



## A new species of *Leptestheria* (Crustacea: Branchiopoda: Spinicaudata) from Western Maharashtra, India

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### Abstract

We describe a new species of *Leptestheria* from a rock pool in the Western Ghats of Maharashtra, India. This species is distinguished from all other Indian congeners by its distinct telson characters and occipital condyle. We also present a comparative table of useful morphological characters of all described Indian *Leptestheria* species.

**Key words:** Clam shrimps, Diplostraca, Leptestheriidae, Rocky outcrops

### Introduction

The large branchiopod fauna of the Indian subcontinent is still poorly understood with about 40 species known from the region (Rogers & Padhye 2015). The region harbors about 25 clam shrimp species (Laevicaudata, Spinicaudata and Cyclestherida), of which 22 are spinicaudatans (Rogers & Padhye 2015). Several members of the Leptestheriidae have been described from India but descriptions for many are brief and are based on highly variable characters, thus leading to subsequent synonymies (Tiwari 1996, Simhachalam & Timms, 2012, Rogers & Padhye 2015). Currently, five leptestheriid species are reported from the subcontinent, out of nearly 37 known species worldwide (Brendonck *et al.* 2008, Garcia & Pereira, 2003, Rogers & Padhye, 2015).

The Western Ghats are currently known to support only *Leptestheria nobilis* Sars, 1900, which is a morphologically variable species (Simhachalam & Timms 2012), originally described from Southeastern India. It is commonly found in pools on some of the rocky outcrops of the northern Western Ghats (Padhye *et al.* 2015; Padhye & Dahanukar, 2015).

We describe a new *Leptestheria* species from a low altitudinal lateritic rocky outcrop located near the western coast of Maharashtra. We also provide a comparison of morphological characters of all currently accepted Indian leptestheriid species.

### Material and methods

**Study area.** Our study site is Devi Hasol, a low altitudinal (< 200 m a.s.l.) lateritic rocky outcrop located near the western coast of Maharashtra, India. For details about the rocky outcrops in Western Maharashtra, please refer to Watve (2013).

**Methods.** Sampling was done in June 2015 using a hand net (mesh size 150 µm) and the specimens were placed in 50 ml plastic containers in absolute ethyl alcohol in the field. The specimens were examined, dissected and photographed under a Stereo Binocular Microscope (Leica MZ6 with attached Canon PowerShot S50). Detailed morphology was studied under a bright field compound microscope (Olympus CX41). Multiple images

were taken and stacked using COMBINE ZP (<http://www.hadleyweb.pwp.blueyonder.co.uk/>) software. Scanning electron microscopy images were taken with a JEOL Analytical Scanning Electron Microscope, at the Department of Physics, University of Pune, using the sample preparation protocol given by Nation (1983). Drawings were digitally inked with Adobe Photoshop CS3 student edition. Maps were made using freeware DIVA-GIS (v7.5) ([www.diva-gis.org](http://www.diva-gis.org)).

Morphological description follows Kaji *et al.* (2014), Shu *et al.* (2015) and Timms (2016). The following references were consulted for data on Indian leptestheriids: Babu & Nandan (2010), Battish (1981), Daday (1923), Nayar & Nair (1968), Sars (1900), Simhachalam & Timms (2012), Tiwari (1966; 1996).

## Results

### Taxonomy

#### Class Branchiopoda Latreille, 1817

#### Order Diplostraca Gerstaecker, 1866

#### Suborder Spinicaudata Linder, 1945

#### Family Leptestheriidae Daday, 1923

#### Genus *Leptestheria* Daday, 1913

#### *Leptestheria gurneyi* sp. nov.

(Figs. 1–5)

**Etymology.** The species is named after Robert Gurney who contributed significantly to the Branchiopoda taxonomy of India during early 1900s.

**Type locality.** A small and shallow rock pool (depth of about 30 cm) on Devi Hasol lateritic plateau (16.7393 N, 17.4324 E), observed during the monsoon season (June–September). The pool had a fine layer of mud but had no aquatic vegetation at the time of collection. No other large branchiopods were observed but few aquatic bugs and beetles were seen.

