



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the Bukovské vrchy Mts (Slovakia) as a result of the recent malacological research, combined with earlier published and unpublished data.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 important communities of predominantly East Carpathian species occur throughout the deciduous woodlands dominated 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 succession

INTRODUCTION

The Východné Karpaty Biosphere Reserve was created 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 flysch belt, which is characterised by alternating sandstone and claystone layers, partly including moderately 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 decalcified 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 investigated 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 differences 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 outcrops. 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 temperatures of 5–5.5°C (January 5.8°C, July 15.3°C). and rainfall of about 1,000–1,100 mm, however with considerable 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 Stučica Nature Reserve) and local patches with ash, sycamore maple or elm confined to landslide scars and base-rich seepages. 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 washed through a bowl-shaped sieve (mesh size 0.5 mm), the coarse plant material was picked out and

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 JUŘIČKOVÁ et al. (2001).

HISTORY OF RESEARCH

The first malacological research in the area of the Bukovské vrchy Mts. was published by LOŽEK & GULIČKA (1955) from the Nature Reserve Stučica. They found 34 mainly woodland species, including the first record of the East Carpathian species *Carpathica calophana* in Slovakia. In 1954 LOŽEK (1962) collected 45 species in the surroundings of Snina and Nová Sedlica. ŠTEFFEK (1995) and ŠTEFFEK & GAVLAS (in

press) compared the Biosphere Reserves of Slovakia including the Bukovské vrchy Mts. The recent research from this area was published in ŠTEFFEK (2001, 2004) and ŠTEFFEK & VAVROVÁ (2004). Reports on molluscs of the Bukovské vrchy were given in LOŽEK (1956), HUDEC (1963, 1966), ŠTEFFEK et al. (1964, 1983, in press), VOLOŠČUK (1988), LISICKÝ (1991), ŠTEFFEK (1994), KOREŇ & ŠTEFFEK (1996).

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. MÍKOVCOVÁ, AJ – A. JANSOVÁ, JG – J. GREGO, JS – J. ŠTEFFEK, LD – L. DVOŘÁK, LJ – L. JUŘIČKOVÁ, LV – L. VÁVROVÁ; MaH – M. HRABÁKOVÁ, MH – M. HORSÁK, PK – P. KMENT, TC – T. ČEJKA; TK – T. KOŘÍNKOVÁ; VL – V. LOŽEK, VLK – V. LUČIVIANSKÁ-KROUPOVÁ). Fig. 1 shows the distribution of the localities.

1. Jalová – Stariná – water-supply reservoir, 49°03'00"N, 22°15'20"E, 500 m, 11.8.2004, 14.7.2004, JS
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 Soliště and Rypy), 49°07'07"N, 22°19'44"E, 540 m, 4.5. 1992, VL
6. Ruské – fen under Soliště, 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
18. Ruské – Nature Reserve Pľaša – western gap, 49°06'32"N, 22°23'39"E, 740 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

