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Ecologic evaluation of malacofauna from the middle terraces loess cover, southern part of the Nitra hilly land.

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Abstract. The paper is dealing with ecologic evaluation of mollusc fauna recovered by some boreholes in the southern part of the Nitra hilly land. In most of the boreholes we found a typical fauna of so called swamp loess represented by a great amount of water species. The studied mollusc assemblages of the southern part of the Nitra hilly land resemble lowland steppes assemblages.

Key words: Quaternary, Pleistocene, Holocene, boreholes, gastropoda, bivalvia, ecology

Introduction

From the geomorphological viewpoint the studied area, located in the southern part of the Nitra hilly land, belongs to the two morphologically conspicuous regions (Košťálik 1974) as follows:

a) - alluvial plain extending from the Danube lowland along Nitra and Váh rivers. The alluvial plain is slightly undulated and it is restricted by a line Soporka - Trnovec nad Váhom - Nové Zámky.

b) - table lowered by an erosion. It is characterized by a higher relief energy, preserved system of eolic dunes as well as a conspicuous erosive escarpment along the line Šintava - Pata - Sládečkovo - Mojmírovce - Komjatice. In the studied area several boreholes (PZ-4 - Ľudovitov, PZ-5 - Malé Čiky (M. Čiky), PZ-7 - Kopec, PZ-9 - Nový Svet, PJ-6 - Kesovský Pereš and PJ-7 - Poľný Kesov) were situated by mapping geologist Dr. Pristaš.

The geological structure of the studied area consists mainly of Pliocene (limnic-fluvial deposits) and Pleistocene deposits as blown sands, loess and loess-like loams, which mask the system of river terraces.

Lithology of described boreholes

The lithology of boreholes described is characterize by a correlation scheme of loess covering middle terraces of the southern part of the Nitra hilly land on Fig. 1.

Systematic overview of identified mollusc fauna

Class: *GASTROPODA*
Subclass: *PROSOBRANCHIA*
Order: *ARCHAEOGASTROPODA*
Family: *VALVATIDAE*
Genus: *Valvata* Müller, 1774 Jurassic - Recent

Valvata cristata Müller, 1774

1952 *Valvata (Valvata) cristata* (Müller) - Žadin: p. 215, fig. 133
1964 *Valvata (Valvata) cristata* (Müller) - Ložek: p. 159, pl. I/9abc
1994 *Valvata cristata* (Müller) - Skompski - Makowska: p. 50, pl. 29/5

Valvata piscinalis (Müller, 1774)

1952 *Valvata (Cincinna) piscinalis* (Müller) - Žadin: p. 212, fig. 129
1964 *Valvata (Cincinna) piscinalis* (Müller) - Ložek: p. 159, pl. I/1abc, 2abc

Valvata pulchella (Studer, 1820)

1952 *Valvata (Tropidina) pulchella* (Studer) - Žadin: p. 214, fig. 132
1964 *Valvata (Cincinna) pulchella* (Studer) - Ložek: p. 160, fig. 23
1994 *Valvata pulchella* (Studer) - Skompski - Makowska: p. 51, pl. 31/1

Family: *HYDROBIIDAE*
Genus: *LITHOGLYPHUS* Hartmann, 1821
Pliocene - Recent

Lithoglyphus naticoides (Pfeiffer, 1828)

1952 *Lithoglyphus naticoides* (Pfeiffer) - Žadin: p. 238, fig. 171

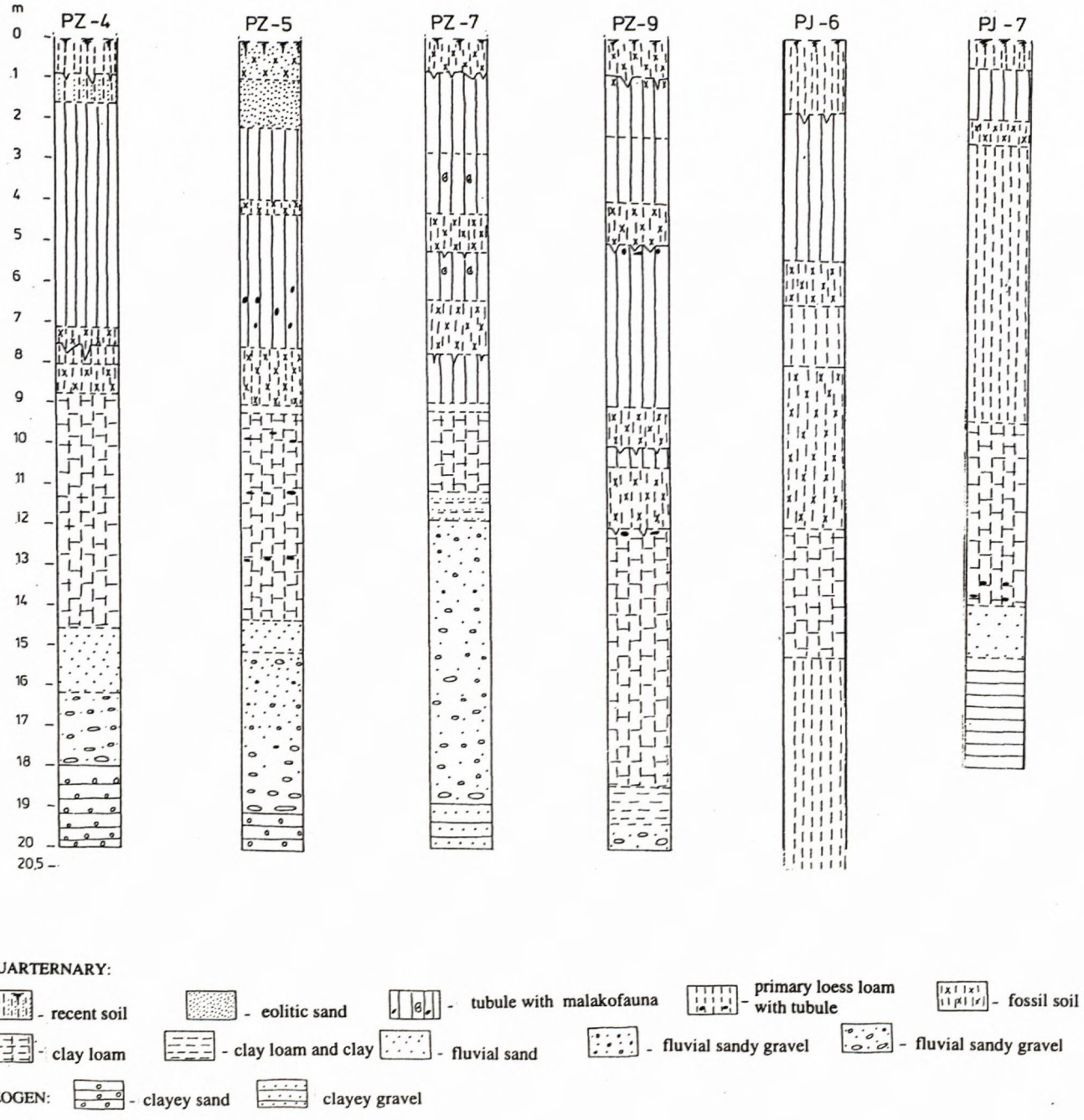

Fig. 1 Correlation scheme of loess blanket of middle terraces on the southern part of the Nitra hilly land (J. Pristaš, 1996)

1964 *Lithoglyphus naticoides* (Pfeiffer)- Ložek: p.165 pl. I/3ab
1994 *Lithoglyphus naticoides* (Pfeiffer) - Skompski - Makowska: p. 54, pl. 31/2

