




First records of Yellowbar King Angelfish, *Pomacanthus maculosus* (Forsskal, 1775) (Perciformes, Pomacanthidae), in the Tropical Eastern Pacific

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Abstract

The first records are presented of *Pomacanthus maculosus* (Forsskal, 1775) in the Tropical Eastern Pacific. The natural range of this fish species extends from the Persian Gulf to the coast of East Africa. Two adults were recorded at Los Arcos de Mismaloya, México, one in June 2018 and another in September 2020, 1 km from the site of the first observation. This species was probably introduced into this area as an aquarium release due to proximity of the two sites to highly dense human population centers.

Keywords

Exotic, fish, introduced, marine, reef

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Introduction

Introduced species can alter ecosystems by preying on and competing with indigenous species as well as introducing parasites and pathogens that are potentially dangerous to native ecosystems (Arndt et al. 2018). Among the marine fish species recorded as introduced or invasive are fishes whose colorful patterns make them a target of interest for the exotic species trade market, such as angelfishes, family Pomacanthidae (Semmens et al. 2004; Deidun et al. 2020). The Pomacanthidae are comprised of 90 tropical reef-dwelling species inhabiting the Atlantic, Indian, and Pacific oceans (Fricke et al. 2022). The characteristic traits of this family of reef fishes are deep, strongly laterally compressed bodies, large preopercular spines, and contrasting colorful patterns that differ

considerably between juvenile and adult phases (Nelson et al. 2016). Here, I report the presence of Yellowbar King Angelfish, *Pomacanthus maculosus* (Forsskal, 1775), at Los Arcos de Mismaloya, Jalisco, México, in Bahía de Banderas, located in the Tropical Eastern Pacific. *Pomacanthus maculosus* is naturally distributed from the Persian Gulf to the coast of Mozambique, East Africa (Fig. 1A). This species inhabits shallow reefs (Schofield 2022), and due to its characteristic color pattern (adults being light blue with an elongate oval-shaped yellow bar on the side of the body under the center of the dorsal fin and a pale caudal fin), it is an easily identifiable species (Bariche 2010) that is commonly traded as an ornamental fish (Okemwa et al. 2016). *Pomacanthus maculosus*

