Ecologica Montenegrina
ISSN 2336-9744 (online) | ISSN 2337-0173 (print)

Ecologica Montenegrina 16: 48-57 (2018)
This journal is available online at: www.biotaxa.org/em

Article

New records of some rare mayflies (Insecta, Ephemeroptera) from Ukraine

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Received 10 January 2018 │ Accepted by *V. Pešić*: 19 February 2018 │ Published online 23 February 2018.

Abstract
Palingenia fuliginosa (Georgi, 1802) and *Isonychia ignota* (Walker, 1853) are reliably recorded in Ukraine for the first time. New localities where larvae of *Brachycercus harrisella* Curtis, 1834, *Siphlonurus aestivalis* Eaton, 1903 and *Metreletus balcanicus* (Ulmer, 1920) develop in Ukraine were registered. *Baetopus* (*Raptobaetopus*) *tenellus* (Albarda, 1878) is given for Ukraine for the first time. Investigated microhabitats of these species are shortly described. Main factors influencing the abundance of *P. fuliginosa* in detected habitats are discussed. *Isonychia ignota*, *P. fuliginosa* and *M. balcanicus* are recommended to be included in the next edition of the Red Data Book of Ukraine.

Key words: mayflies, Ephemeroptera, Ukraine, habitats, new records, Red Data Book of Ukraine.

Introduction

Mayflies (Ephemeroptera) is a very important group in the aquatic biocenosis. The majority of mayfly species is sensitive to pollution and changes of hydrological regime of waterbodies. Therefore this group is commonly used in bioindication and biomonitoring. These investigations are actual because of the ecological situation of the modern world. Bioindication and biomonitoring investigations in any region are impossible without the study of the fauna structure. Thereby, the identification of a species composition (faunistic investigation) is the initial stage of any research.

The investigation of mayflies in Ukraine began in the second part of XIX century, but up to now there were only a few decades of intensive research. Most intensive period of study has begun in 1997 and continues up to now. The first check-list of mayflies of Ukraine was published in 2003 (Godunko & Kłonowska-Olejnik 2003).

By now there are 113 mayfly species in the national species list (Zakharenko 1955; Godunko & Kłonowska-Olejnik 2003, 2008; Godunko *et al*. 2004a, b; Kovács 2006; Prokopov & Godunko 2007; Kłonowska-Olejnik *et al*. 2007; Godunko & Kovács 2008; Kovács & Godunko 2008; Kovács *et al*. 2008; Martynov 2010, 2011, 2013; Martynov & Godunko 2010, 2013). However, the records on some species from Ukraine need confirmation because of absence of the detailed data on the sampling places or high possibility of incorrect identification (see Godunko & Kłonowska-Olejnik 2003 for details). Two species herein

discussed, *Palingenia fuliginosa* (Georgi, 1802) and *Isonychia ignota* (Walker, 1853), were among these 'doubtful' ones. Some species are known by reliable (do not cause doubts and/or confirmed by the material), but solitary findings (Kovács *et al*. 2008; Kovács & Godunko 2008; Martynov 2011, 2013; etc.), and further faunistic studies for these species within Ukraine are actual.

Material and Methods

All specimens were preserved in 85–95% EtOH. Administrative disposition and geographical coordinates of localities are given according to "Google Earth" (http: // earth.google.com). Photographs of mayfly specimens were taken using Canon SX30SI (Figs 1, 2, 5) in the National Museum of Natural History of the National Academy of Sciences of Ukraine (further NMNH NASU) and Leica Z16 APO with Leica DFC450 Digital Camera (Figs 9–12) in the I.I. Schmalhausen Institute of Zoology of the National Academy of Sciences of Ukraine, and subsequently processed with LAS Core 3.8 and Adobe Photoshop™ CS5 software.

The material is housed in the collection of author at the NMNH NASU. All vials have the inventory numbers (IN) (example: *Zkp10Metbal/1*).

