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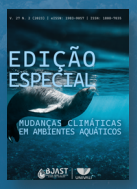

OCCURRENCES OF *Tamoya haplonema* (CNIDARIA: CUBOZOA) IN THE WESTERN SOUTH ATLANTIC

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ABSTRACT

Tamoya haplonema has been highlighted as a species of Cubozoa, with wide distribution in the western South Atlantic coast. However, recent studies highlight its presence mainly in the winter, and its absence in the summer months, in southern Brazil. Strandings of this species on beaches and stings of bathers on the coast of Uruguay suggest that *T. haplonema* may be responding to a more favorable thermal environmental condition. Due to the lack of information on the species, this work presents a compilation of the occurrences and thermal preferences of *Tamoya haplonema* in the Western South Atlantic.

Keywords: Coastal Water Temperature. Stings. Carybdea.

In the Southwestern Atlantic, four species of the Class Cubozoa (Cnidaria, Medusozoa) are observed: *Chiropsalmus quadrumanus* (Müller, 1859) (Chirodropidae), *Tripedalia cystophora* Conant, 1897, *Alatina alata* (Reynaud, 1830), and *Tamoya haplonema* Müller, 1859 (Carybdeidae) (Morandini et al., 2005; Oliveira et al., 2016). *C. quadrumanus* and *T. haplonema* have been associated with sting accidents in bathers (Haddad Jr. et al., 2002; Nagata et al., 2009) and are important in the pelagic trophic net as predators of crustaceans and fishes (Miazan & Cornelius, 1999; Nogueira & Haddad 2008). Although these species are described as having a wide distribution in Central and South America (Mianzan & Cornelius, 1999; Oliveira et al., 2016), *T. haplonema* appears to be a rarer organism, occurring at low densities in the coastal region (Nogueira Jr. & Haddad, 2006; De Barba et al., 2016).

In southern Brazil (Santa Catarina State, 26°S to 29°S), the oldest record of *T. haplonema* is the original description by Fritz Müller, on the island of Santa Catarina (Müller, 1859, Lindner, 2022). According to Müller, when referring to *T. haplonema*, "[...] sometimes I found more than a dozen a day" (translated from German in Müller, 1859), which highlights the abundance of the species at that time. *Tamoya haplonema* is still observed on the beaches of Ilha de Santa Catarina, close to the type locality, but in lesser abundance, with four being the maximum number of specimens observed in a single day (Lindner, personal observation on June 10, 2023, Daniela beach, Florianópolis). Further south, in Rio Grande do Sul State (30°S), the species was found in about 30% of beach surveys of stranded organisms, during 28 consecutive months (2009 to 2011), but always with just a few specimens (<10 individuals) (Cristiano, 2011).

Recent works and unpublished data have highlighted that in addition to the low densities of *T. haplonema* on the south coast of Brazil (generally information obtained mainly from bycatch data from industrial and artisanal fisheries), point to a high interannual variability of occurrences of the species (Nogueira Jr. & Haddad, 2006; Nogueira Jr. et al. 2010; Schroeder et al., 2014; De Barba et al., 2016; Rutkowski et al., 2018) (Figure 1). A second issue is that the occurrences of the species are not concentrated in the hottest months of the year, at least in southern Brazil (Resgalla Jr. et al., 2023).

In recent summer seasons (2012 to 2013 and 2018 to 2023), strandings of *T. haplonema* have been observed on the coast of Uruguay, causing problems associated with bathers (stings), alerting to its possible impact on local tourism. Occurrences of *T. haplonema* off the coast of Uruguay were previously presented by Leoni et al. (2016), but situations of high densities of the species are a new fact that has drawn attention (Figure 1).

