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First records of *Neopomacentrus cyanomos* (Bleeker, 1856) (Pomacentridae, Blenniiformes) in Southwestern Atlantic reefs

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Abstract. Records of non-native species in the Southwestern Atlantic reefs have increased alarmingly within the last two decades. Here, we provide the first report in the Southwest Atlantic of *Neopomacentrus cyanomos* (Bleeker, 1856), Regal Damselfish, a small reef species native to the Indian ocean and western Pacific, based on underwater observations made from three coastal islands in São Paulo State. Outside its natural range, *N. cyanomos* was previously recorded in the Northwest Atlantic and Southeast Atlantic, where it is often associated with oil and gas platforms, a pathway via which *N. cyanomos* probably was introduced to Brazil.

Key words. Alien species, Brazilian Marine Province, exotic fish, Regal Damselfish

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INTRODUCTION

The tropical Southwestern Atlantic, mostly comprising the Brazilian Marine Province, hosts unique reef environments strongly influenced by the discharge of multiple rivers that deliver high terrigenous sediment loads to coastal marine areas and, therefore, are characterized by elevated turbidity and nutrient levels (Santana et al. 2023). The biogeographic limits are the Amazon River plume on the Equator to the North, which substantially limits migration between the Caribbean and Brazil, and the Falklands (Malvinas) Current to the South (at 29°S in Santa Catarina State), which makes the water too cold for the survival of tropical reef species (Rocha 2003; Floeter et al. 2008).

The Southwestern Atlantic reefs host 733 fish species, including 405 reef residents of which 111 (27%) are endemic (Pinheiro et al. 2018). The unique reef fauna of the Southwest Atlantic is currently threatened by an escalation in the introduction of alien species, with over 30 non-native invertebrate and 13 vertebrate species that have already been recorded in the Brazilian coast, including one shark and 12 teleostans (Chaves et al. 2025; ICMBio 2025). At least three species of non-native fishes already reported to the Brazilian Marine Province have potential to become invasive, including *Chromis limbata* (Valenciennes, 1833) (Azores Chromis) and *Opsanus beta* (Goode & Bean, 1880) (Toadfish) in Southern Brazil and *Pterois volitans* (Linnaeus, 1758) (Lionfish) in Northern and Northeastern Brazil (Caires et al. 2007; Carvalho et al. 2022; Anderson et al. 2017; Luiz et al. 2021).

Neopomacentrus cyanomos (Bleeker, 1856) is a small reef fish that reaches a maximum total length of 10.0 cm. It is commonly known as Regal Damselfish (Parenti 2021; Allen and Erdmann 2024). It was originally described from Indonesia (Bleeker 1856) and is widely distributed across the Indo-Pacific, including the Indian Ocean, Red Sea, and Arabian Gulf, and western Pacific from Japan to northern Australia. It is a relatively common, site-attached planktivore, that lives in small aggregations at depths of 5–18 m (Allen and Erdmann 2024; Figure 1A). In addition, the genus *Neopomacentrus* Allen, 1975 includes 17 valid species, all of which are distributed in the Indian and/or Pacific Oceans (Fricke et al. 2025)

Outside of its natural range, *N. cyanomos* was first observed in 2013, already from 43 different sites on reefs south of Veracruz, Mexico, Gulf of Mexico (González-Gándara and Cruz-Francisco 2014). In a very short time span, the species became established elsewhere in the Gulf of Mexico, the east coast of Florida, and

