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Article

Composition and Ecological Structure of the Fauna of Litter and Soil True Bugs (Insecta, Heteroptera) in Kazakh Upland (Central Kazakhstan) Pine Forests

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Abstract: We assessed true bugs among aboveground and soil inhabitants of four different biocoenoses of pine forests representing the intrazone flora and fauna areas of the Kazakh Upland. True bugs had been collected from litter according to the methods of soil zoological studies. The results of a comparative analysis of the similarities and differences of the dominant and ecological structures of Heteroptera complexes of aboriginal and derived forest types are presented. Fourteen species and subspecies of three families were listed for the Central Kazakhstan region for the first time. The species *Eremocoris podagricus* had not previously been registered for the territory of Kazakhstan. Fifteen species (50%) were true aboveground inhabitants or live on grass, whereas other species use soil surface and ground litter as temporary habitats. *Drymus brunneus* and *Eremocoris fenestratus* play a key role in the structure and function of the true bug assemblages in the studied biotopes. The ecological success of typical forest and boreal inhabitants in biotopes of arid region is explained by the relict nature of forests and ancient connections with the taiga zone of Western Siberia and the mountain forests of the Urals and Altai.

Keywords: fauna of forest litter; Hemiptera; Lygaeidae; *Drymus brunneus; Eremocoris podagricus;* boreal species; intrazonal pine forests; Central Kazakhstan

1. Introduction

True bugs (Heteroptera) are one of the largest and most peculiar suborders of hemipterous insects (Hemiptera), playing the important role in different biogeocenoses of Kazakhstan. The annotated list of hemipterous insects in Kazakhstan includes 1250 species of 35 families and 411 genera [1]. Studies of Heteroptera in Kazakhstan started in the 1950s under the supervision of the Laboratory of Entomology at the Institute of Zoology of the Academy of Sciences of Kazakh SSR, with the main focus on the phytophagan group of insects of the southern regions of Kazakhstan [2-4]. Materials of true bugs of steppe, desert-steppe, and desert zones of the Central Kazakhstan were collected in 1957-1962 during biocomplex expeditions of the Zoological Institute of Academy of Sciences of the USSR and Institute of Zoology of Academy of Sciences of Kazakh SSR. Subsequently, these data were generalized and completed [5]. In Central Kazakhstan, 301 species of Heteroptera have been found [6]. However, publications about the composition and structure of hemipterous insect complexes of ground litter and soil in exact ecosystems have, to date, been very limited and sector nonspecific [7-9]. Prior to the studies of N.P. Slavchenko, it was not known, with certainty, that true bugs are aboveground inhabitants of intrazonal pine forests of Central Kazakhstan [10-13]. Some species were subsequently published by Asanova in their review of fauna of the infraorder Pentatomomorpha [14]. Nevertheless, none of the faunistic reviews contain any information on ground litter true bugs in the native pine forests of Central Kazakhstan. The goal of this paper is to assess species composition, abundance, and ecological peculiarities of Heteroptera in the litter of intrazonal pine forests in the Karkaraly mountain range in the eastern part of Kazakh Upland.

2. Material and methods

2.1. The study area

Studies have been carried out in the most common types of forests of the Bayanaul-Karkaraly group of pine groves in Kazakh Upland (territory of Karkaraly National Park, coordinates 49.41667° N latitude and 75.41667° E longitude) (**Fig.1**). The studied area belongs to the eastern floral region of the central Kazakh Uplands and Karkaraly floral subregion [15].

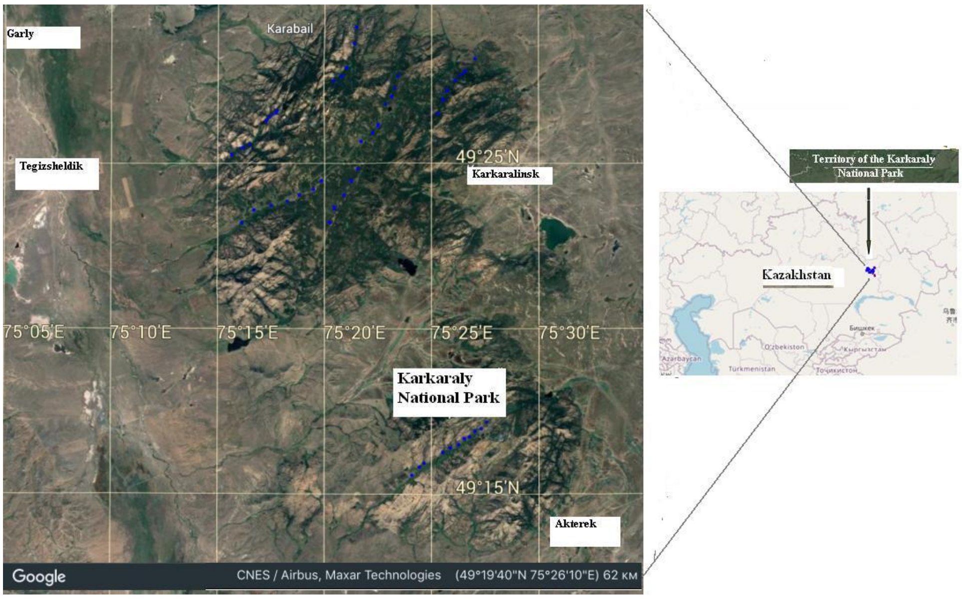

Figure 1. Study area and sampling sites (Sourse: Google Earth 2001, modified).