These facts, combined with the lack of records on the occurrence of *T. haplonema* in the northeast region of Brazil, suggest that the species has more subtropical than tropical preferences, avoiding warmer summer waters in the southeast and southern regions of Brazil (Nogueira Jr. & Haddad 2008; Nogueira Jr. et al., 2010; De Barba et al., 2016) (Figure 2A). Added to this, the records of strandings reported by volunteer observers on the main beaches in Uruguay (Red de Avistamiento de Medusas de Uruguay - RAM) in the summer (Figure 2B), and their occurrence in northern Argentina, confirm the subtropical (<22 °C) characteristics of the species. Leoni et al. (2016) highlights that the occurrences of *T. haplonema* were related to positive water temperature anomalies for the coast of Uruguay, but this observation was not confirmed by Resgalla Jr. et al. (2023) for the south coast of Brazil.

The study by Resgalla Jr. et al. (2023) showed that *T. haplonema* presents interannual variability of occurrences observed in recent years (from 2015 onwards) and with a preference for cold months (Figures 2A and 2C) and peaks in densities at low temperatures in southern Brazil and mostly in summer and close to summer on the coast of Uruguay (Figure 2D). Further south, in the province of Buenos Aires in Argentina, its occurrence was only recorded in 2000 (Pastorino, 2001) and on the coast of Uruguay, the return of occurrences of *T. haplonema* was reported in 2021 (El Pais – Uruguay), with an outbreak of beach strandings in 2022, including cases of stings in Rocha and Punta del Este, where the observed temperatures are lower than those of the southeastern and southern coast of Brazil (Figure 2C). According to RAM, the occurrences of *T. haplonema* in Uruguay have been mostly from late spring (October) to early autumn (April) but maximum densities are in summer, though they have also been observed in winter.

This thermal preference of *T. haplonema*, once established, could be used as an indicator of hydrological conditions as well as climate change processes that are mainly observed in the area of occurrence of the species (28 to 35° S) (Franco et al., 2020). Likewise, seasonal and interannual variations in the position of the Brazil-Malvinas Confluence (BMC)

