



# New records of fishes for the Vitória-Trindade Chain, southwestern Atlantic

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## Abstract

Oceanic islands and seamounts present high and unique biodiversity; however, these environments are still poorly understood. Here we report seven new records of fishes for Martin Vaz Archipelago, five for Trindade Island, and one for Davis Seamount, in the Vitória-Trindade Chain. Three species, *Cookeolus japonicus* (Cuvier, 1829), *Promethichthys prometheus* (Cuvier, 1832), and *Psenes cyanophrys* Valenciennes, 1833 are new records for the whole chain. Such isolated sites are among the last frontiers for shallow-reef exploration in the South Atlantic, and more scientific effort is needed to better understand their biogeography and to help advance conservation efforts.

## Keywords

Biodiversity, biogeography, Brazilian Province, conservation, oceanic islands, reef fish, seamounts.

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## Introduction

The Brazilian Province harbors a substantial proportion of endemic reef fish species (ca 24%) and is considered a secondary biodiversity center in the Atlantic Ocean (Pinheiro et al. 2018). Within this region, oceanic islands and seamounts play an important role in increasing the provincial biodiversity as they have high levels of endemism (Hachich et al. 2015; Pinheiro et al. 2015a, 2017). Although Brazilian oceanic islands and seamounts have been the focus of several studies in the past two decades, the remoteness and difficulty in accessing many of these isolated environments precludes

comprehensive biodiversity surveys. Whereas there is great sampling effort in some oceanic islands (Fernando de Noronha Archipelago, Trindade Island, and St. Peter and St. Paul's Archipelago), yielding many records of reef fish species, the Martin Vaz Archipelago and most of the Brazilian seamounts are poorly studied and have rarely been sampled.

For instance, studies on reef fish biodiversity have been conducted in Trindade Island since the early 20th century (Murray 1902; Nichols and Murphy 1914; Miranda Ribeiro 1919; Carvalho 1950), with more accu-

rate surveys conducted one century later (e.g. Gasparini and Floeter 2001; Pinheiro et al. 2009; Simon et al. 2013). In contrast, Martin Vaz Archipelago, only 50 km east of Trindade, and some seamounts were first investigated in 1992 (Séret and Andreata 1992; Andreata and Séret 1995), with more detailed assessments conducted recently (Pinheiro et al. 2015a; Simon et al. 2013). So far, it has been assumed that Trindade and Martin Vaz are part of a single zoogeographical unit, an assumption that is reasonable given the geographic proximity and the geological similarity of the two island groups (Pereira-Filho et al. 2011; Pinheiro et al. 2009; Simon et al. 2013). However, the low sampling effort in Martin Vaz precludes an accurate estimate. Indeed, while there are 173 fish species recorded in Trindade, only 73 have been recorded in Martin Vaz (Pinheiro et al. 2015a). Therefore, a close look into the marine fauna of oceanic islands and detailed analysis over some taxonomically complex groups could reveal more species, as suggested by the number of endemic species described in the past few years (Pinheiro et al. 2013, 2016; Smith-Vaniz et al. 2018).

