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AQUATIC HETEROPTERA OF GREAT RIVERS OF THE UKRAINIAN STEPPE ZONE AND SEASONAL CHANGES OF ABUNDANCE AND BIOMASS

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Aquatic Heteroptera of Great Rivers of the Ukrainian Steppe Zone and Seasonal Changes of Abundance and Biomass. Grandova, M. A. — Aquatic Heteroptera are one of the important components of water biocoenoses. During the study of the great rivers of the Ukrainian continental steppe zone 34 species were found, among them *Sigara mayri* (Fieber, 1860), a new species for Ukraine. *Cymatia bonsdorffii* (C. R. Sahlberg, 1819) and *Hydrometra stagnorum* (Linnaeus, 1758) are recorded in the Ukrainian continental steppe zone for the first time. During the whole year the aquatic Heteroptera taxocenoses of all the concerned objects create the indivisible complex, which basis is formed by inhabitants of inundated reservoirs. The highest abundance is observed in the reed bed lakes in the middle of July, after the hatching of the second generation nymphs of the polyvoltine species, the maximum of biomass is observed in October in the reed bed lakes, where Nepomorpha gather for overwintering.

K e y w o r d s: aquatic Heteroptera, great rivers, Ukrainian steppe zone, abundance, biomass.

Водные полужесткокрылые больших рек степной зоны Украины и сезонные изменения численности и биомассы. Грандова М. А. — Водные полужесткокрылые представляют собой один из важных компонентов водных биоценозов. В экосистемах больших рек степной зоны материковой Украины обнаружены 34 вида водных клопов, из них *Sigara mayri* (Fieber, 1860) указан впервые для Украины, а *Cymatia bonsdorffii* (C. R. Sahlberg, 1819) и *Hydrometra stagnorum* (Linnaeus, 1758) впервые указаны для степной зоны материковой Украины. Большую часть года таксоценозы водных клопов всех рассматриваемых объектов образуют единый комплекс, основу которого составляют обитатели пойменных водоёмов. Наибольшие значения численности наблюдали в плавнях в середине июля, после появления нимф второго поколения поливольтинных видов, наибольшие значения биомассы — в октябре в плавневых озёрах, где собираются на зимовку представители Nepomorpha.

К л ю ч е в ы е с л о в а: водные полужесткокрылые, большие реки, степная зона Украины, численность, биомасса.

Introduction

Aquatic Heteroptera (true water bugs) are one of the important components of aquatic biocoenoses. However, almost no special studies of specific distribution and seasonal changes of quantitative characteristics of water bugs in Ukrainian steppe zone were carried. There are some faunistic and ecological data in the works of V. Gramma and A. Shatrovsky (Gramma, 1987; Gramma, Shatrovsky, 1992) carried in Chernomorsky Nature Reserve. In our previous work (Grandova, Puchkov, 2012; Grandova, 2013) we discussed the changes of abundance and biomass and specific distribution of water bugs in the small intermitted rivers and associated water bodies. In the present work we examined great rivers of the steppe zone of Ukraine (the Danube, Dniester, Dnieper, and Southern Buh) and associated water bodies: flooded areas, the water meadows, wetlands and reed bed lakes, artificial canals, etc.

Material and methods

Our study was based on the author's own material collected in the course of expeditions (2007–2012), complemented by the collections of V. Dyadichko, A. Martynov and M. Son. Quantitative samples were taken

every two or three weeks with the Balfour-Browne hand net (Golub et al., 2012) or hydroenthomological drag (Patent…, 2007), and also using meiobenthic methods (Kurashov, 1994) for Micronectidae and nymphs of junior stages. Modified fish-traps and light traps were also used for general collecting. Species that overwinter on the shore were collected in the leaf litter and moldering wood. For further examination of quantitative samples, standard methods for macrozoobenthos and meiobenthos were used (Kurashov, 1994, Bubnova, Holicova, 1983). A total of about 10000 specimens of aquatic Hemiptera were studied. They were identified using the works of Kanyukova (2006), Savage (1989), Poisson (1957) and Wroblewski (1958). Classification follows Catalogue of the Heteroptera of the Palaearctic Region (1995) and N. Nieser (2002). The abundance and biomass of aquatic bugs from the quantitative samples were calculated per square meter.