Results and discussion

Palingenia fuliginosa (Georgi, 1802)

There are three species of the genus *Palingenia* Albarda, 1888 in the check list of Ukrainian mayflies (Godunko & Kłonowska-Olejnik 2003). *Palingenia longicauda* (Oliver, 1791) has not been registered in Ukraine since the thirties of the XX century (Soldan *et al*. 2009). Registration of *P. sublongilobata* Tshernova, 1949 in Ukraine needed the confirmation, and *Palingenia fuliginosa* was only suggested for Ukraine (Godunko & Kłonowska-Olejnik 2003; Prokopov & Godunko 2007).

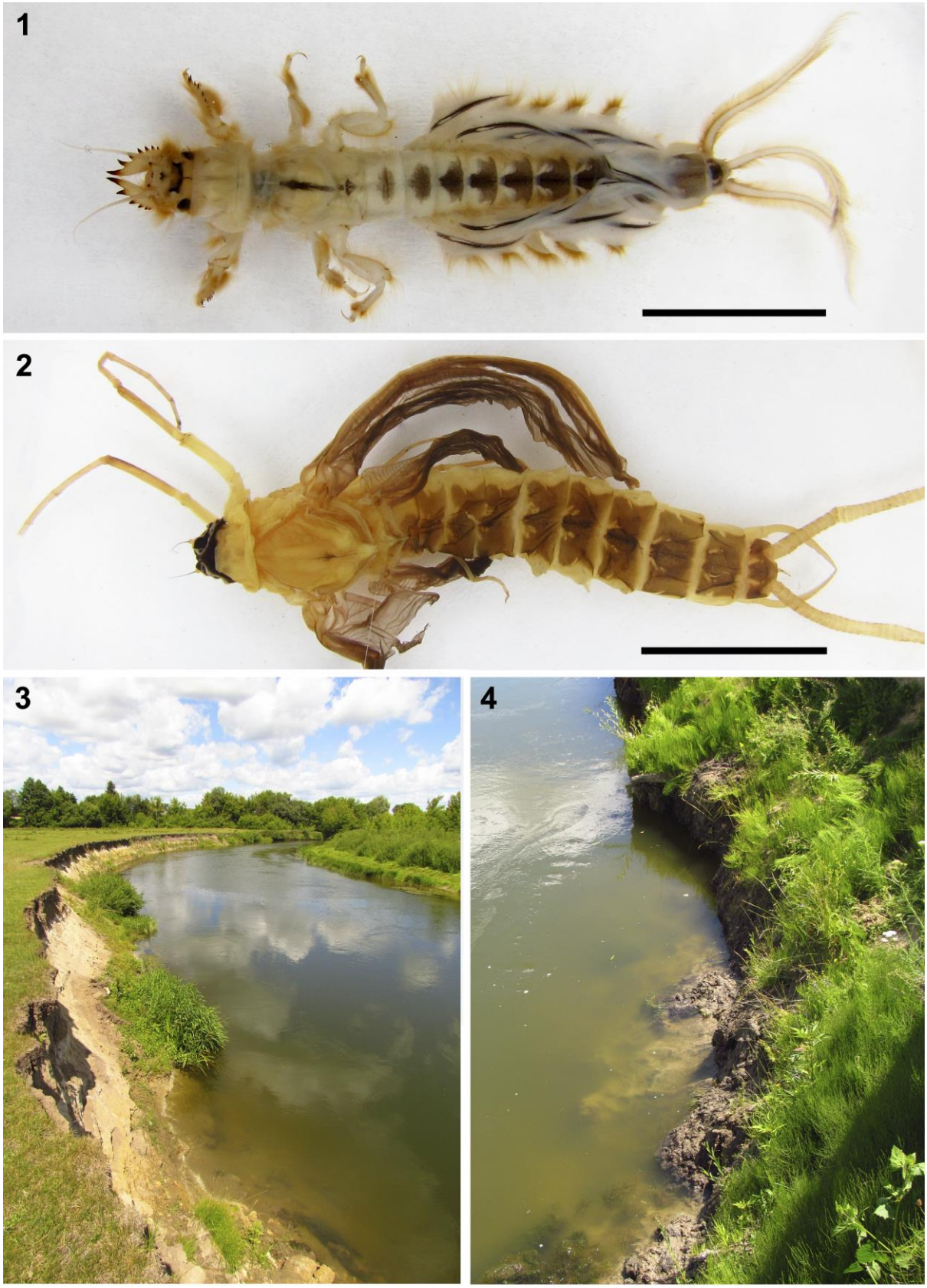
Generally confirmed distribution of *P. fuliginosa* falls within Iran, Caucasus and Slovak Republic (Tshernova 1949; Demoulin 1965; Soldán 1978). Demoulin (1965) recorded *P. fuliginosa* for Crimea basing on one female imago from Kertch Peninsula. It was supposed that species do not develop in Crimea, and the caught specimen was carried by wind from Krasnodar Krai (Russian Federation) (Prokopov & Godunko 2007). The records of this species from the Salgir and Angara Rivers at Crimea by Kiseleva & Yezernitskiy (1985) was subjected to great doubt and consequently the species was removed from check list of mayflies of Crimea (Prokopov & Godunko 2007). Thereby, up to now there are no facts confirming the development of this species within Ukraine.

