



# Nauplius

THE JOURNAL OF THE BRAZILIAN CRUSTACEAN SOCIETY

## ORGANIZATION OF MANUSCRIPTS AND TECHNICAL STANDARDS

This document presents detailed guidelines for the preparation of manuscripts to be submitted to *Nauplius*. Please, read it carefully and follow these directions, along with the [instructions to authors](#), to format your manuscript according to the journal's style and editorial rules. A properly formatted manuscript will help to greatly speed up the editorial process.

Note: Excerpts from different articles published in *Nauplius* will be used to exemplify the procedures.

### Page and text formatting:

- All manuscripts must be submitted as .doc or .docx files.
- Use A4 as page size.
- Use normal margins: 2.54 cm (1 in) for all margins.
- Use font Times New Roman, size 12pt, for the main text (except where otherwise indicated).
- Use **double spacing** throughout the manuscript, except the title (which is single spacing).
- Insert page number at the right corner of the top of the page.
- Insert continuous line numbers throughout the manuscript.
- Uppercase should be used for institutional acronyms (e.g., MZUSP, UCR-MZ, USNM), section headings, statistical tests and some software programmes (e.g., ANOVA, MANOVA, PAUP). Capitalize only the first letter in the beginning of a sentence, in proper names, classification ranks, to indicate table(s) and figure(s) within the text as well as in subsections and subheadings.

- Use times sign “×” (not the letter “x”) for multiplication and dimensions (e.g.,  $cw \times cl$ ).
- It is up to author discretion to elect between variations of some accepted terms, abbreviations and notations, but the authors must be consistent by using the same criterion throughout the manuscript (e.g., pereopod or pereopod;  $m.s^1$  or m/s; c. or ca.; particles.individual<sup>-1</sup> or particles/individual).
- Always insert a space between the value and unit (e.g., 25 °C; 10 mm) as well as when expressing percentage (e.g., 58 %); add space before and after some notations (e.g.,  $N = 10$ ;  $p > 0.5$ ).
- The notation format for geographic coordinates should be given in degree-based formats: Sexagesimal degree - DMS, preferably (e.g., 09°16’55”N 083°22’14”W — only a space separating the pair of values); degrees and decimal minutes - DDM (e.g., 12°34.34’S 034°45.26’E), or decimal degrees - DD (e.g., -3.0951 -59.9894). Always specify latitude first then longitude.
- Collecting permit numbers and issuing agency should be provided, when pertinent, either in the “Material and Methods” or “Acknowledgements” sections.
- Insert the name of the manufacturer first time an instrument is mentioned (e.g., Leitz Laborlux S light microscopy). Insert the registered trademark symbol, ®, when appropriate.
- Sentences must not start with a digit (e.g., “Twenty three specimens”, not “23 specimens”).
- Dates should be given in the format: day-month-year; month should be either written in full or with a 3-letter abbreviation (without full stop) and any of the following formats is acceptable (e.g., 7 September 1822; 7 Sep 1822; 7.ix.1822; 07.ix.1822) provided that the chosen format is used consistently throughout the manuscript.
- The name of vessels should be written in double quotes (e.g., R/V “Atlântico Sul”), not in italics.

### Title:

- It should be concise, informative, and accurately summarize the content of the paper. A subtitle may be included after a colon (:).
- Use font Times New Roman, 12pt, in **boldface**, center aligned, paragraph not indented, line spacing single, and sentence case (however, scientific names, geographic locations and other proper nouns should be capitalized).
- Insert authority of all genera and species of all Crustacea taxa that are the subject of the publication.
- It is not mandatory, but *Nauplius* recommends the indication of the higher classification (at least, two ranks; maximum three) of the species- or genus-level taxa that are the subject

of the publication. As *Nauplius* publishes papers exclusively on Crustacea, this rank need not be mentioned.

- Cite the higher classification in parentheses and use a colon to separate subordinate categories and a comma to separate categories of equal level.

#### **Author(s):**

- Preferably, provide the complete name of all authors. Do not abbreviate first name, but middle name(s) could be abbreviated: e.g., Célio Magalhães (not C. Magalhães) or Peter K.L Ng.
- Names must be left aligned, paragraph not indented.
- Names must be arranged in a vertical row (add a blank line between the title of the paper and the first author name, but do not skip line between the names), each name per line, immediately followed by the number (no space, in superscript) referring to its respective academic affiliation, then a space and his/her ORCID identifier (format: orcid.org/xxxx-xxxx-xxxx).
- All authors must include their ORCID identifier. An author can obtain his/her ORCID identifier at <https://orcid.org/>
- When authorship is individual or all authors have the same academic affiliation, it is not necessary to add the superscript number referring to the affiliation.

#### **Affiliation(s) and address(es):**

- Add a blank line between the author(s) name(s) and the first (or single) paragraph of the academic affiliation/address.
- Single academic affiliation should be left aligned, paragraph not indented.
- For multiple affiliations, add the respective affiliation number in normal size (not superscript) and a single space before the institutional information; in this case, format the paragraph left aligned with a hanging indentation of 0.3 cm (0.12 in).
- Academic affiliation should combine two or three hierarchical levels, be written as a full, non-abbreviated name in the original language of the institution (preferably) or in the English version and be presented in descending order: beginning with the primary affiliation as the first element and followed by up to two subsidiary elements, for instance: University, Department, Laboratory (or as appropriate). If necessary, institutional acronyms must be written in parentheses after the respective affiliation.
- Add a full stop after the academic affiliation and then provide the location of the institution (city, state, country). Names of State/Province/Department should be spelled in full as well as country names, ending with a full stop. Postal address and/or P.O. Box should be avoided.
- Preferably, add the e-mail address of all authors below the respective affiliation as follows: initial of the author's name in **boldface**, space, E-mail: xxxxxx@yyyyyy.zz. The paragraph should be left aligned with a hanging indentation of 0.3 cm (0.12 in).
- Do not skip lines between the author affiliations paragraphs but add a blank line between the last paragraph of the affiliation and that of the corresponding author.

