MOLLUSCS OF THE BUKOVSKÉ VRCHY MTS
IN THE SLOVAKIAN PART OF THE VÝCHODNÉ
KARPATY BIOSPHERE RESERVE

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ABSTRACT: 91 mollusc species were recorded from 92 sites in the Bukovské vrchy Mts (Slovakia) as a result of
the recent malacological research, combined with earlier published and unpublished data. The most impor-
tant communities of predominantly East Carpathian species occur throughout the deciduous woodlands domi-
nated by beech. The mollusc communities are characterised by low numbers of individuals dispersed over
large areas. Rich malacocoenoses are confined to scattered favourable habitats, such as well vegetated
base-rich seepages, landslide scars and water-logged depressions, as well as at fresh calcareous outcrops or
screes. A detailed snail succession from Holocene slope sediments at the Krivoštianka (Humenské vrchy Mts)
provides the most complete record from the Slovak East Carpathians and is the most detailed yet published
from this region. The mollusc succession differs from the standard faunal developmental pattern of Central
Europe due to the absence of a considerable number of common Central European species, whose succession
is well known at present.

KEY WORDS: Bukovské vrchy Mts., Mollusca, East Carpathian fauna, Holocene sediments, molluscan succes-
sion

INTRODUCTION

The Východné Karpaty Biosphere Reserve was cre-
ated in 1993 as tri-national reserve across the border of
Slovakia, Poland and Ukraine. The area dealt with in
this paper is the Slovakian part of the Biosphere Reserve
– National Park Poloniny in the Bukovské vrchy Mts.

The area is built of the Dukla Unit of Carpathian
flysh belt, which is characterised by alternating sand-
stone and claystone layers, partly including moder-
ately calcareous horizons. Since these rocks are
mostly soft, their surface outcrops and screes are
generally confined only to areas that have been strongly
affected by mass rockslides, for example in the nature
reserves Jaraba Skala or Šípková. For this reason, the
soils of the area are rather deep calcified sandy-clayey soils (cambisols). Calcareous soils or
tufa-forming occur only at certain springs or seepages, mostly in landslide areas.

The elevation of the eastern end of the area inves-
tigated is 1,220 m, towards the west it decreases to
800–900 m. In contrast, the bottom of larger valleys
lies only at 300–400 m, so that the altitudinal differ-
ences generally attain 400–500 m and more. The
Bukovské vrchy Mts are characterised by long
rounded ridges, laterally dissected by numerous
V-shaped valleys with steep slopes, without rock out-
crops. Only at larger streams typical floodplains have
developed, for example in the valleys of the rivers
Cirocha at Ruské or Ulička near Kolbasov.

The climate of the mountain zone (800 m) is
moderately cool and moist with mean annual tempera-
tures of 5–5.5°C (January 5.8°C, July 15.3°C). and
rainfall of about 1,000–1,100 mm, however with con-
siderable local variation due to orographic factors
(VOLOŠČUK 1988).
THE RANGE ITSELF IS COVERED BY A DENSE FOREST OF BEECH WITH ADMIXTURE OF FIR IN THE EASTERN PART (MAINLY THE STUŽICA NATURE RESERVE) AND LOCAL PATCHES WITH ASH, Sycamore maple or elm confined to landslide scars and base-rich scree eskers. Such places have also a rich herb layer, which in pure beech stands on acid soils is poorly developed. The summit parts of mountain ridges bear a narrow zone of meadows, which is fringed by dwarf beech or sycamore stands. Atypical sycamore-elm scree forest covers the huge boulder accumulation below the scar of Jaraba Skala. At the foot of the main mountain ridge, areas of pasturelands extend. The largest one in the surroundings of Ruské has been abandoned since the erection of the Starina Dam on the Cirocha River. In the broad Cirocha floodplain, downstream of Ruské, a large calcareous fen called Sihla is situated (the Nature Reserve Pod Ruským).