We found *P. fuliginosa* in potamal zone of the Horyn' and Styr Rivers within Rivne Region (Figs 3, 4, 14, 15). Larvae of different ages and winged stages were collected (Figs 1, 2, 5); this confirms the fact of development of the species within Ukraine. Moreover, these records extend the known distribution of the species towards North.

Habitat: In both rivers larvae of *P. fuliginosa* live under the similar conditions. All larvae were collected from their burrows in different substrates. Most typical substrates were the clay (Fig. 5) and dense deposits of sand, and we also collected some larvae from burrows made in poor bog iron ore with sandstone impurities (Fig. 6). Additionally we recorded that the larvae of last instars can rote the burrows through the wood when it is deposed in the main substrate (Fig. 7).

Current velocity in collecting sites ranged from 0.1 to 0.3 m/s. The inhabited holes of *P. fuliginosa* were registered at depth from 0.2 to 1.7 m (max depth of the rivers in the sampling places was about 3 m). The additional parameters of waterbodies in collecting places measured during the sampling were: water temperature 23–29°C, water hardness 259–270 ppm, pH 8.6–8.7.

Material: Ukraine, Rivne Region: 11 larvae, vicinity of Zbuzh village, Horyn' River, 50.990300, 26.320683, h – 154 m a.s.l., Martynov A.V. leg., 7.07.2017 – IN *Riv2Palful/1–2*; 20 larvae, 14 subimagoes, ibid, Dauletkulov S. leg., 10–25.06.2017 – IN *Riv6Palful/1–6*; 10 larvae, vicinity of Stara Rafalivka village, Styr River, 51.378866, 25.863339, h – 156 m a.s.l., Martynov A.V. leg., 2.08.2017 – IN *Riv7Palful*.



Figures 1–4. Larva and subimago of *Palingenia fuliginosa* (Georgi, 1802) and its habitat: 1. – total view of larva, scale bar 10 mm; 2. – total view of subimago, male, scale bar 10 mm; 3. – Horyn' River, vicinity of Zbuzh village (July 2017); 4. – microhabitats most preferred by *P. fuliginosa* larvae on Horyn' River (July 2017).

Figures 5–8. *Palingenia fuliginosa* (Georgi, 1802), larval burrows and equipment for collecting the larvae: 5. – larva in the burrow, scale bar 50 mm; 6. – burrows in poor bog iron ore with sandstone impurities, scale bar 50 mm; 7. – burrows crossing the wood, scale bar 50 mm; 8. – equipment used by fishermen and dealers for collecting the larvae, scale bar 50 mm.

