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First *in situ* photograph of the genus *Protogrammus* (Callionymidae) and first record of *Protogrammus* cf. *alboranensis* for French waters (Corsica)

by

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Résumé. – Première photographie *in situ* du genre *Protogrammus* (Callionymidae) et premier signalement de *Protogrammus* cf. *alboranensis* dans les eaux françaises (Corse)

Le dragonnet d'Alboran, *Protogrammus alboranensis* Fricke, Ordines, Farias & García-Ruiz, 2016, récemment décrit, n'a été observé qu'une seule fois depuis sa description, au large des îles Baléares. Lors de l'expédition scientifique Gombessa 6 au large du cap Corse en juillet 2021, deux individus, un mâle et une femelle, ont été photographiés dans leur habitat lors d'une plongée sous-marine à –120 m. Ce premier signalement de l'espèce pour les eaux françaises constitue une importante extension de son aire de distribution en Méditerranée occidentale. Observée dans son milieu naturel, l'espèce se distingue principalement par les motifs jaune électrique caractéristiques présents chez le mâle. Ils ont été découverts au sommet de dômes coralligènes recouverts de gorgones et entourés d'anneaux formés par un processus géochimique unique. Cet exemple de première observation *in situ* du dragonnet d'Alboran illustre l'intérêt de la plongée profonde et de la photographie, notamment pour la description des microhabitats et le comportement des petits animaux. La description de *Protogrammus sousai* (Maul, 1972) au large de Madère pouvant aussi correspondre aux spécimens de Corse, la distinction nécessite des clarifications à partir de matériel supplémentaire.

Key words. France, Distribution, Naturalist photography, Deep scuba diving, Coralligenous rings

Callionymidae, known as dragonets, are benthic fishes that live down to 900 m depth in all temperate and subtropical marine waters (Fricke, 1983). They are characterised by a depressed body, a triangular head, large and dorsally-positioned eyes, the presence of a preopercular spine which is bearing additional spinules and/or serrae, tiny gill opening, absence of swim bladder, two dorsal fins (the first with thin, flexible spines, the second with soft rays), and jugular pelvic fins which are separated from each other, but each connected with the pectoral-fin base by a membrane. The Mediterranean Sea counts three callionymid fish genera: *Synchiropus*, represented by *Synchiropus phaeton* (Günther, 1861) and the Lessepsian migrant *Synchiropus sechellensis* Regan, 1908; *Callionymus*, represented by *Callionymus fasciatus* Valenciennes, 1837; *Callionymus filamentosus* Valenciennes, 1837 (a Lessepsian migrant); *Callionymus lyra* Linnaeus, 1758; *Callionymus maculatus* Rafinesque, 1810; *Callionymus pusillus* Delaroche, 1809; *Callionymus reticulatus* Valenciennes, 1837; *Callionymus risso* Lesueur, 1814, and *Protogrammus* (Farias *et al*., 2016). The genus *Protogrammus* was first described by Fricke (1985) and counts three very rare species living on sandy bottoms on seamounts or lower island shelves and slopes: *Protogrammus sousai* (Maul, 1972) described from Madeira (north-eastern Atlantic), *Protogrammus antipodus* Fricke, 2006 described from Lifou, New Caledonia, south-western Pacific and *Protogrammus alboranensis* Fricke, Ordines, Farias & García-Ruiz, 2016 described from Alboran sea, southwestern Mediterranean (Froese and Pauly, 2026). This unusual disjunctive distribution is considered a relict distribution by Farias *et al*. (2016). After an initial description based on four specimens collected in Alboran Island, Spain, in 2014-2015, one specimen of *P. alboranensis* was later collected from the Balearic Islands, Spain, in 2017 (Fricke and Ordines, 2017). They respectively come from bottom trawl sampling carried out at 113 m depth and 159 m depth.

During the *Gombessa 6* "Cap Corse" expedition focused on the study of coralligenous rings off northern Corsica in July 2021, a male and a female identified as most probably *P. alboranensis* were photographed *in situ* by a scuba diver. These first naturalistic photographs expand the distribution range of this rare species. The individuals are described in the present article based on the pictures and the diver's observations. The species distribution and the usefulness of diver's approach are discussed.