For the study of quantitative characteristics, we used the material from the lower reaches of the Dniester and Turunchuk and associated water bodies in the Beljayivsky District of Odessa Region, some of the sampling stations were located on the territory of Nizhnednestrovsky National Park.

The following typical biotopes were studied:

The riverbed. The depth at the sampling stations is up to 1.5 m, in the middle of the river 6–10 m, the bottom is silty, the transparency during the warm period is less than 0.3–0.5 m, the current velocity is up to 0.5 m/s. The vegetation consists of marsh (*Carex* spp., *Typha* spp., *Phragmites* spp.) and submerged forms (*Ceratophyllum* spp., *Utricularia* spp., *Chara* spp., *Ranunculus* spp., filamentous algae).

Floodplain meadows flooded during spring and sometimes summer high waters. The vegetation mostly consists of land grasses and *Carex* spp., the bottom is somewhat silty, at the surface of the water there are a lot of plant remains. The depth is about 0.2–0.4 m, flowage and temperature depends on distance from riverbed, bottom relief and number of microphytes.

Inundated basins which remain after drying up flooded areas, often filled with the river water filtering through the soil. They vary by space (1–2 to several hundred m^2) and depth (0.05–1 m). The bottom is silty, in shadowy places often covered with leaf litter. Vegetation consists of *Equisetum* spp., *Carex* spp., Bryophyta gen. spp., filamentous algae, *Myrriophyllum* sp., *Ceratophyllum* sp., *Potamogeton* spp., *Iris* spp., *Typha* spp., *Phragmites* spp., *Alisma* sp. and *Sagittaria* spp. Bogs and puddles in the floodplain forests often shadowy, with low temperature of the water and acid pH (5–6) due to thick layer of leaf litter on the bottom. Most of them dry during low water period, but due to summer high waters many of them remain full all the year round.

Reed beds. Great surfaces overgrown by aquatic vegetation and covered by the water all year round. The depth is usually 0.5–1.5 m, the bottom is very silty, covered by plant remains. The vegetation mainly consists of *Phragmites* associations, but also *Typha* and *Carex* associations are present. Among the reed beds there are open areas without solid banks: reed bed lakes. Their area may be up to several hundred m^2, the water is clear; vegetation consists of associations of *Nuphar lutea*, *Nymphaea alba*, *Lemna* spp. and *Salvinia natans*. Reed bed lakes are the main habitats for water bugs of great rivers.

Results and discussion

In the ecosystems of steppe great rivers we have recorded 34 species of water bugs from 2 infraorders and 12 families (Nepomorpha: Corixidae (15 species), Nepidae (2 species); Notonectidae (2 species); Micronectidae, Naucoridae, Pleidae и Aphelocheiridae (1 species each), and Gerromorpha: Gerridae (6 species), Hydrometridae (2 species), Hebridae, Mesoveliidae, Vellidae (1 species each) (table 1). This is the majority (79 %) of the known fauna of aquatic Heteroptera for the steppe zone of Ukraine (Putshkov, Putshkov, 1996). *Sigara mayri* was found in Ukraine for the first time, and two new species (*Cymatia bonsdorffii* and *Hydrometra stagnorum*) were added to the faunistic checklist of the Ukrainian steppe zone. The greatest species diversity was recorded in the families Corixidae and Gerridae, which is generally usual for the Palearctic fauna of aquatic Heteroptera (Catalogue..., 1995).

