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## Tree and shrub dwelling Pentatomidae (Heteroptera) of protected areas of South-Eastern Kazakhstan, with notes on natural history

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**Abstract**

A biodiversity inventory of the woody vegetation in five protected areas in SE Kazakhstan (Kulsay kulderi, Altyn-Emel, Charyn, Ile-Alatau and Alakol Nature Reserves) recorded 23 species of Pentatomidae associated with trees, shrubs and woody understory vegetation. Two species, *Arma custos* and *Zicrona caerulea*, are listed as threatened in the Red Data Book of the Almaty region. Of the 23 recorded species, 8 species are predators (zoophagous), with the remainder plant feeders (phytophagous), further divided by dietary breadth into polyphagous -10 species, broad oligophages – 2 species, and narrow oligophages - 3 species. Moisture preference strongly affected the distribution of species: 78.3%, were collected from mesophilic habitats, 8.7% were xeromesophiles, 4.3% mesoxerophiles and 8.7% xerophiles. The majority of species (20) go through diapause as adults; one species diapauses as larva. All were univoltine.

**Keywords:** Pentatomidae, dendrobiont, protected areas, South-Eastern Kazakhstan

**1. Introduction**

Asanov [2, 3] and Esenbekova [6] described the Heteroptera of southeast Kazakhstan and their biological, ecological features. However, these studies lacked detail on the dendrobiont Pentatomidae those closely associated with trees, shrubs and woody understory vegetation. The term dendrobiont was introduced by Arnol'di [1], and we employ it *sensu* Havrylenko and Lystopadskiy [10]. Information on species composition and natural history of this group of Pentatomidae is important. The group includes known eruptive pest species, with the potential to cause significant forest damage. Several Pentatomidae species are listed as threatened in south-west Kazakhstan [14]. Worldwide, the leading threat to listed Pentatomidae is human-caused habitat alterations [8, 9].

The goal of the study was to create an annotated list of all recorded dendrobiont Pentatomidae, with information on each species' preferred habitats, trophic habits, diapause and other relevant data. These data serve two purposes: to inform forest and protected area management plans, and to form the basis for long-term monitoring of protected area forest and ecosystem health. Monitoring the status of key species (pests, threatened species) critical. Detecting changes in the status of species of conservation concern can provide early warning of anthropogenic impact, lead to changes in management approaches, including expanding protection measures and restoration [9]. Monitoring of pest species can better inform forest pest management and control in the protected areas.

**2. Materials and methods**

In 2016-17 we conducted the first inventory and analysis specifically focused on the dendrobiont fauna of the protected natural areas of South-Eastern Kazakhstan. The protected areas included four State National Nature Parks (SNNP) Kulsay kulderi, Altyn-Emel, Charyn, Ile-Alatau, and the Alakol State Nature Reserve (SNR).

Pentatomidae were collected and analyzed following established techniques [7, 13]. We used sweep netting to collect specimens from lower limbs of trees, from shrubs and from woody understory vegetation, and we hand netted visible specimens. We used aspirators and tweezers to collect specimens from surfaces, under the bark of trees and from within crevices and other shelters. Captured insects were killed with ethyl acetate and stored in field collection boxes. Larger specimens were mounted on entomological pins on return to the laboratory.

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All specimens were identified to species using standard texts and vouched against museum holdings [7, 12, 15]. The specimens collected in this research are stored in the Research Institute of Plant Protection and Quarantine, Kazakh Institute of Zoology.

Collected species were assigned a trophic type [11] and habitat moisture preference [4], based on information in existing literature and extensive field data maintained at the Institute. Species were designated as predators (zoophagous) or plant feeders (phytophagous), the latter further divided by dietary breadth into polyphytophagous, broadly oligophytophagous, and narrowly oligophytophagous using the definitions of Huffaker and Gutierrez [11].

We determined the habitat moisture preference of the collected species along a continuum of habitat specialization from as xeric (dry) to mesic (damp) and hygric (wet). For the research areas, we defined mesophiles, xeromesophiles, mesoxerophiles and xerophiles using the scale provided by Bagachanova [4]. Xerophiles tend to occupy arid habitats (open scrublands, grasslands, and barren areas) while mesophiles tend to occupy more consistently moist habitats (forest, woodland). Xeromesophiles and mesoxerophiles occupy habitats in between, with the former trending toward xeric and the latter towards the mesic side of the habitat moisture continuum.

We also used field notes and museum data to establish number of broods per year (voltinism) and overwintering life stage (diapause) [11, 16].