**Corresponding author:**

- Write CORRESPONDING AUTHOR in uppercase and his/her e-mail address in lowercase, each one on separate lines.
- Paragraphs should be formatted left aligned, not indented.

**Running head:**

- Write “Running head” in sentence case followed by a colon, then the author surname (or the senior and junior author’s surnames; or the senior author’s surname plus et al.) also followed by a colon and the abbreviated title not exceeding 52 characters (including spaces).
- Paragraph should be formatted left aligned, not indented.

Examples of title page:

**Freshwater crabs (Decapoda: Brachyura: Pseudothelphusidae, Trichodactylidae) from the state of Roraima, Brazil: species composition, distribution and new records**

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Running head: Zanetti et al.: Freshwater crabs from Roraima, Brazil

**Notes on two shallow water isopods (Crustacea: Peracarida: Isopoda: Idoteidae) from Kino Bay, Gulf of California, Mexico**

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Running head: Hendrickx: Notes on two Idoteidae from the Gulf of California

**Abstract:**

- The heading **Abstract** should be formatted left aligned, not indented, sentence case, **boldface**.
- Leave no blank line after the heading.

- The abstract should preferably not exceed 200 words, and concisely inform the purpose of the study, the most important finding(s) and briefly comment of their implications. Acronyms and abbreviations should be avoided (if needed, write them in full). Abstracts up to 250 words can be accepted; however, any exceeding words (beyond the 250) will be truncated by the ScholarOne system, but not from the manuscript itself.
- The abstract must be formatted in one paragraph, left aligned, first line not indented.
- Do not include citations to literature references, mathematical equations, figures or tabular material. Follow the guidelines in the “[Instruction to authors](#)” for citing scientific names, symbols, units, coordinates, etc.

Examples:

**ABSTRACT**

This study investigated the population dynamics of *Persephona punctata* (Linnaeus, 1758) with emphasis on population structure, sex-ratio, spatial distribution, maturity and reproductive period. Crabs and environmental factors (i.e., water temperature and salinity, and sediment texture and organic matter content) were collected monthly, from July 2012 to June 2014 in four sites within the Federal Environmental Protection Area of Cananéia-Iguape-Peruíbe: located in the oceanic area adjacent to the Cananéia region. The population had a female-biased sex-ratio. *Persephona punctata* had a seasonal reproduction and the higher percentage of ovigerous females (OF) occurred in spring and summer. There was a positive correlation (“lag 0”) between temperature and number of OF (cross-correlation,  $p < 0.05$ ) and a negative correlation between salinity and OF (“lag-2”), suggesting that periods of higher salinity may be favorable to larval hatching. The estimated size (carapace width —  $CW_{50}$ ) at the onset of gonadal maturity of males (35.0 mm) was larger than that of females (30.1 mm), which is a common feature of Brachyura. Our results extend the knowledge on the life history of *P. punctata* and may be useful for the development of future mitigation measures aimed at its conservation.

**ABSTRACT**

Freshwater crabs are macroconsumers that are commonly found in Neotropical headwater streams that may play a key role in energy flow and nutrient cycling in detrital food webs. Although studies have examined the feeding habits of trichodactylid crabs, little is known of this behavior in pseudothelphusid species, and specifically whether they actually consume leaf material. We conducted three nine-day laboratory trials with pseudothelphusid crabs (*Ptychophallus tumimanus* (Rathbun, 1898)) and leaves (*Koanophyllon pittieri*) to investigate whether crabs shred leaves. We hypothesized that leaf mass loss would be faster with crabs present relative to control tanks with only leaves. Leaf mass loss was significantly higher ( $p < 0.001$ ) in tanks with crabs ( $0.49 \pm 0.07$  g, mean  $\pm$  1 SD) compared to control tanks ( $0.31 \pm 0.05$  g). We observed crabs manipulating, shredding, and consuming leaves, with leaf fragments and egesta present in tanks with crabs but not in control tanks. Their consumption and egestion activity may affect nutrient availability and transformation by stimulating microbial activity during leaf breakdown and converting coarse particulate organic matter (CPOM) to fine particulate organic matter (FPOM). Therefore, freshwater crabs need to be considered when studying energy flow and nutrient cycling in detrital food webs of Neotropical headwater streams.

**ABSTRACT**

The pelagic shrimp *Petalidium suspiriosum* Burkenroad, 1937, described from off Clarion Island, Mexico, in the eastern Pacific, is recorded for the first time in the Gulf of California. The unique male specimen was captured in deep water of the central Gulf of California. Diagnostic characters, including the petasma, are illustrated and shortly described.

**Keywords:**

- Add a blank line between the Abstract and the Keywords paragraph.
- The heading **Keywords** should be formatted left aligned, sentence case, **boldface**.
- Include usually five to seven keywords alphabetically arranged and separated by commas. Do not repeat those in the title to enhance identifying the subject matter by retrieval systems.
- The paragraph with the keywords should be left aligned, not indented.

Examples of Keywords formatting:

**Keywords**

Calappidae, Gulf of Aden, India, Indian Ocean, Lakshadweep, redescription, taxonomy

**Keywords**

Abundance, Cananéia, Caridea, ecological distribution, environmental variables

**Section headings and subheadings:**

- Add a blank line between the previous paragraph and the following section heading.
- The sections headings (Introduction, Material and Methods, Results, Discussion, Acknowledgements, Supplementary Material (if any), Additional Information and declarations, and References) should be centered and written in font size 16pt, uppercase, and boldface.
- All paragraphs of these sections (except for the References) should be formatted left aligned, with first line indented according to the paragraph default settings (i.e, 1.27 cm or 0.5 in).
- Do not skip lines between text paragraphs.
- Section **subheadings** should be preceded by a blank line, written in italics, with the paragraph formatted left aligned, first line not indented, not followed by a full stop. Start the paragraph on the next line, formatted left aligned and first line indented according to the paragraph default settings (i.e, 1.27 cm or 0.5 in).