In contrast with small rivers, the species compositions of the riverbeds and floodplain water bodies are considerably different. In the inundated pools and reed bed lakes the representatives of Corixidae dominated — *Hesperocorixa linnaei* (Fieber, 1848), *S. striata* (Linnaeus, 1758), *S. stagnalis* (Leach, 1817) and *S. lateralis* (Leach, 1817), one more dominant is *Plea minutissima* Leach, 1817. In the riverbeds the high current velocity and quite poor vegetation (except for *Phragmites* associations, which are suitable almost only for Nepidae) led to prevailing of Gerridae. Among them the dominant water bug is the great water strider *Aquarius paludum* (Fabricius, 1794), which is rare in other inundated water bodies. Among Corixidae only *S. striata* may reach considerable levels of abundance. Separately the benthic rheophilic species *Aphelocheirus aestivalis* (Fabricius, 1794), which inhabits stony areas of rivers with sufficiently high current velocity and was recorded only

T a b l e 1. Species diversity of aquatic bugs in the great rivers of the Ukrainian steppe zone

Т а б л и ц а 1. Разнообразие видов водных полужесткокрылых больших рек степной зоны Украины

Family	Species	Riverbed	Floodplain lakes and other inundated water bodies
Nepidae	*Nepa cinerea* Linnaeus, 1758	R	R
	Ranatra linearis (Linnaeus, 1758)	R	R
Micronectidae	*Micronecta pusilla* (Horvath, 1895)	R	R
Corixidae	*Cymatia coleoptrata* (Fabricius, 1777)	R	C
	C. bonsdorffii (C. R. Sahlberg, 1819)	–	R
	C. rogenhoferi (Fieber, 1864)	–	R
	Corixa affinis Leach, 1817	–	R
	C. panzeri Fieber, 1848	–	R
	C. punctata (Illiger, 1807)	–	R
	Hesperocorixa linnaei (Fieber, 1848)	C	D
	Paracorixa concinna (Fieber, 1848)	–	R
	Sigara assimilis (Fieber, 1848)	–	R
	S. iactans Jansson, 1983	–	C
	S. lateralis (Leach, 1817)	C	D
	S. mayri (Fieber, 1860)	–	R
	S. nigrolineata (Fieber, 1848)	–	R
	S. stagnalis (Leach, 1817)	C	D
	S. striata (Linnaeus, 1758)	D	D
Naucoridae	*Ilyocoris cimicoides* (Linnaeus, 1758)	C	C
Aphelocheiridae	*Aphelocheirus aestivalis* (Fabricius, 1794)	R	–
Notonectidae	*Notonecta glauca* Linnaeus, 1758	R	C
	N. viridis Delcourt, 1909	R	C
Pleidae	*Plea minutissima* Leach, 1817	C	D
Mesoveliidae	*Mesovelia furcata* Mulsant et Rey, 1852	C	C
Hebridae	*Hebrus pusillus* (Fallen, 1807)	–	R
Hydrometridae	*Hydrometra gracilenta* Horvath, 1899	R	R
	H. stagnorum (Linnaeus, 1758)	R	R
Veliidae	*Microvelia reticulata* (Burmeister, 1835)	C	C
Gerridae	*Aquarius paludum* (Fabricius, 1794)	D	R
	Gerris argentatus Schummel, 1832	C	C
	G. asper (Fieber, 1860)	R	R
	G. lacustris (Linnaeus, 1758)	R	–
	G. odontogaster (Zetterstedt, 1828)	C	R
	G. thoracicus Schummel, 1832	–	R

N o t e. D — dominant (frequency is more than 50 %); C — common species (frequency 10–50 %); R — rare species (frequency less than 10 %).

in the South Buh (collected by A. Martynov), is to be mentioned. Apparently, this species is absent in the other great rivers of the Ukrainian steppe zone.

The hydrological regime of the great rivers strongly differs from those of the small rivers and has several characteristic features. The seasonal water level fluctuations and related successional changes are more fluent. Summer floods usually occur in the majority of great rivers, which sets them apart small intermittent rivers. Periodization of Ukrainian steppe great rivers was proposed by V. Dyadichko (2009). He distinguished 5 periods. With some modifications this system can also be used for analysis of seasonal changes of species composition and quantitative characteristics of water bugs.

Early spring period (the middle of February — the middle of March) is characterized by little rising of water level in the river and appearance of many temporary water objects with melted and rain waters.

Spring period (the middle of March — the end of May) is characterized by high water levels, bank encroachment and active growth of water vegetation.

Summer period (June–September) is characterized by lowering of water levels and by drying up of the floods and many inundated water bodies (if the summer is hot and dry). In the high-water years in June–July the floods and inundated water bodies remain full, and the transition from the spring to summer period is smooth.