METHODS

The literature on the area is fairly abundant (for review see below); there are also many unpublished data. Twenty eight sites were studied in July 2005 to complete the representative network of sites or to inventory some important Nature Reserves. Combined standard 5 litre samples of litter and topsoil were collected from some sites. The samples were dried, washed, and organic matter was – after repeated drying – sorted into separate size categories. Samples from fens were separated size categories. Samples from fens were

...molluscs were extracted by hand sorting (HORSÁK 2003). Slugs and dendrophilous species were collected by visual search, because they did not occur in litter samples. Freshwater molluscs were collected using a bowl-shaped sieve (mesh size 0.5 mm) from water vegetation or sediments. Molluscs from the samples were sorted and identified (some species of Arionidae, Agriolimacidae, and the genus Aegopinella by dissection) under a binocular microscope. The nomenclature follows JURÍČKOVÁ et al. (2001).

HISTORY OF RESEARCH


LOCALITIES

In the locality list below, the data are given in the following order: locality number; name of the nearest village; locality names; geographical co-ordinates; altitude; date of investigation; name of investigators (AM – A. MIKOCOVÁ, AJ – A. JANOSVÁ, JG – J. GREGO, JS – J. ŠTEFFEK, LD – L. DVOŘÁK, LJ – L. JURÍČKOVÁ, LV – L. VAVROVÁ; MA – M. HRAĎÁKOVÁ, MH – M. HORSÁK, PK – P. KMENT, TC – T. ČEJKA; TK – T. KOŘÍNKOVÁ; VL – V. LOŽEK, VLK – V. LUCIVIANSKÁ-KROUPOVÁ). Fig. 1 shows the distribution of the localities.

