



## First record of deep-sea caridean shrimp *Acantheephyra fimbriata* Alcock & Anderson, 1894 (Crustacea: Decapoda: Acantheephyridae) from southwest coast of India

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### Abstract

The present work reports the new occurrence of deep-sea shrimp *Acantheephyra fimbriata* Alcock & Anderson, 1894 from southwestern Indian waters. The samples were caught in bottom trawls conducted between the depths of 200 and 350 m from two fish landing centers off Kerala along Arabian Sea from the southwest coast of India during 2015. Additionally, a phylogenetic analysis was used to explore the relationships of the genus *Acantheephyra* based on two genes: mitochondrial cytochrome c oxidase subunit 1 (COI) and 16S DNA (16S) with the present specimen and sequences retrieved from NCBI GenBank. The results revealed intraspecies (COI: 0–3 % & 16S: 0–0.3 %) and interspecies divergence (COI: 17.5–20.9 % & 16S: 5.2–9.5 %) among *A. fimbriata*.

**Key words:** Morphology, deep-sea, caridean shrimp, phylogenetic, Southwestern India

### Introduction

The genus *Acantheephyra* A. Milne-Edwards, 1881 is the largest genus of the family Acantheephyridae Spence Bate, 1888, being composed by 29 species, globally distributed in tropical, temperate and some subarctic and subantarctic region (Chace 1986; De Grave & Franssen 2011; Pohle *et al.* 1992; Wasmer 1986). The members of the genus are described to have pelagic life style and occur precise on mesopelagic and bathypelagic zones of ocean, inhabits mainly in deep waters from 37 to 5394 m depth (De Man 1920; Springer & Bullis 1956; Crosnier & Forest 1973; Chace 1986; De Grave & Franssen 2011; Cardoso 2013; Alves-Júnior *et al.* 2016). The *Acantheephyra* fauna of India has been poorly investigated, till date only five species were recorded under this genus *viz.*, *A. armata* A. Milne-Edwards, 1881, *A. eximia* Smith, 1884, *A. curtirostris* Wood-Mason & Alcock, 1891, *A. sanguinea* Wood-Mason & Alcock, 1892 and *A. fimbriata* Alcock & Anderson, 1894 (Alcock 1901; Radhakrishnan *et al.* 2012; Radhika Rajasree 2011; Samuel *et al.* 2016). *A. fimbriata* in India previously recorded off Madras at 869 m, Andaman Sea at 741 m and off Goa at 1023 m of depth from southern coast (Alcock & Anderson 1894; Chace 1986). Although *A. fimbriata* was reported from Indian waters, no proper taxonomic description has been given. The present study gives detailed taxonomic information of *A. fimbriata* with molecular barcoding data and quality colored images.

### Materials and methods

The specimens were collected from the two deep-sea fish landing centers, Kalamuku (off Cochin 9°59'02.91"N/76°14'33.14"E), and Sakthikulangara (off Kollam 8°56'60.78"N/76°32'34.27"E) by bottom trawlers with the cod-end mesh size (20 to 26 mm) in 200–350 m depth during 18<sup>th</sup> November 2015 and 3<sup>rd</sup> February 2015 along the

southwest coast of India. Samples were preserved in 95% ethanol and the voucher specimen was deposited at Central Marine Fisheries Research Institute (CMFRI), Cochin, India. The carapace length (CL) measurement refers to the dorsal distance between the posterior margin of the orbit to the posterior margin of the carapace. Total genomic DNA was extracted from the pleopods using the DNeasy® Blood & Tissue Kit. The sequences of mitochondrial genes (COI & 16S rDNA) were amplified using universal primers (Folmer *et al.* 1994; Palumbi 1996). PCR purified products were sequenced by dideoxy chain termination method (Sanger *et al.* 1977) using ABI Prism 3770 automated sequencer from Scigenom, India. The phylogenetic tree for COI, 16S were constructed using the statistical method maximum likelihood with 1000 bootstrap replicates (Felsenstein 1981) using MEGA7.0 software.

