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REVIEWING THE DISTRIBUTION OF THE SEA SLUG Bursatella leachii BLAINVILLE, 1817 (APLYSIIDAE, MOLLUSCA) IN BRAZIL, WITH ITS FIRST RECORD IN THE STATE OF SERGIPE, NORTHEASTERN REGION

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Abstract

This study expands and establishes the known distribution of *Bursatella leachii* in Brazil through a review of the literature on the species' distribution in the country and the first records of the species in the state of Sergipe, Northeastern region. The literature review involved a search in the Google Scholar database, as well as data from preserved specimens in biological collections Available from GBIF. Specimens of *B. leachii* were examined and photographed in the field, during the dry season (summer) on sandy-muddy bottoms within estuaries with distinctives disturbance levels in the State of Sergipe, Northeastern Brazil. Egg masses were also recorded at one locality. These records correspond to the first records of the species for the state. The review of *B. leachii* records in Brazil, together with the first records for Sergipe, allowed us to establish that *B. leachii* occurs along the Brazilian coast from Rio Grande do Sul to Ceará.

Keywords: Estuary. Gastropoda. Heterobranchia. Mollusca. Southwest Atlantic.

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1 Introduction

Heterobranch gastropods, commonly known as sea slugs, are a mollusk subclass characterized by evolutionary changes resulting in reduced, internalized, or absent shells, particularly in their more recent lineages (FERREIRA JUNIOR et al., 2015; DELGADO et al., 2022). These group are not easily observed or studied due to their rarity, appearing infrequently in both space and time (LARKIN et al., 2018; SCHUBERT; SMITH, 2020). Of the 6000 described species, approximately 250 sea slugs are reported in Brazil, with 124 for the Northeastern region (RIOS, 2009; DELGADO et al., 2022).

Commonly known as the shaggy sea hare, ragged sea hare, hairy sea hare, and blue-spotted sea hare, *Bursatella leachii* Blainville, 1817 is a sea slug belonging to the family Aplysiidae (PERISSINOTTO et al., 2014; ALENCAR et al., 2024). This species has a pantropical distribution, occurring in warm temperate to tropical marine waters, with no occurrences reported only along the Eastern Pacific and European Atlantic coasts (BAZZICALUPO et al., 2018; 2020). Nowadays, it is considered an invasive species in the Eastern Mediterranean (ZENETOS et al., 2005).

The first record of *Bursatella leachii* in Brazil is attributed to Couthouy in Gould (1852), based on a specimen from Rio de Janeiro, initially identified as *Bursatella lacinulata* (BAZZICALUPO et al., 2020). However, the first research focused on the distribution of *B. leachii* in Brazil dates back to the 20th century, with research by Marcus (1955) aimed at inventorying Opisthobranchia in the state of São Paulo. Later, García-García; Álvarez; Troncoso (2008), in their book about opistobranchs from Brazil, recorded this species only to São Paulo coast, while Rios (2009) in his compendium of seashells from Brazil cite the species to states of Pernambuco, Rio de Janeiro, São Paulo and Rio Grande do Sul. Recently, Alencar et al. (2024) increased a distribution extension of *B. leachii* on Rio Grande do Norte, northeastern Brazil and stated the states of Paraná, São Paulo, Rio de Janeiro, Ceará and Alagoas as distributional area of the species.

Overall, a few studies have addressed the occurrence of *Bursatella leachii* with its presence typically recorded within broader local and regional malacological surveys (e.g. FERREIRA JUNIOR et al., 2015; DELGADO et al., 2022; ALENCAR et al., 2024). This knowledge gap regarding the known range of the species in Brazil has been exacerbated by the scattered nature of existing information, with newer studies lacking a review of the species' records, leading to uncertainties about the actual distribution of the species in the country.

In this study, we recorded by the first time the occurrence of *Bursatella leachii* in the Sergipe coast, northeastern Brazil. Additionally, we are gathering all information about the occurrence of this species along Brazilian coast from a bibliographic survey and its updated distribution is provided.

