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THE FAUNA OF AQUATIC HEMIPTERA (*HETEROPTERA*) IN CHARYN NATURE PARK

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SUMMARY

The material for this research resulted from the authors' work during 2018–2020 at the Charyn Nature Park in different floodplain reservoirs of the Charyn and Temirlik Rivers, Almaty region, Kazakhstan. Their study of the fauna and ecology of Hemiptera followed the methods of route surveys and stationary observations. The simplest way to collect is to catch aquatic Hemiptera using aquatic entomological nets and account for potential water bugs. Corixidae has 21 species, while other families have one or two species. Their density comprised *Gerridae* (8–10), *Corixidae* (16–20), *Naucoridae* (3–5), *Notonecta* (8–9), and *Ranatra* (3–5) specimens/m^2, respectively. The mass species found included *Ilyocoris cimicoides*, *Noton ecta glauca*, *Nepa cinerea*, and *Gerris costae*. During the autumn survey, an observation revealed that the previously studied reservoirs have decreased in size, and some have even dried up. In the coastal part of the reservoirs, water scorpions (*Nepa cinerea*) were crawling along the bottom of the pool. Water backswimmers (Notonectidae) and toad bugs (Naucoridae) moved to deeper pond areas. Representatives of the Corixidae family were zoophytophages (21 species), with the remaining species being zoophages (12 species). Under the Charyn Nature Park conditions, most species were mono or univoltine (21 species), bivoltine (five species), and poly or multivoltine (seven species). The fauna of the Charyn State National Nature Park (SNNP) has the main characteristic of species of Hemiptera with Western Asia (40%), Trans-Palearctic (21%), Western Palearctic (18%), and Trans-Eurasian (12%) ranges. All the recognized species have a wide selection of hunting objects, feeding on aquatic invertebrates, including regulating the numbers of blood-sucking mosquito larvae (Culicidae).

Keywords: aquatic hemiptera, fauna, ecology, Charyn Nature Park, Charyn and Temirlik Rivers

Key findings: The prime purpose of the research was to identify the species composition of the aquatic hemiptera at the Charyn State National Natural Park, Kazakhstan, where no systematic exceptional study of the fauna of the aquatic hemiptera occurred before. However, two research articles have come out on aquatic hemiptera. Said insects, by species diversity and environmental

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appearance, are one of the groups most suitable for use in various environmental studies because of their best adaptation to different ecological conditions.

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INTRODUCTION

Charyn State National Nature Park (SNNP)'s location is at the Kazakh-Chinese border, east of Almaty Region, Kazakhstan (Figure 1). The park's foundation in 2004 transpired on Ili Intermountain Depression land. The Charyn River is a large left tributary of the Ili River that runs through the Charyn Gorge, home to the Charyn Canyon. It is 427 km in length and has a drainage area of 7720 sq km (Niyazbekova *et al*., 2019). Its source is on the southern slope of Ketmen Ridge's eastern section. The river strongly meanders throughout its length and divides into several equal channels in the floodplain.

The Charyn River Valley becomes flat and wide behind Moiyntogai Canyon, known as Sartogai (Yellow Forest). The Charyn takes a smooth course there and splits into many channels as it passes through the Yasene Grove, which stretches for 20 km along the riverbed. The Charyn Delta begins below Yaseneve Grove, where permanent and temporary channels and irrigation canals deviate from the main channel (Nigmatova *et al*., 2021). The Karkara (right) and Temirlik (left) rivers are the primary tributaries of the Charyn Rivers; however, the Temirlik River's length measures around 24 km.

Hemiptera is a large group of insects with a moderately flattened body and a piercing-sucking mouth of the oral organ type. Nymphs are the intermediate stage between egg and imago in insects with incomplete transformation (Berry *et al*., 2008; Daryanto *et al*., 2021). Aquatic hemiptera are insects whose entire development and life take place in reservoirs. These insects divide into two ecological groups as follows: Gerromorpha (water strides), which live on the surface of water or the wet banks of water bodies, and Nepomorpha (water bugs), which live in the water depths or on the bottom (Ohba, 2019).

Almost all water bugs are predators; only species of the Corixidae family can feed on animal food, algae, and detritus. Many species exterminate the larvae and pupae of blood-sucking insects developing in the water. Some species harm fish farming by attacking eggs and fry. The water bugs and their numerous larvae are an object of nutrition for aquatic and near-aquatic animals (Ebong *et al*., 2012).

Despite the profusion of aquatic Hemiptera, various species of Charyn State National Nature Park's territory have received little attention (UNESCO). Except for the research of P.A. Esenbekova, published in 2009 and 2010, virtually no systematic study of the fauna of hemipterans existed (Esenbekova *et al*., 2015). The authors collected aquatic semi-parasophytes in Charyn State National Nature Park from 2018 to 2020, presenting the results in this research article. Therefore, the pertinent research sought to showcase the examined fauna, biology, ecology, and distribution of aquatic hemipterans in the territory of Charyn State National Nature Park, Almaty Region, Kazakhstan.