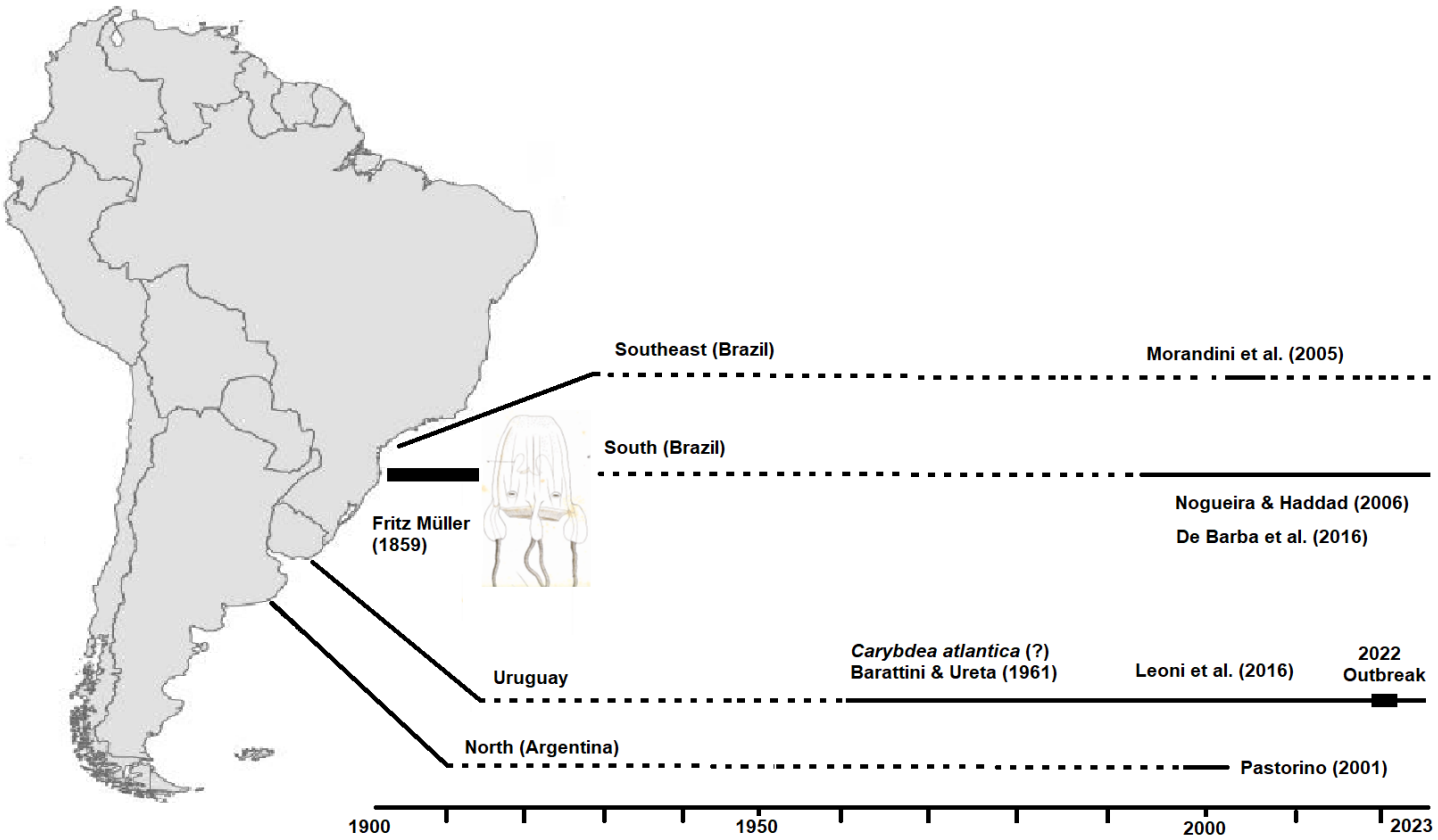

Figure 1. Distribution of *Tamoya haplonema* on the southern coast of western South America. On the temporal scale, dotted horizontal lines indicate no information (---), thin continuous lines indicate low density (—), and wide continuous lines indicate high density (**—**).