Aboriginal forests here are relicts of vast mountain taiga forests of the Pleistocene age. These are the most southern variants of pine forests in subarea of dry and absinth-typchak grass steppes [16].

Haplic Kastanozems with a sodic phase are the dominant soils in dry steppe climatic zones. Stony soils characterize the central part of Kazakh Upland. Mollie Gleysols and Kastanozems occur in depressions and river terraces [17].

Testing biotopes (Tab. 1) were selected in four aboriginal plant associations with *Pinus sylvestris* L., 1753, as the dominant tree: dry stone–lichen pine forest (I), wet herb-and-birch pine forest (II), wet herb-and-stone bramble pine forest (III), and wet herb-moss-and-fern pine forest (IV) [18, 19]. In addition, we gathered herpetobionts from the derived forest–mountain birch forest type (V).

Table 1. Description of investigated localities

		Phytocenoses	Projective cover (%)	Closeness of crowns	Orographic position
aboriginal pine forest	I	Dry stone–lichen pine forest with *Rosa cinnamomea* and *Juniperus sabina* in shrub layer and *Calamagrostis epigeios, Antennaria dioica, Pulsatilla patens, Veronica spicata, Ramischia secunda, Potentilla argentea, Cladonia sylvatica,* and *C. alpestris* in ground cover	5	0.3-0.6	upper part of slope
	II	Wet herb-and-birch pine forest with *Betula pubescens, B.*	>50	0.7-0.8	middle part of N

		microphylla in tree layer; *Rosa acicularis, R. cinnamomea, Cotoneaster melanocarpus,* and *Juniperus sabina* in shrub layer; and *Sedum hybridum, Chamaenerion angustifolium, Pyrola rotundifolia, Anemone patens, Lathyrus pisiformis*, *Pleurozium schreberi, Hylocomium splendens*, and *Dicranum polysetum* in ground cover			slope
	III	Wet herb-and-birch pine forest with *Betula pubescens* and *B. microphylla* in tree layer; *Rosa acicularis, R. cinnamomea, Cotoneaster melanocarpus,* and *Juniperus sabina* in shrub layer; *Sedum hybridum, Chamaenerion angustifolium, Pyrola rotundifolia, Anemone patens, Lathyrus pisiformis, Pleurozium schreberi, Hylocomium splendens*, and *Dicranum polysetum* in ground cover	<70	0.8	depression
	IV	Wet herb-moss-and-fern pine forest with birch (*Betula pubescens,* 10-15% of the total stand) in tree layer; *Ribes nigrum, Padus racemosa, Rosa acicularis, Salix caprea,* and *S. cinerea* in shrub layer; and *Athyrium filix-femina, Equisetum sylvaticum, Calamagrostis arundinacea, Aconitum septentrionale, Ramischia secunda, Fragaria vesca,* and *Pleurozium schreberi* in ground cover	55	0.7-0.85	floodplain terrace
derived birch forest	V	Secondary birch forest (*Betula pubescens* + *B. microphylla*) forest, occasionally with aspen (*Populus tremula*) and pine (*Pinus sylvestris)* in tree layer; *Rosa cinnamomea* and *Juniperus sabina* in shrub layer; and *Pyrola rotundifolia, Rubus saxatilis, Fragaria vesca*, *Pleurozium schreberi*, and *Hylocomium splendens* in ground cover	30	0.7-0.8	N slope

We formed geobotanical descriptions according to Gortchakovskyi [16] and Kupriyanov [20] and date of dominant species in the forest stand. The species nomenclature is given by the study of *List of Vascular Plants of Kazakhstan* [21] and *World Flora Online (WFO)* [22].

Aboriginal and secondary plant associations form the ecological series from the less-moist-assured localities with unstable moisture regime and germinative soil down along the profile to moderately moist-assured localities with more stable moisture regimes and mature soil. Soil is mostly moisturized as a result of atmospheric precipitation and surface flow. Optimal humidification is due to moist inflow from slopes and groundwater.

2.2. Taking censuses of soil surface dwelling true bugs

The samples of soil fauna and were taken over a long period starting from 1980 up to now. Soil zoological studies were carried out from May to October. In total, more than 150 litter samples of 0.0625 m^2 size were taken at depths of 0-10 and 10-20 cm and to the mineral soil level within each biotope [23]. True bugs were collected from litter and upper layer of soil 0-5 cm by hand and sorted onto a plastic sheet and with the help of exhauster. Materials were fixed in 80% ethanol [24]. Abundance data were calculated according to 1 m^2 of surface as specimen/m^2 = sp/m^2.