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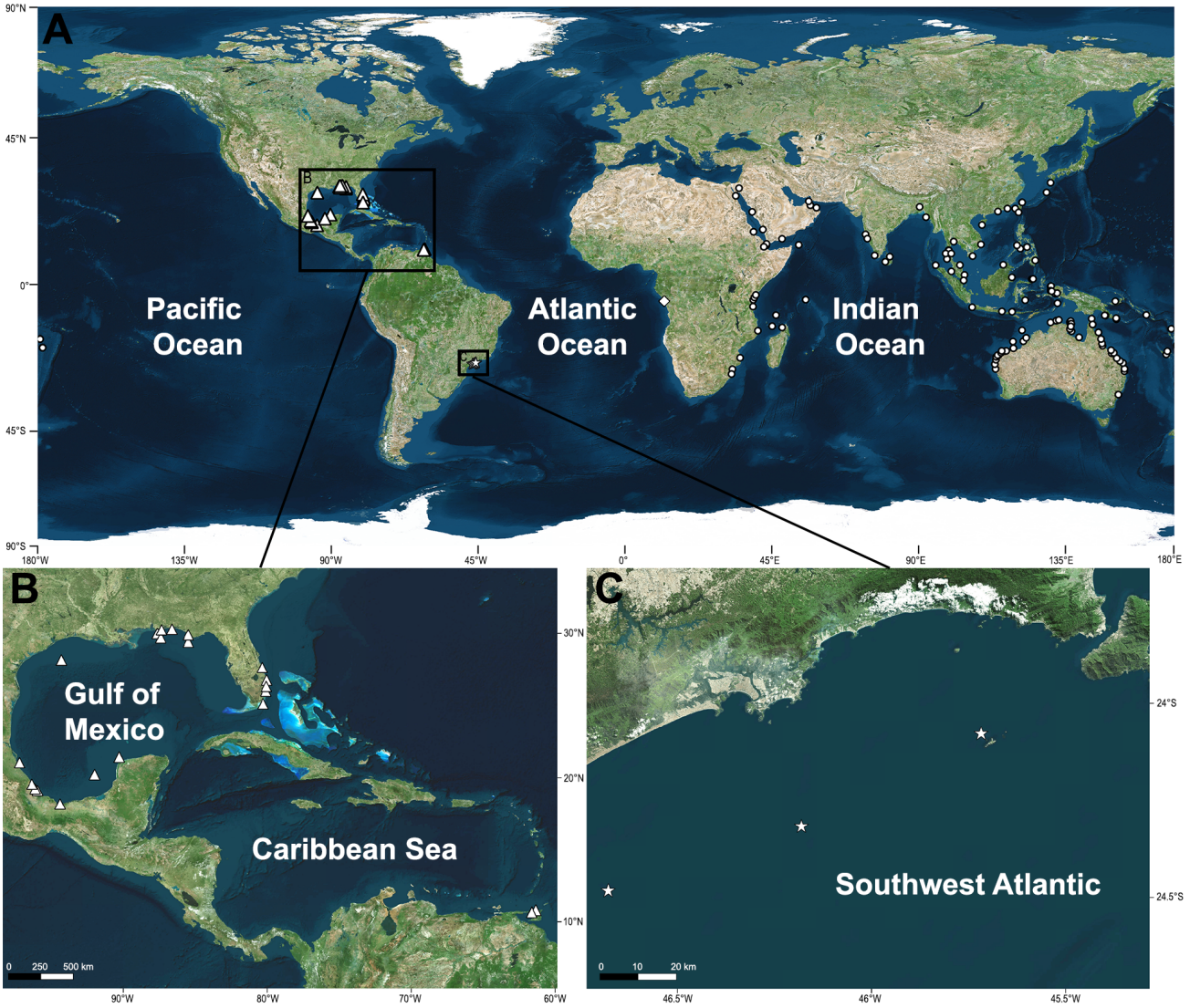

Figure 1. Distribution map of *Neopomacentrus cyanomos* (Bleeker, 1856) (Pomacentridae). **A.** In southwestern Brazil. **B.** Non-native range in the Gulf of Mexico and Caribbean Sea, Northwest Atlantic. **C.** Non-native range in Southern Brazil, Southwest Atlantic. Dots represent the native range (from GBIF 2025); triangles, the non-native records in Northwest Atlantic (from González-Gándara and Cruz-Francisco 2014; Cruz-Francisco et al. 2015; Johnston and Akins 2016; Robertson et al. 2016, 2021; Bennett 2019; Tremblay et al. 2020; Bernardi et al. 2024; Esch et al. 2024; Rivera-Higueras et al. 2025); diamond, in Southeast Atlantic off Angola (from Schramm et al. 2025), and stars, in Southwest Atlantic (our records).

in the southern Caribbean Sea off Trinidad (Cruz-Francisco et al. 2015; Johnston and Akins 2016; Robertson et al. 2016, 2021; Bennett 2019; Tremblay et al. 2020; Bernardi et al. 2024; Esch et al. 2024; Rivera-Higueras et al. 2025; Schofield and Neilson 2025). More recently, Schramm et al. (2025), reported *N. cyanomos* from oil and gas platforms installed off the Angolan coast, Southeast Atlantic (Figure 1B). Herein, we provide the first report of *N. cyanomos* in the Southwest Atlantic based on underwater observations made in three coastal islands in São Paulo State, Brazil.