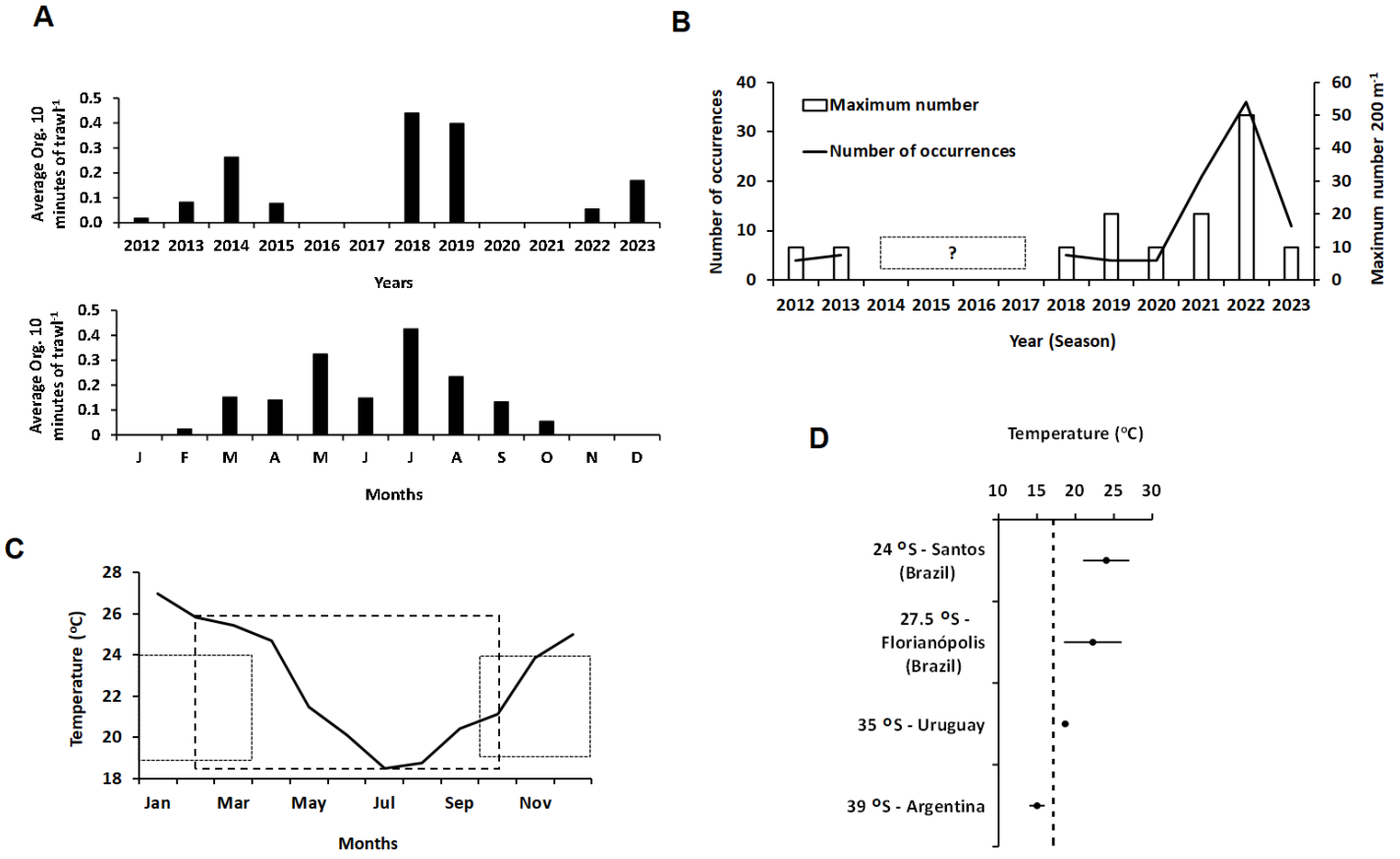

Figure 2. (A) Temporal variation of *Tamoya haplonema* densities in southern Brazil obtained from fishing data. (B) *Tamoya haplonema* strandings on beaches off the coast of Uruguay (RAM). (C) Comparison of seawater temperature variation in southern Brazil (solid line) and *Tamoya haplonema* occurrence interval (dashed box) as well as the summer temperature interval off the coast of Uruguay (dotted boxes). (D) Temperature intervals of occurrences of *Tamoya haplonema* at different latitudes, in Argentina according to Pastorino (2001), Uruguay according to Leoni et al. (2016), Santa Catarina (Florianópolis) according to Nogueira et al. (2010) and De Barba et al. (2016) and Southeast Brazil (Santos) taken from the model by Piola et al. (2000). The vertical dotted line indicates the temperature (16.75 °C) of the highest density of *Tamoya haplonema* in 11 years of monitoring (2012 to 2022) in Santa Catarina (Resgalla Jr. et al., 2023).

have been described in recent decades (Combes & Matano, 2014; Drouin et al., 2021), as well as the seasonality of winds and the northward movement of the sea front of the Rio de la Plata (Plata Front) on the south coast of Brazil and Uruguay. Araújo et al. (2018), Franco et al. (2020) and Perez & Sant'Ana (2022) justify the fact that some fish species and subtropical fish stocks in southern Brazil are disappearing due to their displacement to areas further south, which are more suitable in terms of temperature (tropicalization), a process that could also favor the displacement of *T. haplonema* to the south. However, with the exception of Müller's report (Müller, 1859), there is no other historical information that would allow a possible decrease in its abundance near the type locality, Ilha de Santa Catarina, to be tested.

The discussion presented here highlights the importance of long-term monitoring of jellyfish populations in the coastal regions of Brazil and Argentina, and the model carried out over the last 13 years on the coast of Uruguay (RAM). Most of the historical data on jellyfish population comes from temperate areas (Condon et al. 2011), whereas in tropical and subtropical coastal regions, less is known about possible long-term changes on their local populations. Thus, studying the latter is paramount, since they represent areas of climatic and faunal transition, in which the effects of climate change may be more pronounced. Associated with this, the biology of Cubozoa is poorly understood and studied, due to the difficulties of sampling, cultivation and maintenance in the laboratory, and the lack of studies of polyps in the natural environment (Kingsford & Mooney, 2014).

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