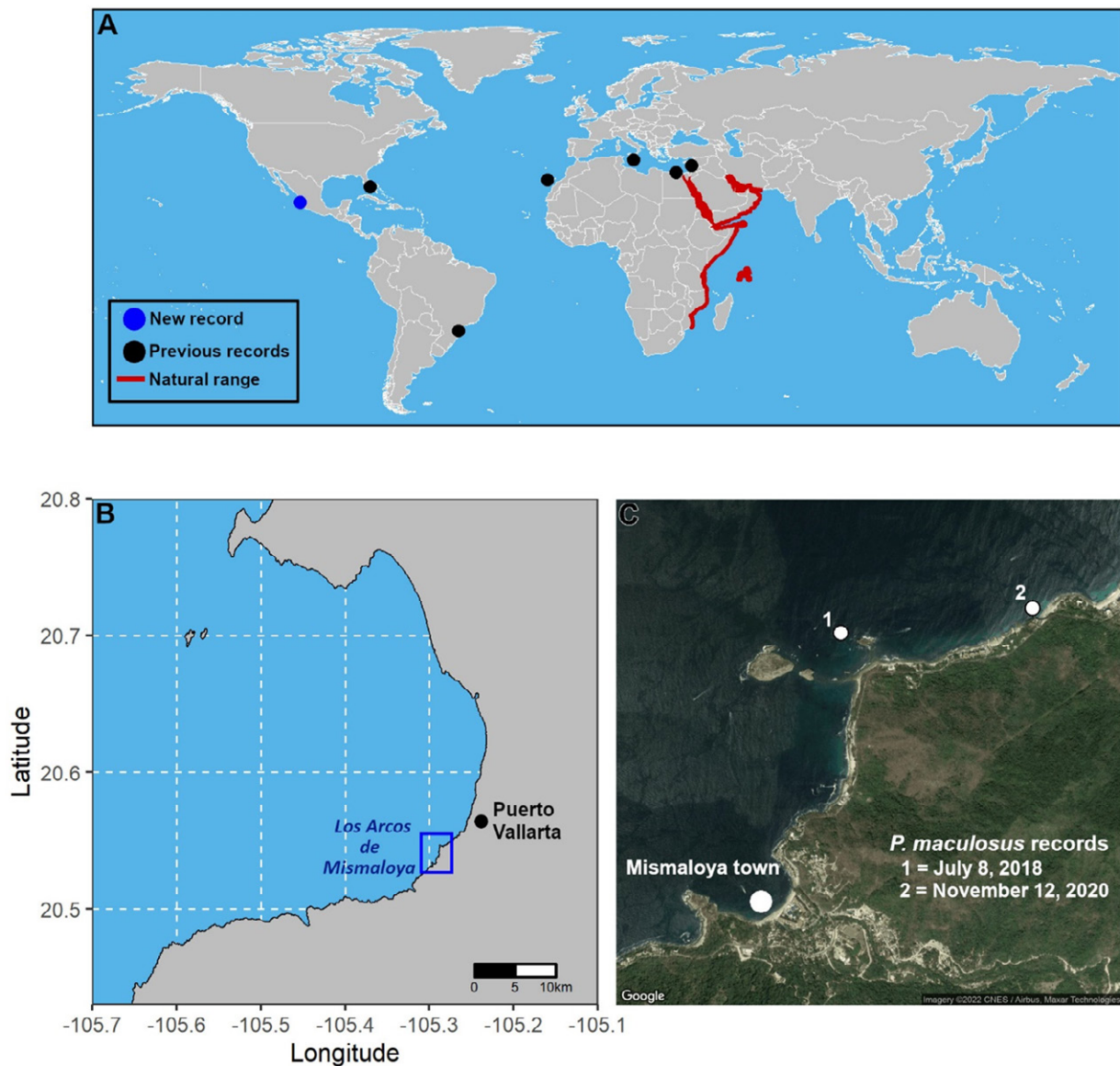


Figure 1. A. Map with the natural range of *Pomacanthus maculosus* in red, records of the species as introduced as black dots and the area of observation in the Tropical Eastern Pacific marked with a blue dot. B. Map of Bahia de Banderas and the location of Los Arcos de Mismaloya marked with a blue rectangle. C. Satellite image of Los Arcos de Mismaloya with white dots and numbers indicating date of observation: 1 = 8 July 2018; 2 = 12 November 2020. Distribution range data of *P. maculosus* downloaded from IUCN (2010). Previous records of *P. maculosus* compiled from Semmens et al. (2004), Brito et al. (2005), Salameh et al. (2012), Evans et al. (2016), Soeth et al. (2018), and Al Mabruk et al. (2021).

is recorded outside of his natural range in the Mediterranean Sea (Salameh et al. 2012; Evans et al. 2016; Al Mabruk et al. 2021), the western (Brazil and Florida) and eastern Atlantic Ocean (Canary Islands), and the central Pacific (Semmens et al. 2004; Brito et al. 2005; Soeth et al. 2018) (Fig. 1A). However, there is no scientific record of its presence in the Eastern Pacific.

Methods

During a recreational scuba dive, I saw an individual of *Pomacanthus maculosus* on 8 July 2018. This individual was videorecorded by my partner using a GoPro Hero 5 at 2.6 k resolution (Fig. 2B; Supplementary file Video S1). A second record of this species from a nearby site was recovered from the iNaturalist database (iNaturalist

2020) (Fig. 2C; Supplementary file Fig S1). Species identification follows Schofield (2022).

Results

Pomacanthus maculosus (Forsskål, 1775)

New records. MEXICO – Jalisco • Los Arcos de Mismaloya; 20.546, –105.288; 8 m depth; 8.VI.2018; A.A. Zavala-Jiménez obs.; 28 °C water temp. • Same locality; 20.547, –105.278; 12.XI.2020; C.S. Martínez-Pérez obs. (iNaturalist 2020).