MATERIALS AND METHODS

The relevant research examined the fauna, biology, ecology, and distribution of aquatic hemipterans in the Charyn State National Nature Park territory, Almaty Region, Kazakhstan. The authors collected aquatic Hemiptera from 2018 to 2020 at the Charyn State National Nature Park, and the results are available in a related article (King and Porter, 2005).

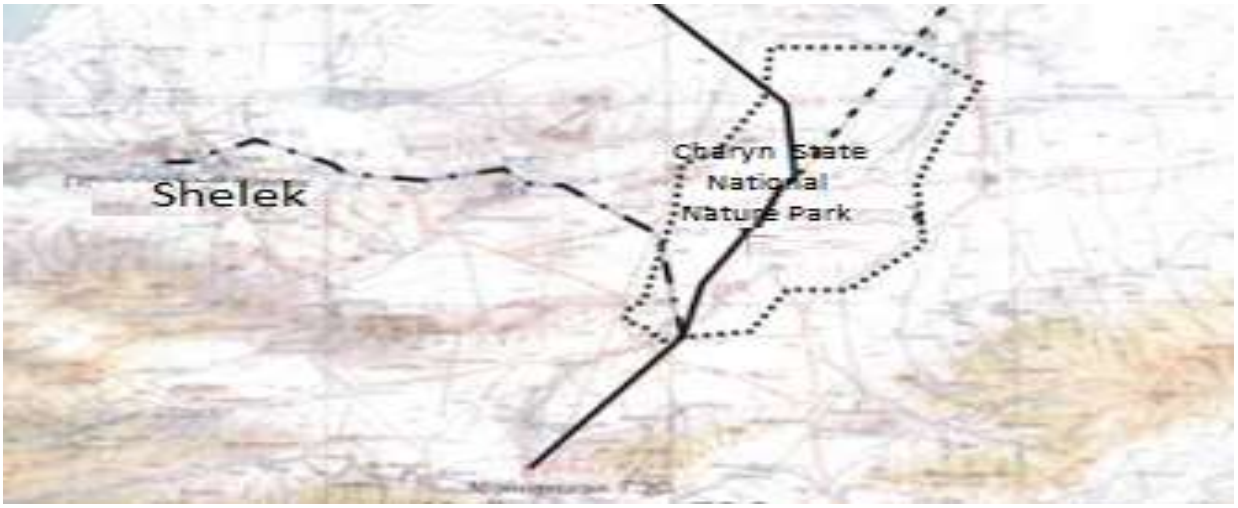

Figure 1. Map of the Charyn State National Nature Park (SNNP) located on the Kazakh-Chinese border in the East to Almaty Region, Kazakhstan.

Collection of hemipterans used various standard entomological survey methods: a unique entomological net collecting small insects using an exhauster, catching those who flew into the night light (particular light sources, car lights, etc.). Collecting Hemiptera living in water and a thick layer of water from the water net was obtainable, and also by examining plants (leaves, stems) extracted directly from the water.

Accounting for the number of individual species of predators (water bugs) proceeded with visual determination (per m^2) and a standard net with subsequent recalculation by 1 m^2.

The eatability or predatory role of water bugs' identification transpired in the laboratory and in vivo by feeding them to a certain number of larvae of blood-sucking mosquitoes. Both cases had control options accompanying them.

During the spring, summer, and fall field trips, over 50 water bodies attained surveys, comprising the places of mass development of the components of the midge (lakes, rivers, streams, wetlands, etc.) of various depths and the degree of overgrowth of aquatic vegetation. Ponds ranged in size from two to 100 m^2 and were open, semi-overgrown, and overgrown. The water body depths ranged from 0.2 to 2 m (Montgomery *et al*., 2021). Classification of the species composition primarily used determination manuals (NCSU; Soldán *et al*., 2012).

RESULTS AND DISCUSSION

The description of the fauna of aquatic hemiptera collected from Charyn State Nature Park is available here. The various species discovered in the area underwent further investigation, and a brief description of each species' distribution, biology, and ecology follows.

INFRAORDER NEPOMORPHA Popov, 1968

Family Nepidae Latreille, 1802 - Water scorpions

Nepa cinerea Linnaeus, 1758. Charyn Nature Park 43°21′00″ N. 79°04′00″ E. Charyn Forest Dacha 43°36′05″ N. 79°20′22″ E. Sartogai, Charyn River floodplain. 17-19.06.2018. 4♀, 3♂; 20-25.07.2019. 6♀, 6♂; Temirlik River floodplain. 20.06.2019. 5♀, 4♂; Ash Grove, Charyn River floodplain. 27.07.2020. 3♀, 3♂. Thrives in stagnant and slow-flowing large and shallow water bodies; swims poorly in the water column and moves along the bottom or on aquatic plants (Ohba, 2019). Zoophagous

adults and larvae feed on the larvae of dragonflies, gadflies, and beetles. They are also monovoltine species, producing only one generation per year. Imago overwinters, but larvae of V age can also overwinter (Sushchik *et al*., 2016). Observed mating was nearly year-round, except in August and September for this Transpalaearctic species (Campos, 2019).

