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PENSOFT

Megalops atlanticus Valenciennes, 1847 (Elopiformes, Megalopidae): new records for the state of São Paulo, with comments on its occurrence in the southeastern coast of Brazil, Southwest Atlantic

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Abstract
New records of *Megalops atlanticus* Valenciennes, 1847 in the state of São Paulo, southeastern Brazil, are reported from recreational catches carried out in February 2017. Data collected is the first occurrence of this species in more than 50 years, extending its geographic distribution by about 250 km, from Cananéia, in the south, to Guarujá, on the central coast. Although rarely recorded, *M. atlanticus* is present off the coast of São Paulo. This possibly represents the southernmost distribution for *M. atlanticus* in the Southwest Atlantic.

Key words
Tarpon; geographical distribution; wide-ranging species; recreational fishing; citizen science; conservation.

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Introduction

Megalops atlanticus Valenciennes, 1847 (Elopiformes, Megalopidae), popularly known as Tarpon in English, sábalo in Spanish, and camarupim or tarpão in Portuguese, is widely distributed in the Western Atlantic Ocean, from Nova Scotia (Canada) to Rio de Janeiro and São Paulo (Brazil) (Sadowsky 1958, Zale and Merrifield 1989, Crabtree et al. 1993, Adams et al. 2012). This species is also in the Eastern Atlantic, off Africa, from Mauritania to Angola (Anyanwu and Kusemiju 2008), and in the North Atlantic (Portugal, including the Azores, France, and Ireland) (Twomey and Byrne 1985). After traversing the Panama Canal, *M. atlanticus* has also become established in the Western Pacific, along the coast between Panama and Costa Rica, and to the south, in Colombia (and possibly north of Ecuador) (Breder 1939, Swanson 1946, Saldanha and Whitehead 1990, Colamarco 2005, Neira and Acero 2016).

Megalops atlanticus is categorized as Vulnerable globally and in Brazil by the International Union for Conservation of Nature, and the Brazilian List of Endangered Animals, respectively (Adams et al. 2012, BRASIL/MMA 2014). In Brazil, *M. atlanticus* occurs mainly in tropical waters, especially along the northeast coast, where it is nearshore, in estuaries, and even hundreds of kilometers upstream in rivers and lakes. This species is a target of coastal artisanal fisheries and is highly appreciated by anglers due to its fighting nature when hooked (Ault 2008, Fedler 2013).

Although *M. atlanticus* is considered a long distance migrant (Ault 2008, Luo and Ault 2012), little is known about its life history. Most information is available from studies carried out in Florida (United States), in the Gulf of Mexico, and in the Bahamas, where *M. atlanticus* supports a popular, lucrative, and predominantly catch-and-release recreational fishery (Ault 2008, Fedler 2013). From Brazil, outdated information suggests that large shoals of *M. atlanticus* move from the coastal waters of Pará and Maranhão to the nearshore zone of Ceará for spawning, returning to the waters of origin in early February (Menezes and Paiva 1966, Menezes 1968). In southeastern Brazil, *M. atlanticus* is rarely recorded for São Paulo state, where it may occur sporadically. There is an old report of 2 specimens captured in Cananéia on the south coast of this state in October 1958 (Sadowsky 1958). However, current information on the presence of *M. atlanticus* in São Paulo is not available in academic literature. Thus, we present new records of *M. atlanticus* for São Paulo, provide new data on its capture on the south coast, and extend the occurrence of the species to the north in areas under strong anthropogenic impact. We comment on how the lack of appropriate monitoring of recreational fisheries affect the actual knowledge of catches in Brazil of *M. atlanticus* and how information obtained directly from fishing guides might contribute important data on the occurrence of this species in the Southwest Atlantic.