Family: *BITHYNIIDAE*
Genus: *Bithynia* Leach, 1818 Paleocene - Recent

***Bithynia tentaculata* (Linne, 1758)**

1952 *Bithynia tentaculata* (Linné) - Žadin: p. 246, fig. 184
1964 *Bithynia (Bithynia) tentaculata* (Linné) - Ložek: p. 166, pl. I/7
1994 *Bithynia tentaculata* (Linné) - Skompski - Makowska: p. 54, pl. 30/4

Family: *THIARIDAE*
Genus: *Fagotia* Boerguignat, 1884 Lower Pliocene - Recent

***Fagotia* sp.**

Subclass: *EUTHYNEURA*
Order: *BASOMMATOPHORA*
Family: *CARYCHIIDAE*
Genus: *Carychium* Müller, 1774 Paleocene - Recent

***Carychium tridentatum* (Risso, 1826)**

1964 *Carychium tridentatum* (Risso) - Ložek: p.171, pl.VI/2
1994 *Carychium tridentatum* (Risso) - Skompski - Makowska: p. 57, pl. 33/7

Family: *PHYSIDAE*
Genus: *Aplexa* Fleming, 1820 Jurassic - Recent

***Aplexa hypnorum* (Linne, 1758)**

1964 *Aplexa hypnorum* (Linné) - Ložek: p. 172, pl. III/1
1994 *Aplexa hypnorum* (Linné) - Skomski - Makowska: p. 58, pl.31/4

Genus: *Physa* Draparnaud, 1801

Physa fontinalis* *(Linne, 1758)

1952 *Physa fontinalis* (Linné) - Žadin: p.178, fig. 81
1964 *Physa fontinalis* (Linné) - Ložek: p. 173, pl. III/2

Family: *LYMNAEIDAE*
Genus: *Lymnaea* Lamarck, 1799

Lymnaea palustris* (Müller, 1774*)

1952 *Galba palustris* (Müller) - Žadin: p.173, fig.72
1964 *Lymnaea (Galba) palustris* (Müller) - Ložek: p. 175, pl. III/4, 6

***Lymnaea peregra peregra* (Müller, 1774)**

1964 *Lymnaea peregra peregra* (Müller) - Ložek: p. 177, pl. III/5

Family: *PLANORBIDAE*
Genus: *Planorbarius* Froriep,1806

***Planorbarius corneus* (Linne, 1758)**

1952 *Coretus corneus* (Linné) - Žadin: p.183, fig.86
1964 *Planorbarius corneus* (Linné) - Ložek: p. 180, fig. 31
1994 *Planorbarius corneus* (Linné) - Skompski - Makowska: p. 59, pl. 34/3

Genus: *Planorbis* Müller, 1774

***Planorbis planorbis* (Linne, 1758)**

1952 *Planorbis planorbis* (Linné) - Žadin: p.182, fig. 85
1964 *Planorbis planorbis* (Linné) - Ložek: p. 181, pl. IV/1abc
1994 *Planorbis planorbis* (Linné) - Skompski - Makowska: p. 60, pl. 35/5

Genus: *Anisus* Studer, 1820 Miocene (Paleocene?) - Recent

***Anisus spirorbis* (Linne, 1758)**

1952 *Anisus (Anisus) spirorbis* (Linné) - Žadin: p. 185, fig. 90
1964 *Anisus (Anisus) spirorbis* (Linné) - Ložek: p. 183, fig.33
1994 *Anisus spirorbis* (Linné) - Skompski - Makowska: p. 60, pl. 35/2

***Anisus vortex* (Linne, 1758)**

1952 *Anisus (Spiralina) vortex* (Linné) - Žadin: p.184, fig.88
1964 *Anisus (Disculifer) vortex* (Linné) - Ložek: p. 184, pl. IV/4abc
1994 *Anisus vortex* (Linné) - Skompski - Makowska: p. 61, pl. 36/2

***Anisus vorticulus* (Troschel, 1834)**

1952 *Anisus (Spiralina) vorticulus* (Troschel) - Žadin: p. 185, fig. 89
1964 *Anisus (Disculifer) vorticulus* (Troschel) - Ložek: p. 185, pl. IV/5abc
1994 *Anisus vorticulus* (Troschel) - Skompski - Makowska: p. 61, pl. 36/3

Genus: *Gyraulus* Charpentiert, 1837 Eocene - Recent

***Gyraulus albus* (Müller, 1774)**

1952 *Gyraulus albus* (Müller) - Žadin: p.188, fig. 94
1964 *Gyraulus albus* (Müller) - Ložek: p. 187, pl. V/1abc
1994 *Gyraulus albus* (Müller) - Skompski - Makowska: p. 62, pl. 37/2

***Gyraulus laevis* (Alder, 1838)**

1952 *Gyraulus laevis* (Alder) - Žadin: p. 191, fig. 100
1964 *Gyraulus laevis* (Alder) - Ložek: p.188, pl.V/2abc
1994 *Gyraulus laevis* (Alder) - Skompski - Makowska: p. 62, pl. 38/1

***Gyraulus acronicus* (Ferusac, 1807)**

1964 *Gyraulus acronicus* (Ferussac) - Ložek: p.188

Genus: *Bathyomphalus* Charpentier, 1837 Miocene - Recent

***Bathyomphalus contortus* (Linne, 1758)**

1952 *Anisus (Bathyomphalus) contortus* (Linné) - Žadin: p. 187, fig. 93
1964 *Bathyomphalus contortus* (Linné) - Ložek: p. 185, pl. IV/6abc

Genus: *Armiger* Hartmmann, 1843 Miocene - Recent

***Armiger crista cristatus* (Draparnaud, 1805)**

1964 *Armiger crista cristatus* (Draparnaud) - Ložek: p. 189

Armiger crista nautileus (Linne, 1758)

1964 *Armiger crista nnautileus* (Linné) - Ložek:p.189

Genus: *Segmentina* Fleming, 1818 Oligocene - Recent

***Segmentina nitida* (Muller, 1774)**

1952 *Segmentina nitida* (Müller) - Žadin: p. 193, fig. 103
1964 *Segmentina nitida* (Müller) - Ložek: p. 190, pl. V/3abc
1994 *Segmentina nitida* (Müller) - Skompski - Makowska: p. 63, pl.39/1

Order: *STYLOMMATOPHORA*
Family: *COCHLICOPIDAE*
Genus: *Cochlicopa* Risso, 1826 Paleocene - Recent

***Cochlicopa lubrica* Müller, 1774**

1956 *Cochlicopa lubrica* (Müller) - Ložek: p.84, pl. II/3
1964 *Cochlicopa lubrica* (Müller) - Ložek: p. 193, pl. V/7,8
1983 *Cochlicopa lubrica* (Müller) - Kerney - Cameron-Jungbluth: p. 84

***Cochlicopa lubricella* (Porro,1838)**

1964 *Cochlicopa lubricella* (Porro) - Ložek: p.194, pl.V/6
1994 *Cochlicopa lubricella* (Porro) - Skompski - Makovska: p. 64, pl. 39/4

Family: *VERTIGINIDAE*
Genus: *Collumela* Westerlund, 1878 Pleistocene - Recent

***Columella collumela* Martens, 1830**

1956 *Columella edentula columella* (Martens) - Ložek: p. 98, pl. V/2
1964 *Columella columella* (Martens) - Ložek: p.198, pl.VI/3
1983 *Columella columella* (Martens) - Kerney - Cameron-Jungbluth: p. 87
1994 *Columella columella* (Martens) - Skompski - Makowska: p. 64, pl. 39/6

Genus: *Vertigo* Muller, 1774 Paleocene - Recent

***Vertigo antivertigo* (Draparnaud,1801)**

1964 *Vertigo (Vertigo) antivertigo* (Draparnaud) - Ložek: p. 202, pl. VII/1
1994 *Vertigo antivertigo* (Draparnaud) - Skompski - Makowska: p. 65, pl. 40/1