MATERIALS AND METHODS

Twenty-four autonomous dives were performed off Cap Corse during the *Gombessa 6* expedition (https://gombessa-expeditions.com/mystere-des-anneaux/) focusing on coralligenous structures described by Bonacorsi *et al*. (2012). Twelve occurred in June 2021 at 62-95 m depth (5.1 h at the bottom), and 12 occurred in July at 87-120 m depth (42.5 h at the bottom). Two individuals of *P. cf. alboranensis* were observed on 8 July at 120 m depth at a single site. Divers were equipped by closed-circuit rebreathers for autonomous saturation diving, an innovative diving technique invented in 2019 for Gombessa 5 "Planète Méditerranée" (https://gombessa-

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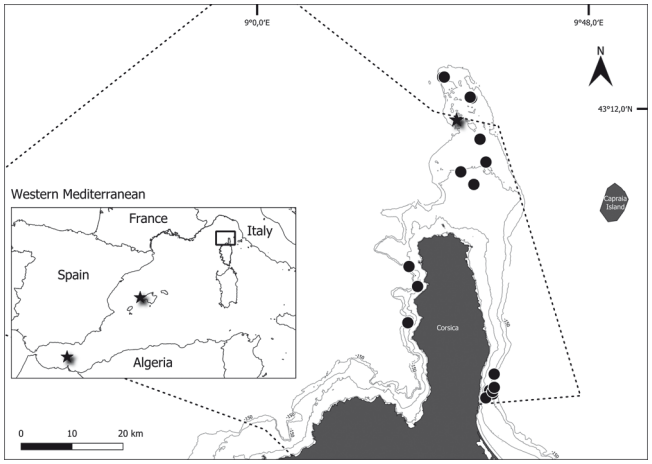

Figure 1. Map of the study area (northern Cap Corse). The black dots mark the 22 dives performed during Gombessa 6 "Cap Corse" expedition; the star mark the site in which *Protogrammus alboranensis* were reported: G6-17 off Corsica (this study), 43°12.528' N 9°27.516' E; type locality, Alboran Island, 35°56'36"N, 3°05'55"W (Farias *et al*., 2016); Balearic Islands 39°38.93' N 2°11.33'E (Fricke and Ordines, 2017). The isobaths shown represent 50, 100 and 150 m depths.

expeditions.com/planete-mediterranee/) and mixing industrial saturation diving with technical scuba diving. The site (G6-17) was located at 43°12.528' N 9°27.516' E (Fig. 1).

Colouration and general morphological traits were compared to the existing descriptions.

RESULTS

Description

The observed morphological characteristics and colouration are consistent with the descriptions of *Protogrammus alboranensis* by Farias *et al*. (2016) and Fricke and Ordines (2017). Both individuals measure approximately 10 cm in total length. The first individual has a relatively elongated first dorsal fin, very long anal fin rays reaching the base of the caudal fin, a distinctly arched snout, and vivid, electric-coloured spots, particularly on the cheeks. These characters, as observed in other Callionymidae, indicate that it is an adult male. The second individual has a relatively elongated second dorsal fin – though not as much as the first individual – and a snout that is not significantly arched. It lacks vivid cheek spots, yet its colour pattern is substantially similar to that of the first individual. Callionymidae are gonochoristic species in which the sexes are clearly differentiated by colouration and morphological traits. These differences manifest in males well before they reach sexual maturity. Thus, the characters observed in the second individual indicate that it is an adult female of the same species (Fig. 2).

They exhibit a well-developed membrane behind the last ray of the first dorsal fin and second dorsal fin rays that are not all branched (Fig. 2B), suggesting it does not belong to the genus *Synchiropus*. The genera *Callionymus* and *Protogrammus* are distinguished, respectively, by the lower half of the operculum being connected to the body with no ventrolateral fold on the side of the body, versus the lower half of the operculum having a free opercular skin flap and the side of the body having a divided ventrolateral skin fold (Fricke, 1986). These diagnostic features are not visible in the photographs of individuals from Corsica and do not currently allow for the identification of the genus of the species in question.