**Type material. Holotype.** One male (in 4% formalin + glycerin) deposited at the Western Regional station of Zoological Survey of India (ZSI), Pune (Registration number: ZSI, WRC-C.1520).

**Other material.** Two males, three females from the type locality in personal collection of SMP. Collector: Ms. Shruti Paripatyadar

**Diagnosis:** Occipital condyle conical, shorter in male than female. Occipital notch at least twice as wide in female as compared to male. Telson with three distinct size and shape classes of spines with largest at least three times longer than the shortest, 2–6 small spines interspersed in between medium spines, cercopods straight in both sexes, about 0.8 times the dorsal margin of telson in length.

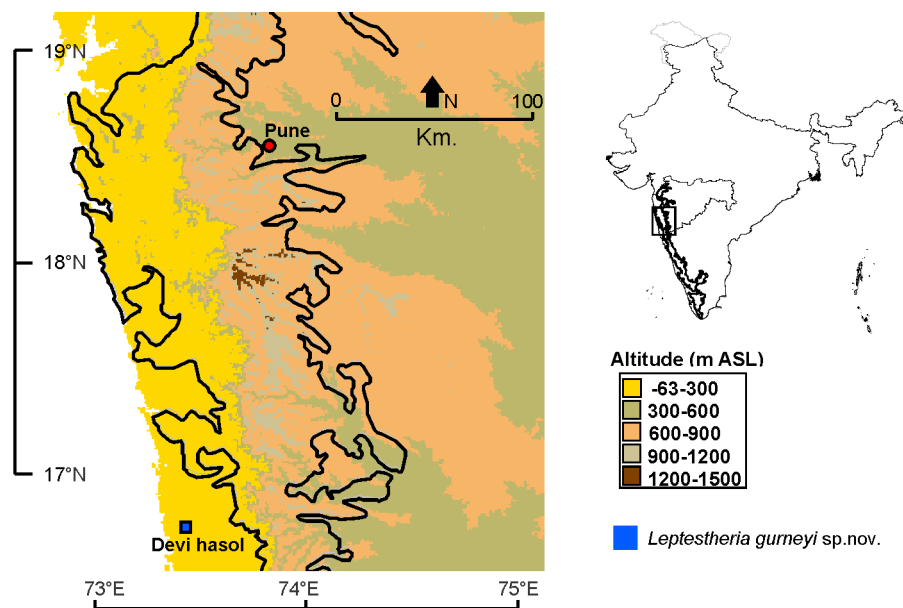
**Description. Male. Head.** Occipital condyle length about 0.7 times basal breadth, blunt apex directed posteriorly, occipital notch shallow but wide ocular tubercle convex, compound eyes large, almost filling tubercle space, ocellus roughly cylindrical in shape and located at rostral base, rostrum broad, spatulate, fornix prominent, arising from rostrum dorsal angle, (Fig. 3 C; Fig. 5 A). Rostrum with single sharp spine, three times longer than basal width.

*First antenna.* Long, more than twice length of second antenna peduncle, about 10–12 anterior lobes, each lobe margined with several sensillae (Fig. 3 F).

*Second antenna.* Peduncle setose; exopod and endopod with 11 flagellomeres (Fig. 3 E); each flagellomere dorsally with 4–6 long distally directed spines and ventral surface with plumose setae (Fig. 5 C).

*Carapace.* 6.92±0.71 mm length and 3.94±0.37 mm height. Oblong ovate in shape, broader anteriorly and tapering posteriorly, dorsal margin straight, ventral margin gently curved, umbone prominent; carapace with 10–15 distinct growth lines (Fig. 2 A & B); growth lines with sparse setae separated by nearly their length (Fig. 2 D);

interval sculpturing of distinct longitudinal carinae perpendicular to the growth lines in the younger intervals and diminishing distally (Fig. 2 C); microsculpturing not observed under SEM (Fig. 4 E).



