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Research Article

Fauna of Heteroptera (Insecta: Hemiptera) in the Republic of Mordovia (Russia)

Anna M. Nikolaeva[1], Alexander B. Ruchin[2]*, Mikhail N. Esin[2], Gennadiy B. Semishin[2], Leonid V. Egorov[2,3], Sergei V. Lukiyanov[2,4], Evgeniy A. Lobachev[2], Oleg N. Artaev[5]

[1]Oka State Nature Biosphere Reserve, Russia
[2]Joint Directorate of the Mordovia State Nature Reserve and National Park «Smolny», Russia
[3]Prisursky State Nature Reserve, Russia
[4]National Research Mordovia State University, Russia
[5]Papanin Institute for Biology of Inland Waters, Russian Academy of Sciences, Russia
*Email: ruchin.alexander@gmail.com

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Abstract
The suborder Heteroptera (order Hemiptera) is one of the most interesting groups of Rynchota. It is found in various ecosystems around the world and belongs to predators, parasitous (in particular hematophagous), mycetophagous and herbivorous types. Species with mixed nutrition are common. The study is aimed to describe the fauna and distribution of hemipteran insect species in the Republic of Mordovia (the central part of the European part of Russia). The study was conducted from 2004 to 2022. Specimens were collected using traditional hemipteran insect collecting methods (manual collecting, light trap, entomological net, Malaise trap, Merike plates, window and soil traps). We examined 4895 specimens of Hemiptera. Species diversity of Heteroptera (order Hemiptera) of Republic of Mordovia accounts for 363 species from 34 families. Of these, 15 species (*Campylosteira verna, Allorhinocoris flavus, Grypocoris sexguttatus, Acetropis gimmerthalii, Geocoris grylloides, Platyplax salviae, Emblethis ciliatus, Aellopus atratus, Rhyparochromus quadratus, Parapiesma quadratum, Berytinus montivagus, Pyrrhocoris marginatus, Enoplops scapha, Dybowskyia reticulata, Ventocoris halophilus*) are listed for the region for the first time. Twenty-three species (*Agramma femorale, Adomerus biguttatus, Aelia acuminata, Carpocoris fuscispinus, Coreus marginatus, Dolycoris baccarum, Eurydema oleracea, Gerris lacustris, Graphosoma lineatum, Kleidocerys resedae, Labops sahlbergii, Lopus decolor, Lygus pratensis, Nithecus jacobaeae, Palomena prasina, Polymerus unifasciatus, Prostemma aeneicolle, Pyrrhocoris apterus, Rhyparochromus pini, Stenodema calcarata, Cymus glandicolor, Eremocoris plebejus, Aphanus rolandri*) constitute the main population of the Heteroptera fauna given in the dataset. The species diversity of Heteroptera of the Republic of Mordovia is roughly similar in number of species to that of neighbouring regions.
Keywords: insects, common species, rare species, fauna of regions, comparison of fauna, Central Russia

Introduction
Currently, the loss of biodiversity on a global scale is beginning to manifest itself to an increasingly significant extent (Gray et al., 2016; Wagner, 2020). To study the biodiversity of the world's faunas of individual insect groups, it is necessary to know regional and local faunas (Dvořák et al., 2023; Dedyukhin, 2023; Vorobjeva, Chertoprud, 2023). Such lists of species will

be the basis for the creation of global databases (Dedyukhin, 2022; Ivanova, Shashkov, 2022; Sandanov et al., 2022). The study of regional and local insect faunas, including hemipterans, seems to be a relevant area of scientific research, especially considering their economic and ecological importance. Many species of Heteroptera are numerous in natural biocenoses (Grozea et al., 2020; Shorenko et al., 2022) some are dangerous pests of agrocenoses (Schaefer, Panizzi, 2000; Sadullaevich et al., 2022). One of the main tasks of modern zoological research is to preserve the gene pool and diversity of animal species, to protect rare and endangered species. A biodiversity inventory is, in essence, a project for the development of biodiversity, while at the same time being a project for its conservation (Janzen, 2003). This is especially relevant now, when many communities are experiencing strong anthropogenic pressure (Trujillo-Arias et al., 2023). In addition, climate change is having a significant impact on invertebrate habitat change (Musolin, 2007; Rabitsch, 2008; Ananyev et al., 2023). And the variety of natural conditions Republic of Mordovia determines the fauna features of the region (Yamashkin, 1998).

Heteroptera, or true bugs, are the most diverse group of insects with incomplete metamorphosis. The suborder Heteroptera has more than 42,000 species, 5,800 genera, and 89 families worldwide (Henry, 2009). The catalog of Hemiptera of the Palaearctic contains about 3000 species for Europe (Aukema, Rieger, 1995, 1996, 1999, 2001, 2006). Heteroptera have sucking mouthparts and feed – depending on the species – as parasites, predators or herbivores on different food sources: from blood or hemolymph to plant sap or the cytoplasma of fungi (Schuh, Slater, 1995; Sadullaevich et al., 2022]. The food preferences of phytophagous Hemiptera have not been well studied (Aleksanov, 2023). Sometimes hemipteran phytophages use extraphytophagous food sources (Adler, Wheeler, 1984). Some phytophagous species of Heteroptera are pests (Heliövaara, 1982; Neymorovets et al., 2007; Tillman et al., 2022). Predatory true bugs such as Orius laevigatus, Macrolophus pygmaeus and some others are used for biological control of harmful insects (Sanchez, 1997; Hillert, 2002). Heteroptera, unique among insects, colonize almost the entire planet, including the ocean surface and Antarctica (Schuh, Slater, 1995).

This study is aimed to describe the fauna and occurrence of Heteroptera (Hemiptera) in the Republic of Mordovia, based on our recently published dataset in GBIF as Darwin Core Archive (Nikolaeva et al., 2023). This is the first complete description of the Heteroptera fauna of the Republic of Mordovia, located in the center of the European part of Russia.

