



Brief Report

Exploring New Territories: New Records and Occurrence Confirmation of Two Caridean Shrimps in Brazil [†]

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Abstract: Here, we confirm the presence of two species of caridean shrimps for the first time in Brazil: *Latreutes parvulus* and *Ambidexter cochensis*. During active samplings conducted in December 2023, April 2024 and September 2024 on the rocky shore of Prainha da USP (Ubatuba municipality, São Paulo state, southeastern Brazil), we captured five ovigerous females of *L. parvulus* and fifteen individuals of *A. cochensis* (five males, three non-ovigerous females and seven ovigerous females). All the females of *L. parvulus* exhibited eyestalks with small, truncated processes separating the cornea from the stalk, a unique feature of this species. On the other hand, all specimens of *A. cochensis* exhibited a unique combination of characteristics: a rostrum with an apex bifid, a stylocerite bearing a lateral spinule and a transverse row of setae between the anterior pair of spines, and three longitudinal rows of setae on the telson. Also, males of *A. cochensis* had the tip of their *appendix masculina* armed with four simple apical setae and another two setae positioned below them. All analyzed shrimps had fully developed gametes in their reproductive systems, indicating breeding populations in this area. This is the first record of *L. parvulus* on the Atlantic coast of South America and a new meridional distribution limit for *A. cochensis*.



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Keywords: Hippolytidae; Processidae; reproductive system; small caridean shrimps; South Atlantic Ocean

1. Introduction

Caridean shrimps inhabit a wide range of marine ecosystems, including rocky shores [1–3]. These environments serve as transitional zones between terrestrial and marine systems and are characterized by significant tidal fluctuations and regular exposure to sunlight and air. The interaction between these elements exerts biological pressures that influence the life strategies of organisms that inhabit these areas [4].

Small caridean shrimps (carapace length (CL) ≤ 5 mm) from the families Hippolytidae, Palaemonidae, Processidae and Thoridae are commonly found in association with these ecosystems [1–3,5,6]. This is primarily due to the availability of shelters and refuge areas. Ovigerous females of these families are frequently observed in these habitats, as the habitats provide protection and contribute to the optimization and viability of their offspring [7,8].

Along the Brazilian coast, rocky shores extend from the states of Maranhão (north-eastern region) to Rio Grande do Sul (southern region), occurring more commonly along the southeastern coast due to the presence of mountains near the Atlantic Ocean [9]. The

coast of São Paulo state is one of the best-studied areas in terms of decapod biodiversity in Brazil. Regarding caridean shrimps, the state harbors a total of 23 species divided into three groups: amphidromous (11 spp.), marine shallow-coastal (9 spp.), and marine deep-water (3 spp.) [10]. Despite the vast extent of rocky shores in Brazil, gaps in distribution records of caridean species within specific ecosystems, locations or territories are common. Knowledge of the reproductive aspects and distribution of crustaceans is often restricted to taxa of economic importance [11–13].

Recently, Terossi and Cardoso [14] assessed the biodiversity and distribution of shrimp species occurring in Brazil, cataloging 176 species of marine and brackish caridean shrimps inhabiting shallow waters (<500 m) in the country. However, during field samplings on the rocky shore of Ubatuba municipality (São Paulo state, southeastern Brazil), we identified, based on morphological characteristics, the occurrence of two caridean shrimps not listed in the Taxonomic Catalog of the Brazilian Fauna. In this context, we present the first records of the hippolytid shrimp *Latreutes parvulus* (Stimpson, 1871) and the processid shrimp *Ambidexter cochensis* Rodríguez and Lira, 2022 on the South Atlantic coast of Brazil. In addition, we document the taxonomic characteristics of both species through photographic records. We also obtained reproductive data (including reproductive indices and microscopic inspection of reproductive systems) to assess whether both species have established breeding populations in this area.

