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Marine Biodiversity Records

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Seeing the invisible: *Chriolepis lepidota* (Gobiidae), literally as never seen before

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Abstract

Background: For the first time, almost half a century after its discovery and description, the poorly known endemic gobiid fish *Chriolepis lepidota* was seen alive at Malpelo Island.

Methods: During a 12-day expedition on March 2017, 18 specimens of this species were observed and photographed at different depths by means of SCUBA diving.

Results: Species maximum size and habitat preference are herein documented.

Conclusions: This sighting represents the first record of the species in the wild. Also, this report increases our knowledge on the ecology and biology of an unknown species.

Keywords: Malpelo Island, Endemic, Pretty goby, Fish

Background

The family Gobiidae includes about 210 genera and at least 1950 species, and is considered one of the most diverse groups among bony fishes (Nelson, 2006). Small size coupled with ecological and physiological flexibility has allowed members of this family to live in many different and sometimes harsh habitats (Thomson et al., 2000). Despite tropical habitats are rich in gobiids, they are often inconspicuous because of their tiny size and ecology; generally, gobies are cryptic species occupying crevices or interstices in the sand, reef or rocky substrates (Thacker, 2011). Even though, gobiids are an important component of the biodiversity in almost every environment, they are often poorly known and frequently misidentified. Amongst gobies the New World genus *Chriolepis* Gilbert 1892 are small, secretive, fishes with cryptobenthic lifestyle. They are sedentary species found in primarily insular and spatially restricted areas of reef-rock and rubble habitats in moderately-deep to deep shelf waters, typically known from only a few specimens (Findley, Unpub. PhD Diss), (Hastings & Findley, 2013; Hastings & Findley, 2015). Recent molecular studies (Tornabene et al., 2016) recognized the non-monophyly of *Chriolepis*, recovering the Atlantic species *Pycnomma roosevelti*, and the Pacific *Pycnomma semisquamatum* (now *Chriolepis roosevelti* and *C. semisquamata*, respectively) nested within this genus. *Chriolepis* has divided pelvic fins, although the inner bases of the fins are closely approximated; typically, species have seven spines in the first dorsal fin (Findley, Unpub.PhD Diss). As currently defined, *Chriolepis* differs from other genera of seven-spined gobies in lacking head pores in all species but *C. roosevelti* (Ginsburg, 1939) and *C. semisquamata* (Rutter, 1904) and by having at least some pelvic-fin rays branched (Hastings & Findley, 2015; Tornabene et al., 2016). Most species can be distinguished by extent of squamation or a combination of this character and color pattern. The inactive behavior of these secretive fishes, combined with small body size related to tight-crevice and rock-interspace inhabitation, has favored morphological adaptation and geographical isolation in these fishes (Findley, Unpub. PhD Diss). Eight species of *Chriolepis* occurs in the tropical eastern Pacific, three of which are endemics of oceanic islands with two of them only known from one or two specimens (e.g. pretty goby *Chriolepis lepidota* Findley 1975, Malpelo Island; and mystery goby *Chriolepis tagus* Ginsburg 1953, Galapagos Islands). This work presents for the first time, after its discovery, habitat data and photos in situ of the poorly known Malpelo endemic *C. lepidota*.

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Methods

Located on the Malpelo Ridge, a volcanic submarine crest that extends northeast-southwest, Malpelo (4°0′07″N; 81° 36′27″W) is a small Colombian oceanic island in the East Pacific Ocean, separated from mainland by approximately 500 km and depths greater than 3300 m (Graham, 1975). The island is part of a Colombian National Natural Parks system and actually is considered as a wildlife sanctuary, declared by UNESCO as a natural World Heritage Site. The present island is the remnant of a much larger structure, once eight to ten times bigger than its present size (Stead, 1975). Cocos, Malpelo and Carnegie Ridges are interpreted to be traces that began to form when the Galápagos hotspot initiated at ~20–22 Ma (Hey, 1977; Lonsdale et al., 1978). The Malpelo Ridge was separated from the Carnegie Ridge in the Miocene by now-extinct seafloor spreading (Lonsdale et al., 1978). Volcanic rocks from Malpelo Island yielded ages around 17 ~ 15 Ma (Hoernle et al., 2002).

Malpelo is one of several oceanic volcanic islands in the tropical eastern Pacific that have never been connected, even by shallow water, with any other islands or the mainland (Graham, 1975). Weather has eroded the island forming steep cliffs and sea caves along its sides (Stead, 1975). The site in which *C. lepidota* was observed is known as "El Arrecife" (4°0′15.81″N; 81°36′15.80″W, Fig. 1). This location has Malpelo's largest coral formation, located between 4 m and 30 m depth (Chasqui et al., 2007), and a flat area with cobbles and rubble interspersed with large-grained sand consisting of eroded coral and shells. The flat area (5–10 m depth) extends to the east about 150 m and sinks in a steep slope down to 30 m.