### 3. Results

Note we used the following English translation of Russian location data: area (Ru: кордон, near village/settlement or named map point), gorge (Ru: ущ., ущелье), peak, mountain, Mt. (Ru: хр., хребет) settlement (Ru: ур., урочище), watershed (Ru: пойма)

We recorded 23 species of dendrobiont Pentatomidae, from the protected natural areas of South-Eastern Kazakhstan, 2 of which are included in the Red Data Book of the Almaty region: *Arma custos* (Fabricius, 1794) and *Zicrona caerulea* (Linnaeus, 1758). Species recorded are:

#### Family Pentatomidae

*Arma custos* (Fabricius, 1794). Ile-Alatau SNNP, Aksay gorge (Ru: ущ., ущелье), 14.07.2016, 1♀, 2♂; Medeu settlement (Ru: ур., урочище), 23.06.2016, 2♀, 2♂; Butakovka gorge, 10.08.2016, 2♀, 3♂; 07.05.2017, 2♀, 1♂; SSRP Altyn-Emel, Shygan area (Ru: кордон, near settlement or map point), July 14, 2016, 2♀, 1♂; Taigak gorge, 21.05.2016, 1♀, 1♂; Kyzylauz gorge, 10.7.2016, 1♀, 2♂; banks of the river Ile, 10.07.2016, 1♂; Charyn SNNP, Charyn River watershed, 23.5.2016, 1♀, 2♂; 06.15.2017, 3♀, 2♂; Alakol SNR, Togzhytbuek area, 11.06.2016, 2♀, 2♂; Alakol SNR, Karamoyin area, 22.06.2017, 3♀, 1♂.

*Jalla dumosa* (Linnaeus, 1758). SNNP Kulsy kulderi, Shelek River watershed, 24.05.2016, 1♀, 1♂; 02.06.2016, 2♀, 2♂; SNNP Altyn-Emel, banks of the river Ile, 14.08.06.2016, 5♀, 7♂; Zhetysusky Alatau, Koyandytau peak (Ru: хр., хребет), Uzynbulak gorge, 16.07.2016, 2♀, 1♂; foothills of the Ile Alatau SNNP, Aksay, 16, 07. 2016, 3♀, 2♂; 11.07.2017, 1♀, 2♂.

*Picromerus bidens* (Linnaeus, 1758). SNNP Altyn-Emel, Ili River watershed, 07.06.2016, 3♀, 2♂; SNNP Altyn-Emel, Shygan area, 07.06.2016, 1♀, 1♂; Zhetysu Alatau, Mt. Sholak (a spur of the Dzungar Alatau mountain range), Taigak gorge, 21.05.2016, 2♀, 1♂; Kyzylauz gorge,

10.07.2016, 2♀, 1♂; SNPP Kulsy kulderi, Shelek River watershed, 24.05.2016, 1♀, 5♂; Alakol SNR, Togzhytbuek area, 11.06.2016, 1♀, 2♂; Tentec River watershed, 23.06.2017, 1♀, 1♂.

*Picromerus lewisi* (Scott, 1874). SNNP Altyn-Emel, banks of the river Ili, 15.06.2016, 2♀, 1♂; foothills of the Ile Alatau, Aksay gorge, 16.06.2016, 1♀, 1♂; 11.07.2017, 2♀, 2♂; Alakol SNR, Kokpekty area, Tentec River watershed, 29.05.2016, 2♀, 1♂; Touyuxu area, 12.06.2017, 1♀, 2♂.

*Rhacognatus punctatus* (Linnaeus, 1758). SNNP Kulsy kulderi, Shelek River watershed, 02.06.2016, 1♀, 1♂; foothills of the Ile Alatau, Aksay gorge, 16.07.2016, 1♀, 2♂; 11.07.2017, 1♀. On willow, birch, aspen, raspberry, and similar; zoophagous (various small arthropods).

*Troilus luridus* (Fabricius, 1775). SNNP Altyn-Emel, banks of the river Ili, 06.08.2016, 1♀, 1♂; Charyn SNNP, Charyn River watershed, 25.05.2016, 1♀, 2♂; 16.06.2017, 3♀, 2♂; Alakol SNR, Kokpekty area, Tentec River watershed, 29.05.2016, 2♀, 3♂; Touyuxu area, 12.06.2017, 3♀, 2♂.