2. Materials and Methods

During December 2023, April 2024 and September 2024, aquatic microhabitats on the rocky shore of Prainha da USP, Ubatuba, São Paulo state, southeastern Brazil (23°30′01.7″ S; 45°07′07.2″ W) were surveyed by two collectors at night (22:00–00:00 h) at low tide (Figure 1). All caridean shrimps were captured using fine-mesh aquarium square nets (6 inches) and transported alive in thermally insulated boxes with aeration to the laboratory. Specimens were kept for a short period (24 h) in aquarium tanks (45 × 25 × 30 cm) with dark bottoms, sand as a substrate, and fragments of brown algae and rocks to provide shelter (temperature 25 ± 0.5 °C).

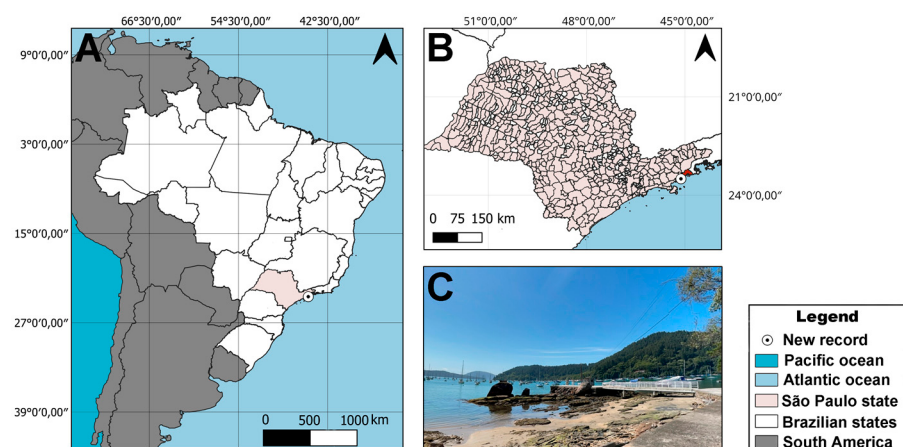


Figure 1. (A) Map showing the new occurrence of two caridean shrimps in Brazil. (B) Detailed map of São Paulo state, highlighting the new record in the Ubatuba municipality, a subtropical region of Brazil. (C) The sampling site, located on the rocky shore of Prainha da USP (Ubatuba municipality, São Paulo state, southeastern Brazil).

Shrimps were anesthetized by chilling (−20 °C for 5 min) and then properly identified using taxonomic guides [3,6] and checklists of caridean shrimps from marine environments in Brazil [13–15]. At this stage, we found that two species did not match existing records for the country. Thus, specific identification keys and species descriptions were consulted

to determine their taxonomic classification [16–20]. Morphological key characteristics were analyzed to confirm the occurrence of *L. parvulus* and *A. cochensis* on the Brazilian coast, as detailed in the Results section. Specimens of both species were deposited in the Crustacean Collection of the Department of Biology (CCDB), Faculty of Philosophy, Sciences and Letters of Ribeirão Preto, University of São Paulo, under the catalog numbers CCDB 8189 (*L. parvulus*) and CCDB 6808 (*A. cochensis*).

All individuals of both species had their CL measured, defined as the distance between the posterior margin of the ocular orbit and the midpoint of the posterior margin of the carapace. For *L. parvulus*, the scaphocerite ratio was also measured, considering the distance between the anterior and posterior margins of the scaphocerite (i.e., length) vs. the distance between its anterolateral margins (i.e., width), as this morphological characteristic has proven to be fundamental in distinguishing species within the genus *Latreutes* [20].

Ovigerous females were the most commonly obtained during field work (*L. parvulus* and *A. cochensis*—100% and 46.7% of captured shrimps, respectively). These females were weighed on an analytical scale (0.0001 g), and their ovaries and hepatopancreas were removed from the cephalothorax, along with embryo masses from the incubation chamber. The organs and embryo masses were weighed on an analytical scale to determine the gonadosomatic (GSI) and hepatosomatic (HSI) indexes, as well as reproductive output (RO), following the methods of Grant and Tyler [21] and Anger and Moreira [22].

