

Synonymy of the Caridean Shrimp Genus *Paralatreutes* Kemp, 1925 with *Latreutes* Stimpson, 1860 (Decapoda: Hippolytidae)

Mary K. Wicksten¹ and Zachary B. Hancock²

¹ Department of Biology, Texas A&M University, College Station, Texas 77843-3258, USA;

² Department of Integrative Biology, Michigan State University, East Lansing, Michigan 48825, USA.

¹ Corresponding author; e-mail: wicksten@bio.tamu.edu

We examined a single specimen of *Paralatreutes bicornis* on loan from the California Academy of Sciences, which was collected during the 2014 Verde Island Passage Expedition. We found no visible differences between the present specimen and that of the original type description. The form of the body closely resembled that of species of *Latreutes*. We conducted a genetic analysis and found no significant difference between that of *L. porcinus* and our specimen. We therefore consider *Paralatreutes* Kemp, 1925 to be a junior subjective synonym of *Latreutes* Stimpson 1860. We provide a diagnosis of the species and extensions of its range.

KEYWORDS: *Latreutes*, *Paralatreutes*, Hippolytidae, shrimp, Philippine Islands

RESUMEN

Un espécimen único de *Paralatreutes bicornis* Kemp, 1925, recolectado durante la expedición 2014 “Verde Island Passaged Expedition”, fue examinado. No se encontraron diferencias visibles entre este espécimen y aquel utilizado en la descripción original del tipo. La forma del cuerpo es muy parecida a la forma del cuerpo observada en especies de *Latreutes*. Se realizó un análisis genético y no se observaron diferencias significativas entre *L. porcinus* Kemp, 1916 y nuestro espécimen. Consecuentemente, consideramos que *Paralatreutes* Kemp, 1925 es un sinónimo júnior, subjetivo de *Latreutes* Stimpson, 1860. Se proporciona una diagnosis de *Latreutes bicornis* nueva combinación y una ampliación de su interval de distribución.

PALABRAS CLAVE.— *Latreutes*, *Paralatreutes*, Hippolytidae, camarones, Islas Philipinas

Eighteen species of the caridean genus *Latreutes* are currently recognized (Worms, 2021a), while *Paralatreutes* is a monotypic genus (Worms, 2021b). Caridean shrimps of the family Hippolytidae tend to be small, 30 mm in total length or less, and difficult to see. They may be colored like algae or sea grasses, or have blotches, spots or broad bands that conceal them. They may be collected by accident. Such may be the case for the tiny shrimp *Paralatreutes bicornis*, known previously from three female specimens described from the Andaman Islands in 1925. We obtained a specimen from the Philippine Islands. This specimen provides the opportunity to compare it with the original description and adds to knowledge of its living color and geographic range. We conducted a genetic comparison of our specimen with a species of *Latreutes*, and found no significant difference between the genotypes of *Paralatreutes* and *Latreutes*. We herein reassign *P. bicornis* to *Latreutes* and provide a new diagnosis.

FAMILY HIPPOLYTIDAE SPENCE BATE, 1888

Genus *Latreutes* Stimpson, 1860*Latreutes bicornis* (Kemp, 1925)

Paralatreutes bicornis Kemp, 1925: 334–338, figs. 23–24; Holthuis 1993: 245, fig. 242; Chace 1997: 55; Yang 2005: 462.

Material examined.—Female, not ovigerous, carapace length 5.33 mm. Philippine Islands: Luzon, Mabini (Calumpán Peninsula), Balayan Bay, Matotungil Point, 13.76°N, 120.91°E, 18 m, 27 April 2014, Peri Paleracio, coll., on Porifera; California Academy of Sciences catalog number CASIZ202665.