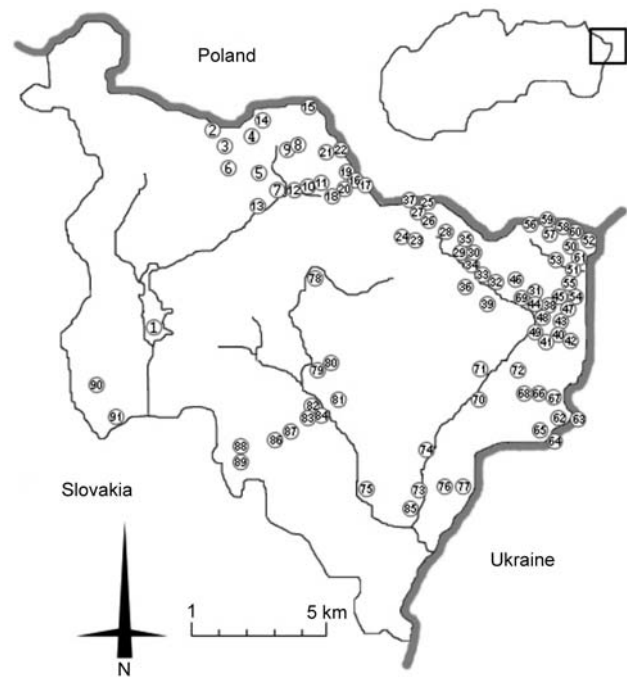


Fig. 1. Location of the Bukovské vrchy Mts. with collecting sites

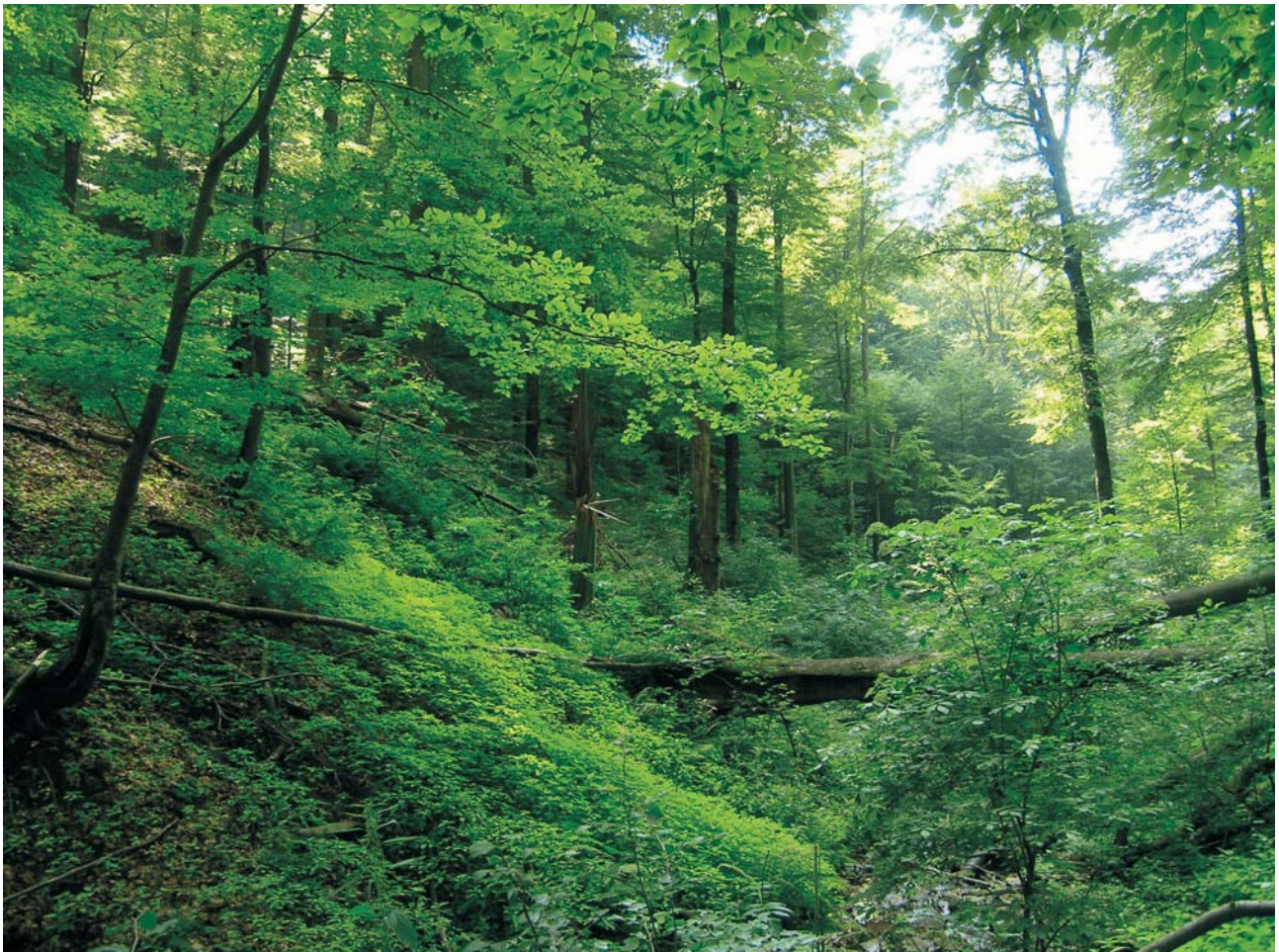


Fig. 2. A typical virgin beech forest in Bukovské vrchy Mts. (the Nature Reserve Rožok)