Autumn period (September–November) usually is characterized by low water level in the river, slow current in the riverbed and creeks, and termination of the growth of water plants. After rains in the middle of the autumn some dried inundated pools fill up again.

Winter period (the end of November — the end of February) is characterized by low or normal water levels in the river, in the cold years with ice coverage. In warm years the riverbed may remain without ice during the whole winter or freeze for a short time. Stagnant water bodies freeze almost every year.

The results of the study of quantitative characteristics of water bugs are shown in figure 1. Data on the abundance and biomass of Micronectidae species will be discussed separately.

During the winter period there are only sporadic water bugs in the samples, because most Nepomorpha overwinter at the adult stage, burying themselves in silt or retaining low levels of activity in the deep parts of water bodies. Gerromorpha overwinter on land in the leaf litter, and assessing their abundance seems impossible.

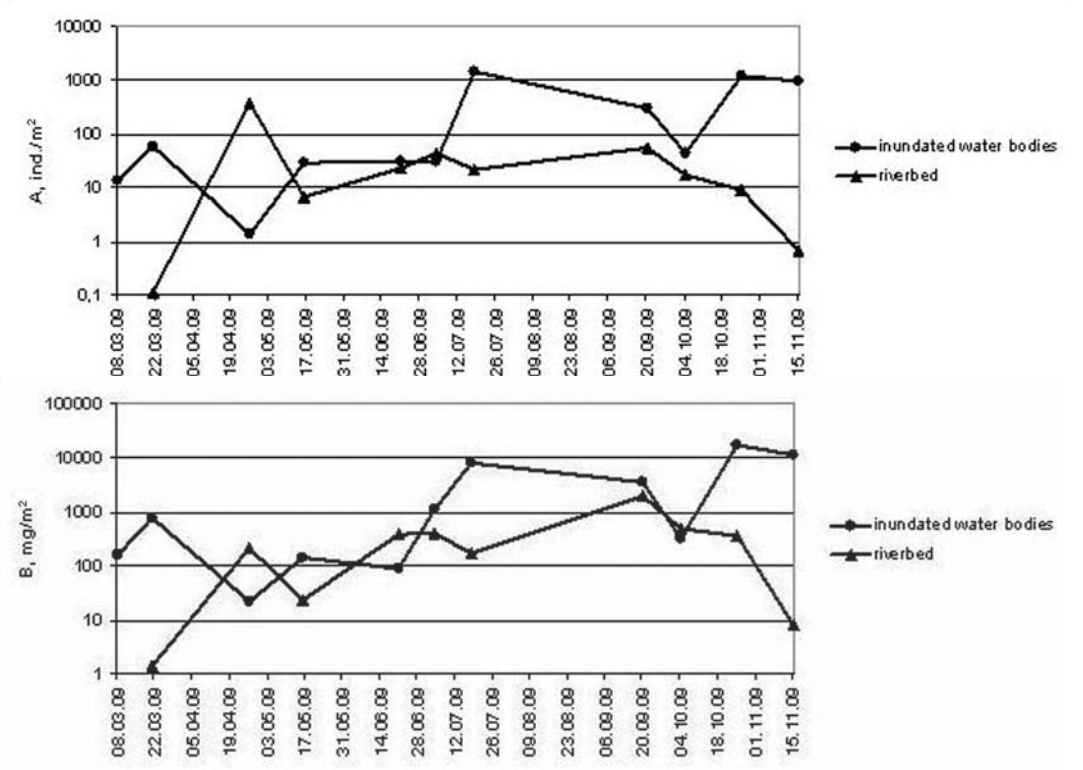

Fig. 1. Seasonal changes of abundance (A, ind./m^2) and biomass (B, mg/m^2) of water bugs in the Dniester and associated water bodies.

Рис. 1. Сезонные изменения численности (А, экз./м^2) и биомассы (В, мг/м^2) водных клопов Днестра и ассоциированных водных объектов.