Example:

## INTRODUCTION

The genus *Alpheus* Fabricius, 1798 is the most speciose of the Family Alpheidae and has more than 300 species described worldwide (De Grave and Fransen, 2011). Alpheid shrimps occur in a wide variety of microhabitats, usually in consolidated and unconsolidated substrates and in tropical and subtropical regions (Bauer, 2004; Anker et al., 2006). The western Atlantic snapping shrimp *Alpheus brasileiro* Anker, 2012, is a common representative of the *Alpheus armillatus* H. Milne Edwards, 1937 species complex, which occurs along the Brazilian coast. It is found in natural pools formed by exposed reef areas and under rocks in estuaries (Anker, 2012; Pescinelli et al., 2017a).

Previous studies investigated the biology of *A. brasileiro* analyzing egg production and social monogamy (Pescinelli et al., 2017a), relative growth (Pescinelli et al., 2018b) and showed that males and females have different relative growth, and that reproduction and recruitment are continuous. The morphology of early larval stages was also analyzed, and led to the conclusion that *A. brasileiro* has an extended larval development in the plankton (Pescinelli et al., 2017b). Although these results combined characterize a great part of the biology of this species, information on population dynamics are still lacking.

(...)

## MATERIAL AND METHODS

### *Study area*

The sampling area was an intertidal estuary in the south-eastern Brazilian coast (25°04'11.2"S 48°03'08.9"W) (Fig. 1). The sediment is composed of a mixture of mud, sand, and small rocks (~ 30 cm) scattered over the area. During low tides the rocks are

exposed, but the remaining small puddles of water provide a suitable refuge for *A. brasileiro* (Fig. 2). (...)

### *Sampling*

The sampling occurred monthly from April 2015 to March 2016. The sampling area was divided in three sub-areas 10 m apart from each other, perpendicular to the water line. Each sub-area was 20 m long and 5 m wide. Inside each sub-area, three 1 m<sup>2</sup> units were sampled, yielding nine sampling units per month. (...)

### *Growth, longevity, age at sexual maturity, and mortality*

The growth analysis was performed separately for males and females, undifferentiated individuals were not used. For each sampling month, the frequency of CL values was distributed in 0.5 mm size classes following Sturges (1926) and modes were calculated using PeakFit software (PeakFit v. 4.06 SPSS Inc. for Windows Copyright 1991–1999, AISN Software Inc., Florence, OR, USA).

To estimate the growth parameters, all cohorts chosen were adjusted to the Bertalanffy growth model (Bertalanffy, 1938), namely  $CL_t = CL_\infty [1 - e^{-k(t-t_0)}]$ , where  $CL_t$  is size estimated at age  $t$ ,  $CL_\infty$  is asymptotic size,  $k$  is the growth coefficient, and  $t_0$  is the theoretical age at size zero. The growth parameters  $CL_\infty$ ,  $k$  and  $t_0$  were estimated using the “Solver” supplement of Microsoft Excel, which minimizes the sum of residues of the comparison between the observed length and the length calculated by the Bertalanffy model. The criteria used to choose the cohorts were based on biological coherence between longevity, growth coefficient and asymptotic size. Growth curves were compared using the  $F$  test ( $p = 0.05$ ) according to Cerrato (1990). Longevity was estimated by the inverse

Bertalanffy growth equation, with modifications suggested by D’Incao and Fonseca (1999),  $t_0 = 0$  and  $CL/CL_\infty = 0.99$ , while the longevity equation was  $t = (t_0 - (1/k) \ln(1 - CL_t/CL_\infty))$ .

(...)

## RESULTS

During the study, 313 individuals were collected and measured: 154 males and 147 females and 12 undifferentiated. The size ranges of each demographic class are shown in Table 1. The size-frequency distribution indicated a similar proportion of males and females in the classes of sexually immature and sexually mature individuals (Fig. 3).

Five cohorts of males and females were chosen to compose the growth curves of *A. brasileiro* (Fig. 4). The final curve, obtained by the combination of all curves of each sex, resulted in the following estimates:  $CL_\infty = 9.49$  mm,  $k = 0.0077$  day<sup>-1</sup>,  $t_0 = -0.7628$  for males; and  $CL_\infty = 9.31$  mm,  $k = 0.0095$  day<sup>-1</sup>,  $t_0 = 0.0374$  for females (Fig. 4).

(...)

## DISCUSSION

Significant differences between the sexes were found in this study, therefore, our initial hypothesis that males and females of *A. brasileiro* had equal growth and longevity was rejected. Males reached larger sizes, grew more slowly, and lived slightly longer than the females. The hypothesis of similar growth was based on the monogamous social system showed by this species, and based on the absence of sexual dimorphism in body size (Pescinelli et al., 2017a). In the monogamous social system, there is a social fidelity between the pair, and cooperation in the defense of territory and maintenance of the refuge (Thiel and Baeza, 2001; Correa and Thiel, 2003). In species with the monogamous social system, body size is an important factor that influences the pair formation. Thus, sexual dimorphism in

size is absent or minimal, and there is a positive correlation between the carapace length (CL) of paired males and females, a phenomenon known as a size-assortative pairing (Rodrigues et al., 2009). (...)

## ACKNOWLEDGMENTS

The authors thank the LABCAM co-workers for their help during the field work. (...)

