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Checklist of hemipteran fauna of Jhunjhunu, Rajasthan, India

Vivek Singh Maharia[1*], M M Trigunayat[2]
[1] Assistant Professor, Department of Zoology, Govt. Science College, Sikar, Rajasthan, India
[2] Professor of Zoology and former Principal, Govt. R.D. Girls P.G. College, Bharatpur, Rajasthan, India

Abstract
Jhunjhunu, located in the semi-arid region of Rajasthan, was the focus of this study. The aim was to explore the diversity of hemipteran species found in Jhunjhunu and prepare an updated checklist of the species. Data collected up to 2020 reflected a total of 55 species from 46 genera and 23 different families. Family Aphididae and Pentatomidae each with 8 species were the most dominant, followed by Coreidae and Cicadellidae each with 4 species.

Keywords: Semi-arid, Checklist, Hemiptera, Diversity, Jhunjhunu

Introduction

Phylum Arthropoda is estimated to have a total of 12,57,040 described species. Among these, class Insecta is the most successful, accounting for over 80% of all arthropods (Zhang, 2013) [24]. Insects are not only the world's most diverse group of animals in terms of taxonomic diversity but also play a crucial ecological role. They represent the vast majority of species in terrestrial and freshwater ecosystems. In fact, insects are estimated to comprise more than 75% of all known animal species (Belamkar and Jadesh, 2014) [1]. With approximately 7,51,000 known species, insects make up about three-fourths of all known species of plants and animals on the planet (Choudhary and Ahi, 2015) [5].

A recent estimate suggests that out of the approximately 63,760 insect species found in India, about 21,166 species are endemic (Sankarganesh, 2017) [21]. There are 1,03,590 species of hemipterans globally and the Zoological Survey of India (ZSI) has reported the presence of 6,479 species of Hemiptera belonging to 92 families in India. Among these known taxa, 2,421 species are endemic to India (Chandra, 2011) [4]. In Rajasthan, a comprehensive literature review revealed the recording of 878 insect species and subspecies, belonging to 104 families and 14 orders (Prajapat and Meena, 2021 [20]). The Thar Desert area is home to a total of 74 species, found in 51 genera and 22 families of Hemiptera, as documented in various studies (Buckton, 1899 [3]; Distant, 1902-1918 [6-12]; Kushwaha and Sharma, 1961) [15]. Presently, the state of Rajasthan has records of 34 species belonging to 19 genera and 10 families of aquatic and semi-aquatic Hemiptera (Lyngdoh *et al*., 2021) [16]. The order Hemiptera comprises two main suborders: Heteroptera, known as true bugs and Homoptera, which includes cicadas, leaf-hoppers, tree-hoppers, plant-hoppers, aphids, whiteflies and others. Hemipteran insects hold significant economic importance, as many of them are agricultural pests affecting various crops. Unfortunately, there is no comprehensive account of the Hemiptera species specifically found in Jhunjhunu, Rajasthan except few scattered information (Ghosh *et al*., 1996 [13]; Sima and Srivastava, 2012 [22]; Maharia and Trigunayat, 2019 [18]; Sima and Srivastava, 2020 [23]; Maharia and Trigunayat, 2021 [19] and 2023 [17]). To address this gap, the present investigation undertook a survey in different locations of Jhunjhunu, Rajasthan and its surrounding areas, aiming to collect and identify species of hemiptera.

Material and methods

The study area, Jhunjhunu, is situated in the northeastern part of Rajasthan, spanning between 27°38'-28°31' north latitudes and 75°02'-76°06' east longitudes. It encompasses a geographical area of approximately 5,926 square kilometers. The survey was conducted within Jhunjhunu and its surrounding regions, with sampling carried out on a monthly basis. The sampling was done during different seasons, including summers, winters, and monsoons. The study was conducted over a period from March 2018 to February 2020. To ensure unbiased results, sites were selected in various habitats within Jhunjhunu, avoiding any predetermined spatial or temporal biases. The selection of sites was done randomly across different seasons. The study primarily focused on four major sites, while additional sites were also visited for the collection of hemipteran species.

The major sites where sampling was carried out are mentioned in Table 1.

Table 1: The major sampling sites.