2. Ruské – PR Šípková – landslide scar, 49°08’10”N, 22°18’10”E, 850 m, 5.5.1992, VL
3. Ruské – valley below Šípková, 49°07’40”N, 22°18’37”E, 680 m, 5.5. 1992, VL
4. Ruské – Rypy, eastern slope, 49°07’57”N, 22°19’35”E, 740 m, 4.5.1992, VL
5. Ruské – valley Runa (between Soliští and Rypy), 49°07’07”N, 22°19’44”E, 540 m, 4.5. 1992, VL
6. Ruské – fen under Soliští, 49°07’16”N, 22°18’49”E, 670 m, 5.5.1992, VL
7. Ruské – cross-road with sub-xerothermic pasture, 49°06’33”N, 22°20’37”E, 500 m, 6.5.1992, VL
8. Ruské – Záruba, 49°07’46”N, 22°21’40”E, 720 m, 6.5.1992, VL
9. Ruské – Polianky, 49°07’41”N, 22°21’15”E, 600 m, 6.5. 1992, VL
10. Ruské – valley near research field station, 49°06’40”N, 22°21’42”E, 540 m, 6.5. 1992, VL
11. Ruské – stream floodplain near research field station, 49°06’38”N, 22°21’36”E, 560 m, 11.10.1995, JS
12. Ruské – meadow near research field station, 49°06’36”N, 22°21’27”E, 560 m, 11.10.1995, JS
13. Ruské – Nature Reserve Lúky under Ruské (so-called Sihla), 49°06'15"N, 22°19'56"E, 460 m, 5.5.1992, VL.
14. Ruské – Ruské sedlo (fen between old and new road), 49°08'23"N, 22°20'00"E, 700 m, 4.5.1992, VL.
15. Ruské – Krúhliak – forest on top (Fagus silvatica and Acer pseudoplatanus), 49°08'50"N, 22°22'00"E, 1,104 m, 14.7.2004, JS
16. Ruské – Nature Reserve Pľaša – forest on top (Fagus silvatica and Acer pseudoplatanus), 49°06'47"N, 22°24'09"E, 1,162 m, 14.7.2004, JS
17. Ruské – Nature Reserve Pľaša – top, 49°06'47"N, 22°24'09"E, 1,162 m, 3.5.1992, VL.
19. Ruské – Nature Reserve Pľaša – valley below top of Pľaša, 49°06'48"N, 22°24'00"E, 1,100 m, 3.5.1992, VL.
20. Ruské – Nature Reserve Pľaša – stony cauldron west of top, 49°06'40"N, 22°23'46"E, 910 m, 3.5.1992, VL.
21. Ruské – Nature Reserve Pľaša – western cauldron, 49°07'35"N, 22°23'07"E, 1,000 m, 3.5.1992, VL.
22. Ruské – Nature Reserve Pľaša – Štiavnik, 49°07'38"N, 22°23'22"E, 1,015 m, 3.5.1992, VL.
23. Runina – Durkovec – valley below Durkovec, 49°05’22"N, 22°26’24"E, 800 m, 1.5.1992, VL
24. Runina – Durkovec – spring area east of Durkovec, 49°05’32"N, 22°26’10"E, 850 m, 1.5.1992, VL
25. Nová Sedlica – Nature Reserve Jaraba skála – top, 49°06’12"N, 22°27’13"E, 1,167 m, 1.5. 1992, VL
26. Nová Sedlica – Nature Reserve Jaraba skála – scree, 49°06’03"N, 22°27’11"E, 1,000 m, 1.5.1992, VL
30. Nová Sedlica – fen 300 m SE of pond Medová baba, 49°04’55"N, 22°27’50"E, 650 m, 19.7.2005, LV, TC
31. Nová Sedlica – beech forest above campsite, 49°03’57"N, 22°31’00"E, 650 m, 10.5.1998, JG
32. Nová Sedlica – valley of Zbojský potok NNE of Syrochemenka, 49°04’02"N, 22°29’24"E, 470 m, LOEJ (1962)
33. Nová Sedlica – valley of Zbojský potok, 49°04’18"N, 22°28’31"E, 500 m, LOEJ (1962)
34. Nová Sedlica – Trosta, 49°04’55"N, 22°27’47"E, 630 m, LOEJ (1962)
35. Nová Sedlica – Chvěška pod Skalou, 49°05’06"N, 22°27’37"E, 640 m, LOEJ (1962)
36. Nová Sedlica – valley NNW of Beskyd, 49°04’02"N, 22°28’01"E, 600 m, LOEJ (1962)
37. Nová Sedlica – valley between bench marks 1,199 m and 1,168 m, 49°06’12"N, 22°27’00"E, 1,150 m, LOEJ (1962)
38. Nová Sedlica – Patrikůšky, 49°03’46"N, 22°31’24"E, 620 m, LOEJ (1962)
40. Nová Sedlica – tufa fen 0.5 km NE of the village, 49°02’40"N, 22°31’50"E, 440 m, 29.4.1992, VL
41. Nová Sedlica – tufa fen 0.5 km NE of the village, 49°02’40"N, 22°31’50"E, 440 m n.m., 20.7.2005, MH, LV
42. Nová Sedlica – fen with Scirpus sp. on left slope above the village, 49°02’42"N, 22°31’57"E, 570 m, 17.7.2005, JS
