PJP, Bauchot ML, Hureau JC, Nielsen J, Tortonese E. (editors) Fishes of the North-eastern Atlantic and the Mediterranean. Volume 3. UNESCO, Paris, pp. 1197-1204.

Bilecenoğlu M, Kaya M, Cihangir B, Çiçek E (2014). An updated checklist of the marine fishes of Turkey. Turkish Journal of Zoology 38 (6): 901-929. doi: 10.3906/zoo-1405-60.

Colihueque N (2010). Genetics of salmonid skin pigmentation: clues and prospects for improving the external appearance of farmed salmonids. Reviews in Fish Biology and Fisheries 20: 71-86. doi: 10.1007/s11160-009-9121-6

Fishing In Greece. (2020, July 25). Posts. Retrieved from https://www.facebook.com/FishingInGreece/photos/pcb.3458632854170543/3458631087504053/

Fujii R (2000). The regulation of motile activity in fish chromatophores. Pigment Cell Research 13 (5): 300-319. doi: 10.1034/j.1600-0749.2000.130502.x

Golani D, Corsini-Foka M, Tikochinskic Y (2019). The occurrence of two xanthochromic fish, *Epiniphelus marginatus* (Serranidae) and *Diplodus vulgaris* (Sparidae) (Osteichthyes) in the eastern Mediterranean. Zoology in the Middle East 65 (3): 215-220. doi: 10.1080/09397140.2019.1627700

Gürlek M, Ergüden D, Doğdu SA, Turan C (2016). First record of greenback horse mackerel, *Trachurus declivis* (Jenyns, 1841) in the Mediterranean Sea. Journal of Applied Ichthyology 32 (5):976-977. doi: 10.1111/jai.13159

Marshall NJ, Cortesi F, de Busserolles F, Siebeck UE, CheneyKL (2019). Colours and colour vision in reef fishes: past, present and future research directions. Journal of Fish Biology 95 (1): 5-38. doi: 10.1111/jfb.13849

Mills MG, Patterson LB (2009). Not just black and white: pigment pattern development and evolution in vertebrates. Seminars in Cell & Developmental Biology 20 (1): 72-81. doi: 10.1016/j.semcdb.2008.11.012

Quigley DTG, Lord R, MacGabhann D, Flannery K (2017). First records of xanthochromism in three-bearded rockling *Gaidropsarus vulgaris* (Cloquet, 1824) and Pollack *Pollachius pollachius* (Linnaeus, 1758). Journal of Applied Ichthyology 33 (6): 1208-1210. doi:10.1111/jai.13456

Salzburger W, Braasch I, Meyer A (2007). Adaptive sequence evolution in a color gene involved in the formation of the characteristic egg-dummies of male haplochromine cichlid fishes. BMC Biology 5, 51. doi: 10.1186/1741-7007-5-51

Sköld HN, Aspengren S, Cheney KL, Wallin M. (2016) Fish chromatophores –from molecular motors to animal. In: Jeon KW (editor): International Review of Cell and Molecular Biology, Vol 321. San Diego, CA, USA: Elsevier Academic Press, pp. 171-220. doi: 10.1016/bs.ircmb.2015.09.005

Šoljan T. (1963). Fishes of the Adriatic (Ribe Jadrana) (originally published in Serbo-Croatian by Nakladi Zavod Hrvatske, Zagreb, 1948). Nolit, Belgrade.

Stagličić N, Dragičević B, Žužul I, Šegvić-Bubić T (2019). Anomalous colouration of a starry weever, *Trachinus radiatus* (Actinopterygii: Perciformes: Trachinidae), from the Adriatic Sea. Acta Ichthyologica et Piscatoria49 (2): 177-180. doi: 10.3750/AIEP/02464

Thomson JM (1981). In Fischer W, Bianchi G, Scott WB. (editors) Fao species identification sheets for fishery purposes. Eastern Central Atlantic; fishing areas 34, 47 (in part). Canada Funds-in-Trust. Ottawa, Department of Fisheries and Oceans Canada, by arrangement with the Food and Agriculture Organization of the United Nations, 3, 3 p.

Tokaç A, Akyol O, Aydın C, Ulaş A (2013). First report of abnormal pigmentation in a surmullet, *Mullus surmuletus* L. (Osteichthyes: Mullidae). Turkish Journal of Veterinary and Animal Sciences 37 (6): 754-755. doi: 10.3906/vet-1211-2

Turan C, Gürlek M, Ergüden D, Yağlıoğlu D, Öztürk B (2011). Systematic status of nine mullet species (Mugilidae) in the Mediterranean Sea.Turkish Journal of Fisheries and Aquatic Sciences 11 (2): 315-321. doi: 10.4194/trjfas.2011.0216

Ulutürk E, Bayhan B, Filiz H, Acarli D, Irmak E (2015). Abnormalities in the wedge sole *Dicologlossa cuneata* (Moreau, 1881) and black sea turbot *Scophthal musmaeoticus* (Pallas, 1814) from Turkish seas. Journal of Aquaculture Engineering and Fisheries Research 1 (2): 98-103. doi: 10.3153/JAEFR15010