Material and methods

The Republic of Mordovia is located in the center of the East European Plain between 42°11' and 46°45' east longitude and 53°38' and 55°11' north latitude in the interfluve of the rivers Moksha and Sura (Figure 1). The region is located mainly in the forest-steppe landscape zone, although, in its northwestern part, there is an array of forests of the southern taiga, and in the south, there

are still some preserved steppe areas. Forests cover more than a third of the republic's area. The main part of open landscapes are agroecosystems. There are many pastures and meadows in the region as open ecosystems. They are mostly located intrazonally (in floodplains of rivers, near reservoirs). The eastern part of Mordovia occupies the northwest of the Volga Upland and the western part of the Oka-Don lowland. In this regard, a variety of habitats is observed in the area of study (Yamashkin, 1998). The variety of landscapes determines the diversity of entomofauna, in which, in addition to the typically nemoral and forest-steppe, taiga and steppe species have been actively detected in recent years (Ruchin et al., 2018).

Figure 1. Study area

Material for this paper was collected during the seasons of 2004–2022 (most intensively since 2008) using the generally accepted entomological methods of field research such as hand collection, light collection, net collection, pitfall traps and barrier traps (Golub et al., 2012). Pitfall traps were set from April to September. The traps were 0.5 L plastic cups containing 200 mL of a 4% formalin solution. We installed 10 traps in various biotopes. The distance between the traps was 2 m (Barber, 1931; Golub et al., 2012). We also conducted a study of the dendrobiont fauna of Heteroptera insects using barrier traps (Nikolaeva et al., 2019; Ruchin et al., 2020). Trap is made of transparent dense plastic and has the following device: two transparent plastic plates (45x30 cm) located perpendicular to each other, under which a cone is attached with a plastic cup (Samkov, Chernyshov, 1983; Økland, 1996). The total surface of the “barrier” is 2.7 m^2 (Nikolaeva et al., 2019). Material from the collections of the Mordovia State Nature Reserve was also used.

To estimate the abundance of a species, we used a scale that was developed by the second and third authors for Scarabaeoidea (Coleoptera) (Egorov et al., 2023). Thus, a single individual means that single specimens of the species was found in one locality in the region, a rare species means species with a population of 10 or fewer specimens found in 2–5 localities. The common species are true bugs found in 6–10 localities, and the abundant species are Heteroptera, found in at least 50% of the studied localities. The collected material was identified by A.M. Nikolaeva, partly A.B. Ruchin and L.V. Egorov. Identification was carried out according to Kerzhner and others (1964), using additional sources (Golub, 1990; Kanyukova, 2006; Belousova, 2007; Namyatova, Konstantinov, 2009). We checked the distribution of Heteroptera using the catalog (Aukema, Rieger, 1995, 1996, 1999, 2001, 2006). We followed the suggested nomenclature in the work of Schuh and Slater (1995). Each observation includes the following information: location (latitude/longitude), date of observation, observer name and identifier name. The coordinates were determined in situ using a GPS device or using Google Maps (Table 1). The dataset contains 2742 occurrences. A total of 4895 specimens were studied.

Table 1. Description of the data in the dataset

Column label	Column description
eventide	An identifier for the set of information associated with an Event (occurs in one place in one time).
occurrenceID	An identifier for the Occurrence (as opposed to a particular digital record of the occurrence)
basisOfRecord	The specific nature of the data record: HumanObservation
eventDate	The date when material from the trap was collected or the range of dates during which the trap collected material
Kingdom	The full scientific name of the kingdom in which the taxon is classified
Phylum	The full scientific name of the phylum or division in which the taxon is classified
Class	The full scientific name of the class in which the taxon is classified
Order	The full scientific name of the order in which the taxon is classified
taxonRank	The taxonomic rank of the most specific name in the scientificName.
decimalLatitude	The geographic latitude of location in decimal degree
decimalLongitude	The geographic longitude of location in decimal degrees
geodeticDatum	The ellipsoid, geodetic datum, or spatial reference system (SRS) upon which the geographic coordinates given in decimalLatitude and decimalLongitude as based. Here - WGS84.
coordinateUncertaintyInMeters	The horizontal distance (in meters) from the given decimalLatitude and decimalLongitude describing the smallest circle containing the whole of the Location
Country	The name of the country in which the Location occurs. Here - Russia.
countryCode	The standard code for the country in which the Location occurs. Here - RU.
individualCount	The number of individuals represented present at the time of the Occurrence.
Year	The integer day of the month on which the Event occurred.
Month	The ordinal month in which the Event occurred.
Day	The integer day of the month on which the Event occurred
recordedBy	A person or group responsible for recording the original Occurrence.
identifiedBy	A list of names of people, who assigned the Taxon to the subject

Results and Discussion

The dataset contains information about 363 species of Heteroptera from 34 families studied during our research (Table 2). Of these, 17 species (*Campylosteira verna*, *Allorhinocoris flavus*, *Grypocoris sexguttatus*, *Acetropis gimmerthalii*, *Acetropis carinata*, *Acetropis longirostris*, *Geo-*

coris grylloides, Platyplax salviae, Emblethis ciliatus, Aellopus atratus, Rhyparochromus quadratus, Parapiesma quadratum, Berytinus montivagus, Pyrrhocoris marginatus, Enoplops scapha, Dybowskyia reticulata, Ventocoris halophilus) are listed for the region for the first time. In addition, Table 2 includes one species (*Codophila varia*) previously noted for the Republic of Mordovia in the literature (Plavilshchikov, 1964), which is confirmed by a single collection specimen. Findings of such species as *Antheminia lunulata* and *Staria lunata* (Timraleev, Susarev, 2008) need to be clarified. Thus, the total fauna of Hemiptera in the Republic of Mordovia currently includes 364 species.

