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Rediscovery of *Cylindrepomus filiformis* Breuning, 1938 (Cerambycidae: Lamiinae: Dorcaschematini) from the Andaman Islands, India

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ABSTRACT: *Cylindrepomus filiformis* Breuning, 1938 (Cerambycidae: Lamiinae: Dorcaschematini) has been rediscovered from south Andamans, India, after nearly eight decades. Redescription and digital illustrations of the species, along with notes on natural history, are provided. *Ficus hederacea* Roxb. (Moraceae), which was found with large numbers of these beetles, is a probable host plant of *C. filiformis*.

KEYWORDS : Cerambycidae, Lamiinae, Dorcaschematini, *Cylindrepomus filiformis, Ficus hederacea*

INTRODUCTION

The genus *Cylindrepomus* comprises 44 species, mostly distributed in the Indo-Malayan subregion of the Oriental Region (according to the unpublished internet list on Animal Diversity Web, University of Michigan, by Myers *et al*., accessed on May 4, 2015). The genus included two species described earlier from the Andaman and Nicobar Islands, namely *C. andamanicus* Gardner, 1930 and *C. filiformis* Breuning, 1938. Now, *C. andamanicus* has been transferred to the genus *Macrocamptus* Dillon & Dillon (Dillon and Dillon, 1947).

The Tribe Dorcaschematini Thomson, to which the genus *Cylindrepomus* Blanchard, 1853, belongs, was first revised by Breuning (1940). In that paper, Breuning included 25 species. Dillon & Dillon (1948) subsequently revised the tribe again and included 23 *Cylindrepomus* species (some species listed by Breuning were transferred to other genera and some were described as new). A few species have since been added, e.g. Hüdepohl (1989) and Vitali (2000) described one new species each. Hüdepohl (1987), while describing three new species

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of the genus, and providing key to the 14 species present in the Philippines, mentioned the list published by Breuning in 1947 (not seen in original). However, an authentic list or revision of all *Cylindrepomus* is not yet published since then. Breuning (1940) and Dillon & Dillon (1948) have given characters of the genus and keys to the known species. Our specimen was identified with these keys and characters, as *Cylindrepomus filiformis* Breuning.

Cylindrepomus filiformis is known only from the holotype so far and no further information is available since its original description and that given by Breuning and Dillon & Dillon cited above. Adults of *C. filiformis* were collected on *Ficus hederacea* Roxb. (Moraceae) from the campus of the Central Island Agricultural Institute, Port Blair, South Andamans (N 11° 50 06.43 E 93° 022 35.29, during July 2014. The species is redescribed and illustrated here, with notes on its biology. *Ficus hederacea* (synonyms: *Ficus scandens* Roxb., *F. anabatos* Voigt, *F. cantoniensis* Bodinier ex Levl., *F. fruticosa* Roxb., *F. longipes* Griff., and *F. ludens* Wall.) is a woody creeping strangler distributed in north India, Myanmar, south China, Tonkin, Laos, Annam, north Thailand and the Andaman Islands (Corner, 1965) (Figs 1, 2). Insect pests of *Ficus* in India and the adjacent countries were documented by Mathur and Singh (1959). Large number of insect pests belonging to all major phytophagous families infest members of the genus *Ficus*. However, *Stromatium barbatum* (Fabricius, 1775), whose larvae bore into the dry wood, is the only pest recorded on *F. hederacea* (under the name *F. scandens*).

MATERIAL AND METHODS

***Cylindrepomus filiformis* Breuning, 1938: 225; 1940: 533; Dillon and Dillon 1948: 276**

Eight adults collected from 4 to 7th July 2014 (deposition: 4 NBAII, 2 CIARI, 2 HVG). The specimens are deposited in the National Bureau of Agricultural Insect Resources, Bangalore (NBAIR), Central Island Agricultural Research Institute, Port Blair (CIARI) and the personal collection of the first author (HVG).

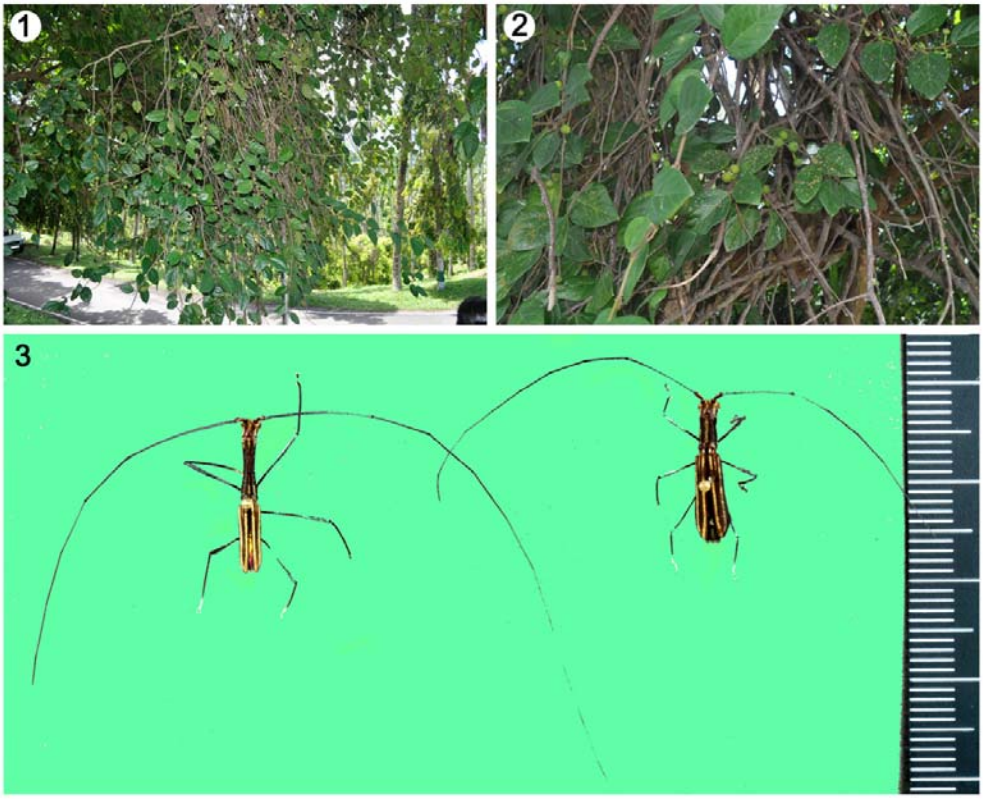
The insects were photographed on Canon Digital SLR with macro lens while details of various parts were photographed under Leica MZ6 with Canon PowerShot S50. Several images were taken at different focus and stacked with Combine ZM software. Images were further processed in Photoshop. For SEM, elytra were thoroughly washed with absolute alcohol and dried before mounting on SEM stub with carbon tape and were sputter-coated with platinum (at thickness of about 10nm). Specimens were scanned and photographed using Analytical SEM (JEOL JSM - 6360 A).

RESULTS AND DISCUSSION

Redescription

Male:

Medium sized, about 14.5 mm long between vertex and tip of elytra, very narrow, elongate with



Figs. 1 & 2. Host plant, *Ficus hederacea,* of the cerambycid beetle *Cylindrepomus filiformis*

Fig. 3. Male (left) and female (right) showing relative difference in the length of pronotum, legs antennae and also elytral breadth. Note extremely thin antennae.

very thin antennae. Dorsal side with head pale brown, pronotum and elytra dark brown or almost black, with longitudinal stripes of short and thick scale-like, yellowish white setae on the dorsal surface of head, pronotum and elytra, and fine thin white short or long setae laterally on head, prothorax and antennae; ventrally blackish. Legs dorsally with sparse white setae and abdomen ventrally with similar setae (see Fig. 3).

Head: Pale brown with reddish tint. More or less rectangular as seen from dorsal side; vertex elongate behind eyes, slightly compressed laterally in middle; front of head flat, at right angles to vertex; antennal tubercles prominently raised with prominent inner angle, area in between grooved longitudinally, a thin sulcus continues from this groove and extends along entire length of vertex right up to anterior border of prothorax. Antennae very thin, hair-like, except for scape which is swollen, pyriform and without cicatrix; scape slightly convex dorsally and covered with spiny short tubercles (asperate), ventral surface slightly concave; third

Fig. 4. Close up of head in dorsal view. Note elongate portion of head behind eyes and dorsally convex, asperate, scape. Yellowish white bands formed by flat setae are prominent.

Fig. 5. Head in front view. Asperate nature of the scape, coarsely facetted eyes and the shape of frons is visible.

Fig. 6. Flask like elongate pronotum of male. Note complete surface (except some part at the base) covered by rings and bands of whitish setae.

Fig. 7. Ventral view of female showing pro-meso and metasternum. Also note sparse, short whitish setae on glossy black body.

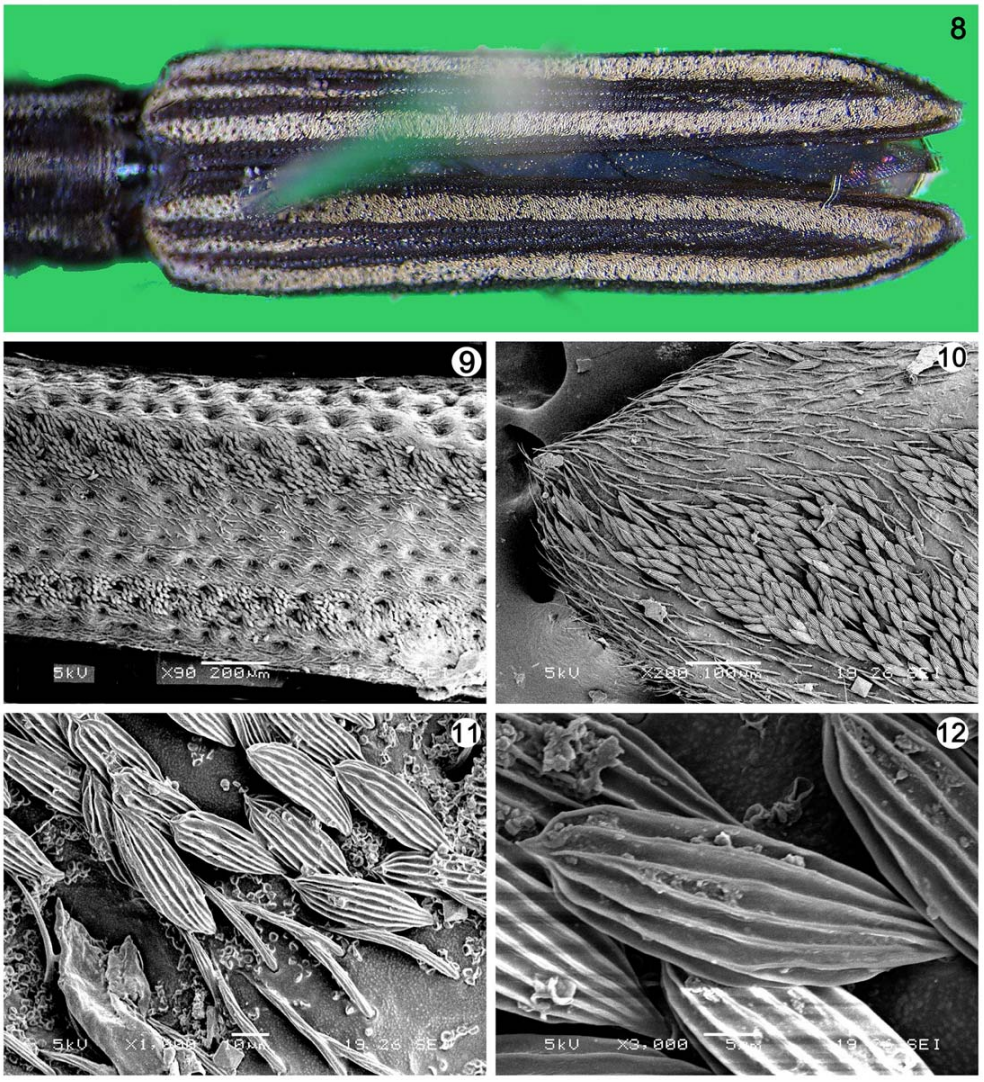


Fig. 8. Dorsal view of elytra : note relative breadth and length as well as broad bands of whitish, flat setae.

Fig. 9. SEM image of elytron showing setae and punctures

Figs. 10 – 12. SEM images of different magnification to show two types of setae on elytra; note scale like setae with 6-7 ribs

Fig. 13. Male genitalia median lobe (on left) and tegmen (on right).
Fig. 14. Male genitalia: median lobe in lateral view
Fig. 15. Male genitalia: details of inner sac within median lobe in transmitted light.

antennomere very long, almost 11 times longer than scape and with many fine spinules, remaining antennomeres with sparse spinules. Eyes moderately large, coarsely facetted, deeply emarginate, lower lobe very large, transverse and connected to small upper lobe by a thin bridge; each eye surrounded by a broad band of yellowish white setae except for a small area near innermost edge. Vertex finely punctured, with fine short greyish setae and five longitudinal stripes of yellowish white, short and thick setae, three of them visible on disc from above: one median and one at either side; median stripe with sparse setae and divided in two behind middle, hence appearing as an inverted Y. A narrow transverse strip at base of vertex devoid of pubescence, smooth. Lateral stripes also with sparse setae and not of full length (Fig. 4).

Frons slightly broader than long, with a distinct median carina along entire length, finely punctate, sparsely covered with yellowish pubescence, which is denser at sides, near eyes, and at base. Clypeus pale, translucent, labrum partly dark partly pale brown, with long and short setae; mandibles black with coarse punctures at base; palps pale brown, partly setose; lateral part with short, thick setae; gular area smooth and shining without any punctures (Fig. 5).

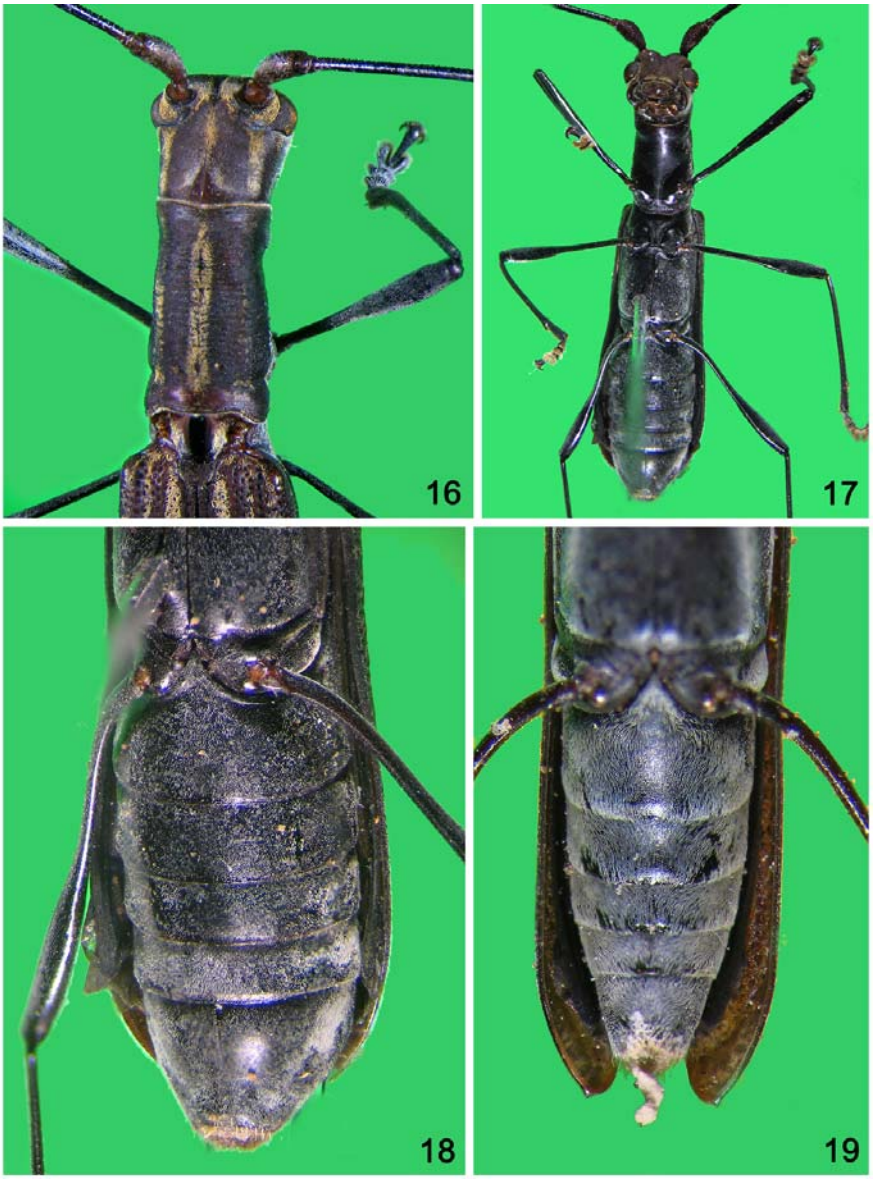


Fig. 16. Dorsal view of female head and prothorax, note short prothorax and bands of setae.
Fig. 17. Ventral view of female, note pedunculate legs.
Fig. 18. Ventral view of female abdomen enlarged to show sternites of more or less similar breadth.
Fig. 19. Ventral view of male abdomen showing narrowing sternites and relatively dense cover of short, thin, white setae.