2.3. Ecology-faunistic analysis of true bug assemblages

Trophic preferences, ecological groups of recorded heteropterans according to the basis position among vegetation tiers, and objective attitude toward soil moisture were defined according to pertinent scientific reports [1, 5, 25-30].

True bug assemblages were characterized according to 1) dominance, determined according to the scale of O. Renkonen [31]; 2) index of abundance: $K = PB/100$, where P is share of the total number of specimens in the samples, in which the given species was registered, and B is the relative number of samples in which the species occurs; 3) Margalef's diversity index (D_{Mg}) [32]. The coefficients of similarity of heteropterofauna of the biogeocenosis—Jaccard faunistic coefficient (K_j), coefficient of common specific abundance of species (K_n), and total Vainstein's coefficient (K_v)—were calculated according to [33]. The nomenclature of species follows the *Catalogues of Heteroptera of the Palaearctic Region* [34-37] and the *Asian Part of Russia* [38]. The classification of the area of species is based upon the scheme of A.F. Emeljanov [39].

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3. Results

3.1. Species diversity, density, and dominance

The true bugs recorded in the studied forests belong to 30 species and subspecies and 8 families. A specific complex of species is registered for each biotope (Table 2).

Fourteen species were found in dry stone–lichen pine forest. The total number of hemipterous insects in the litter is 1.8 ± 0.9 sp/m^2, with an index of abundance of 0.55. Prevalent here are mesophile polyphytophages *Eremocoris plebejus plebejus* (19.0% of the total number) and *Dolycoris baccarum* (14.4%), peculiar representatives of the herb-and-forest complex of species. The largest share (55.3%) of rare species is encountered in severe conditions of pine forest. Moreover, these are distinct from the dominating species of other forest types. Hemipterous insects dwelling here prefer warm and dry habitat conditions and are generally not encountered in other biotopes.

Table 2. Species composition of true bugs in pine forest litter and derived phytocenoses of Kazakh Upland (Central Kazakhstan).

Eremocoris podagricus	*Eremocoris podagricus*				
	Dry stone–lichen pine forest	**Wet herb-and-birch pine forest**	**Wet herb-and-stone bramble pine forest**	**Wet herb-moss-and-fern pine forest**	**Mountain birch forest**
Saldidae Amyot and Serville, 1843					
Saldula saltatoria (Linnaeus, 1758)				+	
Nabidae A. Costa, 1853					
†*Nabis punctatus punctatus* A. Costa, 1847	+		+		
Nabis spp.					+
Miridae Hahn, 1833					
Deraeocoris punctulatus Fallén, 1807				+	+
†*Lygocoris contaminatus* (Fallén, 1807)			+	+	
†*Lygus pratensis* (Linnaeus, 1758)	+				
†*Lygus gemellatus* (Herrich-Schäffer, 1835)	+				+
†*Psallus anticus* (Reuter, 1876)	+				
Lygaeidae Schilling, 1829					
†*Ligyrocoris sylvestris* (Linnaeus, 1758)					+
Nysius spp.	+				
Rhyparochromus pini (Linnaeus, 1758)		+			+
†*Trapezonotus arenarius* (Linnaeus, 1758)				+	+
Emblethis denticollis Horváth, 1878				+	
Peritrechus nubilus (Fallen, 1807)	+				
†*Drymus brunneus* (R.F.Sahlberg, 1848)	+	+	+	+	+
†*Drymus sylvaticus* (Fabricius, 1775)				+	
Plinthisus longicollis Fieber, 1861.			+	+	+
†*Plinthisus reyi* Puton, 1882	+				
Stygnocoris sabulosus (Schilling, 1829)		+		+	

Pterotmetus staphyliniformis (Schilling, 1829)	+				
†*Philomyrmex insignis* R.F. Sahlberg, 1848					+
†*Eremocoris plebejus plebejus* (Fallén, 1807)	+				+
†*Eremocoris fenestratus* (Herrich-Schäffer, 1839)	+	+		+	+
††*Eremocoris podagricus* (Fabricius, 1775)					+
†*Eremocoris abietis* (Linnaeus, 1758)			+	+	+
Rhopalidae Amyot and Serville, 1843					
Corizus hyoscyami (Linnaeus, 1758)	+				
Acanthosomatidae Signoret, 1864					
Elasmucha grisea (Linnaeus, 1758)		+	+	+	+
Cydnidae Billberg, 1820			+		
Pentatomidae Leach, 1815					
Dolycoris baccarum (Linnaeus, 1758)	+	+		+	+
Eurydema ventralis Kolenati, 1846	+				
Total	14	6	7	13	15

"†" registered in Central Kazakhstan for the first time

"††" registered in Kazakhstan for the first time

Drymus brunneus is the superdominating member and comprises 64% of all hemipterous insects in wet herb-and-birch pine forest, where 6 species of true bugs are found. Less simple but related to dominants, *Eremocoris fenestratus* (9.7% of the total number), meso-xerophile oligophytophage, prevailingly dwell in the litter under pine or juniper. The total number of Heteroptera in the litter is 3.5 ± 1.1 sp/m^2, with an index of abundance of 0.95.

