

## SELECTED DIPTERA FAMILIES CAUGHT WITH BEER TRAPS IN THE REPUBLIC OF MORDOVIA (RUSSIA)

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We have studied the fauna of several Diptera families caught with beer traps. In this paper, 36 species from 12 Diptera families are reported: four species of Anisopodidae, one species of Bibionidae, one species of Clusiidae, two species of Dryomyzidae, 11 species of Lauxaniidae, five species of Limoniidae, one species of Megamerinidae, three species of Pallopteridae, one species of Piophilidae, one species of Platystomatidae, four species of Sciomyzidae, and two species of Ulidiidae. From these species, three are new for Russia (*Calliopum splendidum*, *Homoneura biumbata*, *Sapromyza schnabli*, all Lauxaniidae), two new for European Russia (*Sylvicola fusca-toides* (Anisopodidae), *Myennis sibirica* (Ulidiidae)). For the Republic of Mordovia and the Mordovia State Nature Reserve, the families Anisopodidae, Clusiidae, Megamerinidae, Pallopteridae, Piophilidae, Platystomatidae, Ulidiidae, and all Lauxaniidae species published in this list are recorded for the first time. Two species from the family Limoniidae (*Achrolimonia neonebulosa* and *Discobola parvispinula*) and three species from the family Sciomyzidae (*Euthycera chaerophylli*, *Tetanocera ferruginea* and *T. freyi*) are recorded for the first time for the territory of the Mordovia State Nature Reserve. Beer traps can be recommended as one of the successful methods for future surveys of Diptera in the area of interest.

**Key words:** Anisopodidae, bait traps, Bibionidae, biodiversity, Clusiidae, Dryomyzidae, faunistic survey, Limoniidae, Mordovia State Nature Reserve, new records

### Introduction

The order Diptera is among the most diverse insect orders. Its biological diversity contains at least 150 000 species (Courtney et al., 2009), but annually new taxa are being described (e.g., Nourti et al., 2019). Diptera have successfully colonised all continents, including Antarctica, and virtually all habitats except the open sea and inland glaciers. However, the ranges of many species are being studied continuously. Information about the distribution of species and families extends every year (Chursina & Ruchin, 2018a,b; Martín-Park et al., 2018; Astakhov et al., 2019; Gladun, 2019; Pilipenko et al., 2020; Mutin, 2020; Vikhrev et al., 2020). Diptera larvae of different families are found in various terrestrial and aquatic habitats, and can inhabit the tissues of plants and animals; many of them are saproxylic (Martín-Vega & Baz, 2013; Grichanov & Khruleva, 2018; Krivosheina & Krivosheina, 2019).

Due to the considerable diversity of Diptera, there are also many ways to study them. Various devices and traps are used to study Diptera (Matthews & Matthews, 1970; Disney et al., 1982; Baz et al., 2007; Castro et al., 2011; Cavallari et al., 2014). Catching Diptera using the fermental traps

was thoroughly reported by Dvořáková (2008), Dvořák (2014) and Dvořák et al. (2017). Fermental traps with baits from a mixture of beer, sugar, honey, and jam have shown their effectiveness in detecting many Coleoptera (MacRae & Rice, 2007; Guarnieri, 2009; Wong & Hanks, 2016; Egorov & Ivanov, 2018), Lepidoptera (El-Sayed et al., 2005; Uehara-Prado & Freitas, 2009; Jakubíková & Kadlec, 2015), Hymenoptera (Dvořák, 2007; Demichelis et al., 2014; Manko et al., 2019; Sorvari, 2019), and Neuroptera (Duelli et al., 2006; Makarkin & Ruchin, 2019).

The Diptera fauna of the Republic of Mordovia is insufficiently known. Plavilshchikov (1964) summarised the knowledge of insects including Diptera from the territory of the Mordovia State National Reserve, and Feoktistov (2011) published new records for the Republic of Mordovia. Recently, the results of systematic studies of some Diptera families were published, including Bomblyiidae (Chursina & Ruchin, 2018a), Syrphidae (Chursina & Ruchin, 2018b), Asilidae (Astakhov et al., 2019), Limoniidae, Pediciidae, and Tipulidae (Pilipenko et al., 2020). The purpose of the current study was to analyse the fauna of selected Diptera groups caught using beer traps.

## Material and Methods

### Study area

The Republic of Mordovia is located in the centre of the East European Plain between 53.633–55.183° N and 42.183–46.750° E in the southwest part of the River Volga basin in the interfluvium of the River Moksha and the River Sura. The study area is represented by forest and forest-steppe zones of Central Russia. Eastern Mordovia is located in the northwest periphery of the Volga Upland, while Western Mordovia in the Oka-Don Lowland. The landscape variability affects the diversity of habitats. Broad-leaved forests are located in the central and eastern part of the region, growing mainly in the floodplains of large rivers. In some parts of the region, broad-leaved forests of a secondary origin occur. Such forests have appeared on the former sites of old-growth deciduous forests that were cut down. In the northwest part of the Republic of Mordovia, large forests of old-growth coniferous and mixed forests are common. In the western part of the region, there is a large area of mixed and coniferous forests. The east and southeast of the area is predominated by a forest-steppe landscape (Ruchin & Egorov, 2017, 2018; Khapugin & Ruchin, 2019).

### Methods

The study was carried out during the whole season of 2019. Each trap was a five-liter plastic container with a window cut out on one side, at a distance of 10 cm from the bottom. With the help of a load, a rope with a tied trap was thrown on a tree branch at a height of 1.5–10 m from the ground surface. In each case, fermenting beer was used as bait, with an addition of honey, jam, or sugar. The description of traps and their application methods are given in Ruchin et al. (2020a).

All the material was collected by the fourth author who selected Diptera from all samples (Appendix). Then the first author sorted the material into several families for the purpose of identification by particular authors. The list of families identified by individual authors is as follows: The first author identified Anisopodidae (Söli & Rindal, 2014), Bibionidae (Krivoshchina, 1989), Clusiidae (Shtakeberg, 1989c), Megamerinidae (Shtakeberg, 1989a), Pallopteridae (Ozerov, 2009), Piophilidae (Shtakeberg, 1989b), and Platystomatidae (Hendel, 1913; Hennig, 1945; Rikhter, 1989), the second author Dryomyzidae (Ozerov, 1987), Lauxaniidae (Shatalkin, 2000), and Sciomyzidae (Rozkošný, 1987), and the third author Limoniidae (Oosterbroek, 2020). The species of Ulidiidae were identified by V. Korneyev (National

Academy of Sciences of Ukraine, Kiev) from the photos taken by L. Dvořák. We use the abbreviation RU-RUC for Central European Russia according to the Fauna Europaea portal (<https://fauna-eu.org>). In the section Results, the taxa are listed alphabetically after family names (i.e. not systematically).