*Pinthaeus sanguinipes* (Fabricius, 1781). Alakol SNR, Kokpekty area, Tentec River watershed, 15.09.2016, 1♂; 14.06.2016, 2♀, 3♂; foothills of the Ile Alatau, Aksay gorge, 16.07.2016, 2♂; 11.07.2017, 1♀; Alakol SNR, Touyuxu area, 13.06.2016, 2♀, 2♂; Kokpekty area, Tentec River watershed, 23.06.2017, 2♀, 1♂.

*Zicrona caerulea* (Linnaeus, 1758). SNNP Altyn-Emel, Shygan area, 10.06.2016, 3♀, 2♂; Zhetysu Alatau, Mt. Sholak, Taigak gorge, 21.05.2016, 2♀, 1♂; Kyzylauz gorge, 10.07.2016, 1♀, 2♂; Jantogai access area, Ili River watershed, 27.06.2016, 3♀, 2♂; 14-20.09.2016, 3♀, 4♂; Alakol SNR, Kokpekty area, Tentec River watershed, 29.05.2016, 3♀, 2♂; 31.05.2016, 6♀, 6♂; Togzytbek access area, 02.06.2016, 3♀, 4♂; Charyn SNNP, Charyn River watershed, 24.05.2016, 1♀, 2♂; 15.06.2017, 2♀, 2♂; foothills of the Ile Alatau, Aksay gorge, 16.07.2016, 2♀, 2♂; 11.07.2017, 1♀, 3♂.

*Alloeglypta pretiosa* (Kiritshenko, 1952). SNNP Altyn-Emel, Ili River watershed, 07.06.2016, 1♀, 3♂.

*Anthemina aliena* (Reuter, 1891). SNNPP Kulsy kulderi, Shelek River watershed, 28.05.2016, 2♀, 3♂; SNNP Altyn-Emel, banks of the river Ili, 08.06.2016, 2♀, 2♂; Alakol SNR, Kokpekty area, Tentec River watershed, 29.05.2016, 3♀, 2♂; 30.06.2017, 2♀, 3♂; Togzhytbuek area, 02.06.2016, 3♀, 4♂; 11.06.2017, 4♀, 3♂.

*Chlorochroa juniperina juniperina* (Linnaeus, 1758). Zhetysu Alatau, Taigak gorge, 21.05.2016, 2♀, 3♂.

*Chlorochroa picicola* (Mulsant & Rey, 1852). Ile-Alatau SNNP, Ileysky Alatau, Medeu settlement, 17.06.2016, 2♀, 3♂; 23.06.2016, 1♂.

*Palomena prasina* (Linnaeus, 1761). Ile-Alatau SNNP, Aksay gorge, 14.08.2016, 1♀, 2♂; Ileansky Alatau, Butakovka gorge, 20-30.06.2016, 9♀, 6♂.

*Palomena viridissima* (Poda, 1761). Ile-Alatau SNNP, Aksay gorge, 14.06.2016, 4♀, 2♂; Butakovka gorge, 19.06.2016, 2♀; 25.07.2017, 4♀, 3♂; SNNP Altyn-Emel, Ili River watershed, 10.07.2016, 2♀, 1♂; Zhetysu Alatau, Mt. Sholak, Taigak gorge, 23.05.2016, 1♀, 2♂; SNNP Charyn, in ash-tree grove, 25.06.2016, 1♀, 2♂; 15.06.2017, 3♀, 2♂; Alakol SNR, Karamoiyn area, 22.06.2017, 3♀, 4♂; Tentec River watershed, 24.06.2017, 3♀, 3♂.

*Apodiphus integriceps* (Horvath, 1888). SNNP Altyn-Emel, Zhetysu Alatau, Mt. Sholak, Sholak gorge, 25.08.2016, 7♀, 8♂; SNNP Charyn, Temirlik River watershed, 26.07.2016, 5♀, 4♂; Charyn River watershed, 23.05.2016, 3♀, 2♂; 15.06.2017, 2♀, 2♂.

*Desertomenida albula* (Kiritshenko, 1914). SNNP Altyn-Emel, Greater and Lesser Kalkan mountains, 30.05.2016, 3♀, 4♂; Zhetysu Alatau, Mt. Sholak, 21.05.2016, 2♀, 4♂; 14.07.2016. 2♀, 5♂; Alakol SNR, Touyuxu area, 23.06.2017. 3♀, 2♂; Tentec River watershed, 24.06.2017. 3♀, 3♂.

*Desertomenida jakowleffi* (Horvath, 1907). SNNP Altyn-Emel, vicinity of Valikhanov spring, 09.07.2016, 1♀, 2♂; Ili River watershed, 10.07.2016, 2♀, 4♂.

