UDC 595.76(477.86) DOI: 10.36016/KhESG-2020-28-2-1

© 2020 A. M. SUMAROKOV, A. M. ZAMOROKA

SPATIAL PATTERNS AND HABITAT DIFFERENTIATION OF THE BEETLE (INSECTA: COLEOPTERA) FAUNA OF PROTECTED AREAS IN THE EASTERN CARPATHIANS (IVANO-FRANKIVSK REGION, UKRAINE)

Сумароков, О. М., Заморока, А. М. Просторовий розподіл та оселищна диференціація фауни твердокрилих (Insecta: Coleoptera) природно-заповідних територій Східних Карпат (Івано-Франківська область, Україна). ***Вісті Харківського ентомологічного товариства*****. 2020. Т. XXVIII, вип. 2. С. 5–25. DOI: 10.36016/KhESG-2020-28-2-1.**

Попри те, що твердокрилих на території Східних Карпат вивчають ось уже 200 років, до сьогодні залишаються достеменно невідомими ні загальна кількість видів, ані остаточний склад фауни терену. Однак, в умовах природоохоронної діяльності першочерговим завданням є виявлення гарячих точок біорозмаїття і з'ясування причинно-наслідкових зв'язків, що зумовлюють їхнє існування. У цій канві ми здійснили дослідження фауни твердокрилих уздовж висотного градієнта на природно-заповідних територіях Східних Карпат. У результаті досліджень нами виявлено 595 видів жуків із 37 родин, яких проаналізовано за критеріями просторового розподілу та оселищної диференціації. Установлено, що β-розмаїття твердокрилих збіднюється зі зростанням відносних висот від 327 видів на висоті 325 м н. р. м. до 48 видів на висоті 1 800 м н. р. м. При цьому, фауністична матриця регіону складена лісовими видами, на фоні яких виразно виокремлюються фауни лучних степів у долині Дністра та альпійських лук на хребті Чорногора. Фауна твердокрилих є високо диференційованою стосовно оселищ, виявляючи низьку подібність між видовими спектрами в них. Функціональні зв'язки розмаїття твердокрилих у екосистемах виявляються у різних типах трансляції енергії в межах трофічних ланцюгів. Зокрема, ми виявили продуцентно-консументний тип трансляції у лучних екосистемах і редуцентно-консументний — у лісових. Це вказує на різний рівень стабільності екосистем, а відтак і загроз для них. Вважаємо, що функціональне розмаїття твердокрилих є індикатором того, що лісові екосистеми є більш стабільними із вищою екологічною ємністю, а лучні – більш уразливими до антропогенних і природних чинників. У світлі результатів наших досліджень існує потреба забезпечення особливого охоронного режиму для альпійських і лучно-степових оселищ твердокрилих регіону.

4 рис., 2 табл., 52 назв.

Ключові слова: висотний ґрадієнт, β-розмаїття, функціональне розмаїття, екосистемна ємність.

Сумароков, А. М., Заморока, А. М. Пространственное распределение и стациальная дифференциация фауны жесткокрылых (Insecta: Coleoptera) охраняемых территорий Восточных Карпат (Ивано-Франковская область, Украина). ***Известия Харьковского энтомологического общества*****. 2020. Т. XXVIII, вып. 2. С. 5–25. DOI: 10.36016/KhESG-2020-28-2-1.**

Несмотря на то, что жесткокрылых Восточных Карпат изучают вот уже 200 лет, до настоящего времени остаются доподлинно неизвестными как общее количество видов, так и полный состав фауны данной территории. Однако, в условиях природоохранной деятельности первоочередным заданием является выявление горячих точек биоразнообразия и причин их возникновения. В этом русле нами проведены исследования фауны жесткокрылых вдоль высотного градиента на природоохранных территориях Восточных Карпат. В результате исследований нами обнаружено 595 видов жуков из 37 семейств, которых проанализировано по критериям пространственного распределения и стациальной дифференциации. Установлено, что β-разнообразие жесткокрылых обедняется с возрастанием относительных высот с 327 видов на высоте 325 м н. у. м. до 48 видов на высоте 1800 м н. у. м. При этом, фаунистическая матрица региона составлена лесными видами, на фоне которых отчётливо выделяются фауны луговых степей в долине Днестра и альпийских лугов на хребте Черногора. Фауна жесткокрылых высоко дифференцирована относительно стаций, проявляя низкое сходство между спектрами видов в них. Функциональные связи разнообразия жесткокрылых в экосистемах проявляются в разных типах трансляции энергии в пределах трофических цепей. В частности, мы обнаружили продуцентно-консументный тип трансляции в луговых экосистемах и редуцентно-консументный — в лесных экосистемах. Это указывает на разный уровень стабильности экосистем, а, следовательно, и угроз для них. Считаем, что функциональное разнообразие жесткокрылых выступает индикатором того, что лесные экосистемы являются более стабильными с высшей экологической ёмкостью, а луговые — более уязвимыми к антропогенным и природным факторам. В свете результатов наших исследований существует необходимость обеспечения особого охранного режима для альпийских и луго-степных местообитаний жесткокрылых региона.

4 рис., 2 табл., 52 назв.

Ключевые слова: высотный градиент, β-разнообразие, функциональное разнообразие, экосистемная ёмкость.

Sumarokov, A. M., Zamoroka, A. M. Spatial patterns and habitat differentiation of the beetle (Insecta: Coleoptera) fauna of protected areas in the Eastern Carpathians (Ivano-Frankivsk Region, Ukraine). ***The Kharkov Entomological Society Gazette*****. 2020. Vol. XXVIII, iss. 2. P. 5–25. DOI: 10.36016/KhESG-2020-28-2-1.**

Despite the beetles in the Eastern Carpathians have been studied for 200 years, a complete and exhaustive list of beetles has not been done yet. Nevertheless, the main tasks of conservation activity are to identify biodiversity hot spots and to determine the causes of their existence. In this outline, we studied the Coleoptera fauna of protected areas in the Eastern Carpathians. We identified 595 species of beetles from 37 families, which analyzed by the criteria of spatial patterns and habitat differentiation. We found ascending altitudinal gradient in species richness from 327 species at 325 m a. s. l. to 48 species at 1,800 m a. s. l.. The sylvatic species of Coleoptera predominate in throughout the

Sumarokov A. M. Agro-association 'Chysta Krynytsia', 11, Tsentralna St., Drabynivka Village, Poltava District, Poltava Region, 39351, UKRAINE; e-mail: sumarokov_sam@ukr.net, ORCID: 0000-0001-8115-851X
Zamoroka A. M. Vasyl Stefanyk Precarpathian National University, 57, Shevchenko St., Ivano-Frankivsk, 77018, UKRAINE; e-mail: andrew.zamoroka@pnu.edu.ua, ORCID: 0000-0001-5692-7997

Received 16.11.2020 **Accepted 10.12.2020 by Dr. A. G. Shatrovskiy** **Published 21.12.2020**

Eastern Carpathians except alpine meadows of the Chornohora Range and steppes in the Dnister River Valley. Coleoptera fauna is highly differentiated with a low similarity within habitats. We identified two different types of Coleoptera-mediated transmission of energy in meadow and forest habitats including the producer-consumer and the reducer-consumer energy transmission. We believe, this indicates on highest capacity and resilience of the forest ecosystems. Meanwhile, meadow ecosystems are more vulnerable to anthropogenic and natural threats. In light of our findings, there is a need to provide a special protection regime for Coleoptera habitats on alpine meadows and steppes in the region. 4 figs, 2 tabs, 52 refs.
Keywords: altitudinal ecological gradient, β-diversity, functional diversity, ecosystem capacity.

Introduction. Coleoptera is the largest and the most diverse order not only within insects but also within all known groups of living organisms. There are over 350,000–400,000 described species of beetles, constituting about 25% of all described species in the World (Stork et al., 2015; Audisio et al., 2015; Löbl, I., Smetana, 2007, 2010; Löbl, I., Löbl, D., 2015, 2016, 2017; Alonso-Zarazaga et al., 2017; Dariusz, Löbl, I., 2020). Some around 260,000 beetle species (65–75% of all known Coleoptera) belong to the five families. These include Curculionidae (≈ 83,000 species), Staphylinidae (≈ 64,000 species), Carabidae (≈ 43,000 species), Chrysomelidae (≈ 35,000 species), and Cerambycidae (≈ 35,000 species). In Europe, there are near 30,000 known species of beetles (Audisio et al., 2015; Löbl, I., Smetana, 2007, 2010; Löbl, I., Löbl, D., 2015, 2016, 2017; Alonso-Zarazaga et al., 2017; Dariusz, Löbl, I., 2020). The exact number of beetles in Ukraine is unknown yet. We believe that there are at least 15,000 species in Ukraine.

The studies of Coleoptera fauna in the Eastern Carpathians have been started almost 200 years ago, in the third decade of the XIX century. Since that time, it is accumulated large data and formed sufficiently complete information on the local fauna of Coleoptera. However, a complete and exhaustive list of beetles has not yet been compiled for the region. The detailed historical revues of Coleoptera fauna studies are given in the multiple recent papers (Yanytsky, 2001; Rizun, 2003; Mateleshko, 2008; Zamoroka, 2009; Zamoroka et al., 2018).

The earliest known data on 17 species of beetles from the region was published in a shot note of A. Zawadzki (1825). However, detailed and comprehensive studies had been conducted only in the middle of the XIX century. M. Nowicki (1873) presented the first comprehensive list of Coleoptera from the region, which comprised 2,591 species. Decade later, M. Łomnicki (1884) listed 3,182 species of Coleoptera. At the beginning of the XX century, he listed 5,396 species of 76 families of Coleoptera for territory of Western Ukraine and Eastern Poland (Łomnicki, 1913). The important generalization for the understanding of the regional Coleoptera fauna was published in the monograph of R. Kuntze and J. Noskiewicz (1938), where authors provided the first analysis of the spatial distribution of Coleoptera fauna in the regional scale. They listed 181 species distributed exceptionally on Western Podillia and 126 species widespread outside of Western Podillia. V. Lazorko (1963) made a contribution to the knowledge of the regional fauna. He listed 323 species of Coleoptera, 21 of which were new for the region.

After World War II, the generalized coleopterological revues were not published. Instead, many authors specialized in deep studies of certain Coleoptera groups such as Buprestidae (Zahaykevych, 1978), Cerambycidae (Zahaykevych, 1959), Chrysomelidae (Brovdiy, 1977), Curculionidae (Tveritina, 1959), Elateridae (Dolin, 1966), Ipidae (Zahaykevych, 1957), Stahpylinidae (Petrenko, Nadvornyy, 1990), etc.

Modern research of Coleoptera focuses on faunistics, ecology, and phylogeography. The detailed faunistic studies of certain families of Coleoptera are presented in multiple papers. These include Carabidae (Rizun, 2003), Haliplidae, Noteridae, Dytiscidae, Gyrinidae, Hydraenidae, Hydrophilidae (Mateleshko, 2008), Staphylinidae (Petrenko, 2009), Pselaphidae (Krivosheyev, 2012), Cerambycidae (Zamoroka et al., 2012; Zamoroka, 2018), Buprestidae (Yanytsky, 2013), Curculionidae (Nikulina et al., 2015. Yunakov et al., 2018), Cryptophagidae (Ocheretna, 2020), etc. Ecological studies of Coleoptera include altitudinal distribution (Rizun, Tymochko, Chumak, 2004), habitat patterns (Rizun, Tymochko, Chumak, 2004; Zamoroka, 2008), the influence of anthropogenic impact (Chumak et al., 2005), local extinction (Zamoroka et al., 2018; Zamoroka, 2019), etc. The phylogeographic coleopterological studies focused on certain species (Kajtoch, Lachowska-Cierlik, Mazur, 2009; Kubisz et al., 2012; Zamoroka et al., 2019). Despite the sufficiently well-known local fauna of Coleoptera, a number of faunal, ecological and phylogeographic aspects need to be clarified especially in the light of current climatic changes, ecosystems restoration, and conservation.

In the current study, we presented the results of the study of 595 species of Coleoptera within protected areas in the Eastern Carpathians. Their spatial distribution and change under the influence of regional altitude gradients and differentiation within habitats.

Materials and methods. Region of study. The studied territory covers part of the Eastern Carpathian Mountains and its eastern foothills in Ivano-Frankivsk Region (Ukraine). There are four National Parks (NP) and one Nature Reserve (NR). These include Carpathian NP, Halych NP, Hutsulschyna NP, Verkhovyna NP, and Gorgany NR with a total area of 1,148.2 km^2 or 8.2% of the region. The listed protected

areas cover an altitudinal range from 203 to 2,061 m a. s. l. within the regional scale of variation of ecological conditions. Climatic conditions gradually vary from dry (average annual precipitation 600 mm) and warm (average annual temperature + 7 °C) in the foothills (200 m a. s. l.) to wet (average annual precipitation 2,500 mm) and cold (average annual temperature + 4 °C) in mountains highlands (2,000 m a. s. l.). Altitudinal zonation in the region includes steppes (200–350 m a. s. l.), oak-beech forests (300–400 m a. s. l.), oak-beech-fir forests (400–500 m a. s. l.), beech-fir forests (500–750 m a. s. l.), beech-spruce-fir forests (650–900 m a. s. l.), fir-spruce forests (900–1,050 m a. s. l.), pure spruce forests (1,000–1,800 m a. s. l.), cedar pine-spruce forests (1,500–1,800 m a. s. l.), alpine shrubs (1,500–1,900 m a. s. l.), alpine meadows or stony placers (1,800–2,061 m a. s. l.).

H a b i t a t s . We selected five main habitats (Table 1) within all altitudinal vegetation belts. These include steppe meadow, secondary fir-beech forest, primeval beech-fir forest, high mountain pasture meadow among the pure spruce forest, and alpine shrubs and meadows (Malynovskyi, Krichfalushiy, 2000; Hryhora, Solomakha, 2005).

T a b l e 1 . Location of the sample plots

Locality	Habitat	Decimal coordinates (WGS84)	Altitude, m a. s. l.	Administrative location
Mezhyhirskyi Kamin	Steppe	49.119281, 24.804577	325	Mezhyhirtsi, Ivano-Frankivsk; NP Halych
Zhenets	Secondary fir-beech forest	48.373040, 24.540655	760	Tatariv, Nadvirna; NP Carpathian
Dzhurdzhiy	Primeval beech-fir forest	48.478224, 24.291243	900	Zelena, Nadvirna; NR Gorgany
Vesnarka	High mountain meadows	48.023633, 24.658863	1,450	Zelene, Verkhovyna; NP Carpathian
Pozhyzhevska	Alpine shrubs and meadows	48.146276, 24.524220	1,800	Vorokhta, Nadvirna; NP Carpathian

Plot 1. Mezhehirskyi Kamin is located in Halych NP (49.119281, 24.804577) within the westernmost margin of Podillia Upland. The locality occupies the elongated hill (0.85 km long), directed from north to south, with steep slopes and a flat top with numerous appearances of karst. Vegetation represents xerophilous steppe meadows with the dominating of *Brachypodium pinnatum*, *Elytrigia intermedia*, *Festuca valesiaca*, *Carex humilis*, *Stipa capillata*, *Anthericum ramosum*, *Prunella grandiflora*, *Linum flavum*, *Chamaecytisus blockianus*, *Pyrethrum corymbosum*, *Inula ensifolia*, *Artemisia austriaca*.