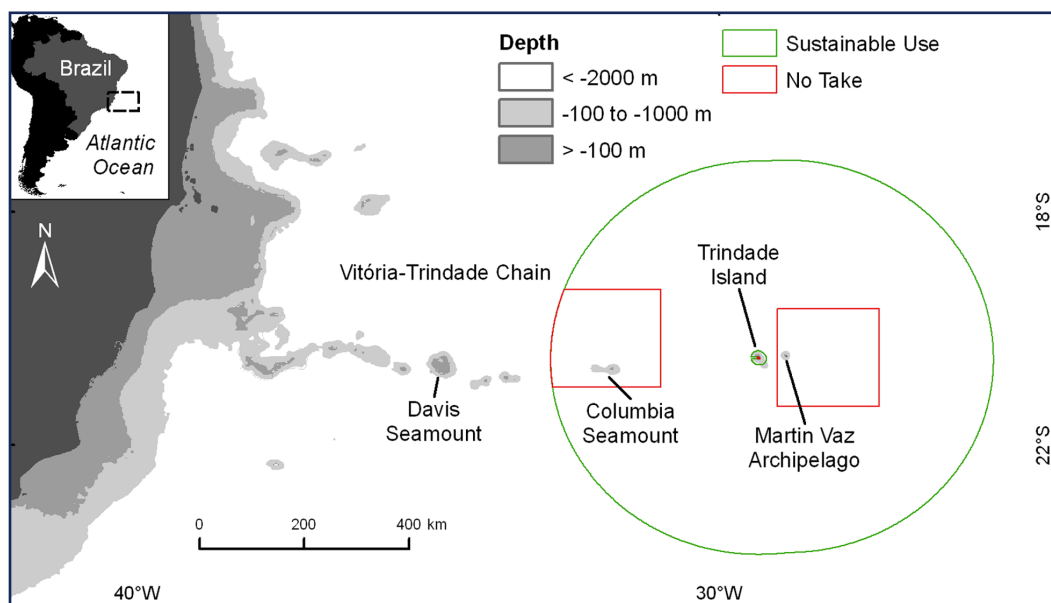
The Brazilian government recently created a large Marine Protected Area (MPA, including no-take and sustainable use zones) in the Vitória-Trindade Chain (VTC), partially encompassing the islands of Trindade and Martin Vaz and the Columbia seamount (Soares and Lucas 2018; see also Giglio et al. 2018). However, the Davis Seamount, which lies in international waters in the middle of the chain, is one of the largest and most biodiverse seamounts of the VTC and is currently unprotected and threatened by fishing and mining (Pinheiro et al. 2014). Thus, management and conservation programs could greatly benefit from studies in most of these remote sites. This study aims to contribute information about fish biodiversity of some of the least studied shallow reefs of the

Brazilian Province, adding new records of occurrences for Martin Vaz Archipelago, Trindade Island, and Davis Seamount which are located within the VTC.

## Methods

**Study area.** The VTC is composed of several volcanic seamounts situated between the latitudes of 19° and 21°S, extending from 200 to 1200 km off the Brazilian central coast (Fig. 1). The islands of Trindade and Martin Vaz are the only emerged areas and also the youngest and farthestmost structures of the VTC (Cordani 1970). Within the VTC, Davis Seamount is in the central portion of the chain, in international waters, approximately 600 km from the coast. The Martin Vaz Archipelago is at the eastern edge of the VTC, while Trindade is located approximately 50 km west of Martin Vaz. Trindade Island seems to harbor the richest fish fauna along the VTC, followed by Vitória and Davis seamounts (Pinheiro et al. 2015a).

**Data collection.** The new records presented here are the results of four expeditions, one conducted in June 2015 to Martin Vaz Archipelago (one dive with two divers), one in February 2018 to Davis Seamount (one dive with seven divers), and two expeditions to Trindade Island between October 2017 and August 2019. New fish records were made by specimen collection, photographs, and baited remote underwater videos (stereo-BRUVs). Collected specimens were first identified following the most detailed taxonomic guide of Southwestern Atlantic reef fishes (e.g. Carvalho-Filho 1999) and then compared to other specimens of the Coleção Ictiológica da Universidade Federal do Espírito Santo (CIUFES). All collected specimens were deposited at CIUFES. The taxonomy of fishes belonging to the genus *Kyphosus* Lacepède 1801 remains dubious due to morphological



**Figure 1.** Map of the Vitória-Trindade Chain, southwestern Atlantic, showing study sites and the limits of sustainable use and no-take Marine Protected Areas of Trindade and Martin Vaz.

characters which are confounding. Such characters were recently clarified (Knudsen and Clements 2013, 2016), allowing for the identification of photographed specimens. Moreover, we conducted a photographic database review [field trips described by Pinheiro et al. (2010)] to identify unreported fish occurrences from the Martin Vaz Archipelago.

