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Research Article

FAUNAL BIODIVERSITY AND UPDATED ANNOTATED CHECKLIST OF PENTATOMOMORPHA BUGS (HETEROPTERA: ARADOIDEA, COREOIDEA, LYGEOIDEA, PYRRHOCOROIDEA) OF JAMMU, KASHMIR & LADAKH HIMALAYAS (INDIA)

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ABSTRACT
The faunal biodiversity of 34 species of true bugs, fewer than 26 genera, belonging to four super-families and eleven families of Infra-order Pentatomomorpha, occurring in diverse areas and localities of Jammu, Kashmir and Ladakh Himalayan regions, has been dealt with in this paper. 16 spp. of Pentatomomorpha bugs, under 8 families are known to occur in Jammu region. It is followed by Kashmir and Ladakh region, showing prevalence of 14 spp.(of 8 families) and 13 spp.(6 families) respectively. The family Lygaeidae is a dominant family in this State, having 11 spp., followed by Rhyparochromidae, comprising 5 spp. Rest of the 9 families, contain either four or two or one species. The host crops and economically important plants, covering 16 spp. pertaining to 11 families of agricultural crops (fibre, food, fruit, vegetable), medicinal / aromatic and ornamental plants, are found to be damaged by 13 spp., under 10 genera of 6 families of Pentatomomorpha bugs in this State. An updated annotated checklist of bug-fauna has also been presented.

Keywords: *Pentatomomorpha Bugs, Biodiversity, Checklist, Jammu, Kashmir, Ladakh*

INTRODUCTION
The Pentatomomorpha bug-fauna of Jammu, Kashmir and Ladakh Himalayan regions fall in the super - families and families,*viz*. Aradoidea (family (Aradidae), Coreoidea (Alydidae, Coeidae, Rhopalidae, Stenocephalidae), Lygeoidea (Heterogastridae, Lygaeidae, Malcidae, Rhyparochromidae) and Pyrrhocoroidea (Largidae, Pyrrhocoridae). The superfamily Aradoidea is the most basal family of the Infraorder Pentatomomorpha in Jammu and Kashmir region.

This group comprises family Aradidae (bark bugs or flat bugs) and is represented by a single species (*Brachyrhynchustagalicus* Stal). These bugs are dull brown to black in colour, strongly dorsoventrally flattened, mostly cryptic and living under dead trees

The super- family Coreoidea cover: Broad-headed bugs (Alydids), having dusky or blackish colouration and the upper side of the abdomen is usually bright orange red, nor visible, as it is covered by wings; Leaf-footed bugs (Coreoida), variable in shape and size, are large group of bugs and mainly herbivorous; Scentless plant bugs (Rhopalids) are small in size, usually light coloured mainly live on weeds; Spurge bugs (Stenocephalids) arestout-bodied, dark brown in colouration, with black and yellow banded antennae, and front of head bilobed.

The superfamily Lygeoidea includes Seed or Chinch bugs, usually found on the ground among vegetation or under stones or low plants and mostly feeding on seeds. The Hetergastrids are elongate to elongate ovoid, sometimes with an anti-mimetic appearance. The Lygaeids have hard elongated body, usually brown red in colour and number of species is pests of agricultural importance, besides damaging other vegetations. The Malcid or Stalked-eye bug in Kashmir regions includes genus *Chauliops*, causing damage to Beans (Fabaceae). The Rhyparochromids are small and dull bugs, generally brown or mottled, with fore femora often enlarged.

The superfamily Pyrrhocoroidea of Jammu region is represented by family Largidae and Pyrrhocoridae. The Largids (Bordered plant bugs), are medium-sized to large, brightly coloured and characterized by lack of ocelli (simple eyes). These bugs are phytophagous, feeding on plant juices and seeds. Pyrrohocorids, also known as Red bugs or Cotton strainers, are medium- sized, with absence of ocelli.

Many species are short winged or totally wingless. These are phytophagous, mainly attacking plants belonging to family Malvaceae or allied families.