A total of 40 dives and 60 belt transects (20 × 2 m) were made along different sites of the island, assessing Malpelo's endemic fishes. Transects were performed at different depths ranks, along which fish were counted. According to depth of detection, two arbitrarily categories were designated: shallow for individuals seen above 10 m and deep for those observed below 10 m. Additionally, the diameter of individual grains of sediment, where the fish were hidden, was considered and its classification follows Wentworth scale (Wentworth, 1922). Finally, fish size was estimated by means of a PVC tube labeled each cm.

A combination of remoteness plus enough evolutionary time has driven speciation biogeographic isolation at Malpelo Island, as a consequence five endemic fish species, one of them *C. lepidota*, exist on the island (Chasqui et al., 2011; Robertson & Allen, 2015). This species had only been seen dead, after two specimens were collected using rotenone-based ichthyocide and SCUBA diving during the 1972 Smithsonian Institution-U.S. Navy Expedition to Malpelo Island. Findley (1975) (Findley, 1975) described the species, and the holotype and paratype (the only known specimens, up to this day) were deposited in the National Museum of Natural History (USNM), Smithsonian Institution, Washington, D. C., under catalog numbers, USNM 211456 and 211,457. Until this record, a very good sketch of the species illustrated by Jeanean Thomson was the only image available of this fish (Fig. 2) (Findley, 1975). *Chriolepis lepidota* can be easily distinguished from the additional three species of gobies found at Malpelo Island (*Bollmania spA, Coryphopterus urospilus* and *Lythrypnus dalli*) by having 7 spines on dorsal fin; pelvic fins completely separated; and by its marbled coloration, containing small black and white spots scattered over head and body; 2 black spots on pectoral base; 5 brown bands on body made-up by 2 dark areas separated by a whitish spotted line; yellow-whitish interspaces between bands with a brownish narrow vertical mid-line; a dorsal white thin line over head just behind the eyes; and a dark bar at the base of the caudal fin across the caudal peduncle. Dorsal (VII,11), anal (10 total elements) and pectoral (20) fin counts (made on photographs), as well as color pattern corresponds in many ways to original drawing and description of the species (see Fig. 2 and Fig. 3) (Findley, 1975).

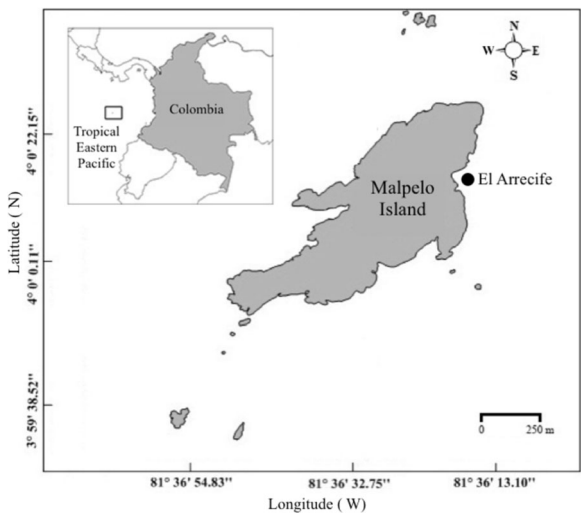

Fig. 1 El Arrecife, site where the endemic gobiid fish *Chriolepis lepidota* was observed. Malpelo Island, Colombia

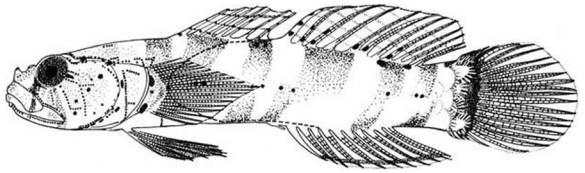

Fig. 2 *Chriolepis lepidotus*, holotype, USNM 211456, male, 30.0 mm SL. Drawing by Jeanean Thomson. Reproduced with permission of Lloyd Findley

Fig. 3 Photographs of *Chriolepis lepidota* at Malpelo Island, Colombia. Pictures credit belongs to Stephania Rojas