Ranatra linearis Linnaeus, 1758. Charyn Nature Park, Charyn River floodplain. 19.06.2018. 2♀, 1♂; 12.07.2019. 3♀, 2♂; Temirlik River floodplain. 23.06.2019. 2♀, 2♂; Ash Grove, Charyn River floodplain. 27.07.2020. 1♀, 2♂. Found in standing and slow-flowing large and small water bodies. They are zoophages that destroy fish fry, dragonfly larvae, and beetles. The said species is also monovoltaic and a Western Palaearctic species with overwintering adults (Campos, 2019).

Family CORIXIDAE Leach, 1815 – Rattlers

Micronecta pusilla (Horvath, 1895). Charyn Nature Park, Charyn Forest Dacha, Sartogai, Charyn River floodplain. 20-25.06.2019. 8♀, 7♂; Temirlik River floodplain. 20.07.2019. 4♀, 5♂. Appears in standing and slow-flowing large and shallow water bodies. These species are also zoophytophagous and feed on tiny algae and animals. They are also monovoltine, larvae overwinter, and are a Western Eurasian species.

Micronecta griseola Horvath, 1899. Charyn Nature Park, Charyn River floodplain. 28.06.2018. 4♀, 3♂; 15.07.2019. 4♀, 5♂; Temirlik River floodplain. 23.06.2019. 4♀, 6♂; Ash Grove, Charyn River floodplain. 27.07.2020. 5♀, 4♂. Their habitat is standing and slowly flowing large and small water bodies. Nekton lives in the water column, can resist the current force, and moves independently for considerable distances. It is a zoophytophagous, monovoltine species with larvae of the IV instar, rarely of the III instar, that hibernate, and also a Western Eurasian species (Hädicke *et al*., 2017).

Cymatia bonsdorffii (Sahlberg, 1819). Charyn Nature Park, Charyn River floodplain. 25.05.2019. 2♀, 1♂; Charyn Forest Estate, Sartogai, Charyn River floodplain. 20-25.07.2018. 8♀, 8♂; Temirlik River floodplain. 20.06.2020. 4♀, 5♂. Flourishes in standing and slow-flowing large and shallow water bodies; is zoophytophagous and monovoltine; winters as an adult; and is a Transpalaearctic species (Nations; Nigmatova *et al*., 2021).

Cymatia coleopterata (Fabricius, 1777). Charyn Nature Park, Charyn Forest Dacha, Sartogai, Charyn River floodplain. 17.06.2018. 2♀, 3♂; 20-25.07.2019. 5♀, 4♂; Temirlik River floodplain. 23.06.2019. 4♀, 5♂; Ash Grove, Charyn River floodplain. 27.07.2020. 2♀, 3♂. They live in standing and slowly flowing large and small water bodies. They also form nekton, are zoophytophagous and monovoltine, winter as adults, and are a Western Eurasian species.

Cymatia rogenhoferi (Fieber, 1804). Charyn Nature Park, Charyn Forest Dacha, Sartogai, Charyn River floodplain. 22.06.2018. 2♀, 2♂; 20-25.07.2019. 4♀, 3♂; Temirlik River floodplain. 22.06.2019. 1♀, 2♂; Ash Grove, Charyn River floodplain. 26-28.07.2020. 5♀, 4♂. They live in standing and slowly flowing large and small water bodies. They form nekton, are zoophytophagous and monovoltine, winter as adults, and are a Western Palaearctic species (Kment and Beran, 2011).

Callicorixa praeusta praeusta (Fieber, 1848). Charyn Nature Park, Charyn Forest Dacha, Sartogai, Charyn River floodplain. 26.07.2019. 2♀, 3♂ ; Temirlik River floodplain. 23.07.2019. 3♀, 2♂; Ash Grove, Charyn River floodplain. 26.07.2020. 3♀, 3♂ . They dwell mainly in lakes, floodplains, standing, and low-water bodies. They also shape nekton, are zoophytophagous and polyvoltine species, winter as adults, and are a Transpalaearctic species.

Callicorixa producta produsta (Reuter, 1880). Charyn Nature Park, Charyn Forest Dacha, Sartogai, Charyn River floodplain. 25.07.2019. 4♀, 3♂ ; Temirlik River floodplain. 23.07.2019. 3♀, 3♂; Ash Grove, Charyn River floodplain. 26.07.2020. 3♀, 4♂ . They dwell in various water bodies with standing water and are zoophage (feed on larvae of dipterans and daphnes) and monovoltine species. Adults overwinter in deep, nonfreezing water bodies,

and they are a Trans-Eurasian species (UNESCO).