METHODS

The observations were made during four scuba surveys on three different rocky, coastal islands in São Paulo State, Brazil as follows: (1) 33 km off the coast of Queimada Grande Island; (2) 30 km off the coast of Laje de Santos State Park and 53 km northeast of Queimada Grande Island; (3) Tupinambás Ecological Station, in the Alcatrazes Archipelago, 35 km off the coast, and 55 km to the northeast of Laje de Santos island (Figure 1C). The specimens were photographed or recorded on video with underwater cameras (supplementary materials), and the total size was estimated *in situ*, during observations. For the present study, no specimen was collected, and no experiment with live or recently captured specimens were conducted. To produce the distribution map, an occurrence database was downloaded from GBIF.org (2025), then manually verified and edited to avoid errors, duplicity, and excessive overlapping of close localities; the invasive records in the

western North Atlantic were verified on literature. The distribution map was prepared using QGIS v. 3.16.3 (QGIS 2025).

RESULTS

***Neopomacentrus cyanomos* (Bleeker, 1856)**
Figures 1, 2 and Supplemental Data 1–3

New records. BRAZIL — São Paulo • Queimada Grande Island; 24.484°S, 046.679°W; 5 m deep; 30.XI.2024; M. Melo obs.; 1 individual photographed • Laje de Santos State Park; 24.318°S, 046.181°W; 5 m deep; 04.I.2025; M. Mies obs.; 2 individuals video recorded • Tupinambás Ecological Station, in the Alcatrazes Archipelago; 24.079°S, 045.718°W; 5 m depth; J.P. Boelter obs.; 1 individual video recorded • Laje de Santos State Park; 24.318°S, 046.181°W; 6 m deep; 04.I.2025; L. A. Rocha obs.; 10 individuals photographed in two groups of 5 individuals each.

Identification. *Neopomacentrus cyanomos* can be easily recognized among other southwestern Atlantic pomacentrids by having an overall dark gray or black body, with a well-marked back humeral spot and a white spot on the posteriormost dorsal-fin rays, the dorsal, caudal, anal and pelvic fins with metal-blue or white margins; a furcate caudal fin; and caudal, dorsal and anal fins bearing a filament on their tips. The males might develop whitish stripes on body while guarding the eggs.

DISCUSSION

In the first observation, a single specimen was spotted and photographed (MRSM) on a shipwreck located near Queimada Grande island. Additionally, two specimens (ca. 6.0 cm) were found and video-recorded (MM) at Laje de Santos State Park, hovering near the crevices of a rock outcrop; another single specimen