Sites	Location	Vegetation
A-1	Waterhole in Beed conservation reserve	Forest
A-2	Beed area	Forest
A-3	Private agricultural land	Various crops
A-4	Ambedkar park and its adjoining habitats	Grassland

In addition to the prominent sites mentioned, opportune surveys were conducted at various minor locations, including the park near the Rani Sati temple, Sitasar village, Dhigal village, and others.

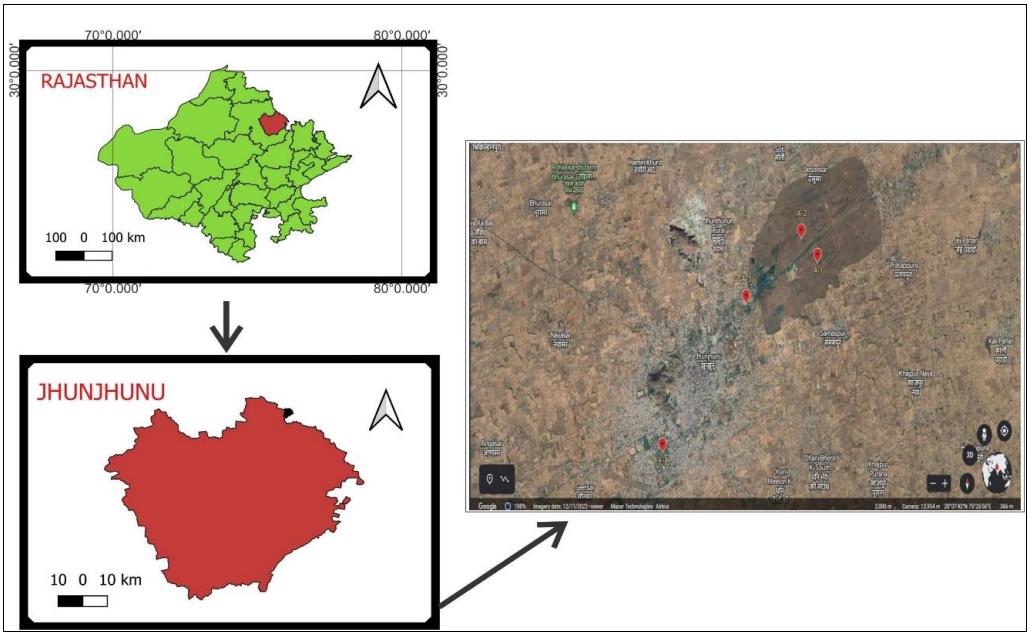

Fig 1: The map showing different locations of the study area

Different methods such as Light trap, Aquatic net and Hand-picking were used to trap hemipteran insects. A light trap was designed and assembled with the help of two bamboo sticks raised vertically. A light source (70W LED Bulb) was hung on a horizontal stick fastened on vertical sticks. A funnel (diameter 7.5 inches) was held below the light source to collect the insects. The trap was run for 3 hrs on every trap night. All the collected insects were photographed using camera DSLR Nikon D3300 and mobile phone camera. The collected insects were subjected to ethyl acetate killing bottles and allowed to remain in the bottle for some time. After the knockdown, these were spread on a stretching/ spreading board, pinned and allowed for drying. Large and medium-sized insects were preserved by dry preservation and kept in an insect box and small bugs were preserved in 70% ethanol in glass vials. The preserved bugs were observed under stereo microscope Olympus SZX-10 and SZX-16 models available at Deptt. Of Zoology, Govt. R.D. Girls College, Bharatpur and taxonomic details were noted.

The identification was done using taxonomic keys after various volumes on Rhynchota by Distant (1902 [6],1904 [7],1906 [8],1908 [9],1910 [10],1916 [11] and 1918 [12]); various pictorial sources on internet; India biodiversity portal and Biswas *et al.*, (2014) [2]. On many occasions personal communication with scientist at Desert regional station of Zoological Survey of India, Jodhpur was undertaken.

Results and discussion

After conducting the survey and extensive studies, a comprehensive list of 55 Hemipteran species was prepared. Total of 55 species belonging to 46 genera were grouped under 15 superfamilies and 23 families. The largest number of species were observed in the families Aphididae (14.55%) and Pentatomidae (14.55 %) followed by Cicadellidae and Coreidae (7.27 %). The specific details of the species observed in the area are shown in Table 2. The family-wise distribution of hemipteran species is given in Table-3 and Figure-2.

