THE FLIGHT PECULIARITIES OF HETEROPTERA (HEMIPTERA) TOWARDS TWO TYPES OF LIGHT TRAPS IN THE REPUBLIC OF MOLDOVA

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Abstract. The paper presents the results of studies on the attraction of Heteroptera towards two types of light traps – ultraviolet and white during 2012-2020. In total, more than 31,000 bugs were caught, belonging to 151 species from 15 families, of which three are prevalent– Corixidae, Miridae and Anthocoridae. The terrestrial heteroptera from the family Miridae and Lygaeidae were almost equally attracted by white and ultraviolet light – the ratio of caught bugs in traps was 1:1.2-1.6, respectively. On the other hand, aquatic (family Corixidae) and palustre (family Saldidae) heteroptera in 2.4-2.6 prevail in the trap with ultraviolet light, compared with white, and predatory heteroptera from family Anthocoridae were more numerous (2.4 times) in traps with white light. Twenty-one species present in all years of investigations make up 13.9 % of the list of species recorded and the majority (93.8 %) of the total captured specimens. Thirty-nine species of heteroptera were attracted exclusively by ultraviolet light, and only 15 species flew in white light, both groups accumulating only 1-7 specimens during the entire research period.

Keywords: Heteroptera, light trap with white and ultraviolet light, Republic of Moldova.

Rezumat. Particularitățile de zbor ale heteropterelor (Hemiptera) către două tipuri de capcane cu lumină în Republica Moldova. Lucrarea prezintă rezultatele studiului privind atracția heteropterelor către două tipuri de capcane cu lumină – ultravioletă și albă în perioada 2012-2020. În total, au fost capturate peste 31.000 de ploșnițe, aparținând la 151 de specii din 15 familii, dintre care numeric dominau trei – Corixidae, Miridae și Anthocoridae. Heteropterele terestre din familia Miridae și Lygaeidae au fost aproape la fel de atrase de lumina albă și ultravioletă – raportul dintre ploșnițe prinse la capcane a fost de 1:1,2-1,6, respectiv. Pe de altă parte, heteropterele acvatice (familia Corixidae) și palustre (familia Saldidae) de 2.4-2.6 ori predomină numeric în capcana cu lumină ultravioletă, comparativ cu cea albă, iar heteropterele prădătoare din familia Anthocoridae au fost mai numeroase (de 2,4 ori) în capcana cu lumină albă. Douăzeci și una specii prezente în toți anii de investigații alcătuiesc 13,9 % din lista speciilor înregistrate și majoritatea (93,8 %) din totalul specimenilor capturați. Exclusiv de lumina ultravioletă au fost atrase 39 specii de heteroptere, iar numai la lumina albă au zburat 15 specii, ambele grupe acumulând doar 1-7 specimeni în toată perioada cercetărilor.

Cuvinte cheie: Heteroptera, capcană cu lumină albă și ultravioletă, Republica Moldova.

INTRODUCTION

The majority of insects and other invertebrates are most sensitive and responsive to the short wavelength end of the light spectrum. There are a huge number of scientific papers in the world devoted to various aspects that affect the attraction of insects to night light sources: from temperature and humidity of air, wind, street lighting of cities, the lunar cycle and light, and many others. (NOWINSZKY, 2004; BRUCE-WHITE & SHARDLOW, 2011).

The arrival of heteroptera to artificial light sources is also well studied, both in Europe and in the whole world. However, special mention should be made of many years of research by English and German scientists. (SOUTHWOOD et al., 2003; GÖLLNER-SCHEIDING, 1989; SCHCHÖNEFELD, 1989).

Earlier, we also devoted some part of our research to this issue, which covered almost the entire territory of the Republic of Moldova, and the volume of material amounted to almost 300,000 bugs caught on traps with ultraviolet light in 5 settlements over 4 years (DERJANSCHI, 2008). However, both in ours and in the studies of other entomologists, light sources were used of the same type: either ultraviolet or white. The work of FROST (1954), in which two light sources (black and white) were used simultaneously to capture insects, served as a stimulus for our researchers.

The aim of this study was to reveal some patterns of attraction of heteroptera to traps with two light sources (ultraviolet and white) operating simultaneously.

MATERIAL AND METHODS

The research was carried out in the northwestern part of the Republic of Moldova at the Scientific Station of the Institute of Zoology in Brînzeni commune, Edineț district (48°04′38′′N, 27°10′51′′E) (Fig. 1).

