OBSERVATIONS AND RESULTS

Santhosh S. “Investigation on the alpha taxonomy of bethylidae (hymenoptera: chrysidoidea) of southern western ghats” Thesis. Department of Zoology, University of Calicut, 2010
CHAPTER: 5

OBSERVATIONS AND RESULTS

GENUS GONIOZUS FÖRSTER 1856


Parasierola Cameron 1883, 197. Type species: Parasierola testaceicornis Cameron, monotypic. (synonymized by EVANS, 1978)

Progoniozus Kieffer 1905b, 29: 105. Type species: Perisemus floridanus Ashmead, original designation (synonymized by EVANS, 1978)

Perisierola Kieffer 1914, 41: 533. Type species: Parasierola gallicola Kieffer 1905c, subsequent designation (MUESEBECK and WALKLEY, 1951). (synonymized by EVANS, 1978)

Diagnosis: Maxillary palpi with 5 segments, labial palpi 3; mandible with several (usually 4) small apical teeth; clypeus with a strongly produced angular or subangular median lobe, with a median, polished streak, ridge or carina which extends onto frons for a short distance; malar space rather long; eye glabrous or setose. Posterior margin of pronotum arcuate or slightly sinuate; scutellum with a pair of very small pits, sometimes obsolescent, connected by a weak groove; propodeum margined laterally, transverse carina margining disc behind complete, medially interrupted or absent; disc roundly elevated mediobasally and usually more polished; mesopleura with a strong pit above; claw of female bifid, male claw trifid. Forewing with or without areolet; pterostigma large, with convex posterior margin; prostigma strong and subtriangular; radial vein not reaching anterior margin of wing, marginal cell open; basal vein gently curved and not forming an angle. Metasoma shining sessile, slightly depressed; male subgenital plate typically truncate and with the median notch; male genitalia with parameres divided or undivided.
Statistics: This is a highly speciose genus of Bethylidae and clearly the largest in the subfamily Bethylinae, represented by 145 nominal species around the World (GORDH and WITETHOM, 1994). So far, 51 species are recorded from Oriental region (SANTHOSH and NARENDRAN, 2009) of which, 37 are from the Indian subcontinent, and only 11 are known to be distributed in Southern Western Ghats.

Biology: Available records suggest that many species are relatively unspecific as to hosts, and the species are adaptive to many and so are widely distributed. They are gregarious parasitoids of microlepidopteran larvae. One New World species is known to attack larvae in nests of sphecid Microstigmus xylicola Melo and M. similis Melo (MELO and EVANS, 1993). Besides, RAU (1922) reported that Goniozus sp. was reared from a nest of Ceratina bee (needs confirmation). Males are less encountered than females in field collections, hence many species are known from the females only.

Distribution: It is a cosmopolitan genus with representation in all the zoogeographical realms, mostly in the tropical and subtropical regions.

Phylogeny: The phylogenetic analysis (POLASZEK and KROMBEIN, 1994) of 11 taxa of Bethylinae for 22 morphological characters provided more stable classification of the subfamily. In this context, the newly described species were manually analyzed and the character coding and data matrix are given in tables (see tables 1 and 2).

Clypeus with longitudinal median carina is a character that bethylids share with other chrysidoid families. Apomorphic states to varying degrees are present in the following; G. aproaeremae sp. nov., G. malabaricus sp. nov., G. borneanus Cameron, G. indicus Ashmead, G. mustus sp. nov., G. jeroeni sp. nov., G. kottiyooricus sp. nov. and G. recentis sp. nov. having their clypeal carina very weak and sometimes reduced to only a smooth ridge or completely absent as in Goniozus platycephalus sp. nov. and G. fulgidus Krombein.

Regarding the number of antennal segments, the plesiomorphic condition in Bethylinae is the possession of 13 segmented antennae. The three genera studied viz. Goniozus, Odontepyris and Sierola shows this plesiomorphy. In Bethylus, a
reduction to 12 segmented antennae has occurred. Regarding labial and maxillary palp segments, the plesiomorphy is the possession of 3 segmented labial and 6 segmented maxillary palps. *Sierola* and *Bethylus* have 2 segmented labial palpi, whereas all other genera in the subfamily showed the plesiomorphic character. The six segmented maxillary palpi are found in the Australian genus, *Eupsenella* Westwood and the Neotropical genus *Lytopsenella* Kieffer. Both *Goniozus* and *Odontepyris* show the apomorphic reduction to five segments, whereas in *Sierola* the maxillary palpi are 4 segmented. The presence of unsculptured shiny frontal streak from the proximal end of the clypeal carina to the frontal ocellus is the plesiomorphic character shared between *Lytopsenella*, *Eupsenella* and *Odontepyris*. In the other genera the head sculpturing is reduced and the streak is absent. *Goniozus*, *Odontepyris* and *Sierola* do not possess notauli. Their presence is low throughout the Hymenoptera. In Bethylinae, it is reported only from the basal taxa, *Lytopsenella* and *Eupsenella* (POLASZEK and KROMBEIN, 1994).

*Goniozus* show the apomorphic character, development of smooth, triangular area on the dorsal propodeum. In the present investigation, *G. mustus* sp. nov. and *G. alarius* sp. nov. showed tendency towards plesiomorphy in varying degrees of development ranging from triangular impression, but coriaceous to total absence of smooth triangle and entire propodeal disc strongly coriaceous. Similarly, the absence of posterior propodeal transverse carina is a plesiomorphic character in Bethylinae, shown by *Lytopsenella*, *Eupsenella*, *Sierola* and *Bethylus*, whereas in all studied *Odontepyris* spp. posterior propodeal transverse carina are present. In *Goniozus*, it is in varying degrees of development, with transverse carina narrowly interrupted, broadly interrupted and completely absent as in *G. platycephalus* sp. nov., *G. orthagae* sp. nov., *G. rutherfordi* Krombein, *G. indicus* Ashmead, *G. mustus* sp. nov., *G. neoterosus* sp. nov., *G. comatus* Krombein, *G. ecarinatus* Krombein, *G. clypeatus* sp. nov., *G. longigastralis* sp. nov., and *G. kottiyooricus* sp. nov. The other apomorphic characters found in *Goniozus* are absence of submarginal cell, absence of closed marginal cell, and the development of prostigma. Submarginal cell is present in basal taxa, *Lytopsenella* and *Eupsenella*. Presence of closed marginal cell is shown by basal taxa, and in *Sierola*. The rs+m vein is long and well developed in
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all Goniozus. The discoidal cell is open in the 42 species of the genus from Indian subcontinent and in the 21 species, it is closed as in the basal taxa.

Remarks: Six Oriental species viz. chowdhari Kurian, madrassippattanami Kurian, morindae Kurian, nephoterycis Kurian, ahmeadi Kurian and thalasodes Kurian are known only from the male, and these males may be conspecific with named females (GORDH and WITETHOM, 1994). EVANS (1964) attempted to revise this large genus for the first time. Most of the species are from the isolated new species descriptions because many species of the genus are with biological control potential and authors found it convenient to provide a name rather than wait several years until a monograph could be prepared. Hence, a revisionary study is definitely required.

Table – 1. Character List and Coding of Goniozus species from Indian Subcontinent

<table>
<thead>
<tr>
<th>#</th>
<th>Character</th>
<th>Coding</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Forewing areolelet</td>
<td>0. absent/1. present</td>
</tr>
<tr>
<td>#2</td>
<td>Head in lateral view</td>
<td>0. weakly compressed, LH 1.60 – 1.74x WH/ 1. moderately compressed, LH 1.75 – 1.88x WH/ 2. strongly compressed, LH 1.89 – 2.2x WH/</td>
</tr>
<tr>
<td>#3</td>
<td>Head in full face view</td>
<td>0. transverse, WH equal to or longer than 1.03x LH/ 1. elongate, WH equal to or less than 0.88x LH/ 2. as long as wide, WH 0.89 – 1.02x LH/</td>
</tr>
<tr>
<td>#4</td>
<td>Posterior propodeal carina</td>
<td>0. absent/1. complete/ 2. broadly interrupted medially/ 3. narrowly interrupted medially/</td>
</tr>
<tr>
<td>#5</td>
<td>Mandible</td>
<td>0. yellow/1. brown/ 2. dark brown black/</td>
</tr>
<tr>
<td>#6</td>
<td>Antenna</td>
<td>0. subequal to head length in full face view/ 1. distinctly longer than head in full face view/</td>
</tr>
<tr>
<td>#7</td>
<td>Head sculpture</td>
<td></td>
</tr>
</tbody>
</table>

Santhosh, S.
0. frons smooth and polished, sometimes vertex weakly coriaceous/
1. frons and vertex moderately coriaceous/
2. frons and vertex strongly coriaceous/

#8. Vertex margin/
0. straight in full face view/
1. emarginate in full face view/

#9. Vertex/
0. ecarinate/
1. carinate/
2. weakly carinate/

#10. Scrobe/
0. ecarinate/
1. weakly carinate/
2. strongly carinate/

#11. Ocellar triangle/
0. obtuse/
1. acute or right angled/

#12. Eye/
0. glabrous/
1. setose, setae as long as or shorter than diameter of single facet/
2. setose, setae longer than diameter of single facet/

#13. Forefemur/
0. shorter than 2x its width/
1. 2x as long as wide/
2. longer than 2x its width/

#14. Forewing median and submedian cells/
0. asetose/
1. sparsely setose/
2. profusely setose/

#15. Ocellocular line (OOL)/
0. shorter than 0.89x width of ocellar triangle (WOT)/
1. 0.89 - 1.09x width of ocellar triangle (WOT)/
2. longer than 1.1x width of ocellar triangle (WOT)/

#16. Posterior ocelli/
0. contiguous with vertex or away from vertex margin by distance less than 0.5x its diameter/
1. away from vertex margin by distance 1 - 2x its diameter/
2. away from vertex margin by distance more than 2x its diameter/

#17. Anterior clypeal margin/
0. acute/
1. right angled/
2. obtuse/

#18. Clypeal carina/
0. strong or moderately strong/
1. very weak, only as a smooth ridge or completely absent/

#19. Clypeus/
0. with median carina extending onto front upto posterior margin of scrobal impression/
1. with median carina extending onto front beyond posterior margin of scrobal impression/

#20. Ventral mandibular teeth/
0. straight or weakly curved/
1. strongly curved backwards and downwards/

#21. Anteromedian propodeal area/
0. elevated, smooth and polished triangle/
1. smooth polished rectangle/
2. weakly coriaceous triangle/
3. smooth and polished triangle, but not elevated/

#22. Pedicel/
1. shorter than F1/
2. as long as F1/
3. longer than F1/

#23. Scape/
0. shorter than 2x pedicel/
1. as long as 2x pedicel/
2. longer than 2x pedicel/

#24. Width of frons (WF)/
0. shorter than 0.97x height of eye (HE)/
1. 0.98 – 1.07x height of eye (HE)/
2. longer than 1.07x height of eye (HE)/

#25. Maximum distance from top of the eye to posterior margin of vertex (EV)/
0. shorter than 0.50x height of eye (HE)/
1. 0.57 – 0.89x height of eye (HE)/
2. longer than 0.90x height of eye (HE)/

#26. Shape of areolet/
0. subtriangular/
1. subrectangular/

#27. Gena/
0. smooth and polished/
1. weakly coriaceous/

#28. Metasoma/
0. as long as mesosoma/
1. longer than mesosoma/
2. shorter than mesosoma/

#29. Metasoma sculpture/
0. completely smooth and polished/
1. T1 completely smooth others with a basal coriaceous band/

#30. Propodeal disc/
0. sharply inclined to lateral margin, usually with a sublateral ridge/
1. smoothly inclined to lateral margin/
Table - 2. Data Matrix of *Goniozus* spp. from Indian Subcontinent

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Character coding</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Goniozus sringeriensis</em> sp. nov.</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus palghatensis</em> sp. nov.</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus buddhai</em> sp. nov.</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus nuperus</em> sp. nov.</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus kainophanestus</em> sp. nov.</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus no~~ellus</em> sp. nov.</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus propodeatus</em> sp. nov.</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus orthagae</em> sp. nov.</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus aproaeremae</em> sp. nov.</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus armigerae</em> Santhosh and Narendran</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus borneanuCameron</em></td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus chatterji</em> Kurian</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus fulgida</em> Krombein</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus kerless</em> Gordh</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus pakanus</em> Gordh</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus rutherfordi</em> Krombein</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus cuttockebn</em> Lal</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus delhiensis</em> Ram</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus fulvicornis</em> (Rohwer)</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus hybleae</em> Kurian</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus indicus</em> Ashmead</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus lygmpiae</em> Kurian</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus marasmi</em> Kurian</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td><em>Goniozus montanus</em> Kieffer</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
</tbody>
</table>

| 1 2 3 4 5 6 7 8 9 | 0 1 2 3 4 5 6 7 8 9 | 0 1 2 3 4 5 6 7 8 9 | 0 1 2 3 4 5 6 7 8 9 | 0 1 2 3 4 5 6 7 8 9 | 0 1 2 3 4 5 6 7 8 9 |

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<table>
<thead>
<tr>
<th>Taxon</th>
<th>Character coding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goniozus mori Kurian</td>
<td>0 ? 2 1 2 ? 2 ? 1 ? 0 0 0 ? ? ? ? 0 0 0 ? 0 N ? 0 0 ?</td>
</tr>
<tr>
<td>Goniozus nilamburensis Kurian</td>
<td>0 ? 2 1 2 ? 1 ? 1 ? ? 0 0 0 ? 2 0 ? 0 1 ? 0 2 0 ? 0 N ? 1 1 ?</td>
</tr>
<tr>
<td>Goniozus sanctijohannis Kurian</td>
<td>0 ? 2 1 2 ? 2 0 1 ? 0 0 0 ? ? 0 ? 0 1 ? 0 2 0 ? 0 N ? ? ? ?</td>
</tr>
<tr>
<td>Goniozus sensorius Gordh</td>
<td>0 0 2 1 0 ? 1 0 ? 0 ? 1 ? 0 0 2 0 1 0 0 1 0 1 0 N ? 1 1 ?</td>
</tr>
<tr>
<td>Goniozus stomopterycis Ram and Subba Rao</td>
<td>0 1 2 3 2 1 2 0 0 0 0 1 0 1 1 0 2 0 0 0 0 2 0 0 0 N 0 2 0 1</td>
</tr>
<tr>
<td>Goniozus musitus sp. nov.</td>
<td>1 1 2 0 1 1 2 0 0 1 0 1 1 1 0 1 1 N 1 2 1 1 0 0 0 ? ? 1</td>
</tr>
<tr>
<td>Goniozus neoterostus sp. nov.</td>
<td>1 0 2 0 0 1 2 0 1 1 0 2 0 2 1 0 0 0 1 0 1 1 1 0 0 0 ? ? 1</td>
</tr>
<tr>
<td>Goniozus ecarinatus Krombein</td>
<td>1 ? 2 0 ? ? 2 ? ? 1 ? 1 0 ? 1 0 0 ? 0 0 0 ? 0 0 2 2 ? ? ? ? ?</td>
</tr>
<tr>
<td>Goniozus cotha sp. nov.</td>
<td>1 0 2 1 2 1 2 1 0 0 0 1 0 2 1 0 0 0 0 0 0 0 2 2 0 1 0 1 0 1 1 1</td>
</tr>
<tr>
<td>Goniozus lucidulus Krombein</td>
<td>1 ? 2 1 0 ? 1 ? ? 1 0 0 0 ? 0 0 ? 0 0 ? 0 2 1 ? 0 ? ? ? ? ?</td>
</tr>
<tr>
<td>Goniozus jeroeni sp. nov.</td>
<td>1 0 2 1 1 1 2 1 0 0 0 1 0 1 0 0 2 1 0 0 0 2 1 1 0 0 0 1 0 1</td>
</tr>
<tr>
<td>Goniozus nephantidis (Muesebeck)</td>
<td>1 1 2 2 2 0 1 0 1 2 0 1 0 2 2 0 0 ? 0 ? 0 0 1 2 2 2 0 0 0 1 1</td>
</tr>
<tr>
<td>Goniozus alarius sp. nov.</td>
<td>1 1 2 2 1 0 2 0 0 1 0 2 0 2 2 0 0 0 0 0 2 1 0 1 0 1 1 1 1</td>
</tr>
<tr>
<td>Goniozus setosus sp. nov.</td>
<td>1 2 1 2 2 0 2 0 0 1 0 2 0 2 0 0 0 0 0 1 0 3 2 1 0 0 1 1 1 0 0 1</td>
</tr>
<tr>
<td>Goniozus kurian sp. nov.</td>
<td>1 2 1 2 2 0 2 1 0 0 1 1 0 1 0 1 2 0 0 0 3 2 1 2 1 0 0 1 0 1</td>
</tr>
<tr>
<td>Goniozus inauditus sp. nov.</td>
<td>1 0 1 2 1 0 2 0 0 2 0 1 0 2 2 0 0 0 1 0 1 2 1 1 1 0 0 1 0 1</td>
</tr>
<tr>
<td>Goniozus clypeatus sp. nov.</td>
<td>1 0 1 0 1 1 2 0 0 0 0 2 0 2 2 0 0 0 0 0 0 1 0 0 0 0 0 1 0 1 1</td>
</tr>
<tr>
<td>Goniozus longigastralis sp. nov.</td>
<td>1 1 1 0 2 1 1 1 0 1 1 1 0 2 2 0 2 0 1 0 0 1 2 2 1 0 1 1 1 1 1 1</td>
</tr>
<tr>
<td>Goniozus kotiyooricus sp. nov.</td>
<td>1 0 1 2 2 1 2 0 0 0 0 1 2 1 2 0 2 1 0 0 2 1 2 1 0 0 0 0 1 1</td>
</tr>
<tr>
<td>Goniozus valvicolosa Krombein</td>
<td>1 ? 1 2 ? ? 2 1 ? 0 2 1 2 ? ? 1 0 0 0 ? 0 1 1 2 1 ? ? ? ? ?</td>
</tr>
<tr>
<td>Goniozus recentis sp. nov.</td>
<td>1 0 0 1 1 1 2 1 0 1 0 1 0 2 1 0 2 1 0 2 1 0 1 1 0 1 2 2 2 0 0 1 1</td>
</tr>
</tbody>
</table>

? - Unknown; N - Not applicable; P - Polymorphic state
5.1.1 Key to species of *Goniozus* Förster from Indian Subcontinent

(Based on female and male specimens)

1. Females: metasoma with 6 exposed segments, last segment conical as viewed from above, sting frequently exserted

   -- Males: metasoma with 7 exposed segments, terminal segments occasionally telescoped, last segment with apical margin broadly rounded

    2(1). Forewing with areolet (fig. 174) .......................... 3

    -- Forewing without areolet, but only short stub arising from basal vein (fig. 178) ................................................................. 23

    3(2). Propodeal disc posteriorly without transverse carina (fig. 193, 226) -- 4

    -- Propodeal disc posteriorly with transverse carina either complete or interrupted medially (fig. 282, 286) ..................................... 10

    4(3). Head length subequal to its width, WH 0.89 - 1.09x LH (fig. 98, 72, 240); OOL less than 1.08x WOT (fig. 240, 244) ......................... 5

    -- Head distinctly elongate, WH equal to or less than 0.89x LH (fig. 56, 217, 226); OOL more than 1.1x WOT (fig. 193, 217, 226) .............. 8

    5(4). Mandible pale yellow; ocular setae 3x diameter of single facet (fig. 72, 244)

       ------------------------------------------------------------------ 6

    -- Mandible brown or dark red; ocular setae as long as diameter of single facet (fig. 240) .................................................................................. 7

    6(5). Pedicel shorter than F1; scape length more than 2x length of pedicel; WF 1.07x HE; OOL 0.88x WOT .......................... *comatus* Krombein

    -- Pedicel length equal to F1; scape length 2x length of pedicel (fig. 245); WF = HE; OOL = WOT (fig. 72) .......................... *neoterosus* sp. nov.

    7(5). Clypeal carina moderately strong, restricted to clypeus, 0.41x as long as HE; smooth elevated anteriomedian propodeal triangle present; pedicel shorter
than F1; scape longer than 2x pedicel; WF 1.35x HE -------------------------------ecarinatus Krombein

-- Clypeal carina absent, but represented by a smooth ridge on clypeus (fig.68); no anteriomedian propodeal triangle (fig.69); entire propodeal disc strongly coriaceous; pedicel as long as F1; scape 2x pedicel (fig.241); WF 1.06x HE-

-----------------------------------------------mustus sp. nov.

8(4). M and SM of forewing with single row of setae (fig.221), speculum asetose; clypeal carina moderately strong, not extending onto frons; malar space distinct with malar groove (fig.219); forefemur 2.1x as long as wide (220)---

-----------------------------------------------kottiyooricus sp. nov.

-- M and SM of forewing profusely setose (fig.193, 226), speculum setose; clypeal carina strong, extending onto frons (fig.23, 24, 226); malar space narrow without malar groove (fig.195); forefemur 1.6-1.8x as long as wide (fig. 196, 229)-----------------------------------------------

9(8). Ocular setae 3x as long as diameter of single facet (fig.24); ocellar triangle obtuse (fig.193); frons and vertex strongly coriaceous (fig.24); OOL 1.10-1.23x WOT; anterior clypeal margin acute (fig.24); propodeal disc with a smooth median band, extending posteriorly onto declivity (fig.25, 193); pedicel shorter than F1 (fig.194); WF 0.92-0.97x HE ----- clypeatus sp. nov.

-- Ocular setae as long as diameter of single facet (fig.56); ocellar triangle acute (fig.56, 226); frons and vertex weakly coriaceous (fig.56); OOL 1.75x WOT (fig.226); anterior clypeal margin obtuse (fig.56); propodeal disc with a smooth anterior median elevated triangle, extending to posterior margin by a median line (fig.226); pedicel as long as F1 (fig.227); WF 1.18x HE -------

-----------------------------------------------longigastralis sp. nov.

10(3). Propodeal disc posteriorly with a complete transverse carina, without any interruption medially (fig. 29, 108, 197, 209, 282)-----------------------------11

-- Propodeal disc posteriorly with a transverse carina interrupted medially (fig.174)-----------------------------------------------18
11(10). Head transverse, WH equal to or more than 1.2x LH

-- Head length subequal to its width, WH 0.89 - 1.09x LH

12(11). Mandible black brown; forefemur 2.33x as long as wide; clypeal carina strong extending onto frons upto posterior scrobal margin; anteromedian propodeal area with a smooth area, not elevated triangle; EV 0.67x HE; metasoma shorter than head plus mesosoma ——- Salvadorae Kurian

-- Mandible yellow brown; forefemur 1.83x as long as wide; clypeal carina absent, present only as median smooth ridge; anteromedian propodeal area with a smooth elevated triangle; EV 0.28-0.29x HE; metasoma distinctly longer than head plus mesosoma ——- recentis sp. nov.

13(12). Frons and vertex smooth or weakly coriaceous, polished; mandible yellow

-- Frons and vertex strongly coriaceous, not polished; mandible dark brown to black

14(13). Posterior transverse propodeal carina weakly complete; EV 0.38x HE; pedicel longer than F1 ——- Lucidulus Krombein

-- Posterior transverse propodeal carina distinct, complete; EV 0.5x HE; pedicel as long as F1 ——- Mellipes (Muesebeck)

15(13). Median clypeal carina absent, represented as a smooth ridge restricted to clypeus (fig.39); M and SM sparsely setose (fig.209); EV 0.46x HE ——- Jeroeni sp. nov.

-- Median clypeal carina strong and extending onto frons as a low carina; other characters partially or completely different ——- 16

16(15). Eye profusely setose, setae 2x as long as diameter of single facet; EV 0.18x HE; scape 2x as long as pedicel; mandible slender, brown ——- Villosus Krombein
-- Eye asetose or if setose, setae sparse, as long as diameter of single facet; EV more than 0.29x HE; scape more than or less than 2x as long as pedicel; mandible stout, black ................................................................. 17

17(16). Eye sparsely setose, setae as long as diameter of single facet (fig.28); scape shorter than 2x as long as pedicel (fig.198); EV 0.31x HE; areolet subrectangular (fig.197); mesosoma shorter than metasoma (fig.26); rs = m ................................................................. cotha sp. nov.

-- Eye bare; forefemur 1.94x as long as wide; scape longer than 2x as long as pedicel; EV 0.67x HE; areolet subtriangular; mesosoma longer than metasoma; rs shorter than m ........................................... pulveriae (Kurian)

18(10). Head length subequal to its width, WH 0.89 - 1.09x LH; OOL 1.22-1.33x WOT .............................................................................................................. 19

-- Head distinctly elongate, WH equal to or less than 0.88x LH; OOL more than 1.33x WOT or less than 1.22x WOT ........................................... 20

19(18). Eye sparsely setose, setae 2x diameter of single facet; forefemur 1.76 - 1.9x as long as wide; anterior median propodeal triangle smooth and polished; pedicel longer than F1; scape 2.5x pedicel ---------- nephantidis (Muesebeck)

-- Eye profusely setose, setae 4x as long as diameter of single facet (fig.9); forefemur 1.54x as long as wide (fig.177); anterior median propodeal triangle coriaceous (fig.10); pedicel = F1; scape 2.8x pedicel (fig.175) ..............
................................................................. alarius sp. nov.

20(18). Vertex straight; scrobe weakly or strongly carinate; M and SM profusely setose; posterior ocelli contiguous with vertex margin; EV 0.35-0.55x HE ................................................................. 21

-- Vertex emarginate; scrobe ecarinate; M and SM sparsely setose; posterior ocelli equal to or more than 0.5x its diameter away from vertex margin; EV 0.75-0.85x HE ................................................................. 22

21(20). Eye profusely setose, setae 3x as long as diameter of single facet (fig.111); forefemur 1.67x as long as wide (fig.289); OOL 0.82-0.94x WOT (fig.286);
WF 0.84-0.93x HE; EV 0.35-0.39x HE; gena weakly coriaceous

setosus sp. nov.

Eye sparsely setose, setae as long as diameter of single facet (fig.33, 201); forefemur 1.92x as long as wide (fig.204); OOL 1.09-1.10x WOT (fig.201); WF = HE; EV 0.47-0.67x HE; gena smooth and polished

inauditus sp. nov.

Ocellar triangle acute (fig.51); forefemur 1.92x as long as wide (fig.225); OOL 0.66x WOT (fig.51, 222); clypeal apical margin weakly produced, obtuse (fig.51); anteromedian propodeal area rectangular, smooth, not elevated (fig.52); pedicel longer than F1

kuriani sp. nov.

Ocellar triangle right angled; forefemur 2.07x as long as wide; OOL 1.54-1.58x WOT; clypeal apical margin strongly produced, acute; anteromedian propodeal area triangular, smooth, elevated; pedicel shorter than F1

valvolicola Krombein

25(24). Head distinctly transverse, WH 1.11x LH; scape less than 2x as long as pedicel

fulgidus Krombein

26(24). Antenna 2x as long as head
cuttockensis Lal

27(26). Eye small, HE shorter than EV (fig.36, 205); thorax slender, narrower than head (fig.35); propodeum without transverse carina (fig.205); median clypeal carina weak, not extending to frons (fig.36); head nearly parallel sided

indicus Ashmead
Investigation on the Alpha Taxonomy of Bethylidae

Observation and Results

-- Eye larger; thorax stouter; propodeum with transverse carina notched in the middle; other characters partially or completely different - *fulvicornis* Kieffer

28(23). Head transverse, WH 1.03 - 1.07x LH (fig. 115, 290)------------------------ 29

-- Head longer than or as long as wide (fig. 87, 256)------------------------------- 35

29(28). EV 0.8x HE; Posterior ocelli separated from vertex by more than its own diameter--------------------------------------------------------------- *rugosus* Samad

-- EV equal to or less than 0.5x HE; Posterior ocelli contiguous or separated from vertex by less than 0.5x its diameter ------------------------------------- 30

30(29). Posterior transverse carina absent; anteromedian propodeal triangle smooth, long extending upto posterior margin ------------------------- *triangulus* Kieffer

-- Posterior transverse carina present, complete or medially interrupted; anteromedian propodeal triangle smooth, run upto or slightly beyond middle 31

31(30). Scape 2x as long as pedicel; EV 0.5x HE; WF 0.75x WH ---------------------- 32

-- Scape longer than 2x pedicel; EV 0.23 - 0.42x HE; WF 0.49 - 0.57x WH- 33

32(31). F2 0.8x F1; clypeal carina running upto a level of 0.25x HE; POL 0.6x OOL; thorax 1.75x as long as its width; forewing 3x as long as its width; metasoma as long as thorax ----------------------------------------------- *lygropiae* Kurian

-- F2 1.8x F1; clypeal carina running upto a level of more than 0.33x HE; POL = OOL; thorax 2x as long as its width; forewing more than 3x as long as its width; metasoma slightly longer than thorax ------------------- *hybleae* Kurian

33(31). Mandible yellow (fig. 115); OOL 0.63-0.73x WOT (fig. 115); clypeal margin acute (fig. 115); pedicel longer than F1 (fig. 291); propodeal disc sharply inclined to lateral margin with weak sublateral ridge (fig. 290)----------------------------------------------- *sringeriensis* sp. nov.

-- Mandible brown-black; OOL 1.12 - 1.25x WOT; clypeal margin obtuse; pedicel equal to or less than F1; propodeal disc smoothly inclined to lateral margin, no sublateral ridge ------------------------------------- 34
Observation and Results

34(33). Posterior propodeal transverse carina weak, but complete; vertex straight in full face view; pedicel shorter than F1 —pakmanus— Gordh

---
Posterior propodeal transverse carina broadly interrupted medially; vertex emarginate in full face view; pedicel = F1 —delhiensis— Ram

35(28). Head subequal, WH 0.91 – 1.02x LH (fig.95, 256, 267) —36

---
Head elongate, WH equal to or less than 0.89x LH (fig.91, 99, 263, 272) —50

36(35). Posterior propodeal transverse carina absent (fig.88, 96, 256, 267) —37

---
Posterior propodeal transverse carina present, either complete or interrupted medially (fig.18, 182, 178) —40

37(36). Head strongly compressed, LH 2.17x WH in lateral view (fig.94, 269); clypeal carina completely absent (fig.95); forefemur 2.14x as long as wide (fig.270) —platycephalus— sp. nov.

---
Head moderately compressed, LH less than 2x as long as WH in lateral view; clypeal carina present; forefemur less than 2x as long as wide —38

38(37). Mandible yellow; pedicel shorter than F1 —keralensis— Gordh

---
Mandible brown-black; pedicel longer than F1 (fig.256) —39

39(38). OOL 0.91x WOT (fig.87); scape 2x pedicel (fig.256); posterior ocelli not contiguous with vertex (fig.256); mandible stout —orthagae— sp. nov.

---
OOL = WOT; scape shorter than 2x pedicel; posterior ocelli contiguous with vertex; mandible slender —rutherfordi— Krombein

40(36). Posterior propodeal transverse carina complete —41

---
Posterior propodeal transverse carina interrupted medially —45

41(40). Scape longer than 2x pedicel; pedicel shorter than F1; scrobe weakly carinate —montanus— Kieffer

---
Scape shorter than 2x pedicel; pedicel equal to or more than F1; scrobe ecarinate —42
42(41). Mandible yellow; eye sparsely setose; propodeal declivity medially smooth; WF = HE; anterior clypeal margin obtuse ------------------ *sensorius* Gordh

-- Mandible brown-black; eye asetose; propodeal declivity entirely coriaceous; other characters partially or completely different------------------ 43

43(42). Forefemur 1.58x as long as wide; parapsidal furrow absent

--------------------------------------------------------------- *sanctijohannis* Kurian

-- Forefemur 1.92 - 1.96x as long as wide; parapsidal furrow present -------- 44

44(43). Metasoma as long as mesosoma; pedicel shorter than F1; clypeal carina extending slightly above lower orbital margin ------------------ *mori* Kurian

-- Metasoma distinctly longer than mesosoma; pedicel longer than F1; clypeal carina extends on to frons, 0.33x as long as HE ---- **nilamburensis** Kurian

45(40). Posterior transverse propodeal carina broadly interrupted medially ---- 46

-- Posterior transverse propodeal carina narrowly interrupted medially ---- 47

46(45). Mandible yellow (fig.103); antenna distinctly longer than head; vertex emarginate (fig.276); forefemur 2.1x as long as wide (fig.277); clypeal carina present (fig.103); malar space distinct (fig.278); setae on vertex distinctly longer than that of frons (fig.276)------------------- *prophatosis* sp. nov.

-- Mandible brown-black (fig.17); antenna as long as head (fig.17); vertex straight (fig.182); forefemur 2x as long as wide (fig.185); clypeal carina absent, represented by a smooth ridge (fig.17); malar space narrow (fig.184); setae on vertex not distinctly longer than that of frons (fig.182)-------------------

--------------------------------------------------------------- *apraeremae* sp. nov.

47(45). Forefemur equal to or more than 2x as long as wide (fig.181, 238); pedicel shorter than F1 (fig.179, 236); metasoma longer than mesosoma (fig.62) ---- 48

-- Forefemur less than 2x as long as wide; pedicel equal to or more than F1; metasoma shorter than or as long as mesosoma ------------------ 49

---

_Santhosh, S._
48(47). OOL 0.75-0.86x WOT; ventral most tooth of mandible straight; anteromedial smooth elevated propodeal triangle extends up to middle of propodeal disc, not connected to posterior margin; WF 0.81-0.89x HE--- *antennalis* sp. nov.

--- OOL 0.89-1x WOT; ventral most tooth of mandible strongly curved downwards; anteromedial smooth elevated propodeal triangle extends beyond middle of propodeal disc, connected to posterior margin by a smooth line; WF 1-1.07x HE------------------------------- *mandibularis* sp. nov.

49(47). Pedicel as long as F1; scape as long as 2x pedicel; metasoma as long as mesosoma; forefemur 1.91x as long as wide; eye asetose---- *marasmi* Kurian

--- Pedicel longer than F1; scape shorter than 2x pedicel; metasoma shorter than mesosoma (fig.117); forefemur 1.81x as long as wide; eye sparsely setose (fig.118)------------------------ *stomopterycis* Ram & SubbaRao

50(35). Parapsidal furrow absent; propodeal disc without median carina and posterior transverse carina, propodeal dorsum shorter than mesoscutum and scutellum combined; POL = OOL ----------------------------- *borneanus* Cameron

--- Parapsidal furrows present; propodeal disc with posterior transverse carina, other characters partially or completely different -------------------------- 51

51(50). Anterior clypeal margin acute (fig.91, 99, 263, 272); scape equal to or more than 2x pedicel (fig.263, 272); eye profusely setose, setae longer than diameter of single facet (fig.91, 99); M, SM profusely setose (fig.263, 272)52

--- Anterior clypeal margin obtuse (fig.21, 43, 79, 83, 248, 252); scape shorter than 2x pedicel (fig.191, 214, 249, 253); eye sparsely setose, setae as long as diameter of single facet (fig.21); M, SM with few scattered setae (fig.190, 248, 252)---------------------------------- 53

52(51). Posterior propodeal transverse carina complete (fig.272); propodeal disc sharply inclined to lateral margin, with sublateral ridges (fig.100); antenna distinctly longer than head in full face view (fig.99); pedicel longer than F1; scape longer than 2x pedicel (fig.273); metasoma longer than mesosoma (fig.97); frons and vertex with shallow punctures (fig.99); ocular setae

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68
slightly longer than diameter of single facet (fig.99) .......................... propodeatus sp. nov.

-- Posterior propodeal transverse carina broadly interrupted medially (fig.92); propodeal disc smoothly inclined to lateral margin, no sublateral ridges (fig.92); antenna as long as head in full face view; pedicel shorter than F1; scape as long as 2x pedicel (fig.90); metasoma shorter than mesosoma (fig.89); frons and vertex without shallow punctures; ocular setae 2.8x as long as diameter of single facet (fig.91)------------------- palghatensis sp. nov.

53(51). Forefemur longer than 2x as long as wide; EV 0.25 - 0.39 x HE------------ 54
-- Forefemur shorter than 2x as long as wide (fig.189, 216, 251, 255); EV 0.44 - 0.83 x HE------------------------------- 55

54(53). Mandible yellow (fig.21); ventral most mandibular tooth strongly curved downwards; tip of anteromedian propodeal triangle reaching posterior transverse carina (fig.190)-------------------------------- buddhai sp. nov.
-- Mandible brown-black; ventral most mandibular tooth straight; tip of anteromedian propodeal triangle connected to posterior transverse carina by means of median carina---------------------------- chatterjii Kurian

55(53). Head in lateral view weakly compressed, 1.5x as long as wide (fig.188); antenna distinctly longer than head; ventral most mandibular tooth straight; metasoma as long as mesosoma (fig.186) -------------------------------- armigerae Santhosh and Narendran
-- Head in lateral view strongly compressed, 1.8 - 2x as long as wide (fig.215, 250, 254); antenna as long as or slightly longer than head (fig.79, 83); ventral most mandibular tooth strongly curved downwards; metasoma distinctly longer than mesosoma (fig.41, 78, 81)---------------------- 56

56(55). Mandible yellow (fig.43); forefemur 1.67x as long as wide (fig.216); anteromedian smooth propodeal triangle not elevated, continued as a smooth patch to transverse carina (fig.44); EV 0.42-0.44x HE ------------------------------- kainophanestus sp. nov.
Mandible brown-black (fig.79,83); forefemur 1.82-1.92x as long as wide (fig.251, 255); anteromedian smooth propodeal triangle elevated, either not continued or connected to the transverse carina by a smooth median line, but not a smooth patch (fig. 80, 84, 248, 252); EV 0.53 - 0.60x HE 57(56). OOL 1.05-1.11x WOT; anteromedian propodeal triangle smooth, elevated, connected to transverse carina by a smooth median line (fig.84, 252); head in lateral view 2x as long as wide (fig.82, 254); mandible stout; antenna slightly longer than head -------------------------------------- nuperus sp. nov.

Males

58(1). Forewing with closed areolet ----------------------------------------------- 59

--- Forewing without closed areolet, only short stub arising from basal vein -- 62

59(58). Head elongate, WH 0.80x LH; mandible red-brown; eye setose  
----------------------------------------------- salvadorae (Kurian)

--- Head subequal or transverse, WH equal to or more than 0.90x LH; mandible red-brown; eye setose ----------------------------------------------- 60

60(59). Posterior transverse propodeal carina complete; head transverse, WH 1.18x LH; OOL 0.77x WOT; posterior ocelli contiguous with vertex ----------------------------------------------- recentis sp. nov.

--- Posterior transverse propodeal carina broadly interrupted medially; head subequal, WH 0.90 - 1.00x LH; OOL more than 0.94x WOT; posterior ocelli separated from vertex by 1.5x its diameter ----------------------------------------------- 61

61(60). Anterior clypeal margin acute; sides of head behind eyes parallel before curing inward at posterolateral angles; EV 0.75x HE; OOL 1.36x WOT; antenna pale yellow; metasoma dark brown ----------------------------------------------- valvolicola Krombein

Santhosh, S.
Anterior clypeal margin obtuse; sides of head behind eyes curving towards rounded posterolateral angles; EV 0.56 - 0.61x HE; OOL 0.94 - 1.10x WOT; antenna brown; metasoma black ----------------- *nephanthidis* Musebeck

62(58). Head longer than wide ----------------------------------------------- 63

63(62). Propodeum without transverse carina separating dorsum from posterior declivity, metasoma brown -------------------------------------------- 64

64(63). Antenna brown and mandibles pale yellow; clypeus with weak carina not extending to frons; LH 1.04x HW; EV 0.41x HE ---- *rutherfordi* Krombein

65(63). Subgenital plate with a well defined posteromedial notch, anteromedial propodeal triangle elevated, connected to transverse carina by a median carina ----------------- *ahmeadi* Kurian

66(62). Head as long as wide (fig.259) ---------------------------------------- 67

67(66). Posterior transverse propodeal carina complete; vertex emarginate; forefemur 2.15x as long as wide; pedicel = F1; parapsidal furrow distinct and complete; mandible red-brown ----------------- *thalasodes* (Kurian)

Santhosh, S.
68(67). Forefemur 2x as long as wide (fig.262); forewing with M and SM profusely setose (fig.259); clypeal carina weak; EV 0.62x HE ——— orthagae sp. nov.

--- Forefemur less than 2x as long as wide; forewing with M and SM sparsely setose; clypeal carina strong; EV 0.22 – 0.46x HE ——— 69

69(68). Pedicel shorter than F1; scape longer than 2x pedicel; head weakly coriaceous; mandible slender ——— montanus Kieffer

--- Pedicel longer than F1; scape shorter than 2x pedicel; head strongly coriaceous; mandible stout ——— 70

70(69). Mandible red-brown; OOL 0.62x WOT (fig.280); setae on vertex distinctly longer than other setae on head (fig.280); head in lateral view 1.76x as long as wide (fig.281) ——— prospathosis sp. nov.