*Desertomenida quadrimaculata* (Horvath, 1892). SNNPP Kulsy kulderi, Kungei Alatau, Sati Sai gorge, 28.07.2016, 2♀, 2♂; SNNP Altyn-Emel, Zhantogai area, Ili River watershed, 10.07.2016, 2♀, 3♂; Alakol SNR, Kokpekty area, Tentec River watershed, 29.05.2016, 3♀, 3♂; 31.05.2016, 3♀, 2♂; Togzhytbuek area, 11.06.2017, 3♀, 3♂.

*Acrosternum breviceps* (Jakovlev, 1889). Zhetysu Alatau, Mt. Sholak, Taigak gorge, 21.06.2016, 3♀, 2♂; 30.07.2016, 1♀, 2♂.

*Pentatoma rufipes* (Linnaeus, 1758). Ile-Alatau SNNP, Aksay gorge, 12.06.2016, 3♀, 2♂; 21.07.2016, 2♀, 1♂; SNNP Charyn, Charyn River watershed, 23.05.2016, 3♀, 2♂; 16.06.2017. 2♀, 1♂; Alakol SNR, Tentec River watershed. 24.06.2017. 3♀, 4♂.

*Priassus exemptus* (Walker, 1868). Ile-Alatau SNNP, Aksay gorge, 24.07.2016, 2♀, 2♂; 21.07.2016, 1♀, 3♂; SNNP Altyn-Emel, Zhantogai area, 14.07.2016, 2♀, 1♂.

*Rhaphigaster brevispina* (Horvath, 1889). Ile-Alatau SNNP, Aksay gorge, 12-14.06.2016, 5♀, 3♂; 19.05.2016, 5♀, 4♂; SNNP Altyn-Emel, Shygan area, 09.07.2016, 1♀, 2♂; Sholak area, 25.07.2016, 10♀, 9♂; Zhantogai area, Ili River watershed, 10.07.2016, 1♀, 2♂; Charyn SNNP, Charyn River

watershed, 23.05.2016, 1♀, 2♂; 16.06.2017. 2♀, 2♂; Alakol SNR, Kokpekty area, Tentec River watershed, 29.05.2016, 3♀, 3♂; 31.05.2016, 3♀, 2♂; Togzhytbuek area, 11.06.2017, 3♀, 3♂.

*Rhaphigaster nebulosa* (Poda, 1761). Ile-Alatau SNNP, Aksay gorge, 12-14.06.2016, 3♀, 2♂; 11.05.2016, 4♀, 3♂; Butakovka gorge, 20-30.06.2016, 7♀, 8♂; 24.06.2017. 3♀, 2♂; SNNP Altyn-Emel, Zhetysu Alatau, Taigak gorge, 21.05.2016, 4♀, 2♂; Kyzylauz gorge, 10.07.2016, 2♀, 1♂; Mt. Koyandytau, Konakbaysay gorge, 18.08.2016, 2♀; Shygan area, 09.07.2016, 5♀, 4♂; Charyn SNNP, Charyn River watershed, 23.05.2016, 3♀, 4♂; 15.06.2017. 3♀, 3♂; Alakol SNR, Kokpekty area, Tentec River watershed, 29.05.2016, 2♀, 2♂; 31.05.2016, 3♀, 2♂; Togzhytbuek area, 11.06.2017, 3♀, 4♂.

#### 4. Discussion

The biology and ecology of the dendrobiont Pentatomidae of South-Eastern Kazakhstan are poorly studied. This study is the first to focus on identifying tree and shrub dwelling Pentatomidae in the protected areas of this highly biodiverse region. We also documented key life history and ecological characteristics of the collected species: feeding type, diapause, voltinism and habitat moisture preferences, using both our field data and field notes from existing collections maintained at the Kazakh national museum collections.

Trophic types were diverse, including predators (zoophagous), parasites, herbivores (phytophagous) and facultative predators (zoophytophagous).