**FIGURE 1.** Map showing the locality of *Leptestheria gurneyi* sp. nov. from the Western Ghats of Maharashtra.

*Thoracopods.* 22–24 pairs. Clasper movable finger (endopod) broad basally, tapering and hooked distally; apex with many small scales; large palp (endite V) arcuate, of two palpomeres, palpomere length subequal in both claspers; distal palpomere (endite V outgrowth) slightly elongated, apex with fine setae; small palp (endite IV outgrowth) cylindrical, nearly twice as long as broad, directed anteriorly or slightly posteriorly, with apex covered with fine setae; palm (endite IV) broadly rectangular, projecting slightly obtusely, gripping area covered with small roughly conical, blunt tipped spines, increasing in size posteriorly (Fig. 4 B); gripping area as long as broad in first clasper, slightly longer than broad in second clasper; clasper 1 endite III roughly triangular, length half the width at base, apex acute; clasper 2 endite III smaller, triangular with blunt apex (Fig. 4 A & C). *Other thoracopods* structure as per genus, decreasing in size posteriorly; last 5–8 very small, (Fig. 3 A & B).

*Abdomen.* Segments 10–24 dorsal margin each bearing a transverse row of 5–8 aciculate, posteriorly directed setae (Fig. 4 G).

*Telson.* Dorsal margin slightly arched, posteriolateral ridges with 25–30 spines in three size and shape classes: (type A), long triangular spines length two to three times longer than basal width, situated just proximal to posteriolateral spiniform projection; (type B), triangular spines length subequal to basal width, anterior most spines slightly recurved, situated along telson ridge, roughly half the size of type A spines; (type C), small triangular spines similar to type B spines in shape, roughly half the size or smaller of the type B spines, situated along the telson ridges; spiniform projection curved dorsally, 0.4 times length of cercopod (Figs. 4 D & F); caudal filaments originating between the 1<sup>st</sup> and 2<sup>nd</sup> spines of telson ridges.

*Cercopod.* Long, straight, subequal in length to telson dorsal margin; apex bent dorsally, not reaching the posteriolateral projection of telson; dorsal margin medial 80% with longitudinal row of small spinulae, ~30–45 in number (Fig. 4 D; Fig. 5 D).

**Female.** *Carapace* 6.74 mm 0.54 mm length and 3.92 mm 0.31 mm breadth. Slightly smaller than male.

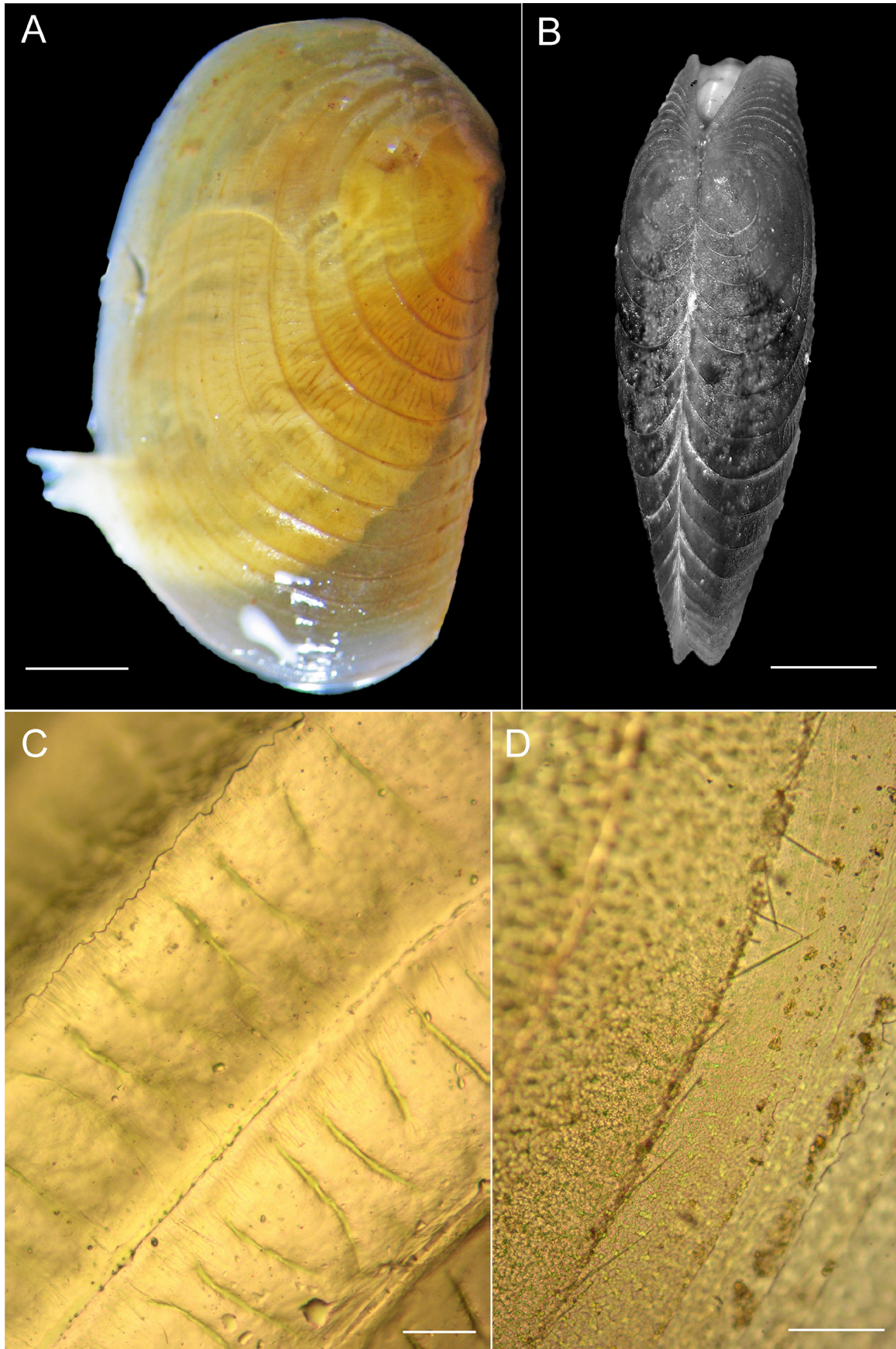
*Rostrum* broadly triangular.