Corixa affinis Leach, 1817. Charyn Nature Park, Charyn Forest Dacha, Sartogai, Charyn River floodplain. 25.07.2019. 2♀, 4♂; Temirlik River floodplain. 23.07.2019. 3♀, 4♂; Ash Grove, Charyn River floodplain. 26.07.2020. 3♀, 2♂.. Predominantly inhabit standing water reservoirs in lowland and mountainous areas up to 2000–2300 m above sea level. These species are also monovoltine, zoophytophagous, and hibernating imagoes, and a Western Palaearctic species (Guilbert and Guidoti, 2018).

Corixa dentipes Thomson, 1869. Charyn Nature Park, Charyn Forest Dacha, Sartogai, Charyn River floodplain. 25.07.2019. 3♀, 4♂; Temirlik River floodplain. 23.07.2019. 3♀, 2♂; Ash Grove, Charyn River floodplain. 26.07.2020. 5♀, 4♂ . Emerge in permanent pond-type reservoirs with rich aquatic vegetation. They are zoophagous, mostly feed on insect larvae and crustaceans, and are monovoltine with hibernating imago. When mating, adults of *Corixa punctata* emit a specific sound. Acoustic studies have confirmed that mating occurs mainly in autumn and less frequently in winter and spring and is the Western Eurasian species (Esenbekova *et al*., 2015).

Hesperocorixa linnaei (Fieber, 1848). Charyn Nature Park, Charyn Forest Dacha, Sartogai, Charyn River floodplain. 24.07.2019. 2♀, 3♂; 16.08.2020. 3♀, 3♂; Temirlik River floodplain. 23.07.2019. 3♀, 4♂; 13.08.2020. 3♀, 2♂; Ash Grove, Charyn River floodplain. 26.07.2020. 3♀, 4♂. They occur in floodplain reservoirs with standing water and well-developed vegetation. They are caught in light and are monovoltine and zoophytophagous, with adults overwintering in water bodies, and are a Western Palaearctic species (Esenbekova *et al*., 2015).

Hesperocorixa sahlbergi (Fieber, 1848). Charyn Nature Park, Charyn Forest Dacha, Charyn River. 24.07.2019. 2♀, 1♂; 16.08.2020. 2♀, 3♂; Temirlik River floodplain. 24.07.2019. 2♀, 2♂; 16.08.2020. 2♀, 3♂. They are prevalent in standing and slow-flowing large and shallow water bodies. In addition, they are a monovoltine, zoophytophagous, hibernating imago, and are a Western Eurasian species.

Paracorixa kiritshenkoi (Lundbland, 1933). Charyn Nature Park, Charyn Forest Dacha, Sartogai, Charyn River floodplain. 25.07.2019. 3♀, 4♂; Temirlik River floodplain. 23.07.2019. 3♀, 2♂; Ash Grove, Charyn River floodplain. 26.07.2020. 3♀, 4♂. They are common in floodplains of rivers and lakes of steppe and desert climatic zones. They are zoophytophages and monovoltines that winter as an adult, fly to light, and are a Middle Eurasian species.

Paracorixa caspica (Horvath, 1878). Charyn Nature Park, Charyn Forest Dacha, Sartogai, Charyn River floodplain. 25.07.2019. 3♀, 4♂; Temirlik River floodplain. 23.07.2019. 3♀, 2♂; Ash Grove, Charyn River floodplain. 26.07.2020. 8♀, 9♂, on light. They occur in desert springs, and floodplains of rivers and lakes, and are zoophytophagous, monovoltines, winter as adults, fly to light, and are a Middle Palaearctic species.

Sigara limitata (Fieber, 1848). Charyn Nature Park, Charyn Forest Dacha, Charyn River. 20-25.05.2019. 6♀, 5♂; Temirlik River floodplain. 29.05.2019. 3♀, 2♂; 20.06.2020. 3♀, 2♂. They mostly occur in standing and weakly flowing well-warmed water bodies with rich vegetation, and are zoophytophagous, monovoltines, winter as adults, and are a Western Eurasian species.

Sigara semistriata (Fieber, 1848). Charyn Nature Park, Charyn Forest Dacha, Sartogai, Charyn River floodplain. 25.07.2019. 3♀, 2♂; Temirlik River floodplain. 23.07.2019. 2♀, 2♂; 27.07.2020. 4♀, 5♂; Ash Grove, Charyn River floodplain. 26.07.2020. 4♀, 3♂. They are pervasive in various standing and slow-flowing floodplain reservoirs with muddy bottoms and rich vegetation. They are zoophytophagous and monovoltine, hibernating imagoes, and are a Western Eurasian species (Esenbekova *et al*., 2015).

Sigara assimilis (Fieber, 1848). Charyn Nature Park, Charyn Forest Dacha, Charyn River. 28.05.2019. 2♀, 3♂; Temirlik River floodplain. 20.06.2020. 1♀, 2♂. They are frequent in brackish and saline water bodies; however, they are also found in freshwater (UNESCO). They are zoophytophagous,

monovoltines, winter as adults, fly to light, and are a Western Eurasian species.