**Table 1:** summarizes the feeding habits of dendrobiont Pentatomidae reported from this study.

Species	Trophic specialization	Ecological notes
<i>Arma custos</i> (Fabricius, 1794)	predator	On isolated trees and shrubs in floodplain forests, especially on willow ( <i>Salix</i> ) and alder ( <i>Alnus</i> )
<i>Jalla dumosa</i> (Linnaeus, 1758)	predator	On various woody and herbaceous plants
<i>Picromerus bidens</i> (Linnaeus, 1758)	predator	On trees and shrub vegetation of river valleys, esp. birch ( <i>Betula</i> ) and aspen ( <i>Populus tremula</i> )
<i>Picromerus lewisi</i> Scott, 1874	predator	On various trees and herbaceous plants
<i>Rhacognatus punctatus</i> (Linnaeus, 1758)	predator	In mixed montane belt forests, on willow ( <i>Salix</i> ), birch ( <i>Betula</i> ), aspen ( <i>Populus tremula</i> ), raspberry ( <i>Rubus</i> )
<i>Troilus luridus</i> (Fabricius, 1775)	predator	In mixed forests, on leaves of trees and shrubs: birch ( <i>Betula</i> ), bird cherry ( <i>Prunus padus</i> ), willow ( <i>Salix</i> ), aspen ( <i>Populus tremula</i> ).
<i>Pinthaeus sanguinipes</i> (Fabricius, 1781)	predator	in broad-leaved forests, On trees, shrubs and herbaceous plants.
<i>Zicrona caerulea</i> (Linnaeus, 1758)	predator	On trees, shrubs and grasses in steppe floodplain forests, wooded stands and nearby.
<i>Alloeogypta pretiosa</i> Kiritshenko, 1952	broadly oligophytophagous	On various maples ( <i>Acer</i> )
<i>Anthemina aliena</i> (Reuter, 1891)	phytophagous	On birch ( <i>Betula</i> ), alder ( <i>Alnus</i> ), willow ( <i>Salix</i> ), honeysuckle ( <i>Lonicera</i> )
<i>Chlorochroa juniperina juniperina</i> (Linnaeus, 1758)	broadly oligophytophagous	On juniper ( <i>Juniperus nana</i> ), larch ( <i>Larix</i> ), Scots pine ( <i>Pinus sylvestris</i> )
<i>Chlorochroa pinicola</i> (Mulsant & Rey, 1852)	narrowly oligophytophagous	Found on conifers: juniper ( <i>Juniperus</i> ), spruce ( <i>Picea</i> ), Scots pine ( <i>Pinus sylvestris</i> ) and other <i>Pinus</i> sp.
<i>Palomena prasina</i> (Linnaeus, 1761)	phytophagous	On various trees and shrubs. Most common on bushes and trees: <i>Ribes</i> , <i>Rubus</i> , <i>Rosa</i> , <i>Quercus</i> , <i>Crataegus</i> , <i>Prunus</i> , <i>Sorbus</i> , <i>Acer</i> , <i>Fraxinus</i> , <i>Tilia</i> , <i>Betula</i> , <i>Alnus</i>
<i>Palomena viridissima</i> (Poda, 1761)	phytophagous	On trees and bushes of the family Rosaceae
<i>Apodiphus integriceps</i> Horvath, 1888	phytophagous	On poplars ( <i>Populus</i> ), apple ( <i>Malus</i> ), as well as willows ( <i>Salix</i> ), elms ( <i>Ulmus</i> ), plane trees ( <i>Platanus</i> ) and others, mainly in populated areas
<i>Desertomenida albula</i> Kiritshenko, 1914	phytophagous	On tamarisk ( <i>Tamarix</i> ) and saxaul ( <i>Haloxylon</i> )
<i>Desertomenida jakowleffi</i> (Horvath, 1907)	phytophagous	On tamarisk ( <i>Tamarix</i> ) and saxaul ( <i>Haloxylon</i> )
<i>Desertomenida quadrimaculata</i> (Horvath, 1892)	phytophagous	On tamarisk ( <i>Tamarix</i> ) and juzgun ( <i>Calligonum</i> )
<i>Acrosternum breviceps</i> (Jakovlev, 1889)	narrowly oligophytophagous	On juniper ( <i>Juniperus</i> ), specialist seed predator
<i>Pentatoma rufipes</i> (Linnaeus, 1758)	phytophagous	On various trees and shrubs

<i>Priassus exemptus</i> (Walker, 1868)	narrowly oligophytophagous	seed predator of <i>Acer turkestanicum</i> , <i>A. negudo</i>
<i>Rhapigaster brevispina</i> Horvath, 1889	phytophagous	On willow ( <i>Salix</i> ), oleaster, Siberian elm ( <i>Ulmus pumila</i> ) and others, seed predator
<i>Rhapigaster nebulosa</i> (Poda, 1761)	phytophagous	On various deciduous trees and shrubs, feeding on leaves, stems, flowers, fruit

Of the 23 recorded Pentatomidae species, 8 species were predators; the remaining species were plant feeders, including 10 species classified as polyphytophagous, 2 broadly oligophytophagous, and 3 narrowly oligophytophagous (specifically seed predators).