The territory surrounding the traps is composed of limestones, reef limestones and clays of the Volynian substage of the Sarmatian stage of the Miocene. It includes adjacent clear oak forests of English oak (*Quercus robur* L.), areas of the Balti steppes with clusters of bushes and rocks, as well as wetland areas of the Rakovats and Dragishte rivers (ANDREEV et al., 2012).

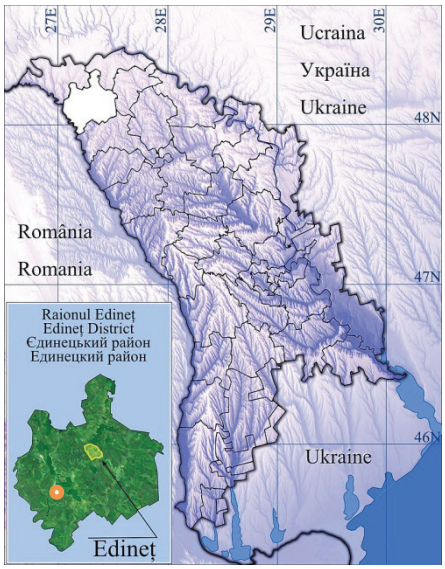

Figure 1. The location of the Scientific Station of the Institute of Zoology in Brînzeni commune (), Edineț district.

The insects were collected from May to October during the years 2012-2020 (the entomological material is missing in 2015 for technical reasons) in two traps: with white and ultraviolet light, which worked simultaneously and were placed 10 meters apart. In the light traps produced by the Institute of Genetics, Physiology and Plant Protection as a light source the lamps with 380-780 nm (white) and 320-400 nm (ultraviolet) wavelengths were installed.

The light trap used in the present investigation was made at a height of 1.5 metres and is placed in a margin of the field of scientific station of Institute of Zoology. The entire catch of the night was then extracted out in the morning. The traps were connected at intervals of 3-4 days, so that during the season they worked an average of 30 nights.

RESULTS AND DISCUSSIONS

Following the research for 8 years (2012-2020) 34,014 heteroptera of 151 species were captured, which are part of 15 taxonomic families. According to the number of collected specimens, 3 families were dominant: Corixidae – 19815 specimens, Miridae – 10530 and Anthocoridae – 1796 specimens. At the same time, 7 families (Notonectidae, Gerridae, Tingidae, Reduviidae, Pyrrhocoridae, Acanthosomatidae and Pentatomidae) were presented by a single species (Table 1.).

Table 1. The families of Heteroptera (Hemiptera) collected in the trap with white and ultraviolet light in Brînzeni village, Edineț district (2012-2020).

The Families	Total specimens	
	White	Ultraviolet
Corixidae (13 species)	5512	14303
Miridae (88 species)	4810	5720
Saldidae (4 species)	234	553
Lygaeidae (19 species)	355	548
Nabidae (3 species)	60	72
Stenocephalidae (3 species)	10	14
Rhopalidae (4 species)	4	10
Other 7 families (Notonectidae, Gerridae, Tingidae, Reduviidae, Pyrrhocoridae, Acanthosomatidae, Pentatomidae) present with one species	5	8
Total: 151 species and 34,014 speciemens	12257	21757

In this context, the analysis of the list of heteropteran species attracted to white and ultraviolet light sources shows that 40 species from 9 families were captured in number by a single specimen. This allows us to consider it as an accidental phenomenon.

At the same time, it was found that there are some species representing 63-98 % of the total number of specimens from the dominant families. Thus, the number of captured specimens of the species *Amphiareus obscuriceps* (Poppius, 1909) from the Anthocoridae family constitutes 98.0 % of the total of family, and the species *Sigara lateralis* (Leach, 1817) from the Corixidae family reaches 72.0 %, as mentioned above. In the Miridae family, three species – *Adelphocoris lineolatus* (Goeze, 1778); *Lygus rugulipennis* Poppius, 1911; *Trigonotylus caelestialium* (Kirkaldy, 1902) make up 63.0 % of the number of collected mirids.