2 Material and Methods

On December 31, 2021, one individual with approximately 91 mm long (Figure 1D) was recorded during the low tide period in a shallow water (10 cm of depth) sandy-muddy bottom of the Parapuca Channel (10°34.491' S 36°35.827' W), at the municipality of the Pacatuba, northern coast of Sergipe state (Figures 1A-1B). The individual was examined, photographed and released back to the environment. Three years later and 62 km southward, at the Aracaju city, capital of Sergipe state (10°55.810' S 37°2.569' W; Figures 1A; 1C), six other individuals with lengths ranging from 45 to 74 mm were recorded in a sandy-muddy tidal flat near to mouth of the Sergipe Estuary, during a field class carried out on January 27, 2024 (Figure 1E). In this occasion, it was also possible record egg mass deposited on rock fragments (Figure 2).

Considering the distribution range of *Bursatella leachii* along the Brazilian coast, we conducted a bibliographic research in the Google Scholar database using the terms "(Bursatella OR leachi OR leachii) AND (Brazil OR Brasil)" and "(Bursatella OR leachi OR leachii) AND (the name of each one coastal state of Brazil individually)". Additionally, we consulted the Global Biodiversity Information Facility (GBIF) database (www.gbif.org) to verify possible records of preserved specimens of *B. leachii* in biological collections not documented in scientific publications.

3 Results

Taxonomy:

Phylum Mollusca Cuvier, 1795
Class Gastropoda Cuvier, 1795
Order Aplysiida (Fischer, 1883)
Family Aplysiidae Lamarck, 1809
Genus *Bursatella* Blainville, 1817
Bursatella leachii Blainville, 1817

Examined material: BRAZIL – State of Sergipe, Pacatuba, Parapuca Channel, (10°34.491' S 36°35.827' W; Figures 1A-1B), 31.X.2021; one specimen, 91 mm long (Figure 1D). Sergipe, Aracaju (10°55.810' S 37°2.569' W; Figures 1A; 1C), 27.I.2024, six specimens, ranging from 45 to 74 mm (Figure 1E) and an egg mass (Figure 2).

Diagnosis: Absence of a shell and a long oval-shaped soft body that tapers at the anterior part and is wider at the posterior part. The dorsal region of the head features two rhinophores and several tentacles around the mouth.