Seven species in a collection of 2.3 ± 0.9 sp/m^2 true bugs were recorded in the moist litter of herb-and-stone bramble pine forest (index of abundance 0.29). *D. brunneus* (1.0 ± 0.3 sp/m^2) is usually superdominant in the litter. *Plinthisus longicollis* (0.25 ± 0.1 sp/m^2) is dominant and dwells in the plant detritus of dry grassy mountain shoulders with poor planting. Forest litter was found to often contain Lygaeidae nymphs.

Wet herb-moss-and-fern pine forest is distinguished by a high number of herpetobionts (5.7 ± 1.7 sp/m^2). Thirteen species of Heteroptera are present, and the index of abundance increased to 1.08. Here, the conditions for development were optimal for *D. brunneus* to prevail in herpetobium. The domination of *Elasmucha grisea* species (0.77 ± 0.2 sp/m^2) is more closely connected with birch forests. Polyphytophage *Stygnocoris sabulosus* is also attracted to this station (0.38 ± 0.1 sp/m^2). These plantings were the only ones where the species *D. sylvaticus* and *Emblethis denticollis* (0.09 ± 0.05 sp/m^2) were found, as they prefer moderately moist conditions, along with hydrophilic *Saldula saltatoria* (0.09 ± 0.05 sp/m^2).

Secondary mountain birch forest is similarly rich in species. Ecological peculiarities (nature of litter and its turf content, hydrothermal regime) attract a vast array of Heteroptera groups. Litter includes predatory, herbivorous species, and detritophages, for which the total reaches 3.7 ± 0.2 sp/m^2, with an index of abundance of 1.0. *D. brunneus* (0.9 ± 0.05 sp/m^2) is superdominant, and *E. fenestratus* (0.5 ± 0.2 sp/m^2) is dominant. Mountain birch forest attracts *P. longicollis* (0.3 ± 0.1 sp/m^2) and mesophile polyphytophage *Trapezonotus arenarius*, which eat the plant seeds (0.3 ± 0.1 sp/m^2).

3.2. Ecological structure of true bug assemblages

The collected true bugs are represented the following groups according to trophic preferences: predators (zoophages), plant eaters (phytophages), and true bugs with mixed nutrition, consuming both flesh and plants (zoophytophages) [1, 5, 25].

The group of phytophages unites 25 species, or 83.3% (where 12.5% of the total number of phytophage species are considered to be narrow oligophages; 12.5% are wide oligophages; and 75% are polyphages). The group of zoophages comprises 10% of the total number of Heteroptera, with zoophytophages being 6.7% overall (**Fig. 2**).

The group of phytophages is represented by species of Lygaeidae, Rhopalidae, Acanthosomatidae, Cydnidae, and Pentatomidae families and, partially, of Miridae family (12.5% of the total number of phytophage species).

Among the polyphytophages are many species of the Lygaeidae (45% of the total number of polyphytophage species), Miridae (26.25%), and Pentatomidae (15%) families.

In the group of wide oligophytophages, we may distinguish species of the Lygaeidae, Pentatomidae, and Acanthosomatidae families. The group of narrow oligophytophages is formed mainly of species of the Miridae (*Lygocoris contaminatus*) and Lygaeidae (*Philomyrmex insignis, Eremocoris fenestratus)* families.

In the Saldidae and Nabidae families, all the species found in biocenoses are related to obligate zoophages. Zoophytophages act as oligophages toward plant food. Zoophytophage species are only found in Miridae family (*Deraeocoris punctulatus, Psallus anticus*; 40% of the total number of species).

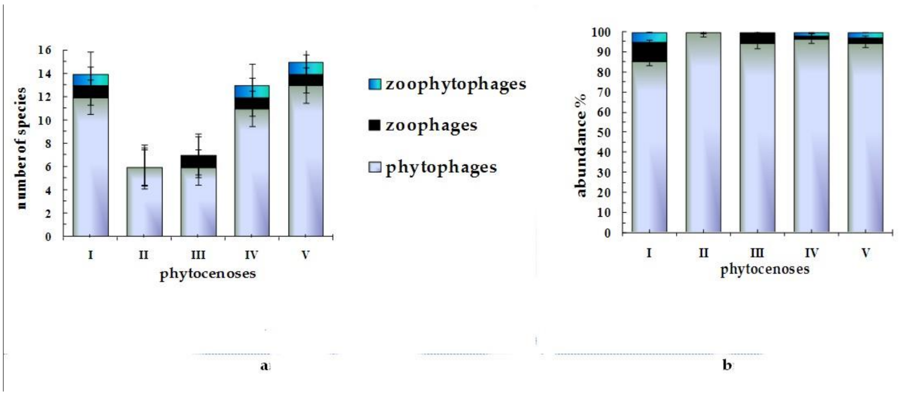


Figure 2. Trophic structure of true bug complexes in litter of forest phytocenoses of Kazakh Upland by a—number of species and b—abundance.