It was established that the faunal nucleus of the registered heteropterans consists of 21 species from 6 families, which were present in the collections from the all years of investigations: Corixidae family – *Sigara iactans* Jansson,

1983; *Sigara lateralis* (Leach, 1817); *Sigara* (Linnaeus, 1758); Saldidae family – *Saldula pallipes* (Fabricius, 1794); Nabidae family – *Nabis punctatus* A.Costa, 1847; Anthocoridae family – *Amphiareus obscuriceps* (Poppius, 1909); Miridae family – *Adelphocoris lineolatus* (Goeze, 1778); *Campylomma verbasci* (Meyer-Dür, 1843); *Charagochilus gyllenhali* (Fallen, 1807); *Lygus gemellatus* (Herrich-Schäffer, 1835); *Lygus pratensis* (Linnaeus, 1758); *Lygus rugulipennis* Poppius, 1911; *Macrotylus horvathi* (Reuter, 1876); *Megalocoleus molliculus* (Fallen, 1807); *Orthops campestris* (Linnaeus, 1758); *Orthops kalmii* (Linnaeus, 1758); *Orthotylus flavosparsus* (Sahlberg, 1841); *Phytocoris insignis* Reuter, 1876; *Polymerus cognatus* (Fieber, 1858); *Trigonotylus caelestialium* (Kirkaldy, 1902) and Lygaeidae family – *Sphragisticus nebulosus* (Fallen, 1807). These species make up 13.9 % of the list of registered species and the majority (93.8 %) of the total specimens caught during the years 2012-2020.

The ultraviolet light is known to be used by terrestrial invertebrates in a variety of activities such as mate selection, navigation and foraging (SALCEDO et al., 2003). However, we found that the terrestrial heteroptera from the Miridae and Lygaeidae family were almost equally attracted by white and ultraviolet light – the ratio of caught bugs in traps was 1:1.2-1.6, respectively. On the other hand, aquatic (family Corixidae) and palustre (family Saldidae) heteroptera in 2.4-2.6 prevail in the trap with ultraviolet light, compared with white. And predatory heteroptera from family Anthocoridae were more numerous (2.4 times) in traps with white light.

Our research has shown that some species of heteroptera have preferences for a specific light source. Thus, 39 species of bedbugs from 11 families were attracted by ultraviolet light, accumulating only 1-7 specimens during the entire research period: Notonectidae family – *Notonecta glauca* Linnaeus, 1758; Corixidae family – *Hesperocorixa linnaei* (Fieb,1848), *Micronecta pusilla* (Horváth,1895); Gerridae family – *Gerris odontogaster* (Zetterstedt, 1828); Saldidae family – *Saldula saltatoria* (Linnaeus, 1758); Anthocoridae family – *Anthocoris confusus* Reuter, 1884; *Lyctocoris dimidiatus* (Spinola, 1837); *Orius majusculus* (Reuter, 1879); *Orius niger* (Wolff, 1811); *Temnostethus reduvinus* (Herrich-Schäffer, 1850); Miridae family – *Agnocoris rubicundus* (Fallen, 1807); *Alloeotomus ghoticus* (Fallen, 1807); *Calocoris affinis* (Herrich-Schäffer, 1835); *Compsidolon absinthii* (Scott, 1870); *Criocoris crassicornis* (Hahn, 1834); *Deraeocoris ruber* (Linnaeus, 1758); *Leptopterna albescens* (Reuter, 1891); *Liocoris tripustulatus* (Fabricius, 1781); *Malacocoris chlorizans* (Panzer, 1794); *Megaloceroea recticornis* (Geoffroy, 1785); *Orthotylus prasinus* (Fallen, 1826); *Phylus melanocephalus* (Linnaeus, 1767); *Phytocoris ulmi* (Linnaeus, 1758); *Placochilus seladonicus* (Fallen, 1807); *Polymerus holosericeus* Hahn, 1831; *Psallopsis neglecta* Konstantinov, 1997; *Stenotus binotatus* (Fabricius, 1794); *Stethoconus pyri* (Mella, 1869); *Trigonotylus brevipes* Jakovlev, 1880; *Trigonotylus pulchellus* (Hahn, 1834); Tingidae family – *Stephanitis pyri* (Fabricius, 1775); Lygaeidae family – *Peritrechus meridionalis* Puton, 1877; *Peritrechus nubilus* (Fallen, 1807); *Raglius alboacuminatus* (Goeze, 1778); Pyrrhocoridae family – *Pyrrhocoris apterus* (Linnaeus, 1758); Stenocephalidae family – *Dicranocephalus albipes* (Fabricius, 1781); *Dicranocephalus medius* (Mulsant & Rey, 1870) and Rhopalidae family – *Brachycarenus tigrinus* (Schilling, 1829).

