

# Color pattern anomaly of the spotted pufferfish *Arothron meleagris* (Bloch & Schneider, 1801) in the Gulf of California, Mexico

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**Abstract:** An anomalous specimen of the pufferfish *Arothron meleagris* was photographed at Cabo Pulmo reef, southwestern Gulf of California, Mexico (23.5°N-109.5°W). The specimen did not present white spots across the body (a diagnostic character of the species) but instead showed a reticulated pattern of white lines over a black-purple background. The coloration did not conform with that of any of the known species of *Arothron*, and we propose three explanations: a) this is a new species; b) we observed a hybrid of *A. meleagris* with another Indo Pacific species; or most probably, c) this is a very uncommon morphotype of *A. meleagris* never reported in the Americas.

**Résumé:** *Anomalie de couleur du poisson-globe tacheté Arothron meleagris (Bloch & Schneider, 1801) dans le Golfe de Californie, Mexique.* Un spécimen anormal du poisson-globe *Arothron meleagris* a été photographié au récif de Cabo Pulmo, sud-ouest du Golfe de Californie, au Mexique (23,5°N-109,5°W). Le spécimen ne présentait pas de taches blanches sur le corps (un caractère diagnostique de l'espèce) mais à la place un patron réticulé de lignes blanches sur un fond noir-violet. La coloration n'est conforme à aucune autre espèce connue d'*Arothron*, et nous proposons trois explications : a) ceci est une nouvelle espèce ; b) on a observé un hybride de *A. meleagris* avec une autre espèce de l'Indopacifique; ou plus probablement, c) ceci est une forme très rare de *A. meleagris* jamais rapporté dans les Amériques.

**Keywords:** Cabo Pulmo reef • Tetraodontidae • Morphological variability

## Introduction

The spotted or guineafowl pufferfish *Arothron meleagris* (Bloch & Schneider, 1801) is a common reef fish

distributed in the Indian Ocean and central Pacific (Matsuura, 2016), and also along the eastern tropical Pacific, from Mexico (27°N) to Ecuador (3°S), and in all oceanic islands adjacent to the west coast of the Americas (Bussing, 1995; Allen & Robertson, 1996). In the latter region, the species is resident of coral and rocky reef areas, at depths of 2 to 30 m, and it can grow to 30 cm in total length (Bussing, 1995; de la Cruz-Agüero et al., 1997;

Humann & DeLoach, 2003 & 2004). The species feeds on algal turf, sponges, tunicates, mollusks and sea urchins, but especially on reef corals of the genus *Pocillopora* (Guzmán, 1988; Guzmán & Robertson, 1989; Guzmán & López, 1991; Moreno et al., 2009). This fish is also acknowledged for the high concentration of tetrodotoxin in the skin, gonads and liver, which may work as a deterrent to predators (Thomson et al., 2000).

One interesting feature of *A. meleagris* is the presence of several color morphs that may work as aposematic coloration against enemies. In one extreme, the pufferfish can typically occur in the form of a black to deep purple body covered by numerous small white spots ("spotted phase"; Humann & DeLoach, 2004) and with the tail and dorsal fin bordered in white, but there is also a second form in which the body have a bright yellow coloration ("golden pufferfish"); in this state, the belly is whitish, and the fins (especially in the tail) have a gray or light purple lining at the end (Thomson et al., 2000). In addition there are many intermediate forms, presenting parts of the body black with spots, and parts in yellow (Su & Tyler, 1986; Humann & DeLoach, 2004). Also it is noticeable that in Indo Pacific reefs, the species shows small white dots against a completely black body, while in the eastern Pacific, the spots are much larger (compare images in Su & Tyler, 1986, Thomson et al., 2000 and in Matsuura, 2016). In short, the color that this species can present show significant variation depending on the geographic location where the populations live.

The objective of this paper is to report and provide photographic evidence of a very unusual specimen of *A. meleagris* found at Cabo Pulmo reef, a marine park located in the Gulf of California, Mexico, which has gained notoriety because of the excellent state of the local marine fish assemblages (Aburto-Oropeza et al., 2011). The color pattern of the organism did not conform with that of any other species of *Arothron* in the world, and represents the first report of that kind of pigmentation for *A. meleagris* in the eastern Pacific Ocean.