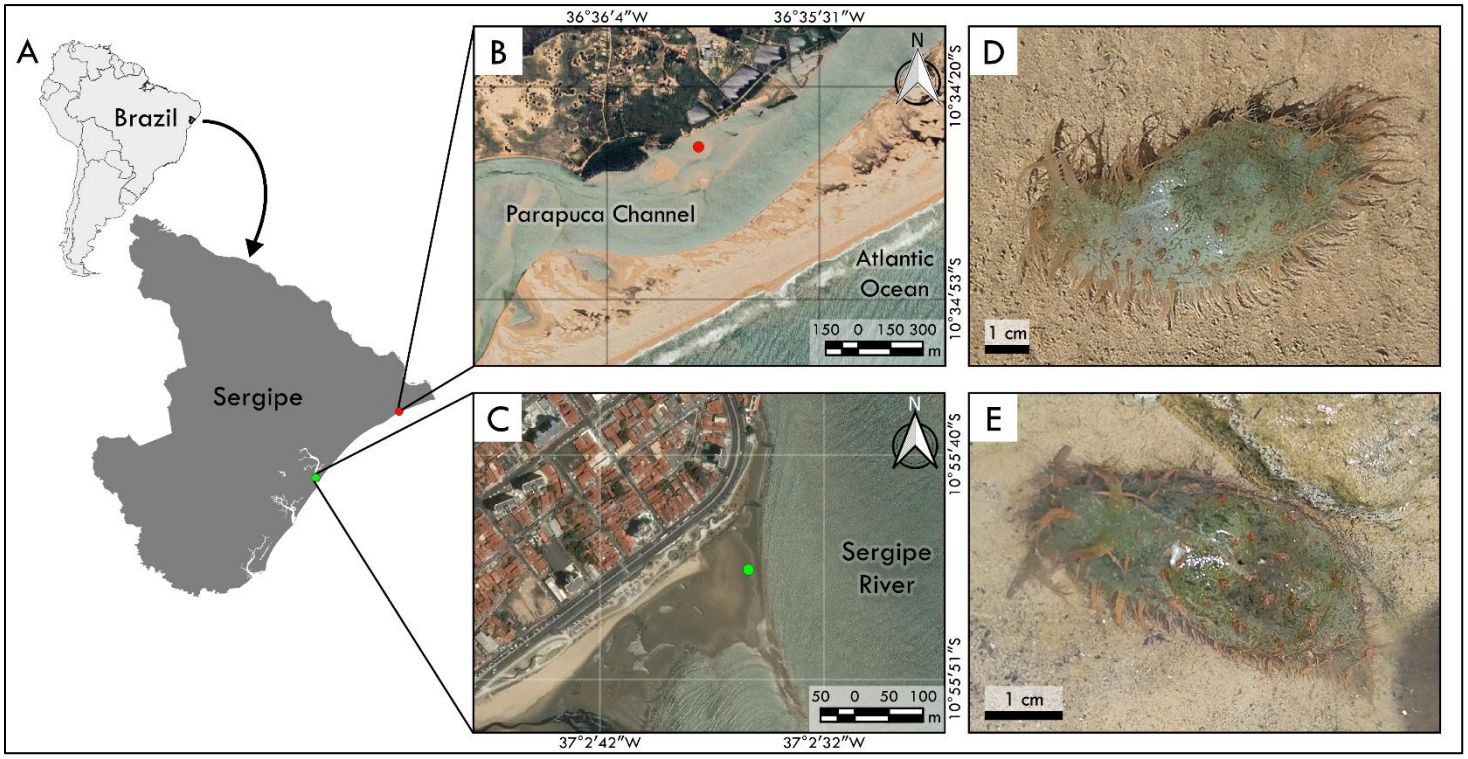

Figure 1. Study Area: A. Map of the State of Sergipe. B. Sampling site of *Bursatella leachii* Blainville, 1817 in the Parapuca Channel (red dot). C. Sampling site of *B. leachii* at the mouth of the Sergipe River (green dot). D. Specimen of *B. leachii* recorded at the Parapuca Channel. E. One of the specimens of *B. leachii* recorded at the mouth of the Sergipe River.

Figure 2. Egg masses of *B. leachii* recorded at the mouth of the Sergipe River on a rocky substrate.

The dorsal region is covered with ramified papillae, varying in size, with the primary papillae being larger than their branches. There are two small fused parapodial flaps covering the gills in the posterior region. All specimens were greenish with papillae of orange/copper color. The egg mass was a resilient, gelatinous tube-shaped cord.

Remarks: All these external morphological characteristics corroborate with the descriptions proposed by Meirelles, Galvão Filho and Matthews-Cascon (2011), Bazzicalupo et al. (2020) and Delgado et al. (2022) to the *Bursatella leachii*. Thus, the present record represents the first occurrence of this species in the coastal zone of the Sergipe state.

Global distribution: Pantropical distribution, inhabiting warm temperate and tropical marine waters worldwide, except along the eastern Pacific and European Atlantic coasts. Western Atlantic from USA to Brazil, Eastern Atlantic from Canary Islands to South Africa. Mediterranean and Red Seas. Indian and Pacific Oceans, ranging from Japan to Australia, including New Zealand and French Polynesia, but absent from the Hawaiian Islands (ZENETOS et al., 2005; PERISSINOTTO et al., 2014; GUTIÉRREZ et al., 2015; BAZZICALUPO et al., 2018; 2020).

Distribution in the Brazilian states: Ceará (BARROSO; MATTHEWS-CASCON, 2009), Rio Grande do Norte (DELGADO et al., 2022; ALENCAR et al., 2024), Paraíba (DUARTE; MOTA; DIAS, 2014), Pernambuco (MARCUS, 1972; RIOS, 2009), Alagoas (PADULA et al., 2012), Sergipe (**this study**), Rio de Janeiro (GOULD, 1852; RIOS, 2009; BAZZICALUPO et al., 2020), São Paulo (MARCUS, 1955; RIOS, 2009), Paraná (FERREIRA JUNIOR et al., 2015), Santa Catarina (LINDNER, 2014), Rio Grande do Sul (RIOS, 2009).

Additional information from the reports in Brazil: Our bibliographic survey identified the occurrence of *Bursatella leachii* in ten of the 17 Brazilian coastal states. According with GBIF database, there are records of preserved specimens of the *B. leachii* for the states of Espirito Santo, material deposited in the Mollusk Collection of the Museu Nacional do Rio de Janeiro (MNRJ) on ID "Br:MNRJ:Mollusca:10644" (PIMENTA, 2024 - https://www.gbif.org/occurrence/1435843043), and Bahia, material deposited in the Gastropoda Collection of the Museu de Zoologia da UNICAMP (ZUEC-GAS) on ID "BRA:UNICAMP:ZUEC-GAS:6696" (DIAS PASSOS, 2024 - https://www.gbif.org/occurrence/2973759884).

