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Generic notes on the Assassin bugs of the Subfamily Harpactorinae (Hemiptera: Reduviidae) of Karnataka

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Abstract
Harpactorinae are the largest predaceous subfamily in the famiy Reduviidae with 2,800 described species. Examination of 629 specimens collected from various localities of Karnataka revealed the presence of relatively 24 genera under 3 tribe *viz.*, Harpactorini Amyot and Serville, Raphidosomini Jennel and Tegeini Villiers. For the recorded genera, dichotomous identification keys, diagnostic characters and illustrations of the genus habitats were provided to facilitate the easy identification.

Keywords: Harpactorinae, Karnataka, Diagnosis and Keys

1. Introduction
Harpactorinae Reuter, 1887 are the largest subfamily in the Famiy Reduviidae with 2,800 described extant species in ~320 genera with diverse body shape, size and colour [1]. They are characterized by elongated head, long scape, cylindrical postocular and quadrate cell formed by anterior and posterior cross vein between Cu and Pcu on hemelytron. Harpactorinae are economically important as beneficial predators of insect pests. The prey consumption ranges from stenophagy (specialists) to euryphagy (generalists). More than 150 species of assassin bugs are predators of insect pests and several species are used as natural enemies in agricultural ecosystem. A few species of Harpactorinae are successfully utilised in integrated pest management system include *Pristhesancus plagipennis* Walker against cotton and soybean [2], *Zelus longipes* L. against *Spodoptera frugiperda* (J.E. Smith) [3], *Endochus albomaculatus* Stål, *Epidaus bicolor* Distant, *Euagoras plagiatus* Burmeister, *Irantha armipes* Stål, *Panthous bimaculatus* Distant and *Sphedanolestes signatus* Distant against tea mosquito bugs (*Helopeltis* Spp.) in Cashew [4]. A few typical characteristic features like venomous saliva, morphological adaptation of their fore legs, ecological diversity, range of prey consumption from generalists to specialists, consuming the prey larger than their body size and diverse prey capturing strategy makes them a potential candidate in biological control. But the biological potential of reduviids has not been investigated under field situation and large scale release studies are marginal. Despite of their good biocontrol potential, these bugs are unexploited for pest management, because of poor taxonomy and other fundamental works which is creating gaps in their utilization.
Harpactorinae was first recognized by Amyot and Serville [5]. Six tribes have been recognized by Schuh and Slater [6], mainly based on the treatment of Davis [7] namely, Diaspidiini, Ectinoderini, Apiomerini, Harpactorini, Rhaphidosomini and Tegeini which are poorly used. In India, most of the works were done by Livingstone, Ravichandran, Murugan and Ambrose. Ambrose [8] listed 156 species under 41 genera from India. But, most the genera have never been properly illustrated or described only with line drawings only. Therefore in this paper, attempt have been made to provided clear diagnostic characters along with keys for clear identification of the genera which are known to occur in Karnataka.

2. Materials and Methods
2.1. Collection techniques
Reduviids occur in a variety of habitats depending on the occurrence of their prey, therefore, diverse methods were followed for their collection. Generally, field collections were done by sweeping on various vegetation using an insect net and few species that are specifically adopted to dwell on tree trunks, under bark, between cracks and crevices, under large boulders

and leaf litter were also carefully searched and picked by foreceps when found. Since a few bugs are attracted to light, collections were also made at light and from light traps. In addition to field collection, rich collections of Reduviidae present in the insect repository of the Department of Agricultural Entomology, University of Agricultural Sciences, GKVK, Bengaluru (UASB), were extensively used for the study.

2.2. Identification of specimen

Identification of genera were made using the various available literature especially the Distant's Rhynchota volumes in the Fauna of British India Series [9, 10]. After identification, illustrations of dorsal habitus of small genera were made using Leica M205A stereomicroscope with DFC 420 camera attachment and by using the software Auto montage®. .Habitus images of larger specimens measuring more than 1 cm were taken with Nikon camera fitted with SLR lense. Davis [7] terminologies were used in description.

3. Results and discussion

In Karnataka, 3 tribes and 26 genera were recorded, the Taxonomic studies pertaining to various genera are briefly presented under respective tribes.

