

# Fauna of arboreal Hemiptera in South-Eastern Kazakhstan

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**Abstract.** Korganbek K, Esenbekova P. 2024. Fauna of arboreal Hemiptera in South-Eastern Kazakhstan. Biodiversitas 25: 3460-3467. Arboreal hemipterans are a part of the living world, occupying a special place in natural food chain and contact with many living organisms in nature. The purpose of the research is to study and describe the fauna of arboreal hemipterans in the South-Eastern Kazakhstan region. This research was conducted according to various methods generally accepted in the field of entomology. Also materials were processed in laboratory conditions. Samples were collected from 48 locations in South-Eastern Kazakhstan. In total, 939 specimens were collected, including 442 males (47%), 429 females (46%) and 68 nymphs (7%). As a result of the study, 57 species of arboreal hemipterans belonging to 9 families were identified in South-Eastern Kazakhstan. They are Miridae (15 species), Pentatomidae (11 species), Acanthosomatidae (8 species), Lygaeidae (7 species), Anthocoridae (6 species), Nabidae (4 species), Aradidae (4 species), Reduviidae (3 species), Tingidae (2 species). In addition, the article provides information about the nutritional relationships, the number of generations they give per year (voltinism), and the habitats of arboreal hemipterans. Information about the biology of arboreal hemipterans plays an important role in assessing the stability of the biodiversity in the area where they live.

**Keywords:** Arboreal hemipterans, habitat, trophic relationships, voltinism, woody plants

## INTRODUCTION

Hemiptera are one of the largest orders of insects. Due to the diversity of its biology, this order has more than 100,000 species worldwide (Bohn and Huth 2017; Ostovan et al. 2017; Taszakowski and Pasińska 2017; Çerçi et al. 2018; Scudder 2018; Ghahari and Moulet 2019; Bugaj-Nawrocka and Taszakowski 2021; Feday and Markina 2021; Çerçi and Koçak 2023). Among the arboreal hemipterans, some species damage the important vegetative and generative organs of forest trees or agricultural crops (Çerçi et al. 2021; Kaçar and Dursun 2022; Guilbert and Guidoti 2018; Limonta et al. 2022; Baymak and Kiyak 2019). In some cases, they suck the sap of plants (Tsai and Rédei 2015, 2017; Dursun and Fent 2017; Heiss and Guilbert 2018). In addition, this group includes species that carry disease-causing viruses (Wheeler and Krimmel 2015; Nascimento et al. 2017; Fent and Dursun 2019; Alevis et al. 2021). However, predatory species of arboreal hemipterans are often beneficial. These species are vital as natural regulators, controlling the population of harmful insects in the ecosystem (Moulet et al. 2017; Simov et al. 2017; Ademokoya et al. 2022; Rather et al. 2022). In most cases, such predatory arboreal Hemiptera species belong to Pentatomidae, Nabidae, Aradidae, Reduviidae families (Gil-Santana 2019; Ramsay 2019; Laterza et al. 2022; Ferro et al. 2023; Gil-Santana and Husemann 2023). They feed on many small arthropods, including their eggs and larvae. For example, insects such as aphids (*Amphorophora rubi* (Kaltenbach, 1843)), Acariformes, *Tetranychus urticae* Koch, 1836, Thripidae, Psyllidae, and caterpillars are a food for arboreal

hemipterans (Jung et al. 2017). Studying the biology of arboreal hemipterans allows us to determine, which species are harmful or beneficial for the environment.

The arboreal hemipterans are an important component of the world and regional biological diversity of living organisms. In this regard, taking into account the economic and ecological importance of arboreal hemipterans in nature, protecting and preserving their biological diversity is one of the urgent problems for the human race. The purpose of the study was to identify the taxonomic composition of the arboreal Hemiptera living in the South-Eastern Kazakhstan and also to determine their trophic relationships, the number of generations per year and their habitats.

In general, the study of arboreal hemipterans in Kazakhstan began at the second half of the 19th century. One of the first researchers, V.E. Yakovlev, studied Hemiptera of Mangistau, Taraz, and Shymkent cities (Yakovlev 1886). The intensive study of insects began in the second half of the 20th century. Dzhihikbaev (1997) studied some species of the Miridae family that damage *Medicago* L. in the southern region of Kazakhstan. Kamensky (1949) compiled a list of Hemiptera species living in the Nauryzym State Reserve in North Kazakhstan. Kirichenko (1951) made a great contribution to the study of the Hemiptera fauna in the cities of Ural and Atyrau in Western Kazakhstan. Tilmenbayev (1962) researched the pests of the Aelia family that harm grain crops in the Akmola region, and made recommendations on how to deal with them in 1960-1962. From 1957 to 1962, Asanova (1962) made a great contribution to the study of the biology and taxonomic composition of hemipterans living in

Karaganda region of Central Kazakhstan and Akmola region of North Kazakhstan. In the 1970s, Elov (1976) studied the biological characteristics of hemipterans belonging to the Anthocoridae family living in Central Asia and Kazakhstan.

Conducting ecological and faunal studies of arboreal Hemiptera species in the South-Eastern Kazakhstan was primarily caused by the insufficient study of their original faunal composition. South-Eastern Kazakhstan is a unique region for environmental and entomological research. Because this territory is located on the border of forest-steppe and forest natural zones. In addition, the study area includes the Altyn-Emel and Charyn state national natural parks and the Alakol National Reserve, which are aimed at preserving biological diversity in nature.