## Results

Seven species are recorded for the first time in the Martin Vaz Archipelago, one species in Davis Seamount, and five species in Trindade Island. At least three species, *Cookeolus japonicus* (Cuvier, 1829), *Promethichthys prometheus* (Cuvier, 1832), and *Psenes cyanophrys* Valenciennes, 1833 are newly recorded for the whole VTC. The family Apogonidae is recorded for the first time from Martin Vaz with two species, *Apogon americanus* Castelnau, 1855 and *Phaeoptyx pigmentaria* (Poey, 1860), while Aulostomidae, with *Aulostomus strigosus* Wheeler, 1955 and Nomeidae (*Psenes cyanophrys*), were recorded for the first time on Davis Seamount and Trindade, respectively.

The previously underestimated diversity and doubtful occurrence of Kyphosidae (Pinheiro et al. 2015a) is now clarified with photographic records of all four species (Fig. 2) occurring in the Atlantic Ocean (Knudsen and Clements 2016): *Kyphosus bigibbus* Lacepède, 1801, *Kyphosus cinerascens* (Forsskål, 1775), and *Kyphosus*

*vaigiensis* (Quoy & Gaimard, 1825), recorded for the first time, and *Kyphosus sectatrix* (Linnaeus, 1758) [already reported by Gasparini and Floeter (2001)]. *Aluterus monoceros* (Linnaeus, 1758) was also recorded for the first time in Trindade Island.

Three additional species were seen in Martin Vaz but neither collection nor photographs were made. Two of them are undescribed species belonging to the genera *Acyrtus* Schultz 1944 and *Lythrypnus* Jordan & Evermann 1896 [see Pinheiro et al. (2018) for further details] and are likely endemic to the VTC. The third was *Sparisoma rocha* Pinheiro, Gasparini & Sazima, 2010, a species endemic to the VTC. These taxa were not counted as new records due to the absence of vouchers or photographs.

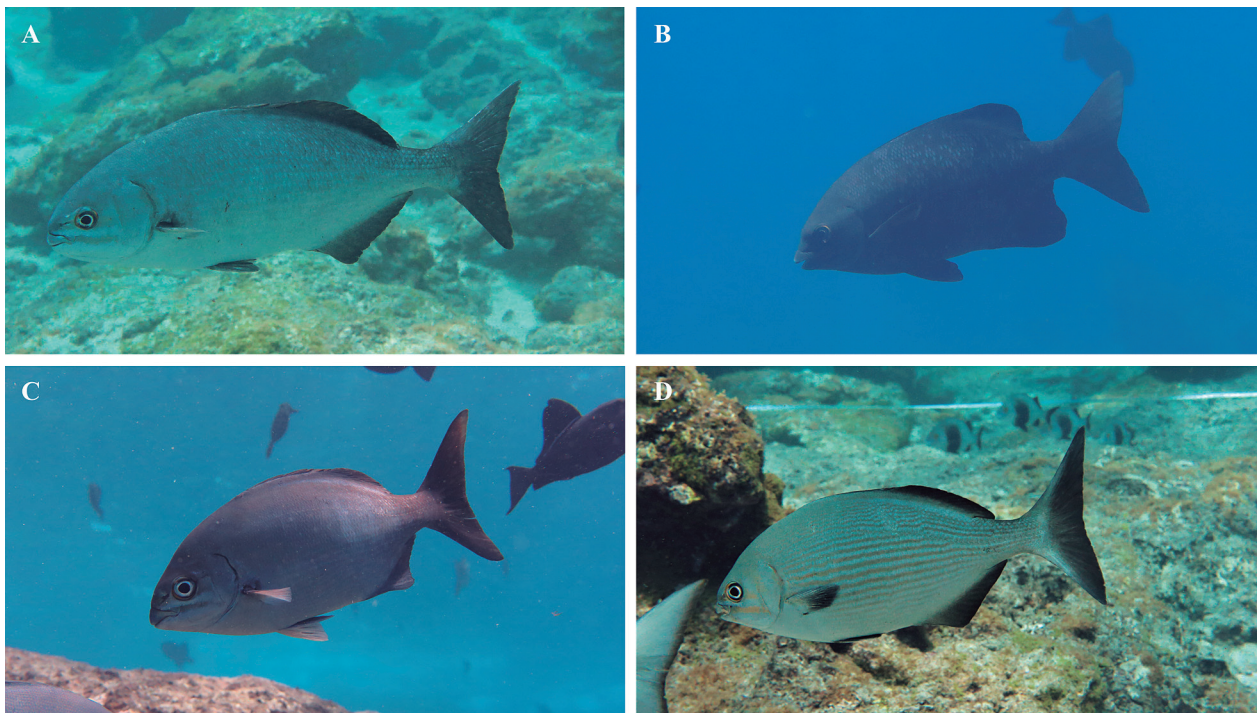
### *Aluterus monoceros* (Linnaeus, 1758)