Abbreviations and symbols used in the Material paragraph for every species: MSNR – Mordovia State Nature Reserve, ♂ – male, ♀ – female, L – low, H – high, T – *Tilia cordata* Mill., B – *Betula pendula* Roth, A – *Alnus glutinosa* (L.) Gaertn., Q – *Quercus robur* L., P – *Pinus sylvestris* L.).

## Results

During the survey, the material from 67 traps was studied. Altogether 1062 specimens belonging to 36 species of 12 Diptera families were identified (see below, the sub-section Faunistics).

### Faunistics

#### Family Anisopodidae

##### *Sylvicola cinctus* (Fabricius, 1787)

Material. Makarovka: 1 ♂, 6 ♀♀. Saransk: 1 ♀. MSNR 5: 1 ♂, 1 ♀. MSNR 24: 1 ♂. MSNR 28: 2 ♀♀. MSNR 30: 2 ♀♀. MSNR 31: 1 ♀. MSNR 32: 1 ♂, 1 ♀. MSNR 33: 1 ♂. MSNR 34: 1 ♀. MSNR 36: 1 ♂, 1 ♀. MSNR 37: 1 ♂♂, 16 ♀♀. MSNR 38: 1 ♀. MSNR 39: 1 ♂, 19 ♀♀. MSNR 40: 16 ♂♂, 29 ♀♀. MSNR 41, QL: 1 ♀. MSNR 41, AL: 2 ♀♀. MSNR 42, AH: 1 ♀. MSNR 42, QL: 2 ♀♀. MSNR 43: 4 ♂♂, 3 ♀♀. MSNR 45: 1 ♀. MSNR 47: 4 ♀♀. MSNR 50: 3 ♀♀. MSNR 51: 2 ♀♀. MSNR 52: 11 ♀♀.

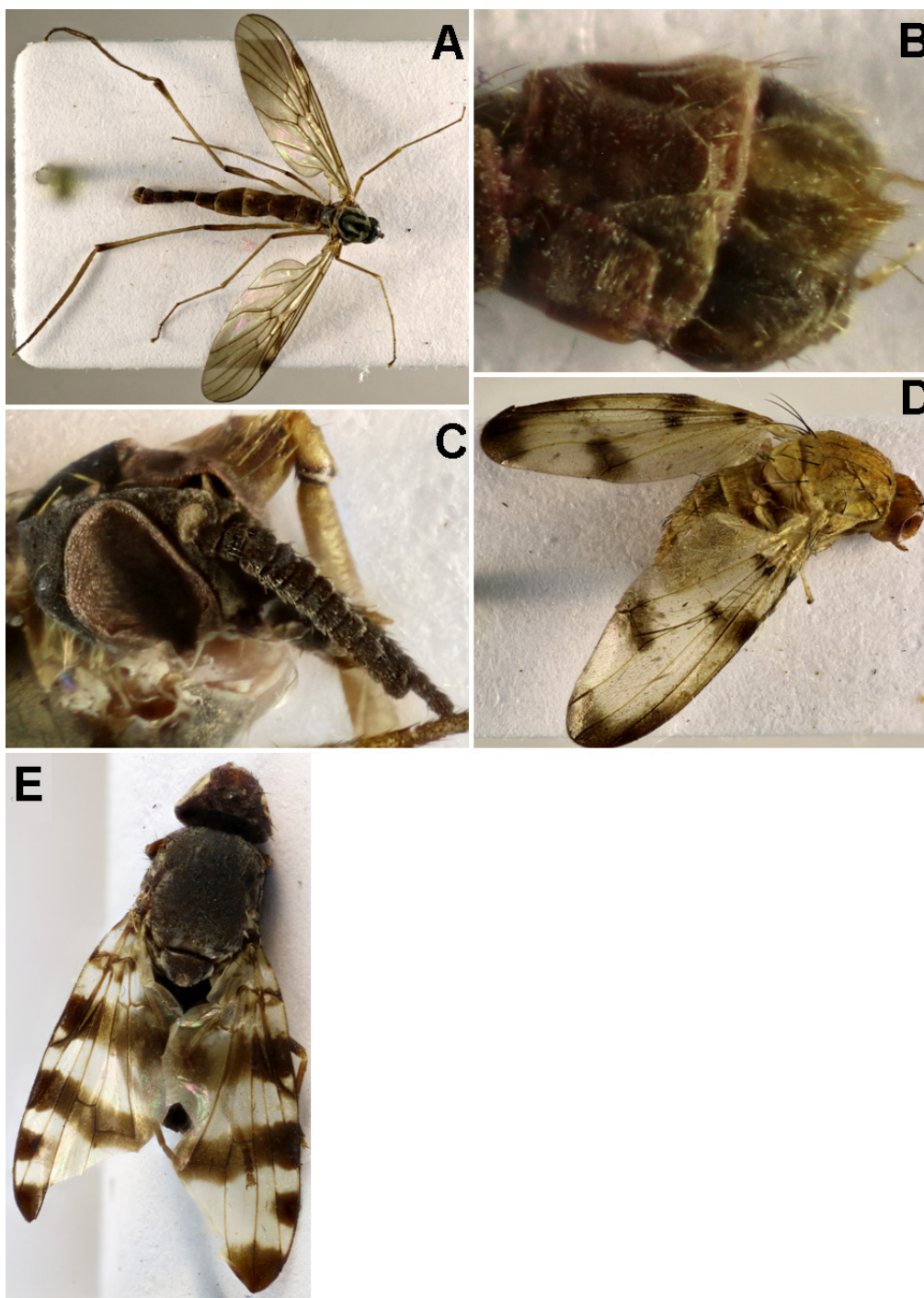
Comments. This is a common species with a large European distribution (Dvořák et al., 2019).