Sigara striata (Linnaeus, 1758). Charyn Nature Park, Charyn Forest Dacha, Charyn River. 17.07.2018. 3♀, 4♂; 22-24.05.2019. 4♀, 5♂; 27.07.2020. 3♀, 5♂; Temirlik River floodplain. 30.06.2018. 3♀, 4♂; 28.06.2019. 3♀, 2♂; 22.07.2020. 6♀, 5♂. They are eurytopic species, mostly found in standing, low-flow, floodplain bodies that avoid heavily polluted waters. They are zoophytophagous and feed on plant and animal food, but they also eat mosquito larvae. Likewise, they are polyvolatile, and adults overwinter in reservoirs. They fly well, fly at night to light, and are a Western Eurasian species (UNESCO).

Sigara distincta (Fieber, 1848). Charyn Nature Park, Charyn Forest Dacha, Charyn River. 27-29.05.2018. 5♀, 4♂; 28.06.2019. 2♀, 3♂; 27.07.2020. 3♀, 2♂; Temirlik River floodplain. 20.06.2019. 3♀, 4♂; 27.07.2020. 4♀, 5♂. They occur in silted areas with aquatic vegetation in various standing and floodplain water bodies. They are also zoophytophagous and polyvolatile with overwintering adults and are a Western Eurasian species (Jansson, 1996).

Sigara falleni (Fieber, 1848). Charyn Nature Park, Charyn Forest Dacha, Sartogai, Charyn River floodplain. 19.06.2018. 2♀, 3♂; 20-25.07.2019. 5♀, 6♂; Temirlik River floodplain. 20.06.2019. 3♀, 4♂; 22.07.2020. 3♀, 3♂; Ash Grove, Charyn River floodplain. 26-27.07.2020. 6♀, 7♂, on light. They are widespread in low-water bodies, various floodplains, standing bodies of water, and backwaters of rivers and lakes, including moderately polluted ones. They are also referred to as nekton and are a zoophytophage that is polyvolatile and winters as an adult. They live and overwinter in reservoirs and are a Western Eurasian species.

Sigara longipalis (Sahlberg, 1878). Charyn Nature Park, Charyn River floodplain. 20.06.2018. 2♀, 3♂; 28.07.2019. 4♀, 5♂; Temirlik River floodplain. 10.07.2018. 3♀, 2♂; 20.06.2019. 3♀, 4♂; 22.07.2020. 3♀, 2♂; Ash Grove, Charyn River floodplain. 27.07.2020. 3♀, 4♂. They occur in floodplain-standing water bodies as nekton, are zoophytophagous and polyvolatile that winter as adults, and are a Western Eurasian species (Reinhardt and Siva-Jothy, 2007).

Sigara lateralis (Leach, 1817). Charyn Nature Park, Charyn Forest Dacha, Sartogai, Charyn River floodplain. 17-19.06.2018. 4♀, 5♂; 23-25.07.2019. 8♀, 7♂; Temirlik River floodplain. 20.06.2019. 5♀, 4♂; Ash Grove, Charyn River floodplain. 27.07.2020. 3♀, 3♂. They are widespread in standing water bodies, often in brackish and strongly saline waters, and sometimes in polluted water bodies of steppe and forest-steppe zones (UNESCO). They are zoophytophages and bivoltines that form two breeding per year, winter as adults, fly well, arrive at night for light, and are a Western Palaearctic species.

Family NAUCORIDAE Leach, 1815 - Plautes.

Ilyocoris cimicoides (Linnaeus, 1758). Charyn Nature Park, Charyn Forest Dacha, Sartogai, Charyn River floodplain. 17-19.06.2018. 4♀, 5♂; 20-25.07.2019. 6♀, 6♂; 27.07.2020. 3♀, 1♂; Temirlik River floodplain. 20.06.2019. 3♀, 4♂; Ash Grove, Charyn River floodplain. 11.08.2019. 3♀, 4♂; 27.07.2020. 3♀, 3♂. They persist in long-term undrained standing and slow-flowing water bodies with advanced vegetation. Periphyton leads to an attached life predominantly on water-solid substrates of various origins (stones, rocks, higher aquatic plants, covers of animals, submerged large debris, piles, and ship bottoms). They also prefer to feed on small, weakly chitinized pond dwellers, such as, dragonfly larvae, leeches, amphipods, and larvae of blood-sucking mosquitoes of the genera *Aedes* and *Culex*. A univoltine species, their adults hibernate on dry land by burrowing into the top layer of the ground. Past studies have also reported the peculiarities of wintering of finches on land, which are a Trans-Eurasian species (UNESCO; Sushchik *et al*., 2016).

Family NOTONECTIDAE Latreille, 1802 - Gladys.