Methods

Data were provided by 2 fishing guides who had their catches of *M. atlanticus* published in electronic portals and social media. They were contacted by us by phone and email and invited to share their experiences. Information such as date, place, time, depth, and conditions of the captures (fishing equipment such as hook type, bait or lures, fight duration, etc.), general conditions (size of the fish) and fate of the animals (released or landed) was shared. The general knowledge of the fishing guides about the legislation that relevant to this species was also collected. We consulted specialists of the ichthyological collection of the Museu de Zoologia da Universidade de São Paulo (MZUSP), the ichthyological literature, electronic portals dedicated to the recreational fishing, and the fishery landings database of the Programa de Monitoramento da Atividade Pesqueira Marinha e Estuarina do Instituto de Pesca de São Paulo (PROPESQ) looking for catch data of *M. atlanticus* in São Paulo. The PROPESQ database was consulted using the descriptor *tarpão* and the following variables: year, month, municipality, kilograms in the period, and number of landings in the period.

The identification of the specimens was made using photos and videos shared by the fishing guides, and following Figueiredo and Menezes (1978) and Nelson et al. (2016). Due to the use of third-party information, voucher specimens were unavailable for deposition in scientific collections.

Results

Seven records of *M. atlanticus* for São Paulo were found through the sources consulted (Fig. 1, Table 1). Three of these records came from the fisheries monitoring conducted by the São Paulo government since 1998, with information on the date and place of landing and quantity of fish landed, in kilograms. No data on the number of individuals landed and specific locations were available from the PROPESQ database.

The remaining records included other sources such as an old publication (Sadowsky 1958), which presented records of 2 catches, and 2 recent captures of *M. atlanticus* shared by fishing guides.

The guides mentioned that *M. atlanticus* was accidentally captured when they were targeting mainly fish of the family Carangidae, using artificial shrimp on weighted jig-head J-hooks and conventional light-strength spinning rods. Deep hooking was not observed. Tight time was estimated to be 1h20 for the Santos/Guarujá capture and 0h30 for the Cananéia capture. In both cases, the guides reported that the fishes were in good condition. The guides noted that this species was easily distinguishable from other large species that they were targeting because it presents a single dorsal fin midway along the body and with the last ray greatly prolonged; it has a silver coloration given by the almost vertical large scales; it exhibits a superior mouth with the lower mandible extending far beyond the gape; and it presents a deeply falcate anal fin and a large, dark and strongly forked caudal fin (Fig. 2).

Fishing guides highlighted that *M. atlanticus* was not the target of their fisheries and that they were surprised to observe this fish in São Paulo—and to watch the jumps of the tarpon during the fight. In Santos/Guarujá the fish died after being landed for pictures and hook removal. In Cananéia the fish escaped when landing. Neither guide was aware that *M. atlanticus* is listed as Vulnerable in the Brazilian List of Endangered Animals and fully protected in Brazil, with the prohibition of its capture and landing. One of the fishing guides mentioned having taken notice about this prohibition only after the announcement in social networks of its capture.

Discussion

The occurrence of *M. atlanticus* in São Paulo was based only in anecdotal observations made in the 1950s on the south coast by Sadowsky (1958) and on uncertain data (see below) from the PROPESQ database. According to Sadowsky, the fishers of the Cananéia lagoon-estuarine complex knew about the occurrence of Tarpon, but considered its capture uncommon, with only 2 to 4 individuals captured each year during the warm season (September to March) (Sadowsky 1958). He thought that occurrence of *M. atlanticus* along the south coast of São Paulo could be explained as a few stray individuals that had entered the estuarine system after separating from a