Data on the ecology, biology, taxonomic composition, annual number of generations and their trophic relationships of arboreal hemipterans can be used in the process of assessing the state of biological diversity in the environment and compiling fauna inventories, catalogues, atlases of common insects in Kazakhstan. In addition, these data can be used in the development of measures to control pests of woody plants.

## MATERIALS AND METHODS

### Study area

The studies have been carried out in the Almaty and Zhetysu Regions, located in South-Eastern Kazakhstan. Insects were collected from 28 locations in the Almaty Region and 20 locations in the Zhetysu Region (Figure 1). A Garmin GPS navigator was used to determine the coordinates of the traveled route and the places where the insects were caught.

Various generally accepted entomological methods were used to collect arboreal hemipterans, namely the collection with an entomological net, shaking the tree with a white cloth on the ground, catching small insects with an exhaustor, collecting at night with a light source.

All collected samples were processed in the Entomology Laboratory of the Institute of Zoology of the Republic of Kazakhstan in Almaty. Insects were identified according to Kerzhner and Yachevsky (1964).

## RESULTS AND DISCUSSION

The article presents the results of studies of arboreal hemipterans in South-Eastern Kazakhstan, conducted in 2023. In total, 939 specimens were collected, including 442 males (47%), 429 females (46%) and 68 nymphs (7%).

### Family Tingidae

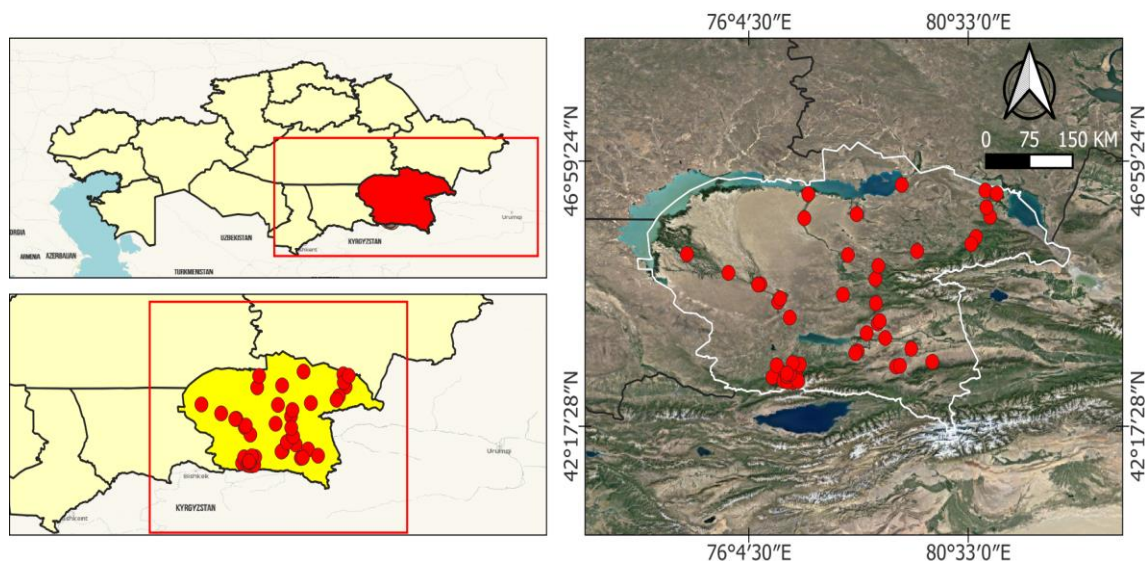
*Physatocheila smreczynskii* (China 1952). Almaty Region, Talgar District, Panfilova Village (43°23'06.6"N 77°07'10.2"E), 20.06.2023, 3♀, 3♂, 1 nymph.

*Stephanitis pyri* (Fabricius 1775). Almaty Region, Enbekshikazakh District, Masak Village, floodplain of the Chilik River (43°37'12.2"N 78°17'40.6"E), 20-22.05.2023, 2♀, 2♂, 1 nymph.

### Family Nabidae

*Nabis pallidus* (Fieber 1861). Almaty Region, Enbekshikazakh District, Masak Village, floodplain of the Chilik River (43°37'12.6"N 78°17'44.2"E), 20-22.05.2023, 8♀, 2♂, 1 nymph. Almaty Region, Balkhash District, Miyaly Village, floodplain of the Ili River (44°29'43.4"N 76°40'27.5"E), 25-27.05.2023, 4♀, 6♂; Zhetysu Region, Altyn-Emel National Park, floodplain of the Ili River (43°51'19.1"N 78°51'33.4"E), 09-10.06.2023, 5♀, 5♂, 1 nymph.

*Nabis viridulus* (Spinola 1837). Almaty Region, Balkhash District, Miyaly Village, floodplain of the Ili River (44°29'43.4"N 76°40'27.5"E), 25-27.05.2023, 4♀, 4♂; Zhetysu Region, Altyn-Emel National Park, floodplain of the Ili River (43°51'19.1"N 78°51'33.4"E), 09-10.06.2023, 8♀, 6♂, 1 nymph; Almaty Region, Balkhash District, Koshkarbay Village (45°20'39.3"N 74°48'54.1"E), 30.05.2023, 4♀, 4♂.



**Figure 1.** Map of study locations in South-Eastern Kazakhstan. Designations: A. Almaty Region; B. Zhetysu Region

### Family Anthocoridae

*Anthocoris confusus* (Reuter 1884). Almaty Region, Karasay District, Alatau Village (43°10'15.1"N 76°53'55.6"E), 02.06.2023, 3♀, 2♂, 1 nymph; Zhetysu Region, Altyn-Emel National Park, Shygan Territory (44°06'56.0"N 78°42'18.1"E), 11.06.2023, 1♀, 2♂.

