Type of Manuscript:
Full Article

e-ISSN: 2595-5527
Doi: 10.32435/envsmoke-2024-0009
Volume 7, 2024
Manuscript ID: es20240009
(01-07)

REPORT OF COMMENSAL INTERACTION BETWEEN Lepas (Lepas) anatifera LINNAEUS, 1758 (CIRRIPEDIA: LEPADIDAE) AND Stenocionops furcatus (OLIVIER, 1791) (DECAPODA: EPIALTIDAE), COLLECTED IN A MARINE PROTECTED AREA IN NORTHEASTERN BRAZIL

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Abstract

We report the first documented occurrence worldwide of the goose barnacle *Lepas* (*Lepas*) *anatifera* Linnaeus, 1758 as an epibiont on the furcate spider crab *Stenocionops furcatus*. A male furcate spider crab was collected at a depth of 100 meters off the coast of Pernambuco, Brazil. We observed five individuals of *L.* (*Lepas*) *anatifera* attached to the crab, representing a new commensal association. This finding improves knowledge about marine biodiversity and highlights the dispersal potential of *L.* (*Lepas*) *anatifera*. It also emphasizes the importance of monitoring epibiotic interactions to assess their effects on host organisms. Further research is recommended to explore the ecological implications and adaptive strategies of this relationship.

Keywords: Goose barnacle. Crustacean interaction. Marine biodiversity. Epibiosis. Tamandaré beach.

Submitted on: 04 Oct. 2024
Accepted on: 26 Oct. 2024
Published on: 22 Nov. 2024

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1 Introduction

In marine environments, the most common biological interaction is represented by commensalism, which corresponds to an ecological relationship between two species, where the epibiont benefits without significantly affecting the host basibiont (DOMÈNECH et al., 2015; ALVES-JÚNIOR et al., 2022; DVORETSKY; DVORETSKY, 2022).

Epibiosis is widely observed in commensalism, with the epibiont using temporarily or definitely the host's body for its biological relationships (FERNANDEZ-LEBORANS, 2010). The epibiosis can be performed for several groups, including hydrozoans, bryozoans, nemerteans, polychaetes, echinoderms, mollusks and crustaceans (including amphipods, barnacles, copepods and decapods), and these groups have been reported to cover a wide range of hosts (DVORETSKY; DVORETSKY, 2022; ALVES-JÚNIOR et al., 2022).

The cosmopolitan cirripeds of the genus *Lepas* Linnaeus, 1758 occur in tropical and subtropical oceans and can be found on natural substrates, attaching to algae, driftwood (THIEL; GUTOW, 2005), fish (DULČIĆ et al., 2015), crocodiles (CUPUL-MAGAÑA et al., 2011), sea turtles (DOMÈNECH et al., 2015; TEN et al., 2019) and human bodies (MAGNI et al., 2015). However, the species *Lepas* (*Lepas*) *anatifera* Linnaeus, 1758 is predominantly reported attached to artificial substrates, such as bottles (THIEL; GUTOW, 2005), boats (FARRAPEIRA, 2010), buoys, microplastics (SCOTTI et al., 2023), tarballs (BÉRGAMO et al., 2023) and aircraft fragments (AL-QATTAN et al., 2023).

Despite its adhesion in marine organisms, the occurrence of the goose barnacle *L.* (*Lepas*) *anatifera* as epibiont in decapod crustaceans is sparse and occasionally registered (ALVES-JÚNIOR et al., 2022; NOAA, 2024). The species *L.* (*Lepas*) *anatifera* can be found from surface to deep-sea and has been recorded at depths of up to 700 m (CONWAY; ELLIS; HUMPHERYES, 1990; MARTIN et al., 2020; LIN et al., 2022). It is widely distributed in Brazilian waters, with recorded occurrences in Pará, Paraíba, Pernambuco, Bahia, Espírito Santo, Rio de Janeiro, São Paulo, Santa Catarina, and Rio Grande do Sul, and also in the São Pedro and São Paulo Archipelago (YOUNG, 1999; FARRAPEIRA, 2010; ALVES-JÚNIOR et al., 2022).