In earlier studies (Sima and Srivastava, 2012 [22] and 2020 [23]) 12 species of hemiptera were reported where they mentioned *Dysdercus cingulatus* and *Dysdercus koenigii* as two separate species. *Dysdercus cingulatus* nowadays is named as *Dysdercus koenigii*.

Pentatomidae is the largest family of Pentatomoidea superfamily and many of them are agricultural pests and are resistant to pesticides. They are potential threats to the crops like Bajra, Moong, Moth, many vegetable crops, shrubs, trees etc. in the study area. Aphididae also is a large family in Aphidoidea. They suck sap from the crop plants and cause heavy losses. They are known to carry plant viruses also. *Myzus persicae* is a known vector of PLRV (Potato leafroll virus). Cicadellidae includes leaf hoppers, which suck sap from various crop plants. They are also known to carry plant viruses. Some species of leafhoppers can transmit plant pathogens. Species of *Empoasca* are agricultural pests known in the area. Coreidae are leaf-footed bugs and sap suckers. Their tendency was found to seek shelter within leaves or scrapes. Their presence was marked in Cucurbit plantations.

The identification process for some of the collected Hemipteran insects is still underway and more comprehensive results shall be communicated in future.

Table 2: Checklist of hemipteran species in Jhunjhunu, Rajasthan

	Sub Order- Heteroptera		
➢ Superfamily- Pentatomoidea			
Family	**Subfamily**	**S.N.**	**Scientific Name**
• Pentatomidae	❖ Pentatominae	1	*Nezara viridula* (Linnaeus, 1758)
		2	*Bagrada hilaris* (Burmeister, 1835)
		3	*Aspongopus janus* (Fabricius, 1775)
		4	*Halyomorpha halys* Stål, 1855
		5	*Piezodorus hybneri* (Gmelin, 1790)