4 Discussion

The species *Bursatella leachii* is a benthic herbivorous and detritivores organism (MARCUS, 1955; CLARKE, 2006; GUTIÉRREZ et al., 2015), inhabiting shallow waters, from intertidal to less than 10 m (GUTIÉRREZ et al., 2015; ALENCAR et al., 2024).

This species has been found in various habitats, including sandy beaches (MARCUS, 1972; CLARKE, 2006; DELGADO et al., 2022; ALENCAR et al., 2024), tide pools (PERISSINOTTO et al., 2014), intertidal sand-mud flats (MEIRELLES; GALVÃO FILHO; MATTHEWS-CASCON, 2011; FERREIRA JUNIOR et al., 2015), patch reefs (DUARTE; MOTA; DIAS, 2014), shell mound zones, rocky coastal areas (CLARKE, 2006; ALENCAR et al., 2024), saline mangroves (BARROSO; MATTHEWS-CASCON, 2009; ALENCAR et al., 2024), estuaries and rivers (BARROSO; MATTHEWS-CASCON, 2009; PERISSINOTTO et al., 2014).

B. leachii also has been associated with seagrass beds (CLARKE, 2006; GUTIÉRREZ et al., 2015) and algae mats, including *Gracilaria cervicornis* (Turner, 1808) (MARCUS, 1955) and others (see CLARKE, 2006).

In Sergipe coast, both records occurred in estuarine tidal flats during low tide periods. The Parapuca Channel is part of the delta of the São Francisco River, extending approximately 25 km southward of the river mouth. This channel is situated inside the Santa Isabel Biological Reserve; the region is relatively undisturbed with low urbanization level.

Therefore, this area might be considered as a pristine environment, despite the increasing presence of nearby shrimp farms (SANTOS et al., 2016).

In other hand, the Sergipe estuarine area is a very disturbed and polluted area affected by whole metropolitan region of Aracaju (ALVES; PASSOS; GARCIA, 2007; ROSA, 2023).

The presence of individuals as well as their egg mass in this highly polluted area suggests a great plasticity of this species to explore areas with different levels of disturbance.

Thus, considering the first record of this species on Sergipe coast documented here and the results of our bibliographic surveys, the distribution range of *Bursatella leachii* along the Brazilian coast extends from Rio Grande do Sul to Ceará.

5 Conclusions

In this study, we describe the first records of Bursatella leachii for the coast of Sergipe, in different localities and years.

We address the distribution gap of B. leachii in Sergipe, increases the recorded marine invertebrates for the state, and updates the species' known range in Brazil.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

All the authors contributed with the conceptualization, study design, species identification, and manuscript writing.

DECLARATION OF INTEREST

The authors disclose that they have no known competing financial interests or personal relationships that could have appeared to influence the study reported in this manuscript.

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REFERENCES

ALENCAR, C.E.R.D.; SILVA, T.A.; RODRIGUES, L.S.; MELO, M.D.; PERETTI, D. Distribution extension of the sea slug *Bursatella leachii* Blainville, 1817 (Gastropoda, Heterobranchia) on Rio Grande do Norte, Northeast Brazil. **Oecologia Australis**, v. 28, n. 2, p. 134–140, 2024. Available from: https://doi.org/10.4257/oeco.2024.2802.05

ALVES, J.P.H.; PASSOS, E.A.; GARCIA, C.A.B. Metals and Acid Volatile Sulfide in Sediment Cores from the Sergipe River Estuary, Northeast, Brazil. **Journal of the Brazilian Chemical Society**, v. 18, n. 4, p. 748–758, 2007. Available from: https://doi.org/10.1590/S0103-50532007000400013

BARROSO, C.X.; MATTHEWS-CASCON, H. Distribuição espacial e temporal da malacofauna no estuário do rio Ceará, Ceará, Brasil. **Pan-American Journal of Aquatic Sciences**, v. 4, n. 1, p. 79–86, 2009. Available from: https://panamjas.org/artigos.php?id_publi=166. Accessed on: 11 Aug. 2024.