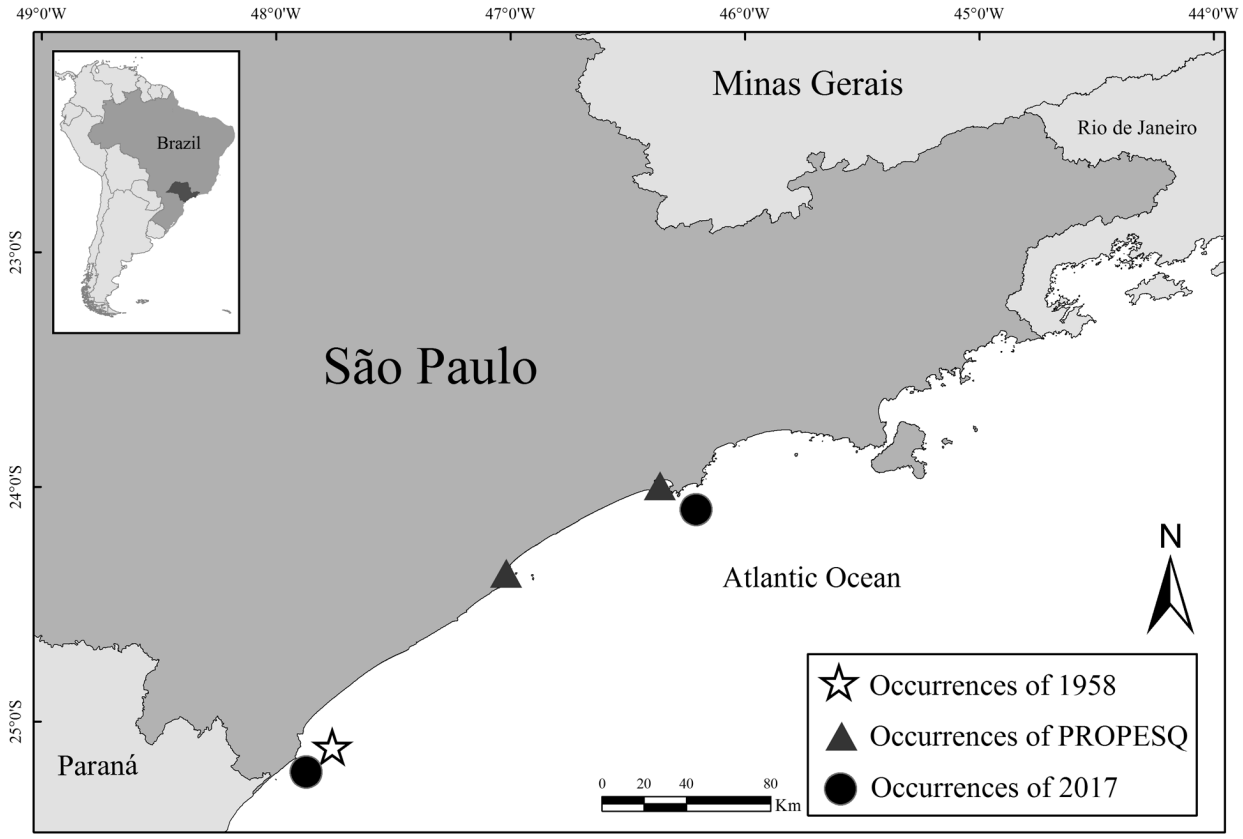

Figure 1. Records of *Megalops atlanticus* in the coast of São Paulo, Southeastern Brazil. The star represents the captures occurred in Cananéia, in 1958. The triangle shows the landings recorded in 2011, 2013 and 2014. The black dots constitute the captures occurred in Cananéia and Guarujá in 2017.

Table 1. Summary of the records of *Megalops atlanticus* along the coast of São Paulo, southeastern Brazil, 1958–2017. Geographic coordinates (*) are approximate. TL = total length.

Date	Source	Location	Latitude*	Longitude*	Depth (m)	TL (cm)	Weight (kg)	Observation
18 Oct. 1958	Sadowsky 1958	Cananeia	25°05′10″S	047°47′52″W	15	195	45.7	Male, gonads in regression, without any fat reserves
18 Oct. 1958	Sadowsky 1958	Cananeia	25°05′10″S	047°47′52″W	16	—	—	Mutilated animal; fish similar to the previous record
June 2011	PROPESQ	Santos/Guarujá	—	—	—	—	22.0	Information based only in fishing landings; Number of individuals not informed; No information about the approximate location
June 2013	PROPESQ	Peruíbe	—	—	—	—	7.4	Information based only in fishing landings; Number of individuals not informed; No information about the approximate location
March 2014	PROPESQ	Santos/Guarujá	—	—	—	—	80.0	Information based only in fishing landings; Number of individuals not informed; No information about the approximate location
8 Feb. 2017	Fishing guide pers. com.	Guarujá, around Moela I.	24°03′04″S	046°15′57″W	10	150	30.0	Captured, not released; Animal died possibly due to exhaustion
26 Feb. 2017	Fishing guide pers. com.	Cananéia, near Bom Abrigo I.	25°06′54″S	047°51′24″W	8	110	—	Not landed, escaped; supplementary material on the capture available

school at the end of a long migration (Sadowsky 1958).

