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SHORT COMMUNICATION

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ADDITIONS TO THE SCORPION FAUNA (ARACHNIDA: SCORPIONES) OF KERALA, INDIA, WITH AN ILLUSTRATED KEY TO THE GENERA

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Abstract: Two species of scorpions (Arachnida: Scorpiones) *Lychas laevifrons* (Pocock), and *Heterometrus flavimanus* (Pocock) are reported for the first time from Kerala, and an illustrated key to the genera and checklist of scorpion species of Kerala are provided. Currently, 22 species belonging to nine genera of scorpions are known from the state.

Keywords: *Heterometrus flavimanus*, India, Kerala, *Lychas laevifrons*, new distribution records.

Scorpions constitute an important group of soil arthropods, which are ancient, medically important, ecologically, morphologically and taxonomically diverse and are distributed in most terrestrial habitats and elevations on all continents except Antarctica. They play a vital role in the terrestrial ecosystems, as links in complex food webs, are valuable bio-indicators, and their disappearance signals habitat degradation. Many scorpion species are also habitat specific and range-restricted, aggravating their risk of extinction due to human activities. Despite their notoriety (due to poisonous nature), worldwide distribution, medical, ecological, and conservation importance, scorpions

are poorly studied in India. According to the recent literature on scorpion fauna, 113 species belonging to 25 genera and six families are known from the country, of which species under nine genera and three families known from the state of Kerala (Tikader & Bastawade 1983; Sureshan et al. 2007a,b; Bastawade et al. 2004, 2012). Bastawade et al. (2005) also discovered an interesting new subfamily of scorpion, Rugodentinae, the genus *Rugodentus* and the species *Rugodentus keralaensis* from Kerala.

Zoological Survey of India, Western Ghat Regional Centre, Kozhikode conducts regular faunal exploration surveys in southern Western Ghats and its environs and such surveys yielded a good collection of scorpion specimens and the present study is based on them. The present study reports two species of scorpions, *Heterometrus flavimanus* (Pocock, 1900) and *Lychas laevifrons* (Pocock 1897), for the first time from Kerala thereby raising the total number of species known from the state to 22 (Table 1). An illustrated key to the genera and the checklist of the species of scorpions currently known from the state are also provided.

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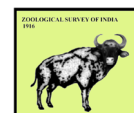
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Competing interests: The authors declare no competing interests.

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MATERIALS AND METHODS

The present study is based on the hand-collected specimens from the field and preserved in 70% ethyl alcohol. The terminology and mensuration used in this paper follows that of Stahnke (1970). The specimens were examined with a stereoscopic binocular microscope (Leica MZ16), and the photographs were taken by the microscope (Leica DFC 420) with the aid of the software Leica Application Suite V3.6 and Canon FX 120 camera. The specimens are deposited in Zoological Survey of India, Western Ghat Regional Centre, Kozhikode, Kerala (ZSIK).

New distributional records

Class: Arachnida

Order: Scorpiones

Family: Scorpionidae

1. *Heterometrus flavimanus* (Pocock, 1900) (Image 1)

Palamnaeus swammerdami flavimanus Pocock, 1900: 87.

Heterometrus (Gigantometrus) flavimanus: Tikader & Bastawade, 1983: 36; Kovařík, 1998: 137; Fet, 2000: 443.

Heterometrus (Gigantometrus) swammerdami flavimanus: Couzijn, 1981: 164.

Heterometrus flavimanus: Pocock, 1990: Kovařík, 2004:13.

Diagnosis: Adults 100–150 mm long. Body coloration uniformly brown. Basal piece of chelicera yellow with light brown anterior margin. Manus of pedipalp yellowish-brown with brown granules without true carinae. Movable and immovable fingers of chela and chelicera dark brown. Carapace sparsely granulated. Patella of pedipalp without pronounced internal tubercle. Chela length to width ratio 1.7. Fourth segment of the metasoma as long as femur of pedipalp, fifth segment longer than femur; pedipalp femur approximately as long as patella. Telson brownish-yellow and bulbous, vesicle longer than aculeus. Pectinal tooth count 17–22.