23. Runina – Ďurkovec – valley below Ďurkovec, 49°05'22"N, 22°26'24"E, 800 m, 1.5.1992, VL
24. Runina – Ďurkovec – spring area east of Ďurkovec, 49°05'32"N, 22°26'10"E, 850 m, 1.5.1992, VL
25. Nová Sedlica – Nature Reserve Jaraba skala – top, 49°06'12"N, 22°27'13"E, 1,167 m, 1.5. 1992, VL
26. Nová Sedlica – Nature Reserve Jaraba skala – scree, 49°06'03"N, 22°27'11"E, 1,000 m, 1.5.1992, VL
27. Nová Sedlica – Nature Reserve Jaraba skala, 49°06'10"N, 22°27'15"E, 1,050 m, 19.7.2005. AJ, AM, LD, LJ, MH, MaH, PK, TK
28. Nová Sedlica – path below Nature Reserve Jaraba skala, 49°05'48"N, 22°27'07"E, 900 m, 19.7.2005, AJ, AM, LD, LJ, MH, MaH, PK, TK
29. Nová Sedlica – pond Medová baba, 49°05'00"N, 22°27'40"E, 620 m, 19.7.2005, AJ, AM, JS, LD, LJ, MH, MaH, PK, TK
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 Syrochomenka, 49°04'02"N, 22°29'24"E, 470 m, LOŽEK (1962)
33. Nová Sedlica – valley of Zbojský potok, 49°04'18"N, 22°28'31"E, 500 m, LOŽEK (1962)
34. Nová Sedlica – Trosta, 49°04'55"N, 22°27'47"E, 630 m, LOŽEK (1962)
35. Nová Sedlica – Chýška pod Skalou, 49°05'06"N, 22°27'37"E, 640 m, LOŽEK (1962)
36. Nová Sedlica – valley NNW of Beskyd, 49°04'02"N, 22°28'01"E, 600 m, LOŽEK (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, LOŽEK (1962)
38. Nová Sedlica – Patrikúsky, 49°03'46"N, 22°31'24"E, 620 m, LOŽEK (1962)
39. Nová Sedlica – Nature Reserve Bahno, 49°03'36"N, 22°28'50"E, 670 m, 29.4.1992, VL
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 Kýčera, 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 Kýčera, 49°04'06"N, 22°30'07"E, 550 m, LOŽEK (1962)
47. Nová Sedlica – stream floodplain between field station and cross-road Pod Kýčerou, 49°03'22"N, 22°31'33"E, 480 m, 18.7.2005, AM, TK
48. Nová Sedlica – fen in N part of the village with *Typha*, 49°03'05"N, 22°30'55"E, 420 m, 20.7.2005, MH, LD
49. Nová Sedlica – urban area, 49°02'25"N, 22°30'50"E, 420 m, 20.7.2005, LD
50. Nová Sedlica – Nature Reserve Stužica, 49°05'00"N, 22°32'32"E, 840 m, LOŽEK & GULIČKA (1955)
51. Nová Sedlica – Nature Reserve Stužica – Stužická rieka, 49°04'23"N, 22°32'38"E, 650 m, LOŽEK (1962)
52. Nová Sedlica – Nature Reserve Stužica – beech-fir forest, 49°05'06"N, 22°33'34"E, 1,050 m, 31.7.1978, VLK
53. Nová Sedlica – Nature Reserve Stužica 49°04'23"N, 22°32'30"E, beech-fir forest, Stužická rieka, 650 m, 16.7.2005, LD, LJ, MH, MaH, PK
54. Nová Sedlica – Nature Reserve Stužica – Packova Kýčera, 49°04'05"N, 22°32'35"E, 871 m, LOŽEK (1962)
55. Nová Sedlica – Nature Reserve Stužica – ridge N of Packova Kýčera, 49°04'12"N, 22°32'34"E, 800 m, LOŽEK (1962)
56. Nová Sedlica – Nature Reserve Stužica – Santove Polianky, 49°05'33"N, 22°31'00"E, 1,040 m, LOŽEK (1962)
57. Nová Sedlica – Nature Reserve Stužica – Pod Hrubkami, 49°05'24"N, 22°31'51"E, 1,080 m, LOŽEK (1962)
58. Nová Sedlica – Nature Reserve Stužica – Pod Kamenou lúkou, 49°05'35"N, 22°32'32"E, 1,100 m, LOŽEK (1962)
59. Nová Sedlica – Nature Reserve Stužica- Hrubky, 49°05'37"N, 22°31'49"E, 1,186 m, LOŽEK (1962)
60. Nová Sedlica – Nature Reserve Stužica – Kamenná lúka, 49°05'28"N, 22°32'50"E, 1,200 m, LOŽEK (1962)
61. Nová Sedlica – Nature Reserve Stužica – Kamenistý potok, 49°04'53"N, 22°32'56"E, 800 m, LOŽEK (1962)
62. Nová Sedlica – Nature Reserve Stinská – spring area below Majková, 49°00'22"N, 22°32'05"E, 980 m, 2.5.1992, VL
63. Nová Sedlica – Nature Reserve Stinská – eastern summit, 49°00'22"N, 22°32'44"E, 1,063 m, 2.5.1992, VL
64. Nová Sedlica – Nature Reserve Stinská – western summit 49°00'02"N, 22°31'33"E, 1,092 m, 2.5.1992, VL
65. Nová Sedlica – Nature Reserve Stinská – beech forest below top, 49°00'15"N, 22°31'27"E, 980 m, 20.7.2005, AJ, AM, LJ, MaH, PK
66. Nová Sedlica – Nature Reserve Stinská slatina, 49°01'10"N, 22°31'40"E, open fen with *Sphagnum*, 680 m, 30.4.1992, VL
67. Nová Sedlica – Nature Reserve Stinská slatina, 49°01'10"N, 22°31'40"E, forest and bushes sur-