## SUPPLEMENTARY MATERIAL

Video S1. Video of crabs (*Ptychophallus tumimanus*) shredding and consuming leaves. Available at <https://vimeo.com/385357347>

## ADDITIONAL INFORMATION AND DECLARATIONS

*Author contributions* (...)

(...)

## REFERENCES

Bauer RT 2004. Remarkable shrimps: adaptations and natural history of the Carideans.

Norman, OK, University of Oklahoma Press, 316p.

(...)

### Taxonomic papers:

- Manuscripts dealing with systematics and taxonomy may follow a sequence of contents somewhat distinct from the regular “Original Article” type of publication, particularly

regarding the “Results” section, which is replaced by “Systematics” (also written in boldface, font size 16pt, uppercase, centered). Do not skip the line after the section heading.

- Authors describing new taxa are strongly advised to strictly adhere to the rules of the last edition of the [International Code of Zoological Nomenclature](#) and its [amendment](#) as well as to follow all recommendations of the Code.
- New taxon names must be clearly indicated as such by adding the respective abbreviation after the new name (sp. nov.; gen. nov.; fam. nov.).
- Other taxonomic changes should also be clearly indicated (e.g., n. comb.; comb. nov., nomen nov.; new rank).
- *Nauplius* suggests that the “Systematics” section be composed of the following topics:
  - Taxonomic ranks: write the appropriate taxonomic categories (and respective authorities) of the studied taxon in Sentence case, in boldface, centered. Skip one line between the categories. Reference to figure(s) should be centered, normal font (not in boldface) and follow the name of the last taxon without skipping a line but add a blank line before the next topic.
  - Synonymic list: if any, the paragraph corresponding to each entry of the synonymic list must be formatted left aligned and with **hanging indentation** according to the paragraph default settings (i.e, 1.27 cm or 0.5 in); do not skip a line between entries. Use a clear separation between the name of the taxon and a secondary citation (e.g., semicolon; m-dash). Add a blank line before the next topic.
  - Material examined: the topic heading should be in italics; the paragraph must be formatted left aligned and with first line indented according to the paragraph default settings (i.e, 1.27 cm or 0.5 in). If a new taxon is being described, replace “*Material examined*” with “*Type material*” (specify the holotype first and then the paratype(s). If any, “*Comparative material*” must be listed, without skipping a line, in the following paragraph formatted with the same default settings (i.e, 1.27 cm or 0.5 in). Similarly, for “*Additional material examined*”, if any. Add a blank line before the next topic.
  - Diagnosis (mandatory for describing new taxa): the topic heading should be in italics; one paragraph only, which must be formatted left aligned and with the first line indented according to the paragraph default settings (i.e, 1.27 cm or 0.5 in). Use telegraphic style and write numbers as numerals. Add a blank line before the next topic.
  - Description: formatting as in previous paragraph. Use telegraphic style and write numbers as numerals. Do not skip lines between paragraphs of the description, but add a blank line before the next topic.
  - Etymology (mandatory for describing new taxa): formatting as in previous paragraph.
  - Type locality: formatting as in previous paragraph.
  - Distribution: formatting as in previous paragraph.

- Remarks: formatting as in previous paragraph. Do not use telegraphic style and write numbers less than 12 in letters, except for body parts and ranges.
- Identification key: if any, each couplet should be separated by a blank line.
- Discussion (if pertinent) should be formatted as a section heading of a regular “Original Article” (see above).
- Avoid using the name of new taxa in the title.
- Descriptions of new species-group taxa must clearly specify a type-specimen deposited in an institutional research collection so as to comply with ICZN, Article 16.4.2 and Recommendation 16C. Catalog numbers of deposited material should be provided at the moment of submission or, at the latest, by the time of correcting the proof. Failure to do so will delay publication.
- Voucher specimens must be deposited in an institutional research collection and their catalog number should be provided in the main text or tables.
- *Nauplius* recommends that the available elements in a “Material examined” list are preferably presented as follows: (a) specimens: number and sex {measurements, if pertinent}, locality/geographic data {from the least to most specific}, coordinates, elevation/depth {m a.s.l.; m}, date {format: 7 Sep 1822 or 9.ix.1822 or 9.IX.1822}, collector(s) {initials and surname}, additional collecting data {e.g., microhabitat/host/method of collecting/time of collection etc.}, barcodes/identifiers {e.g., GenBank accession number}, repository data {institution acronym and catalog number}. Use a comma to separate each data field and semicolon to separate data from each lot. If needed, data included or interpreted by the author should be presented between square brackets (e.g., coordinates not written on the label, but obtained from other sources (which should be provided in the “Material and Methods” section): [~ 08°27’N 77°58’W]).
- Authors may use other formats as long as consistency is maintained across records.
- Repository acronyms must be stated in full in the “Material and Methods” section.
- Etymology of new names should be provided.

Examples:

## **SYSTEMATICS**

**Order Mysida Boas, 1883**

**Family Mysidae Haworth, 1825**

**Genus *Mysidopsis* G.O. Sars, 1864**

***Mysidopsis gemina* sp. nov.**

(Fig. 1–3)

*Type material.* Holotype: adult male (length [L] 6.4 mm), MZUCR 2843-02, Costa Rica, Puntarenas, Playa Caldera, 09°92'75"N 84°71'64"W, depth 1.0 m, grey sand beach, kicknet, intertidal zone, R. Heard, O. Breedy and R. Vargas coll., 15 Sep 2010. —

Paratypes: 1 adult male (L 5.1 mm), 4 ovigerous females (L 5.0, 5.1, 5.5, 5.4 mm), MZUCR 2843-03, same collection data as holotype; 2 adult males (L 6.2, 5.9 mm), MZUCR 2817-02, Costa Rica, Puntarenas, Playa Caldera, 09°92'75"N 84°71'64"W, depth 0.5 m, grey sand beach, kicknet, intertidal zone, R. Heard and R. Vargas coll., 12 Sep 2010.