Table 2. Biodiversity of Heteroptera species in the Republic of Mordovia

Taxa	Approximate Estimate of the Number
NEPIDAE Latreille, 1802	
Nepa cinerea Linnaeus, 1758	common specimens
Ranatra linearis (Linnaeus, 1758)	rare specimens
CORIXIDAE Leach, 1815	
Callicorixa praeusta (Fieber, 1848)	common specimens
Corixa dentipes (Thomson, 1869)	single individual
Hesperocorixa linnaei (Fieber, 1848)	common specimens
Hesperocorixa sahlbergi (Fieber, 1848)	common specimens
Paracorixa concinna (Fieber, 1848)	single individual
Sigara falleni (Fieber, 1848)	common specimens
Sigara limitata (Fieber, 1848)	single individual
Sigara semistriata (Fieber, 1848)	common specimens
NAUCORIDAE Leach, 1815	
Ilyocoris cimicoides (Linnaeus, 1758)	common specimens
NOTONECTIDAE Latreille, 1802	
Notonecta glauca Linnaeus, 1758	common specimens
Notonecta lutea Müller, 1776	single individual
HEBRIDAE Amyot & Serville, 1843	
Hebrus pusillus (Fallén, 1807)	common specimens
Hebrus ruficeps Thomson, 1871	rare specimens
HYDROMETRIDAE Billberg, 1820	
Hydrometra gracilenta Horváth, 1899	common specimens
GERRIDAE Leach, 1815	
Aquarius najas (De Geer, 1773)	single individual
Aquarius paludum (Fabricius, 1794)	common specimens
Gerris argentatus Schummel, 1832	rare specimens
Gerris lacustris (Linnaeus, 1758)	numerous specimens
Gerris lateralis Schummel, 1832	common specimens
Gerris odontogaster (Zetterstedt, 1828)	common specimens
Gerris thoracicus Schummel, 1832	common specimens
Limnoporus rufoscutellatus (Latreille, 1807)	common specimens
VELIIDAE Brullé, 1836	
Microvelia reticulata (Burmeister, 1835)	single individual
CERATOCOMBIDAE FIEBER, 1861	
Ceratocombus coleoptratus Zetterstedt, 1819	rare specimens
SALDIDAE Amyot et Serville, 1843	
Chartoscirta cincta (Herrich-Schaeffer, 1841)	common specimens
Chartoscirta elegantula (Fallén, 1807)	common specimens

Saldula arenicola (Scholtz, 1847)	common specimens
Saldula c-album (Fieber, 1859)	single individual
Saldula opacula (Zetterstedt, 1838)	common specimens
Saldula pallipes (Fabricius, 1794)	common specimens
Saldula saltatoria (Linnaeus, 1758)	common specimens
REDUVIIDAE Latreille, 1807	
Coranus subapterus (De Geer, 1773)	rare specimens
Empicoris culiciformis (De Geer, 1773)	single individual
Pygolampis bidentata (Goeze, 1778)	rare specimens
Rhynocoris annulatus (Linnaeus, 1758)	common specimens
MICROPHYSIDAE Dohrn, 1859	
Loricula exilis (Fallén, 1807)	single individual
NABIDAE A. Costa, 1853	
Alloeorhynchus flavipes (Fieber, 1836)	common specimens
Himacerus apterus (Fabricius, 1798)	common specimens
Himacerus boops (Schiødte, 1870)	rare specimens
Himacerus mirmicoides (O. Costa, 1834)	common specimens
Nabis brevis Scholtz, 1847	rare specimens
Nabis ferus (Linnaeus, 1758)	common specimens
Nabis flavomarginatus Scholtz, 1847	common specimens
Nabis limbatus Dahlbom, 1851	common specimens
Nabis lineatus Dahlbom, 1851	rare specimens
Nabis pseudoferus Remane, 1949	rare specimens
Nabis rugosus (Linnaeus, 1758)	common specimens
Prostemma aeneicolle Stein, 1857	numerous specimens
ANTHOCORIDAE Fieber, 1836	
Anthocoris confusus Reuter, 1884	rare specimens
Anthocoris limbatus Fieber, 1836	rare specimens
Anthocoris nemoralis (Fabricius, 1794)	rare specimens
Anthocoris nemorum (Linnaeus, 1761)	common specimens
Lyctocoris campestris (Fabricius, 1794)	rare specimens
Orius horvathi (Reuter, 1884)	rare specimens
Orius minutus (Linnaeus, 1758)	common specimens
Orius niger (Wolff, 1811)	common specimens
Temnostethus gracilis Horváth, 1907	single individual
MIRIDAE Hahn, 1833	
Acetropis carinata (Herrich-Schaeffer, 1841)	common specimens
Acetropis gimmerthalii (Flor, 1860)*	single individual
Acetropis longirostris Puton, 1875	rare specimens
Adelphocoris lineolatus (Goeze, 1778)	common specimens
Adelphocoris quadripunctatus (Fabricius, 1794)	common specimens
Adelphocoris seticornis (Fabricius, 1775)	common specimens
Adelphocoris ticinensis (Meyer-Dür, 1843)	common specimens
Agnocoris rubicundus (Fallén, 1807)	rare specimens
Allorhinocoris flavus J. Sahlberg, 1878*	single individual
Amblytylus nasutus (Kirschbaum, 1856)	single individual
Apolygus lucorum (Meyer-Dur, 1843)	common specimens
Apolygus spinolae (Meyer-Dür, 1841)	common specimens
Blepharidopterus angulatus (Fallén, 1807)	common specimens
Bothynotus pilosus (Boheman, 1852)	common specimens
Brachyarthrum limitatum Fieber, 1858	single individual
Bryocoris pteridis (Fallén, 1807)	common specimens
Calocoris roseomaculatus De Geer, 1773	single individual