## Systematics

### Order Decapoda Latreille, 1802

### Infraorder Caridea Dana, 1852

### Family Acanthephyridae Spence Bate, 1888

### Genus *Acanthephyra* A. Milne-Edwards, 1881

### *Acanthephyra fimbriata* Alcock & Anderson, 1894

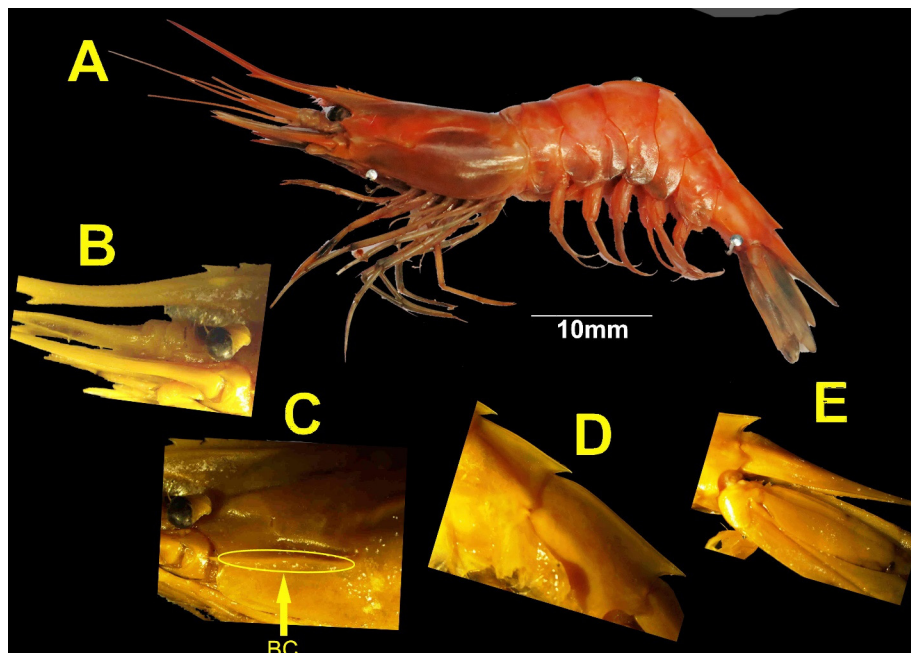
Fig. 1 (A–E)

*Acanthephyra armata*.—Wood-Mason and Alcock, 1892:359, fig. 2 [not *A. armata* A. Milne-Edwards].

*Acanthephyra armata* var.—Wood-Mason, 1892, pi. 3: fig. 1.

*Acanthephyra armata* var. *fimbriata* Alcock & Anderson, 1894: 156 [type-locality: the original specimen, described and illustrated but not named in 1892, it was reported in the Andaman Sea off Little Andaman; 11°25'05"N, 92°27'06"E, 741 m; the two additional specimens were reported in 1894 from the Bay of Bengal off Madras; 12°50'N, 81°30'E, 869 m and off Goa; 15°29'N, 72°41'E, 1023 m].

*Acanthephyra fimbriata*.—Chace 1986, fig. 2l, 4l, 5l, 6j, 9c.