The reproductive systems of all captured shrimps were fixed in 4% paraformaldehyde (in seawater) for 24 h. After fixation, the organs were washed twice in 0.2 M phosphate buffer (pH 7.6 in seawater), dehydrated in a series of ethanol mixtures with increasing concentrations (70 to 95%), and embedded in glycol-methacrylate historesin Leica® (Leica, Deerfield, IL, USA). After microtomy (3–4 µm thickness), the slides were stained with hematoxylin and eosin for general histological description [23].

The evaluation of reproductive indices in ovigerous females, combined with the histological analyses of reproductive systems performed here, can confirm whether or not both species of caridean shrimps have breeding populations in this area [23,24].

3. Results

3.1. Systematics

Family Hippolytidae Spence Bate, 1888

Genus *Latreutes* Stimpson, 1860

Latreutes parvulus (Stimpson, 1871 [25]) (Figure 2)

Latreutes parvulus—Almeida et al., 2007 [5]: 18; Almeida et al., 2012 [13]: 23; Terossi et al., 2017 [26]: Figure 2; Terossi et al., 2018 [15]: 79, 81; Terossi et al., 2019 [20]: Figure 5.

Material examined. Brazil, São Paulo, Ubatuba: 5 ♀(ovigerous) (CL: 2.38–2.77 mm, all specimens dissected), 23°30′01.7″ S; 45°07′07.2″ W, 14 December 2023, depth 0.70 m, nocturnal hand net sample, tide pool with banks of brown algae *Sargassum* spp. (CCDB 8189).

Diagnosis. Rostrum laterally compressed, with the upper margin possessing a middorsal row of 5–8 teeth (Figure 2A,C). Eyes well-developed, with eyestalks featuring a truncated process at the upper inner margin, overlapping the line separating the cornea from the stalk (Figure 2B,D). Scaphocerite 2.32–2.62 (usually <2.5) times as long as broad (Figure 2E and Table 1).