Threats and recommendations for conservation: *Palingenia fuliginosa* is a highly stenobiotic species that prefers only the oxygenated unpolluted waterbodies. As the result, species inhabits only a few rare types of microhabitats in some middle-sized rives within Ukraine. We suppose that at the present time there are several main factors influencing the abundance of the species in discovered habitats except of the moderate pollution. The first factor is the significant decrease of the average water level in Horyn' and Styr Rivers in last few years. Because of this decrease the main part of the suitable microhabitats appeared to be located above the water during most of a year. Many old burrows made by larvae of *P. fuliginosa* were registered above the water level. Now only a small area with suitable microhabitats was preserved in these rivers. Larvae of the species can not inhabit bottom and neighboring microhabitats because of their siltation.

The second factor is the human factor. It is very popular among the people of Rivne Region to collect the larvae and winged stages (imagoes and subimagoes) of *P. fuliginosa* for fishing. We consider this as a significant threat. People use special hand device that scrapes the substrate to collect the larvae (Fig. 8). Because of this the large areas of rare suitable habitats of the species were destroyed. Also people collect the newly emerged winged stages (mainly subimagoes) with the light traps. Before the water level decrease in the Horyn' and Styr Rivers some people collected for the sale up to one hundred (!) kilograms of larvae and up to 5–6 hundreds (!) kilograms of winged stages (mainly subimagoes). Obviously the caught subimagoes could not participate in the reproduction. Because of significant restriction of the species' distribution in the region, small area and number of suitable microhabitats and big volume of collected mayflies, we consider the human activity as one of the significant threats for the discovered (!) populations of *P. fuliginosa*.

Thus, we suppose that this species deserves to be included in the Red Data Book of Ukraine. Detailed investigation (also genetic affinity to other populations) of discovered populations of *P. fuliginosa* continues.

Isonychia ignota **(Walker, 1853)**

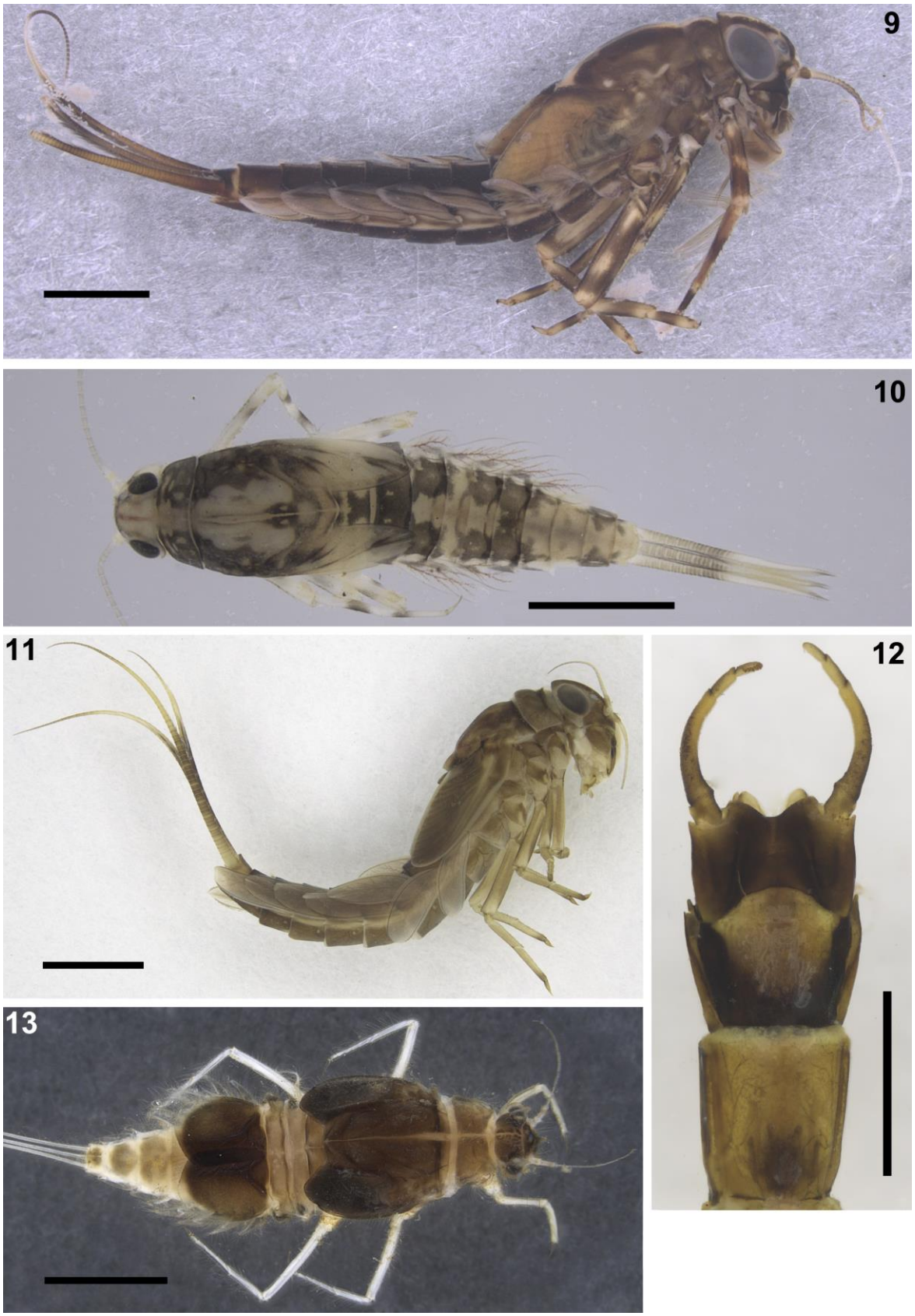
This species was given for Ukraine in Godunko & Kłonowska-Olejnik (2003) basing on data of Mikulski (1936). The latter article was devoted to Ephemeroptera of Poland that previously included some regions of modern Western Ukraine and Belarus. Mikulski (1936) declared *I. ignota* for tributaries of the Prypyat' River without precise points. Basin of this river falls within territory of modern Ukraine and Belarus. During the revision of the collections housed at the Institute of Systematics and Evolution of Animals PAS (Kraków), where the materials of J.S. Mikulski is housed, none specimen of *I. ignota* from the basin of Prypyat' River was found (Kłonowska-Olejnik *et al.* 2005; Godunko R.J. *personal communication*). Thus, up to know there were no confident records of *I. ignota* for Ukraine.