*Occipital condyle* elongate conical.

*Occipital notch* wider than in male (Fig. 3 D).

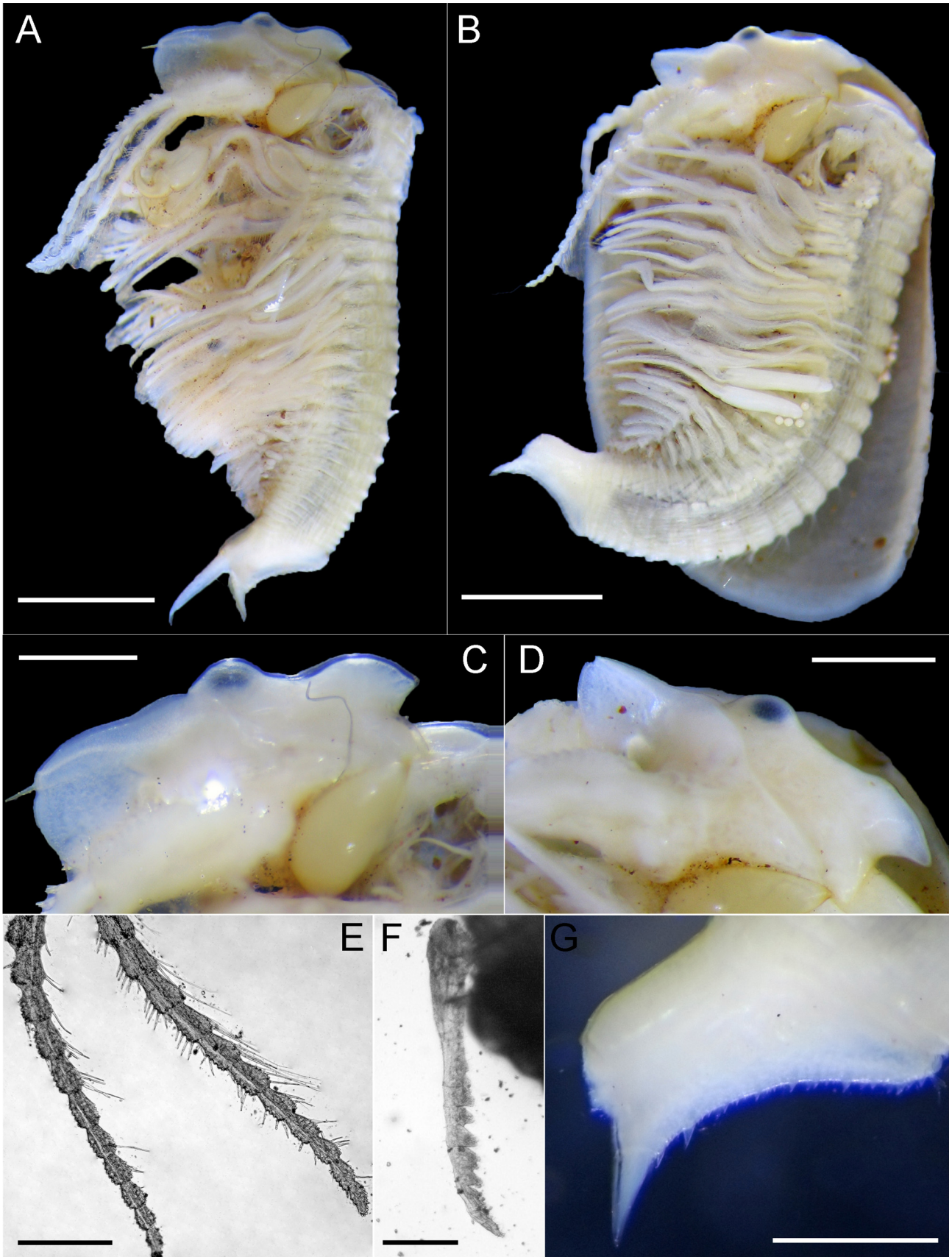
*Thoracopods* 9 and 10 with long epipodites for carrying eggs (Fig. 3 B), 2–6 type C spines present between two type B spines (Fig. 3 G).