3.1 List of genera know to occur in Subfamily Harpactorinae Reuter, 1887

Tribe Harpactorini Amyot and Serville, 1843

Genus *Brassivola* Distant, 1904
Genus *Coranus* Curtis, 1833
Genus *Cydnocoris* Stål, 1866
Genus *Endochus* Stål, 1859
Genus *Epidaus* Stål, 1859
Genus *Euagorus* Burmeister, 1853
Genus *Henricohahnia* Breddin, 1900
Genus *Irantha* Stål, 1861
Genus *Isyndus* Stål, 1858
Genus *Lanca* Distant, 1906
Genus *Macracanthopsis* Reuter, 1881
Genus *Occamus* Distant, 1909
Genus *Panthous* Stål, 1863
Genus *Platerus* Distant, 1903
Genus *Poldidus* Stål, 1858
Genus *Rhynocoris* Kolenati, 1857
Genus *Rihirbus* Stål, 1861
Genus *Scipinia* Stål 1861
Genus *Serendiba* Distant, 1906
Genus *Sphedanolestes* Stål, 1866
Genus *Sycanus* Amyot and Serville, 1843
Genus *Vesbius* Stål, 1865

Tribe Raphidosomini Jennel, 1919

Genus *Rhaphidosoma* Amyot and Serville, 1843

Tribe Tegeini Villiers, 1948

Genus *Lopocephala* Laporte, 1833

Key to the tribes and genera of the subfamily Harpactorinae

1. Labial segment straight and uniformly thick..... 2
-Labial segment distinctly curved and tapering from base to apex..…….**Harpactorini**…….....… 3
2. Body and legs long and very slender, usually without glandular setae; wingless.....……**Rhaphidosomini**…..…..***Rhaphidosoma*** **Amyot and Serville** - Body more robust, with numerous glandular setae; winged form.....……..…**Tegeini**…….…..***Lophocephala*** **Laporte**
3. Head with anteocular and postocular area subequal in length .....…… 4
-Head with postocular longer than anteocular area ……....…..... 5
4. Posterior lobe of pronotum neither longitudinally impressed nor elevated.....……..……..***Rhynocoris*** **Kolenati**
-Posterior lobe of pronotum either longitudinally impressed or elevated.....…..…….. ***Sphedanolestes*** **Stål**
5. Pronotum with posterior dilation covering scutellum and base of corium....***Panthous*** **Stål** - Pronotum without posterior dilation covering scutellum and base of corium…… 6
6. Head armed with spines or tubercles at antennal base .....……..…… 7
- Head without spines or tubercles at antennal base 18
7. Anterior tibia incurved and spined before apex .....…… ***Rihirbus*** **Stål** - Anterior tibia simple not inwardly spined before apex .....……..…… 8
8. Anterior lobe of pronotum prominently tuberculate on each side .....…….. ***Isyndus*** **Stål**
- Anterior lobe of pronotum not prominently tuberculate with spines on each side .....… 9
9. Posterior lobe of pronotum discally unarmed .....……...…… 10
- Posterior lobe of pronotum discally armed .....……..…… 14
10. First segment of labium shorter than second .....…..... 11
-First segment of labium longer than second .....…….....……. 12
11. Antennal base tuberculated behind; posterior pronotal lobe armed with long spine laterally…….....…… ***Euagorus*** **Burmeister** -Antennal base spined behind; posterior pronotal lobe unarmed laterally.....……..... ***Macracanthopsis*** **Reuter**
12. Head shorter than pronotum .....…….…… 13
-Head as long as pronotum .....***Endochus*** **Stål**
13. Head with anteocular and postocular area about equal in length; lateral pronotal angle not spinously produced …….....…….…..... ***Cydnocoris*** **Stål**
- Head with postocular area about half as long as anteocular area; lateral pronotal angle spinously produced..... …….…… ***Serendiba*** **Distant**
14. Pronotum with anterior lobe armed discally .....…… ***Brassivola*** **Distant**
- Pronotum with anterior lobe unarmed discally, but posterior lobe discally spinned 15
15. Head as long as pronotum…….. …… 16
- Head distinctly shorter than pronotum...…….…….……...…. 17
16. Postocular area little longer than anteocular area; hemelytra passing abdominal apex ……..... ***Platerus*** **Distant**
- Postocular area much longer than anteocular area; hemelytra not passing abdominal apex.....…… …….....…… ***Lanca*** **Distant**
17. Scutellum with suberect spine .....***Occamus*** **Distant**

- Scutellum without suberect spine……..…… ***Epidaus* Stål**

18. Head distinctly longer than pronotum; anterior lobe of pronotum posteriorly impressed ..... …… ***Sycanus* Amyot and Serville**

-Head and pronotum almost subequal; anterior lobe of pronotum completely impressed.....……....19

19. Head with postocular three times longer than anteocular; eyes inserted at apex .....…… …….…… ***Vesbius* Stål**

- Head with postocular 1.5 times longer than anteocular; eyes inserted in middle (Fig.57K) …… 20