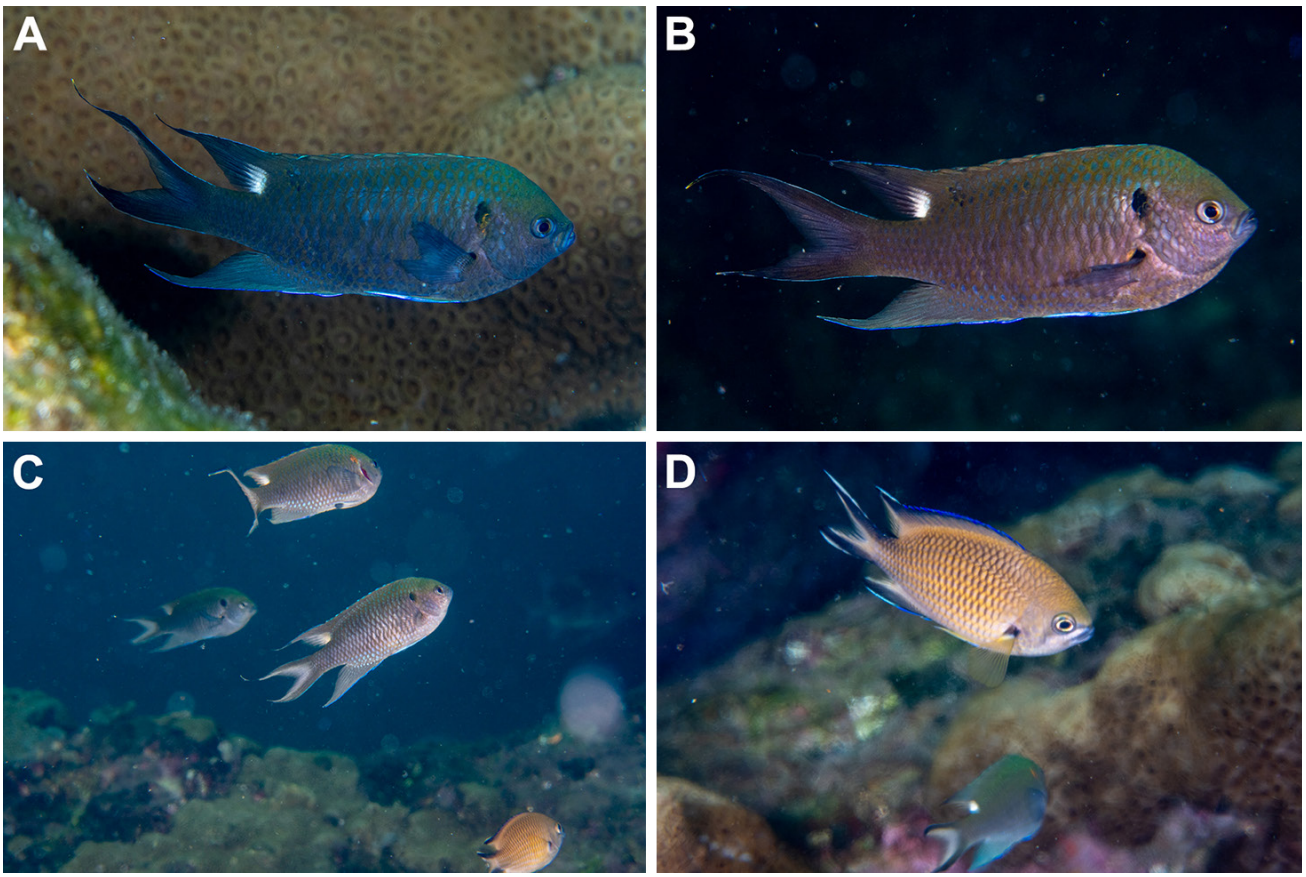

Figure 2. Underwater photography of *Neopomacentrus cyanomos* (Bleeker, 1856) at Laje de Santos, southern Brazil, in the western South Atlantic. **A, B.** Detail of two different specimens. **C.** A pack of three individuals. **D.** Dwelling along with the also non-native *Chromis limbata*, which is on first the plane of picture. All photographs by LAR.

with about 8.0 cm was observed and video-recorded (JPB) dwelling in a small rocky cave, at the Tupinambás Ecological Station, within the Alcatrazes Archipelago; and two groups of five individuals were observed and photographed (LAR) at the Laje de Santos State Park. All specimens were observed at depths between 5 and 6 m. Noteworthy, at both Queimada Grande Island and Laje de Santos, *N. cyanomos* was observed dwelling with *Chromis limbata*, another alien pomacentrid that is now established on subtropical rocky reefs (Figure 2, Supplemental Data Figure S1). In addition, *N. cyanomos* was observed in sites where frequent scuba diving and environmental monitoring activities take place, in groups of few individuals composed of medium-sized to large adults, but with no juveniles or larger aggregations, suggesting that this is a recent arrival.

Neopomacentrus cyanomos is a protogynous hermaphrodite, with the individuals of up to 6.5 cm in TL being all females, and those larger than 8.0 cm in TL, all males (Sreeraj and Gopakumar 2004). In captivity experiments, the females can deposit 3210–3560 adhesive eggs on a hard substrate, with a new spawn every 5–13 days, which are then fertilized and guarded by the males, and hatch on the third day (Setu et al. 2010; Loh et al. 2013). The duration of the planktonic larval stage in natural conditions is estimated to be ca. 18 days (Thresher et al. 1989). However, neither the egg clusters nor planktonic larvae were detected in Brazil yet.

The spread of *N. cyanomos* in the Gulf of Mexico and the Caribbean Sea has been attributed, among many other factors, to its wide temperature tolerance in the native distribution and its ability to thrive in marginal reef environments heavily influenced by river discharges (Rivera-Higueras et al. 2025). The fact that *N. cyanomos* has preferences for habitat conditions that are similar to those found in southern Brazil allied to its biological traits such the high reproductive rate, the generalist habitat preferences, and the ability to colonize and get established on large artificial structures (e.g. oil platforms) and, hence, be transported from one area to another (Robertson et al. 2018), we predict that this species will very likely become established throughout the entire Brazilian Marine Province.