43. Nová Sedlica – forest fen 750 m NE of the village, 49°02’55"N, 22°32’00"E, 560 m, 20.7.2005, MH, LV
44. Nová Sedlica – fen NNW 800 m of the village near Zbojský potok, 49°03’23"N, 22°30’33"E, 430 m, 18.3.2005, LD, LJ, MH, MaH, PK
45. Nová Sedlica – forest 300 m SW of Packova Kyčera, 49°04’02"N, 22°32’26"E, woodland and seepage with Petasites, 760 m, 16.7.2005, LD, LJ, MH, MaH, PK
46. Nová Sedlica – valley S of Kyčera, 49°04’06"N, 22°30’07"E, 550 m, LOEJ (1962)
47. Nová Sedlica – stream floodplain between field station and cross-road Pod Kyčerou, 49°03’22"N, 22°31’33"E, 480 m, 18.7.2005, AM, TK
49. Nová Sedlica – urban area, 49°02’25"N, 22°30’50"E, 420 m, 20.7.2005, LD
50. Nová Sedlica – Nature Reserve Stužička – western reach, 49°05’00"N, 22°32’32"E, 840 m, LOEJ & GULIČKA (1955)
52. Nová Sedlica – Nature Reserve Stužička – beech-fir forest, 49°05’06"N, 22°33’34"E, 1,050 m, 31.7.1978, VLK
53. Nová Sedlica – Nature Reserve Stužička – line of Packova Kyčera, 49°04’12"N, 22°32’34"E, 800 m, LOEJ (1962)
54. Nová Sedlica – Nature Reserve Stužička – Santove Pollany, 49°05’33"N, 22°31’00"E, 1,040 m, LOEJ (1962)
55. Nová Sedlica – Nature Reserve Stužička – Pod Hrubíkami, 49°05’24"N, 22°31’51"E, 1,080 m, LOEJ (1962)
56. Nová Sedlica – Nature Reserve Stužička – Pod Kamenou lúkou, 49°05’35"N, 22°32’32"E, 1,100 m, LOEJ (1962)
57. Nová Sedlica – Nature Reserve Stužička-Hrubý, 49°05’37"N, 22°31’49"E, 1,186 m, LOEJ (1962)
58. Nová Sedlica – Nature Reserve Stužička – Kamenná lúka, 49°05’28"N, 22°32’50"E, 1,200 m, LOEJ (1962)
60. Nová Sedlica – Nature Reserve Stínšká – spring area below Majková, 49°00’22"N, 22°32’05"E, 980 m, 2.5.1992, VL
61. Nová Sedlica – Nature Reserve Stínšká – eastern summit, 49°00’22"N, 22°32’44"E, 1,063 m, 2.5.1992, VL
62. Nová Sedlica – Nature Reserve Stínšká – western summit 49°00’02"N, 22°31’33"E, 1,092 m, 2.5.1992, VL
64. Nová Sedlica – Nature Reserve Stínšká – fen with Sphagnum, 680 m, 30.4.1992, VL
69. Nová Sedlica – floodplain of Zbojský potok stream, 49°03’22”N, 22°30’31”E, 420 m, 18.7.2005, JS, VLK
70. Zboj – fen on right bank with Typha latifolia
71. Zboj – fen on right bank with Typha latifolia
72. Zboj – Bystrý potok stream, 49°01’26”N, 22°29’27”E, 740 m, 30.4.1992, VL
73. Uličské Krivé – floodplain of Zbojský potok stream, 48°59’07”N, 22°26’00”E, 280 m, 13.7.2004, 17.7.2005, JS
78. Topoľa – junction of streams Ulička and Verblačí potok, 49°04’23”N, 22°22’40”E, 450 m, 15.7.2004, JS
79. Topoľa – ford across Ulička stream 600 m S of the village, 49°01’50”N, 22°21’27”E, 350 m, 18.7.2005, LD, LJ, MH, MaH, PK
80. Topoľa – seepage among bushes 400 m SE of the village, 49°01’55”N, 22°21’40”E, 400 m, 18.7.2005, LD, LJ, MH, MaH, PK
81. Kolbasov – Nature Reserve Bzaná, 49°00’40”N, 22°22’35”E, 450 m, 18.3.2005, LD, LJ, MH, MaH, PK
82. Kolbasov – floodplain of Ulička stream, 49°01’02”N, 22°22’00”E, 310 m, 13.9.2004, JS
83. Kolbasov – floodplain of Ulička stream – above the village, 49°01’00”N, 22°22’07”E, 320 m, 6.5.1992, VL
84. Kolbasov – Nature Reserve Ulička, floodplain of Ulička stream, 49°00’01”N, 22°22’00”E, 320 m, 18.7.2005, LD, LJ, MH, MaH, PK
85. Ulič – stream floodplain of Zbojský potok, 48°58’00”N, 22°26’04”E, 275 m, 17.7.2005, JS
87. Kalná Roztoka – Nature Reserve Havešová, 49°00’40”N, 22°20’30”E, 650 m, 11.10.1995, JS
91. Stakčín – urban area, 49°00’05”N, 22°13’25”E, 255 m, 21.7.2005, LD
92. Vydra – Husárská dolina valley, 49°18’N, 21°58’E, 500 m, 10.10.1963, VL