--- Mandible yellow; OOL 0.94x WOT; setae on vertex as long as other setae on head; head in lateral view 1.54x as long as wide ——— stomopterycis Ram & SubbaRao

71(67). Scape as long as or longer than 2x length of pedicel ——— 72

--- Scape less than 2x length of pedicel ——— 73

72(71). Clypeus without median longitudinal carina; antenna uniformly honey yellow, F1 and F2 slightly serrate; POL 0.75x OOL ——— morindae Kurina

--- Clypeus with median longitudinal carina extending to one-third eye length; antenna reddish brown, F1 and F2 not serrate; POL 0.6x OOL ——— nephoterycis Kurian

73(71). Posterior transverse propodeal carina weak, interrupted medially; EV 0.20x HE; parapsidal furrow weak and incomplete ——— madrassippatanami Kurian

--- Posterior transverse propodeal carina distinct, complete; EV 0.40-0.41x HE; parapsidal furrow distinct and complete ——— 74

74(73). Mandible pale yellow; anteromedial propodeal triangle connected to transverse carina by a median carina ——— sensorius Gordh
Mandible red – brown; anteromedial propodeal triangle upto middle of disc, not connected to transverse carina ––––––––––––––––––– chowdhari Kurian

Goniozus alarius sp. nov.
(figs. 7-10, 174-177)

**Diagnosis:** Head slightly longer than wide, WH 0.91 x LH; strongly compressed in lateral aspect, 1.83 x as long as wide; frons and vertex coriaceous, with scattered shallow punctures, profusely setose; gena weakly coriaceous; eye profusely setose, setae 4 x as long as diameter of single facet; malar space distinct; malar groove present; OOL 1.31-1.33 x WOT. Antenna slightly longer than head in full face view; all funicular segments longer than wide; pedicel shorter than F1; scape longer than 2 x pedicel. Basal median propodeal triangle not smooth, elevated and distinct; only weakly coriaceous impression; posterior transverse propodeal carina broadly interrupted medially. Forewing 2.97 x as long as wide with subtriangular areolet; M, SM, and areolet profusely setose. Forefemur 1.54 x as long as wide.

**Description:** *Holotype – Female.*

**Measurements:** Length 3.11 mm; LH 0.73 mm; WH 0.66 mm; WF 0.38 mm; FWL 2.16 mm; LM 1.13 mm; LP 0.32 mm; WPD 0.51 mm; LPD 0.24 mm.

**Colour:** Body black, metasoma with dark brown tinge; antenna brown-yellow, last 3 segments fuscous; mandible reddish brown, teeth red; leg yellow, except light brown forefemur and forecoxa. Wing hyaline; costa, prostigma, pterostigma, light brown; other veins colourless.

**Head:** Head (figs. 9, 174) longer than wide, WH 0.91 x LH, compressed in lateral aspect, 1.83 x as long as wide (figs. 8, 176); frons and vertex coriaceous, with scattered shallow punctures (fig. 9); gena weakly coriaceous; vestiture short, profuse, decumbent; six pairs of long setae on vertex, longest being 0.18 mm; two of them lie close to outer posterolateral ocular margin; anterior clypeal margin strongly produced, sharply angulated, acute; clypeal carina 0.67 x HE, strong, arcuate in profile, extending onto frons upto level of posterior scrobal margin; scrobe weakly.
carinate; mandible stout with 4 short, pointed teeth, ventral most straight; WF 0.53x LH; WF = HE; EV 0.47x HE; LH 2x HE; malar space distinct; malar groove present; eye profusely setose with long setae, 4x diameter of single facet; ocelli in obtuse triangle; posterior ocelli contiguous with vertex margin; OOL 1.33x WOT; POL: AOL: DAO = 4:2:2.3; vertex straight in full face view, acute, sharply angulated, ecarinate. Relative lengths of first five antennal segments (fig.175) 8:4.2:3.5:3.5:3.8; scape 1.33x as long as wide, 2.8x pedicel; pedicel shorter than F1; all funicular segments longer than wide; antenna slightly longer than head in full face view (29:32).

*Mesosoma:* Pronotum, mesonotum and scutellum uniformly coriaceous (fig.10); vestiture short, profuse; sparse on scutellum; pronotal disc 0.46x as long as wide; two pits on base of scutellum connected by a narrow groove, parapsidal furrow complete; notauli absent; propodeum 0.62x as long as wide, smoothly inclined to lateral margin; basal median propodeal triangle not smooth, elevated and distinct, only weakly coriaceous impression in basal median area; propodeal disc and declivity entirely coriaceous, shallow longitudinal depression on sides of propodeal disc; few setae on disc around spiracles; posterior transverse propodeal carina broadly interrupted medially. Forewing (fig.174) 2.97x as long as wide; areolet present; areolet subtriangular in shape; M, SM, speculum and areolet profusely setose. Forefemur (fig.177) 1.54x as long as wide; SI 5.14.

*Metasoma:* Metasoma (fig.7) distinctly longer than mesosoma (42:34), shorter than head plus mesosoma (42:57); T1 smooth and polished, others weakly coriaceous. T1-T2 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

*Male:* Unknown.

*Ecology and Biology:* Collected from the forest canopy. Host unknown.

*Etymology:* The species epithet is after the Latin word, *ala* meaning wing, in allusion to the characteristically hairy forewing cells of the species.

*Distribution:* India – Karnataka - Nilgiris; Kerala.
Material Examined: Holotype – Female. INDIA: Tamil Nadu, Nilgiris, Chamrajnagar, Kurimandai, 4.78kms NW Punanjanur, 11°81.89’N 77°11.28’E, 1013 m, DDF, YPT, 31.i.2007; Mahadesha, leg.; VRN 159 (DZUC). Paratype. 1♀. INDIA: Kerala, Calicut University Botanical Garden, Arboretum, 11°07.58’N 75°53.24’E, 80m, MT, 14-27.xii.2006, S. Santhosh, leg., VRN 111 (DZUC).

Variation: EV 0.36x HE. See table- 3 for the morphometric ratios of type materials examined.

Discussion: Goniozus alarius sp. nov. is very closely related to G. nephantidis (Muesebeck) in having head length subequal to its width, WH 0.89 - 1.09x LH and OOL 1.22-1.33x WOT. Goniozus alarius sp. nov. differs from G. nephantidis in having eye profusely setose, ocular setae 4x as long as diameter of single facet, forefemur 1.54x as long as wide, anterior median propodeal triangle coriaceous, pedicel shorter than F1 and scape 2.8x pedicel, whereas in G. nephantidis eye sparsely setose, ocular setae as long as the diameter of single facet, forefemur 1.76 - 1.9x as long as wide, anterior median propodeal triangle smooth and polished, pedicel longer than F1 and scape 2.5x pedicel.

Table – 3. Morphometric ratios of Goniozus alarius sp. nov.

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<thead>
<tr>
<th>VRN</th>
<th>WH / LH</th>
<th>OOL / WOT</th>
<th>EV / HE</th>
<th>WF / HE</th>
<th>LH / LA</th>
<th>LS / PL</th>
<th>PL / LF1</th>
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<td>0.357143</td>
<td>1.21429</td>
<td>0.76316</td>
<td>2.8</td>
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<td>Mean Values</td>
<td>0.91</td>
<td>1.32</td>
<td>0.33</td>
<td>1.20</td>
<td>0.64</td>
<td>2.8</td>
<td>0.83</td>
</tr>
</tbody>
</table>

Goniozus antennalis sp. nov.

(figs.11-14, 178-181)

Diagnosis: Head longer than wide, WH 0.92-0.96x LH, strongly compressed in lateral aspect, 1.84x as long as wide; frons and vertex coriaceous with scattered shallow punctures; ventral most tooth of mandible straight; WF 0.81-0.89x HE; OOL 0.75-0.86x WOT. Propodeal disc sharply inclined to lateral margin; sublateral carina on posterolateral corner; anteromedial propodeal triangle smooth elevated,
extends upto middle of propodeal disc, not connected to posterior margin; posterior transverse propodeal carina narrowly interrupted medially. Forewing without areolet, but only short stub arising from basal vein; M, SM with single row of setae; speculum asetose; metasoma longer than mesosoma.

**Description:** *Holotype – Female.*

**Measurements:** Length 3.06mm; LH 0.75mm; WH 0.68mm; WF 0.37mm; FWL 2.1mm; LM 0.37mm; LP 0.39mm; WPD 0.52mm; LPD 0.29mm.

**Colour:** Body dark brown; metasoma especially first 2 tergites, pronotum lighter; mandible yellowish brown, basally dark brown, teeth brown; antenna brownish yellow; scape, terminal 6 segments brown; coxa, femur dark brown, trochanter, tibia, tarsi brown-yellow. Wing infumated; costa, subcosta, prostigma, pterostigma light brown; other veins straw coloured.

**Head:** Head longer than wide, WH 0.92x LH (figs.13, 178), compressed in lateral aspect, 1.84x as long as wide (figs.12, 180); frons and vertex coriaceous with scattered shallow punctures; gena smooth and polished; vestiture sparse, long, erect; 3 pairs of long setae on vertex, longest being 0.13mm; mandible robust with 4 long, pointed teeth; ventral most tooth blunt and weakly curved; anterior clypeal margin strongly produced, obtuse; clypeal carina strong, arcuate in profile, 0.5x HE, extending onto frons upto level of posterior scrobal margin; scrobe ecarinate; WF 0.49x LH; WF 0.86x HE; EV 0.36x HE; LH 1.84x HE; malar space narrow; malar groove absent; eye sparsely setose; setae as long as diameter of single facet; ocelli in obtuse triangle; posterior ocelli contiguous with vertex margin; OOL 0.86x WOT; POL:AOL:DAO = 5.5:2.5:2.5; vertex straight in full face view, weakly carinate. Relative lengths of first five antennal segments (fig.179) 9:5:6:5:5; scape 1.5x as long as wide, equal to or more than 2x pedicel; pedicel shorter than F1; all antennal segments longer than wide; antenna longer than head in full face view (51: 37).

**Mesosoma:** Pronotum, mesonotum and scutellum uniformly coriaceous (fig.14); vestiture sparse, long; setae on pronotum long; pronotal disc (fig.178) 0.57x as long as wide; scutellum with pair of basal slits; propodeal dorsum with basal median smooth elevated triangle extending upto middle, not connected to posterior margin,
rest of disc and declivity coriaceous; transverse carina strong and narrowly interrupted medially; propodeal disc 0.59x as long as wide, sharply inclined to lateral margin; sublateral carina on posterolateral corner of propodeum. Forewing (fig.178) 2.75x as long as wide; without areolet, only a short stub arising from basal vein; M, SM with single row of setae; setae absent in distal one-third of M cell; speculum asetose; m:rs:rs+m = 6.5:4.5:5. Forefemur (fig.181) 2x as long as wide; SI 5.12.

Metasoma: Metasoma (fig.11) slightly longer than mesosoma (29:25), shorter than head plus mesosoma (29:41); tergites smooth and polished; T1 completely smooth; other tergites with delicately coriaceous basal band; T1-T3 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

Male: Unknown.

Ecology and Biology: Collected from the paddy ecosystem. Host unknown.

Etymology: The species epithet is after the characteristically long antenna of the species.

Distribution: India – Kerala; Chhattisgarh – Durg.


Variation: In one paratype, scape is less than 2x length of pedicel. See table- 4 for morphometric ratios of the type materials examined.

Discussion: Goniozus antennalis sp. nov. is closely related to G. mandibularis sp. nov. in having forefemur equal to or more than 2x as long as wide, pedicel shorter
than F1 and metasoma longer than mesosoma. *Goniozus antennalis* sp. nov. is different from *G. mandibularis* sp. nov. in having OOL 0.75-0.86x WOT, ventral most tooth of mandible straight, anteromedial smooth elevated propodeal triangle extends upto middle of propodeal disc not connected to posterior margin and WF 0.81-0.89x HE, whereas in *G. mandibularis* sp. nov., OOL 0.89-1x WOT, ventral most tooth of mandible strongly curved downwards, anteromedial smooth elevated propodeal triangle extends beyond middle of propodeal disc connected to posterior margin by a smooth line and WF 1-1.07x HE.

Table – 4. Morphometric ratios of *Goniozus antennalis* sp. nov.

<table>
<thead>
<tr>
<th>VRN</th>
<th>WH / LH</th>
<th>OOL / WOT</th>
<th>EV / HE</th>
<th>WF / HE</th>
<th>LH / LA</th>
<th>LS / PL</th>
<th>PL / LF1</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0.916667</td>
<td>0.85714286</td>
<td>0.357143</td>
<td>0.82857</td>
<td>0.75</td>
<td>1.66667</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>0.916667</td>
<td>0.85714286</td>
<td>0.357143</td>
<td>0.85714</td>
<td>0.77419</td>
<td>2</td>
<td>0.83333</td>
</tr>
<tr>
<td>101</td>
<td>0.92</td>
<td>0.8</td>
<td>0.357143</td>
<td>0.89286</td>
<td>0.80645</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>106</td>
<td>0.961538</td>
<td>0.75</td>
<td>0.322581</td>
<td>0.80645</td>
<td>0.83871</td>
<td>2</td>
<td>0.90909</td>
</tr>
<tr>
<td>108</td>
<td>0.923077</td>
<td>0.75</td>
<td>0.34375</td>
<td>0.8125</td>
<td>0.78788</td>
<td>2.5</td>
<td>0.8</td>
</tr>
<tr>
<td>Mean Values</td>
<td>0.93</td>
<td>0.80</td>
<td>0.35</td>
<td>0.84</td>
<td>0.79</td>
<td>2.03</td>
<td>0.91</td>
</tr>
</tbody>
</table>

*Goniozus aproaeremae* sp.nov.

(figs.15-18, 182-185)

**Diagnosis:** Head subequal, WH 0.90-1x LH; head strongly compressed in lateral aspect, 1.85x as long as wide; mandible brownish black; clypeal carina absent, represented by a smooth ridge; eye sparsely setose, setae minute, as long as diameter of single facet; malar space narrow; vertex straight. Antenna as long as head; scape shorter than 2x pedicel; pedicel longer than F1; pedicel and F11 longer than wide; F1-F3 wider than long; F4-F10 as long as wide. Posterior transverse propodeal carina broadly interrupted medially. Forefemur 2x as long as wide. Forewing without areolet, but only short stub arising from basal vein.

**Description:** *Holotype – Female.*
Measurements: Length 2.29mm; LH 0.57mm; WH 0.52mm; WF 0.31mm; FWL 1.68mm; LM 0.91mm; LP 0.2mm; WPD 0.4mm; LPD 0.34mm.

Colour: Body black, basal 2 tergites dark brown; mandible reddish brown; antenna yellow, terminal 4 segments light brown; coxa and femur dark brown, rest of leg brown-yellow; Wing hyaline, pterostigma light brown, other veins colourless.

Head: longer than wide, WH 0.92x LH (figs.17, 182), compressed in lateral aspect, 1.85x as long as wide (figs.16, 184); frons and vertex coriaceous with scattered shallow punctures; gena smooth and polished; vestiture short, sparse, suberect; setae on vertex not distinctly longer than other head setae; anterior clypeal margin weakly projecting, broadly rounded, obtuse; clypeal carina weak, appear as smooth ridge, 0.54x HE, extending onto frons, falling short of level of posterior scrobal margin; scrobe ecarinate; mandible robust with 4 short, blunt teeth, ventral most weakly curved; WF 0.54x LH; WF 0.97x HE; EV 0.41x HE; LH 1.89x HE; malar space narrow; malar groove absent; eye sparsely setose, setae minute, as long as diameter of single facet; ocelli in obtuse triangle, posterior ocelli contiguous with vertex margin; OOL = WOT; POL : AOL : DAO = 6.5 : 2.8 : 3; vertex straight in full face view, ecarinate. Relative lengths of first five antennal segments (fig.183) in the ratio of 6:3.5:2:2.5:3; scape 1.2x as long as wide, shorter than 2x length of pedicel; pedicel longer than F1; pedicel and F11 longer than wide; F1-F3 wider than long; F4-F10 as long as wide; antenna subequal to head length in full face view (40:38).

Mesosoma: Pronotum strongly coriaceous, mesonotum and scutellum polished (fig.18), weakly coriaceous, with scattered shallow punctures; vestiture on pronotum sparse, long, suberect; mesonotum and scutellum with only few scattered setae; pronotal disc (fig.182) 0.55x as long as wide; parapsidal furrow weak, but complete; notauli absent; scutellum with a pair of basal slits connected by a narrow groove; propodeal disc 0.54x as long as wide, smoothly inclined to lateral margin; basal median propodeal triangle smooth, extending to posterior margin of disc, propodeal triangle elevated only in basal half of dorsum; transverse carina broadly interrupted medially, only smooth impression of transverse carina in middle; rest of dorsum and declivity coriaceous. Forewing (fig.182) 3.26x as long as wide, without areolet; only a short stub arising from basal vein; M and SM setose; distal one third of M setose;
speculum with only a pair of setae near short stub from basal vein; m:rs:rs+m 6:3:4.
Forefemur (fig.185) 2x as long as wide; SI 5.21.

Metasoma: Metasoma (fig.15) slightly shorter than mesosoma (31:34), shorter than head plus mesosoma (31:57); tergites smooth and polished; T1-T3 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

Male: Unknown.

Ecology and Biology: ex. larvae of groundnut leaf miner, *Aproaerema modicella* (Deventer) (Lepidoptera: Gelechiidae). It was also collected from the paddy fields in Palghat.

Etymology: The species epithet is after the host’s generic name, *Aproaerema*.

Distribution: India – Kerala; Tamil Nadu; Chhattisgarh – Durg.

groundnut leaf miner, *Aproaerema modicella* (Deventer), G. Santharam, VRN 132 (DZUC).

*Variation:* Mandible brownish yellow (VRN 132); prostigma, pterostigma straw coloured, teeth of mandible dark red (VRN 14); teeth red (VRN 105); scape red-brown concolourous with mandible (VRN 169). In few paratypes, WH = LH, OOL 0.83x WOT, WF = HE, LH 0.86x LA, LS 1.7x PL and PL 1.16x LF1. See table-5 for morphometric ratios of the type materials examined.

*Discussion:* Goniozus aproaeremae sp. nov. is similar to *G. prosphatosis* sp. nov. in having posterior transverse propodeal carina broadly interrupted medially and head as long as wide in full face view, WH 0.91x - 1.02x LH, but it differs in having brown-black mandible, antenna as long as head, vertex straight, forefemur 2x as long as wide, clypeal carina absent, malar space narrow and setae on vertex as long as that of frons, whereas in *G. prosphatosis* sp. nov., mandible is yellow, antenna distinctly longer than head, vertex emarginate, forefemur 2.1x as long as wide, clypeal carina present, malar space distinct and setae on vertex distinctly longer than that of frons.

**Table 5. Morphometric ratios of Goniozus aproaeremae sp. nov.**

<table>
<thead>
<tr>
<th>VRN</th>
<th>WH / LH</th>
<th>OOL / WOT</th>
<th>EV / HE</th>
<th>WF / HE</th>
<th>LH / LA</th>
<th>LS / PL</th>
<th>PL / LF1</th>
</tr>
</thead>
<tbody>
<tr>
<td>133</td>
<td>1</td>
<td>1</td>
<td>0.432432</td>
<td>1</td>
<td>0.944444</td>
<td>1.714286</td>
<td>1.25</td>
</tr>
<tr>
<td>169</td>
<td>0.914286</td>
<td>1</td>
<td>0.35</td>
<td>1</td>
<td>0.875</td>
<td>2</td>
<td>1.5</td>
</tr>
<tr>
<td>58</td>
<td>0.933333</td>
<td>1</td>
<td>0.411765</td>
<td>1</td>
<td>0.857143</td>
<td>1.666667</td>
<td>1.5</td>
</tr>
<tr>
<td>55</td>
<td>0.882353</td>
<td>1</td>
<td>0.388889</td>
<td>1</td>
<td>0.918919</td>
<td></td>
<td></td>
</tr>
<tr>
<td>56</td>
<td>0.881356</td>
<td>1</td>
<td>0.4375</td>
<td>1</td>
<td>0.867647</td>
<td>1.666667</td>
<td>1.5</td>
</tr>
<tr>
<td>124</td>
<td>0.9</td>
<td>1</td>
<td>0.410256</td>
<td>0.974359</td>
<td>0.972222</td>
<td>1.5</td>
<td>1.6</td>
</tr>
<tr>
<td>105</td>
<td>0.904762</td>
<td>0.9</td>
<td>0.411765</td>
<td>1</td>
<td>0.9</td>
<td>1.571429</td>
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</tr>
<tr>
<td>132</td>
<td>0.909091</td>
<td>0.863636</td>
<td>0.388889</td>
<td>1</td>
<td>0.916667</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>0.930233</td>
<td>0.892857</td>
<td>0.375</td>
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<td>1.666667</td>
</tr>
<tr>
<td>163</td>
<td>0.888889</td>
<td>0.833333</td>
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<td>1</td>
<td>0.923077</td>
<td>1.5</td>
<td>2</td>
</tr>
<tr>
<td>14</td>
<td>0.944444</td>
<td>0.875</td>
<td>0.425</td>
<td>1</td>
<td>0.878049</td>
<td>1.75</td>
<td>1.6</td>
</tr>
<tr>
<td>59</td>
<td>0.9</td>
<td>0.84</td>
<td>0.355556</td>
<td>0.888889</td>
<td>0.952381</td>
<td>1.714286</td>
<td>1.166667</td>
</tr>
</tbody>
</table>

Mean values: 0.91 0.93 0.40 0.98 0.91 1.37 1.26

Santhosh, S.
Goniozus armigerae Santhosh and Narendran
(figs.186-189)


**Diagnosis:** Head elongate, WH 0.84-0.89x LH, clypeal margin obtuse, eye setose, mandible and antenna brown-yellow, F1 1.14-1.29x as long as wide; OOL 0.84-0.95x WOT; EV 0.42x HE. Anterior median propodeal carina connected to posterior transverse carina by a smooth line, scape less than 2x pedicel and areolet absent.

**Redescription:** *Holotype – Female.*

**Measurements:** Length 3.15mm; FWL 2.35mm; LH 0.79mm; WH 0.70mm; WF 0.43mm; LM 0.95mm; LP 0.43mm; WPD 0.55mm; LPD 0.33mm.

**Colour:** Body black; mandible brownish yellow, basal, dorsal and ventral margin dark brown, teeth red; antenna uniformly yellow except single brown terminal segment; coxa and forefemur of all legs and hindfemur brown, hindfemur lighter than forefemur and coxa, other segments yellow. Wing hyaline, stigma and prostigma brown, costa and subcosta light brown, other veins colourless.

**Head:** Distinctly longer than wide, WH 0.84x LH (fig.186), somewhat compressed in lateral aspect, 1.5x as long as wide (fig.188); frons and vertex coriaceous with scattered shallow punctures; gena smooth and polished; vestiture suberect, short and sparse, longest on vertex margin being 0.13mm; vertex margin straight, ecarinate; mandible robust with 4 teeth; anterior clypeal margin obtuse; clypeal carina strong, arcuate in profile, 0.68-0.78x HE, extending onto frons upto level of posterior scrobal margin; scrobe weakly carinate; WF 0.54x LH; WF 1x HE; EV 0.42x HE; LH 1.89x HE; malar space narrow; malar groove absent; eye sparsely setose, setae minute as long as single facet; ocelli in obtuse triangle, posterior pair separated from vertex crest by less than their own diameters; OOL 0.91x WOT; POL: AOL: DAO = 6:2.5:2.5. Relative lengths of first five antennal segments (fig.187) 8:4.2:4:4:3.5; scape 1.44x as long as wide, shorter than 2x pedicel; F1 1.25x as long as wide; F2 -
F5 wider than long; F6 - F10 as long as wide; F11 longer than wide; antenna slightly longer than head in full face view (25:20).

**Mesosoma:** Pronotum dull coriaceous, 0.45x as long as wide, vestiture longer than that of head; mesoscutum rather smooth and shining, and only weakly coriaceous with relatively sparse punctures; propodeum (fig.186) 0.63x as long as maximum width at level posterior to spiracles, with complete transverse carina on posterior margin; disc smoothly inclined to lateral margin; median basal triangle of propodeal dorsum smooth and polished, extending beyond middle of propodeal dorsum and connected to posterior transverse carina as a smooth line, rest of disc and posterior declivity coriaceous. Forewing (fig.186) without areolet, M sparsely setose, SM with a row of setae, rs+m slightly curved at apex, m:rs:rs+m = 9:5:7. Forefemur (fig.189) length 1.78-1.85x its width; SI 4.72;

**Metasoma:** (fig.1) Metasoma (fig.186) subequal to mesosoma (52:50), shorter than head plus mesosoma (50:85); tergites smooth and polished; T1-T3 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

**Male:** Unknown.

**Ecology and Biology:** ex. larvae of *Helicoverpa armigera* (Hüb.n.) (Lepidoptera: Noctuidae).

**Distribution:** India – Himachal Pradesh.

**Material Examined: Holotype** – Female. INDIA: Himachal Pradesh, Solan, 30°54'N 77°05'E, 06.ii.1995, rearing, ex. larvae of *Helicoverpa armigera*, J. N. Thakur leg., VRN 25. (INPC) ON LOAN. **Paratypes** – 4 ♀. same data as holotype except VRN 23, VRN 24, VRN 26, VRN 27 (INPC) ON LOAN.

**Variation:** In the paratypes, VRN 23, scape is 1.55x pedicel and OOL 0.83x WOT. See table- 6 for morphometric ratios of all the type materials examined.

**Discussion:** *Goniozus armigerae* is closely related to *G. kainophanestus* sp. nov., *G. nuperus* sp. nov., and *G. novellus* sp. nov., but in all the three later species head is strongly compressed in lateral view; ventral most mandibular tooth strongly curved downwards; metasoma distinctly longer than mesosoma; antenna as long as head in

Santhosh, S.
full face view; *G. armigerae* is similar to *G. chatterjii* Kurian, but in *G. armigerae*, the mandible is yellow in colour, EV 0.42x HE, and the propodeal triangle is connected to the transverse carina by a smooth line, whereas in *G. chatterjii* mandible is red-brown in colour, EV 0.25x HE, and the anteromedial propodeal triangle smooth, connected to the posterior transverse carina by a raised median carina. This species is also similar to *G. japonicus* Ashmead, but in *G. armigerae* the clypeal margin is obtusely angulated, the posterior transverse carina is complete, eye setose, and the anteromedial smooth propodeal triangle is connected to the transverse carina by a median smooth line, whereas in *G. japonicus* the clypeal margin is acutely angulated, the posterior transverse carina of propodeum is evanescent in the middle, the eye bare, and the anteromedial smooth propodeal triangle is connected to the posterior margin by a smooth blotch.

**Remarks:** *Goniozus (= Paraseriola) species* emerged from *Helicoverpa (= Heliothis) armigera* (Hübn.) had been previously recorded from Coimbatore, Tamil Nadu (VADIVELU et al., 1975), from maize fields of Bangalore, Karnataka (DIVAKAR and PAWAR, 1982; DIVAKAR et al., 1983) but none were described so far. These undescribed species may be conspecific to new species but specimens of previous records are not available to study for confirmation. The types are deposited in INPC. Some parts of the description given above are adapted from SANTHOSH and NARENDRAN (2009). The species is redescribed here for the comprehensive treatment of the genus *Goniozus*.

**Table – 6. Morphometric ratios of Goniozus armigerae Santhosh and Narendran**

<table>
<thead>
<tr>
<th>VRN</th>
<th>WH / LH</th>
<th>OOL / WOT</th>
<th>EV / HE</th>
<th>WF/HE</th>
<th>LH / LA</th>
<th>LS / PL</th>
<th>PL / LF1</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>0.83784</td>
<td>0.90909</td>
<td>0.42105</td>
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<td>0.860465</td>
<td>1.8</td>
<td>1.25</td>
</tr>
<tr>
<td>26</td>
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<td>0.42105</td>
<td>1</td>
<td>0.833333</td>
<td>1.90476</td>
<td>1.2</td>
</tr>
<tr>
<td>24</td>
<td>0.86111</td>
<td>0.95238</td>
<td>0.42444</td>
<td>1</td>
<td>0.837209</td>
<td>1.77778</td>
<td>1.125</td>
</tr>
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<td>23</td>
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<td>0.83636</td>
<td>0.42105</td>
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<td>0.833333</td>
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</tr>
<tr>
<td>27</td>
<td>0.88889</td>
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<td>0.42105</td>
<td>1</td>
<td>0.837209</td>
<td>1.77778</td>
<td>1.125</td>
</tr>
</tbody>
</table>

Mean values: 0.87, 0.90, 0.42, 1, 0.84, 1.76, 1.16

Santhosh, S.
**Goniozus buddhai** sp. nov.  
(figs.19-21, 190-192)

**Diagnosis:** Head elongate, WH 0.87-0.89x LH; mandible yellow; ventral most mandibular tooth strongly curved downwards; EV 0.31x – 0.39x HE; scape shorter than 2x pedicel; eye sparsely setose, setae as long as diameter of single facet; anterior clypeal margin obtuse. Parapsidal furrow present; propodeal disc with complete posterior transverse carina; anteromedian propodeal triangle elevated, smooth, as such reaching posterior transverse carina; forefemur longer than 2x as long as wide. Forewing without areolet, but a short stub arising from basal vein only; M, SM, speculum with few scattered setae.

**Description:** Holotype – Female.

*Measurements:* Length 2.45mm; FWL 1.83mm; LH 0.61mm; WH 0.53mm; WF 0.32mm; LM 0.98mm; LP 0.33mm; WPD 0.42mm; LPD 0.26mm.

*Colour:* Body dark brown, base of metasoma lighter; mandible dark yellow with brown teeth; antenna yellow, scape and 4 terminal segments fuscous; leg brown except yellow tarsi and tibia. Wing hyaline, costa, subcosta, prostigma and stigma light brown, other veins colourless.

*Head:* Head (figs.21, 190) distinctly longer than broad, WH 0.87x LH, compressed in lateral aspect, 1.71x as long as wide (figs.20, 192); frons and vertex dull coriaceous with scattered shallow punctures (fig.21); gena smooth and polished; vestiture short, sparse, decumbent, longest on vertex margin being 0.1mm; vertex emarginate, carinate; anterior clypeal margin strongly projecting, bluntly angulated, obtuse; clypeal carina 0.63x HE, extending onto frons upto level of posterior margin of scrobe; scrobe weakly carinate; mandible moderately slender with 4 short, pointed teeth, ventral most curved; WF 0.51x LH; WF 0.89x HE; EV 0.39x HE; LH 1.89x HE; malar space narrow; malar groove absent; eye sparsely setose, setae minute, as long as diameter of single facet; ocelli in obtuse triangle; posterior ocelli contiguous with vertex margin; OOL 0.90x WOT; POL:AOL:DAO = 6:3:2.5. Relative lengths of first five antennal segments (fig.191) 5:3:2.5:2.5:3; scape 1.25x as long as wide, shorter than 2x pedicel length; pedicel longer than F1; F1 – F4...
wider than long, F5-F10 as long as wide; terminal segment longer than wide; antenna slightly longer than head in full face view (38:35).

_Mesosoma:_ Pronotum coriaceous with scattered shallow punctures; sculpture of mesonotum and scutellum same as that of head and pronotum but weaker; pronotal disc (fig.190) 0.45x as long as wide; mesonotum with weak parapsidal furrow, no notauli; scutellum with a pair of basal slits; propodeal disc 0.53x as long as wide, smoothly inclined to lateral margin; basal median propodeal triangle smooth and shining, elevated, reaching posterior margin; rest of propodeal disc, declivity coriaceous; posterior transverse carina complete. Forewing (fig.190) 2.82x as long as wide, without areolet, M, SM with a row of setae; speculum asetose; m:rs:rs+m = 5:4:4. Forefemur (fig.192) 2.1x as long as wide; SI 6.

_Metasoma:_ Metasoma (fig.19) distinctly longer than mesosoma (67:56), shorter than head plus mesosoma (67:91); tergites smooth and polished; T1-T2 completely smooth, others with a weak coriaceous basal band; T1-T3 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

_Male:_ Unknown.

_Ecology and Biology:_ Unknown.

_Etymology:_ The species epithet is after the Great Buddhist Spiritual Master, Gauthama Buddha.

_Distribution:_ India – Kerala.

Variation: In some paratypes WF = HE, OOL 1.05x WOT and LS 2x PL. See table-7 for morphometric ratios of all the type materials examined.

Discussion: Goniozus chatterji Kurian is closely related to G. buddhai sp. nov. in having forefemur longer than 2x as long as wide and EV 0.25-0.39x HE, but differs in having mandible brown-black; ventral most mandibular tooth straight; tip of anteromedian propodeal triangle elevated, smooth, and connected to posterior transverse carina by means of median carina, whereas in G. buddhai sp. nov., mandible yellow; ventral most mandibular tooth strongly curved downwards; tip of anteromedian propodeal triangle elevated, smooth, reaching posterior transverse carina. Goniozus buddhai sp. nov. is also related to G. armigerae, but in G. armigerae forefemur is less than 2x as long as wide and EV 0.44 – 0.83x HE whereas in G. buddhai sp. nov. forefemur is more than 2x as long as wide and EV 0.25 – 0.39x HE.

Remarks: The paratype VRN 165 is with a damaged head. Hence morphometric measurements were not taken from the same.

Table 7. Morphometric ratios of Goniozus buddhai sp. nov.

<table>
<thead>
<tr>
<th>VRN</th>
<th>WH / LH</th>
<th>OOL / WOT</th>
<th>EV / HE</th>
<th>WF / HE</th>
<th>LH / LA</th>
<th>LS / PL</th>
<th>PL / LF1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.870968</td>
<td>0.9</td>
<td>0.38889</td>
<td>0.88889</td>
<td>0.92357</td>
<td>1.66667</td>
<td>1.30435</td>
</tr>
<tr>
<td>2</td>
<td>0.892857</td>
<td>1.05555556</td>
<td>0.375</td>
<td>0.90625</td>
<td>0.96552</td>
<td>2</td>
<td>1.25</td>
</tr>
<tr>
<td>3</td>
<td>0.878571</td>
<td>1</td>
<td>0.3125</td>
<td>0.96875</td>
<td>0.96552</td>
<td>1.66667</td>
<td>1.5</td>
</tr>
<tr>
<td>4</td>
<td>0.873333</td>
<td>0.9</td>
<td>0.33333</td>
<td>0.88889</td>
<td>0.9375</td>
<td>1.66667</td>
<td>1.30435</td>
</tr>
<tr>
<td>6</td>
<td>0.863226</td>
<td>0.95</td>
<td>0.38889</td>
<td>0.94444</td>
<td>0.96875</td>
<td>1.83333</td>
<td>1.5</td>
</tr>
<tr>
<td>164</td>
<td>0.890909</td>
<td>0.94444444</td>
<td>0.38889</td>
<td>0.83333</td>
<td>0.85938</td>
<td>1.6</td>
<td>1.38889</td>
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<tr>
<td>162</td>
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<td>1.05882353</td>
<td>0.366667</td>
<td>1</td>
<td>0.89286</td>
<td>1.8</td>
<td>1.25</td>
</tr>
<tr>
<td>99</td>
<td>0.894286</td>
<td>0.8</td>
<td>0.375</td>
<td>1</td>
<td>0.96552</td>
<td>2</td>
<td>1.30435</td>
</tr>
</tbody>
</table>

Mean Values

|           | 0.88 | 0.95 | 0.37 | 0.92 | 0.93 | 1.78 | 1.35 |

Santhosh, S.
Goniozus clypeatus sp. nov.  
(figs.22-25, 193-196)

**Diagnosis:** Head longer than wide, WH 0.87-0.89 x LH, compressed in lateral aspect, 1.73x as long as wide; frons and vertex strongly coriaceous with scattered shallow punctures; anterior clypeal margin acute; clypeal carina strong, extending onto frons; eye profusely setose; setae long, 3x as long as diameter of single facet; OOL 1.10-1.23 x WOT; EV 0.32-0.37 x HE; vertex slightly convex in full face view, carinate. Antenna slightly longer than head in full face view; pedicel shorter than F1; F2 and F3 wider than long, F4-F10 as long as wide. Propodeal disc with a smooth median band, extending posteriorly onto declivity; propodeal disc posteriorly without transverse carina. Forewing with subtriangular areolet, M, SM profusely setose.

**Description:** Holotype – Female.

**Measurements:** Length 3.16mm; LH 0.73mm; WH 0.64mm; WF 0.41mm; FWL 2.07mm; LM 1.12mm; LP 0.32mm; WPD 0.5mm; LPD 0.25mm.

**Colour:** Body black, basal and terminal abdominal tergites brown; antenna brownish yellow, terminal six segments dark brown; mandible yellow, teeth darker; leg yellow; coxa, femur of foreleg and hindleg with a brown patch on dorsal margin; wing hyaline, costa, subcosta, prostigma and stigma light brown, other veins colourless.

**Head:** Head (fig.24, 193) longer than wide, WH 0.87x LH, compressed in lateral aspect, 1.73x as long as wide (fig. 23, 195); frons and vertex strongly coriaceous with scattered shallow punctures; gena smooth and polished; vestiture long, profuse, decumbent; four pairs of long setae on vertex, longest being 0.25mm; anterior clypeal margin strongly produced, sharply angulated, acute; clypeal carina 0.67x HE, strong and arcuate in profile, extending onto frons as a low carina up to level of posterior scrobal margin; scrobe ecarinate; mandible moderately stout with 4 short, blunt teeth, ventral most straight; WF 0.56x LH; WF 0.96x HE; OOL 1.16x WOT; EV 0.35x HE; LH 1.78x HE; malar space narrow; malar groove absent; eye profusely setose; setae long, 3x as long as diameter of single facet; ocelli in obtuse...
triangle; posterior ocelli contiguous with vertex margin; POL:AOL:DAO = 5:2.7:2:2; vertex slightly emarginated, convex in full face view, sharply angulate, carinate. Relative lengths of first five antennal segments (fig. 194) 8:5:3.5:4:3.5:3.5; scape 1.55x as long as wide, shorter than 2x pedicel; pedicel shorter than F1; F2 and F3 wider than long, F4-F10 as long as wide; terminal segment longer than wide; antenna slightly longer than head in full face view (28:23).

Mesosoma: Pronotum, mesonotum, scutellum uniformly coriaceous (fig.25); vestiture long, profuse, decumbent; pronotal disc (fig. 25, 193) 0.54x as long as wide; parapsidal furrow complete; notauli absent; scutellum with a pair of basal pits connected by narrow groove; propodeal disc 0.64x as long as wide, smoothly inclined to lateral margin; basal median propodeal area with smooth, polished band, not elevated, extending beyond posterior margin of disc to declivity, rest of disc and declivity coriaceous; posterior transverse carina absent; setae on propodeal disc around inner margin of spiracles. Forewing (fig.193) 2.84x as long as wide; areolet present, subtriangular in shape; M, SM, areolet speculum profusely setose. Forefemur (fig. 196) 1.64x as long as wide; SI 5.23.

Metasoma: Metasoma (fig.22) longer than mesosoma (36:28), shorter than head plus mesosoma (36:43); tergites smooth and polished; T1-T3 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

Male: Unknown.

Ecology and Biology: Unknown.

Etymology: The species epithet is after the clypeus of the species with an acute anterior margin.

Distribution: India – Kerala.

Investigation on the Alpha Taxonomy of Bethylidae

Observation and Results

75°50.25'E, 29m, 4.iv.2004, sweeping, K.P. Girish Kumar, leg., VRN 75; 2♀.
Malappuram, Calicut University Botanical Garden, Arboretum, 11°07.58'N
75°53.24'E, 80m, MT, 5-12.iv.2007. S. Santhosh leg., VRN 179, VRN 178; 1♀.
Malappuram, Calicut University Botanical Garden, Arboretum, 11°07.58'N
75°53.24'E, 80m, MT, 19-27.xii.2006, S. Santhosh leg., VRN 112. (DZUC).

Variation: In paratypes, WH 0.81x LH, OOL – WOT and EV 0.44x HE. See table- 8 for morphometric ratios of all the type materials examined.

Discussion: Goniozus clypeatus sp. nov. is similar to G. longigastralis sp. nov. in having M and SM of forewing profusely setose, speculum setose, clypeal carina strong extending onto frons, malar space narrow without malar groove and forefemur 1.6 – 1.8x as long as wide. Goniozus clypeatus sp. nov. differ from G. longigastralis sp. nov. in having ocular setae 3x as long as diameter of single facet, ocelli in obtuse triangle, frons and vertex strongly coriaceous, OOL 1.10-0.23x WOT, anterior clypeal margin acute, propodeal disc with a smooth median band extending posteriorly onto declivity, pedicel shorter than F1 and WF 0.92-0.97x HE, whereas in G. longigastralis sp. nov. ocular setae as long as diameter of single facet, ocellar triangle acute, frons and vertex weakly coriaceous, OOL 1.75x WOT, anterior clypeal margin obtuse, propodeal disc with a smooth anterior median elevated triangle extending to posterior margin by a median line, pedicel as long as F1 and WF 1.18x HE.
Table – 8. Morphometric ratios of Goniozus clypeatus sp. nov.