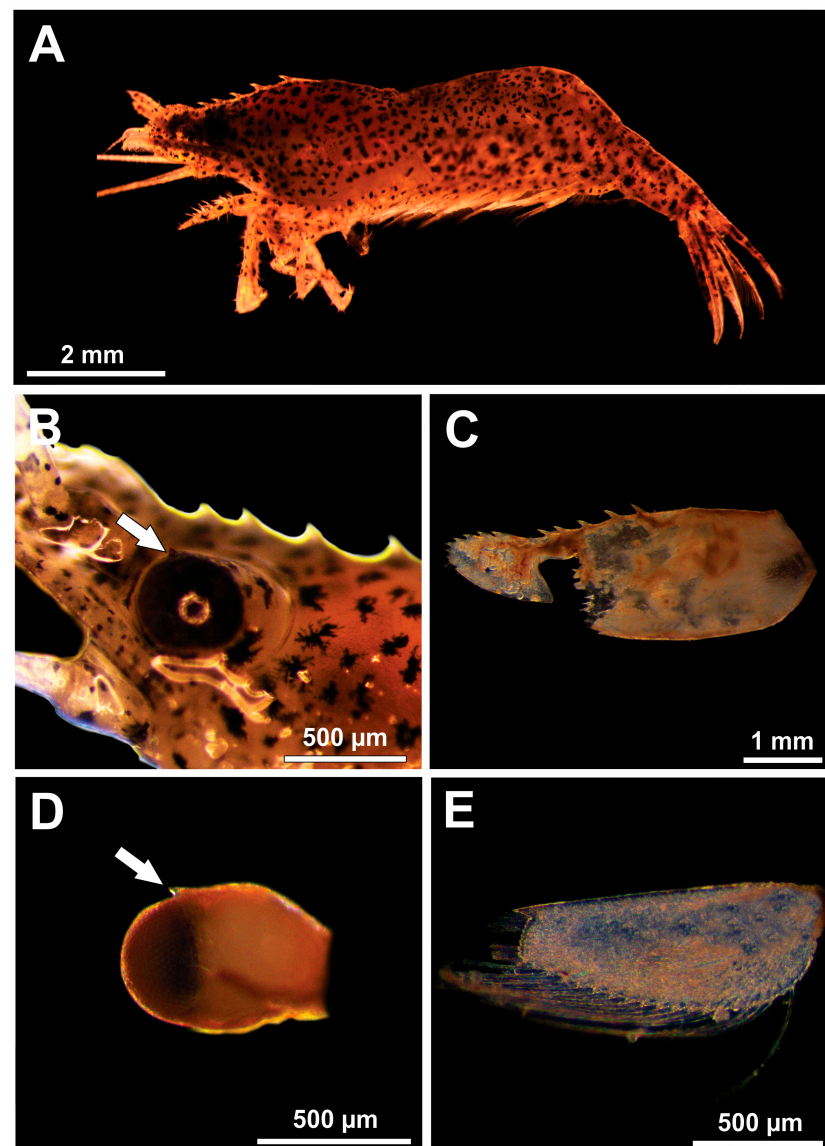


Figure 2. *Latreutes parvulus* (Stimpson, 1871) (CCDB 8189). (A) Ovigerous female (eggs removed), body, lateral view. (B) Frontal region highlighting the eyestalk with a small, truncated process (white arrow), lateral view. (C) Rostrum and carapace, lateral view. (D) Detail of the eyestalk with a small, truncated process separating the cornea from the stalk (white arrow), lateral view. (E) Scaphocerite of left antenna.

Distribution. Western Atlantic: Beaufort [6]; Florida [20]; Caribbean Sea, Honduras [20]; Prainha da USP, Ubatuba, São Paulo (this study). Eastern Atlantic: West Africa, Congo and Angola [20].

Ecology. This species inhabits a wide variety of habitats in littoral waters, both associated with sponges and among shells, dead coral, hydroids, and seagrass flats, ranging from shallow waters to depths of up to 44 m [6]. It likely utilizes fronds of brown algae, *Sargassum filipendula* C. Agardh, 1824, *S. vulgare* C. Agardh, 1820, and *S. cymosum* C. Agardh, 1820, as shelter and nursery areas in tide pools (this study).

Remarks. The occurrence of *L. parvulus* was mistakenly attributed to the Brazilian coast. Terossi et al. [20], through a combination of morphological and molecular data, revealed that specimens previously identified as *L. parvulus* in Brazil were actually *Latreutes baueri* Terossi, Almeida and Mantelatto, 2019. The latter species differs from *L. parvulus* by having a smooth eyestalk and a scaphocerite ratio usually greater than 3 (range: 2.5 to 3.3), whereas in *L. parvulus*, the eyestalk bears a small, truncated process separating the cornea from the

stalk, and the scaphocerite ratio is usually less than 2.5 (range: 1.5 to 2.5). To date, only one specimen from the Ubatuba coast has shown slight variability in the scaphocerite ratio (2.62), differing from the original description.

Family Processidae Ortmann, 1896

Genus *Ambidexter* Manning and Chace, 1971 [17]

Ambidexter cochensis Rodríguez and Lira, 2022 [18] (Figure 3)

Ambidexter sp.—Rodríguez et al., 2020 [27]: 195, Figure 10a–f.

Ambidexter symmetricus—Vera-Caripe and Lira, 2019 [28]: 21, plates 15A–C (?).

Ambidexter cochensis—Rodríguez and Lira, 2022 [18], Figures 1 and 2

Material examined. Brazil, São Paulo, Ubatuba: 5 ♀(ovigerous) (CL: 4.19–5.00 mm, all specimens dissected), 23°30′01.7″ S; 45°07′07.2″ W, 14 December 2023, depth 0.70 m, nocturnal net sample, tide pool with banks of brown algae *Sargassum* spp. (CCDB 6808); 3 ♀(CL: 4.5–4.9 mm, all specimens dissected), 1 ♂(CL: 3.43 mm, specimen dissected), 4 September 2024, depth 0.50 m, nocturnal net sample, tide pool with sand bottom sediment; 2 ♀(ovigerous) (CL: 3.90–4.90 mm, all specimens dissected), 4 ♂(CL: 2.57–3.57 mm, all specimens dissected), 3 September 2024, depth 0.30 m, nocturnal net sample, tide pool with sand bottom sediment.