Plot 2. Zhenets is located in Carpathian NP (48.373040, 24.540655) in the Gorgany Range. It is a narrow valley of the Zhenets River (4.6 km long), directed to southeast. The valley is bordered by the Khomiak-Syniak Range (1,500–1,600 m a. s. l.) on south and the Yavirnyk Range (1,000–1,400 m a. s. l.) on north. Vegetation represents mountain fir-beech forests (up to 1,000 m a. s. l.) and pure spruce forest (over 1000 m a. s. l.). Fir-beech forests consist of *Abies alba*, *Fagus sylvatica* in the trees layer, and *Oxalis acetosella*, *Carex pilosa*, *Dentaria glandulosa*, *Dentaria bulbifera*, *Anemone nemorosa*, *Athyrium filix-femina*, *Vaccinum myrtillus*, *Rubus hirtus* in the herbs layer. Small patches of the secondary meadows are scattered among the valley.

Plot 3. Dzhurdzhiy is located in Gorgany NR (48.478224, 24.291243) in the Gorgany Range. It is a narrow valley of the Dzhurdzhynets River (3.8 km long), directed to north. The valley is bordered by the Berezovachka Range (1,200–1,500 m a. s. l.) on east and the Skalky Range (1,300–1,500 m a. s. l.) on west. Vegetation represents primeval mountain beech-fir forests (up to 1,000 m a. s. l.) and pure spruce forest and cedar pine-spruce forests (over 1,000 m a. s. l.). Beech-fir forests consist of *Abies alba*, *Fagus sylvatica*, *Acer pseudoplatanus* in the trees layer, and *Lonicera nigra*, *Sambucus racemosa*, *Sorbus aucuparia* in the shrub layer, and *Vaccinum myrtillus*, *Oxalis acetosella*, *Lusula sylvatica*, *Dryopteris affinis*, *Carex pilosa*, *Dentaria glandulosa*, *Soldanella hungarica* in the herbs layer.

Plot 4. Vesnarka is located in Carpathian NP (48.023633, 24.658863) in the Chornohora Range. It is a high mountain pasture meadow (local name ‘polonyna’) on the mountain range of mount Pip Ivan Chornohirskyi. The location is surrounded by pure spruce forest. Vegetation of the polonyna is represented by dominating *Deschampsia caespitosa*, *Phleum alpinum*, *Luzula luzuloides*, *Festuca picturata*, *Festuca rubra*, *Potentilla aurea*, *Ligusticum mutellina*, *Rumex alpinum*. Pure spruce forests consist of *Picea abies* at trees level and *Oxalis acetosella*, *Euphorbia amygdaloides*, *Dentaria glandulosa*, *Dentaria bulbifera*, *Anemone nemorosa* in the herbs layer.

Plot 5. Pozhyzhevska is located in Carpathian NP (48.146276, 24.524220) in the Chornohora Range. It is an alpine meadow with patches of alpine shrubs around of summit of mount Pozhyzhevska. The vegetation of the alpine meadows is represented by dominating *Carex sempervirens*, *Juncus trifidus*, *Sesleria coerulans*, *Calamagrostis villosa*, *Phleum alpinum*, *Festuca supina*, *Rhododendron myrtifolium*, *Potentilla aurea*, *Soldanella hungarica*. Vegetation of the alpine shrubs consists *Pinus mugo*, *Alnus viridis* in shrubs layer, and *Rhododendron myrtifolium*, *Vaccinum myrtillus*, *Empetrum nigrum*, *Athyrium filix-femina*, *Deschampsia caespitosa*, *Luzula*

sylvatica, *Nardus stricta*, *Doronicum pardalianches*, *Senecio fuchsii* in herbs layer, and *Sphagnum magellanicum* in moss layer.

Collecting methods. Materials were collected during 2010–2013. The multiple methods of material collecting were applied. These included manual collecting insects on the forage plants, on withered, felled, and damaged broadleaf and coniferous trees, beating tray, flotation method, using entomological sweep-net, pitfall traps (line of 10 cans with an interval of 5 m), and light traps (combining of day-light and UV-light lamps) (Ghilarov, 1941; Fasulati, 1971; Grootaert et al., 2010; Steiner, Häuser, 2010). We also studied additional materials collected during 1993–1996 (A. Sumarokov's collection).

Insects sampling was carried under the limits set by the Ministry of Ecology and Natural Resources of Ukraine for Carpathian NP (2011–2013), Halych NP (2010–2011), and Gorgany NR (2013). All material has been collected under approved ethics guidelines (Drinkwater, Robinson, Hard, 2019; Fischer, Larson, 2019).

Taxonomy and nomenclature. In giving species names and taxonomy, we followed 'Catalogue of Palaearctic Coleoptera' (Löbl, I., Smetana, 2007, 2010; Löbl, I., Löbl, D., 2015, 2016, 2017; Dariusz, Löbl, I., 2020) and 'Cooperative Catalogue of Palaerctic Coleoptera Curculionoidea' (Alonso-Zarazaga et al., 2017).

Results and discussions. General diversity patterns. Comprehensive collection methods allowed us to identify 595 beetle species of 37 families (Table 2) on the territory of protected areas of the Eastern Carpathians. We found 344 species in Carpathian NP, 327 species — in Halych NP, and 192 species — in Gorgany NR. These include Carabidae (169 species), Curculionidae (107 species), Chrysomelidae (59 species), Cerambycidae (49 species), Staphylinidae (30 species), Cantharidae (22 species), Elateridae (22 species), Coccinellidae (15 species), Brentidae (14 species), Silphidae (11 species), Attelabidae (10 species), Melyridae (10 species), Scarabaeidae (10 species). Remained 24 families consist of less than 10 species. Taxonomical composition (Fig. 1) of Coleoptera fauna highly varies among studied territory. While the number of Coleoptera families decreases evenly along with increasing in altitude, the proportion per family dramatically varies within the studied area. For instance, we found 26 families at an altitude 325 m a. s. l. in Halych NP, 27 families — at 760 m a. s. l. in Carpathian NP, 25 families — at 900 m a. s. l. in Gorgany NR, 19 families — at 1,450 m a. s. l. in Carpathian NP, and 15 families — at 1,800 m a. s. l. in Carpathian NP.

Table 2. Taxonomic composition and spatial distribution of Coleoptera among the sample plots

Species	Mezhyhirskyi Kamin	Zhenets	Dzhurdzhiy	Vesnarka	Pozhyzhevska
ATTELABIDAE					
Apoderus coryli (Linnaeus, 1758)	*	–	–	–	–
Attelabus nitens (Scopoli, 1763)	–	*	–	–	–
Byctiscus betulae (Linnaeus, 1758)	–	–	–	–	*
Byctiscus populi (Linnaeus, 1758)	*	–	–	–	–
Deporaus betulae (Linnaeus, 1758)	*	–	–	–	–
Involvulus cupreus (Linnaeus, 1761)	*	–	–	–	–
Involvulus pubescens (Fabricius, 1775)	*	–	–	–	–
Mecorhis aethiops (Bach, 1854)	*	–	–	–	–
Neocoenorrhinus germanicus (Herbst, 1797)	*	*	–	–	–
Tatianaerhynchites aequatus (Linnaeus, 1767)	*	–	–	–	–
Subtotal:	8	2	0	0	1
BRENTIDAE					
Apion cruentatum Walton, 1844	–	*	–	–	–
Apion frumentarium (Linnaeus, 1758)	*	–	–	–	–
Cyanapion gyllenhalii (W. Kirby, 1808)	*	–	–	–	–
Eutrichapion viciae (Paykull, 1800)	*	–	–	–	–
Holotrichapion pisi (Fabricius, 1801)	–	*	–	–	–
Ischnopterapion loti (W. Kirby, 1808)	*		–	–	–
Nanophyes marmoratus (Goeze, 1777)	–	*	–	–	–
Oxystoma ochropus (Germar, 1818)	–	*	–	–	–
Perapion violaceum (W. Kirby, 1808)	*	–	–	–	–
Protapion apricans (Herbst, 1797)	*	*	–	–	–
Protapion assimile (Kirby, 1808)	*		–	–	–
Protapion fulvipes (Geoffroy, 1785)	–	*	*	–	–
Protapion gracilipes (Dietrich, 1857)	*	–	–	–	–
Pseudostenapion simum (Germar, 1817)	*	–	–	–	–
Subtotal:	9	6	1	0	0
BUPRESTIDAE					
Anthaxia helvetica Stierlin, 1868	–	*	*	–	–

Continuation of Table 2

Species	Mezhyhirskyi Kamin	Zhenets	Dzhurdzhiy	Vesnarka	Pozhyzhevska
Anthaxia nitidula signaticollis (Krynicki, 1832)	–	–	–	–	*
Coraebus elatus (Fabricius, 1787)	*	–	–	–	–
Trachys minutus minutus (Linnaeus, 1758)	–	–	–	–	*
Subtotal:	1	1	1	0	2
BYRRHIDAE					
Byrrhus pilula (Linnaeus, 1758)	–	–	*	–	–
Byrrhus glabratus Heer, 1841	–	*	*	–	–
Byrrhus luniger Germar, 1817	–	*	*	–	*
Carpathobyrrhulus transsylvanicus (Suffrian, 1848)	–	–	*	–	–
Cytilus sericeus (Forster, 1771)	–	*	*	–	–
Subtotal:	0	3	5	0	1
BYTURIDAE					
Byturus ochraceus (Scriba, 1790)	*	*	–	*	–
Byturus tomentosus (De Geer, 1774)	–	*	–	–	*
Subtotal:	1	2	0	1	1
CANTHARIDAE					
Ancistronycha abdominalis (Fabricius, 1798)	–	*	–	–	–
Ancistronycha violacea (Paykull, 1798)	–	*	–	–	–
Cantharis annularis Ménétriés, 1836	–	**	**	–	–
Cantharis flavilabris Fallén, 1807	–	*	–	–	–
Cantharis fusca Linnaeus, 1758	*	*	*	–	–
Cantharis livida var. *rufipes* Herbst, 1784	**	–	**	–	–
Cantharis nigricans (O. F. Müller, 1776)	*	**	*	–	–
Cantharis obscura Linnaeus, 1758	***	*	*	–	–
Cantharis pellucida Fabricius, 1792	*	*	*	–	–
Cantharis quadripunctata (O. F. Müller, 1776)	–	*	*	–	–
Cantharis rufa Linnaeus, 1758	**	*	*	*	–
Cantharis rustica Fallén, 1807	*	**	*	–	–
Malthodes sp.	–	–	*	–	–
Metacantharis discoidea (Ahrens, 1812)	–	*	–	–	–
Podabrus alpinus (Paykull, 1798)	–	*	–	–	–
Podistra rufotestacea (Letzner, 1845)	–	*	–	–	–
Podistra schoenherri (Dejean, 1837)	–	*	–	–	–
Rhagonycha fulva (Scopoli, 1763)	***	*	–	–	–
Rhagonycha lignosa (O. F. Müller, 1764)	–	*	**	–	–
Rhagonycha nigriventris Motschulsky, 1860	*	*	*	*	–
Rhagonycha testacea (Linnaeus, 1758)	–	*	*	–	–
Silis nitidula Fabricius, 1792	*	–	–	–	–
Subtotal:	10	19	13	2	0
CARABIDAE					
Abax parallelepipedus (Piller et Mitterpacher, 1783)	*	***	**	*	–
Agonum fuliginosum (Panzer, 1809)	–	*	–	–	–
Agonum muelleri (Herbst, 1784)	*	–	*	–	–
Agonum sexpunctatum (Linnaeus, 1758)	–	*	–	–	–
Agonum versutum Sturm, 1824	*	–	*	–	–
Agonum viduum (Panzer 1796)	–	*	*	–	–
Agonum viridicupreum (Goeze, 1777)	–	*	–	–	–
Amara aenea (De Geer, 1774)	**	–	–	–	–
Amara bifrons (Gyllenhal, 1810)	–	*	–	–	–
Amara communis (Panzer 1797)	–	*	*	–	–
Amara consularis (Duftschmid, 1812)	*	–	*	–	–
Amara convexior Stephens, 1828	–	–	*	–	–
Amara curta Dejean, 1828	–	–	*	–	–
Amara eurynota (Panzer, 1796)	–	*	–	–	–
Amara familiaris (Duftschmid, 1812)	*	–	–	–	–
Amara ovata (Fabricius, 1792)	*	–	*	–	–
Amara plebeja (Gyllenhal, 1810)	*	*	–	–	–
Amara similata (Gyllenhal, 1810)	*	–	–	–	–
Anchomenus dorsalis (Pontoppidan, 1763)	–	*	–	–	–
Anisodactylus binotatus (Fabricius, 1787)	*	*	–	–	–
Anisodactylus nemorivagus (Duftschmid, 1812)	–	*	–	–	–
Anisodactylus signatus (Panzer, 1796)	–	–	*	–	–
Asaphidion caraboides (Schrank, 1781)	–	*	*	–	–