During the early spring period the number of water bugs in all types of water object remains low, possibly due to low temperature and poor vegetation. During this period only 4 species were recorded in the quantitative samples (12 % from the total number of species found in the great rivers, hereinafter TNS). The highest species diversity was registered in the reed bed lakes and permanent inundated water bodies, where the water bugs overwinter and which get warmer faster than the riverbed. At the beginning of March 2009 the average abundance of water bugs in these habitats was 13.25 ind./m^2, average biomass — 160.5 mg/m^2. The main contribution to these values was made by Corixidae, among them the dominant was *S. striata* (12 ind./m^2). Other species were represented by single specimens. In the riverbed water bugs in quantitative samples were absent.

During the spring period water bugs actively migrate and inhabit most of the riverbed and floodplain water objects. This period is marked by a sharp rise of quantitative characteristics and maximum species diversity. During the spring period 29 species of aquatic Heteroptera were registered (88 % TNS). The highest number of species was recorded in floods and reed bed lakes, where many water bugs overwintered and where the higher temperature (in comparison with the riverbed) and quick growth of water vegetation created favorable conditions for reproduction. In the floods 18 species were found (55 % TNS), in the riverbed — 12 (36 % TNS), in the other inundated water objects (soil-reclamation canals, pools, etc.) — 9 species.

At the beginning of the spring period water bugs appeared in the riverbed. Their average abundance at the end of March was 0.11 ind./m^2, biomass — 1.39 mg/m^2, the majority of these water bugs belonged to Corixidae. In the floods and reed bed lakes the average abundance was 57.32 ind./m^2, biomass — 760.65 mg/m^2, Corixidae also dominated. Among them *S. striata* and *H. linnaei* prevailed. In addition, a considerable contribution to the biomass was made by adults of *Notonecta glauca* Linnaeus, 1758. On the water surface Gerridae appeared, with the dominant *Gerris argentatus* Schummel, 1832. Pleidae, Naucoridae, Nepidae also appeared in the quantitative samples.

In April the spring high water floods the extensive silt shoals, where at the well warmed open areas with the depth up to 10 cm the first nymphs of Gerridae and *P. minutissima* appeared. At the end of April 2009 their abundance reached 400 ind./m^2. In addition, there gather the overwintered nymphs of Micronectidae. Their abundance in these stations reachs the huge values. So, 04.24.2009 the abundance of Micronectidae was 35 472 ind./ m^2 with the biomass 28 302 mg/m^2. Besides, in the riverbed Corixidae, Gerridae, Pleidae, Naucoridae were registered. Except the above-described shoals, the average abundance and biomass in the riverbed was small, 0.8 ind./m^2 and 32.8 mg/m^2 respectively.

Due to the high water the space of floods and floodplain basins arise, as the result the values of abundance and biomass accounted per square meter become lower. At the end of April 2009 the average abundance of aquatic Heteroptera in the floods and floodplain water bodies was 1.35 ind./m^2, the average biomass 22.19 mg/m^2. In the floods and reed bed lakes, in addition to the above-listed families, Hydrometridae, Veliidae, Hebridae appear and start reproduction, but adults of Corixidae continue to dominate both by abundance and biomass. At the end of April the first nymphs of Corixidae and Notonectidae appear in the floods, and Micronectidae nymphae turn to adults.

In May the quantitative characteristics of aquatic Heteroptera continues growing. In 2009 the average abundance in the riverbed reached 6.92 ind./m^2, in the floods and reed bed lakes 28.21 ind./m^2. The average biomass was 23.25 mg/m^2 and 142.14 mg/m^2, respectively. The nymphs of Veliidae, Mesoveliidae and Naucoridae appear, and some of Gerridae, Pleidae and Notonectidae reach the third instar. However, in the floods and reed bed lakes the abundance of nymphs is approximately 1.5 times as high as the abundance of adults (in May 2009 it was 16.19 ind./m^2 and 12.02 ind./m^2 respectively). In the riverbed the ratio is reversed, the abundance of adults is about one order of magnitude

higher than the abundance of nymphs (6.33 ind./m^2 and 0.58 ind./m^2 respectively). In the riverbed adults of *Microvelia reticulata* (Burmeister, 1835) and *S. striata* dominate together with Gerridae, *G. argentatus* and *G. odontogaster* (Zetterstedt, 1828). In the floods and reed bed lakes the majority of the water bugs were nymphs of Corixidae, Notonectidae, Gerridae and adults of Veliidae in approximately equal ratio, by the biomass nymphs of Notonectidae prevail.