Notonecta glauca glauca Linnaeus, 1758. Charyn Nature Park, Charyn Forest Dacha,

Sartogai, Charyn River floodplain. 19.06.2018. 4♀, 2♂; 20.06.2019. 3♀, 4♂; 27.07.2020. 5♀, 3♂; Temirlik River floodplain. 20.06.2019. 3♀, 4♂; 23.07.2020. 3♀, 5♂. They are distributed mainly in ponds, small lakes, and varied floodplain reservoirs with standing and slightly flowing water. They are univoltine zoophage. Adults overwinter buried in the bottom silt. Before hibernation, the number of oviducts in females increases, further suspending development for the entire hibernation period until the formation of oocytes (Gharaat and Hassanzadeh, 2009). In males, testes grow intensively as early as summer and reach their maximum size by August, and males hibernate with mature sperm (Papacek and Soldan 2008). Mating occurs after wintering, in April or May, when the females already contain mature eggs. They are a Western Palaearctic species.

Family PLEIDAE Fieber, 1851 - Pleidae.

Plea minutissima minutissima Leach, 1817. Charyn Nature Park, Charyn Forest Dacha, Sartogai, Charyn River floodplain. 17-19.06.2018. 9♀, 7♂; 20-25.07.2019. 6♀, 8♂; 27.07.2020. 8♀, 10♂; Temirlik River floodplain. 20.06.2019. 5♀, 4♂; Ash Grove, Charyn River floodplain. 11.08.2019. 3♀, 4♂; 27.06.2020. 5♀, 3♂; 23.07.2020. 6♀, 5♂. Species inhabit primarily standing and slow-flowing large and shallow water bodies with abundant vegetation. They are also zoophages, and both adults and larvae feed on larvae of various hydrobionts. They are univoltine with wintering adults. Adults live very long (up to two years), can reproduce even in the second year of life, and are a Western Palaearctic species (Hafeez *et al*., 2020).

INFRAORDER GERROMORPHA Popov, 1971.

The family HYDROMETRIDAE Billberg, 1820 represents the bacilliform waterflies

Hydrometra stagnorum (Linnaeus, 1758). Charyn Nature Park, Charyn Forest Dacha, Sartogai, Charyn River floodplain. 17-19.06.2018. 4♀, 3♂; 23-25.07.2019. 5♀, 6♂; 27.07.2020. 6♀, 5♂; Temirlik River floodplain. 20.06.2019. 3♀, 3♂; Ash Grove, Charyn River floodplain. 11.08.2019. 3♀, 4♂; 27.07.2020. 3♀, 2♂. They occur in floating leaves of aquatic plants, along banks of standing and low-water bodies, and on moist soil and mosses. Zoophages feed on small arthropods and are a monovoltine species. They overwinter on the banks of reservoirs and are a Transpalaearctic species (Sushchik *et al*., 2016).

Family GERRIDAE Leach, 1815 - waterflies.

Aquarius paludum paludum (Fabricius, 1794). Charyn Nature Park, Charyn Forest Dacha, Sartogai, Charyn River floodplain. 23-25.05.2019. 4♀, 5♂; 27.07.2020. 7♀, 6♂; Temirlik River floodplain. 20.06.2018. 2♀, 3♂; 23.07.2019. 4♀, 5♂. They mostly show on the water surface of different water bodies, prefer large water bodies with clear vegetation and an open water surface along the banks of plain rivers, in wide irrigation canals of rice checks departing from rivers, in old reservoirs, and large quarries and lakes located in the floodplain. In summer, they are pronounced colonial species, including up to several hundred individuals, such as, neuston, zoophage (feeding by running around a water body and grabbing insects from the surface), polyvoltine, wintering adults, which are a Trans-Eurasian species (Esenbekova *et al*., 2015).

Gerris argentatus Schummel, 1832. Charyn Nature Park, Charyn Forest Dacha, Sartogai, Charyn River floodplain. 17-19.06.2018. 9♀, 7♂; 20-25.07.2019. 6♀, 8♂; 27.07.2020. 8♀, 10♂; Temirlik River floodplain. 20.06.2019. 5♀, 4♂; Ash Grove, Charyn River floodplain. 11.08.2019. 3♀, 4♂; 27.06.2020. 5♀, 3♂; 23.07.2020. 6♀, 5♂. They exist in reservoirs with standing water and with a partially overgrown mirror. They are zoophagous and bivoltine, adults overwinter, and are a Transpalaearctic species (Papacek and Soldan 2008).

Gerris lacustris (Linnaeus, 1758). They live in ponds, lakes, and floodplain reservoirs with standing water and developed vegetation. They are zoophagous, feeding on small aquatic

arthropods, polyvolatile, overwinter in adults, and are a Transpalaearctic species.