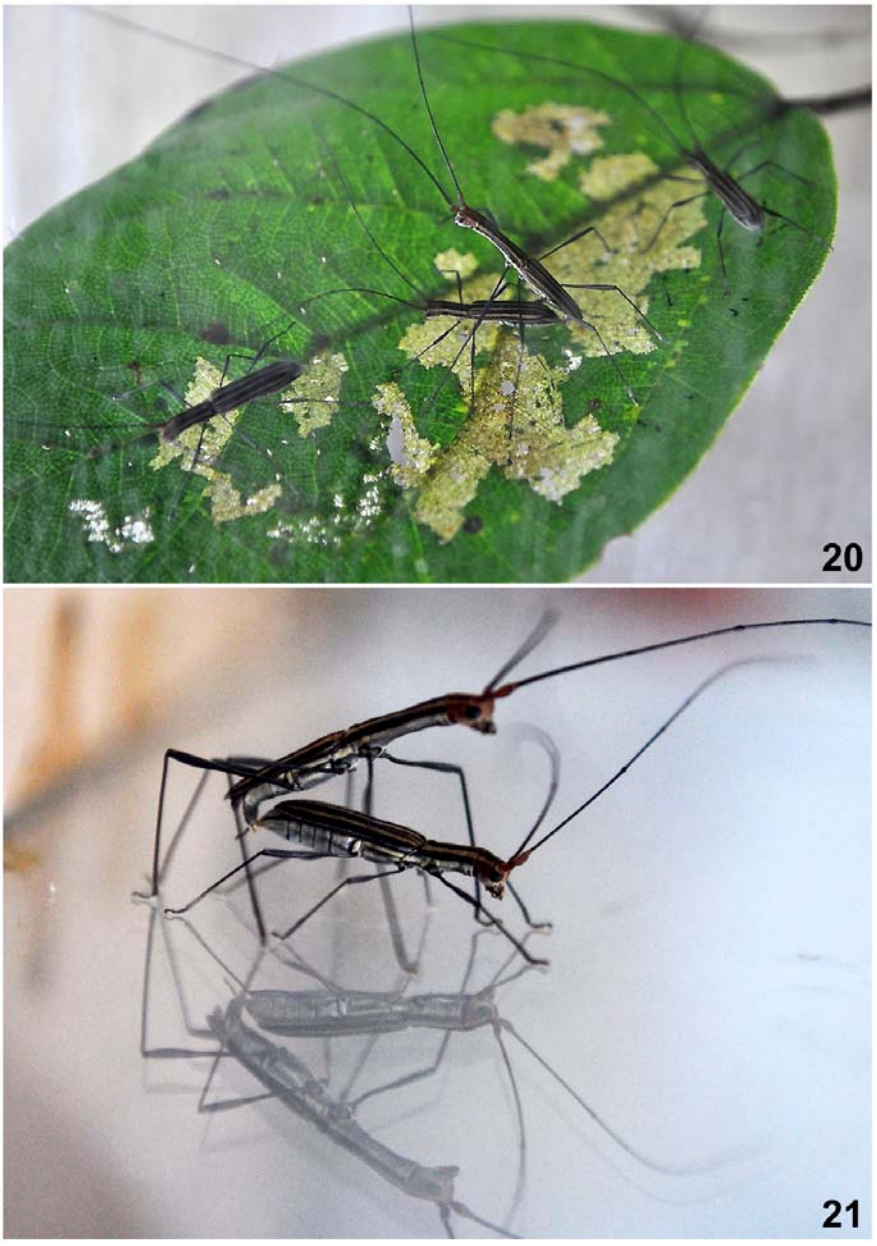


Fig. 20. Live beetles aggregating for feeding and mating on leaf, note also feeding pattern.
Fig. 21. Mating pair

Thorax: Pronotum very long, slightly more than three and half times as long as maximum breadth at base, almost cylindrical with moderate narrowing laterally near middle region and some dilation near anterior and posterior borders, darker than head. Entire length of pronotum with thin, complete rings or grooves except for a small area near base, finely punctate with a few setae. Three longitudinal stripes of short, thick, yellowish setae on disc and two at side, all interrupted at places, median row on disc divided in two, slightly after anterior border, and then again united beyond middle (Fig. 6). Both anterior and posterior borders with fringe of setae. A lateroventral stripe of pubescence on each side, significantly interrupted at places, thick and strong at base, whence it is continued as a band on pro-, meso- and metepisterna. Prosternum sparsely punctured and with sparse setae. Prosternal process very narrow, not raised above level of procoxae, widening posterior to coxae; mesosternum depressed anterior to coxae then slightly raised as narrow tongue between mesocoxae, distinctly emarginate at apex; metasternum longer than broad, with an anterior process that meets distal tip of mesosternum. Ventral side of thorax covered with sparse, thin and short greyish setae (Fig. 7).

Elytra: Dark brown to almost black, slightly broader than prothorax at base, much longer (>3 times) than breadth at humerus, coarsely punctured, punctures arranged partly in rows, borders of punctures slightly raised; almost parallel-sided, except at apex, where there is a slight truncated lateral part ending in a small marginal spine. Each elytron with three stripes of thick short yellowish white scale-like setae, two of these stripes (one near suture and one lateral) are broader and complete, and one in between is very short, slightly narrow, only extending about one-fourth of length in basal region. Elytral punctures in some places are obscured under stripes; stripe near suture complete, straight up to apex; lateral stripe complete along entire length from shoulder downward and slightly turned inward, near truncated apical region, to meet near-suture stripe (Fig. 8). Elytron beyond this lateral stripe bent at right angles covering body partly on lateral side. A very thin line of scale-like flat setae present on lateral side at apex. Under Scanning Electron Microscope (SEM), the scale like setae and long thin setae can be seen to have a characteristic appearance. Each seta has longitudinal ribs but these ribs are especially prominent on flat scale like setae. Figs 9 to 12 show dorsal surface of elytra under SEM at different magnifications.

Legs: All legs black, very thin and long and sparsely covered with short thin white setae visible from above, shining black and devoid of setae on underside. Forelegs much longer than other two. Femora pedunculate, tibia slender and of uniform diameter, tarsi moderately long claws divaricate; hind femora just reaching elytral apex.

Abdomen: Five visible sternites, distinctly narrowed towards apex (only in male), especially terminal two segments; surface covered with sparse short white setae.

Male genitalia moderately sclerotized, brownish. Median lobe and tegmen are shown in separated condition (Fig. 13), median lobe is shown in lateral view (Fig. 14) and details of inner sac within median lobe are shown at higher magnification (Fig. 15).

Female:

Distinct sexual dimorphism evident: females have shorter antennae, shorter and broader pronotum (Fig. 16) and shorter legs (especially forelegs) than in males. Body proportions are different in male and female due to very long pronotum in male. In addition, males have slightly narrower and shorter elytra than in females. In full ventral view of female, it is possible to see pedunculate legs (Fig. 17) and finely setose abdominal sternites (Fig. 18), all more or less of same width except last. Compare this with male abdomen in which abdominal sternites are narrowed towards apex (Fig. 19).

Body proportions:

Male – Prothorax 3.3 times longer than head, female – 1.8 times longer than head;

Male – Prothorax about 4 times longer than maximum breadth near base, female—prothorax about 1.6 times longer than maximum breadth near base.

Male – Third antennomere 10.5 times longer than scape, in female — 6.4 times longer than scape.

According to Breuning (1940), this species is similar to *C. vittatus* (Pic, 1925), but it has only two longitudinal stripes on elytra and third antennomere is 12 times longer than scape; pronotum is four times longer than broad in both the species; besides, elytra are 'nearly' 4 times longer than broad at base in *C. vitattus* but 3.7 times longer than broad in *C. filiformis*; elytral apex is also different in these two species: it is much narrower and almost pointed in *C. vittatus* but it is slightly truncate laterally and with a marginal spine in *C. filiformis*. It is also similar to *C. rubriceps* (Aurivillius, 1907), as per description given in Breuning (1940), but *C. rubriceps* has pronotum nearly three times longer than broad in male and two time times longer than broad in female; also in *C. rubriceps*, third antennomere in male is 8 times longer than scape; in coloration also *C. rubriceps* has red head, and scape as well as base of elytra while in *C. filiformis*, there is only a reddish tinge on head and scape; both these species have three stripes or bands on elytral disc and a small one at the lateral side near apex of elytra. It may be noted here that Dillon and Dillon (1948) have treated *C. vittatus* as a junior synonym of *C. rubriceps*. The only other Indian species is *C. uniformis* Breuning, 1938; however, it has no bands but uniform coloration on elytra.

Biology: Adults of *C. filiformis* were found feeding on leaves of *Ficus hederacea,* Roxb. (Moraceae), a woody climber on *Crypteronia paniculata* Blume (Crypteroniaceae). Beetles settled themselves on mature green leaves of the climber in cool shady zones and actively fed on the leaf lamina by scraping the green matter, leaving out scorched areas, which subsequently dried up. Continuous adult feeding turned the foliar surface into brownish papery patches**.** The leaves gave a typical appearance visible even from a distance of about 4 m. The congregating beetles showed more preference for previously infested leaves rather than

fresh tender leaves and were found in groups of two (usually a male and a female) resting on a single leaf. A third member sometimes joined the group on the abaxial surface of the same leaf or on the next closest leaf. The beetles also had a typical habit of dropping down when they sensed an intruder. Once they fell over the dry leaves underneath the tree, they could not be located easily. However in a few seconds they were seen taking off an oblique flight from the ground and landing on some other nearby leaf of *F. hederacea*. They were weak fliers and could fly only for less than a metre.

A pair was collected on the plant on 4th July 2014. Adult population was exclusively confined to thickly shaded regions under the tree *C. paniculata,* where sunlight hardly fell. These beetles could also be noticed in the top-most canopy of *Ficus* leaves, well within the shade of the host tree. A closer observation revealed that an entire shoot of the climber had been killed and showed many circular holes at the tip, with drooping leaves. This indicates that *F. hederacea* is probably the host plant of *C. filiformis* and the grubs are most likely stem borers, as is the case with most cerambycids. Two to five adults were collected every day from 4 to 30th July, 2014. Living adults were light brown with longitudinal stripes. These thin delicate adults never attempted to bite even when held between fingers. The adult activity temporarily ceased from 21 to 24th July 2014. However, adults were again noticed for six more days since 25th July 2014. The adult activity for the year continued only till July 2014 and the beetles were never seen in the ensuing months.However, with the onset of rainfall on 16th April 2015, the climber was again checked for beetle activity. The first beetles of the season were noticed on 25th May 2015 after 14 rainy days. Five and seven beetles each were spotted on 25th and 26th May 2015 respectively. During heavy rains when the climber was checked, beetles could not be seen on any of the shoots accessible from the ground level and also up to a height of about 3 m. A brief observation on mating behaviour showed that mating ensued immediately after confinement of males with females. Frequent and multiple matings were observed under confinement. It was interesting to note that during mating, which lasted for about 30 minutes, the male intermittently released the female for about five seconds while still remaining mounted. This was observed in the case of two pairs. Also in confinement, it was very common to find a pair constituting a male and a female resting on a single leaf. A mating pair, along with two other beetles feeding on a leaf are shown here, also note feeding marks in the form of scraping (Fig. 20, 21).

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The medicinal annual legume *Senna (= Cassia) tora* (L.) Roxb. and its insect associations in Kerala, India

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ABSTRACT: Plant-animal interaction is an important biotic interaction of evolutionary significance in the tropics. Although we have a rich biodiversity, our knowledge of the natural history of species and their biotic interaction is poor. In this study, we highlight the insect community that interacts with an important medicinal herb, *Senna tora* in Kerala. We have studied the herbivorous insects of the plant and their parasitoids. Thirty four species of insects are identified as major herbivores of *S. tora*. The parasitoid community recorded comprises of 19 species. The caterpillar of *Eurema hecabe* was the most dominant herbivore of *S. tora* and it completes its entire life cycle on the plant. The results of the study indicate that *S. tora* is a potential plant to be used in habitat management for conservation biological control.

KEYWORDS: Herbivory, *Senna tora*, parasitoid insects, insect-plant interaction

INTRODUCTION

Plant-animal interaction is an important biotic interaction of evolutionary significance. Herbivory is an important interaction that can limit the recruitment of plants in different climatic zones and eco-regions. Herbivory by insects, however, lead to a fourth level trophic (biotic) interaction between the herbivorous insects and their natural enemies. Gathering the baseline information on animals associated with plants and their role in plant recruitment, although important, is less studied from Indian region; such information is particularly useful for the cultivation and propagation of plants of medicinal importance. Here we report our findings on the flower visitors, herbivorous insects, and their natural enemies of a common medicinal herb, *Senna* (=*Cassia) tora* (L.) Roxb. (Family Leguminosae) (The Plant List, 2013) with two broad objectives: 1) what is the diversity and associated roles of herbivorous insects

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on *S. tora*? and 2) how important the plant species is in maintaining the natural insect parasitoid diversity locally?

Senna tora L. is an important wild legume with food, forage and medicinal potential. Volatile oils extracted from the seeds of *S. tora* have a strong antioxidant activity, and they may be valued highly in the treatment of hyperlipidemia, hypertension, oculopathy and inflammatory disease (Zhang *et al.,* 2007a). The whole plant is used in ayurveda as medicine for several ailments that include skin infections and psoriasis. The roasted seeds of *S. tora* are often used as a substitute for coffee among some humans. It grows in dry soil throughout the tropical part of India. It is an annual foetid herb, and reaches the height of up to 90 cm. The plant is an important choice in butterfly gardens as some species of butterflies are known to have larvae that feed on the leaves of *C. tora* (Mathew and Mary, 2007)

MATERIALS AND METHODS

The study was carried out in the University of Calicut Campus (11°7'N, 75°5'E). In India *Senna tora* occur as a rainy season weed. It is an annual foetid herb, and grows up to a height of 30–90 cm. Leaves are pinnate, up to 10 cm long rachis grooved, conical gland between each of two lowest pairs of leaflet, leaflets in three pairs, opposite, obovate, oblong and base oblique. Flowers are found in pair in axils of leaves, petals five, pale yellow. Fruit is a pod. About 30-50 rhombhedral shaped seeds are found in the pods. Usually they flower after the monsoon rains (in Indian conditions).

The study site is characterized by the abundance of mango trees (*Mangifera indica*). *Senna tora* plants (n =121) were tagged using aluminum labels and monitored for insect activity since its leaf flush, which continued throughout the flowering and fruiting season of the plant. Hourly observations were carried out from 06 00 h –18 00 h and insect species were recorded, and their specific roles observed and documented. Insects that were found to chew and suck the leaves of *S. tora* and continue to feed for more than 30 seconds and those who fed on stem and pods were classified as herbivores. Insect visitors to the flowers of *S. tora* were recorded. The adult insect visitors were closely examined for any oviposition on the plant. The herbivorous insects were collected by hand picking, killed, labeled and preserved and then identified with the help of experts,

The parasitoids were collected using an aspirator. Pseudococcid species are major pests of the plant, and the infested parts of the plant such as stem and pod, were collected and enclosed in glass beakers covered with muslin cloth. The parasitoids that emerged from these pseudococcids were collected, identified, labeled and preserved. Pods of the plant were also collected and the number of weevils that emerged was recorded. All specimens are kept in the Entomology Museum of Department of Zoology, University of Calicut.

