



SHORT COMMUNICATION

First Report of Xanthic Phenotype of the Common Bream *Abramis brama* (Linnaeus, 1758) from Krasnoyarsk Reservoir, Russian Federation

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Abstract

Abnormal body colouration in fishes usually occurs as either a deficiency or an excess of various pigmented substances. Despite the fact that abnormal pigmentation is known in many fish species, they are extremely rare and of significant interest from the point of view of aquaculture, evolutionary biology and behavioural ecology. One of the forms of abnormal pigmentation is xanthism, expressed by the appearance of a yellow or orange colour. The article reports about the capture of a female common bream *Abramis brama* (Linnaeus, 1758) with abnormal xanthic colouration in the Znamensky Bay of the Krasnoyarsk Reservoir, Russian Federation (54°26'07.2"N, 91°11'55.3"E) in June 2020. The xanthic individual had a pinkish-orange colouration of the dorsal and sides of the body, and the pectoral fins. The pelvic, dorsal, caudal, and anal fins are dark orange in colour and almost brown at the tips. The aetiology of abnormal pigmentation as in this case is not always clear. It is assumed that this variation of the common bream pigmentation is caused by a non-pathological genetic mutation, as in the cases of many other fish species described in scientific literature currently.

Keywords: xanthism, abnormal pigmentation, common bream

Introduction

The body colouration of fish is due to the presence and combination of black (melanophores), red and yellow pigment cells (xanthophores and erythrophores) (Burton, 2002; Yarzhombek and Zhukova, 2018). The distribution, density and size of each of the cell types mentioned above determine the colour range and intensity of pigmentation of the fish integument (Burton, 2002). Irregularities in the pigment systems lead to the appearance of aberrant forms of colouration. Among the main types of aberrations are usually albinism (lack or absence of certain pigments), melanism (excess of pigments, usually melanin), and ambicolouration (differences in the pigmentation of some parts of the fish body, normally coloured uniformly) (Moore et al., 1974; Muto et al., 2013). The appearance of such phenotypic deviations in the colouration of fish and other living organisms is of considerable interest in evolutionary biology (Nelson and Planes, 1993; Baer et al., 1995).

One of the most notable forms of colour aberrations is the appearance of orange or yellow body colour in some fish, so-called xanthism, or golden colouration (Dawson and Heal, 1976; Valencia-Méndez et al., 2018). Individuals with aberrant xanthic colouration have now been recorded for many species of orders Perciformes (Denoncourt et al., 1976), Gadiformes (Quigley et al., 2017), Salmoniformes (Dawson, 1964), Cypriniformes (Kobayasi, 1957; Vekhov, 2008), Cyprinodontiformes (Turner and Liu, 1977) and others (Dawson, 1964; Dawson and Heal, 1976). Xanthism is most widespread in Cypriniformes (Kobayasi, 1957; Vekhov, 2008; Podushka, 2013; Pawar and Jawad, 2017). Such deviations in pigmentation became the basis for the breeding of decorative forms of crucian carp (goldfish) *Carassius auratus* (Linnaeus, 1758), common carp (koi) *Cyprinus carpio* Linnaeus, 1758 (Yarzhombek and Zhukova, 2018), ide (orfe) *Leuciscus idus* var. *orfus* (Linnaeus, 1758) (Koopmans and van Emmerik, 2004), tench *Tinca tinca* (Linnaeus, 1758) (Kvasnicka et al., 1998). In natural populations, there are also known

cases of catching golden individuals of roach *Rutilus rutilus* (Linnaeus, 1758) (Podushka, 2013), silver carp *Hypophthalmichthys molitrix* (Valenciennes, 1844) (Pawar and Jawad, 2017), mud loach *Misgurnus anguillicaudatus* (Cantor, 1842) (Kobayasi, 1957).

According to currently existing scientific publications, the presence of a xanthic phenotype in common bream has not previously been recorded in either wild or artificial habitats. The aim of this study was to describe for the first time the presence of a xanthic phenotype in this fish species.

Materials and Methods

During the annual monitoring studies on 4 June 2020 in the Znamensky Bay of the Krasnoyarsk Reservoir, Russian Federation (54°26'07.2"N, 91°11'55.3"E) an individual of the common bream *Abramis brama* (Linnaeus, 1758) with a xanthic colouration was captured. An aberrant bream was caught with a gill net with a mesh size of 50 mm, set at a distance of about 100 m from the coast at 5 m depth. The specimen was photographed, and then the total (TL), standard length (SL) and weight (W) were measured. Scales were used to determine the age.

Later, during the monitoring studies in the reservoir from June to July 2020, 1418 specimens of common bream were examined for xanthic colour, but were not found.