**New record.** Brazil • 4; Trindade Island; 20°29'16"S, 029°19'26"W; 32 m depth; 19 Oct. 2017; C.R. Pimentel leg.; recorded by stereo-BRUVs at Cabritas Beach (Fig. 3). Specimen not collected.

**Identification.** Silvery coloration, elongated body, caudal peduncle longer than deep and caudal fin deeper than long.

### *Apogon americanus* Castelnau, 1855

**New record.** Brazil • 1; Martin Vaz Archipelago; 20°28'30"S, 028°51'16"W; 18 m depth; 20 Jun. 2015; T. Simon leg.; CIUFES 3339 (Fig. 4).



**Figure 2.** Records of the Kyphosidae species for Trindade Island. **A.** *Kyphosus bigibbus*: oblong body, brownish to silvery coloration with dusky caudal and unpaired (dorsal and anal) fins and opercular margin black. **B.** *Kyphosus cinerascens*: deeper body compared to other species of *Kyphosus*, bluish-grey to black coloration, distal tip of dorsal and anal fins rounded and highly elevated. **C.** *Kyphosus sectatrix*: oblong, deep and wider body, anal fin proximal portion prominent and caudal fin not deeply emarginated. **D.** *Kyphosus vaigiensis*: elongated body, golden lines on the face and horizontally along the body, besides opercular margin also with golden coloration. Photographs by G.C. Cardozo-Ferreira.



**Figure 3.** *Aluterus monoceros* (black arrow) recorded by baited remote underwater video systems (BRUVs) in Trindade Island. Photograph by C.R. Pimentel.

**Identification.** Brazilian endemic *Apogon*, pink to reddish coloration, no dark spot beneath second dorsal fin and slight dark spot in the edge of the operculum (Fig. 4). Comparative material: *Apogon americanus* (CIUFES 1255, 1407, 2670, 3103); *Apogon pseudomaculatus* (CIUFES 2727); *Apogon planifrons* (CIUFES 1246); *Apogon quadrisquamatus* (CIUFES 1218).

***Aulostomus strigosus* Wheeler, 1955**

**New record.** Davis Seamount • 1; international waters; 20°40'02"S, 034°45'10"W; 25 m depth; 07 Feb. 2018; L.A. Rocha leg.; photographed (Fig. 4). Specimen not collected.

**Identification.** Elongated and cylindrical body, usually with gray-brown to reddish coloration. Dorsal and anal fin close to caudal fin (Fig 4). Recent revision of Brazilian Province fish fauna recognized only *A. strigosus* occurring in the region (Pinheiro et al. 2018).

***Cookeolus japonicus* (Cuvier, 1829)**

**New record.** Brazil • 1; Martin Vaz Archipelago; 20°28'30"S, 028°51'16"W; between 100 and 150 m depth; 27 Mar. 2007; H.T. Pinheiro leg.; commercial fishing vessel *Oceania*; specimen caught by bottom line; photographed (Fig. 5). Specimen not collected.

**Identification.** Reddish body with soft dorsal and anal fins long and slightly pointed.

***Enneanectes altivelis* Rosenblatt, 1960**

**New record.** Brazil • 1; Martin Vaz Archipelago; 20°28'30"S, 028°51'16"W; 20 m depth; 20 Jun. 2015; T. Simon leg.; CIUFES 3342.

**Identification.** Small elongated body with reddish to transparent coloration, three or four dusky diagonal bars along the body, and another similar bar at the base of the caudal fin. Comparative material: *Enneanectes altivelis* (CIUFES 870, 2236, 2214).