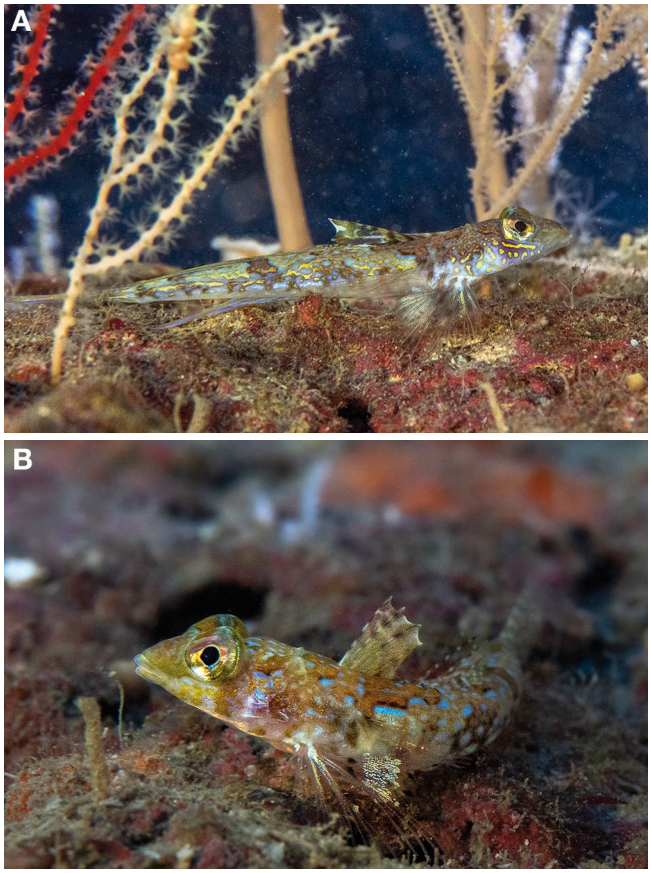

Figure 2. Male (**A** = individual 1) and female (**B** = individual 2) individuals of *Protogrammus alboranensis* in their natural habitat, at site G6-17, western Mediterranean Sea, France, Corsica at –120 m. Both were close to one another among *Callogorgia verticillata* colonies. Length around 10 cm. © L. Ballesta.

In the majority of species within the genus *Callionymus*, the fin rays of the first dorsal fin in adult males decrease noticeably in length, whereas in adult females, the first dorsal fin is very small and somewhat triangular. The male specimen examined here exhibits elongated first and second dorsal fin rays of very similar length (Fig. 2A). Furthermore, the female displays a distinctly tall, quadrangular dorsal fin. These characteristics allow for the exclusion of most *Callionymus* species, with the exception of *Callionymus bairdi* Jordan, 1888, which is found in West Africa. The appearance of the first two rays of the male's first dorsal fin is consistent with species of the genus *Protogrammus* known to occur in the Northeast Atlantic.

The two species *Protogrammus sousai* and *Protogrammus alboranensis* are distinguished by the following characteristics: number of pectoral-fin rays (20-21 vs. 20-22); shape of the main tip of the preopercular spine (straight vs. upcurved); length of the first and second spines of the first dorsal fin (equal to the first ray of the second dorsal fin and non-filamentous vs. longer than the first ray of the second dorsal fin and filamentous); number of segments in the ventrolateral skin fold (18-22 vs. 9-11); and colouration of the distal margin of the anal fin (pale vs. dark) (Farias *et al*., 2016; Fricke and Ordines, 2017). In the male specimen, the first two dorsal spines appear non-filamentous, and the tip of the anal fin appears pale blue; these diagnostic traits are characteristic of *P. sousai*. Experi-

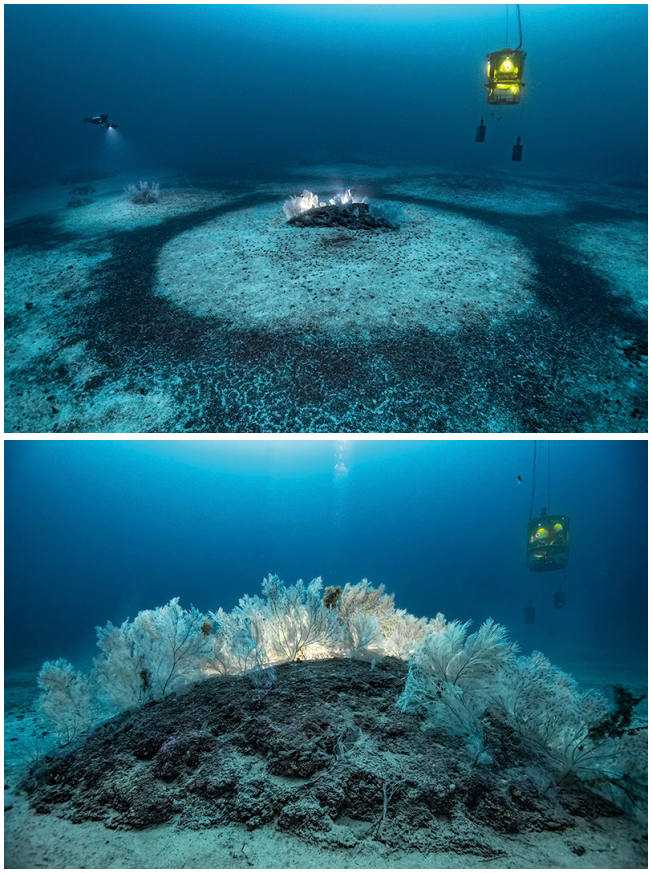

Figure 3. Habitat of *Protogrammus cf. alboranensis*: coralligenous domes (1 m high, 3 m in diameter) covered by *Callogorgia verticillata* and surrounded by coarse sand and rings made of rhodoliths at 120 m depth. In yellow, the saturation diving tower. © L. Ballesta.

ence with large-scale captures of Callionymidae suggests that the filamentous appearance of the first dorsal fin spines in males may result from slight degradation of the inter-radial membranes during capture and that dark and light fin tones can vary among individuals of the same species. Only the colouration of male *P. alboranensis* is known (Farias *et al*., 2016; Fricke and Ordines, 2017). It is characterised notably by yellow reticulations on the body and yellow spots on the sides of the head. This same characteristic colouration is observed in the male specimen described here. The colouration of *P. sousai* remains unknown (Maul, 1972).