RESULTS

Thirty four (morpho) species of herbivorous insects were observed on different plant parts (leaves, stems, flowers and pods) of *S. tora*. The parasitoids comprised 19 species of hymenopterans. *Eurema hecabe* (Linnaeus) (Lepidoptera: Pieridae), commonly known as common (or two-spot) grass yellow, was the most frequent floral visitor on *S. tora* flowers, and fed on the nectar, and deposited eggs on the underside or on the margin of the leaf blades. The number of eggs per leaf varied between 2 and 6 (average 3.4 eggs, N = 56), and the number of eggs per plant varied between 12 and 28 (average 16 eggs, N = 21). *Spindasis vulcanus* Fabricius (Lepidoptera: Lycaenidae) and *Ypthima ypthimoides* (Moore) (Lepidoptera: Nymphalidae) were also seen visiting *C. tora.*

Insects of three orders, Coleoptera, Orthoptera and Hemiptera visited and used the floral resources of the plant. Fourteen (morpho) species of beetles (Order : Coleoptera) were observed feeding on different parts of the plant. The family Chrysomelidae with eight species was the most common (Table 1). The mango leaf cutting weevil, *Deporaus marginatus* Pascoe was found in large numbers feeding on the pods of *S. tora*. In the present study, at least 65.39% of the total pods (N = 1033) examined were infested by the weevil. A curculionid weevil, *Myllocerus viridanus* Fabricius also caused severe damage to this plant by feeding on its leaves. One unidentified species each of Anobiidae and Tenebrionidae and two unidentified species of Coccinellidae also occasionally visited the plants and ate the leaves and pods (Table 1). Fourteen species of Orthoptera were observed feeding on this plant (Table 1) with twelve species belonging to the family Acrididae.

Nineteen species of parasitic wasps visited or were reared from the herbivores of *S. tora* leaves and pods during the present study. Pseudococcid sp.1 infested the stems, while Pseudococcidae sp. 2 infested the pods. *Coccophagus* sp. (Hymenoptera: Aphelinidae), *Apanteles opacus* (Ashmead) (Hymenoptera: Braconidae) and *Philosindia* sp. (Hymenoptera: Encyrtid) were recorded as parasitoids of the pseudococcids. Other parasitoids visiting *S. tora* are listed in Table 2. Among the nineteen species of parasitoids the majority (5 species) belonged to family Braconidae. These include one unidentified species of Encyrtidae, two unidentified species of Platygastridae and three unidentified species of Eurytomidae.

DISCUSSION

The common grass yellow which was the dominant lepidopteran visiting *S. tora* is among the most polyphagous of butterflies in its larval stages. All its host plants are leguminous and belong to the families Mimosaceae, Caesalpiniaceae and Fabaceae (Kunte, 2000).

The mango leaf cutting weevil, *Deporaus marginatus* Pascoe, which has been reported as a pest of mango (Nair, 1975), was found in large numbers feeding on the pods of *S. tora*. The observation is interesting as the study was carried out in an area where there is an abundance of mango trees.

Table 1. List of herbivorous insects collected from S*enna tora*

Insect	Family
Coleoptera	
Alticine sp.	Chrysomelidae
Aulacophora atripennis (Fabricius)	Chrysomelidae
Aulacophora foveicollis Lucas	Chrysomelidae
Cassida circumdata Herbst	Chrysomelidae
Criocerine sp.	Chrysomelidae
Cryptocephaline sp.	Chrysomelidae
Hispine sp.	Chrysomelidae
Monolepta signata Oliv.	Chrysomelidae
Myllocerus viridanus Fabricius	Curculionidae
Deporaus marginatus Pascoe	Curculionidae
Epilachna sp. 1	Coccinellidae
Coccinellide sp. 2	Coccinellidae
Anobiid sp. 1	Anobiidae
Tenebrionid sp. 1	Tenebrionidae
Hemiptera	
Idioscopus niveosparsus (Lethierry)	Cicadellidae
Pseudococcid sp.1	Pseudococcidae
Pseudococcid sp.2	Pseudococcidae
Lepidoptera	
Eurema hecabe L.	Pieridae
Spindasis vulcanus Fabricius	Lycaenidae
Ypthima ypthimoides Moore	Nymphalidae
Orthoptera	
Acrida exaltata Walker	Acrididae
Cercina sp.	Acrididae
Dnopherula sp. 1	Acrididae
Dnopherula sp. 2	Acrididae
Dnopherula sp. 3	Acrididae
Neorthacris acuticeps (Bolivar)	Acrididae
Neorthacris sp.	Acrididae
Orthacris sp.	Acrididae
Parabida sp.	Acrididae
Phyllochoreia sp.	Acrididae
Poekilocerus sp.	Acrididae
Zygophlaeoba sp.	Acrididae
Atractomorpha sp.1	Pyrgomorphidae
Atractomorpha sp.2	Pyrgomorphidae

Table 2. Parasitoids collected from *Senna tora*

Parasitic Hymenoptera	Family
Coccophagus sp.	Aphelinidae
Apanteles expulsus Turner	Braconidae
Apanteles opacus Ashmead	Braconidae
Apanteles sp.	Braconidae
Cotesia sp.	Braconidae
Orgilus sp.	Braconidae
Hockeria sp.	Chalcididae
Tropimeris monodon Boucek	Chalcididae
Sympiesis sp.	Eulophidae
Encyrtid sp.	Encyrtidae
Philosindia sp.	Encyrtidae
Eurytoma sp. 1	Eurytomidae
Eurytoma amaranthusa Narendran	Eurytomidae
Eurytoma dentata Mayr	Eurytomidae
Eurytoma sp. 2	Eurytomidae
Eurytoma sp. 3	Eurytomidae
Calotelea sp.	Scelionidae
Platygastrid sp.1	Platygastridae
Platygastrid sp. 2	Platygastridae

The factors which contribute to association of thirty four species of insect herbivores and nineteen species of hymenopteran parasitoids with *S. tora*, observed in the present study are to be investigated further. It has been observed that plants extensively communicate with organisms in the environment through volatiles and these volatiles can be induced by herbivory (Pichersky and Gershenzon, 2002). Plants synthesize and emit blends of volatile compounds from their damaged and undamaged tissues, which act as important host-location cues for parasitic insects. The volatile terpenoids and other compounds emitted from leaves in response to insect damage allow insect parasitoids and predators to distinguish between infested and non-infested plants and this helps in locating hosts or prey (Pare and Tumlinson, 1999; Tumlinson 1998). The production by phylogenetically diverse plant species and the exploitation by parasitoids of highly specific chemical signals keyed to individual herbivore species, indicates that the interaction between the plants and the natural enemies of the herbivores that attack them is more complex than previously realized (Dicke *et al*, 2003; Turlings and Wäckers, 2004). The leaves of *S. tora* contains the hexahydroxy flavones and other

glycosides (Chakrabarty and Chawla, 1983) which may be acting as important host location cues for the herbivorous as well as the parasitic insects.

Oil from *S. tora* seeds was found to contain chrysophanic acid and sterulic acid (Desai and Shukla, 1978). Also 13 phenolic glycosides were isolated from the pods of *S. tora* (Sinha *et al*. 2001). In our study the larvae of the mango leaf cutting weevil, *D. marginatus* Pascoe, were found to be feeding on the pods of this plant and pupating in small, orange, oval chambers. The beetle may have acquired adaptations to overcome the effects of these secondary plant metabolites.

The study found that at least one reported pest species, *D. marginatus* and several beneficial parasitoid species, along with many insects species associated with *S. tora.* It has been observed that pollinators and natural enemies depend on plant-provided resources such as nectar, pollen, alternate prey, refuge and shelter, and nesting materials (Landis *et al*., 2000; Ricketts *et al*., 2008, Klein *et al*., 2007, Zhang *et al*., 2007b, Tscharntke *et al*., 2008, Wackers *et al*., 2008). The species richness and abundance of plant communities which offer these resources are important to population dynamics of beneficial insects, present in cropped field surrounding cultivated lands (Landis *et al*., 2000). Bowie *et al*. (1999) has noted that mass-flowering crops such as canola (*Brassica napus* L.) provide floral resources to natural enemies.

The seeds and pods of the plant may be an important alternate host for the mango pest, *D. marginatus* during the non-leaf flush season of mango trees, which would keep its population viable in nature. The parasitoids, hitherto unknown of their target hosts, may also be benefited by the diversity of the egg, larvae and pupae of herbivorous insects associated with the plant. However, it is known that *S. tora* is an important foraging plant for some butterflies and moths (Atluri *et al.,* 2004, Mathew and Mary, 2007) and is being introduced into the butterfly gardens. At least one study (Agrawal, 2002) reported a psychid moth (Lepidoptera) causing at least 20% defoliation in *S. tora*. Here we report that the mango leaf cutting weevil could also check the recruitment of *S. tora* by consuming the seeds.

Many studies have shown that patches of non-crop vegetation within agricultural landscapes do play an important role in maintaining beneficial insect communities near agricultural fields before, during, and after periods when insect-derived ecosystem services are valuable to crops (Landis *et al.,* 2000, Coll and Guershon 2002, Bianchi *et al.,* 2006, Isaacs *et al.,* 2009). The presence of nineteen species of parasitoids associated with *S.tora* points to the importance of this plant in maintaining beneficial insect communities in the ecosystem.

It is proposed that *Senna tora* may be used in habitat management as the goal of habitat management is to create a suitable ecological infrastructure within the agricultural landscape to provide resources such as food for adult natural enemies, Habitat management can be considered a subset of conservation biological control methods that alters habitats to improve availability of the resources required by natural enemies for optimal performance and providing a habitat in which alternative hosts or prey are present (Landis *et al.,* 2000).

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A new species of predatory mite (Acari: Phytoseiidae) from Kerala, India

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ABSTRACT: Mites belonging to the family Phytoseiidae are renowned biocontrol agents of the plant feeding mites and other phytophagous insects. A survey conducted in different districts of North Kerala revealed a new species of predatory mite under the family Phytoseiidae from Thrissur district. The new species viz., *Amblyseius perseani* sp. nov. is described with appropriate illustrations.

KEYWORDS: *Amblyseius,* Mesostigmata, Kerala, India, new species.

INTRODUCTION

Phytoseiid mites (Acari: Mesostigmata) constitute a large family of predatory mites. They are fast movers that have extensively exploited the foliage of higher plants (Chant and McMurty, 2007). They are seen mostly feeding on spider mites but can also survive on small insects, nematodes, fungi, honeydew and pollen (McMurty and Croft, 1997; Van Rijin *et al*., 2002; Nomikou *et al*., 2003).The importance of the mite family Phytoseiidae in biological and integrated control of injurious plant mite has stimulated taxonomic and ecological work on the group and has led to the discoverey and descriptions of more than 2280 species from the world (Chant and McMurty, 2007; Tixier *et al*., 2012).

Genus *Amblyseius* was erected by Berlese in 1914 and *Zercon obtuses* Koch (1839) was designated as its type species. The status of subgenus to genus *Amblyseius* was given by Chant (1959). Pritchard and Baker (1962) also recognized it as a genus. They divided it into groups and described 20 species in it. Denmark and Muma (1989) revised the genus and described 136 species.

Based on several different characters, genus *Amblyseius* consists of five different groups and

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they are the *americanus, largoensis, obtusus, pusillus* and *sundi* . The *americanus* group with z4 longer; the *largoensis* group with the female ventrianal shield vase shaped or divided into separate ventral and anal shield; the *obstusus* group with setae z4 shorter ;the *pusillus* group with seta J2 absent ; and the *sundi* group with setae Z1 absent (Chant and Mc Murty, 2004).

The genus *Amblyseius* is further diagnosed in having a lightly sclerotized dorsal shield, female ventrianal shield with variety of shapes, chelicerae with many teeth, leg I, II, III with macrosetae, spermatheca highly variable in form, seta s4, Z4 and Z5 usually greatly elongated with a few exceptions and caudoventral seta ZV3 unstable and absent on a number of species (Chant and McMurty, 2007).

Amblyseius is the largest group of species in the subfamily Amblyseiinae with 367 nominal species and out of them 25 are known from India (Chant and McMurty, 2007).The research work of Chant and Baker (1965), Chant and Hansell (1971), De Leon (1966), Ehara (1959,1966), Khan *et al*., (2000), Muma and Denmark (1970), Schuster and Pritchard (1963), Tuovinen (1993), Wainstein and Arutunjan (1970), on the genus *Amblyseius* is worth mentioning. Despite of this, there is only a meagre contribution to the acarine fauna from the region of Kerala and the new species described here is a result of the rapid surveys taken to explore the diversity of predatory mites from various districts of Kerala.

The specimens under study were collected from infested parts of economically important plants by beating or shaking methods. Specimens were cleared in lactic acid and permanent slides were prepared using Hoyer Cs medium (Walter and Krantz, 2009). Detailed structural studies and illustrations were made using Wild Leitz GMBH microscope. All measurements are given in microns. The classification system used is that of Chant and McMurty (2007). The setal nomenclature is of Rowell *et al*. (1978).

All the type specimens are kept in the Department of Zoology, Malabar Christian College but eventually will be transferred to the National Zoological Collection of the Zoological Survey of India, Calicut, Kerala.

***Amblyseius perseani* sp.nov. (Fig .1)**

urn:lsid:zoobank.org:act:E8582784-A15C-47CA-9250-078FAB741002

Material examined

Holotype: Female marked on the slide, "INDIA: Kerala: Mannuthy, 10.52891Ú N 76.262412Ú E, Thrissur district, 24.iv.2013, ex. *Persea americana* Mill, coll. Sajna (No.C.25/9)".

Paratype: Three paratype slides, collection details same as holotype (No.C 25/6, 25/7, 25/8).

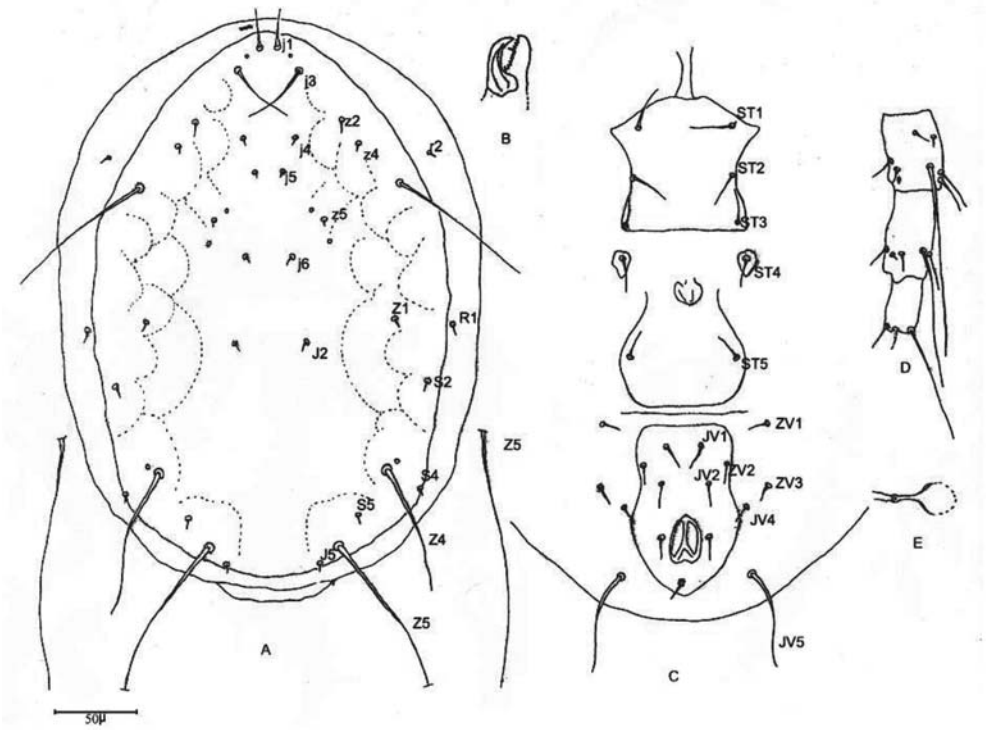

Fig. 1. *Amblyseius perseani* sp. nov. (female)
A-Dorsal view; B-Chelicera; C-Ventral view; D-Let IV; E-Spermatheca

Female

Dorsum. Dorsal shield gently reticulate specially at the posterior region and indistinct at the anterior region, with 4 pairs of lyrifissures, 17 pairs of setae present, all being smooth. Shield **363** 359 (355–363) long and **257** 253 (249–257) wide. Setae *j1* **32** 29 (26–32), *j3* **45** 40 (36–45), *j4* **5** 4 (3–5), *j5* **3** 3 (2–3), *j6* **5** 4 (3–5), *J2* **6** 5 (4–6), *J5* **5** 4 (3–5), *z2* **8** 7 (6–8), *z4* **5** 4 (3–5), *z5* **4** 4 (3–4), *Z1* **6** 5 (4–6), *Z4* **84** 79 (75–84), *Z5* **157** 154(152–157), *s4* **95** 94 (92–95), *S2* **6** 5 (4–6), *S4* **5** 4 (3–5), *S5* **6** 5 (4–6), *r3* **6** 5 (4–6), *R1* **8** 7 (6–8). Distances between *j1* **10** 9 (8–10), *j3* **41** 39 (37–41), *S5* **6** 5 (4–6) and *S4* **5** 4 (3–5).