Results

Almost half a century passed before *C. lepidota*, a fish that had never been seen alive, could be detected. During a 12-day expedition made from the 5 th to the 16 th of March 2017, several specimens of the species were photographed (Fig. 3). Coincidentally the only two specimens known of this species were also collected in March (2nd and 3rd) back in 1972. The banded color pattern shown by *C. lepidota*, certainly related to its cryptic mode of life, kept this species out of sight for 45 years. *C. lepidota* was discovered on the east side of the island and its identity was confirmed using (Robertson & Allen, 2015; Findley, 1975) and (Findley, Unpub. PhD Diss). The small marbled looking fish was observed, at depths between 8 m to 18 m, over rocky bottom with some calcareous sand and very sparse algal growth. Ten small (2–4 cm) specimens were detected, on the flat portion of El Arrecife, posed over cobbles where they seek refuge underneath few seconds after being recognized. Eight bigger specimens (4–7 cm), were found deeper over the slope hidden in crevice-like interspaces under or at the bases of boulder size rocks. The habitat in which *C. lepidota* was found corresponds accurately with previous descriptions of preferred habitats in which most eastern Pacific *Chriolepis* have been collected (Findley, Unpub. PhD Diss). Our observations extend species maximum size to approx. 6 cm.

Discussion

C. lepidota distribution suggests that habitat segregation might be related to size, with smaller individuals (n = 10) living on flat shallower bottoms underneath cobbles, and bigger ones (n = 8) found over the slope hidden in the interspaces under boulders and rocks crevices sheltered at the interface between sand and rock. Possibly, three major environmental gradients, acting together or independently, influence species segregation: substrate inclination, depth and grain size (Fig. 4). This preliminary result prompts a testable hypothesis for future ecological studies.

According to the IUCN red list of threatened species *C. lepidota* is considered as Vulnerable (Findley & Van Tassell, 2010), being the increased duration and frequency of ENSO events the mayor threats identified, given the restricted range of this species. Despite being an endemic to Malpelo Island, regional assessment includes it under the category Data Deficient given the

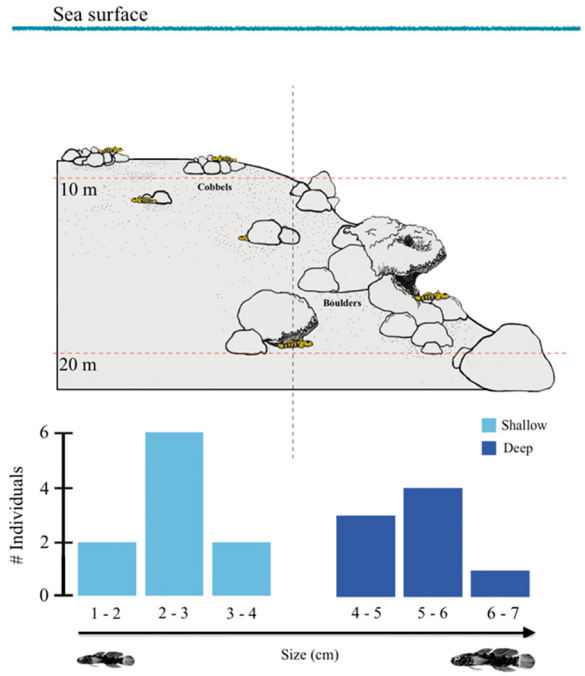

Fig. 4 Schematic diagram of environmental factors inferred to affect *Chriolepis lepidota* habitat segregation (substrate inclination, depth and grain size). The black dashed line indicates an abrupt change on substrate inclination; red dashed lines show 10 m depth increments; cobbles: grain size <250 mm, boulder: grain size >250 mm. Lower bar plot shows total of fish detected by size intervals colored according to depth: shallow correspond to observations above 10 m and deep below 10 m

lack of information available for the species (Zapata & Chasqui, 2017). This paper constitutes the first data published for this species since its discovery.

Finally, there is much more to investigate about this endemic species. Quoting J. L. B. Smith (1958) in (Findley, Unpub. PhD Diss): *"The gobioid fishes are one of the major trials of ichthyologists… Being of little or no economic significance, although normally abundant, especially in tropical areas, these fishes are virtually unknown to any but the expert seeking them".*

Conclusions

Up to this date, reports regarding *Chriolepis lepidota* were lacking and the existence of the species was even questioned. This report represents the first record of *C. lepidota* after its description (1975) and increases our biological and ecological knowledge on this cryptic species. It also highlights the need for a comprehensive assessment of Pacific Colombian fish diversity, which have been overseen for decades.

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Authors' contributions
JT sight and identified the fish, collected data and drafted the manuscript; SRV collected data photographed *C. lepidota* and reviewed the manuscript. Both authors read and approved the final manuscript.

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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