We registered *I. ignota* (Fig. 9) in potamal zone of meddle-sized Horyn', Styr and Sluch Rivers within Rivne Region (Figs 3, 14, 15). These rivers are the right tributaries of the Prypyat' River of the first or second orders. We found fresh exuvia of *I. ignota* at the Styr River in the first decade of August; this confirms that a part of population of *I. ignota* emerges at this period.

Habitat: In all rivers the larvae were registered at microhabitats with sand, sometimes with small stones or/and pieces of bog iron ore, or silted sand bottom and current velocity from 0.2 to 0.3 m/s. Larvae were collected from bottom and vascular aquatic plants, *Potamogeton natans* Linnaeus, 1758 and *P. pectinatus* Linnaeus, 1758 mainly. The additional parameters of waterbodies in collecting places measured during the sampling were: water temperature 23–30°C, water hardness 210–270 ppm, pH 8.6–9.0.

Material: Ukraine, Rivne Region: 15 larvae, vicinity of Zbuzh village, Horyn' River, 50.990300, 26.320683, h – 154 m a.s.l., Martynov A.V. leg., 7.07.2017 – IN *Riv2Isoign/1–2*; 1 larva, vicinity of Horodets' village, Horyn' River, 51.284421, 26.366363, h – 149 m a.s.l., Martynov A.V. leg., 2.08.2017 – IN *Riv8Isoign*; 1 larva, 1 exuviae, vicinity of Stara Rafalivka village, Styr River, 51.378866, 25.863339, h – 156 m a.s.l., Martynov A.V. leg., 2.08.2017 – IN *Riv7Isoign*; 1 larva, vicinity of Sarny town, Sluch River, 51.317445, 26.635826, h – 148 m a.s.l., Martynov A.V. leg., 2.08.2017.