##### *Sylvicola fuscatoides* (Michelsen, 1999)

Material. Makarovka: 1 ♀. Saransk: 1 ♂. MSNR 1: 3 ♀♀. MSNR 2: 1 ♀. MSNR 3: 1 ♂, 2 ♀♀. MSNR 4: 1 ♂. MSNR 5: 7 ♂♂, 15 ♀♀. MSNR 6: 1 ♂, 4 ♀♀. MSNR 7: 1 ♀. MSNR 10: 11 ♀♀. MSNR 11: 1 ♀. MSNR 12: 1 ♀. MSNR 13: 1 ♂, 3 ♀♀. MSNR 14: 6 ♀♀. MSNR 16: 1 ♀. MSNR 17: 1 ♀. MSNR 18: 2 ♀♀. MSNR 19: 3 ♀♀. MSNR 20: 1 ♂, 6 ♀♀. MSNR 21: 3 ♀♀. MSNR 22: 1 ♂, 1 ♀. MSNR 24: 1 ♂, 4 ♀♀. MSNR 25: 2 ♂♂, 1 ♀. MSNR 26: 1 ♀. MSNR 27: 3 ♂♂, 3 ♀♀. MSNR 29: 1 ♀. MSNR 30: 2 ♂♂, 1 ♀. MSNR 31: 1 ♂, 6 ♀♀. MSNR 34: 1 ♂. MSNR 35: 2 ♀♀. MSNR 36: 1 ♀. MSNR 37: 1 ♂, 1 ♀. MSNR 38: 1 ♀. MSNR 40: 9 ♀♀. MSNR 41, PL: 6 ♀♀. MSNR 41, PH: 2 ♀♀. MSNR 41, AL: 1 ♀. MSNR 42, TL: 1 ♀. MSNR 45: 1 ♀. MSNR 47: 1 ♂, 1 ♀. MSNR 49: 1 ♂, 3 ♀♀. MSNR 50: 1 ♂. MSNR 51: 3 ♂♂, 6 ♀♀. MSNR 52: 2 ♂♂, 7 ♀♀.

Comments. The occurrence of this species was published by Andersson (1967) and Krivosheina & Menzel (1998) under the name *S. fuscatus* (Fabricius, 1775) on the basis of the material from Sweden and Asian Russia (Ussuri region). Michelsen (1999) stated that this name belongs to another species and described *S. fuscatooides* based on the diagnostic figures by Andersson (1967) and Krivosheina & Menzel (1998). After that, several records were published from Poland (Haenni, 2006), Estonia (Kurina, 2006), Finland (Haarto, 2011),

and Norway (Söli & Rindal, 2014). The species seems to be a typical eastern boreal species, confined to coniferous forests (Söli & Rindal, 2014). These are the first records from European Russia and the second record outside the boreal zone. The occurrence in the Republic of Mordovia is the southernmost record of this species (Fig. A,B,C). Hitherto, 67 specimens of *S. fuscatooides* were published from six regions worldwide. However, in this paper, in total 158 specimens are presented from the Republic of Mordovia (Table 1).



**Fig.** Diptera specimens caught in the Republic of Mordovia (Russia). Designations: A – *Sylvicola fuscatooides* male; B – *Sylvicola fuscatooides* male genitalia with one pointed lobe on hypoproct; C – *Sylvicola fuscatooides* female antenna with strongly widened basal flagellomeres; D – *Toxoneura basimaculata* male; E – *Pseudotephritis millepunctata* male (Photos: Ondřej Kouklík).

**Table 1.** Number of specimens of *Sylvicola fuscatooides* published from various regions worldwide, compared to the Republic of Mordovia

Region	Number of specimens	Source
Estonia	1	Kurina (2006)
Poland	2	Haenni (2006)
Finland	14	Haarto (2011)
Norway	34	Söli & Rindal (2014)
Sweden	2	Andersson (1967), Michelsen (1999)
Asian Russia	14	Krivosheina & Menzel (1998)
In total:	67	
Republic of Mordovia	158	This study

*Sylvicola punctatus* (Fabricius, 1787)

**Material.** Svinosovkhoz: 4 ♀♀. Makarovka: 7 ♂♂, 5 ♀♀. Saransk: 6 ♂♂, 6 ♀♀. MSNR 1: 3 ♂♂, 1 ♀. MSNR 2: 3 ♀♀. MSNR 3: 1 ♀. MSNR 4: 2 ♂♂, 1 ♀. MSNR 5: 9 ♂♂, 19 ♀♀. MSNR 6: 1 ♀. MSNR 12: 1 ♀. MSNR 14: 1 ♀. MSNR 21: 2 ♀♀. MSNR 22: 1 ♀. MSNR 24: 2 ♀♀. MSNR 25: 2 ♂♂, 1 ♀. MSNR 27: 2 ♂♂, 4 ♀♀. MSNR 30: 9 ♂♂. MSNR 31: 1 ♀. MSNR 33: 2 ♀♀. MSNR 34: 2 ♂♂, 2 ♀♀. MSNR 35: 2 ♂♂, 17 ♀♀. MSNR 36: 1 ♂, 1 ♀. MSNR 37: 1 ♂, 2 ♀♀. MSNR 38: 1 ♀. MSNR 39: 1 ♀. MSNR 40: 2 ♀♀. MSNR 41, PL: 1 ♀. MSNR 41, PH: 1 ♂, 1 ♀. MSNR 41, QL: 1 ♀. MSNR 41, QH: 1 ♀. MSNR 41, AH: 1 ♀. MSNR 41, AL: 4 ♀♀. MSNR 42, BH: 1 ♀. MSNR 43: 2 ♂♂. MSNR 44: 1 ♀. MSNR 47: 1 ♂, 4 ♀♀. MSNR 48: 1 ♂, 2 ♀♀. MSNR 49: 2 ♀♀. MSNR 50: 1 ♂, 2 ♀♀. MSNR 51: 5 ♂♂, 6 ♀♀. MSNR 52: 4 ♂♂, 5 ♀♀.

**Comments.** This is a common species, widely distributed across Europe (Dvořák et al., 2019).

*Sylvicola stackelbergi* Krivosheina & Menzel, 1998

**Material.** MSNR 4: 1 ♂, 1 ♀. MSNR 5: 1 ♂. MSNR 31: 1 ♂. MSNR 35: 1 ♀.

**Comments.** The main part of the species range is restricted to Northern and North-East Europe. Isolated records are known from the Netherlands (Beuk, 2002), Slovakia (Ševčík, 2011), Austria (Dvořák, 2014), Armenia (Oboňa et al., 2017), and Romania (Dvořák et al., 2019). In Russia, the species is known from St. Petersburg, Vuduyavr (Khibin Mts., Murmansk), Solovetsky Island, Yascera (near Luga, Leningrad region), and Nakhabino (Moscow region) (Krivosheina & Menzel, 1998). Except the high number of *S. fuscatooides* specimens caught during the present study, it is also interesting to compare the number of this species with other species of the genus *Sylvicola*, as shown in Table 2.

