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SHORT COMMUNICATION

Occurrence of the driftfish *Nomeus gronovii* (Scombriformes: Stromateoidei: Nomeidae) in the sandy beach surf zone of southern Brazil

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ABSTRACT. We record a single juvenile specimen of a driftfish, *Nomeus gronovii* (Gmelin, 1789), in a shallow surf zone in the southern Brazilian waters. This is the southernmost record of *N. gronovii* on the South Atlantic. The specimen was identified based on morphological characters that had been unintentionally recorded with a small underwater video camera. Although the species is usually found in symbiotic association with the Portuguese man-of-war, a species of *Physalia* (Cnidaria: Hydrozoa), siphonophores were not found as part of this record. This finding emphasizes the role citizen scientists play in the process of recording poorly-documented species, thus helping to increase their known distribution range.

KEYWORDS. Citizen science, jellyfish symbiont, phoresis, species distribution.

Nomeidae consists of 16 species in three genera (*Cubiceps*, *Nomeus*, and *Psenes*) and *Nomeus gronovii* (Gmelin, 1789) is the only species in the genus (Miya et al. 2013, Nelson et al. 2016, Froese and Pauly 2024). The species is marine pelagic, with a worldwide distribution in the warm waters of tropical and subtropical regions of the Atlantic, Indian, and Pacific Oceans (Nelson et al. 2016, Froese and Pauly 2024). It is distributed in the western Atlantic, including Newfoundland, Canada, and from the northern Gulf of Mexico to Brazil (Robins and Ray 1986, Vaske Jr. 2005). In the eastern Atlantic, the family is distributed in north-west Africa and in the Canary Islands (Froese and Pauly 2024). In the western North Pacific, it is distributed in Japan and Taiwan (Ho et al. 2010), and Korea (Lee et al. 2015). The young stages, measuring less than 15 cm in length, are epipelagic, and are associated with drifting debris, algae, and mainly pleustonic cnidarian siphonophores (Jenkins 1983). Little information is available on the adults, which are apparently demersal and are rarely spotted (Suda et al. 1986, Acero et al. 1994, Fahary 2007).

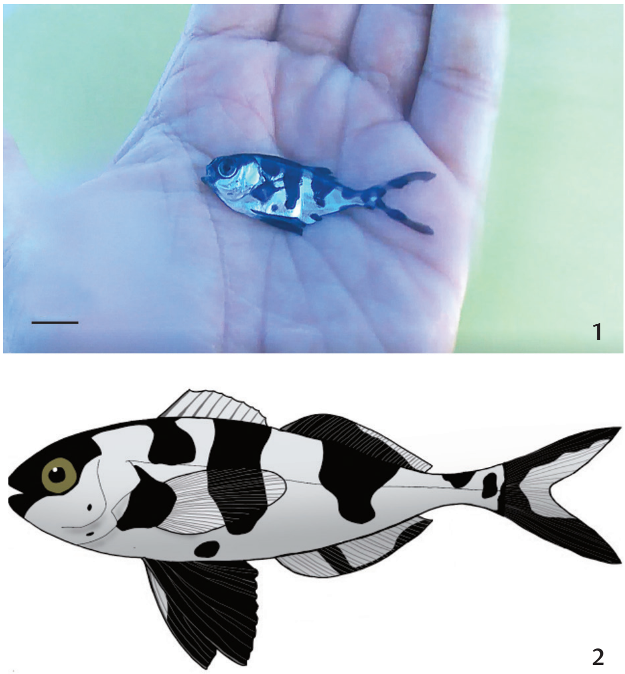
One of the most iconic fish-jellyfish symbiosis involves the pleustonic Portuguese man-of-war *Physalia* (Linnaeus, 1758) and the fish *N. gronovii* (Jenkins 1983). *Physalia physalis* was widely recognized until recently as the only species of the genus, but a more recent study including genomic and morphological data from specimens sampled around the world indicated the presence of multiple species, some of which have overlapping distributions (Church et al. 2024). Species of the Portuguese man-of-war are found from subtropical and tropical regions of the Pacific, Indian, and