Material examined: ZSI/WGRC/IR/INV/4243, 19.xi.1996, 1 male (young), India: Kerala: Idukki, Chinnar Wildlife Sanctuary, (12.64233°N & 78.06020°E; elevation 629.7m), coll. P.M. Sureshan; ZSI/WGRC/IR/INV/4242, 10.ii.2011, 1 female (adult), Kerala, Palakkad, Sitharkundu (10.55553°N & 76.71441°E; 1,044.25m), coll. C. Bijoy; ZSI/WGRC/IR/INV/4186, 24.i.2015, 1 male (sub adult), Kerala, Palakkad, Chittoor (10.70326°N & 76.75392°E, 134m), coll. M. Gnanakumar.

Distribution: India: Tamil Nadu: Coimbatore (type locality); Kerala, Idukki: Chinnar Wildlife Sanctuary, Palakkad: Sitharkundu, Chittoor (current record).



Image 1. *Heterometrus flavimanus*

Habits and habitats: The specimens were hand collected and found in holes under stones. The vegetation type of Chinnar Wildlife Sanctuary is dry deciduous forest and scrub jungle. During the time of collection Sitharkundu looked like a dry deciduous forest and that of Chittoor covered with Eucalyptus trees.

Remarks: Not a common species, only reported from Coimbatore District of Tamil Nadu. It is a new record from Chinnar Wildlife Sanctuary, Idukki and Palakkad districts of Kerala. Faunal exploration surveys conducted throughout the southern Western Ghats never yielded specimens of this species except for the specimens studied here which indicates the restricted distribution range of the species in the type locality (Coimbatore) and its nearby areas.

Class: Arachnida

Order: Scorpiones

Family: Buthidae

2. *Lychas laevifrons* (Pocock, 1897) (Images 2,3)

Isometrus shoplandi Pocock, 1891: 434

Archisometrus laevifrons Pocock, 1897: 113

Archisometrus shoplandi laevifrons Kraepelin, 1899:

50

Lychas laevifrons Pocock, 1900: 41; Kraepelin,



Images 2. *Lychas laevifrons* female



Images 3. *Lychas laevifrons* male

1913: 133; Takashima, 1945: 83; L.E. Koch, 1977: 124; Kovařík, 1995: 189.

Lychas (Endotrichus) laevifrons Tikader & Bastawade, 1983: 79; Tikader, 1987: 32.

Lychas laevifrons (Pocock, 1897): Kovařík, 1997: 336.

Diagnosis: Total length 41–69 mm. Male differs from female in longer metasoma and a deep cut in the beginning of movable fingers of pedipalp. Entire body coarsely granular. Mesosomal tergites II–VI with tricarinae, but carinae weakly developed on II tergite. Tergite VII with two pairs of carinae extending from antero-median to posterior margin, and with a carina like projection in the middle. Sternites smooth except last segment, which is slightly granular with two pairs of granular carinae. Metasomal segments I–III with 10 keels, segment IV with 8 keels and segment V with 5 keels. Pedipalp segments are spotted. Telson golden brown with thin vesicle possess brown bands ventrally, subaculear tubercle present. Aculeus short and not much curved. Pectinal tooth count 20–25. Legs variegated yellow and black. Tarsomere II of legs with reddish-brown spinules thickened in an increasing order from leg I–IV.

Material examined: ZSI/WGRC/IR/INV/4245, 10.xi.2014, 3 specimens (one adult male and two adult females) were collected from Sitharkundu, Palakkad (10.567689°N & 76.7094°E, 165m), coll. K. Aswathi; ZSI/WGRC/IR/INV/4246, 24.xii.2014; 2 specimens (adult females) were collected from Narayamkulam, Kozhikode (11.5088654°N & 75.805639°E, 100.9m), coll. K. Aswathi.

Distribution: India: Bihar, Gujarat, Madhya Pradesh, Maharashtra, Odisha, West Bengal, Kerala: Palakkad -Sitharkundu and Kozhikode - Narayamkulam (current record).

Habits and habitats: Specimens were hand collected by lifting stones during day search. Vegetation type of Narayamkulam (Kozhikode) is a mixed crop field (coconut and rubber) with grasses and teak plants. During the time of collection, the vegetation type of Sitharkundu (Palakkad District) was an area with many trees and plants like Mango, *Lantana* sp., *Allamanda* sp. The specimens were found without much movement under the stones by holding metasoma over the body.