***Vertigo pygmaea* Draparnaud,1801**

1956 *Vertigo pygmaea* (Draparnaud) - Ložek: p. 93, pl. IV/5
1964 *Vertigo (V.) pygmaea* (Draparnaud) - Ložek: p. 203, pl. VII/3
1983 *Vertigo (V.) pygmaea* (Draparnaud) - Kerney - Cameron - Jungbluth: p. 92

***Vertigo genesis* (Gredler, 1856)**

1964 *Vertigo genesis* (Gredler) - Ložek: p. 206, pl. VII/8
1983 *Vertigo (V.) genesii* (Gredler) - Kerney - Cameron - Jungbluth: p. 94

***Vertigo parcedentata* (Braun, 1847)**

1964 *Vertigo parcedentata* (Braun) - Ložek: p. 206, pl.VII/8
1994 *Vertigo parcedentata* (Braun) - Skompski - Makowska: p. 66, pl. 40/2

***Vertigo geyeri* Lindholm, 1925**

1983 *Vertigo (V.) geyeri* (Lindholm) - Kerney - Cameron - Jungbluth: p. 95

Family: *CHONDRINIDAE*
Genus: *Granaria* Turton, 1831 Eocene - Recent

***Granaria frumentum* (Draparnaud, 1801)**

1964 *Abida frumentum* (Draparnaud) -Ložek:p.211,pl. VIII/7
1983 *Granaria frumentum* (Draparnaud) - Kerney - Cameron - Jungbluth: p. 107

Family: *PUPILLIDAE*
Genus: *Pupilla* Fleming, 1828 Oligocene - Recent

***Pupilla triplicata* Studer, 1820**

1956 *Pupilla triplicata* (Studer) -Ložek: p. 102
1964 *Pupilla triplicata* (Studer) - Ložek: p. 244, pl. IX/5,6

***Pupilla muscorum* Linne, 1758**

1956 *Pupilla muscorum* (Linné) - Ložek: p. 99, pl. VI/1
1964 *Pupilla muscorum* (Linné) - Ložek: p. 215, pl. IX/1,7
1983 *Pupilla (Pupilla) muscorum* (Linné) - Kerney - Cameron - Jungbluth: p. 118
1994 *Pupilla muscorum* (Linné) - Skompski - Makowska: p. 66, pl. 40/2

***Pupilla sterri* Voith,1838**

1956 *Pupilla sterri* (Voith) - Ložek: p. 101, pl. VI/3
1964 *Pupilla sterri* (Voith) - Ložek: p.216, pl. IX/2
1983 *Pupilla (Pupilla) sterri* (Voith) - Kerney - Cameron - Jungbluth: p. 120

***Pupilla loessica* Ložek, 1954**

1964 *Pupilla loessica* (Ložek) - Ložek: p. 277, pl. IX/3
1994 *Pupilla loessica* (Ložek) - Skompski - Makowska: p. 67, pl. 40/5

***Pupilla muscorum densegyrata* Ložek, 1954**

1955 *Pupilla muscorum densegyrata* (Ložek) - Ložek: p. 401, pl. II/1, 2
1964 *Pupilla muscorum densegyrata* (Ložek) - Ložek: p . 216, pl.IX/4

***Pupilla* sp.**

Family: *VALLONIIDAE*
Genus: *Vallonia* Risso,1826 Paleocene - Recent

***Vallonia pulchella* Müller, 1774**

1955 *Vallonia pulchella* (Müller) - Ložek: p.108, pl.8/3
1964 *Vallonia pulchella* (Müller) - Ložek: p.221, pl.X/5a,b,c
1983 *Vallonia pulchella* (Müller) - Kerney - Cameron- Jungbluth: p.127
1994 *Vallonia pulchella* (Müller) - Skompski - Makowska : p. 67, pl. 41/

Vallonia enniensis (Gredler, 1856)

1964 *Vallonia enniensis* (Gredler) - Ložek: p. 222, pl.X/2abc
1983 *Vallonia enniensis* (Gredler) - Kerney - Cameron - Jungbluth: p.127
1994 *Vallonia enniensis* (Gredler) - Skompski - Makowska: p. 68, pl. 42/1

Vallonia tenuilabris Braun, 1843

1955 *Vallonia tenuilabris* (Braun) - Ložek: p.106
1964 *Vallonia tenuilabris* (Braun) - Ložek: p. 223, pl. X/1a,b,c
1994 *Vallonia tenuilabris* (Braun) - Skompski - Makowska: p. 68, pl. 42/2

Family: *ENIDAE*
Genus: *Chondrula* Beck, 1837 Pliocene - Recent

***Chondrula tridens* Müller, 1774**

1955 *Chondrula tridens* (Müller) - Ložek: p. 114, fig. 29, pl. 10/3
1964 *Chondrula tridens* (Müller) - Ložek: p. 225, fig. 41
1983 *Chondrula (Chondrula) tridens* (Muller) - Kerney - Cameron - Jungbluth: p. 133
1994 *Chondrula tridens* (Müller) - Skompski - Makowska: p. 68, pl. 40/3

Family: *SUCCINEIDAE*
Genus: *Succinea* Draparnaud, 1801 Paleocene-Recent

***Succinea putris* (Linne, 1758)**

1964 *Succinea (S.) putris* (Linné) - Ložek: p. 229, pl. XII/1,2
1994 *Succinea putris* (Linné) - Skompski - Makowska: p. 69, pl. 40/6

***Succinea oblonga* Draparnaud, 1801**

1955 *Succinea (Succinella) oblonga* (Draparnaud) - Ložek: p. 83, pl. II/2
1964 *Succinea (Succinella) oblonga* (Draparnaud) - Ložek: p. 230, pl. 12/7,8,9
1983 *Succinea (S.) oblonga* (Draparnaud) - Kerney - Cameron - Jungbluth: p. 79
1994 *Succinea oblonga* (Draparnaud) - Skompski - Makowska: p. 69, pl. 40/8

Family *ZONITIDAE*
Genus: *Nesovitrea* Cooke, 1921

***Nesovitrea hammonis* Ström, 1765**

1955 *Perpolita radiatula* (Alder) - Ložek: p. 151, pl. 1 19/1
1964 *Perpolita radiatula* (Alder) - Ložek: p. 243, pl. 19/3a, b, c
1983 *Nesovitrea hammonis* (Ström) - Kerney - Cameron-Jungbluth: p.168
1994 *Nesovitrea hammonis* (Ström) - Skompski - Makowska: p. 70, pl. 43/1

Family: *LIMACIDAE/ AGRIOLIMACIDAE*

Family: *BRADYBAENIDAE*
Genus: *Bradybaena* Beck,1837 Upper Pliocene - Recent

***Bradybaena fruticum* (Müller, 1774)**

1964 *Bradybaena fruticum* (Müller) - Ložek: p. 284, pl. XXII/1abc, XXX/3
1983 *Bradybaena (B.) fruticum* (Müller) - Kerney - Cameron - Jungbluth: p. 242
1994 *Bradybaena fruticum* (Müller) - Skompski - Makowska: p. 73, pl. 44/2

Family: *HELICIDAE*
Genus: *Helicopsis* Titzinger, 1833

***Helicopsis striata* Müller, 1774**

1955 *Helicella (Helicopsis) striata* (Müller) - Ložek: p. 195, pl. 30/1
1964 *Helicopsis striata* (Müller) - Ložek: p.289, pl.22/2a,b,c
1983 *Helicella (Helicopsis) striata* (Müller) - Kerney - Cameron - Jungbluth: p. 242

Genus: *Perforatella* Schluter, 1838 Pleistocene - Recent

***Perforatella rubiginosa* Schmidt,1853**

1955 *Monachoides rubiginosa* (Schmidt) - Ložek: p. 209, pl. 34/1, 2
1964 *Monachoides rubiginosa* (Schmuidt) - Ložek: p. 289, pl. 22/2a, b, c
1983 *Perforatella (P.) rubiginosa* (Schmidt) - Kerney - Cameron- Jungbluth: p.259
1994 *Perforatella rubiginosa* (Schmidt) - Skompski - Makowska: p. 73, pl. 45/1