In this context, the furcate spider crab *Stenocionops furcatus* (Olivier, 1791) (Epialtidae) is reported along the Brazilian continental shelf, from coastal zones up to 180 m deep, associated with adjacent areas of coral reefs in gravel seabeds (MELO, 1996). *S. furcatus* is known for attaching other organisms to its carapace (CUTRESS; ROSS; SUTTON, 1970). However, until now, there has been no record of *L.* (*Lepas*) *anatifera* associating with this basibiont. Here, we present the first recorded occurrence worldwide of *L.* (*Lepas*) *anatifera* as an epibiont on *S. furcatus*, collected offshore near Pernambuco, Brazil, marking a novel association that expands our understanding of epibiotic interactions in these species.

2 Material and Methods

S. furcatus specimen and its epibionts were captured as bycatch from artisanal fisheries using hook and line, off Tamandaré, State of Pernambuco (8°49'29.52"S; 34°46'57.03"W) Northwestern Brazil, in January 2024 (Figure 1).

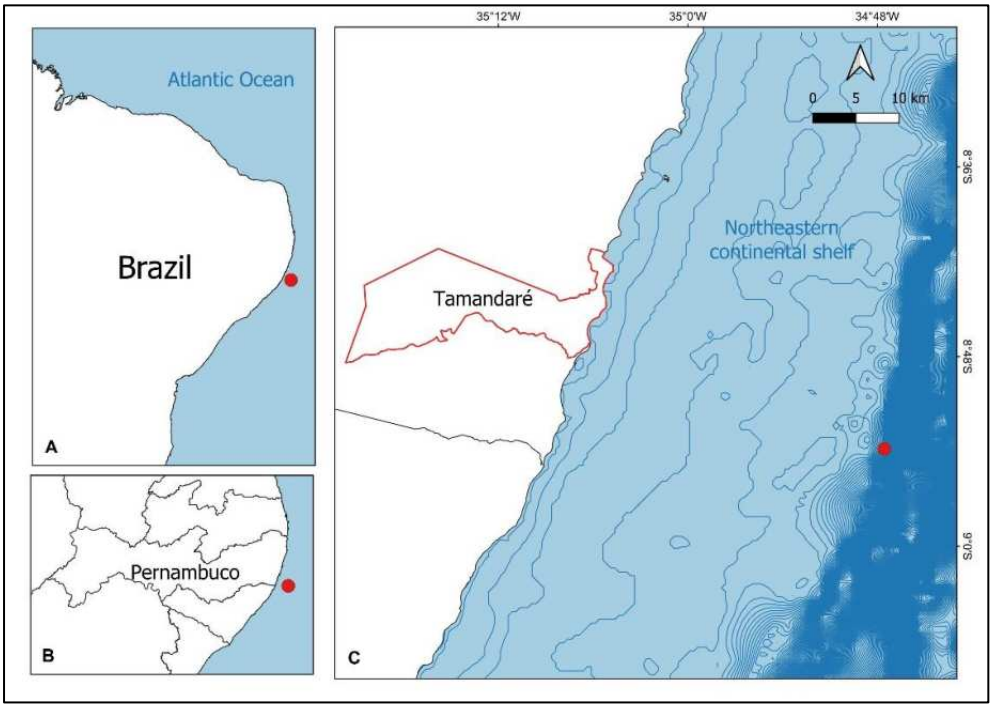

Figure 1. Map of the study area, A. Brazilian Northeast Coast. B. State of Pernambuco. C. Sampling point (red circle) on the continental slope off the city of Tamandaré.

The individuals were allocated in plastic bags, stored in a styrofoam box filled with ice, and transported to the laboratory of the *Centro Nacional de Pesquisa e Conservação da Biodiversidade Marinha do Nordeste* - CEPENE/ICMBio [National Center for Research and Conservation of Marine Biodiversity of the Northeast]. In the laboratory, the specimens were sorted out, photographed and measured using a digital caliper (0.01 mm) in the Carapace Length (cl.), Carapace Width (cw.), Wet Weight (ww.) and the Capitulum Length (cpl.).

The furcate spider crab specimen was identified following Melo (1996), and the goose barnacles according to Young (1999). After the analysis, both species were fixed in 70% ethanol and deposited under voucher number at the Coleção Biológica do CEPENE - CBC (FRANCISCO et al., 2021).