*Egg.* As per the genus, smooth and spherical. Size: ~ 200µm.

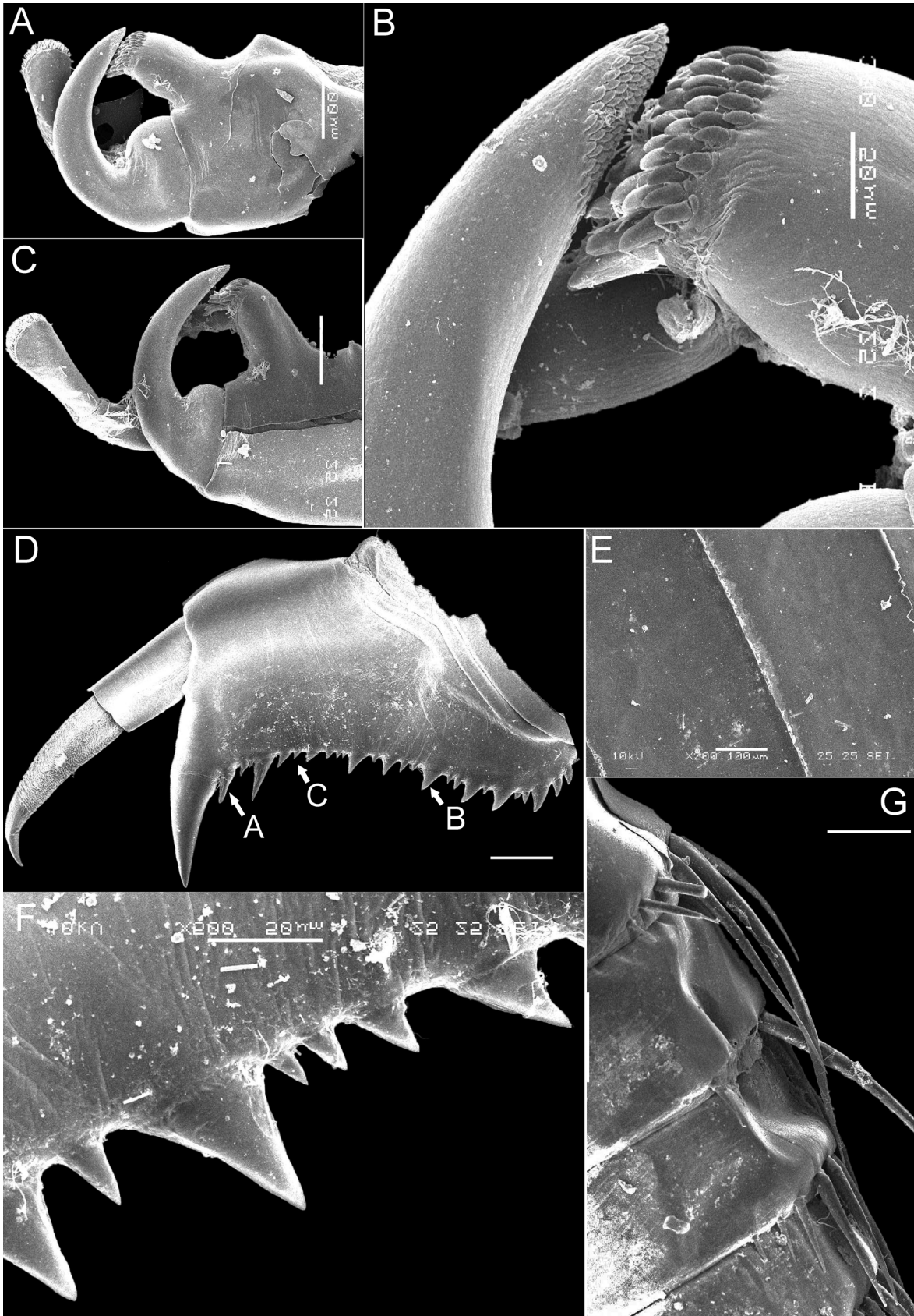


**FIGURE 2.** *Leptestheria gurneyi* sp. nov. A, carapace. B, dorsal view of carapace. C, carapace (part) showing the longitudinal lines. D, carapace (part) showing the setae on the carapace (Scale bars: A–B: 1 mm. C–D: 0.01 mm).