20. Scutellum with longitudinal carination body not spinoce .....***Coranus* Curtis**

- Scutellum without longitudinal carination, body spinoce..... 21

21. Head with central lobe not spinously produced …….....***Henricohahnia* Breddin**

- Head with central lobe longly spinously produced .....……..……...……. 22

22. First and second joint of labium distinctly subequal in length ….....…...***Scipinia* Stål**

- First joint of labium longer than second .....……..……..… **27**

23. Head with postocular nearly 1.5 times longer than anteocular; only anterior femur spined …….....…….....***Irantha* Stål**

-Head with postocular either equal or slightly longer than anteocular; all femora spined .....***Polididus* Stål**

Diagnosis for the tribe and genera of the subfamily Harpactorinae

Tribe Harpactorini Amyot and Serville, 1843

Diagnosis: Head cylindrical; ocelli small, dorsally placed; antennae long, scape longer than head, sometimes subequal to head, pronotum and scutellum together; labium curved; struts short, attached to dorsal phallothecal sclerites; paramere simple, tubular, slightly curved, sometimes coiled; endosoma membranous armed with spines and denticles.

Genus *Brassivola* Distant, 1904

Diagnosis: Head elongated, shorter than pronotum, antennal base armed with long and erect spine; scape subequal in length to anterior femora; pronotum with anterior lobe discally armed and anteriorly laterally tuberculate, posterior lobe both discally and laterally armed with spine; abdominal segments gibbous and curved upward; median pygophore process round; bursa laterally dilated (Fig. 1).

Genus *Coranus* Curtis, 1833

Diagnosis: Generally dull brown coloured insects; body oblong and robust; scape and head subequal in length; pronotum with anterior lobe strongly impressed at middle, antero-lateral angles unarmed, constricted before middle; scutellum with longitudinal carinae, sometimes produced into suberect spine; legs short and stout, anterior femora incrassated; connexivum moderately developed; dorsal phallothecal sclerites laterally sclerotized (Fig. 2).

Remarks: The genus *Coranus* is poorly described group, in need of revision from Indian region. It can be easily recognized by dull brown coloured body, small size and by the carinated scutellum.

Genus *Cydnocoris* Stål, 1866

Diagnosis: Red; head tumid, armed with spines at antennal base, shorter than pronotum, anteocular and postocular subequal; eyes prominent; pronotum constricted before middle, anterior lobe medially impressed, humeral angles unarmed, ampliated; foretibial spur well developed; bursa elongated, laterally undilated, oval in shape; subrectal glands short and swollen, placed at the apex of bursa (Fig. 3).

Genus *Endochus* Stål, 1859

Diagnosis: Head cylindrical, subequal in length to pronotum, antennal base armed with spines; postocular longer than anteocular; scape long sometimes twice longer than pronotum; labial segment II longer than III, subequal to III and IV combined together; pronotum with anterior lobe medially impressed, humeral angles spinously produced; abdomen slightly exposed beyond hemelytra (Fig. 4).

Genus *Epidaus* Stål 1859

Diagnosis: Head shorter than pronotum, antennal base armed with tubercles; postocular nearly twice longer than anteocular; antennae long, scape subequal in length to posterior femora; labial segment II shorter than III and IV together; posterior pronotal pronotal lobe with discal as well as humeral spine (Fig. 5).

Genus *Euagorus* Burmeister, 1853

Diagnosis: Body elongated; head cylindrical, as long as pronotum, base of antennae armed with tubercles; postocular little longer than anteocular; labial segment II longer than III; pronotum with anterior lobe medially impressed, posterior pronotal lobe laterally armed with long spines; legs long and slender (Fig. 6).

Genus *Euagorus* Burmeister, 1853

Diagnosis: Body elongated; head cylindrical, as long as pronotum, base of antennae armed with tubercles; postocular little longer than anteocular; labial segment II longer than III; pronotum with anterior lobe medially impressed, posterior pronotal lobe laterally armed with long spines; legs long and slender (Fig. 5).

Remarks: This genus resembles males of *Endochus inornatus* Stål by size and coloration, but can be easily distinguished by the longer and porrect humeral spine and the labial segment III is longer than II.

Genus *Henricohahnia* Breddin, 1900

Diagnosis: Body oblong to ovate, quite bizarre shaped; head elongated, clypeus spinously anteriorly produced; postocular longer than anteocular; scape short, tuberculate, as long as postocular region of head; femora granulose and spinous; internal cell of membrane 2/3rd long and 1/3rd wider than external cell, corium with triangular cell in addition to discal cell; endosoma membranous and lobate (Fig. 7).