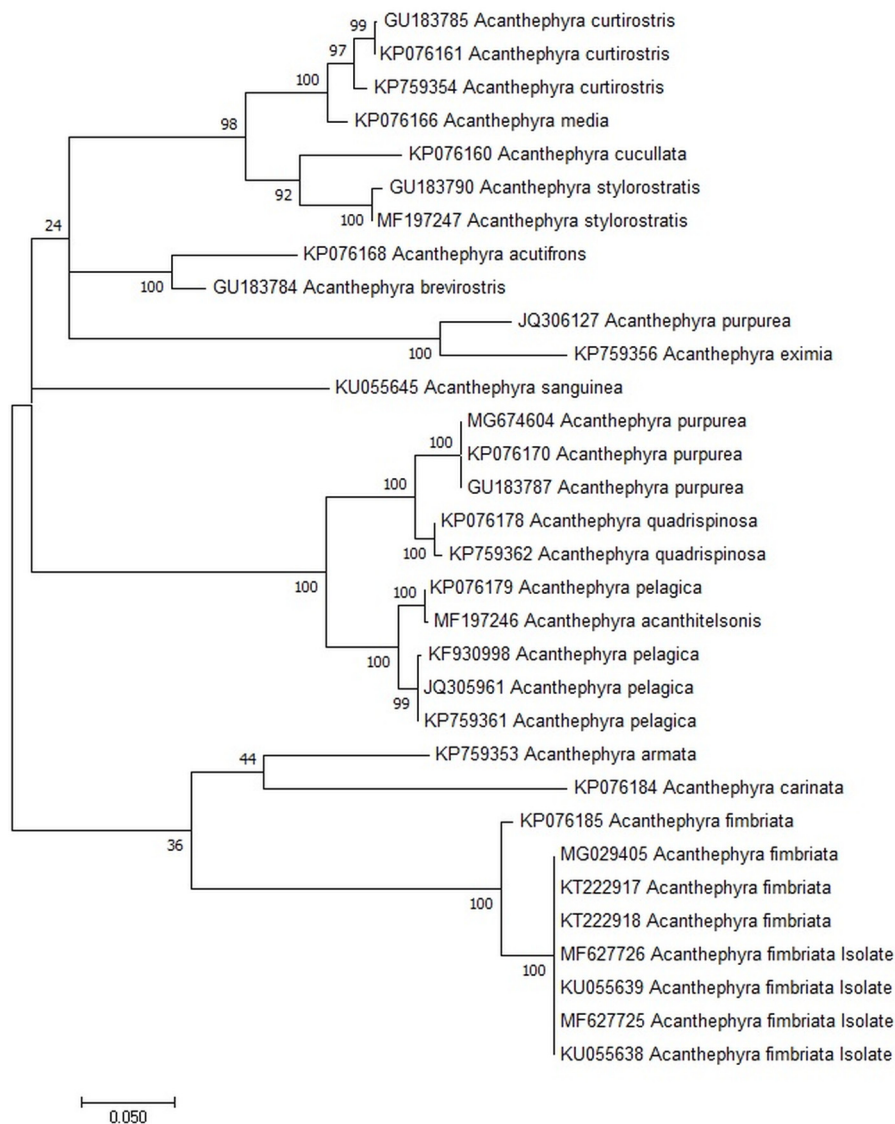


**FIGURE 1.** *Acanthephyra fimbriata* Alcock & Anderson, 1894, Male (CL: 30 mm) A. Total view. B. Lateral view of rostrum. C. Branchiostegal carina (BC) on lateral view of carapace. D. Lateral view of abdominal somites 4–6<sup>th</sup> with the posteromesial tooth. E. Lateral view of telson.

**Material examined.** Kalamuku fish landing center, off Cochin (9°59'02.91"N; 76°14'33.14"E), 1♂ (CL: 30 mm), 200–300 m at depth, during 18<sup>th</sup> November 2015; Sakthikulangara (off Kollam 8°56'60.78"N; 76°32'34.27"E), 3♂ (CL 26–28 mm), depth at 200–350 m, during 3<sup>rd</sup> February 2015. Voucher specimen accession number, CMFRI: ED.5.9.5.1.

**Characters of specimen from off Kerala** Rostrum as long as carapace, overreaching antennal scale, dorsal margin armed with 4 teeth on base, ventral margin armed with 1 tooth; carapace smooth, without carina on the entire lateral surface; antennal spine present, branchiostegal spine with strong carina, sharp carina extending posteriorly nearly to branchial region; exopod of third maxilliped and all pereopods neither foliaceous nor rigid; abdomen smooth, dorsally carinate on somites 2–6, somites 3–6 with posteromesial tooth, third somite not deeply excavate either side of median tooth, pereopods are not slender. Telson with strong dorsal midline, with 3 dorsolateral spines (Modified from Chace 1986).

**Coloration:** Body is entirely reddish and orangish in the abdominal region.

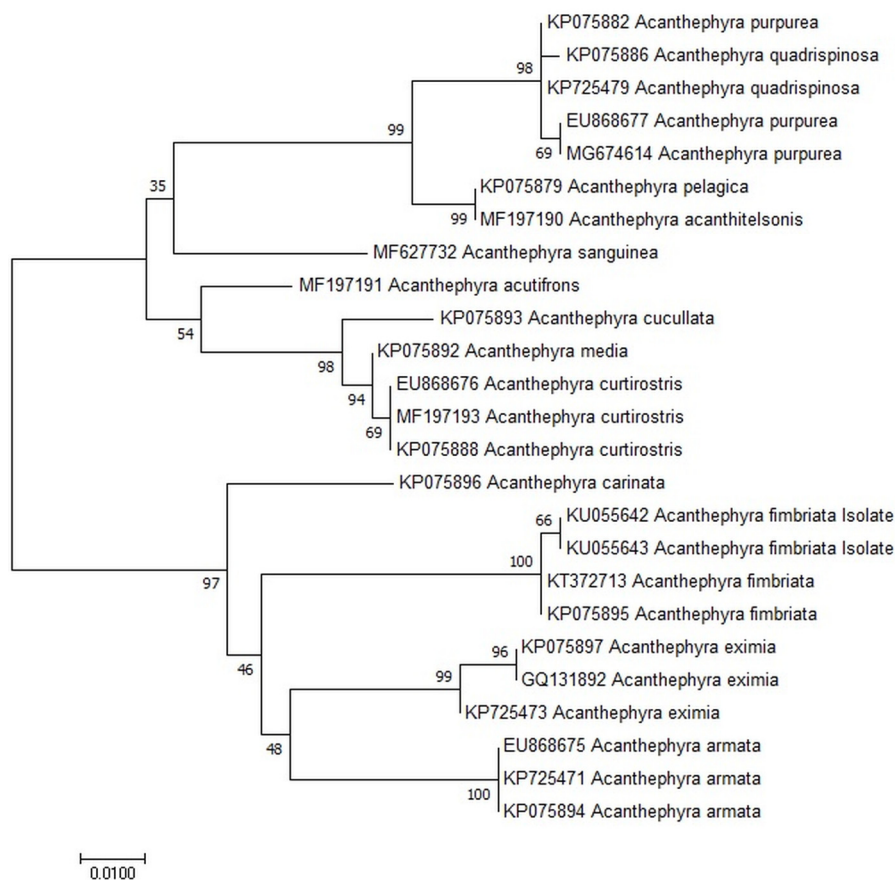


**FIGURE 2.** Maximum Likelihood tree for *AcanthePHYRA* COI sequences with 1000 bootstrap showing the relationship of the specimen with other related species.