Venter. Ventrally sternal shield **89** 86 (82–89) long, **88** 84 (82–88) wide, smooth, slightly concave anteriorly. Setae *ST1* **28** 25 (24–28), *ST2* **27** 23 (21–27), *ST3* **22** 19 (17–22), *ST4* **21** 17 (14–21), *ST5* **17** 15 (13–17), *ST4* on metasternal plate measuring **18** 15 (13–18). Distance between *ST1–ST2* **59** 56 (54–59), *ST2–ST2* **61** 58 (57–61), *ST3–ST3* **71** 69 (67–71), *ST5–ST5* **68** 66 (64–68). Genital shield smooth measuring **65** 63(60–65) wide and with *ST5*. Genital and ventrianal shield separated by a membranous fold in between them. Ventrianal shield **104** 101 (100–104)

long and **55** 51 (49–55) wide with three pairs of preanal setae measuring *JV1* **17** 16 (13–17), *ZV2* **12** 10 (9–12), *JV2* **17** 15 (13–17) long. Setae *ZV1* **12** 10 (9–12), *ZV3* **12** 10 (9–12), *JV4* **13** 11 (10–13), *JV5* **62** 59 (57–62) long, anal setae *a1* **14** 11 (10–14), *a2* **14** 12 (10–14), *a3* **12** 10 (9–12).

Peritreme. Extends anteriorly upto the base of *j1*.

Spermatheca. Spermatheca with tubular cervix and short atrium, major duct quite wide, minor duct invisible.

Chelicera. Fixed digit on chelicera **27** 26 (24–27) long, smooth, movable digit **31** 29 (25–31) long with six teeth anterior to *pilus dentilus* and four teeth posterior to that.

Legs. Macroseta present on leg IV: genu IV **113** 111 (109–113), tibia **81** 78 (75–81), basitarsus **69** 67 (65–69).

Leg chaetotactic formula: Genu II 2 2/0 2/0 1 ; Tibia II 1 2/1 1/1 1

Genu III 1 1/1 2/1 2 ; Tibia III 1 2/1 2/0 1

Etymology. The nomenclature of this new species is based on the name of the host plant *Persea americana* Mill. from which the specimen was collected.

Male: Unknown.

Habitat: *Persea americana* Mill, family Lauraceae.

Remarks: This species resembles *Amblyseius largoensis* (Muma, 1955) in having almost similar lengths of dorsal setae but it can be separated by following characters:

1. Fixed digit of chelicerae with six teeth anterior to *pilus dentilus* against four teeth in *largoensis.*

2. Difference in chaetotactic formula with regard to genu III, tibia III and Tibia II.

3. Cervix of spermatheca also differs in length being shorter in this species as compared to that of *largoensis.*

4. Length of macrosetae also differs in the two species with regard to the length of macrosetae on tibia and basitarsus.

This new species is also seen related to *Amblyseius phillipsi* (McMurty and Schicha, 1987) but differs distinctly in following characters.

1. Shape of sternal shield is lacking notch on the posterior margin as is present in case of *phillipsi.*

2. Setae Z5 smaller in this new species as compared to that in *phillipsi*.

3. Macrosetae on leg IV being smaller in this new species as it is longer in the case of *phillipsi.*

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Encyrtidae (Hymenoptera: Chalcidoidea) from Arunachal Pradesh, India

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ABSTRACT: Forty-one species of Encyrtidae (Hymenoptera: Chalcidoidea) are recorded and one new genus and six new species are described from the Indian State of Arunachal Pradesh. Of the 41 species, 38 species are newly recorded from Arunachal Pradesh. Also 18 genera are newly recorded from Arunachal Pradesh. These are: *Adelencyrtus* Ashmead, *Aenasius* Walker, *Apoleptomastix* Kerrich, *Blepyrus* Howard, *Callipteroma* Motschulsky, *Cheiloneuromyia* Girault, *Cheiloneurus* Westwood, *Gentakola* Noyes & Hayat, *Haligra* Noyes & Hayat, *Homalotylus* Mayr, *Leptomastix* Foerster, *Metaphycus* Mercet, *Neodusmetia* Kerrich, *Ooencyrtus* Ashmead, *Proleurocerus* Ferrière, *Psyllaephagus* Ashmead, *Rhopus* Foerster, *Trechnites* Thomson. The new taxa described are: *Chalaruna indica* Hayat, **gen. et sp. nov.**, *Cheiloneuromyia idnia* Hayat, **sp. nov.**, *Metaphycus zabica* Zeya, **sp. nov.**, *Ooencyrtus bidentatus* Hayat, **sp. nov.**, *Psyllaephagus pauropsylla* Hayat, **sp. nov.**, *Trechnites albicrus* Hayat, **sp. nov.** A list of the 16 species of Encyrtidae known from Arunachal Pradesh prior to this publication is also given.

KEYWORDS: Hymenoptera, Encyrtidae, new genus, new species, new records, Arunachal Pradesh, India.

INTRODUCTION

The fauna of the family Encyrtidae (Hymenoptera: Chalcidoidea) of Arunachal Pradesh (India), was very poorly known, with seven species. Hayat & Kazmi (2011) added nine species. A list of these 16 species is given below. This paper is based on the collections made by K. Veenakumari from Pasighat (Arunachal Pradesh).

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This paper describes one new genus and six new species, and reports 18 genera and 38 species as new record from Arunachal Pradesh. Thus the current faunal inventory of the family Encyrtidae of Arunachal Pradesh is 31 genera and 60 species.

METHODS

The terminology follows Hayat (2006), except for the use of the terms 'mesosoma' for the thorax plus propodeum, and 'metasoma' for the petiole plus gaster. Body length is given in millimetres; other measurements are relative, taken from the divisions of a linear scale micrometer placed in the eye piece of a stereozoom binocular microscope at 10× zoom 8 (one micrometer division = 0.01234 mm) for carded specimens, and placed in the eye piece of a compound microscope at 100× magnification (one micrometer division = 0.00988 mm) or 400× magnification (one micrometer division = 0.0025 mm) for slide-mounted parts.

Original citations to the species recorded here are not given as these are available in Hayat (2006), but citations are given for species described after 2006. We may note that the species of the tribe Anagyrini and of the genus *Metaphycus* Mercet were identified by the second author (SBZ) indicated in the text by an asterisk (*), and the remaining species were identified by the first author (MH).

The following abbreviations are used in the text:

F1, F2, etc. = Funicle segments 1, 2, etc.

(MT) = Malaise Trap. (Abbreviations placed in brackets indicate the method of collection.)

OCL = Minimum distance between a posterior ocellus and the occipital margin.

OOL = Minimum distance between a posterior ocellus and the corresponding eye margin.

POL = Minimum distance between the posterior ocelli.

(SN) = Sweep Net.

TI, TII, etc. = Tergites 1, 2, etc. of gaster.

(YPT) = Yellow Pan Trap.

The following acronyms are used for the depositories:

NBAIR = National Bureau of Agricultural Insect Resources, Bengaluru, India.

ZDAMU = Insect Collections, Department of Zoology, Aligarh Muslim University, Aligarh, India.

RESULTS AND DISCUSSION

Description of new taxa

***Chalaruna* Hayat, gen. nov. (Figs 1–9)**

urn:lsid:zoobank.org:act:F3221F7D-5D80-40B3-804A-A3DDB5689339

Type species *Chalaruna indica* Hayat, sp. nov.

Female

Head, in dorsal view, with frontovertex broad, about 0.5× head width; frontovertex nearly as long as broad; occipital margin narrow, but not sharp; eye posteriorly separated from occipital margin by about 3 diameters of a facet; head, in frontal view (Fig. 1), very slightly broader than high; scrobes long, extending to 0.79× head height, with margins rounded; mouth fossa broad, only slightly less than frontovertex width; antennal torulus near mouth margin; malar sulcus present; head, in profile, with eye small, only slightly (1.15×) higher than malar space. Mandible (Figs 1, 2) with 2 sharp teeth. Maxillary palp 4-segmented, labial palp 3-segmented. Antennal formula, 1163 (Fig. 3); scape almost cylindrical; pedicel distinctly (more than 2×) longer than F1, the latter shorter than F2; funicle segments, except F1, longer than broad; clava 3-segmented, sutures transverse, third segment with apex obliquely truncate.

Mesosoma (Fig. 4). Pronotum, visible part, short, one-fifth mesoscutum length; mesoscutum with notaular lines absent; axillae nearly meeting in the middle; scutellum with a distinct, translucent, apical flange overlapping about anterior half of propodeum; propodeum median length 0.32× scutellum length, including the apical flange; propodeum with dense, irregular sculpture and with a fine groove beginning from posterior margin of each spiracle and ending near posterior margin of propodeum (Fig. 5). Fore wing (Fig. 6) with postmarginal vein absent; stigmal vein nearly as long as marginal vein with a hyaline break at base, and with 4 circular sensilla arranged in a line; parastigma slightly swollen, with a hyaline break apically; costal cell with a line of 5 to 6 setae distally on dorsal surface, and a single line of setae on ventral surface; linea calva complete, posteriorly broad; filum spinosum present (6–7 spines); proximal to linea calva with about 7 lines of setae, but except for the presence of a line of setae below submarginal vein (= filum subvenale), bare in basal triangle. Legs unmodified; tarsal formula 5–5–5.

Metasoma 1.4× as long as mesosoma; gaster with TVI and TVII U-shaped; paratergites absent (Fig. 7); last two sternites with well-developed anterior apodemes; hypopygium extending slightly beyond apex of gaster; ovipositor exserted to 0.27× gaster length; third valvula long and in membranous connection with second valvifer.

Male. Unknown.

Comments: This new genus was initially confused for a tetracnemine (subfamily Tetracneminae) as most characters appear to be similar to those of the *Charitopus*-group of genera. After looking into the figures and description, Dr. J.S. Noyes (BMNH, London) convincingly proved that this genus is an encyrtine (subfamily Encyrtinae). The characters which place this genus in the Encyrtinae are: the presence of a filum spinosum in the fore wing; the absence of paratergites; and the U-shaped TVI and TVII of gaster. However, within the Encyrtinae, it is not possible to find a genus which can be considered as similar or related to this new genus. Because of the unusual combination of characters, this genus does not run to any genus in the available keys to the encyrtid genera (Prinsloo & Annecke, 1979, South African genera; Noyes, 1980, Neotropical genera; Noyes & Hayat, 1984, Indo-Pacific genera; Noyes, 1988, New Zealand genera; Trjapitzin, 1989, Palaearctic genera; Noyes et al., 1997, Nearctic genera). A similar situation still exists for the genera *Ruanderoma* Noyes & Hayat (1984), *Acerophagoides* Blanchard (see Noyes, 2000) which are currently placed, probably erroneously, in the Tetracneminae, and *Noyesencyrtus* Singh, in Singh et al. (2014).

Etymology: The generic name is an anagram of 'Arunachal' Pradesh.

1. *Chalaruna indica* Hayat, sp. nov. (Figs 1–9)

urn:lsid:zoobank.org:act:37AC7A2E-DA64-4D74-9D00-B6633BAD5E80

Female

Holotype. Length, 1.56 mm. Head black. Last segment of both maxillary and labial palp brown. Antenna black. Mesosoma, including tegula, black; scutellum with light bluish green shine. Fore wing lightly infuscate pale brown, with infuscation dark brown below parastigma. Hind wing hyaline. Fore leg with coxa and femur black; tibia black, apically brownish yellow; tarsus brownish yellow, fifth segment brown. Mid leg with coxa black; femur black, becoming yellowish brown apically; tibia yellowish brown with upper half basally to upper fourth apically dark brown; tarsus yellowish brown, fifth segment brown. Hind leg with coxa and femur black; tibia yellowish brown, with upper half basally to upper third apically dark brown; tarsus as in mid leg. Metasoma black; ovipositor sheaths (= third valvulae) dark brown.

Head (Fig. 1). Ocellar triangle with apical angle obtuse, posterior ocellus separated from eye margin by nearly two diameters of an ocellus, and from occipital margin by 3 diameters of an ocellus; POL 3.75× OOL (36:13); frontovertex with raised, transversely elongate to nearly lineolate reticulate sculpture, and with minute setigerous punctures; face, except scrobes, with slightly longitudinally elongate reticulate sculpture; malar space behind sulcus with lineolate reticulate sculpture; setae brown; eye apparently bare, but at higher magnification sparse, short setae can be seen. Antenna (Fig. 3) with scape 3.8× as long as broad; pedicel 2.3× as long as broad, and about as long as F1 and F2 combined; F1 very slightly longer than broad, and shorter (0.63×) than F2; F2–F6 subequal in length, but gradually increasing in width, F1 1.46× and F6 1.1× as long as broad; clava slightly shorter than F3–F6 combined.

Relative measurements (card): head dorsal width, 29.5; head dorsal length, 16; frontovertex width, 15; head frontal height, 28; eye height, 15; malar space, 13; antennal scape length, 19. Antennal segments length (width) (slide, at 400×): scape, 76 (20); pedicel, 34 (14.75); F1, 12 (11); F2, 19 (13); F6, 22 (20); F3–F6, 87; clava, 80.

Mesosoma (Fig. 4). Pronotum with raised reticulate sculpture; mesoscutum with slightly raised, transversely elongate reticulate sculpture; scutellum with fine polygonal reticulate sculpture, but on card appears smooth; metanotum laterally with prominent longitudinal ridge-like reticulations; propodeum mesal to spiracular groove with raised, polygonal to irregular reticulate sculpture (Fig. 5); setae brown; propodeum distal to spiracles appears without setae, except for 1 seta anterior to each spiracle. Fore wing 2.87× as long as broad, otherwise as in Fig. 6. Hind wing 4.89× as long as broad; marginal fringe 0.23× wing width. Mid tibia 2.64× as long as mid basitarsus; mid tibial spur 0.88× mid basitarsus length. *Relative measurements* (card): mesosoma length, 46; pronotum visible part, length (width), 3.5 (26); mesoscutum length (width), 16 (33); scutellum length (width), 16 (16). (slide, at 100×): mid tibia length, 45; mid basitarsus length, 17; mid tibial spur length, 15.

Metasoma. Distal 3 tergites of gaster and part of ovipositor as in Fig. 7; hypopygium as in Fig. 9; ovipositor with second valvifer 3.4× as long as third valvula. *Relative measurements* (slide, at 100×): TVII length (width), both measured between cercal plates, 34 (34), but actual median length of TVII, 13; ovipositor length, 97; third valvula length, 22. [Ovipositor 2.15× as long as mid tibia; third valvula 1.29× as long as mid basitarsus.]

Male: Unknown.

Material examined: Holotype, female (on slide under 5 coverslips, slide No. EH.1759), labelled "INDIA: ARUNACHAL PRADESH: Pasighat, 5.v.2014 (YPT), Coll. K. Veenakumari" (NBAIR; registration No. ICAR/NBAIR/EN.44)

Distribution: India: Arunachal Pradesh.

Etymology: The species name is derived from the name of the country, India.

2. *Cheiloneuromyia idnia* Hayat, sp. nov. (Figs 10–15)

urn:lsid:zoobank.org:act:ED0792A5-BE4F-44D9-AE6C-9B3531DB1040

Female

Holotype. Length, 1.1 mm. Head yellow. Antenna with radicle and scape yellow; pedicel yellow, basal two-thirds dorsally pale brown; funicle yellow to pale brownish yellow; clava brown, with basal half of first segment pale brownish yellow. Mesosoma largely brownish yellow; pronotum brownish yellow, collar with purple shine, and about middle third dark brown; mesoscutum brownish yellow, with two broad longitudinal pale infuscate brown bands;

tegula brownish yellow with a little bronzy shine; scutellum with irregular pale brownish patches, with sides and apex narrowly brown; metanotum on sides brown; propodeum yellowish brown; mesopleuron and metapleuron yellowish brown. Fore wing hyaline, with infuscation below distal half of venation (Fig. 13). Hind wing hyaline. Legs, including coxae, whitish; fore tibia and hind femur with very pale brown suffusions; last segment of all tarsi brown. Gaster largely dark brown; TI narrowly along base yellow, otherwise TI to TIII brown, with bluish green shine laterally.