During the summer period nymphs of water bugs turn to adults and the subsequent reproduction of polyvoltine species takes place. Species diversity remains rather high. During this period 23 species of aquatic Heteroptera were collected (70 % TNS). In the riverbed 16 species were found (49 % TNS), in the reed bed and floodplain water bodies 17 species (52 % TNS). In most riverbed stations the majority of species belong to Gerridae, in the reed bed and floodplain water bodies to Corixidae.

Due to the permanency of riverbed biotopes, summer migrations of water bugs which are the characteristic feature of small intermittent rivers, are occasional in the ecosystems of great rivers. Species composition of the riverbed and constant inundated water bodies during the whole summer period remains quite changeless.

In June the abundance of nymphs in the riverbed is quickly rising. So, in 2009 over the period of a month (from May 16 to June 21) the abundance of nymphs grew by a factor of nearly 30 times, from 0.58 ind./m^2 to 16.67 ind./m^2. As the result, the abundance of nymphs at the end of June was by 3 times higher than the abundance of adults (16.67 ind./ m^2 and 6.14 ind./m^2 respectively). In this period the average abundance of water bugs in the riverbed was 22.81 ind./m^2, the average biomass — 392.76 mg/m^2. Both values are mainly formed by Gerridae nymphs of senior instars, including such big species as *A. paludum,* which nymph of 4th–5th instars can weigh around 20 mg.

Up to the end of June most of the nymphs reach the later instars, and some nymphs of Gerridae, Corixidae, Pleidae turn to adults and start reproduction. In the reed bed and floodplain water bodies there appear recently shed immature adults of *S. striata, S. iactans* Jansson, 1983*, H. linnaei, S. lateralis, S. stagnalis, G. argentatus, G. odontogaster*. The average abundance in these biotopes at the end of June 2009 was 30 ind./m^2, the average biomass — 90.56 mg/m^2. The decrease of biomass is the result of the death of old overwintered adults. The abundance is mainly formed by *M. reticulata* nymphs of middle and senior instars, the biomass by young adults of *G. argentatus* and *S. striata*.

At the beginning of July the quantitative characteristics of aquatic Heteroptera continue growing. Gerridae nymphs of new generation appear, they prevail in the riverbed. The biomass there is mainly formed by adults of *A. paludum,* and also by *Nepa cinerea* Linnaeus, 1758*,* and *Ranatra linearis* (Linnaeus, 1758). The nymphs of the last two species appear in June and up to the beginning of July reach the third instar. The average abundance in the riverbed increased by nearly 2 times, up to 43 ind./m^2, the average biomass rose up to 415 mg/m^2. Near the shore line and at the flooded shoals adults of Micronectidae gather. Their abundance in these biotopes was up to 100 ind./m^2.

In the reed bed lakes and inundated water bodies up to the beginning of July the young adults of Notonectidae (*N. glauca* and *N. viridis* Delcourt, 1909) appear. As the result, the biomass sufficiently grows up. At the beginning of July 2009 the average biomass in these biotopes was 1124 mg/m^2, with the abundance 31 ind./m^2. The majority by abundance consists of adults of Gerridae (*G. argentatus* prevail) and Veliidae (*M. reticulata*). Most of the nymphs turn to adults, as the result the ratio between adults and larvae changes for the benefit of the first ones. At the beginning of July the abundance of adults was by the 10 times as high as the abundance of nymphs (28.9 ind./m^2 and 2.2 ind./ m^2 respectively).

