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Study on Specie Diversity, Zoogeographical Distribution and Ecological Properties of the Miridae (Hemiptera) Family in the Hulun Buir City, Inner Mongolia of China

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Abstract. The main aim of this study was to understand the species diversity composition, zoogeographic distribution and ecological properties of the family Miridae (Hemiptera) from the Hulun Buir city. Our results showed there were 51 genera 122 species, including three new record species of China and one endemic species of China. In the world animal geographical fauna, the composition of Palaearctic region was dominant. There were 79 species only distributed there, about 64.75 % of the total known. Studies of ecological properties had shown the most species were distributed in 48 ° 01' -49 ° N and the most appropriate altitudinal range was 601-800 m.

Keywords: Miridae, species diversity, zoogeographical distribution, ecological properties.

1. Introduction

The Hulun Buir city is located in 47° 05′ - 53° 20′ N and 115° 31′ - 126° 04′ E, Northeast of Inner Mongolia of China; and having an area of approximately 253,000 square kilometers[1]. Its territory has famous Hulun Buir Grassland. The city is a transitional zone from the forest meadows of Northeast of China to arid grassland. In recent years, due to the large area of farmland reclamation and mine development, coupled with the rapid development of tourism, the Hulun Buir city showing habitat fragmentation, has become Chinese typical ecological fragile area.

Miridae is the first largest family of Heteroptera of Hemiptera. Up to now, more than 1,400 genera, 11,139 species have been described worldwide (Schuh, 2002-2013, http://research.amnh.org/pbi/catalog/). Most Miridae are herbivorous, especially *Lygus* spp., *Trigonotylus* spp. and *Apolygus* spp. likely become threatening pasture pests. Our study focuses on the following three aspects, studying the species diversity composition, zoogeographic distribution and ecological properties of Miridae in order to provide some supporting data for further the relevant biogeography, biodiversity conservation, ecology research etc.

2. Materials and Methods

Our data were compiled from three resources: from all the literatures published up to now; from all the collected records between June and September of 2011-2015 deposited in Inner Mongolia University for the Nationalities; from accumulation label records of specimens and/or types deposited in the Nonnaizab Entomology Research Center of Inner Mongolia Normal University. According to the literatures [2]-[4], all the specimens were sorting, classification, verification and identification. In addition, we also conducted the

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zoogeographical distribution analysis according to classical six zoogeographical regions [5].Using Excel 2010 statistical software, we made ecological properties analysis to Miridae of Hulun Buir.

Table 1: Miridae species composition of Hulun Buir city and their zoogeographical distribution
PA: Palaearctic region, OR: Oriental region, NEA: Nearctic region, ET: Ethiopian region, ● New record species of China; ▲endemic species of China

Subfamily	Genus	Species	Zoogeographical Distribution
Deraeocorinae	*Deraeocoris*	*D. annulipes* (Herrich-Schaeffer)	PA
		D. ater (Jalovlev)	PA
		D. kerzhneri Josifov	PA
		D. morio (Boheman)	PA
		D. olivaceus (Fabricius)	PA
		D. pallidicornis Josifov	PA
		D. punctulatus (Fallén)	PA, NEA
		D. salicis Josifov	PA
		D. scutellaris (Fabricius)	PA
Mirinae	*Adelphocoris*	*A. fasciaticollis* Reuter	PA, OR
		A. ferrugineus Hsiao	PA
		A. laeviusculus Vinokurov	PA, OR
		A. lineolatus (Goeze)	PA, OR
		A. melanocephalus Reuter	PA
		A. nigritylus Hsiao	PA, OR
		A. obliquefasciatus Lindberg	PA, OR
		A. ponghvariensis Josifov	PA, OR
		A. quadripunctatus (Fabricius)	PA, OR
		A. reicheli (Fieber)	PA
		A. rufescens Hsiao	PA, OR
		A. tenebrosus (Reuter)	PA
		A. triannulatus (Stål)	PA
	Apolygus	*A. lucorum* (Meyer-Dür)	PA, OR, NEA
		A. nigronasutus (Stål)	PA
		A. nigrovirens (Kerzhner)	PA
		A. spinolae (Meyer- Dür)	PA, OR
	Capsodes	*C. gothicus* (Linnaeus)	PA
	Capsus	*C. cinctus* (Kolenati)	PA, NEA
		C. pilifer Remane	PA
		C. wagneri Remane	PA
	Lygidea	*L. illota* (Stål)	PA
	Lygocoris	*L. pabulinus* (Linneaus)	PA, OR, NEA
	Lygus	*L. adspersus* (Schilling)	PA
		L. gemellatus (Herrich-Schaeffer)	PA
		L. orientis Aglyamzyanov	PA, NEA
		L. pratensis (Linnaeus)	PA
		L. punctatus (Zetterstedt)	PA, OR, NEA
		L. rugulipennis Poppius	PA
		L. sibiricus Aglyamzyanov	PA
		L. wagneri Remane	PA
	Neolygus	*N. chinensis* (Lu and Yasunaga)	PA
	Orthops	*O. forelii* Fieber ●	PA
		O. mutans (Stål)	PA, OR
		O. scutellatus Uhler	PA
	Phytocoris	*P. insignis* Reuter	PA
		P. nowickyi Fieber	PA
	Polymerus	*P. brevicornis* (Reuter)	PA
		P. carpathicus (Horvath)	PA
		P. cognatus (Fieber)	PA
		P. funestus (Reuter)	PA
		P. palustris (Reuter)	PA, OR
		P. pekinensis Horvath	PA, OR, NEA
		P. unifasciatus (Fabricius)	PA, OR
	Actitocoris	*A. signatus* Reuter*	PA, NEA
	Leptopterna	*L. albescens* (Reuter)	PA
		L. kerzhneri Vinokurov	PA
		L. xilingolana Jorigtoo and Nonnaizab▲	PA
	Myrmecoris	*M. gracilis* (Sahlberg)	PA
	Notostira	*N. sibirica* Golub	PA, OR
	Stenodema	*S. calcarata* (Fallén)	PA
		S. holsata (Fabricius)	PA
		S. mongolia Nonnaizab and Jorigtoo	PA
		S. parvulum Zheng	PA, OR
		S. pilosa (Jakovlev)	PA, OR
		S. sericans (Fieber) ●	PA
		S. sibirica Bergroth	PA
		S. trispinosa Reuter	PA, NEA
		S. turanic Reuter	PA