- rounding fen, 680 m, 20.7.2005, AJ, AM, LD, LJ, MH, MaH, PK, TK
68. Nová Sedlica – Nature Reserve Stinská slatina, 49°01'10"N, 22°31'40"E, open fen with *Sphagnum*, 680 m, 20.7.2005, AJ, AM, LD, LJ, MH, MaH, PK, TK
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 1.5 km SW of the village, 49°00'43"N, 22°27'48"E, 320 m, 17.7.2005, LD, LJ, MH, MaH, PK
71. Zboj – fen on right bank with *Typha latifolia*, 49°01'09"N, 22°28'15"E, 320 m, 14.7.2004, 17.7.2005, JS
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
74. Uličské Krivé – cemetery NE of the village, 48°59'50"N, 22°26'35"E, 295 m, 18.7.2005, LD, LJ, MH, MaH, PK
75. Uličské Krivé – Nature Reserve Uličská Ostrá, 48°59'15"N, 22°23'57"E, 360 m, 18.7.2005, LD, LJ, MH, MaH, PK
76. Uličské Krivé – valley of stream below Nature Reserve Rožok, 48°58'58"N, 22°27'16"E, 400 m, 17.7.2005, LD, LJ, MH, MaH, PK
77. Uličské Krivé – Nature Reserve Rožok, beech forest, 48°58'48"N, 22°27'45"E, 450 m, 17.7.2005, LD, LJ, MH, MaH, PK
78. Topoľa – junction of streams Ulička and Verbláč 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
86. Kalná Roztoka – Nature Reserve Havešová, 49°00'30"N, 22°19'50"E, 480 m, 21.7.2005, AJ, AM, LD, LJ, MH, MaH, PK, TK
87. Kalná Roztoka – Nature Reserve Havešová, 49°00'40"N, 22°20'30"E, 650 m, 11.10.1995, JS
88. Kalná Roztoka – floodplain of Ublianka stream near reservoir, 48°59'47"N, 22°18'57"E, 343 m, 21.7.2005, AJ, AM, LD, LJ, MH, MaH, PK, TK
89. Kalná Roztoka – small reservoir in Ublianka floodplain, 48°59'47"N, 22°18'57"E, 343 m, 21.7.2005, AJ, AM, LD, LJ, MH, MaH, PK, TK
90. Stakčín – floodplain of Chotinka stream at its junction with Hlboký potok, 49°02'12"N, 22°12'07"E, 320 m, 21.7.2005, AJ, AM, LD, LJ, MH, MaH, PK
91. Stakčín – urban area, 49°00'05"N, 22°13'25"E, 255 m, 21.7.2005, LD
92. Vydraň – Husárska 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 dibothryon*, *Faustina faustina*, *Macrogastra latestriata*, *M. tumida* and *Vestia gulo*. *V. gulo*, *Discus perspectivus*, *Schistophallus orientalis*, *Monachoides vicinus*, *Macrogastra tumida*, *Carychium tridentatum*, *Macrogastra latestriata* 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 malacocoenoses 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 syc-