Campylomma verbasci (Meyer-Dür, 1843)	single individual
Capsodes gothicus (Linnaeus, 1758)	common specimens
Capsus ater (Linnaeus, 1758)	common specimens
Capsus wagneri Remane, 1950	single individual
Charagochilus gyllenhalii (Fallén, 1807)	common specimens
Chlamydatus pulicarius (Fallén, 1807)	common specimens
Chlamydatus pullus (Reuter, 1870)	common specimens
Closterotomus biclavatus (Herrich-Schaeffer, 1835)	common specimens
Closterotomus fulvomaculatus (De Geer, 1773)	single individual
Compsidolon salicellum (Herrich-Schaeffer, 1841)	single individual
Cyllecoris histrionius (Linnaeus, 1767)	single individual
Cyrtorhinus caricis (Fallén, 1807)	single individual
Deraeocoris lutescens (Schilling, 1837)	rare specimens
Deraeocoris olivaceus (Fabricius, 1777)	single individual
Deraeocoris ruber (Linnaeus, 1758)	common specimens
Deraeocoris scutellaris (Fabricius, 1794)	rare specimens
Deraeocoris ventralis Reuter, 1904	single individual
Dicyphus globulifer (Fallén, 1829)	common specimens
Dryophilocoris flavoquadrimaculatus (De Geer, 1773)	common specimens
Europiella albipennis (Fallén, 1829)	rare specimens
Europiella artemisiae (Becker, 1864)	single individual
Euryopicoris nitidus (Meyer-Dür, 1843)	common specimens
Globiceps flavomaculatus (Fabricius, 1794)	common specimens
Globiceps fulvicollis Jakovlev, 1877	common specimens
Globiceps salicicola Reuter, 1880	single individual
Grypocoris sexguttatus (Fabricius, 1777) *	single individual
Hallodapus montandoni Reuter, 1895	rare specimens
Halticus apterus (Linnaeus, 1758)	common specimens
Halticus pusillus (Herrich-Schaeffer, 1835)	common specimens
Heterocordylus genistae (Scopoli, 1763)	common specimens
Heterocordylus leptocerus (Kirschbaum, 1856)	common specimens
Hoplomachus thunbergii (Fallén, 1807)	common specimens
Labops sahlbergii (Fallén, 1829)	numerous specimens
Leptopterna dolabrata (Linnaeus, 1758)	common specimens
Leptopterna ferrugata (Fallén, 1807)	rare specimens
Liocoris tripustulatus (Fabricius, 1781)	common specimens
Lopus decolor (Fallén, 1807)	numerous specimens
Lygus gemellatus (Herrich-Schaeffer, 1835)	common specimens
Lygus pratensis (Linnaeus, 1758)	numerous specimens
Lygus punctatus (Zetterstedt, 1838)	common specimens
Lygus rugulipennis Poppius, 1911	common specimens
Lygus wagneri Remane, 1955	common specimens
Macrotylus herrichi (Reuter, 1873)	rare specimens
Malacocoris chlorizans (Panzer, 1794)	single individual
Megacoelum infusum (Herrich-Schaeffer, 1837)	single individual
Megaloceroea recticornis (Geoffroy, 1785)	common specimens
Miris striatus (Linnaeus, 1758)	single individual
Monalocoris filicis (Linnaeus, 1758)	common specimens
Monosynamma bohemanni (Fallén, 1829)	single individual
Myrmecophyes alboornatus (Stal, 1858)	common specimens
Myrmecoris gracilis (R. Sahlberg, 1848)	common specimens
Neolygus contaminatus (Fallén, 1807)	common specimens
Neolygus viridis (Fallén, 1807)	common specimens
Notostira elongata (Geoffroy, 1785)	common specimens

Notostira erratica (Linnaeus, 1758)	common specimens
Orthocephalus brevis (Panzer, 1798)	single individual
Orthocephalus saltator (Hahn, 1835)	common specimens
Orthocephalus vittipennis (Herrich-Schaeffer, 1835)	common specimens
Orthonotus rufifrons (Fallén, 1807)	rare specimens
Orthops basalis (A. Costa, 1853)	common specimens
Orthops campestris (Linnaeus, 1758)	common specimens
Orthops kalmii (Linnaeus, 1758)	common specimens
Orthotylus fuscescens (Kirschbaum, 1856)	single individual
Orthotylus marginalis Reuter, 1883	common specimens
Orthotylus nassatus (Fabricius, 1787)	rare specimens
Orthotylus tenellus (Fallén, 1807)	single individual
Pantilius tunicatus (Fabricius, 1781)	common specimens
Phoenicocoris obscurellus Fallén, 1829	single individual
Phylus coryli (Linnaeus, 1758)	single individual
Phytocoris dimidiatus Kirschbaum, 1856	common specimens
Phytocoris intricatus Flor, 1861	rare specimens
Phytocoris longipennis Flor, 1861	rare specimens
Phytocoris populi (Linnaeus, 1758)	single individual
Piezocranum simulans Horváth, 1877	single individual
Pilophorus cinnamopterus (Kirschbaum, 1856)	rare specimens
Pilophorus clavatus (Linnaeus, 1767)	single individual
Pilophorus confusus (Kirschbaum, 1856)	single individual
Pinalitus rubricatus (Fallén, 1807)	single individual
Pithanus maerkelii (Herrich-Schaeffer, 1838)	single individual
Placochilus seladonicus (Fallén, 1807)	single individual
Plagiognathus arbustorum (Fabricius, 1794)	common specimens
Plagiognathus chrysanthemi (Wolff, 1804)	common specimens
Plagiognathus fulvipennis (Kirschbaum, 1856)	single individual
Polymerus holosericeus Hahn, 1831	rare specimens
Polymerus nigrita (Fallén, 1807)	common specimens
Polymerus palustris (Reuter, 1907)	rare specimens
Polymerus unifasciatus (Fabricius, 1794)	numerous specimens
Polymerus vulneratus (Panzer, 1805)	common specimens
Polymerus cognatus (Fieber, 1858)	rare specimens
Psallus betuleti (Fallén, 1826)	rare specimens
Stenodema calcarata (Fallén, 1807)	numerous specimens
Stenodema holsata (Fabricius, 1787)	single individual
Stenodema laevigata (Linnaeus, 1758)	common specimens
Stenodema virens (Linaeus, 1767)	rare specimens
Stenotus binotatus (Fabricius, 1794)	rare specimens
Strongylocoris leucocephalus (Linnaeus, 1758)	common specimens
Strongylocoris steganoides (J. Sahlberg, 1875)	single individual
Systellonotus triguttatus (Linnaeus, 1767)	rare specimens
Trigonotylus caelestialium (Kirkaldy, 1902)	common specimens
Trigonotylus ruficornis (Geoffroy, 1785)	common specimens
TINGIDAE Laporte, 1832	
Acalypta carinata (Panzer, 1806)	common specimens
Acalypta marginata (Wolff, 1804)	single individual
Acalypta nigrina (Fallén, 1807)	common specimens
Acalypta platycheila (Fieber, 1836)	single individual
Agramma femorale (Thompson, 1871)	numerous specimens
Agramma tropidopterum Flor, 1860	rare specimens
Catoplatus fabricii (Stål, 1868)	common specimens