***Kyphosus bigibbus* Lacepède, 1801**

**New records.** Brazil • 1; Trindade Island; 20°30'17"S, 29°18'40"W; 5–10 m depth; 29 Aug. 2019; G.C. Cardozo-Ferreira leg.; photographed at Tartarugas Beach (Fig. 2). Specimen not collected.

**Identification:** Oblong body, brownish to silvery coloration with dusky caudal and unpaired (dorsal and anal) fins and black opercular margin.

***Kyphosus cinerascens* (Forsskål, 1775)**

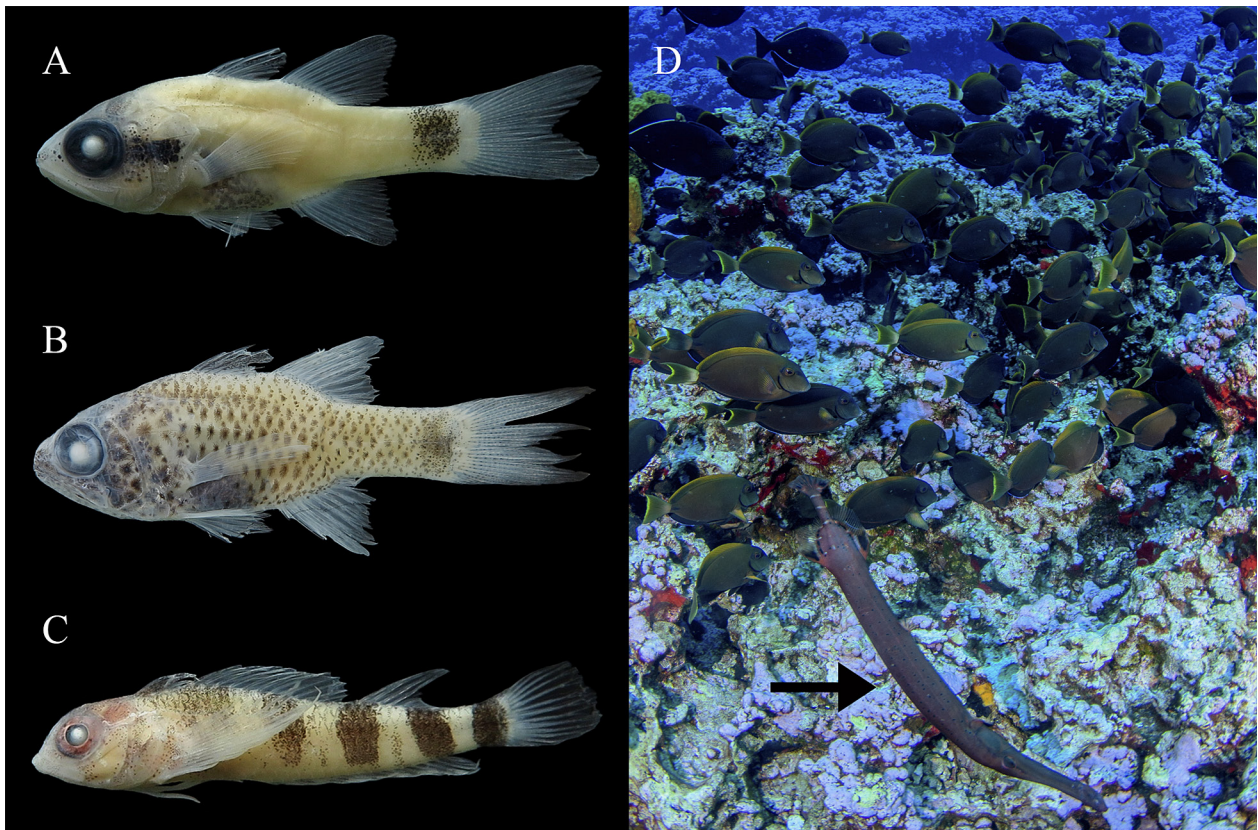
**New records.** Brazil • 1; Trindade Island; 20°30'17"S 29°18'40"W; 5–10 m depth; 5 Sep. 2019 G.C. Cardozo-Ferreira leg.; photographed around carbonate reefs (Fig. 2). Specimen not collected.