Family Bibionidae

*Bibio clavipes* Meigen, 1818

**Material.** MSNR 30: 1 ♂. MSNR 31: 1 ♀. MSNR 34: 9 ♂♂, 6 ♀♀. MSNR 35: 5 ♂♂, 2 ♀♀.

MSNR 36: 11 ♀♀. MSNR 38: 9 ♂♂, 4 ♀♀. MSNR 40: 1 ♂. MSNR 44: 1 ♂, 1 ♀. MSNR 48: 9 ♂♂. MSNR 49: 48 ♂♂, 9 ♀♀. MSNR 50: 2 ♂♂, 21 ♀♀. MSNR 51: 1 ♀. MSNR 52: 1 ♂.

**Comments.** This is a species with a wide European distribution. It has been already known from the Republic of Mordovia (Feoktistov, 2011).

Family Clusiidae

*Clusia tigrina* (Fallén, 1820)

**Material.** MSNR 29: 1 ♂.

**Comments.** This is a species with a wide European distribution, except for the southernmost and easternmost parts. It is also known from RU-RUC (Roháček & Merz, 2013).

Family Dryomyzidae

*Dryomyza anilis* Fallén, 1820

**Material.** Saransk: 2 ♀♀. MSNR 1: 8 ♂♂, 11 ♀♀. MSNR 2: 7 ♂♂, 18 ♀♀. MSNR 3: 1 ♂, 4 ♀♀. MSNR 5: 34 ♂♂, 14 ♀♀. MSNR 6: 4 ♂♂, 3 ♀♀. MSNR 13: 1 ♂, 2 ♀♀. MSNR 14: 1 ♀. MSNR 15: 1 ♀. MSNR 16: 1 ♂. MSNR 17: 1 ♀. MSNR 19: 1 ♂. MSNR 20: 1 ♂. MSNR 22: 1 ♂, 1 ♀. MSNR 26: 1 ♂. MSNR 31: 1 ♂, 5 ♀♀. MSNR 33: 1 ♂, 1 ♀. MSNR 34: 1 ♀. MSNR 37: 2 ♂♂. MSNR 39: 1 ♂, 1 ♀. MSNR 41, PL: 1 ♂, 2 ♀♀. MSNR 41, QL: 3 ♂♂, 7 ♀♀. MSNR 41, QH: 2 ♂♂. MSNR 41, AH: 1 ♂. MSNR 41, AL: 18 ♂♂, 1 ♀. MSNR 42, TL: 1 ♂. MSNR 42, AL: 6 ♂♂, 2 ♀♀. MSNR 42, QH: 1 ♂. MSNR 49: 1 ♂, 1 ♀. MSNR 56: 3 ♀♀.

**Comments.** This is a common and widely distributed species, known from Canada, USA, Europe, Korea, Japan, Russian Far East (Mathis & Sueyoshi, 2011), RU-RUC (Soós, 1984b).

**Table 2.** Number of caught specimens for selected *Sylvicola* species and their proportional representation

Species	Specimens	Percentage, %
<i>Sylvicola cinctus</i>	139	29.1
<i>Sylvicola fuscatooides</i>	158	33.1
<i>Sylvicola punctatus</i>	176	36.8
<i>Sylvicola stackelbergi</i>	5	1.0
All species together	478	100.0

*Dryope decrepita* (Zetterstedt, 1838)

Material. MSNR 43: 1 ♂.

Comments. This is a species known from several regions in Canada, USA, Asian Russia, and Europe, except for the southern parts. It is known also from European Russia (Mathis & Sueyoshi, 2011). In the Republic of Mordovia, it has been reported already by Plavilshchikov (1964).

## Family Lauxaniidae

*Aulogastromyia anisodactyla* (Loew, 1845)

Material. MSNR 52: 1 ♀.

Comments. This species is known from most of Europe, and also from RU-RUC (Merz, 2013).

*Calliopum simillimum* (Collin, 1933)

Material. MSNR 42, AL: 3 ♂♂.

Comments. This species is known from most of Europe, also from RU-RUC (Merz, 2013).

*Calliopum splendidum* Papp, 1978

Material. MSNR 43: 1 ♀.

Comments. This species is known from Western, Southern, and Central Europe and also from the Near East (Merz, 2013). The present record in the Republic of Mordovia is the first for Russia.

*Homoneura biumbrata* (Loew, 1847)

Material. MSNR 42, AL: 1 ♂.

Comments. This is a rare species known from western and middle parts of Europe (Merz, 2013). The present record in the Republic of Mordovia is the first for Russia.

*Meiosimyza decempunctata* (Fallén, 1820)

Material. Svinosovkhoz: 1 ♀. Kalinovka: 1 ♂. Makarovka: 1 ♀. Saransk: 1 ♂. MSNR 34: 1 ♀. MSNR 42, BH: 1 ♀.

Comments. This species is known from most of Europe, and also from RU-RUC (Merz, 2013).

*Meiosimyza rorida* (Fallén, 1820)

Material. MSNR 2: 1 ♀. MSNR 29: 1 ♀. MSNR 33: 1 ♂, 14 ♀♀. MSNR 37: 11 ♀♀. MSNR 38: 1 ♀. MSNR 39: 4 ♀♀. MSNR 41, QL: 1 ♀. MSNR 41, AH: 1 ♀. MSNR 41, AL: 1 ♂. MSNR 42, AL: 3 ♀♀. MSNR 48: 1 ♀. MSNR 49: 4 ♀♀. MSNR 52: 1 ♂, 8 ♀♀.

Comments. This species is known from most of Europe, the Near East, and North America, and also from RU-RUC (Merz, 2013).

*Meiosimyza subfasciata* (Zetterstedt, 1838)

Material. MSNR 26: 1 ♀. MSNR 39: 1 ♂. MSNR 42, QH: 1 ♂.

Comments. This species is known from Europe, except for the Iberian Peninsula, most of the Balkans, Eastern Europe, and also from the Near East. It is the first records for RU-RUC.

*Minettia lupulina* (Fabricius, 1787)

Material. MSNR 26: 2 ♀♀.

Comments. This species is known from most of Europe. It is the first record from RU-RUC.

*Minettia plumicornis* (Fallén, 1820)

Material. Saransk: 1 ♂.

Comments. This species is known from most of Europe, and also from RU-RUC (Merz, 2013).