		S. virens (Linnaeus)	PA, NEA
	Teratocoris	*T. saundersi* Douglas and Scott	PA, NEA
	Trigonotylus	*T. caelestialium* (Kirkaldy)	PA, NEA, OR
		T. cremeus Golub	PA
		T. longitarsus Golub	PA
		T. ruficornis (Geoffroy)	PA, NEA, ET
Orthotylinae	*Anapus*	*A. kirschbanumi* Stål●	PA, NEA
	Euryopicoris	*E. nitidus* (Meyer-Dür)	PA
	Halticus	*H. apterus* (Linnaeus)	PA, NEA
		H. pusillus (Herrich-Schaeffer)	PA
	Labops	*L. bami* Kulik	PA
		L. nivchorum Kerzhner	PA
		L. sahlbergi (Fallén)	PA, NEA
	Myrmecophyes	*M. alboornatus* (Stål)	PA
	Orthocephalus	*O. funestus* Jakovlev	PA
	Strongylocoris	*S. leucocephalus* (Linnaeus)	PA
	Blepharidopterus	*B. angulatus* (Fallén)	PA, NEA
	Cyllecoris	*C. equestris* Stål	PA
	Cyrtorhinus	*C. caricis* (Fallén)	PA, NEA
	Excentricus	*E. planicornis* (Herrich-Schaeffer)	PA
	Globiceps	*G. flavomaculatus* (Faricius)	PA
	Labopidea	*L. algens* (Vinokurov)	PA
	Mecomma	*M. dispar* (Boheman)	PA
	Orthotylus	*O. flavosparsus* (Sahlverg)	PA, NEA
		O. interpositus Schmidt	PA
		O. oschanini Reuter	PA
		O. parvulus Reuter	PA
	Ulmocyllus	*U. virens* Seidenstucker	PA
Phylinae	*Hallodopus*	*H. sibiricus* Poppius	PA
	Acrotelus	*A. pilosicornis* (Reuter)	PA
	Atomoscelis	*A. asiatica* (Josifov)	PA
		A. onustus (Fieber)	PA, NEA
	Chlamydatus	*C. pulicarius* (Fallén)	PA, NEA
		C. pullus (Reuter)	PA, NEA
	Compsidolon	*C. pumilum* (Jakovlev)	PA, NEA
	Criocoris	*C. crassicornis* (Hahn)	PA
		C. quadrimaculatus (Fallén)	PA
		C. sibiricus Kerzhner	PA
	Europiella	*E. leucopus* (Kerzhner)	PA
	Eurycolpus	*E. flaveolus* (Stål)	PA
	Excentricoris	*E. pictipes* (Reuter)	PA
	Macrotylus	*M. mundulus* (Stål)	PA
		M. zinovievi Kezhner	PA
	Phaeochiton	*P. caraganae* (Kerzhner)	PA
	Plagiognathus	*P. chrysanthemi* (Wolff)	PA, NEA
		P. collaris (Matsumura)	PA
	Psallopsis	*P. kirgisicus* (Becker)	PA
	Psallus	*P. betuleti* (Fallén)	PA, NEA
		P. fallenii Reuter	PA, NEA
		P. ulmi Kerzhner and Josifov	PA
	Sacculifer	*S. picticeps* Kerzhner	PA
	Pilophorus	*P. cinnamopterus* (Kirschbaum)	PA, NEA
		P. clavatus (Linnaeus)	PA, NEA
		P. setulosus Horvath	PA

3. Results

3.1. Species diversity composition and zoogeographical distribution of Miridae

A total of 122 species from 4 subfamilies 51 genera were recorded from Hulun Buir city. Among of them, *Orthops forelii* Fieber, *Anapus kirschbanumi* Stål and *Stenodema sericans* Fieber were new record species of China; and *Leptopterna xilingolana* Jorigtoo and Nonnaizab was the endemic species of China. The subfamily Mirinae had the most abundant species diversity (65 species), followed by Phylinae (26 species). The genus *Adelphocoris* Reuter had the most species (13 species).