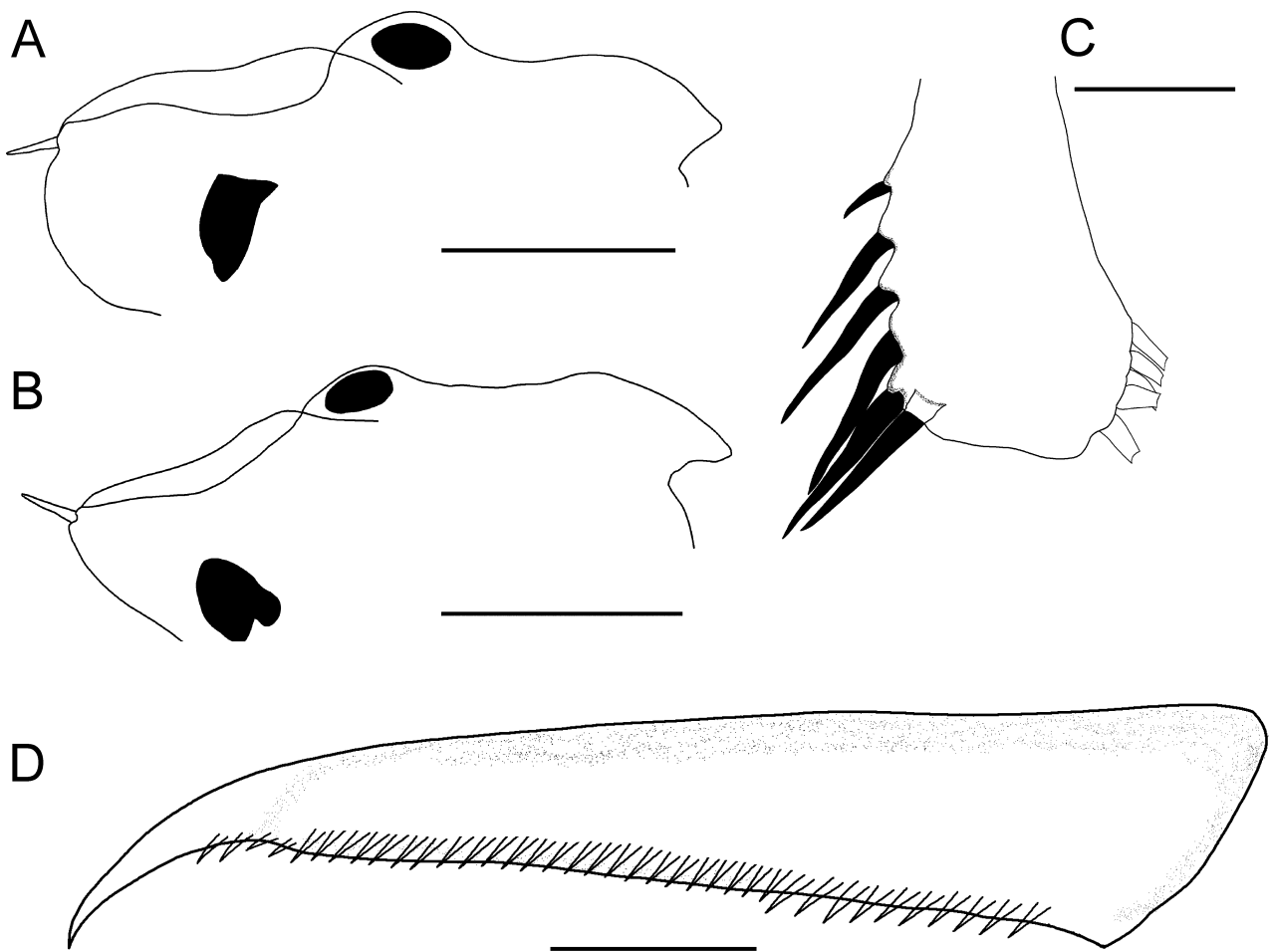




**FIGURE 3.** *Leptestheria gurneyi* sp. nov. A, male 1. B, female. C, male head. D, female head. E, second antenna. F, first antenna. G, female telson (Scale bars: A–B: 1 mm; C–D: 0.2 mm; E, 0.2mm; F, 0.1mm; G, 0.5 mm).



**FIGURE 4.** *Leptestheria gurneyi* sp. nov. SEMs. A, clasper 1. B, gripping area of the palm (endite IV). C, clasper 2. D, telson showing cercopod (male) (A,B & C represent three types of spines observed). E, carapace (part) surface showing no sculpturing. F, telson margin spines. G, dorsal margin armature (Scale bars: A–B: 1 mm; C–D: 1 mm; E, 0.2mm; F, 0.1mm; G, 0.5 mm).



**FIGURE 5.** *Leptestheria gurneyi* **sp. nov.** A, male head showing ocellus. B, female head showing ocellus. C, single flagellomere of second antenna. D, cercopod (female) (Scale bars: A–B: 0.2mm; C–D: 0.1mm).

**Differential diagnosis.** This species differs from all other described Indian *Leptestheria* (sensu Rogers & Padhye, 2015) by having three classes of spines by size and shape on the telson posteriolateral ridges. The other species (such as *L. nobilis* (Sars, 1900) and *L. sarsi* Daday, 1923) have spines of similar sizes or the spines are randomly placed and of unequal length. *Leptestheria gurneyi* **sp. nov.** most closely resembles the recently described *L. kunmingensis* Shu *et al.