

# A leucistic Spanish stone loach from Cadagua River (Basque Country, Spain)

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## SUMMARY

Albinism and leucism are genetic disorders that affect the normal coloration of animals and are truly rare among wild fishes. During a sampling of adult zebra mussels in the Cadagua River (Basque Country, Spain), a leucistic specimen of Spanish stone loach (*Barbatula hispanica*) was seen and subsequently captured to take some photographs. This is the first published record of leucism for a non-cavefish from the family Nemacheilidae.

**Keywords:** Albinism, *Barbatula hispanica*, leucism, Nemacheilidae

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## INTRODUCTION

As in other poikilothermic vertebrates, coloration in fishes is determined by pigmentary cells called chromatophores (Moyle & Cech, 1988; Bechtel, 1995), of which there are three basic types. Melanophores produce melanin, responsible for black and brown pigments, xanthophores generate reds and yellows, and iridophores, which do not synthesize pigments and are responsible for colour reflection (Clark, 2002). As in other animals, black and brown integumentary pigmentation of fish is a result of melanophores derived from the embryonic

neural crest (Bechtel, 1995), while retinal pigmentation results from melanophores arising from the optic cup of the embryo (Zhao *et al.*, 1997).

Albinism is a genetically inherited condition in which the pigment-protein melanin is either absent or non-functional (Reum *et al.*, 2008), resulting in a total lack of normal pigmentation in both the skin and iris. Leucism, however, is a genetic disorder controlled by a single recessive allele expressed as the complete or partial loss of skin pigmentation but with normal iris pigmentation (Clark, 2002; Quigley *et al.*,

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2015; Bigman *et al.*, 2016). So, albino animals have pigmentary cells in their organs but cannot synthesize melanin, while leucistic animals can produce melanin and they do so in the melanophores of their retinal pigmented epithelium and iris, but they do not have melanophores in their skin (or they have them only in a part of its skin).

Both albinism and leucism are truly rare among wild fishes. A recent review of published literature on albinism and leucism in Chondrichthyans has compiled 61 species with published examples of those pigmentation disorders, which supposes

only the 5% of the total species of the taxon (Arronte *et al.*, 2022). Several authors affirm that the frequency of appearance of these chromatic aberrations is greater in bony fishes than in cartilaginous fishes (Deynat, 2003; Sandoval-Castillo *et al.*, 2006; Reis *et al.*, 2013), but this appreciation may be biased by the larger number of species and the much greater volume of commercial catches of the former, involving an increase in the probability of detecting both albinism and leucism (Reis *et al.*, 2013).



**Figure 1.** Two *Barbatula hispanica* specimens: Above, specimen with typical coloration from Baia River (Álava, Basque Country). Below, the leucistic specimen reported here. Photographs by Ramiro Asensio.



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These chromatic aberrations can appear in nature due to random genetic alterations, but several factors may induce a higher rate of albinism/leucism than usual, including the exposure to heavy metals, nutritional deficiencies, or inbreeding (Westerman & Birge, 1978; Oliveira & Foresti, 1996; Ueda *et al.*, 2007). Leucism and albinism in fish may reduce the probability of survival in the wild by increasing predation risk. It has been shown that these chromatic alterations are more commonly detected in fish with nocturnal and/or cryptobiotic habits, in which their condition is less evident (Sazima & Pombal, 1986), and more in pelagic elasmobranchs than in benthic ones, due to the color contrast with the substrate (Sandoval *et al.*, 2006).

The Spanish stone loach *Barbatula hispanica* (Lelek, 1987; Figure 1), previously considered a junior synonym of *B. quignardi*, has been recently revalidated as a valid species (Denys *et al.*, 2021). It inhabits the Ebro drainage and short Cantabrian rivers from Cantabria (Spain) to Basque Country (Spain/France), reaching the Adour basin (Southwestern France). The Spanish stone loach is a small fish (up to 12-15 cm), with an elongated body and small eyes on an also elongated head. Its inferior mouth is surrounded by three pairs of barbels. Body coloration is brown, with

irregular dark spots all over the body and fins (Figure 1). All fish within the genus *Barbatula* are described as benthic and nocturnal/crepuscular, a favourable factor against predation on specimens that are easily detectable by their appearance.