## Methods

In September 2015, during a visit to Cabo Pulmo reef (23.5°N-109.5°W), in the southwestern Gulf of California, one of the authors of this note (AHV) noticed the presence of very singular specimen of *Arothron* sp. at a depth of -20 m, and in a site locally known as "El Bajo". Because of the anomalous coloration, three photographs of the individual were taken using a Canon PowerShot camera model SD990 IS, ISO 200, with no flash. Unfortunately, as the area is part of a National Park the collection of the animal was not allowed, a feat which would have been very useful to confirm its identity. In absence of other evidence, the

images were compared with those of *A. meleagris* taken in the field along the eastern Pacific by many divers and researchers, with photos included in field guides and other taxonomic references related to the eastern Pacific region (e.g. Allen & Robertson, 1994), and also with the diagnoses and dichotomic keys of *Arothron* spp. presented by Su & Tyler (1986) and Matsuura (2016).

## Results

The color pattern of the unusual fish (Fig. 1) was quite different from the typical one of *A. meleagris* in the east Pacific (Fig. 2). The organism that was spotted at Pulmo reef had a reticulate pattern of white lines over a black body, instead of the traditional white dots (small or large), which were only observed around the mouth and in the cheek. Also, the animal has a round black line around the eye, and the belly was black and also presented the white reticula. The dorsal and anal fin were yellow with black stripes, and they had a conspicuous white line in the posterior section.

It is important to notice that in over 40 years of combined diving experience of the authors in reefs of the Pacific, which includes immersions conducted from northern Mexico to Ecuador, and in Japan and Indonesia, we have never seen another example of *A. meleagris* presenting this color configuration.

## Discussion

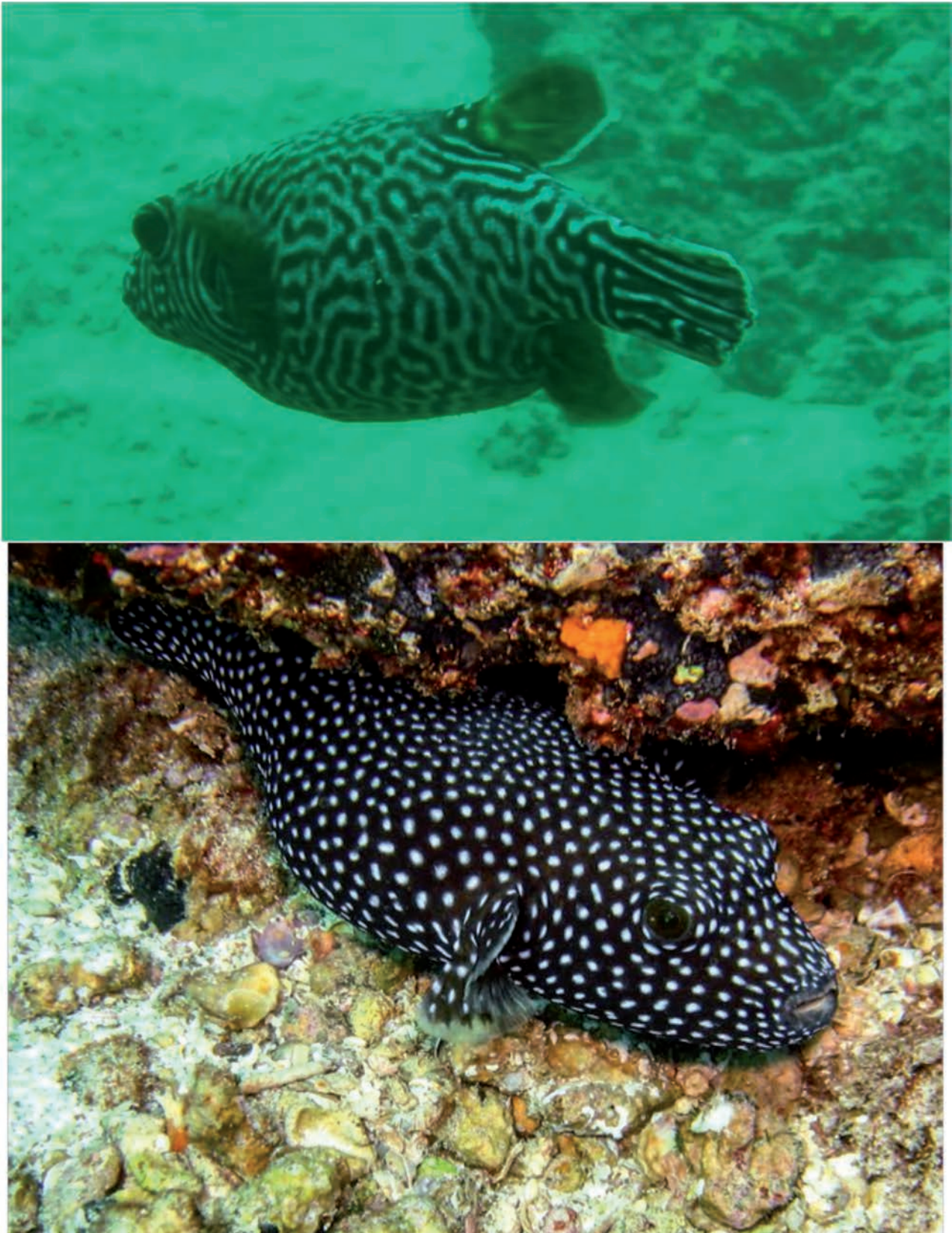
Taking in consideration the key and diagnoses of *Arothron* species presented by Su & Tyler (1986) and Matsuura (2016), and of *A. meleagris* in the eastern Pacific by Allen & Robertson (1996), Bussing (1995) and Garrison (2005), we confirmed that the coloration pattern of the specimen seen at Pulmo reef did not correspond to that of any other spotted pufferfish ever reported in the Americas. The differences included the fact that the eye were surrounded by a black line, and that there were no multiple white spots on the body; instead, the white lines across the entire body and the reticulate pattern were perfectly appreciable. Furthermore, no illustration or photography of *A. meleagris* that we found in the literature and taken either in locations of the west coast of the Americas or in the central or western Pacific, showed any similar design. Notwithstanding, Su & Tyler (1986) indicated that in some individuals of this species the spots elongates ventrally forming a reticulate pattern; however, the geographic origin of these specimens was not referred, and no illustrations are provided in the paper.