Four hypotheses had been raised to explain the recent increase in alien species introductions to Brazil, as discussed below: (1) aquarium release; (2) transport in ship-ballast water; (3) carried by association with oil platforms; and (4) natural, long-distance dispersal of either larvae or adult. Aquarium release is a common pathway of fish introduction in both freshwater and marine environments (Padilla and Williams 2004; Walters et al. 2011; Magalhães et al. 2017). One of the most remarkable cases is the release from aquaria of two species of lionfish *Pterois volitans* and *P. miles* (Scorpaenidae) in the Gulf of Mexico, followed by their further expansion throughout the Northwest Atlantic and, more recently, in the Southwest Atlantic through northern Brazil and Fernando de Noronha (Hamner et al. 2007; Betancur-R et al. 2011; Luiz et al. 2021; Soares et al. 2022). The increasing records of non-native marine fish that are imported and sold by the Brazilian ornamental trade is noteworthy, including Whitetip Reef Shark, *Triaenodon obesus* (Rüppell, 1837) (Carcharhinidae) in Paraná State; Pennant Coralfish *Heniochus acuminatus* (Linnaeus, 1758) (Chaetodontidae) along the coast of Rio de Janeiro, São Paulo and Paraná States; Yellowbar Angelfish *Pomacanthus maculosus* (Forsskål, 1775) (Pomacanthidae), also from Paraná State; and, possibly, an odd record of the Lionfish *Pterois volitans* (Scorpaenidae) in Rio de Janeiro State (Luiz et al. 2014; Ferreira et al. 2015; Adelir-Alves et al. 2018; Bornatowski et al. 2018; Soeth et al. 2018). The proximity between those locations to the cities of São Paulo, Curitiba and Rio de Janeiro, combined with the fact that those areas are frequently used for recreational fishing, spearfishing, and scuba diving increase the possibility of the intentional introduction of ornamental species. However, this does not seem to be the case for *N. cyanomos*, because it is not popular in the aquarium trade and is not listed by the Ministry of Environment among the ornamental fish species authorized for import into Brazil (IBAMA 2022).

Ballast water is another important vector of introduction of non-native species, especially during the larval stage (Bailey 2015). Although ballast water is more efficient for the transport and introduction of invertebrates, it probably caused the introduction of Muzzled Blenny *Omobranchus punctatus* (Valenciennes, 1836) (Bleniidae), Toadfish *Opsanus beta*, Burrowing Goby *Trypauchen vagina* (Bloch & Schneider, 1801) (Gobiidae), and Mud Sleeper *Butis koilomatodon* (Bleeker, 1849) (Eleotridae) in the Southwest Atlantic (Gerhardinger et al. 2006; Caires et al. 2007; Macieira et al. 2012; Carvalho et al. 2022; Trevisan et al. 2022, 2023). For *N. cyanomos*, however, Robertson et al. (2018) demonstrated that lengthy transports impose significant constraints to survival of larvae in confined ship hulls.

The third, and most likely hypothesis, is the introduction of *N. cyanomos* via transport in association with oil platforms, as seen in the Gulf of Mexico and the Caribbean Sea (Robertson et al. 2018). In the Southwest Atlantic, *N. cyanomos* was reported strictly associated to an oil and gas platform installed off the coast of Angola (Schramm et al., 2025). It is well documented that the relocation of oil platforms between oceans significantly facilitates the introduction of alien species. As the drilling parts are maintained partially submerged during towing, they can carry benthic organisms, egg masses of demersal-spawning fishes, and even individuals that actively follow the platform or find shelter within its parts (Ferreira et al. 2006; Wanless et al. 2010; Marnane et al. 2022). Indeed, oil platforms are frequently transported through southeastern Brazil (Anjos et al. 2024), particularly in the Santos and Campos regions, with the former encompassing the region near the three islands where *N. cyanomos* was detected. *Neopomacentrus cyanomos* uses oil platforms as substrate for aggregation and spawning, and can survive when those structures are moved (Harvey et al.

2021). The relocation of oil platforms from the Indo-Pacific into the Gulf of Mexico was then identified as the vector by which it was introduced (Robertson et al. 2018; Harvey et al. 2021). Indeed, *N. cyanomos* was detected at dense aggregations of up to 100,000 individuals (~100 individuals/m^2) at depths of up to 60 m, dwelling on an oil-loading platform near the Cayo Arcas reefs, in Campeche Bank, Gulf of Mexico (Robertson et al. 2016, 2021; Simões and Robertson 2016). The transport via oil platforms is also considered to be the most probable source of African Hind *Cephalopholis taeniops* (Valenciennes, 1828) (Epinephelidae), and Azores Chromis *Chromis limbata* (Pomacentridae) in the Southwest Atlantic (Garcia et al. 2018; Anderson et al. 2020). Nonetheless, molecular and phylogeographic investigations on Brazilian *N. cyanomos* are needed for further clarification on the origins and vectors of this arrival.