3 Results and Discussion

Crustacean commensalism is well-documented (FERNANDEZ-LEBORANS, 2010), with recent records of these relationships along the Brazilian coast (ALVES-JÚNIOR et al., 2022). Here, we present a new interspecific record of commensalism worldwide, marking the first known occurrence of this association. Five individuals of *L.* (*Lepas*) *anatifera* were found colonizing a male specimen of *S. furcatus* (Voucher ID: CBC n° 554; cl.: 11 cm; cw.: 8.5 cm; ww.: 196 g, Figure 2).

According to the local fishermen (personal communication) these specimens were captured at around 100 m deep. The colonization by the goose barnacles occurred in various parts of the crab's body, with four individuals (cpl.: #1=6.1 mm; #3=5.1 mm; #4=5.9 mm; #5=6.0 mm) on the carapace and one (cpl.: #2=6.2 mm) on the cheliped (Figure 3 A-D).

According to Cutress, Ross and Sutton (1970), *S. furcatus* is observed decorating its body with organisms that act as epibionts, such as algae, anemones, sponges, and other invertebrates. Although *Lepas* is commonly observed as a commensal organism, there are few studies specifically documenting *L. (Lepas) anatifera* in epibiotic relationships with crustaceans.

Isolated records include *Spinolambrus pourtalesii* (Stimpson, 1871) collected on the continental shelf in the Great Amazon Reef System (GARS) at a depth of 76 meters (ALVES-JÚNIOR et al., 2022), and *Chaceon* spp. (Manning & Holthuis, 1989), observed at a depth of 740 meters on the North American Continental Margin (NOAA, 2024). Additionally, we report *L.* (*Lepas*) *anatifera* as an epibiont on *S. furcatus* on the Northeast Brazilian Continental Shelf at a depth of 100 meters. It is known that settled barnacles are considered pioneer species that facilitate the colonization of subsequent epibionts (FRICK; PFALLER, 2013), which may indicate that this could be an initial stage of colonization on the Decapoda organisms.



Figure 2. The furcate spider crab *Stenocionops furcatus* (Olivier, 1791) with red arrows showing epibiotic *Lepas* (*Lepas*) *anatifera* Linnaeus, 1758. # = indicate the position of each goose barnacle individual aforementioned in this study. Scale bar = 5 cm.