**Identification:** Deeper body compared to other species of *Kyphosus*, bluish-grey to black coloration, distal tip of dorsal and anal fins rounded and elevated.

***Kyphosus vaigiensis* (Quoy & Gaimard, 1825)**

**New records.** Brazil • 1; Trindade Island; 20°30'17"S, 029°18'40"W; 5–10 m depth; 5 Sep. 2019 G.C. Cardozo-Ferreira leg.; photographed around carbonate reefs (Fig. 2). Specimen not collected.

**Identification.** Elongated body, golden lines on the face and horizontally along the body, opercular margin also with golden coloration.



**Figure 4.** New records of shore fishes for Martin Vaz Archipelago and Davis Seamount. **A.** *Apogon americanus* (CIUFES 3339). **B.** *Phaeoptyx pigmentaria* (CIUFES 3340). **C.** *Enneanectes altivelis* (CIUFES 3342). **D.** *Aulostomus strigosus* (black arrow). Photographs by H. Guabiroba (A, B, and C) and L. Rocha (D).

***Phaeoptyx pigmentaria* (Poey, 1860)**

**New records.** Brazil • 1; Martin Vaz Archipelago; 20°28'30"S, 028°51'16"W; 20 m depth; 20 Jun. 2015; T. Simon leg.; CIUFES 3340 (Fig. 4).

**Identification.** Transparent body with pale orange to pinkish brown coloration and scattered spots, dark blotch at caudal peduncle, but no dark pigment at the base of second dorsal and anal fins. Comparative material: *Phaeoptyx pigmentaria* (CIUFES 1556, 1239, 3101).

***Promethichthys prometheus* (Cuvier, 1832)**

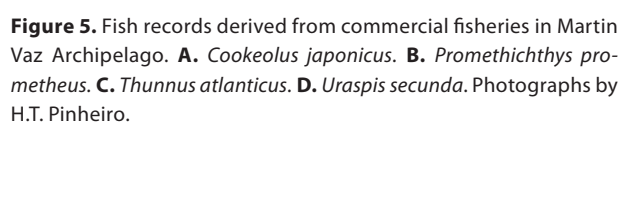
**New records.** Brazil • 1; Martin Vaz Archipelago; 20°28'30"S, 028°51'16"W; between 100 and 150 m depth; 27 Mar. 2007; H.T. Pinheiro leg.; commercial fishing vessel *Oceania*; specimen caught by bottom line; photographed (Fig. 5). Specimen not collected.

**Identification.** Body moderately elongate and mouth with fang-like teeth and dusky fins.

***Psenes cyanophrys* Valenciennes, 1833**

**New records.** Brazil • 1; Trindade Island; 20°30'17"S, 029°18'40"W; 0.5 m depth; 03 Sep. 2019; G.C. Ferreira-Cardozo leg.; CIUFES 3961. Specimen was collected while rafting under a plastic box.

**Identification.** Green-yellowish coloration, caudal fin deeply emarginated and fine horizontal lines along sides of body.



**Figure 5.** Fish records derived from commercial fisheries in Martin Vaz Archipelago. **A.** *Cookeolus japonicus*. **B.** *Promethichthys prometheus*. **C.** *Thunnus atlanticus*. **D.** *Uraspis secunda*. Photographs by H.T. Pinheiro.

***Uraspis secunda* (Poey, 1860)**

**New records.** Brazil • 1; Martin Vaz Archipelago; 20° 28'30"S, 028°51'16"W; between 100 and 150 m depth; 27 Mar. 2007; H.T Pinheiro leg.; commercial fishing vessel *Oceania*; specimen caught by bottom line; photographed (Fig. 5). Specimen not collected.

**Identification.** Dark gray coloration, deeply oval body and short bluntly-pointed snout.

***Thunnus atlanticus* (Lesson, 1831)**

**New records.** Brazil • 1; Martin Vaz Archipelago; 20° 28'30"S, 028°51'16"W; between 10 and 15 m depth; 27 Mar. 2007; H.T Pinheiro leg.; commercial fishing vessel *Oceania*; photographed (Fig. 5). Specimen not collected.