**Remarks:** *A. fimbriata* is similar to *A. armata*, but different in the carapace with strong carina supporting branchiostegal spine to branchial region and abdomen with posterior margin of 3<sup>rd</sup> pleura not distinctly excavate either side of the posteromedian tooth (Chace 1986). The present specimens concede well with the earlier descriptions (Alcock & Anderson 1894; Chace 1986) without any dissimilarity. In this study, only male specimens

were obtained from the southwest off Kerala between depths of 200 and 350 m, but the previous records of this species was off Madras, Bay of Bengal (BOB, 869 m) and Goa, Arabian Sea (AS, 1023 m) at higher depths. The distributional records of this species are limited to Gulf of Aden, Andaman Sea, Bay of Bengal, Laccadive Sea, and Arabian Sea: off Goa and Philippines occurring between 412–1785 m (Chace 1986).

The gene sequence obtained from the present specimen was deposited in GenBank (Accession no's: COI, MF627725, MF627726, KU055638, KU055639; 16S, KU055642, KU055643). The sequence lengths are 540 and 407 bp for cytochrome c oxidase I (COI) and 16S rDNA genes, respectively. The present specimen sequences was compared with the NCBI sequences of the genus *Acanthephyra* was obtained from the GenBank (Table. 1). The level of intraspecies genetic divergence was 3% with COI and 0.3% in 16S between the Indian and Philippines samples (COI: KP076185; 16S:KP075895) while it showed 100% similarity within the Indian material (COI: KT222917, KT222918, MG029405; 16S:KP372713). Interspecies genetic divergence (COI: 17.5–20.9% & 16S: 5.2–9.5%) between the present specimen and 14 species of *Acanthephyra* sequences collected from NCBI was depicted in Fig.2 & Fig.3. COI sequence divergences of less than 3% are generally considered to be intraspecific in decapod crustaceans (Darling 2011; Vergamini *et al.* 2011; Yang *et al.* 2016).



**FIGURE 3.** Maximum Likelihood tree for *Acanthephyra* 16S sequences showing with 1000 bootstrap the relationship of the specimen with other related species.

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TABLE 1. Sequence data of *Acanthephyra*, GenBank accession.

	16S			COI			
<i>Acanthephyra purpurea</i>	EU868677*	MG674614 §	KP075882#	GU183787 *	MG674604 §	KP076170#	JQ306127+
<i>Acanthephyra pelagica</i>	KP075879#	AM076956 ¥		KP076179#	JQ305961 +	KP759361€	AM083324 ¥
<i>Acanthephyra curirostris</i>	EU868676*	MF197193\$	KP075888#	GU183785 *	KP076161 #	KP759354€	KF930998#
<i>Acanthephyra eximea</i>	KP075897#	KP725473€	GQ131892'	KP759356€			
<i>Acanthephyra acutifrons</i>	MF197191\$			KP076168#			
<i>Acanthephyra armata</i>	EU868675*	KP075894#	KP725471€	KP759353€			
<i>Acanthephyra quadrispinosa</i>	KP075886#	KP725479€		KP076178#	KP759362€		
<i>Acanthephyra sanguinea</i>	MF627732 ©			KU055645 ©			
<i>Acanthephyra carinata</i>	KP075896#			KP076184#			
<i>Acanthephyra media</i>	KP075892#			KP076166#			
<i>Acanthephyra cucullata</i>	KP075893#			KP076160#			
<i>Acanthephyra stylorostriis</i>				GU183790 *	MF197247\$		
<i>Acanthephyra acanthiteksomis</i>	MF197190\$			MF197246\$			
<i>Acanthephyra brevirostris</i>				GU183784 *			
<i>Acanthephyra fimbriata</i>	KP075895#	KU055643 †	KU055642 †	KP076185#	MF627725 †	KU055639 †	KU055638 †
				KT372713 @			KT222918 @
							KT222917 @
							MG029405 @

NCBI Sequences authors: § Leignel *et al.*, 2005; \* Brackten *et al.*, 2009; † Lei *et al.*, 2009; # Wong *et al.*, 2014; € Aznar *et al.*, 2015; @ Deepak *et al.*, 2015; \$ Wilkins *et al.*, 2017; © Purushothaman *et al.*, 2017; † this study

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