Far fewer (a total of 15 species) were heteropterans, which were exclusively attracted to the white light source: Nabidae family – *Nabis ferus* (Linnaeus, 1758); Anthocoridae family – *Anthocoris gallarumulmi* (De Geer, 1773); Miridae family – *Adelphocoris ticinensis* (Meyer-Dür, 1843); *Chlamydatus pullus* (Reuter, 1870); *Hadrophyes sulphurella* Puton, 1874; *Lygocoris pabulinus* (Linnaeus, 1761); *Orthotylus interpositus* Schmidt, 1938; *Orthotylus marginalis* Reuter, 1883; *Orthotylus viridinervis* (Kirschbaum, 1856); *Plagiognathus bipunctatus* Reuter, 1883; *Salicarus roseri* (Herrich-Schäffer, 1838); Lygaeidae family – *Ortholomus punctipennis* (Herrich-Schäffer, 1838); *Scolopostethus decoratus* (Hahn, 1833); Rhopalidae family – *Rhopalus subrufus* (Gmelin, 1790) and Acanthosomatidae family – *Elasmostethus interstinctus* (Linnaeus, 1758).

The number of heteroptera species (151) collected in the light trap in our research is commensurable with the results obtained by colleagues from some European countries. Thus, in Germany (Berlin) 144 species of heteroptera were collected for 6 years (131 terrestrial species and 13 – aquatic) (GÖLLNER-SCHEIDING, 1989; SCHCHÖNEFELD, 1989). In the United Kingdom at Rothamsted Experimental Station in the years 1933-2000 118 species of heteroptera were collected (SOUTHWOOD et al., 2003), and in Hungary, 95 species of heteroptera were recorded at the light trap in the apple orchard (MÉSZÁROS et al., 1984). Also, in the European part of Turkey (Edirne) 128 species of heteroptera were recorded in similar research (ÖNDER et al., 1984).

Comparing our results with data obtained by colleagues in the UK (SOUTHWOOD et al., 2003), which totaled 67 years of research into the light trap, we can find that of the most abundant (by total number of specimens) 30 species of terrestrial heteroptera 8 are also present in our list for the Republic of Moldova: *Lygus rugulipennis* Popp., *Adelphocoris lineolatus* Gz., *Orthops kalmii* L., *Orthotylus flavosparsus* Sahlb., *Trigonotylus ruficornis* Geoffr., *Phytocoris varipes* Boh., *Megalocoleus molliculus* Fall. and *Stenodema calcarata* Fall. It should be noted that these species belong to the family Miridae, and most of them are considered as pests of agricultural crops.

In addition to the above, it is worth mentioning that light traps have contributed to the enrichment of the faunal list of heteroptera with 15 new species for the Republic of Moldova (DERJANSCHI & CHIRIAC, 2020): Corixidae family – *Hesperocorixa sahlbergi* (Fieber, 1848); *Paracorixa kiritshenkoi* (Lundbland, 1933); *Sigara iactans* Jansson, 1983; Anthocoridae family – *Amphiareus obscuriceps* (Poppius, 1909); *Lyctocoris dimidiatus* (Spinola, 1837); Miridae family – *Alloeotomus ghoticus* (Fallen, 1807); *Hadrophyes sulfurella* Puton, 1874; *Macrotylus elevatus* (Fieber, 1858); *Orthotylus interpositus* Schmidt, 1938; *Orthotylus viridinervis* (Kirschbaum, 1856); *Pilophorus cinnamopterus* (Kirschbaum, 1856); *Psallopsis neglecta* Konstantinov, 1998; *Trigonotylus brevipes* Jakovlev, 1880; Lygaeidae family

– *Paraparomius leptopoides* (Baerensprung, 1859) and Stenocephalidae family – *Dicranocephalus medius* (Mulsant & Rey, 1870).

It was found that the male and female of trapped insects were observed to be more or less equal and the ratio was 1:1. At the same time, most females of the Corixidae family, caught in late summer and early autumn, had zygotes formed in the ovaries. This phenomenon has also been reported in the research of colleagues in Hungary (BODA & CASABAI, 2009).

CONCLUSIONS

In total, more than 31,000 bugs were caught, belonging to 151 species from 15 families, of which is numerically dominated by three – Corixidae, Miridae and Anthocoridae. The terrestrial heteroptera from the family Miridae and Lygaeidae were almost equally attracted by white and ultraviolet light – the ratio of caught bugs in traps was 1:1.2-1.6, respectively. On the other hand, aquatic (family Corixidae) and palustre (family Saldidae) heteroptera in 2.4-2.6 numerically predominate in the trap with ultraviolet light, compared with white, and predatory heteroptera from family Anthocoridae were more numerous (2.4 times) in traps with white light.

Twenty-one species present in all years of investigations make up 13.9 % of the list of recorded species and the majority (93.8 %) of the total specimens captured. Thirty-nine species of heteroptera were attracted exclusively by ultraviolet light, and only 15 species flew in white light, both groups accumulating only 1-7 specimens during the entire research period.

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