*Anthocoris flavipes* (Reuter 1884). Almaty Region, Ili Alatau, Medeu tract (43°09'35.6"N 77°03'17.7"E), 14.06.2023, 2♀, 2♂; Almaty Region, Balkhash District, Akkol Village (45°00'41.1"N 75°39'39.6"E), 30.05.2023, 4♀, 4♂, 1 nymph; Almaty Region, Uyghur District, Aktam Village (43°26'04.4"N 79°49'10.1"E), 31.05.2023, 5♀, 5♂, 1 nymph.

*Anthocoris nemorum* (Linnaeus 1761). Almaty Region, Karasay District, Zhandosov Village (43°09'43.3"N 76°33'32.1"E), 07.06.2023, 1♀, 2♂; Almaty Region, Nauryzbay District, Tausamaly Village (43°11'02.2"N 76°50'45.8"E), 25.06.2023, 1♀, 2♂; Zhetysu Region, Altyn-Emel National Park, Minbulak Territory (43°56'24.4"N 78°28'51.8"E), 12.06.2023, 4♀, 3♂, 1 nymph; Almaty Region, 119 km from Kapchagay downstream of the Ili River (44°48'33.1"N 76°18'51.1"E), 07.07.2023, 1♀, 3♂.

*Anthocoris nemoralis* (Fabricius 1794). Almaty Region, Karasay District, Alatau Village (43°10'36.2"N 76°54'05.4"E), 02.06.2023, 4♀, 4♂; Almaty Region, Balkhash District, Bakbakty Village (44°33'31.4"N 76°43'01.3"E), 28.05.2023, 1♀, 2♂; Zhetysu Region, Altyn-Emel National Park, Shygan Territory (44°06'56.0"N 78°42'18.1"E), 11.06.2023, 2♀, 3♂; Almaty Region, Ili Alatau, Medeu tract (43°09'35.6"N 77°03'17.7"E), 14.06.2023, 5♀, 3♂, 1 nymph.

*Elatophilus stigmatellus* (Zetterstedt 1838). Almaty region, Ili Alatau, Medeu tract (43°09'35.6"N 77°03'17.7"E), 14.06.2023, 1♀, 2♂; Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 2♀, 1♂.

*Orius laticollis* (Reuter 1884). Almaty Region, Karasay District, Kemertogan Village (43°14'45.9"N 76°44'47.5"E), 01.06.2023, 1♀, 2♂, 1 nymph; Zhetysu Region, Aksu District, Village Zhansugurov (45°23'49.9"N 79°30'34.7"E), 11.08.2023, 1♀, 1♂.

*Orius majusculus* (Reuter 1879). Almaty Region, Karasay District, floodplain of the Kaskelen River (43°12'46.6"N 76°38'16.1"E), 03-04.06.2023, 1♀, 3♂; Almaty Region, Nauryzbay District, Tausamaly Village (43°11'02.2"N 76°50'45.8"E), 25.06.2023, 2♀, 1♂; Zhetysu Region, Aksu District, Kuraksu Village (46°03'09.7"N 78°16'39.9"E), 11.08.2023, 5♀, 5♂.

### Family Reduviidae

*Empicoris vagabundus* (Linnaeus 1758). Almaty region, 40 km from Kapchagay downstream of the Ili River (44°13'09.8"N 76°54'44.4"E), 07.07.2023, 2♀, 1♂.

*Rhynocoris annulatus* (Linnaeus 1758). Almaty region, Enbekshikazakh District, Masak Village, floodplain of the Chilik River (43°37'12.6"N 78°17'44.2"E), 20-22.05.2023, 2♀, 3♂; Almaty Region, Balkhash District, Miyaly Village, floodplain of the Ili River (44°29'43.4"N 76°40'27.5"E), 25-27.05.2023, 1♀, 2♂; Almaty Region, Nauryzbay District, Tausamaly Village (43°11'02.2"N 76°50'45.8"E), 25.06.2023,

2♀; Almaty Region, Ili District, Intymak Village (43°24'47.4"N 76°58'21.1"E), 15.07.2023, 2♀, 2♂.

*Rhynocoris iracundus* (Poda 1761). Almaty Region, Balkhash District, Miyaly Village, floodplain of the Ili River (44°29'43.4"N 76°40'27.5"E), 25-27.05.2023, 2♀, 2♂; Almaty Region, 40 km from Kapchagay downstream of the Ili River (44°13'09.8"N 76°54'44.4"E), 07.07.2023, 2♀, 2♂; Zhetysu Region, Alakol Reserve, Kukpekti Territory, floodplain of the Tentek River (46°00'22.7"N 81°00'04.7"E), 20.07.2023, 1♀, 2♂; Zhetysu Region, Alakolsky Reserve, Tuguztubek Territory (46°25'00.0"N 81°08'00.0"E), 28.07.2023, 2♀, 3♂.

### Family Miridae

*Deraeocoris olivaceus* (Fabricius 1777). Almaty Region, Ili Alatau, Aksay Ravine (43°05'49.4"N 76°47'08.3"E), 15.06.2023, 2♀, 3♂.

*Deraeocoris annulipes* (Herrich-Schaffer 1842). Almaty Region, Ili Alatau, floodplain of the Bolshaya Almatinka River (43°04'39.8"N 76°59'00.5"E), 18.06.2023, 2♀, 1♂.