On August 5<sup>th</sup> 2022 a leucistic Spanish stone loach was seen during an adult zebra mussels survey developed in the Cadagua River (Güeñes, Biscay, Basque Country, Spain; UTM 492354-4784307). Unfortunately, it was not possible to capture it, although some photographs of the specimen were taken (Figure 2) (UTE Anbiotek-Ekolur, 2022).

A few days later (August 8<sup>th</sup>) the site was visited again with the aim of capturing the leucistic specimen and obtaining higher-quality photographs. The search was deemed feasible because the specimen was detected in a narrow secondary arm, parallel to the main one, with an average width around 3 m, a maximum depth of 50 cm and a low water current speed. By slightly stirring the stones on the bottom, the stone loachs were forced to come out of their hiding places. After about 20 minutes of search, the leucistic specimen was detected and quickly captured with a hand net. Once photographed using a small aquarium (Figure 1), the leucistic loach was returned, in perfect conditions, at the same site where it had been captured.



**Figure 2.** The leucistic Spanish stone loach specimen as spotted on the day it was discovered. Photograph by Ramiro Asensio.

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The specimen was 37.5 mm in total length. Its body was totally white or yellowish, almost transparent in some zones and specially in the ventral part, but with eyes normally pigmented (Figure 3).

According to data from electrofishing samplings of the last seven years, carried out just 350 meters downstream from the detection point of the leucistic loach (<https://uragentzia.euskadi.eus/informacion/ubegi/webura00-01040102seguimiento/es/> visited October 13<sup>th</sup> 2023), fish assemblage is composed by Pyrenean minnow (*Phoxinus phoxinus* Kottelat 2007: 47% of individuals and 1% of biomass), Ebro nase (*Parachondrostoma miegii* Steindachner 1866: 18% individuals, 4% biomass), Spanish stone loach (11% individuals, 1% biomass), Ebro barbel (*Luciobarbus graellsii* Steindachner 1866: 8% individuals, 25%

biomass), Pyrenean gudgeon (*Gobio lozanoi* Doadrio & Madeira 2004: 8% individuals, 3% biomass), European eel (*Anguilla anguilla* Linnaeus 1758: 6% individuals, 40% biomass), Brown trout (*Salmo trutta* Linnaeus 1758: 1% individuals, 27% biomass) and, very exceptionally, Rainbow trout (*Oncorhynchus mykiss* Walbaum 1792: only one individual in the seven considered annual samplings). Brown trout and European eel, as potentially piscivorous species, could be a risk source for the survival of the leucistic loach, but according to several studies (Alonso *et al.*, 2017; Gómez-Juaristi & Salvador, 2017) fish are not as common as popularly thought in trout and eel's diet, especially when these hypothetical predators are not really big, as is the case in the studied stretch.



**Figure 3.** Different images of the leucistic Spanish stone loach specimen. Photograph by Ramiro Asensio.

Other possible predator is Kingfisher (*Alcedo atthis* Linnaeus 1758) but it usually does not catch loaches, even if they are abundant, due to their benthic and nocturnal habits (Vilches *et al.*, 2012; Raven, 1986). Grey heron (*Ardea cinerea* Linnaeus 1758), also a specialised piscivorous bird, tends to focus on large fish and neglect small ones, like stone loaches (Gwiazda & Amirowicz, 2006; Feunteun & Marion, 1994). These circumstances seem to have favoured the survival of the leucistic individual.

The cases of albinism and leucism in the Iberian ichthyofauna are exceptional but not unknown. They have probably gone unnoticed because they have never been published, or only published as anecdotes in magazines aimed at recreational fishermen (Fernando Cobo pers. comm.). It is also possible that some specimens with altered pigmentation are kept in ichthyological collections, but their detection has not been formally published (Ignacio Doadrio pers. comm.).

There are few reported cases of Nemacheilidae species with morphological traits compatible with leucism or albinism (e.g. lack of skin pigmentation), and all of them involve geographically restricted populations of cavefish (Behrmann-Godel *et al.*, 2017; Luo *et al.*, 2023). The processes leading to those features differ from the genetic disorders related to leucism and albinism, since in cavefish pigmentation loss is a selected trait among the original phenotypic plasticity of fish occupying caves (Bilandžija *et al.*, 2020; Cupic *et al.*, 2023; Behrmann-Godel *et al.*, 2024). Anyway, to the best of my knowledge, this is the first published record of leucism for an epigeal (i.e. non-cavefish) Nemacheilidae species.

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