On the other hand, the fish seen at Pulmo reef resembled other species of the genus; for example, the lines on the



**Figure 1.** *Arothron meleagris*. Anomalous specimen observed at Cabo Pulmo reef. Notice the conspicuous reticulated white lines that cover the body, and the virtual lack of white dots (diagnostic character of the black-purple phase of the species), except in the face.





**Figure 2.** *Arothron meleagris*. A comparison of the unusual specimen seen at Pulmo reef (above), with another from the same location but showing the typical coloration (below).

body were alike those presented by *Arothron multilineatus* Matsuura, 2016; however, this fish has a green-brown coloration (not black or purple) in the body and tails, a white ventral section (instead of black), and has no black ring surrounding the eye. Moreover, the geographic range of *A. multilineatus* comprises from Mozambique to Japan and the Philippines, on the other side of the Pacific Ocean. Another possibility is that the fish in Figure 1 was a form of *Arothron reticularis* Bloch & Schneider, 1801, a species of pufferfish distributed from India to Australia (Matsuura, 2016), because both present conspicuous white lines along the body. Nevertheless, the body of the latter species is greenish, shows white dots on the tail fin (absent in the organism pictured in Figure 1), and the belly is completely white (not black as the fish from Cabo Pulmo). Finally, *Arothron carduus* (Cantor, 1849) also has lines all along the body, but the color of the body scales is white, not black. From all these comparisons, we judge that the organism photographed at the Gulf of California did not correspond to any species of *Arothron* so far known, or instead it is a very unusual form of *A. meleagris*, which is the only representative of its genus in the east Pacific.

The first possibility to explain our finding is that the fish in figure 1 belongs to a new species unknown to science. Although that might be probable, the lack of a collected specimen precludes to present any argument other than opening the possibility of the case. Rocha et al. (2014) discuss the need of having voucher specimens to deposit in scientific collections to better document biological variability, even if the organism is found in a protected area. Although we endorse that opinion, in this particular situation the Mexican law is very explicit on the limitations of collecting inside a national park, and we believe that in the long term, this position is acceptable in order to maintain the health of the local populations.

A second option was to consider that the organism photographed in Baja California was a hybrid of *meleagris* and another species that have the reticulated pattern, probably *multilineatus* or *reticularis*. However, the distribution area of these two species is very far away from the location of Cabo Pulmo reef (more than 5,000 km to the west), and thus the possibility is quite remote. After all these considerations, and following the observations of Su & Tyler (1986), we suggest that the unusual organism seen might actually be a very uncommon form of *A. meleagris*, which has not been referred previously in the specialized literature on reef fishes of the eastern Pacific.

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*Arothron meleagris* showing its typical coloration in the eastern Pacific. We are grateful for the suggestions of two anonymous reviewers, that improved the quality of the final product.

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