The dendrobiont Pentatomidae of the studied protected natural areas were exclusively univoltine (one generation per year). Most species of Pentatomidae in this study diapause in the adult stage, but a few species go through the winter as eggs or larvae (Table 2).

Organisms are often associated with particular habitats that can be defined, in part, on their moisture/humidity characteristics. Several researchers have recommended using such groupings to better describe habitat preferences of arthropods [5, 16]. For the dendrobiont Pentatomidae of the study area, we determined that they were distributed along a decreasing moisture gradient as follows: 18 species of mesophylls (78.3%), 2 species of xeromesophiles (8.7%), 1 mesoxerophile (4.3%), and two xerophile species (8.7%, see Table 2).

**Table 2:** Habitat type and diapause Life history Peculiarities of biology and ecology of dendrobionts of specially protected natural areas of South-Eastern Kazakhstan

Species	Habitat moisture type	Diapause life stage
<i>Arma custos</i> (Fabricius, 1794)	mesophyll	imago
<i>Jalla dumosa</i> (Linnaeus, 1758)	mesophyll	imago
<i>Picromerus bidens</i> (Linnaeus, 1758)	mesophyll	egg
<i>Picromerus lewisi</i> Scott, 1874	mesophyll	egg
<i>Rhacognatus punctatus</i> (Linnaeus, 1758)	mesophyll	imago
<i>Troilus luridus</i> (Fabricius, 1775)	mesophyll	imago
<i>Pinthaeus sanguinipes</i> (Fabricius, 1781)	mesophyll	imago
<i>Zicrona caerulea</i> (Linnaeus, 1758)	mesophyll	imago
<i>Alloeoglypta pretiosa</i> Kiritshenko, 1952	mesophyll	imago
<i>Anthemina aliena</i> (Reuter, 1891)	mesophyll	imago
<i>Chlorochroa juniperina juniperina</i> (Linnaeus, 1758)	mesophyll	imago
<i>Chlorochroa pinicola</i> (Mulsant & Rey, 1852)	mesophyll	imago
<i>Palomena prasina</i> (Linnaeus, 1761)	mesophyll	imago
<i>Palomena viridissima</i> (Poda, 1761)	mesophyll	imago
<i>Apodiphus integriceps</i> Horvath, 1888	mesophyll	imago
<i>Desertomenida albula</i> Kiritshenko, 1914	xeromesophyll	imago
<i>Desertomenida jakowleffi</i> (Horvath, 1907)	xerophyll	imago
<i>Desertomenida quadrimaculata</i> (Horvath, 1892)	xerophyll	imago
<i>Acrosternum breviceps</i> (Jakovlev, 1889)	xeromesophyll	imago
<i>Pentatoma rufipes</i> (Linnaeus, 1758)	mesophyll	larvae
<i>Priassus exemptus</i> (Walker, 1868)	mesoxerophyll	imago
<i>Rhapigaster brevispina</i> Horvath, 1889	mesophyll	imago
<i>Rhapigaster nebulosa</i> (Poda, 1761)	mesophyll	imago

The majority of species (87%) diapause/over winter in the imago stage there are 20 species. Only 1 species went through diapause as a larva (*Pentatoma rufipes*) and both species of the genus *Picromerus* overwintered as eggs.

## 5. Conclusions

Within the five specially protected natural territories of South-East Kazakhstan, we recorded 23 species of specialized dendrobiont Heteroptera, including 2 species listed in the Red Data Book of Almaty oblast: *Arma custos* and *Zicrona caerulea*. Eight species were predators, and the remainder divided among generalist polyphagous herbivores (10), more specialist broad oligophagous herbivores (3), and highly specialized narrow oligophagous herbivores (2). All 23 species were univoltine. By habitat type, we recorded 18 mesophylls, 2 xeromesophiles, 1 mesoxerophile, and 2 xerophiles. Most species (20) diapaused in the adult stage, winter, 1 species in the larval stage, and 2 species in the egg stage.

## 6. Acknowledgments

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biodiversity inventory of Kazakhstan. We gratefully acknowledge support from the National Agrarian University for MTA and AMK, from the Republic of Kazakhstan Institute of Zoology for PAE, and the US Fulbright Scholars program for support for JH.

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