Atlantic Oceans (Prieto et al. 2015, Church et al. 2024), and can be found associated with six other fish species (Purcell and Arai 2001). *Nomeus gronovii* is unique in that it is tolerant to the host's extremely toxic tentacles in addition to being a proficient swimmer that can avoid them (Jenkins 1983). Resistance to the sting comes from a robust skin structure with a mucous layer that reduces nematocyst penetration. *Nomeus gronovii* has at least one antibody that may contribute to its capacity to survive a high dose of siphonophore toxin. Although not completely immune to the toxine (Purcell and Arai 2001), *N. gronovii* survives to injected doses that are 10 times higher than the lethal dose for other fish species of a similar size. Nevertheless, both the fish and the jellyfish can feed on each other (Jenkins 1983), demonstrating the complex ratio between the mutual risks and benefits involved in their association.

In this study, we report the driftfish *N. gronovii* in a shallow surf zone in the southern Brazilian waters. The record (Supplementary material 1) was made by an amateur photographer with a small video camera. To the best of our knowledge, this is the southernmost record of *N. gronovii* in the South Atlantic. The occurrence of warmer waters and their symbionts in areas of climatic transition between subtropical and temperate climates may be evidence of climate change or climatic phenomena (Prieto et al. 2015). The present observation emphasizes the valuable contributions citizen scientists can provide in recording poor-documented marine species (Terenzini et al. 2023, Miranda et al. 2024). With their help, unusual occurrences are more likely to be recorded, since marine locations are more often frequented by the general population than by scientists (Di Camillo et al. 2017).

A single juvenile specimen of *N. gronovii* was observed in the surf zone (less than 2 m depth) of Imbé (29°57'28"S; 050°06'36"W), Rio Grande do Sul, by Lucas Antônio Morates during attempts to record the Portuguese man-of-war *Physalia* sp. on video. The record was made during the austral summer of 2022 (January to March), between 3:00 and 4:00 pm, using a small video camera Tomate MT-1091K. The observer contacted a fisheries specialist for species identification. Although the specimen was not collected (only recorded on video), it was possible to obtain a snapshot of it and to identify the species through external morphological characteristics.

The lenght of the specimen was estimated to be approximately 60 mm in total (Fig. 1). Specimens smaller than 15 cm have a dark blue pattern of spots distributed along their silver body, while adults are brownish (Fahary 2007). The main diagnostic characteristics of the species are (Fig. 2) i) body elongated and somewhat compressed, with the dorsal portion bright blue, and the ventral region silvery; there are five or more dark blotches on the underside of the body; ii) bases of second dorsal and anal fins very long; pelvic fin large and broad; color of pelvic fin black blue; two dorsal fins; pelvic fin large broadly joined to the belly; caudal fin deeply forked and with dark blue spots and blotches, with transparent margins, and iii) pectoral fin extends far beyond the origin of the anal fin (Robins and Ray 1986).



Figures 1–2. (1) Single juvenile specimen of *Nomeus gronovii* recorded at Imbé, Rio Grande do Sul by video during austral summer, in 2022. Approximate size = 6.0 cm. The photograph is a screen capture from a video made by Lucas A. Morates. (2) Hand-drawn illustration highlighting the diagnostic fin morphology of *N. gronovii*. Illustration by João Pedro Krahe. Scale bar: 2 cm.

Since the species has a worldwide distribution in warm waters of tropical and subtropical regions (Froese and Pauly 2024), we performed an active search on the web to find records in Brazilian ichthyological collections. Of the 28 fish collections registered in Brazil, 12 have records of marine fish, but only the Coleção Ictiológica do Museu de Zoologia da Universidade de São Paulo (MZUSP) has a record of *N. gronovii*, based on three specimens. No records were found in the literature review addressing catches from fishing and/or incidental capture by fishing. Due to their association with pleustonic cnidarians, juveniles may be more commonly seen. However, the few records of publications addressing the species (n = 9) indicate that encounters are not very common.