The discovered hemipterous insects were divided into 6 groups depending on the layer of their dwelling: epigeobionts, herpetobionts, herpeto-chortobionts, chortobionts, dendrobionts, and dendro-tamnobionts (**Fig. 3**) [1, 5, 26-28, 30]. The group of herpetobionts dominates in terms of number of species and abundance (13 species and 43.3% of all collected material). All species and subspecies belong to the Lygaeidae family: *Rhyparochromus pini, Trapezonotus arenarius, Peritrechus nubilus, Drymus brunneus, D. sylvaticus, Plinthisus longicollis, P. reyi, Stygnocoris sabulosus, Philomyrmex insignis, Eremocoris plebejus plebejus, Eremocoris fenestratus, E. podagricus,* and *E. abietis*. The most numerous herpetobiont species in this family are *D. brunneus* (4.8% of all collected material) and *E. fenestratus* (7.1%). According to **Fig. 3**, the smallest population of herpetobiont species is registered in stone–lichen pine forest (40% of all species in biotope), and the largest population in wet herb-and-birch pine forest (86.9%). With an increase of the moisture content in pine forests, the abundance of herpetobiont species is slightly changed (70.4-75.1%), as is also observed in the secondary type of forest–mountain birch forest (73%).

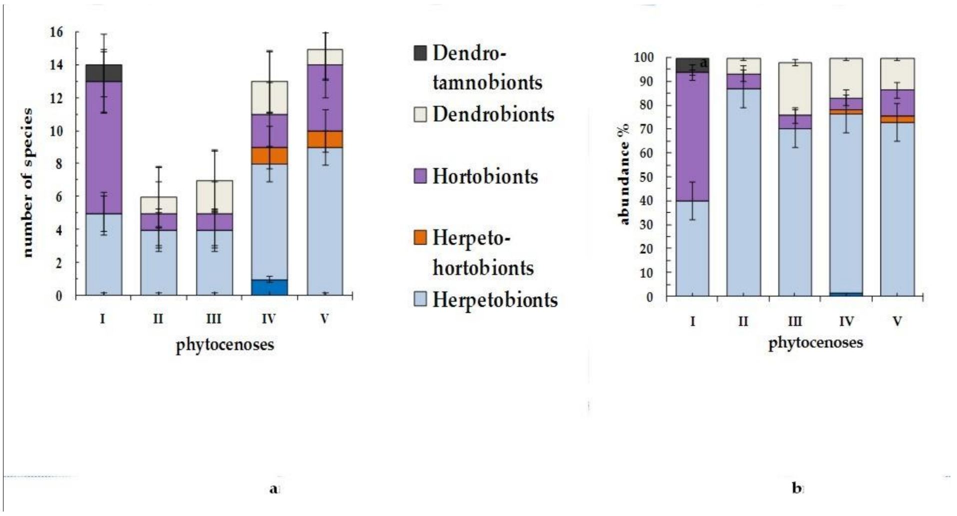


Figure 3. Ecological structure of true bug complexes in litter of forest phytocenoses of Kazakh Upland according to the basis position of species among vegetation tiers: a—number of species and b—abundance.

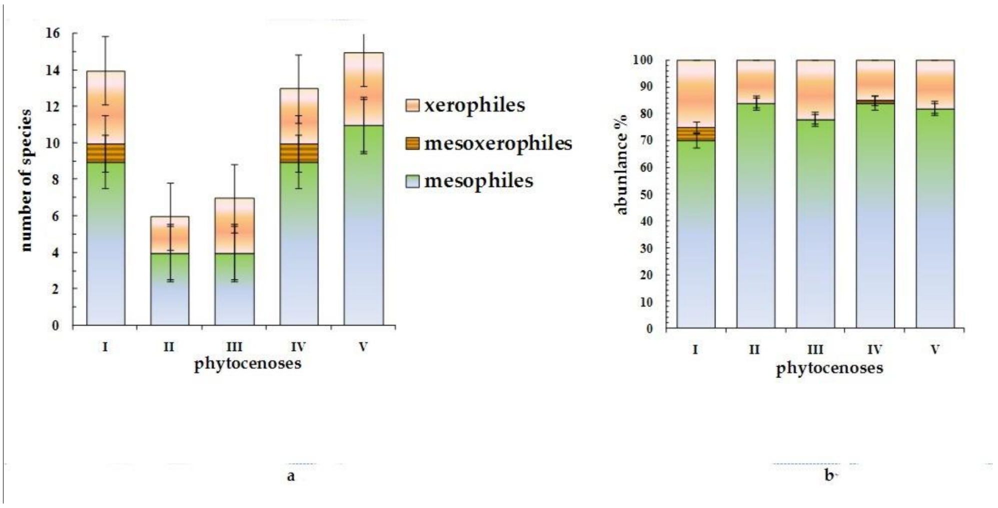
The following group subject to number of species and population is the group of chortobionts (8 species and 26.7% of all collected material: *Nabis punctatus punctatus* (Nabidae), *Deraeocoris punctulatus, Lygocoris contaminates, Lygus gemellatus* (Miridae), *Pterotmetus staphyliniformis* (Lygaeidae), *Corizus hyoscyami* (Rhopalidae), *Dolycoris baccarum,* and *Eurydema ventralis* (Pentatomidae). The number of chortobiont species *D. baccarum* exceeds those of other species (4.6% of all collected material). The largest population of chortobiont species is registered in stone–lichen pine forest (54% of all species in biotope). In other types of studied pine forests, the population of chortobionts is significantly small (4.9-6.5%). In mountain birch forest, the abundance of chortobionts reaches 10.8%.

