



<http://dx.doi.org/10.11646/zootaxa.3768.5.2>

<http://zoobank.org/urn:lsid:zoobank.org:pub:6C45A67E-37B5-4FCE-8A25-855AA842B948>

## Description, DNA barcode and phylogeny of a new species, *Macrobrachium abrahami* (Decapoda: Palaemonidae) from Kerala, India

P.M. PILLAI<sup>1</sup>, V. UNNIKRISHNAN<sup>2</sup> & U. SURESH KUMAR<sup>3</sup>

<sup>1</sup>Central Agricultural University, Iroisemba, Manipur, India 795004. E-mail: [pmpillai@gmail.com](mailto:pmpillai@gmail.com), [pmpillai@outlook.com](mailto:pmpillai@outlook.com)

<sup>2</sup>Post Graduate Department of Zoology and Research Centre, Mahatma Gandhi College, Thiruvananthapuram, Kerala, India 695004

<sup>3</sup>Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram, Kerala, India 695014

### Abstract

*Macrobrachium abrahami*, new species is described from Vamanapuram River, Kerala, South India. DNA bar-coding using Cytochrome B gene sequences has elucidated the taxonomic status of the new species and the ML tree reveals that *M. abrahami* sp. nov., is phylogenetically close to *M. prabhakarani*, but morphologically more similar to *M. scabriculum*. However, the species shares certain morphological characters with *M. scabriculum*, *M. prabhakarani* and *M. lanatum*, but differs remarkably from these three species in distinctive diagnostic characters: rostrum moderately long, convex, distal end directed upwards, rostral formula 12–15/2–3 with 5–6 postorbital teeth, and carapace glabrous. In larger second chelate leg, fingers stout, pubescence restricted to their base; proximal half of cutting edge with fifteen denticles. In smaller second chelate leg, cutting edge of both fingers carry six small denticles situated proximally, distal one comparatively larger. Delicate setae are seen throughout the palm. A row of dark chromatophores is present along the postero-dorsal margin of uropodal exopods and endopods, close to the base of uropodal setae. The thickness of each band of the row is almost equal to the thickness of uropodal setae.

**Key words:** taxonomy, new species, Palaemonidae, *Macrobrachium*, Cytochrome b, Kerala, India

### Introduction

The family Palaemonidae Rafinesque, 1815 represents one of the few decapod groups that have successfully colonized oceans, estuaries and rivers in the subtropical and tropical regions. The genus *Macrobrachium* includes more than 240 species (Wowor *et al.* 2009) and has the largest number of species of all Palaemonid genera with more than sixty species reported from India. The commercially important freshwater prawns viz., *M. rosenbergii* and *M. malcolmsonii* are extensively used for aquaculture. But there are many more undescribed species, in the rivers of Kerala, which have to be investigated.

Classification based on morphology is well known since the time of Linnaeus (1735), though the traditional system has inherent limitations. But, modern molecular tools of species identification place an organism in its full taxonomic hierarchy from kingdom to species. The use of DNA sequence signature has the advantage that it expresses the elucidation of phylogeny that enables the testing of morphology based systematic hypothesis, for the independent assessment of morphological evolution. Most popular tools in phylogenetics are sequences of cytochrome b (CytB) and cytochrome oxidase 1 (COX1) genes, which are used for taxa comparison at the species level, Johns & Avise (1998). Apart from their taxonomy, the phylogenetic affinities among *Macrobrachium* species are poorly understood and Pereira (1997) carried out the first phylogenetic study based on morphological characters of the family Palaemonidae. But molecular studies of *Macrobrachium* (Liu *et al.* 2007) have received much attention in recent years.

During the survey of Palaemonid prawns of southern Kerala, India, the present authors obtained several species from Vamanapuram River, stations 50 m. above Mean Sea Level. Among these, eight specimens showed morphometric and meristic characters that did not conform to any other known species of *Macrobrachium*. Hence, a thorough comparison of its morphology with closely related species, coupled with DNA bar-coding using CytB gene sequences has been carried out for establishing the taxonomic status of the new species, described herein.