RESULTS

Altogether 91 mollusc species were found in 92 sites (Table 1): 8 species of freshwater snails, 4 – of bivalves and 79 – of land snails and slugs. The number constitutes 38% of the Slovak mollusc fauna. Frequent species (occurring in more than 50% sites) were: Perforatella diothryon, Faustina faustina, Macrogastra lastriata, M. tumida and Vestia gulo. V. gulo, Discus perspectivus, Schistophallus orientalis, Monachoides vicinus, Macrogastra tumida, Carychiium tridentatum, Macrogastra lastriata and Isognomostoma isognomostomos showed the highest abundance. Among freshwater species Pisidium personatum and P. casertanum were common.

MOLLUSCAN COMMUNITIES

In the Bukovské vrchy region, snails occur throughout the deciduous woodlands dominated by beech. However, molluscan communities of the pure beech forest with poor herb layer on acid soils are characterised by low numbers of individuals dispersed over large areas. Rich malacoconoes are confined to scattered favourable habitats, such as well-vegetated base-rich seepages, landslide scars and waterlogged depressions, as well as fresh calcareous outcrops or screes. Mollusc abundance in these habitats depends not only on abiotic factors, but also on vegetation. Such places are generally characterised by the occurrence of trees, whose litter provides calcium in the form of easily decomposed citrate, particularly syca-
Table 1. The list of mollusc species recorded from Bukovské Vrchy Mts.: 1–92 numbers of localities; + species present in locality or number of specimens in litter sample

| Species                        | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 |
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| Species                        | 47 | 48 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 |
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more maple, ash and elm. In open areas – meadows and pastures – the situation is similar: the richest malacoconoses appear in meadow wetlands with forming tufa or at calcareous outcrops. Most pastures on acid soils are nearly devoid of molluscs.

In terms of biological conservation, the most important molluscan communities are those of mountain forests. Woodland malacoconoses of the Bukovské hory are dominated by the following five snail species.

- *Macrogastra latestriata* inhabits the entire woodland zone in all altitudinal belts, being predominantly found under bark of trees and logs. *M. tumida* is non-climber, frequent in moist and well-vegetated places on the soil surface.

- *Schistophallus orientalis* occurs in a wide variety of mesic, well-vegetated habitats.

- *Vestia gulo* prefers moist shaded habitats, particularly at valley bottoms and landslide kettles, being confined to the soil surface, never climbing. *Aegopinella pura* is widespread in mesic to moderately moist habitats, especially under ground litter, at higher elevations entering more open environments.

Other species of mesic woodland habitats are *Ena montana*, *Cochlodina orthostoma*, *Bulgara cana*, *Psuedalinda stabulis*, *Aegopinella epipedostoma*, *Vitrea diaphana*, *V. transylociana*, *Euconulus fulvus*, *Fruticicola fruticum*, and *Faustina faustina*. *Argna bielzi* occurs in old wood. Humid woodland provides favourable habitats for *Vestia turgida*, *Vitrea crystallina*, *Eucobresia nivalis*, *Monachoides vicinus*, *Carychium minimum*, and *C. tridentatum*. *Perforatella dibothryon*, *Discus perspectivus* and *Petasina leucozona bielzi* are characteristic of altitudes below 600 m. *Euomphalia strigella*, *Aegopinella minor*, *Truncatellina cylindrica*, *Pupilla muscorum* and *Vitrina pellucida* are found on pastures and in other dry open habitats, while meadow wetlands, especially with tufa forming, harbour *Vertigo angustior*, *V. antivertigo*, *Carychium minimum*, *C. tridentatum*, *Succinella oblonga*, and *Platyla polita*.

In human settlements, particularly villages, only local species, native to the area in question, are found, for example *Vestia gulo*, *Bielzia coeruleus* or *Perforatella dibothryon*, without any synanthropic elements. Mollusc

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**Table 1 continued**

| Species                      | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  | 16  | 17  | 18  | 19  | 20  | 21  | 22  | 23  | 24  | 25  | 26  | 27  | 28  | 29  | 30  | 31  | 32  | 33  | 34  | 35  | 36  | 37  | 38  | 39  | 40  | 41  | 42  | 43  | 44  | 45  | 46  |
|------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
weeds and recent immigrants are very rare. *Arion fasciatus*, *A. busitanicus*, *Deroceras sturanyi*, *D. reticulatum*, and *Limax maximus* have not been recorded in urban areas until quite recently.

**COMMENTS ON SELECTED SPECIES**

Two species in the Bukovské vrchy are represented by very large specimens: *Arianta arbustorum* (Dolina pod Duňkovec 22/28.5 mm, Nová Sedlica 22/27 mm, Šípková – útrž 22.3/26.7 mm) and *Marcogastrea tumida* (Bystý potok u Zboje 15.7/4.5 mm, dolina pod Duňkovec 14.5/4.5 mm). *V. turgida* is represented by robust specimens more or less resembling *V. gulo* (Nová Sedlica, tufa 17/4.1, external characters as in typical *V. turgida*; Šípková, scar 16/4.2 comparatively strongly ribbed). At Stínská slatina both species are found syntopically, but intermediate forms are absent.