<table>
<thead>
<tr>
<th>VRN</th>
<th>WH / LH</th>
<th>OOL / WOT</th>
<th>EV / HE</th>
<th>WF / HE</th>
<th>LH / LA</th>
<th>LS / PL</th>
<th>PL / LF1</th>
</tr>
</thead>
<tbody>
<tr>
<td>155</td>
<td>0.87234</td>
<td>1.16666667</td>
<td>0.346154</td>
<td>0.96154</td>
<td>0.81034</td>
<td>2.5</td>
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<tr>
<td>156</td>
<td>0.875</td>
<td>1.23636364</td>
<td>0.357143</td>
<td>0.92857</td>
<td>0.8</td>
<td>2.5</td>
<td>0.8</td>
</tr>
<tr>
<td>154</td>
<td>0.877551</td>
<td>1.07692308</td>
<td>0.333333</td>
<td>1</td>
<td>0.79032</td>
<td>2.5</td>
<td>0.8</td>
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<tr>
<td>140</td>
<td>0.88</td>
<td>1.15384615</td>
<td>0.321429</td>
<td>0.96429</td>
<td>0.86207</td>
<td>2.5</td>
<td>0.8</td>
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<tr>
<td>139</td>
<td>0.86</td>
<td>1.07142857</td>
<td>0.37037</td>
<td>1</td>
<td>0.83333</td>
<td>2.5</td>
<td>0.8</td>
</tr>
<tr>
<td>75</td>
<td>0.810811</td>
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<td>0.444444</td>
<td>0.94444</td>
<td>0.97368</td>
<td>2.33333</td>
<td>0.6</td>
</tr>
<tr>
<td>178</td>
<td>0.897959</td>
<td>1.15384615</td>
<td>0.321429</td>
<td>0.96429</td>
<td>0.84483</td>
<td>2.25</td>
<td>0.8</td>
</tr>
<tr>
<td>179</td>
<td>0.897959</td>
<td>1.15384615</td>
<td>0.321429</td>
<td>0.96429</td>
<td>0.84483</td>
<td>2.25</td>
<td>0.8</td>
</tr>
<tr>
<td>112</td>
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<td>1.07142857</td>
<td>0.333333</td>
<td>0.96667</td>
<td>0.87097</td>
<td>2.9</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Mean Values: 0.87, 1.12, 0.35, 0.97, 0.85, 2.47, 0.78

Goniozus cotha sp. nov.

(figs.26-29, 197-200)

**Diagnosis:** Head slightly longer than wide, WH 0.91x LH; weakly compressed in lateral aspect, 1.66x as long as wide; frons and vertex strongly coriaceous with scattered shallow punctures; anterior clypeal margin strongly produced, sharply angulated, acute; gena smooth and polished; malar space distinct; malar groove present; mandible black, EV 0.31x HE; metasoma distinctly longer than mesosoma. Antenna longer than head in full face view; scape shorter than 2x pedicel; pedicel longer than F1; F1 and F2 longer than wide; F3- F8 as long wide; F9-F11 longer than wide. Forewing 2.74x as long as wide with subrectangular areolet; M, SM, areolet sparsely setose.

**Description:** Holotype – Female.

**Measurements:** Length 3.83mm; LH 0.81mm; WH 0.74mm; WF 0.45mm; FWL 2.21mm; LM 1.14mm; LP 0.38mm; WPD 0.61mm; LPD 0.31mm.
Colour. Body black, metasoma dark brown; mandible black, teeth brown; antenna yellowish brown, terminal 5 segments darker; coxa, femur dark brown, foretibia, tarsus yellow; midtibia, hindtibia brown. Wing hyaline; prostigma, pterostigma, subcosta light brown, other veins straw coloured.

Head: Head (figs.28, 197) longer than wide, WH 0.91x LH, compressed in lateral aspect, 1.66x as long as wide (figs.27, 199); frons and vertex strongly coriaceous with scattered shallow punctures; gena smooth and polished; vestiture moderately long, 0.086mm; sparse, suberect; setae on vertex distinctly longer than setae on head, longest being 0.24mm; anterior clypeal margin strongly produced, sharply angulated, acute; clypeal carina strong, arcuate in profile, 0.64x HE; extending onto frons as a low carina upto level of posterior margin of scrobe; scrobe ecarinate; mandible stout, teeth 4, short, ventral most straight; WF 0.55x LH; WF = HE; EV 0.31x HE; LH 2.1x HE; malar space distinct; malar groove present; eye setose, setae minute, as long as diameter of single facet; ocelli in obtuse triangle; posterior ocelli contiguous with vertex margin; OOL 0.9x WOT; POL: AOL: DAO = 6:2.5:2; vertex slightly emarginate in full face view, acute, sharply angled to occiput, ecarinate. Relative lengths of first five antennal segments (fig.198) 7:4:3:3:3; scape 1.89x as long as wide, shorter than 2x pedicel; pedicel longer than F1; F1 and F2 longer than wide; F3- F8 as long wide; F9-F11 longer than wide; antenna longer than head in full face view (43:34).

Mesosoma. Pronotum, mesonotum, and scutellum (fig.29) strongly coriaceous uniformly, with scattered shallow punctures; vestiture long, sparse, suberect on pronotum, mesonotum and scutellum; pronotal disc 0.33x as long as wide; mesonotum with distinct, complete parapsidal furrow; notauli absent; scutellum with a pair of basal slits connected by a weak transverse groove; propodeal disc 0.49x as long as wide, smoothly inclined to lateral margin; basal median propodeal elevated triangle weakly coriaceous, not well defined at edges, extending to posterior margin by a smooth line; rest of propodeal disc and declivity strongly coriaceous; posterior transverse propodeal carina complete. Forewing (fig.197) 2.74x as long as wide; areolet present; areolet subrectangular in shape; M, SM and areolet sparsely setose, speculum profusely setose. Forefemur (fig.200) 1.68x as long as wide; SI 5.36.
Metasoma. Metasoma (fig.26) distinctly longer than mesosoma (79:48), slightly shorter than head plus mesosoma (79:82); tergites generally smooth and polished; T1 completely smooth, other tergites with weakly coriaceous basal half; T1-T2 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

Male: Unknown.

Ecology and Biology: Collected from the forest canopy. Host unknown.

Etymology: The name of the species is technically an arbitrary combination of letters, but the pronunciation of this name is after the Nilgiris tribal group, Kotha for their help in the exploration leading to the collection of this specimen.

Distribution: India – Tamil Nadu – Nilgiris.

Material Examined: Holotype – Female. INDIA: Tamil Nadu, Nilgiris, Coonoor, Pudukadu, 3.88kms SE Coonoor, 11°19.93’N 76°50.02E, 890m, SEF, YPT, 27.xii.2007, T.A. Priya leg., VRN 158 (DZUC).

Discussion: Goniozus cotha sp. nov. is similar to G. pulveriae (Kurian) in having frons and vertex strongly coriaceous, mandible dark brown to black and median clypeal carina strong and extending onto frons as a low carina, but differ in having eye sparsely setose, setae as long as diameter of single facet, scape shorter than 2x as long as pedicel, EV 0.31x HE, areolet subrectangular, rs = m and mesosoma shorter than metasoma, whereas in G. pulveriae eye is asetose, forefemur 1.94x as long as wide, scape longer than 2x as long as pedicel, EV 0.67x HE, areolet subtriangular, rs shorter than m and mesosoma longer than metasoma. Goniozus villosus Krombein is also similar to G. cotha sp. nov. and G. pulveriae in having frons and vertex strongly coriaceous, mandible dark brown to black and median clypeal carina strong and extending onto frons as a low carina, but differ in having eye profusely setose, ocular setae 2x as long as diameter of single facet, EV 0.18x HE, scape 2x as long as pedicel, and mandible is slender and brown.
**Goniozus delhiensis** Ram
(fig.30)


**Diagnosis:** Head transverse, WH 1.07x LH, compressed in lateral aspect, 1.72x as long as wide; frons and vertex polished, weakly coriaceous with scattered shallow punctures; clypeal margin obtuse; mandible red brown; vertex emarginate in full face view; OOL 1.12x WOT; EV 0.39x HE. Antenna slightly longer than head in full face view; scape shorter than 2x pedicel; pedicel = F1. Parapsidal furrow complete, but anteriorly weak; propodeal disc smoothly inclined to lateral margin, no sublateral ridge; posterior propodeal transverse carina broadly interrupted medially. Forewing without areolet, but only short stub arising from basal vein.

**Redescription: Paratype – Female.**

*Measurements:* Length 3.37mm; LH 0.68mm; WH 0.73mm; WF 0.42mm; FWL 2.44mm; LM 1.27mm; LP 0.51mm; WPD 0.54mm; LPD 0.37mm.

*Colour:* Body dark brown, mandible red brown with dark brown teeth; antenna yellow, 6 terminal segments fuscous; leg brown except yellow tarsi and tibia; wing hyaline, costa, subcosta, prostigma and stigma light brown, other veins colourless.

*Head:* Head transverse, WH 1.07x LH; compressed in lateral aspect, 1.72x as long as wide; frons and vertex polished and weakly coriaceous with scattered shallow punctures; gena smooth and polished; vestiture short, sparse, decumbent, setae along vertex margin are not distinctly longer than other setae on head; anterior clypeal margin strongly produced, bluntly angulated, obtuse; clypeal carina 0.61x HE, extending onto frons beyond level of posterior scrobal margin; scrobe ecarinate; mandible stout with 4 moderately long, blunt teeth, ventral most straight; WF 0.55x LH; WF 0.94x HE; EV 0.39x HE; LH 1.83x HE; eye sparsely setose, setae minute, shorter than diameter of single facet; ocelli in obtuse triangle; posterior ocelli contiguous with vertex margin; OOL 1.12x WOT; POL: AOL: DAO = 4.5:4:2.5; vertex straight in full face view, weakly carinate. Relative lengths of first five antennal segments 5.5:2.5:2.5:2.5:3; scape 1.72x as long as wide, longer than 2x
pedicel length; pedicel = F1; F2 and F3 wider than long, F4-F10 as long as wide; terminal segment longer than wide; antenna slightly longer than head in full face view (33:28).

Mesosoma: Pronotum (fig.30) strongly coriaceous with scattered shallow punctures; sculpture of mesonotum and scutellum weaker and polished; vestiture sparse, short, suberect; pronotal disc 0.41x as long as wide; parapsidal furrow complete, but anteriorly weak; notaui absent; scutellum with a pair of basal slits connected by a narrow transverse groove; propodeal disc 0.68x as long as wide, smoothly inclined to lateral margin; basal median propodeal triangle smooth, shining, and elevated extending beyond middle of disc, reaching to posterior margin by a weak carina; rest of propodeal disc and declivity coriaceous; posterior transverse carina broadly interrupted medially. Forewing 2.78x as long as wide, without areolet, only a short stub arising from basal vein; M, SM with single row of setae; speculum asetose; m:rs:rs+r = 7:5:5. Forefemur 1.74x as long as wide; SI 4.7.

Metasoma: Metasoma slightly longer than mesosoma (58:52), shorter than head plus mesosoma (58:80); tergites smooth and polished; T1-T3 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

Male: Unknown.

Ecology and Biology: ex. Dichocrocis punctiferalis (Guenee) (Lepidoptera: Pyralidae).

Distribution: India – Delhi.

Material Examined: Holotype – Female. INDIA: Delhi, 219m, 20.x.1964, rearing, ex. Dichocrocis punctiferalis (Guenee), Atma Ram, (INPC). Paratype, l♂. same data of holotype, (INPC).

Discussion: Goniozus delhiensis Ram is similar G. pakmanus Gordh in having brown-black mandible, OOL 1.12 – 1.25x WOT, clypeal margin obtuse, pedicel equal to or less than F1, propodeal disc smoothly inclined to lateral margin and no sublateral ridge on propodeal disc. Goniozus delhiensis is having posterior propodeal transverse carina broadly interrupted medially, vertex emarginate in full
Observation and Results

face view and pedicle = F1, but *G. pakmanus* is having posterior propodeal transverse carina weak, but complete, vertex straight in full face view and pedicle shorter than F1. *Goniozus sringeriensis* sp. nov. differ from both *G. delhiensis* and *G. pakmanus* in having yellow mandible, OOL 0.70x WOT, clypeal margin acute, pedicel longer than F1, propodeal disc sharply inclined to lateral margin with weak sublateral ridge.

Remarks: Since the original description is inadequate for specific identification the species is redescribed here with complete details. Holotype is in bad condition, fungal infested and antennal terminal segments are lost. The diagrams and descriptions were based on the paratype.

*Goniozus inauditus* sp. nov.
(figs.31-34, 201-204)

Diagnosis: Head distinctly longer than wide, WH 0.83-0.85x LH, compressed in lateral aspect, 1.72x as long as wide; frons and vertex strongly coriaceous, with scattered shallow punctures; gena smooth and polished; malar space distinct; malar groove present; eye sparsely setose, setae as long as diameter of single facet; posterior ocelli contiguous with vertex margin; ocelli in obtuse triangle; OOL 1.09-1.1x WOT; WF = HE; EV 0.47-0.55x HE. Anteromedian smooth propodeal triangle absent; median smooth longitudinal band not elevated, extending to posterior margin of propodeal disc, wider in posterior half. Forewing with subtriangular areolet, M, SM profusely setose. Forefemur 1.92x as long as wide;

Description: **Holotype – Female.**

Measurements: Length 3.08mm; LH 0.64mm; WH 0.54mm; WF 0.31mm; FWL 1.66mm; LM 0.9mm; LP 0.29mm; WPD 0.39mm; LPD 0.21mm.

Colour: Body brownish black, metasoma brown at apex; mandible, teeth dark brown; antenna yellow, terminal 5 segments light brown; coxa, femur light brown, other segments yellow. Wing hyaline; prostigma, pterostigma costa, subcosta light brown, other veins straw coloured.
**Investigation on the Alpha Taxonomy of Bethylidae**

**Observation and Results**

**Head:** Head (figs.33, 201) distinctly longer than wide, WH 0.85x LH, compressed in lateral aspect, 1.72x as long as wide (figs.32, 203); frons and vertex strongly coriaceous, with scattered shallow punctures; gena smooth and polished; vestiture moderately long, 0.066mm; profuse, decumbent; setae on vertex distinctly longer than setae on head, longest being 0.15mm; anterior clypeal margin strongly produced, bluntly angulated, acute; clypeal carina 0.73x HE, strong, arcuate in profile, extending onto frons as a low carina slightly beyond posterior scrobal margin; scrobe carinate; mandible stout with 4 short, blunt teeth, ventral most straight and longest; WF 0.48x LH; WF = HE; EV 0.50x HE; LH 1.74x HE; malar space distinct; malar groove present; eye sparsely setose, setae minute, as long as diameter of single facet; ocelli in obtuse triangle; posterior ocelli contiguous with vertex margin; OOL 1.09x WOT; POL:AOL:DAO = 4:2:2; vertex straight in full face view, acutely, smoothly curving to occiput, ecarinate. Relative lengths of first five antennal segments (fig.202) 7:3.5:2.5:3:3; scape 1.4x as long as wide, 2x as long as pedicel; pedicel longer than F1; F1 segment as long as wide; F2-F7 wider than long; F8-F9 as long wide; F10-F11 longer than wide; antenna slightly shorter than head in full face view (25:27).

**Mesosoma:** Pronotum, mesonotum, and scutellum (fig.34) strongly coriaceous uniformly; vestiture long, profuse, decumbent; sparse on scutellum, mesonotum; pronotal disc 0.55x as long as wide; mesonotum with complete parapsidal furrow; notauli absent; scutellum with a pair of slits at base connected by a weak narrow groove; propodeal disc 0.55x as long as wide, smoothly inclined to lateral margin; basal median smooth triangle absent; median smooth longitudinal band not elevated, extending to posterior margin of propodeal disc, wider in posterior half; rest of propodeal disc and declivity strongly coriaceous; transverse propodeal carina medially interrupted broadly. Forewing (fig.201) 2.8x as long as wide; areolet present; areolet subtriangular in shape; M, SM profusely setose, areolet sparsely setose; speculum profusely setose. Forefemur (fig.204) 1.92x as long as wide; SI 10.74.

**Metasoma:** Metasoma (fig.31) distinctly longer than mesosoma (36:27), shorter than head plus mesosoma (36:41); tergites completely smooth and polished; T1-T3 with
Observation and Results

few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

*Male:* Unknown.

**Ecology and Biology.** ex. leaf galls (fig.144) of thrips on *Memecylon umbellatum* Brum.f. (Memecylaceae); associate host: undetermined Staphylinidae. The species is also reported from *Opisina arenosella* Walker (Oecophoridae). This host record needs verification.

**Etymology:** The species epithet is after the Latin word *inauditus* meaning new.

**Distribution:** India – Karnataka; Kerala.


**Variation:** See table - 9 for the morphometric ratios of the type materials examined.

**Discussion:** It comes close to *G. nephantidis* but differ in having ocular setae as long as diameter of single facet, scape 2x pedicel, WF = HE, EV 0.62x HE, mandible black brown and antenna shorter than head in full face view, whereas in *G. nephantidis* ocular setae 2x as long as diameter of single facet, scape longer than 2x pedicel, WF 1.15x – 1.20x HE, EV 0.36 – 0.47x HE, mandible black and antenna slightly longer than head in full face view. *Goniozus inauditus* sp. nov. comes close to *G. alarius* sp. nov. in having eye sparsely setose, setae 2x diameter of single facet, forefemur 1.76 - 1.9x as long as wide, anterior median propodeal triangle smooth and polished, pedicel longer than F1 and scape longer than 2x pedicel, whereas in *G. alarius* sp. nov. eye is profusely setose, setae 4x as long as diameter of single facet,
forefemur 1.54 as long as wide, anterior median propodeal triangle coriaceous, pedicel = F1 and scape shorter than 2x length of pedicel

Table – 9. Morphometric ratios of *Goniozus inauditus* sp. nov.

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<th>VRN</th>
<th>WH / LH</th>
<th>OOL / WOT</th>
<th>EV / HE</th>
<th>WF / HE</th>
<th>LH / LA</th>
<th>LS / PL</th>
<th>PL / LF1</th>
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<tr>
<td>160</td>
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<td>1.090909</td>
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<td>1</td>
<td>1</td>
<td>2.2222</td>
<td>1.2</td>
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<td>0.473684</td>
<td>1</td>
<td>1</td>
<td>2.2222</td>
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<td>1</td>
<td>0.89474</td>
<td>1.94444</td>
<td>1.5</td>
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</table>

Mean Values 0.85 1.09 0.51 1 0.97 2.15 1.35

*Goniozus indicus* Ashmead

(figs.35-36, 205-208)

*Goniozus indicus* Ashmead, 1903. *Ind. Mus. Notes* 5: 178. (Not described)


**Diagnosis:** Head smooth and polished, longer than wide, WH 0.87x LH; anterior margin of clypeus acute; clypeal carina absent; mandible stout; antenna distinctly longer than head; mandible brown-black; eye sparsely setose, setae as long as diameter of single facet; EV 1.79x HE; OOL 2.15x WOT. Anteromedian propodeal triangle smooth, not elevated, beyond posterior margin of disc; no transverse carina. Forefemur 2.11x as long as wide. Forewing 3.69x as long as wide, without areolet, only a short stub curved at end arising from basal vein; M, SM with single row of setae. Metasoma distinctly longer than mesosoma, slightly longer than head plus mesosoma.

**Redescription:** *Plesiotype - Female.*

**Measurements:** Length 4.4mm; LH 0.84mm; WH 0.74mm; WF 0.45mm; FWL 2.53mm; LM 1.37mm; LP 0.53mm; WPD 0.59mm; LPD 0.34mm.
**Colour:** Body dark brown, first two segments light brown; mandible brown-black, teeth brown; antenna uniformly yellow except brown scape; leg brown, lighter than body colour. Wing hyaline; subcosta, pterostigma, prostigma brown; other veins straw coloured.

**Head:** Head (fig.36, 205) longer than wide, WH 0.87x LH, compressed in lateral aspect, 1.74x as long as wide (fig.207); frons and vertex smooth polished with sparse shallow punctures; gena smooth and polished; vestiture sparse, short, suberect; vertex straight in full face view sides behind eyes slightly convex before curving inward at posterolateral angles; mandible stout, with 4 long blunt teeth, ventral most straight; anterior margin of clypeus acute, carina weak, not extending onto frons; scrobe ecarinate; vertex ecarinate, without distinctly long setae; WF 0.53x LH; EV 1.79x HE; WF 1.78 HE; LH 3.37x HE; malar space distinct; malar groove present; eye sparsely setose, setae as long as diameter of single facet; ocelli in right angled triangle; posterior ocelli away from vertex by 3x its' diameter; OOL 2.15x WOT; POL:AOL:DAO = 4:3:1.5. Relative lengths of first five antennal segments (fig.206) 10:4:2.5:3:3; scape 1.82x as long as wide, longer than 2x pedicel; F1 as wide as long, terminal segment longer than wide, rest of them wider than long; F1 shorter than pedicel; antenna distinctly longer than head in full face view (32:39).

**Mesosoma:** Pronotum, mesonotum, scutellum (fig.35) polished, weakly coriaceous; vestiture short, decumbent, sparse on pronotum, only few setae on mesonotum and scutellum; pronotal disc (fig.205) 0.48x as long as wide; scutellum with a pair of basal shallow slits connected by a narrow groove; parapsidal furrow weak, incomplete, posteriorly absent; notauli absent; propodeal dorsum 0.59x as long as wide, smoothly inclined to lateral margin; basal median propodeal triangle smooth, not elevated; reaching beyond posterior margin of disc connected to smooth and polished median region of declivity; rest of dorsum and declivity coriaceous; posterior transverse carina absent. Forewing 3.69x as long as wide, without areolet, only a short stub arising from basal vein curved at the tip; M, SM with single row of setae; speculum sparsely setose; m:rs:rs+m = 6:3:5. Forefemur (fig.208) 2.11x as long as wide; SI 5.3.
Metasoma: Metasoma (fig.35, 205) distinctly longer than mesosoma (110:52),
longer than head plus mesosoma (110:90); tergites generally smooth and polished;
T1-T3 with few setae restricted to lateral margin; other tergites profusely setose all
across dorsal side.

Male: Same as female except following; head as long as wide, sides behind eyes
strongly convex before curving to straight vertex; EV 0.82x HE; WF 1.27x HE; LH
2.09x HE; malar space narrow; malar groove absent; posterior ocelli away from
vertex by its' diameter; OOL = WOT; POL:AOL:DAO = 3.5:2:3; length of first 5
antennal segments are in a ratio of 7.5:4:5:3.5:4; scape shorter than 2x pedicel;
pedicel shorter than F1.

Measurements: Length 3.24mm; LH 0.61mm; WH 0.61mm; WF 0.37mm; LM
1.24mm.

Ecology and Biology: ex. Emmalocera depressella (Swinhoe) (Lepidoptera:
Pyralidae) on Sugarcane.

Distribution: India – Bihar.

Material Examined: Plesiotype - 2♀. INDIA: Bihar, Pusa, 69 kms NE Patna,
25°59.03'N 85°41.30'E, 59m, collection date unknown, Vivai leg., ex. Emmalocera
depressella on Sugarcane, VRN 1804, VRN 1807(INPC). 1♂. same data except
VRN 1805 (INPC).

Discussion: Goniozus indicus closely resembles G. fulvicornis in having frons and
vertex smooth and polished and well defined clypeal carina, but differ in having the
head nearly parallel sided, small eye, HE shorter than EV, median clypeal carina not
extending to frons, thorax slender, narrower than head and propodeum without
transverse carina. In G. fulvicornis, eye is larger, thorax stouter and propodeum with
transverse carina notched in the middle.

Goniozus jeroeni sp. nov.

(figs.37-40, 209-212)

Diagnosis: Head slightly longer than wide, WH 0.96x LH; weakly compressed in
lateral aspect, 1.65x as long as wide; frons and vertex strongly coriaceous with

Santhosh, S.
scattered shallow punctures; clypeal carina absent, only smooth polished ridge present; ocelli in obtuse triangle; antenna slightly longer than head in full face view; 2x as long as pedicel; pedicel longer than F1; F1- F10 as long as wide; EV 0.46x HE. Basal median propodeal triangle elevated, smooth, extending to posterior margin of propodeal disc as a weak carina; posterior transverse propodeal carina in a zigzag fashion, complete. Forewing with subtriangular areolet; M, SM sparsely setose.

**Description:** *Holotype – Female.*

**Measurements:** Length 2.79mm; LH 0.56mm; WH 0.53mm; WF 0.33mm; FWL 1.64mm; LM 0.98mm; LP 0.28mm; WPD 0.43mm; LPD 0.23mm.

**Colour.** Body brownish black, metasoma dark brown; mandible yellowish brown, teeth yellow; antenna brownish yellow, scape, terminal 5 segments brown; leg brown, apex of tibia and tarsi yellow. Wing hyaline; prostigma, pterostigma brown, other veins colourless.

**Head:** Head (figs.39, 209) slightly longer than wide, WH 0.96x LH, compressed in lateral aspect, 1.65x as long as wide (figs.38, 211); frons and vertex strongly coriaceous with scattered shallow punctures; gena smooth and polished; vestiture moderately long, sparse, decumbent; setae on vertex moderately longer than setae on head, longest being 0.11mm; anterior clypeal margin strongly produced, bluntly angulate; obtuse; clypeal carina absent, very smooth, polished ridge present; scrobe ecarinate; mandible robust with 4 short blunt teeth, ventral most straight and longest; WF 0.59x LH; WF = HE; EV 0.46x HE; LH 1.75x HE; malar space distinct; malar groove present; eye sparsely setose, setae minute, as long as diameter of single facet; ocelli in obtuse triangle; posterior ocelli contiguous with vertex margin; OOL 0.88x WOT; POL:AOL:DAO = 5:2.5:1.5; vertex slightly emarginated in full face view; acutely angled, sharply margined; ecarinate. Relative lengths of first five antennal segments (fig.210) 7:3.5:2.5:3:3; scape 1.46x as long as wide, 2x as long as pedicel; pedicel longer than F1; F1- F10 as long as wide; terminal segment longer than wide; antenna slightly longer than head in full face view (45:35).
Mesosoma: Pronotum, mesonotum, and scutellum (fig.40) uniformly coriaceous, with scattered shallow punctures; vestiture on pronotum moderately long, profuse, decumbent; sparse on scutellum, mesonotum; pronotal disc 0.5x as long as wide; mesonotum with complete parapsidal furrow, notauli absent; scutellum with two pits at base connected by a very narrow transverse groove, propodeal disc 0.53x as long as wide, smoothly inclined to lateral margin; basal median propodeal triangle elevated, smooth, extending to posterior margin of propodeal disc as a weak carina; rest of propodeal disc, declivity coriaceous; posterior transverse propodeal carina in a zigzag fashion, complete. Forewing (fig.209) 2.88x as long as wide; areolet present, subtriangular in shape with single setae; M, SM sparsely setose; speculum sparsely setose. Forefemur (fig.212) 1.83x as long as wide; SI 5.39.

Metasoma: Metasoma (fig.37) distinctly longer than mesosoma (35:26), slightly shorter than head plus mesosoma (35:39); tergites smooth and polished; T1-T3 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

Male: Unknown.

Ecology and Biology: Collected from the forest canopy. Host unknown.

Etymology: The species epithet is after Jeroen de Rond, the Dutch bethylid taxonomist.

Distribution: India – Tamil Nadu – Nilgiris.

Material Examined: Holotype – Female. INDIA: Tamil Nadu, Nilgiris, Mudumalai WLS, Sigur, 4.69kms E Chemmanatham, 11°34.32'N 76°41.08'E, 883 m, 3.v.2007, scrub jungle, YPT, Justinraj leg., VRN 144 (DZUC).

Discussion: Goniozus jeroeni sp. nov. is similar to G. villosus Krombein, pulveriae (Kurian) and G. cotha sp. nov. in having frons and vertex strongly coriaceous and mandible dark brown to black, but differ in having no median clypeal carina, M, SM sparsely setose and EV 0.46x HE. Goniozus villosus, G. pulveriae and G. cotha sp. nov. have strong median clypeal carina. The new species and G. villosus have brown mandible and scape as long as 2x pedicel, but differ in having ocular setae as long...
the diameter of single facet, whereas in *G. jeroeni* sp. nov. it is 2x the diameter of single facet and EV 0.18x HE. *Goniozus pulveriae* and *G. cotha* sp. nov. differ from *G. jeroeni* sp. nov. in having brown-black mandible, M, SM with numerous setae.

**Goniozus kainophanestus** sp. nov.

(figs.41-44, 213-216)

**Diagnosis:** Head longer than wide, WH 0.86 - 0.89x LH; strongly compressed, 1.78x as long as wide; antenna as long as or slightly longer than head; scape shorter than 2x pedicel; mandible yellow; ventral most mandibular tooth strongly curved downwards; anterior clypeal margin obtuse; EV 0.42-0.44x HE; eye sparsely setose, setae as long as diameter of single facet; OOL 0.94-1x WOT; parapsidal furrows present; anteromedian smooth propodeal triangle not elevated, continued as a smooth patch to transverse carina; forefemur 1.67x as long as wide; forewing without areolet, but only short stub arising from basal vein; M, SM and speculum with few scattered setae; metasoma distinctly longer than mesosoma.

**Description:** *Holotype* – Female.

**Measurements:** Length 2.54mm; LH 0.62mm; WH 0.54mm; WF 0.31mm; FWL 1.6mm; LM 0.94mm; LP 0.33mm; WPD 0.43mm; LPD 25mm.

**Colour:** Body dark brown, pronotum, propodeum and base of metasoma (T1 and half of T2) brown; mandible yellow, teeth brown; antenna brown-yellow, terminal 5 segments brown, scape brown-yellow; coxa and femur brown; forefemur dark brown; trochanter, tibia, basitarsus brown-yellow, other tarsi yellow. Wings hyaline, costa, subcosta, prostigma, pterostigma, and stigmal vein straw coloured; other veins colourless.

**Head:** Head (figs.43, 213) longer than wide, WH 0.86x LH, compressed in lateral aspect, 1.78x as long as wide (figs.42, 215); frons and vertex strongly coriaceous; with scattered shallow punctures; gena smooth and polished; vestiture short, sparse, decumbent; anterior clypeal margin strongly produced, bluntly angulated, obtuse; clypeal carina strong and arcuate in profile, 0.56x HE, extending onto frons upto
Observation and Results

level of posterior scrobal margin; scrobe ecarinate; mandible stout with 4 long pointed teeth, ventral most curved; WF 0.5x LH; WF 0.92x HE; EV 0.42x HE; LH 1.75x HE; malar space narrow; malar groove absent; eye sparsely setose, setae minute, as long as diameter of single facet; ocelli in an obtuse triangle; posterior ocelli contiguous with occipital margin; OOL = WOT; POL:AOL:DAO = 6:3:2; vertex straight in full face view; sharply angulate, weakly carinate; with a pair of long setae, longest being 0.08mm. Relative lengths of first five antennal segments (fig.214) 7:4.5:2.5:3:3; scape 1.4x as long as wide, shorter than 2x pedicel; pedicel longer than F1; F2 as long as wide, other funicular segments wider than long; antenna subequal to head in full face view (33:32).

Mesosoma: Pronotum mesonotum and scutellum (fig.44) coriaceous without scattered shallow punctures same as that of head; vestiture short, sparse, suberect; pronotal disc (fig.213) 0.48x as long as wide; mesonotum with distinct parapsidal furrow; propodeal disc 0.59x as long as wide, smoothly inclined to lateral margin; basal median propodeal triangle smooth, margins not distinctly elevated and demarcated posteriorly; smooth blotch present between triangle and transverse carina; other parts of disc and declivity coriaceous; posterior transverse carina complete. Forewing (fig.213) 2.86x as long as wide, without areolet; M with single row setae, SM with single setae; speculum asetose; m: rs: rs+m = 6.5:5:4. Forefemur (fig.216) 1.67x as long as wide; SI 4.9.

Metasoma: Metasoma (fig.41) distinctly longer than mesosoma (65:50), shorter than head plus mesosoma (65:82); T1-T2 completely smooth and polished, other segments with weakly coriaceous basal band. T1-T3 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

Male: Unknown.

Ecology and Biology: Unknown

Etymology: The species epithet is from the Greek word, kainophanes meaning new.

Distribution: India – Kerala.

Santhosh, S.
Material Examined: Holotype – Female. INDIA: Kerala, Kollam, DB college campus, Shasthamkota, 09°02.21'N 76°38.03'E, 19m, 12.xii.2004. sweeping, scrub jungle near fresh water lake, S. Santhosh leg., VRN 81 (DZUC). Paratypes. 2♀. same data as holotype, VRN 82, 83; 1♀. Idukki, Moolamattam, 09°47.26'N 76°51.03'E, 14.xi.1988, sweeping, T. C. Narendran leg., VRN 120; 1♀. Malappuram, Calicut University Botanical Garden, 11°07.58'N 75°53.24'E, 80m, 17.xi.1995, K. Rajmohana leg., VRN 166 (DZUC).

Variation: Some of the paratypes have OOL 0.94-0.97x WOT. In one of the paratypes (VNR 82) LH 0.88x LA. See table- 10 for the morphometric ratios of the type materials examined.

Discussion: Goniozus kainophanestus sp. nov. is closely related to G. nuperus sp. nov. and G. novellus sp. nov. but differs in having yellow mandible, forefemur 1.67x as long as wide, anteromedian smooth propodeal triangle is not elevated and continued as a smooth patch to the transverse carina and EV 0.42-0.44x HE, whereas in G. nuperus sp. nov. and G. novellus sp. nov., mandible is brown-black, forefemur 1.82-1.92x as long as wide and EV 0.53 - 0.60x HE. Anteromedian smooth propodeal triangle elevated not connected to the transverse carina in G. novellus sp. nov., whereas it is connected by a smooth median line in G. nuperus sp. nov.

Table – 10. Morphometric ratios of Goniozus kainophanestus sp. nov.

<table>
<thead>
<tr>
<th>VRN</th>
<th>WH / LH</th>
<th>OOL / WOT</th>
<th>EV / HE</th>
<th>WF / HE</th>
<th>LH / LA</th>
<th>LS / PL</th>
<th>PL / LF1</th>
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<td>0.92</td>
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Mean Values: 0.88 0.97 0.43 0.94 0.92 1.6 1.67
Goniozus kotiyooricus sp. nov.
(figs.45-48, 217-221)

**Diagnosis:** Head distinctly longer than wide, WH 0.83x LH, compressed in lateral aspect, 1.74x as long as wide; frons and vertex strongly coriaceous; anterior clypeal margin weakly projecting, broadly rounded, obtuse; clypeal carina moderately strong, not extending onto frons; WF 0.61x LH; EV 0.68x HE; malar space distinct; malar groove present; OOL 1.43x WOT; eye very sparsely setose; setae minute, as long as diameter of single facet. Forewing 2.96x as long as wide with subtriangular areolet; M, SM with single row of setae; areolet asetose. Forefemur 2.1x as long as wide.

**Description:** *Holotype* – Female.

**Measurements:** Length 2.84mm; LH 0.67mm; WH 0.62mm; WF 0.41mm; FWL 1.69mm; LM 0.93mm; LP 0.26mm; WPD 0.45mm; LPD 0.19mm.

**Colour.** Body black, metasoma dark brown; mandible black, teeth and base of mandible brown; antenna uniformly yellow, scape basally brown; leg yellow; coxa, femur, and basal half of mid and hind tibia brown. Wing hyaline; prostigma, pterostigma light brown, other veins colourless.

**Head:** Head (figs.47, 217) distinctly longer than wide, WH 0.83x LH, compressed in lateral aspect, 1.74x as long as wide (figs.46, 219); frons and vertex strongly coriaceous; gena smooth and polished; vestiture short, sparse, suberect; setae on vertex longer than setae on head, longest being 0.1mm; anterior clypeal margin weakly projecting, broadly rounded, obtuse; clypeal carina moderately strong, restricted to clypeus and not extending onto frons; scrobe smoothly margined, ecarinate; mandible robust with 4 short blunt teeth, ventral most straight; WF 0.61x LH; WF 1.24x HE; EV 0.68x HE; LH 2.05x HE; malar space distinct; malar groove present; eye very sparsely setose; setae minute, as long as diameter of single facet; ocelli in obtuse triangle; posterior ocelli separated from vertex margin by half of its diameter; OOL 1.43x WOT; POL:AOL:DAO = 6:3:2.5; vertex straight in full face view, smoothly margined, acutely angulated to occiput, ecarinate. Relative lengths of first five antennal segments (fig.218) 7:3.5:2:3:3; scape 1.46x as long as wide, 2x
pedicel length; pedicel longer than F1; F1 wider than long; F2-F10 as long as wide; terminal segment longer than wide; antenna longer than head in full face view (44: 39).

**Mesosoma:** Pronotum, mesonotum and scutellum (fig.48) strongly coriaceous with scattered shallow punctures; vestiture sparse, long, decumbent; Pronotal disc 0.39x as long as wide; mesonotum with parapsidal furrow weak in anterior half, notauli absent; scutellum with a pair of basal slits connected by weak transverse groove; propodeal disc 0.42x as long as wide, smoothly inclined to lateral margin; basal median propodeal triangle smooth, not elevated, extending to posterior margin by a smooth line that joins a smooth blotch extending to posterior declivity; rest of propodeal disc, declivity coriaceous; transverse propodeal carina absent. Forewing (fig.221) 2.96x as long as wide, areolet present, subtriangular in shape; M, SM with single row of setae; areolet, speculum asetose. Forefemur (fig.220) 2.1x as long as wide; S1 6.

**Metasoma:** Metasoma (fig.45) distinctly longer than mesosoma (52:39), shorter than head plus mesosoma (41:52); tergites smooth and polished; T1-T3 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

**Male:** Unknown.

**Ecology and Biology:** Unknown.

**Etymology:** The species epithet is after the type locality, Kottiyoor.

**Distribution:** India – Kerala.

**Material Examined:** Holotype – Female. INDIA: Kerala, Kannur, Kottiyoor, 11°52.33'N 75°51.91'E, 140m, 25.ii.1989, sweeping, T.C. Narendran leg., VRN 145 (DZUC).

**Discussion:** Goniozus clypeatus sp. nov. and G. longigastralis sp. nov. are similar to G. kottiyooricus sp. nov. in having no propodeal transverse carina on the posterior margin, but differ in having M, SM of the forewing profusely setose, speculum setose, clypeal carina strong, extending onto frons, malar space narrow without malar groove and forefemur 1.6 – 1.8x as long as wide, whereas in G. kottiyooricus
sp. nov., M, SM of forewing with single row of setae, speculum asetose; clypeal carina absent, only represented by a median ridge; malar space distinct with malar groove; forefemur 2.1x as long as wide.

**Goniozus kuriani** sp. nov.

(figs.49-53, 222-225)

**Diagnosis:** Head distinctly longer than wide, WH 0.77-0.81x LH, compressed in lateral aspect, 2x as long as wide; sides behind eye are parallel before curving inwards to vertex clypeal apical margin weakly produced, obtuse; antenna slightly shorter than head in full face view; pedicel longer than F1; malar space distinct; malar groove present; ocelli triangle acute; posterior ocelli equal to or more than 0.5x its diameter away from vertex margin; EV 0.72–0.83x HE; OOL 0.61-0.67x WOT; vertex emarginate. Anteromedian propodeal area rectangular, smooth, not elevated. Forewing with areolet, M, SM sparsely setose. Forefemur 1.92x as long as wide.

**Description:** **Holotype** – Female.

**Measurements:** Length 2.75mm; LH 0.66mm; WH 0.52mm; WF 0.32mm; FWL 1.75mm; LM 0.91mm; LP 0.27mm; WPD 0.41mm; LPD 0.20mm.

**Colour:** Body black, metasoma dark brown; mandible black, teeth brown; antenna yellow, terminal 5 segments brown, last being darkest; legs yellow; coxa, femur with dorsal margin brown. Wing hyaline, subcosta, prostigma, pterostigma brown, others colourless.

**Head:** Head (figs.51, 222) longer than wide, WH 0.81x LH, compressed in lateral aspect, 2x as long as wide (figs.50, 224); sides behind eye are parallel before curving inwards to slightly emarginated vertex; frons and vertex coriaceous with scattered shallow punctures; gena smooth and polished; vestiture short, sparse, suberect; setae on vertex not distinctly longer than setae on rest of head, longest being 0.068mm; anterior clypeal margin weakly produced, obtuse; clypeal carina strong and weakly arcuate in profile, extending onto frons as a low carina upto level of posterior
Observation and Results

scrobal margin; scrobe ecarinate; mandible robust, 4 teeth, ventral most straight longest teeth; WF 0.48x LH; WF = HE; EV 0.83x HE; LH 2.3x HE; malar space distinct; malar groove present; eye sparsely setose, setae minute, shorter than diameter of single facet; ocelli in acute triangle; posterior ocelli separated from vertex margin by half its diameter; OOL 0.67x WOT; POL:AOL:DAO = 3.5:2:1.8; vertex smoothly curved to occiput, ecarinate. Relative lengths of first five antennal segments (fig.223) 6:3:2.3:2.3:2.7; scape 1.33x as long as wide, 2x as long as pedicel; pedicel longer than F1; all segments wider than long except terminal single segment; antenna slightly shorter than head in full face view (27:29).