Campylosteira verna (Fallén, 1826)*	single individual
Derephysia foliacea (Fallén, 1807)	common specimens
Derephysia longispina Golub, 1974	common specimens
Dictyla echii (Schrank, 1782)	common specimens
Dictyla humuli (Fabricius, 1794)	common specimens
Dictyla lupuli (Herrich-Schaeffer, 1837)	single individual
Dictyla rotundata (Herrich-Schaeffer, 1835)	common specimens
Dictyonota strichnocera Fieber, 1844	common specimens
Kalama tricornis (Schrank, 1801)	rare specimens
Oncochila simplex (Herrich-Schaeffer, 1830)	rare specimens
Physatocheila costata (Fabricius, 1794)	rare specimens
Physatocheila smreczynskii China, 1952	common specimens
Stephanitis oberti (Kolenati, 1856)	rare specimens
Tingis ampliata Herrich-Schaeffer, 1838	common specimens
Tingis cardui (Linnaeus, 1746)	rare specimens
Tingis crispata (Herrich-Schaeffer, 1838)	common specimens
Tingis geniculata (Fieber, 1844)	common specimens
Tingis pilosa Hummel, 1825	common specimens
Tingis reticulata Herrich-Schaeffer, 1835	common specimens
ARADIDAE Brullé, 1836	
Aneurus avenius (Dufour, 1833)	common specimens
Aneurus laevis (Fabricius, 1775)	single individual
Aradus angularis J. Sahlberg, 1886	common specimens
Aradus aterrimus Fieber, 1864	single individual
Aradus betulae (Linnaeus, 1758)	common specimens
Aradus betulinus Fallén, 1807	single individual
Aradus bimaculatus Reuter, 1872	common specimens
Aradus cinnamomeus Panzer, 1806	common specimens
Aradus corticalis (Linnaeus, 1758)	rare specimens
Aradus crenaticollis R.F. Sahlberg, 1848	single individual
Aradus depressus (Fabricius, 1794)	common specimens
Aradus distinctus Fieber, 1860	common specimens
Aradus hieroglyphicus Sahlberg, 1878	single individual
Aradus obtectus Vásárhelyi, 1988	rare specimens
Aradus ribauti Wagner, 1956	single individual
Aradus signaticornis R.F. Sahlberg, 1848	common specimens
Mezira tremulae (Germar, 1822)	common specimens
ACANTHOSOMATIDAE Signoret, 1864	
Acanthosoma haemorrhoidale (Linnaeus, 1758)	common specimens
Elasmostethus brevis Lindberg, 1934	rare specimens
Elasmostethus interstinctus (Linnaeus, 1758)	common specimens
Elasmostethus minor Horváth, 1899	are specimens
Elasmucha ferrugata (Fabricius, 1787)	rare specimens
Elasmucha grisea (Linnaeus, 1758)	common specimens
CYDNIDAE Billberg, 1820	
Adomerus biguttatus (Linnaeus, 1758)	numerous specimens
Cydnus aterrimus (Forster, 1771)	single individual
Legnotus picipes (Fallén, 1807)	rare specimens
Sehirus luctuosus Mulsant & Rey, 1866	common specimens
Sehirus morio (Linnaeus, 1761)	rare specimens
Tritomegas bicolor (Linnaeus, 1758)	rare specimens
THYREOCORIDAE Amyot & Serville, 1843	
Thyreocoris scarabaeoides (Linnaeus, 1758)	common specimens

PENTATOMIDAE Leach, 1815	
Aelia acuminata (Linnaeus, 1758)	numerous specimens
Aelia klugii Hahn, 1833	rare specimens
Arma custos (Fabricius, 1794)	common specimens
Carpocoris fuscispinus (Boheman, 1851)	numerous specimens
Carpocoris purpureipennis (De Geer, 1773)	common specimens
Chlorochroa pinicola (Mulsant & Rey, 1852)	common specimens
Codophila varia (Fabricius, 1787)	single individual
Dolycoris baccarum (Linnaeus, 1758)	numerous specimens
Dybowskyia reticulata (Dallas, 1851) *	single individual
Eurydema dominulus (Scopoli, 1763)	common specimens
Eurydema oleracea (Linnaeus, 1758)	numerous specimens
Eysarcoris aeneus (Scopoli, 1763)	common specimens
Eysarcoris venustissimus (Schrank, 1776)	common specimens
Graphosoma lineatum (Linnaeus, 1758)	numerous specimens
Jalla dumosa (Linnaeus, 1758)	single individual
Neottiglossa leporina (Herrich-Schaeffer, 1830)	common specimens
Neottiglossa pusilla (Gmelin, 1790)	common specimens
Palomena prasina (Linnaeus, 1761)	numerous specimens
Palomena viridissima (Poda, 1761)	rare specimens
Pentatoma rufipes (Linnaeus, 1758)	common specimens
Peribalus strictus vernalis (Wolff, 1804)	common specimens
Picromerus bidens **(**Linnaeus, 1758)	common specimens
Piezodorus lituratus (Fabricius, 1794)	common specimens
Pinthaeus sanguinipes (Fabricius, 1781)	rare specimens
Rhacognathus punctatus (Linnaeus, 1758)	common specimens
Rubiconia intermedia (Wolff, 1811)	single individual
Sciocoris cursitans (Fabricius, 1794)	common specimens
Sciocoris distinctus Fieber, 1851	common specimens
Sciocoris macrocephalus Fieber, 1851	rare specimens
Sciocoris umbrinus (Wolff, 1804)	rare specimens
Stagonomus bipunctatus (Linnaeus, 1758)	common specimens
Troilus luridus (Fabricius, 1775)	rare specimens
Ventocoris halophilus (Jakovlev, 1874) *	single individual
Zicrona caerulea (Linnaeus, 1758)	common specimens
PLATASPIDAE Dallas,1851	
Coptosoma scutellatum (Geoffroy, 1785)	common specimens
SCUTELLERIDAE Leach, 1815	
Eurygaster austriaca (Schrank, 1776)	common specimens
Eurygaster integriceps Puton, 1881	rare specimens
Eurygaster maura (Linnaeus, 1758)	common specimens
Eurygaster testudinaria (Geoffroy, 1785)	common specimens
PYRRHOCORIDAE Amyot et Serville, 1843	
Pyrrhocoris apterus (Linnaeus, 1758)	numerous specimens
Pyrrhocoris marginatus (Kolenati, 1845) *	common specimens
ALYDIDAE Amyot et Serville, 1843	
Alydus calcaratus (Linnaeus, 1758)	common specimens
COREIDAE Leach, 1815	
Bathysolen nubilus (Fallén, 1807)	common specimens
Ceraleptus gracilicornis (Herrich-Schaeffer, 1835)	common specimens
Ceraleptus lividus Stein, 1858	rare specimens
Coreus marginatus (Linnaeus, 1758)	numerous specimens
Coriomeris scabricornis (Panzer, 1805)	single individual
Enoplops scapha (Fabricius, 1794) *	rare specimens