*Pseudolyciella pallidiventris* (Fallén, 1820)

Material. Makarovka: 1 ♀. Saransk: 1 ♂, 2 ♀♀. MSNR 1: 1 ♂. MSNR 26: 1 ♀.

Comments. This species is known from most of Europe, and also from RU-RUC (Merz, 2013).

*Sapromyza schnabli* Papp, 1987

Material. MSNR 37: 1 ♀.

Comments. This is a poorly known European species, recorded only from some countries: Austria, Belarus, the Czech Republic, France, Hungary, Poland, Romania, Slovakia, and Switzerland. It is the first record for Russia.

## Family Limoniidae

*Achyrolimonia neonebulosa* (Alexander, 1924)

Material. MSNR 15: 1 ♂.

Comments. This is a common Holarctic species with a large distribution area (Asia, Europe, USA, Russia including RU-RUC (Tver region), North Caucasus, West Siberia (Altay), Russian Far East (Primorsky Krai, Sakhalin region) (Pilipenko et al., 2019; Oosterbroek, 2020).

*Discobola parvispinula* (Alexander, 1947)

Material. MSNR 33: 1 ♂, 1 ♀. MSNR 41, QL: 1 ♀. MSNR 41, AH: 1 ex.

Comments. This is a Palaearctic species known from Europe, Japan, and Russia including RU-RUC, West Siberia (Altay), East Siberia (Krasnoyarsky Krai), and the Russian Far East (Amur region, Primorsky Krai, Sakhalin region, Kuril Islands) (Pilipenko et al., 2019; Oosterbroek, 2020).

*Limonia macrostigma* (Schummel, 1829)

Material. MSNR 33: 1 ♂.

Comments. This is a Palearctic and Oriental species, common in Europe and Asia. In Russia, it is known from almost all parts including the Republic of Mordovia, West Siberia (Altay), Russian Far East (Primorsky Krai) (Pilipenko et al., 2019; Oosterbroek, 2020).

*Metalimnobia bifasciata* (Schrank, 1781)

Material. MSNR 7: 1 ♀. MSNR 9: 1 ♂. MSNR 13: 1 ♀. MSNR 22: 2 ♂♂. MSNR 31: 1 ♀. MSNR 42, QL: 1 ♂.

Comments. This is Palearctic and Oriental species, common in Europe and Asia. In Russia, it is known from almost all parts including the Republic of Mordovia, Siberia, Russian Far East (Kamchatka, Amur region, Primorsky Krai, Sakhalin region, Kuril Islands) (Pilipenko et al., 2019; Oosterbroek, 2020).

*Metalimnobia quadrimaculata* (Linnaeus, 1760)

Material. MSNR 3: 1 ♀. MSNR 4: 2 ♀♀. MSNR 6: 1 ♂, 4 ♀♀. MSNR 7: 2 ♂♂, 3 ♀♀. MSNR 8: 4 ♂♂, 2 ♀♀. MSNR 9: 2 ♀♀. MSNR 13: 3 ♂♂. MSNR 17: 1 ♀. MSNR 20: 7 ♂♂, 5 ♀♀. MSNR 22: 1 ♂. MSNR 23: 2 ♂♂. MSNR 33: 1 ♀. MSNR 38: 3 ♂♂, 2 ♀♀. MSNR 41, PL: 2 ♂♂, 5 ♀♀. MSNR 41, PH: 1 ♀. MSNR 41, QL: 5 ♂♂, 7 ♀♀. MSNR 41, QH: 1 ♂, 1 ♀. MSNR 41, AH: 2 ♂♂, 2 ♀♀. MSNR 41, AL: 22 ♂♂. MSNR 42, TL: 2 ♂♂, 1 ♀. MSNR 42, BH: 1 ♀. MSNR 42, BL: 2 ♂♂. MSNR 42, AH: 2 ♂♂. MSNR 42, AL: 9 ♂♂, 8 ♀♀. MSNR 42, QL: 4 ♂♂, 10 ♀♀. MSNR 42, QH: 1 ♂, 1 ♀. MSNR 52: 1 ♂.

Comments. This is a Holarctic species, common in Europe, Asia and the USA. In Russia, it is known from almost all parts including the Republic of Mordovia, Siberia, the Russian Far East (Kamchatka, Amur region, Primorsky Krai, Sakhalin region, Kuril Islands) (Pilipenko et al., 2019; Oosterbroek, 2020).

## Family Megamerinidae

*Megamerina dolium* (Fabricius, 1805)

Material. MSNR 4: 1 ♀.

Comments. This is a widely distributed European species, known also from RU-RUC (Nartshuk, 1984).

## Family Pallopteridae

*Paloptera ustulata* Fallén, 1820

Material. MSNR 52: 1 ♀.

Comments. This species is known from Europe, Primorsky Krai, and Kazakhstan, and also

from RU-RUC (Ozerov, 2009). Recently, it was newly reported from Turkey (Yaran, 2019).

*Toxoneura basimaculata* (Czerny, 1934)

Material. MSNR 5: 1 ♂. MSNR 50: 1 ♀.

Comments. So far this rarely collected species was known from Austria, Croatia, the Czech Republic, Germany, Hungary, Italy, Kazakhstan, Poland, and Russia (Yaroslavl region, Samara region, Republic of Dagestan) (Ozerov, 2009; Merz, 2013). The newest records were published from Slovakia (Dvořák, 2012) and Turkey (Yaran, 2019). Only its record in the Samarskaya Luka National Park (Rosenberg, 2007) is relatively close to the Republic of Mordovia. It is the first records from RU-RUC (Fig. D).

*Toxoneura usta* (Meigen, 1830)

Material. MSNR 41, PL: 1 ♀. MSNR 41, PH: 1 ♀. MSNR 50: 1 ♀.

Comments. This species is known from Europe including European Russia, and also from the Republic of Altai and Primorsky Krai (Ozerov, 2009). The records in the Republic of Mordovia are the first for RU-RUC.

## Family Piophilidae

*Mycetaulus bipunctatus* (Fallén, 1823)

Material. MSNR 25: 5 ♂♂, 1 ♀. MSNR 26: 1 ♀.

Comments. This species has a wide distribution, including Europe (the Czech Republic, Great Britain, France (mainland), Finland, Germany, the Netherlands, Poland, Slovakia, Sweden, Switzerland (Ozerov, 2013)), Russia (European Russia; Caucasus; Russian Far East) (Ozerov, 1999), Crimea (mainland) (Bukowski, 1940; Misiachna & Korneyev, 2015), Asia (Kyrgyzstan (Ozerov, 1999)).