Remarks: Most of the species of this genus are endemic to Indian subcontinent. This genus is unique in the subfamily Harpactorinae in having bizarre shaped and dorsoventrally depressed body, straight labium and anteriorly projected clypeus. Tribal level placement of this genus is still in question, presently it is placed in the tribe Harpactorini.

Genus *Irantha* Stål, 1861

Diagnosis: Body tuberculate and longley spinous; segment II

of labium passing the anterior margin of eyes; posterior pronotal lobe sculptured with hexagonal cells; forefemora incrassated, nodulous with 4-5 whorls of spines; foretibia ventrally with a longitudinal series of denticulate process on either side; pygophore elongated, median pygophore process triangularly produced; paramere absent (Fig. 8).

Genus *Isyndus* Stål, 1858

Diagnosis: Large; bright reddish patterned; head shorter than pronotum; scape subequal in length to anterior femora and to anterior tibia; base of antennae armed with prominent tubercle; anterior margins of pronotum armed with prominent tubercle, posterior lobe with humeral angles spinously produced; bursa laterally dilated, anterior projections of gonapophysis VIII, long medially sinuate, highly sclerotized, reaching ¾th of bursa; endosoma membranous medially with two coiled strings (Fig. 9).

Genus *Lanca* Distant, 1906

Diagnosis: Body narrow, elongated; head as long as pronotum, armed with short tuberculate spine at antennal base, postocular much longer than anteocular, attenuated towards base; pronotum with anterior lobe much shorter than posterior lobe, armed with two moderately long, erect discal and two long slender, porrect humeral spine (Fig. 10).

Genus *Macracanthopsis* Reuter, 1881

Diagnosis: Small, golden yellow, shining bugs with long legs and antennae; head cylindrical, as long as pronotum, scape very long, subequal in length to head pronotum and scutellum combined together, basally armed with laterally directed spines; anteocular distinctly shorter than postocular; paramere rugose, straight and cylindrical (Fig. 11).

Remarks: This genus resembles males of *Euagorus* Burmeister in size and structure, but can be easily distinguished by the shining body, by the presence of spines beyond by the base of antennae and rounded humeral margins.

Genus *Occamus* Distant, 1909

Diagnosis: Head as long as pronotum, armed with short tuberculous spine behind antennal base, anteocular much shorter than postocular; scape long subequal to anterior femora; labial segment II passing the eyes, subequal in length to segment III; posterior pronotal lobe armed with discal and humeral spine; scutellum slightly elongated, armed with two spines, one near base almost straight, other at apex strongly curved; abdomen elongated, subbasally slender, slightly widen at apex (Fig. 12).

Remarks: This is a monotypic genus, endemic to Indian subcontinent, resemble *Lanca* Distant in general appearance, size and colour but can be easily distinguished by two erect spines on scutellum and head shorter than pronotum.

Genus *Panthous* Stål, 1863

Diagnosis: Large sized and robust bodied; head oblong and unarmed; pronotum posteriorly dilated, covering the scutellum and base of corium, 1.5 times broader than hemelytra, anterior lobe nearly five times shorter than posterior, medially longitudinally impressed; paramere reduced; pygophore round and poorly sclerotized; endosoma membranous, medially denticulate (Fig. 13).

Genus *Platerus* Distant, 1903

Diagnosis: Medium sized with long and slender appendages; head as long as pronotum, armed with an oblique, erect, slender spine at antennal base, postocular longer and slender than anteocular; pronotum subtriangular, posterior lobe discally tuberculate and humerally spinous; abdomen long, strongly exposed beyond hemelytra (Fig. 14).

Genus *Polididus* Stål, 1858

Diagnosis: Body elongated and thorny; bark colored; head, pronotum, scutellum, femora, connexival margins and apex of abdomen armed with long and erect spines; postocular little longer than anteocular, marginally rounded; hemelytra fully covering the abdomen, membrane narrow and elongated; spiracles placed on raised tubercle, dorsally visible; paramere reduced; median pygophore process round; endosoma apically spinous (Fig. 15).

Genus *Rhynocoris* Kolenati, 1857

Diagnosis: body oblong or subelongated; anteocular and postocular subequal in length; pronotum constricted before middle, discally and humerally unarmed; labium II shorter than remaining segments; anterior extension of gonapophysis VII broad, sinuate at middle, occupiying ¾ th region of triangular bursa; paramere tubular; endosoma indistinct sclerotized and apically with membranous round lobes (Fig. 16).