Head, in dorsal view, nearly flat; ocellar triangle with apical angle slightly obtuse; posterior ocellus separated from eye margin by about half its diameter, and from occipital margin by about 3 diameters of an ocellus; head, in frontal view (Fig. 10, eyes collapsed), 1.3× as broad as high; frontovertex width 0.31× head width; mouth fossa width subequal to frontovertex width; antennal torulus with upper margin above lower margin of eye; inter-torular distance greater than torulus-mouth margin distance (7:5.5); torulus-mouth margin distance greater than torulus height (5.5:4.5); eye height 1.5× malar space; head, in profile, subtriangular, with the eye antero-posteriorly elongate, length greater than height [measurements not made]; frontovertex with slightly raised polygonal reticulate sculpture; face with same sculpture, but cells fine and slightly obliquely elongated; malar space behind sulcus with lineolate reticulate sculpture; setae on frontovertex brown; setae on face and malar space hyaline; eye setose, setae hyaline, and each seta shorter than a facet. Mandible (Fig. 11) with two teeth and a truncation. Antenna (Fig. 12) with scape 4× as long as broad; pedicel longer than F1; F1 slightly narrower and shorter than F2; funicle segments quadrate to slightly broader than long; clava subequal in length to preceding 3 segments combined. *Relative measurements* (slide, at 100×): head frontal width, eyes collapsed, 31.5; head frontal height, 24; frontovertex width, 10; mouth fossa width, 10.25; eye height, 18; malar space, 12; antennal scape length, 12.5; pedicel length, 4; F1 length, 2.5; funicle length, 21; clava length, 11.5.

Mesosoma (Fig. 14) slightly shorter than metasoma (41.5:50); mesoscutum between tegulae 1.28× as broad as long, and 1.31× as long as scutellum; scutellum slightly broader than long; propodeum medially short, about 0.125× scutellum length; mesoscutum with hardly raised, irregular, polygonal reticulate sculpture; scutellum with a similar sculpture, but the cells smaller and finer, and may appear almost smooth; setae brown on thorax; pronotal collar with a line of setae (in addition to several setae anterior to collar), with a long seta at each postero-lateral corner; mesoscutum, in addition to a curved line of shorter setae along anterior margin, with 38 (19 + 19) long setae, arranged in a bilateral symmetry; each axilla with 2 setae; scutellum with 12 (6 + 6) setae, arranged in two submedian lines; propodeum with a few short, hyaline setae distal to each spiracle. Fore wing (Fig. 13) 2.58× as long as broad; costal cell with a line of setae in distal third on dorsal surface, and at least about two lines of setae on ventral surface; linea calva open posteriorly; basal triangle largely bare. Mid tibia 3.28× as long as mid basitarsus; mid basitarsus 1.1× as long as mid tibial spur. *Relative measurements* (slide, at 100×): mesosoma length, 41.5; mesoscutum length (width), 21 (27); scutellum length (width), 16 (17.5); median length of propodeum, 2; fore wing length (width), 84 (32.5); mid tibia length, 34.5; mid basitarsus length, 10.5; mid tibial spur length, 9.5.

Metasoma (Fig. 15). Ovipositor extends from TIV of gaster, and hardly exserted at apex; hypopygium extends to three-fourths gaster length. *Relative measurements* (slide, at 100×): metasoma length, 50; gaster length, 48; TVII length, measured between cercal plates, 23; ovipositor length, 31; third valvula length, 5.5. [Ovipositor 0.89× mid tibia length; third valvula 0.52× mid basitarsus length, and 0.57× mid tibial spur length.]

Male: Unknown.

Material examined: Holotype, female (on slide under 4 coverslips, slide No. EH. 1740), labelled "INDIA: ARUNACHAL PRADESH: Pasighat, 5.v.2014 (YPT), Coll. K. Veenakumari". (NBAIR; registration No. ICAR/NBAIR/EN.45)

Distribution: India: Arunachal Pradesh.

Comments: This species is problematic. It does not run to any genus in the keys to genera given by Prinsloo & Annecke (1979; Afrotropical genera), Trjapitzin (1989; Palaearctic genera) and Noyes et al. (1997; Nearctic genera), but runs to *Xenostryxis* Girault in the keys by Noyes & Hayat (1984; Indo-Pacific genera; there as *Paraschedius* Mercet) and Hayat (2006; Indian genera). However, it is out of place in *Xenostryxis* as that genus is characterized by the presence of a denticle on the mandible, presence of 3 circular sensilla on the stigmal vein, and propodeum medially very narrow. This species is apparently similar to *Cheiloneurella* Girault (Hayat, 2006: figs 763–767), but differs in having the pronotum (as seen from above) very short, several times shorter than mesoscutum. In *Cheiloneurella:* pronotum triangular, at least about 0.75× mesoscutum length.

This new species is placed in *Cheiloneuromyia* Girault as it agrees in a majority of characters of this genus, except for the presence of 4 circular sensilla on the stigmal vein. In *C. javensis* Girault, the stigmal vein has 3 circular sensilla as confirmed in the Indian specimens of this species (Hayat, 2006) present in ZDAMU.

Etymology: The species name is an anagram of India.

3. *Metaphycus zabica* Zeya, sp. nov. (Figs 16–23)

urn:lsid:zoobank.org:act:A7AC4E06-C4B2-430F-A966-0B6F91DD02AE

Female

Holotype. Length, 0.73 mm (paratypes, 0.62–0.92 mm). Head with frontovertex and face up to toruli, white; yellow below toruli; mouth margin dark brown; eye bordered posteriorly by white, otherwise brown; malar space ventrally dark brown; occiput dark brown. Mandible with apex dark brown. Palps white. Antenna (Fig. 19) with radicle dark brown; scape dark brown with dorsal margin and apex white; pedicel basal two-thirds dark brown, apical third

white; F1–3 brown, F4–6 white; clava with basal two segments dark brown, base of third segment brown, rest of third segment yellowish. Mesosoma (Fig. 21) with pronotal collar and sides white, otherwise dark brown, with a dark brown spot at each posterolateral corner; mesoscutum, except white lateral margins, axilla and scutellum brown; tegula white, with distal half (or a spot at distal half) brown; metanotum dark brown; propodeum mesal to spiracles dark brown, distal to spiracles white; pleurites and sternites white. Fore wing (Fig. 20) hyaline, with pale infuscation from base to at least slightly beyond end of venation; discal setae brown. Hind wing hyaline. Legs, including coxae, white, with brown incomplete bands on tibiae as follows (Fig. 21): fore tibia with a pale brown band at about basal fourth, and apex narrowly brown; mid tibia with 4 brown to pale brown bands, two at middle and one each at base and apex, the second medial band may be faint, and the apical spot may be absent; hind tibia with a basal band, a sub-basal incomplete brown band, subapical band very faint or absent; fore tarsus yellow, with fifth segment brown; mid and hind tarsi white, with fifth segment brown. Metasoma (Fig. 21) with petiole dark brown; dorsum of gaster dark brown, except sides up to cercal plates white; venter white; ovipositor sheaths yellow.

Head, in frontal view [frontovertex shrunken], 1.2× as broad as high; frontovertex width 0.21× head width; in a paratype (Fig. 16), head in frontal view, 1.28× as broad as high; frontovertex width nearly 0.24× head width; ocellar triangle with apical angle acute; posterior ocellus nearly touching eye margin; frontovertex with regular polygonal reticulate sculpture, cells small; face with longitudinally elongate reticulate sculpture; setae on head white. Mandible (Fig. 18) with three teeth, ventral tooth short, pointed; middle and dorsal teeth rounded. Maxillary palp (Fig. 17) and labial palp 2-segmented. Antenna (Fig. 19) with scape 2.23× as long as broad, ventral margin rounded [the slight notch on ventral margin of the right antenna in Fig. 19, as an artefact]; pedicel subequal in length to F1–F3 combined; F1–F4 subequal in length and width, each slightly smaller than F5; F6 larger than F5; clava about as long as F2–F6 combined; only F6 with longitudinal sensilla. *Relative measurements* (holotype, slide, at 100×): head frontal width, 33; head frontal height, 27.5; frontovertex width, 7; eye height, 22; malar space, 7; antennal scape length (width), 14.5 (6.5). [In paratype, Fig. 16: head frontal width, 31.5; head frontal height, 24.5; frontovertex with, 7.5; eye height, 19.5; malar space, 9]

Mesosoma as in Fig. 21; sculpture on mesoscutum and scutellum as in Figs 22 and 23; setae white. Fore wing (Fig. 20) 2.48× as long as broad; linea calva interrupted by 4 lines of setae. Hind wing 6.1× as long as broad; marginal fringe 0.55× wing width. Mid tibia 2.6× as long as mid basitarsus; mid tibial spur 0.8× mid basitarsus length. *Relative measurements* (holotype, slide, at 100×): mesosoma length, 42; mesoscutum length (width), 18 (37); scutellum length (width), 19 (18.5); fore wing length (width), 82 (33); hind wing length (width), 55 (9); marginal fringe length, 5; mid tibia length, 26; mid basitarsus length, 10; mid tibial spur length, 8.

Metasoma (Fig. 21), slightly distended in figure; second valvifer 4.4× as long as third valvula. *Relative measurements* (holotype, slide, at 100×): TVII length (width), 23 (27); ovipositor length, 27; third valvula length, 5. [Ovipositor subequal in length to mid tibia; third valvula 0.5× mid basitarsus length, and 0.62× mid tibial spur length.]

Male: Unknown.

Material examined: Holotype, female (on slide under 4 coverslips, slide No. EH.1840), labelled "INDIA: ARUNACHAL PRADESH: Pasighat, 5.v.2014 (SN), Coll. K. Veenakumari" (NBAIR, registration No. ICAR/NBAIR/EN.51)

Paratypes: 26 females: 4 females (1 on slide, EH.1841), with same data as holotype; 22 females with same data as holotype, but collected on different dates or by different methods: 6 females, 3.v.2014 (YPT); 8 females, 5.v.2014 (YPT); 6 females, 7.v.2014 (MT); 1 female, 7.v.2014 (YPT); 1 female (on slide, EH.1842), 10.v.2014 (YPT). (6 females in ZDAMU, registration No. HYM.CH.724; 20 females in NBAIR, registration No. ICAR/NBAIR/EN.52–62)

Distribution: India: Arunachal Pradesh.

Comments: This species belongs to the *alberti* species-group of *Metaphycus* Mercet, characterized by having both the maxillary and labial palps 2-segmented (palp formula, 2–2).

Because of the following combination of characters, this new species does not run well in the available keys to species of *Metaphycus* (Annecke & Mynhardt, 1981, mainly South African species; Trjapitzin, 1989, Palaearctic species; Guerrieri & Noyes, 2000, European species; Noyes, 2004, Cota Rican species; Hayat, 2006, Indian species): malar space and mouth margin dark brown; antennal scape dark brown with dorsal margin and apex white; mesothoracic dorsum brown; metanotum and propodeum mesal to spiracles dark brown; fore wing lightly but distinctly infuscate below venation, the infuscation extending slightly beyond apex of venation; all tibiae with a basal and a sub-basal brown, the latter incomplete; sub-apical incomplete brown band present on mid and hind tibiae, and in some specimens, an apical narrow brown band is also present on mid and hind tibia; metasoma dorsally dark brown, except sides up to cercal plates white; antennal scape 2.23× as long as broad; only F6 with longitudinal sensilla; second valvifer 4.4× as long as third valvula; ovipositor subequal in length to mid tibia (27:26); and third valvula 0.62× mid tibial spur length.

Etymology: The species name is an arbitrary combination of letters, and may be taken as a noun in apposition.

4. *Ooencyrtus bidentatus* Hayat, sp. nov. (Figs 24–29)

urn:lsid:zoobank.org:act:C234F562-179B-4179-8348-A39FC78CF98F

Female

Holotype. Length, 1.3 mm. Head black, shiny. Antenna with radicle black; scape whitish in basal two-fifths, brownish in apical three-fifths; pedicel dark brown, apex ventrally whitish; funicle and clava dark brown. Mesosoma black; tegula dark brown. Fore wing with light

yellowish tinge from base to about end of venation, beyond venation hyaline. Hind wing hyaline. Legs, including coxae, yellow. Gaster dark brown laterally and on TVII; TIV–TVI brown; TI–TIII, except for dark brown sides, yellow; venter pale brownish yellow, becoming white in distal half of hypopygium.

Head, in dorsal view, 2× as broad as long, and 7.4× as broad as frontovertex width; (frontovertex width 0.13× head width); ocellar triangle with apical angle strongly acute; posterior ocellus touching eye margin, and removed from occipital margin by about one diameter of ocellus; POL equal to OCL (2:2); head, in frontal view (Fig. 24), slightly (1.057×) broader than high; eye height 3× malar space; frontovertex with raised reticulate sculpture, but finely reticulate on face with cells slightly elongated and obliquely oriented; malar space with fine, longitudinally elongate reticulate sculpture; setae on head pale brown; eye densely setose, setae hyaline, each seta clearly longer than a facet. Mandible (Figs 24, 25) bidentate, upper tooth shorter than lower tooth. Antenna (Fig. 26) with scape 5.37× as long as broad; pedicel 2.2× as long as broad, as long as F1 and F2 combined; funicle segments, except F6, longer than broad, 1.6× (F1) to 1.2× (F5), as long as broad; F6 quadrate; F3 longer than F1 and F2 individually; clava with second suture slightly oblique, and third segment obliquely truncate; clava about as long as distal half of F2 and F3–F6 combined. *Relative measurements* (card): head dorsal width, 37; head dorsal length, 18; frontovertex width, 5. (From slide, at 100×): head frontal width, 49; head frontal height, 43; frontovertex width, 5.5; eye height, 34; malar space, 11.

Mesosoma (Fig. 28). Mesoscutum with slightly raised, irregular polygonal reticulate sculpture; scutellum with deep, regular polygonal reticulate sculpture, the cells small, and on sides slightly elongate reticulate; sculpture on scutellum deeper than on mesoscutum; propodeum medially with a ridge on each side, and on sides with a groove behind each spiracle; mesoscutum with setae silvery white, except brown setae along posterior margin; axilla and scutellum with brown setae; propodeum distal to spiracles with fine, long, silvery white setae. Fore wing 2.7× as long as broad; disc nearly bare in basal triangle; otherwise venation and setation as in Fig. 27. Hind wing 5.22× as long as broad; marginal fringe 0.32× wing width. Mid tibia 3× as long as mid basitarsus; mid basitarsus 1.25× as long as mid tibial spur. *Relative measurements* (slide, at 100×): mesosoma length, 52; mid tibia length, 46; mid basitarsus length, 15; mid tibial spur length, 12.

Metasoma (Fig. 29) 1.3× as long as mesosoma; ovipositor extending from base of gaster, and exserted at apex, the exserted part 0.18× gaster length. *Relative measurements* (slide, at 100×): ovipositor length, 75; third valvula length, 22.5 [Ovipositor 1.63× as long as mid tibia; third valvula 1.5× as long as mid basitarsus, and 1.87× as long as mid tibial spur.]

Male: Unknown.

Material examined: Holotype, female (on slide under 4 coverslips, slide No. EH.1752), labelled "INDIA: ARUNACHAL PRADESH: Pasighat, 7.v.2014 (YPT), Coll. K. Veenakumari" (NBAIR; registration No. ICAR/NBAIR/EN.46).

Distribution: India: Arunachal Pradesh.

Comments: The following combination of characters distinguishes this new species from all the described species of *Ooencyrtus* Ashmead: mandible with two sharp teeth; frontovertex very narrow, at least one-seventh of head width; eye large, 3× as high as malar space; clava with second suture slightly oblique and apical segment obliquely truncate; fore wing with marginal vein longer than broad, and slightly longer than stigmal vein; and ovipositor long, 1.63× as long as mid tibia, and distinctly exserted at apex of gaster, the exserted part slightly more than one-fifth gaster length. Because of these combination of characters, this new species does not run to any known species in the available keys to *Ooencyrtus* species (Prinsloo, 1987, species from sub-Saharan Africa; Noyes, 1985, Neotropical species; Trjapitzin, 1989, Palaearctic species; Huang & Noyes, 1994, Indo-Pacific species; Zhang et al., 2005, Chinese species; Hayat, 2006, Indian species; Noyes, 2010, Costa Rican species.) It may further be noted that because of the bidentate mandibles, this species does not even run to *Ooencyrtus* in the available keys to the genera of Encyrtidae.

Etymology: The species name refers to the bidentate mandibles.

5. *Psyllaephagus pauropsylla* Hayat, sp. nov. (Figs 30–42)

urn:lsid:zoobank.org:act:301EF6FA-95B2-4E58-A74C-D1D01691FB46

Female

Holotype. Length, 1.4 mm (paratype, on card, 1.39 mm). Head with bluish shine with purple in ocellar triangle; inter-torular area violet. Antenna with radicle and scape black; pedicel dark brown with apex narrowly yellow; F1 brown; F2 brown or with apex narrowly yellow; F3 and F4 each with about basal half brown and apical half yellow; F5 and F6 narrowly brown basally, otherwise yellow; clava yellow with about basal half of first segment brown. Mesosoma black; pronotum and mesonotum uniformly bluish with some purple shine; tegula dark brown. Wings hyaline. Legs pale yellow, with all coxae, fore femur except pale yellow apex, and hind femur except pale yellow base and apex, dark brown. Metasoma black.