Diagnosis. Rostrum is short, unarmed, not extending beyond the anterior margin of the eye, with a bifid apex (Figure 3B,C). Antennular peduncle with stylocerite bearing a small spinule at the lateral margin (Figure 3D,F). Second pleopod of the male with *appendix masculina* armed with four apical simple setae; additional setae similar to the apical ones are located posteriorly, with a small simple seta positioned at approximately three-fourths of the length of the *appendix masculina* (Figure 3E). Second pair of pereopods symmetrical, both chelate, carpus subdivided into 9 to 11 articles (Figure 3G). Telson with two pairs of dorsal spines; a transverse row of setae between the anterior pair of spines; three longitudinal rows of setae: one central row and two lateral rows along with the pair of dorsal spines (Figure 3H).

Distribution. Western Atlantic: Coche and Margarita Islands, Venezuela [18]; Prainha da USP, Ubatuba, São Paulo (this study).

Ecology. This species inhabits shallow areas with a depth less than 1 m, associated with beds of the seagrass *Thalassia testudinum* [18] or in tide pools with sandy bottom sediment (this study).

Remarks. *Ambidexter cochensis* can be easily distinguished from *A. symmetricus* Manning and Chace, 1971 (the most common species of the genus *Ambidexter* in Brazil) by the presence of a stylocerite armed with a lateral spinule, whereas in *A. symmetricus*, the stylocerite is rounded and unarmed [17]. In addition, only *A. cochensis* exhibits three longitudinal rows of setae (one central row and two lateral rows along with the pair of dorsal spines) on its telson [18]. Another distinguishing feature is the number and arrangement of setae on the *appendix masculina* of the second pleopod in males. *Ambidexter symmetricus* and *A. swifti* Abele, 1972 have four strong simple apical setae, while *A. panamensis* Abele, 1972 exhibits four weaker lateral setae in addition to the four apical setae. In contrast, the *appendix masculina* in *A. cochensis* displays four strong simple apical setae and two weaker simple setae positioned below them [16–18].