*Deraeocoris lutescens* (Schilling 1837). Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 2♀, 2♂; Almaty Region, Talgar District, Panfilova Village (43°23'06.6"N 77°07'10.2"E), 20.06.2023, 1♀; Almaty Region, Karasay District, Alatau Village (43°21'08.8"N 77°08'55.2"E), 02.06.2023, 2♀, 2♂.

*Deraeocoris ruber* (Linnaeus 1758). Almaty Region, Ili Alatau, Karagaily ravine (43°04'58.3"N 76°52'00.1"E), 17.06.2023, 2♀, 2♂; Almaty Region, 40 km from Kapchagay downstream of the Ili River (44°13'09.8"N 76°54'44.4"E), 07.07.2023, 1♀, 3♂.

*Agnocoris rubicundus* (Fallen 1807). Almaty Region, Balkhash District, Miyaly Village, floodplain of the Ili River (44°29'43.4"N 76°40'27.5"E), 25-27.05.2023, 2♀, 1♂.

*Apolygus limbatus* (Fallen 1807). Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 2♀, 3♂; Almaty Region, Balkhash District, Bakanas Village, floodplain of the Ili River (44°48'11.6"N 76°15'57.8"E), 29.05.2023, 1♀, 4♂.

*Phytocoris ulmi* (Linnaeus 1758). Almaty region, Ili Alatau, Aksay ravine (43°05'49.4"N 76°47'08.3"E), 15.06.2023, 3♀, 2♂; Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 2♀, 4♂.

*Blepharidopterus angulatus* (Fallen 1807). Almaty Region, Nauryzbay District, Tausamaly Village (43°11'02.2"N 76°50'45.8"E), 25.06.2023, 2♀, 2♂; Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 2♀, 1♂; Almaty Region, 119 km from Kapchagay downstream of the Ili River (44°48'33.1"N 76°18'51.1"E), 07.07.2023, 4♀, 3♂.

*Cylloceria decorata* (Kiritshenko 1931). Almaty Region, Balkhash District, Miyaly Village, floodplain of the Ili River (44°29'43.4"N 76°40'27.5"E), 25-27.05.2023, 3♀, 2♂; Almaty Region, Karasay District, floodplain of the Kaskelen River (43°12'46.6"N 76°38'16.1"E), 03-04.06.2023, 3♀, 1♂; Almaty Region, Nauryzbay District, Tausamaly Village (43°11'02.2"N 76°50'45.8"E), 25.06.2023,

3♀, 4♂; Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 3♀, 3♂, 2 nymphs.

*Malacocoris chlorizans* (Panzer, 1794). Almaty region, Ili Alatau, Aksay ravine (43°05'49.4"N 76°47'08.3"E), 15.06.2023, 5♀, 3♂; Almaty Region, Karasay District, near the village of Shamalgan (43°22'21.2"N 76°38'38.1"E), 08.06.2023, 5♀, 3♂, 1 nymph.

*Orthotylus bilineatus* (Fallen, 1807). Almaty region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 1♀, 2♂; Almaty Region, Ili Alatau, Aksay ravine (43°05'49.4"N 76°47'08.3"E), 15.06.2023, 2♀, 3♂; Almaty Region, Karasay District, floodplain of the Kaskelen River (43°12'46.6"N 76°38'16.1"E), 03-04.06.2023, 3♀, 3♂.

*Orthotylus marginalis* Reuter, 1883. Zhetysu Region, Alakol Reserve, Kukpekti Territory, floodplain of the Tentek River (46°00'22.7"N 81°00'04.7"E), 20.07.2023, 3♀, 3♂, 1 nymph; Almaty region, Ili Alatau, Aksay ravine (43°05'49.4"N 76°47'08.3"E), 15.06.2023, 2♀, 1♂, 1 nymph; Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 2♀, 1♂; Almaty region, 40 km from Kapchagay downstream of the Ili River (44°13'09.8"N 76°54'44.4"E), 07.07.2023, 2♀, 2♂.

*Pilophorus confusus* (Kirschbaum, 1856). Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 1♀, 2♂; Zhetysu Region, Alakol Reserve, Kukpekti Territory, floodplain of the Tentek River (46°00'22.7"N 81°00'04.7"E), 20.07.2023, 3♀, 2♂.

*Atractotomus mali* (Meyer-Dur, 1843). Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 1♀, 3♂, 1 nymph; Almaty Region, Ili Alatau, Malaya Almatinka Ravine (43°05'29.7"N 77°04'47.6"E), 16.06.2023, 2♀, 2♂; Zhetysu Region, Alakol reserve, Karamoyin Territory (46°28'08.8"N 80°54'11.3"E), 21.07.2023, 1♀, 2♂.

*Campylomma verbasci* (Meyer-Dur, 1843). Almaty Region, Karasay District, floodplain of the Kaskelen River (43°12'46.6"N 76°38'16.1"E), 03-04.06.2023, 2♀, 2♂; Almaty Region, Nauryzbay District, Tausamaly Village (43°11'02.2"N 76°50'45.8"E), 25.06.2023, 3♀, 2♂, 2 nymphs; Almaty Region, Enbekshikazakh District, Masak Village, floodplain of the Chilik River (43°37'12.6"N 78°17'44.2"E), 20-22.05.2023, 1♀, 1♂.

### Family Aradidae

*Aneurus avenius* (Dufour 1833). Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 5♀, 4♂.

*Aradus angularis* (J.Sahlberg 1886). Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 2♂.

*Aradus betulae* (Linnaeus 1758). Almaty Region, Ili Alatau, Aksay Ravine (43°05'49.4"N 76°47'08.3"E), 15.06.2023, 3♀, 2♂; Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 4♀, 3♂, 5 nymphs.