**Identification.** Fusiform body with bluish-black to brownish stripe in upper side. Pectoral, second dorsal, and anal fins dusky.

## Discussion

The Martin Vaz Archipelago and Davis Seamount are among the least explored sites of the VTC and Brazilian Province. For instance, while there are over 200 scientific dives cumulatively logged by our team in Trindade Island, only 20 dives were made in Martin Vaz and 46 in Davis (Pinheiro et al. 2015a). With one more dive in Martin Vaz and Davis, and recovering unreported species from our photographic database, we update the number of fish records to 80 and 104 in each site, respectively. The rate of new records per dive decreased from nine (Pinheiro et al. 2009; Simon et al. 2013) to three (this study) in Martin Vaz, and from 1.5 (Pinheiro et al. 2015a) to one (this study) in Davis Seamount. However, even in well-sampled sites, such as Trindade, the constant sampling effort and the use of different methods (e.g. stereo-BRUVS) still yielded new records (e.g. *Aluterus monoceros* and *Psenes cyanophrys*).

Within oceanic islands, the arrival of migrants (mainly those with wide distribution and good dispersal potential) is expected (Pinheiro et al. 2017; Ávila et al. 2019), which makes a continuous sampling effort necessary for understanding biogeographic patterns. Also, new records of kyphosids for Trindade Island bring attention to the need of detailed studies on taxonomically challenging groups. Pinheiro et al. (2015a) already indicated the possibility of occurrence of multiple *Kyphosus* species in Trindade based on video and photo archives. Recent morphological (Knudsen and Clements 2013), phylogenetic and biogeography studies (Knudsen and Clements 2016) are disentangling and clarifying their differences and occurrences worldwide. More taxonomic and genetic surveys on the isolated fish populations of the VTC might disclose the existence of even more cryptic lineages and species in the region.

Three of the new records presented here for Martin Vaz are cryptobenthic fishes of small body size, which makes them difficult to be detected. On the other hand,

four of the new records are derived from commercial fishery activities, which highlight the importance of fisheries monitoring programs not just for conservation purposes, but also for biodiversity assessments. Recent surveys using artisanal fishing gear in St. Peter and St. Paul Archipelago revealed many new records, including new species (Nunes et al. 2016), and an extensive biodiversity investigation in a coastal island found that up to 26% of the fish records were exclusively reported via fisheries (Pinheiro et al. 2015b). The new records presented here seem to approximate Trindade and Martin Vaz as a single zoogeographical unit; however, we highlight that at least six species [*Cookeolus japonicus*; *Katsuwonus pelamis* (Linnaeus, 1758); *Priacanthus arenatus* Cuvier, 1829; *Promethichthys prometheus*, *Thunnus atlanticus*, and *Xanthichthys ringens* (Linnaeus, 1758)] were only recorded in Martin Vaz, mainly via fisheries monitoring, suggesting that Trindade Island should shelter a higher diversity of species than reported.

This study calls attention to the need of better understanding the biodiversity of remote sites of the VTC, aiming to support both biogeographic analyses and conservation initiatives. The Martin Vaz Archipelago is currently a no-take zone, part of a convoluted mosaic of protected areas created around Trindade Island (see Giglio et al. 2018; Vilar et al. 2020). Conversely, Davis Seamount, a priority area for conservation in the VTC (Meirelles et al. 2015), is in international waters and is threatened by mining and fishing activities (Pinheiro et al. 2014). As a portion of the no-take area of this MPA mosaic is among the least known areas of the VTC, gathering information on the local biodiversity is a basic step to inform management. This knowledge gap is critical, and filling it will allow managers to better understand the effects of protection and threats in these remote sites.

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dedicated to the memory of our great friend and colleague Thiony Simon.

## Authors' Contributions

HCG collected data and wrote the first version of the paper. All other authors contributed equally collecting data and editing the manuscript. The authors declare no conflicts of interest.

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