Results

The captured individual of common bream was a female, and had the following dimensional characteristics: TL = 297 mm, SL = 231 mm, W = 242 g. The age of xanthic individual was 4+ years. The specimen was identified as common bream based on the following morphological characteristics: the number of scales in the lateral line 56; the number of rays in the dorsal fin 12; the number of rays in anal fin 27; specific sub-interior mouth, which can be extended as tube (Kottelat and Freyhof, 2007). It

should also be noted that the ichthyofauna of the Krasnoyarsk Reservoir does not include species belonging to the genera *Ballerus*, *Blicca*, and *Vimba*, which can be confused with *A. brama* (Popov, 2015). These facts allow us to consider the described individual as a common bream.

Common bream is an introduced species in the Yenisei river system. Stocking of bream in the Krasnoyarsk Reservoir was carried out at the initial stages of reservoir formation in the period from 1964 to 1970. Subsequently, bream spread throughout the water area of the reservoir and currently is it one of the most abundant commercial fish species here (Zuev et al., 2016).

Normally, the body colour of common bream varies from silvery with a bluish tint in young individuals to dark gray with a yellow tint in large fish. The dorsal and top of the head are blackish-gray, the belly is almost white. The pectoral fins are dark gray or brownish, the other fins are darker, with almost black edges (Kottelat and Freyhof, 2007). The discovered individual had a pinkish-orange colouration of the dorsal and sides of the body. The belly is lighter than the sides of the body with a silvery sheen. The pectoral fins are pinkish-orange; the pelvic, dorsal, caudal, and anal fins are darker in colour and almost brown at the tips (Fig. 1).

Discussion

It is known that the orange or yellow colour of the integument of the body of fish is due to the content of carotenoid pigments or pterins in xanthophore cells (Yarzhombek and Zhukova, 2018). At the same time, pterin pigments are synthesized directly in the fish organism, and carotenoids are supplied exclusively with food. Some researchers note that pterin pigments mainly determine the colour of cyprinids (Matsumoto et al., 1960; Yarzhombek and Zhukova, 2018). Changes in the density of orange pigment cells may significantly alter the body colour of the fish (Webber et al., 1973). Angus and Blanchard (1991) have



Fig. 1. Individuals of common bream with normal (A) and xanthic (B) colouration, Znamensky Bay, Krasnoyarsk Reservoir, Russian Federation, June 2020.

suggested that xanthophores can be overproduced in the absence of melanophores or other pigment cells. The complete or partial disappearance of melanophores, in turn, leads to the appearance of orange or yellow (xanthic) colouration in some individuals (Webber et al., 1973).

In most fish species, xanthism is a rare variant of pigmentation (Palacios-Salgado and Rojas-Herrera, 2012). The case of xanthic pigmentation in *A. brama* described in this study demonstrates almost complete absence of dark pigment in body colouration. The closest colour variants among cyprinids were previously observed in the common roach in a number of water bodies of the European part of Russia and in the *Rutilus heckelii* (Nordmann, 1840) (Podushka, 2013). Other species of this family in natural populations, characterized by the presence of individuals with an aberrant xanthic colouration, in most cases, have a more intense orange colour and the cornea of the eye, bearing clusters of dark pigment spots (Kobayasi, 1957; Kvasnicka et al., 1998; Koopmans and van Emmerik, 2004; Yarzombek and Zhukova, 2018). In the common bream individual that we described, dark pigment was present exclusively along the edges of the anal and caudal fins; however, the colour intensity was significantly lower than in the normally coloured individuals. According to a number of researchers, variations in xanthic colouration, in which an individual has no or practically no normally coloured body parts, are caused by a recessive mutation of the xanthophore genes (Lister et al., 1999; Watanabe and Kondo, 2015; Pawar and Jawad, 2017.). The xanthic pigmentation observed in *A. brama* from the Krasnoyarsk Reservoir is probably one of the variants of such mutation. Mechanisms of occurrence and inheritance of this colouration require further study.

Conclusion

The individual of common bream *Abramis brama* (Linnaeus, 1758) with a xanthic colouration caught in the Krasnoyarsk Reservoir is the first case of such aberration in this fish species described in the scientific literature. In the future, the study of the mechanisms of the emergence and inheritance of such colour variants in bream can serve as a basis for breeding decorative forms of this species, by analogy with trout, rudd, carp, ide, or other species. In addition, field and experimental studies of aberrantly coloured fish will make it possible to form ideas about intraspecific (including relationships in a school, reproductive success) and interspecific aspects of behaviour (predator-prey relationships).

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