Head, in dorsal view (Fig. 30), 2.9× as broad as long; frontovertex width 0.39× head width; ocellar triangle with apical angle a right angle; posterior ocellus close to eye margin; OOL, OCL, POL ratios, 1:2.5:8; head, in frontal view, 1.28× as broad as high (in paratype on slide, 1.35× as broad as high, Fig. 31); eye height 2.2× malar space; frontovertex with raised, polygonal reticulate sculpture and with fine setigerous punctures; malar space with fine, elongate reticulate sculpture; setae on head silvery white; eye appears bare, but with very short, hyaline setae, each seta much shorter than a facet diameter. Mandible (Fig. 32) with two teeth and a dorsal truncation. Antenna (Fig. 35, paratype) with scape 3.62× as long as broad; pedicel 1.5× as long as broad, and shorter than F1 and F2 combined; F1 and F2 each shorter than F3; F3 and F4 each slightly longer than broad; 1.4× (F1), 1.23× (F2), 1.29× (F3), and 1.11× (F4), as long as broad; F5 nearly quadrate, and F6 1.13× as broad as long; clava about as long as distal half of

F4 , F5 and F6 combined. *Relative measurements* (holotype, card): head dorsal width, 41; head dorsal length, 14; frontovertex width, 16; head frontal height, 32; eye height, 22; malar space, 10.

Mesosoma (Fig. 33). Mesoscutum with raised polygonal reticulate sculpture, the cells very small; scutellum with similar sculpture, but cells smaller than and not deeper than on mesoscutum; setae on thoracic dorsum and on sides of propodeum distal to spiracles silvery white. Fore wing 2.3× as long as broad; ratios of marginal, postmarginal and stigmal veins, 14:25:37; disc sparsely setose below parastigma and submarginal vein, with a large bare area in basal triangle (Fig. 34). Mid tibia 3.36× as long as mid basitarsus; mid basitarsus 1.38× as long as mid tibial spur. *Relative measurements* (paratype, slide, at 100×): mid tibia length, 42; mid basitarsus length, 12.5; mid tibial spur length, 9.

Metasoma, in holotype, as long as mesosoma (gaster with tergites slightly stretched), but in one paratype, 0.8× mesosoma length; ovipositor (Fig. 36, paratype) with second valvifer 6.83× as long as third valvula. *Relative measurements* (paratype, slide, at 100×): ovipositor length, 47; third valvula length, 6. [Ovipositor 1.11× as long as mid tibia; mid basitarsus 2.08× as long as third valvula; mid tibial spur 1.5× as long as third valvula.]

Male

Length, 1.22 mm. Head with frontovertex with bluish shine; ocellar area with largely purple bronzy shine; face, scrobes and malar space with intense bluish shine. Antenna with radicle, scape and pedicel dark brown; flagellum yellowish brown. Mesosoma, including tegula, dark brown; pronotum bluish with collar purple; mesoscutum bluish with purple bronzy anteriorly and medially; scutellum violet with sides and apex bluish. Wings hyaline. Leg colour as in female. Gaster black, TI–TIV with bluish shine, but purple along posterior margins.

Head, in dorsal view, transverse, 3.54× as broad as long; frontovertex width 0.5× head width; ocellar triangle with apical angle obtuse; ratios of POL, OOL, OCL, 11:2:2; head, in frontal view (Fig. 37), 1.3× as broad as high; scrobes shallow, margins rounded; torulus with lower margin nearly in line with lower margin of eye; inter-torular distance equal to torulus height; torulus-mouth margin distance slightly more than torulus height (7:6); eye height 1.46× malar space; frontovertex with raised polygonal reticulate sculpture, the cells small; between sides of scrobes and eye margin finely reticulate; scrobes and inter-antennal prominence nearly smooth; setae on head small and silvery white, except setae brown between posterior ocelli and occipital margin. Mandible as in female (Fig. 38). Antenna with scape 1.8× as long as broad, otherwise as in Fig. 39.

Mesosoma. Mesoscutum and scutellum with sculpture about as in female; setae on mesoscutum silvery white and brown; scutellum with setae brown. Fore wing 2.11× as long as broad; venation and setation as in Fig. 40. Hind wing 3× as long as broad. Mid tibia 3× as long as mid basitarsus; mid basitarsus 1.6× as long as mid tibial spur. *Relative measurements*

(paratype, slide, at 100×): mid tibia length, 37; mid basitarsus length, 12; mid tibial spur length, 7.5.

Metasoma shorter than mesosoma (40:48); genitalia as in Figs 41, 42. [Phallobase 0.54× mid tibia length.]

Material examined: Holotype, female (on card, right antenna beyond distal part of F4 broken off and lost), labelled "INDIA: ARUNACHAL PRADESH: Pasighat, 17.iv.2014 (A.1363[1]), Coll. K. Veenakumari" and "Ex psyllids on *Alstonia*" [2] (NBAIR; registration No. ICAR/NBAIR/EN.47)

Paratypes: 2 females (1 female on slide No. EH.1736), 2 males (1 male on slide No. EH.1737), with same data as holotype. (1 female, 1 male, in NBAIR; registration No. ICAR/NBAIR/EN.48 and 49; 1 female, 1 male, on slides EH.1736 and EH.1737, in ZDAMU; registration No. HYM.CH.723)

[1] This number refers to the number maintained by K. Veenakumari for host reared material.

[2] The host insect was identified as *Pauropsylla tuberculata* Crawford by the first author, M.H. (2 specimens returned to NBAIR and 2 specimens retained in ZDAMU)

Host: *Pauropsylla tuberculata* Crawford (Hemiptera: Psylloidea).

Distribution: India: Arunachal Pradesh.

Comments: This new species does not run to any species in the keys to the species of *Psyllaephagus* Ashmead given by Trjapitzin (1989; Palaearctic species), Noyes & Hanson (1996; Costa Rican species) or Hayat (2006; Indian species) and it runs out at couplet No. 14 in the key to the South African species given by Prinsloo (1981). The new species differs from similar species in having the fore femur dark brown; in other species which are similar to the new species, the fore femur is yellow to white.

Etymology: The species name is derived from the generic name of the host insect.

6. *Trechnites albicrus* Hayat, sp. nov. (Figs 43–46)

urn:lsid:zoobank.org:act:6249E698-865B-4579-AE5C-4E05BCB62977

Female

Holotype. Length, 1.25 mm. Head completely greenish blue. Antenna with radicle dark brown; scape yellow in about basal third and apically, medially brownish; pedicel brown, apical half yellow; funicle brownish yellow; clava brown. Mesosoma dark brown, with pronotum, mesoscutum and axilla shiny greenish blue; scutellum bluish, but not as shiny as mesoscutum;

tegula dark brown. Wings hyaline. Legs, including coxae, whitish yellow. Gaster dark brown, with violet shine.

Head, in frontal view (Fig. 43), 1.22× as broad as high; frontovertex width 0.33× head width; eye height 2.15× malar space; frontovertex with raised, irregular polygonal reticulate sculpture, and with minute setigerous punctures; face with fine, obliquely elongate reticulations; malar space with elongate reticulate sculpture; setae on head largely brown, with some setae white; eye setose, setae hyaline, each seta shorter than a facet. Mandible 4-dentate, upper tooth rounded (Fig. 43). Maxillary and labial palps each 3-segmented. Antenna (Fig. 44) with scape 5.7× as long as broad; pedicel 2.42× as long as broad, longer than F1 and F2 combined, but shorter than F1–F3 combined; F1–F3 individually shorter than F4; F2–F4 very slightly longer than broad, F1 and F5 quadrate; clava 3-segmented, about as long as 3 preceding segments combined; longitudinal sensilla absent on F1. *Relative measurements* (slide, at 100×): head frontal width, 46; head frontal height, 37.5; frontovertex width, 15.5; mouth fossa width, 16; eye height, 28; malar space, 13; antennal scape length, 20.

Mesosoma (Fig. 46). Mesoscutum with notaular lines complete; mesoscutum and axilla with slightly raised, irregular polygonal reticulate sculpture; scutellum with raised reticulate sculpture, slightly elongate on sides, but fading apically, cells deeper than those on mesoscutum; setae pale brown; setae on sides of propodeum distal to spiracles silvery white. Fore wing 2.42× as long as broad, otherwise as in Fig. 45; basal triangle largely bare. Hind wing 3.83× as long as broad. Mid tibia 3× as long as mid basitarsus; mid basitarsus slightly longer than mid tibial spur. *Relative measurements* (slide, at 100×): mesosoma length, 58; mid tibia length, 40; mid basitarsus length, 13; mid tibial spur length, 11.

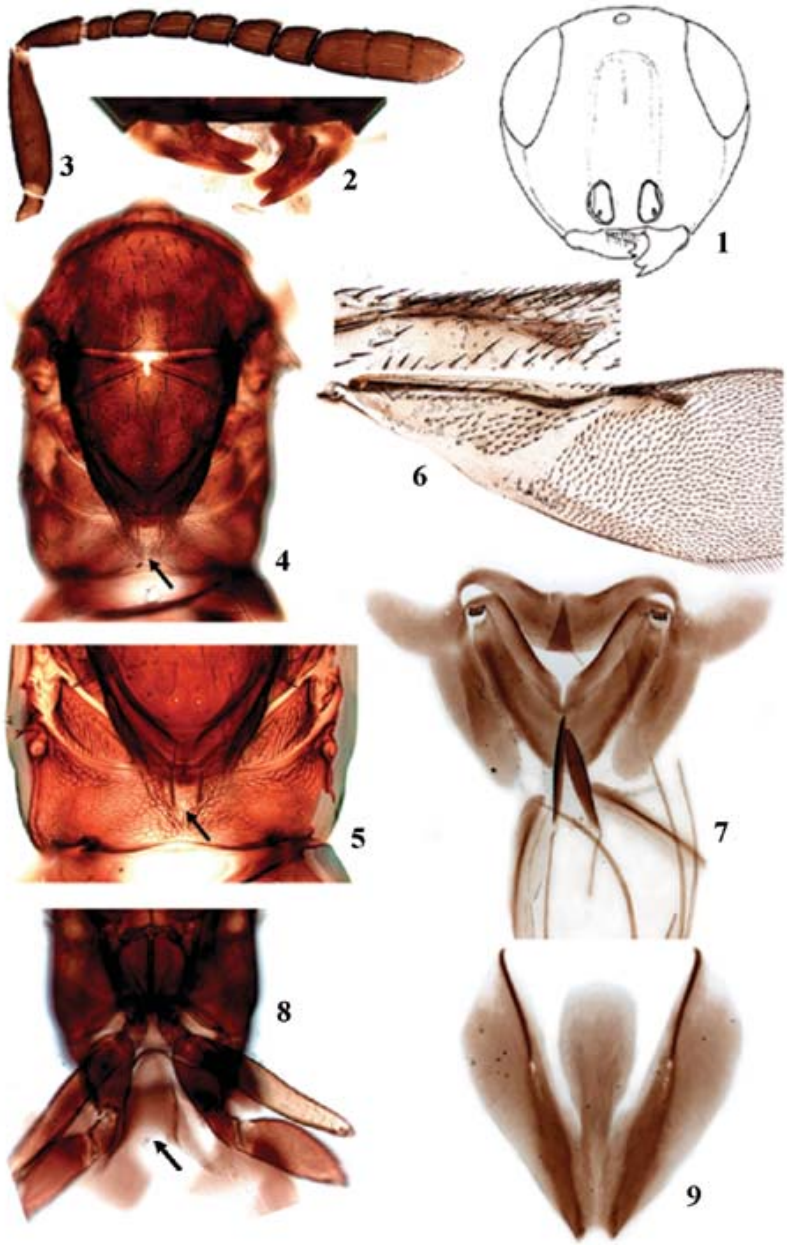
Metasoma. Hypopygium about as in *T. concinnus* Kazmi & Hayat (see Fig. 55). *Relative measurements* (slide, at 100×): metasoma length, 50; ovipositor length, 27; third valvula length, 5.5. [Ovipositor 0.67× mid tibia length; mid basitarsus and mid tibial spur both longer than third valvula, 13:11:5.5]

Male: Unknown.

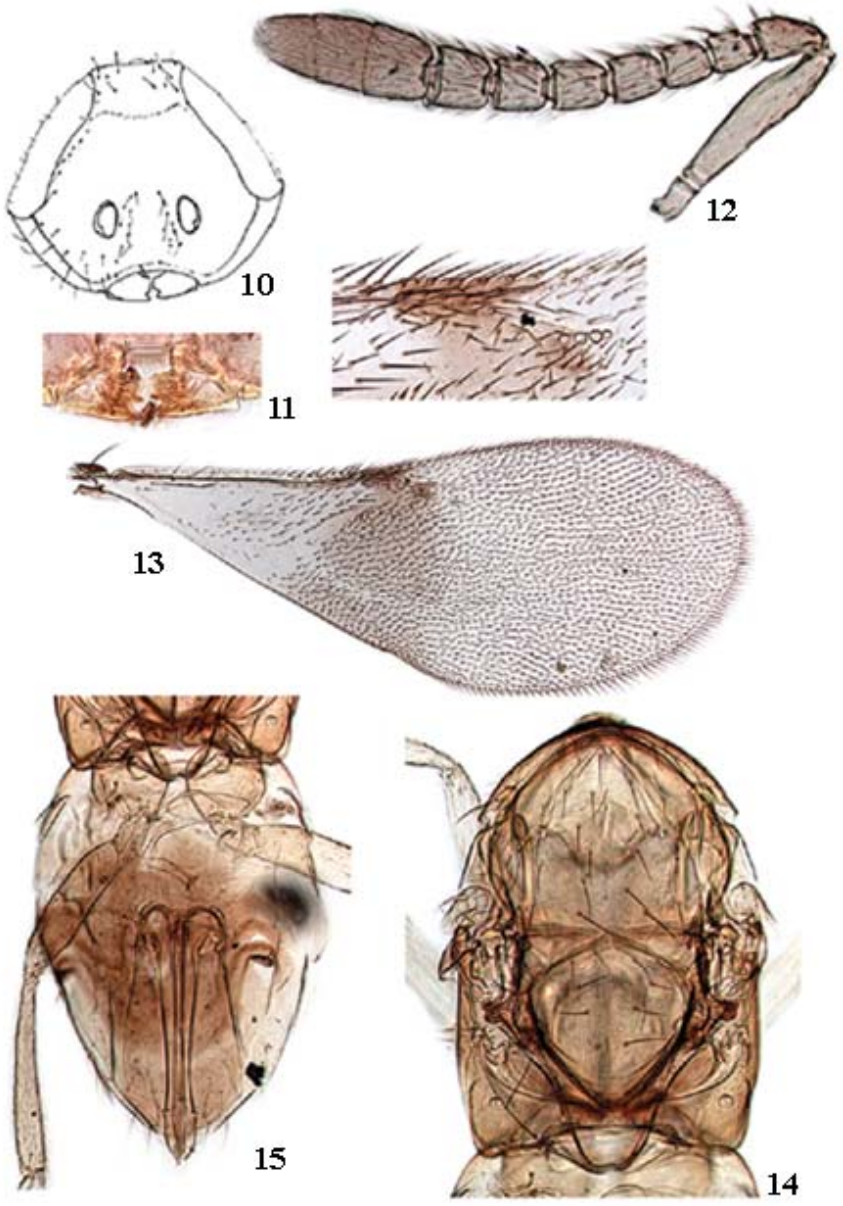
Material examined: Holotype, female (on slide under 4 coverslips, slide No. EH.1745), labelled "INDIA: ARUNACHAL PRADESH: Pasighat, 3.v.2014 (YPT), Coll. K. Veenakumari" (NBAIR; registration No. ICAR/NBAIR/EN.50)

Distribution: India: Arunachal Pradesh.