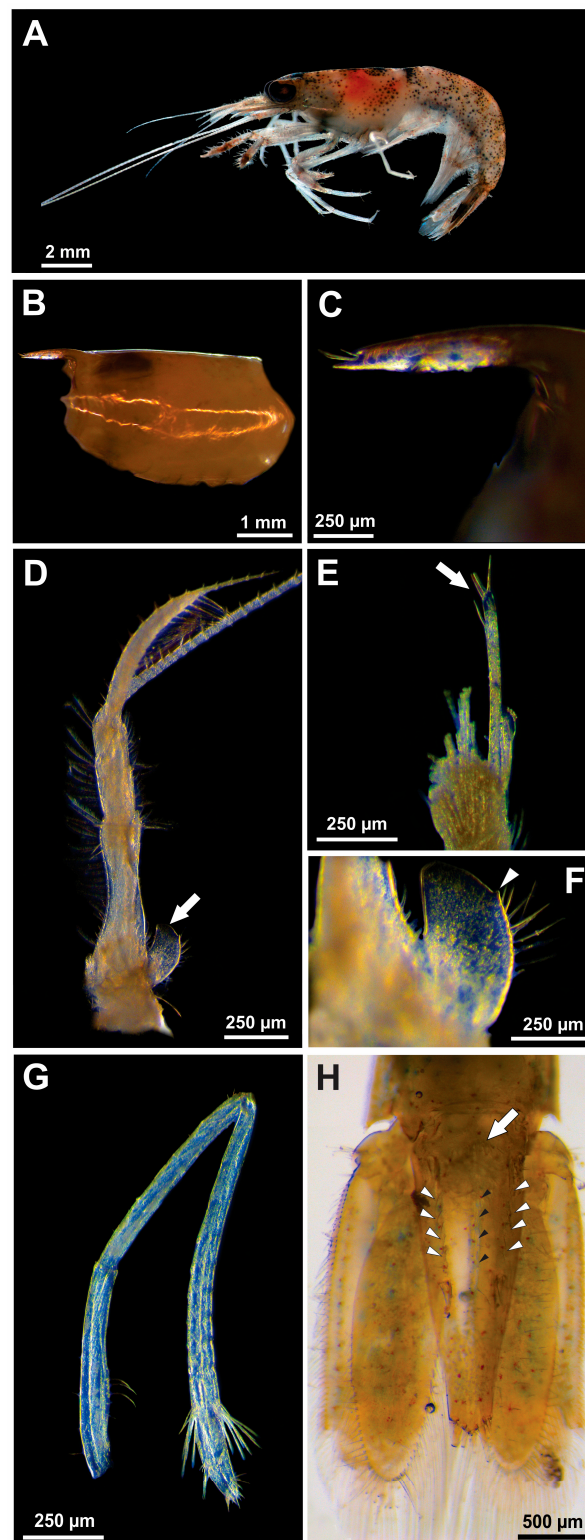


Figure 3. *Ambidexter cochensis* Rodríguez and Lira, 2022 (CCDB 6808). (A) Non-ovigerous female, body, lateral view. (B) Frontal region of carapace, lateral view. (C) Distal end of B showing rostrum with bifid apex, lateral view. (D) Right antennule, highlighting the stylocerite (white arrow). (E) *Appendix masculina* and *appendix interna*, with the tip of *appendix masculina* armed with four apical setae (white arrow). (F) Stylocerite bearing a lateral spinule (white arrowhead). (G) Second pereopod. (H) Telson and uropod in dorsal view, showing a transverse row of setae between the anterior pair of spines (white arrow) and three longitudinal rows of setae: one central row (black arrowheads) and two lateral rows along with the pair of dorsal spines (white arrowheads).

3.2. Reproductive Aspects

In both species, non-ovigerous and ovigerous females had ovaries fully or almost fully filled with oocytes in secondary or exogenous vitellogenesis, meaning that the cytoplasm of these oocytes was filled with mature acidophilic yolk granules and lipid droplets. These oocytes were surrounded by an ovarian follicle composed of rounded to flattened follicular cells, forming a simple squamous epithelium (Figure 4A,B). Males of *A. cochensis* showed a small number of spermatozoa immersed in an eosinophilic secretion, which was restricted to the distal region of the vasa deferentia (VD) (Figure 4C). The proximal (not shown here) and medial regions of the VD lacked both spermatozoa and secretion. The VD epithelium remained simple cuboidal along its entire length, with an increase in the muscle layer only in the distal region (Figure 4C). Ovigerous females of both species exhibited distinct reproductive investment strategies. *Latreutes parvulus* displayed higher values of GSI and RO, similar values of HSI and lower fecundity when compared to *A. cochensis* (Tables 1 and 2).