Continuation of Table 2

Species	Mezhyhirskyi Kamin	Zhenets	Dzhurdzhiy	Vesnarka	Pozhyzhevska
Asaphidion flavipes (Linnaeus, 1761)	*	–	*	–	–
Badister bullatus (Schrank, 1798)	*	–	*	–	–
Badister lacertosus Sturm, 1815	–	*	–	–	–
Badister peltatus (Panzer, 1796)	*	–	–	–	–
Bembidion argenteolum Ahrens, 1812	**	–	–	–	–
Bembidion articulatum (Panzer, 1796)	–	–	*	–	–
Bembidion ascendens K. Daniel, 1902	*	*	–	–	–
Bembidion assimile Gyllenhal, 1810	–	**	–	–	–
Bembidion atrocoeruleum (Stephens, 1828)	–	–	*	–	–
Bembidion bipunctatum nivale Heer, 1837	**	–	*	–	–
Bembidion conforme Dejean, 1831	*	–	–	–	–
Bembidion dalmatinum Dejean, 1831	–	*	*	–	–
Bembidion dentellum (Thunberg, 1787)	–	*	–	–	–
Bembidion doderoi Ganglbauer, 1891	–	–	*	–	–
Bembidion doris (Panzer, 1796)	–	*	–	–	–
Bembidion fasciolatum (Duftschmid, 1812)	–	**	–	–	–
Bembidion geniculatum Heer, 1837	**	–	*	–	**
Bembidion guttula (Fabricius, 1792)	**	**	–	–	–
Bembidion lampros (Herbst, 1784)	**	**	*	–	–
Bembidion litorale (Oliver, 1790)	*	–	*	–	–
Bembidion lunatum (Duftschmid, 1812)	*	**	*	–	–
Bembidion lunulatum (Geoffroy, 1785)	–	*	–	–	–
Bembidion mannerheimii C. R. Sahlberg, 1827	*	*	*	–	–
Bembidion milleri Jacquelin du Val, 1852	–	–	–	–	*
Bembidion monticola monticola Sturm, 1825	–	**	*	–	–
Bembidion nigricorne Gyllenhal, 1827	–	–	–	–	*
Bembidion properans (Stephens, 1828)	**	**	–	–	–
Bembidion pygmaeum (Fabricius, 1792)	–	*	–	–	–
Bembidion quadrimaculatum (Linnaeus, 1761)	*	**	*	–	–
Bembidion quadripustulatum Audinet-Serville, 1821	*	*	–	–	–
Bembidion ruficorne Sturm, 1825	–	**	*	–	–
Bembidion saxatile saxatile Gyllenhal, 1827	–	–	*	–	–
Bembidion scapulare Dejean, 1831	–	–	*	–	–
Bembidion schueppeli Dejean, 1831	**	**	*	–	–
Bembidion splendidum Sturm, 1825	–	**	–	–	–
Bembidion striatum (Fabricius, 1792)	**	*	–	–	–
Bembidion tetracolum Say, 1823	**	*	*	–	–
Bembidion tibiale (Duftschmid, 1812)	–	*	*	–	–
Bembidion varicolor (Fabricius, 1803)	–	–	*	–	–
Bembidion varium (Olivier, 1795)	–	**	*	–	–
Bembidion velox (Linnaeus, 1761)	–	**	–	–	–
Calathus fuscipes (Goeze, 1777)	*	*	*	–	–
Calathus melanocephalus (Linnaeus, 1758)	*	**	*	–	–
Calathus metallicus Dejean, 1828	–	–	***	–	–
Carabus arcensis emerita Fischer von Waldheim, 1823	–	–	–	–	*
Carabus auronitens escheri Palliardi, 1825	–	***	***	*	*
Carabus cancellatus cancellatus Illiger, 1798	*	**	*	–	–
Carabus convexus convexus Fabricius, 1775	*	–	*	–	–
Carabus coriaceus rugifer (Kraatz, 1877)	*	**	**	–	–
Carabus excellens Fabricius, 1798	*	–	–	–	–
Carabus fabricii ucrainicus Lazorko, 1951	–	–	*	–	–
Carabus glabratus glabratus Paykull, 1790	*	**	*	*	*
Carabus granulatus granulatus Linnaeus, 1758	*	**	*	–	–
Carabus intricatus Linnaeus, 1761	*	–	–	–	–
Carabus irregularis montandoni Buysson, 1882	–	*	–	–	–
Carabus linnei Panzer, 1810	–	**	**	*	–
Carabus obsoletus Sturm, 1815	–	–	**	*	*
Carabus rothi hampei Küster, 1846	–	–	–	–	*
Carabus scheidleri zawadzkii Kraatz, 1854	–	***	***	*	*
Carabus sylvestris transsylvanicus Dejean, 1826	–	–	–	*	***
Carabus variolosus Fabricius, 1787	–	**	*	–	–
Carabus violaceus Linnaeus, 1758	*	***	**	*	–
Chlaenius spoliatus spoliatus (P. Rossi, 1792)	–	–	*	–	–
Chlaenius vestitus (Paykull, 1790)	–	–	*	–	–

Continuation of Table 2

Species	Mezhyhirskyi Kamin	Zhenets	Dzhurdzhiy	Vesnarka	Pozhyzhevska
Cicindela campestris Linnaeus, 1758	***	*	*	–	–
Cicindela sylvicola Dejean, 1822	–	–	***	–	–
Clivina collaris (Herbst, 1784)	*	–	*	–	–
Clivina fossor (Linnaeus, 1758)	**	*	*	–	–
Cychrus caraboides (Linnaeus, 1758)	*	*	**	*	***
Cylindera germanica (Linnaeus, 1758)	**	–	–	–	–
Cymindis cingulata Dejean 1825	–	–	*	–	–
Cymindis humeralis (Geoffroy, 1785)	*	–	*	–	–
Deltomerus carpathicus (L. Miller, 1868)	–	***	*	–	–
Dicheirotrichus obsoletus (Dejean, 1829)	–	–	*	–	–
Drypta dentata (P. Rossi, 1790)	**	*	–	–	–
Duvalius subterraneus (L. Miller, 1868)	–	–	*	–	–
Dyschirius aeneus (Dejean, 1825)	–	*	–	–	–
Dyschirius globosus (Herbst, 1784)	–	*	*	–	–
Dyschirius rufipes (Dejean, 1825)	*	–	–	–	–
Elaphrus aureus P. W. J. Müller, 1821	–	–	*	–	–
Elaphrus cupreus Duftschmid, 1812	–	*	*	–	–
Elaphrus riparius (Linnaeus, 1758)	–	*	–	–	–
Harpalus affinis (Schrank, 1781)	*	–	*	–	–
Harpalus calceatus (Duftschmid, 1812)	***	*	–	–	–
Harpalus distinguendus (Duftschmid, 1812)	–	**	–	–	–
Harpalus griseus (Panzer, 1796)	–	*	*	–	–
Harpalus latus (Linnaeus, 1758)	**	*	–	–	–
Harpalus rubripes (Duftschmid, 1812)	**	*	–	–	–
Harpalus serripes (Quensel in Schönherr, 1806)	–	**	–	–	–
Harpalus smaragdinus (Duftschmid, 1812)	–	*	–	–	–
Harpalus tardus (Panzer, 1797)	*	–	–	–	–
Harpalus rufipes (De Geer, 1774)	*	*	*	–	–
Laemostenus terricola (Herbst, 1784)	–	–	*	–	–
Lebia cruxminor (Linnaeus, 1758)	–	–	*	–	–
Lebia cyanocephala (Linnaeus, 1758)	–	*	–	–	–
Leistus ferrugineus (Linnaeus, 1758)	***	–	–	–	–
Leistus piceus (Frölich, 1799)	–	*	*	–	–
Licinus depressus (Paykull, 1790)	*	–	*	–	–
Licinus hoffmannseggii (Panzer, 1803)	–	*	–	–	–
Microlestes maurus (Sturm, 1827)	*	*	–	–	–
Microlestes plagiatus (Duftschmid, 1812)	–	*	–	–	–
Molops piceus (Panzer, 1793)	–	**	*	*	–
Nebria brevicollis (Fabricius, 1792)	–	*	*	–	–
Nebria fuscipes Fuss, 1849	–	–	*	–	–
Nebria jockischii hoepfneri Dejean, 1826	–	–	*	–	–
Nebria picicornis (Fabricius, 1801)	–	–	*	–	–
Nebria reitteri Rybiński, 1902	–	–	*	–	*
Nebria rufescens rufescens (Ström, 1768)	–	*	–	–	–
Nebria transsylvanica Germar 1824	–	–	*	–	***
Notiophilus aquaticus (Linnaeus, 1758)	–	–	*	–	–
Notiophilus biguttatus (Fabricius, 1779)	*	*	*	–	–
Notiophilus palustris (Duftschmid, 1812)	*	–	*	–	*
Notiophilus rufipes Curtis, 1829	*	*	–	–	–
Oodes helopioides (Fabricius, 1792)	*	*	–	–	–
Ophonus rufibarbis (Fabricius, 1792)	*	–	–	–	–
Ophonus rupicola (Sturm, 1818)	***	–	–	–	–
Oxypselaphus obscurus (Herbst, 1784)	*	*	–	–	–
Panagaeus bipustulatus (Fabricius, 1775)	*	–	–	–	–
Panagaeus cruxmajor (Linnaeus, 1758)	–	–	*	–	–
Patrobus quadricollis L. Miller, 1868	–	*	*	*	–
Perileptus areolatus (Creutzer, 1799)	–	*	*	–	–
Platynus assimilis (Paykull, 1790)	–	***	***	–	–
Poecilus lepidus (Leske, 1785)	–	–	*	–	–
Poecilus versicolor (Sturm, 1824)	*	–	*	–	–
Pterostichus anthracinus (Illiger, 1798)	*	*	*	–	–
Pterostichus diligens (Sturm, 1824)	*	–	*	–	–
Pterostichus foveolatus (Duftschmid, 1812)	–	***	**	–	*
Pterostichus jurinei (Panzer, 1803)	–	*	*	–	*

Continuation of Table 2

Species	Mezhyhirskyi Kamin	Zhenets	Dzhurdzhiy	Vesnarka	Pozhyzhevska
Pterostichus melanarius (Illiger, 1798)	*	*	**	–	–
Pterostichus niger (Schaller, 1783)	*	*	*	–	–
Pterostichus nigrita (Paykull, 1790)	*	*	*	–	–
Pterostichus oblongopunctatus (Fabricius, 1787)	*	–	**	–	*
Pterostichus ovoideus (Sturm, 1824)	–	*	*	–	–
Pterostichus pilosus pilosus (Host, 1789)	–	–	***	–	*
Pterostichus strenuus (Panzer, 1796)	*	*	*	–	–
Pterostichus unctulatus (Duftschmid, 1812)	–	**	–	–	*
Pterostichus vernalis (Panzer, 1796)	**	*	*	–	–
Stenolophus teutonus (Schrank, 1781)	–	–	*	–	–
Synuchus vivalis (Illiger, 1798)	–	–	–	–	*
Tachys micros (Fischer von Waldheim, 1828)	–	*	*	–	–
Trechus carpaticus Rybiński, 1902	–	–	*	–	–
Trechus latus Putzeys, 1847	–	–	–	–	*
Trechus pulchellus Putzeys, 1846	–	–	*	–	–
Trechus quadristriatus (Schrank, 1781)	**	*	–	–	–
Trichotichnus laevicollis (Duftschmid, 1812)	–	*	–	–	–
Zabrus tenebrioides (Goeze, 1777)	*	*	–	–	–
Subtotal:	75	96	102	11	20
CERAMBYCIDAE					
Agapanthia cardui (Linnaeus, 1767)	***	–	–	–	–
Agapanthia intermedia Ganglbauer, 1884	**	–	–	–	–
Agapanthia villosoviridescens (De Geer, 1775)	**	–	–	*	–
Alosterna tabacicolor (De Geer, 1775)	*	***	***	–	–
Anaglyptus mysticus (Linnaeus, 1758)	**	*	–	–	–
Anastrangalia dubia (Scopoli, 1763)	–	***	***	**	–
Anastrangalia sanguinolenta (Linnaeus, 1761)	–	**	**	*	*
Anoplodera sexguttata (Fabricius, 1775)	**	–	–	–	–
Calamobius filum (Rossi, 1790)	***	–		–	–
Cyrtoclytus capra (Germar, 1824)	–	*	*	–	–
Dinoptera collaris (Linnaeus, 1758)	**	***	***	–	–
Dorcadion fulvum opillicum Zamoroka, 2019	***	–	–	–	–
Dorcadion holosericeum Krynicki, 1832	***	–	–	–	–
Etorofus pubescens (Fabricius, 1787)	–	–	–	*	–
Evodinus clathratus (Fabricius, 1793)	–	***	***	***	**
Gaurotes virginea (Linnaeus, 1758)	–	***	***	–	–
Hylotrupes bajulus (Linnaeus, 1758)	–	*	–	–	–
Judolia sexmaculata (Linnaeus, 1758)	–	**	*	–	–
Leiopus nebulosus (Linnaeus, 1758)	*	–	–	–	–
Leptura annularis Fabricius, 1801	**	*	*	*	–
Leptura quadrifasciata Linnaeus, 1758	–	***	***	**	–
Lepturobosca virens (Linnaeus, 1758)	–	**	***	**	–
Molorchus minor (Linnaeus, 1758)	–	***	***	–	–
Monochamus sartor (Fabricius, 1787)	–	***	***	***	–
Monochamus sutor (Linnaeus, 1758)	–	***	***	***	–
Nivellia sanguinosa (Gyllenhal, 1827)	–	*	**	***	–
Oberea erythrocephala (Schrank, 1776)	**	–	–	–	–
Obrium brunneum (Fabricius, 1792)	–	***	–	–	–
Oxymirus cursor (Linnaeus, 1758)	–	–	–	***	**
Pachyta quadrimaculata (Linnaeus, 1758)	–	**	–	*	–
Pachytodes cerambyciformis (Schrank, 1781)	*	***	*	–	–
Paracorymbia maculicornis (De Geer, 1775)	*	–	*	–	–
Phytoecia affinis (Harrer, 1784)	*	*	*	–	–
Phytoecia coerulescens (Scopoli, 1763)	***	–	–	–	–
Phytoecia cylindrica (Linnaeus, 1758)	*	*	–	–	–
Phytoecia tigrina Mulsant, 1851	*	–	–	–	–
Phytoecia uncinata (W. Redtenbacher, 1842)	**	–	–	–	–
Pidonia lurida (Fabricius, 1793)	–	***	***	–	–
Pseudovadonia livida (Fabricius, 1776)	–	*	–	–	–
Rhagium inquisitor (Linnaeus, 1758)	–	***	***	***	–
Rhagium mordax (De Geer, 1775)	*	–	*	–	–
Rutpela maculata (Poda, 1761)	**	–	–	–	–
Stenocorus meridianus (Linnaeus, 1758)	–	*	–	–	–
Stenostola ferrea (Schrank, 1776)	*	–	–	–	–