		6	*Halys dentatus* (Fabricius,1775)
	❖ Asopinae	7	*Andrallus spinidens* (Fabricius,1787)
	❖ Cydninae	8	*Cydnus indicus* Westwood, 1803
• Scutelleridae	❖ Scutellerinae	9	*Chrysocoris stollii* (Wolff, 1801)
		10	*Chrysocoris patricius* (Fabricius, 1798)
➢ Superfamily-Pyrrhocoroidea			
• Pyrrhocoridae	❖ Pyrrhocorinae	11	*Dysdercus koenigii* (Fabricius, 1775)
➢ Superfamily- Tingoidea			
• Tingidae	❖ Tinginae	12	*Urentius hystricellus* Richter, 1869
		13	*Urentius echinus* Distant,1892
➢ Superfamily- Reduvioidea			
• Reduviidae	❖ Reduviinae	14	*Acanthaspis quinquespinosa* Fabricius,1781
	❖ Stenopodainae	15	*Oncocephalus Sp.* Klug,1830
➢ Superfamily - Lygaeoidea			
• Lygaeidae	❖ Lygaeinae	16	*Spilostethus pandurus* (Scopoli, 1763)
	❖ Oxycareninae	17	*Oxycarenus laetus* Kirby, 1891
➢ Superfamily - Coreoidea			
• Coreidae	❖ Pseudophloeinae	18	*Clavigrella gibbosa* Spinola, 1837
	❖ Coreinae	19	*Homoeocerus signatus* (Walker,1871)
		20	*Homoeocerus variabilis* Dallas,1852
		21	*Cletus bipunctatus* (Herrich-Schaffer,1840)
➢ Superfamily - Gerroidea			
• Gerridae	❖ Gerrinae	22	*Onychotrechus rhexenor* Kirkaldy,1903
		23	*Limnogonus fossorum* Fabricius,1775
➢ Superfamily - Notonectoidea			
• Nepidae	❖ Nepinae	24	*Laccotrepes maculates* (Fabricius,1775)
		25	*Ranatra filiformis* Linnaeus,1758
		26	*Ranatra elongata* Fabricius,1790
• Belostomatidae	❖ Belostomatinae	27	*Diplonychus rusticus* (Fabricius,1871)
	❖ Lethocerinae	28	*Lethocerus indicus* (Lepeletier and Serville,1825)
➢ Superfamily - Corixoidea			
• Corixidae	❖ Corixinae	29	*Corixa lima* Linnaeus,1758
		30	*Corixa hieroglyphica* Dufour,1833
	Sub Order-Homoptera		
➢ Superfamily - Fulgoroidea			
• Flatidae	❖ Flatinae	31	*Siphanta acuta* (Walker,1851)
• Lophopidae	❖ Lophopinae	32	*Pyrilla perpusilla* (Walker,1851)
• Eurybrachidae	❖ Eurybrachinae	33	*Eurybrachys tomentosa* (Fabricius,1775)
➢ Superfamily - Cicadelloidea			
• Cicadellidae	❖ Typhlocybinae	34	*Amrasca biguttula* (Ishida,1912)
		35	*Amrasca devastans Distant,1918* [12]
	❖ Cicadellinae	36	*Empoasca kerri* (Singh- Pruthi,1940)
		37	*Empoasca motti* (Singh- Pruthi,1940)
• Membracidae	❖ Membracinae	38	*Oxyrachis tarandus* Fabricius,1787
		39	*Oxyrachis geniculata* Ananthasubramanian, 1980
		40	*Tricentrus bicolor* Distant,1908 [9]
➢ Superfamily - Aleyrodoidea			
• Aleyrodidae	❖ Aleyrodinae	41	*Bemisia tabaci* (Gennadius,1889)
➢ Superfamily - Aphidoidea			
• Aphididae	❖ Aphidinae	42	*Lipaphis erysimi* (Kaltenbach,1843)
		43	*Aphis gossypii* (Glover,1877)
		44	*Aphis craccivora* (Koch,1854)
		45	*Brevicorynae brassicae* (Linnaeus,1758)
		46	*Setaphis bougainvilleae* Berlese,1903
		47	*Rhopalosiphum maidis* (Fitch,1856)
		48	*Schizaphis graminum* (Rondani, 1852)
		49	*Myzus persicae* Sulzer, 1776
➢ Superfamily -Coccoidea			
• Pseudococcidae	❖ Maconellicoccinae	50	*Maconellicoccus hirsutus* (Green, 1908)
• Coccidae	❖ Ceroplasinae	51	*Ceroplastes ceriferus* (Fabricius, 1798)
	❖ Coccinae	52	*Macropulvinaria maxima* (Green,1904) [7]
• Margarodidae	❖ Margarodinae	53	*Drosicha mangiferae* (Stebbing,1903)
• Kerriidae	❖ Keriinae	54	*Tachardia lacca* (Chamberlin,1923)
➢ Superfamily - Psylloidea			
• Liviidae	❖ Liviinae	55	*Diaphorina citri* (Kuwayama,1908)

Table 3: Family-wise distribution of hemipteran species in the study area

S. No.	Name of the family	Number of species	Percent distribution
1.	Aleyrodidae	1	1.82
2.	Aphididae	8	14.55
3.	Belostomatidae	2	3.64
4.	Cicadellidae	4	7.27
5.	Coccidae	2	3.64
6.	Coreidae	4	7.27
7.	Corixidae	2	3.64
8.	Eurybrachidae	1	1.82
9.	Flatidae	1	1.82
10.	Gerridae	2	3.64
22.	Kerriidae	1	1.82
11.	Liviidae	1	1.82
12.	Lophopidae	1	1.82
13.	Lygaeidae	2	3.64
14.	Margarodidae	1	1.82
15.	Membracidae	3	5.45
16.	Nepidae	3	5.45
17.	Pentatomidae	8	14.55
18.	Pseudococcidae	1	1.82
19.	Pyrrhocoridae	1	1.82
20.	Reduviidae	2	3.64
21.	Scutelleridae	2	3.64
23.	Tingidae	2	3.64