## Family Platystomatidae

*Platystoma lugubre* (Robineau-Desvoidy, 1830)

Material. MSNR 4: 4 ♀♀. MSNR 5: 2 ♀♀. MSNR 7: 1 ♀. MSNR 42, BL: 2 ♂♂. MSNR 42, QL: 1 ♀.

Comments. This species is known from the temperate and southern parts of Europe, Caucasus, and Turkey (Soós, 1984a), and also from RU-RUC (Lyubvina, 2016).

## Family Sciomyzidae

*Euthycera chaerophylli* (Fabricius, 1798)

Material. MSNR 21: 1 ♀. MSNR 22: 1 ♀.

Comments. This is a common species, known from almost the whole of Europe, Turkey, and also from RU-RUC (Rozkošný, 2013).

*Tetanocera elata* (Fabricius, 1781)

Material. MSNR 5: 1 ♀.

Comments. This is a widely distributed Palearctic species, known also from RU-RUC (Rozkošný, 2013).

*Tetanocera ferruginea* Fallén, 1820

Material. MSNR 1: 1 ♂.

Comments. This is a widely distributed Holarctic species, known also from RU-RUC (Rozkošný, 2013).

*Tetanocera freyi* Stackelberg, 1963

Material. MSNR 2: 1 ♂.

Comments. This is a species of Western and Northern Europe, known from France to North European Russia and also from North America (Rozkošný, 2013). It is the first record for RU-RUC.

## Family Ulidiidae

*Myennis sibirica* Portschinsky 1892

Material. MSNR 2: 1 ♀. MSNR 4: 1 ♀.

Comments. This species is known from the southern part of the Russian Far East (Krivoshchina & Krivosheina, 1997; Kameneva & Korneyev, 2006), Korea (Han, 2013), and from Ukraine (Kameneva et al., 2013). The records in the Republic of Mordovia are the first for European Russia.

*Pseudotephritis millepunctata* (Hennig, 1939)

Material. MSNR 1: 1 ♂. MSNR 3: 1 ♂.

Comments. The presented records are reported also in Ruchin et al. (2020b). Our material covers in total ten localities of this species (35 specimens) in the Republic of Mordovia (Ruchin et al., 2020b) (Fig. E).

**Dominancy and frequency occurrence**

The most abundant species were *Dryomyza anilis* (181 specimens), *Sylvicola punctatus* (176 specimens), *S. fuscatoides* (158 specimens), *Bibio clavipes* (141 specimens), *Sylvicola cinctus* (139 specimens), and *Metalimnobia quadrimaculata* (136 specimens). Almost the same species were the most frequent in the traps: *Sylvicola fuscatoides* (44 samples), *S. punctatus* (41 samples), *Dryomyza anilis* (30 samples), *Metalimnobia quadrimaculata* (27 samples), and *Sylvicola cinctus* (25 samples).

The traps with the highest numbers of captured Diptera specimens were MSNR 5 (105 specimens), MSNR 49 (69 specimens), MSNR

40 (57 specimens), MSNR 41, AL (49 specimens), and MSNR 52 (45 specimens). The highest species diversity was documented from the following traps: MSNR 52 (nine species), MSNR 5 (eight species), Saransk, MSNR 1, MSNR 4, MSNR 31, and MSNR 33 (each with seven species).

**Affinity to forest types**

For the comparison of the frequency occurrence of the caught species, all localities were divided into established in deciduous forest (22 localities), mixed forest (27 localities), and pine (*Pinus sylvestris* L.) forest (14 localities). Of 36 species identified during the survey, 27 species were trapped in deciduous forest, 24 species in mixed forest, and only 13 species in pine forest. Noteworthy, the species *Dryope decrepita* and *Calliopum splendidum* were trapped only in pine forest.

For a more precise evaluation of affinity to selected forest types, we suggest the following 13 most common (most frequently occurred) species: *Sylvicola cinctus*, *S. fuscatoides*, *S. punctatus*, *S. stackelbergi*, *Bibio clavipes*, *Dryomyza anilis*, *Meiosimyza decempunctata*, *M. rorida*, *M. subfasciata*, *Pseudolyciella pallidiventris*, *Metalimnobia bifasciata*, *M. quadrimaculata*, and *Platystoma lugubre*. The following three aspects were chosen for the comments.

– Percentage of localities in each forest type, where the species was found. Almost all species were found to be the rarest in the mixed forests. Three common *Sylvicola* species (*S. cinctus*, *S. fuscatoides*, *S. punctatus*) occupied considerably more localities in deciduous and pine forests than in mixed forests. *Bibio clavipes* was trapped noticeably most often in pine forest, while *Dryomyza anilis* and *Metalimnobia quadrimaculata* in deciduous forest. Interesting is the trapping of *Meiosimyza subfasciata* in mixed forest, while it was absent in both other forest types. Evaluating of all 13 species shows that nine of them have the highest average abundance in deciduous forests, two of them in pine forests, and two of them in mixed forests.

– In each forest type, the average abundance of species counted as the sum of specimens in the forest type divided by the number of localities in this forest type. Three common *Sylvicola* species (*S. cinctus*, *S. fuscatoides*, *S. punctatus*) were more abundant in deciduous and pine forests compared to mixed forests. *Bibio clavi-*

*pes* was most abundant in pine forests, while *Dryomyza anilis* in deciduous forests. *Metalimnobia quadrimaculata* was abundant in deciduous forests, less abundant in mixed forests, and non-abundant in pine forests. The evaluation of seven species (as the differences in the other six were minimal) shows that five of them have the highest average abundance in deciduous forests, two of them in pine forests, and none of them in mixed forests.

– Maximum abundance of specimens in one trap. The analysis shows almost the same results as in the previous paragraphs. *Sylvicola* spp. had the highest abundance values in deciduous and in pine forests, *Bibio clavipes* in pine forests, *Dryomyza anilis* in deciduous forests, and *Metalimnobia quadrimaculata* in deciduous forests and slightly lower in mixed forests. *Meiosimyza rorida* has a higher abundance in mixed forests and slightly lower abundance in deciduous forests compared to pine forests. The evaluation of 11 species (as the differences in the other two were minimal) shows that seven of them have the highest abundance in deciduous forests, two of them in pine forests, and two in mixed forests.