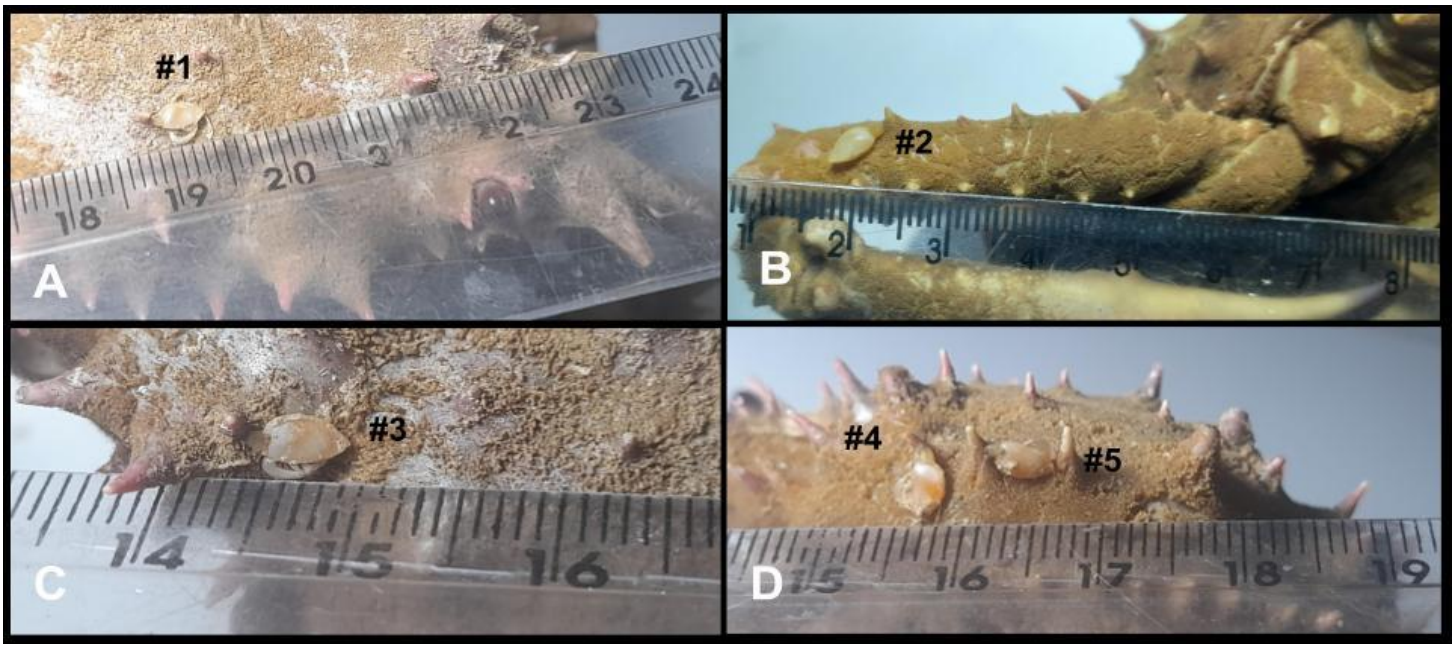

Figure 3. A-D: A. L*epas* (*Lepas*) *anatifera* Linnaeus, 1758 adhered in carapace of *Stenocionops furcatus* (Olivier, 1791) (high side). B. *L. anatifera* Linnaeus, 1758 adhered to the left cheliped; C. *L. anatifera* Linnaeus, 1758 adhered in carapace (left side); D. *L. anatifera* Linnaeus, 1758 adhered in carapace (left side). *#* = indicate the position of each individual *L. anatifera* cited in the text.

The negative effects on the basibiont include the additional weight from large infestations and friction with water, which affects the basibiont's mobility, potentially increasing the risk of predation due to difficulty escaping (OVERSTREET, 1979; FERNANDEZ-LEBORANS, 2010). Furthermore, when food resources are scarce, epibiosis results in high consumption of energy reserves, affecting basibiont defense, growth, or reproduction (FERNANDEZ-LEBORANS, 2010). On the other hand, this epibiotic relationship can have a positive effect for the basibiont, as it provides visual camouflage (FERNANDEZ-LEBORANS, 2010).

Due to the dispersion of the basibiont in marine environments, epibionts can gain several benefits, including low competition for substrates, greater larval dispersal and gene flow, increased availability of nutrients, and protection against predators (FERNANDEZ-LEBORANS, 2010). However, the basibiont may experience adverse effects, such as exposure to environmental conditions outside its tolerance range, removal due to abrasion or during ecdysis and desiccation due to emersion in coastal regions. Fortunately, the facultative adhesion capability allows for temporary adjustments to the substrate, helping to mitigate these challenges (FERNANDEZ-LEBORANS, 2010; FRICK; PFALLER, 2013).

The presence of the species *L. (Lepas) anatifera* and *S. furcatus* at the depth of 100 meters falls within the known depth ranges for both species (CONWAY; ELLIS; HUMPHERYES, 1990; MELO, 1996; MARTIN et al., 2020; LIN et al., 2022).

The association of these goose barnacles with the furcate spider crab suggests a potential commensal phoresy relationship (WHITE; MORRAN; ROODE, 2017), similar to other epibiosis interactions already reported in the literature for cirripedes and other decapods species, such as *Octolasmis lowei* (Darwin, 1852) on carapaces of the spider crab *Libinia spinosa* Guérin, 1832 (CORDEIRO; COSTA 2010), and on *Callinectes ornatus* Ordway, 1863 and *Callinectes danae* Smith, 1869 (MACHADO et al., 2013; SILVA-INÁCIO et al., 2016).

Other symbiotic interaction with Lepadidae family have also been reported on marine macrofauna, such as *Lepas hilli* (Leach, 1818) on the tripletail fish *Lobotes surinamensis* (Bloch, 1790) (DULČIĆ et al., 2015) and *L. (Lepas) anatifera* in sea turtles (MIGNUCCI-GIANNONI et al., 2022) which increases its potential for dispersal and cosmopolitan distribution (YOUNG, 1999).