Continuation of Table 2

Species	Mezhyhirskyi Kamin	Zhenets	Dzhurdzhiy	Vesnarka	Pozhyzhevska
Stenurella melanura (Linnaeus, 1758)	–	***	–	–	–
Stenurella nigra (Linnaeus, 1758)	**	–	–	–	–
Stictoleptura rubra (Linnaeus, 1758)	–	***	***	***	–
Strangalia attenuata (Linnaeus, 1758)	***	–	–	–	–
Tetropium castaneum (Linnaeus, 1758)	–	***	***	***	–
Subtotal:	25	29	23	16	3
CHRYSOMELIDAE					
Agelastica alni (Linnaeus, 1758)	*	***	–	–	–
Aulacophora quadrimaculata (Fabricius, 1781)	**	–	–	–	–
Bromius obscurus (Linnaeus, 1758)	–	–	–	*	–
Cassida panzeri Weise, 1907	*	–	–	–	–
Cassida rubiginosa O. F. Müller, 1776	*	–	–	–	–
Cassida vibex Linnaeus, 1767	*	*	–	–	–
Cassida viridis Linnaeus, 1758	*	*	–	–	–
Chaetocnema concinna (Marsham, 1802)	–	*	–	–	–
Chrysolina fastuosa (Scopoli, 1763)	–	***	–	–	–
Chrysolina graminis (Linnaeus, 1758)	**	*	–	–	–
Chrysolina herbacea (Duftschmid, 1825)	*	***	–	–	–
Chrysolina polita (Linnaeus, 1758)	–	**	–	–	–
Chrysolina varians (Schaller, 1783)	–	**	–	*	–
Clytra quadripunctata (Linnaeus, 1758)	–	–	***	–	–
Coptocephala scopolina (Linnaeus, 1767)	*	–	–	–	–
Coptocephala unifasciata (Scopoli, 1763)	*	–	–	–	–
Crepidodera aurata (Marsham, 1802)	–	***	–	–	–
Cryptocephalus aureolus Suffrian, 1847	–	–	**	–	–
Cryptocephalus octopunctatus (Scopoli, 1763)	–	**	–	–	–
Cryptocephalus quinquepunctatus (Scopoli, 1763)	–	**	–	*	–
Cryptocephalus virens Suffrian, 1847	*	–	–	–	–
Derocrepis rufipes (Linnaeus, 1758)	–	*	–	–	–
Dibolia schillingii (Letzner, 1847)	***	–	–	–	–
Entomoscelis adonidis (Pallas, 1771)	***	–	–	–	–
Eumolpus asclepiadeus (Pallas, 1776)	**	–	–	–	–
Exosoma collare (Hummel, 1825)	*	–	–	–	–
Galeruca dahlii (Joannis, 1865)	–	*	–	–	–
Galeruca pomonae (Scopoli, 1763)	***	–	–	–	–
Galeruca tanaceti (Linnaeus, 1758)	**	–	–	–	–
Galerucella lineola (Fabricius, 1781)	–	*	–	–	–
Gastrophysa viridula (De Geer, 1775)	*	**	–	*	*
Gonioctena interposita (Franz et Palmen, 1950)	*	*	–	–	–
Hippuriphila modeeri (Linnaeus, 1761)	–	–	–	**	–
Labidostomis axillaris (Lacordaire, 1848)	*	–	–	–	–
Leptinotarsa decemlineata (Say, 1824)	*	–	–	–	–
Lilioceris merdigera (Linnaeus, 1758)	**	–	*	–	–
Lochmaea caprea (Linnaeus, 1758)	–	–	–	***	–
Lochmaea suturalis (C. G. Thomson, 1866)	–	**	–	*	–
Longitarsus echii (Koch, 1803)	***	–	–	–	–
Longitarsus luridus (Scopoli, 1763)	**	–	–	–	–
Neocrepidodera femorata (Gyllenhal, 1813)	–	**	–	–	–
Oreina cacaliae senecionis (Schummel, 1843)	–	–	*	**	**
Oreina intricata (Germar, 1824)	–	*	–	**	–
Oreina virgulata praefica (Weise, 1884)	–	–	–	**	–
Pachnephorus tessellatus (Duftschmid, 1825)	*	–	–	–	–
Pachybrachis fimbriolatus Suffrian, 1848	**	–	–	–	–
Phaedon cochleariae (Fabricius, 1792)	–	–	–	*	–
Phratora vitellinae (Linnaeus, 1758)	*	–	–	*	–
Phyllotreta nemorum (Linnaeus, 1758)	**	–	–	–	–
Phyllotreta undulata Kutschera, 1860	–	–	***	–	–
Plagiosterna aenea (Linnaeus, 1758)	–	*	*	–	–
Plateumaris consimilis (Schrank, 1781)	–	–	*	*	*
Plateumaris rustica (Kunze, 1818)	–	*	–	–	–
Plateumaris sericea (Linnaeus, 1758)	–	***	***	–	–
Plateumaris sp.	–	*	–	–	–
Prasocuris marginella (Linnaeus, 1758)	–	*	–	–	–
Sclerophaedon carpathicus (Weise, 1875)	–	–	–	–	**

Continuation of Table 2

Species	Mezhyhirskyi Kamin	Zhenets	Dzhurdzhiy	Vesnarka	Pozhyzhevska
Smaragdina salicina (Scopoli, 1763)	*	–	–	–	–
Timarcha goettingensis (Linnaeus, 1758)	***	–	–	–	–
Subtotal:	30	25	8	13	4
CLERIDAE					
Thanasimus formicarius (Linnaeus, 1758)	*	–	–	*	–
Tillus elongatus (Linnaeus, 1758)	–	–	*	–	–
Trichodes apiarius (Linnaeus, 1758)	**	–	–	–	–
Subtotal:	2	0	1	1	0
COCCINELLIDAE					
Adalia bipunctata (Linnaeus, 1758)	**	**	–	–	–
Anatis ocellata (Linnaeus, 1758)	–	–	–	*	–
Calvia quatuordecimguttata (Linnaeus, 1758)	–	*	*	–	–
Coccinella septempunctata Linnaeus, 1758	***	**	–	**	–
Halyzia sedecimguttata (Linnaeus, 1758)	*	–	–	–	–
Harmonia axyridis (Pallas, 1773)	***	***	–	–	–
Hippodamia variegata (Goeze, 1777)	**	–	–	*	–
Hyperaspis erytrocephala (Fabricius, 1787)	**	–	–	*	–
Nephus bipunctatus (Kugelann, 1794)	*	–	–	–	–
Nephus quadrimaculatus (Herbst, 1783)	*	–	–	–	–
Platynaspis luteorubra (Goeze, 1777)	*	–	–	–	–
Propylaea quatuordecimpunctata (Linnaeus, 1758)	**	*	*	–	–
Scymnus auritus Thunberg, 1795	*	–	–	–	–
Scymnus frontalis (Fabricius, 1787)	–	–	–	*	–
Scymnus haemorrhoidalis Herbst, 1797	*	–	–	–	–
Subtotal:	12	5	2	5	0
CRYPTOPHAGIDAE					
Cryptophagus subdepressus Gyllenhal, 1827	–	*	–	–	–
Micrambe ulicis (Stephens, 1830)	*	–	–	–	–
Telmatophilus typhae (Fallén, 1802)	*	–	–	–	–
Subtotal:	2	1	0	0	0
CURCULIONIDAE					
Anoplus roboris Suffrian, 1840		*	–	–	–
Anthonomus rectirostris (Linnaeus, 1758)	*	–	–	–	–
Anthonomus rubi (Herbst, 1795)	*	–	–	*	–
Archarius salicivorus (Paykull, 1792)		*	–	–	–
Argoptochus quadrisignatus (Bach, 1856)	*	–	–	–	–
Bryodaemon hanakii (J. Frivaldszky, 1865)	–	*	–	–	–
Centricnemus leucogrammus (Germar, 1824)	**	–	–	–	–
Ceutorhynchus obstrictus (Marsham, 1802)	**	–	–	–	–
Cionus hortulanus (Geoffroy, 1785)	–	*	–	–	–
Cionus tuberculosus (Scopoli, 1763)	–	*	–	–	–
Cleonis pigra (Scopoli, 1763)	**	–	–	–	–
Cleopomiarus graminis (Gyllenhal, 1813)	*	–	–	–	–
Cyphocleonus dealbatus (Gmelin, 1790)	***	–	–	–	–
Donus comatus (Boheman, 1842)	–	**	–	*	–
Donus ovalis (Boheman, 1842)	–	**	–	–	–
Donus rubi (Krauss, 1900)	–	***	–	*	–
Donus velutinus (Boheman, 1842)	–	**	–	–	–
Eusomus ovulum Germar, 1824	*	–	–	–	–
Foucartia squamulata (Herbst, 1795)	**	*	–	–	–
Gymnetron melanarium (Germar, 1821)	*	–	–	–	–
Hylastes cunicularius Erichson, 1836	–	–	*	–	–
Hylobius abietis (Linnaeus, 1758)	*	***	–	–	–
Hypera rumicis (Linnaeus, 1758)	*	–	–	–	–
Hypera transsylvanica (Petri, 1901)	**	–	–	–	–
Isochnus foliorum (O. F. Müller, 1764)	–	*	–	–	–
Larinus obtusus Gyllenhal, 1835	***	–	–	*	–
Larinus sturnus (Schaller, 1783)	**	–	–	–	–
Larinus turbinatus Gyllenhal, 1835	**	–	–	–	–
Liophloeus gibbus Boheman,1842	*	–	–	–	–
Liophloeus liptoviensis Weise, 1894	*	*	–	*	*
Liophloeus tessulatus (O. F. Müller, 1776)	**	–	–	*	–
Liparus coronatus (Goeze, 1777)	*	–	–	–	–

Continuation of Table 2

Species	Mezhyhirskyi Kamin	Zhenets	Dzhurdzhiy	Vesnarka	Pozhyzhevska
Liparus glabrirostris (Küster, 1849)	–	***	**	–	*
Lixus bardanae (Fabricius, 1787)	*	–	–	–	–
Lixus iridis Olivier, 1807	***	–	–	–	–
Lixus punctiventris Boheman, 1835	**	–	–	–	–
Magdalis armigera (Geoffroy, 1785)	*	–	–	–	–
Magdalis ruficornis (Linnaeus, 1758)	–	–	*	–	–
Mecaspis alternans (Hellwig, 1795)	***	–	–	–	–
Miarus ajugae (Herbst, 1795)	*	–	–	–	–
Miarus simplex Solari, 1947	–	*	–	–	–
Microplontus campestris (Gyllenhal, 1837)	*	–	–	–	–
Nedyus quadrimaculatus (Linnaeus, 1758)	*	–	*	*	–
Otiorhynchus asplenii Miller, 1868	–	–	–	–	*
Otiorhynchus coecus coecus Germar, 1824	–	–	**	**	*
Otiorhynchus deubeli Ganglbauer, 1896	–	**	–	*	–
Otiorhynchus fullo (Schrank, 1781)	**	–	–	–	–
Otiorhynchus krattereri Boheman, 1843	–	*	–	–	*
Otiorhynchus kuenburgi Stierlin, 1866	–	*	–	–	–
Otiorhynchus morio (Fabricius, 1781)	–	–	–	–	*
Otiorhynchus multipunctatus (Fabricius, 1792)	–	–	***	–	–
Otiorhynchus nodosus (O. F. Müller, 1764)	–	–	**	**	–
Otiorhynchus obsidianus Boheman, 1843	–	*	–	–	–
Otiorhynchus opulentus Germar, 1836	–	*	–	–	–
Otiorhynchus ovatus (Linnaeus 1758)	**	–	***	–	–
Otiorhynchus peneckianus Smreczyński, 1963	–	**	–	–	–
Otiorhynchus raucus (Fabricius, 1777)	***	–	–	–	–
Otiorhynchus tenebricosus (Herbst, 1784)	–	***	**	*	*
Otiorhynchus singularis (Linnaeus, 1767)	–	–	–	–	**
Otiorhynchus velutinus Germar, 1824	***	–	–	–	–
Paophilus afflatus (Boheman, 1833)	*	–	–	–	–
Phyllobius argentatus (Linnaeus, 1758)	***	–	–	*	–
Phyllobius brevis Gyllenhal, 1834	**	–	–	–	–
Phyllobius contemptus Schönherr, 1832	**	–	–	–	–
Phyllobius glaucus (Scopoli, 1763)	*	*	–	*	–
Phyllobius maculicornis Germar, 1824	–	–	–	**	–
Phyllobius oblongus (Linnaeus, 1758)	**	–	*	–	–
Phyllobius pomaceus Gyllenhal, 1834	**	–	–	–	–
Phyllobius pyri (Linnaeus, 1758)	***	–	–	–	–
Plinthus sturmii Germar, 1819	–	–	–	*	–
Plinthus tischeri Germar, 1824	–	–	*	*	–
Polydrusus amoenus (Germar, 1824)	–	–	–	*	–
Polydrusus fulvicornis (Fabricius, 1792)	–	*	–	–	–
Polydrusus inustus Germar, 1824	–	–	–	*	–
Polydrusus mollis (Ström, 1768)	–	–	–	*	–
Polydrusus picus (Fabricius, 1792)	*	–	–	–	–
Polydrusus pilosus Gredler, 1866	*	*	–	*	–
Polydrusus pterygomalis Boheman, 1840	*	–	–	–	–
Rhinoncus bruchoides (Herbst, 1784)	*	–	–	–	–
Rhinoncus leucostigma (Marsham, 1802)	*	*	–	*	–
Rhinoncus pericarpius (Linnaeus, 1758)	*	–	–	–	–
Sciaphilus asperatus (Bonsdorff, 1785)	*	–	–	–	–
Scleropterus serratus (Germar, 1824)	–	*	–	–	–
Sibinia pellucens (Scopoli 1772)	*	–	–	–	–
Sitona ambiguus Gyllenhal, 1834	*	–	–	–	–
Sitona inops Gyllenhal, 1832	**	–	–	–	–
Sitona languidus Gyllenhal, 1834	***	–	–	–	–
Sitona lineatus (Linnaeus, 1758)	–	**	–	–	–
Sitona longulus Gyllenhal, 1834	*	–	–	–	–
Sitona striatellus Gyllenhal, 1834	***	–	–	–	–
Sitona sulcifrons (Thunberg, 1798)	*	–	–	–	–
Sitona suturalis Stephens, 1831	*	–	–	–	–
Sitona waterhousei Walton, 1846	***	–	–	–	–
Smicronyx jungermanniae (Reich, 1797)	*	*	–	–	–
Smicronyx reichii (Gyllenhal, 1836)	*	–	–	–	–
Stephanocleonus microgrammus (Gyllenhal, 1834)	**	–	–	–	–