The above explanations sufficiently validate the fact that depending on the species, the level of speciation varies, and percentage of nucleotide difference or genetic distance between closely related species may also disagree. Nucleotides within the sequence of *M. abrahami* sp. nov., might have evolved through substitution, causing nucleotide change, which might have been the main driving force behind the formation of the new species.

**Etymology.** The species name is in honor of Prof. Thomas Abraham (former Head, Department of Zoology, St. Thomas College, Kozhenchery, Kerala) who is the teacher of the second author. The name thus is a noun in the genitive singular.

## Acknowledgements

The authors are grateful to Mr. Anoop T.P. and Mr. Binoop T.P., Thalathil Leelalayam, Thrikkannapuram for the assistance offered in collecting the specimens.

## References

- Applied Biosystems (2013) Sequence Scanner Software v1. Available from: [http://www3.appliedbiosystems.com/cms/groups/mcb\\_marketing/documents/generaldocuments/cms\\_042188.pdf](http://www3.appliedbiosystems.com/cms/groups/mcb_marketing/documents/generaldocuments/cms_042188.pdf) (accessed 16 April 2013)
- Big Dye Terminator v3.1 Cycle sequencing Kit (2010) Protocol, User Manual, Applied Biosystems, USA. Available from: <http://www.appliedbiosystems.com> (accessed 16 August 2012)
- Burns, J.M., Janzen, D.H., Hajibabaei, M., Hallwachs W. & Hebert, P.D.N. (2007) DNA barcodes of closely related (but morphologically and ecologically distinct) species of skipper butterflies (hesperiidae) can differ by only one to three nucleotides. *Journal of the Lepidopterists' Society*, 61 (3), 138–153. Available from: <http://entomology.si.edu/staffpages/Burns/JLSx-07Burns.pdf> (accessed 16 October 2013)
- Cai, Y., Naiyanetr, P. & Ng, P.K.L. (2004) The freshwater prawns of the genus *Macrobrachium* Bate, 1868 of Thailand (Crustacea: Decapoda: Palaemonidae). *Journal of Natural History*, 38, 581–649. <http://dx.doi.org/10.1080/0022293021000033238>
- Cai, Y. & Ng, P.K.L. (2002) The fresh water palaemonid prawns (Crustacea: Decapoda: Caridea) of Myanmar. *Hydrobiologia*, 487 (1), 59–83. Available from: <http://link.springer.com/article/10.1023/A%3A1022991224381#page-1> (accessed 13 January 2014)
- Chace, Jr., F.A. & Bruce, A.J. (1993) The Caridean shrimps (Crustacea: Decapoda) of the Albatross Philippine Expedition, 1907–1910, Part I: Superfamily Palaemonoidea. *Smithsonian Contributions to Zoology*, 543, 1–152. <http://dx.doi.org/10.5479/si.00810282.543>