The group of herpeto-chortobionts (1.1% of all collected material) is represented by two species of small population belonging to the Lygaeidae family: *Ligyrocoris sylvestris, Emblethis denticollis*. They are registered in wet pine forest IV and mountain birch forest V. The group of epigeobionts (0.5% of all collected material) is represented by the species of *Saldula saltatoria* (Saldidae) in conditions of the wettest pine forest IV.

Dendrobiont species (12.9% of all collected material) were found in all types of forests, except stone–lichen pine forest and represented by the species *Elasmucha grisea* (Acanthosomatidae) and *Lygocoris contaminatus* (Miridae). In the group of dendro-tamnobionts (0.5% of all collected material), species of *Psallus anticus* (Miridae) are only found in cenoses of stone–lichen pine forest.

Thus, the distribution of true bugs along the tiers of vegetation in biocenoses remained more or less the same and typical for all studied forests. However, we can observe the peculiar complex of ecological groups in the driest conditions of stone–lichen pine forest.

Registered species of hemipterous insects were subdivided into three groups according to their preferable localities reflecting different soil-water contents: mesophiles, mesoxerophiles, and xerophiles **[1, 5, 27-30](Fig. 4)**.



a

b

Figure 4. Ecological structure of true bug complexes in litter of forest phytocenoses of Kazakh Upland according to objective attitude toward soil moisture: a—number of species and b—abundance.

It was discovered that mesophiles prevail at average values of temperature and soil moisture (56.7% of all registered species). This group includes all registered species of the Miridae, Rhopalidae, Acanthosomatidae, and Pentatomidae families and the majority of Lygaeidae species. Each biocenosis included no less than nine species linked to moderate soil moisture conditions, and in pine forests II and III, the number of mesophilic species is minimal. True bug mesophiles include the majority of definite herpetobiont species—*Drymus brunneus*, *D. sylvaticus*, and *Eremocoris plebejus*, among others. The abundance of mesophiles is more than 80% everywhere, except the driest conditions of dry pine forest I. Hygromesophilic *Saldula saltatoria* (Saldidae) dwells only in conditions of wet pine forest IV.

3.3 Comparative analysis of the similarities of true bug assemblages

For hemipterous insects, the highest species diversity (Margalef's index) was observed in composition of herpetobium as calculated for stone–lichen pine forest ($D_{Mg} = 5$), herb-moss-and-fern pine forest ($D_{Mg} = 4.8$), and mountain birch forest ($D_{Mg} = 5.2$). These are the extreme points in ecological serial of biocenoses I-IV in relation to the moisture regime.

The highest similarity of biocenoses to species composition is between herb-and-birch pine forest, located in the northern slopes, and herb-moss-and-fern pine forest, located in the valley, with a coefficient of faunistic similarity of $K_j = 0.36$. In biocenoses with different edificators moss-and-fern pine forest and mountain birch forest, $K_j = 0.4$. According to the Table 3, the faunistic similarity of complexes of hemipterous insects is registered in neighboring biocenoses in ecological series I–IV.

Table 3. Coefficients of similarity of complexes of true bugs as aboveground inhabitants of pine forests and derived phytocenosis of Kazakh Upland (Central Kazakhstan).