*, 2015 from China, but differs in that *L. kunmingensis* has two size classes of spines instead of three. The cercopod of *L. gurneyi* **sp. nov.** is also straight in both sexes and has similar sized dentition on its dorsal margin, whereas in *L. kunmingensis* the spinulae bear smaller spinules; the male cercopod has a longitudinal sulcus, and the female cercopod is arcuate. *Leptestheria gurneyi* **sp. nov.** lacks the endopodal spine on clasper 1 that is present in *L. kunmingensis*. Distinct sexual dimorphism in the occipital condyle structure is also a unique character not observed and/or reported from other Indian species (Sars, 1900; Daday, 1923; Simhachalam & Timms, 2012; Padhye *et al.* 2015; Shu *et al.* 2015) (Table 1)

**Distribution.** Currently known only from its type locality.

## Discussion

Clam shrimp taxonomy and systematics is not yet resolved due to great morphological plasticity observed in these animals (Brendonck *et al.* 2008; Rogers *et al.* 2012; Shu *et al.* 2015). Using novel characters like the egg morphology for Limnadiidae (Belk, 1989; Rabet *et al.* 2012; 2015; Rogers *et al.* 2012) and sequence based methods for Cyzicidae (Schwentner *et al.* 2015) have helped in resolving identities of many species. Stable taxonomic characters for Leptestheriidae are still few.