Genus: *Trichia* Hartmann, 1840 Paleogene - Recent

***Trichia hispida* Linne, 1758**

1955 *Trichia hispida* (Linné) - Ložek: p. 208, pl. 32/3
1964 *Trichia (Trichia) hispida* (Linné) - Ložek: p. 300, pl. 25/1a, b, c
1983 *Trichia (Trichia) hispida* (Linné) - Kerney - Cameron-Jungbluth: p. 261
1994 *Trichia hispida* (Linné) - Skompski - Makowska: p. 74, pl. 44/3

Genus: *Arianta* Turton, 1831 Late Pliocene - Recent

***Arianta arbustorum* Linne, 1758**

1955 *Arianta arbustorum* (Linné) - Ložek: p. 221, pl. 37/2

1964 *Arianta arbustorum* (Linné) - Ložek: p. 309, pl. 30/5
1983 *Arianta arbustorum* (Linné) - Kerney - Cameron- Jungbluth: p. 272

Class: *BIVALVIA*
Order: *EULAMELLIBRANCHIATA*
Family: *PISIDIDAE*
Genus: *Pisidium* Pfeiffer, 1821 Tertiary - Recent

***Pisidium personatum* Malm, 1855**

1964 *Pisidium (Rivulina) personatum* (Malm) - Ložek: p. 329

***Pisidium obtusale* (Lamarck, 1818)**

1952 *Pisidium (Eupisidium) obtusale* (Lamarck) - Žadin: p. 334, fig. 294/5, 303
1964 *Pisidium (Rivulina) obtusale* (Lamarck) - Ložek: p. 330, pl. XXXII/5abcd, 6ab
1994 *Pisidium obtusale* (Lamarck) - Skompski - Makowska: p. 45, pl. 25/3

***Pisidium* sp.**

Quantitative - qualitative analysis of the studied fauna

1. Borehole PZ - 4 (Ľudovítov)

More than 332 pieces of fossil mollusc were identified from both samples of the borehole. The mollusc belongs to 15 Families and 26 Taxons (Tab. 1).

2. Borehole PZ - 5 (M. Čiky)

From seven samples of the borehole PZ - 5 more than 1134 fossil mollluscs assigned to 15 Families and 35 varios Taxons were identified. (Tab. 2).

3. Borehole PZ - 7 (Kopec)

From nine samples of the borehole PZ - 7 more than 1155 fosil molluscs assigned to the 17 Families and 44 various Taxons. (Tab. 3).

4. Borehole PZ - 9 (Nový svet)

More than 62 fosil mollusc assigned to the 6 Families and 9 various Taxons were identified from the borehole PZ - 9. (Tab. 4).

Tab. 1. The frequency of individual Taxons and their ecological characteristics in the borehole PZ-4

Main ecological groups	Ecological characteristics	Biostratigraphic date	Species	3,0 - 3,1 (m)	4,6 - 5,0 (m)	Sum
A	L(S)	!	*1. Bradybaena fruticum*		Ú	Ú
	L(M)	(+)	*2. Arianta arbustorum*		Ú	Ú
B	O	(G)	*3. Vertigo pygmaea*		5	5
	O	+	*4. Pupilla muscorum*		3	3
	S	+	*5. Pupilla sterri*		Ú	Ú
	O	++	*6. Pupilla muscorum densegyrata*		5	5
	O	G	*7. Valonia pulchela*		22	22
	O	++	*8. Vallonia tenuilabris*	5	3	8
	S	+	*9. Helicopsis striata*		2	2
C	VS	!	*10. Carychium tridentatum*		2	2
	VS	+	*11. Succinea oblonga*	11	48	59
	M	+	*12. Trichia hispida*		14	14
	M	(+)	*13. Nesovitrea hammonis*		7	7
	M	(+)	*14. Limacidae/Agriolimacidae*		18	18
D	B	(+)	*15. Succinea putris*	2	33	35
	B		*16. Vertigo geyeri*		2	2
	H		*17. Lymnaea peregra peregra*		16	16
	H		*18. Physa fontinalis*		2	2
	H		*19. Planorbarius corneus*	1j		1
	H		*20. Planorbis planorbis*		1	1
	H		*21. Gyraulus laevis*		45	45
	H		*22. Gyraulus laevis*	2j	66	68
	H		*23. Bythynia tentaculata-viečka*	2		2
	H		*24. Valvata pulchella*		3	3
	H		*25. Pisidium obtusale*		6	6
	H		*26. Pisidium personatum*		8	8
			Sum	23	309	332+Ú

Tab. 2 The frequency of individual Taxons and their ecological characteristics in the borehole PZ-5

				1	3	4	5	6	7	11	
Main ecological groups	Ecological characteristics	Biostratigraphic date	Species	2,1 - 3,1 (m)	4,7 - 5,3	5,3 - 6,1	6,1 - 6,9	7,7 - 8,0	8,0 - 8,8	13,0 - 13,2	Sum
A	L(S)	!	*1. Bradybaena fruticus*		Ú						Ú
	L(M)	(+)	*2. Arianta arbustorum*		Ú	Ú		Ú			Ú
	O	++	*3. Columella columella*	17	4						21
	O	(G)	*4. Vertigo pygmaea*			10	13	2	3		28
	O	+	*5. Pupilla muscorum*			8	8	2			18
	S	+	*6. Pupilla triplicata*			2					2
B	S	+	*7. Pupilla sterri*			3					3
	O	++	*8. Pupilla muscorum densegyrata*	9	11	11	21	4	2		58
	O	++	*9. Pupilla loessica*			2	3	2			7
	O	G	*10. Vallonia pulchella*		4	60	80	20		2	166
	O	++	*11. Vallonia tenuilabris*	6			2	1			9
	O	(+)	*12. Vallonia costata*			23	15	2	7		47
	S	+	*13. Helicopsis striata*			1					1
	M		*14. Vallonia enniensis*			2	25	6	2		35
	VS	+	*15. Succinea oblonga*	50	13	80	45	25	28	30	271
C	M	(+)	*16. Cochlicopa lubrica*			4			2		6
	M	+	*17. Trichia hispida*	5		21	20	10	13	1	70
	M	(+)	*18. Nesovitrea hammonis*				4	2	2	2	10
	M	(+)	*19. LimicidaeI/ Agriolimicidae*			29				6	35
	B	(+)	*20. Succinea putris*	9						7	16
	B		*21. Vertigo genesii*	5							5
	H		*22. Lymnaea peregra peregra*	12	1j	1	1j			4	19
	H		*23. Planorbarius corneus*							1j	1
	H		*24. Anisus vortex*	14							14
	H		*25. Anisus spirorbis*	10		13	55	14	10	40	142
	H		*26. Gyraulus laevis*		2						2
D	H		*27. Gyraulus albus*							35	35
	H		*28. Armiger crista cristatus*	1							1
	H		*29. Lithoglyphus naticoides*							2	2
	H		*30. Bythynia tentaculata -viečka*	5			1			22	28
	H		*31. Valvata piscinalis*	7						5	12
	H		*32. Valvata pulchella*	1			2			35	38
	H		*33. Valvata cristata*							30	30
	H		*34. Pisidium obtusale*	1							1
	H		*35. Pisidium personatum*	1							1
			Sum	135	35+Ú	270+Ú	295	90+Ú	69	222	1134+Ú

Main ecologic groups

A - forest (generally)
B - treeless land (generally)
C - forest and treeless land
D - water, bogs

Ecologic characteristics (Biotop)