Continuation of Table 2

Species	Mezhyhirskyi Kamin	Zhenets	Dzhurdzhiy	Vesnarka	Pozhyzhevska
Strophosoma melanogrammus (Förster, 1771)	*	–	–	–	–
Tachyerges pseudostigma (Tempere, 1982)	–	*	–	–	–
Tachyerges salicis (Linnaeus, 1758)	*	–	–	–	–
Tanymecus palliatus (Fabricius, 1787)	***	–	–	–	–
Tapinotus sellatus (Fabricius, 1794)	*	–	–	–	–
Trichosirocalus troglodytes (Fabricius, 1787)	*	*	–	–	–
Tychius breviusculus Desbrochers, 1873	–	*	–	–	–
Tychius medicaginis C. N. F. Brisout de Barneville, 1862	–	*	–	–	–
Tychius meliloti Stephens, 1831	*	–	–	–	–
Tychius picirostris (Fabricius, 1787)	*	*	*	–	–
Tychius stephensi Schönherr, 1836	–	*	–	–	–
Subtotal:	69	35	12	21	8
DERMESTIDAE					
Anthrenus fuscus Olivier, 1789	–	**	**	*	–
Anthrenus pimpinellae (Fabricius, 1775)	*	–	–	–	–
Anthrenus scrophulariae (Linnaeus, 1758)	–	**	–	–	–
Attagenus pellio (Linnaeus, 1758)	–	–	*	–	–
Dermestes laniarius Illiger, 1802	***	–	–	–	–
Subtotal:	2	2	2	1	0
DRYOPIDAE					
Dryops ernesti Des Gozis, 1886	*	–	–	–	–
Dryops striatopunctatus (Heer, 1841)	–	–	*	–	–
Subtotal:	1	0	1	0	0
DYTISCIDAE					
Agabus bipustulatus (Linnaeus, 1767)	–	–	*	–	–
Ilybius fuliginosus (Fabricius, 1792)	–	*	–	–	–
Ilybius quadriguttatus (Lacordaire, 1835)	–	*	–	*	–
Platambus maculatus (Linnaeus, 1758)	–	–	–	*	–
Subtotal:	0	2	1	2	0
ELATERIDAE					
Actenicerus sjaelandicus (Müller, 1764)	**	*	**	*	–
Agriotes acuminatus (Stephens, 1830)	**	–	–	–	–
Agriotes gurgistanus (Faldermann, 1835)	–	*	–	–	–
Agriotes obscurus (Linnaeus, 1758)	**	*	–	–	–
Agriotes pallidulus (Illiger, 1807)	*	–	–	–	–
Agriotes pilosellus (Schönherr, 1817)	***	–	–	–	–
Agriotes sputator (Linnaeus, 1758)	**	*	–	–	–
Agrypnus murinus (Linnaeus, 1758)	**	***	–	–	–
Ampedus nigroflavus (Goeze, 1777)	**	–	–	–	–
Anostirus purpureus (Poda, 1761)	–	*	–	–	–
Athous subfuscus (O. F. Müller, 1767)	*	–	–	–	–
Athous haemorrhoidalis (Fabricius, 1801)	***	*	–	–	–
Athous vittatus (Fabricius, 1792)	**	*	–	*	–
Ctenicera cuprea (Fabricius, 1775)	*	–	–	–	–
Ctenicera pectinicornis (Linnaeus, 1758)	*	***	–	*	*
Dalopius marginatus (Linnaeus, 1758)	–	*	–	*	–
Denticollis linearis (Linnaeus, 1758)	–	**	–	–	–
Ectinus aterrimus (Linnaeus, 1761)	–	*	–	–	–
Melanotus crassicollis (Erichson, 1841)	–	–	–	–	–
Melanotus tenebrosus (Erichson, 1841)	**	–	–	–	–
Selatosomus aeneus (Linnaeus, 1758)	–	*	–	*	–
Selatosomus latus (Fabricius, 1801)	*	*	–	–	–
Subtotal:	15	14	1	5	1
GEOTRUPIDAE					
Anoplotrupes stercorosus (Scriba, 1791)	*	***	***	–	–
Geotrupes spiniger (Marsham, 1802)	–	**	–	***	–
Lethrus apterus (Laxmann, 1770)	**	–	–	–	–
Subtotal:	2	2	1	1	0
HETEROCERIDAE					
Heterocerus marginatus (Fabricius, 1787)	–	–	–	–	*
Subtotal:	0	0	0	0	1

Continuation of Table 2

Species	Mezhyhirskyi Kamin	Zhenets	Dzhurdzhiy	Vesnarka	Pozhyzhevska
HYDROPHILIDAE					
Cercyon analis (Paykull, 1798)	*	–	–	–	–
Hydrobius fuscipes (Linnaeus, 1758)	*	–	–	–	–
Sphaeridium scarabaeoides (Linnaeus, 1758)	–	–	**	–	–
Subtotal:	2	0	1	0	0
LATRIDIIDAE					
Corticaria impressa (Olivier, 1790)	**	–	–	–	–
Corticarina similata (Gyllenhal, 1827)	*	–	–	–	–
Cortinicara gibbosa (Herbst, 1793)	–	–	–	*	–
Subtotal:	2	0	0	1	0
LYCIDAE					
Dictyoptera aurora (Herbst, 1784)	–	–	*	–	–
Lopheros rubens (Gyllenhal, 1817)	–	*	*	–	–
Subtotal:	0	1	2	0	0
LYMEXILIDAE					
Hylecoetus dermestoides (Linnaeus, 1761)	*	–	–	–	–
Subtotal:	1	0	0	0	0
MELANDRYIDAE					
Melandrya dubia (Schaller, 1783)	–	*	–	–	–
Subtotal:	0	1	0	0	0
MELYRIDAE					
Charopus concolor (Fabricius, 1801)	*	–	–	–	–
Charopus flavipes (Paykull, 1798)	*	–	–	–	–
Charopus pallipes (Olivier, 1790)	*	–	–	–	–
Danacea nigritarsis (Küster, 1850)	*	–	–	–	–
Dasytes caeruleus (De Geer, 1774)	–	*	–	–	–
Dasytes fusculus (Illiger, 1801)	–	*	–	–	–
Dasytes plumbeus (O. F. Müller, 1776)	*	–	*	–	–
Dolichosoma lineare (Rossi, 1794)	***	**	**	–	–
Malachius aeneus (Linnaeus, 1758)	–	**	–	*	–
Malachius bipustulatus (Linnaeus, 1758)	***	*	**	–	–
Subtotal:	7	5	3	1	0
NITIDULIDAE					
Cychramus variegatus (Herbst, 1792)	–	*	*	–	–
Epuraea marseuli Reitter, 1872	–	–	–	–	*
Glischrochilus quadrisignatus (Say, 1835)	**	–	–	–	–
Meligethes atratus (Olivier, 1790)	–	–	–	–	*
Omosita colon (Linnaeus, 1758)	*	–	–	–	–
Subtotal:	2	1	1	0	2
OEDEMERIDAE					
Anogcodes ustulatus (Scopoli, 1763)	*	*	–	–	–
Chrysanthia viridissima (Linnaeus, 1758)	–	–	–	–	*
Oedemera femorata (Scopoli, 1763)	***	*	–	–	–
Oedemera lurida (Marsham, 1802)	–	*	–	–	–
Oedemera virescens (Linnaeus, 1767)	–	**	–	–	–
Subtotal:	2	4	0	0	1
ORSODACNIDAE					
Orsodacne cerasi (Linnaeus, 1758)	–	*	–	–	–
Subtotal:	0	1	0	0	0
PTINIDAE					
Lasioderma redtenbacheri (Bach, 1852)	–	–	–	–	*
Lasioderma serricorne (Fabricius, 1792)	–	*	–	–	–
Subtotal:	0	1	0	0	1
PYROCHROIDAE					
Schizotus pectinicornis (Linnaeus, 1758)	–	–	*	–	–
Subtotal:	0	0	1	0	0
SCARABAEIDAE					
Amphimallon solstitiale (Linnaeus, 1758)	***	–	–	–	–
Aphodius abdominalis (Bonelli, 1812)	–	–	–	–	*
Cetonia aurata aurata (Linnaeus, 1758)	**	**	–	–	–
Copris lunaris (Linnaeus, 1758)	*	–	–	–	–

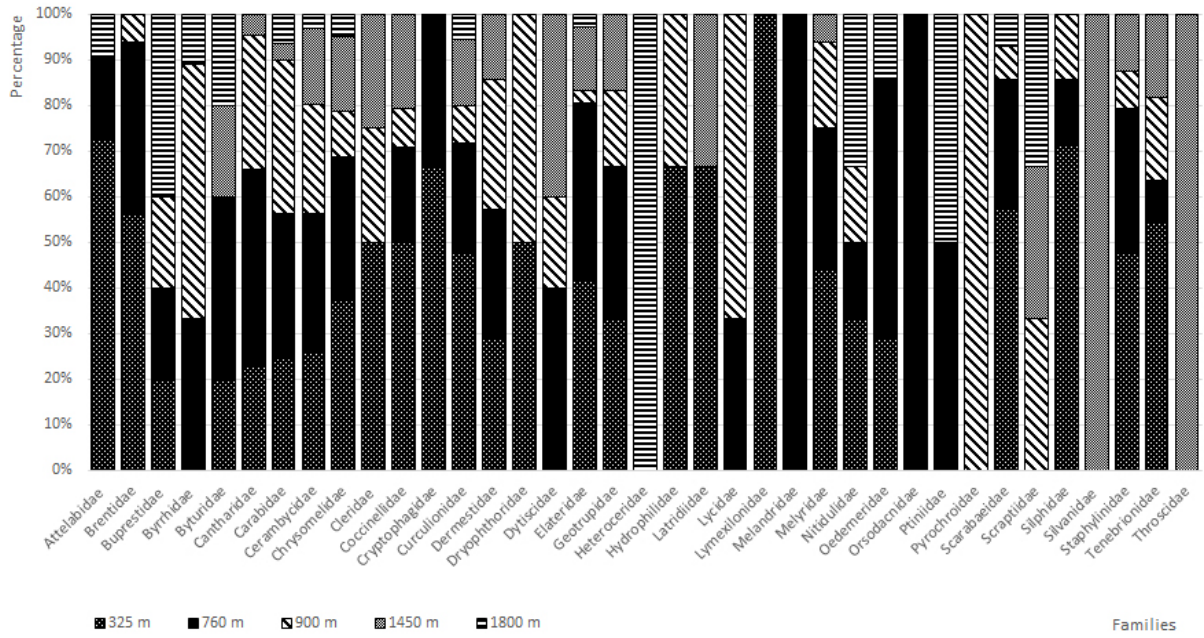
Continuation of Table 2

Species	Mezhyhirskyi Kamin	Zhenets	Dzhurdzhiy	Vesnarka	Pozhyzhevska
Melolontha melolontha (Linnaeus, 1758)	***	–	–	–	–
Oxythyrea funesta (Poda, 1761)	**	**	–	–	–
Phyllopertha horticola (Linnaeus, 1758)	***	*	–	–	–
Trichius fasciatus (Linnaeus, 1758)	–	*	*	–	–
Tropinota hirta (Poda, 1761)	***	–	–	–	–
Valgus hemipterus (Linnaeus, 1758)	**	–	–	–	–
Subtotal:	8	4	1	0	1
SCRAPTIIDAE					
Anaspis frontalis (Linnaeus, 1758)	–	–	*	*	*
Subtotal:	0	0	1	1	1
SILPHIDAE					
Nicrophorus germanicus (Linnaeus, 1758)	*	–	–	–	–
Nicrophorus humator (Gleditsch, 1767)	*	–	–	–	–
Nicrophorus interruptus (Stephens, 1830)	*	–	–	–	–
Nicrophorus vespillo (Linnaeus, 1758)	***	–	–	–	–
Nicrophorus vespilloides Herbst, 1783	***	–	–	–	–
Oiceoptoma thoracicum (Linnaeus, 1758)	*	–	**	–	–
Phosphuga atrata (Linnaeus, 1758)	*	*	–	–	–
Silpha carinata Herbst, 1783	***	–	**	–	–
Silpha perforata Gebler, 1832	–	*	–	–	–
Thanatophilus rugosus (Linnaeus, 1758)	*	–	–	–	–
Thanatophilus sinuatus (Fabricius, 1775)	**	–	–	–	–
Subtotal:	10	2	2	0	0
SILVANIDAE					
Silvanoprus fagi (Guérin-Ménéville, 1844)	–	–	–	*	–
Subtotal:	0	0	0	1	0
STAPHYLINIDAE					
Amphichroum canaliculatum (Erichson, 1840)	**	–	–	*	–
Anotylus rugosus (Fabricius, 1775)	*	–	–	–	–
Deleaster dichrous (Gravenhorst, 1802)	**	**	*	–	–
Drusilla canaliculata (Fabricius, 1787)	***	*	–	–	–
Eusphalerum longipenne (Erichson, 1839)	*	–	–	–	–
Eusphalerum sp.	*	–	–	–	–
Geodromicus sp.	*	–	–	–	–
Gyrohypnus sp.	*	–	–	–	–
Ochthephilus sp.	**	–	–	–	–
Ocypus macrocephalus (Gravenhorst, 1802)	–	*	*	–	–
Ocypus ormayi (Reitter, 1887)	*	*	–	**	–
Ocypus tenebricosus (Gravenhorst, 1846)	*	*	*	–	–
Ontholestes haroldi (Eppelsheim, 1884)	*	–	–	–	–
Ontholestes murinus (Linnaeus, 1758)	–	*	–	–	–
Paederus fuscipes Curtis, 1826	–	*	–	–	–
Paederus littoralis Gravenhorst, 1802	*	*	–	–	–
Paederidus ruficollis (Fabricius, 1777)	–	*	–	–	–
Pella humeralis (Gravenhorst, 1802)	*	–	–	–	–
Pella limbata (Paykull, 1789)	**	–	–	–	–
Philonthus addendus Sharp, 1867	–	*	–	–	–
Philonthus decorus (Gravenhorst, 1802)	**	**	***	**	–
Platydracus fulvipes (Scopoli, 1763)	–	*	–	–	–
Platydracus latebricola (Gravenhorst, 1806)	*	*	–	–	–
Platydracus stercorarius (Olivier, 1795)	*	*	–	–	–
Quedius transsylvanicus Weise, 1875	–	–	–	*	–
Staphylinus caesareus Cederhjelm, 1798	*	–	–	–	–
Stenus similis (Herbst, 1784)	*	–	–	*	–
Tachinus rufipes (Linnaeus, 1758)	*	*	–	*	–
Tasgius melanarius (Heer, 1839)	*	–	–	–	–
Xantholinus dvoraki Coiffait, 1956	**	–	–	–	–
Subtotal:	23	15	4	6	0
TENEBRIONIDAE					
Allecula morio (Fabricius, 1787)	*	–	–	–	–
Bolitophagus reticulatus (Linnaeus, 1767)	–	–	*	–	–
Blaps lethifera Marsham, 1802	*	–	–	–	–
Cteniopus sulphureus (Linnaeus, 1758)	–	*	–	*	–

Continuation of Table 2

Species	Mezhyhirskyi Kamin	Zhenets	Dzhurdzhiy	Vesnarka	Pozhyzhevska
Lagria hirta (Linnaeus, 1758)	**	–	*	*	–
Opatrum sabulosum (Linnaeus, 1761)	***	–	–	–	–
Pedinus femoralis (Linnaeus, 1767)	***	–	–	–	–
Stenomax aeneus (Scopoli, 1763)	*	–	–	–	–
Subtotal:	6	1	2	2	0
THROSCIDAE					
Trixagus dermestoides (Linnaeus, 1766)	–	–	–	*	–
Subtotal:	0	0	0	1	0
Total:	**327**	**280**	**192**	**92**	**48**

N o t e s : * — solitary records; ** — common; *** — abundant.