*Aradus cinnamomeus* (Panzer 1806). Almaty Region, Ili Alatau, Medeu Tract (43°09'35.6"N 77°03'17.7"E),

14.06.2023, 1♀, 2♂; Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 2♀, 3♂; Zhetysu Region, Alakol District, Zhylandy Village (45°38'58.4"N 80°42'44.7"E), 12.08.2023, 5♀, 5♂; Zhetysu Region, Alakol District, Lepsinsk Village (45°31'15.5"N 80°36'49.0"E), 12.08.2023, 5♀, 5♂, 5 nymphs.

### Family Lygaeidae

*Arocatus roeselii* (Schilling 1829). Almaty Region, Ili Alatau, Medeu Tract (43°09'35.6"N 77°03'17.7"E), 14.06.2023, 1♀, 2♂; Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 4♀, 5♂; Almaty Region, Charyn State National Natural Park (43°21'05.3"N 79°04'51.0"E), 05.08.2023, 8♀, 9♂, 5 nymphs; Zhetysu Region, Kerbulak District, Village of Kugaly (44°28'20.3"N 78°40'11.8"E), 15.08.2023, 5♀, 5♂.

*Arocatus melanocephalus* (Fabricius 1798). Almaty Region, Almaty City, Auezov District, Family Park (43°13'35.2"N 76°51'18.2"E) 07.06.2023, 22♀, 25♂; Almaty Region, Ili Alatau, Aksay Ravine (43°05'49.4"N 76°47'08.3"E), 15.06.2023, 21♀, 23♂; Zhetysu Region, Eskeldinsky District, Zhendik Village (44°54'04.4"N 78°39'33.5"E), 13.08.2023, 8♀, 9♂; Zhetysu Region, Eskeldinsky District, Konyr Village (45°08'12.4"N 78°43'15.1"E), 13.08.2023, 9♀, 9♂.

*Orsillus maculatus* (Fieber 1861). Almaty Region, Ili Alatau, floodplain of the Bolshaya Almatinka River (43°04'39.8"N 76°59'00.5"E), 19.06.2023, 2♀, 3♂.

*Kleidocerys resedae* (Panzer 1797). Almaty Region, 119 km from Kapchagay downstream of the Ili River (44°48'33.1"N 76°18'51.1"E), 07.07.2023, 4♀, 3♂, 5 nymphs; Almaty Region, Talgar District, Panfilova Village (43°23'06.6"N 77°07'10.2"E), 20.06.2023, 1♀; Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 2♀, 3♂; Zhetysu Region, Altyn-Emel National Park, Shygan Territory (44°06'56.0"N 78°42'18.1"E), 11.06.2023, 3♀, 2♂; Zhetysu Region, Alakol Reserve, Usharal City (46°10'15.2"N 80°55'26.0"E), 25.07.2023, 1♀, 2♂.

*Artheneis alutacea* (Fieber 1861). Almaty Region, Enbekshikazakh District, Masak Village, floodplain of the Chilik River (43°37'12.6"N 78°17'44.2"E), 20-22.05.2023, 3♀, 2♂; Almaty Region, 40 km from Kapchagay downstream of the Ili River (44°13'09.8"N 76°54'44.4"E), 07.07.2023, 4♀, 4♂, 5 nymphs.

*Gastrodes grossipes* (De Geer 1773). Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 3♀, 2♂; Almaty Region, Ili Alatau, Medeu Tract (43°09'35.6"N 77°03'17.7"E), 14.06.2023, 2♀, 2♂; Zhetysu Region, Koksus District, Ainabulak Village (44°37'36.7"N 77°59'51.1"E), 17.08.2023, 4♀, 4♂; Zhetysu Region, Sarkand District, Akbalyk Village (46°34'16.9"N 79°11'47.9"E), 18.08.2023, 5♀, 10♂.

*Gonocerus juniperi* (Herrich-Schaffer 1839). Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 1♀, 2♂; Almaty Region, Ili Alatau, Medeu Tract (43°09'35.6"N 77°03'17.7"E), 14.06.2023, 2♀, 3♂, 5 nymphs; Zhetysu Region, Karatal

District, Zhylybulak Village (45°19'39.4"N 78°05'53.9"E), 14.08.2023, 4♀, 4♂.

### Family Acanthosomatidae

*Acanthosoma spinicolle* (Jakovlev 1880). Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 2♀, 2♂; Almaty Region, Ili Alatau, Aksay Ravine (43°05'49.4"N 76°47'08.3"E), 15.06.2023, 2♀, 2♂.

*Acanthosoma haemorrhoidale* (Linnaeus 1758). Zhetysu Region, Basshi Village (44°09'24.2"N 78°44'50.3"E), 19.09.2023, 2♀, 2♂.

*Elasmotethus interstinctus* (Linnaeus 1758). Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 5♀, 2♂, 5 nymphs; Zhetysu Region, Karatal District, Village 1 May, (45°58'53.8"N 77°12'31.8"E), 14.08.2023, 4♀, 4♂; Found everywhere in the republic.

*Elasmucha ferrugata* (Fabricius 1787). Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 2♀, 2♂.

*Elasmucha grisea* (Linnaeus 1758). Almaty Region, Enbekshikazakh District, Env. Shelek Village (43°35'21.6"N 78°15'01.0"E), 23.05.2023, 2♀, 2♂, 9 nymphs; Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 1♀, 2♂; Found everywhere in the republic.