1 - L(M) forest, locally also moderately wet treeles sites
2 - L(S) forest, locally also dry treeless sites
3 - S steppes, xerotermous rocks
4 - O open land
5 - XS drier forest and treeless sites
6 - M moderately or variably wet sites
7 - RL moderately wet rocks, tree trunks in forest
8 - VS more wet forest and treeless sites
9 - B banks, bogs
10 - H water environment

Biostratigraphic data

! - typical kind of warm periods
+ - loess species
(+) - local or occasional loess species
++ - index loess species
G - species surviving glacial outside loess zone
(G) - species surviving glacial outside loess zone as a relic
j - juvenil individual
Ú - fragments

Tab. 3. The grequency of individual Taxons and their ecological characteristics in the borehole PZ-9

Main ecological characteristics	Ecological characteristics	Biostratigraphic date	Species	0,6 - 0,8 (m)	1,0 - 1,4	1,8 - 2,0	2,6 - 2,7	3,0 - 3,4	4,0 - 4,4	5,0 - 5,4	5,6 - 6,0	6,5 - 6,9	Sum
A	L(S)	!	*1. Bradybaena fruticum*				Ú						Ú
	XS	!	*2. Cochlicopa lubricella*					1					1
	O	++	*3. Columella columella*				1						1
	O	(G)	*4. Vertigo pygmaea*				1	11	4		12	2	30
	O	+	*5. Vertigo parcendentata*					1					1
	S		*6. Granaria frumentum*									Ú	Ú
	O	+	*7. Pupilla muscorum*					3					3
B	S	+	*8. Pupilla triplicata*					3					3
	S	+	*9. Pupilla sterri*		2								2
	O	++	*10. Pupilla muscorum densegyrata*				7	9	6	12		1	35
	O	++	*11. Pupilla loessica*					12		5			17
			12. Pupilla sp.		Ú								Ú
	O	G	*13. Vallonia pulchella*				1	13	2		15	5	36
	O	++	*14. Vallonia tenuilabris*		1		Ú	1					2+Ú
	S	(+)	*15. Chondrula tridens*									Ú	Ú
	VS	+	*16. Succinea oblonga*	1			4	20	4	52		5	86
C	M	(+)	*17. Cochlicopa lubrica*							1		Ú	1+Ú
	M	(+)	*18. Limacidae/ Agriolimacidae*	1			4		1		1		7
	B	(+)	*19. Succine putris*	1			5	30	40	15	8		99
	B		*20. Vertigo antivertigo*					1	1				2
	B		*21. Vertigo genesii*					2				2	4
	B		*22. Perforatella rubiginosa*		Ú	1		1			1		3+Ú
	H		*23. Lymnaea peregra peregra*				5	30	14	12	2	1	64
	H		*24. Lymnaea palustris*					1					1
	H		*25. Aplexa hypnorum*					1					1
	H		*26. Planorbarius corneus*						7				7
	H		*27. Planorbis planorbis*					10	Ú	23			33+Ú
	H		*28. Anisus vortex*					7			2		9
	H		*29. Anisus vorticulus*							2			2
	H		*30. Anisus spirorbis*				10	110	19	80	50	18	287
D	H		*31. Gyraulus laevis*				8	22	39	5			74
	H		*32. Gyraulus acronicus*					30					30
	H		*33. Gyraulus albus*									1	1
	H		*34. Bathyomphalus contortus*					2		2			4
	H		*35. Armiger crista cristatus*					10	2				12
	H		*36. Armiger crista nautileus*					1	2				3
	H		*37. Segmentina nitida*					2					2
	H		*38. Bithynia tentaculata viečka*				14	20	30		2		66
			39. Fagotia sp.				Ú						Ú
	H		*40. Valvata piscinalis*				1	11	8	5	Ú		25+Ú
	H		*41. Valvata pulchella*				16	89	52	22	7		186
	H		*42. Valvata cristata*						4				4
	H		*43. Pisidium obtusale*				1		5	1			7
	H		*44. Pisidium sp.*				Ú	4					4+Ú
			Spolu	3	3+Ú	1	78+Ú	458	240+Ú	235	100+Ú	35+Ú	1156+Ú

5. Borehole PJ-6 (Kesovský Pereš)

From the depth interval 0.0 - 10. 0 m in the borehole PJ - 6 more than 87 individuals of fossil molluscs assigned to 8 Families and 11 Taxons were identified. (Tab. 5).

6. Borehole PJ - 7 (Poľný Kesov)

From four samples of the borehole PJ - 7 518 fossil molluscs assigned to 11 Families and 26 Taxons were identified. (Tab. 6).

Tab. 4.The frequency of individual Taxons and their ecological characteristics in the borehole PZ-9

Main ecological groups	Ecological characteristics	Biostratigraphic date	Species	5,5 - 5,6 (m)	Sum
B	O	+	*1. Pupilla muscorum*	3	3
	S	+	*2. Pupilla triplicata*	3	3
	S	+	*3. Pupilla sterri*	5	5
	O	++	*4. Pupilla muscorum densegyrata*	10	10
	O	++	*5. Vallonia tenuilabris*	10	10
	S	+	*6. Helicopsis striata*	5	5
C	VS	+	*7. Succinea oblonga*	22	22
	M	(+)	*8. Cochlicopa lubrica*	Ú	Ú
	M	(+)	*9. Limacidae/ Agriolimacidae*	4	4
			Sum	62+Ú	62+Ú

Tab. 5. The frequency of individual Taxons and their ecologic chracteristics in the borehole PJ-6

Main ecological groups	Ecological characteristics	Biostratigraphic date	Species	9,0 - 10,0 (m)
B	O	(G)	*1. Vertigo pygmaea*	2
	O	+	*2. Pupilla muscorum*	10
	O	++	*3. Pupilla muscorum densegyrata*	3
	O	G	*4. Vallonia pulchella*	1
C	VS	+	*5. Succinea oblonga*	20
	M		*6. Vallonia enniensis*	3
	M	(+)	*7. Limacidae/ Agriolimacidae*	1
D	H		*8. Lymnaea peregra peregra*	2
	H		*9. Anisus spirorbis*	40
	H		*10. Gyraulus albus*	4
	H		*11. Valvata pulchella*	1
			Sum	87

Ecologic evaluation of fauna

Borehole PZ - 4 (Ľudovitov)

The species typical by higher afinity to moisture are most conspicuously represented in the borehole PZ-4 in the depth interval 3.0 - 3.1 m. These species have not unambiguous stratigraphic assignment. As shown in Tab. 1 and Chart 1, moist environments as swamps, bogs and water environment in general are most frequent. The presence of these species suggests the vicinity of a water flow during the deposition. The presence of index loess species *Vallonia tenuilabris* indicates the environment of an open land and a cool and relatively dry climate. The above mentioned characteristics suggest a steppes environment with a possible depression with shrubs nearby a water flow. The climate is cool.

The more variable association of environments is observed in depth 4.6 - 5.0 m. The species with higher afinity to a moist environment prevail again. The variability of species represented as well as their environment suggests slightly warmer and moister climatic fluctuation during some stadial. The environmental composition indicates a land as park taiga and steppes.

Borehole PZ - 5 (M. Čiky)

In the borehole PZ - 5 moister environments are present in the depth interval 2.1 - 3.1 m. The environments are probably represented by moist forest and treeless lands, swamp banks and water environment in general. The open land represented by cool fauna of Columela and Pupila is partly represented (see Tab. 2, Chart 2).

In the depth interval 4.7 - 5.3 the frequency of species characteristic for moist and water environment decreases. The species typical for an open land are more frequent. Some of species suggest forest environment and locally dry or moderately medium dry treeless land. The above mentioned finding as well as the presence of the transition type fauna suggests a warmer condition during some stadial.

In depth intervals 5.3 - 6.1 m, 6.1 - 6.9 m and 7.7 - 8.0 m variable sites are found. There is relatively equivalent frequency of an open land and steppes and moderately moist, moist and water environments. In the depth interval 8.0 - 8.8 m the moister environments indicating a warmer climatic phase prevail and the environment of an open land occurs less frequently.