BAZZICALUPO, E.; CROCETTA, F.; ESTORES-PACHECO, K.; GOLESTANI, H.; BAZAIRI, H.; GIACOBBE, S.; JAKLIN, A.; POURSANIDIS, D.; SNEHA CHANDRAN, B.K.; CERVERA, J.L.; VALDÉS, Á. Population genetics of *Bursatella leachii* (De Blainville, 1817) and implications for the origin of the Mediterranean population. **Helgoland Marine Research**, v. 72, n. 1, 2018. Available from: https://doi.org/10.1186/s10152-018-0521-7

BAZZICALUPO, E.; CROCETTA, F.; GOSLINER, T.M.; BERTEAUX-LECELLIER, V.; CAMACHO-GARCÍA, Y.E.; SNEHA CHANDRAN, B.K.; VALDÉS, Á. Molecular and morphological systematics of *Bursatella leachii* de Blainville, 1817 and *Stylocheilus striatus* Quoy & Gaimard, 1832 reveal cryptic diversity in pantropically distributed taxa (Mollusca: Gastropoda: Heterobranchia). **Invertebrate Systematics**, v. 34, n. 5, p. 535–568, 2020. Available from: https://doi.org/10.1071/IS19056

CLARKE, C.L. The population dynamics and feeding preferences of *Bursatella leachii* (Opisthobranchia: Anaspidea) in northeast Queensland, Australia. **Records of the Western Australian Museum, Supplement**, v. 69, n. 1, p. 11, 2006. Available from: https://doi.org/10.18195/issn.0313-122x.69.2006.011-021

DELGADO, M.; FREIRE, F.A.M.; MEIRELLES, C.A.O.; D'OLIVEIRA, R.G.; PADULA, V.; BAHIA, J.; BRANDÃO, S.N. Sea slugs (Gastropoda: Heterobranchia) from Rio Grande do Norte, Northeastern Brazil. **Papeis Avulsos de Zoologia**, v. 62, 2022. Available from: https://doi.org/10.11606/1807-0205/2022.62.063

DIAS PASSOS, F. **ZUEC-GAS - Coleção de Gastropoda do Museu de Zoologia da UNICAMP**. Version 1.93. Universidade Estadual de Campinas - Instituto de Biologia. Occurrence dataset accessed via GBIF.org. Available from: https://doi.org/10.15468/73mksc

DUARTE, R.C.S.; MOTA, L.S.; DIAS, T.L.P. Mollusk fauna from shallow-water back reef habitats of Paraíba coast, northeastern Brazil. **Strombus**, v. 21, n. 2, p. 15–29, 2014. Available from: https://strombusjournal.org/archives/405-2/. Accessed on: 11 Aug. 2024.

FERREIRA JUNIOR, A.; CARVALHO, I.; CHRISTO, S.; ABSHER, T. New records of marine "sea slugs" (Mollusca: Gastropoda: Heterobranchia) in the outlets of the estuary systems in Paraná, southern Brazil. **Check List**, v. 11, n. 1, 2015. Available from: https://doi.org/10.15560/11.1.1548

GARCÍA-GARCÍA, F.J.; ÁLVAREZ, M.D.; TRONCOSO, J.S. **Opistobranquios de Brasil:** Descripción y distribución de opistobranquios del litoral de Brasil y del Archipiélago Fernando de Noronha. Vigo**:** Feito, 2008. Available from: https://dialnet.unirioja.es/servlet/libro?codigo=720285. Accessed on: 11 Aug. 2024.

GOULD, A.A. **Mollusca and shells in United States Exploring Expedition. During the years 1838, 1839, 1840, 1841, 1842. Under the Command of Charles Wilkes, U.S.N.** Gould & Lincoln: 1852. Available from: https://www.biodiversitylibrary.org/page/10991152#page/12/mode/1up. Accessed on: 11 Aug. 2024.

GUTIÉRREZ, M.C.; ORTEA, J.; RIVERO, N.; TUCKER, G.C.; MALAQUIAS, M.A.E.; NARCISO, S. The opisthobranch gastropods (Mollusca: Heterobranchia) from Venezuela: An annotated and illustrated inventory of species. **Zootaxa**, v. 4034, n. 2, p. 201–256, 2015. Available from: https://doi.org/10.11646/zootaxa.4034.2.1

LARKIN, M.F.; SMITH, S.D.A.; WILLAN, R.C.; DAVIS, T.R. Diel and seasonal variation in heterobranch sea slug assemblages within an embayment in temperate eastern Australia. **Marine Biodiversity**, v. 48, n. 3, p. 1541–1550, 2018. Available from: https://doi.org/10.1007/s12526-017-0700-9

LINDNER, A. (ed.). **Vida marinha de Santa Catarina**. Florianópolis: Editora da UFSC, 2014. Available from: https://livraria.ufsc.br/. Accessed on: 11 Aug. 2024.