Remarks: This genus is very distinct among other genus of Harpactorinae by the absence of elongated body, long and slender appendages and size, it closely resembles the species of subfamily Reduvinae by the robust body and the short appendages but can be easily distinguished by the hexagonal cell and the large and slender scape.

Genus *Rihirbus* Stål, 1861

Diagnosis: Medium to large sized bugs; head distinctly shorter than pronotum, with a spine behind base of each antenna; scape almost as long as or slightly shorter than head, pronotum and scutellum together; labial segment II little longer than or as long two segments combined together; anterior pronotal lobe much shorter and narrower than posterior lobe, lateral angeles of posterior lobe sharp or rounded; apex of anterior tibia incurved and armed with a long tooth (Fig. 17a and 17b).

Remarks: This genus is endemic to oriental region and shows sexual dimorphism in colour pattern but can be easily diagnosed by the incurved foretibial at apex.

Genus *Scipinia* Stål 1861

Diagnosis: Body subelongate; head subqual in length to first antennal segment, armed with 2 series of spines; labial segments II and III subequal; anterior lobe of pronotum with 4 long and numerous short spines, posterior lobe hexagonally reticulated, humeral angles suberect; forefemur incrassated, nodulous, subequal in length to tibia; scutellum foveate; pygophore spouted and produced apically; paramere, subrectal and vermiform glands absent (Fig. 18).

Genus *Serendiba* Distant 1906

Diagnosis: Orange colored; medium sized and elongated bodied; head oval, shorter than pronotum, armed with short tuberculate spines behind antennal base, postocular twice longer than anteocular; scape slender as long as posterior

femora; humeral angles with long porrect spine; 3/4th of hemelytra passing beyond abdominal apex (Fig. 19).

Genus *Sphedanolestes* Stål, 1866

Diagnosis: Body oblong; head long, elliptic and unarmed; pronotum unarmed, lateral and posterior angles round, median longitudinal sulcus of anterior lobe subequal to ½ of posterior lobe in length; subapical part of femora nodulose; phallus with lateral phallothecal sclerites along with dorsal pallothecal sclerite (Fig. 20).

Remarks: This is the largest genera in the subfamily Harpactorinae, with 174 known species in the world (Maldonado, 1990) and 21 species in India, members of this genus are widely distributed in the Eastern Hemisphere (Zhao *et al.* 2015). It resembles *Biasticus* Stål in structure and general appearance but can be easily diagnosed by the median longitudinal sulcus of anterior pronotal lobe.

Genus *Sycanus* Amyot and Serville, 1843

Diagnosis: Body elongate and ovate; head long and slender, as long as pronotum and scutellum combined together; postocular nearly twice longer than anteocular, cylindrical; anterior pronotal lobe twice shorter than posterior, medially sulcate, posterior lobe rugose and granulate; scutellum armed with long erect spine sometimes bifid; subrectal glands well developed, shrivelled, long reaching tip of bursa; gonoplac fused at apex and well sclerotized; paramere apically swollen; pygophore ovate, median pygophore process longly spinously produced along with 1+1 basal lobes (Fig. 21).

Remarks: This genus is quite distinct among the tribe Harpactorini by having the long and slender head and the appendages, postocular nearly twice longer than the anteocular, spinous nature of the endosoma and by the apically swollen paramere.

Genus *Vesbius* Stål, 1865

Diagnosis: Small sized, oblong, shining, reddish bodied insects; head with postocular three times longer than anteocular and eyes inserted at the apex of head; II and III labial segment subequal in length; 1/4th of membrane passing abdominal apex (Fig. 22).

Tribe *Rhaphidosomini* Jennel, 1919

Diagnosis: Body and appendages long and slender; head cylindrical, eyes small; labium straight, long and slender; edge of forecoxal cavities not visible from above, usually closed; styloids fused into single rim like plate; paramere reduced.

Genus *Rhaphidosoma* Amyot and Serville, 1843

Diagnosis: Body linear, very elongated, apterous; head elongated, cylindrical, its apex shortly and porrect; eyes small; ocelli absent; labium slender, I and III joint short, III more than five times larger than I; antennae shorter than body, scape longer than head; anterior and posterior lobe of pronotum indistinct (Fig. 23).