Nemocoris fallenii Sahlberg, 1848	rare specimens
Syromastus rhombeus (Linnaeus, 1767)	rare specimens
Ulmicola spinipes (Fallén, 1807)	rare specimens
RHOPALIDAE Amyot and Serville, 1843	
Brachycarenus tigrinus (Schilling, 1829)	common specimens
Chorosoma schillingii (Schilling, 1829)	single individual
Corizus hyoscyami (Linnaeus, 1758)	common specimens
Myrmus miriformis (Fallén, 1807)	common specimens
Rhopalus conspersus (Fieber, 1837)	common specimens
Rhopalus maculatus (Fieber, 1837)	common specimens
Rhopalus parumpunctatus Schilling, 1829	common specimens
Rhopalus subrufus (Gmelin, 1790)	common specimens
Stictopleurus abutilon (Rossi, 1790)	common specimens
Stictopleurus crassicornis (Linnaeus, 1758)	common specimens
Stictopleurus punctatonervosus (Goeze, 1778)	common specimens
Stictopleurus punctatonervosus (Goeze, 1778)	rare specimens
Stictopleurus unicolor (Jakovlev, 1873)	rare specimens
STENOCEPHALIDAE Dallas, 1852	
Dicranocephalus agilis (Scopoli, 1763)	common specimens
Dicranocephalus albipes (Fabricius, 1781)	single individual
BERYTIDAE Fieber, 1851	
Berytinus clavipes (Fabricius, 1775)	common specimens
Berytinus minor (Herrich-Schaeffer, 1835)	rare specimens
Berytinus montivagus (Meyer-Dür, 1841) *	single individual
Neides tipularius (Linnaeus, 1758)	common specimens
BLISSIDAE Stål, 1862	
Dimorphopterus spinolae (Signoret, 1857)	common specimens
Ischnodemus sabuleti (Fallén, 1826)	common specimens
CYMIDAE Baerensprung, 1860	
Cymus aurescens Distant, 1883	common specimens
Cymus claviculus (Fallén, 1807)	common specimens
Cymus glandicolor Hahn, 1833	numerous specimens
Cymus melanocephalus Fieber, 1861	common specimens
GEOCORIDAE Baerensprung, 1860	
Geocoris ater (Fabricius, 1787)	rare specimens
Geocoris dispar (Waga, 1839)	single individual
Geocoris grylloides (Linnaeus, 1761) *	single individual
HETEROGASTRIDAE Stål, 1872	
Platyplax salviae (Schilling, 1829) *	single individual
LYGAEIDAE Schilling, 1829	
Arocatus roeselii (Schilling, 1829)	single individual
Kleidocerys resedae (Panzer, 1797)	numerous specimens
Lygaeus equestris (Linnaeus, 1758)	common specimens
Nithecus jacobaeae (Schilling, 1829)	numerous specimens
Nysius ericae (Schilling, 1829)	common specimens
Nysius helveticus (Herrich-Schaeffer, 1850)	common specimens
Nysius thymi (Wolff, 1804)	common specimens
Ortholomus punctipennis (Herrich-Schaeffer, 1850)	common specimens
OXYCARENIDAE Stål, 1862	
Oxycarenus modestus (Fallén, 1829)	common specimens
Oxycarenus pallens (Herrich-Schaeffer, 1850)	single individual
PIESMATIDAE Amyot and Serville, 1843	
Parapiesma quadratum (Fieber, 1844) *	rare specimens
Piesma capitata (Wolff, 1804)	common specimens

Piesma maculata (Laporte, 1833)	common specimens
RHYPAROCHROMIDAE Amyot and Serville, 1843	
Aellopus atratus (Goeze, 1778) *	rare specimens
Aphanus rolandri (Linnaeus, 1758)	numerous specimens
Drymus brunneus (Sahlberg, 1848)	common specimens
Drymus ryeii Douglas & Scott, 1865	common specimens
Drymus sylvaticus (Fabricius, 1775)	common specimens
Emblethis ciliatus Horvath, 1875*	rare specimens
Emblethis verbasci (Fabricius, 1803)	common specimens
Eremocoris abietis (Linnaeus, 1758)	common specimens
Eremocoris fenestratus (Herrich-Schaeffer, 1839)	common specimens
Eremocoris plebejus (Fallén, 1807)	numerous specimens
Eremocoris podagricus (Fabricius, 1775)	single individual
Gastrodes grossipes (De Geer, 1773)	rare specimens
Graptopeltus lynceus Fabricius, 1775	common specimens
Ischnocoris angustulus (Boheman, 1852)	single individual
Lampoprax picea (Flor, 1860)	single individual
Ligyrocoris sylvestris (Linnaeus, 1758)	common specimens
Megalonotus antennatus (Schilling, 1829)	rare specimens
Megalonotus dilatatus (Herrich-Schaeffer, 1840)	common specimens
Pachybrachius fracticollis (Schilling, 1829)	common specimens
Pachybrachius luridus Hahn, 1826	rare specimens
Panaorus adspersus (Mulsant & Rey, 1852)	common specimens
Peritrechus geniculatus (Hahn, 1833)	common specimens
Pterotmetus staphyliniformis (Schilling, 1829)	common specimens
Raglius alboacuminatus (Goeze, 1778)	common specimens
Rhyparochromus pini (Linnaeus, 1758)	numerous specimens
Rhyparochromus quadratus (Fabricius, 1798) *	rare specimens
Rhyparochromus vulgaris (Schilling, 1829)	common specimens
Scolopostethus affinis (Schilling, 1829)	rare specimens
Scolopostethus pilosus Reuter, 1874	common specimens
Scolopostethus puberulus Horvath, 1887	rare specimens
Scolopostethus thomsoni Reuter, 1874	common specimens
Sphragisticus nebulosus (Fallén, 1807)	common specimens
Stygnocoris pedestris (Fallén, 1807)	single individual
Stygnocoris rusticus (Fallén, 1807)	rare specimens
Stygnocoris sabulosus (Schilling, 1829)	common specimens
Trapezonotus anorus (Flor, 1860)	common specimens
Trapezonotus arenarius (Linnaeus, 1758)	common specimens

*—first record for the Republic of Mordovia.