*Additional material examined.* 8 males, 15 ovigerous females, 7 non-ovigerous females, Costa Rica, Puntarenas, Playa Caldera, 09°92'75"N 84°71'64"W, depth 0.5 m, 12 Sep 2010, R. Heard and R. Vargas coll., grey sand beach, kicknet, intertidal zone, MZUCR 2817-01; 2 males, 3 ovigerous females, Costa Rica, Guanacaste, Playa Ocotal,

10°32'52.8"N 85°43'19.2W, Mar 2014, coll. unknown, rocky area, intertidal, algal washings, MZUCR 3122-02.

*Diagnosis.* Antennal scale lanceolate, apex rounded with indistinct suture; carapace with anterior margin produced into an acutely pointed triangular rostrum reaching mid-length to distal end of article 1 of antennular peduncle; carpopropodus of thoracic endopods 3–8 3-articulated; male pleopod 1 with 2-articulated linguiform endopod; male pleopods 2–5 with enlarged membranous, transparent pseudobranchial lobes (exites) on basal article of endopods; telson entire, linguiform, with rounded to truncate apex; (...).

*Description.* General body form (Fig. 1A): moderately slender, adult males to 6.4 mm and females to 5.5 mm; carapace with anterior margin produced into an acutely pointed triangular rostrum extending mid-length to distal end of article 1 of the antennular peduncle; posterior dorsal margin broadly emarginate, partially exposing thoracic somite 8; antero-lateral corners rounded.

Eyes (Fig. 1A): cornea large, globular, broader than eyestalk, occupying distal 45 % of eye, extending to article 2 of antennular peduncle.

Antennular peduncle (Fig. 1B): more robust in males than females, shorter than antennal scale; article 1 subequal in length with article 3, disto-lateral epiprocess with 3–5 plumose setae, apophysis near disto-medial margin with 5–9 plumose setae; (...).

Antenna (Fig. 1C): scale lanceolate, extending well beyond peduncle, 5.5–7 × as long as maximum width; outer margin slightly concave to straight; inner margin slightly convex; peduncle 3-articulated; article 1 (not shown in Fig. 1C) slightly shorter than article 3 and about half as long as article 2; (...).



Maxillule (Fig. 1F): outer lobe apex with 9 strong serrate setae; inner lobe with 2 apical microserrated setae and 1 medial microserrated seta along outer margin.

(...)

*Color* (in preserved specimens): body uniformly brown to beige with diffuse brown pigmentation irregularly distributed on eyestalks, carapace, thorax, abdomen, telson, and appendages; heavy pigmentation near posterior ventral margins of abdominal somites, dorsal base of telson, and posterior-most pair of oostegites.

*Etymology.* The species name is a Latin adjective with female gender referring to the similarity of the new species to its Atlantic cognate, *M. furca* Bowman, 1957.

*Habitat.* Collected from sandy beaches in depths of 0.5 to 1.0 m.

*Type locality.* Costa Rica, Puntarenas, Playa Caldera (09°92'75"N 84°71'64"W), grey sand beach, depth 1 m.

*Distribution.* At present known only from the provinces of Guanacaste and Puntarenas along the Pacific coast of Costa Rica.

*Remarks.* *Mysidopsis gemina* n. sp. has its closest morphological affinities with *M. furca*. These two species, respectively, appears to represent Eastern Pacific and Western Atlantic cognate or sister species. (...) For additional morphological details for these and other characters for distinguishing the two sister species, see Tab. 1.

## DISCUSSION

With the inclusion of *Mysidopsis gemina* n. sp., 51 nominal species and one subspecies currently compose the genus *Mysidopsis* (see Mees and Meland, 2012; present study), which represents the largest and most diverse of the other 30 genera presently composing the subfamily Leptomysinae. Table 2 presents a synopsis of the geographical distribution of these characters among species in the three tribes (Afromysini, Leptomysini, and Mysidopsini) of the Leptomysinae.

*Telsonic sexual dimorphism within the subfamily Leptomysinae.* Within the tribe Mysidopsini, *Mysidopsis* is the only genus to exhibit sexually dimorphic telsons. (...)

Sexually dimorphic telsons occur in members of the other two tribes of the Leptomysinae, the Afromysini and Leptomysini. (...)

*Presence of a biarticulated endopod on the first male pleopod.* Apparently, only two genera of leptomysids have a first male pleopod with a biarticulated endopod. (...)

Besides the genus *Mysidopsis*, this male character has been documented for only one other leptomysid species, *Doxomysis australiensis* (W. Tattersall, 1940) belonging to the tribe Afromysini. (...)

(...)

## SYSTEMATICS

### Superfamily Calappoidea De Haan, 1833

### Family Calappidae De Haan, 1833

### Genus *Mursia* Desmarest, 1823

*Type species. Mursia cristiata* H. Milne Edwards, 1837

### *Mursia spiridonovi* Karasawa, 2018

(Figs. 1–4)

*Mursia bicristimana* — Laurie, 1906: 355; Galil, 1993: 356 (part); figs. 1f, 3j, k, 5c, d (not *Mursia bicristimana* Alcock and Anderson, 1894).

*Mursia minuta* Spiridonov and Apel, 2007: 2870, figs. 2G, H, 4E, F, 8C, 10A–D, 11A, B, 12A, B. — Trivedi et al., 2018: 32. — Suvarna Devi et al., 2019: 493 (name preoccupied by fossil calappid *Mursia minuta* Karasawa, 1993)

*Mursia spiridonovi* Karasawa, 2018: 587 (replacement name).