Mesosoma: Pronotum, mesonotum, and scutellum (fig.52) uniformly coriaceous, with scattered shallow punctures; vestiture short, sparse, decumbent; pronotal disc 0.52x as long as wide; mesonotum with complete parapsidal furrow, notauli absent; scutellum with a pair of basal pits at base connected by a narrow transverse groove, propodeal disc 0.53x as long as wide, smoothly inclined to lateral margin; basal median propodeal triangle absent, median smooth band, not elevated, extending beyond posterior margin of propodeal disc; rest of propodeal disc, declivity coriaceous; posterior transverse propodeal carina broadly interrupted medially. Forewing (fig.222) 2.88x as long as wide; areolet present; M, SM with single row of setae; areolet and speculum sparsely setose. Forefemur (fig.225) 1.92x as long as wide; SI 7.67.

Metasoma: Metasoma (fig.49) distinctly longer than mesosoma (54:40), shorter than head plus mesosoma (54:67); tergites smooth and polished, T1-T3 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

Male: Unknown.

Ecology and Biology: ex. unidentified leaf galls (fig.53) of Syzygium cumini L. (Myrtaceae). The species was also collected from the plant host, Dipterocarpus indicus Bedd. (Dipterocarpaceae).

Etymology: The species epithet is after Chandy Kurian, Indian bethylid taxonomist.

Distribution: India – Kerala; Karnataka.

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Investigation on the Alpha Taxonomy of Bethylidae


Variation: In paratypes, OOL 0.62x WOT and EV 0.72x HE. See table- 11 for the morphometric ratios of the type materials examined.

Discussion: Goniozus kuriani sp. nov. is closely related to G. valvolicola Krombein in having vertex emarginate, scrobe ecarinate, M, SM sparsely setose, posterior ocelli equal to or more than 0.5x its diameter away from vertex margin and EV 0.75-0.85x HE. Goniozus kuriani sp. nov. differs from G. valvolicola in having ocellar triangle acute, forefemur 1.92x as long as wide, OOL 0.66x WOT, clypeal apical margin weakly produced and obtuse, anteromedian rectangular smooth propodeal area, but not elevated and pedicel longer than F1, whereas in G. valvolicola ocellar triangle in right angle, forefemur 2.07x as long as wide, OOL 1.54 – 1.58x WOT, clypeal apical margin strongly produced, acute, anteromedian triangular smooth propodeal area is elevated and pedicel is shorter than F1.

Table – 11. Morphometric ratios of Goniozus kuriani sp. nov.

<table>
<thead>
<tr>
<th>VRN</th>
<th>WH/LH</th>
<th>OOL/WOT</th>
<th>EV/HE</th>
<th>WF/HE</th>
<th>LH/LA</th>
<th>LS/PL</th>
<th>PL/LF1</th>
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<td>0.809524</td>
<td>0.66666667</td>
<td>0.83333</td>
<td>1</td>
<td>1.05</td>
<td>2</td>
<td>1.33333</td>
</tr>
<tr>
<td>161</td>
<td>0.809524</td>
<td>0.66666667</td>
<td>0.83333</td>
<td>1</td>
<td>1.05</td>
<td>2</td>
<td>1.33333</td>
</tr>
<tr>
<td>187</td>
<td>0.8</td>
<td>0.61538462</td>
<td>0.72222</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1.33333</td>
</tr>
<tr>
<td>28</td>
<td>0.769231</td>
<td>0.61538462</td>
<td>0.8125</td>
<td>1</td>
<td>0.975</td>
<td>2</td>
<td>1.33333</td>
</tr>
</tbody>
</table>

Mean Values: 0.80 0.64 0.80 1 1.02 2 1.33
Goniozus longigastralis sp. nov.
(figs.54-57, 226-229)

Diagnosis: Head distinctly longer than wide, WH 0.83x LH, compressed in lateral aspect, 1.82x as long as wide; frons and vertex weakly coriaceous; anterior clypeal margin obtuse; pedicel as long as F1; scape longer than 2x pedicel; WF 1.18x HE; EV 0.88x HE; eye sparsely setose, setae as long as diameter of single facet; ocellar triangle acute; OOL 1.75x WOT. Propodeal disc with a smooth anterior median elevated triangle, extending to posterior margin by a median line; posterior transverse propodeal carina absent, represented by a weak smooth line. Forewing 3.1x as long as wide subtriangular areolet; S, SM and areolet profusely setose.

Description: Holotype – Female.

Measurements: Length 4.6mm; LH 0.93mm; WH 0.77mm; WF 0.46mm; FWL 2.86mm; LM 1.29mm; LP 0.42mm; WPD 0.56mm; LPD 0.33mm.

Colour: Body black, metasoma brownish black; mandible black, teeth red; antenna yellow, terminal 7 segments brown; legs yellow; forefemur brown, coxa, mid and hind femur brownish yellow. Wing hyaline; prostigma, pterostigma costa brown, other veins straw coloured.

Head: Head (figs.56, 226) distinctly longer than wide, WH 0.83x LH, compressed in lateral aspect, 1.82x as long as wide (figs.55, 228); frons and vertex weakly coriaceous with scattered shallow punctures; gena very weakly coriaceous, polished; vestiture long (0.095mm), sparse, erect; setae on vertex, four pairs slightly longer than setae on head, longest being 0.19mm; anterior clypeal margin obtusely angulated; clypeal carina 0.91x HE, strong, arcuate in profile, extending onto frons well beyond posterior scrobal margin; scrobe ecarinate; mandible robust with four long, blunt teeth, ventral most straight; WF 0.49x LH; WF 1.18x HE; EV 0.88x HE; LH 2.29x HE; malar space narrow; malar groove absent; eye sparsely setose, setae minute, as long as diameter of single facet; ocelli in acute triangle; posterior ocelli separated from vertex margin by its diameter; OOL 1.75x WOT; POL:AOL:DAO = 3.5:2.5:3; vertex slightly emarginate in full face view, smoothly angled to occiput, ecarinate. Relative lengths of first five antennal segments (fig.227) 11:4.5:4.5:5:5;
Observation and Results

scape 1.83x as long as wide, longer than 2x pedicel length; pedicel = F1; F1-F4, F11 longer than wide; other funicular segments subequal; antenna longer than head in full face view (44:39).

Mesosoma: Pronotum, mesonotum, and scutellum (fig.57) weakly coriaceous with scattered shallow punctures; vestiture long, sparse, erect; pronotal disc (fig.226) 0.47x as long as wide; mesonotum with weak complete parapsidal furrow, notauli absent; scutellum with a pair of basal slits connected by a weak groove; propodeal disc 0.6x as long as wide, smoothly inclined to lateral margin; few short setae on lateral margin; basal median propodeal triangle smooth, extending to posterior margin by a smooth line that slightly wider posteriorly; rest of propodeal disc and declivity coriaceous; posterior transverse propodeal carina absent, represented at posterolateral margin by a smooth line. Forewing (fig.226) 3.1x as long as wide; areolet present, subtriangular in shape; M, SM,, areolet, speculum profusely setose. Forefemur (fig.229) 1.83x as long as wide; SI 5.39.

Metasoma: Metasoma (fig.54) distinctly longer than mesosoma (100:54), slightly longer than head plus mesosoma (100:93); tergites smooth and polished; T1-T3 with setae restricted to lateral margin; other tergites with setae all across dorsal side.

Male: Unknown.

Ecology and Biology: Collected from semi-evergreen forest canopy. Host unknown.

Etymology: The species epithet is after the characteristically long gaster of the species.

Distribution: India – Tamil Nadu.

Material Examined: Holotype – Female. INDIA: Tamil Nadu, Chamrajnagar, Galidhimbam, 7.84kms SW Hasanur, 11°58'90"N 77°11'10"E, 1245 m, SEF, YPT, 10.i.2007, Mahadesha leg., VRN 143 (DZUC).

Discussion: Goniozus longigastralis sp. nov. is similar to G. clypeatus sp. nov. in having SM of the forewing profusely setose, speculum setose, clypeal carina strong, extending onto frons, malar space narrow without malar groove and forefemur 1.6 – 1.8x as long as wide, but differ in having ocular setae as long as diameter of single...
facet, ocellar triangle acute, frons and vertex weakly coriaceous, OOL 1.75x WOT, anterior clypeal margin obtuse, propodeal disc with a smooth anterior median elevated triangle extending to posterior margin by a median line, pedicel as long as F1, scape longer than 2x pedicel and WF 1.18x HE. *Goniozus clypeatus* sp. nov. has ocular setae 3x as long as diameter of single facet, ocellar triangle obtuse, frons and vertex strongly coriaceous, OOL 1.10-1.23x WOT, anterior clypeal margin acute, propodeal disc with a smooth median band extending posteriorly onto declivity, pedicel shorter than F1, scape shorter than 2x pedicel and WF 0.92-0.97x HE.

*Goniozus malabaricus* sp. nov.

(fig.58-61, 230-234)

**Diagnosis:** Head slightly wider than long, WH 1.04-1.05x LH; strongly compressed in lateral aspect, 1.73x as long as wide; frons smooth and polished; ventral most mandibular teeth long and distinctly curved downwards; clypeal carina absent, represented only by a smooth ridge; EV 0.35-0.39x HE; vertex weakly coriaceous. Antenna distinctly longer than head in full face view scape 2-2.3x as long as pedicel, pedicel shorter than F1. Forewing without areolet, but only short stub arising from basal vein.

**Description:** *Holotype* – Female.

**Measurements:** Length 4.53mm; LH 0.84mm; WH 0.86mm; WF 0.52mm; FWL 2.73mm; LM 1.53mm; LP 0.4mm; WPD 0.73mm; LPD 0.29mm

**Colour:** Body black; mandible yellowish brown; mandible base, teeth black; antenna brown-yellow, scape basally, terminal 8 segments brown; femur dark brown; trochanter, tibia and tarsi yellow, tibia darker than rest. Wing hyaline; costa, subcosta, prostigma and stigmatic vein tainted; pterostigma darker, other veins straw coloured.

**Head:** Head (figs.60, 230) wider than long, WH 1.04x LH, compressed in lateral aspect, 1.73x as long as wide (figs.59, 232); frons smooth and polished; vertex weakly coriaceous; gena smooth and polished; vestiture sparse, short, decumbent;
Observation and Results

anterior clypeal margin strongly produced, obtuse; clypeal carina weak, appear as smooth ridge, restricted to clypeus, not extending onto frons; mandible (fig.234) robust, visible in full face view with 4 teeth; ventral most teeth long and distinctly curved downwards; scrobe ecarinate; vertex slightly emarginated in full face view, smoothly angulated, ecarinate; setae along vertex longer than others, longest being 0.14mm; WF 0.62x LH; WF 1.1x HE; EV 0.35x HE; LH 1.81x HE; malar space narrow; malar groove absent; eye sparsely setose, minute as long as diameter of single facet; ocelli in obtuse triangle; posterior ocelli contiguous with vertex margin; OOL 1.05 WOT; POL: AOL: DAO = 6.5:3:3. Relative lengths of first five antennal segments (fig.231) 8:3.8:5.5:4.5:4; all segments longer than wide; scape 2.3x pedicel; scape 1.6x as long as wide; pedicel shorter than F1; antenna distinctly longer than head in full face view (55:37).

Mesosoma: Pronotum (fig.61) weakly coriaceous; mesonotum and scutellum smooth and polished with scattered shallow punctures; pronotum (fig.230) 0.58x as long as wide; vestiture long, sparse; mesonotum with distinct, complete parapsidal furrow; notauli absent; scutellum with a pair of basal slits connected by a weak transverse groove; propodeal disc 0.41x as long as wide, smoothly inclined to lateral margin; basal median smooth triangle elevated and extend upto midline of propodeal disc and connected to complete transverse carina by a median carina; rest of dorsum and declivity coriaceous. Forewing 2.79x as long as wide, without areolet, only a short stub arising from basal vein; M, SM and speculum asetose; region posterior to pro and pterostigma devoid of setae; m:rs:rs+m = 6:5:5. Forefemur (233) 1.87x as long as wide; SI 4.2.

Metasoma: Metasoma (fig.58) distinctly longer than mesosoma (42:30), slightly shorter than head plus mesosoma (46:42); tergites generally smooth and polished; T1 – T2 completely smooth; others with weakly coriaceous basal band; T1-T3 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

Male: Unknown.

Ecology and Biology: Unknown.
Etymology: The species epithet is after the type locality, Malabar.

Distribution: India – Kerala – Malabar.


Variation: In the paratypes, LS 2x PL and PL 0.87x LF1. See table- 12 for morphometric ratios of all the type materials examined.

Discussion: Goniozus malabaricus sp. nov. is similar to G. fulgidus Krombein in having smooth polished head in dorsal side and no clypeal carina, but it differs in having head as long as wide, WH 1.04-1.05x LH and scape 2-2.3x as long as pedicel. In G. fulgidus Krombein, head is distinctly transverse, WH 1.1lx LH and scape less than 2x as long as pedicel.

Table – 12. Morphometric ratios of Goniozus malabaricus sp. nov.

<table>
<thead>
<tr>
<th>VRN</th>
<th>WH / LH</th>
<th>OOL / WOT</th>
<th>EV / HE</th>
<th>WF / HE</th>
<th>LH / LA</th>
<th>LS / PL</th>
<th>PL / LF1</th>
</tr>
</thead>
<tbody>
<tr>
<td>117</td>
<td>1.043478</td>
<td>1.04761905</td>
<td>0.35</td>
<td>1.1</td>
<td>0.73404</td>
<td>2.28571</td>
<td>0.7</td>
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<tr>
<td>173</td>
<td>1.054545</td>
<td>1.11764706</td>
<td>0.387097</td>
<td>1.12903</td>
<td>0.6875</td>
<td>2</td>
<td>0.875</td>
</tr>
<tr>
<td>77</td>
<td>1.050847</td>
<td>1.11764706</td>
<td>0.352941</td>
<td>1.11765</td>
<td>0.81944</td>
<td>2</td>
<td>0.77778</td>
</tr>
<tr>
<td>Mean Values</td>
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<td>1.09</td>
<td>0.36</td>
<td>1.11</td>
<td>0.75</td>
<td>2.09</td>
<td>0.78</td>
</tr>
</tbody>
</table>

Goniozus mandibularis sp. nov.

(figs. 62-65, 235-239)

Diagnosis: Head subequal in full face view, WH 0.91-0.97x LH, weakly compressed in lateral aspect, 1.65x as long as wide; OOL 0.89-1x WOT; ventral most tooth of mandible strongly curved downwards; WF 1-1.07x HE; EV 0.33-0.44x HE. All funicular segments longer than wide; antenna distinctly longer than head in full face view; pedicel shorter than F1. Anteromedial smooth elevated propodeal triangle extends beyond middle of propodeal disc, connected to posterior.
margin by a smooth line; propodeal disc sharply inclined to lateral margin; posterior transverse propodeal carina narrowly interrupted medially; metasoma longer than mesosoma. Forefemur 2.15x as long as wide; forewing without areolet, but only short stub arising from basal vein.

**Description:** *Holotype – Female.*

**Measurements:** Length 3.23mm; LH 0.77mm; WH 0.75mm; WF 0.44mm; FWL 2.3mm; LM 1.26mm; LP 0.42mm; WPD 0.35mm; LPD 0.31mm.

**Colour:** Body black; mandible brown, basally darker, teeth red; antenna yellowish brown, basal area of scape and apical 9 funicular segments fuscous; coxa and femur black; trochanter, tibia, and tarsi yellow; midtibia and hindtibia brown. Wing hyaline; costa, subcosta, and prostigma yellow, other veins colourless.

**Head:** Head (figs.64, 235) longer than wide in full face view, HW 0.97x LH, weakly compressed in lateral aspect, 1.65x as long as wide (figs.63, 237); frons and vertex coriaceous with shallow punctures; gena smooth and polished; vestiture sparse, long and decumbent; vertex margin with a pair of long setae, longest being 0.14mm; anterior clypeal margin strongly produced, obtuse, clypeal carina 0.76x HE, extending onto frons beyond level of posterior scrobal margin; scrobe ecarinate; mandible stout with 4 long pointed teeth, ventral most curved; WF 0.57x LH; WF 1.03x HE; EV 0.40x HE; LH 1.76x HE; malar space narrow; malar groove absent; eye sparsely setose, setae minute, shorter than diameter of single facet; ocelli in obtuse triangle; posterior ocelli contiguous with vertex margin; POL: AOL: DAO = 7.5:3.5:3; OOL 0.94x WOT; vertex margin straight in full face view, ecarinate, margin sharply angled, acute. Relative lengths of first five antennal segments (fig.236) 8:4.2:5:4.5:4.2; scape 1.82x as long as wide, shorter than 2x pedicel; pedicel shorter than F1; all funicular segments longer than wide; F1 is longer than F2; F2 subequal to F3; antenna distinctly longer than head in full face view (105:77).

**Mesosoma:** Pronotum (fig.65) coriaceous; mesoscutum and scutellum weakly coriaceous; vestiture long, sparse, decumbent; mesonotum with parapsidal furrow, weak towards anterior end; pronotal disc (fig.235) narrow, 0.56x as long as wide,
propodeal disc 0.59x as long as wide, sharply inclined to lateral margin; basal triangular area smooth and elevated, rest of disc and declivity coriaceous; transverse carina narrowly interrupted in middle; basal triangle connected to smooth blotch at posterior margin of propodeal disc by smooth line, visible in certain play of lights. Forewing (fig.239) 2.86x as long as wide, without areolet; M, SM with a single row of setae; speculum asetose; m; rs; rs+m = 7:6:5. Forefemur (fig.238) 2.15x as long as wide; SI 3.64.

Metasoma: Metasoma (fig.62) distinctly longer than mesosoma (93:65), shorter than head plus mesosoma (93:103); tergites smooth and polished; T1 completely smooth, other tergites with weakly coriaceous basal band. T1-T3 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

Male: Unknown.

Ecology and Biology: Collected from the paddy ecosystem. Host is unknown.

Etymology: The species epithet is after the strongly curved mandibular tooth.

Distribution: India – Karnataka; Kerala.

Material Examined: Holotype – Female. INDIA: Kerala, Palghat, Puliyampettakayal, 1.64kms NW of Koottanad, 10°45.67'N 76°07.10'E, 8m, 28.ii.2008, rice field, sweeping, S. Santhosh leg., VRN 10 (DZUC). Paratypes. 2♀. same data as holotype, VRN 8, VRN 9; 5♀. Koottanad, 10°45.34'N 76°06.58'E, 2.vi.2004, 48m, sweeping, scrub jungle, S. Santhosh, leg., VRN 84, VRN 85, VRN 86, VRN 20, VRN 21; 1♀. Kozhikode, Kodanjeri, NW of Kozhikode, 11°24.35'N 75°56.16'E, 45m, 3.iv.2007, sweeping, agricultural plot – mixed vegetation, S. Santhosh leg., VRN 5; 1♀. Alappuzha, Kayankulam, CPCRI Campus, 09°08.42'N 76°30.47'E, 13m, 12.iv.2004, sweeping, S. Santhosh leg., VRN 97; 1♀. Idukki, Cheruthoni, near reservoir, 09°47.52'N 76°56.48'E, 727m, 10.i.2004, sweeping, TEF, short stretch of lemon grass field, S. Santhosh leg., VRN 90; 1♀. Kannur, Payyannore, 12°05'N 75°12'E, 9m, 26.xii.1988, sweeping, T.C. Narendran leg., VRN 95; 1♀. Kasaragode, CPCRI Campus, 5kms NW Kasaragode Town, 12°31.04'N 74°57.10'E, 18m, 27.ii.1988, sweeping, K. Surekha leg., VRN 100; 2♀. INDIA: Karnataka, Uppinangady, 12°49.42'N 75°14.49'E, 65m, 17.xii.1988, sweeping, T.C. Narendran leg., VRN 79, VRN 80 (DZUC).
Variation: A pair of setae is present below the short stub from basal vein in one of the paratypes. In some paratypes, LH 1.03x WH, EV 0.33-0.35x HE; OOL 0.85x WOT; LS 2.2x PL. See table-13 for morphometric ratios of all the type materials examined.

Discussion: This new species is closely related to G. antennalis sp. nov. In G. mandibularis sp. nov., OOL 0.89-1x WOT, ventral most tooth of mandible strongly curved downwards, anteromedial smooth elevated propodeal triangle extends beyond middle of propodeal disc connected to posterior margin by a smooth line and WF 1-1.07x HE, whereas in G. antennalis sp. nov. OOL 0.75-0.86x WOT, ventral most tooth of mandible straight, anteromedial smooth elevated propodeal triangle extends up to middle of propodeal disc not being connected to posterior margin, WF 0.81-0.89x HE. This new species is also related to G. stomopterycis Ram and SubbaRao and G. marasmi Kurian, but differ in having forefemur equal to or more than 2x as long as wide, pedicel shorter than F1 and metasoma longer than mesosoma, whereas in G. stomopterycis and G. marasmi forefemur less than 2x as long as wide, pedicel equal to or more than F1 and metasoma shorter than or as long as mesosoma.

Table – 13. Morphometric ratios of Goniozus mandibularis sp. nov.

<table>
<thead>
<tr>
<th>VRN</th>
<th>WH / LH</th>
<th>OOL / WOT</th>
<th>EV / HE</th>
<th>WF / HE</th>
<th>LH / LA</th>
<th>LS / PL</th>
<th>PL / LF1</th>
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<tbody>
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<td>0.83333</td>
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<td>10</td>
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Mean Values: 0.97 0.92 0.4 1.03 0.69 1.88 0.82
Observation and Results

**Goniozus mustus** sp. nov.
(figs.66-69, 240-243)

**Diagnosis:** Head as long as wide, compressed in lateral aspect, 1.76x as long as wide; frons and vertex strongly coriaceous; clypeal carina absent, represented by a smooth ridge on clypeus; malar space distinct; malar groove present; mandible brown; ocular setae as long as diameter of single facet; pedicel is along as F1; scape 2x pedicel; WF 1.06x HE; no anteriomedian propodeal triangle; entire propodeal disc strongly coriaceous; propodeal disc posteriorly without transverse carina.

**Description:**

*Holotype – Female.*

**Measurements:** Length 3.5mm; LH 0.69mm; WH 0.69mm; WF 0.43mm; FWL 2.09mm; LM 1.07mm; LP 0.41mm; WPD 0.57mm; LPD 0.31mm.

**Colour:** Body black, metasoma with brown tinge; mandible brown, darker at base and teeth; antenna yellow, terminal 6 segments brown; leg yellow; coxa, femur brown. Wings hyaline; prostigma, pterostigma costa, subcosta, stigmal vein light brown, other veins colourless.

**Head:** Head (figs.68, 240) as long as wide, WH = LH, compressed in lateral aspect, 1.76x as long as wide (figs.67, 242); frons and vertex strongly coriaceous with scattered shallow punctures; gena smooth and polished; vestiture moderately long, 0.069mm; sparse, decumbent; setae on vertex slightly longer than setae on head, longest being 0.086mm; anterior clypeal margin strongly produced, sharply right angled; clypeal carina weak, only a smooth ridge, 0.41x HE, weakly arcuate in profile, not extending onto frons as a low carina; scrobe weakly carinate; mandible stout, 4 moderately long teeth, ventral most curved downwards; WF 0.62x LH; WF 1.06x HE; EV 0.35x HE; LH 1.73x HE; malar space distinct; malar groove present; eye sparsely setose, setae minute, as long as diameter of single facet; ocelli in obtuse triangle; posterior ocelli contiguous with vertex margin; OOL = WOT; POL:AOL:DAO = 5.5:2.5:2.2; vertex straight in full face view, smoothly angled to occiput, ecarinate. Relative lengths of first five antennal segments (fig.241) 6:3:3:3:3; scape 2x as long as wide, 2x pedicel; pedicel = F1; all antennal segments longer than wide; antenna longer than head in full face view (42:29).

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Investigation on the Alpha Taxonomy of Bethylidae

Observation and Results

Mesosoma. Pronotum, mesonotum, and scutellum (fig.69) uniformly coriaceous, vestiture short, sparse, decumbent, pronotal disc (fig.240) 0.38x as long as wide; mesonotum with complete parapsidal furrow; notauli absent; scutellum with a pair of basal slits connected by a weak transverse groove; propodeal disc 0.5x as long as wide, smoothly inclined to lateral margin; basal median propodeal elevated smooth triangle absent; entire propodeal disc and declivity strongly coriaceous; posterior transverse propodeal carina absent. Forewing (fig.240) 2.84x as long as wide; areolet present, subtriangular in shape; M, SM, areolet and speculum sparsely setose. Forefemur (fig.243) 2x as long as wide; SI 5.56.

Metasoma: Metasoma (fig.66) distinctly longer than mesosoma (45:73), subequal to head plus mesosoma; tergites smooth and polished; T1-T3 with few setae restricted to lateral margin; other tergites sparsely punctuate and setose all across dorsal side.

Male: Unknown.

Ecology and Biology: Unknown.

Etymology: The species epithet is after the Latin word mustus meaning new.

Distribution: India – Kerala – Malappuram.

Material Examined: Holotype – Female. INDIA: Kerala, Botanical Garden, Calicut University Campus, 11°07.58'N 75°53.24'E, 80m, sweeping, 4.ix.2003, S. Santhosh leg., VRN 115 (DZUC).

Discussion: Goniozus mustus sp. nov. is similar to G. ecarinatus Krombein in having the mandible brown or dark red, ocular setae as long as diameter of single facet, but differ in having clypeal carina absent, sometimes as median ridge only, extending onto frons for a short distance not beyond posterior scrobal margin, no anteromedian propodeal triangle and entire propodeal disc strongly coriaceous, pedicel is along as F1, scape 2x pedicel and WF 1.06x HE. In G. ecarinatus, clypeal carina moderately strong, restricted to clypeus, 0.41x as long as HE, smooth elevated anteromedian propodeal triangle present, pedicel shorter than F1; scape longer than 2x pedicel and WF 1.35x HE.
Goniozus neoterosus sp. nov.  
(figs.70-73, 244-247)

**Diagnosis:** Head slightly longer than wide, WH 0.92x LH, compressed in lateral aspect, 1.73x as long as wide; frons and vertex strongly coriaceous, profusely setose; mandible pale yellow; eye profusely setose, setae 3x diameter of single facet; clypeal carina strong, extending onto frons beyond posterior scrobal margin; pedicel equal to F1; scape 2x pedicel; F1-F4 longer than wide; WF = HE; OOL = WOT. Propodeal disc posteriorly without transverse carina. Forewing with subtriangular areolet; M, SM profusely setose.

**Description:** *Holotype – Female.*

**Measurements:** Length 3.31mm; LH 0.74mm; WH 0.68mm; WF 0.4mm; FWL 2.1mm; LM 1.2mm; LP 0.36mm; WPD 0.54mm; LPD 0.29mm.

**Colour:** Body black; mandible brown-yellow, teeth brown; antenna yellow, terminal 5 segments light brown; legs yellow, dorsal margin of coxa, forefemur and hindfemur brown. Wing hyaline; prostigma, pterostigma, costa brown, other veins straw coloured.

**Head:** Head (figs.72, 244) longer than wide, WH 0.92x LH, compressed in lateral aspect, 1.73x as long as wide (figs.71, 246); frons and vertex strongly coriaceous with scattered shallow punctures; gena smooth and polished; vestiture long (0.12mm); profuse, subappressed; setae on vertex, 3 pairs distinctly longer than setae on head, longest being 0.26mm; anterior clypeal margin strongly produced, sharply angulated, acute; clypeal carina 0.7x HE, strong, arcuate in profile, extending onto frons well beyond posterior scrobal margin; scrobe carinate; mandible robust, 4 short, blunt teeth, ventral most straight; WF 0.54x LH; WF = HE; EV 0.35x HE; LH 1.82x HE; malar space narrow; malar groove absent; eye profusely setose, setae long, 3x as long as diameter of single facet; ocelli in obtuse triangle; posterior ocelli contiguous with vertex margin; OOL = WOT; POL:AOL:DAO = 5:2:2; vertex straight in full face view, sharply angled to occiput, carinate in middle. Relative lengths of first five antennal segments (fig.245) 8:4:4:4:4; scape 1.4x as long as wide, 2x pedicel; pedicel = F1; F1-F4, F11 longer

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than wide; other funicular segments subequal; antenna longer than head in full face view (39:31).

**Mesosoma:** Pronotum and mesonotum (fig.73) strongly coriaceous with scattered shallow punctures; scutellum weakly coriaceous, sparsely punctuate; vestiture long, sparse, suberect; pronotal disc (fig.244) 0.43x as long as wide; mesonotum with distinct complete parapsidal furrow, notaulli absent; scutellum with a pair of basal slits connected by a weak groove; propodeal disc 0.43x as long as wide, smoothly inclined to lateral margin; few short setae on lateral margin; median propodeal smooth band extending to declivity, elevated only in anterior one fourth; basal median smooth triangle absent; rest of propodeal disc, declivity coriaceous; posterior transverse propodeal carina absent. Forewing (fig.244) 2.8x as long as wide; areolet present, subtriangular in shape; M, SM profusely setose; areolet, speculum setose. Forefemur (247) 1.75x as long as wide; SI 3.9.

**Metasoma:** Metasoma (fig.70) slightly longer than mesosoma (58:50), distinctly shorter than head plus mesosoma (58: 81); tergites smooth and polished in general; T1-T3 completely smooth, setae restricted to lateral margin; other tergites with setae all across dorsal side, weakly coriaceous basal half.

**Male:** Unknown.

**Ecology and Biology:** Unknown.

**Etymology:** The species epithet is after the Greek word, *neos* meaning new or recent.

**Distribution:** India – Kerala.

**Material Examined:** Holotype – Female. INDIA: Kerala, Kannur, Panayathanparamba, 3kms W Kannur Airport, 11°54'32"N 75°30'27"E, 70m, 11-26.v.2008, scrub jungle, MT, S. Santhosh leg., VRN 29 (DZUC).

**Discussion:** Goniozus neoterosus sp. nov. is closely similar to *G. comatus* Krombein in having pale yellow mandible, ocular setae 3x diameter of single facet, clypeal carina strong extending onto frons beyond posterior scrobal margin, but differ in having pedicel equal to F1, scape 2x pedicel, WF = HE, OOL = WOT. Goniozus *comatus* is having pedicel less than F1, scape more than 2x pedicel, WF 1.07x HE, OOL 0.88x WOT.

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Observation and Results

**Goniozus nephantidis** (Muesebeck)

(FIGS. 74-77)


**Holotype ♀.** Not examined (USNM). Transferred by GORDH, 1988: 363.

**Diagnosis:** Female. Mandible robust, dark brown; clypeal carina (fig. 76) strong, arcuate in profile, extending onto frons a distance equal to its length on clypeus; front dull delicately coriaceous with scattered shallow punctures; antennal scrobe carinate; WH 0.94-0.95x LH; WF 1.15-1.2x HE; EV 0.36-0.47x HE (fig. 75); ocelli in flat triangle. Posterior pair one half their diameter from posterior margin of head, OOL 1.22-1.33x WOT; eye sparsely setose, ocular setae 2x diameter of single facet; posterior transverse propodeal carina (fig. 77) medially evanescent. Forefemur (fig. 74) length 1.76-1.9x width. Forewing with closed areolet; M, SM and speculum profusely setose. Scape longer than 2x pedicel; pedicel longer than F1; antenna as long as or slightly longer than head in full face view (29:30).

**Male:** Mandible relatively slender compared to that of female, pale yellow; clypeal carina weaker than that of female; front delicately coriaceous, shiner and with sparser punctuation than in female; antennal scrobes weakly carinate; WH 0.90-1.00x LH; WF 1.17-1.22x HE; EV 0.56-0.61x HE; ocelli almost right triangle; OOL 0.94-1.10x WOT; posterior transverse propodeal carina present only laterally and quite weak; forefemur length 2.06-2.27x width; forewing with closed areolet.

**Ecology and Biology:** ex. *Opisina arenosella* Walker (Oecophoridae) larvae on *Cocos nucifera*; ex. *Corcyra cephalonica* (Stainton) (Pyralidae).

**Distribution:** India – Tamil Nadu, Kerala, Karnataka; Sri Lanka.

**Material Examined:** 5♀. INDIA: Kerala, Alappuzha, Kayankulam, CPCRI Campus, 09°08.42'N 76°30.47'E, 13m, 17.iv.2004, rearing, ex. *Opisina arenosella*, S. Santhosh leg., VRN 65, VRN 61, VRN 60, VRN 69, VRN 67; 7♀. Kasaragode, CPCRI Campus, 5kms NW Kasaragode Town, 12°31.04'N 74°57.10'E, 18m, 21.vii.2006, rearing, ex. *Corcyra cephalonica*, S. Santhosh leg., VRN 191, VRN 195, VRN 190, VRN 192, VRN 19, VRN 18, VRN 189; 7♀. INDIA: Karnataka,

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Discussion: Goniozus nephantidis closely related to G. alarius sp. nov. in having head length subequal to its width, WH 0.89 - 1.09x LH; OOL 1.22-1.33x WOT, but differ in having eye sparsely setose, setae as long as the diameter of single facet; forefemur 1.76 - 1.9x as long as wide; anterior median propodeal triangle smooth and polished; pedicel longer than F1; scape longer than 2x pedicel. In G. alarius sp. nov., eye profusely setose, setae 4x as long as diameter of single facet; forefemur 1.54x as long as wide; anterior median propodeal triangle coriaceous; pedicel = F1; scape shorter than 2x pedicel.

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**Goniozus novellus** sp. nov.

(figs.78-80, 248-251)

**Diagnosis:** Head longer than wide, WH 0.83x LH, compressed in lateral view, 1.87x as long as wide; clypeus beak like in lateral view; anterior margin of clypeus obtuse; mandible slender; antenna as long as head; mandible brown-black; eye sparsely setose, setae minute, shorter than diameter of single facet; EV 0.60x HE; OOL 0.94x WOT; anteromedian propodeal triangle smooth, elevated, only upto middle of disc, not connected to transverse carina; metasoma distinctly longer than mesosoma. Forefemur 1.82x as long as wide. Forewing 3x as long as wide, without areolet, only a short stub arising from basal vein; M, SM with single row of setae.

**Description:** *Holotype – Female.*

**Measurements:** Length 2.8mm; LH 0.68mm; WH 0.57mm; WF 0.34mm; FWL 1.9mm; LM 1.1mm; LP 0.34mm; WPD 0.45mm; LPD 0.28mm.

**Colour:** Body black, first two segments and last segment of metasoma brown; mandible, antenna uniformly yellow-brown; leg orange brown; tibiae light-brown. Wing hyaline; subcosta, pterostigma, prostigma, brown; other veins straw coloured.

**Head:** Head (figs.79, 248) longer than wide, WH 0.83x LH, compressed in lateral aspect, 1.87x as long as wide (fig.250); frons and vertex coriaceous; gena smooth and polished; vestiture sparse, long, decumbent; vertex straight in full face view sides behind eyes parallel before curving inward at posterolateral angles; mandible slender hidden under clypeus in dorsal view, with 4 long pointed teeth, ventral most curved downwards; clypeus beak like in lateral view; anterior margin of clypeus obtuse, carina moderately strong, arcuate in profile extending onto frons as a low carina upto level of posterior margin of scrobe; scrobe ecarinate; vertex ecarinate with a row of long setae, longest being 0.09mm; WF 0.5x LH; EV 0.6x HE; WF = HE; LH 2x HE; malar space narrow; malar groove absent; eye sparsely setose, setae minute, shorter than diameter of single facet; ocelli in obtuse triangle; posterior ocelli contiguous with vertex; OOL 0.94x WOT; POL:AOL:DAO = 8:4:3. Relative lengths of first five antennal segments (fig.249) 6.5:3.5:2:3:4; scape 1.44x as long as wide, shorter than 2x pedicel; F1 wider than long, terminal segment longer than...
wide, rest of them as long as wide; F1 shorter than pedicel; antenna subequal to head length in full face view (24:22).

**Mesosoma:** Pronotum, mesonotum, scutellum (fig.80) coriaceous; vestiture long, decumbent, sparse on pronotum, only few setae on mesonotum and scutellum; pronotal disc (fig.248) 0.5x as long as wide; scutellum with a pair of basal slits connected by a narrow groove; parapsidal furrow weak, but complete; notauli absent; propodeal dorsum 0.65x as long as wide, smoothly inclined to lateral margin; basal median propodeal triangle smooth, elevated, reaching upto middle of disc, not reaching to posterior margin, rest of dorsum and declivity coriaceous; posterior transverse carina narrowly interrupted medially. Forewing (fig.248) 3x as long as wide, without areolet, only a short stub arising from basal vein; M, SM with single row of setae; setae present in distal 1/3rd of M and speculum sparsely setose; m:rs:rs+m = 9:5.5:6. Forefemur (fig.251) 1.82x as long as wide; SI 6.1.

**Metasoma:** Metasoma (fig.78) slightly longer than mesosoma (45:38), shorter than head plus mesosoma (45:61); tergites generally smooth and polished; T1 completely smooth; T2-T4 with weakly coriaceous basal band; T1-T3 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

**Male:** Unknown.

**Ecology and Biology:** Unknown.

**Etymology:** The species epithet is after the Latin word, *novellus* meaning recent.

**Distribution:** India – Kerala.

**Material Examined:** Holotype – Female. INDIA: Kerala, Malappuram, Calicut University Botanical Garden, 11°07.58’N 75°53.24’E, 80m, 17.iv.2003, S. Santhosh, leg. VRN 113 (DZUC).

**Discussion:** Goniozus novellus sp. nov. is closely related to *G. nuperus* sp. nov. in having brown-black mandible, forefemur 1.82-1.92x as long as wide and EV 0.53 - 0.60x HE. *Goniozus novellus* sp. nov. differs from *G. nuperus* sp. nov. in having OOL 0.94x WOT, anteromedian propodeal triangle smooth elevated not connected to the transverse carina, head in lateral view 1.87x as long as wide, mandible slender.
and antenna as long as head, whereas in *G. nuperus* sp. nov. OOL 1.05-1.11x WOT, anteromedian propodeal triangle smooth elevated connected to transverse carina by a smooth median line, head in lateral view 2x as long as wide, mandible stout and antenna slightly longer than head.

**Goniozus nuperus** sp. nov.

(figs.81-84, 252-255)

**Diagnosis:** Head longer than wide, WH 0.86 - 0.91x LH, strongly compressed in lateral view, 2x as long as wide; antenna distinctly longer than head in full face view; mandible stout, brown-black, ventral most tooth strongly curved downwards; anterior clypeal margin obtuse; OOL 1.05-1.11x WOT; EV 0.53-0.58x HE; eye sparsely setose, setae as long as diameter of single facet; parapsidal furrow present; propodeal disc sharply inclined to lateral margin; sublateral carina distinct only on posterolateral corner of propodeum; posterior transverse propodeal carina complete; anteromedian propodeal triangle smooth, elevated, connected to transverse carina by a median smooth line; metasoma distinctly longer than mesosoma. Forefemur 1.92x as long as wide. Forewing without areolet, but only short stub arising from basal vein; M with numerous setae, SM and speculum with few scattered setae.

**Description:** *Holotype – Female.*

**Measurements:** Length 3.35mm; LH 0.68mm; WH 0.596mm; WF 0.35mm; FWL 2mm; LM 1.17mm; LP 0.44mm; WPD 0.5mm; LPD 0.34mm.

**Colour:** Body black; mandible yellow, teeth brown; antenna yellow-brown, scape basally darker; terminal 9 segments progressively darker towards apex; all coxae, forefemur black; mid and hind femur dark brown; tibia yellow-brown; trochanter, tarsi yellow. Wing hyaline, prostigma and pterostigma brown, other veins straw coloured.

**Head:** Head (figs.83, 252) longer than wide, WH 0.88x LH, strongly compressed in lateral aspect, 2x as long as wide (figs.82, 254); frons and vertex coriaceous with scattered shallow punctures; gena smooth and polished; vestiture short, sparse,
decumbent; 3 pairs of long setae on vertex, longest being 0.096 mm; anterior clypeal margin strongly produced, broadly rounded, obtuse; clypeal carina strong and arcuate in profile, 0.71 x HE, extending onto frons beyond level of posterior scrobal margin; scrobe ecarinate; mandible stout with 4 short, pointed teeth, ventral most curved; WF 0.51 x LH; WF = HE; EV 0.53 x HE; LH 2 x HE; malar space narrow; malar groove absent; eye sparsely setose, setae minute, as long as diameter of single facet; ocelli in obtuse triangle, posterior ocelli not contiguous, separated from vertex margin by less than half its diameter; OOL 1.1 x WOT; POL:AOL:DAO = 6:3:2.5; vertex straight in full face view, carinate. Relative lengths of first five antennal segments (fig.253) 9:5:4:4.3:5; scape 1.88 x as long as wide, shorter than 2 x pedicel length; pedicel longer than F1; all funicular segments are longer than wide; antenna slightly longer than head in full face view (42:49).