In the depth interval 13.0 - 13.2 m the increasing frequency of water environment is observed and a retreat of other environments as banks and swamps, moist and moderately moist forest and treeless sites. The open land is represented only by tenth of percents in this composition. The studied sediment is clayey loam suggesting a fluvial origin. This origin is confirmed by the identified fauna. Finally it is possible to state that the land in the vicinity of the borehole was formed by a cool climate steppes typical by slightly moister and warmer climatic fluctuations. These fluctuations enabled the plant development and the change of the land character to a park taiga. The depositional environment was periodically flooded suggesting a vicinity of a water flow.

Tab. 6. The frequency of individual Taxons and their ecologic characteristics in the borehole PJ-7

Main ecological groups	Ecological characteristics	Biostratigraphic date	Species	0,8 - 1,3 (m)	1,3 - 1,5	2,6 - 3,6	6,8 - 7,9	Sumar
	O	++	*1. Columella columella*			42		42
	O	(G)	*2. Vertigo pygmaea*				4	4
	O	+	*3. Pupilla muscorum*			20	4	24
	S	+	*4. Pupilla sterri*			10	2	12
B	O	++	*5. Pupilla muscorum densegyrata*			40	10	50
	O	++	*6. Pupilla loessica*			10		10
	O	G	*7. Vallonia pulchella*				20	20
	O	++	*8. Vallonia tenuilabris*			20		20
	S	+	*9. Helicopsis striata*				3	3
	VS	+	*10. Succinea oblonga*	2	30	60	55	147
	M		*11. Vallonia enniensis*				5	5
C	M	(+)	*12. Limacidae/ Agriolimacidae*		2	1	1	4
	M	+	*13. Trichia hispida*			8	3	11
	B	(+)	*14. Succinea putris*		11			11
	H		*15. Lymnaea peregra peregra*		4		8	12
	H		*16. Anisus spirorbis*		24		65	89
	H		*17. Gyraulus laevis*				2	2
	H		*18. Gyraulus albus*		18			18
	H		*19. Armiger crista cristatus*				1	1
D	H		*20. Armiger crista nautileus*		3			3
	H		*21. Bithynia tentaculata viečka*		7		2	9
	H		*22. Valvata piscinalis*		1		1	2
	H		*23. Valvata pulchella*	1	2		9	12
	H		*24. Valvata cristata*		1			1
	H		*25. Pisidium obtusale*				1	1
	H		*26. Pisidium personatum*		5			5
			Sum	3	108	211	196	518

Borehole PZ - 7 (Kopec)

In the depth interval 0.6 - 0.8 m species with higher afinity to moisture are found. The species suggest moister forest and treeless sites, moderately or variably moist sites, swamps and banks (Tab. 3, Chart 3). The increasing frequency of the steppes and open land and a retreat of moister sites is observed in the depth interval 1.0 - 1.4 m . In the depth 1.8 - 2.0 m the water environment in general is represented by the only individual of species *Perforatella rubiginosa.* This depth interval makes a boundary between two different developments. From the interval downward the variable frequency of water environment species, species with higher moist afinity typical for banks, swamps, moderately moist and moist sites and species typical for open land occur. Only a small percentage of this variable environmental range is made by forest, steppes and drier sites. But in all samples from depth intervals 2.6 - 2.7 m, 3.0 - 3.4 m, 4.0 - 4.4 m, 5.0 - 5.4 m, 5.6 - 6.0 m, 6.0 - 6.9 m water environment prevails. The environmental and species composition of the studied fauna enables to interpret a presence of steppes land or park taiga in the vicinity of water flow with local surface depressions. This enabled the development of species with afinity to moisture. It is possible to discern at least three climatic oscillations in the whole studied profile. The samples nr. 4 - 9 from the depth interval 2.0 - 6.9 indicate a cool climate with moister and warmer oscillations. The samples from the depth interval 1.1 - 1.4 m suggest cooler and drier climatic fluctuation. In the depth interval 0,6 - 0.8 m again onset of moister and wa9rmer climatic oscillation occurs.

Borehole PZ - 9 (Nový svet)

In the borehole PZ - 9 loess species and species occasionally found in loesses occur. The species indicate following environment: open land, steppes, moist and moderately moist sites (Tab.4, Chart 4). The environmental composition of the studied fauna indicates a cool steppes during the deposition of the sediment studied. The climate is cool and relatively dry.

Borehole PJ - 6 (Kesovský Pereš)

In the borehole PJ-6 in the depth interval 9.0 - 10.0 m the species of following environment are present: open