F i g . 1 . Percentage variation of taxonomic (families) composition of the studied Coleoptera fauna.

T r o p h i c c o m p o s i t i o n of studied Coleoptera fauna represents all types of feeding specialization. Phytophagous species (including herbivorous, palynophagous, xylophagous, bryophagous, etc.) constitute 45.5% of Coleoptera fauna of the region. The phytophages represent mainly by Curculionidae, Chrysomelidae, Cerambycidae, Elateridae, and Tenebrionidae. Carnivorous Coleoptera constitutes 38.3% of the studied species and represent mainly by Carabidae, Cantaridae, Coccinellidae, and Staphylinidae. Finally, species with other feeding specialization (*e.g.*, coprophagous, necrophagous, detritophagous, mycetophagous, myxophagous, commensals) constitute 16.2% of Coleoptera fauna and represent mainly by Scarabaeidae, Silphidae, Dermestidae, Stapylinidae, Cryptophagidae, and Melandryidae.

S p a t i a l d i s t r i b u t i o n . The composition of Coleoptera fauna, species richness, and general biodiversity vary due to the regional altitudinal ecological gradient. The general trend of the regional altitudinal ecological gradient extends on over 100 km and directed from the south-west (mountains) to north-east (lowlands) within the studied territory. It causes synchronous changes of the main ecological variables, including altitude (decreases), annual temperature (increases), annual precipitation (decreases), annual air and soil humidity (decrease), annual duration, and intensity of solar insolation (increase). These lead to the formation of β-diversity of beetles and their spatial distribution within different types of ecosystems.

The regional altitudinal ecological gradient strongly impacts on β-diversity and species richness of beetles within the studied territory (Fig. 2). In general, species richness gradually decreases along with increasing altitude. The highest species richness (327 species) is in lowlands at 325 m a. s. l. At an altitude of 760 m a. s. l., we found 280 species, and significantly fewer species (192) were identified at an altitude of 900 m a. s. l. Species richness decreases sharply when altitude exceeds 1,000 m a. s. l. For instance, we collected 92 species at an

altitude of 1,450 m a. s. l. and 48 species at 1,800 m a. s. l. Our data suggest that species richness is changing at least seven times under the impact of the regional altitudinal ecological gradient.

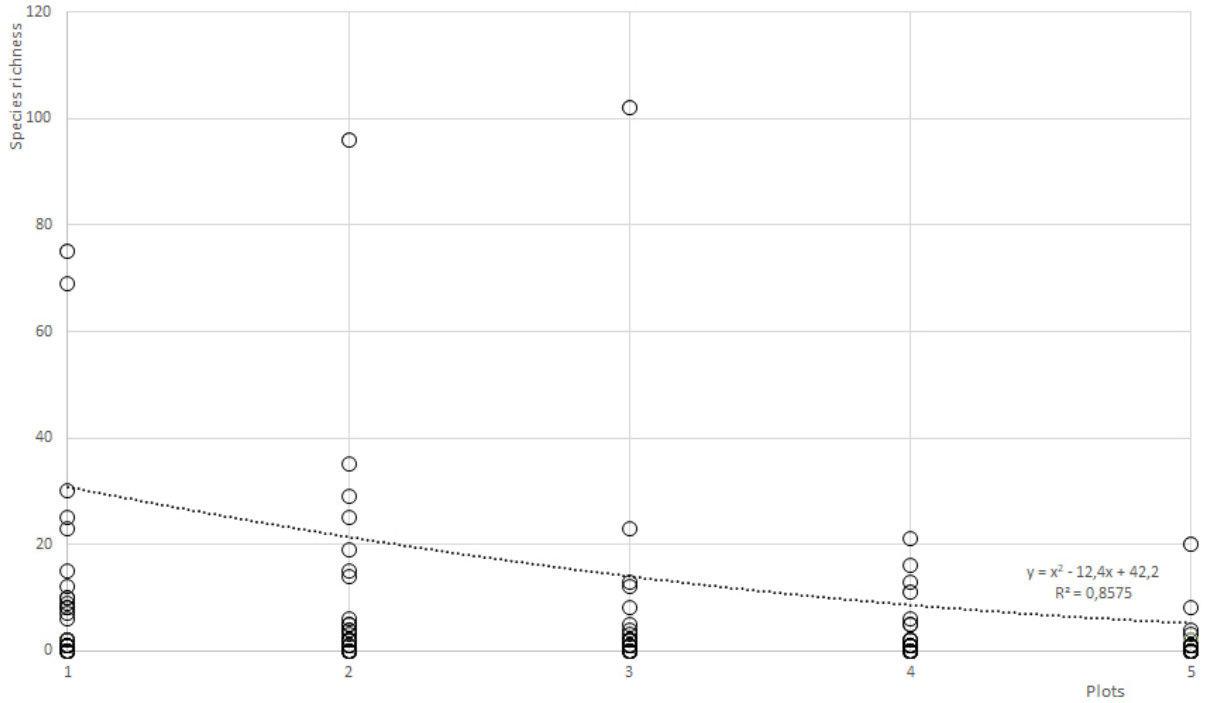


Fig. 2. Changing of Coleoptera species richness within sample plots: 1 — Mezhyhirskyi Kamin, 325 m a. s. l.; 2 — Zhenets, 760 m a. s. l.; 3 — Dzhudzhiy, 900 m a. s. l.; 4 — Vesnarka, 1450 m a. s. l.; 5 — Pozhyzhevska, 1800 m a. s. l.

Altitudinal ecological gradient also affects species composition. Ubiquist species consist of only 3.5% of all registered beetles. These include *Abax parallelopipedus*, *Bembidion geniculatum*, *Carabus violaceus*, *Carabus glabratus*, *Carabus caraboides*, *Notiophilus palustris*, *Anastrangalia sanquinolenta*, *Leptura annularis*, *Rhagium inquisitor*, *Stictoleptura rubra*, *Tetropium castaneum*, *Gastrophysa viridula*, *Cocinella septempunctata*, *Harmonia axyridis*, *Liophloeus liptoviensis*, *Actenicerus sjaelandicus*, *Ctenicera pectinicornis*, *Lagria hirta*, *Anoplotrupes stercorosus*, *Philonthus decorus*.

We found 327 species of beetles for the steppe ecosystems, which consist of nemoral species (81%), steppic species (7%) and boreo-montane species (5%) on the easternmost foothills of the Eastern Carpathians. The remain 7% of species are ubiquists. The specific steppic speciesare represernted by *Carabus excellens*, *Ophonus rupicola*, *Ophonus rufibarbis*, *Calamobius filum*, *Dorcadion fulvum*, *Dorcadion holosericeum*, *Phytoecia coerulescens*, *Phytoecia tigrina*, *Phytoecia uncinata*, *Dibolia schillingii*, *Entomoscelis adonidis*, *Eumolpus asclepiadeus*, *Liparus coronatus*, *Stephanocleonus microgrammus*, *Lethrus apterus*, *Copris lunaris*, *Tropinota hirta*, *Thanatophilus sinuatus*, *Thanatophilus rugosus*, *Blaps lethifera*, *Opatrum sabulosum*, *Pedinus femoralis*, *Xantholinus dvoraki.*

In the mountain part of the region we identified 435 species including boreo-montane species (63%), nemoral species (31%), alpine species (1.3%), and ubiquists (4.7%). Alpine species are the most specific for the region. These include *Otiorhynchus asplenii*, *Ancistronycha abdominalis*, *Carabus rothi*, *Carabus sylvestris*, *Carabus fabricii*, *Nebria transsylvanica*.

Habitat differentiation. Our findings showed that Coleoptera fauna is highly differentiated with a low similarity within habitats (Fig. 3). In particular, Coleoptera fauna of the steppes is only 20% similar to the fauna of fir-beech forests (share 101 species) and much low in comparison with the fauna in other studied habitats. The least similar (2.2%) faunas of steppes and alpine meadows, sharing only 8 species (all are ubiquitous). Surprisingly, however, Coleoptera faunas of secondary fir-beech forests and primeval beech-fir forests are similar only on 29% (share 106 species). We believe that a possible explanation is the ongoing recovery processes in secondary forests in response to their past exploitation before conservation. The fauna of high mountains pastures is very different from other habitats. It is 15% similar to forest habitats, and 13% — to alpine meadows.

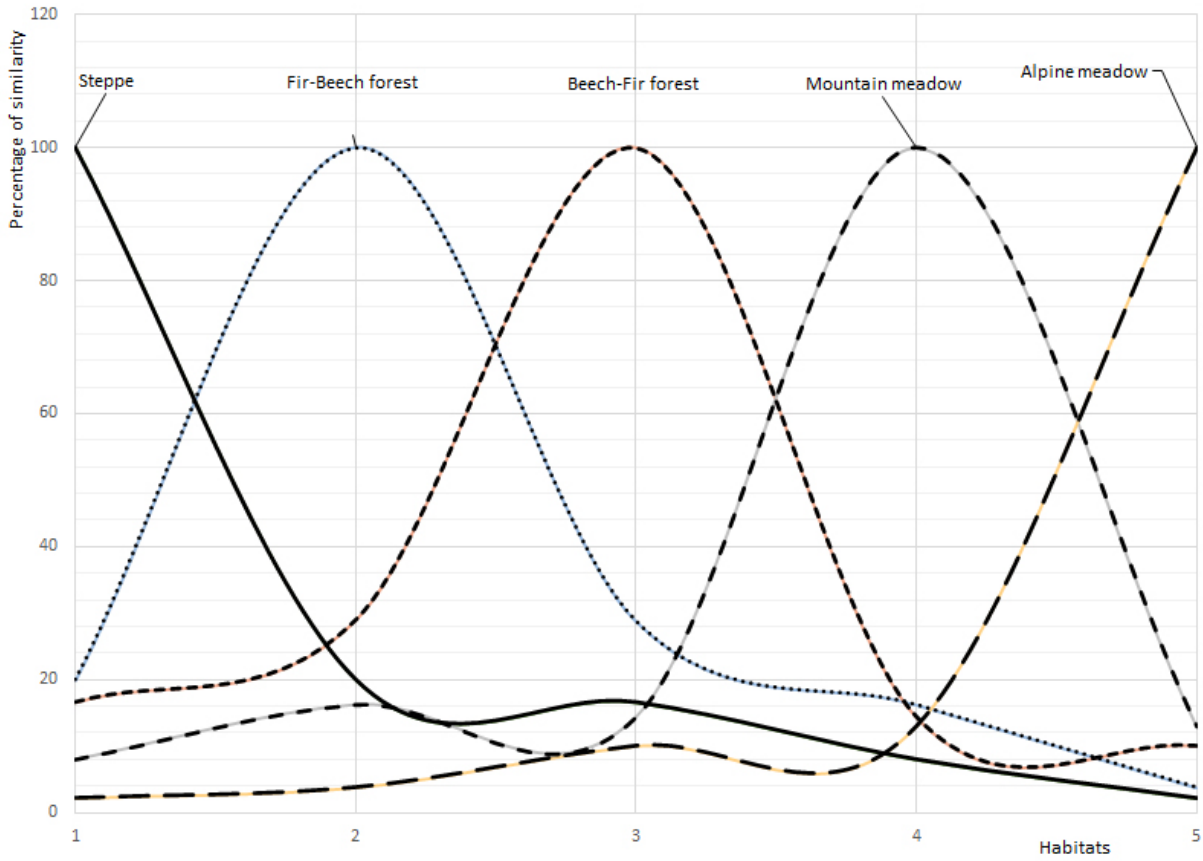


Fig. 3. Habitat differentiation of Coleoptera fauna within sample plots: 1 — Mezhyhirskyi Kamin, 325 m a. s. l.; 2 — Zhenets, 760 m a. s. l.; 3 — Dzhudzhiy, 900 m a. s. l.; 4 — Vesnarka, 1450 m a. s. l.; 5 — Pozhyzhevska, 1800 m a. s. l.

The most common and abundant species on steppes are *C. obscura, C. rufa, Rh. fulva, A. aenea, C. fossor, D. dentate, H. calceatus, L. ferrugineus, O. rupicola, T. quadristriatus, A. cardui, C. filum, D. fulvum, D. holosericeum, O. erythrocephala, Ph. coerulescens, S. attenuata, A. quadrimaculata, D. schillingii, E. adonidis, E. asclepiadeus, G. pomonae, L. echii, T. goettingensis, C. campestris, C. septempunctata, H. axyridis, C. dealbatus, L. obtusus, L. iridis, M. alternans, O. velutinus, O. raucus, O. ovatus, Ph. argentatus, Ph. pyri, S. languidus, S. striatellus, S. waterhousei, T. palliates, D. laniarius, A. pilosellus, A. murinus, A. haemorrhoidalis, D. lineare, M. bipustulatus, A. solstitiale, M. melolontha, P. horticola, T. hirta, N. vespillo, N. vespilloides, S. carinata, Th. sinuatus, D. canaliculata, X. dvoraki, O. sabulosum, P. femoralis.*

Typical species for the secondary fir-beech forest are *C. annularis, C. nigricans, A. parallelopipedus, B. quadrimaculatum, B. lunatum, C. auronitens, C. violaceus, C. obsoletus, C. glabratus, C. linnei, C. coriaceus, D. carpathicus, P. assimilis, P. foveolatus, A. tabacicolor, C. virginea, D. collaris, E. clathratus, L. quadrifasciata, L. virens, M. minor, M. sartor, M. sutor, O. brunneum, P. cerambyciformis, P. lurida, Rh. inquisitor, S. melanura, S. rubra, T. castaneum, A. alni, C. fastuosa, C. herbacea, C. aurata, N. femorata, P. sericea, C. septempunctata, H. axyridis, D. rubi, H. abietis, L. glabrirostris, O. tenebricosus, O. ovatus, S. lineatus, A. polonicus, A. scrophulariae, A. murinus, C. pectinicornis, D. lineare, M. bipustulatus, G. quadrisignatus, O. femorata, G. stercorosus, G. spiniger, Ph. decorus.*

In the primeval beech-fir forests the most abundant species are *C. annularis, A. parallelopipedus, C. metallicus, C. auronitens, C. violaceus, C. obsoletus, C. glabratus, C. linnei, C. coriaceus, P. assimilis, P. pilosus, A. tabacicolor, C. virginea, D. collaris, E. clathratus, L. quadrifasciata, L. virens, M. minor, M. sartor, M. sutor, P. lurida, Rh. inquisitor, S. rubra, T. castaneum, C. quadripunctata, Ph. undulata, P. sericea, C. sylvicola, L. glabrirostris, O. coecus, O. multipunctatus, O. tenebricosus, A. polonicus, D. lineare, M. bipustulatus, Oe. virescens, G. stercorosus, O. thoracica, S. carinata, Ph. decorus.*

The abundant species of the high mountain pastures are *E. clathratus, L. quadrifasciata, L. virens, M. minor, M. sartor, M. sutor, O. cursor, Rh. inquisitor, S. rubra, T. castaneum, H. modeeri, L. caprea,*

O. cacaliae, O. intricata, O. virgulata, C. septempunctata, O. coecus, Ph. maculicornis, G. spiniger, O. ormayi, Ph. decorus.