Phytocenoses and coefficients of similarity	**Phytocenoses and coefficients of similarity**				
	I	**II**	**III**	**IV**	**V**
I	1	0.02$^{\#\#}$	0.006$^{\#\#}$	0.007$^{\#\#}$	0.07$^{\#\#}$
II	0.19$^{\#}$	1	0.05$^{\#\#}$	0.19$^{\#\#}$	0.1$^{\#\#}$
III	0.11$^{\#}$	0.18$^{\#}$	1	0.1$^{\#\#}$	0.08$^{\#\#}$
IV	0.13$^{\#}$	0.36$^{\#}$	0.33$^{\#}$	1	0.14$^{\#\#}$
V	0.22$^{\#}$	0.31$^{\#}$	0.22$^{\#}$	0.40$^{\#}$	1

#Jaccard faunistic coefficient (K_j)

##Total Vainstein's coefficient (K_v)

The similarity of biocenoses to abundance of complexes of hemipterous insects, in general, is a repetition of the abovementioned ratio and gives a clear reason through confirmation. For stations of pine forests, the priority is defined, as follows, according to the coefficient of common specific abundance of species: complexes of herb-and-birch pine forest and herb-moss-and-fern pine forest are most similar (K_n = 52.7), and complexes of stone–lichen pine forest and herb-moss-and-fern pine forest are less equal (K_n = 5.2).

Estimation of general biotopic similarity showed that highest value of the total Vainstein's coefficient is registered for complexes of hemipterous insects of herb-and-birch pine forest and herb-moss-and-fern pine forest (K_v = 0.19). Further, in the course of decrease in biotopic similarity, the following pairs are formed: herb-moss-and-fern pine forest and mountain birch forest (K_v = 0.14) and herb-and-stone bramble pine forest and herb-moss-and-fern pine forest (K_v = 0.10); herb-and-birch pine forest and mountain birch forest (K_v = 0.10) and herb-and-stone bramble pine forest and mountain birch forest (K_v = 0.08); and stone–lichen pine forest and mountain birch forest (K_v = 0.07) (Tab. 3).

4. Discussion

Natural modifications of environment and planting in the result of weathering of granite rocks of the eastern part of Kazakh upland form the genetic series of peculiar stations for species of Heteroptera. In the ecological series of biocenoses I-IV, confinement of species to definite types of forests is traced, which defines the differences and similarities of the heteropterofauna of litter.

The number of Heteroptera in the litter was low in all biocenoses. The pine forest engaging the floodland of the stream is distinguished by a higher number of true bugs in herpetobium.

Complexes of litter hemipterous insects are the most diverse in limiting conditions of ecological series of associations of *Pinus sylvestris*, less moist-assured localities (stone–lichen pine forest), and moderately moist-assured localities with stable moisture regime (herb-moss-and-fern pine forest). We believe that this is related to the wide ecological range of Heteroptera complexes in these biocenoses [40]. Moreover, hemipterous insect complexes show a rich range of herpetobiums of derivative types of forest–mountain birch forest as the result of the development to pre-climax community [41, 42].

Thus, a number of similarities of complexes of litter true bugs in the biocenoses II-IV, IV-V, III-IV, II-V, III-V, I-V, II-III, and I-II is formed, where the proximity of heteropterofauna of native pine forests and derivative forest–mountain birch forest type is disclosed. The hydrothermal regime of litter in herb-and-birch pine forest with less warming and desiccation of soil approaches that of valley pine forests. The formation of close ecological conditions is also evident in the composition of tree, grass, shrub, and moss layers [16, 20]. Ecological conditions of secondary birch forest are the most similar to conditions of herb-and-birch pine forest according to its distribution over the relief. Such similarity of litter true bugs in biocenoses might partly be explained by species migration from neighboring localities, because the composition of ecological groups of Heteroptera with regard to moist factor is defined with the nature of neighboring biotope and presence of ecological corridors in the network of forest faunistic complexes [43].

In each biocenoses, the largest number of species is related to Lygaeidae (17 species, or 56.7% of the total number of detected species). The majority of their representatives dwell in the ground layer. They compose dominating taxonomic and ecological groups (nuclei) of studied herpetobionts. The second highest number of species is represented by the Miridae family (5 species or 16.6% of the total number of species), which includes dwellers of grassy and tree layers.

The number of *D. brunneus* species exceed the number other species in all types of forests, with the exception of stone–lichen pine forest. This species is most abundantly encountered in plant detritus of herb-and-birch and herb-moss-and-fern pine forests, where the numbers reach 2.3 ± 0.3 and 2.9 ± 0.4 sp/m^2, respectively. In the litter of herb-and-birch pine and valley pine forests, the share of background species of *D. brunneus* exceeds 50%. In wet herb-moss-and-fern pine forest, it is the only dominating species among hemipterous insects in litter.

In derivative mountain birch forest, *D. brunneus* is also superdominant. However, more favorable lighting conditions and warmer soil in these localities evidently restrict the optimum zone for *D. brunneus*. Due to this, the share of species here is decreased by up to 24%, becoming lower than that of other more thermophilic forms. In dry plantings, *D. brunneus* was sporadic. It is worth emphasizing that *D. brunneus* tends to be found in dry plantings in Buzuluk Pine Forest surrounded by steppes on the East European Plain [44, 45].

It is less abundant in pure-breed forest stands. Our observations indicate the sensitivity of this species to the nature of litter and its composition and moisture content, and it tends toward plantings of mixed type. These features of the species are also noted by other researchers [46]. The eurybiontness of species is described in works on study of heterophterofauna of forest steppe [47-49].