Diagnosis.—Body form robust. Rostrum with dorsal margin bearing 8–11 teeth, diminishing in size from posterior to anterior; apex truncate, one sharp apical spine and two spinules, lower margin without teeth; widest at level of peduncle of first antenna. Carapace dorsally carinate with two large teeth posterior to rostrum, submarginal articulated antenna tooth, series of 9–10 spinules along anterior margin. Eyes large, pigmented; ocular peduncle with antero-internal process projecting slightly beyond cornea. First antenna with sharp anterolateral tooth on first segment, flagella equal in length, stylocerite acute, reaching end of first segment; second and third segments unarmed. Antennal scale triangular, three times as long as wide, nearly same length as rostrum, spine exceeding blade. Peduncle of second antennae reaching top end of second segment of antennular peduncle. Mandible without palp. First and second maxilliped with exopods, Third maxilliped without exopod. Epipods on first four pereopods, without arthrobranchs. First to fourth pereopods with epipods. First pereopods shorter than third maxillipeds, merus with blunt tooth at distal tooth, chelate, fingers shorter than palm. Second pereopod slender, chelate, carpus with three articles. Third pereopod with merus having distolateral sharp tooth, upper margin with blunt tooth, propodus with coarse spinules, dactyl biunguiculate with 4 spines posterior to terminal unguis. Fourth and fifth pereopods similar but shorter. Abdominal somites without dorsal teeth or carinae. Pleura blunt or rounded but posteroventral border of fifth somite with at least one minute tooth. Telson with two pairs dorsal spines, apex with two lateral spines on each side, inner spines longer than outer.

Color in life.—Carapace and abdomen dull, plum-colored or vermilion, with large reddish mid-dorsal patch on carapace; antennal scale and anterior third of rostrum plum-colored or mottled with grey and green, legs red or vermilion or with distal end of merus and carpus pale grey green and propodus purplish orange, propodus of pereopods 3–4 transparent with large deep blue apical spot, fifth dactyl bright red; pleopods dull reddish purple, eggs orange. (Kemp 1925). Figure 1 shows two views of the specimen in life, and shows the “dorsal patch” on the carapace and marks of tan and red on the pereopods. Photographs of a similar shrimp from Kwajalein show a shrimp that is dark blue with white bands of brown, with hair-like processes on the body (www.underwaterkwaj.com/uw-misc/shrimp/Shrimp-Halimeda-blue.htm).

Type location.—Ross Channel, Port Blair, Andaman Islands, 11°36.1'N, 92°54.5'E, 57 m. The type material, three female specimens, was deposited in the Indian Museum (now the Zoological Survey of India, Calcutta). Some of the specimens of this or other species described by Kemp were sent to the Natural History Museum in London, the Australian Museum, and other locations. The specimens may still exist (Shane Ahyong, Australian Museum, pers. comm.) but as of this writing, they have not been found.

Genetic analysis.—Whole genomic DNA was extracted from 2–4 pleopods using an EZNA Tissue DNA kit (Omega Bio-tek Inc.) following the manufacturer's protocol. The 16S ribosomal RNA (16S) was amplified via polymerase chain reaction (PCR) using primer sets and conditions