MATERIALS AND METHODS

The database provided in this paper pertains to 34 spp. of Pentatomomorpha bugs, prevalent in diverse habitats in vast areas and localities of J & K State of Indian subcontinent. The bug- fauna is representing three geographically and climatically different Provinces of this State: Trans Himalayanregion, Ladakh (cold desert); Jammu (sub-tropical) and Kashmir (temperate) regions, in western Himalaya. The Pentatomomorphans of these regions of paramount zoo-geographical significance have been updated in the light of recent taxonomical and nomenclatural changes, besides additional faunal records, along with host plant and distributional data, incorporated in the Checklist.

The valid species / genera under various super- families and families are listed under the systematic checklist. In this checklist, the synonyms of the taxa are listed under the valid species, given in parentheses. This checklist also provides the references pertaining to authors reporting and describing taxa from different regions / localities are in the form of code numbers, given in long brackets in front of each listed species. In addition to this, abbreviations in connection with distribution of each listed species in various Provinces and localities of J & K State are also given in the square brackets in front of each listed species. The key to the code numbers and abbreviations, are cited at the end of checklist.

In the recently published paper by Prabkhar (2015) on biogeogrpahical distribution of Coreoidea of India, many already recorded Coreoids from Jammu, Kashmir and Ladakh region have not been included in this paper. In the present communication, the proper distribution of these has been highlighted. For the purpose of updating of systematic changes of Pentatomomorphan bugs, the monumental works by Schuh and Slater (1995), Slater (1995), Aukema and Rieger (2001, 2006) besides, online database by Livermore *et al.*, (2015), have been followed.

RESULTS AND DISCUSSION

Systematic Checklist

Order Hemiptera
Sub-order Heteroptera
Infra-order: Pentatomomorpha
Superfamily 1. Aradoidea
Family Aradidae (Flat bugs)
1. *Brachyrhynchus tagalicus* Stal [J, K (Pir Panjal),17]
Superfamily 2. Coreoidea
Family1. Alydidae (Broad-headed bugs)
Subfamily Alydinae
Tribe Alydini
2. *Riptortus linearis* (Fabricius) [J,K, 20]
Hosts plants: *Desmodium gongetum* DC (Fabaceae), *Murraya koenigii*(Linnaeus)(Rutaceae),*Magnifera indica*(Anacardiaceae)
3 *Riptortus pedestris* (Fabricius) [J, K, 21]
Host plant:*Rauvolfia serpentina* (Apocynaceae)
Subfamily Micrelytrinae
Tribe: Leptocorisini
4. *Leptocorisa acuta* (Thunberg) (Rice ear- head bug) [J,K, 1]
Host plant: *Zea mays*(Poaceae)
5. *Leptocorisa varicornis* Fabricius (Rice bug) [L, 5]
Family 2. Coreidae (Leaf-footed bugs)
Subfamily Coreinae
Tribe 1. Gonocerini