The subspecies *Carychium tridentatum* elongatum is dominant in mountain forests; only the form from Sihla resembles *C. tridentatum* tridentatum (see also BAIDASHNIKOV 1985). *Perforatella dibothryon*, in contrast to the hygrophilous *P. bidentata*, prefers mesic woodland, being absent from moist habitats. *Monachoides vicinus* has brown shells and bluish dark grey body (see also PO-LIŃSKI 1924). *Eucobresia nivalis* occurs throughout the region, including valleys at low altitudes.
DISCUSSION

The malacoфаuna of the Bukovské vrchy has a rather monotonous composition resulting from the specific character of the flysh bedrock. The situation is quite different from the high habitat diversity of the Central Carpathians (LOZEK & GULÍČKA 1955). The East Carpathian character of molluscan fauna is unique in the Slovakia. The absence of many Central European species occurring in the West Carpathians, such as Discus rotundatus, Oxychilus cellarius, Daukebardia rufa, D. brevipes, Petasina unidentata, Monachoides incarnatus (Perforatella dibothryon (Perforatella dibothryon vicariates ecologically with M. incarnata), Urticicola umbrosus, Causa holoserica, Cepaea hortensis, including a number of West Carpathian endemics, for example Trichia villosola or Faustina rossmaessleri, is noteworthy. Species that occur in the West Carpathians and Transylvania (e.g. Cochlodina cerata, Alinda biplicata and Vestia elata), and some widespread species (e.g. Discus ruderalis and Clausilia cruciata) are also absent. Some Carpathian endemics are more common in the Bukovské vrchy than in other parts of their distribution area (Argna bielzii, Macrogastria latestriata, M. tumida, Pseudalinda stabilis, Vestia gulo, V. turgida, Schistophallus orientalis, Vitrea transylvanica, Monachoides vicinus, Faustina faustina, Perforatella dibothryon and Acicula parcelina). Among the East Carpathian elements, Petasina leucozona bielzii and Carpathica calophana are largely limited to the East Carpathian Region (east of the Duclo Pass), whereas Perforatella dibothryon and Pseudalinda stabilis have their western distribution border approximately at the line of the eastern part of the Slovak Karst and eastern foothills of the High Tatra Mts. It should be pointed out that P. stabilis is very frequent in the Slovenský Raj [Slovak Paradise], but absent from the adjacent areas of the Low Tatra Mts. and Muránska planina. Some species, which have been recorded neither in the Bukovské vrchy or Eastern Slovakia (LISICKY 1991), nor in the Transcarpathian Ukraine (BAIDASHNIKOV 1985) are reported from this region by WIKTOR (2004): Periplanta petronella, Daukebardia brevipes, Malacolimax tenellus, Macrogastria plicatula, M. ventricosa, Pseudalinda fallex, Vestia elata and Trichia villosula. Clausilia cruciata, C. pumila, Discus ruderalis, Deroceras modavicum, Lehmannia macrogallata and Petasina bakowksi are lacking in both Slovakia and Poland (BAIDASHNIKOV 1985).

REFERENCES


APPENDIX

MOLLUSCAN SUCCESSION FROM THE COLLUVIAL DEPOSIT AT KRIVOŠTIANKA

A detailed snail succession from a 3.5 m thick deposit of Holocene slope sediments at the westernmost reach (called Okurie) of the Krivoštianka Range (Humenské vrchy Mts) above the Laborec River provides the most complete record from the Slovak East Carpathians and is the most detailed yet published from this region. Although it lies outside the area of the Bukovské vrchy, it makes it possible to reconstruct molluscan histories that are also relevant to the adjacent flysch Carpathians. The depositional sequence is located on a west-facing, steep, rocky slope built of Mesozoic limestones. It forms an infilling of rock step at the elevation of 200 m, 30 m above the nearby Laborec River, about 1.5 km downstream of Brekov. It consists of subangular to angular breakdown of all sizes up to blocks 50–70 cm large, in a matrix of calcareous greyish brown, partly humic loam with fine limestones rubble (Fig. 3). Mollusc shells are abundant, but mostly preserved as fragments only.