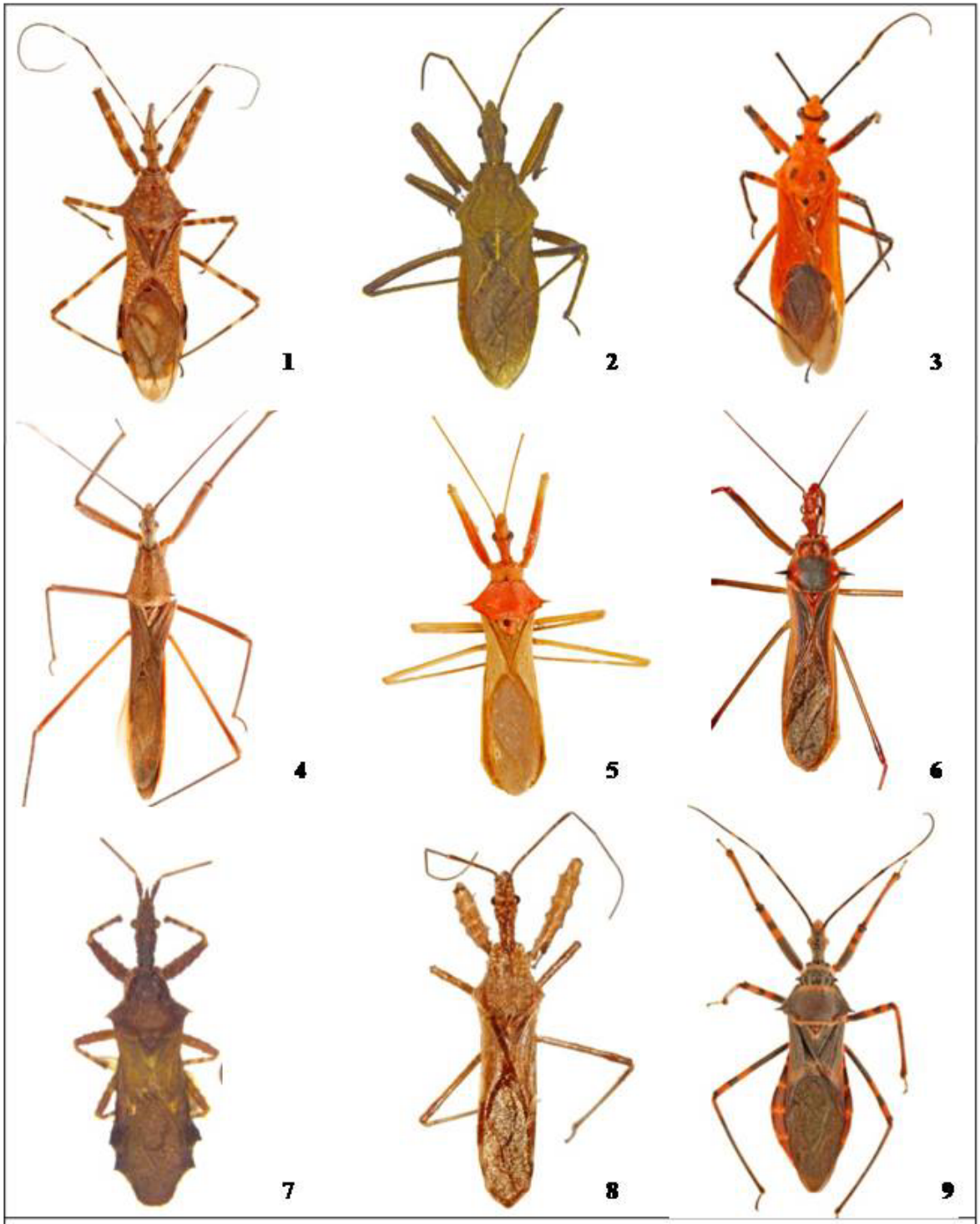
Tribe Tegeini Villiers, 1948

Diagnosis: Body covered with dense glandular setae; postocular region of head subhemispherical, ocelli widely separated, placed dorsolaterally; labium long, straight and slender, segmentation obscured between segment III and IV, segment III many times longer than IV; subrectal glands absent and gonoplac V-shaped; parameres absent.