6. *Cletus bipunctatus* (Herrich- Shaffer) [J, K, L,5, 20,21)
Host plants: *Chenopodium ambrosiodes* L (Chenopodiaceae),
*Rumex acetocella*L. (Polygonaceae)
Tribe 2. Homoeocerini
7. *Homoeocerus prominulus* (Dallas) [J,11]
Family 3. Rhopalidae (Scentless plant bugs)
Subfamily Rhopalinae
Tribe 1. Niestrini
8. *Strictopleurus* sp.[L,(Tso Morari, Tso-Kar), 12, 17]
Tribe 2. Rhopalini
9. *Brachycarenus tigrinus* (Schilling) [K, 15]
10. *Corizus hyoscyami hyoscyami* (Linnaeus) [L,2]
(= *Consivius collinus* (Distant) [L,5]
11. *Rhopalus parumpunctatus*Schilling[K,2,15]
Family 4. Stenocephalidae (Spurge bugs)
12. *Dicranocephalus marginicollis* (Puton)
(= *Dicranocephalus kashmirensis* Lansbury) [K, 10, 26]
Superfamily 2. Lygeoidea (Seed or Chinch bugs)
Family 1.Heterogastridae
13. *Artemidorus pressus* Distant [J (Nagrota), 16]
Family 2. Lygaeidae
14. *Dolmacoris deterran* Hutchinson [L (Nyringri,Chungangla),12,17]
Host:*Artemisia minor* Jacquem ex Besser (Compositae)
Subfamily Lygaeinae
15. *Melanotelus villosulus* Stal)[J,7]
16. *Spilostethus saxatilis* Scopoli
(= *Lygaeus saxatilis* Scopoli) [K (Sind valley), 9]
Tribe Lygaeini
17. *Lygaeus equistris* Linnaeus [J, 20]
Host plant:*Withania somnifera* (Solanaceae)
Subfamily Orsillinae
Tribe Nysini
18. *Nysius ericae* (Schilling) [L (Tso Morari, Tso Kar),16]
19. *Nysius ericae alticola* Hutchinson [L(Orortse, Kyan La),12,17]
20. *Nysius graminicola* (Kolenati) [L,12]
21. *Nysius minor* Distant [J,K , 19, 21]
Host plant:*Matricaria chamomilla* L (Asteraceae)
Subfamily Oxycareninae
22. *Bianchiella adelungi* Reuter [L(Leh),17]
23.*Microplax hissarensis* Kiritchenko [L(MitpalTso,Tso Kar)16,17]
24. *Oxycarenus loetus* Kirby [J, K, 20]
Hosts:*Abelmoschusmoschatus* (Malvaceae), *Abutilon indicum*
(Malvaceae)
Family 3. Malcidae
Subfamily Chauliopinae
25. *Chauliops* sp. [K 3,4]
Host plant:*Phaseolus vulgaris*(Fabaceae*)*
Family 4. Rhyparochromidae (Dirt-coloured seed bugs)
Subfamily Rhyparochrominae
Tribe 1. Drymini

26. *Appolonius cincticoris* (Walker) [J(Nagrota),8]
Host: Bark of plant
27. *Appolonius cressus* (Distant) [J (Nagrota),8]
Host: Under side of tree bark
28. *Eremocoris ndicus* Breddin [K, 9]
Tribe 2. Gonianotini
29. *Emblethis horvathiana* Hutchinson [L(Renka-la),12,16,17]
Tribe 3. Megalonotini
30. *Lamprodema brevicollis* Fieber [L (Pongong valley),13,16,17]
Superfamily Pyrrhocoroidea
Family Largidae 1. (Bordered plant bugs)
Subfamily Physopeltinae
Tribe Physopeltini
31. *Physopelta* (*Neophysopelta) gutta gutta* (Burmeister)[J, 22]
(= *Physopelta gutta* (Burmeista) [J, 23,25]
Hosts:*Murraya koenigii* (L.), *Magnifera indica*L.
32. *Physopelta*(*Neophysopelta) slanbuschii* Fabricius [22]
(= *Physopelta schlanbuschi* Fabricius) [J, L, 23]
Host plant:*Murrayakoenigii* (L.)
Family 2. Pyrrhocoridae (Red bugs or Stainers)
Subfamily Pyrrhocorinae
33. *Dysdercus* (*Paradysdercus) cingulatus* (Fabricius)(Red bug)
(= *Dysdercus cingulatus* Fabricius) [J, 25]
Host plant:*Magnifera indica*L
34. *Dysdercus* (*Paradysdercus*) *koenigii* (Fabricius)(Cotton stainer)
(= *Dysdercus koenigii* Fabricius) [J,14]
Host plants: Okra (*Abelmoschus*), Hollyhock(*Alcea*)(Malvaceae),
cotton seed(*Gossypium*)(Malvaceae)

Key to distribution abbreviations and references code numbers:

K= Kashmir; L =Ladakh; J= Jammu; J & K =Jammu and Kashmir

1=Ahad *et al*. (2012); 2= Aukema and Rieger (2006); 3= Bhat (1988); 4= Bhat (1987); 5= Chandra and Kushwaha (2013); 6= Chopra and Rustagi (1980); 7=Chopra and Rustagi (1982); 8= Chopra and Singal (1982); 9= Distant (1910); 10= Dolling (2006); 11= Gupta *et al*. (2013); 12= Hutchinson (1934); 13= Kristschenko (1931); 14= Koul and Sexana (1979); 15= Linnavuori (2012); 16= Mani (1962); 17= Mani and Singh (1961); 18= Mathur and Sharma (1962 a); 19= Mathur and Sharma (1962b);20= Mathur and Srivastava (1967); 21= Srivastava (1982); 22= Stehlik (2013); 23= Tara and Sharma (2010a); 24= Tara and Sharma (2010b); 25= Tara *et al*. (2014); 26= Tshernova (1996).