Alpine meadows are inhabited by the next abundant species *C. caraboides, C. sylvestris, N. transsylvanica, E. clathratus, O. cursor, O. cacaliae, O. intricata, O. virgulata, O. singularis*.

While the richness and the diversity of Coleoptera species vary widely, functional diversity is stable in ecosystems and is more conservative. This indicates ecosystems capacity, complexity, and resilience (Sumarokov, 2009). Functional diversity describes ecosystem processes and the role of sole species or group of species in the ecosystem, such as the transmission of energy through trophic networks, diversification of ecological niches, and predicting of ecosystem dynamics (Petchey, Gaston, 2006). We analyze the trophic subdivision of Coleoptera in studied habitats (Fig. 4). First of all, we found that herbivorous Coleoptera predominates on carnivorous in the meadow habitats. They share 46% on steppes, 41% on high mountain pastures, and 42% on alpine meadows. These explained by the availability of a high variety of fodder herbaceous plants. In the forest habitats, however, herbivorous species constitute only near 20% of identified Coleoptera. Instead, carnivorous species predominate (41–47%) in forest habitats, and, surprisingly, on alpine meadows (42%). Contrary to meadows, in forest habitats it is a large proportion of xylophagous (11–17%) and mycetophagous (13–15%) Coleoptera. The proportion of detritophagous, necrophagous, and myxophagous species little vary within studied habitats. The total proportion of all types decompositors of dead organic (including mycetophagous species) consists of 16–19% for meadow habitats and 34–37% for the forest habitats. It should be noted that the comparatively large amount (12%) of commensal beetles in the nests of social insects is typical for the steppe habitats.

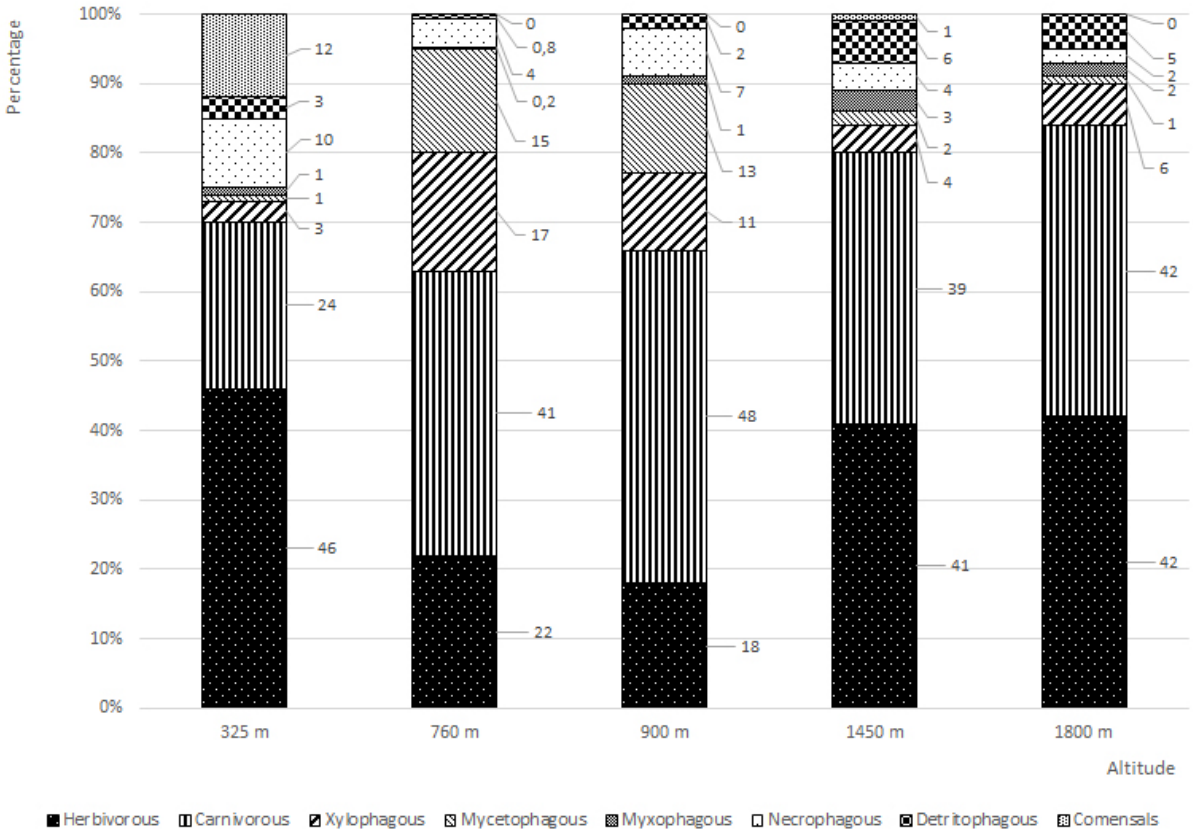


Fig. 4. Trophical composition of Coleoptera fauna.

Thus, two different types of Coleoptera-mediated transmission of energy have been identified in meadow and forest habitats. The first is typical of meadows and represents the producer-consumer type of energy transmission (living plants–phytophagous–lower carnivorous–higher carnivorous–saprotrophs). The second is typical of forests and represents the reducer-consumer type of energy transmission (dead plants debris and fungi–saprotrophs–lower carnivorous–higher carnivorous–saprotrophs). We found that role of predation within Coleoptera in the primeval forest is slightly higher than in the secondary forest. This may indicate higher ecosystems capacity and deeper Coleoptera niche differentiation.

Conservation consequences. Of the 595 species of identified Coleoptera, we found 344 species in Carpathian NP, 327 species in Halych NP, and 192 species in Gorgany NR. The most representative of studied Coleoptera fauna is in Carpathian NP, because there are all altitudinal vegetation belts. The beetle fauna of alpine meadows stands out sharply from the general forest matrix. The area of alpine meadows is very small and restricted only to Chornohora range in The Eastern Carpathians. Similarly, the steppe habitats are restricted by agricultural fields in the valley of the Dnister River and additionally, they are very fragmented (Zamoroka et al., 2018). Both types of habitats are rare and characterized by a large amount of Coleoptera species that do not occur in any other habitat within the region. Their fauna is vulnerable to the amount of anthropogenic and natural threats. These include land usage, recreation activity, the current climate changes, as well as spontaneous successions. While all alpine meadows are under protection, only a small part of the steppe habitats is protected (Zamoroka et al., 2018). Thus it needs to be a stricter limitation of usage of those habitats.

Conclusions. In summary, our results demonstrated that the Coleoptera fauna of the protected areas in Eastern Carpathians is highly diverse. We identified 595 species of beetles from 37 families within five types of habitats in two National Parks and one Nature Reserve. The general species richness gradually decreases from 327 species at an altitude of 325 m a. s. l. to 48 species at 1,800 m a. s. l. The sylvatic species of Coleoptera are predominating through the territory except alpine meadows in Chornohora range and steppes in the Dnister River valley. Coleoptera fauna is highly differentiated with a low similarity within habitats. We identified two different types of Coleoptera-mediated transmission of energy in meadow and forest habitats including the producer-consumer and the reducer-consumer energy transmission. The most vulnerable Coleoptera fauna is in habitats of alpine meadows and steppes due to land usage, recreation activity, climate changes, and spontaneous successions.

Acknowledgements. We wish to thank all people who helped us in identification of the collected materials. In particular, to Dr. O. F. Bartenev (Vasyl Karazin Kharkiv National University), Dr. I. A. Belousov (All-Russian Institute of Plant Protection), Dr. L. S. Cherniey (I. I. Schmalhausen Institute of Zoology of NAS of Ukraine), Dr. V. O. Chumak (Uzhhorod National University), Dr. V. G. Dolin (I. I. Schmalhausen Institute of Zoology of NAS of Ukraine), Mr. O. M. Drogvalenko (Museum of Nature of the Vasyl Karazin Kharkiv National University), Dr. B. M. Kataev (Zoological Institute of RAS), Dr. A. G. Kirejtchuk (Zoological Institute of RAS), Dr. V. V. Martynov (Donetsk National University), Dr. G. S. Medvedev (Zoological Institute of RAS), Dr. V. Yu. Nazarenko (I. I. Schmalhausen Institute of Zoology of NAS of Ukraine), Dr. A. A. Petrenko (I. I. Schmalhausen Institute of Zoology of NAS of Ukraine), Dr. V. B. Rizun (State Museun of Natural History of NAS of Ukraine); Dr. M. Ye. Sergeyev (Donetsk National University). We also wish to thanks people who supported our expeditions, accompanied and hosted us. In particular, we are very grateful to Dr. O. I. Kyseliuk (Carpathian National Park), Dr. V. B. Malaniuk (Halych National Park), Dr. V. I. Parpan (Vasyl Stephanyk Precarpathiam National University), Dr. O. M. Slobodian (Nature Reserve Gorgany), Mr. R. M. Bidychak (Vasyl Stephanyk Precarpathiam National University), Mr. V. V. Buchko (Halych National Park), Mr. V. M. Kysliak (Nature Reserve Gorgany), Mr. V. B. Tymochko (Carpathian National Park). In addition, we are grateful to Mr. O. M. Drogvalenko (Museum of Nature of the Vasyl Karazin Kharkiv National University) and Mr. D. V. Vovk (National Scientific Center 'Institute of Experimental and Clinical Veterinary Medicine') for their assistance in preparing the manuscript.

REFERENCES

Alonso-Zarazaga, M. A., Barrios, H., Borovec, R., Bouchard, P., Caldara, R., Colonnelli, E., Gültekin, L., Hlavač, P., Korotyaev, B., Lyal, C. H. C., Machado, A., Meregalli, M., Pierotti, H., Ren, L., Sanchez-Ruiz, M., Sforzi, A., Silfverberg, H., Skuhrovec, J., Tryzna, M., Velazquez de Castro, A. J., Yunakov, N. N. 2017. Cooperative Catalogue of Palaerctic Coleoptera Curculionoidea. Sociedad Entomológica Aragonesa, Zaragoza, 1–729. URL: http://sea-entomologia.org/monoelec.html. LSID: urn:lsid:zoobank.org:pub:911EF526-33F0-4970-8EC2-A7F5AC1E1D3D.

Audisio, P., Alonso Zarazaga, M., Slipinski, A., Nilsson, A., Jelínek, J., Taglianti, A., Turco, F., Otero, C., Canepari, C., Kral, D., Liberti, G., Sama, G., Nardi, G., Löbl, I., Horak, J., Kolibac, J., Háva, J., Sapiejewski, M., Jäch, M., Bologna, M., Biondi, M., Nikitsky, N., Mazzoldi, P., Zahradnik, P., Wegrzynowicz, P., Constantin, R., Gerstmeier, R., Zhantiev, R., Fattorini, S., Tomaszewska, W., Rücker, W., Vazquez-Albalate, X., Cassola, F., Angelini, F., Johnson, C., Schawaller, W., Regalin, R., Baviera, C., Rocchi, S., Cianferoni, F., Beenen, R., Schmitt, M., Sassi, D., Kippenberg, H., Zampetti, M., Trizzino, M., Chiari, S., Carpaneto, G., Sabatelli, S., de Jong, Y. 2015. Fauna Europaea: Coleoptera 2 (excl. series Elateriformia, Scarabaeiformia, Staphyliniformia and superfamily Curculionoidea). *Biodiversity Data Journal*, **3**, e4750. DOI: https://doi.org/10.3897/BDJ.3.e4750.

Brovdiy, B. M. 1977. *Fauna of Ukraine. Volume 19: Beetles. Issue 16: Leaf Beetles. Chrysomelinae [Фауна України. Том 19: Жуки. Випуск 16: Жуки-листоїди. Хризомеліни].* Naukova Dumka, Kyiv, 1–384. [in Ukrainian].

Chumak, V., Duelli, P., Rizun, V., Obrist, M. K., Wirz, P. 2005. Arthropod biodiversity in virgin and managed forests in Central Europe. *Forest Snow and Landscape Research*, **79**(1–2), 101–109. URL: https://www.dora.lib4ri.ch/wsl/islandora/object/wsl:15330.

Dariusz, I., Löbl, I., eds. 2020. *Catalogue of Palaearctic Coleoptera. Vol. 5: Tenebrionoidea.* Revised and updated edition. Brill, Leiden, Boston, 1–945. DOI: https://doi.org/10.1163/9789004434998.

Dolin, V. H. 1966. To the knowledge of fauna and ecology of click beetles (Coleoptera, Elateridae) in Ukrainian Carpathians [До фауни та екології жуків-коваликів (Coleoptera, Elateridae) Українських Карпат]. *In*: *Insects of Ukrainian Carpathians and Zakarpattia [Комахи Українських Карпат та Закарпаття]*. Naukova Dumka, Kyiv, 38–44. [in Ukrainian].

Drinkwater, E., Robinson, E. J. H., Hart, A. G. 2019. Keeping invertebrate research ethical in a landscape of shifting public opinion. *Methods in Ecology and Evolution*, **10**(8), 1–9. DOI: https://doi.org/10.1111/2041-210X.13208.

Fasulati, K. K. 1971. *The Field Studies of Terrestrial Invertebrates [Полевое изучение наземных беспозвоночных]*. Vysshaya Shkola, Moscow, 1–424. [in Russian].

Fischer, B., Larson, B. M. H. 2019. Collecting insects to conserve them: a call for ethical caution. *Insect Conservation and Diversity*, **12**(3), 173–182. DOI: https://doi.org/10.1111/icad.12344.

Ghilarov, M. S. 1941. Methods for quantifying soil fauna [Методы количественного учёта почвенной фауны]. *Pedology [Почвоведение]*, **4**, 48–77. URL: https://www.elibrary.ru/item.asp?id=21627983. [in Russian].