In the riverbed, on the contrary, the junior nymphs of Gerridae prevail. The studies of the biology and fenology of *A. paludum* carried in Japan near the border of boreal and subtropical zone (Harada, 1993, 1998, 2003 a, b; Saulich, Musolin, 2007) show that the main part of the nymphs hatching in July die at the junior instars due to overheat and high

insolation. It seems that the death of junior nymphs also happens in our area. The high infant mortality of the dominant species led to sufficient decrease of quantitative characteristics. In 2009 the average abundance in the riverbed was 21.1 ind./m^2, the average biomass 167.2 mg/m^2. The biomass is mainly formed by adults of *A. paludum,* the abundance by the Gerridae nymphs of the 1–2 instars. Among them the main role is played by nymphs of the second generation of *A. paludum,* which hatch in the middle–end of July. The survival rate of these nymphs is rather low, as the result the number of senior nymphs remains low up to the end of July. It seems that nymphs of other Gerridae species living at the open spaces of the riverbed are also affected by the high temperature and insolation. The abundance of 1st and 2nd instar nymphs in early July was 36 ind./m^2; in late July, 15 ind./m^2; late instar nymphs were absent.

In the floodplain water bodies at this time the maximum number of nymphs is observed. It is formed by larvae of Veliidae, Mesoveliidae, Pleidae, Corixidae and Naucoridae. In 2009 the average abundance at this period was 1438.9 ind./m^2, the average biomass 7883.9 mg/ m^2. The main contribution to these values was made by *P. minutissima* nymphs of different instars, which were found in almost equal proportion (the abundance of junior nymphs was 300 ind./m^2, middle ones 311 ind./m^2, senior ones 383 ind./m^2). The biomass was mainly formed by *I. cimicoides* nymphs of 4th–5th instars, which total biomass in July 2009 was 5.7 g/m^2.

The summer floods which often happen in July–August change the space, depth, availability and other characteristics of all the components of river ecosystem. As the result, in the summer period the quantitative characteristics of aquatic Heteroptera taxocenosis may significantly vary and depend not only on succession process, but also on the water regime, that is often related with man-made evacuation of water (for example, in the steppe part of the Dniester summer floods are often the result of water evacuation from Dubossary hydropower plant and Dniester hydrosystem).

In August the hatching and maturing of nymphs of the second generation continue. The junior nymphs of Gerridae are found up to the end of September, the junior nymphs of Corixidae are present up to the middle of October. However, the main contribution to the quantitative characteristics is made by senior nymphs and adults. At the end of September 2009 in the riverbed the average abundance was 55.6 ind./m^2, the average biomass 1944 mg/m^2. The dominant role belongs to the adults of *A. paludum* imago.

In the reed bed and inundated water bodies Corixidae prevail. From the end of June the abundance decreases by several times, as the result of the partial death of the nymphs of the second generation. At the end of September 2009 the average abundance was 293.3 ind./ m^2, among them the part of Corixidae senior nymphs was 43 %, the part of Corixidae adults was 39.8 %. The average biomass was 3480 mg/m^2. *H. linnaei* prevails.

During the autumn period the water bugs move to the places of wintering. The abundance and species diversity in the riverbed decrease greatly, because the main dwellers of this biotope, pond skaters, go for wintering to the shore and hide in the leaf litter and forest cover. In this period in the riverbed only 6 species were registered (18 % TNS). In the inundated water bodies water bugs concentrate in the reed bed lakes and girts, which don't freeze to the bottom in winter. Due to this fact, the species diversity in these biotopes remains at the previous level in spite of migration of Gerromorpha. During the autumn period in the inundated reservoirs 17 species were found, among them 15 species belonged to Nepomorpha. Often in the autumn there are observed the peaks of abundance and biomass which values exceed the spring ones.