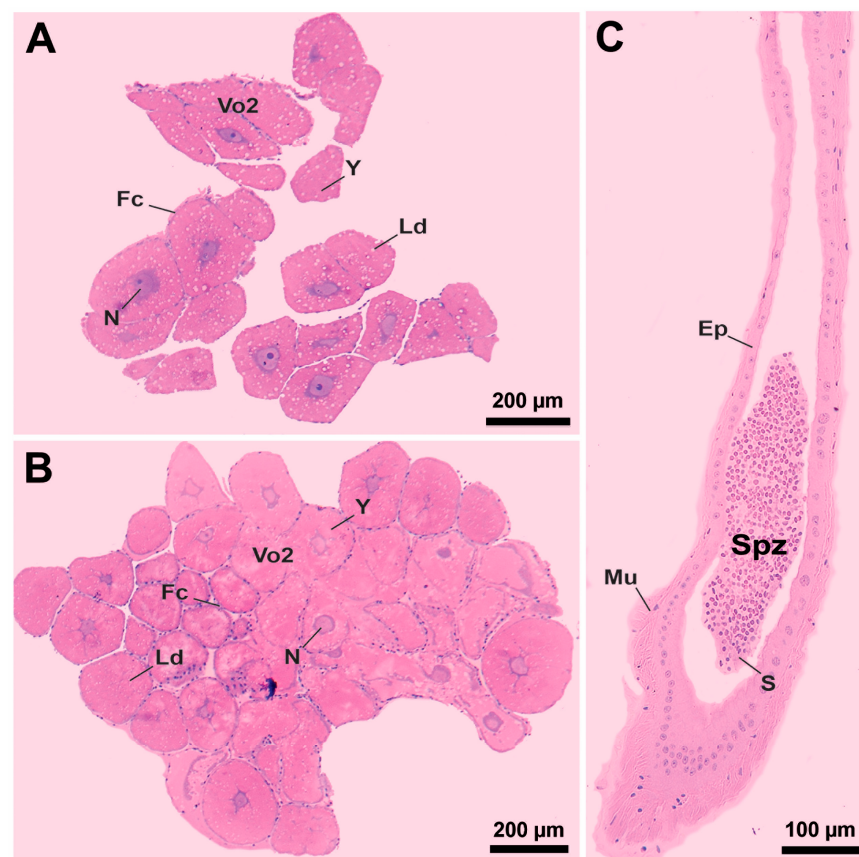


Figure 4. (A,B) Ovaries of ovigerous females of *Latreutes parvulus* (Stimpson, 1871) and *Ambidexter cochensis* Rodríguez and Lira, 2022 carrying embryos in the initial stage. The oocytes are fully filled with mature acidophilic yolk granules and lucid lipid droplets, surrounded by connective tissue and follicular cells that are either rounded or flattened. (C) The vas deferens of *Ambidexter cochensis* Rodríguez and Lira, 2022 showing a small number of spermatozoa in its distal portion. Ep: epithelium; Fc: follicular cell; Ld: lipid droplet; Mu: muscle; N: nucleus; S: secretion; Spz: spermatozoa; Vo2: oocytes in secondary vitellogenesis; Y: yolk.

Table 1. Morphometric and reproductive aspects of *Latreutes parvulus* (Stimpson, 1871) ovigerous females obtained at the rocky shore of Prainha da USP (Ubatuba municipality, São Paulo state, southeastern Brazil). CL: carapace length; GSI: gonadosomatic index; HSI: hepatosomatic index; RO: reproductive output; s.d.: standard deviation; SH: scaphocerite height; SW: scaphocerite width.

Individual	CL (mm)	Body Weight (mg)	Hepatopancreas Weight (mg)	Ovary Weight (mg)	Embryo Mass (mg)	HIS	GSI	RO	Fecundity	SH (mm)	SW (mm)	SH/SW Ratio
1	2.77	0.0272	0.0002	0.0007	0.0037	0.74	2.57	13.60	107	1.267	0.55	2.30
2	2.63	0.0135	0.0002	0.0003	0.0010	1.48	2.22	7.41	76	1.219	0.514	2.37
3	2.78	0.0188	0.0005	0.0006	0.0020	2.66	3.19	10.64	76	1.220	0.465	2.62
4	2.58	0.0155	0.0006	0.0004	0.0025	3.87	2.58	16.13	75	1.115	0.467	2.39
5	2.38	0.0168	0.0001	0.0003	0.0023	0.60	1.79	13.69	103	1.142	0.493	2.32
Mean (±s.d.)	2.63 (±0.12)	0.0183 (±0.0037)	0.0003 (±0.0001)	0.0005 (±0.0001)	0.0023 (±0.0006)	1.87 (±1.12)	2.47 (±0.37)	12.29 (±2.61)	87 (±14)	1.192 (±0.05)	0.498 (±0.02)	2.40 (±0.08)

Table 2. Morphometric and reproductive aspects of *Ambidexter cochensis* Rodríguez and Lira, 2022 ovigerous females obtained at the rocky shore of Prainha da USP (Ubatuba municipality, São Paulo state, southeastern Brazil). CL: carapace length; GSI: gonadosomatic index; HSI: hepatosomatic index; RO: reproductive output.