Gerris costae (Herrich-Schaffer, 1850). They occur in the territory of Charyn Nature Park with species representation from the subspecies *Gerris costae fieberi* (Stichel, 1938). Charyn Nature Park, Charyn Forest Dacha, Sartogai, Charyn River floodplain. 18.06.2018. 3♀, 1♂; 21.07.2019. 2♀, 3♂; 27.07.2020. 3♀, 4♂; Temirlik River floodplain. 20.06.2019. 2♀, 4♂; Ash Grove, Charyn River floodplain. 11.08.2019. 3♀, 2♂; 27.06.2020. 1♀, 3♂; 23.07.2020. 3♀, 4♂. They are mostly found on surfaces of different water bodies and ubiquitously in puddles. They are zoophages, probably a bivoltine species, hibernate as adults, and are a Western Eurasian species.

Gerris odontogaster (Zetterstedt, 1828). Charyn Nature Park, Charyn Forest Dacha, Sartogai, Charyn River floodplain. 15-18.06.2018. 8♀, 7♂; 21.07.2019. 3♀, 3♂; 27.07.2020. 5♀, 4♂; Temirlik River floodplain. 20.06.2018. 5♀, 3♂; 23.07.2019. 4♀, 5♂. 20.06.2019. 3♀, 4♂; Ash Grove, Charyn River floodplain. 11.08.2019. 3♀, 5♂; 27.06.2020. 4♀, 3♂; 23.07.2020. 6♀, 5♂. They inhabit all rivers, freshwater lakes, temporary reservoirs, and surface water bodies with standing or weakly flowing water with partially overgrown water surfaces. In lakes, they stick to banks with overgrown reeds and quickly inhabit puddles formed after rainfall. Neuston attaches to the surface film of water and moves along it from above or below. Zoophages are natural enemies of blood-sucking insects and are bivoltine species with wintering adults. They migrate to other places in winter on land where they diapauses and are a trans-Eurasian species (Berchi *et al*., 2018).

Limnoporus rufoscutellatus (Latreille, 1807). Charyn Nature Park, Charyn Forest Dacha, Sartogai, Charyn River floodplain. 15-18.06.2018. 4♀, 3♂; 21.07.2019. 5♀, 3♂; 27.07.2020. 2♀, 3♂; Temirlik River floodplain. 20.06.2018. 2♀, 3♂; 23.07.2019. 4♀, 3♂. 20.06.2019. 3♀, 2♂; Ash Grove, Charyn River floodplain. 11.08.2019. 3♀, 2♂; 27.06.2020. 3♀, 3♂; 23.07.2020. 2♀, 3♂. They most often inhabit the surface of shallow floodplain standing ponds with partially overgrown water surfaces in wet overgrown ponds and large lakes. Less often, representatives of this species can appear along riverbanks in shaded areas among stems of aquatic plants, avoid the open water surface, and are widespread and ecologically plastic species. Zoophages regulate populations of mosquitoes and are a bivoltine species. They occur in a range from Finland to Austria and complete only one generation a year, with adults overwintering, and are a Transpalaearctic species (Radomír, 2001).

The collections conducted in 2018–2020 in Charyn Nature Park identified 33 species of aquatic semipods belonging to 16 genera in seven families. The predominant species of aquatic semipods are representatives of the families Corixidae (21 species) and Gerridae (six species). The other five families have representatives of one or two species (Table 1). The diet of hemipterans is highly diverse. According to food relationships, zoophagous and zoophytophagous species are distinctive among hemipterans of the Charyn SNNP (Table 1). The ratio of species number with different types of feeding relationships is available in Table 2.

Zoophages include species that feed exclusively on animal food, and a plant- food diet was not visible. In Charyn SNNP, zoophages have representatives of 12 species (36%). Semiparasitic predators generally have a wide range of prey, from various arthropods to certain vertebrates. For example, fish fry, frog tadpoles, and other small vertebrates are food for many aquatic bed bugs, especially Notonectidae and Nepidae. Zoophytophagous indicates species that feed on both plant and animal staples, and plants and invertebrates form the basis of the diet of these hemipterans. Mixed feeding is characteristic of representatives of Corixidae (21 species, 64%).

The seasonal development of hemipterans is heterodynamic. Population voltinism reflects the number of annual generations a population occurs in a particular part of the species range. The known types of voltinism are typical for aquatic hemipterans of the Charynskiy SNNP as follows (Table 1):

- monovoltinism (one generation per year) = 21 species;

- bivoltinism (two generations per year) = 5 species;
- polyvolatility (more than two generations per year) = 7 species.

The geographical distribution of bed bugs and other insects is primarily subject to the same regularities known for other terrestrial organisms. A.P. Semenov-Tyan-Shansky created an elaborate scheme of zoogeographic subdivisions of the Palaearctic region. V.F. Oshanin authored one of Russia's first major zoogeographical works on hemipterans.

Adopting the scheme of biogeographic zoning proposed by A.F. Yemelyanov helped to analyze the zoogeographic relationships of bugs in Kazakhstan. A detailed analysis of the geographical distribution of hemipterans of the Charyn SNNP distinguished seven types of species' ranges (Table 3). The fauna of the Charyn SNPP consists of species of semi-hard wings with West Eurasian (40%), Transpalaearctic (21%), West Palaearctic (18%), and Trans-Eurasian (12%) ranges.