Remarks: Not a common species in Kerala and reported for the first time from the state.

Key to the genera of scorpions of Kerala including southern Western Ghats

1. Pedipalps with slender hands and chelae comparatively narrow (Image 4); Pectines generally long and provided with numerous teeth (20–23); Cephalothoracic sternum generally triangular in shape except two genera (sub-pentagonal in *Charmus* and *Buthoscorpio*); conspicuous apical node present on sternum (Image 5); Trichobothriotaxy type 'A' (Fig. 1) Family: Buthidae (2)
- Pedipalps with hands not slender as above and chelae more wider (Images 6 & 7); Pectines not long and provided with less number of teeth (5–22); Cephalothoracic sternum Pentagonal or sub-pentagonal; no conspicuous apical node present on sternum (Image 8); Trichobothriotaxy type 'C' (Fig. 2) (6)
2. Carapace without carinae (Image 9); Cephalothoracic sternum sub-pentagonal; Subaculear tooth absent (Image 10); Trichobithria d_1 , d_3 & d_4 on femur of pedipalp with α - configuration (Fig. 3) (3)
- Carapace with carinae (Image 11); Cephalothoracic sternum triangular; Subaculear tooth present (Image 12); Trichobithria d_1 , d_3 & d_4 on femur of pedipalp with β - configuration (Fig. 4) (4)
3. Entire body hirsute (Fig. 5); Vesicle round with short aculeus (Fig. 6); 4 contiguous pairs of lateral eyes (Fig. 7); Total length 10–16 mm *Charmus* Karsch
- Entire body not hirsute (Image 13); Vesicle pyriform with short aculeus (Image 14); 5 contiguous pairs of lateral eyes (Fig. 8); Total length 30–45mm *Buthoscorpio* Werner
4. Subaculear tooth distinctly present; vesicle pyriform with granulation ventrally (Image 12); Total length 20–80 mm (5)
- Subaculear tooth present but not distinct as above; vesicle round with granulation ventrally (Image 15); Total length 30–130 mm *Hottentotta* Birula
5. Tibial spur present on legs III and IV (Fig. 9); Total length 20–80 mm *Lychas* C.L. Koch
- Tibial spur absent on all legs (Fig. 10); Total length 30–70 mm *Isometrus* Ehrenberg
6. Pedipalp manus flat (Image 7); Metasoma very narrow, compressed or pyriform vesicle with short aculeus (Images 16, 17); Body punctuated (Image 21) Family *Liochelidae* (7)
- Pedipalp manus not flat as above (Image 6); Metasoma thick and strong, not narrow, vesicle not compressed with long aculeus (Image 18); Body not punctuated (Image 19) Family *Scorpionidae* (9)
7. Tarsomere II of legs smooth with a ventro-median row of fine spinules (Image 20) (8)
- Tarsomere II of legs smooth without a ventro-median row of fine spinules *Liocheles* Sundevall, 1833
8. Median eye situated anteriorly in the ratio 1:1.5 (Image 21); Total length 40–60 mm *Iomachus* Pocock, 1893
- Median eye situated anteriorly in the ratio 1:2 (Image 22); Total length 80–90 mm *Chiromachetes* Pocock, 1899
9. Pedipalp manus round or lobed and fingers of chela with pointed triangular teeth (Image 23) *Heterometrus* Ehrenberg, 1828
- Pedipalp manus globular or lobed (Image 24) and chela fingers with rugously granular dentition in a band along the interior surface (Image 25) *Rugodentus* Bastawade, Sureshan & Radhakrishnan, 2005