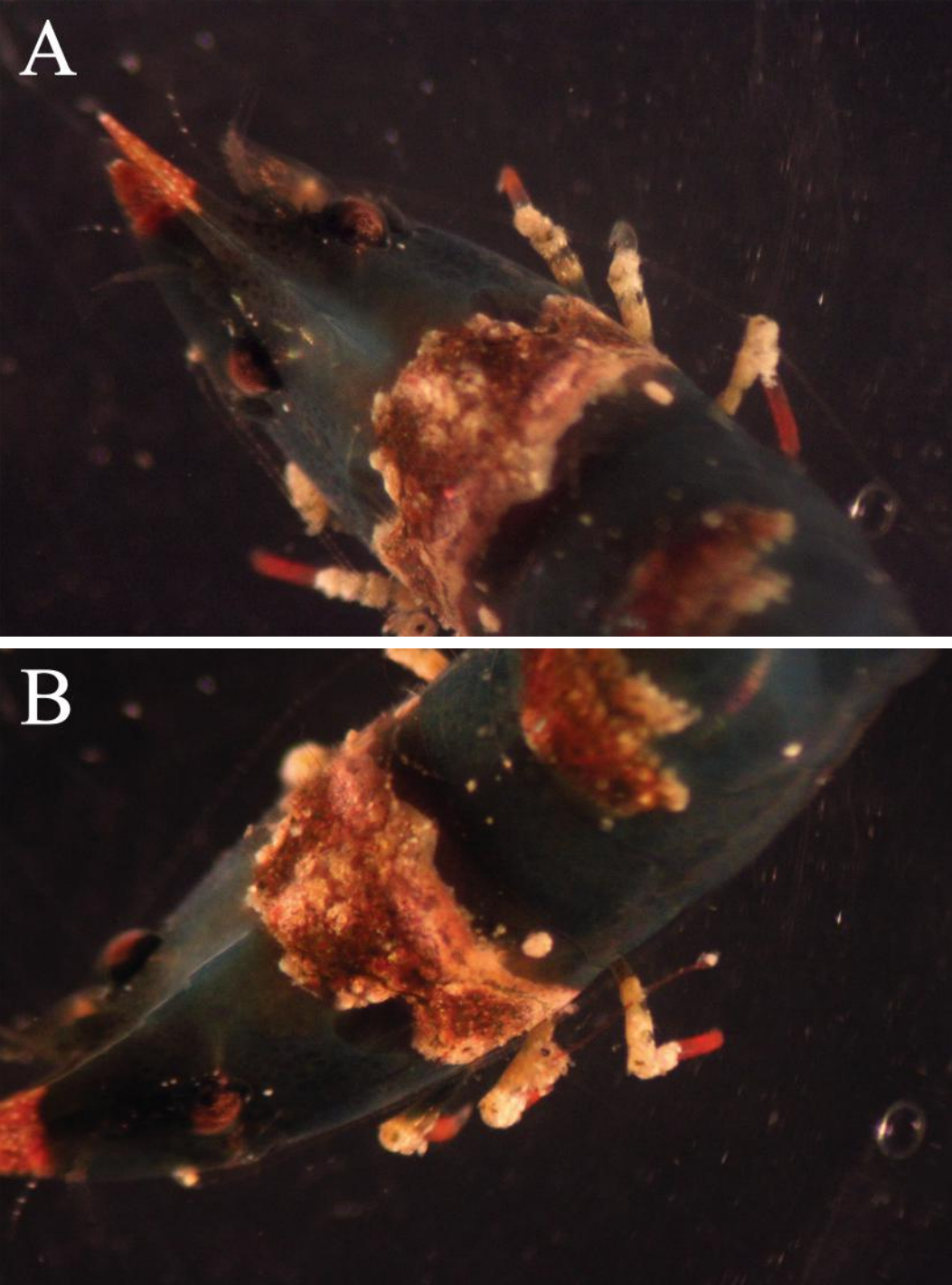


FIGURE 1. A, *Latreutes bicornis* (Kemp, 1925) (CASIZ 202665), dorsal view showing rostrum and anterior carapace. B, Same specimen, dorsal view showing abdomen and posterior pereopods.

as described in Cuesta et al. (2012). Forward and reverse strand Sanger sequencing was performed at Psomagen, Inc. (<https://psomagen.com/>). Chromatograms were manually checked in MEGA7 (Kumar et al. 2016), cleaned and filtered, and then a BLAST search was performed to verify the identity of the sequence and evaluated similarity to existing sequences in the NCBI database (<https://blast.ncbi.nlm.nih.gov/Blast.cgi>). The sequence aligned with 99.18% identity to a 481 bp 16S sequence of *Latreutes porcinus* (Kemp, 1916) (MK722383; Terossi et al. 2019), indicating that the collected shrimp known as *Paralatreutes bicornis* should be assigned to *Latreutes* instead of a separate genus. The sequence has been deposited in GenBank (MZ367600). We also sequenced CO1 but the result was of poor quality, possibly due to a pseudogene, and not usable for further analysis. The high genetic similarity between *L. bicornis* and *L. porcinus* could indicate that the two are con-specific, but at present this similarity reflects an analysis of only one gene.

The original separation of the monotypic genus *Paralatreutes* was based on the lack of an exopod on the third maxilliped. This feature has been seen to be variable in other related carideans (G. Jensen, University of Washington, pers. comm). The large dorsal teeth on the carapace are not present in other species of *Latreutes* but occur in other related genera.

Discussion.—The large carapace teeth and the lack of an exopod on the third maxilliped readily distinguish *L. bicornis* from other species of *Latreutes*. (See Chace, 1972 for a key to the species). All four specimens (the three in the type series and the present specimen) are or were females with a ventrally expanded rostrum, as in other species of *Latreutes*. Male *Latreutes* have a narrow rostrum with fewer teeth. *Latreutes bicornis* also may be sexually dimorphic.