Nomeus gronovii has a global distribution, but it has not yet been formally recorded from the coast of the state of Rio Grande do Sul. Although associated with Portuguese man-of-war, which has been recorded throughout southern Brazil (Cristiano 2011, Nagata et al. 2022), the fish species has few records in Brazilian fish collections (only MZUSP) and scientific publications, with isolated records for the coast of Pernambuco, between 1968–1979, but without the former in subsequent surveys (Rocha et al. 1998).

A number of teleost fish, particularly young stages, swim in association with larger cnidarians (e.g., Carangidae, Centrolophidae), and such associations may influence the distribution of the fish (Arai 1988, Purcell and Arai 2001). In addition to fish species, crabs, shrimps, and echinoderms find shelter and food under jellyfish bells and tentacles, in many different types of documented symbioses (Riascos et al. 2018, Vitoria et al. 2021, Nascimento et al. 2022). Concerning different types of symbioses, those between jellyfish and fish species are among the most well-known. These relationships involve 84 jellyfish taxa—including cubomedusae, hydromedusae, scyphomedusae, and siphonophores—hosting 86 species of fish from Carangidae, Centrolophidae, Nomeidae, and Monacanthidae (Purcell and Arai 2001, Lawley and Faria 2018, Griffin et al. 2019). These associations are often considered non-specific and facultative, where fish find a microhabitat and shelter from predators during their larval and juvenile stages; however, the ecological functions of these symbioses vary widely (Purcell and Arai 2001). For instance, the juveniles of Atlantic bumper, *Chloroscombrus chrysurus* (Linnaeus, 1766), directly consume their scyphozoan jellyfish hosts (D'Ambra et al. 2014). Conversely, other fish species may feed on crustacean parasites present in their jellyfish hosts (Purcell and Arai 2001).

Despite the fact in most cases jellyfish are considered unwelcome stressors of marine ecosystems, their occurrences benefit certain organisms, for example, jellyfish predators, some of which are specialized consumers of jellyfish. For example, some species of fish and turtles, or opportunist consumers like fish, penguins, pelagic birds, crabs, and others, find an ease source of food during jellyfish blooms (Hays et al. 2018, Vitoria et al. 2021, Brodeur et al. 2021, Nascimento et al. 2022). In many cases, fish tenants may consume their hosts directly (D'Ambra et al. 2014), steal food captured by the jellyfish (i.e., zooplankton), or either feed on other symbionts/parasites (e.g., hyperiid amphipods) of the jellyfish (Purcell and Arai 2001, Doyle et al. 2014). Such associations may also be flexible, for example in the case of the scyphozoan *Chrysaora quinquecirrha* (Desor, 1848) and the harvestfish *Peprilus alepidotus* (Linnaeus, 1766), which is initially a commensal but became an ectoparasite, and finally a predator of the jellyfish host (Mansueti 1963). The massive presence of the jellyfish may also affect the distribution of their symbionts. In Japan, for example, the jack mackerel *Trachurus japonicus* (Temminck & Schlegel, 1844) may use the giant jellyfish *Nemopilema nomurai* Kishinouye, 1922 as a vehicle for its northward migration at an area of high predation pressure from benthic piscivorous fish. Each jellyfish may harbor schools with hundreds of juvenile fish (Sobolewski et al. 2004), and the provision of space, protection, and food may enhance the survival and recruitment of fish symbionts (Lynam and Brierley 2007, Griffin et al. 2019).

Planktonic cnidarians (siphonophores and medusae) often occur in abundance in coastal areas, in episodes known as jellyfish blooms (Purcell et al. 2007, Nagata et al. 2009, Fernández-Alías et al. 2024). The hypothesis that these blooms are rising in frequency and magnitude over recent decades, in response to the degradation of the marine environment (Richardson et al. 2009), has been a source of intense debate in the marine sciences over the past two decades (Duarte et al. 2013, Fernández-Alías et al. 2024). Some well-studied coastal areas have experienced recent increases in these blooms, which have been associated with anthropogenic stressors such as hypoxia, overfishing, and climate change, among others (Purcell 2012, Slater et al. 2020). On the other hand, some jellyfish populations in some coastal areas have been stable long-term (Brotz et al. 2012). It remains uncertain whether the recent increase of blooms in some populations represents a global phenomenon or whether populations are oscillating in different patterns, in response to major oceanographic cycles (Duarte et al. 2013, Condon et al. 2013).