Threats and recommendations for conservation: Water pollution is the most obvious threat to *I. ignota*. In common with other Ephemeroptera, this species relies upon good water quality. Other concrete threats for *I. ignota* within Ukraine are not defined. We consider that it deserves to be included in the Red Data Book of Ukraine because of the restricted distribution within the country, its rarity within the whole areal and stenobiotic nature. Detailed investigation (also genetic affinity to other populations) of Ukrainian populations of the species continues.



Figures 9–13. Larvae and imago of some registered species: 9. – *Isonychia ignota* (Walker, 1853), total view of larva, scale bar 2 mm; 10. – *Baetopus tenellus* (Albarda, 1878), total view of larva, scale bar 1 mm; 11. – *Metreletus balcanicus* (Ulmer, 1920), total view of larva, scale bar 2 mm; 12. – the same species, genitalia and posterior part of abdomen, male imago, ventral view, scale bar 1 mm; 13. – *Brachycercus harrisella* Curtis, 1834, total view of larva, scale bar 2 mm.

Baetopus (*Raptobaetopus*) *tenellus* (Albarda, 1878)

This transpalaearctic species is rare within all areal. Larvae are evidently predaceous (Bauernfeind & Soldán 2012). One larva of *B. tenellus* (Fig. 10) was registered in Styr River (Figs 14, 15), the right tributary of the Prypyat' River, at microhabitat with silted sand bottom and current velocity from 0.2 to 0.3 m/s. The additional parameters of waterbody in collecting place measured during the sampling were: water temperature 29°C, water hardness 259 ppm, pH 8.6. This is the first record of the genus *Baetopus* Keffermüller, 1960, as well as the species *B. tenellus* within Ukraine.

Material: 1 larva, Ukraine, Rivne Region, vicinity of Stara Rafalivka village, Styr River, 51.378866, 25.863339, h – 156 m a.s.l., Martynov A.V. leg., 2.08.2017 – IN *Riv7Btpten.*

Brachycercus harrisella Curtis, 1834

This species is widely distributed all over Europe, but rare in the Mediterranean area (Bauernfeind & Soldán 2012). In Ukraine *B. harrisella* also belongs to rare species; it was known only from the Dnister River, middle and low courses of the Desna River, upper course of the Dnipro River (Polishchuk 1964; Invertebrates… 1989; Nedostup 1994). We registered larvae of this species (Fig. 13) at different points of the Stvyga River within Rivne Region (Figs 14, 16).

Habitat: In all sampling places the river had the moderate current velocity (from less than 0.05 to 0.5 m/s) and the bottom of sand or silted sand (Fig. 16). The main number of larvae was collected in microhabitats with accumulations of detritus and current velocity 0.1–0.3 m/s. Additional parameters of waterbody in sampling places were: water temperature 21–22°C, water hardness 47–49 ppm, pH 7.4–7.5.