There are details on the distribution and abundance of a few species that can be classified as low abundance and of limited distribution in the region.

Campylosteira verna inhabits all parts of Western Europe. In Russia, it is known only within the borders of the European part (Aukema, Rieger, 1996). This lace bug lives in mosses on calcareous soils with sparse vegetation (Péricart, 1997). In the Republic of Mordovia, the only habitat was recorded in the southern part of the republic (in the vicinity of the Torbeevo village).

Acetropis gimmerthalii is distributed mainly in the southern regions (Aukema, Rieger, 1999). This insect is rarely found in wet and dry meadows. These bugs occur in open habitats and feed on grasses (Poaceae) (Wachmann et al., 2004). In the Republic of Mordovia, the only habitat was

recorded in a large forest clearing on the territory of the Mordovia State Nature Reserve. It was not recorded in neighboring regions.

Aellopus atratus is distributed in Europe (mostly in the southern part) and Central Asia (Aukema, Rieger, 2001). It inhabits young forest belts, protective plantings near gardens, sandy fallows, mounds, gentle slopes of ravines, clearings and other biotopes with ruderal vegetation. *A. atratus* is polyphytophage, but prefers plants of the borage family (Boraginaceae) (Wagner, 1966; Nikolaeva, 2021). It is rare in regions neighboring the Republic of Mordovia (Nikolaeva, 2021). There were two occurrences in the Republic of Mordovia and both were found in forest biotopes within the territory of the Mordovia State Nature Reserve.

Emblethis ciliatus is extremely rarely observed in Central Russia. The species is typical for the south of the European part of the former USSR (Putchkov, 1974). There was some data about the isolated location of the species in the Ryazan region (Kirichenko, 1951). The seed bug prefers steppe areas. In the Republic of Mordovia, two habitats have been identified in the east of the republic. *E. ciliatus* is highly abundant in the biotope with exposed carbonate rocks (Chamzinka district).

Platyplax salvia inhabits Central and Southern Europe (Aukema, Rieger, 2001). In Central Russia, *P. salvia* is distributed along ravines where the food plant sage (*Salvia* sp.) is found (Nikolaeva, 2021; Evsyunin, 2021). In the Republic of Mordovia, it was only found within the Endova tract (a ravine with steppe vegetation), where a food plant is present.

Geocoris grylloides is a European-Siberian species (Aukema, Rieger, 2001). The species is more common in the forest-steppe zone (Lychkovskaya, 2006; Nikolaeva, 2021). In the Republic of Mordovia, it was once found within the territory of the Mordovia State Nature Reserve.

Enoplops scapha is a local species found on sandy soils. Its food plants are Asteraceae. *E. scapha* is a Palearctic species, which gradually becomes rarer towards the north. It is absent from Northern Europe (Wagner, 1966; Aukema, Rieger, 2006). In the Republic of Mordovia, its habitats are located in oak forests and on steppe hills. Both occurrences were recorded in the east of the Republic of Mordovia. *E. scapha* was recorded in the neighboring Ulyanovsk and Ryazan regions (Nikolaeva, 2021, data of the first author).

Rhyparochromus quadratus is a characteristic species for Southern Europe (Aukema, Rieger, 2006). In Russia, the northernmost find was the Lipetsk region until 2016 (Lychkovskaya, 2006). Currently, the habitats of the species for the Republic of Mordovia and neighboring territories are reliably known. This is a typical steppe species, common in virgin areas, as well as in dry and moderately wet meadows. In the Republic of Mordovia, it was found on the territory of the Mordovia State Nature Reserve and beyond.

Pyrrocoris marginatus is a specias of the Southern part of Europe. In Russia, the Voronezh region was considered the northern border of the species' distribution for a long time (Puchkov, 1963; Aukema, Rieger, 2001). Currently in the Republic of Mordovia, it is recorded in nine different places. Most of them are edges or ravines with limestone or chalk. The species is also found in adjacent territories in the Ryazan region and Chuvashia (Nikolaeva, 2021; Nikolaeva, Egorov, 2023).

Pygolampis bidentata is a species with a wide Palearctic range (Aukema, Rieger, 1996). It is rare throughout its habitat, including the European part of Russia. This species is a predator. *P. bidentata* lives and hunts in dry areas along the banks of rivers and lakes. It has a two-year development cycle. The species is included in the regional Red Data Books of the Republic of Mordovia and Samara Region (Red Data Book, 2005; Rosenberg, Saxonova, 2009).

Dybowskyia reticulata is a rare species throughout most of its range. It is distributed in the forest zone of the Eastern Palaearctic (Hemala, Rindoš, 2018; Aukema, Rieger, 2006). In the Republic of Mordovia, it is located on the southwestern border of distribution. The only occurrence was recorded near the village of Kitsaevka, Temnikov district.

Ventocoris halophilus is a species common in the Southeast of the European part of the former USSR (Putchkov, 1961). Information about the ecology and biology of *Ventocoris halophilus* is extremely scarce. The food plants are certain species of the Brassicaceae family (Seidenstücker, 1958; Dursun, Fent, 2013). In the Republic of Mordovia, its only habitat is a forest near the village of Kalysha (territory of the National Park “Smolny”). The species was also recorded in the Samara and Ulyanovsk regions (Dyuzhaeva, 2012, data of the first author).

Figure 2 shows the abundance (in absolute terms) of the most numerous species of Heteroptera. It includes *Agramma femorale*, *Adomerus biguttatus*, *Aelia acuminata*, *Carpocoris fuscispinus*, *Coreus marginatus*, *Dolycoris baccarum*, *Eurydema oleracea*, *Gerris lacustris*, *Graphosoma lineatum*, *Kleidocerys resedae*, *Labops sahlbergii*, *Lopus decolor*, *Lygus pratensis*, *Nithecus jacobaeae*, *Palomena prasina*, *Polymerus unifasciatus*, *Prostemma aeneicolle*, *Pyrrhocoris apterus*, *Rhyparochromus pini*, *Stenodema calcarata*, *Cymus glandicolor*, *Eremocoris plebejus*, *Aphanus rolandri*. These 23 species accounted for 56.3% in number and 23.9% in occurrence of all studied individuals. Most of these species are found throughout the field season.