The lack of long-term historical data on jellyfish populations in most of the world's coastal areas still hampers a global perspective on the trends of their occurrence patterns (Condon et al. 2013). Although the latitudinal range of Portuguese man-of-war spreads from 55°N to 40°S (Kirkpatrick and Pugh 1984), in Brazil, the species is mostly found within the tropical domain of the North and Northeast coast (4°N to 15°S). There, marine envenomation happens throughout the year, characterizing a public health problem (Bastos et al. 2017, Cavalcante et al. 2020, Nascimento 2023). By contrast, in the subtropical southeast and southern Brazilian coast (> 22°S), the species is less common and envenomation is seldom reported (Haddad et al. 2013). In the southernmost Brazilian state, Rio Grande do Sul (~ 32°S), for example, in a study of stranded planktonic cnidarians, only a few individuals of *Physalia* were found in a three-year study that conducted fortnightly samplings along a 15 km transect of coastline (Cristiano 2011).

Although large swarms of Portuguese man-of-war in subtropical areas of Brazil are unusual, cases of mass envenomation caused by this species have been reported in the state of São Paulo, causing hundreds of accidents (Haddad et al. 2013). Mass strandings of Portuguese man-of-war were also reported in southern Brazil and Uruguay during the summers of 2011, 2017 (Pinotti et al. 2019), and 2020. In 2021, dozens to hundreds of colonies were counted about 100 m off the beach (Nagata et al. 2022). By compiling observations shared by citizen scientists on the web, 70 colonies were recorded on the southeast and southern coasts in 2018, 56 in 2019, 518 in 2020, 863 in 2021, and 289 in 2022 (Nascimento 2023). In this region, this jellyfish was mainly observed from the end of spring to the end of summer (Nascimento 2023). However, further investigations and acquisitions of long-term data are still necessary to reveal possible trends in the species distribution or possible association of these mass strandings with oceanographic conditions (Prieto et al. 2015) or long-term trends in occurrence patterns (Condon et al. 2013). In the South Atlantic, as in many coastal regions globally, fish species with tropical and subtropical waters are expanding their range towards the poles due to warming temperatures in transitional zones (Araujo et al. 2018). Historical data also indicates that the Brazil-Malvinas confluence, a significant South Atlantic oceanographic feature, has shifted poleward in recent decades (Droin et al. 2021). However, due to a lack of historical occurrence data for *Physalia* spp. and *N. gronovii* in this region, it remains inconclusive whether climate change is directly driving an increase in their presence, as observed for some fish species (Araujo et al. 2018).

Physalia spp. and *N. gronovii* are globally distributed and remarkably conspicuous, but their capture and observation in traditional monitoring methodologies are challenging (Headlam et al. 2020). In this context, citizen science approaches are increasingly being applied to obtain observations of these species, helping to obtain relevant data about ecological relations and highlighting its utility as a research tool in data-poor situations (Pastana et al. 2023, Terenzini et al. 2023). On the other hand, such data are usually accompanied by biases, such as those related to patterns of observations associated with human behavior rather than the patterns of the photographed species (Dickinson et al. 2010). Even so, this work exemplifies the importance of citizen scientist observations in revealing records of species that are rare in certain areas, and whose occurrences may be evidence of major ecological changes.

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Competing Interests

The authors have declared that no competing interests exist.

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Supplementary material 1

Supplementary S1. A single juvenile specimen of *Nomeus gronovii* recorded in the surf zone of Imbé, Rio Grande do Sul, Brazil.

Authors: Lucas Antônio Morates.

Data type: MP4 video.

Link: https://doi.org/10.1590/S1984-4689.v42.e24048