MOLLUSCAN SUCCESSION (Fig. 3)

Layer 8 – Species-poor assemblage; *Discus ruderatus*, *Faustina faustina*, *Isognomostoma isognomostomos*, *Ruthenica filograna*, *Vitrea subrimata*, *Chondrula tridens* and *Clausilia dubia* occur through-

Fig. 3. Stratigraphic representation of Krivoštianka–Okurie sequence

1 – greyish black humic loam with scattered scree fragments (rendzina soil), 2 – brownish grey slightly humic loam, richer in scree, 3 – fine rubble with loose slightly humic loamy matrix and numerous of shells, 4 – greyish brown loam, rich in fine to medium coarse scree, partly compacted, 5 – pale greyish brown compact loam, rich in medium coarse scree with scattered blocks, 6 – brownish grey humic crumbly loam, rich in rubble with coarser fragments, 7 – pale brownish grey loam, rich in scree, 8 – pale greyish brown (some loess) loam with scree of all sizes incl. coarse blocks, 9 – talus, S – limestone bedrock
out the sequence; *Perforatella binentata*, *Semilimax semilimax* and *Euomphalia strigella* repeatedly appear in younger strata.

Layer 7 – Appearance of *Cochlodina orthostoma*, *Petasina biezi* (1 fragment), *Perforatella dibothryon* (1 fragment), *Fruticicola fruticum*, *Helix pomatia*, *Vestia turgida*, *Monachoides vicinus*, *Vallonia costata*, *Pupilla muscorum* and *Vitrea crystallina orientalis*.

Layer 6 – Appearance of *Sphyradium doliolum* and of a group of grassland species: *Cepaea vindobonensis*, *Pupilla triplicata*, *Truncatellina cylindrica*, *Vallonia pulchella*, *V. tenuilabris*, *Vertigo pygmaea*; decline of *Vitrea crystallina orientalis*. This reflects increasing sparsity of forest and establishing of parkland, which is in accordance with the character of this layer – humic soil, and probably with the high content of charcoals. The record of two well preserved shells of *V. tenuilabris*, probably not re-deposited from older deposits, is of particular interest!

Layer 5 – Appearance of *Cochlodina laminata*, *Perforatella dibothryon* (in greater numbers), *Limax* sp., *Oxychilus glaber*; decline of *Vallonia costata* and *Vallonia pulechella*; 1 specimen of *Carychium tridentatum*. Retreat of *Discus ruderatus*. Shrinkage of open country. ? Erosion event.

Layer 4 – Appearance of *Carpathica calophana* and *Laciniaaria plicata*, decline of *Vestia turgida*. Mass occurrence of *Isognomostoma isognomostomos* and *Ruthenica filograna*. Closed forest.


Layer 2 – Appearance of *Truncatellina claustralis* (present in this layer only!) and *Galba truncatula*. *Clausilia dubia* – minimum, reappearance of *Truncatellina cylindrica*.

Layer 1 – In 2 and 1 several very small fragments of *Discus ruderatus* (? re-deposited from older strata). This surface horizon includes as well developed closed woodland fauna, which considerably differs from the present day impoverished local communities, dominated by reduced number of drought-tolerant species.

**DISCUSSION**

The mollusc faunal succession at Krivoštianka differs considerably from the standard developmental pattern of Central Europe due to the absence of a considerable number of common Central European species, whose succession is well known at present (LOŽEK 1982). The great number of *Discus ruderatus* in layers 8–5, as well as its coexistence with several open country species, may indicate early Holocene, particularly the Boreal period, whereas the expansion and final dominance of closed forest species in 5, 4 and particularly 3 probably corresponds to Atlantic and Epiatlantic. Also layer 2 with the temporal appearance of *Truncatellina claustralis* may be assigned to the Epiatlantic period. Even the surface soil (1) includes as well developed closed woodland fauna, which considerably differs from the present day impoverished local communities, dominated by reduced number of drought-tolerant species.

Of prime interest is the late arrival of most of the Carpathian endemics, particularly of East Carpathian provenance (Carpathica calophana, Pseudalinda stabilis, Perforatella dibothryon, Petasina leucosona biezi) that entered this region only during the post glacial climatic optimum, mostly towards its decline, which corresponds with the recent evidence from the Slovak Karst. However, other endemics survived the glacial within the present day range (Faustina faustina, Cochlodina cerata etc.), which is apparently also true of several further demanding species, such as Ruthenica filograna or Isognomostoma isognomostomos that survived the glacial in the foothill zone of the eastern West Carpathians (Slovak Karst) or farther to the east.

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