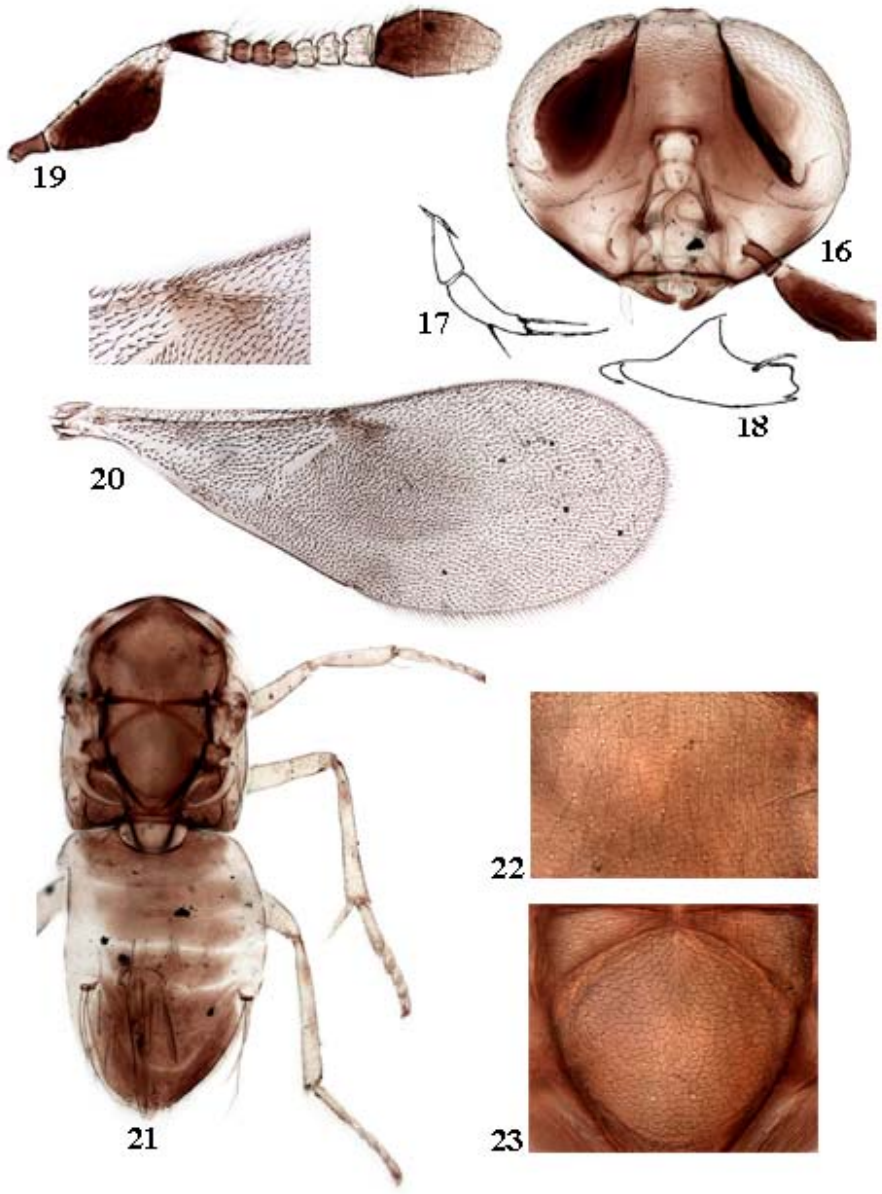
Comments: This species of *Trechnites* Thomson belongs to a group of species characterized by a 3-segmented antennal clava and presence of complete notaular lines on the mesoscutum. To this group belong 8 species of which the following 3 species have their legs, including coxae, completely pale yellow to white: *T. angolensis* Prinsloo (1981), *T. flavipes* (Mercet, 1921), and *T. versicolor* Prinsloo (1981).



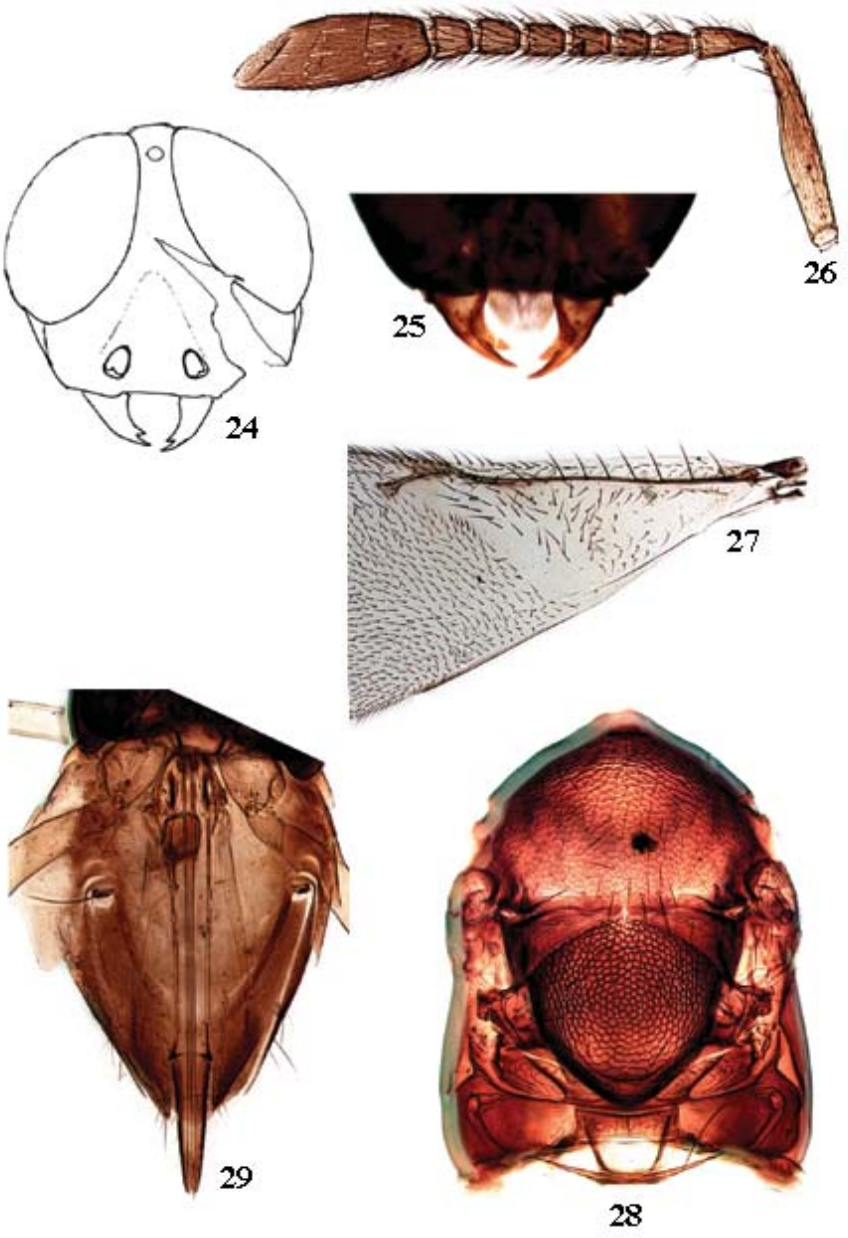
FIGURES 1–9. *Chalaruna indica* Hayat, gen. et sp. nov., female, holotype: 1, head, frontal view; 2, mandibles, 3, antenna; 4, mesosoma, arrow points to the apex of scutellar flange; 5, apex of scutellum, metanotum and propodeum, arrow points to the apex of scutellar flange; 6, fore wing, with distal veins enlarged; 7, TV–TVII and distal part of ovipositor; 8, sternite 1, shown by an arrow; 9, hypopygium.



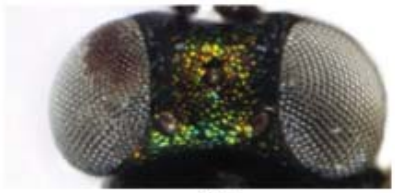
FIGURES 10–15. *Cheiloneuromyia idnia* Hayat, sp. nov., female, holotype: 10, head, frontal view; 11, mandibles; 12, antenna; 13, fore wing, with distal veins enlarged; 14, mesosoma; 15, propodeum and metasoma.



FIGURES 16–23. *Metaphycus zabica* Zeya, sp. nov., holotype, except Fig. 16, female: 16, head, frontal view, paratype; 17, maxillary palp; 18, mandible; 19, antenna; 20, fore wing, with distal veins enlarged; 21, meso- and metasoma; 22, sculpture of mesoscutum; 23, sculpture of scutellum.



FIGURES 24–29. *Ooencyrtus bidentatus* Hayat, sp. nov., female, holotype: 24, head, frontal view; 25, mandibles; 26, antenna; 27, fore wing, basal part; 28, mesosoma; 29, metasoma.



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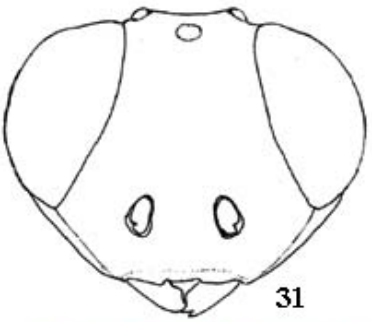

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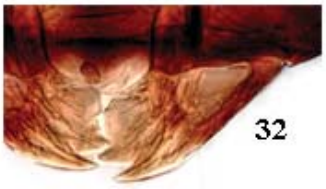

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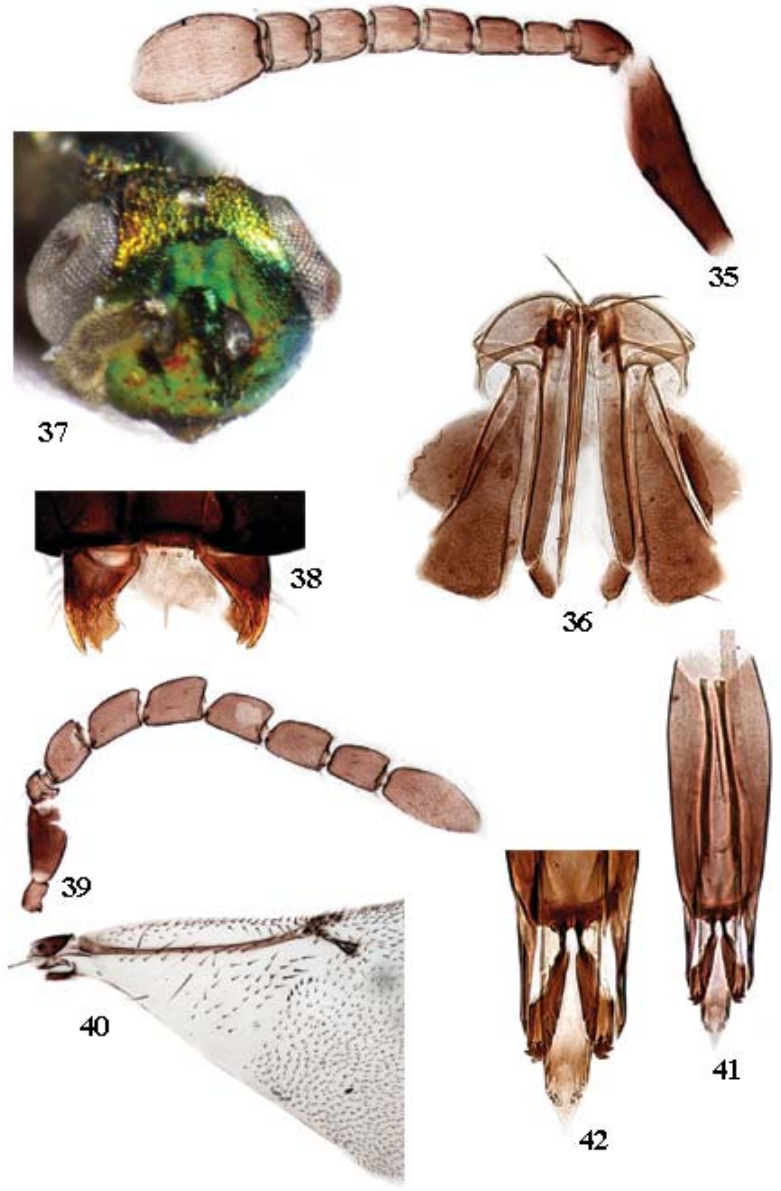
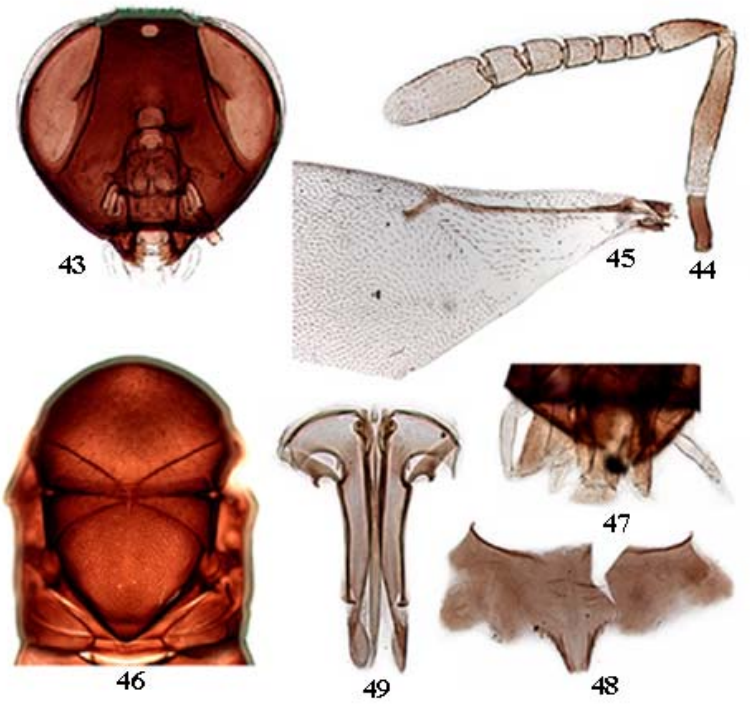
FIGURES 30–34. *Psyllaephagus pauropsylla* Hayat, sp. nov., female, Figs 30 and 33, holotype, rest from paratype: 30, head, dorsal view; 31, head, frontal view; 32, mandibles; 33, head and mesosoma; 34, fore wing basal part, with distal veins enlarged.

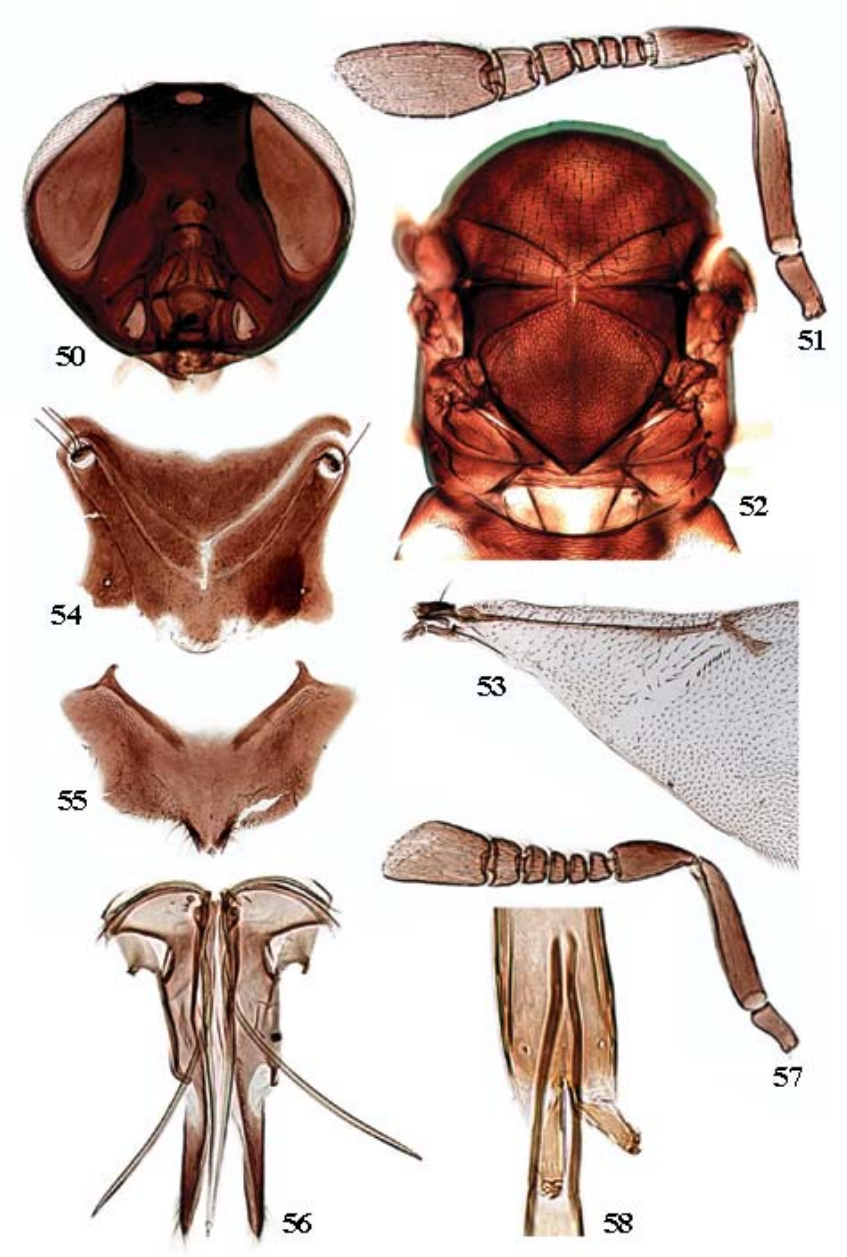


FIGURES 35–42. *Psyllaephagus pauropsylla* Hayat, sp. nov., paratypes: (female, 35, 36): 35, antenna; 36, ovipositor. (Male, 37–42): 37, head, frontal view; 38, mandibles; 39, antenna; 40, fore wing, basal part; 41, genitalia; 42, distal part of genitalia.