### Discussion

Concurrently with advancing research in the fields of ecology and nature conservation, taxonomists have acquired a considerable amount of knowledge in species diversity. The availability of this scientific knowledge varies greatly over space, time, taxa, and type of information, creating gaps in biodiversity information (Amano et al., 2016). Particularly Diptera are often exemplary in this respect. The knowledge of the biodiversity is crucial from the conservation point of view. Collecting in the Republic of Mordovia was designed to reduce the gap in the knowledge of Diptera and other invertebrates. Very popular, efficient, cheap and simple passive methods of insect sampling are bait traps (e.g., Manko et al., 2019; Dvořák et al. 2019). Beer (with various additions and modifications) is very commonly used as bait, attracting especially Diptera, Mecoptera and other insect groups (e.g., Dvořák et al., 2017; Oboňa et al., 2017). This method is very attractive because it can be also used for monitoring of the occurrence and distribution of pests or parasites; furthermore it is able to capture rare and little-known species (e.g., like in the pres-

ent study). A thorough knowledge of biodiversity is a suitable pillar for further special and applied research.

By analysing the results of dominance, frequency, and affinity to forest types we can assume that *Sylvicola fuscatoides*, *S. punctatus*, and *S. stackelbergi* had the optimum in deciduous forests with the respect to all three above mentioned parameters, and *Sylvicola cinctus* in pine forests. All four Anisopodidae species had the lowest abundance in mixed forests. *Bibio clavipes* was the most frequent and abundant in pine forests, less abundant in mixed forests, and least abundant in deciduous forests. Completely other abundance values were found for *Dryomyza anilis*, which was abundant in deciduous forests, and less abundant in mixed and pine forests. No considerable differences were found for Lauxaniidae species, but members of this family occurred less frequently in pine forests. Data for *Metalimnobia bifasciata* did not show any remarkable results, while *Metalimnobia quadrimaculata* had preferences similar to those for *Dryomyza anilis*, being abundant in deciduous forests and less abundant in mixed and pine forests. *Platystoma lugubre* occurred almost evenly everywhere. But it seems that it slightly prefers deciduous forests. No species of the families Pallopteridae and Sciomyzidae were found in pine forests. All Ulidiidae species were found only in deciduous forests.

The obtained results show that the deciduous forests are the most diverse in terms of Diptera species. The results obtained in mixed forests were similar to deciduous forest. But this forest type is not so diverse in terms of species. In the pine forests, the species composition was the least diverse, some species are missing or less abundant compared to deciduous and mixed forests.

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**Appendix.** Characteristics of study sites in the Republic of Mordovia.

Study site	District/Quarter	Co-ordinates	Date(s)	Habitat
Localities outside the Mordovia State Nature Reserve				
Svinosovkhoz	Dubenki	54.419972° N, 46.201500° E	26.07–04.08.2019	mixed forest
Kalinovka	Chamzinka	54.401167° N, 45.903111° E	26.07–04.08.2019	deciduous forest
Makarovka	Oktyabrskiy	54.176778° N, 45.273833° E	27.07–05.08.2019	deciduous forest
Saransk	Saransk	54.176722° N, 45.265333° E	05–23.08.2019	deciduous forest
Localities in Temnikov district, Mordovia State Nature Reserve (= MSNR)				
MSNR 1	quarter 448	54.708750° N, 43.196250° E	01–21.08.2019	deciduous forest
MSNR 2	quarter 435	54.727639° N, 43.134139° E	03–22.08.2019	deciduous forest
MSNR 3	quarter 446	54.718583° N, 43.220639° E	02–19.08.2019	deciduous forest
MSNR 4	quarter 436	54.727889° N, 43.149250° E	02–20.08.2019	deciduous forest
MSNR 5	quarter 299	54.798306° N, 43.146194° E	01–21.08.2019	deciduous forest
MSNR 6	quarter 390	54.769500° N, 43.303917° E	05–17.08.2019	mixed forest
MSNR 7	quarter 405	54.751972° N, 43.146583° E	27.08–04.09.2019	pine forest
MSNR 8	quarter 381	54.760694° N, 43.170167° E	27.08–04.09.2019	mixed forest
MSNR 9	quarter 422	54.730222° N, 43.129222° E	28.08–04.09.2019	floodplain forest
MSNR 10	quarter 365	54.770778° N, 43.304472° E	05–17.08.2019	mixed forest
MSNR 11	quarter 401	54.744722° N, 43.086417° E	28.08–04.09.2019	floodplain forest, river bank
MSNR 12	quarter 338	54.780278° N, 43.319833° E	05–17.08.2019	mixed forest
MSNR 13	quarter 421	54.731583° N, 43.119667° E	28.08–04.09.2019	floodplain forest
MSNR 14	quarter 414	54.756389° N, 43.285778° E	05–17.08.2019	pine forest
MSNR 15	quarter 442	54.731472° N, 43.260139° E	27.08–05.09.2019	mixed forest
MSNR 16	quarter 402	54.733167° N, 43.106139° E	28.08–04.09.2019	floodplain meadow
MSNR 17	quarter 402	54.737083° N, 43.093417° E	28.08–04.09.2019	floodplain forest, forest glade
MSNR 18	quarter 402	54.741944° N, 43.093667° E	28.08–04.09.2019	floodplain forest, lake shore
MSNR 19	quarter 389	54.768000° N, 43.301944° E	05–17.08.2019	pine forest
MSNR 20	quarter 403	54.744944° N, 43.118889° E	27.08–04.09.2019	floodplain forest
MSNR 21	quarter 421	54.731000° N, 43.115000° E	28.08–04.09.2019	floodplain meadow
MSNR 22	quarter 430	54.737444° N, 43.266611° E	27.08–05.09.2019	mixed forest
MSNR 23	quarter 429	54.735694° N, 43.264278° E	27.08–05.09.2019	mixed forest
MSNR 24	quarter 413	54.755083° N, 43.283167° E	05–17.08.2019	pine forest
MSNR 25	quarter 431	54.746778° N, 43.274000° E	27.08–05.09.2019	mixed forest
MSNR 26	quarter 412	54.750333° N, 43.273000° E	27.08–05.09.2019	mixed forest
MSNR 27	quarter 409	54.745528° N, 43.216278° E	19.09–02.10.2019	mixed forest
MSNR 28	quarter 440	54.723333° N, 43.225806° E	19.09–02.10.2019	mixed forest
MSNR 29	quarter 437	54.733278° N, 43.174056° E	04–16.10.2019	mixed forest
MSNR 30	quarter 360	54.771861° N, 43.226444° E	19.09–02.10.2019	mixed forest
MSNR 31	quarter 361	54.773361° N, 43.241917° E	19.09–02.10.2019	mixed forest
MSNR 32	quarter 406	54.744167° N, 43.172611° E	04–16.10.2019	pine forest
MSNR 33	quarter 383	54.754361° N, 43.203167° E	19.09–02.10.2019	mixed forest
MSNR 34	quarter 306	54.794194° N, 43.248889° E	02–10.10.2019	pine forest
MSNR 35	quarter 384	54.758056° N, 43.215194° E	19.09–02.10.2019	mixed forest
MSNR 36	quarter 280	54.795722° N, 43.247750° E	02–10.10.2019	pine forest
MSNR 37	quarter 445	54.719639° N, 43.217750° E	04–16.10.2019	deciduous forest
MSNR 38	quarter 333	54.783389° N, 43.250083° E	02–10.10.2019	pine forest
MSNR 39	quarter 439	54.723944° N, 43.209417° E	04–16.10.2019	mixed forest
MSNR 40	quarter 383	54.763389° N, 43.187889° E	16–31.10.2019	pine forest
MSNR 41, PL	quarter 448	54.708750° N, 43.196250° E	21–27.08.2019	deciduous forest
MSNR 41, PH	quarter 448	54.708750° N, 43.196250° E	21–27.08.2019	deciduous forest
MSNR 41, QL	quarter 448	54.708750° N, 43.196250° E	21–27.08.2019	deciduous forest
MSNR 41, QH	quarter 448	54.708750° N, 43.196250° E	21–27.08.2019	deciduous forest
MSNR 41, AL	quarter 448	54.708750° N, 43.196250° E	21–27.08.2019	deciduous forest
MSNR 41, AH	quarter 448	54.708750° N, 43.196250° E	21–27.08.2019	deciduous forest
MSNR 42, TL	quarter 436	54.727889° N, 43.140917° E	21–27.08.2019	mixed forest
MSNR 42, TH	quarter 436	54.727889° N, 43.140917° E	21–27.08.2019	mixed forest
MSNR 42, BH	quarter 436	54.727889° N, 43.140917° E	21–27.08.2019	mixed forest
MSNR 42, BL	quarter 436	54.727889° N, 43.140917° E	21–27.08.2019	mixed forest
MSNR 42, AL	quarter 436	54.727889° N, 43.140917° E	21–27.08.2019	mixed forest
MSNR 42, AH	quarter 436	54.727889° N, 43.140917° E	21–27.08.2019	mixed forest
MSNR 42, QL	quarter 436	54.727889° N, 43.140917° E	21–27.08.2019	mixed forest
MSNR 42, QH	quarter 436	54.727889° N, 43.140917° E	21–27.08.2019	mixed forest
MSNR 43	quarter 330	54.777333° N, 43.184194° E	16–31.10.2019	pine forest
MSNR 44	quarter 281	54.796417° N, 43.252194° E	02–10.10.2019	raised bog
MSNR 45	quarter 358	54.770861° N, 43.186556° E	16–31.10.2019	young post-fire forest
MSNR 46	quarter 283	54.803972° N, 43.280667° E	02–10.10.2019	pine forest
MSNR 47	quarter 445	54.719556° N, 43.219167° E	04–16.10.2019	mixed forest
MSNR 48	quarter 307	54.796222° N, 43.266028° E	02–10.10.2019	pine forest
MSNR 49	quarter 305	54.786722° N, 43.249111° E	02–10.10.2019	pine forest
MSNR 50	quarter 334	54.779194° N, 43.250917° E	19.09–02.10.2019	mixed forest
MSNR 51	quarter 282	54.797222° N, 43.274694° E	02–10.10.2019	pine forest
MSNR 52	quarter 438	54.721667° N, 43.209917° E	04–16.10.2019	deciduous forest