The original description of *L. bicornis* and the specimen we examined both show two very large flat teeth on the dorsal surface of the carapace instead of a series of short more or less equal teeth, as are found in other species such as *L. porcinus*. Anker and De Grave (2016) provided photos of *L. porcinus* in which its color resembled that of sea grasses or sand. Color patterns of species of *Latreutes* tend to be variable but the color pattern of the present specimen of *L. bicornis* more closely resembles that in the description by Kemp than that seen in photographs of *L. porcinus*. Pending analysis of additional specimens we prefer to consider *L. porcinus* and *L. bicornis* to be separate species.

The family designation of the species of *Latreutes* remains in question. Stimpson (1860) placed *Latreutes* within the Hippolytidae, as did Holthuis (1993) and Chace (1997). Yang (2005), on examining the larvae of *Latreutes anoplonyx* Kemp, 1914 and comparing them with other *Latreutes* species, noted there were significant differences between the first zoea of these species and those of other species of the Hippolytidae. Christoffersen (1987) suggested that members of the genera *Gelastocaris*, *Gelastreutes*, *Latreutes*, *Paralatreutes*, *Tozeuma* and *Trachycaris* might consist a subfamily, the Latreutinae. Yang disagreed, noting differences in the morphology of the first zoea between *Tozeuma carolinense* (Kingsley, 1878) and species of *Latreutes*. De Grave et al. (2014) using genetical analyses, concluded that the family Hippolytidae *sensu* Stimpson was polyphyletic. According to this analysis, *Latreutes* remains in a clade that contains the type genus, *Hippolyte*. This species may be more widespread in the Indian and Pacific Oceans than previously recorded. We received a photograph likely to be this species taken off Kwajalein Atoll (9.19° N, 167.42° E, Johnson and Johnson, pers. comm.)

ACKNOWLEDGEMENTS

We thank Christine Piotrowski, California Academy of Sciences, for the opportunity to examine this specimen, and Sammy De Grave, Oxford University, for providing us with a copy of the original description. Kandasamy Valarmathi, Zoological Survey of India, and Shane Ah Yong, Aus-

tralian Museum, provided information on the possible fate of Kemps's type material. We thank Gregory Jensen, University of Washington, for sharing unpublished information on variability in the development of the exopod of the third maxilliped. We are grateful to photographers Scott and Jeanette Johnson of Underwater Kwajalein for information on shrimp of Kwajalein. We also thank Jenna Warfield, Department of Biology, and Natalie Hamilton, Department of Ecology and Conservation Biology, Texas A&M University; for aid with the molecular work. Michel Hendrickx, Instituto de Ciencias del Mar y Limnología, Mazatlán, Mexico translated the abstract into Spanish. This research was supported by a grant from the National Science Foundation: DEB 1257630 grant to Terrence Gosliner, Kent Carpenter, Richard Mooi, Luiz Rocha and Gary Williams. This collaborative research involved the following partners in the Philippines: former Secretary of Agriculture Proceso J. Alcala; former Philippine Consul General Marciano Paynor and the Consular staff in San Francisco; former Bureau of Fisheries and Aquatic Resources (BFAR) Director Attorney Asis G. Perez; BFAR colleagues, especially Attorney Analiza Vitug, Ludivina Labe; National Fisheries and Research Development Institute (NFRDI) colleagues, especially Director Drusila Bayate and November Romena; U.S. Embassy staff, especially Heath Bailey, Richard Bakewell and Maria Theresa N. Villa; staff of the Department of Foreign Affairs; University of the Philippines (UP) administrators and colleagues including former UP President Alfredo Pascual, former Vice President Giselle Concepción, and Dr Annette Meñez and the staff of the National Museum of the Philippines, especially Dr Jeremy Barns, Anna Labrador and Marivene Manuel Santos. We also thank Boy Venus, Joy Napeñas, Peri Paleracio, Alexis Principe, the staff of Atlantis Dive Resort Puerto Galera (especially Gordon Strahan, Andy Pope, Marco Inocencio, Stephen Lamont, and P.J. Aristorenas), Kati Eschweiler and the other staff of the 3P Resort Romblon, Ipat Luna, Anne Hazel Javier, Jay-o Castillo, Arvel Malubag and Mary Lou Salcedo. Lastly, our sincere thanks are extended to our fellow Academy and Filipino teammates on the expeditions. All the specimens from the Philippines were collected under our Gratuitous Permit (GP-0077-14) from the shallow waters of the municipalities of Mabini and Tingloy