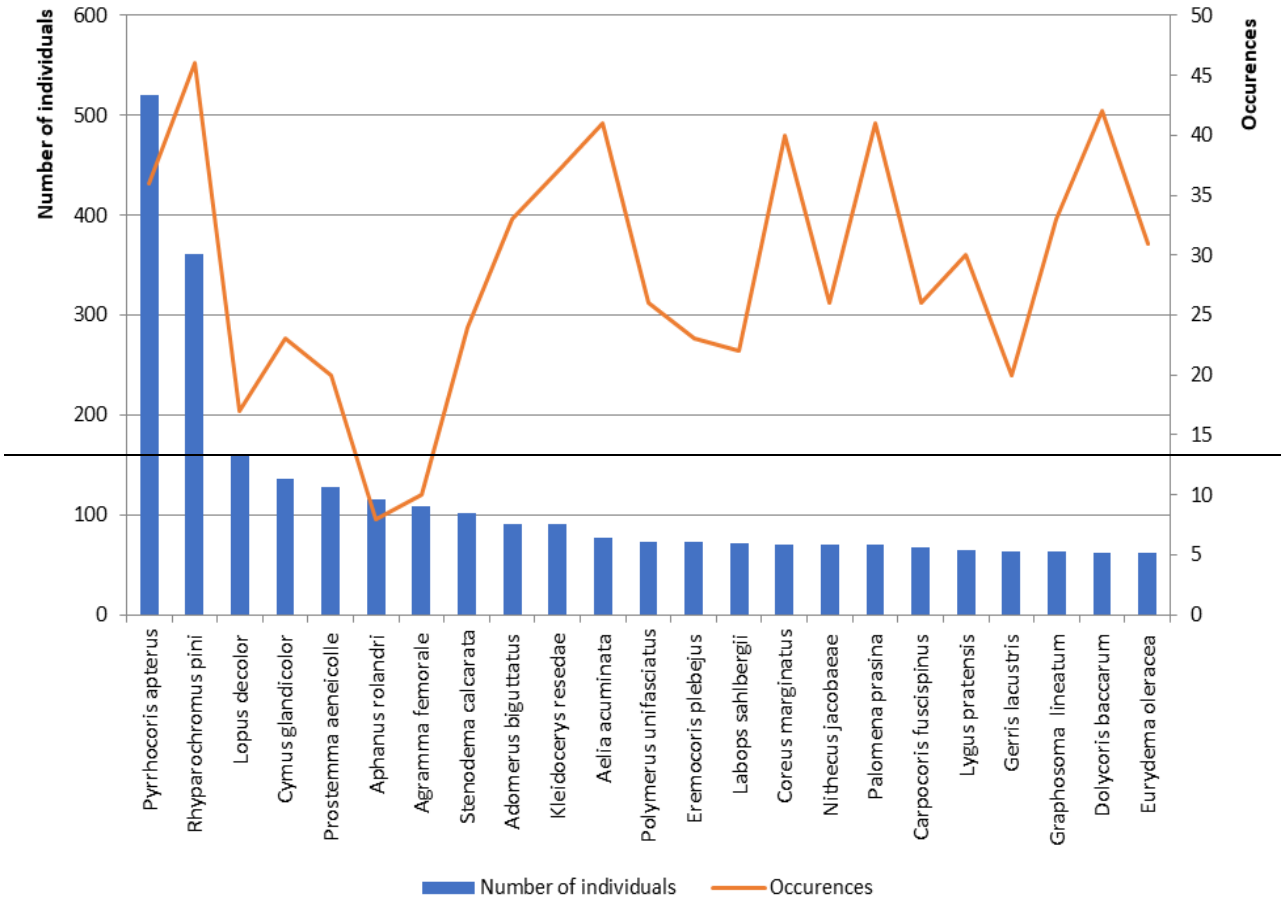

Figure 2. Species of Heteroptera of the Republic of Mordovia with the highest occurrence and highest numbers represented in the dataset.

In the Hemiptera order, representatives of the suborder Heteroptera are one of the most studied groups. Faunistic data have been published for various regions of European Russia (Table 3).

Table 3. Comparison of Heteroptera species diversity in some regions of European Russia.

Region	Species Diversity	Data
Republic of Mordovia	364	Our data
Ryazan Region	390	Nikolaeva, 2021, data of the first author
Chuvash Republic	319	Kanyukova et al., 2021; Egorov, et al., 2022; Nikolaeva, Egorov, 2023
Saratov Region	195	Grebennikov, Anikin, 2020
Penza Region	200	Zinovyeva, Polumordvinov, 2017, 2023; Shveenkova, Stoyko, 2022
Lipetsk Region	298	Golub, 1996; Golub, Parfenova, 2000; Lychkovskaya, 2006
Voronezh region	380	Golub, Parfenova, 2000; Negrobov, 2005; Kondratyeva, Golub, 2009; Svyatoduh, Golub, 2015
Tula region	290	Evsyunin, 2021
Samara region	549	Dyuzhaeva, 1999, 2012
Bryansk region	151	Data of the first author

The species diversity of Heteroptera of the Republic of Mordovia is roughly similar in number of species to that of the neighboring regions. At the same time, in some more southern regions of the European Russia (Samara region), the number of Heteroptera species is much higher (Table 3). The Tula, Voronezh, Lipetsk, Ryazan and Samara regions were the most studied. These are

the regions where specialists carried out a long-term, targeted research on this group of insects. There were the most species found in the Samara region. This is due not only to a good study of this territory, but also to the fact that the region is located further south than others. True bugs are a group of mostly heat-loving insects, so the number of species increases to the south.

Conclusion

A long-term study of the Heteroptera biodiversity of the Republic of Mordovia has been conducted. We examined 4,895 specimens. It is shown that the species diversity of Heteroptera is 363 species from 34 families. Of these, 15 species are mentioned for the first time in this report. The main part of the fauna consists of 23 species that live in terrestrial biotopes. We have made a comparison of the Heteroptera fauna of the Republic of Mordovia and the nearest regions of European Russia. It is shown that the biodiversity of this group is similar in different regions and largely depends on the degree of study of the region.

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