4 Conclusions

We report here the first documentation of an epibiotic relationship between *L.* (*Lepas*) *anatifera* and *S. furcatus* on the northeastern continental shelf of Brazil, marking a new association observed worldwide.

The presence of *L.* (*Lepas*) *anatifera* on benthic crustaceans and other organisms underscores its significant potential for global dispersal, given its cosmopolitan distribution.

The observed interaction enhances our understanding of marine biodiversity and emphasizes the need to monitor such associations to better comprehend the potential ecological effects, both positive and negative.

This contribution highlights the complex interactions that occur within marine ecosystems and their implications for species distribution and ecological dynamics.

Further studies, incorporating additional samples and abiotic data, are essential to deepen our understanding of these relationships and their broader ecological impacts.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

JAF and IBS conceived the research ideas, first draft of this manuscript, writing of the manuscript and revisions along the main text; ARP, ES, AKC and LTM writing and revisions along the main text.

DECLARATION OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence this study.

FUNDING SOURCE

No financial contribution was used for the development of this article.

ACKNOWLEDGMENTS

The authors would like to thank the fisherman known as Maturi for the donation of material provided in this study.

REFERENCES

AL-QATTAN, N.; HERBERT, G.S.; SPERO, H.J.; MCCARTHY, S.; MCGEADY, R.; TAO, R.; POWER, A.M. A stable isotope sclerochronology-based forensic method for reconstructing debris drift paths with application to the MH370 crash. **AGU Advances**, v. 4, e2023AV000915, 2023. Available from: https://doi.org/10.1029/2023AV000915

ALVES-JÚNIOR, F.A.; MARTINS, D.E.G.; SILVA, K.C.A.; KLAUTAU, A.G.C.M.; CINTRA, I.H.A. Barnacles as Epibionts in Crustaceans from the Great Amazon Reef System (GARS) Northern of Brazil: New Records and New Host Associations. **Thalassas: An International Journal of Marine Sciences,** v. 38, p. 1371-1378, 2022. Available from: https://doi.org/10.1007/s41208-022-00480-y

BÉRGAMO, D.B.; CRAVEIRO, N., MAGALHÃES, K.M.; YOGUI, G.T.; SOARES, M.O.; ZANARDI-LAMARDO, E.; ROJAS, L.A.V.; LIMA, M.C.S.; ROSA FILHO, J.S. Tar balls as a floating substrate for long-distance species dispersal. **Marine Pollution Bulletin**, v. 196, 115654, 2023. Available from: https://doi.org/10.1016/j.marpolbul.2023.115654

CONWAY, D.V.P.; ELLIS, C.J.; HUMPHERYES, I.G. Deep distributions of oceanic cirripede larvae in the Sargasso Sea and surrounding North Atlantic Ocean. **Marine Biology,** v. 105, p. 419-428, 1990. Available from: https://doi.org/10.1007/BF01316313

CORDEIRO, C.A.M.M.; COSTA, T.M. Infestation rates of the pedunculated barnacle *Octolasmis lowei* (Cirripedia: Poecilasmatidae) on the spider crab *Libinia spinosa* (Decapoda: Majoidea). **Journal of the Marine Biological Association of the United Kingdom,** v 90 (2), p. 315-322, 2010. Available from: https://doi.org/10.1017/S0025315409990506

CUPUL-MAGAÑA, F.G.; RUBIO-DELGADO, A.; ESCOBEDO-GALVÁN, A.H.; REYES-NÚÑEZ, C. First report of the marine barnacles *Lepas anatifera* and *Chelonibia testudinaria* as epibionts on American crocodile (*Crocodylus acutus*). **Herpetology Notes**, v. 4, p. 213–214, 2011. Available from: https://www.seh-herpetology.org/journals/herpetology-notes/back-issues/volume-4-2011. Accessed on: 30 Sep. 2024.