*Elasmucha fieberi* (Jakovlev 1865). Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 2♀, 2♂; Zhetysu Region, Alakol Reserve, Kukpekti Territory, floodplain of the Tentek River (46°00'22.7"N 81°00'04.7"E), 20.07.2023, 7♀, 2♂; Almaty Region, Charyn State National Natural Park, floodplain of the Charyn River (43°39'57.0"N 79°23'27.1"E), 08.08.2023, 1♀, 2♂.

### Family Pentatomidae

*Arma custos* (Fabricius 1794). Almaty Region, Ili Alatau, Aksay Ravine (43°05'49.4"N 76°47'08.3"E), 15.06.2023, 1♀, 2♂; Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 1♀, 1♂.

*Jalla dumosa* (Linnaeus 1758). Almaty Region, Enbekshikazakh District, Masak Village, floodplain of the Chilik River (43°37'12.6"N 78°17'44.2"E), 20-22.05.2023, 1♀, 1♂; Almaty Region, 40 km from Kapchagay downstream of the Ili River (44°13'09.8"N 76°54'44.4"E), 07.07.2023, 5♀, 7♂; Almaty Region, Balkhash District, Miyaly Village, floodplain of the Ili River (44°29'43.4"N 76°40'27.5"E), 25-27.05.2023, 3♀, 2♂; Almaty Region, Ili Alatau, Aksay Ravine (43°05'49.4"N 76°47'08.3"E), 15.06.2023, 3♀, 2♂.

*Picromerus bidens* (Linnaeus 1758). Almaty Region, Balkhash District, Miyaly Village, floodplain of the Ili River (44°29'43.4"N 76°40'27.5"E), 25-27.05.2023, 3♀, 2♂, 5 nymphs; Almaty Region, Enbekshikazakh District, Masak Village, floodplain of the Chilik River (43°37'12.6"N 78°17'44.2"E), 20-22.05.2023, 1♀, 5♂; Zhetysu Region, Altyn-Emel National Park, Shygan Territory (44°06'56.0"N

78°42'18.1"E), 11.06.2023, 1♀, 1♂; Found everywhere in the republic.

*Rhacognathus punctatus* (Linnaeus 1758). Almaty Region, Enbekshikazakh District, Masak village, floodplain of the Chilik River (43°37'12.6"N 78°17'44.2"E), 20-22.05.2023, 1♀, 2♂.

*Zicrona caerulea* (Linnaeus 1758). Zhetysu Region, Alakol Reserve, Kukpekti Territory, floodplain of the Tentek River (46°00'22.7"N 81°00'04.7"E), 20.07.2023, 1♀, 2♂.

*Palomena prasina* (Linnaeus 1761). Almaty Region, Nauryzbay District, Tausamaly Village (43°11'02.2"N 76°50'45.8"E), 25.06.2023, 9♀, 6♂; Almaty Region, Ili Alatau, Aksay Ravine (43°05'49.4"N 76°47'08.3"E), 15.06.2023, 11♀, 10♂; Zhetysu Region, Karatal District, Kopbirlik Village (46°24'25.0"N 77°17'23.8"E), 14.08.2023, 5♀, 5♂.

*Palomena viridissima* (Poda 1761). Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 4♀, 2♂; Almaty Region, Nauryzbay District, Tausamaly Village (43°11'02.2"N 76°50'45.8"E), 25.06.2023, 2♀, 3♂; Almaty Region, 40 km from Kapchagay downstream of the Ili River (44°13'09.8"N 76°54'44.4"E), 07.07.2023, 2♀, 1♂.

*Apodiphus integriceps* (Horvath 1888). Almaty Region, Ili Alatau, Aksay Ravine (43°05'49.4"N 76°47'08.3"E), 15.06.2023, 3♀, 4♂; Almaty Region, Charyn State National Natural Park, floodplain of the Temirlik River (43°21'54.9"N 79°09'42.1"E), 10.08.2023, 5♀, 4♂.

*Pentatoma rufipes* (Linnaeus, 1758). Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 3♀, 2♂.

*Rhapigaster brevispina* (Horvath 1889). Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 5♀, 3♂; Zhetysu Region, Altyn-Emel National Park, Shygan Territory (44°06'56.0"N 78°42'18.1"E), 11.06.2023, 1♀, 2♂.

*Piezodorus lituratus* (Fabricius 1794). Almaty Region, Almaty City, Botanical Garden (43°13'13.9"N 76°54'50.3"E), 09.07.2023, 2♀, 2♂; Almaty Region, Ili Alatau, Karagaily Ravine (43°04'58.3"N 76°52'00.1"E), 17.06.2023, 1♀; Almaty Region, Ili Alatau, Aksay Ravine (43°05'49.4"N 76°47'08.3"E), 15.06.2023, 2♀, 2♂.

Arboreal hemipterans are divided into zoophagous, zoophytophagous, mycetophagous, wide oligophytophagous, narrow oligophytophagous, and polyphytophagous according to their nutritional relationship. Also, 1 species (*A. avenius*) was found that does not have a food specialization (Figure 2).

According to the type of food specialization, phytophagous predominate in the fauna (41%). Phytophagous were divided into three subgroups:

Narrow oligophytophagous are species that feed on different plant species of the same genus. In our case, only 1 species belongs to this type of nutrition, it is *Andrena alutacea*. This species feeds on the seeds of *Tamarix gracilis* Willd.