Note: At the localities MSNR 41 and MSNR 42, the traps were hung on different trees at two heights, named as «low» (1.5 m) and «high» (5–7 m) on various tree species: *Tilia cordata* Mill., *Betula pendula* Roth, *Alnus glutinosa* (L.) Gaertn., *Quercus robur* L., *Pinus sylvestris* L. Abbreviations added to the locality name refer to tree species (T: *Tilia cordata*, B: *Betula pendula*, A: *Alnus glutinosa*, Q: *Quercus robur*, P: *Pinus sylvestris*) and height (H: high, L: low).

## НЕКОТОРЫЕ СЕМЕЙСТВА ДВУКРЫЛЫХ (DIPTERA), ПОЙМАННЫХ ПИВНЫМИ ЛОВУШКАМИ В РЕСПУБЛИКЕ МОРДОВИЯ (РОССИЯ)

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Мы исследовали фауну некоторых семейств двукрылых (Diptera), пойманных с помощью пивных ловушек. В данной статье представлены данные о 36 видах из 12 семейств двукрылых, в т.ч. четырех видах семейства Anisopodidae, одного – Bibionidae, одного – Clusiidae, двух – Dryomyzidae, одиннадцати – Lauxaniidae, пяти – Limoniidae, одного – Megamerinidae, трех – Pallopteridae, одного – Piophilidae, одного – Platystomatidae, четырех – Sciomyzidae и двух – Ulidiidae. Из них три вида явились новыми для фауны России (*Calliopum splendidum*, *Homoneura biumbrata*, *Sapromyza schnabli*, все относятся к семейству Lauxaniidae), два вида – для Европейской России (*Sylvicola fuscatoides* (Anisopodidae), *Myennis sibirica* (Ulidiidae)). Впервые для Республики Мордовия и Мордовского государственного заповедника приводятся семейства Anisopodidae, Clusiidae, Megamerinidae, Pallopteridae, Piophilidae, Platystomatidae, Ulidiidae, Lauxaniidae, обнаруженные в результате настоящего исследования. Два вида семейства Limoniidae (*Achyrolimonia neonebulosa* и *Discobola parvispinula*) и три вида семейства Sciomyzidae (*Euthycera chaerophylli*, *Tetanocera ferruginea* и *T. freyi*) впервые отмечены для территории Мордовского заповедника. Пивные ловушки рекомендуются как один из методов для дальнейших исследований Diptera на территории исследования.

**Ключевые слова:** Anisopodidae, Bibionidae, Clusiidae, Dryomyzidae, Limoniidae, биоразнообразие, ловушки с приманкой, Мордовский государственный заповедник, новые находки, фаунистическое исследование