DISCUSSION

The malacofauna 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 (LOŽEK & GULIČKA 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*, *Daudebardia rufa*, *D. brevipes*, *Petasina unidentata*, *Monachoides incarnatus* (*Perforatella dibothryon* vicariates ecologically with *M. incarnatus*), *Urticicola umbrosus*, *Causa holosericea*, *Cepaea hortensis*, including a number of West Carpathian endemics, for example *Trichia villosula* 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 ruderratus* 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 bielzi*, *Macrogastra latestriata*, *M. tumida*, *Pseudalinda stabilis*, *Vestia gulo*, *V. turgida*, *Schistophallus orientalis*, *Vitrea transsylvanica*, *Monachoides vicinus*, *Faustina faustina*, *Perforatella dibothryon* and *Acricula parcelineata*). Among the East Carpathian elements, *Petasina leucozona bielzi* and

Carpathica calophana are largely limited to the East Carpathian Region (east of the Dukla 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 (LISICKÝ 1991), nor in the Transcarpathian Ukraine (BAIDASHNIKOV 1985) are reported from this region by WIKTOR (2004): *Perpolita petronella*, *Daudebardia brevipes*, *Malacolimax tenellus*, *Macrogastra plicatula*, *M. ventricosa*, *Pseudalinda fallax*, *Vestia elata* and *Trichia villosula*. *Clausilia cruciata*, *C. pumila*, *Discus ruderratus*, *Deroceras moldavicum*, *Lehmannia macroflagellata* and *Petasina bakowskii* are lacking in the Slovakian part of the East Carpathians, but occur across the border in Poland and Ukraine. The southern slopes of the East Carpathians are characterised by the occurrence of *Mastus bielzi*, *Serrulina serrulata*, *Prostenomphalia carpathica*, *Drobacia banatica* and *Arianta aethiops*, which are lacking in both Slovakia and Poland (BAIDASHNIKOV 1985).

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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 flysh 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-