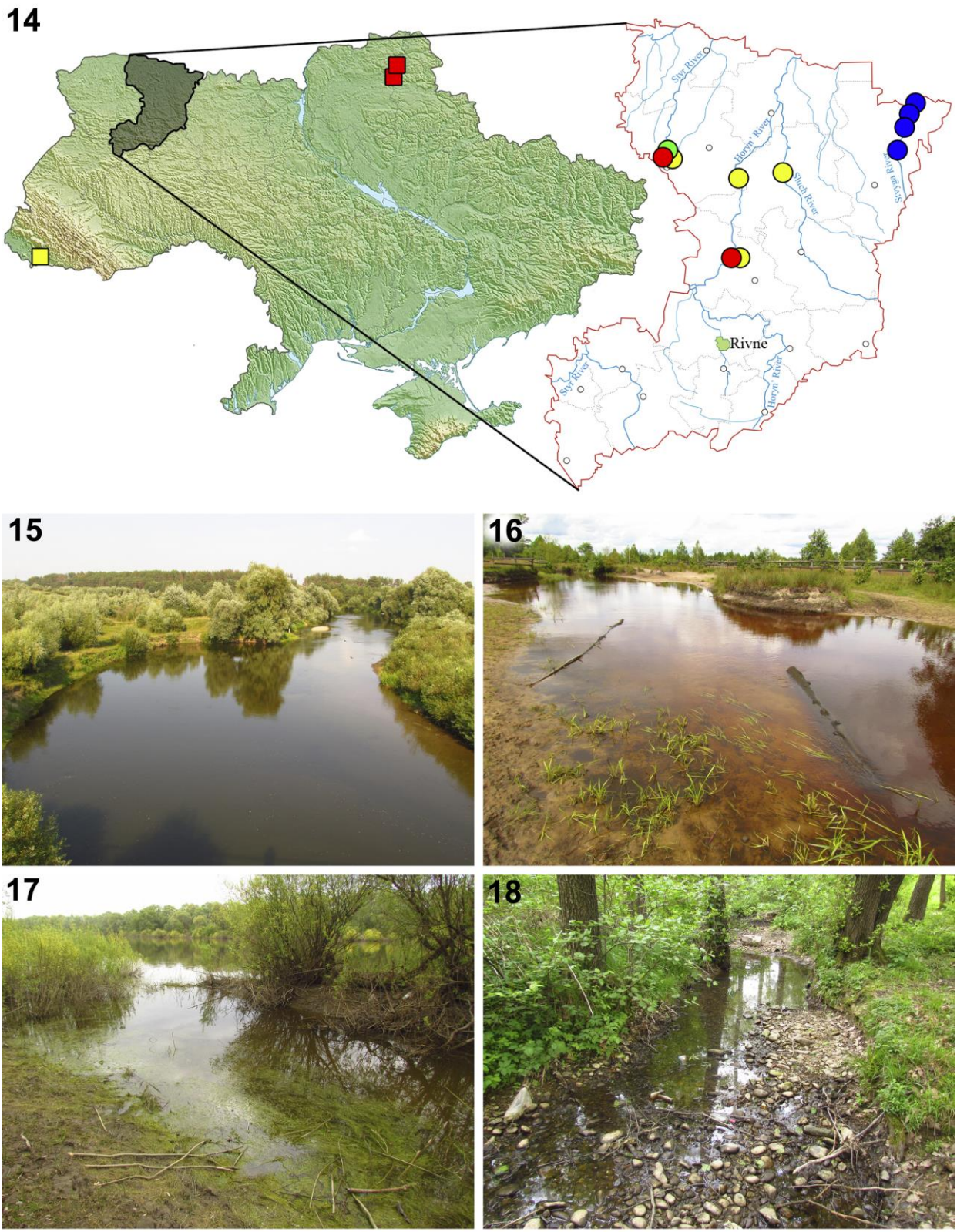
Material: Ukraine, Rivne Region: 2 larvae, vicinity of Blazhove village, Stvyga River, 51.419617, 27.351633, h – 146 m a.s.l., Martynov A.V. leg., 3.07.2017 – IN *Riv3Brahar*; 7 larvae, territory of Glynne village, Stvyga River, 51.529883, 27.421400, h – 144 m a.s.l., Martynov A.V. leg., 5.07.2017 – IN *Riv5Brahar*; 18 larvae, Stvyga River, between Glynne and Poznan' villages, 51.563133, 27.428250, h – 147 m a.s.l., Martynov A.V. leg., 5.07.2017 – IN *Riv1Brahar/1–2*; 2 larvae, vicinity of Poznan' village, Stvyga River, 51.591450, 27.477868, h – 139 m a.s.l., Martynov A.V. leg., 5.07.2017 – IN *Riv4Brahar*.

Siphlonurus aestivalis Eaton, 1903

This species is rare in Ukraine. Previously it was known only from one point in Chernivtsi Region at the vicinity of Berehomet settlement (Martynov 2013). We registered *S. aestivalis* in two localities at the Desna River within Chernihiv Region (Figs 14, 17).