The recent records of *M. atlanticus* in Cananéia, Peruíbe, and Santos/Guarujá corroborate the hypothesis proposed by Sadowsky (1958) and attest to the possibility of sporadic occurrences along the São Paulo coast. However, some caution is needed when comparing data from the commercial fisheries and those from the recreational segment. The 3 records from the PROPESQ database are limited because the number of individuals and the specific location of the fisheries are not recorded. Only a large fishing area, between the central coast of Espírito Santo and the south coast of Rio de Janeiro, between 10–60 m of depth, was reported, which might mean that the captures of *M. atlanticus* were outside of São Paulo. In contrast, the recreational catches of *M. atlanticus* presented a higher degree of resolution, con-

Figure 2. *Megalops atlanticus* (TL 150 cm) caught around the Moela Island, Guarujá. It is possible to note the large and silver scales, the superior mouth with the lower mandible extending far beyond the gape and the large, dark and strongly forked caudal fin of the fish (Photo credits: Nam Kyu Lee).

firming the capture of the species in São Paulo, around coastal islands, between depths of 7–15 m.

The available information about captures of *M. atlanticus* along the Brazilian coast indicates that catches become more frequent to the north, from Bahia to Amapá (Menezes and Paiva 1966, Menezes 1968, Lopes and Sena 1996). The 2017 São Paulo captures show that *M. atlanticus* is present along the coast of São Paulo, but rarely captured. São Paulo may possibily be at the southernmost limit of this species' distribution in the Southeastern Atlantic. As *M. atlanticus* is normally distributed in tropical to warm-temperate waters and the average sea surface temperature for February 2017 along the coast of São Paulo (Guarujá/Santos and Cananéia) was 27 °C (NOAA 2017), this species may not be as rare there as it is thought. The recreational fishing may provide relevant ichtyofaunal data, including for species with few records such as *M. atlanticus* in São Paulo, even if there are inherent limitations. Nevertheless, the lack of monitoring of the recreational fishing in Brazil (Freire et al. 2015, Motta et al. 2016), besides neglecting data on the volume captured, makes it impossible to incorporate capture data in the official databases.

The recent captures of *M. atlanticus* in São Paulo are associated with coastal islands about 1.5 km off the coast near 2 large estuaries (Guarujá/Santos and Cananéia). These new data update the occurrence of *M. atlanticus* in São Paulo by more than 50 years and extends the range of this species occurrence northward by about 250 km. These data also reinforce the fact that adult tarpon (> 100–110 cm total length) are primarily coastal fishes that inhabit inshore waters and bays of tropical countries (Figueiredo and Menezes 1978, Ault 2008, Nelson et al. 2016). As the estuarine area of Guarujá/Santos is under strong anthropogenic impacts, such as fisheries, oil and gas exploration, and expansion of port areas, and that most islands located along the coast of Cananéia have perimeters of fishing exclusion, it should be noted that the main threats to *M. atlanticus* include habitat loss (especially to 0–9-year-old sexually immature individuals) and large directed recreational fishing throughout its range (Adams et al. 2012). As there is evidence of regional declines for *M. atlanticus* and concerns about long-term population stability (Holt et al. 2005, FAO 2015), the dissemination of information to the fishing sector (with emphasis on the recreational segment), in association with an improvement in the monitoring of the activity, is needed and could improve information on the occurrence of the species and the management of its catches in southeastern Brazil.

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Authors' contributions

DGN made contributions throughout the manuscript, from its conception, data collection and manuscript preparation to conclusions. AR contributed the general idea, organized the figures and made contributions throughout all the text.

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Supplementary File

A video (MP4 format), showing the capture near Bom Abrigo Island, Cananeia, is available as a supplementary file.