CUTRESS, C.; ROSS, D. M.; SUTTON, L. The association of *Calliactis tricolor* with its pagurid, calappid, and majid partners in the Caribbean. **Canadian Journal of Zoology**, v. 48, n. 2, p. 371–376, 1970. Available from: https://doi.org/10.1139/z70-059

DOMÈNECH, F.; BADILLO, F.J.; TOMÁS, J.; RAGA, J.A.; AZNAR, F.J. Epibiont communities of loggerhead marine turtles (*Caretta caretta*) in the western Mediterranean: influence of geographic and ecological factors. **Journal of the Marine Biological Association of the United Kingdom**, v. 95, n. 4, p. 851-861, 2015. Available from: https://doi.org/10.1017/S0025315414001520

DULČIĆ, J.; DRAGIČEVIĆ, B.; DESPALATOVIĆ, M.; CVITKOVIĆ, I.; BOJANIĆ-VAREŽIĆ, D.; ŠTIFANIĆ, M. Lepadid barnacles found attached to a living *Lobotes surinamensis* (Pisces). **Crustaceana**, v. 88, n. 6, p. 727-731, 2015. Available from: https://doi.org/10.1163/15685403-00003435

DVORETSKY, A. G.; DVORETSKY, V. G. Epibiotic Communities of Common Crab Species in the Coastal Barents Sea: Biodiversity and Infestation Patterns. **Diversity**, v. 14, n. 1, 6, 2022. Available from: https://doi.org/10.3390/d14010006

FARRAPEIRA, C.M.R. Shallow water Cirripedia of the northeastern coast of Brazil: The impact of life history and invasion on biogeography. **Journal of Experimental Marine Biology and Ecology**, v. 392, n. 1-2, p. 210–219, 2010. Available from: https://doi.org/10.1016/j.jembe.2010.04.021

FERNANDEZ-LEBORANS, G. Epibiosis in Crustacea: An overview. **Crustaceana**, v. 83, p. 549–640, 2010. Available from: https://doi.org/10.1163/001121610X532657

FRANCISCO, J.A.; PESSOA, A.R.; RESENDE, S.M.; MESSIAS, L.T.; FERREIRA, B.P.; SOMMER, I.B. Coleção Biológica do CEPENE/ICMBio: Aspectos Históricos e Acervo Atual. **Biodiversidade Brasileira**, v. 12, n. 4, p. 1-26, 2022. Available from: https://doi.org/10.37002/biodiversidadebrasileira.v12i4.2056

FRICK, M.G.; PFALLER, J.B. Sea turtle epibiosis. In: WYNEKEN, J.; LOHMANN, K.J.; MUSICK, J.A. (eds) **The biology of sea turtles**, vol 3. CRC Marine Biology Series, Boca Raton, p. 399–426, 2013. Available from: https://www.routledge.com/The-Biology-of-Sea-Turtles-Volume-III/Wyneken-Lohmann-Musick/p/book/9781439873076?srsltid=AfmBOop0oKuTurIsYXSd2Upf340l87QrN9qcwXbtTVT29LT-yfKfPSar. Accessed on: 30 Sep. 2024.

LIN, X. N.; HU, L. S.; CHEN, Z. H.; DONG, Y. W. Thermal heterogeneity is an important factor for maintaining the genetic differentiation pattern of the pelagic barnacle Lepas anatifera in the northwest Pacific. **Ecology and Evolution**, v. 13, n. 2, p. e9843, 2023. Available from: https://doi.org/10.1002/ece3.9843

MACHADO, G.B.O.; SANCHES, F.H.C.; FORTUNA, M.D.; COSTA, T.M.S. Epibiosis in decapod crustaceans by stalked barnacle *Octolasmis lowei* (Cirripedia: Poecilasmatidae). **Zoologia,** v. 30, p. 307-311, 2013. Available from: https://doi.org/10.1590/S1984-46702013000300007

MAGNI, P.A.; VENN, C.; AQUILA, I.; PEPE, F.; RICCI, P.; NUNZIO, C.D.; AUSANIA, F.; DADOUR, I. R. Evaluation of the floating time of a corpse found in a marine environment using the barnacles *Lepas anatifera* L. (Crustacea: Cirripedia: Pedunculata). **Forensic Science International,** v. 247, p. 6–10, 2015. Available from: https://doi.org/10.1016/j.forsciint.2014.11.016

MARTIN, M.V.; VENKATESAN, R.; BEYLINE, M.; LIMMA MOL, V.P.; DIVYA, L. Influence of environmental factors on macrofoulant assemblages on moored buoys in the eastern Arabian Sea. **PLoS One**, v. 15, n. 1, art. e0223560, 2020. Available from: https://doi.org/10.1371/journal.pone.0223560

MELO, G.A.S. **Manual de identificação dos Brachyura (caranguejos e siris) do litoral brasileiro**. Plêiade, São Paulo, p. 603, 1996. Available from: https://repositorio.usp.br/item/000921427. Accessed on: 30 Sep. 2024.