The analysis of zoogeographical distribution showed all the genera and species were distributed in the Palaearctic region. But, there were 79 species only distributed in the Palaearctic region, accounting for 64.75% of the total known number. And other species were distributed by cross- regions. For example, there were 22 species distributed across the Palaearctic and Nearctic regions; 15 species across the Palaearctic and Oriental regions. Table 1 showed the species diversity composition and their zoogeographical distribution.

3.2. Ecological properties analysis to the Miridae of Hulun Buir city

Because vegetation with a clear geographical differentiation in the horizontal direction in Hulun Buir city [6], it is necessary to study horizontal distribution of Miridae. The latitudinal range (47 °47'- 52 °04' N) was further divided into 6 intervals. Our results showed that abundant species were distributed in the two intervals of 48 °01'-49 °N and 49 °01'-50 °N. Deraeocorinae had the largest species number (8 species) at the interval of 48 °01'-49 °N; while Mirinae (41 species), Orthotylinae (13 species) and Phylinae (10 species) all reached the highest at the interval of 49 °01'-50 °N. Details of horizontal distribution of Miridae were shown in Fig. 1.

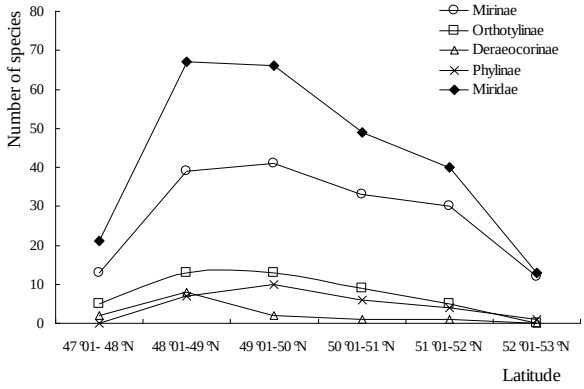

Fig. 1. Horizontal distribution of Miridae from Hulun Buir city

Our data also revealed the range of vertical distribution of Miridae (Fig. 2). We divided the whole altitudinal range (318-834m) into 5 intervals. For the family Miridae, the abundance reached a peak (86 species) in 601-800m which took 70.49 % of the total species number; there was no distributional record in 0-200 m. From the perspective of the subfamily, Mirinae, Orthotylinae and Phylinae all reached the highest species number (49 species, 16 species, 18 species) within the range of 601-800 m; while the Deraeocorinae subfamily reached the highest species number within the range of 201-400 m. This circumstance suggested that the species of Deraeocorinae was more suitable for living in low altitude area than other subfamilies.

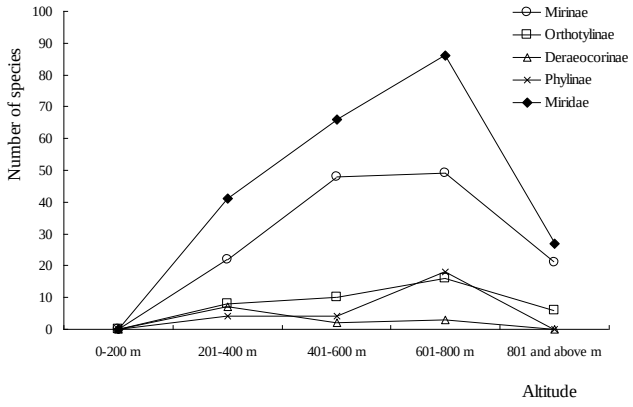

Fig. 2. Vertical distribution of Miridae from Hulun Buir city

4. Conclusion and Discussion

Our study showed a total of 122 species of Miridae from Hulun Buir city, distributed in four animal geographical regions. The Palaearctic composition was dominant. Studies of ecological properties had shown about half of the species were distributed in both latitudinal interval 48 °01'-49 °N and 49 °01'-50 °N. While in the range of 48 °01'-50 °N was just covered the Hulun Buir Grassland. This also confirmed that Miridae was very suitable for the survival in the grassland. In addition, the most appropriate altitudinal range was 601-800 m. Our results also suggested the adaptability of Mirinae to the environment was stronger; while Deraeocorinae was more suitable for low latitude and low altitude area than other subfamilies. For the Miridae possessed above-mentioned species diversity and ecological properties characteristics, the reason

probably was its special geographical location and overall environmental characteristics and other factors. Our study reflects the basic situation of Miridae from Hulun Buir city. But the city is very vast, the habitat, the climate, the vegetation type is also complex and diverse. At present, the research on Miridae is still very weak, on the insect's further biological geography, biology and ecology research needs to strengthen.

5. Acknowledgements

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