The recent appearance of several non-native species in the Southwest Atlantic could possibly have resulted from natural habitat expansion through long-distance dispersal, including either trans-Atlantic (e.g. Luiz et al. 2004; Anderson et al. 2020) or Western Indian Ocean into the Western Atlantic (e.g. Luiz et al. 2014; Bornatowski et al. 2018; Soeth et al. 2018). Even though the first is plausible for a few species (Luiz et al. 2012), the latter seems to be the least parsimonious and, therefore, not the case for *N. cyanomos*. Another possibility is that the introduced populations of *N. cyanomos* from the Caribbean Sea had naturally crossed the Amazon River plume barrier by utilizing the mesophotic reef as a corridor beneath the plume (Rocha 2003). However, *N. cyanomos* occurs in shallow waters and was never observed in mesophotic reefs (LAR pers. obs.), and had the invasion occurred in this manner, it would have been detected first along the coasts of North and Northeastern Brazil, in a similar pattern to that observed for the arrival of *P. volitans* in Brazil (Luiz et al. 2021; Soares et al. 2022).

In the Gulf of Mexico and Caribbean Sea, *N. cyanomos* prefers areas that are already impacted, and, so far, the invasion has not resulted in any noticeable impacts on local planktivorous assemblages (Robertson et al. 2018; Rivera-Higueras et al. 2025). The potential ecological impacts of an invasion of *N. cyanomos* in the Southwest Atlantic remain uncertain. The native species most likely to be affected are other planktivorous damselfishes, such as *Azurina multilineata* (Guichenot, 1843) and *Chromis jubauna* Moura, 1995, which could face competition for resources and/or by changing the ecological structure of the southern Brazilian coral reefs (Mack et al. 2000). However, *N. cyanomos* occurs in shallow reefs and typically feeds on plankton in a flow of water (i.e. 0.5–1 m above the substrate) taking rapid refuge when disturbed, whereas *A. multilineata* ranges far from the substrate (i.e. 5–10 m or more), and *C. jubana* typically occurs in mesophotic reefs, except for the southern Brazilian where it can be also found in shallow waters (CELF pers. obs.). Therefore, the impacts of a possible invasion of *N. cyanomos* in the Southwest Atlantic remain uncertain.

Nevertheless, we highlight that new reports of non-native marine species should be given high attention to advert other invasions, be monitored, studied and prioritized in terms of implementation of necessary management strategies (Frazer et al. 2012; Johnston and Akins 2016). We also highlight that new reports of non-native marine species should be given high attention to avert other invasions, be monitored, studied and prioritized in terms of implementation of necessary management strategies. Finally, current Brazilian regulations favor the installation of artificial substrates (Miranda et al. 2020), and that could accelerate the spread of *N. cyanomos* and other non-native species (Robertson et al. 2018; Soares et al. 2020).

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ADDITIONAL INFORMATION

Conflict of interest

The authors declare that no competing interests exist.

Ethical statement

No ethical statement is reported.

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Author contributions

Conceptualization: MM, MRSM. Data curation: JPB, LAR, MM, MRSM. Formal analysis: CELF, JPB, LAR, MM, MRSM. Investigation: JPB, LAR, MM, MRSM. Methodology: JPB, LAR, MM, MRSM. Visualization: JPB, LAR, MM, MRSM. Validation: CELF, JPB, LAR, MM, MRSM. Writing – original draft: MM, MRSM. Writing – review and editing: CELF, JPB, LAR, MM, MRSM, MVK.

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Data availability

All data that support the findings of this study are available in the main text and Supplementary materials.

Supplemental data includes underwater photography and videos of *Neopomacentrus cyanomos* in three different Brazilian sites.

Figure S1. Photograph of a specimen of *Neopomacentrus cyanomos* on a shipwreck near Queimada Grande Island (–24.484, –046.679), about 5 m deep, 30 November 2024, by Marcelo R.S. Melo.

Video S1. Video of two specimens of *Neopomacentrus cyanomos* at Laje de Santos State Park (–24.318, –046.181), about 5 m deep, 4 January 2025, by Miguel Mies.

Video S2. Video of a specimen of *Neopomacentrus cyanomos* at Tupinambás Ecological Station, in the Alcatrazes Archipelago (–24.079, –045.718), about 5 m deep, 26 February 2025, by Jéssica P. Boelter.

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