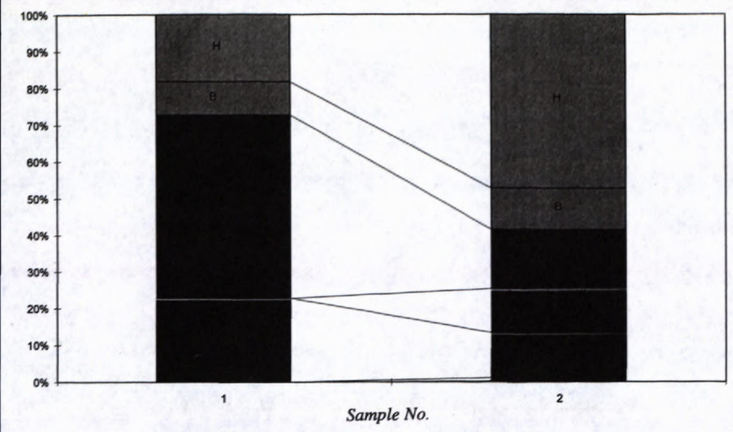

Chart 1 The frequency of Biotops in samples of the borehole PZ-4

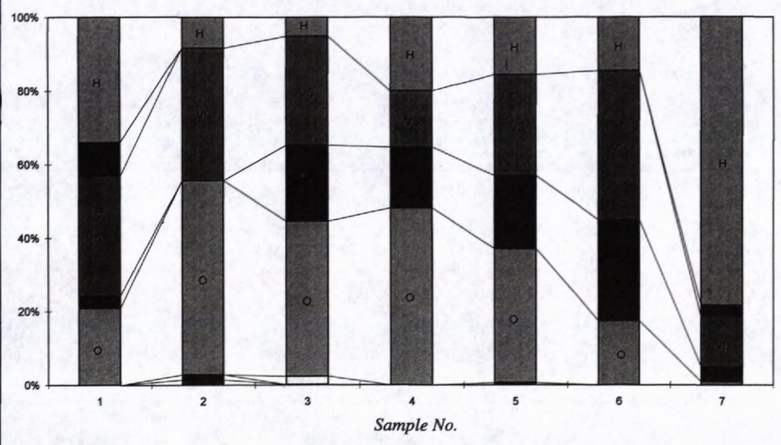

Chart 2 The frequency of Biotops in samples of the borehole PZ-5

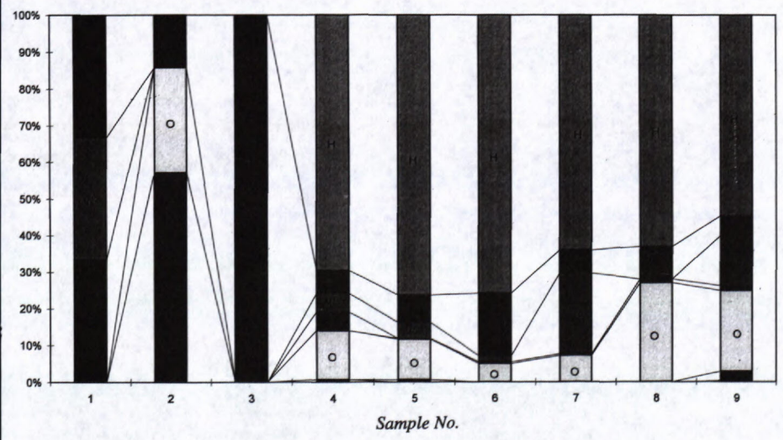

Chart 3 The frequency of Biotops in samples of the borehole PZ-7

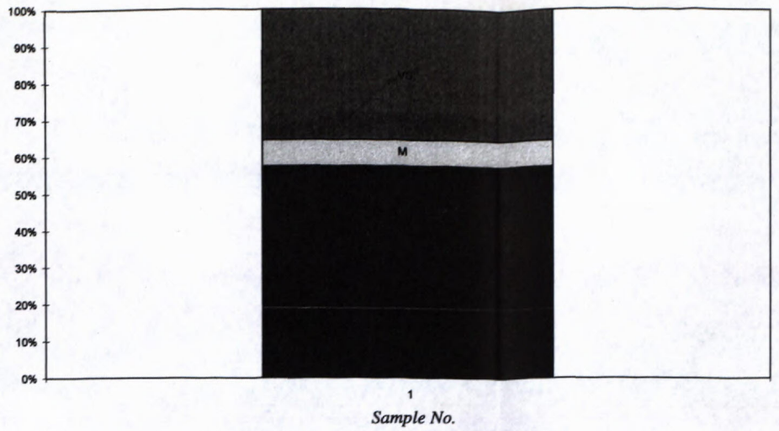

Chart 4 The frequency of Biotops in samples of the borehole PZ-9

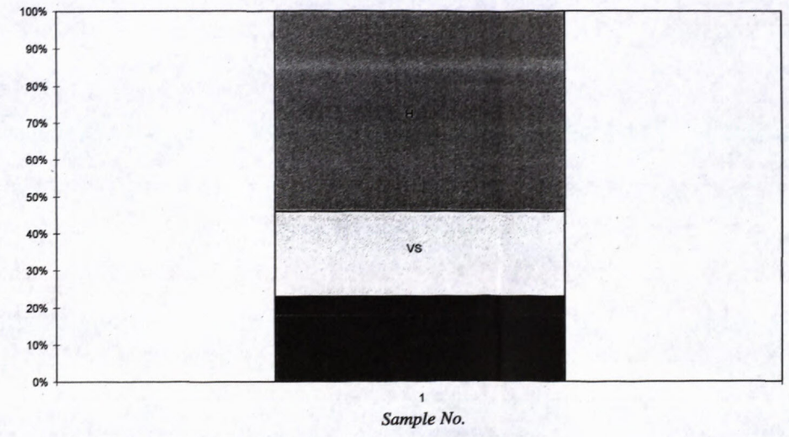

Chart 5 The frequency of Biotops in samples of the borehole PZ-6

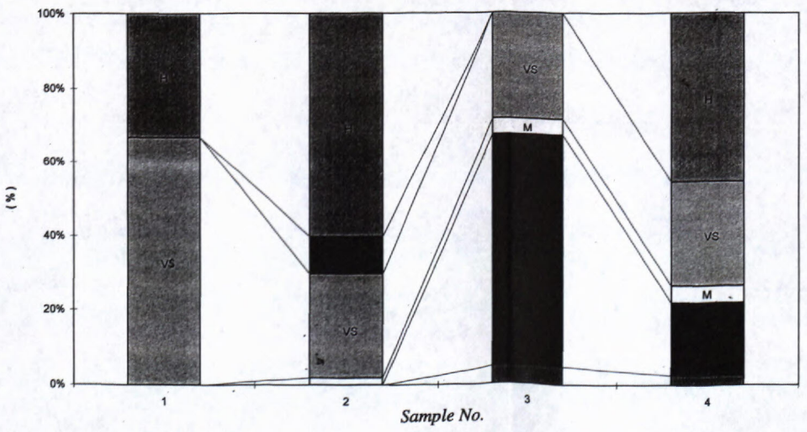

Chart 6 The frequency of Biotops in samples of the borehole PZ-7

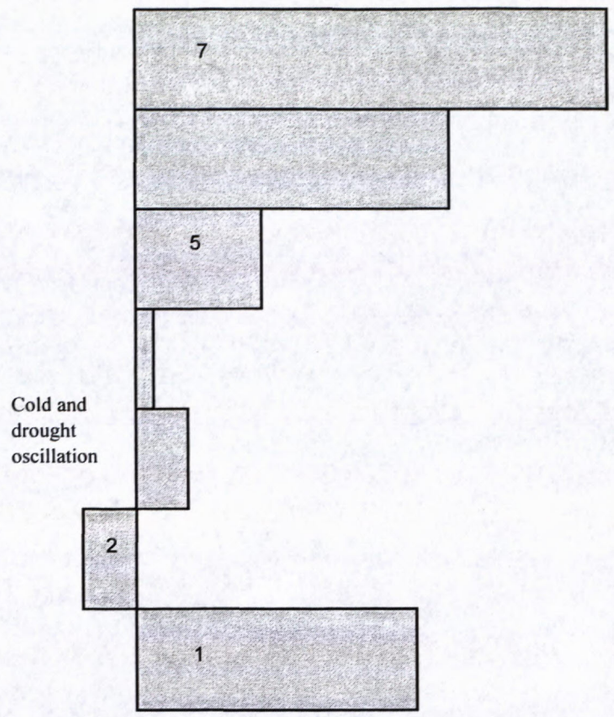

Chart 7 Climatic oscillation in the borehole PZ-5

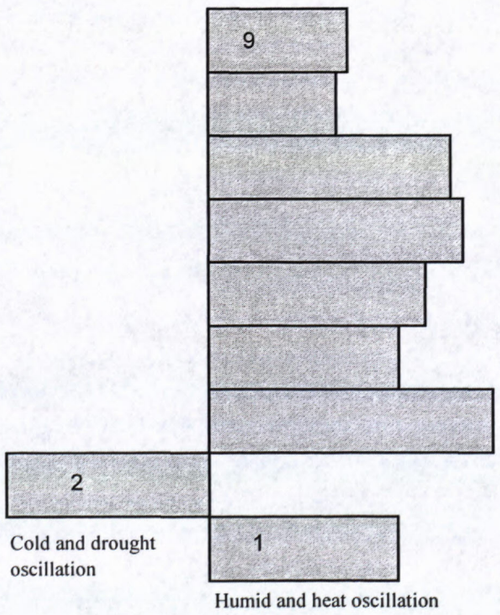

Chart 8 Climatic oscillation in the borehole PZ-7

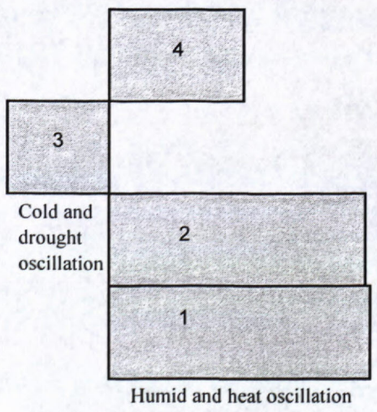

Chart 9 Climatic oscillation in the borehole PJ-7

land, moist and moderately moist sites, water environment in general. The more frequent occurrence of species with higher afinity to moisture (Tab.5, Chart 5) is also reflected in a higher extent of moister environment in the studied sample.

Environmental composition as well as species fauna composition indicate steppes with a cool climate with a possible water flow in the vicinity of the borehole.