Table 1. Checklist of scorpion species currently known from Kerala

Buthidae

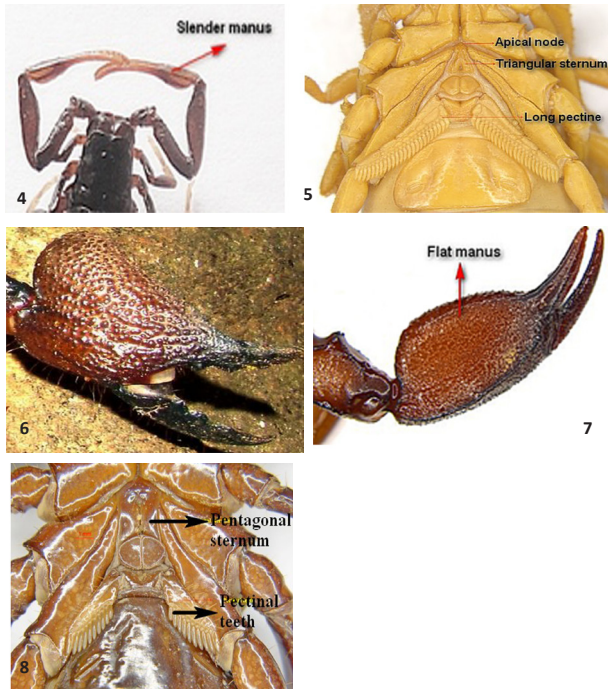
1. *Charmus indicus* Hirst, 1915
Distribution: Andhra Pradesh, Kerala, Pondicherry and Tamil Nadu.
2. *Hottentotta rugiscutis* (Pocock, 1897) (Fig. 36)
Distribution: Andhra Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Pondicherry, Tamil Nadu and West Bengal.
3. *Isometrus (Reddyanus) brachycentrus* Pocock, 1899
Distribution: Kerala, Karnataka, and Tamil Nadu.
4. *Isometrus (Isometrus) maculatus* (De Geer, 1778)
Distribution: Kerala, Andhra Pradesh, Madhya Pradesh, Karnataka, Maharashtra, Meghalaya and Tamil Nadu.
5. *Isometrus (Isometrus) thurstoni* Pocock, 1893
Distribution: Kerala, Andhra Pradesh, Madhya Pradesh, Karnataka, Maharashtra, Tamil Nadu and West Bengal.
6. *Lychas albianus* Henderson, 1919
Distribution: Kerala, Himachal Pradesh, Odisha, Uttar Pradesh and Tamil Nadu
7. *Lychas hendersoni* (Pocock, 1897)
Distribution: Kerala and Tamil Nadu.
8. *Lychas laevifrons* (Pocock, 1897)
Distribution: Kerala, Bihar, Gujarat, Madhya Pradesh, Maharashtra, Odisha and West Bengal.
9. *Lychas tricarinatus* (Simon, 1884)
Distribution: Kerala, Andhra Pradesh, Madhya Pradesh, Karnataka, Maharashtra, Tamil Nadu, Bihar and Goa.
10. *Buthoscorpio chinnaensis* Aswathi, Sureshan & Lourenco, 2015
Distribution: Kerala.

Liochelidae

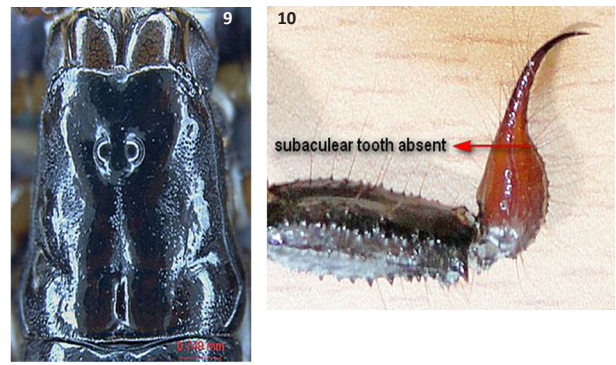
11. *Chiromachetes fergusonii* Pocock, 1899
Distribution: Kerala
12. *Iomachus laeviceps* (Pocock, 1890)
Distribution: Kerala and Tamil Nadu.
13. *Liocheles australasiae* (Fabricius, 1775)
Distribution: Kerala and Andaman & Nicobar Island.