*Material.* 1 male (23.9 × 14.6 mm) (ZRC 2019.0492), India, Tamil Nadu, bycatch at Colachel port, approx. 12 km north of Muttom, 4 Mar 2019, coll. Suvarna S. Devi; 1 ovigerous female (26.7 × 16.1 mm) (ZRC 2019.0511), 1 ovigerous female (28.4 × 18.1 mm) (DABFUK), India, Tamil Nadu, Kanyakumari district, Muttom, Jeppiaar fishing harbour, 30 Jan 2019, coll. Suvarna S. Devi.

*Comparative material.* *Mursia bicristimana* Alcock and Anderson, 1894 — 1 male (37.2 × 19.6 mm), 1 female (43.2 × 23.2 mm) (ZRC 2017.0134), southern India, Kerala, Kollam port, 20 Mar 2017, coll. fishermen; 1 male (75.0 × 42.2 mm) (ZRC 1999.0086) [holotype of *Mursia xianshengi* Lai and Galil, 2006], trawled from the Andaman Sea, off southern Thailand-Burma coast, 06°41.7'N 97°58.2'E, 342 m, 20 Mar 1989, coll. fishing vessels.

*Diagnosis.* Small species, females ovigerous at 28.4 × 18.1 mm. Dorsal carapace surface with numerous prominent granules with regions well defined (Figs. 1A, 2E, F); gap between last 2 distal spines on merus of cheliped relatively narrow, acute (Fig. 2G); third short spine present on merus of cheliped (Fig. 2G); anterolateral teeth clearly defined (Fig. 2F); granules on posterolateral margin and the median lobe on posterior carapace margin distinct, relatively larger (Fig. 2F, H); (...).

*Description of males.* Carapace transversely ovate, broader than long; dorsal surface unevenly convex, regions well defined by grooves, distinctly granular all over, granules on lateral and posterior parts proportionately larger; mesogastric region with 2 low larger median granules; metagastric, urogastric, cardiac and intestinal regions with 4 low median tubercles; branchial region with 4–6 low tubercles (Figs. 1A, 2E, F). (...)

Chelipeds almost symmetrical, right slightly larger; outer surface covered with low tubercles and numerous small granules, inner surface smooth (Figs. 1A, C–E, 2E). Merus short, with 3 laterally directed, stout, spinule-covered spines on distal margin, outermost spine largest, innermost spine smallest, outer 2 spines separated by relatively narrow gap (Fig. 2G). (...)

Ambulatory legs relatively short, laterally compressed. Dactylus distinctly longer than propodus, gently curved, slender, unarmed (Figs. 1A, 2E, H). (...)

*Females.* Similar to males except that the pleon is ovate and covers most of the thoracic sternum. In ovigerous females, the egg mass is large and extends laterally beyond the base of the ambulatory legs (Fig. 1F). When freshly obtained, the eggs are small, less than 1.0 mm in diameter and bright red in color (Fig. 1F).

*Color in life.* The carapace is entirely orange on the dorsal surface, with a white longitudinal stripe medially in males (Fig. 1A), but in females, the white stripe is reduced to a spot. The inner margins of the mandibles are bright red (Fig. 1C). (...)

*Remarks.* *Mursia spiridonovi* (as *M. minuta*) was described on the basis of the holotype male (28.0 × 17.1 mm) and a paratype female from the Gulf of Mannar in Sri Lanka as well as four other complete males (20.5 × 13.0 mm – 32.4 × 19.5 mm) and an ovigerous female (25.4 × 16.8 mm) from the Laccadives (Lakshadweep) and Gulf of Aden (see also Suvarna Devi et al., 2019). (...)

In contrast to almost all other *Mursia* species that occur in depths over 300 m (see Galil, 1993), *M. spiridonovi* appears to prefer shallower waters. Spiridonov and Apel (2007) noted that their specimens from the Gulf of Aden occurred on muddy sand bottom at depths of 83–87 m, while the Laccadives (Lakshadweep) material was collected from sandy and stony substrates at depths of 124–271 m. (...)

#### **Acknowledgements:**

- Use this section to acknowledge an individual and/or institutional contributions to the research project, whose contribution (if restricted to this sole activity) does not qualify for authorship (e.g., general supervision of a research group or administrative support, funding acquisition, technical and/or language editing, proofreading, etc.).

Example:

## **ACKNOWLEDGEMENTS**

We thank Wilbert J. Jiménez Hernández and Giulia Sturmo for their help with data collection. We are grateful to the Van den Akker family for providing field site access and the Monteverde Institute for providing laboratory facilities. We thank Fresia Villalobos-Rojas (CIMAR, Universidad de Costa Rica) for her assistance with crab identification, Willow Zuchowski and Bill Haber for helping with plant identification and information, and Zachary Butter for helping with the video. We are also indebted to Universidad de Costa Rica, Escuela de Biología for the logistic support during this work. Our manuscript was improved by suggestions from Dr. Mary Freeman and two anonymous reviewers.

### **Supplementary Material:**

- Large tables, spreadsheets, figures, PDF files, multimedia files, software codes, external databases, etc. may accompany the manuscript for publication as supplementary material along with the article.
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**Video S1.** Video of crabs (*Ptychophallus tumimanus*) shredding and consuming leaves. Available at <https://vimeo.com/385357347>

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**S1** - Registration entries for voucher material deposited in the crustacean collection of the Instituto Nacional da Mata Atlântica (MBML).

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## **ADDITIONAL INFORMATION AND DECLARATIONS**

### *Author contribution*

Conceptualization and Design: ABC, DEF. Performed research: ABC, DEF, GHI.

Acquisition of data: DEF, GHI. Analysis and interpretation of data: ABC, DEF, GHI.

Preparation of figures/tables/maps: GHI. Writing - original draft: ABC, DEF, GHI. Writing - critical review & editing: ABC, DEF.