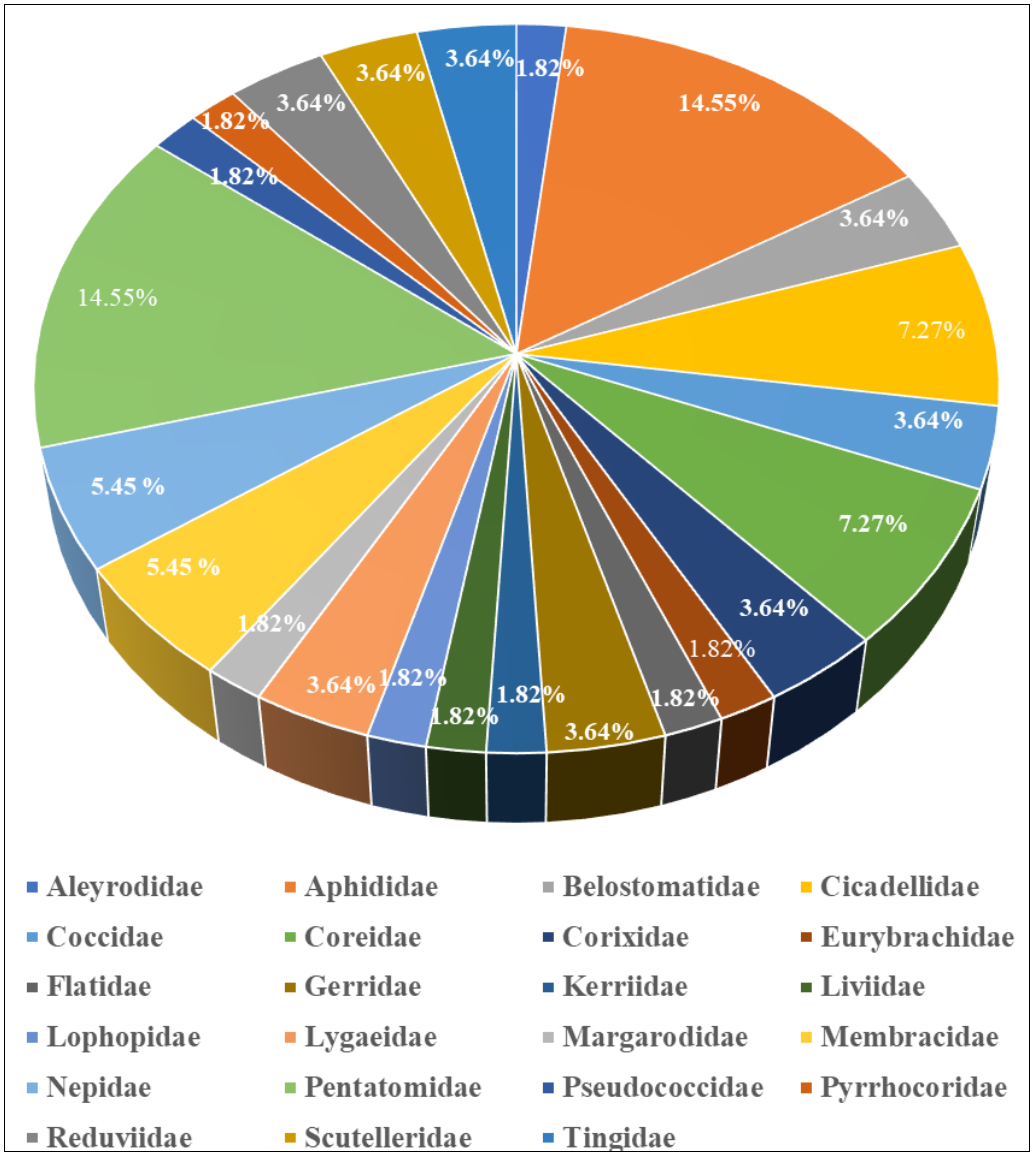

Fig 2: Percent of Species of Different Hemipteran Families

Conclusion

Jhunjhunu, located in the Shekhawati region of Rajasthan, is a rapidly developing city facing the challenge of maintaining a balance between preserving its natural biodiversity and accommodating upcoming infrastructure projects. This poses a significant challenge for entomologists working in the area. Agriculture serves as a vital source of income for many residents in the study area Hemiptera, known as plant bugs are potent pests that cause damage to agriculture and also cause various diseases rendering marginal farmers into heavy losses. The knowledge of local bug fauna and their occurrence, therefore, is necessary to formulate and initiate control measures to safeguard agricultural productivity.

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