Scorpionidae

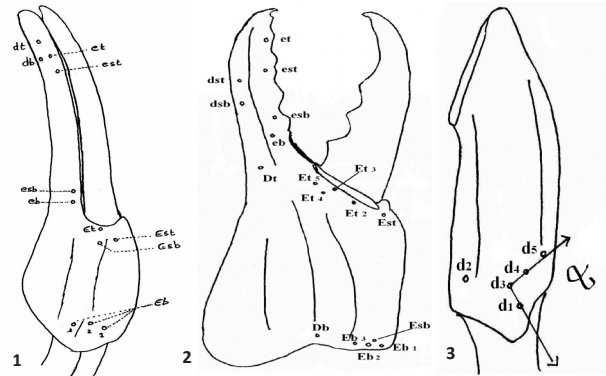
14. *Heterometrus barberi* (Pocock, 1900)
Distribution: Kerala and Tamil Nadu.
15. *Heterometrus gravimanus* (Pocock, 1894)
Distribution: Kerala and Tamil Nadu.
16. *Heterometrus kanaraensis* (Pocock, 1900)
Distribution: Kerala, Karnataka and Goa.
17. *Heterometrus keralaensis* Tikader & Bastawade, 1983
Distribution: Kerala and Maharashtra.
18. *Heterometrus phipsoni* (Pocock, 1893)
Distribution: Kerala, Andhra Pradesh, Madhya Pradesh, Maharashtra, Odisha, West Bengal and Tamil Nadu.
19. *Heterometrus scaber* (Thorell, 1876)
Distribution: Kerala, Karnataka, Maharashtra, Puducherry and Tamil Nadu.
20. *Heterometrus swammerdami* Simon, 1872
Distribution: Kerala, Andhra Pradesh, Chhattisgarh, Madhya Pradesh, Karnataka, Maharashtra, Odisha, Pondicherry, Uttarakhand, Uttar Pradesh, Tamil Nadu and West Bengal.
21. *Heterometrus flavimanus* (Pocock, 1900)
Distribution: Kerala and Tamil Nadu
22. *Rugodentus keralaensis* Bastawade, Sureshan & Radhakrishnan, 2005
Distribution: Kerala.



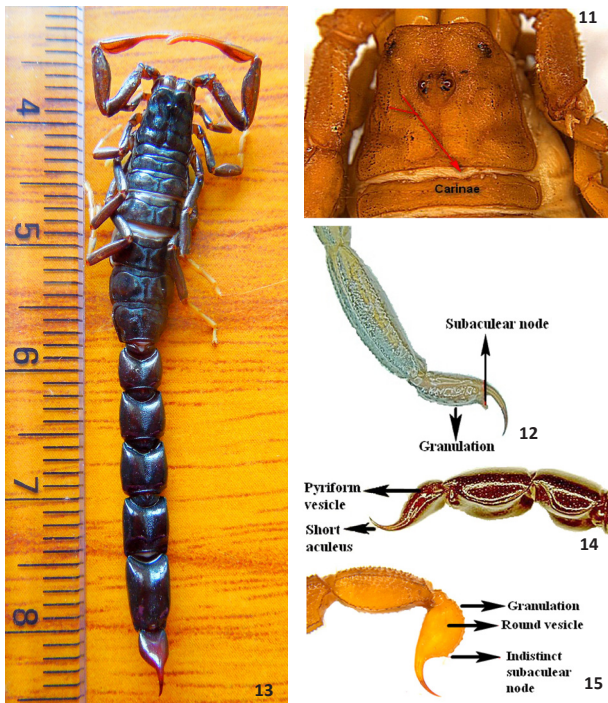
Images 4–8. 4 - Slender chela of pedipalp, *Buthoscorpio chinnarensis*; 5 - Apical node, triangular sternum, long pectine, *Hottentotta rugiscutis*; 6–7 - Round, lobed, *Heterometrus flavimanus* & flat manus of pedipalp chela, *Iomachus laeviceps*; 8 - No apical node on sternum, *Heterometrus barberi*. © K. Aswathi