Habitat: In Chernivtsi Region larvae were collected at limnocrene (shallow draw-well). In contrast, in Chernihiv Region larvae of the species were collected in small well-warmed bay and the standing area along the bank of the Desna River. These microhabitats were located within the potamal zone of the river and characterized by the silted bottom densely overgrown with *Agrostis stolonifera* Linnaeus, 1753 (Poaceae) (Fig. 17). Population density of *S. aestivalis* in grass thickets at the bay of the Desna River was 117 specimens/m^2. Additional parameters of waterbody in sampling places were: water temperature 18°C, water hardness 160–181 ppm, pH 8.7–9.0.

Material: Ukraine, Chernihiv Region: 232 larvae, vicinity of Prydesnyans'ke village, bay of Desna River, 51.613417, 33.007583, h – 118 m a.s.l., Martynov A.V. leg., 1.05.2017 – IN *Chg11Siphae/1–7*; 29 larvae, vicinity of Sverdlovka village, Desna River, 51.772583, 33.070317, h ~ 125 m a.s.l., Martynov A.V. leg., 1.05.2017 – IN *Chg12Siphae*.



Figures 14–18. New collection sites of the investigated species within Ukraine: 14. – map showing new sites (red circles – *Palingenia fuliginosa* (Georgi, 1802); yellow circles – *Isonychia ignota* (Walker, 1853); green circle – *Baetopus tenellus* (Albarda, 1878); blue circles – *Brachycercus harrisella* Curtis, 1834; red quadrates – *Siphlonurus aestivalis* Eaton, 1903*;* yellow quadrate – *Metreletus balcanicus* (Ulmer, 1920)); 15. – Styr River, (vicinity of Stara Rafalivka village, July 2017); 16. – Stvyga River (vicinity of Poznan' village, July 2017); 17. – bay of Desna River (vicinity of Prydesnyans'ke village, May 2017); 18. – Salva River (territory of Bukove village, May 2017).

***Metreletus balcanicus* (Ulmer, 1920)**

Metreletus balcanicus is a rare stenobiotic species distributed in South-Central Europe (Soldán & Zahrádková 2000). For the first time it was given for Ukraine from Kharkiv Region (Martynov 2011): this is the most eastern known point within the whole species distribution. Present research revealed a new locality of *M. balcanicus* in Ukraine, at Zakarpattia Region (Figs 14, 18).

Habitat: In Kharkiv Region *M. balcanicus* inhabits the hipopotamal zone of middle-sized Lukonovakha River that dries up periodically. In Zakarpattia Region this species was found in the Salva River, which looked like a cascade of puddles connected with shallow streams in May, 2017 when material was collected (Fig. 18). Additional parameters of waterbody in sampling place were: water temperature 14°C, water hardness 52 ppm, pH 7.1. All larvae (Fig. 11) were gathered from stones or silted stones at the bottom and roots in puddles. We had also found the fresh exuvia and imagoes (Fig. 12) that confirms the fact of emergence for *M. balcanicus* at this period.

Material: 16 larvae, 4 exuviae, 9 imagoes (3♂+6♀), Ukraine, Zakarpattia Region, territory of Bukove village, Salva River, 48.198433, 23.090850, h – 181 m a.s.l., Martynov A.V. leg., 11.05.2017 – IN *Zkp10Metbal/1–4*.

Recommendations for conservation: *Metreletus balcanicus* is rare and stenobiotic in Ukraine and whole its areal, it has the restricted distribution within Ukraine; therefore we think that the species should be considered as perspective for including in the Red Data Book of Ukraine. Detailed investigation (also genetic affinity to other populations) of Ukrainian populations of *M. balcanicus* continues.

Acknowledgments

Author is grateful to Taras Kryvulskyy and Mykhaylo Franchuk (Rivne Nature Reserve) and S. Dauletkulov for useful information and help when collecting material in Rivne Region. The current results were obtained during fieldworks supported by the Mohamed Bin Zayed Species Conservation Fund (project 160514607). Some equipment used in this investigation was provided by IDEA WILD organization.

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