Distribution and habitat

The individuals were observed at 120 m depth; the temperature was 13.9°C (see Deter *et al*. (2021) for the water column profile). The bottom was covered by coarse sand and rhodoliths surrounding domes (1 m high, 3 m in diameter) formed of irregular dead and living coralligenous blocks and sediment. The area is surrounded on its northern and eastern sides by coralligenous drop-offs leading to a plateau 10 m higher up. Hard substrate (coralligenous) was colonised by numerous erect species: *Dendrophyllia cornigera* (Lamarck, 1816), *Callogorgia verticillata* (Pallas, 1766) covered by *Ophiacantha setosa* (Bruzelius, 1805) and *Simnia purpurea* Risso, 1826, and some *Parantipathes larix* (Esper, 1788). Divers observed numerous invertebrates: *Palinurus elephas* (Fabricius, 1787) eating *Cidaris cidaris* (Linnaeus, 1758), *Doris verrucosa* Linnaeus, 1758, *Tritonia callogorgiae* Chimienti, Furfaro & Taviani, 2020, *Astrospartus mediterraneus* (Risso, 1826) and alcyonarians. A *Scorpaena scrofa* Linnaeus, 1758 was also observed nearby.

Behaviour

Only two individuals (a male and a female) close to each other (< 10 cm) were observed on the coralligenous dome among branching corals *C. verticillata*. The male was circling the female, interpreted as courtship display behaviour. They remained on the coralligenous reef without fleeing and never went to the soft bottom, despite the presence of the divers. Both individuals were observed with their heads raised, not pressed against the sediment as is generally observed in Callionymidae (Fig. 2).

DISCUSSION

The specimens photographed here share characteristics with both *P. sousai* and *P. alboranensis*, making it impossible to definitively distinguish morphologically between the two species. Fricke and Ordines (2017) suggest the existence of a geographical barrier that led to speciation between *P. sousai* off Madeira and *P. alboranensis* in the Mediterranean. If such a barrier exists, it would support the view that the Corsican specimens described here belong to the species *P. alboranensis*. Assigning the two Corsican *Protogrammus* specimens to *P. alboranensis* appears to be the most parsimonious option, yet this remains a provisional conclusion requiring confirmation. To confirm the distinction between the species *P. sousai* and *P. alboranensis*, further specimen collection is necessary to assess the morphological, ontogenetic, sexual, and genetic variability among these nominal species.

Underwater photographs of various *Callionymus* species (*e.g*., on iNaturalist.org) reveal that, in living specimens, the body and head lie along a single straight axis. In the two individuals observed here, however, there is a distinct upward bend in the forebody, causing the head to be clearly lifted off the substrate and positioned at a different angle from the body (Fig. 2). Furthermore, the individuals appear to be resting the front part of their bodies distinctly on their pelvic fins. This posture, atypical for *Callionymus*, suggests it could be a body posture characteristic to the genus *Protogrammus*.

The Corsican individuals were observed on biogenic substrate at a depth (120 m) between the previous reports (113-159 m depth). None of the species previously caught with this fish species were observed during the dive, but *C. maculatus* another dragonet species, and *Serranus cabrilla* (Linneus, 1758) were detected by environmental DNA at two nearby sites (G6-15 and G6-16, 5.2 km from G6-17) (Andromède Océanologie, 2022). As with fish, the invertebrates observed were different from previous observations in the Balearic Islands that were already different from Alboran Island.

This record of *P.* cf. *alboranensis* off Corsica is an addition to the *Checklist of the marine fishes from metropolitan France* (Béarez *et al*., 2017). If confirmed, it extends the distribution of *P. alboranensis* 1353 km and 726 km northeast from its first and second description, respectively. This first naturalistic observation of both sexes provides additional information on the behaviour and environment of this species. With the development of diving and the increase in the number and duration of incursions into the mesophotic zone, further observations may follow.

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G. Delaruelle, data analysis, co-contributor
F. Holon, data acquisition, conceptualisation, co-contributor
J. Deter, conceptualisation, data analysis, data curation, principal

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