Bug-faunal Diversity and Species Richness

A total of 34 species of true bugs, distributed over 26 genera, belonging to 4 super-families and 11 families, under Infra-order Pentatomomorpha, is known to be occurring in diverse areas and localities of Jammu, Kashmir and Ladakh Himalyan regions of Indian sub-continent. In this State, two super-families-Lygeoidea and Coreoidea, are dominant, incorporating 4 families each, with former superfamily having 18 spp. of 14 genera whereas latter one having 11 species (8 genera). Rest of the two super-families Pyrrhocoroidea and Aradoidea contains 4 spp.(2 genera) and 1 sp. (1 genus) respectively.

The family Lygaeidae has been found to be a dominant family in this State, containing as many as 11 species, under 8 genera. Lygaeids of Jammu, Kashmir and Ladakh comprise 3 spp., 4 spp. and 6 spp. respectively. The next species-rich family of this State is Rhyparochromidae, having a total of 5 species, with 2 spp. each from Jammu and Ladakh, and 1 sp. from Kashmir. The families, *viz.* Alydidae and Rhopalidae, show 4 spp. each and, Coreidae, Largidae and Pyrrocoridae, having 2 spp. each, known to exist in various Provinces of this State.

Table 1: Total number of bug Species and Genera, under representative superfamilies and the families, belonging to the Infra-order Pentatomomorpha in Jammu, Kashmir and Ladakh region of the J & K State

Superfamily/Family	Number of Species (Genus/Genera)	Distribution in the Region of Jammu & Kashmir State		
		Jammu	Kashmir	Ladakh
Aradoidea	**01(01)**	+	+	-
Aradidae	01(01)	+	+	-
Coreoidea	**11(09)**	+	+	+
Alydidae	04(02)	+	+	+
Coreidae	02(02)	+	+	+
Rhopalidae	04(04)	-	+	+
Stenocephalidae	01(01)	-	+	-
Lygeoidea	**18(14)**	+	+	+
Heterogastridae	01(01)	+	-	-
Lygaeidae	11(08)	+	+	+
Malcidae	01(01)	-	+	-
Rhyparochromidae	05(04)	+	+	+
Pyrrhocoroidea	**04(02)**	+	-	-
Largidae	02(01)	+	-	-
Pyrrhocoridae	02(01)	+	-	-

(+)=Pentatomomorpha bug species, under various superfamilies /families, present in different Provinces of Jammu and Kashmir State.
(-)= Pentatomomorpha bug species absent in the Provinces of J & K State

Table 2: Pentatomomorpha bugs of economic importance, damaging agricultural crops, medicinal /aromatic and ornamental plants of Jammu and Kashmir State

Host Crops/Plants(Family)	Pentatomomorpha bug species (Family)
Fibre Crop	
Cotton seeds(*Gossypium*)(7)	*Dysdercus koenigii*(VI)
Food Crop	
Maize (*Zea mays*) (8)	*Leptocorisa acuta*(I)
Fruits Crop	
Mango (*Magniferaindica*)(1)	*D. cingulata*(IV),*Physopelta gutta gutta*(III),*Riptortus linearis*(I)
Medicinal and aromatic Plants	
Abelomoschus moschatus(7)	*Oxycarenus laetus*(IV)
Abutilon indicum(7)	*O. laetus*(IV)
Artemisia minor(5)	*Dolmacoris deterrana*(IV)
Chenopdium ambrosiodes(4)	*Cletus bipunctatus*(II)
Desmodium gongetum (6)	*R. linearis*(I)
Matricaria chamomilla(2)	*Nysius minor*(IV)
Murraya koenigii(10)	*Physopelta slanbuschii*(III), *P.g.gutta*(III),*R.linearis*(I)
Rauvolfia serpentina(3)	*Riptortus pedestris*(I)
Rumex acetocella(9)	*C. bipunctatus*(II)
Withania somnifera(11)	*Lygaeus equistris*(IV)
Ornamental Plants	
Hollyhock(*Alcea*)(7)	*D. koenigii* (VI)
Vegetable Crops	
Beans (*Phaseolus vulgaris*)(8)	*Chauliops* sp. (V)
Okra(*Abelomoschus*)(7)	*D. koenigii*(VI)