- De Grave, S. & Franssen, C.H.J.M. (2011) Carideorum catalogus: the recent species of the Dendrobranchiate, Stenopodidean, Procarididean and Caridean Shrimps (Crustacea: Decapoda). *Zoologische Mededelingen*, 85, 195–588. Available from: <http://dpc.uba.uva.nl/cgi/t/text/get-pdf?c=zoomed;idno=8502a01> (accessed 16 August 2012)
- DNeasy® Blood & Tissue Handbook (07/2006) Qiagen. Available from: [http://lycofs01.lycoming.edu/~gcatseek/protocols/DNeasy\\_Blood\\_&\\_Tissue\\_Handbook.pdf](http://lycofs01.lycoming.edu/~gcatseek/protocols/DNeasy_Blood_&_Tissue_Handbook.pdf) (accessed 16 August 2012)
- Drummond, A.J., Ashton, B., Buxton, S., Cheung, M., Cooper, A., Heled, J., Kearse, M., Moir, R., Stones-Havas, S., Sturrock, S., Thierer, T. & Wilson, A. (2010) Geneious v5.1. Available from: <http://www.geneious.com>. (accessed 16 August 2012)
- ExoSAP-IT (2000) User Guide. GE Healthcare, USB Corporation, 26111 Miles Road, Cleveland, Ohio 44128. Available from: <http://www.usbweb.com> (accessed 16 August 2012)
- González, P., Sawyer, Y.E., Avila, M., Armien, A.G., Armien, B. & Cook, J.A. (2010) Variation in cytochrome b haplotypes suggests a new species of *Zygodontomys* (Rodentia: Cricetidae) endemic to Isla Coiba, Panama. *Zoologia*, 27 (4), 660–665. <http://dx.doi.org/10.1590/s1984-46702010000400014>
- Heller, C. (1862) Beiträge zur Crustaceen-Fauna des Rothen Meeres. *Zweiter Theil. Sitzungsberichte der mathematisch-naturwissenschaftlichen Classe der Kaiserlichen Akademie der Wissenschaften in Wien*, 44 (1), 241–295. Available from: [www.repository.naturalis.nl/document/150152](http://www.repository.naturalis.nl/document/150152) (accessed 16 August 2012)
- Henderson, J.R. (1893) A contribution to Indian Carcinology. *The Transactions of the Linnean Society of London. Zoology*, 5 (2), 325–458. Available from: <http://archive.org/stream/contributiontoind00hend#page/438/mode/2up> (accessed 16 August 2012)
- Holthuis, L.B. (1950a) Subfamily Palaemoninae. The Palaemonidae collected by the Siboga and Snellius Expeditions with remarks on other species. I. The Decapoda of Siboga Expedition Part X. *Siboga Exped.*, Mon., 39a (9), 1–268. Available from: <http://decapoda.nhm.org/pdfs/17152/17152-001.pdf> (accessed 16 August 2012)
- Holthuis, L.B. (1950b) Preliminary descriptions of twelve new species of Palaemonid prawns from American waters (Crustacea: Decapoda). *Proceedings of the Koninklijke Nederlandsche Akademie van Wetenschappen* Vol. LIII, No. 1, (C), 53, 93–99. Available from: <http://decapoda.nhm.org/pdfs/25760/25760.pdf> (accessed 16 August 2012)