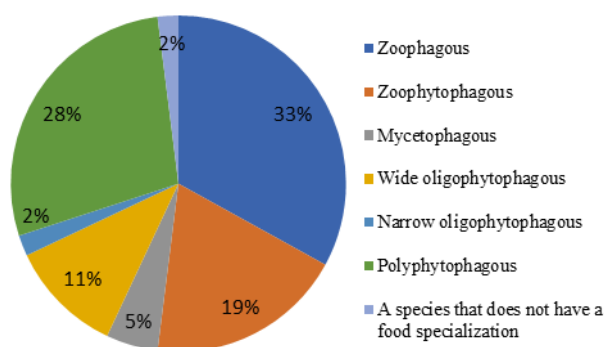


Figure 2. Distribution of species by trophic relationships

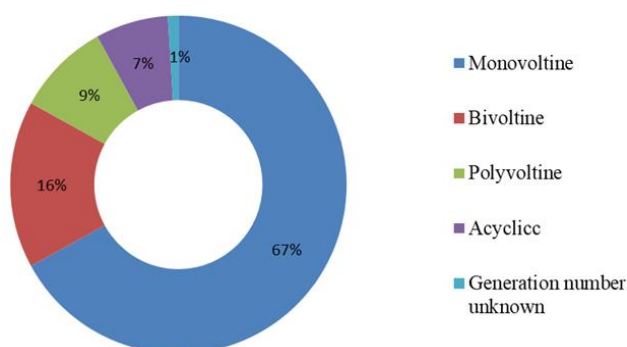


Figure 3. Distribution of species by voltinism

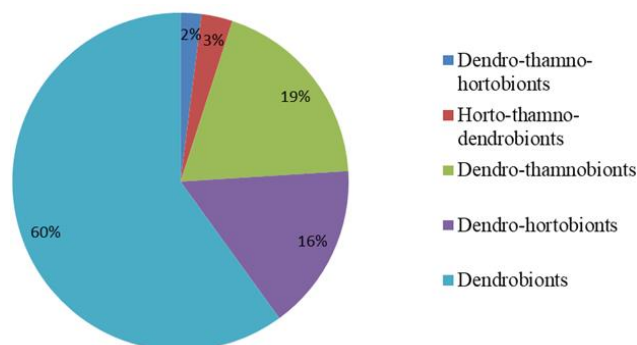


Figure 4. Distribution of species by habitat

Wide oligophytophagous are species that feed on plants belonging to different genera of the same family. 6 species were identified that belong to this type of nutrition. They are *P. smreczynskii*, *O. maculatus*, *G. grossipes*, *G. juniperi*, *E. grisea*, and *P. lituratus*.

Polyphytophages are species that feed on a large number of plant species, regardless of their taxonomy. Polyphytophages are represented by Tingidae (*S. pyri*), Miridae (*A. rubicundus*, *A. limbatus*), Lygaeidae (*A. roeselii*, *A. melanocephalus*, *K. resedae*), Acanthosomatidae (*A. spinicolle*, *A. haemorrhoidale*, *E. interstinctus*, *E. ferrugata*, *E. fieberi*) and Pentatomidae (*P. prasina*, *P. viridissima*, *A. integriceps*, *P. rufipes*, *R. brevispina*).

Zoophagous are predators that feed on other insects. The zoophages include 19 species of all identified arboreal hemipterans. They are *N. pallidus*, *N. viridulus*, *A. confusus*, *A. flavipes*, *A. nemorum*, *A. nemoralis*, *E. stigmatellus*, *O. laticollis*, *O. majusculus*, *E. vagabundus*, *R. annulatus*, *R. iracundus*, *D. lutescens*, *C. decorata*, *A. custos*, *J. dumosa*, *P. bidens*, *R. punctatus*, *Z. caerulea*. These species feed mainly on flies, Psyllinea, some species of aphids (*Pterocallis alni* (De Geer 1773), *Pterocallis albida* Börner, 1940, *Pterocomma rufipes* (Hartig 1841), *Aphis podagrariae* (Schrank 1801), eggs and larvae of other hemipterans, butterfly caterpillars.

Zoophytophagous are omnivorous hemipterans. They feed on plants and other insects. 11 species were identified that belong to this type of nutrition. They are *D. olivaceus*, *D. annulipes*, *D. ruber*, *P. ulmi*, *B. angulatus*, *M. chlorizans*, *O. bilineatus*, *O. marginalis*, *P. confusus*, *A. mali*, *C. verbasci*.

Mycetophagous are species that feed only on fungi. They are represented by 3 species (*A. angularis*, *A. betulae*, *A. cinnamomeus*). They feed mainly on *Fomes fomentarius* (L.) Fr., 1849.

Arboreal hemipterans of South-Eastern Kazakhstan are divided into 4 groups according to the number of generations they give per year: monovoltine, bivoltine, polyvoltine, acyclic, number of generations unknown (Figure 3).

According to the voltinism the vast majority of arboreal hemipterans found in South-Eastern Kazakhstan are monovoltine (38 species). Monovoltine are species that produce 1 generation per year. Monovoltine are represented by Nabidae (*N. viridulus*), Anthocoridae (*A. confusus*, *A. flavipes*, *E. stigmatellus*), Reduviidae (*R. annulatus*, *R. iracundus*), Miridae (*D. olivaceus*, *D. annulipes*, *D. ruber*, *A. rubicundus*, *B. angulatus*, *C. decorata*, *O. bilineatus*, *P. confusus*, *A. mali*), Lygaeidae (*A. roeselii*, *A. melanocephalus*, *O. maculatus*, *K. resedae*, *A. alutacea*, *G. juniperi*), Acanthosomatidae (*A. spinicolle*, *A. haemorrhoidale*, *E. interstinctus*, *E. ferrugata*, *E. grisea*, *E. fieberi*) and Pentatomidae (*A. custos*, *J. dumosa*, *P. bidens*, *R. punctatus*, *Z. caerulea*, *P. prasina*, *P. viridissima*, *A. integriceps*, *P. rufipes*, *R. brevispina*, *P. lituratus*).