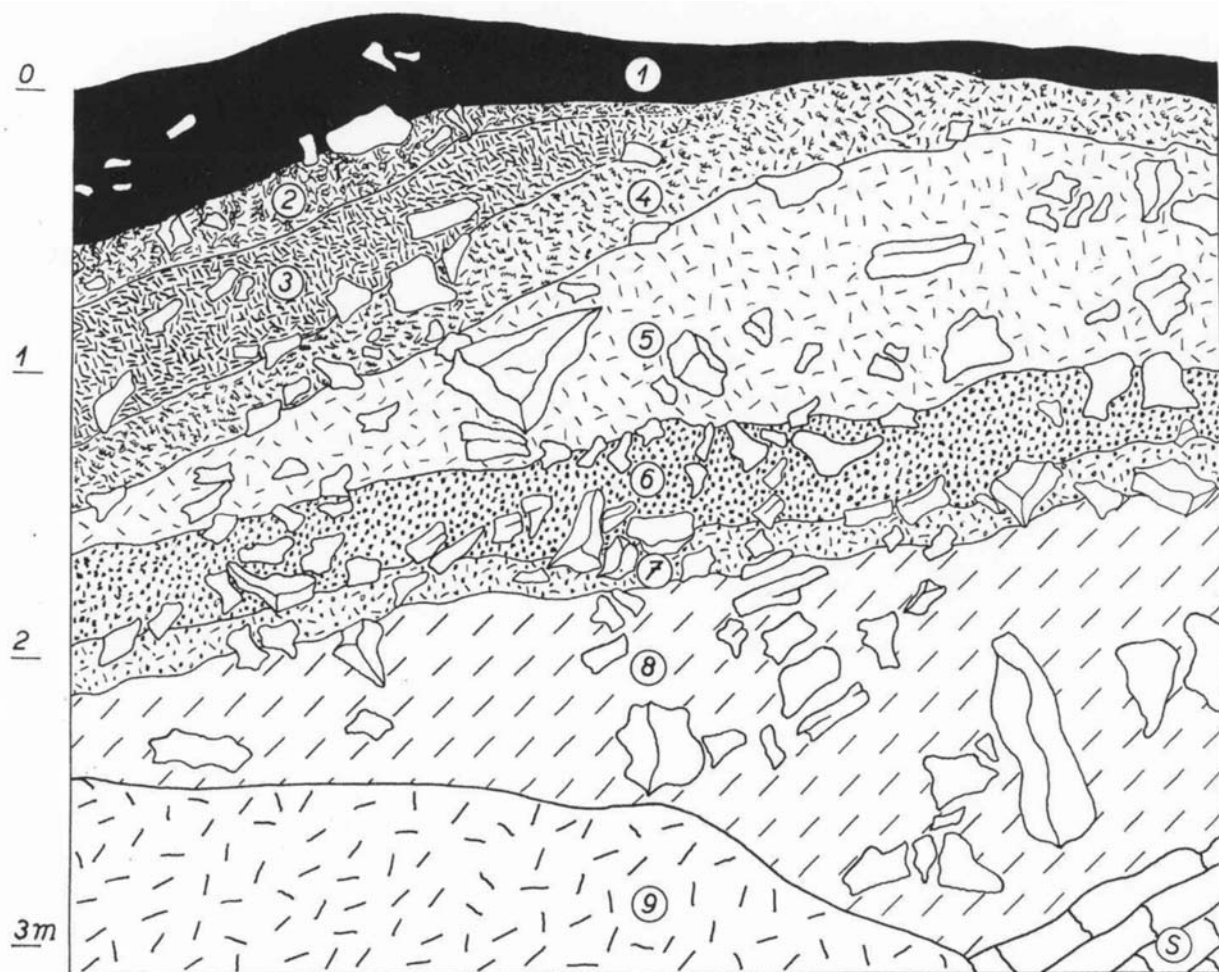


Fig. 3. Stratigraphic representation of Krivoštianka–Okurie sequence

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 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 blocs, 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 bielzi* (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 pulchella*; 1 specimen of *Carychium tridentatum*. Retreat of *Discus ruderratus*. Shrinkage of open country. ? Erosion event.

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 ruderratus* 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

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

Layer 3 – Maximum of species richness and abundance. Appearance of *Aegopinella* cf. *epipedostoma*, *Oxychilus depressus*, *Platyla polita*, *Pseudalinda stabilis*, *Vitrea diaphana*. Maximum abundance of *Isognomostoma isognomostomos*. Forest optimum (Epiatlantic).

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 ruderratus* (? re-deposited from older strata). This surface horizon includes an atypical forest assemblage, whereas the present-day malacofauna is impoverished, consisting mostly of drought-tolerant species. This indicates that slope sedimentation ceased and was replaced by soil formation.

In addition, at the foot of the Okurie slope a small loess exposure provided a characteristic pleniglacial fauna consisting of *Pupilla muscorum*, *P. sterii* and *P. loessica*, as well as *Vallonia tenuilabris* in large numbers.

provenance (*Carpathica calophana*, *Pseudalinda stabilis*, *Perforatella dibothryon*, *Petasina leucozona bielzi*) 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 filigrana* 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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