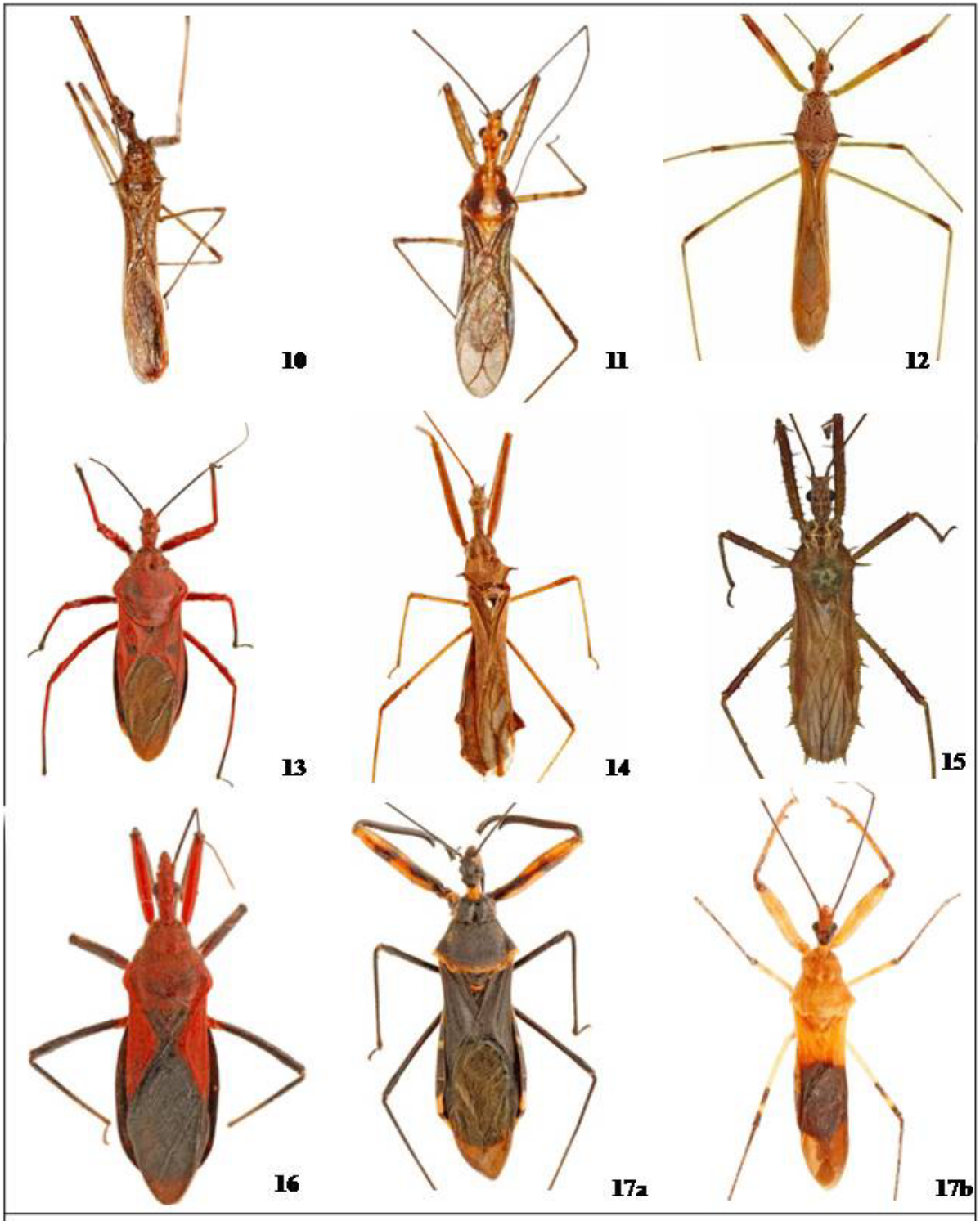
Genus *Lopocephala* Laporte, 1833

Diagnosis: Bright red coloured, medium sized insects; head anteriorly porrect, eyes inserted exactly at mid of anteocular; labium straight with indistinct segmentation, segment III more than five times longer than IV; subrectal glands are absent; dorsal phallothecal Y shaped (Fig. 24).