*Mesosoma:* Pronotum, mesonotum and scutellum (fig.84) uniformly coriaceous, similar to head in dorsal view; vestiture sparse, short, decumbent; pronotal disc (fig.252) 0.57 x as long as wide; mesonotum with parapsidal furrow, anteriorly weak; notauli absent; scutellum with a pair of basal slits; propodeal disc 0.69 x as long as wide, sharply inclined to lateral margin; sublateral carina only on posterolateral corner of propodeum; basal median propodeal triangle smooth, shining, and elevated, extending to middle of propodeal disc, continued as weak line to transverse carina; rest of propodeal disc and declivity coriaceous; posterior transverse carina complete. Forewing (fig.252) 3.71 x as long as broad, without areolet, only a short stub arising from basal vein; M with numerous setae and SM with single row of setae; speculum sparsely setose; m:rs:rs+m = 6:5:6. Forefemur (fig.255) 1.92 x as long as wide; SI 4.31.

*Metasoma:* Metasoma (fig.81) distinctly longer than mesosoma (78:61), shorter than head plus mesosoma (78:96); tergites smooth and polished; T1 completely smooth, others with a weak coriaceous basal band; distinctly longer than mesosoma; T1-T4 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

*Male:* Unknown.
Investigation on the Alpha Taxonomy of Bethylidae

Observation and Results

Ecology and Biology: Collected from the riverside woodlands, paddy field and mixed agricultural plots. Host unknown.

Etymology: The species epithet is after the Latin word, nuperus meaning new.

Distribution: India – Kerala.


Variation: In one paratype (VRN 168) OOL 0.91x WOT; EV 0.41x HE and WH 0.91x LH. See table- 14 for morphometric ratios of all the type materials examined.

Discussion: Goniozus nuperus sp. nov. is closely related to G. novellus sp. nov. in having mandible brown black, forefemur 1.82-1.92x as long as wide, anteromedian smooth propodeal triangle elevated, either not continued or connected to transverse caina by a smooth median line, but not with a smooth patch and EV 0.53-0.60x HE. Goniozus nuperus sp. nov. differs from G. novellus sp. nov. in having OOL 1.05-1.11x WOT, anteromedian propodeal triangle is smooth, elevated, connected to the transverse carina by a smooth median line, head in lateral view 2x as long as wide, mandible stout, and antenna slightly longer than head, whereas in G. novellus sp. nov. OOL 0.94x WOT, anteromedian propodeal triangle is smooth, elevated, only upto the middle of disc, not connected to the transverse carina, head in lateral view.

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1.87x as long as wide, mandible slender, and antenna as long as head. *Goniozus kainophanestus* sp. nov. is also related to *G. nuperus* sp. nov., but differs in having yellow mandible; forefemur 1.67x as long as wide, anteromedian smooth propodeal triangle not elevated continued as smooth patch to the transverse carina and EV 0.42-0.44x HE, whereas in *G. nuperus* sp. nov. mandible is brown-black, forefemur 1.82-1.92x as long as wide, anteromedian smooth propodeal triangle elevated, either not continued or connected to the transverse carina by a smooth median line, but not a smooth patch, and EV 0.53 - 0.60x HE.

Table 14. Morphometric ratios of *Goniozus nuperus* sp. nov.

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Mean Values 0.87 1.07 0.55 0.98 0.75 1.71 1.27

*Goniozus orthagae* sp. nov.

(figs.85-88, 256-262)

**Diagnosis:** Head strongly coriaceous, subequal, WH 0.91x LH; head in lateral view moderately compressed, 1.7x as long as wide; mandible stout, brown-black; scape 2x pedicel; pedicel longer than F1; anterior clypeal margin strongly produced, obtuse; clypeal carina 0.67x HE, extending onto frons as low carina upto level of posterior scrobal margin; OOL 0.91x WOT. Posterior ocelli not contiguous with
vertex; propodeal disc sharply inclined to lateral margin; posterior propodeal transverse carina absent; forefemur 1.85x as long as wide. Forewing without areolet, but only short stub arising from basal vein; M, SM profusely setose.

**Description:** *Holotype – Female.*

**Measurements:** Length 2.67mm; LH 0.67mm; WH 0.61mm; WF 0.38mm; FWL 1.89mm; LM 1.06mm; LP 0.34mm; WPD 0.50mm; LPD 0.26mm.

**Colour:** Body brownish black; mandible yellow, teeth brown; antenna uniformly yellow, scape basally brown; legs yellow except coxae, forefemur and hind femur dark brown, hindfemur lighter than forefemur. Wing hyaline; subcosta, prostigma and pterostigma light brown, other veins colourless.

**Head:** Head (figs.87, 256) longer than wide, WH 0.91X LH, compressed in lateral aspect, 1.7x as long as wide (figs. 86, 257); frons and vertex strongly coriaceous with scattered shallow punctures; gena smooth and polished; vestiture long, sparse, decumbent; long setae on vertex, longest being 0.14mm; anterior clypeal margin strongly produced, obtuse; clypeal carina 0.67x HE, extending onto frons as low carina upto level of posterior scrobal margin; scrobe ecarinate; mandible robust with 4 short, pointed teeth, ventral most tooth pointed, straight; WF 0.57x LH; WF = HE; EV 0.3x HE; LH 1.85x HE; malar space narrow; malar groove absent; eye sparsely setose, setae minute, shorter than diameter of single facet; ocelli in obtuse triangle; posterior ocelli separated from occipital margin by less than half their diameter; OOL 0.91x WOT; POL:AOL:DAO = 7:3:3; vertex straight, weakly carinate. Relative lengths of first five antennal segments (fig.256) 6:3:2.5:3:2.8; scape 1.5x as long as wide, 2x pedicel length; pedicel longer than F1; F3 wider than long, F1, F2, F4-F10 as long as wide; F11 longer than wide; antenna distinctly longer than head in full face view (43:36).

**Mesonotum:** Pronotum (fig.88) strongly coriaceous without scattered shallow punctures; mesoscutum coriaceous, with shallow punctures, anteriorly with weak sculpture; scutellum weakly coriaceous, with few punctures; vestiture long, sparse, decumbent; pronotal disc (fig.256) 0.48x as long as wide; mesonotum with weak parapsidal furrow; notauali absent; scutellum with narrow basal transverse groove.
expanded into small pits on either end; propodeal disc 0.69x as long as wide, sharply inclined to lateral margin, basal propodeal triangle smooth, elevated, reaching posterior margin as a smooth line, rest of disc and posterior declivity coriaceous; posterior transverse carina is restricted to posterolateral corner, inner ends anteriorly curving. Forewing 2.8x as long as wide, without areolet; M, SM with numerous hairs; speculum setose; m:rs:rs+m = 7.5:5.5:6. Forefemur (fig.258) 1.85x as long as wide; SI 4.32.

Metasoma: Metasoma (fig.85) distinctly longer than mesosoma (68:57), shorter than head plus mesosoma (68:93); T2 weakly coriaceous at base; other tergites smooth and polished; T1-T3 completely with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

Male. Allotype

Male: Same as female except the following (fig.259-262), body brown-black; legs except forefemur and coxa yellow; forefemur red-brown. Antenna and mandible uniformly yellow. HW 0.97x LH (fig.259); WF 0.88x HE; OOL 0.58x WOT; POL: AOL = 7:3.3; m: rs:rs+m = 8:6:5; EV 0.62x HE (fig.261). Forefemur (fig.262) 2x as long as wide.

Ecology and Biology: ex. larvae of Orthaga exvinacea Hampson (Lepidoptera: Pyralidae) on Mangifera indica L. (Anacardiaceae).

Etymology: The species epithet is after the genus name of the host species, Orthaga.

Distribution: India – Kerala.

Material Examined: Holotype – Female. INDIA: Trichur, Chawaghad, 10°35.21'N 76°01.07'E, 01.iii.2006, K. Bindu leg., VRN 30 (DZUC). Paratype: 1m, same data as holotype, VRN 31 (DZUC).

Discussion: Goniozus rutherfordi is closely related to G. orthagae sp. nov., but it differs in having OOL as long as WOT, scape is less than 2x pedicel, posterior ocelli contiguous with vertex and mandible is slender, whereas in G. orthagae sp. nov. OOL 0.91x WOT, scape 2x pedicel, posterior ocelli is not contiguous with vertex and mandible is stout. Goniozus orthagae sp. nov. is also related to G. keralensis,
but the mandible is yellow and pedicel shorter than F1, whereas in *G. orthagae* sp. nov. mandible is brown-black and pedicel is longer than F1.

**Goniozus palghatensis** sp. nov.

(figs.89-92, 263-266)

**Diagnosis:** Head longer than wide, WH 0.79x LH; head and thorax uniformly strongly coriaceous and profusely setose; frons and vertex without shallow punctures; antenna as long as head in full face view; anterior clypeal margin acute, pedicel shorter than F1; scape as long as 2x pedicel; eye with long profuse setae; ocular setae 2.8x as long as diameter of single facet; OOL = WOT. Parapsidal furrow present; posterior propodeal transverse carina broadly interrupted medially; propodeal disc smoothly inclined to lateral margin; propodeal declivity medially smooth; metasoma shorter than mesosoma. Forewing without areolet, but only short stub arising from basal vein; M, SM and speculum profusely setose.

**Description:** *Holotype — Female.*

**Measurements:** Length 2.34mm; LH 0.63mm; WH 0.5mm; WF 0.3mm; FWL 1.61mm; LM 0.9mm; LP 0.3mm; WPD 0.44mm; LPD 0.24mm.

**Colour:** Body black; metasoma basally brown; mandible brown, teeth darker; antenna uniformly yellow; coxa, femur light brown; other leg segments yellow. Wing hyaline, prostigma and pterostigma brown, other veins straw coloured.

**Head:** Head (figs.91, 263) longer than wide, WH 0.79x LH, compressed in lateral aspect, 1.79x as long as wide (figs.90, 265); frons and vertex coriaceous without shallow punctures; gena smooth and polished; vestiture short, profuse, suberect; setae longer on vertex, longest being 0.11mm;; anterior clypeal margin strongly produced, sharply angulate, acute; clypeal carina strong and arcuate in profile, 0.56x HE, extending onto frons falling short of level of posterior scrobal margin; scrobe weakly carinate; mandible stout with 4 long, pointed teeth, ventral most weakly curved inwards; WF 0.48x LH; WF 0.91x HE; EV 0.5x HE; LH 1.95x HE; malar space narrow; malar groove absent; eye profusely setose, setae long, 2.8x as long as
diameter of single facet; ocelli in obtuse triangle, posterior ocelli separated from vertex margin by less than half its diameter; OOL = WOT; POL:AOIL:DAO = 7.5:4:2.5; vertex straight in full face view, ecarinate. Relative lengths of first five antennal segments (fig.264) 7:3.5:3.8:3.5:3; scape 1.27x as long as wide, 2x pedicel; pedicel shorter than F1; pedicel, F1, F11 longer than wide; other funicular segments as long as wide; antenna subequal to head length in full face view (37:36).

Mesosoma: Pronotum, mesonotum and scutellum (fig.92) strongly coriaceous without shallow punctures; vestiture long, profuse, suberect; pronotal disc (fig.263) 0.48x as long as wide; mesonotum with distinct, complete parapsidal furrow; notaufi absent; scutellum with a pair of basal slits connected by narrow groove; propodeal disc 0.56x as long as wide, smoothly inclined to lateral margin; sublateral carina on posterolateral corner of propodeal disc; basal median triangular area smooth, elevated, reaching posterior margin by weak median smooth line, declivity medially smooth; rest of disc and declivity coriaceous; posterior transverse carina broadly interrupted medially. Forewing (fig.263) 2.89x as long as wide, without areolet; M, SM with abundant setae; speculum with numerous setae; m; rs; rs+m = 6.5:3:6.5. Forefemur (fig.266) 1.75x as long as wide; SI 5.3.

Metasoma: Metasoma (fig.89) slightly shorter than mesosoma (54:60), distinctly shorter than head plus mesosoma (54:102); tergites with weakly coriaceous in apical band rest smooth, polished; T1-T3 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

Male: Unknown.

Ecology and Biology: Unknown.

Etymology: The species epithet is after the type locality, Palghat.

Distribution: India – Kerala.

Material Examined: Holotype – Female. INDIA: Kerala, Palghat, Anakatti, 11°06.15'N 76°46.01'E, 690m, 12.xii.1987, sweeping, T.C. Narendran leg., VRN 57 (DZUC).
Discussion: *Goniozus palghatensis* sp. nov. is closely related to *G. propodeatus* sp. nov. in having the anterior clypeal margin acute, scape equal to or more than 2x pedicel, eye profusely setose, setae longer than diameter of single facet, and M, SM and speculum profusely setose. *Goniozus propodeatus* sp. nov. differ from *G. palghatensis* sp. nov. in having the posterior propodeal transverse carina complete, propodeal disc sharply inclined to lateral margin with sublateral ridges, antenna distinctly longer than head in full face view, pedicel longer than F1, scape longer than 2x pedicel; metasoma longer than mesosoma, frons and vertex with shallow punctures and ocular setae slightly longer than diameter of single facet, whereas in *G. palghatensis* sp. nov. posterior propodeal transverse carina broadly interrupted medially, propodeal disc smoothly inclined to lateral margin without sublateral ridges, antenna as long as head in full face view, pedicel shorter than F1, scape as long as 2x pedicel, metasoma shorter than mesosoma, frons and vertex without shallow punctures and ocular setae 2.8x as long as diameter of single facet.

*Goniozus platycephalus* sp. nov.

(figs.93-96, 267-271)

**Diagnosis:** Head weakly coriaceous, subequal in full face view, WH 0.93x LH, head strongly compressed in lateral view, 2.17x as long as wide; clypeal carina completely absent; eye sparsely setose, setae minute, shorter than diameter of single facet; vertex ecarinate, emarginate; posterior propodeal transverse carina absent. Forefemur 2.14x as long as wide. Forewing without areolet, but only short stub arising from basal vein.

**Description:** *Holotype – Female.*

**Measurements:** Length 3.25mm; LH 0.73mm; WH 0.68mm; WF 0.40mm; FWL 2.35mm; LP 0.5mm; LM 1.38mm; WPD 0.52mm; LPD 0.38mm.

**Colour:** Body black; mandible brownish yellow, teeth darker; antenna yellow, apical two segments and base of scape fuscous; coxae and femora brown; trochanters,
tibiae and tarsi yellow. Wing hyaline; subcosta, prostigma and pterostigma light brown, other veins colourless.

**Head:** Head (figs.95, 267) longer than wide, WH 0.93x LH; strongly compressed in lateral aspect, 2.17x as long as wide (figs.94, 269); frons and vertex weakly coriaceous with scattered shallow punctures; gena smooth and polished; vestiture short, sparse and suberect, longest on vertex margin being 0.08mm; anterior clypeal margin strongly produced, broadly rounded, obtuse; clypeal median ridge and carina absent; frons without polished streak; scrobe ecarinate; mandible slender with long, pointed 4 teeth, ventral most straight; WF 0.55x LH; WF 1.1x HE; EV 0.68x HE; LH 2.05x HE; malar space distinct; malar groove absent; eye sparsely setose, setae minute, shorter than diameter of single facet; ocelli in obtuse triangle; posterior ocelli separated from vertex margin by less than half of their diameter; OOL 0.85x WOT; POL:AOL:DAO = 8.5:4:3; vertex ecarinate, emarginate. Relative lengths of first five antennal segments (fig.268) 8:4:3.5:3:3; scape 2x as long as wide; pedicel longer than F1; F2 to F3 as long as wide, other funicular segments longer than wide, antenna longer than head in full face view (38:47).

**Mesosoma:** Pronotum (fig.96) coriaceous with scattered shallow punctures; mesonotum weakly coriaceous; scutellum smooth and glossy; vestiture sparse, long, suberect; pronotal disc 0.64x as long as wide, mesonotum with parapsidal furrow, absent in posterior one-third, notafuli absent; scutellum with a pair of basal slits; propodeal disc as long as wide; sharply inclined to lateral margin, basal median propodeal triangle polished, not elevated, extending into declivity, rest of propodeal disc coriaceous, weaker towards posterior margin, declivity medially smooth; transverse carina absent, restricted to posterolateral corners as very short carina. Forewing (fig.271) 3x as long as wide, without areolet, only a short stub arising from basal vein; M, SM and speculum sparsely setose; m:rs:rs+m= 8:4.5:5. Forefemur (fig.270) 2.14x as long as wide; SI 6.6.

**Metasoma:** Metasoma (fig.93) slightly longer than mesosoma (86:75), shorter than head plus mesosoma (86:113); tergites smooth and polished; T1-T2 completely smooth, others with weakly coriaceous basal band; T1-T3 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

*Santhosh, S.*
Male: Same as female except the following; HW 1.02x LH; WF = HE; OOL 0.63x WOT; POL: AOL: DAO = 4.5:2:2; m: rs: rs+m = 9:5:7; EV 0.43x HE. Forefemur 2.3x as long as wide.

Ecology and Biology: ex. larvae of rice leaf folder, *Cnaphalocrocis medinalis* (Guenee) (Lepidoptera: Pyralidae)

Etymology: The species epithet is from the Latin *platy* meaning flat and *cephalus* meaning head in allusion to the strongly flat head of the species.

Distribution: India – Manipur; Karnataka.


Discussion: This new species falls into the group of seven species of *Goniozus* without areolet and posterior propodeal transverse carina, viz. *Goniozus orthagae* sp. nov., *G. borneanus*, *G. keralensis*, *G. rutherfordi*, *G. indicus*, and *G. triangulus*. *Goniozus platycephalus* sp. nov. strongly differs from all other related species in having an extremely flat head, 2.17x as long as wide in lateral view; forefemur more than 2x as long as wide; anteromedian propodeal triangle smooth and not elevated, clypeus devoid of median carina. In *G. platycephalus* sp. nov., head sculpture is weakly coriaceous like *G. rutherfordi*, whereas in *G. indicus* head is smooth and in *G. orthagae* sp. nov., *G. keralensis* and *borneanus* head is strongly coriaceous with shallow punctures. Mandible is yellow in *G. platycephalus* sp. nov., *G. borneanus*, *G. keralensis*, and *G. triangulus*, whereas in *G. orthagae* sp. nov. and *G. rutherfordi* mandible is brown.

Remarks: The configuration and concomitant ratios of the head differ between the sexes, but the propodeal shape and sculpture remains consistent within the species. The male specimen collected from Uppinangady in Karnataka closely resembles the female collected from Manipur except in the configuration and concomitant ratios of the head. Though the male and female specimens are geographically separated, the male specimen from the Western Ghats is tentatively kept as a paratype of the

*Santhosh, S.*
female from Eastern Himalaya in the present investigation. It is expected that further study of the species involving more specimens from the study area may support this view.

_Goniozus propodeatus_ sp. nov.

(figs.97-100, 272-275)

**Diagnosis:** Head longer than wide, WH 0.88x LH; in lateral aspect, strongly compressed, 1.78x as long as wide; frons and vertex coriaceous with shallow punctures; anterior clypeal margin acute; antenna distinctly longer than head in full face view; pedicel longer than F1; scape longer than 2x pedicel; eye profusely setose, setae longer than diameter of single facet; parapsidal furrows present; posterior propodeal transverse carina complete; propodeal disc sharply inclined to lateral margin, with distinct sublateral ridges; metasoma longer than mesosoma. Forewing without areolet, only a short stub arising from basal vein; M, SM and speculum profusely setose.

**Description:** _Holotype_ – Female.

**Measurements:** Length 3.38mm; LH 0.75mm; WH 0.66mm; WF 0.39mm; FWL 2.05mm; LM 1.11mm; LP 0.36mm; WPD 0.52mm; LPD 0.27mm.

**Colour:** Body brownish black, metasoma basally (T1) brown; mandible red-brown with brown teeth; antenna uniformly yellow with 4 terminal segments light brown; coxa, trochanter, femur dark brown, tibia and tarsi yellowish brown. Wing hyaline; prostigma and pterostigma brown, other veins straw coloured.

**Head:** Head (figs.99, 272) longer than wide, WH 0.88x LH, compressed in lateral aspect, 1.78x as long as wide (figs.98, 274); frons and vertex coriaceous with scattered shallow punctures; gena smooth and polished; vestiture short, long, decumbent; anterior clypeal margin strongly produced, acute; clypeal carina strong, arcuate in profile, 0.6x HE, extending onto frons upto level of posterior scrobal margin; scrobe ecarinate; mandible stout with 4 short, pointed teeth, ventral most straight; WF 0.52x LH; WF = HE, EV 0.53x HE; LH 1.88x HE; malar space
narrow; malar groove absent; eye sparsely setose, setae slightly longer than diameter of single facet; ocelli in obtuse triangle; posterior ocelli separated from vertex margin by less than half its diameter; OOL = WOT; POL: AOL: DAO = 6:3:3; vertex straight in full face view, weakly carinate with 3 pairs of long setae, longest being 0.21mm; 2 pairs of setae near outer posterior ocular margin very long. Relative lengths of first five antennal segments (fig.273) 9:4:3:3.5:3.5; scape 1.8x as long as wide, longer than 2x pedicel; pedicel longer than F1; F2-F11 longer than wide; antenna longer than head in full face view (30:26).

**Mesosoma:** Pronotum, mesonotum and scutellum (fig.100) coriaceous; scutellum with shallow punctures; vestiture profuse, long, decumbent; pronotal disc 0.52x as long as wide; parapsidal furrow weak, complete; notauli absent; scutellum basally with a pair of pits connected in between by a narrow groove; propodeal dorsum 0.52x as long as wide, sharply inclined to lateral margin; disc with distinct sublateral ridges, basal median propodeal triangle smooth, shining, elevated, extending beyond middle of disc, connected to posterior margin by a smooth line, rest of propodeal disc and declivity coriaceous; posterior transverse carina complete. Forewing 2.73x as long as wide, without areolet, only a short stub arising from basal vein; M, SM, speculum with numerous setae; m:rs:rs+m = 5:4:4.5. Forefemur (fig.275) 1.62x as long as wide; SI 5.57.

**Metasoma:** Metasoma (fig.97) distinctly longer than mesosoma (47:39), shorter than head plus mesosoma (47:62); tergites smooth and polished; T3 and T4 weakly coriaceous. T1-T3 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

**Male:** Unknown.

**Ecology and Biology:** Unknown.

**Etymology:** The species epithet is after the propodeum, which shows distinct sublateral ridges.

**Distribution:** India – Kerala.
**Material Examined:** Holotype – Female. INDIA: Kerala: Malappuram, Calicut University Botanical Garden, Arboretum, 11°07.58’N 75°53.24’E, 80m, MT, 5-12.xii.2006, S. Santhosh leg., VRN 110 (DZUC).

**Discussion:** Goniozus propodeatus sp. nov. and G. palghatensis sp. nov. are similar in having anterior clypeal margin acute, scape equal to or more than 2x pedicel, eye profusely setose, setae longer than diameter of single facet and M, SM and speculum profusely setose. Goniozus propodeatus sp. nov. differ from G. palghatensis sp. nov. in having complete posterior propodeal transverse carina, propodeal disc sharply inclined to lateral margin with sublateral ridges, antenna distinctly longer than head in full face view, pedicel longer than F1, scape longer than 2x pedicel, metasoma longer than mesosoma, frons and vertex with shallow punctures and ocular setae slightly longer than diameter of single facet, whereas in G. palghatensis sp. nov., posterior propodeal transverse carina is broadly interrupted medially, propodeal disc smoothly inclined to lateral margin without sublateral ridges, antenna as long as head in full face view, pedicel shorter than F1, scape as long as 2x pedicel, metasoma shorter than mesosoma, frons and vertex without shallow punctures and ocular setae 2.8x as long as diameter of single facet.

**Goniozus prosphatosis** sp. nov.

(figs.101-104, 276-281)

**Diagnosis:** Head slightly longer than wide in full face view, WH 0.94-0.95x LH; strongly compressed in lateral aspect, 1.83x as long as wide; frons and vertex strongly coriaceous with scattered shallow punctures; clypeal carina present; mandible yellow; antenna distinctly longer than head; scape shorter than 2x pedicel; pedicel longer than F1; malar space distinct; vertex emarginate; propodeal disc 0.5x as long as wide, sharply inclined to lateral margin; disc with distinct sublateral ridges; posterior transverse propodeal carina broadly interrupted medially; metasoma distinctly longer than mesosoma. Forefemur 2.1x as long as wide. Forewing without areolet, but only short stub arising from basal vein.

**Description:** Holotype – Female.

Santhosh, S.
Measurements: Length 3.26mm; LH 0.74mm; WH 0.7mm; WF 0.41mm; FWL 2.32mm; LM 1.1mm; LP 0.32mm; WPD 0.5mm; LPD 0.25mm.

Colour: Body black, antenna light yellow, terminal 4 segments with brown tinge; mandible yellow, teeth brown; coxa, femur light to dark brown, other leg segments yellow. Wing hyaline; pterostigma, prostigma brown; costa, subcosta, stigmal vein straw coloured.

Head: Head (figs.103, 276) longer than wide in full face view, WH 0.95x LH, compressed in lateral aspect, 1.83x as long as wide (figs.102, 278); frons and vertex strongly coriaceous with scattered shallow punctures; gena smooth and polished; vestiture sparse, long, suberect; 4 pairs of long setae on vertex margin, longest being 0.15mm long; anterior clypeal margin strongly produced, bluntly angulated, obtuse; clypeal carina 0.8x HE, strong, arcuate in profile, extending onto frons upto level of posterior scrobal margin; scrobe weakly carinate; mandible robust, 4 short, pointed teeth, ventral most short, slightly curved inwards; WF 0.55x LH; WF = HE; EV 0.30x HE; LH 1.83x HE; malar space distinct; malar groove absent; eye sparsely setose; setae minute, shorter than diameter of single facet; ocelli in obtuse triangle; posterior ocelli contiguous with vertex margin; OOL 0.82x WOT; POL:AOL:DAO = 5:2.3:2.8; vertex emarginate in full face view, carinate. Relative lengths of first five antennal segments (fig.277) 7:5:3.5:4:4.5; scape 1.4x as long as wide, shorter than 2x pedicel; pedicel longer than F1; pedicel and F1 0 longer than wide; F1-F10 as long as wide; antenna longer than head in full face view (35:29).

Mesosoma: Pronotum (fig.104) coriaceous similar to head in full face view; mesonotum, scutellum weakly coriaceous; vestiture sparse, long; longest on pronotum being 0.14mm; pronotal disc (fig.276) very short, 0.42x as long as wide; mesonotum with parapsidal furrow, anteriorly absent; notauli absent; scutellum with a pair of basal slits; propodeal disc 0.5x as long as wide, sharply inclined to lateral margin; disc with distinct sublateral ridges; median basal triangle smooth, polished, elevated extending slightly beyond middle, continued as smooth line to posterior margin of disc; rest of dorsum and declivity coriaceous; transverse carina broadly interrupted medially, substituted with smooth line in middle; propodeal disc sharply inclined to lateral margin. Forewing (fig.276) 3.09x as long as wide, without areolet,
only a short stub arising from basal vein; M, SM with single row of setae; setae present in distal one-third of M cell; speculum with a pair of setae; m:rs:rs+m = 6:3.5:4. Forefemur (fig.279) 2.1x as long as wide; SI 4.

**Metasoma:** Metasoma (fig.101) distinctly longer than thorax (45:34), shorter than head plus mesosoma (45:54); tergites smooth and polished; T1-T2 completely smooth; other tergites with weakly coriaceous basal band; T1-T4 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

**Male. Allotype.**

**Measurements:** Length 2.66mm; LH 0.66mm; WH 0.64mm; WF 0.36mm; FWL 2.1mm; LM 1.1mm; LP 0.29mm; WPD 0.48mm.

**Description:** Similar to female except leg, antenna, mandible light yellow; teeth red; terminal 4 antennal segments light brown; metasoma shorter than thorax; POL:AOL:DAO = 5:2.5:3; antenna longer than head in full face view (25:19).

**Ecology and Biology:** Unknown.

**Etymology:** The species epithet is after the Greek word, *prosphatos* meaning new.

**Distribution:** India – Kerala; Tamil Nadu – Chennai.

**Material Examined:** Holotype – Female. INDIA: Kerala, Nilambur, Ganapathikallu, 11°24.06'N 76°22.11'E, 303m, 30.i.2003, sweeping, MDF, K. Sudheer leg., VRN 172 (DZUC). Paratypes: 1♀. same data as holotype, VRN 170; 1♂. same data as holotype, VRN 171; 2♀. INDIA: Tamil Nadu, Chennai, 13°03.22'N 80°14.05'E, 14m, 16.x.2007, rearing, Alexander Yesudasan leg., VRN 193, VRN 194. (DZUC).

**Variation:** Teneral female specimens are light brown in colour; antenna light yellow, concolourous to mandible and leg. In paratypes, OOL 0.72x WOT, EV 0.37x HE, WF 0.96x HE, LS 1.7-1.8x PL and PL 1.36-1.4x LF1. See table- 15 for morphometric ratios of all the type materials examined.

**Discussion:** Goniozus prosphatos* sp. nov. closely resembles *G. aproaeremae* sp. nov. in having posterior transverse propodeal carina broadly interrupted medially and head as long as wide in full face view, WH 0.91x – 1.02x LH, but it differs in having yellow mandible, antenna distinctly longer than head, vertex emarginate,
forefemur 2.1x as long as wide and clypeal carina present, malar space distinct and setae on vertex distinctly longer than that of frons, whereas in G. aproaeremae sp. nov., brown-black mandible, antenna as long as head, vertex straight, forefemur 2x as long as wide and clypeal carina absent, malar space narrow and setae on vertex as long as that of frons.

**Table – 15. Morphometric ratios of Goniozus prosphatosis sp. nov.**

<table>
<thead>
<tr>
<th>VRN</th>
<th>WH / LH</th>
<th>OOL / WOT</th>
<th>EV / HE</th>
<th>WF / HE</th>
<th>LH / LA</th>
<th>LS / PL</th>
<th>PL / LF</th>
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<td>0.3</td>
<td>1</td>
<td>0.88095</td>
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<td>1.6</td>
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<td></td>
</tr>
<tr>
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<td>0.368421</td>
<td>1</td>
<td>0.87179</td>
<td>1.71429</td>
<td>1.4</td>
<td></td>
</tr>
</tbody>
</table>

Mean Values: 0.94 0.80 0.32 0.99 0.87 1.64 1.49

**Goniozus recentis** sp. nov.

(figs.105-108, 282-285)

**Diagnosis:** Head strongly transverse in full face view, WH 1.19x LH, compressed in lateral view, 1.71x as long as wide; head vestiture long, moderately profuse, clypeal carina absent, only as smooth ridge, extending onto frons, not reaching level of posterior scrobal margin; mandible yellow-brown; ventral most mandibular tooth long, strongly curved inward and backward; WF 0.73x LH; EV 0.28-0.29x HE. Scape longer than 2x pedicel length; pedicel = F1; all antennal segments longer than wide. Posterior propodeal carina complete metasoma distinctly longer than mesosoma. Forewing with subtriangular areolet, 1.7x as long as maximum width, asetose; M, SM profusely setose.

**Description:** *Holotype – Female.*

*Measurements:* Length 4.11mm; LH 0.79mm; WH 0.95mm; WF 0.58mm; FWL 2.84mm; LM 1.62mm; LP 0.43mm; WPD 0.81mm; LPD 0.35mm.
**Colour:** Body black; mandible brown, basal area, teeth darker; antenna yellowish brown, scape, terminal 7 segments darker; coxa, femur dark brown, other leg segments yellow-brown. Wing hyaline; pterostigma, prostigma dark brown; other veins light brown.

**Head:** Head (figs.107, 282) strongly transverse in full face view, WH 1.19x LH; compressed in lateral aspect, 1.71x as long as wide (figs.106, 284); frons and vertex strongly coriaceous with scattered shallow punctures; gena smooth and polished; vestiture long, moderately profuse, decumbent; 4 pairs of setae on vertex distinctly longer than others, longest being 0.19mm; anterior clypeal margin strongly produced, bluntly angulated, obtuse; median carina weak as a ridge, extending onto frons, not reaching level of posterior scrobal margin; scrobe deep, distinctly margined, weakly carinate; mandible moderately robust, with 4 blunt long teeth, ventral most long, strongly curved inwards and backwards; WF 0.73x LH; WF 1.13x HE; EV 0.29x HE; LH 1.68x HE; malar space narrow; malar groove absent; eye sparsely setose; setae minute, as long as diameter of single facet; ocelli in obtuse triangle; posterior ocelli contiguous with vertex margin; OOL = WOT; POL: AOL: DAO = 5.8:3:2.5; vertex emarginated in full face view, ecarinate. Relative lengths of first five antennal segments (fig.283) 13:6:6:6.8:7; scape 1.53x as long as wide; longer than 2x pedicel; pedicel = F1; all segments longer than wide. Antenna distinctly longer than head in full face view (42:32).

**Mesosoma:** Pronotum, mesonotum, scutellum (fig.108) coriaceous as on frons; vestiture on pronotum and mesonotum profuse, long, decumbent, but sparsely on scutellum; pronotal disc (fig.282) 0.47x as long as wide; parapsidal furrow distinct and complete; notauli absent; scutellum with basal pair of pits connected by narrow groove in middle; propodeum 0.42x as long as wide, smoothly inclined to lateral margin; median basal triangle elevated, coriaceous similar to scutellum, extending slightly beyond middle of disc, not reaching posterior margin, rest of propodeal dorsum and declivity strongly coriaceous; no sublateral carina on posterolateral corner; posterior transverse carina distinct and complete. Forewing (fig.282) 2.76x as long as wide, with areolet present, subtriangular in shape, 1.7x as long as
Investigation on the Alpha Taxonomy of Bethylidae

Observation and Results

maximum width; M, SM profusely setose; speculum sparsely setose; areolet asetose. Forefemur (fig.285) 1.83x as long as wide; SI 4.69.

Metasoma: Metasoma (fig.105) distinctly longer than mesosoma (42:25), longer than head plus mesosoma (42:39); tergites generally smooth and polished; T1 completely smooth; others with scattered shallow punctures; T1-T3 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

Male. Allotype.

Measurements: Length 2.73mm; LH 0.62mm; WH 0.73mm; WF 0.43mm; FWL 1.78mm; LM 1.08mm; LP 0.35mm; WPD 0.54mm; LPD 0.28mm.

Similar to female except following: mandible yellow, base brown; F1-F3 as long as pedicel; WF 1.1x HE; WH 1.17x LH; length of first 5 antennal segments in a ratio of 9:5:5:5:5:5; scape shorter than 2x pedicel; OOL 0.71x WOT; POL: AOL: DAO 4.5:2:2.3.

Ecology and Biology: Collected from the paddy fields. Host unknown.

Etymology: The species epithet is after the Latin word, recens meaning new.

Distribution: India – Kerala.


Variation: In paratype scape is 2x as long as pedicel. See table- 16 for morphometric ratios of all the type materials examined.

Discussion: Goniozus recentis sp. nov. comes close to G. salvadorae Kurian in having the head transverse, WH equal to or more than 1.2x LH, propodeal disc posteriorly with a complete transverse carina and forewing with areolet, but differs in having yellow-brown mandible, forefemur 1.83x as long as wide, clypeal carina

Santhosh, S.
absent, anteromedian propodeal area with a smooth elevated triangle, EV 0.28-0.29x HE and metasoma distinctly longer than head plus mesosoma, whereas in G. salvadorae, mandible is black brown, forefemur 2.33x as long as wide, clypeal carina strong extending onto frons upto posterior scrobal margin, anteromedian propodeal area with a smooth area, but not an elevated triangle, EV 0.67x HE and metasoma shorter than head plus mesosoma.

Table – 16. Morphometric ratios of Goniozus recentis sp. nov.

<table>
<thead>
<tr>
<th>VRN</th>
<th>WH / LH</th>
<th>OOL / WOT</th>
<th>EV / HE</th>
<th>WF / HE</th>
<th>LH / LA</th>
<th>LS / PL</th>
<th>PL / LF1</th>
</tr>
</thead>
<tbody>
<tr>
<td>141</td>
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<td>0.289474</td>
<td>1.13158</td>
<td>0.67045</td>
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</tr>
<tr>
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<td>1</td>
</tr>
<tr>
<td>Mean Values</td>
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<td>1.12</td>
<td>0.66</td>
<td>2.08</td>
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</tbody>
</table>

Goniozus setosus sp. nov.

(figs.109-112, 286-289)

**Diagnosis:** Head distinctly longer than wide, WH 0.73-0.78x LH, strongly compressed in lateral aspect, 1.89x as long as wide; frons and vertex strongly coriaceous with scattered shallow punctures, profusely setose; gena weakly coriaceous; eye profusely setose, setae 3x as long as diameter of single facet; OOL 0.82-0.94x WOT; WF 0.84-0.93x HE; EV 0.35-0.39x HE; vertex straight. Metasoma distinctly longer than mesosoma. Forefemur 1.67x as long as wide. Forewing 3x as long as wide, with sub rectangular, setose areolet, 1.83x as long as wide; M, SM profusely setose.

**Description:** *Holotype* – Female.

**Measurements:** Length 2.38mm; LH 0.56mm; WH 0.43mm; WF 0.26mm; FWL 1.33mm; LM 0.75mm; LP 0.25mm; WPD 0.32mm; LPD 0.19mm.

**Colour:** Body black; mandible dark brown, teeth yellow; antenna yellow- brown, scape basally and terminal six segments brown; coxa, femur dark brown; trochanter, tibia, tarsi yellow; base of tibia fuscous. Wing hyaline; costa, stigmal vein straw coloured; prostigma, pterostigma dark brown; other veins colourless.
Head: Head (figs. 111, 286) longer than wide, WH 0.78x LH; compressed in lateral aspect, 1.89x as long as wide (figs. 110, 288); frons and vertex strongly coriaceous with scattered shallow punctures; gena weakly coriaceous; vestiture long, profuse, decumbent; setae on vertex margin distinctly very long; long and strong setae near posterolateral ocular margin, longest being 0.22mm in length; anterior clypeal margin strongly produced, sharply angulate, acute; clypeal carina 0.62x HE, strong, arcuate in profile, extending onto frons slightly beyond posterior scrobal margin; scrobe deep, weakly carinate; mandible robust, with very short, pointed teeth ventral most straight; WF 0.46x LH; WF 0.93x HE; EV 0.39x HE; LH 1.84x HE; malar space distinct; malar groove absent; eye profusely setose; setae 3x diameter of single facet; ocelli in obtuse triangle; posterior ocelli contiguous with vertex margin; OOL 0.82x WOT; POL: AOL: DAO = 6:3:2; vertex straight in full face view, smoothly angulated, ecarinate. Relative lengths of first five antennal segments (fig.287) 7:3.5:2.5:2.5:3; scape 1.49x as long as wid M with numerous setae, 2x pedicel length; pedicel longer than F1; F1-F10 as long as wide; F11 longer than wide; antenna slightly longer than head in full face view (26:21); head as wide as maximum width of thorax.

Mesosoma: Pronotum, mesonotum and scutellum (fig.112) strongly coriaceous; vestiture long, sparse, suberect; pronotal disc (fig.286) 0.54x as long as wide; scutellum with a pair of basal pits connected by a narrow groove; parapsidal furrow complete; notauli absent; propodeal disc 0.65x as long as wide, smoothly inclined to lateral margin, no sublateral carina on posterolateral corner of disc; basal median propodeal area smooth, rectangular, not elevated, not reaching posterior margin of disc, rest of disc and declivity coriaceous; posterior transverse carina broadly interrupted medially. Forewing (fig.286) 3x as long as wide; areolet present, subrectangular in shape; 1.83x as long as wide; setose; M, SM with numerous setae; speculum and areolet profusely setose. Forefemur (fig.289) 1.67x as long as wide; SI 9.6x.

Metasoma: Metasoma (fig.109) distinctly longer than mesosoma (46:30), shorter than head plus mesosoma (46:53); tergites smooth and polished; T1-T3 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.
Male: Unknown.

Ecology and Biology: Collected from plantain and coconut plantations. Host unknown.

Etymology: The species epithet 'setosus' is after the profusely setose head of the species.

Distribution: India – Kerala.


Variation: In some of the paratypes, WH 0.80~ LH, OOL 0.98~ WOT and EV 0.41~ HE. See table-17 for morphometric ratios of all the type materials examined.

Discussion: Goniozus setosus sp. nov. is closely related to G. inauditus sp. nov. in having vertex straight, scrobe weakly or strongly carinate, M, SM profusely setose, posterior ocelli contiguous with vertex margin and EV 0.35~0.39~ HE. Goniozus setosus sp. nov. differs from G. inauditus sp. nov. in having eye profusely setose, ocular setae 3x as long as diameter of single facet, forefemur 1.67x as long as wide, OOL 0.82-0.94x WOT, WF 0.84-93 HE, EV 0.35-0.39x HE, gena weakly coriaceous, whereas in G. inauditus sp. nov. eye sparsely setose, ocular setae as long as diameter of single facet, forefemur 1.92x as long as wide, OOL 1.09-1.1x WOT, WF = HE, EV 0.47-0.55x HE and gena smooth and polished.
Table – 17. Morphometric ratios of *Goniozus setosus* sp. nov.