The quantitative characteristics in the riverbed begin to reduce at the beginning of October. In 2009 the average abundance was 17 ind./m^2, the average biomass 488 mg/m^2. As in September, the dominant species was the great pond-skater *A. paludum.*

At the beginning of autumn period the abundance and biomass in the inundated water bodies are not high. At the beginning of October 2009 the average abundance was

43.3 ind./ m^2. The part of nymphs decreased nearly in a half in comparison with September samples (from 57 % to 38 % respectively). The average biomass in this period was 320 mg/ m^2. The majority by abundance and biomass belong to adults of Corixidae, mostly *S. striata.*

Up to the end of October the quantitative characteristics in the riverbed continue to decrease. Most of the water striders left the water bodies and migrate to the wintering places. In the riverside vegetation there gather adults of *N. cinerea,* which partially overwinter at the shore. The average abundance and biomass were 9.17 ind./m^2 and 363.3 mg/m^2 respectively and formed by *N. cinerea* and Corixidae, mostly *H. linnaei.*

In the inundated water bodies which are suitable for wintering the quantitative characteristics sharply rise. At the end of October 2009 the average abundance reached 1226.7 ind./m^2, the average biomass was more than 17 g/m^2. In the quantitative samples only Nepomorpha were registered, among them Corixidae (*H. linnaei, S. striata, S. stagnalis*) prevailed. A considerable part of biomass also belonged to Notonectidae (*N. glauca, N. viridis*).

At the end of autumn period the quantitative characteristics in the inundated water bodies decrease due to migration of water bugs to the bottom to the hard-to-reach parts of the reservoirs. In the middle of November the 2009 the average abundance reached 941.67 ind./m^2, the average biomass was more than 11.8 g/m^2. The majority of the abundance in this period consists of Corixidae (*H. linnaei* prevails), the sufficient part of biomass also belongs to Notonectidae (*N. glauca* prevails). Up to the end of November — the beginning of December the abundance continues to decrease, but some specimens of Corixidae and Notonectidae remain active all the winter period.

Conclusions

In the ecosystems of great rivers of Ukrainian continental steppe zone 33 species of water bugs were found, that is the main part (79 %) of the whole fauna of aquatic Heteroptera in Ukraine. They belong to 2 infraorders and 12 families — Nepomorpha, Corixidae (14 species), Nepidae and Notonectidae (2 species each), Micronectidae, Naucoridae, Pleidae and Aphelocheiridae (1 species each); and Gerromorpha, Gerridae (6 species), Hydrometridae (2 species), Hebridae, Mesoveliidae and Vellidae (1 species each). During the research the new species for Ukraine, *S. mayri*, was found. Two species (*C. bonsdorffii* and *H. stagnorum*) were first recorded in the Ukrainian continental steppe zone.

Seasonal changes of the species diversity, abundance and biomass of water bugs are wavelike and depend of weather-climatic conditions of the year and peculiarities of life cycles of the dominant species. The quantitative analysis shows that during almost all the year round the species diversity, biomass and abundance of water bugs in the floodplain water bodies was higher that the same characteristics in the riverbed. It is caused by the high depth, high current velocity and poor vegetation (except *Phragmites* associations which are hardly suitable for living of most water bugs) which form unfavorable conditions for many Nepomorpha, and the riverbed is mainly occupied by Gerridae only. A special case is the period of spring high water, when on the flooded shoals at the well warmed open areas with the depth up to 10 cm the hatchlings of Gerridae and Pleidae and overwintered Micronectidae nymphs gather. Their abundance may reach a few dozen thousand per m^2.

Due to the stability of riverbed biotopes the summer migration of water bugs which are typical for small intermittent rivers, in the great rivers are occasional. The species composition of the riverbed and constant inundated water bodies remain quite permanent during the whole summer period.

In summer the quantitative characteristics of aquatic Heteroptera of great rivers may

sufficiently vary and depend not only on succession processes, but also the fluctuations of water level during the summer floods, often accompanied by man-made evacuations of water. The highest abundance (1438 ind./m^2) was observed in the reed bed lakes in the middle of July, after the hatching of second generation nymphs of the polyvoltine species. In the riverbed the number is lower due to death of Gerridae nymphs hatching in the hot period. The maximum of biomass (17.01 g/m^2) was observed in October in the reed bed lake, where water bugs gather for wintering. So, during the whole year the aquatic Heteroptera taxocenoses of all the concerned objects create the indivisible complex, which basis is made by inhabitants of inundated reservoirs. The roles of different water bodies which form the river ecosystem as the habitats for aquatic organisms are not the same and not replaceable, as the result the conservation of biodiversity is impossible without the study and protection of all the uniform architectonic complex of a river valley.

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