Host crop and plant Family: (1) = Anacardiaceae; (2) = Asteraceae ; (3) = Apocynaceae ; (4) = Chenopodiaceae ; (5) = Compositae; (6) = Fabaceae ; (7) = Malvaceae ; (8) = Poaceae ; (9) = Polygonaceae ; (10) = Rutaceae ; (11) = Solanaceae; (I)= Alydid , (II) = Coreids ; (III) = Largids; (IV) = Lygaeids , (V) = Malcid , (VI): Pyrrhocorids

Rest of the four families (Aradidae, Stenocephalidae, Heterogastridae and Malcidae), species have one species eachknown to be prevalent in various regions of this State (*seeTable 1 and Systematic checklist*). The Alydids, Coreids, Lygaeids and Rhyparochromids, have representative species, distributed in the three Provinces. From Jammu Province, Rhopalid, Stenocephalis and Malcid, have so far not been reported. There are no records of Heterogastrid, Largid and Pyrrhorocorid known from from Kashmir region. The bug species, belonging to families – Aradidae, Stenocephalidae, Heterogastgridae, Largidae and Pyrrhocoridae, have not been reported from Trans Himalyan region (Ladakh). As many as 16 spp. of Pentatomomorpoha bugs, under 8 families, are known to exist in Jammu region. It is followed by Kashmir and Ladakh region, showing prevalence of 14 spp. (of 8 families) and 13 spp.(6 families) respectively (*see systematic Checklist and Table 1*).

Biodiversity of Pentatomomorpha Bugs of Economic Importance

A total of 13 spp. under 10 genera and 6 families, is observed to damage agricultural cops (food, fibre, fruit, vegetables) and other economically important plants like medicinal / aromatic and ornamental plants in diverse areas and localities of J & K State. These bugs damage as many as 16 host crop and plant species, belonging to 11 families. The highest number of Pentatomomorpha bug species*i.e.*9, belonging to families Alydidae, Coreidae, Largidae and Lygaeidae, are known to attack 9 species of medicinal / aromatic plants , under 9 different families. This is followed by 3 spp. of bugs, under family Alydidae, Largidae and Pyrrhocoridae, attacking mango fruit crop in Jammu region. Rest of the crops (cotton, maize, beans, okra) and ornamental plant (hollyhock), are damaged by single species each, under different families (*see Table 2*).

Four species of Lyaeids , *viz. Dolmacoris deterrana*, *Lygaeus equistris*, *Nysius minor* and *Oxycarenus laetus*, damage medicinal/ aromatic plants as *Artemisia minor*,*Withania somnifera*, *Matricaria chamomilla*, *Abelomoschus moschatus*/*Abutilon indicum* respectively. The bug family Alydidae includes three species – *Leptocorisa acuta*, *Riptortus linearis*, *R. pedestris*, found to attack maize crop, mango fruit /*Desmodiumgongetum* (medicinal plant) and *Rauvolfia serpentine* respectively.

Largidae of economic importance include 2 spp.: *Physopelta gutta gutta*, affecting mango fruit and medicinal / aromatic plant (*Murraya koengii*); P. *slanbuschii*, affecting *M. koengii*. Two bug species, under the family Pyrrhocoridae as *Dysdercuskoengii*, damage cotton seed, hollyhock and okra, and *D. cingulata* attack mango fruit. Coreid (*Cletus bipunctatus*),is responsible for damaging medicinal plants (*Chenopodiumambrosiodes*, *Rumex acetocella*) and Malcid (*Chauliops*) is known to damage bean crop.

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