<table>
<thead>
<tr>
<th>VRN</th>
<th>WH / LH</th>
<th>OOL / WOT</th>
<th>EV / HE</th>
<th>WF / HE</th>
<th>LH / LA</th>
<th>LS / PL</th>
<th>PL / LF1</th>
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<td>0.375</td>
<td>0.90625</td>
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<td>0.387097</td>
<td>0.90323</td>
<td>0.93333</td>
<td>2.2</td>
<td>1.38889</td>
</tr>
<tr>
<td>153</td>
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<td>0.90323</td>
<td>0.93333</td>
<td>2.2</td>
<td>1.38889</td>
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<tr>
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<td>0.375</td>
<td>0.875</td>
<td>0.9375</td>
<td>2.4</td>
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<td>148</td>
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Mean Values

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<th>WH / LH</th>
<th>OOL / WOT</th>
<th>EV / HE</th>
<th>WF / HE</th>
<th>LH / LA</th>
<th>LS / PL</th>
<th>PL / LF1</th>
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<tbody>
<tr>
<td>0.77</td>
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<td>0.88</td>
<td>0.91</td>
<td>2.27</td>
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</table>

*Goniozus sringeriensis* sp. nov.

(figs.113-116, 290-293)

**Diagnosis:** Head transverse, WH 1.0-1.03x LH; clypeal margin acute; mandible yellow; scape less than 2x as long as pedicel; pedicel longer than F1; EV 0.23-0.27x HE; WF 0.56x WH; OOL 0.63-0.73x WOT; eye sparsely setose; setae minute, shorter than diameter of single facet. Propodeal disc sharply inclined to lateral margin with distinct sublateral ridge; posterior transverse carina present, complete; anteromedian smooth propodeal triangle slightly beyond middle connected to posterior margin by weak median carina; posterior ocelli contiguous or separated from vertex by less than 0.5x its diameter. Forewing without areolet, but only short...
stub arising from basal vein; M, SM with single row of setae; speculum with scattered setae.

**Description:** *Holotype – Female.*

**Measurements:** Length 4.1mm; LH 0.77mm; WH 0.81mm; WF 0.45mm; FWL 2.59mm; LM 1.43mm; LP 0.57mm; WPD 0.66mm; LPD 0.37mm.

**Colour:** Body brownish black; mandible light yellow, teeth brown; antenna uniformly light yellow; leg dark brown except yellow trochanter, tibia, and tarsi. Wing hyaline; costa, subcosta, and prostigma light brown, other veins straw coloured.

**Head:** Head (figs.115, 290) wider than long in full face view; HW 1.03x LH; weakly compressed in lateral aspect, 1.6x as long as wide (figs.114, 292); frons and vertex coriaceous with scattered shallow punctures; gena smooth and polished; vestiture long, sparse, decumbent; vertex margin with long setae, longest being 0.19mm; anterior clypeal margin strongly produced, acute, carina 0.6x HE, strongly arcuate in profile, extending onto frons up to level of posterior scrobal margin; scrobe carinate; moderately stout with 4 short, blunt teeth, ventral most straight; WF 0.58x LH; WF 0.95x HE; EV 0.27x HE; LH 1.76x HE; malar space distinct; malar groove absent; eye sparsely setose; setae minute, shorter than diameter of single facet; ocelli in obtuse triangle; posterior ocelli separated from vertex margin by less than half its diameter; OOL 0.73x WOT; POL: AOL: DAO = 4.5:2.5:2.5; vertex margin slightly emarginate in full face view, carinate, acutely angled to occiput. Relative lengths of first five antennal segments (fig.291) 8.5:4:3.5:4.5:4.5; scape 1.6x as long as wide, longer than 2x pedicel; pedicel longer than F1; F2-F10 as long as wide, F11 longer than wide; antenna slightly longer than head in full face view (35:30).

**Mesosoma:** Pronotum (fig.116) strongly coriaceous with scattered shallow punctures; mesoscutum weakly coriaceous; scutellum anteromedially weakly coriaceous, posterolaterally smooth and polished; vestiture long, sparse, suberect; pronotal disc (fig.290) 0.35x as long as wide; mesonotum with parapsidal furrow only in posterior half; notaui absent; scutellum with a pair of basal slits connected
by narrow groove; propodeal disc 0.55x as long as wide, sharply inclined to lateral margin; disc with distinct sublateral ridges; basal median triangular area smooth and elevated, reaching posterior margin by weak median carina, rest of disc and declivity coriaceous; posterior transverse carina complete. Forewing (fig.290) 2.64x as long as wide, without areolet; M, SM with single row of setae; speculum with scattered setae; m: rs: rs+m = 5:3:4. Forefemur (fig.293) 1.86x as long as wide; SI 4.

**Metasoma:** Metasoma (fig.113) distinctly longer than mesosoma (63:48), shorter than head plus mesosoma (63:74); Tergites smooth and polished; T1-T3 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

**Male:** Unknown.

**Biology:** Ex. unknown larvae on *Hibiscus* spp.

**Etymology:** The species epithet is after the type locality, Sringeri.

**Distribution:** India – Karnataka.

**Material Examined:** Holotype – Female. INDIA: Karnataka, Sringeri, 13°22.24’N 75°15.07’E, 668m, 27.ix.2003, grassland, rearing, P. A. Sinu leg., VRN 48. (DZUC). Paratype. 3♀. same data as holotype, VRN 46, VRN 47, VRN 49 (DZUC).

**Variation.** In one of the paratypes (VRN 46), OOL 0.63x WOT and EV 0.23x HE. See table- 18 for morphometric ratios of all the type materials examined.

**Discussion:** *Goniozus sringeriensis* sp. nov. is closely related to *G. pakmanus* Gordh and *G. delhiensis* Ram in having scape longer than 2x pedicel, EV 0.23x – 0.42x HE and WF 0.49x - 0.57x WH, whereas *G. pakmanus* and *G. delhiensis* differ from *G. sringeriensis* sp. nov. in having the brown-black mandible, OOL 1.12x – 1.25x WOT, obtuse clypeal margin and propodeal disc smoothly inclined to lateral margin devoid of sublateral ridge, whereas in *G. sringeriensis* sp. nov. mandible is yellow, OOL 0.63-0.73x WOT, clypeal carina acute, pedicel longer than F1 and propodeal disc sharply inclined to lateral margin with weak sublateral ridge.
Observation and Results

Table – 18. Morphometric ratios of *Goniozus sringeriensis* sp. nov.

<table>
<thead>
<tr>
<th>VRN</th>
<th>WH / LH</th>
<th>OOL / WOT</th>
<th>EV / HE</th>
<th>WF / HE</th>
<th>LH / LA</th>
<th>LS / PL</th>
<th>PL / LF1</th>
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<tbody>
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<td>0.954545</td>
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<td>47</td>
<td>1</td>
<td>0.733333</td>
<td>0.272727</td>
<td>0.954545</td>
<td>0.83333</td>
<td>2.22222</td>
<td>1.25</td>
</tr>
<tr>
<td>49</td>
<td>1.012987</td>
<td>0.715447</td>
<td>0.272727</td>
<td>0.977727</td>
<td>0.85555</td>
<td>2.22222</td>
<td>1.25</td>
</tr>
<tr>
<td>46</td>
<td>1</td>
<td>0.631068</td>
<td>0.235294</td>
<td>0.970588</td>
<td>0.77582</td>
<td>2.22222</td>
<td>1.25</td>
</tr>
</tbody>
</table>

Mean Values: 1.01 0.70 0.26 0.96 0.82 2.22 1.25

*Goniozus stomopterycis* Ram and SubbaRao

(figs.117-118)


Diagnosis: Head as long as wide, compressed in lateral aspect, 1.78x as long as wide; antenna longer than head in full face view; pedicel longer than F1; scape shorter than 2x pedicel; F2 and F3 wider than long, F4-F10 as long as wide; eye sparsely setose, setae minute, shorter than diameter of single facet; OOL 0.94x WOT; EV 0.4-0.43x HE. Posterior transverse propodeal carina narrowly interrupted medially; metasoma shorter than mesosoma. Forewing without areolet, but only short stub arising from basal vein. Forefemur 1.81x as long as wide.

Redescription: *Holotype – Female.*

Measurements: Length 2.46mm; LH 0.53mm; WH 0.53mm; WF 0.31mm; FWL 1.83mm; LM 0.89mm; LP 0.39mm; WPD 0.51mm; LPD 0.29mm.

Colour: Body dark brown, base of metasoma lighter; mandible brown, teeth darker; antenna uniformly pale yellow; leg brown except yellow tarsi and tibia. Wing hyaline, costa, subcosta, prostigma and stigma light brown, other veins colourless.

Head: Head (fig.118) as long as wide, WH = LH, compressed in lateral aspect, 1.78x as long as wide; frons and vertex dull coriaceous with scattered shallow

Santhosh, S.
In~vestigation on the "Alpha Taxonomy of Bethylidae"  

Observation and Results

punctures; gena smooth and polished; vestiture short, sparse, decumbent, vertex margin without distinctly long setae; anterior clypeal margin strongly produced, bluntly angulated, obtuse; clypeal carina 0.57x HE, extending onto frons upto level of posterior scrobal margin; scrobe ecarinate; mandible stout with 4 long blunt teeth, ventral most straight; WF 0.55x LH; WF 0.96x HE; EV 0.43x HE; LH 0.94x HE; eye sparsely setose, setae minute, shorter than diameter of single facet; ocelli in obtuse triangle; posterior ocelli contiguous with vertex margin; OOL 0.94x WOT; POL: AOL: DAO = 5:3:2; vertex straight in full face view, ecarinate. Relative lengths of first five antennal segments 4.5:2.5:2:2:2.5; scape 1.6x as long as wide, shorter than 2x pedicel length; pedicel longer than F1; F2 and F3 wider than long, F4-F10 as long as wide; terminal segment longer than wide; antenna longer than head in full face view (64: 55).

Mesosoma: Pronotum coriaceous with scattered shallow punctures; sculpture of mesonotum and scutellum same as that of head and pronotum, vestiture sparse, short, suberect; pronotal disc 0.36x as long as wide; mesonotum with parapsidal furrow, anteriorly weak; notauli absent; scutellum with a pair of basal slits; propodeal disc 0.53x as long as wide, smoothly inclined to lateral margin; basal median propodeal triangle smooth, shining, and elevated, extends slightly beyond middle reaching posterior margin by weak carina, rest of propodeal disc and declivity coriaceous; posterior transverse carina narrowly interrupted medially. Forewing 2.78x as long as wide, without areolet, only a short stub arising from basal vein; M, SM with single row of setae; speculum sparsely setose; m:rs:rs+m = 5:4.5:4.5. Forefemur 1.81x as long as wide; SI 4.61.

Metasoma: Metasoma (fig.117) distinctly shorter than mesosoma (20:25), distinctly shorter than head plus mesosoma (20:40); tergites smooth and polished; T1-T3 with few setae restricted to lateral margin; other tergites sparsely setose all across dorsal side.

Male: Smaller in size (1.72mm); same as female except for sexual characters, metasoma shorter than mesosoma; head compressed in lateral aspect 1.54x as long as wide; WOT 1.64x OOL; EV 0.4x HE; forefemur 2.09 as long as wide.

Santhosh, S.
Ecology and Biology: ex. larvae of Stomopteryx nerteria (Meyrick) (Lepidoptera: Gelechiidae).

Distribution: India – Andhra Pradesh – Anantapur.

Material Examined: Holotype – Female. INDIA: Andhra Pradesh, Anantapur, 14°41.46'N 77°36.03'E, 331m, 20.ix.1964, rearing, G.G. Kundu leg. (INPC). Type collection – VRN 13/11. Paratypes: 1♀, 1♂; same data of holotype. (INPC)

Discussion: Goniozus stomopterycis Ram and SubbaRao is similar to G. marasmi Kurian in having forefemur less than 2x as long as wide, pedicel equal to or more than F1, EV 0.40 - 0.43x HE and metasoma shorter than or as long as mesosoma. Goniozus stomopterycis is having pedicel longer than F1, scape shorter than 2x pedicel, metasoma shorter than mesosoma, forefemur 1.81x as long as wide and eye sparsely setose, but G. marasmi has pedicel as long as F1, scape as long as 2x pedicel, metasoma as long as mesosoma, forefemur 1.91x as long as wide and eye asetose.

Remarks: Right forewing, right hind and mid legs of the holotype is missing. Both holotype and one paratype are brown in colour with mesoscutum slightly collapsed. Both of them appear to be teneral specimens. The other paratype is dark brown to black and mesoscutum is not collapsed. Thus, shallow lateral depression on mesoscutum mentioned in original description which is based on the tenderal specimen is not of any taxonomic value.
Goniozus alarius sp. nov. Female, 7. body profile; 8. head, side view; 9. head, full face view; 10. mesosoma, dorsal view. Goniozus antennalis sp. nov. Female, 11. body profile; 12. head, side view; 13. head, full face view; 14. mesosoma, dorsal view.
*Goniozus aproaeremae* sp. nov. Female, 15. body profile; 16. head, side view; 17. head, full face view; 18. mesosoma, dorsal view. *Goniozus buddhai* sp. nov. Female, 19. body profile; 20. head, side view; 21. head, full face view. *Goniozus clypeatus* sp. nov. Female, 22. body profile.
Goniozus clypeatus sp. nov. Female, 23. head, side view; 24. head, full face view; 25. mesosoma, dorsal view. *Goniozus colha* sp. nov. Female, 26. body profile; 27. head, side view; 28. head, full face view; 29. mesosoma, dorsal view. *Goniozus delhiensis* Ram, Holotype. Female, 30. mesosoma, dorsal view
Goniozus inauditus sp. nov. Female, 31. body profile; 32. head, side view; 33. head, full face view; 34. mesosoma, dorsal view. Goniozus indicus Ashmead, Female, 35. body profile; 36. head, full face view. Goniozus jeroeni sp. nov. Female, 37. body profile; 38. head, side view.
*Goniozus jeroeni* sp. nov. Female, 39. head, full face view; 40. mesosoma, dorsal view. *Goniozus kainophanestus* sp. nov. Female, 41. body profile; 42. head, side view; 43. head, full face view; 44. mesosoma, dorsal view. *Goniozus kottiyooricus* sp. nov. Female, 45. body profile; 46. head, side view.
Goniozus kottiyooricus sp. nov. Female, 47. head, full face view; 48. mesosoma, dorsal view. Goniozus kuriani sp. nov. Female, 49. body profile; 50. head, side view; 51. head, full face view; 52. mesosoma, dorsal view; 53 leaf galls of Syzygium cumini L. Goniozus longigastralis sp. nov. Female, 54. body profile
Goniozus longigastralis sp. nov. Female, 55. head, side view; 56. head, full face view; 57. mesosoma, dorsal view. Goniozus malabaricus sp. nov. Female, 58. body profile; 59. head: side view; 60. head, full face view; 61. mesosoma, dorsal view. Goniozus mandibularis sp. nov. Female, 62. body profile.
*Goniozus mandibularis* sp. nov. Female, 63. head, side view; 64. head, full face view; 65. mesosoma, dorsal view. *Goniozus mustus* sp. nov. Female, 66. body profile; 67. head, side view; 68. head, full face view; 69. mesosoma, dorsal view. *Goniozus neoterosus* sp. nov. Female, 70. body profile.
*Goniozus neoterosus* sp. nov. Female, 71. head, side view; 72. head, full face view; 73. mesosoma, dorsal view. *Goniozus nephatidis* (Muesebeck), Female, 74. body profile; 75. head, side view; 76. head, full face view; 77. mesosoma, dorsal view. *Goniozus novellus* sp. nov. Female, 78. body profile.
*Goniozus novellus* sp. nov. Female, 79. head, full face view; 80. mesosoma, dorsal view. *Goniozus nuperus* sp. nov. Female, 81. body profile; 82. head, side view; 83. head, full face view; 84. mesosoma, dorsal view. *Goniozus orthagae* sp. nov. Female, 85. body profile; 86. head, side view.
Goniozus orthagae sp. nov. Female, 87. head, full face view; 88. mesosoma, dorsal view. Goniozus palhatensis sp. nov. Female, 89. body profile; 90. head, side view; 91. head, full face view; 92. meso soma, dorsal view. Goniozus platycephalus sp. nov. Female, 93. body profile; 94. head, side view.
Goniozus platycephalus sp. nov. Female, 95. head, full face view; 96. mesosoma, dorsal view. Goniozus propodeatus sp. nov. Female, 97. body profile; 98. head, side view; 99. head, full face view; 100. mesosoma, dorsal view. Goniozus prosphatos is sp. nov. Female, 101. body profile; 102. head, side view.
Goniozus prosphatosis sp. nov. Female, 103. head, full face view; 104. mesosoma, dorsal view. *Goniozus recentis* sp. nov. Female, 105. body profile; 106. head, side view; 107. head, full face view; 108. mesosoma, dorsal view. *Goniozus setosus* sp. nov. Female, 109. body profile; 110. head, side view.
*Goniozus setosus* sp. nov. Female, 111. head, full face view; 112. mesosoma, dorsal view. *Goniozus sringeriensis* sp. nov. Female, 113. body profile; 114. head, side view; 115. head, full face view; 116. mesosoma, dorsal view. *Goniozus stomopterycis* Ram and SubbaRao, Paratype. Female, 117. body profile; Holotype. Female, 118. head, full face view.
Figs. 174 - 177. Goniozus alarius sp. nov. Female, 174. body, dorsal view; 175. antenna; 176. head, side view; 177. foretibia.
Figs. 178 - 181. *Goniozus antennalis* sp. nov. Female, 178. body, dorsal view; 179. antenna; 180. head, side view; 181. foretibia.
Figs. 182 - 185. *Goniozus aproaeremae* sp. nov. Female, 182. body, dorsal view; 183. antenna; 184. head, side view; 185. foretibia.
Figs. 186 - 189. *Goniozus armigerae* Santhosh and Narendra. Female, 186. body, dorsal view; 187. antenna; 188. head, side view; 189. foreleg.
Figs. 190 - 192. *Goniozus buddhai* sp. nov. Female, 190. body, dorsal view; 191. antenna; 192. head, side view.
Figs. 193 - 196. *Goniozus clypeatus* sp. nov. Female, 193. body, dorsal view; 194. antenna; 195. head, side view; 196. foretibia.
Figs. 197 - 200. *Goniozus cotha* sp. nov. Female, 197. body, dorsal view; 198. antenna; 199. head, side view; 200. foretibia.
Figs. 201 - 204. *Goniozus inauditus* sp. nov. Female, 201. body, dorsal view; 202. antenna; 203. head, side view; 204. foretibia.
Figs. 205 - 208. *Goniozus indicus* Ashmead. Female, 205. body, dorsal view; 206. antenna; 207. head, side view; 208. foretibia.
Figs. 209 - 212. *Goniozus jeroeni* sp. nov. Female, 209. body, dorsal view; 210. antenna; 211. head, side view; 212. foretibia.
Figs. 213 - 216. *Goniozus kainophanestus* sp. nov. Female, 213. body, dorsal view; 214. antenna; 215. head, side view; 216. foretibia;
Figs. 217 - 221. Goniozus kottiyooricus sp. nov. Female, 217. body, dorsal view; 218. antenna; 219. head, side view; 220. foretibia; 221. forewing.
Figs. 222 - 225. *Goniozus kuriani* sp. nov. Female, 222. body, dorsal view; 223. antenna; 224. head, side view; 225. foretibia.
Figs. 226 - 229. *Goniozus longigastralis* sp. nov. Female, 226. body, dorsal view; 227. antenna; 228. head, side view; 229. foretibia.
Figs. 230 - 234. *Goniozus malabaricus* sp. nov. Female, 230. body, dorsal view; 231. antenna; 232. head, side view; 233. foretibia; 234. mandible.
Figs. 235 - 239. *Goniozus mandibularis* sp. nov. Female, 235. body, dorsal view; 236. antenna; 237. head, side view; 238. foretibia; 239. forewing and hindwing.
Figs. 240 - 243. *Goniozus mustus* sp. nov. Female, 240. body, dorsal view; 241. antenna; 242. head, side view; 243. foretibia.
Figs. 244 - 247. *Goniozus neoterosus* sp. nov. Female, 244. body, dorsal view; 245. antenna; 246. head, side view; 247. foretibia.
Figs. 248 - 251. *Goniozus novellus* sp. nov. Female, 248. body, dorsal view; 249. antenna; 250. head, side view; 251. foretibia.
Figs. 252 - 255. *Goniozus nuperus* sp. nov. Female, 252. body, dorsal view; 253. antenna; 254. head, side view; 255. foretibia.
Figs. 256 - 258. *Goniozus orthagae* sp. nov. Female, 256. body, dorsal view; 257. head, side view; 258. foretibia.
Figs. 259 - 262. Goniozus orthagae sp. nov. Male, 259. body, dorsal view; 260. antenna; 261. head, side view; 262. foretibia.
Figs. 263 - 266. *Goniozus palghatensis* sp. nov. Female, 263. body, dorsal view; 264. antenna; 265. head, side view; 266. foretibia.
Figs. 267-271 Goniozus platycephalus sp. nov. Female, 267. body, dorsal view; 268. antenna; 269. head, side view; 270. foretibia; 271. forewing and hindwing.\textit{nov}. Male, 280. head, full face view; 281. head, lateral view.
Figs. 272 - 275. Goniozus propodeatus sp. nov. Female, 272. body, dorsal view; 273. antenna; 274. head, side view; 275. foretibia.
Figs. 276 - 279. *Goniozus prosphatosis* sp. nov. Female, 276. body, dorsal view; 277. antenna; 278. head, side view; 279. foretibia. Figs. 280 - 281. *Goniozus prosphatosis* sp. nov. Male, 280. head, full face view; 281. head, lateral view.
Figs. 282 - 285. *Goniozus recentis* sp. nov. Female, 282. body, dorsal view; 283. antenna; 284. head, side view; 285. foretibia.
Figs. 286 - 289. *Goniozus setosus* sp. nov. Female, 286. body, dorsal view; 287. antenna; 288. head, side view; 289. foretibia.
Figs. 290 - 293. Goniozus sringeriensis sp. nov. Female, 290. body, dorsal view; 291. antenna; 292. head, side view; 293. foretibia.
Map 3.
Distribution Map -
Goniozus mandibularis sp. nov.

- Goniozus mandibularis sp. nov.
- Coffee
- Savanna-woodland
- Scrub-woodland
- Shrub savanna
- Shrub savanna to grassland
- Tea
- Evergreen to semi-evergreen
- Riparian type
- Dry deciduous
- Evergreen
- Grassland
- Moist deciduous
- Scrub
- Swamp
- Western Ghats

State Boundary
0 15 30 60 90 120
Kilometers

Arabian Sea
KARNATAKA
TAMIL NADU
KERALA
Map 5.
Distribution Map -
Goniozus nuperus sp. nov.

- Goniozus nuperus sp. nov.
- Coffee
- Savanna-woodland
- Scrub-woodland
- Shrub savanna
- Shrub savanna to grassland
- Tea
- Evergreen to semi-evergreen
- Riparian type
- Dry deciduous
- Evergreen
- Grassland
- Moist deciduous
- Scrub
- Swamp
- Western Ghats

State Boundary

Kilometers
GENUS ODONTEPYRIS KIEFFER 1904

Odontepyris Kieffer 1904c, 1: 378. Type-species: Odontepyris flavinervis Kieffer.
Original Designation. Holotype: female. SUMATRA: Pangherang-Pisang, x. 90, iii. 91 (E. Modigliani) (MCSN). Note- The genus was not characterized until 1905.

Trissomalus Kieffer 1905b 29: 105. Type-species: Goniozus transvaalensis

Diagnosis: Maxillary palpi with 5 segments, labial palpi 3; median lobe of clypeus large, anteriorly produced, triangular or subtriangular; median carina of clypeus continues well onto front; narrow, unsculptured, shiny streak extends from proximal end of clypeal carina to front ocellus; antenna with 13 segments. Pronotum short, wider than long; notauli absent; scutellum with a pair of enlarged pits basally; mesopleuron expanded bearing a dentate process developed in varying degrees in some species; propodeal disc with median, lateral and transverse carinae; a pair of pits present near base of propodeal disc. Forewing with pterostigma large; prostigma present and rectangular; areola present (absent in few species); Rs + m vein is reduced, shorter than Rs vein; radial vein without a sharp angle.

Statistics: The genus Odontepyris Kieffer is represented by 33 species in the world (XU and HE, 2006a; LIM et al., 2009) with four species from Palaearctic region, three species from Ethiopian region, four species from Australian region, and 17 species from Oriental region (POLASZEK and KROMBEIN, 1994; KROMBEIN, 1996; TERAYAMA, 1995a, 1997b; XU et al., 2002a).

Biology: They are parasitoids of microlepidopteran larvae. Host species are from Pyralidae, Noctuidae and Crambidae.
Distribution: The genus *Odontepyris* Kieffer is represented by 33 species in the world and 17 of them are known from Oriental region. Seven species are distributed in India, but none of them in Southern Western Ghats.

Phylogeny: The phylogenetic analysis (POLASZEK and KROMBEIN, 1994) of 11 taxa of Bethylinae for 22 morphological characters provided more stable classification of the subfamily. In this context, the newly described species were manually analyzed and the character coding and data matrix are given in tables (see tables 19 and 20).

The apomorphic characters found in *Odontepyris* are absence of notauli, enlarged scutellar foveae connected by broad transverse groove, expansion of mesopleuron, sometimes with dentate processes, presence of posterior transverse propodeal carina, median longitudinal propodeal carina, and longitudinal discal propodeal carina. The absence of posterior propodeal transverse carina is a plesiomorphic character in Bethylinae and it is shown by *Lytopsenella, Eupsenella, Sierola* and *Bethylus*, whereas in all studied *Odontepyris* spp. posterior propodeal transverse carina is present.

Remarks: The genus is mostly distributed in the tropics.

**Table – 19. Character list and coding of Oriental *Odontepyris***

<table>
<thead>
<tr>
<th>#1. Forewing areolet/</th>
</tr>
</thead>
<tbody>
<tr>
<td>0. absent/</td>
</tr>
<tr>
<td>1. present/</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>#2. Median propodeal carina/</th>
</tr>
</thead>
<tbody>
<tr>
<td>0. incomplete/</td>
</tr>
<tr>
<td>1. complete/</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>#3. Transverse propodeal carina/</th>
</tr>
</thead>
<tbody>
<tr>
<td>0. complete/</td>
</tr>
<tr>
<td>1. interrupted medially/</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>#4. Paramedian propodeal carina/</th>
</tr>
</thead>
<tbody>
<tr>
<td>0. absent/</td>
</tr>
<tr>
<td>1. weak, incomplete, converging/</td>
</tr>
<tr>
<td>2. complete/</td>
</tr>
<tr>
<td>3. weak, incomplete, parallel/</td>
</tr>
</tbody>
</table>
#5. Anterior clypeal margin/
   0. obtuse/
   1. acute/
   2. right angled/
#6. Clypeal carina/
   0. not extending onto front, but only polished streak/
   1. extending onto front as carina itself/
#7. Posterior vertex margin/
   0. straight/
   1. concave/
#8. Ocellar triangle/
   0. right angled/
   1. acute/
#9. Shape of areolet/
   0. ellipsoidal/
   1. subtriangular/
   2. subrectangular/
#10. Second sterna/
   0. smooth/
   1. sparsely punctate/
   2. densely punctate/
   3. coriaceous/
   4. with piliferous tubercles/
#11. Scrobe/
   0. ecarinate/
   1. weakly carinate/
   2. distinctly carinate/
#12. Scape/
   0. shorter than 2x pedicel/
   1. as long as 2x pedicel/
   2. longer than 2x pedicel/
#13. Ocellocular line (OOL)/
   0. shorter than 1.11x width of ocellar triangle (WOT)/
   1. 1.2 – 1.5x width of ocellar triangle (WOT)/
   2. 1.53 – 2x width of ocellar triangle (WOT)/
#14. Width of frons (WF)/
   0. 1.05 – 1.19x height of eye (HE)/
   1. 1.2x – 1.41x height of eye (HE)/
#15. First flagellar segment (F1)/
   0. longer than pedicel/
   1. as long as pedicel/
   2. shorter than pedicel/
#16. Forefemur/
   0. 2.0 – 2.4x as long as wide/
   1. 2.45 – 2.87x as long as wide/
   2. more than 2.88x as long as wide/
#17. Length of first flagellar segment (F1)/
   0. less than 2x its width/
   1. 2x its width/
   2. more than 2x its width/

#18. Length of areolet/
   0. 1.6 – 1.9x its width/
   1. 2 – 2.9x its width/
   2. 3 – 4x its width/

#19. Pronotal lateral margin/
   0. carinate/
   1. ecarinate/

#20. Width of head in full face view/
   0. shorter than 1.1x its length/
   1. longer than 1.1x its length/

#21. Maximum distance from top of the eye to posterior margin of vertex (EV)/
   0. shorter than 0.45x height of eye (HE)/
   1. longer than 0.50x height of eye (HE)/

#22. Width of head in full face view (WH)/
   0. shorter than 1.56x width of frons (WF)/
   1. 1.60 – 1.69x width of frons (WF)/
   2. longer than 1.70x width of frons (WF)/

#23. Head/
   0. sparsely punctate, punctures separated by distance equal to or more than 2
      3x its diameter/
   1. moderately punctate, punctures separated by distance equal to its own
      diameter/
   2. densely punctate, punctures separated by distance less than its diameter/
   3. not punctate/

#24. Forewing/
   0. hyaline/
   1. infumated/
Table – 20. Data matrix of Oriental *Odontepysis*

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Character coding</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td><em>Odontepysis batrae</em> Kurian</td>
<td>1</td>
</tr>
<tr>
<td><em>Odontepysis hypsipyla</em> (Kurian)</td>
<td>1</td>
</tr>
<tr>
<td><em>Odontepysis ovatus</em> Xu &amp; He</td>
<td>1</td>
</tr>
<tr>
<td><em>Odontepysis rufipes</em> Xu &amp; He</td>
<td>1</td>
</tr>
<tr>
<td><em>Odontepysis rudicrus</em> Krombein</td>
<td>1</td>
</tr>
<tr>
<td><em>Odontepysis taiwanus</em> Terayama</td>
<td>1</td>
</tr>
<tr>
<td><em>Odontepysis anamalaicus</em> sp. nov.</td>
<td>1</td>
</tr>
<tr>
<td><em>Odontepysis argyriae</em> Kurian</td>
<td>1</td>
</tr>
<tr>
<td><em>Odontepysis cirphi</em> Kurian</td>
<td>1</td>
</tr>
<tr>
<td><em>Odontepysis muezebecki</em> Krombein</td>
<td>1</td>
</tr>
<tr>
<td><em>Odontepysis keystoneurus</em> sp. nov.</td>
<td>1</td>
</tr>
<tr>
<td><em>Odontepysis hainanus</em> Xiao &amp; Xu</td>
<td>1</td>
</tr>
<tr>
<td><em>Odontepysis formosicola</em> Terayama</td>
<td>1</td>
</tr>
<tr>
<td><em>Odontepysis quadrifoveatus</em> (Muezebeck)</td>
<td>1</td>
</tr>
<tr>
<td><em>Odontepysis cephalopunctatus</em> sp. nov.</td>
<td>1</td>
</tr>
<tr>
<td><em>Odontepysis obtusus</em> Xu &amp; He</td>
<td>1</td>
</tr>
<tr>
<td><em>Odontepysis terayamaei</em> sp. nov.</td>
<td>1</td>
</tr>
<tr>
<td><em>Odontepysis fujianus</em> Xu, He &amp; Terayama</td>
<td>0</td>
</tr>
<tr>
<td><em>Odontepysis liukueiensis</em> Terayama</td>
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</tr>
<tr>
<td><em>Odontepysis mandibularis</em> Krombein</td>
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<tr>
<td><em>Odontepysis koottanadensis</em> sp. nov.</td>
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<tr>
<td><em>Odontepysis ventralis</em> Krombein</td>
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</tr>
<tr>
<td><em>Odontepysis indicus</em> (Kurian)</td>
<td>0</td>
</tr>
</tbody>
</table>

? - Unknown; N - Not applicable
5.2.1 Key to Oriental species of *Odontepyris* Kieffer

1. Forewing without areolet -------------------------------------------- 2

-- Forewing with areolet --------------------------------------------- 7

2(1). Anterior clypeal margin acute; vertex crest emarginate ---------- 3

-- Anterior clypeal margin obtuse; vertex crest straight

--------------------------------------------------------------------- *liukueiensis* Terayama

3(2). Median propodeal carina complete; forefemur length shorter than 3x its width----------------------------------------------- 4

-- Median propodeal carina incomplete, absent in basal one-third; forefemur length 3.1x its width----------------------------- *mandibularis* Krombein

4(3). OOL 1.33 - 1.4x WOT; F₁ 1.4-1.5x as long as wide------------------ 5

-- OOL 1.7 - 1.88x WOT; F₁ 2-2.5x as long as wide---------------------- 6

5(4). Pronotal lateral margin ecarinate; F₁ as long as pedicel; forefemur length 2.58 - 2.63x its width----------------------------- *ventralis* Krombein

-- Pronotal lateral margin carinate; F₁ distinctly longer than pedicel; forefemur length 2.78x its width------------------------ *koottanadensis* sp. nov.

6(4). EV 0.45x HE; F₁ 2.5x as long as wide; ------------------------ *indicus* (Kurian)

-- EV 0.56x HE; F₁ 2x as long as wide ------ *fujianus* Xu, He and Terayama

7(1). Vertex crest straight ------------------------------------------ 8

-- Vertex crest emarginate--------------------------------------------- 14

8(7). Anterior clypeal margin obtuse or right angled; areolet ellipsoidal ------ 9

-- Anterior clypeal margin acute; areolet subtriangular --------------- 11
9(8). Clypeal carina restricted to clypeus, not extending to frons; paramedian carina on propodeum not joining posterior transverse carina; head coriaceous without punctures--------------------------------- terayamai sp. nov.

-- Clypeal carina extending to frons as a low carina beyond posterior scrobal margin; paramedian carina on propodeum joining posterior transverse carina; head coriaceous with punctures ---------------------------------- 10

10(9). Pronotal lateral margin ecarinate; F₁ 1.9x as long as wide, equal to pedicel; scape 2.9x as long as wide; propodeal disc 0.62x as long as wide; anterior clypeal margin obtuse; forewing infumated, areolet 3.6x as long as wide; head sparsely punctate, separated by ≥ 1x its diameter - obtusus Xu and He

-- Pronotal lateral margin carinate; F₁ 1.1x as long as wide, less than pedicel; scape 2x as long as wide; propodeal disc 0.45x as long as wide; anterior clypeal margin right angled; forewing hyaline, areolet 2.3x as long as wide; head densely punctate, separated by 0.5x its diameter --------------------------------- cephalopunctatus sp. nov.

11(8). Scape 1.8 - 1.83x pedicel; F₁ 1.45 – 1.5x as long as wide ------------------ 12

-- Scape 2.2 - 2.8x pedicel; F₁ 1.75 – 1.8x as long as wide ------------------ 13

12(11). OOL 1.4 - 1.5x WOT; propodeal disc 0.53x as long as wide; areolet narrow, no wider than veins enclosing it; transverse propodeal carina complete; paramedian propodeal carina converging posteriorly --------------------------------- quadrifoveatus (Muesebeck)

-- OOL 1.89x WOT; propodeal disc 0.69x as long as wide; areolet distinctly wider than veins enclosing it; transverse propodeal carina narrowly interrupted medially; paramedian propodeal carina parallel ------------------------------ formosicola Terayama

13(11). Antenna uniformly yellow; areolet narrow, 3x as long as wide; F₁ equal to pedicel; scape 2.5 - 2.67x as long as wide ---------------- keystonellus sp. nov.
Antenna reddish brown; areolet relatively wide, 2x as long as wide; F₁ shorter than pedicel; scape 2.8x as long as wide. **hainanus** Xiao and Xu

14(7). Clypeal carina not extending to frons

15(14). Pronotal lateral margin ecarinate; punctures on head separated by 2-3x its diameter; EV 0.29-0.31x HE; OOL 1.06-1.07x WOT; scape 2x pedicel; F₁ shorter than pedicel; scrobe ecarinate. **musebecki** Krombein

-- Pronotal lateral margin carinate; punctures on head separated by its diameter; EV 0.5-0.57x HE; OOL 1.4-1.67x WOT; scape longer than 2x pedicel; F₁ as long as or longer than pedicel; scrobe strongly carinate. **anamalaicus** sp. nov.

16(14). Head longer than wide in front view; parapsidal furrow absent, if present, very weak and incomplete; F₁ 2x as long as wide; head sparsely punctate; mesosoma narrower than head; eyes with sparse microscopic setae; EV 0.5x HE; small triangular areolet; mesopleuron with dentate process. **flavinervis** Kieffer

-- Head as long as or wider than long in front view; other characters not in above combination, partly or completely different

17(16). Propodeal paramedian discal carina absent

18(17). Ocelli arranged in acute triangle; forewing with moderately large subtriangular areolet; F₁ as long as pedicel; scape 2.5x pedicel. **ruficus** Krombein

-- Ocelli arranged in obtuse triangle; forewing with small ellipsoidal/oval areolet; F₁ longer than pedicel; scape 2x pedicel
19(18). Mesosoma 2x its width at tegula; forewing length 3x its width; ocellocular length 3x the front ocellar length; forefemur 2.86x as long as wide ----------- cirphi Kurian

-- Mesosoma more than 2.33x its width at tegula; forewing length more than 3x its width; ocellocular length more than 3.5x front ocellar length; forefemur 2x as long as wide ------------------ argyriae Kurian

20(17). Pronotal lateral margin carinate; forewing with rectangular areolet; head densely punctate dorsally, punctures separated by 0.5-1.0x their own diameter; anterior clypeal margin narrowly rounded, obtuse ----------------
----------------------------------------------- taiwanus Terayama

-- Pronotal lateral margin ecarinate; forewing with ellipsoidal or subtriangular areolet; head sparsely punctuate dorsally; anterior clypeal margin acute -21

21(20). Scape shorter than 2x pedicel; F1 as long as pedicel --- hypsipylea (Kurian)

-- Scape longer than 2x pedicel; F1 longer than pedicel----------------------22

22(21). Propodeal paramedian discal carina weak; scape 2.2x as long as pedicel; F1 2.67x as long as wide ------------------------------------------ batrae Kurian

-- Propodeal paramedian discal carina strong; scape 2.4 - 2.56x as long as pedicel; F1 1.8 – 2.2x as long as wide-----------------------------------23

23(22). Legs fully ferruginous; forewing with veins brown and pterostigma black, areolet 2.8x as long as its width --------------------------rufipedis Xu and He

-- Legs black except trochanters, tibiae and tarsi brown reddish; forewing veins testaceous and pterostigma brown; areolet 2.33x as long as its width-
--------------------------------------------- ovatus Xu and He
*Odontepyris anamalaicus* sp. nov.

(figs.119-122, 294-297)

**Diagnosis.** Head coriaceous, moderately punctate, separated by its diameter; anterior clypeal margin acute; clypeal carina not extending onto front; scrobe strongly carinate; vertex crest emarginated; EV 0.5-0.57x HE; WH 1.09-1.14x LH; eye sparsely setose, setae as long as diameter of single facet; OOL 1.4–1.67x WOT; ocellar triangle acute. Antenna brown; scape longer than 2x pedicel; F₁ ≥ pedicel. Pronotal lateral margin carinate; median propodeal carina complete; paramedian propodeal carina incomplete, not joining posterior transverse carina. Forewing infumated with ellipsoidal areolet; areolet 2.5x as long as wide, narrow, but wider than vein enclosing it. Forefemur 2.45-2.6x as long as wide; SI 3.6 – 3.8.

**Description:** *Holotype – Female.*

**Measurements:** Length 6.65mm; LH 1.4 mm; WH 1.55 mm; WF 0.97 mm; LM 2.3 mm; FWL 4 mm; LPD 0.57 mm; WPD 1.14mm.

**Colour:** Body black, last tergite brown; mandible dark brown; antenna brown; forefemur and forecoxa black, coxa and femur of mid and hind legs dark brown; tibia, trochanter, tarsi brownish yellow; tarsal claw pale brown. Forewing infumated; pterostigma brown, other veins straw coloured.

**Head:** Head (figs.294, 121) wider than long, WH 1.09x LH; coriaceous with shallow setigerous punctures, separated by their own diameter; vestiture short, sparse, decumbent; head as wide as maximum width of mesosoma; mandible robust with 4 teeth, ventral most tooth being longest, curved downwards; clypeus strongly produced anteriorly, anterior margin acute; clypeal carina restricted to clypeus; smooth line extends from posterior end of clypeal carina to anterior ocellus; scrobe strongly carinate; vertex strongly emarginate in full face view, smoothly curving to occiput, ecarinate; setae on vertex margin not longer than that of frons; gena (fig.120) smooth, polished with scattered setae; eye 0.69mm long, sparsely setose, setae minute, as long as diameter of single facet; ocelli in acute triangle, posterior ocelli away from occipital margin by 1.5x the diameter of posterior ocelli; HE 1.54x

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OOL; OOL 1.63x WOT; EV 0.5x HE (fig.296); WF 1.4x HE; WH 1.61x HE; POL:AOL:DAO = 4:3.5:2. Relative lengths of first five antennal segments (fig.295) 17:8:8:7:6; scape 2.45x as long as wide; scape longer than 2x pedicel length; pedicel 1.78x as long as wide; F1 longer than wide.