- Jayachandran, K.V. (2001) *Palaemonid Prawns- Biodiversity, Taxonomy, Biology and Management*. Oxford and IBH Publishing Company Pvt. Ltd. New Delhi, Calcutta, 622 pp. Available from: <http://www.amazon.com/Palaemonid-Prawns-Biodiversity-Taxonomy-Management/dp/1578081823> (accessed 16 August 2012)
- Johns, G.C. & Avise, J.C. (1998) A comparative summary of genetic distances in the vertebrates from the mitochondrial cytochrome b gene. *Molecular Biology and Evolution* 15, 1481–1490.  
<http://dx.doi.org/10.1093/oxfordjournals.molbev.a025875>
- Kemp, S. (1917) *Leander styliferus* Milne Edwards, and related forms. Notes on Crustacea, Decapoda in the Indian Museum. IX. *Records of the Indian Museum*, 13, 203–231. Available from: <http://www.biodiversitylibrary.org/page/11128039#page/308/mode/1up> (accessed 16 August 2012)
- Kimura, M. (1980) A simple method for estimating evolutionary rate of base substitutions through comparative studies of nucleotide sequences. *Journal of Molecular Evolution*, 16, 111–120. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/7463489> (accessed 16 August 2012)
- Linnæus, C. (1735) *Systema naturæ, sive regna tria naturæ systematice proposita per classes, ordines, genera, & species*. Notes, 1. Lugduni Batavorum (Haak), pp. I., 1–11.  
<http://dx.doi.org/10.5962/bhl.title.877>
- Liu, M.Y., Cai, Y. & Tzeng, C.S. (2007) Molecular systematics of the freshwater prawn genus *Macrobrachium* Bate, 1868 (Crustacea: Decapoda: Palaemonidae) inferred from mtDNA sequences, with emphasis on East Asian species. *Zoological Studies*, 46 (3), 272–289. Available from: <http://zoolstud.sinica.edu.tw/Journals/46.3/272.pdf> (accessed 16 August 2012)
- Panno, J. (2005) *The Cell: Evolution of the First Organism*. Facts on File INC. ISBN 0-8160-4946-7. Available from: <http://www.amazon.com/The-Cell-Evolution-Organism-Biology/dp/0816049467> (accessed 16 August 2012)
- Pereira, G. (1997) A cladistic analysis of the freshwater shrimps of the family Palaemonidae (Crustacea, Decapoda, Caridea). *Acta Biologica, Venezuelica*. 17, 1–69. Available from: <http://decapoda.nhm.org/pdfs/12715/12715.pdf> (accessed 10 January 2014)
- Phone, H. & Suzuki, H. (2004) *Macrobrachium patheinense*, a new species of freshwater prawn (Crustacea: Decapoda: Palaemonidae) from Myanmar. *Proceedings of the Biological Society of Washington*, 117 (4), 523–528. Available from: <http://biostor.org/reference/81364> (accessed 16 August 2012)
- Pillai, P.M. & Unnikrishnan, V. (2012) A new species of *Macrobrachium* (Decapoda, Palaemonidae) from Vamanapuram River, Southern Kerala, India. *Zootaxa*, 3528, 63–68.
- Pillai, P.M. & Unnikrishnan, V. (2013) Morphology and molecular phylogeny of *Macrobrachium snpurii*, a new species of the genus *Macrobrachium* Bate, 1868 from Kerala, India. *Zootaxa*, 3664 (4), 434–444.  
<http://dx.doi.org/10.11646/zootaxa.3664.4.2>
- Rafinesque, C.S. (1815) *Analyse de la Nature ou Tableau de l'univers et des corps organises*. Palermo, 224 pp. Available from: <http://gallica.bnf.fr/ark:/12148/bpt6k98061z.r=rafinesque.langEN> (accessed 16 August 2012)
- Spence Bate, C. (1868) On a new genus, with four new species of freshwater prawns. *Proceedings of the Zoological Society of London*, 1868, 363–368, pls. 30–31.
- Tamura, K., Dudley, J., Nei, M. & Kumar, S. (2007) MEGA4: Molecular Evolutionary Genetics Analysis (MEGA) software version 4.0. *Molecular Biology and Evolution*, 24, 1596–1599.  
<http://dx.doi.org/10.1093/molbev/msm092>
- Unnikrishnan, V., Pillai, P.M. & Jayachandran, K.V. (2010) On a new species of *Macrobrachium* (Decapoda: Palaemonidae) from Ithikkara river, South-West coast of India. *Crustaceana*, 83 (9), 1115–1123.  
<http://dx.doi.org/10.1163/001121610x521253>
- Uy, A.C.J., Moyle, G.R., Filardi, E.C. & Cheviron, A.Z. (2009) Difference in plumage color used in species recognition between incipient species is linked to a single amino acid substitution in the melanocortin-1 receptor. *The American naturalist*, 174 (2), 1–11.  
<http://dx.doi.org/10.1086/600084>
- Verma, S.K. & Singh, L. (2003) Novel universal primers establish identity of an enormous number of animal species for forensic application. *Molecular Ecology Notes*, 3 (1), 28–31.  
<http://dx.doi.org/10.1046/j.1471-8286.2003.00340.x>
- Wowor, D., Muthu, V., Rudolf, M., Michael, B., Yixiong, C. & Ng, P.K.L. (2009) Evolution of life history traits in Asian freshwater prawns of the genus *Macrobrachium* (Crustacea: Decapoda: Palaemonidae) based on multilocus molecular phylogenetic analysis. *Molecular Phylogenetics and Evolution*, 52 (2) 340–350.  
<http://dx.doi.org/10.1016/j.ympev.2009.01.002>