Bivoltine are species that produce 2 generations per year. 9 species were identified that belong to this type of voltinism: *N. pallidus*, *A. nemoralis*, *O. majusculus*, *D. lutescens*, *A. limbatus*, *P. ulmi*, *M. chlorizans*, *O. marginalis*, *G. grossipes*.

Polyvoltine are species that produce 3 or more generations per year. 5 species were identified that belong to this type of voltinism: *P. smreczynskii*, *S. pyri*, *A. nemorum*, *O. laticollis*, *C. verbasci*.

Acyclic species have a stretched life cycle, i.e. throughout a year there are different phases and stages of development. Acyclic species are represented by 4 species (*A. avenius*, *A. angularis*, *A. betulae*, *A. cinnamomeus*).

There is also 1 species (*E. vagabundus*) whose generation number is unknown.

In addition, arboreal hemipterans are divided into several groups depending on their habitat: dendrobiont, dendro-thamnobiont, dendro-thamno-hortobiont, dendro-hortobiont, horto-thamno-dendrobionts (Figure 4).

Dendrobionts are species that live only on woody plants. 34 species were identified that belong to this type of habitat. They are represented by Nabidae (*N. pallidus*, *N. viridulus*), Anthocoridae (*A. confusus*, *E. stigmatellus*, *O. laticollis*, *O. majusculus*), Reduviidae (*E. vagabundus*), Miridae (*D. olivaceus*, *D. annulipes*, *D. lutescens*, *A. rubicundus*, *A. limbatus*, *P. ulmi*, *B. angulatus*, *C. decorata*, *O. bilineatus*, *O. marginalis*, *P. confusus*, *A. mali*), Aradidae (*A. avenius*, *A. angularis*, *A. betulae*, *A. cinnamomeus*), Lygaeidae (*A. roeselii*, *A. melanocephalus*, *O. maculatus*, *A. alutacea*, *G. grossipes*, *G. juniperi*), Acanthosomatidae (*A. spinicolle*, *E. grisea*), Pentatomidae (*R. punctatus*, *A. integriceps*, *R. brevispina*). These species live on such trees as *Tamarix tetrandra* Pall., *Salix alba* L., *Populus laurifolia* Ledeb., *Betula populifolia* Marshall, *Alnus incana* (L.) Moench., and also on coniferous trees such as *Pinus sylvestris* L., *Abies sibirica* Korsh., *Picea excelsa* Wender.

Dendro-hortobionts are species that inhabit woody and herbaceous plants. 9 species were identified that belong to this type of habitat: *A. flavipes*, *A. nemorum*, *A. nemoralis*, *R. annulatus*, *R. iracundus*, *C. verbasci*, *A. custos*, *J. dumosa*, *P. bidens*. These species live on such trees as *Pinus sylvestris* L., *Picea excelsa* Wender., *Juniperus communis* L., *Betula populifolia* Marshall, *Corylus avellana* L., *Alnus incana* (L.) Moench, *Quercus robur* L., *Populus tremula* L.; they also live on various herbaceous plants such as Apiaceae, Fabaceae, Asteraceae.

Dendro-thamnobionts are species that inhabit woody and shrubby plants. 11 species were identified that belong to this type of habitat: *P. smreczynskii*, *S. pyri*, *M. chlorizans*, *K. resedae*, *A. haemorrhoidale*, *E. interstinctus*, *E. ferrugata*, *E. fieberi*, *P. prasina*, *P. viridissima*, *P. rufipes*. They live on *Betula* L., *Crataegus* L., *Corylus* L., *Tilia* L.

Dendro-tamno-hortobionts are species that live on different plants, but mainly on trees. Only 1 species (*D. ruber*) belongs to them. This species was found on *Lupinus luteus* L., *Tilia* × *vulgaris* Hayne, *Crataegus laevigata* (Poir.) DC.

Horto-tamno-dendrobionts are species that live on various plants, but mainly on herbaceous plants. 2 species (*Z. caerulea*, *P. lituratus*) were identified that belong to this type of habitat. These species were found on *Daphne mezereum* L., *Betonica grandiflora* Thuill., *Malus sylvestris* Mill.

According to ecological groups, the majority of arboreal hemipterans are mesophiles (95%) and only 3 species (*O. maculatus*, *A. alutacea*, *G. juniperi*) are mesoxerophiles.

After conducting a comparative analysis of families by species abundance, it was revealed that the dominant species were bugs from the Miridae family (26.32%), including 15 species. As can be seen from the above list of localities, the greatest species diversity (28 species) was established on the territory of the botanical garden in Almaty. Undoubtedly, the environmental protection regime and the virtually complete absence of anthropogenic impact in the botanical garden have a beneficial effect on the entire entomological complex. In the other surveyed localities of

South-Eastern Kazakhstan, the species are nearly equally distributed. This suggests that the climate in South-Eastern Kazakhstan is favorable for their development.

Summing up the results of the study of arboreal hemipterans, it should be noted that today in South-Eastern Kazakhstan there are 57 species of arboreal hemipterans belonging to 9 families: Miridae (15 species), Pentatomidae (11 species), Acanthosomatidae (8 species), Lygaeidae (7 species), Anthocoridae (6 species), Nabidae (4 species), Aradidae (4 species), Reduviidae (3 species), Tingidae (2 species).

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