Grootaert, P., Pollet, M., Dekoninck, W., van Achterberg, C. 2010. Chapter 15 — Sampling insects: general techniques, strategies and remarks. *In*: Eymann, J., Degreef, J., Häuser, Ch., Monje, J. C., Samyn, Y., VandenSpiegel, D., eds. *Manual on Field Recording Techniques and Protocols for All Taxa Biodiversity Inventories and Monitoring*. *Abc Taxa*, **8**(2), 377–399. URL: http://www.abctaxa.be/volumes/volume-8-manual-atbi/volumes/volume-8-manual-atbi/chapter-15/Chapter_15.pdf.

Hryhora, I. M., Solomakha, V. A. 2005. *Vegetation of Ukraine (Ecological-Coenotic, Floral and Geographical Essay) [Рослинність України (еколого-ценотичний, флористичний та географічний нарис)]*. Fitosotsiotsentr, Kyiv. ISBN: 9663060107, 1–452. [in Ukrainian].

Kajtoch, Ł., Lachowska-Cierlik, D., Mazur, M. 2009. Genetic diversity of the xerothermic weevils *Polydrusus inustus* and *Centricnemus leucogrammus* (Coleoptera: Curculionidae) in central Europe. *European Journal of Entomology*, **106**(3), 325–334. DOI: https://doi.org/10.14411/eje.2009.040.

Krivosheyev, R. Ye. 2012. Annotated list of the short-winged mold beetles (Coleoptera: Pselaphidae) of the State Museum of Natural History, NAS of Ukraine (Lviv) [Анотований список жуків-потаємців (Coleoptera: Pselaphidae) Державного природознавчого музею НАН України (Львів)]. *Ukrainska Entomofaunistyka [Українська ентомофауністика]*, **3**(3), 5–13. URL: https://sites.google.com/site/ukraienskaentomofaunistikaua/contents-1/pdfs_2/Ukrentfau 3_3_2_Krivosheyev.pdf. [in Ukrainian].

Kubisz, D., Kajtoch, Ł., Mazur, M., Rizun, V. 2012. Molecular barcoding for central-eastern European *Crioceris* leaf-beetles (Coleoptera: Chrysomelidae). *Central European Journal of Biology*, **7**(1), 69–76. DOI: https://doi.org/10.2478/s11535-011-0099-4.

Kuntze, R., Noskiewicz, J. 1938. Zarys zoogeografii polskiego Podola. *Prace Naukowe Wydawnictwo Towarzystwa Naukowego we Lwowie*, **2**(4), 1–538.

Lazorko, V. 1963. *Materials to Systematics and Faunistics of Beetles of Ukraine [Матеріяли до систематики і фавністики жуків України]*. The Shevchenko Scientific Society, Vancouver, Canada, 1–123. [in Ukrainian].

Löbl, I., Löbl, D., eds. 2015. *Catalogue of Palaearctic Coleoptera. Vol. 2: Hydrophiloidea — Staphylinoidea.* Revised and updated edition. Brill, Leiden, Boston, 1–1702. DOI: https://doi.org/10.1163/9789004296855.

Löbl, I., Löbl, D., eds. 2016. *Catalogue of Palaearctic Coleoptera. Vol. 3: Scarabaeoidea — Scirtoidea — Dascilloidea — Buprestoidea — Byrrhoidea.* Revised and updated edition. Brill, Leiden, Boston, 1–983. DOI: https://doi.org/10.1163/9789004309142.

Löbl, I., Löbl, D., eds. 2017. *Catalogue of Palaearctic Coleoptera. Vol. 1: Archostemata — Myxophaga — Adephaga.* Revised and updated edition. Brill, Leiden, Boston, 1–1443. DOI: https://doi.org/10.1163/9789004330290.

Löbl, I., Smetana, A., eds. 2007. *Catalogue of Palaearctic Coleoptera. Vol. 4: Elateroidea — Derodontoidea — Bostrichoidea — Lymexyloidea — Cleroidea — Cucujoidea.* Apollo Book, Stenstrup, 1–935. DOI: https://doi.org/10.1163/9789004260894.

Löbl, I., Smetana, A., eds. 2010. *Catalogue of Palaearctic Coleoptera. Vol. 6: Chrysomeloidea.* Apollo Book, Stenstrup, 1–924. DOI: https://doi.org/10.1163/9789004260917.

Łomnicki, M. A. 1884. *Catalogus Coleopterorum Haliciae.* Sumptibus L. Zontaki, Custodis Musaei Dzieduszyckiani, Leopoli, 1–43. URL: https://rcin.org.pl/dlibra/doccontent?id=57366.

Łomnicki, M. A. 1913. Wykaz chrząszczów czyli Tęgopokrywych (Coleoptera) ziem polskich. (Catalogus coleopterorum Poloniae). *Kosmos. Seria A — Biologia*, **38**, 21–155. URL: https://baza.biomap.pl/en/getpdf/5282_Lomnicki_MA_1913.pdf.

Malynovskyi, K. A., Krichfalushiy, V. V. 2000. *Vegetation of Ukraine. High Mountain Vegetation. Volume 1. [Рослинність України. Високогірна рослинність. Том 1]*. Fitosotsiotsentr, Kyiv, 1–231. ISBN: 9667459780. [in Ukrainian].

Mateleshko, O. Yu. 2008. *Water Beetles of the Ukrainian Carpathians [Водні твердокрилі Українських Карпат]*. Mystetska liniia, Uzhhorod, 1–200. ISBN: 9789668764684. DOI: https://doi.org/10.13140/RG.2.1.3470.9365/1. [in Ukrainian].

Nikulina, T., Mandelshtam, M., Petrov, A., Nazarenko, V., Yunakov, N. 2015. A survey of the weevils of Ukraine. Bark and ambrosia beetles (Coleoptera: Curculionidae: Platypodinae and Scolytinae). *Zootaxa*, **3912**(1), 1–61. DOI: https://doi.org/10.11646/zootaxa.3912.1.1.

Nowicki, M. 1873. Verzeichniss galizischer Käfer. *In*: *Beitrage zur Insektenfauna Galiziens*. Jagiellonian University, Krakow, 7–52.

Ocheretna, K. 2020. Silken-fungus beetles (Cryptophagidae, Coleoptera) of the Ukrainian Carpathians. *Geo&Bio*, **19**, 104–120. DOI: https://doi.org/10.15407/gb1911.

Petchey, O. L., Gaston, K. J. 2006. Functional diversity: back to basics and looking forward. *Ecology Letters*, **9**(6), 741–758. DOI: https://doi.org/10.1111/j.1461-0248.2006.00924.x.

Petrenko, A. A. 2009. Staphylinidae. *In*: Prykhodko, M. M., Kyseliuk, O. I., Yavorskyi, A. I., eds. *Carpathian National Nature Park [Карпатський національний природний парк]*. Foliant, Ivano-Frankivsk, 539–552. ISBN: 9789662988192. [in Ukrainian].

Petrenko, A. A., Nadvornyy, V. G. 1990. The rove beetles as indicators of biocenoses' state in Carpathian Reserve [Жуки-стафилиниды — индикаторы состояния биоценозов Карпатского заповедника]. *Reserves of the USSR — Their Present and Future: Abstracts of the All-Union Conference [Заповедники СССР — их настоящее и будущее: тезисы докладов всесоюзной конференции]*, **3**, 112–114. [in Russian].

Rizun, V. B. 2003. *The Ground Beetles of the Ukrainian Carpathians [Туруни Українських Карпат]*. Lviv, 1–207. ISBN: 9660215398. [in Ukrainian].

Rizun, V. B., Tymochko, V. B., Chumak, V. O. 2004. Communities of the ground beetles (Coleoptera, Carabidae) in beech and fir forests of the Carpathian National Nature Park [Угруповання жуків-турунів (Coleoptera, Carabidae) букових та ялицевих лісів Карпатського національного природного парку]. *Scientific Bulletin of the Uzhhorod University. Series: Biology [Науковий вісник Ужгородського університету. Серія: Біологія]*, **14**, 34–43. [in Ukrainian].

Steiner, A., Häuser, Ch. 2010. Chapter 16 — Recording insects by light-traps. *In*: Eymann, J., Degreef, J., Häuser, Ch., Monje, J. C., Samyn, Y., VandenSpiegel, D., eds. *Manual on Field Recording Techniques and Protocols for All Taxa Biodiversity Inventories and Monitoring*. *Abc Taxa*, **8**(2), 400–422. URL: http://www.abctaxa.be/volumes/volume-8-manual-atbi/volumes/volume-8-manual-atbi/chapter-16/Chapter_16.pdf.

Stork, N. E., McBroom, J., Gely, C., Hamilton, A. J. 2015. New approaches narrow global species estimates for beetles, insects, and terrestrial arthropods. *Proceedings of the National Academy of Sciences of the United States of America*, **112**(24), 7519–7523. DOI: https://doi.org/10.1073/pnas.1502408112.

Sumarokov, A. M. 2009. *Renewals of Biotic Potential of Biogeocenoses at Diminishing of the Pesticidal Loadings [Восстановление биотического потенциала биогеоценозов при уменьшении пестицидных нагрузок]*. Veber, Donetsk, 1–193. ISBN: 9789663352695. [in Russian].

Tveritina, T. A. 1959. Weevils of the Transcarpathian Region [Долгоносики Закарпатской области]. *Scientific Notes of Uzhgorod University [Научные записки Ужгородского университета]*, **40**, 181–187. [in Russian].

Yanytsky, T. P. 2001. *Jewel Beetles (Coleoptera, Buprestidae) of Western Ukraine [Жуки-златки (Coleoptera, Buprestidae) Західної України]*. PhD Thesis. The State Museum of Natural History of the National Academy of Sciences of Ukraine, Lviv, 1–163. [in Ukrainian].

Yanytsky, T. P. 2013. A checklist of the Western Ukrainian Buprestidae (Coleoptera). *Scientific Notes of the State Museum of Natural History*, **29**, 173–180. URL: http://nbuv.gov.ua/UJRN/Nzdpm_2013_29_29.

Yunakov, N., Nazarenko, V., Filimonov, R., Volovnik, S. 2018. A survey of the weevils of Ukraine (Coleoptera: Curculionoidea). *Zootaxa*, **4404**(1), 1–494. DOI: https://doi.org/10.11646/zootaxa.4404.1.1.

Zahaykevych, I. K. 1957. Materials to study of bark beetles' fauna in western regions of Ukraine [Матеріяли до вивчення фавни короїдів західних областей України]. *Proceeding of the Zoological Museum of the Academy of Sciencies of Ukrainian SSR [Збірник праць Зоологічного музею АН УССР]*, **28**, 100–101. [in Ukrainian].

Zahaykevych, I. K. 1959. Contribution to study of the longhorn beetles (Cerambycidae) of Stanislav Region [До вивчення вусачів (Cerambycidae) Станіславської обл.]. *In*: *Problems of Entomology in Ukraine [Проблеми ентомології на Україні]*. Publishing House of the Academy of Sciencies of Ukrainian SSR, Kyiv, 45–47. [in Ukrainian].

Zahaykevych, I. K. 1978. Jewel beetles (Coleoptera, Buprestidae) [Твердокрилі родини златок (Coleoptera, Buprestidae)]. *In*: *Catalogues of Museum Collections: Collection of Scientific Works of the State Museum of Natural History of the Academy of Sciencies of Ukrainian SSR [Каталог музейних фондів: збірник наукових праць Державного природознавчого музею АН УРСР]*. Naukova Dumka, Kyiv, 210–229. [in Ukrainian].

Zamoroka, A. M. 2008. The longhorn beetles in the forest ecosystems of Carpathians and Precarpathia [Жуки-вусачі у лісових екосистемах Карпат і Передкарпаття]. *Herald of Vasyl Stefanyk Precarpathian National University. Series Biology [Вісник Прикарпатського національного університету імені Василя Стефаника. Серія: Біологія]*, **10**, 21–31. [in Ukrainian].

Zamoroka, A. M. 2009. *Ecological Features of Entomocomplexes of the Longhorn Beetles (Coleoptera: Cerambycidae) in the Forest Ecosystems of Northern-East Macroslope of Ukrainian Carpathians [Екологічні особливості ентомокомплексів жуків-вусачів (Coleoptera: Cerambycidae) у лісових екосистемах північно-східного макросхилу Українських Карпат]*. PhD Thesis. Vasyl Stefanyk Precarpathian National University, Ivano-Frankivsk, 1–212. [in Ukrainian].

Zamoroka, A. M. 2018. The longhorn beetles (Coleoptera: Cerambycidae) of the Eastern Carpathian Mountains in Ukraine. *Munis Entomology & Zoology*, **13**(2), 655–691. URL: https://www.munisentzool.org/Issue/abstract/the-longhorn-beetles-coleoptera-cerambycidae-of-the-eastern-carpathian-mountains-in-ukraine-1224.

Zamoroka, A. M. 2019. A new subspecies of *Dorcadion fulvum* (Scopoli, 1763) (Coleoptera: Cerambycidae) from western Ukraine. *Polish Journal of Entomology*, **88**(4), 363–378. DOI: https://doi.org/10.2478/pjen-2019-0024.

Zamoroka, A. M., Panin, R. Yu., Kapelukh, Y. I., Podobivskiy, S. S. 2012. The catalogue of the longhorn beetles (Coleoptera: Cerambycidae) of western Podillya, Ukraine. *Munis Entomology & Zoology*, **7**(2), 1145–1177. URL: https://www.munisentzool.org/Issue/abstract/the-catalogue-of-the-longhorn-beetles-coleoptera-cerambycidae-of-western-podillya-ukraine-614.

Zamoroka, A. M., ed., Shumska, N. V., Buchko, V. V., Dmytrash-Vatseba, I. I., Malaniuk, V. B., Smirnov, N.A. 2018. *The Steppe Biota of Burshtyn Opillya [Біота лучних степів Бурштинського Опілля]*. Symfoniia Forte, Ivano-Frankivsk, 1–212. ISBN: 9789662861372. [in Ukrainian].

Zamoroka, A. M., Semaniuk, D. V., Shparyk, V. Yu., Mykytyn, T. V., Skrypnyk, S. V. 2019. Taxonomic position of *Anastrangalia reyi* and *A. sequensi* (Coleoptera, Cerambycidae) based on molecular and morphological data. *Vestnik Zoologii*, **53**(3), 209–226. DOI: https://doi.org/10.2478/vzoo-2019-0021.

Zawadzki, A. 1825. Rzut oka na osobliwości we względzie historyi naturalnej, widziane w podróży przedsięwziętej przez Karpaty Stryjskiego i Stanisławowskiego obwodu. *Rozmaitości. Pismo Dodatkowe do Gazety Lwowskiej*, **5**(21), 161–163. URL: https://www.wbc.poznan.pl/dlibra/publication/210080/edition/185843.

Agro-association 'Chysta Krynytsia',
Vasyl Stefanyk Precarpathian National University