Identification. *Pomacanthus maculosus* is characterized by having 12 or 13 dorsal spines, 21 dorsal soft rays, 3 anal spines, and 19 or 20 anal soft rays. Juveniles are darkly colored with iridescent blue-and-white bars,

while adults usually are light blue with an elongate oval yellow bar on the side of the body under the center of the dorsal fin and a pale caudal fin (Fig. 2A). The caudal color varies from pale blue-white to white or cream, and in some individuals the yellow body bar can be dark. Furthermore, some Red Sea specimens have grey bodies and an orange body bar (Debelius et al. 2003). Two pomacanthids are native to the continental shores of the Tropical Eastern Pacific: *Holacanthus passer* Valenciennes, 1846 and *Pomacanthus zonipectus* (Gill, 1862). Neither *P. zonipectus* and *H. passer* resemble *P. maculosus* in color and shape when adult (Fig. 2). *Holacanthus passer* has a dark blue body with a slender straight white bar on the upper flank under the front part of the dorsal fin, and a yellow caudal fin, while *P. zonipectus* has a yellow body with a lobe-shaped anal fin (Fig. 2). However, *Pomacanthus asfur* (Forsskal, 1775), another angelfish species reported as introduced to the Gulf Coast of Florida (Semmens et al. 2004), has similarities to *P. maculosus* which can lead to misidentifications (Evans and Schembri 2017). Distinguishing characteristics of *P. asfur* include a dark blue to black body, a bright yellow caudal fin, a curved, bright yellow bar on the side of the body under the front part of the dorsal fin (further forward than the bar in *P. maculosus*), and a filament extending from the rear end of the dorsal fin (Debelius

et al. 2003). Both individuals recorded at Los Arcos de Mismaloya showed morphological attributes of *P. maculosus* rather than *P. asfur*, including pointed oblique mouths, light blue body color, pale yellow caudal fin, and elongated filaments at the end of the dorsal fin (Salameh et al. 2012; Evans and Schembri 2017), as well as the same color pattern of the adult stage. The individual recorded in the 2018 video (Fig. 2B, Supplementary file Video S1) was swimming around a prominent rock formation. In the video a large *Microspathodon dorsalis* (Gill, 1862), a damselfish endemic to the Tropical Eastern Pacific is also recorded, confirming that the video was taken in that region. The second individual observed in 2020 was photographed in a similar environment and in a feeding position (Fig. 2C, Supplementary Fig. S1). Both fish likely were the same individual, as both records were adult and observed within 1 km of each other.

Discussion

Los Arcos de Mismaloya is a protected area composed of a group of four promontories surrounded by rocky reefs, coral communities, and sandy patches, located on the southern coast of Bahía de Banderas, Mexico, within the Tropical Eastern Pacific (Medina-Rosas and Cupul-Magaña 2001). Given the distance between Los Arcos de Mismaloya and the nearest known points of occurrence (ca. 2600 linear km to Florida, USA and ca. 8000 linear km to Paraná, Brazil) and the biogeographical barriers between these points, it is unlikely that the introduction of *Pomacanthus maculosus* was caused by natural dispersal or as larvae hitchhiking in ships' ballast water. This species is traded in the ornamental fish trading business, which is the most probable cause of its presence in the Atlantic Ocean (Brito et al. 2005; Semmens et al. 2004; Soeth et al. 2018). Along the coastline adjacent to Los Arcos de Mismaloya, there are tourist and real estate developments, and the city of Puerto Vallarta (population >220,000) (INEGI 2020) is approximately 8 km away from the park (Fig. 1C). The presence of cities and other areas of high human density has been linked to an increase in the number of introduced species reported in coastal cities of southern Florida (Semmens et al. 2004). Therefore, the introduction of *P. maculosus* into Los Arcos de Mismaloya is mostly likely by aquarium release in the ocean.