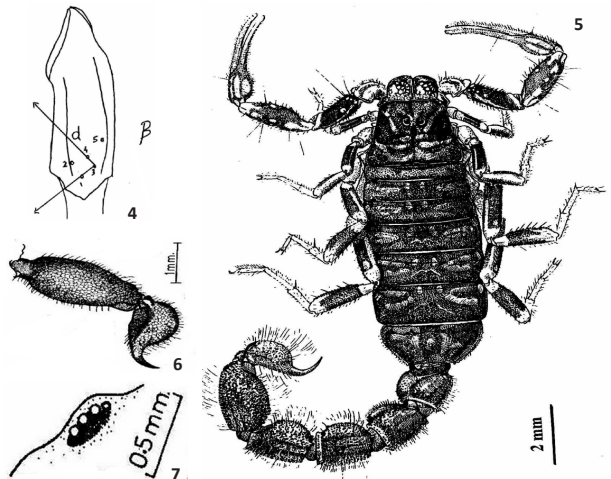
Images 9–10. 9 - Carapace without carinae, *Buthoscorpio chinnarensis*; 9 - Subaculear tooth absent, *Heterometrus scaber*; 10 - Trichobothria d_1 , d_3 & d_4 on femur with α -configuration. © K. Aswathi



Figures 1–3. Trichobothriotaxy Type A of chela of pedipalp; 2 - Trichobothriotaxy Type C of chela of pedipalp; 3 - Subaculear tooth absent, *Heterometrus scaber*. © K. Aswathi



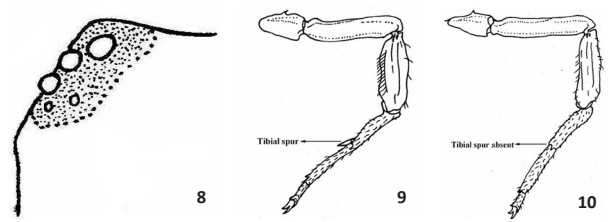
Images 11–15. 11 - Carapace with carinae, *Hottentotta rugiscutis*; 12 - Subaculear tooth present, *Lychas tricarinatus*; 13 - Body not hirsute, *Buthoscorpio chinnarensis*; 14 - Vesicle pyriform with short aculeus, *Buthoscorpio chinnarensis*; 15 - Round vesicle with subaculear tooth not distinct and granulation ventrally, *Hottentotta rugiscutis*. © K. Aswathi



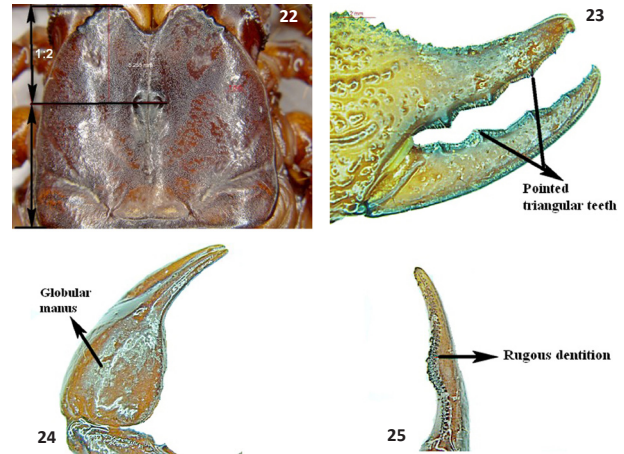
Figures 4–7. 4 - Trichobothria d_1 , d_3 & d_4 on femur with β -configuration; 5 - Entire body hirsute (*Charmus indicus*, after Tikader & Bastawade 1983); 6 - Vesicle round with short aculeus (after Lourenço 2000); 7 - Four contiguous pairs of lateral eyes (after Tikader & Bastawade 1983). © K. Aswathi



Images 16–21. 16 - Compressed or pyriform vesicle, *Iomachus laeviceps*; 17 - Body punctuated, *Iomachus laeviceps*; 18 - Vesicle of telson not compressed, *Heterometrus flavimanus*; 19 - Body not punctuated, *Heterometrus scaber*; 20 - Tarsomere II with ventro-medial spinules; 21 - Median eye situated anteriorly in the ratio 1:1.5 (*Iomachus*). © K. Aswathi



Figures 8–10. 8 - Five contiguous pairs of lateral eyes; 9 - Tibial spur present; 10 - Tibial spur absent. © K. Aswathi



Images 22–25. 22 - Median eye situated anteriorly in the ratio 1:2 (*Chiromachetes*); 23 - Triangular pointed teeth; 24 - Globular manus of pedipalp, *Rugodentus keralaensis*; 25 - Rugous granular dentition on chela fingers of pedipalp, *Rugodentus keralaensis*. © K. Aswathi

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