**Mesosoma:** Pronotum (fig.122) strongly coriaceous, vestiture abundant, long suberect; pronotum (fig.294) 0.5x as long as wide with lateral sides carinate in dorsal view, carinae corrugated; mesonotum with shallow setigerous punctures separated from each other by 2x its diameter; vestiture short, sparse, decumbent; parapsidal furrow present, anteriorly incomplete; scutellum smooth, polished, vestiture sparse, decumbent, long; basal pair of scutellar pits slit like, separated at least by 4.5x their maximum diameter, deep wide groove connects two pits; propodeal disc 0.5x as long as its maximum width; propodeal dorsum with three distinct discal carinae, median carina straight reaching posterior, straight, strong, complete transverse carina; paramedian carina distally converging, not joining posterior transverse carina; median area depressed with transverse rugae; sublateral area transversely striate; declivity coriaceous without median longitudinal carina. Forewing (fig.294) 2.9x as long as wide, with very small ellipsoidal areolet, 2.5x as long as wide; median cell with abundant setae; submedian cells with single row of few setae; area posterior to areolet sparsely setose. Forefemur (fig.297) 2.6x as long as wide; SI 3.4.

**Metasoma:** Metasoma (fig.119) distinctly longer than mesosoma (92:68); T1 – T3 smooth and polished; T4 – T5 with weakly coriaceous basal band; T6 - T7 smooth and polished. T1- T2 with few setae on lateral sides, others with setae on the dorsal side.

**Male:** Unknown.

**Ecology and Biology:** Plant host is *Cinchona* spp. (Rubiaceae).

**Etymology:** The species epithet is after the type locality, Anamalai Hills.
Material examined: Holotype – Female. INDIA: Tamil Nadu, Anamalai Hills, 10°22’17.40”N 77°9’27.05”E, 1200m, v.1964, TEF, ex. Cinchona spp., Susai Nathan leg., VRN 212 (ZMAN). ON LOAN. Paratypes. 2 ♀. same data as holotype except VRN 211, VRN 210 (ZMAN). ON LOAN.

Variations. The paratypes are similar to holotype except the variation in morphometric measurements as shown in table - 21.

Remarks. This new species resembles O. muezebecki Krombein, but differs in having pronotal lateral margin carinate whereas in O. muezebecki, pronotal lateral margin is ecarinate. In this new species, head is moderately punctate, that is punctures separated by their own diameter, whereas in O. muezebecki head is sparsely punctate, that is punctures separated by 2-3x their diameter. In this new species, scrobe strongly carinate, whereas in O. muezebecki scrobe is ecarinate. In this new species EV 0.5-0.57x HE, OOL 1.4–1.67x WOT, scape longer than 2x pedicel and F₁ ≥ pedicel, whereas in O. muezebecki EV 0.29–31x HE, OOL 1.06-1.07x WOT, scape 2x pedicel and F₁ shorter than pedicel.

Table – 21. Morphometric ratios of Odontepyris anamalaicus sp. nov.

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<thead>
<tr>
<th>VRN</th>
<th>WH/LH</th>
<th>WF/HE</th>
<th>EV/HE</th>
<th>LPD/WPD</th>
<th>OOL/WOT</th>
<th>FFL/FFW</th>
<th>PDL/PDW</th>
<th>LS/PL</th>
<th>SI</th>
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<tr>
<td>211</td>
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<td>0.5789</td>
<td>1.6666</td>
<td>2.5454</td>
<td>0.5</td>
<td>2.1666</td>
<td>3.8024</td>
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</table>

Mean Values

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<th>WH/LH</th>
<th>WF/HE</th>
<th>EV/HE</th>
<th>LPD/WPD</th>
<th>OOL/WOT</th>
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<th>LS/PL</th>
<th>SI</th>
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<tr>
<td>1.11</td>
<td>1.43</td>
<td>0.53</td>
<td>0.54</td>
<td>1.58</td>
<td>2.53</td>
<td>0.50</td>
<td>2.15</td>
<td>3.69</td>
</tr>
</tbody>
</table>

Odontepyris cephalopunctatus sp. nov.

(figs.123-126, 298-301)

Diagnosis: Head coriaceous, densely punctate, separated by 0.5x its diameter; anterior clypeal margin right angled; clypeal carina extending onto front; scrobe strongly carinate; eye sparsely setose, setae shorter than diameter of single facet;

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OOL 1.22x WOT; ocellar triangle acute; vertex crest straight; EV 0.38x HE; WH 1.05x LH. Antenna yellow, scape at base and terminal 7 flagellar segments brown; scape 2x as long as wide; F₁ 1.1x as long as wide, less than pedicel. Pronotal lateral margin carinate; propodeal disc 0.45x as long as wide; median and paramedian propodeal carina complete, joining posterior transverse carina. Forefemur length 2.2x its width. Forewing hyaline, areolet 2.3x as long as wide.

**Description:** *Holotype* – Female.

**Measurements:** Length 3.89 mm; LH 0.89 mm; WH 0.93 mm; WF 0.56 mm; LM 1.29 mm; FWL 2.4 mm; LPD 0.29 mm; WPD 0.66 mm.

**Colour:** Body black; mandible, teeth black; antenna yellow, scape at base and terminal 7 flagellar segments brown; coxa, femur dark brown; fore trochanter brown; tibia, mid and hind trochanters, tarsi yellow; tarsal claw brownish black. Forewing hyaline; parastigma, pterostigma brown, costa, subcosta yellow, other veins colourless.

**Head:** Head (figs.125, 298) wider than long, WH 1.05x LH, strongly coriaceous and heavily punctuate, setigerous punctures shallow separated from each other by less than its own diameter; vestiture short, sparse, decumbent; head wider than maximum width of mesosoma; mandible robust with 4 teeth, basal blunt, others pointed; ventral most tooth being longest, straight; clypeus strongly produced anteriorly, anterior margin right angled; clypeal carina extending onto front well beyond posterior scrobal margin; shallow short groove extends from anterior ocellus to frons, not reaching middle of head; scrobe strongly carinate; vertex straight in full face view, smoothly curving to occiput, ecarinate; setae on vertex margin not longer than that of frons; gena (fig.124) coriaceous with scattered setigerous punctures; eye 0.48mm long, sparsely setose; ocular setae minute, as long as diameter of single facet; ocelli in acute triangle, posterior ocelli away from occipital margin by its diameter; HE = OOL; OOL 1.22x WOT; EV 0.38x HE (fig.300); WF 1.17x HE; WH 1.95x HE; POL:AOL:DAO = 4:3.5:2.5; Relative lengths of first five antennal segments (fig.299) 11:5.5:5:4.5:4; scape 2x as long as wide; scape 2x pedicel;

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pedicel 1.37x as long as wide; F1, F11 longer than wide, other flagellar segments wider than long.

**Mesosoma:** Pronotum (fig.126) strongly coriaceous without punctures, vestiture short, sparse, decumbent; pronotum (fig.298) 0.38x as long as wide with carinate lateral sides in dorsal view; mesonotum and scutellum strongly coriaceous with shallow setigerous punctures; vestiture long, sparse, and suberect; parapsidal furrow present, complete; scutellum with 4 foveae anteriorly, lateral ellipsoidal pair separated at least by 3.4x their maximum diameter, median pair shallower, separated on midline by carina; propodeal disc 0.45x as long as its maximum width; propodeal dorsum with three distinct discal carinae, median carina straight reaching posterior strong, concave, complete transverse carinae; paramedian carina distally converge and join with posterior transverse carinae; median area depressed with transverse rugae; sublateral area transversely striate; disc and declivity coriaceous. Forewing (fig.298) 3x as long as wide, with small ellipsoidal areollet, 2.3x as long as wide; median and submedian cells with a row of few setae; area posterior to areollet with few sparsely scattered setae. Forefemur (fig.301) 2.2x as long as wide; SI 3.65.

**Metasoma:** Smooth and polished; T1 – T4 with few setae on lateral sides, others with setae on the dorsal side. Metasoma (fig.123) distinctly longer than mesosoma (75:57).

**Male:** Unknown.

**Ecology and Biology:** Unknown.

**Etymology:** The species epithet is after the densely punctate head.

**Material Examined. Holotype –** Female. INDIA: Tamil Nadu, Nilgiris, Chamrajnagar, Bedaguli, 9.46kms NW Punanjanur, 11°49.61'N 77°10.90'E; 1356m; SEF; WPT; 18. iv. 2007, Mahadesha leg., VRN 203 (DZUC).

**Discussion:** This new species comes close to *O. obtusus* Xu and He recorded from Fujian province of China. In this new species, pronotal lateral margin is carinate, head is densely punctate dorsally, punctures separated by 0.5x its diameter, anterior
clypeal margin right angled, forewing is hyaline and areolet is 2.3x as long as wide, F1 is 1.1x as long as wide, F1 shorter than pedicel and scape 2x as long wide, whereas in O. obtusus it is ecarinate, head sparsely punctate, separated by $\geq 1x$ its diameter, clypeal margin obtuse, forewing is infumated and areolet 3.6x as long as wide, F1 1.9x as long as wide, F1 is equal to pedicel and scape 2.9x as long as wide. In this new species propodeal disc is wider than that of O. obtusus.

This new species differs from O. terayamai sp. nov. in having dense punctures on head and mesosoma, clypeal carina in extending onto front as a low carina and paramedian propodeal carina is joining posterior transverse carina whereas in O. terayamai sp. nov., head and mesosoma are devoid of punctures, clypeal carina is restricted to median lobe of clypeus and paramedian propodeal carina is not joining transverse carina.

**Odontepyris kestonellus** sp. nov.

(figs.127-131, 302-305)

**Diagnosis:** Head coriaceous, moderately punctate, separated by its own diameter; anterior clypeal margin acute; clypeal carina extending onto front; scrobe ecarinate; ocellar triangle acute; vertex crest straight; eye sparsely setose, setae as long as diameter of single facet. Antenna uniformly yellow; F1 equal to pedicel; scape 2.5 - 2.67x as long as wide. Pronotal lateral margin ecarinate; paramedian propodeal carina distally convergent, 0.86x as long as propodeal disc, not joining posterior transverse carina. Forewing infumated with acutely triangular areolet; areolet 3x as long as wide, narrow, not wider than the vein enclosing it. Forefemur 2.2 - 2.3x as long as wide; SI 4.1 - 4.26.

**Description:** Holotype – Female.

**Measurements:** Length 5.35mm; LH 1.14mm; WH 1.14mm; WF 0.69mm; LM 1.67 mm; FWL 3.27mm; LPD 0.43mm; WPD 0.84mm.
Colour: Body black; mandible yellow with brownish tinge, teeth brown; antenna uniformly yellow; leg yellow; tarsal claw brownish black. Forewing infumated; parastigma and pterostigma pale brown, other veins straw coloured.

Head: Head (figs.129, 302) as long as wide, WH = LH; microreticulate with shallow setigerous punctures, separated from each other by its own diameter; vestiture moderately dense decumbent, thin; head slightly wider than maximum width of mesosoma; mandible with 4 teeth, ventral most being longest, curved downwards; clypeus strongly produced anteriorly, anterior margin acute; clypeal carina extending onto front as low carina slightly beyond the level of posterior margin of scrobe; smooth line extends from posterior end of clypeal carina to anterior ocellus; scrobe ecarinate; vertex smoothly angled to occiput, ecarinate; vertex almost straight in full face view; setae on vertex margin not longer than others; gena (fig.128) weakly coriaceous, sparsely setose; eye 0.53mm long, sparsely setose with minute setae as long as diameter of single facet; ocelli in acute triangle, posterior ocelli away from occipital margin by twice its diameter; HE 1.53x OOL; OOL 1.42x WOT; EV 1.59x HE (fig.304); WF 1.31x HE; POL:AOL:DAO = 2.5:2:2. Relative lengths of first five antennal segments (fig.303) 16:7:7:6:6; scape 2.67x as long as wide; scape longer than 2x pedicel length; pedicel 1.75x as long as wide; F1 1.75x as long as wide.

Mesosoma: Mesosoma (fig.130) microreticulate with shallow setigerous punctures similar to head sculpture, but vestiture sparser; pronotum (fig.302) 0.48x as long as wide with rounded anterolateral corners in dorsal view; lateral margin ecarinate; parapsidal furrow distinct; scutellum with 4 foveae anteriorly, lateral pair ellipsoidal pits, separated at least by 2.5x their maximum diameter, median pair shallower, separated on midline by carina; propodeal disc 0.5x as long as its maximum width; propodeal dorsum with distinct three discal carinae, median discal carina straight reaching posterior concave transverse carina; paramedian carina 0.86x as long as LPD, distally convergent, not joining transverse carina; median area depressed with transverse rugae; sublateral area microreticulate with distal irregular rugae; declivity microreticulate; no median longitudinal carina on declivity. Forewing (fig.302) 4x as

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long as wide, areolet (fig.131) acutely triangular, 3x as long as wide, wider than the veins enclosing it; median cell with sparsely scattered setae, distal posterior corner clear, submedian cell with a row of setae; area posterior to areolet setose. Forefemur (fig.305) 2.3x as long as wide; SI 4.1.

Metasoma: Tergites smooth and polished. Metasoma (fig.127) longer than mesosoma (62:41)

Male: Unknown.

Ecology and Biology: Unknown

Etymology: The name of the species is technically an arbitrary combination of letters, but the pronunciation of this name is after the name of Keystone Foundation, the institute which led the exploration leading to the collection and discovery of this specimen.

Material Examined: Holotype – Female. INDIA: Tamil Nadu, Nilgiris, Chamrajnagar, Kurimandai, 4.78kms NW Punanjanur, 11°81.89'N 77°11.28'E, 1013m, DDF, YPT, 14.iv. 2007; Mahadesha leg., VRN 209 (DZUC). Paratypes. 2 ♀. same data of holotype, VRN 208, VRN 207 (DZUC).

Variation: The paratypes resemble holotype in all characters except following morphometric measurements: in both paratypes scape 2.5x as long as wide; forefemur 2.2x as long as wide; SI 4.26; scape 2.14x pedicel; OOL 1.36x WOT. In paratype VRN 207, WF 1.39x HE and in paratype VRN 208, pronotal disc 0.54x as long as wide. See table-22 for morphometric ratios of all the type materials examined.

Discussion: Odontepyris kestonellus sp. nov. is closely related to O. hainanus Xiao and Xu recorded from Hainan province of southern China. In O. kestonellus sp. nov. antenna uniformly yellow, areolet is narrow, 3x as long as wide, F1 equal to pedicel and scape 2.5 - 2.67x as long as wide, whereas in O. hainanus antenna reddish brown, areolet relatively wide, 2x as long as wide, F1 shorter than pedicel and scape 2.8x as long as wide.

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Table – 22. Morphometric ratios of *Odontepyrus kestonellus* sp. nov

<table>
<thead>
<tr>
<th>VRN</th>
<th>WH/LH</th>
<th>WF/HE</th>
<th>EV/HE</th>
<th>LPD/WPD</th>
<th>OOL/WOT</th>
<th>FFL/FFW</th>
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<td>0.65385</td>
<td>0.5122</td>
<td>1.416667</td>
<td>2.3125</td>
<td>0.489362</td>
<td>2.2857</td>
<td>4.11111</td>
</tr>
</tbody>
</table>

| Mean Values | 1 | 1.33 | 0.55 | 0.50 | 1.38 | 2.25 | 0.50 | 2.19 | 4.21 |

*Odontepyrus koottanadensis* sp. nov.

(figs.132-135, 306-309)

**Diagnosis:** Head coriaceous, moderately punctate, separated by its own diameter; anterior clypeal margin acute; clypeal carina extending onto front; scrobe strongly carinate; eye sparsely setose, setae shorter than diameter of single facet; OOL 1.4x WOT; ocellar triangle acute; vertex crest emarginated; EV 0.42x HE; WH 1.11x LH. Antenna dark brown, first 3 segments paler; scape 2x pedicel; F1 is distinctly longer than pedicel; F1 1.5x as long as wide. Pronotal lateral margin carinate; median and paramedian propodeal carina complete, joining posterior transverse carina. Forefemur length 2.78x its width. Forewing infumated without areollet.

**Description:** Holotype – Female.

**Measurements:** Length 6.3 mm; LH 1.3 mm; WH 1.45 mm; WF 0.86 mm; LM 2.14 mm; FWL 3.4 mm; LPD 0.48 mm; WPD 0.93mm.

**Colour:** Body black; mandible dark brown; antenna first 3 segments brown with yellow tinge, other segments dark brown; leg pale brown; tarsal claw pale brown. Forewing hyaline and central disc slightly infumated; pterostigma brown, other veins straw coloured.

**Head:** Head (figs.134, 306) wider than long, WH 1.12x LH; micoreticulate with shallow setigerous punctures, separated from each other by its own diameter;

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vestiture short, sparse, decumbent; head distinctly wider than maximum width of mesosoma; mandible robust with 4 teeth, ventral most being longest, curved downwards; clypeus strongly produced anteriorly, anterior margin acute; clypeal carina extending onto front as low carina not reaching level of posterior margin of scrobe; no smooth line extends from posterior end of clypeal carina to anterior ocellus; scrobe strongly carinate; vertex smoothly curving to occiput, ecarinate; vertex strongly emarginate in full face view; setae on vertex margin not longer than others on head; gena (fig.133) weakly coriaceous abundantly setose; eye 0.66mm long, sparsely setose, setae minute, shorter than diameter of single facet; ocelli in acute triangle, posterior ocelli away from occipital margin by 2x diameter of posterior ocelli; HE 1.69x OOL; OOL 1.4x WOT; EV 2.1x HE (fig.308); WF 1.3x HE; POL:AOL:DAO = 4.5:3:2. Relative lengths of first five antennal segments (fig.307) 14:7:7.5:7:7; scape 1.54x as long as wide; scape 2x pedicel length; pedicel 1.5x as long as wide; F1 longer than wide.

**Mesosoma:** Pronotum (fig.135) anteriorly and mesonotum posteriorly strongly coriaceous; scutellum smooth and polished; mesosoma with shallow setigerous punctures separated from each other by 3x its diameter; vestiture short, sparse, and decumbent; pronotum (fig.306) 0.56x as long as wide with carinate lateral sides in dorsal view; parapsidal furrow present, but anteriorly weak; scutellum with 4 foveae anteriorly, lateral pair as rounded pits, separated at least by 3.5x their maximum diameter, median pair shallower, separated on midline by carina; propodeal disc 0.52x as long as its maximum width; propodeal dorsum with distinct three discal carinae, median discal carina straight reaching posterior, straight, strong, complete transverse carina; paramedian carina distally converging, joining posterior transverse carina; median area depressed with transverse rugae; sublateral area transversely striate; declivity coriaceous; no median longitudinal carina on declivity. Forewing (306) 3x as long as wide, without areolet, only a very short stub from posterior half of basal vein; median and submedian cells with very few setae; area posterior to stub from basal vein clear; area anterior to base of stigmal vein devoid of setae. Forefemur (fig.309) 2.78x as long as wide; SI 4.6.
Metasoma: Metasoma (fig.132) longer than mesosoma (83:61); smooth and polished; T3 with weakly coriaceous in the basal band; T1 to T3 with few setae on lateral sides, others with setae on the dorsal side.

Male: Unknown.

Ecology and Biology: Unknown

Etymology: The species epithet is after the type locality, Koottanad.

Material examined: Holotype – Female. INDIA: Kerala, Palghat, Koottanad, 10°45.34'N 76°06.58'E, 48m, 21.xi.2004, sweeping, scrub jungle, S. Santhosh leg., VRN 199 (DZUC).

Remarks: The new species comes close to O. ventralis Krombein found in Sri Lanka. In O. koottanadensis sp. nov., pronotal lateral margin carinate, F1 is distinctly longer than pedicel and forefemur length 2.78x its width, whereas in O. ventralis pronotal lateral margin ecarinate, F1 is as long as pedicel and forefemur length 2.58 - 2.63x its width.

Odontepyris terayamai sp. nov.

(figs.136-139, 310-313)

Diagnosis: Head coriaceous, impunctate; anterior clypeal margin obtuse; clypeal carina not extending onto front; scrobe ecarinate; eye sparsely setose, setae as long as diameter of single facet; OOL 0.94-1.23x WOT; ocellar triangle acute; gena smooth, asetose; vertex crest straight; EV 0.28-0.34x HE; WH 0.98-1.39x LH. Antenna reddish brown; scape 2.5x as long as wide; F1 2x as long as wide, less than pedicel; scape longer than 2x pedicel length; pedicel 1.63x as long as wide. Pronotal lateral margin ecarinate; propodeal disc 0.47-0.60x as long as wide; paramedian propodeal carina incomplete, not joining posterior transverse carina. Forefemur length 2.2-2.57x its width. Forewing hyaline, areolet 3x as long as wide.

Description: Holotype – Female

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**Measurements:** Length 5.8mm; LH 1.22 mm; WH 1.22 mm; WF 0.69 mm; LM 2 mm; FWL 3.3 mm; LPD 0.47 mm; WPD 0.99mm.

**Colour:** Body black; mandible brown, teeth darker; antenna reddish brown, scape darker at base; coxa black, femur dark brown; trochanter, tibia, tarsi brownish yellow; tarsal claw brownish black. Forewing infumated, especially disc; pterostigma, margin of stigma vein brown, other veins straw coloured.

**Head:** Head (figs.138, 310) as long as wide, WH 1.09x LH; strongly coriaceous without shallow setigerous punctures; vestiture short, sparse, decumbent; head narrower than maximum width of mesosoma; mandible robust with 4 teeth, basal blunt, others pointed; ventral most tooth being longest, curved downwards; clypeus strongly produced anteriorly, anterior margin obtuse; clypeal carina restricted to clypeus; no smooth line extends from posterior end of clypeal carina to anterior ocellus; scrobe ecarinate; vertex straight in full face view, smoothly curving to occiput, ecarinate; setae on vertex margin not longer than that of frons; gena (fig.137) smooth, polished, asetose; eye 0.65mm long, sparsely setose; ocular setae minute, as long as diameter of single facet; ocelli in acute triangle, posterior ocelli away from occipital margin by its diameter; HE 2.23x OOL; OOL 0.94x WOT; EV 0.34x HE (fig.312); WF 1.05x HE; WH 1.87x HE; POL:AOL:DAO = 3.5:3:2.5. Relative lengths of first five antennal segments (fig.311) 14.5:6.5:7.5:7:7; scape 2.5x as long as wide; scape longer than 2x pedicel length; pedicel 1.63x as long as wide; F1 2x as long as wide.

**Mesosoma:** Pronotum, mesonotum and scutellum (fig.139) strongly coriaceous, without shallow setigerous punctures; vestiture of pronotum sparse, moderately long decumbent; mesonotum with short sparse suberect setae; scutellum with few scattered setae; pronotum 0.53x as long as wide with lateral sides ecarinate in dorsal view; parapsidal furrow weak, anteriorly incomplete; scutellum with 4 foveae anteriorly, lateral pair slit like pits, separated at least by 2.8x their maximum diameter, median pair shallower, separated on midline by carina; propodeal disc 0.47x as long as its maximum width; propodeal dorsum with three distinct discal carinae, median carina strong, straight reaching posterior, complete, strong, slightly

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concave transverse carina; paramedian carina distally converging, extending 0.77x the disc length, not joining posterior transverse carina; transverse rugae on inner margin of paramedian carina; sublateral area transversely striae; sides of median discal carina and declivity coriaceous. Forewing (fig.310) 2.91x as long as wide, with large ellipsoidal areole, 3x as long as wide; median cell with abundant setae, distal posterior corner clear; submedian cells with a row of few setae; area posterior to areole sparsely setose. Forefemur (fig.313) 2.5x as long as wide; SI 3.91.

Metasoma: Metasoma (fig.136) distinctly longer than mesosoma (76:58); T1 completely smooth and polished; other tergites with weakly coriaceous basal band. First two tergites with few setae on lateral sides, others with setae on the dorsal side.

Male: Unknown.

Ecology and Biology: collected from scrub jungle. Host is unknown.

Etymology: The species epithet is after M. Terayama, Japanese bethylid taxonomist.


Variation: Paratypes are similar to Holotype except the variation in the morphometric measurements as shown in table - 23.

Discussion: Odontepyris terayamai sp. nov. is related to O. cephalopunctatus sp. nov. and O. obtusus in having anterior clypeal margin obtuse or right angled; areole

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ellipsoidal, but it differs in having clypeal carina restricted to clypeus, not extending to frons, paramedian carina on propodeum not joining posterior transverse carina and head coriaceous without punctures, whereas in *O. cephalopunctatus* sp. nov. and *O. obtusus*, clypeal carina extending to frons as a low carina beyond posterior scrobal margin, paramedian carina on propodeum joining posterior transverse carina and head coriaceous with punctures.

Table – 23. Morphometric ratios of *Odontepyris terayamai* sp. nov.

<table>
<thead>
<tr>
<th>VRN</th>
<th>WH/LH</th>
<th>WF/HE</th>
<th>EV/HE</th>
<th>LPD/WPD</th>
<th>OOL/WOT</th>
<th>FFL/FFW</th>
<th>PDL/PDW</th>
<th>LS/PL</th>
<th>SI</th>
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<tr>
<td>200</td>
<td>1</td>
<td>1.0526</td>
<td>0.3421</td>
<td>0.4736</td>
<td>0.9444</td>
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<td>2.2307</td>
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<td>1.125</td>
<td>0.3125</td>
<td>0.5681</td>
<td>1.1538</td>
<td>2.315789</td>
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<td>2</td>
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<td>1</td>
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<td>0.575</td>
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<td>2</td>
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<tr>
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<td>0.3428</td>
<td>0.5681</td>
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<td>2.571429</td>
<td>0.5714</td>
<td>2.0930</td>
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</tr>
<tr>
<td>205</td>
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<td>1.0625</td>
<td>0.3125</td>
<td>0.5</td>
<td>1.1538</td>
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<tr>
<td>196</td>
<td>1.3958</td>
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<td>2.421053</td>
<td>0.5925</td>
<td>2</td>
<td>6.0694</td>
</tr>
</tbody>
</table>

| Mean Values | 1.06 | 1.07 | 0.31 | 0.55 | 1.14 | 2.44 | 0.57 | 2.09 | 5.29 |
*Odontepyris anamalaicus* sp. nov., Female. 119. body profile; 120. head, side view; 121. head, full face view; 122. mesosoma, dorsal view. *Odontepyris cephalopunctatus* sp. nov., Female. 123. body profile; 124. head, side view; 125. head, full face view; 126. mesosoma, dorsal view.
Odontepyris keystoneellus sp. nov., Female. 127. body profile; 128. head, side view; 129. head, full face view; 130. mesosoma, dorsal view; 131. forewing. Odontepyris koottanadensis sp. nov., Female. 132. body profile; 133. head, side view; 134. head, full face view.
*Odontepyris koottanadensis* sp. nov., Female. 135. mesosoma, dorsal view. *Odontepyris terayamae* sp. nov., Female. 136. body profile; 137. head, side view; 138. head, full face view; 139. mesosoma, dorsal view.
Figs. 294 - 297. *Odontepyris anamalaicus* sp. nov. Female, 294. body, dorsal view; 295. antenna; 296. head, side view; 297. foretibia.
Figs. 298 - 301. *Odontepyris cephalopunctatus* sp. nov. Female, 298. body, dorsal view; 299. antenna; 300. head, side view; 301. foretibia.
Figs. 302 - 305. *Odontepyris keystoneellus* sp. nov. Female, 302. body, dorsal view; 303. antenna; 304. head, side view; 305. foretibia.
Figs. 306 - 309. *Odontepyris koottanadensis* sp. nov. Female, 306. body, dorsal view; 307. antenna; 308. head, side view; 309. foretibia.
Figs. 310 - 313. *Odontepyris terayamai* sp. nov. Female, 310. body, dorsal view; 311. antenna; 312. head, side view; 313. foretibia.
GENUS SIEROLA CAMERON 1881

Sierola Cameron 1881, 556. Type species: Sierola testaceipes Cameron. Monotypic.

Holotype: female. HAWAII: Sandwich islands (BMNH).


Diagnosis: small wasps, 1 – 3 mm in length, fully winged. Maxillary palpi with 4 segments, labial with 2; median lobe of clypeus angulate or rounded, with a median carina or keel; eye glabrous or with sparse, very short setae; antenna short, somewhat moniliform with 13 segments; notauli absent; scutellum with an anterior groove; propodeum slightly elevated medially, with or without a transverse carina marginal the disc behind and with lateral carinae, median carina absent. Forewing with areolet and a closed marginal cell; pterostigma large, prostigma developed; radial vein curved upward apically to join the costal vein, which is extending beyond the stigma; m vein shorter than rs vein.

Statistics: Approximately 200 species in the world. There are 196 species from Hawaiian Islands alone (FULLAWAY, 1920). Three species are from Australia and three species from USA. Oriental region has 3 species, one species each from India, Thailand and China. One species is from the Far East and two species are from Japan (TERAYAMA, 2006).

Biology: They are parasitoids of microlepidopteran larvae. Host species are mostly from Pyralidae, Gelechiidae, Tortricidae, Lyonetiidae and Gracillariidae.

Distribution: This genus is distributed mainly in the Nearctic region with around 200 species from Hawaii. It is also recorded from Australian and Oriental regions.

Phylogeny: The phylogenetic analysis (POLASZEK and KROMBEIN, 1994) of 11 taxa of Bethylinae for 22 morphological characters provided more stable classification of the subfamily. In this context, the newly described species were manually analyzed and the character coding and data matrix are given in tables (see tables 24 and 25).

The apomorphic characters found in Sierola are 2 segmented labial palpi, 4 segmented maxillary palpi, absence of notauli, absence of unsculptured shiny frontal
streak from the proximal end of the clypeal carina to the frontal ocellus, presence of median longitudinal propodeal carina, presence of prostigma, presence of submarginal cell and radial vein sharply angled. Both the new species described in the present investigation showed the presence of smooth median triangular area and the absence of median longitudinal carina.

Remarks: The genus is regarded as established in North America and may well have been introduced accidentally or in connection with biological control efforts.

Table – 24. Character list and coding of Oriental Sierola

#1. Posterior transverse carina on propodeum/
   0. absent/
   1. present/

#2. Width of head/
   0. 0.94x as long as length of head/
   1. 1.12–1.22x as long as length of head/
   2. 1.5x as long as head/

#3. Vertex margin/
   0. straight/
   1. concave in full face view/
   2. weakly convex in full face view/

#4. Width of frons (WF)/
   0. longer than height of eye (HE)/
   1. as long as height of eye (HE)/
   2. shorter than height of eye (HE)/

#5. Mandible/
   0. black/
   1. orange yellow/

#6. Ocellocular distance (OOL)/
   0. longer than width of ocellar triangle (WOT)/
   1. as long as width of ocellar triangle (WOT)/

#7. Colour of antenna/
   0. uniformly yellow/
   1. yellow brown, terminal segments fuscous/

#8. Antenna/
   0. distinctly longer than head in full face view/
   1. as long as head in full face view/
Table – 25. Data matrix of Oriental Sierola

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Character coding</th>
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<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td><em>Sierola mawarajo</em></td>
<td>1</td>
</tr>
<tr>
<td><em>Sierola indra</em></td>
<td>1</td>
</tr>
<tr>
<td><em>Sierola nasserii</em> sp. nov.</td>
<td>0</td>
</tr>
<tr>
<td><em>Sierola kannurensis</em> sp. nov.</td>
<td>0</td>
</tr>
<tr>
<td><em>Sierola sinensis</em> Fullaway</td>
<td>0</td>
</tr>
</tbody>
</table>

? - Unknown

5.3.1 Key to Oriental species of *Sierola* Cameron

1. Posterior transverse carinae on propodeum absent ........................................... 2

   Posterior transverse carinae on propodeum present ........................................... 4

2(1). Vertex concave; antenna distinctly longer than head in full face view; mandible orange - yellow ........................................... *nasserii* sp. nov.

   -- Vertex weakly convex or straight; antenna as long as head in full face view; mandible black .................................................................

3 (2). Head 1.12x as long as wide; vertex weakly convex; pedicel 1.75x as long as wide .................................................. *kannurensis* sp. nov.

   Head 1.5x as long as wide; vertex straight; pedicel slightly longer than wide...

   ...................................................................................................................... *S. sinensis* Fullaway

4(1). Propodeum no smooth area; propodeum posterior margin straight; WF equal to HE; vertex margin weakly convex ....................... *S. mawarajo* Terayama

   Propodeum with median smooth longitudinal band; propodeum with posterior margin weakly concave; WF less than HE; vertex margin almost straight ......

   ...................................................................................................................... *S. indra* Terayama
Sierola kannurensis sp. nov.

(figs.140-143, 314-318)

**Diagnosis:** Head 1.12x as long as wide; vertex weakly convex; pedicel 1.75x as long as wide. Posterior transverse carinae on propodeum present.

**Description:** *Holotype – Female.*

**Measurements:** Length 2.47mm; LH 0.55mm; WH 0.48mm; WF 0.25mm; LM 0.77mm; LP 0.29mm; HE 0.27mm; WPD 0.34mm; FWL 1.42mm.

**Colour:** Body brownish black; mandible, teeth black; antenna brown-yellow, scape basally and terminal 8 flagellar segments brown; coxa, trochanter, femur brown; tibia and tarsi yellow. Wing hyaline, veins colourless.

**Head:** Head (figs.142, 314) longer than wide; WH 0.87x LH; WF 0.93x HE; frons and vertex (fig.142) strongly coriaceous; vestiture abundant, short, suberect setae; setae on vertex margin not distinctly longer; vertex straight in full face view; gena (fig.141) weakly coriaceous; mandible (fig.318) with 4 teeth; clypeus with a median carina; eye setose, setae sparse, minute; ocelli in obtuse triangle; POL:AOL = 4.5:2; OOL = WOT. Antenna (fig.317) distinctly longer than head in full face view (43:35); Relative lengths of first four antennal segments 7:3.5:2.2:2.5; scape 1.52x as long as wide; pedicel 1.75x as long as wide; F1 and F2 as long as wide; terminal 8 segments moniliform.

**Mesosoma:** Pronotal disc (fig.143) strongly coriaceous with sparse, small, decumbent setae; mesonotum, scutellum coriaceous, but weaker than that of pronotum and head. Scutellum with a narrow transverse basal groove widened at both extremities into small pits; propodeum 0.79x as long as maximum width, disc microreticulate except small basal triangular smooth area; posterior transverse carina and discal carina absent; declivity microreticulate. Forewing (fig.315) discal cell sparsely setose.

**Metasoma:** Smooth and shining.

**Ecology and Biology:** Unknown.
Etymology: The species epithet is after the type locality, Kannur.

Distribution: India – Kerala.

Material Examined: Holotype – Female. INDIA: Kerala, Kannur, Panayathanparamba, 3kms W Kannur Airport, 11°54.32"N 75°30.27"E, 70m, 13-27.iii.2008, MT, scrub jungle, S. Santhosh leg., VRN 214 (DZUC).

Discussion: This new species closely resembles S. sinensis Fullaway, but it differs in having head 1.12x as long as wide, vertex weakly convex and pedicel 1.75x as long as wide. In S. sinensis, head 1.5x as long as wide, vertex straight and pedicel slightly longer than wide.

*Sirola nasserii* sp. nov.

(figs.319-320, 360-363)

Diagnosis: Mandible orange – yellow; vertex concave; antenna distinctly longer than head in full face view; no posterior transverse propodeal carina.

Description: Holotype – Female.

Measurements: Length 2.86mm; LH 0.67mm; WH 0.63mm; WF 0.36mm; LM 0.88mm; LP 0.33mm; HE 0.32mm; WPD 0.44mm; FWL 1.83mm.

Colour: Body brownish black; mandibles orange; teeth brown; antenna yellow, apical 2 segments dusky; legs yellow. Wing hyaline.

Head: Head (figs.319, 362) longer than broad; WH 0.94x LH; WF 1.12x HE; frons and vertex microreticulate; vestiture sparse; setae short suberect; setae on vertex not distinctly longer than other setae on head; vertex weakly concave in full face view; gena smooth and polished (fig.361); mandible with 4 teeth, ventral most longest and curved downwards; clypeus with a median carina; eye (figs.320, 362) sparsely setose; setae shorter than diameter of single facet; ocelli in obtuse triangle; POL:AOL = 5:3; OOL 1.3x WOT. Relative lengths of first four antennal segments (fig.319) 7:3.5:2.2:2; scape 1.75x as long as wide; pedicel 1.4x as long as wide; F1
length subequal to its width; F2 to F6 slightly wider than long; other terminal segments moniliform.

**Mesosoma:** Pronotal disc microreticulate with sparse long decumbent setae; mesonotum microreticulate, sculpture on scutellum weaker than that of pronotum and mesonotum. Scutellum with a narrow transverse groove basally widened at both the extremities; propodeum (figs.319, 363) 0.74x as long as wide in dorsal view, microreticulate except basal triangular smooth area and posterior margin; discal and posterior transverse carina absent; declivity weakly microreticulate. Forewing discal cells asetose.

**Metasoma:** Smooth and shining (fig.360).

**Male:** Unknown.

**Biology:** Ex. leaf galls (fig.144) by unidentified thrips (Thysanoptera: Thripidae) on Memacylon umbellatum Brum.f. (Memecylaceae). Co-inhabited in the gall by unidentified rove beetle (Coleoptera: Staphylinidae).

**Etymology:** The species epithet is after the collector and donator of the specimen, M. Nasser.

**Distribution:** India – Karnataka.

**Material Examined:** Holotype – Female. INDIA: Karnataka, Sringeri, Saunabitta, 13°23.59'N 75°47.30'E, 689m, 27.i.2007, rearing, MDF, Community Managed Forests, M. Nasser, VRN 213 (DZUC).

**Discussion:** This new species is closely similar to *S. kannurenis* and *S. sinensis*, but it differs in having the vertex concave, antenna distinctly longer than head in full face view and mandible orange – yellow. In *S. kannurenis* and *S. sinensis*, vertex is convex or straight, antenna as long as the head in full face view and mandible is black.
Sierola kannurensis sp. nov., Female. 140. body profile; 141. head, side view; 142. head, full face view; 143. mesosoma, dorsal view. Sierola nasserii sp. nov., Female. 360. body profile; 361. head, side view; 362. head, full face view; 363. mesosoma, dorsal view.
144. leaf gall of *Memecylon umbellatum* Burm. f.
Figs. 314 - 318. *Sierola kannurensis* sp. nov., Female, 314. body, dorsal view; 315. antenna; 316. head, side view; 317. foretibia; 318. mandible
Figs. 319 - 320. *Sierola nasserii* sp. nov., Female, 319. body, dorsal view; 320. head, side view.
GENUS SCLERODERMUS LATREILLE 1809


Diagnosis: Small wasps (1.5-6mm) with or without wings in either sex. Head longer than wide, its width slightly to considerably exceeding maximum width of thorax. Mandibles with 2 sharp apical teeth, usually with 1-3 small apical teeth basal of these; clypeus with short median lobe which is truncate or emarginated apically; antennae 13 segmented, scape quite long, inserted at base of clypeus, below bottom level of eyes; eye glabrous or with sparse short setae, rather small in apterous forms; HE at least 0.25x WH; ocelli absent in apterous forms, normally developed in alate forms; occipital carina absent. Apterous females with mesoscutum and scutellum fused into a single smooth plate whereas in alate forms scutellum separated from mesoscutum with a narrow transverse groove basally, sometimes widened on each side; propodeum parallel sided or somewhat broadened posteriorly, disc without longitudinal or transverse carinae; mesopleura prominent, forming widest part of thorax; middle tibiae bare or densely covered on upper side with short spines; claws dentate. Forewing with costa absent, subcosta median and basal veins present, anal and transverse median veins present or absent. Subcosta thickened between basal vein and stigma, but not forming a distinct prostigma, stigma minute, not giving rise
to radial vein; abdomen sessile, relatively very long especially in females. Male genitalia with basal ring small; parameres divided into 2 completely separate lobes much as in *Pseudisobrachium*; cuspides broad partially divided into ventral and dorsal arms, ventral portion setose; subgenital plate of male simple, with a long median basal stalk.

**Statistics:** Currently represented by about 70 species around the world, mainly from the Palearctic and Oriental regions and Hawaiian Islands (TERAYAMA, 2006). Twelve species are known so far from Oriental region, of which three species each are from India and Sri Lanka. Nine Oriental species are known from apterous females. *S. mori* is based on a alate single male. *Sclerodermus harmandi* and *S. vigilans* are known from alate males and apterous and alate females. *Sclerodermus luteicollis* and *S. hirsutus* are known only from winged females only.

**Biology:** *Sclerodermus* attacks wood-boring beetle larvae, chiefly Cerambycidae in the case of the American species (EVANS, 1978). Several South American species have been found in association with ant nests, and Hawaiian species are known to attack larvae of wood boring Lepidoptera (BRIDWELL, 1920; EVANS, 1964). A species is found attacking larvae of *Ceratina* bees from Japan.