Los Arcos de Mismaloya is a tropical coastal ecosystem that harbors a rich marine biodiversity (Medina-Rosas and Cupul-Magaña 2001; Stokes et al. 2019) including two species of pomacanthids endemic to the Tropical Eastern Pacific: *Pomacanthus zonipectus* and *Holacanthus passer*. *Pomacanthus maculosus* is known to be host of exotic parasite species and to produce hybrids with other pomacanthid species (Kemp 2000; Li et al. 2016). Thus, the introduction of this species may cause negative effects on the ecosystem that could gradually increase in magnitude. The record of introduced species in Los Arcos de Mismaloya adds to the

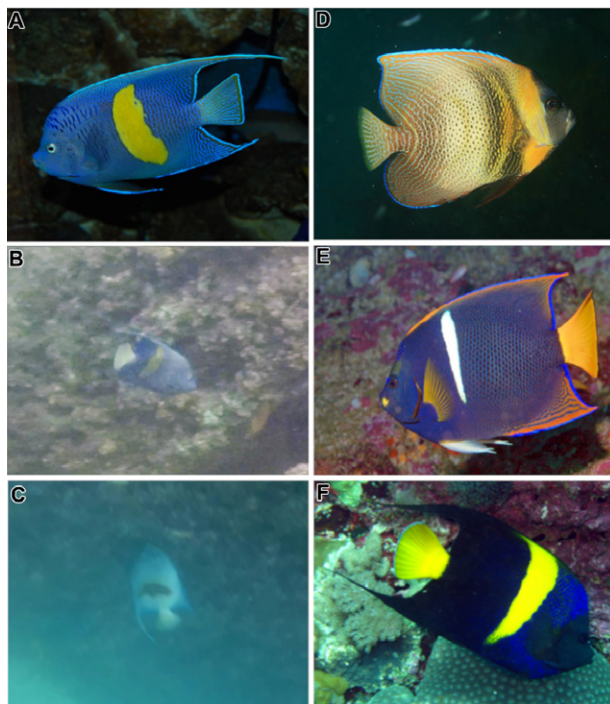


Figure 2. A–C. *Pomacanthus maculosus*: (A) adult individual in the Red Sea on 12 May 2008; (B) individual recorded at Los Arcos de Mismaloya on 8 July 2018; (C) individual at Playa Paredón on 12 November 2020. D, E. Adult individuals of endemic angelfishes of the Tropical Eastern Pacific: (D) *Pomacanthus zonipectus* and (E) *Holacanthus passer*. F. Adult individual of *Pomacanthus asfur*. Photos: A = Heinz Albers (Wikimedia, CC by 3.0), B = videoframe modified from Dave Fitzgerald (Supplementary Video S1), C = modified from Christian Saúl Martínez-Pérez (iNaturalist 2020) (CC by NC 4.0), D and E = Laszlo Ilyes (Wikimedia, CC by 3.0), F = Sylvain Le Bris (iNaturalist, CC by NC).

negative human impacts currently known to be present in the area, such as illegal fishing, seabed removal, and destruction of coral reef colonies by anchoring and tourism malpractices (Balzaretto-Medino et al. 2021; Medina-Rosas and Cupul-Magaña 2001; Stokes et al. 2019). Even when it seems that it is the same *P. maculosus* individual sighted twice, the presence of more individuals should not be ruled out. Therefore, future efforts should focus on the analysis of habitat suitability for *P. maculosus* in the Tropical Eastern Pacific as well as biological monitoring at Los Arcos de Mismaloya and surrounding reef areas to evaluate the establishment of the species and possible means of eradication.

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Supplemental Files

Supplementary Video 1. *Pomacanthus maculosus* recorded at Los Arcos de Mismaloya on 6 July 2018.

Supplementary Figure 1. Photograph of an individual of *Pomacanthus maculosus* in Bahía de banderas on 12 November 2020, uploaded to the iNaturalist platform (taken from: <https://www.naturalista.mx/observations/65097776>).