Individual	CL (mm)	Body Weight (mg)	Hepatopancreas Weight (mg)	Ovary Weight (mg)	Embryo Mass (mg)	HSI	GSI	RO	Fecundity
1	4.19	0.0766	0.0019	0.0001	0.0057	2.68	0.14	8.04	268
2	4.48	0.0719	0.0024	0.0017	0.0101	3.88	2.75	16.34	303
3	4.41	0.0614	0.0018	0.0004	0.0043	3.15	0.70	7.53	245
4	4.86	0.0938	0.0019	0.0004	0.0080	2.21	0.47	9.32	309
5	5.00	0.0872	0.0008	0.0003	0.0028	0.95	0.36	3.32	203
6	4.90	0.1052	0.0015	0.0015	0.0101	1.58	1.58	10.62	273
7	3.90	0.0406	0.0001	0.0009	0.0029	2.39	0.27	7.69	100
Mean (±s.d.)	4.53 (±0.33)	0.0766 (±0.1605)	0.0014 (±0.0005)	0.0007 (±0.0005)	0.0062 (±0.0002)	2.40 (±0.71)	0.89 (±0.72)	8.98 (±2.67)	243 (±52)

4. Discussion

Through the analysis of the morphological characteristics presented here, we confirm the occurrence of *L. parvulus* and *A. cochensis* in Brazil, specifically in the rocky shore habitats of Ubatuba, São Paulo state (southeastern Brazil). Currently, the coast of São Paulo state harbors 25 species of caridean shrimps, 11 of which inhabit shallow marine coastal environments (≤ 50 m depth) ([10], this study). The geographic distribution of both species has expanded considerably: we present the first confirmed record of *L. parvulus* in the Atlantic coast of South America, while *A. cochensis* is recorded for the first time in Brazil, establishing a new meridional limit for its distribution. With these new records, Brazil now harbors 178 species of marine and brackish water caridean shrimps inhabiting shallow waters (< 500 m) ([14], this study). Despite this diversity, small caridean shrimps (< 5 mm CL) from rocky shores remain largely overlooked in Brazilian studies. We believe that increased sampling efforts in these environments could significantly raise the number of recorded species and potentially lead to the discovery of new taxa.

In both species, all analyzed shrimps had fully mature gametes in their reproductive systems. Non-ovigerous and ovigerous females of *L. parvulus* and *A. cochensis* had oocytes in secondary vitellogenesis (exogenous phase) in their ovaries, indicating that these females can quickly restart the ovarian cycle even while carrying an embryo mass, being continuous multiple breeders [1]. In addition, all males of *A. cochensis* had VD with a small number of mature spermatozoa immersed in a seminal fluid secretion. Despite presenting distinct reproductive investment strategies, both species had breeding populations in the study area. Considering these aspects, we can state that the population of *A. cochensis* is well established, since reproductive individuals were found over time. The same cannot be confirmed for *L. parvulus*, since specimens were only obtained in December 2023. It is possible that males and non-ovigerous females of *L. parvulus* inhabit deeper areas (5 to 20 m), as verified by Terossi et al. [20] for the related *L. baueri*, while ovigerous females seek tide pools as shelter and nursery areas, explaining why only ovigerous females were obtained in the present study.

The extended occurrence range of both species proposed here highlights significant gaps in their known geographic distribution. It is unlikely that these species exhibit a truly disjunct distribution. As suggested by Almeida et al. [13], these gaps are more likely due to undersampling or limitations in taxonomic resolutions. In this sense, studies like the present one are crucial as a basis for future research aimed at bridging gaps in our knowledge on the biogeography and reproductive biology of Caridea.

Author Contributions: Conceptualization: L.R.P.P., C.S.N. and F.J.Z.; methodology: L.R.P.P. and C.S.N.; software: L.R.P.P.; validation: L.R.P.P., C.S.N. and F.J.Z.; investigation: L.R.P.P. and C.S.N.; data curation: L.R.P.P.; writing: all authors; supervision: F.J.Z.; project administration: L.R.P.P., C.S.N. and F.J.Z. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: All data are included in this manuscript.

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Conflicts of Interest: The authors declare no conflicts of interest.

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