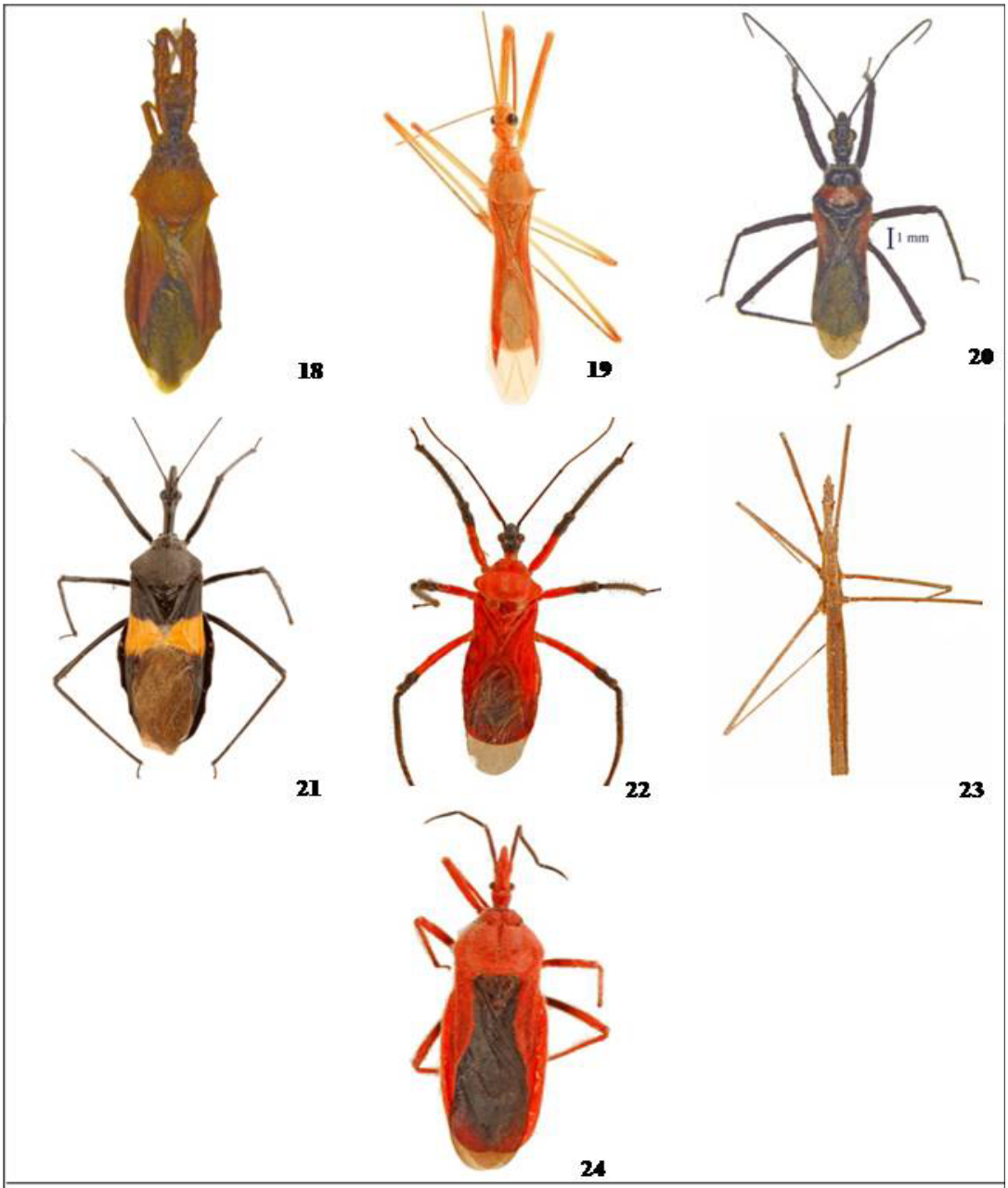
Remrks: This genus resembles *Rhynocoris* in external structure, size and colour, but can be easily distinguished by the porrect head, subglobous postocular, straight and the long labium, by the presence of glandular setae and the absence of subrectal glands on bursa copulatrix.



Habitus of 1. *Brassoiwola hystrix* Distant; 2. *Coranus carinata* Livingstone and Ravichandran; 3. *Cydnocoris gilvus* (Burmeister); 4. *Endochus parvispinus* Distant; 5. *Epidanus bicolor* Distant; 6. *Euagoras plagiatus* (Burmester); 7. *Henricohahnia gallus* (Distant); 8. *Irantha armipes* (Stål) and 9. *Isyndus heros heros* (Fabricius)



Habitus of 10. *Lanca kandyensis* Distant; 1. *Macrocanthopsis hampsoni* Distant; 12. *Occamus typicus* Distant; 13. *Panthous bimaculatus* Distant; 14. *Polididus armatissimus* Stål; 15. *Rhynocoris marginatus* (Fabricius) and 16. *Rihirbus trochantericus* Stål (female); 17. *Rihirbus trochantericus* Stål (male) and 18. *Scipinia horrida* (Stål)



Habitus of 19. *Serendiba pandelusoyus* Distant; 20. *Sphedanolestes stigmatellus* Distant; 21. *Sycanus galbanus* Distant; 22. *Vesbius sanguinosus* Stål ; 23. *Rhaphidosoma atkinsoni* Bergroth and 24. *Lopocephala guerni* Laporte

4. Conclusion

All the recorded genera from Karnataka, to be more specific, including India, were poorly described or described just with line diagram creating difficulties in identification. The line diagram and descriptions given by previous workers were inadequate. So the keys, diagnostic characters and habitus images were provided to facilitate identification.

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