MARCUS, E. Opisthobranchia from Brazil. Boletim da Faculdade de Filosofia, Ciências e Letras, Universidade de São Paulo. **Zoologia**, v. 20, n. 20, p. 89-261, 1955. Available from: https://doi.org/10.11606/issn.2526-3382.bffclzoologia.1955.120213

MARCUS, E. On the Anaspidea (Gastropoda: Opisthobranchia) of the warm waters of the western Atlantic. **Bulletin of Marine Science** v. 22, n. 4, p. 841–874, 1972. Available from: https://www.ingentaconnect.com/content/umrsmas/bullmar/1972/00000022/00000004/art00005. Accessed on: 11 Aug. 2024.

MEIRELLES, C.A.O.; GALVÃO FILHO, H.; MATTHEWS-CASCON, H. *Bursatella leachii* de Blainville, 1817. In: MATTHEWS-CASCON, H.; ROCHA-BARREIRA, C.A.; MEIRELLES, C.A.O. (eds.) **Egg masses of some Brazilian mollusks** [*Desovas de alguns moluscos Brasileiros*]. Fortaleza: Expressão Gráfica e Editora, 2011. p. 91-93. Available from: https://www.researchgate.net/publication/216719335_Egg_Masses_of_some_Brazilian_Mollusks_-_Desovas_de_alguns_Moluscos_Brasileiros. Accessed on: 11 Aug. 2024.

PADULA, V.; BAHIA, J.; CORREIA, M.D.; SOVIERZOSKI, H. H. New records of opisthobranchs (Mollusca: Gastropoda) from Alagoas, Northeastern Brazil. **Marine Biodiversity Records,** v. 5, n. 3, p. 1–11, 2012. Available from: https://doi.org/10.1017/S1755267212000346

PERISSINOTTO, R.; MIRANDA, N.A.F.; RAW, J.L.; PEER, N. Biodiversity census of lake St Lucia, iSimangaliso Wetland Park (South Africa): Gastropod molluscs. **ZooKeys**, n. 440, p. 1–43, 2014. Available from: https://doi.org/10.3897/zookeys.440.7803

PIMENTA, A. (2024). **Mollusca Collection - Museu Nacional/UFRJ. Version 1.10. Museu Nacional / UFRJ.** Occurrence dataset accessed via GBIF.org. Available from: https://doi.org/10.15468/g5ykee

RIOS, E.C. **Compendium of Brazilian sea shells**. Rio Grande: Editora Evangraf. 2009. Available from: https://books.google.com.br/books/about/Compendium_of_Brazilian_Sea_Shells.html?id=_ETYZwEACAAJ&redir_esc=y. Accessed on: 11 Aug. 2024.

ROSA, L.C. Plastic debris usage by tube-building polychaete *Diopatra cuprea* complex. **Arquivos de Ciências do Mar**, v. 56, n. 2, 2023. Available from: https://doi.org/10.32360/acmar.v56i2.82806

SANTOS, L.C.M.; ROLLO JUNIOR, M.M.; COSTA, T.M.; PINHEIRO, M.A.A.; DAHDOUH-GUEBAS, F.; BITENCOURT, M.D. Spatial analysis of a coastal area for conservation and fishery of mangrove edible crab (*Ucides cordatus*). **Journal of Coastal Research**, v. 1, n. 75, p. 685–689, 2016. Available from: https://doi.org/10.2112/SI75-137.1

SCHUBERT, J.; SMITH, S.D.A. Sea slugs—"rare in space and time"—but not always. **Diversity**, v. 12, n. 11, p. 1–14, 2020. Available from: https://doi.org/10.3390/d12110423

ZENETOS, A.; ÇINAR, M.E.; PANCUCCI-PAPADOPOULOU, M.A.; HARMELIN, J.G.; FURNARI, G.; ANDALORO, F.; BELLOU, N.; STREFTARIS, N.; ROWIUS, H.Z. Annotated list of marine alien species in the Mediterranean with records of the worst invasive species. **Mediterranean Marine Science**, v. 6, n. 2, p. 63–118, 2005. Available from: https://doi.org/10.12681/mms.186