Table 1. Taxonomic composition of aquatic hemipterans of Charyn State National Nature Park.

Family	Name of species	Food specialization	Voltinism
Nepidae	Nepa cinerea (Linnaeus, 1758)	zoophage	monovoltine
	Ranatra linearis (Linnaeus, 1758)		monovoltine
Corixidae	Micronecta pusilla (Horvath, 1895)		monovoltine
	Micronecta griseola Horvath, 1899	zoophytophage	monovoltine
	Cymatia bonsdorffii (C.R.Salberg, 1819)		monovoltine
	Cymatia coleopterata (Fabricius, 1777		monovoltine
	Cymatia rogenhoferi (Fieber, 1804)		monovoltine
	Callicorixa praeusta (Fieb., 1848)		polyvoltine
	Callicorixa producta produsta (Reut., 1880)		monovoltine
	Corixa affinis (Leach, 1817)		monovoltine
	Corixa dentipes (Thomson, 1869)		monovoltine
	Hesperocorixa linnaei (Fieber, 1848)		monovoltine
	Hesperocorixa sahlbergi (Fieber, 1848)		monovoltine
	Paracorixa kiritshenkoi (Lundbland, 1933)		monovoltine
	Paracorixa caspica (Horvath, 1878)		monovoltine
	Sigara limitata (Fieber, 1848)		monovoltine
	Sigara semistriata (Fieber, 1848)		monovoltine
	Sigara assimilis (Fieber, 1848)		monovoltine
	Sigara striata (Linnaeus, 1758)		polyvoltine
	Sigara distincta (Fieber, 1848)		polyvoltine
	Sigara falleni (Fieber, 1848)		polyvoltine
	Sigara longipalis (J.Sahlberg, 1878)		polyvoltine
	Sigara lateralis (Leach, 1817)		bivoltine
Naucoridae	Ilyocoris cimicoides (L., 1758)	zoophage	monovoltine
Notonectidae	Notonecta glauca (Linnaeus, 1758)	zoophage	monovoltine
Pleidae	Plea minutissima (Leach, 1817)	zoophage	monovoltine
Hydrometridae	Hydrometra stagnorum (Linnaeus, 1758)	zoophage	presumably monovalent
Gerridae	Aquarius paludum (Fabr., 1794)	zoophage	polyvoltine
	Gerris argentatus (Schummel, 1832)		bivoltine
	Gerris lacustris (Linnaeus, 1758)		polyvoltine
	Gerris costae fieberi (Stichel, 1938		bivoltine
	Gerris odontogaster (Zetterstedt, 1828)		bivoltine
	Limnoporus rufoscutellatus (Latr., 1807)		bivoltine

Table 2. Nutritional specialization of aquatic hemipterans of the Charynskiy SNNP.

Species groups	Number of species	% of the total number
zoophages	12	36
zoophytophages	21	64
total:	33	100

Table 3. Distribution of semi-podidopteran species of the Charyn SNNP by groups of habitat type.

Range type groups	Number of species	% of the total number
Trans Palaearctic	7	21
Western Palaearctic	6	18
East Palaearctic	1	3
Middle Palaearctic	1	3
Trans-Eurasian	4	12
West Eurasian	13	40
Central Eurasian	1	3
Total	33	100

Species of water bugs (*Heteroptera*) inhabiting all types of reservoirs are predators that eat various representatives of aquatic insects, including larvae, pupae, and imago of blood-sucking mosquitoes (*Diptera*, Culicidae). From aquatic bugs (*Heteroptera*), the following species were found: *Nepa cinerea* Linnaeus, 1758; *Ranatra linearis* (Linnaeus, 1758); *Notonecta glauca* glauca Linnaeus, 1758; *Ilyocoris cimicoides* cimicoides (Linnaeus, 1758); *Mesovelia furcata* Mulsant & Rey, 1852; *Hydrometra gracilenta* Horvath, 1899; *Sigara lateralis* (Leach 1817); *Micronecta minutissima* (Linnaeus, 1758); *Plea minutissima* minutissima Leach, 1817; *Gerris lateralis* Schummel, 1832; and *Gerris lacustris* (Linnaeus, 1758). They feed on larvae of blood-sucking mosquitoes of the genera *Anopheles*, *Aedes*, *Culex*, and other small objects.

CONCLUSIONS

The pertinent research conducted on the territory of the Charyn Nature Park in 2018-2019 revealed that 33 species of aquatic *Hemiptera* belonged to seven families. The study of *Hemiptera* fauna and ecology also used the methods of route surveys and stationary observations. During the spring, summer, and autumn visits, surveys transpired at more than 50 reservoirs. The reservoirs were open, semi-overgrown, and overgrown types, with an area of 2 to 100 m^2, and their depth ranged from 0.2 to 2 m.

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