MIGNUCCI-GIANNONI, A.A.; CINTRÓN-DE JESUS, J.; RIVERA-PÉREZ, C. I.; RIVERA-TRISTSARE, G. S.; ZARDUS, J. D. Barnacles Associated with Whales, Dolphins, Manatees, and Sea Turtles from the Puerto Rico Archipelago and Florida. **Caribbean Naturalist**, v 86. 2022. Available from: https://www.eaglehill.us/CANAonline/CANA-access-pages/CANA-regular/CANA-086-Mignucci.shtml. Accessed on: 30 Sep. 2024.

NOAA Ocean Exploration. **NOAA Ocean Exploration Benthic Deepwater Animal Identification Guide**, Version 4. NOAA Ocean Exploration. Web application. Available from: https://www.ncei.noaa.gov/maps/benthic-animal-guide/. Accessed on: 30 Sep. 2024.

OVERSTREET, R.M. Metazoan symbionts of the blue crab. In: PERRY, H.M.; VAN ENGEL, W.A. (eds.), **Proceedings of the blue crab colloquium**: 81-87. Gulf States Marine Fisheries Commission, Biloxi, Mississippi, 1979. Available from: https://www.naturalhistorybooks.com/products/proceedings-blue-crab-colloquium-october-18-19-1980. Accessed on: 30 Sep. 2024.

SCOTTI, G.; D'ALESSANDRO, M.; ESPOSITO, V.; VIVONA, P.; PANTI, C. Anthropogenic fibers and microplastics in the pelagic gooseneck barnacle *Lepas* (*Lepas*) *anatifera* in Capo Milazzo Marine Protected Area (Tyrrhenian Sea): A first characterization. **Ecological Indicators**, v. 152, 2023. Available from: https://doi.org/10.1016/j.ecolind.2023.110368

SILVA-INÁCIO, L. M.; MACHADO, G. B. O.; FORTUNA, M. D.; SANCHES, F. H. C.; COSTA, T. M. S. Infestation by the epibiont *Octolasmis lowei* in a portunid crab assemblage from a subtropical coast. **Nauplius,** v. 24, p. e201602, 2016. Available from: https://doi.org/10.1590/2358-2936e2016022

TEN, L.T.; PASCUAL, M.I.; PÉREZ-GABALDÓN, J.; TOMÁS, J.; DOMÈNECH, F.J.; AZNAR, F.J. Epibiotic barnacles of sea turtles as indicators of habitat use and fishery interactions: An analysis of juvenile loggerhead sea turtles, *Caretta caretta*, in the western Mediterranean. **Ecological Indicators**, v. 107, p. 105672, 2019. Available from: https://doi.org/10.1016/j.ecolind.2019.105672

THIEL, M.; GUTOW, L. The Ecology of Rafting in the Marine Environment. II. The Rafting Organisms and Community. **Oceanography and Marine Biology**, v. 43, p. 279-418, 2005. Available from: https://doi.org/10.1201/9781420037449

WHITE, P.; MORRAN, L.; DE ROODE, J. Phoresy. **Current Biology**, v. 27, n. 12, p. R578-R580, 2017. Available from: https://doi.org/10.1016/j.cub.2017.03.073

YOUNG, P.S. Subclasse Cirripedia (cracas). In: BUCKUP, L.; BOND BUCKUP, G. (eds). **Os crustáceos do Rio Grande do Sul.** Editora Universidade/UFRGS, Porto Alegre, p. 24-53, 1999. Available from: https://livraria.funep.org.br/product/os-crustaceos-do-rio-grande-do-sul/. Accessed on: 30 Sep. 2024.