### *Consent for publication*

All authors declare that they have reviewed the content of the manuscript and gave their consent to submit the document.

### *Funding and grant disclosures*

This research was supported by [name-acronym of the funding agency 1, grant # xxxx-x] to [initials of the Author A], by [name-acronym of the funding agency 2, grant # xxxx-x] to [initials of the Author 2], by [name-acronym of the funding agency 2, fellowship grant # xxxx-x] to [initials of the Author 3].

OR

There were no external funding sources for this study.



*Competing interests*

The author(s) declare(s) no competing interest.

*Study association*

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*Study permits*

Field collection and transportation of specimens were made under the SISBIO permit number 1111/2010 issued to C. Magalhães.

*Data availability*

All study data are included in the article and/or supplementary material.

OR

All data are archived within the University of [...Name...] research data repository and available on request from the corresponding author.

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Clark RL 1987. Aspects of growth and reproduction of the hairy handed crab, *Hemigrapsus crenulatus* (Brachyura: Grapsidae). Christchurch, University of Canterbury, M. Sc. Thesis. 159p. [Unpublished].

Costa FZ da 2016. Composição específica e distribuição da fauna de caranguejos de água doce (Crustacea: Decapoda: Brachyura) do estado de Roraima, Brasil. Manaus, Instituto Nacional de Pesquisas da Amazônia, Master thesis, 64p. [Unpublished]

Available at

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Magalhães C 2005. A new species of freshwater crab (Decapoda: Pseudothelphusidae) from the southwaestern Amazon Basin. *Nauplius*, 12(2) (for 2004): 99–107. <https://crustacea.org.br/wp-content/uploads/2014/02/nauplius-v12n2a06.Magalhaes.pdf>

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Magalhães C 1985. Desenvolvimento larval obtido em laboratório de palaemonídeos da Região Amazônica. I. *Macrobrachium amazonicum* (Heller, 1862) (Crustacea, Decapoda). *Amazoniana*, 9 (2): 247-274.

Magalhães C 1986a. Revisão taxonômica dos caranguejos de água doce brasileiros da família Pseudothelphusidae (Crustacea, Decapoda). *Amazoniana*, 9(4): 609–636.

Magalhães C 1986b. The larval development of palaemonid shrimps from the Amazon Region reared in the laboratory. IV. The abbreviated development of *Palaemonetes ivonicus* Holthuis, 1950 (Crustacea: Decapoda). *Amazoniana*, 10 (1): 67–78.

Magalhães C and Türkay M 2008a. Taxonomy of the neotropical freshwater crab family Trichodactylidae, IV. The genera *Dilocarcinus* and *Poppiana* (Crustacea, Decapoda, Trichodactylidae). *Senckenbergiana biologica*, 88: 185–215.

Magalhães C and Türkay M 2008b. Taxonomy of the neotropical freshwater crab family Trichodactylidae, V. The genera *Bottiella* and *Rotundovaldivia* (Crustacea, Decapoda, Trichodactylidae). *Senckenbergiana biologica*, 88: 217–230.

Magalhães C and Türkay M 2010. A new freshwater crab of the genus *Brasiliothelphusa* Magalhães and Türkay, 1986 from Rio Aripuanã, southern Amazon region, Brazil. (Crustacea: Decapoda: Pseudothelphusidae). *Nauplius*, 18(2): 103–108.

Magalhães C; Türkay M and Means DB 2009. The status of *Kunziana* Pretzmann, 1971 (Crustacea: Decapoda: Pseudothelphusidae), with a redescription of the holotype of *K. irengis* Pretzmann, 1971. *Zootaxa*, 2276: 40–48.

Magalhães C; Abrunhosa FA; Pereira MO and Melo MA 2005a. New records of *Fredius denticulatus* (H. Milne Edwards, 1853) and *F. reflexifrons* (Ortmann, 1897), and the eastern limits of the distribution of pseudothelphusid crabs (Crustacea: Decapoda) in Brazil. *Acta Amazonica*, 35(1): 93–96.

Magalhães C; Bueno SLS; Bond-Buckup G; Valenti WC; Silva HLM; Kiyohara F; Mossolin EC; Rocha SS 2005b. Exotic species of freshwater decapod crustaceans in the state of São Paulo, Brazil: records and possible causes of their introduction. *Biodiversity and Conservation*, 14(8): 1929–1945.

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The morphology of the first gonopod (Fig. 1) is very similar to (...)

Figure 1 shows that the morphology of the first gonopod is very similar to (...)

First antenna (Fig. 4E, G, K) with two antennomeres (...)

Second antenna (Figs. 2B, C, 4C–G) biramous (...)

First pereopods strongly heterochelous in both sexes (Figs. 3A–C, 6D–F); (...)

The species is distributed in the southern slope of the Guiana Shield (Fig. 3).

Right side thoracopod VI typical for genus (Fig. 9F).

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Examples:

While not commented upon in that report, their illustration of a Gulf of Mexico specimen (Rabalais et al., 1981: fig. 2g) does clearly shows a median spine on the telson, a sometimes subtle character shared with the Atlantic seaboard population (Williams, 1984: fig. 125d), even though these two populations can be seen to differ markedly in other morphological features, size, and ecology.

*Gilvossius setimanus*. — Manning and Felder, 1992: 558 (part, Rickenbacker Causeway, Miami, Florida only); Felder and Robles, 2009: 335, 336, tab. 1, fig. 1).

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Examples:

**FIGURE CAPTIONS**

**Figure 1.** Line drawings of *Lynceus grossipedia* n. sp., **A–G**: male, **H–M**: female. **A**, Head, anterior view; **B**, head, left lateral view; **C**, carapace, left lateral view; **D**, left clasper, posterior view; **E**, right clasper, anterior view; **F**, opercular lamella, ventral view; **G**, telson, left lateral view; **H**, telson, ventral view; **I**, telson, dorsal view; **J**, head, left lateral view; **K**, head, anterior view; **L**, carapace, left lateral view; **M**, lamina abdominalis, left lateral view. Scale bars = 1 mm.