**Distribution:** Oriental region (India, Taiwan, Myanmar, Indonesia); Palearctic region (Japan, Austria, Italy, France, Albania, Algeria); Australian region (Australia); Neotropical region (Brazil, Bolivia, Chile, Argentina); Nearctic region (USA).

**Phylogeny:** Studies on phylogeny and taxonomy of Scleroderminii by LANES and AZEVEDO (2008) for 72 characters assessed the monophyly of Scleroderminii. In this context, the newly described species were manually analyzed and the character coding and data matrix are given in tables (see tables – 26 and 27).

The apomorphic characters found in *Sclerodermus* are subrectangular or oval shape of head, in lateral view; temple and vertex convex in dorsal view; four or five segmented maxillary palpi; three segmented labial palpi; clypeus with thin median elevation, thirteen segmented antennae; scape slender, width less than 0.3x length;
frontal groove in dorsal view; pronotal collar long, length more than 0.16x pronotal disc length; anterior transverse carina present.

Remarks: Alate females are generally much less common than apterous females, but in the male sex the alate form is the more common. Males are generally much less common than females, and apterous males are very rare indeed. Males are short lived and hence are almost never collected except while rearing them from their hosts.

Table – 26. Character list and coding of Oriental *Sclerodermus*

#1. Wing and Ocelli/
   0. absent/
   1. present/

#2. Scape/
   0. 2.1 – 2.69x pedicel/
   1. 2.7 – 3.2x pedicel/

#3. Pedicel/
   0. as long as 1.17 – 1.5x its width/
   1. as long as 1.6 – 1.8x its width/
   2. longer than 1.81x its width/

#4. Scape length/
   0. less than 2.51x pedicel length/
   1. 2.55 –2.95x pedicel length/
   2. more than 3x pedicel length/

#5. Head length in lateral view/
   0. shorter than 1.69x its width/
   1. longer than 1.72x its width/

#6. Head width in full face view/
   0. 0.70 – 0.89x its length/
   1. longer than 0.91x its length/

#7. Head width in full face view/
   0. shorter than 2.7x height of eye (HE)/
   1. longer than 2.79x height of eye (HE)/

#8. Width of frons (WF)/
   0. shorter than 1.49x height of eye (HE)/
   1. 1.54 -1.69x height of eye (HE)/
   2. longer than 1.7x height of eye (HE)/

#9. Maximum distance from top of the eye to posterior margin of vertex (EV)/
   0. shorter than 2x height of eye (HE)/
   1. longer than 2x height of eye (HE)/

#10. Ocellocular line (OOL)/
   0. shorter than 2.45x width of ocellar triangle/
1. longer than 2.5x width of ocellar triangle/

#11. Forefemur/
  0. shorter than 1.8x its width/
  1. longer than 1.81x its width/

#12. Mandible/
  0. black/
  1. light brown/
  2. reddish brown/

#13. Mandibular tooth/
  0. 2 in number/
  1. 3 in number/
  2. 4 in number/

#14. Eye/
  0. setose, setae equal to or shorter than diameter of single facet/
  1. asetose/
  2. setose, setae longer than diameter of single facet/

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Character coding</th>
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<tr>
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<tr>
<td>Scleroderma hirsutus Krombein</td>
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<tr>
<td>Scleroderma undulatus (Krombein)</td>
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</tr>
<tr>
<td>Scleroderma harmandi (Buysson)</td>
<td>1</td>
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<tr>
<td>Scleroderma vigilans Westwood</td>
<td>1</td>
</tr>
<tr>
<td>Scleroderma luteicollis Kieffer</td>
<td>1</td>
</tr>
<tr>
<td>Scleroderma hardwickiae Kurian</td>
<td>1</td>
</tr>
<tr>
<td>Scleroderma seenae sp. nov.</td>
<td>1</td>
</tr>
<tr>
<td>Scleroderma bicolor Smith</td>
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</tr>
<tr>
<td>Scleroderma delhiensis Kurian</td>
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<tr>
<td>Scleroderma variegatus Krombein</td>
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<td>Scleroderma harmandi (Buysson)</td>
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<tr>
<td>Scleroderma castaneus Kieffer</td>
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</tr>
<tr>
<td>Scleroderma guani Xiao and Wu</td>
<td>0</td>
</tr>
</tbody>
</table>

? - Unknown; N - Not applicable
5.6.1 Key to Oriental species of Sclerodermus Latreille (based on females)

1. Ocelli absent (figs.321, 326, 344, 347, 356); wingless .......................... 2
   -- Ocelli present (figs.331, 339, 351); fully winged ......................... 11

2 (1). Eye bare .................................................................................. 3
   -- Eye setose .................................................................................. 7

3(2). Forefemur 1.74x as long as wide; sides of the head straight; EV 2.1x HE;
     WF 1.7x HE; LH 1.68x depth of head in lateral view; vertex straight;
     propodeum posteriorly 1.07x wider than at spiracles ............................
     ................................................................................ variegatus Krombein
     -- Forefemur more than 2x as long as wide; sides of the head weakly convex;
       other characters not in above combination, partly or completely different. 4

4(3). Scape as long as or longer than 3x its width .................................. 5
   -- Scape shorter than 3x its width .................................................. 6

5(4). Forefemur 2.5 as long as wide; head and mesosoma castaneous; mandible
     quadridentate; scape 4x as long as pedicel .................................. harmandi (Buysson)
     -- Forefemur 2.15 as long as wide; head and mesosoma reddish brown;
       mandible tridentate; scape 2.67x as long as pedicel .................. delhiensis Kurian

6(4). Propodeum posteriorly 1.12-1.17x wider than at spiracles; WF 1.7-1.86x
     HE; head weakly coriaceous with few tiny scattered punctures ............
     ................................................................................ vigilans Westwood
     -- Propodeum posteriorly 1.23x wider than at spiracles; WF 2.1x HE; head
       weakly coriaceous without punctures .................................. bicolor Smith

7(2). EV longer than 2x HE; WH as long as or longer than 3x HE ............ 8
   -- EV shorter than 2x HE; WH shorter than 3x HE .............................. 9

8(7). Scape 3x as long as wide (fig.357); scape 2.25x as long as pedicel; body
     pale brown; mandible tridentate; ocular setae as long as width of single
     facet ...................................................................................... sumatranus sp. nov.
-- Scape 2.57x as long as wide (fig.348); scape 3x as long as pedicel; body dark brown; mandible bidentate; ocular setae 1.5x as long as width of single facet ................................................. *seenae* sp. nov.

9(7). Pedicel 1.17x as long as wide (fig.322); scape 2.74x as long as wide, 3.29x as long as pedicel; LH 1.88x depth of head in lateral view (fig.323); ocular setae less than width of single facet ................................................. *castaneus* Kieffer

-- Pedicel 1.4-1.8x as long as wide (fig.327); scape 2.4 - 2.5x as long as wide, 2 - 2.75x as long as pedicel; LH 1.74 - 1.78x depth of head in lateral view (fig. 328, 345); ocular setae ≥ width of single facet ................................................. 10

10(9). EV 1.4x HE (fig.345); body completely brownish black; ocular setae as long as the width of single facet; scape 2.75x as long as pedicel; WH 2.57x HE ................................................................. *nigrus* Kieffer

-- EV 1.9x HE (fig.328); body brown, pronotum and propodeum yellow; ocular setae slightly longer than width of single facet; scape 2 - 2.22x as long as pedicel (fig.327); WH 2.8x HE ....................... *hardwickiae* Kurian

11(1). OOL 3.57x WOT; EV as long as or longer than 2x HE; WH 0.71x LH ...... ................................................................. *hirsutus* (Krombein)

-- OOL 2.11 - 2.67x WOT; EV shorter than 2x HE; WH 0.81- 0.94x LH.... 12

12(11). EV 0.94x HE; WF 0.54x WH; scape 2.89x as long as pedicel; pedicel 1.5x as long as wide ................................................................. *undulatus* (Krombein)

-- EV 1.58 – 1.91x HE; WF as long as or longer than 0.56x WH; other characters not in above combination, partly or completely different ........ 13

13(12). Head, pronotum and propodeum castaneous, mesonotum and metanotum dark brown; WH 0.94x LH ......................................................... *harmandi* (Buysson)

-- Body light brown to reddish brown; WH 0.81-0.86x LH...................... 14

14(13). Forefemur longer than or as long as 2x its width; body light brown; WF 1.54 – 1.64x HE ................................................................. 15
Forefemur shorter than 2x as long as wide; body reddish brown; WF 1.4 – 1.47x HE ................................................................. 16

15(14). OOL 2.11 – 2.25x WOT; EV 1.83 - 1.91x HE; WH 2.85x HE ..............

................................................................. vigilans Westwood

-- OOL 2.67x WOT; EV 1.62x HE; WH 2.67x HE ..........luteicollis Kieffer

16(14). Pedicel 2.5x as long as wide (fig.332); forefemur 1.89x as long as wide (fig.334); OOL 2.33x WOT ............................................... hardwickiae Kurian

-- Pedicel 1.6x as long as wide; forefemur 1.55x as long as wide; OOL 2.42x WOT ................................................................. seenae sp. nov.

Note: Sclerodermus guani Xiao & Wu from China (Xiao and Wu, 1983) is not included in the key for want of type material. However, it is included in the interactive key and character analysis and data matrix.

Sclerodermus bicolor Smith

(figs.364-367)

Sclerodermus bicolor Smith, 1860, 5: 77-78. Female. Examined (OUMNH)

Redescription: Holotype – Female. Apterous.

Measurements: Length 3.22mm. LH 0.56mm; HW 0.49mm; WF 0.30mm; LM 0.92mm; LP 0.37mm; WPD 0.30mm.

Colour: Body dark brown except antenna and propodeum yellow; mandible yellow with terminal ends dark brown, forefemur and pronotum brown; tibia and tarsi yellowish brown.

Head: Head (fig.365) generally smooth and polished, front and vertex weakly coriaceous; 1.14x as long as wide, with subparallel sides, curving inwards posterolaterally to slightly convex vertex in full face view. In lateral view (fig.367), ventral and dorsal margin convex; 1.73x as long as its depth; mandible (fig.366) with 3 teeth, apical 2 long and basal one short; WH 0.87x LH; WF 2.26x HE; WH

Sauthosh, S.
3.68x HE; EV 2.3x HE; eye length 2.11x malar space; ocelli absent. scape clavate, 2.55x as long as maximum width.

**Mesosoma:** Dorsum of mesosoma (fig.364) coriaceous, slightly stronger than that of head; pronotal disc slightly wider than long (48:44); mesonotum wider than long, 0.62x as long as wide; propodeum widest near the posterior end, maximum width 1.26x minimum width; posterolateral angles bluntly angulated. Forefemur 2.2x as long as wide.

**Metasoma:** Weakly coriaceous, stronger than that of head; 1.09x wider than maximum head width; 1.46x as long as head plus mesosoma (fig.364).

**Male:** Unknown.

**Ecology and Biology:** Unknown.

**Distribution:** Indonesia – Sulawesi

**Material Examined:** INDONESIA: Sulawesi, Makasser (OUMNH)

**Discussion:** In wingless form of females, *Sclerodermus bicolor* is close to wingless female of *S. vigilans* Westwood in having scape shorter than 3x its width, forefemur more than 2x as long as wide and sides of the head weakly convex. *Sclerodermus bicolor* is having propodeum posteriorly 1.23x wider than at spiracles, WF 2.26x HE and head weakly coriaceous without punctures, whereas *S. vigilans* is having propodeum posteriorly 1.12-1.17x wider than at spiracles, WF 1.7-1.86x HE, head weakly coriaceous with few tiny scattered punctures.

**Remarks:** Though this species is distributed well outside the study area, their identity is important to bring about clarity and accuracy to the present investigation. Hence, it is also included in the study. Moreover it is assumed that this species might have been transported to other regions for biological control reasons. The type is a very bad condition and this redescription is based on photographs and the microscopic examination by James Hogan on request. The anterior clypeal margin is obscure as the head is dissected to take the mandibles out.

*Santhosh, S.*
**Sclerodermus castaneus** Kieffer
(figs.145-148, 321-325)

*Scleroderma castaneum* Kieffer, 1904c, 1:373,375-376. Female. Examined (MCSN)

**Diagnosis:** Apterous. Pedicel 1.17x as long as wide; scape 2.74x as long as wide, 3.29x as long as pedicel; LH 1.88x depth of head in lateral view; ocular setae less than width of single facet; EV shorter than 2x HE; WH shorter than 3x HE.

**Redescription:** *Holotype* – Female. Apterous.

**Measurements:** Length 3.32mm. LH 0.56mm; WH 0.48mm; WF 0.28mm; LM 0.84mm; LP 0.35mm; WPD 0.32mm.

**Colour:** Body reddish brown; antenna, mandible and tarsi yellow.

**Head:** Head (fig.147) generally smooth and polished; weakly coriaceous in the front; vestiture almost absent, few short, thin setae present laterally and posteriorly 1.17x as long as wide (fig.321), with subparallel sides, curving inwards posterolaterally to straight vertex in full face view; in lateral view (figs.146, 323), ventral and dorsal margins convex, 1.88x as long as its depth; mandible teeth not visible due to poor card mounting; anterior margin of clypeus transverse, not medially notched; shallow short groove running from posterior margin of clypeus towards front beyond the level of anterior ocular margin; eye 0.17mm long; WH 0.86x LH; WF 1.6x HE; WH 2.8x HE; EV 1.8x HE; eye length 4x malar space; eye sparsely setose, setae minute shorter than the diameter of single facet; ocelli absent. Relative lengths of first five antennal segments (fig.322) 11.5:3.5:1.5:1.5:1.5 in length; scape clavate, 2.74x as long as maximum width; pedicel slightly longer than wide; 3rd to 12th wider than long; apical segment 2x as long as wide;

**Mesosoma:** Pronotal disc (fig.148, 321) 1.05x as long as wide; mesonotum 0.69x as long as wide; propodeum broadest near posterior margin; maximum width 1.2x its minimum width; posterolateral corners bluntly angulated; dorsum of mesosoma generally polished, very weakly coriaceous. Forefemur (fig.324) 1.73x as long as wide.
Metasoma: Smooth and polished; metasoma (fig.145, 325) 1.3x as long as head plus mesosoma; wider than head (28:32) and thorax.

Male: Unknown.

Ecology and Biology: Unknown.

Distribution: Indonesia – Moluques.


Discussion: Sclerodermus castaneus is related to S. hardwickiae Kurian and S. nigrus Kieffer in having EV shorter than 2x HE and WH shorter than 3x HE., but it differs in having pedicel 1.17x as long as wide, scape 2.74x as long as wide, 3.29x as long as pedicel, LH 1.88x depth of head in lateral view and ocular setae less than width of single facet, whereas in S. hardwickiae and S. nigrus, pedicel 1.4-1.8x as long as wide, scape 2.4 - 2.5x as long as wide, 2 - 2.75x as long as pedicel, LH 1.74 - 1.78x depth of head in lateral view and ocular setae ≥ width of single facet.

Remarks: Label on the holotype read like Scleroderma castaneum J.J.Kieffer, 1904.

Sclerodermus hardwickiae Kurian
(figs.149-156, 326-338)

Sclerodermus hardwickiae Kurian 1955, 4: 78, 79-80. fig.52. Female. Not examined.

Diagnosis: Apterous – EV 1.9x HE; body brown, pronotum and propodeum yellow; ocular setae slightly longer than width of single facet; scape 2 - 2.22x as long as pedicel; WH 2.8x HE. Alate – Pedicel 2.5x as long as wide; forefemur 1.89x as long as wide; OOL 2.33x WOT; forefemur shorter than 2x as long as wide; body reddish brown; WF 1.4 – 1.47x HE; WH 0.81-0.86x LH.

Description: Female. Apterous.
Measurements: Length 3.1mm. LH 0.54mm; WH 0.45mm; WF 0.26mm; LM 0.84mm; LP 0.33mm; WPD 0.28mm.

Colour. Antenna, tarsi, prothorax and propodeum yellow; rest of legs, mesonotum, head and metasoma brown; metasomal tergites darker; mandibles yellow, teeth brown.

Head: Head (fig.150) weakly coriaceous; vestiture sparse, thin and very short; head (fig.150, 326) 1.2x as long as wide, with subparallel sides, curving inwards posterolaterally to straight vertex in full face view. In lateral view (fig.328), dorsal margin subparallel, ventral margin convex, 1.78x as long as its depth; mandible (fig.330) with 2 apical long teeth; anterior margin of clypeus transverse with shallow median notch; shallow short groove running from posterior margin of clypeus towards front, distinctly extending beyond the level of anterior ocular margin; eye 0.16mm long; WH 0.83x LH; WF 1.67x HE; WH 2.89x HE; EV 1.9x HE; eye length 4.5x malar space; eye sparsely setose, setae slightly longer than diameter of single facet; ocelli absent. Relative lengths of first five antennal segments (fig.327) 10:4.5:1.5:1.5:1.5 in length; scape clavate, 2.5x as long as maximum width; pedicel 1.8x as long as maximum width; antennal segments 3 – 12 wider than long; apical segment 2x as long as wide.

Mesosoma. Pronotal disc 1.1x as long as wide; mesonotum 0.75x as long as wide; propodeum broadest near posterior margin; maximum width 1.14x its minimum width; posterolateral corners smoothly rounded; dorsum of mesosoma weakly coriaceous, relatively stronger than that of head. Forefemur (fig.329) 2.1x as long as wide.

Metasoma. Generally smooth and polished, weakly coriaceous; 1.17x as long as head plus mesosoma (fig.326); wider than head (26:32) and mesosoma.


Santhosh, S.
Description: Female. Alate.

Measurements: Length 2.9mm. LH 0.5mm; WH 0.42mm; WF 0.24mm; LM 0.95mm; LP 0.34mm; WPD 0.3mm.

Colour: Head, mesonotum and metasoma brown except paler basal tergite; pronotum, legs, and basal inverted triangle shaped area of propodeum pale brown; distal half of propodeum, antenna yellow; mandibles yellow teeth brown; wings hyaline, veins brown.

Head: Head (fig.153) weakly coriaceous, relatively stronger than that of apterous female; vestiture sparse and short, setae on outer side of eyes and ventral side of head longer; 1.18x as long as wide (fig.331), with subparallel sides, curving inwards posterolaterally to straight vertex in full face view. In lateral view (fig.333), dorsal margin of head subparallel, ventral margin convex, 1.77x as long as its depth; mandible with 2 apical long teeth; anterior margin of clypeus transverse with shallow median notch; shallow short groove running from posterior margin of clypeus towards front, distinctly extending beyond the level of anterior ocular margin; eye 0.16mm long; WH 0.84x LH; WF 1.47x HE; WH 2.58x HE; EV 1.58x HE; eye sparsely setose, setae slightly longer than diameter of single facet; ocelli in acute triangle; OOL 2.33X WOT; POL: AOL = 3:2; posterior ocelli 1.5x its own diameter from vertex in full face view. Relative lengths of first five antennal segments (fig.332) 10:4:2:1.5:1.5 in length; scape clavate, 2.5x as long as maximum width; pedicel 1.4x as long as maximum width; antennal segments 3 – 12 wider than long; apical segment 2x as long as wide.

Mesosoma: Mesosoma (fig.154) coriaceous, stronger than that of head; vestiture sparse and short; Pronotal disc 0.69x as long as wide; mesonotum without notaui and parapsidal furrows; scutellum shorter than mesonotum, anteriorly with a shallow transverse groove slightly curved backwards at both ends; propodeum broadest near posterior margin; maximum width 1.06x its minimum width; posterolateral corners bluntly angulated. Forewing (fig.331) with anal vein obscure; pterostigma very short restricted to 1/3rd of the forewing. Forefemur (fig.334) 1.9 x as long as wide.
*Metasoma:* abdomen weakly coriaceous; slightly shorter than head plus mesosoma (fig.152, 331); distinctly wider than head (24:30) and mesosoma.

*Material Examined:* 5♀. Alate. **INDIA:** Karnataka, Bangalore, 13°00.37'N 77°34.20'E, 939m, rearing, 13.xii.2005, on decaying log, O.K. Remadevi leg., Vr.No.104, 105, 106, 116, 117 (DZUC).

*Description:* Male. Alate.

*Measurements:* Length 2mm. LH 0.4mm; WH 0.36mm; WF 0.22mm; LM 0.83mm; LP 0.31mm; WPD 0.28mm.

*Colour:* Body, antenna, legs brown; wings hyaline, veins pale yellow.

*Head:* Head coriaceous; vestiture sparse and short; 1.1x as long as wide (fig.335), with convex sides, curving inwards posterolaterally to convex vertex in full face view. In lateral view (fig.337), dorsal margin subparallel, ventral margin convex; 1.77x as long as its depth; mandible with 3 teeth; anterior margin of clypeus transverse with shallow median notch; shallow short groove running from posterior margin of clypeus towards front, distinctly extending beyond the level of anterior ocular margin; eye 0.16mm long; WH 0.83x LH; WF 1.37x HE; WH 2.2x HE; EV 1.16x HE; eye asetose; ocelli in acute triangle; OOL 1.12x WOT; POL:AOL = 3:2; posterior ocelli very close to vertex in full face view. Relative lengths of first five antennal segments (fig.336) 7:4:2:2:2; scape slightly clavate, 2x as long as maximum width; pedicel 2x as long as maximum width; 3rd to 12th as long as or slightly longer than wide; apical segment 1.8x as long as wide.

*Mesosoma:* Mesosoma coriaceous; vestiture sparse, thin and short; pronotal disc (fig.335) 0.53x as long as wide; mesonotum without notauli and parapsidal furrows; posterior margin of scutellum separated from propodeum by short metanotum; propodeum broadest near posterior margin; maximum width 1.07x its minimum width; posterolateral corners smoothly curved; very short petiole is present. Forewing (fig.335) with anal vein obscure; pterostigma very short restricted to basal 1/3rd. Forefemur (fig.338) 4.75 x as long as wide.

_Santhosh, S._
Metasoma: Metasoma coriaceous; as long as mesosoma (fig.155); wider than head (21:26) and mesosoma.

Ecology and Biology: Parasitoids of Lyctus spp. (Coleoptera: Lycidae) (fig.156) on decaying log.

Distribution: India – Karnataka; Tamil Nadu.

Material Examined. 1♂. Alate. INDIA: Karnataka, Bangalore, Malleshwaram, IWST campus, rearing, 20.iii.2006; from decaying log, O.K. Remadevi., VRN 108; 1♂. data same as before except 5.i.2005, VRN 113 (DZUC).

Discussion: In wingless form of females, S. hardwickiae is related to S. nigrus in having pedicel 1.4-1.8x as long as wide, scape 2.4 - 2.5x as long as wide, 2- 2.75x as long as pedicel, LH 1.74 - 1.78x depth of head in lateral view and ocular setae ≥ width of single facet, but it differs in having EV 1.9x HE, body brown, pronotum and propodeum yellow, ocular setae slightly longer than width of single facet, scape 2 - 2.22x as long as pedicel and WH 2.8x HE, whereas in S. nigrus EV 1.4x HE, body completely brownish black, ocular setae as long as the width of single facet, scape 2.75x as long as pedicel and WH 2.57x HE. In winged form of females, S. hardwickiae is related to S. seenae sp.nov. in having forefemur less than 2x as long as wide, body reddish brown and WF 1.4 – 1.47x HE, but it differs in having pedicel 2.5x as long as wide, forefemur 1.89x as long as wide and OOL 2.33x WOT, whereas in S. seenae sp. nov. pedicel 1.6x as long as wide, forefemur 1.55x as long as wide and OOL 2.42x WOT.

Remarks: This is the first record of the winged male and winged female forms of the species. So far, this species was known only from the type locality, Madras. This is the first record of the species from Karnataka.
Sclerodermus luteicollis Kieffer
(figs. 157-160, 339-343)

Scleroderma luteicollis Kieffer, 1904c, 1: 373,375. Female. (MCSN)

Diagnosis: Alate – OOL 2.67x WOT; EV 1.62x HE; WH 2.67x HE; forefemur longer than or as long as 2x its width; body light brown; WF 1.54 – 1.64x HE; WH 0.81-0.86x LH; WF as long as or longer than 0.56x WH.

Redescription: Holotype – Female, Alate.

Measurements: Length 3.16mm. LH 0.55mm; WH 0.48mm; WF 0.28mm; LM 1mm; LP 0.4mm; WP 0.35mm.

Colour: Head and mesosoma pale brown; metasoma dark brown; antenna, mandible, pronotum and legs pale yellow; teeth of mandible red brown; wings hyaline; veins brown; dark brown patch around all ocelli.

Head: Head (fig.157) weakly coriaceous; vestiture erect, short, thin and sparse; 1.14x as long as wide (fig.339), with subparallel sides, curving inwards posterolaterally to convex vertex in full face view. In lateral view, ventral and dorsal margins of head convex (figs.158, 341) 1.72x as long as its depth; anterior margin of clypeus transverse with shallow median notch; shallow short groove running from posterior margin of clypeus towards front beyond level of anterior ocular margin; mandible (fig.343) with 2 apical teeth and one basal small tooth; eye 0.18mm long; WH 0.87x LH; WF 1.54x HE; WH 2.67x HE; EV 1.62x HE; eye length 3.33x malar space; eye sparsely setose, setae minute as long as diameter of single facet; ocelli in acute triangle; OOL 2.67x WOT; POL: AOL = 2.5:2. Relative lengths of first five antennal segments (fig.340) in a ratio of about 11:4:2:2:2 in length; scape clavate, 2.75x as long as maximum width; pedicel 1.52x as long as wide; 3rd to 12th wider than long;

Mesosoma: Mesosoma (fig.160) weakly coriaceous; vestiture erect, short, and sparse; pronotal disc (fig.339) 0.7x as long as wide; mesonotum without notauli and parapsidal furrows; scutellum with a basal shallow transverse groove; propodeum

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widest near posterior margin; maximum width 1.1x its minimum width; posterolateral corners smoothly rounded; short petiole present. Forefemur (fig.342) 2.33x as long as wide.

Metasoma: Metasoma (fig.159) weakly coriaceous; 1.14x as long as head plus mesosoma; wider than the width of head (32:39) and mesosoma; vestiture long, moderately profuse in terminal segments.

Male: Unknown.

Ecology and Biology: Unknown.

Distribution: Burma.


Discussion: Sclerodermus luteicollis and S. vigilans Krombein are related in having forefemur ≥ 2x as long as wide, body light brown and WF 1.54 – 1.64x HE, but it differs in having OOL 2.67x WOT, EV 1.62x HE and WH 2.67x HE, whereas in S. vigilans, OOL 2.11 – 2.25x WOT, EV 1.83 - 1.91x HE and WH 2.85x HE.

Remarks: Label on the holotype read “Scleroderma luteicolle J.J. Kieffer, 1904.”

**Scleroderma nigrum** Kieffer

(figs.161-164, 344-346)

Scleroderma nigrum Kieffer, 1904c, 1: 373,375. Female. (MCSN)

Diagnosis: Apterous – Body completely brownish black; EV 1.4x HE; ocular setae as long as the width of single facet; scape 2.4 - 2.5x as long as wide, 2.75x as long as pedicel; WH 2.57x HE; pedicel 1.4-1.8x as long as wide; LH 1.74 - 1.78x depth of head in lateral view; ocular setae ≥ width of single facet.

Redescription: Holotype – Female. Apterous.

Measurements: Length 4.64mm. LH 0.81mm; WH 0.72mm; WF 0.43mm; LM 1.34mm; LP 0.65mm; WPD 0.56mm.
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Colour: Body dark brown; antenna, mandible, tibia and tarsi yellow; teeth of mandible red brown.

Head: Head (figs.163, 344) weakly coriaceous; vestiture erect, short, thin and sparse; 1.13x as long as wide, with subparallel sides, curving inwards posterolaterally to slightly convex vertex in full face view. In lateral view, ventral margin distinctly and dorsal margin of head slightly convex; 1.74x as long as its depth (fig.162, 345); mandible with 4 teeth, basal tooth very short; anterior margin of clypeus transverse with shallow median notch; shallow short groove running from posterior margin of clypeus towards front beyond level of anterior ocular margin; eye 0.28mm long; WH 0.89x LH; WF 1.54x HE; WH 2.58x HE; EV 1.4x HE; eye length 3x malar space; eye sparsely setose, setae minute as long as diameter of single facet; ocelli absent. Relative lengths of first 5 antennal segments 11:4:2:2:2; scape clavate, 2.44x as long as maximum width; pedicel 1.4x as long as wide; antennal segments 3 – 12 wider than long; apical segment 1.5x as long as wide.

Mesosoma: Mesosoma weakly coriaceous; vestiture erect, short, and sparse; pronotal disc as long as wide; propodeum broadest near posterior margin; maximum width 1.12x its minimum width; posterolateral corners bluntly angulated. Forefemur (fig.346) 2x as long as wide.

Metasoma: Metasoma weakly coriaceous; 1.15x as long as head plus mesosoma; wider than head (31:40) and mesosoma.

Male: Unknown.

Ecology and Biology: Unknown.

Distribution: Indonesia – Mentawei.


Discussion: Sclerodermus nigrus and S. hardwickiae are closely related in having pedicel 1.4-1.8x as long as wide, scape 2.4 - 2.5x as long as wide, 2 - 2.75x as long as pedicel, LH 1.74 - 1.78x depth of head in lateral view and ocular setae ≥ width of

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single facet, but it differs in having EV 1.4x HE, body completely brownish black, ocular setae as long as the width of single facet, scape 2.75x as long as pedicel and WH 2.57x HE, whereas in *S. hardwickiae*, EV 1.9x HE, body brown, pronotum and propodeum yellow, ocular setae slightly longer than width of single facet, scape 2 - 2.22x as long as pedicel and WH 2.8x HE.

*Remarks*: Label on the Holotype read like *Scleroderma nigrum* J.J. Kieffer, 1904.

*Scleroderma seenae* sp. nov.

(figs.165-169, 347-355)

**Diagnosis**: *Apterous* - Body dark brown; mandible bidentate; scape 2.57x as long as wide, 3x as long as pedicel; ocular setae 1.5x as long as width of single facet; EV longer than 2x HE; WH as long as or longer than 3x HE. *Alate* – Body reddish brown; pedicel 1.6x as long as wide; forefemur 1.55x as long as wide; OOL 2.42x WOT; forefemur length shorter than 2x its width; WF 1.4 – 1.47x HE; WF 1.73x HE; WH 0.94x LH; EV 1.58 – 1.91x HE; WF as long as or longer than 0.56x WH.

**Description**: *Holotype – Female, Apterous.*

*Measurements*: Length 2.96mm. LH 0.48mm; WH 0.4mm; WF 0.22mm; LM 0.81mm; LP 0.28mm; WPD 0.26mm.

*Colour*: Body dark brown, pronotum paler; antenna yellow; scape with brownish tinge; mandible yellow, teeth brown; legs with coxa and femur concolourous with body; all other segments yellow.

*Head*: Head (figs.166, 347) weakly coriaceous; vestiture erect, sparse, and short, ventral side with long curved setae; 1.2x as long as wide, with subparallel sides, curving inwards posterolaterally to straight vertex in full face view; head in lateral view (fig.349) 1.75x as long as its depth; ventral and dorsal margin subparallel; mandible with 2 apical blunt teeth; anterior margin of clypeus transverse without median notch in full face view; shallow median short groove running from posterior
margin of clypeus towards front, distinctly extending beyond the level of anterior ocular margin; eye 0.13mm long; WH 0.83x LH; WF 1.73x HE; WH 3.1x HE; EV 2.13x HE; Eye length 3.5x malar space; eye sparsely setose, setae 1.5x as long as diameter of single facet; ocelli absent. Relative lengths of first 5 antennal segments 9:3:1.2:1:1.2; scape clavate, 2.57x as long as maximum width; pedicel slightly longer than wide; 3rd to 12th wider than long; apical segment 1.33x as long as wide;

_Mesosoma:_ Mesosoma (fig.167) weakly coriaceous; vestiture short, erect sparse and thin; pronotal disc (fig.347) 1.13x as long as maximum width; mesonotum without notauli and parapsidal furrows; propodeum broadest near posterior margin; maximum width 1.15x its minimum width; posterolateral corners bluntly angulated. Forefemur 1.86x as long as wide; short petiole present.

_Metasoma:_ Metasoma weakly coriaceous; vestiture short, sparse on basal tergites and long and moderately profuse on terminal segments (fig.165); 1.3x as long as head plus mesosoma (70:53); wider than head (23:28) and mesosoma.

_Paratype – Female. Alate._

_Measurements:_ Length 3.02mm. LH 0.53mm; WH 0.43mm; WF 0.24mm; LM 0.97mm; LP 0.35mm; WPD 3mm.

_Colour:_ Body dark brown except pronotum brown; posterior 1/3rd of propodeum yellow; antenna yellow, scape brown at base; mandible yellow, teeth brown; legs with coxa and femur brown, all other segments yellow.

_Head:_ Head weakly coriaceous; vestiture sparse, short and erect, sides subparallel before curving inwards posterolaterally to convex vertex in full face view; head (fig.351) 1.24x as long as wide, 1.72x as long as its depth in lateral view (fig.353), ventral and dorsal margins convex. Anterior margin of clypeus truncated, without median notch; shallow groove running from clypeus onto front beyond anterior level of ocular margin; eye 0.17mm in length; WF 1.4x HE; WH 2.5x HE; EV 1.6x HE; ocelli present, brown in colour, OOL 2.42x WOT, POL: AOL = 2:2; acute triangle; posterior ocelli away from occipital margin by diameter of posterior ocelli. Relative lengths of first five antennal segments (fig.352) 10.5:3.5:1.5:1.5:1.5; scape clavate,
2.63x as long as maximum width, pedicel 1.6x as long as wide; F1 to F10 wider than long, terminal segment 2x as long as wide.

Mesosoma: Mesosoma (fig.169) weakly coriaceous; vestiture sparse, short and erect; pronotal disc 0.77x as long as wide; mesonotum without notaulli and parapsidal furrows; scutellum with basal shallow transverse groove; propodeum widest near posterior margin, maximum width 1.03x minimum width at spiracle; posterolateral corner smoothly rounded, short petiole present.

Metasoma: Metasoma weakly coriaceous, vestiture sparse, short on basal tergites and long profuse on distal tergites; metasoma (fig.198) as long as head plus mesosoma; metasoma as wide as mesosoma (27:26) and slightly wider than head (27:25).

Male: Unknown.

Ecology and Biology: Unknown.

Etymology: Species epithet is after the name of the collector and donator of the specimen, K. Seena Narayanan.

Distribution: India – Kerala.


Discussion: In winged form of females, S. seenae sp. nov. is related to S. hardwickiae in having forefemur less than 2x as long as wide, body reddish brown and WF 1.4 – 1.47x HE, but it differs in having pedicel 1.6x as long as wide, forefemur 1.55x as long as wide and OOL 2.42x WOT, whereas in S. hardwickiae pedicel 2.5x as long as wide, forefemur 1.89x as long as wide and OOL 2.33x WOT. In wingless form of females, S. seenae sp. nov. is related to S. sumatranus sp. nov. in having eye setose; EV longer than 2x HE and WH ≥ 3x HE, but it differs in having scape 2.57x as long as wide, scape 3x as long as pedicel, body dark brown,
mandible bidentate and ocular setae 1.5x as long as width of single facet. Whereas in *S. sumatranus* sp. nov., scape 3x as long as wide, scape 2.25x as long as pedicel, body pale brown, mandible tridentate and ocular setae as long as width of single facet.

**Sclerodermus sumatranus** sp. nov.
(figs.170-173, 356-359)

**Diagnosis:** Body pale brown; mandible tridentate; scape 3x as long as wide; scape 2.25x as long as pedicel; ocular setae as long as width of single facet; EV longer than 2x HE; WH as long as or longer than 3x HE; eye setose.

**Description:** *Holotype – Female, Apterous.*

**Measurements:** Length 3.78mm; LH 0.52mm; HW 0.43mm; WF 0.24mm; LM 0.84mm; LP 0.34mm; WPD 0.26mm.

**Colour:** Body shining brown except antenna, legs, pronotum, mandible, and propodeum yellow.

**Head:** Head (figs.172, 356) smooth and polished, front weakly coriaceous; vestiture on dorsal side short thin and sparse, ventrally long and strong; 1.21x as long as wide, with subparallel sides, curving inwards posterolaterally to slightly convex vertex in full face view. In lateral view, ventral and dorsal margin convex; 1.67x as long as its depth (figs.171, 358); mandible with 3 teeth, apical 2 long and basal one short; anterior clypeal margin transverse with shallow median notch; shallow short groove running from posterior margin of clypeus towards front beyond the level of anterior ocular margin; WH 0.83x LH; WF 1.75x HE; WH 3.1x HE; EV 2.25x HE; eye length 2.66x malar space; eye sparsely setose, setae as long as the diameter of single facet; ocelli absent. Relative lengths of first five antennal segments (fig.357) 9:4:1.5:1:1; scape clavate, 3x as long as maximum width; pedicel 1.6x as long as wide; antennal segments 3 – 12 wider than long; apical segment 1.67x as long as wide.
**Mesosoma:** Dorsum of mesosoma (fig. 173) weakly coriaceous, slightly strong than that of head; pronotal disc (fig. 356) slightly wider than long (17:18); mesonotum wider than long, 0.8x as long as wide; propodeum widest near posterior end, maximum width 1.19x minimum width; posterolateral angles bluntly angulated.

**Metasoma:** Weakly coriaceous, stronger than that of head; 1.2x wider than maximum head width; 1.77x as long as head plus mesosoma (fig. 170).

**Male:** Unknown.

**Ecology and Biology:** Unknown.

**Etymology:** The species epithet is after type locality, Sumatra.

**Distribution:** Indonesia – Sumatra.

**Material Examined:** INDONESIA: Sumatra, Padang; E. Modigliani leg. iv. 1894 (MCSN)

**Discussion:** In wingless form of females, *Sclerodermus sumatranus* sp. nov. is close to wingless female of *S. seenae* sp. nov. in having eye setose; EV longer than 2x HE and WH ≥ 3x HE. *Sclerodermus sumatranus* sp. nov. is having scape 3x as long as wide; scape 2.25x as long as pedicel; body pale brown; mandible tridentate; ocular setae as long as width of single facet, whereas *S. seenae* sp. nov. is having scape 2.57x as long as wide; scape 3x as long as pedicel; body dark brown; mandible bidentate; ocular setae 1.5x as long as width of single facet.

**Remarks:** Though this species is distributed well outside the study area, their identity is important to bring about clarity and accuracy to the present investigation. Hence, it is also included in the study.
Sclerodermus castaneus Kieffer, Apterous. Female. 145. body, dorsal view; 146. head, side view; 147. head, full face view; 148. mesosoma, dorsal view. Sclerodermus hardwickiae Kurian, Apterous. Female, 149. body profile; 150. head, full face view; 151. mesosoma, dorsal view.
Sclerodermus hardwickiae Kurian, Alate. Female, 152. body profile; 153. head, full face view; 154. mesosoma, dorsal view. Sclerodermus hardwickiae Kurian, Alate. Male, 155. body profile; 156. Lyctus spp. Sclerodermus luteicollis Kieffer, Alate. Female. 157. head, full face view; 158. head, side view; 159. metasoma, dorsal view.
Sclerodermus luteicollis Kieffer, Alate. Female. 160. mesosoma, dorsal view
Sclerodermus nigrus Kieffer, Apterous. Female. 161. body, dorsal view; 162. head, side view; 163. head, full face view; 164. mesosoma, dorsal view. Sclerodermus seenae sp. nov. Apterous. Female. 165. body profile.
Sclerodermus seenae sp. nov. Apterous. Female. 166. head, full face view; 167. mesosoma, dorsal view; Sclerodermus seenae sp. nov. Alate. Female. 168. body profile; 169. mesosoma, dorsal view. Sclerodermus sumatranus sp. nov., Apterous. Female. 170. body, dorsal view; 171. head, side view; 172. head, full face view; 173. mesosoma, dorsal view.
Sclerodermus bicolor Smith, Holotype. Apterous. Female. 364. body, dorsal view; 365. head full face view; 366. body, side view; 367. mandible.
Figs. 321 - 325. *Sclerodermus castaneus* Kieffer. Female, 321. head and mesosoma, dorsal view; 322. antenna; 323. head, side view; 324. foretibia; 325. metasoma.
Figs. 331 - 334. *Sclerodermus hardwickiae* Kurian. Alate. Female, 331. body, dorsal view; 332. antenna; 333. head, side view; 334. foretibia.
Figs. 339 - 343. *Sclerodermus luteicollis* Kieffer. Alate. Female, 339. body, dorsal view; 340. scape and pedicel; 341. head, side view; 342. foretibia; 343. mandible
Figs. 347 - 350. *Sclerodermus seenae* sp. nov., Apterous. Female, 347. body, dorsal view; 348. antenna; 349. head, side view; 350. foretibia.
Figs. 351 - 355. *Sclerodermus seenae* sp. nov., Alate. Female. 351. body, dorsal view; 352. antenna; 353. head, side view; 354. foretibia; 355. mandible.
Figs. 356 - 359. *Sclerodermus sumatranus* sp. nov., Female, 356. body, dorsal view; 357. antenna; 358. head, side view; 359. foretibia.