REFERENCES

- ANKER, A. & S. DE GRAVE. 2017. An updated and annotated checklist of marine and brackish caridean shrimps of Singapore. *Raffles Bulletin of Zoology, Supplement* 34:343–454.
- CHACE, F.A. JR. 1997. The caridean shrimps (Crustacea: Decapoda) of the Albatross Philippine Expedition, 1907-1910, Part 7: Families Atyidae, Eugonatonotidae, Rhynchocinetidae, Bathypalaemonellidae, Procecididae, and Hippolytidae. *Smithsonian Contributions to Zoology* 587:1–106.
- CHRISTOFFERSEN, M.K. 1987. Phylogenetic relationships of hippolytid genera, with an assignment of two new families for Crangonoidea and Alpheoidea (Crustacea, Decapoda, Caridea). *Cladistics* 3:348–362.
- CUESTA, J.A., P. DRAKE, G. MARTÍNEZ-RODRÍGUEZ, A. RODRÍGUEZ, & C.D. SCHUBART. 2019. Phylogeny of the genera *Palaemon* and *Palaemonetes* (Decapoda, Caridea, Palaemonidae) from a European perspective. *Crustaceana* 85:877–888.
- De Grave, S., C. Li, L. Tsang, K. Chu, & T. Chane. 2014. Unweaving hippolytid systematics (Crustacea, Decapoda, Hippolytidae): resurrection of several families. *Zoologica Scripta: Norwegian Academy of Science and Letters*, 43:496–507.
- HOLTHUIS, L.B. 1993. *The recent genera of the caridean and stenopodidean shrimps (Crustacea, Decapoda), with an appendix on the order Amphionidacea*. Leiden: Nationaal Natuurhistorisch Museum, 328 pp..
- JOHNSON, J. & S. JOHNSON. 2021. Marshall Island Shrimp. *Paralatreutes* cf. *bicornis*. Accessed at: <www.underwaterkwaj.com/ww-misc/shrimp/Shrimp-Halimeda-blue.Htm>.
- KEMP, S. 1914. Notes on Crustacea Decapoda in the Indian Museum, V: Hippolytidae. *Records of the Indian Museum* 10:81–129.
- KEMP, S. 1916. Notes on Crustacea Decapoda in the Indian Museum, VII: Further notes on Hippolytidae. *Records of the Indian Museum* 12:385–405.

- KEMP, S. 1925. Notes on Crustacea Decapoda in the Indian Museum XVIII: On various Caridea. *Records of the Indian Museum* 27:249–342.
- KINGSLEY, J.S. 1878. Notes on the North American Crustacea in the Museum of the Peabody Academy of Science at Salem, Mass. *Proceedings of the Academy of Natural Science of Philadelphia* 1878:89–98.
- KUMAR, S., G. STECHER, & K. TAMURA. 2016. MEGA7: Molecular Evolutionary Genetics Analysis Version 7.0 for bigger datasets. *Molecular Biology and Evolution* 33:1870–1874.
- STIMPSON, W. 1860. Crustacea Macrura. In *Prodromus descriptionis animalium evertabratorum, quae in Expeditione ad Oceanum Pacificum Septentrionalem, a Republica Federata missa, Cadwaladaro Ringgold et Johanne Rodgers Ducibus, observatit et descripsit. Proceedings of the Academy of Natural Sciences of Philadelphia* 1860:22–47.
- TEROSSI, M., A.O. ALMEIDA, & F.L. MANTELATTO. 2019. Morphology and DNA data reveal a new shrimp species of genus *Latreutes* Stimpson, 1860 (Decapoda: Hippolytidae) from the Western Atlantic. *Zoological Science* 36:440–447.
- WORMS. 2021a. *Latreutes* Stimpson, 1860. Accessed at: <<http://www.marinespecies.org/aphia.php?p=taxdetails&id=106988> on 2021-08-02>
- WORMS. 2021b. *Paralatreutes bicornis* Kemp, 1925. Accessed at: <<http://www.marinespecies.org/aphia.php?p=taxdetails&id=515321> on 2021-08-02>
- YANG, H.J. 2005. Larval development of *Latreutes anoplonyx* (Decapoda: Hippolytidae) reared in the laboratory. *Journal of Crustacean Biology* 25:462–479.