FIGURES 43–49. (43–46) *Trechnites albicrus* Hayat, sp. nov., female, holotype:43 head, frontal view; 44, antenna; 45, fore wing, basal part; 46, mesosoma. (47–49) *Trechnites albipodus* Kazmi & Hayat, female, Arunachal Pradesh specimen: 47, palps; 48, hypopygium; 49, ovipositor.

This new species appears similar to the southern African species, *T. versicolor* and *T. angolensis*. It differs from *T. versicolor* in having the head width 2.96× as broad as frontovertex width; antennal scape with basal third and apex yellow, and medially brownish; and sculpture of the scutellum deeper than that on the mesoscutum. (In *T. versicolor:* head width 2.5–2.7× as broad as frontovertex width; antennal scape yellowish; and sculpture of mesoscutum and scutellum of same coarseness. Relative lengths of the ovipositor and mid tibia were not given in the original description.) The new species differs from *T. angolensis* in having the head 2.96× as broad as frontovertex width; and mesoscutum entirely greenish blue. (In *T. angolensis:* head width 3.2× as broad as frontovertex width; and mid lobe of mesoscutum dark metallic green, but side lobes blackish purple. This species was described from a card mounted female (holotype) and 5 males. The female antenna and genitalia were described in relation to *T. versicolor*, and were not illustrated). The new species also differs from *T. flavipes* in having the head width 2.96× as broad as frontovertex width; ovipositor 0.67× mid tibia length; and second valvifer 3.9× as long as third valvula. (In *T. flavipes:* head width 2.5× as broad as



FIGURES 50–58. *Trechnites concinnus* Kazmi & Hayat, Arunachal specimens: (female, 50–56): 50, head, frontal view; 51, antenna; 52, mesosoma; 53, fore wing, basal part; 54, TV–TVII of gaster; 55, hypopygium; 56, ovipositor. (Male): 57, antenna; 58, genitalia, distal part enlarged.

frontovertex width; ovipositor 1.18× as long as mid tibia; and second valvifer 2× as long as third valvula. Based on the diagnosis and illustrations given by Guerrieri & Noyes, 2009).

Etymology: Latin, *albus* = white, *crus* = leg; and refers to the white legs in this species.

Records of species

All the specimens were collected from Pasighat (Arunachal Pradesh) by K. Veenakumari. Therefore collector's name is not given under 'Material examined' section.

Out of the 41 species recorded here, **38 species are newly recorded from Arunachal Pradesh.** The 3 species already known from Arunachal Pradesh are: *Anagyrus diversicornis* (Howard), *Protyndarichoides indicus* Singh & Agarwal and *Tassonia gloriae* Girault.

1. *Adelencyrtus moderatus* (Howard)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female (on slide, No. EH.1739), 10.v.2014 (MT). (ZDAMU).

2. *Aenasius arizonensis* (Girault)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female, 3.v.2014 (YPT). (NBAIR).

3. *Agarwalencyrtus citri* (Agarwal)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 2 females, 3.v.2014 (YPT); 2 females, 4.v.2014 (YPT). (NBAIR).

4. *Anagyrus aquilonaris* (Noyes & Hayat) (*)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female, 5.v.2014 (SN). (NBAIR).

5. *Anagyrus diversicornis* (Howard) (*)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female, 2.v.2014 (SN); 2 females, 3.v.2014 (YPT); 2 females, 7.v.2014 (YPT). (NBAIR).

6. *Anagyrus gracilis* (Hayat) (*)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 3 females, 2.v.2014 (SN) 15 females, 3.v.2014 (YPT); 1 female, 7.v.2014 (YPT); 1 female, 10.v.2014 (YPT). (NBAIR).

7. *Anagyrus shahidi* Hayat (*)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 7 females, 3.v.2014 ((YPT); 1 female, 5.v.2014 (SN); 2 females, 5.v.2014 (YPT); 1 female, 7.v.2014 (YPT). (NBAIR).

8. *Anagyrus tricolor* (Girault) (*)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 2 females, 5.v.2014 (SN); 1 female, 7.v.2014 (YPT). (NBAIR).

9. *Apoleptomastix bicoloricornis* (Girault) (*)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 4 females, 2.v.2014 (SN); 15 females, 3.v.2014 (YPT); 3 females, 5.v.2024 (YPT); 1 female, 10.v.2014 (YPT). (NBAIR).

10. *Blepyrus insularis* (Cameron)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female, 3.v.2014 (YPT); 2 females, 5.v.2014 (YPT). (NBAIR).

11. *Callipteroma sexguttata* Motschulsky (*)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female, 2.v.2014 (SN); 1 female, 5.v.2014 (YPT). (NBAIR).

12. *Cheiloneurus bangalorensis* (Subba Rao)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female, 3.v.2014 (YPT); 1 female, 4.v.2014 (YPT); 4 females, 5.v.2014 (YPT); 2 females, 7.v.2014 (MT); 3 females, 7.v.2014 (YPT); 9 females, 10.v.2014 (MT); 1 female, 10.v.2014 (YPT). (NBAIR).

13. *Cheiloneurus exitiosus* (Perkins)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, Ayung, 1 female, 5.v.2014 (SN); Pasighat, 1 female, 5.v.2014 (YPT). (NBAIR).

14. *Cheiloneurus gonatopodis* Perkins

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 2 females, 2.v.2014 (SN); 1 female, 4.v.2014 (SN); 1 female, 4.v.2014 (YPT); 1 female, 5.v.2014 (SN); 2 females, 7.v.2014 (YPT); 4 females, 8.v.2014 (SN); 3 females, 10.v.2014 (YPT). (2 females in ZDAMU; rest of the material in NBAIR).

15. *Cheiloneurus hadrodorys* Anis & Hayat

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female, 10.v.2014 (MT). (ZDAMU).

16. *Cheiloneurus latifrons* Hayat, Alam & Agarwal

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 3 females, 2.v.2014 (SN); 1 female, 3.v.2014 (YPT); 7 females, 5.v.2014 (YPT); 1 female, 10.v.2014 (MT). (NBAIR).

17. *Cheiloneurus nigricornis* Hayat, Alam & Agarwal

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female, 5.v.2014 (YPT. (NBAIR).

18. *Cheiloneurus quadricolor* (Girault)

Material examined: [mac. = macropterous; brac. = brachypterous] INDIA: ARUNACHAL PRADESH: Pasighat, 1 female, mac., 2.v.2014 (SN); 1 female, brac., 3.v.2014 (YPT); 1 female, mac., 5.v.2014 (SN); 1 female, brac., 7.v.2014 (MT). (NBAIR).

19. *Eugahania flaviscapus* Singh & Agarwal

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 2 females, 5.v.2014 (YPT); 1 female, 7.v.2014 (MT). (1 female in ZDAMU; 2 females in NBAIR).

20. *Gentakola trifasciata* (Saraswat)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female, 7.v.2014 (YPT). (NBAIR).

21. *Haligra concolor* Noyes & Hayat

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female (on slide. EH.1742), 7.v.2014 (MT). (NBAIR).

22. *Homalotylus hemipterinus* (De Stefani)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female, 10.v.2014 (MT). (NBAIR).

23. *Leptomastix salemensis* Hayat, Alam & Agarwal (*)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female, 7.v.2014 (YPT). (NBAIR).

24. *Leptomastix tsukumiensis* Tachikawa (*)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female, 2.v.2014 (SN); 1 female, 3.v.2014 (YPT); 2 females, 5.v.2014 (YPT); 1 female, 7.v.2014 (YPT). (NBAIR).

25. *Metaphycus bolangerae* Hayat (*)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1female, 2.v.2014 (SN); 1 female, 3.v.2014 (SN); 8 females (one on slide No. EH.1837), 5.v.2014 (SN); 1 female, 7.v.2014 (MT); 4 females (one on slide, EH.1838), 7.v.2014 (YPT). (6 females, in ZDAMU; 9 females, in NBAIR)

26. *Metaphycus cassiae* Singh & Hayat (*)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 2 females, 2.v.2014 (SN); 6 females (one on slide, EH.1826), 3.v.2014 (YPT); 7 females, 4.v.2014 (YPT); 1 female, 5.v.2014 (SN); 2 females (on one slide, EH.1827), 7.v.2014 (MT); 2 females, 7.v.2014 (YPT); 1 female, 10.v.2014 (YPT). (8 females, in ZDAMU; 13 females, in NBAIR)

27. *Metaphycus gilvus* Compere (*)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female, 3.v.2014 (YPT); 1 female (on slide, EH.1828), 4.v.2014 (YPT); 7 females (Two on two slides, EH.1829, EH.1830), 5.v.2014 (SN); 4 females, 4 males (Two females, 4 males, on 3 slides, EH.1831, EH.1832, EH.1833), 5.v.2014 (YPT); 2 females (one on slide, EH.1834), 7.v.2014 (YPT). (5 females, 4 males, in ZDAMU; 10 females, in NBAIR)

28. *Neodusmetia sangwani* (Subba Rao)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female, 1 male, 5.v.2014 (SN); 2 females, 7 males, 7.v.2014 (MT); 2 females, 7.v.2014 (YPT); 4 females, 10.v.2014 (YPT); 2 females, 4 males, 10.v.2014 (MT). (NBAIR).

29. *Ooencyrtus guamensis* Fullaway

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 2 females, 3.v.2014 (YPT); 8 females, 1 male, 5.v.2014 (YPT); 4 females, 7.v.2014 (YPT). (NBAIR).

30. *Ooencyrtus segestes* Trjapitzin

Material examined: [mac. = macropterous; brac. = brachypterous] INDIA: ARUNACHAL PRADESH: Pasighat, 8 females, mac., 6 females, brac., 2.v.2014 (SN); 4 females, mac., 22 females, brac., 3.v.2014 (YPT); 1 female, mac., 4.v.2014 (SN); 1 female, mac., 4 females, brac., 5.v.2014 (SN); 1 female, mac., 9 females, brac., 7.v.2014 (YPT); 1 female, brac., 10.v.2014 (YPT). (NBAIR).

31. *Parablatticida citri* (Mercet)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female (on slide, EH.1756), 5.v.2014 ((YPT); 1 female (on slide, EH.1757), 7.v.2014 (YPT). (NBAIR).

32. *Proleurocerus litoralis* Hayat & Kazmi

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female, 3.v.2014 (YPT). (NBAIR).

33. *Protyndarichoides indicus* Singh & Agarwal

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female, 4.v.2014 (YPT); 1 female, 5.v.2014 (SN); 1 female, 7.v.2014 (YPT); 1 female, 10.v.2014 (MT). (1 female in ZDAMU; 3 females in NBAIR).

34. *Psyllaephagus tekeddyensis* Singh & Agarwal

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female (on slide, EH.1820), 7.v.2014 (YPT); 1 female, 3.v.2014 (YPT). (1female, on slide, in ZDAMU; 1 female in NBAIR)

35. *Rhopus gramineus* Hayat (*)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female (on slide EH.1819, left side coverslips), 3.v.2014 (YPT); 1 female (on slide, EH.1817), 4.v.2014 (YPT). (NBAIR).

36. *Rhopus harena* Noyes & Hayat (*)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female (on slide, EH.1818), 2.v.2014 (SN). (NBAIR).

37. *Rhopus nigroclavatus* (Ashmead) (*)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female (on slide, EH.1806), 2.v.2014 (SN); 2 females (one on slide EH.1807, second on slide EH.1819, right side coverslips), 3.v.2014 (YPT); 1 female (on slide EH.1808), 4.v.2014 (YPT); 4 females (on slides EH.1809–EH.1812), 5.v.2014 (YPT); 2 females (on slide, EH.1813), 2 females (on slide, EH.1814), 1 female

(on slide, EH.1815 – antennae missing), 7.v.2014 (YPT); 1 female (on slide, EH.1816), 10.v.2014 (MT). (NBAIR).

38. *Tassonia gloriae* Girault

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female, 5.v.2014 (YPT); Pasighat, Ayang, 1 female, 5.v.2014 (SN). (NBAIR).

39. *Trechnites albipodus* Kazmi & Hayat (Figs 47–49)

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female (on slide, EH.1746), 7.v.2014 (MT). (NBAIR).

Comments: In the original description of this species, Kazmi & Hayat (1995) did not mention the number of segments of the maxillary and labial palps. In the paratype (ZDAMU) from Kerala State as well as in the above listed specimen from Arunachal Pradesh, the maxillary and labial palps are both 2-segmented (Fig. 47). We have also illustrated the hypopygium and the ovipositor (Figs 48, 49)

40. *Trechnites concinnus* Kazmi & Hayat (Figs 50–58)

This species was described by Kazmi & Hayat (1995) from a single female collected in Kerala (India). It is newly recorded here from Arunachal Pradesh, and the male is recorded for the first time. As the head of the holotype was slightly shrunken and the ovipositor length was measured from an intact gaster, we provide here some relative measurements and illustrations (Figs 50–58).

Female

Relative measurements (slide at 100×)—Head frontal width, 37.5; head frontal height, 30; frontovertex width, 13.5; mouth fossa width, 13; eye height, 23; malar space, 9.5; mid tibia length, 29; ovipositor length, 25; third valvula length, 10.

Male

Length, 0.64 mm. More or less similar to female, except for the antenna and genitalia. Antenna (Fig. 57) with funicle segments all transverse; clava solid. Genitalia (Fig. 58) with phallobase 0.57× mid tibia length, and 1.71× as long as mid basitarsus; digitus 0.54× mid tibial spur length; each digitus with two denticles.

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 1 female, 1 male (on slides, EH.1805 and EH.1748), 5.v.2014 (SN); 1 female (on slide, EH.1747), 7.v.2014 (YPT). (1 female, slide EH. 1747, in NBAIR; 1 female, 1 male, slides EH. 1805, EH.1748, in ZDAMU)

41. *Trechnites hairah* Hayat

Trechnites hairah Hayat, in Hayat & Veenakumari, 2013: 102 – 105, female, male. Holotype, female, India, Kerala. Paratypes from Kerala and Andaman & Nicobar Islands.

Material examined: INDIA: ARUNACHAL PRADESH: Pasighat, 3 females, 3.v.2014 (YPT); 3 females, 2 males (1 male, on slide EH.1755), 5.v.2014 (YPT); 1 female, 7.v.2014 (MT); 2 females (on slides, EH.1753, EH.1754), 2 males, 7.v.2014 (YPT); 1 female,10. v.2014 (YPT); 1 male, 10.v.2014 (MT). (3 slides and 2 females in ZDAMU; rest of the material in NBAIR).

Comments: This species was described from specimens collected in Kerala State (holotype, paratypes) and from Andaman and Nicobar Islands (paratype), and later Hayat & Veenakumari (2014) recorded 13 females and 2 males from Andaman and Nicobar Islands.

LIST OF ENCYRTIDAE FROM ARUNACHAL PRADESH (INDIA)

This list includes only the species known prior to the publication of this paper. The reference to the first record of a species from Arunachal Pradesh is given in square brackets. For species described on material (holotypes/paratypes) from Arunachal Pradesh, only the year is enclosed in square brackets.

1. *Agarwalencyrtus dispar* Hayat [Hayat & Kazmi, 2011]

2. *Anagyrus diversicornis* (Howard) [Hayat & Khan, 2009]

3. *Charitopus panchgania* (Mani & Saraswat) [Singh & Agarwal, 1993]

4. *Cladiscodes orientalis* Singh & Agarwal [1993]

5. *Eugahania indicus* Singh & Agarwal [1993]

6. *Ixodiphagus sureshani* Hayat & Kazmi [2011]

7. *Parablatticida brevicornis* (Dalman) [Hayat & Kazmi, 2011]

8. *Parencyrtomyia zedesi* Hayat & Kazmi [2011]

9. *Protyndarichoides indicus* Singh & Agarwal [1993]

10. *Rhytidothorax horticola* Hayat & Kazmi [2011]

11. *Rhytidothorax namdapha* Hayat & Kazmi [2011]

12. *Rhytidothorax nigrum* Singh & Agarwal [Hayat & Kazmi, 2011]

13. *Rhytidothorax ramakrishnai* Hayat & Kazmi [2011]

14. *Sharqencyrtus hulbi* Hayat & Kazmi [2011]

15. *Tassonia amaura* Hayat [Hayat & Khan, 2009]

16. *Tassonia gloriae* Girault [Hayat & Khan, 2009]

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