**Figure 2.** *Lynceus grossipedia* n. sp., male, stereo microscopy, holotype (NHMD-615874). **A**. Left lateral view, intact animal; **B**, left lateral view, carapace valve removed; **C**, ventral view, carapace valves apart.

**Figure 3.** *Mursia spiridonovi* Karasawa, 2018, color in life. **A–E**, male (23.9 × 14.6 mm) (ZRC 2019.0492); **F**, ovigerous female (28.4 x 18.1 mm) (DABFUK). **A**, overall dorsal view; **B**, **F**, thoracic sternum and pleon; **C**, frontal view of cephalothorax and chelae; **D**, outer view of chelae; **E**, inner surface of right chela. Photographs: Chan T.-Y.; P.K.L. Ng; S. Suvarna Devi.

**Figure 4.** Maximum likelihood phylogenetic tree of *Aegla* from Chile. Branch lengths are shown proportional to the amount of change along the branches. Bootstrap proportions (if  $\geq 70\%$ ) are indicated for main internal nodes.

**Figure 5.** *Kingsleya parnaiba* n. sp., male holotype (MZUSP 40264): **A–D**, distal region of left first gonopod in sternal, lateral, mesial and abdominal views, respectively. *Kingsleya attenboroughi* Pinheiro and Santana, 2016, male paratype (MZUSP 9699): **E–H**, distal region of left first gonopod in sternal, lateral, mesial and abdominal views, respectively. Abbreviations: ap, apical plate; dl, distal lobe; fs, field of apical spines; me, mesial process; mp, marginal process; pl, proximal lobe. Scale bars: **A–H**, 2 mm.

**Figure 6.** Pictures of hermit crabs performing air-exposure. **(A)** *Clibanarius albidigitus* climbing for air-exposure in Playa del Carmen, Costa Rica. **(B)** *Clibanarius albidigitus* inside a *Turritella* sp. and *Cerithium browni* air-exposure in Playa del Carmen, Costa Rica. **(C)** Two *Clibanarius albidigitus* inside of *Nerita funiculata*, air-exposure in Playa del Carmen, Costa Rica. **(D, E)** *Clibanarius erythropus* inside shells of different species performing air-exposure in Santibañez beach, Spain.

**Figure 7.** Sampling sites of hermit crabs collected in Spain (*Clibanarius erythropus*) and at the Pacific coast of Costa Rica (*Clibanarius albidigitus*, *Calcinus obscurus*, *Paguristes* sp. (Images from Google Earth, v. 7.3.0.3832 ©2017).

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Examples:

**Table 1.** Mean with standard deviation ( $\pm$  SD), minimum and maximum of carapace width (CW), carapace length (CL), and wet weight of crabs (*Ptychophallus tumimanus*) in the experiments.

	<b>Mean (<math>\pm</math> SD)</b>	<b>Minimum</b>	<b>Maximum</b>	<b>N</b>
CW (mm)	26 $\pm$ 2.8	23	29	8
CL (mm)	19 $\pm$ 1.2	17	20	8
Wet weight (g)	4.49 $\pm$ 0.81	3.03	5.66	8

**Table 2.** Comparison of longevities between higher taxa.

	No. of species with longevity data	Longevity range (yr)*	Mean (yr) ± SD and CV (%)
Dendrobranchiata	29 of 540	0.1–9	2.13±1.61; 75.6
Caridea	43 of 3,268	0.5–18	4.19±4.05; 96.7
Astacidea	54 of 653	1.5–72	11.00±13.80; 125.5
Gebiidea	1 of 192	4–4	4.00±0.00; 0.0
Achelata	6 of 140	15–40	27.17±8.56; 31.5
Anomura	19 of 2,451	0.7–70	11.34±18.28; 161.2
Brachyura	92 of 6,559	0.7–30	5.59±5.75; 102.9
Decapoda	244 of 14,335	0.1–72	7.12±10.18; 142.9

\* Based on reported maximum values of species. CV=coefficient of variation. No reliable data were found for the 69 Stenopodidea, 2 Glypheidea, 423 Axiidea and 38 Polychelida. Species numbers of decapod groups are from De Grave *et al.* (2009).

**Table 3.** First zoea of *Libinia* spp. Character comparison of three species of *Libinia*. Nm, not mentioned; (\*) obtained of the figure. Bold type indicates observed differences.

Structure Character	<i>L. spinosa</i> (see Boschi and Scelzo, 1968)	<i>L. emarginata</i> (see Johns and Lang, 1977)	<i>L. rhomboidea</i> (Current study)
Cephalothorax			
Total length (mm)	2.3	2.15 ± 0.15	<b>2.75 ± 0.05</b>
Carapace length	0.8	0.78 ± 0.02	<b>0.85 ± 0.05</b>
Lateral spines	absent	absent	absent
Length of dorsal spine	0.59 (*)	0.44 (*)	0.50 ± 0.01
Maxillule			
Coxal endite (plumodenticulate terminal setae, subterminal sparsely plumose setae)	8 s	5, 2	5, 2
Basal endite (spines, sparsely plumose setae, sparsely plumose terminal setae, plumodenticulate subterminal setae)	4, 2, 0, 0	0, 2, 2, 3	<b>0, 5, 0, 2</b>
Maxilla			
Endopod (terminal setae, microtrichia)	4–5, Nm	5, Nm	5, present
Third maxilliped	Rudimentary	Nm	Rudimentary
Pereiopods	Rudimentary	Nm	Rudimentary

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