**TABLE 1.** Comparative of the more reliable morphological characters of Indian *Leptestheria* species

	<i>Leptestheria dumonti</i> Babu & Nandan, 2010	<i>Leptestheria simhadrii</i> (Simhachalam & Timms, 2012)	<i>Leptestheria jaisalmerensis</i> Tiwari, 1962	<i>Leptestheria nobilis</i> Sars, 1900	<i>Leptestheria sarsi</i> (Daday, 1923)	<i>Leptestheria gurneyi</i> sp. nov.
<b>Occipital condyle</b>	Elongate and acute	Elongate and acute	Slightly produced and acute	Elongate and acute	Hardly produced with blunt apex	Slightly produced with blunt apex in male; Moderately elongate with blunt apex in female
<b>Dorsal margin armature</b>	Slender, long setae	Small setae	Small setae	Small, posteriorly directed setae	Long, posteriorly directed setae	Long, posteriorly directed setae
<b>Telson marginal spines</b>	Dorsal margin gently arched, with 18 serrated, unequal spines, gradually increasing in size posteriorly	Dorsal margin gently arched, with about 40 unequal serrated spines	Dorsal margin almost straight, with 70-80 spines, gradually increasing in size posteriorly	Dorsal margin almost straight, with 40-50 small serrated spines gradually increasing in size posteriorly	Dorsal margin gently arched, with 30-35 equally spaced unequal spines	Dorsal margin slightly arched, lined with 30-40 smooth unequal spines
<b>Cercopod</b>	Cercopod long, nearly 1.3 times the length of telson dorsal margin, with 24 smooth marginal spines	Cercopod long, straight, subequal in length to telson dorsal margin, with 35 small spines,	Cercopod about 0.6 times telson dorsal margin length, with small spinules	Cercopod subequal to telson dorsal margin, with small serrated spinules. Female cercopod slightly arched.	Cercopod ~0.8 times telson dorsal margin, with two different sized denticles, small in proximal 2/3 <sup>rd</sup> with longer sized distally	Cercopods straight, nearly 0.8 times telson dorsal margin length, with small subequal sized spinules



Five other *Leptestheria* species are known from the Indian subcontinent (Rogers & Padhye, 2015) (Table 1) and are in need of a thorough re-examination due to the aforementioned problem of morphological variability and overlap in some characters like carapace lines and second antennal flagellomere number. At the same time, characters like the occipital condyle, telson and cercopod characters seem to be distinct for each species (Table 1) and hence should be studied amongst leptestheriid species. *Leptestheria gurneyi* **sp. nov.** is distinctive among Indian species due to its distinct occipital condyle shape and telson spine morphology. We acknowledge that there are few specimens of this species, but efforts are underway to collect more specimens and to attempt to culture them.

The extent of distribution of each Indian species is also not completely known due to: 1) uncertain taxonomic status; 2) morphological variation; and 3) inadequate collecting. Of the 5 described species, *L. nobilis* has been reported throughout the Indian subcontinent (Simhachalam & Timms, 2012; Rogers & Padhye, 2015). This species is the most common clam shrimp in the Western Ghats of Maharashtra (Padhye *et al.* 2015). Species like *Leptestheria dumonti* Babu & Nandan, 2010 are only known from their type localities (Babu & Nandan, 2010). The range of species like *L. sarsi* is vague, listed only as 'Hindustan' (Daday, 1923). Currently, *Leptestheria gurneyi* **sp. nov.** is known only from its type locality.

This species represents the second endemic large branchiopod described from the lateritic rock pools of the Western Ghats, besides the recently described *Streptocephalus sahyadriensis* Rogers & Padhye, 2014.

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