Phytophagy (polyphagy) prevails among true bugs in all types of studied forest biocenoses. True herpetobionts and herperto-chortobionts include 15 species (50%), all remaining species, being in forest litter during diapause, or moving along the soil surface, using it as a temporary station [50-52]. The predominant species (excluding *Dolycoris baccarum* and *Elasmucha grisea*) are also mainly typical inhabitants of the litter.

We believe that domination and subdomination of chortobiont *Dolycoris baccarum* (Pentatomidae) in the herpetobium of separate forest biocenoses may be explained by the specific seasonal cycle and seasonal adaptations (like summer diapauses) of species in litter [48, 53-55].

Therefore, regular registration of typical hortobionts and dendrobionts in the litter over a long time and throughout the growing season can be considered as a result of diurnal or seasonal migrations of these species [50].

Regarding the prevalence of species related to conditions of moderate moisture, most of the superdominant and dominant (*Drymus brunneus*, *Eremocoris plebejus plebejus*, *Dolycoris baccarum*, and *Eremocoris fenestratus*) belong to the grass–forest and forest–meadow ecological complex of species, except *Plinthisus longicollis* (rocky-desert group) and *Elasmucha grisea* (deciduous-forest group) [1, 5].

In the studied forests, a significant proportion of litter true bugs are known as typical forest species. For example, the baseline species *Drymus brunneus* is typical for northern forests [56] and is encountered in the subzones of northern and far-north taiga [38, 57].

A dweller in the litterfall of leafy forests, *Drymus sylvaticus* is encountered at the southern border of medium taiga. *Ligyrocoris sylvestris* is widely spread in the taiga zone, forest-tundra, and in Polar and Northern Urals [58].

Rhyparochromus pini and *Philomyrmex insignis* were found in litter of pine forest of Northern Kazakhstan, in the forest zone of Siberia [59-61].

Eremocoris plebejus plebejus is usual litter inhabitant of lichen pine forests of Northern Kazakhstan, pine-birch forest of forest zone of European part of Russia [5, 58]. *Eremocoris abietis* dwells in litter of pine forests of Northern Kazakhstan [5]. The species is widespread in subzones of medium, northern, far northern taiga, and in forest-tundra, prevailing in conifer forests. It is encountered in mixed and leafy forests to the south in the taiga zone [61, 62].

Eremocoris podagricus dwells mainly in forests, on limestone, or in sand soils. We distinguished the singular occurrence of *E. podagricus* in the mountain birch forest of Kazakh upland, and this species has not previously been registered in the territory of Kazakhstan.

Species and subspesies of open area, subarid, and arid habitats, *Nabis punctatus punctatus, Trapezonotus arenarius, Emblethis denticollis,* and *Plinthisus reyi*, etc., under the canopy of forests are evidence of regional peculiarities of these cenoses, such as a wide range of environmental conditions [46, 48].

The majority of discovered true bug species are widely spread: their ranges include Transpalearctic, Holarctic, and Western, with the belt boreal–subtropic group prevailing. Transpalearctic boreal–subtropic ranges are peculiar for 40.8% of species, with Transeurasian boreal–subboreal accounting for 7.4%. Holarctic ranges of species comprise 14.8% (among them 75% of boreal–subtropic species). The species with a Western Palearctic type of range comprise 14.8%: superatlantic boreal–subtropic 7.4%; and Panatlantic boreal–subtropic 7.4%. Around 14.8% of species are related to a Western boreal–subtropic type of range; with 3.7% to Western–Sharp continental, southern; and 3.7% to extratropic pancontinental.

The faunistic complexes of litter true bugs in the studied forests specificity show, in fact, that the majority of species is distinguished by wide boreal–subtropic distribution and large longitudinal continuity of ranges—Transpalearctic, with more species with more narrow Transeurasian, Western, and Continental types of range in addition.

5. Conclusions

According to the results of soil zoological studies inside the herpetobium of intrazonal native pine forests in Karkaraly mountain range in the eastern part of Kazakh Upland and derivative forest–mountain birch forest type, 30 species and subspesies of hemipterous insects belonging to 22 genera and 8 families were discovered. Fourteen species and subspecies (ten representatives of the Lygaeidae) are registered in the Central Kazakhstan for the first time. The species *Eremocoris podagricus* is reported from Kazakhstan for the first time.

The boreal mesophilic *Drymus brunneus* (Lygaeidae family), dominant in most investigated forest biotopes, are actually eurytopic here. In the arid steppe zone formation of specific hemipterous insect complexes of litter of pine forests, and typical forest species comprise a significant proportion of true bugs (more than 26.7%). The majority of have Transpalearctic boreal–subtropic ranges. The presence of a significant share (20%) of species of open spaces in forest cenoses and eurybiont species are evidence of the subtility and violation of the integrity of forests in Kazakh Upland.

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