Borehole PJ - 7 (Poľný Kesov)

In the borehole PJ - 7 only two species with higher afinity to moisture and water occur. A relation of identified species to the moister environments as swamps, bogs and water environment in general is preserved in the depth interval 1.3 - 1.5 m. The environmental composition of the sample is more variable as in the previous sample (Tab.6, Chart 6). It suggests a periodically flooded local depression watered by a flow in vicinity. This enabled the development of species assemblage typical for standing waters and periodical swamps. In the depth interval 2.6 - 3.6 m we observe an abrupt retreat of water species and species with higher afinity to moisture. Index loess species and occasional species occurring in loesses prevail in this interval, suggesting steppes and open land. This indicates an abrupt climatic change connected with a pronounce cooling and dry climate of steppes and tundra.

In the depth interval 6.8 - 7.9 fauna consisting of both terrestrial and aquaous mollusc species is identified. It suggests moderately moist and moister environment and water environment in general. In less extent steppes environment and open land is present. As to number and amount of environments, this sample is most variable.

The environmental analysis as well as species composition of fauna enabled to interpret the land during the deposition as a steppes in the vicinity of water flow. The climate is cool and interrupted by more wet climatic oscillation.

Conclusion

A detail ecological evaluation of the malacofauna and an environmental analysis of single Taxons enabled to record a climatic development of the area, especially during the Upper (Young/ Pleistocene. The analyses reflect very good local environment.

According to identified molluscs, small climatic oscillations directed toward inrease of humidity and temperature occur also in cool periods of stadials and vice versa (Charts 7, 8 and 9). The presence of a great amount of species with afinity to water is not only connected with climatic oscillations but it is also connected with the vicinity of two big rivers, Nitra and Váh rivers, and their tributaries. It represents species enrichment of the whole biocenosis, which especially in poorly loess covers is usually poor on species. The method of environmental analysis is very suitable especially for covered areas which miss sufficient amount of outcrops. The determined climatic oscillations are consistent with change of both fauna and depositional environment. These oscillations govern the general stratigraphic assignment of Quaternary deposits.

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Tables captions

Tab. I.

Fig. 1	*Trichia hispida*	width: 3,5 mm
	Borehole PZ-7, hĺbka: 4, 6 - 5,0 m	hight: 2,3 mm
Fig. 2	*Nesovitrea hammonis*	width: 3,1 mm
	Borehole PZ-5, depth: 6,1 - 6,9 m	hight: 1,5 mm

Tab. II.

Fig. 3	*Anisus spirorbis*	width: 6,2 mm
	Borehole PZ-7, depth: 5,0 - 5,4 m	hight: 1,5 mm
Fig. 4	*Anisus vortex*	width: 4,2 mm
	Borehole PZ-5, depth: 2,1 - 3,1 m	hight: 0,5 mm
Fig. 5	*Anisus vorticulus - monstrositas scalaris*	width: 1,8 mm
	Borehole PZ-7, depth 5,0 - 5,4 m	hight: 1,9 mm

Tab. III.

Fig. 6	*Valvata pulchella*	width: 3,3 mm
	Borehole PZ-7, depth 5,0 - 5,4 m	hight: 2,5 mm
Fig. 7	*Valvata pincinalis*	width: 2,0 mm
	Borehole PZ-7, depth 5,0 - 5,4 m	hight: 3,0 mm
Fig. 8	*Valvata cristata*	width: 2,0 mm
	Borehole PZ-5, depth: 13,0 - 13,2m	hight: 0,7 mm
Fig. 9	*Segmentina nitida*	width: 3,0 mm
	Borehole PZ-7, depth: 3,0 - 3,4 m	hight: 1,0 mm
Fig. 10	*Gyraulus acronicus*	width: 2,0 mm
	Borehole PJ-5, depth: 15,0 - 16,0 m	hight: 0,9 mm

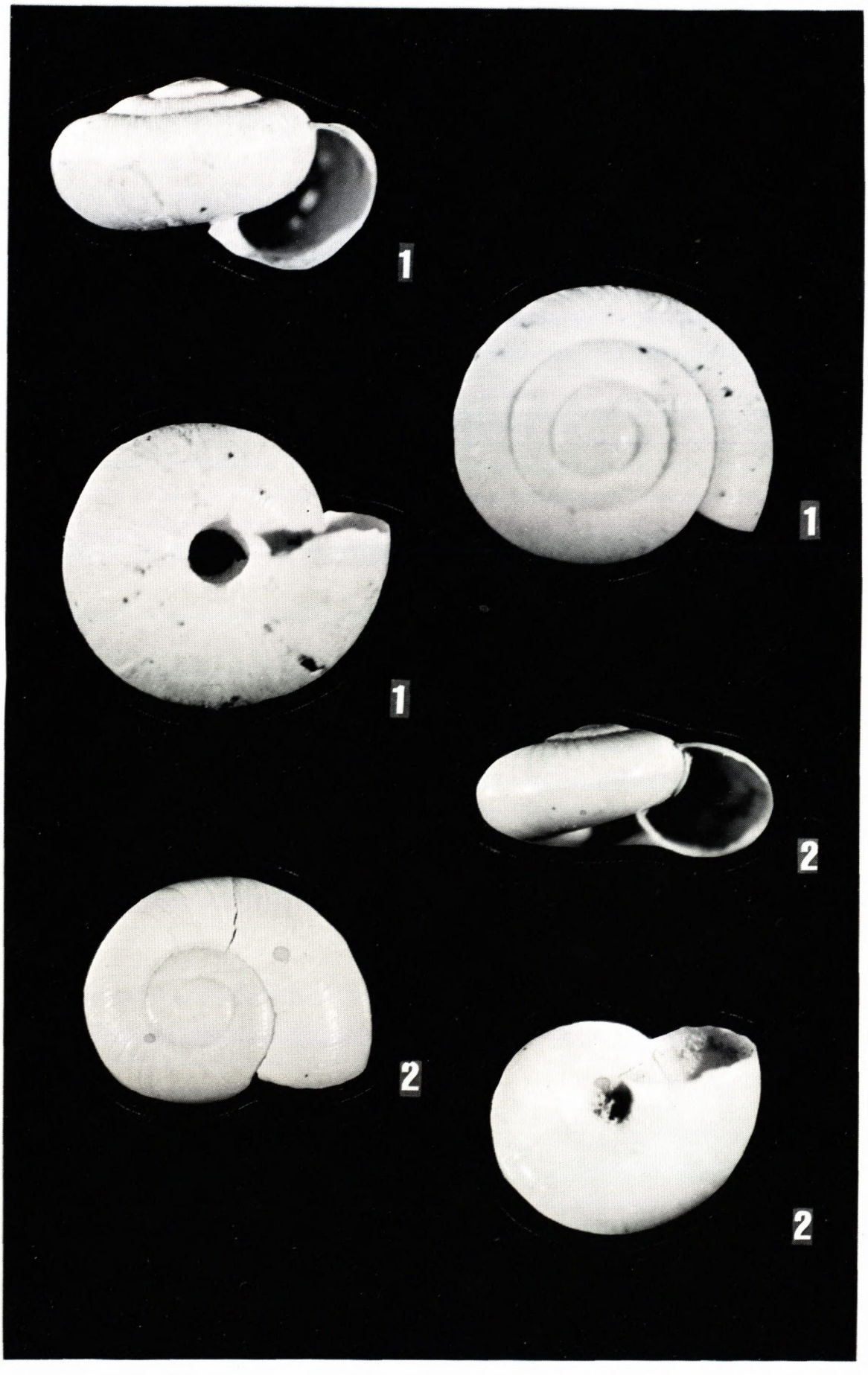
Tab. IV.

Fig. 11	*Planorbis planorbis*	width: 7,3 mm
	Borehole PZ-7, depth: 5,0 - 5,4 m	hight: 1,9 mm
Fig. 12	*Gyraulus laevis*	width: 3,2 mm
	Borehole PZ-7, depth: 5,0 - 5,4 m	hight: 1,2 mm
Fig. 13	*Vallonia enniensis*	width: 2,5 mm
	Borehole PZ-5, depth: 6,1 - 6,9 m	hight: 1,1 mm

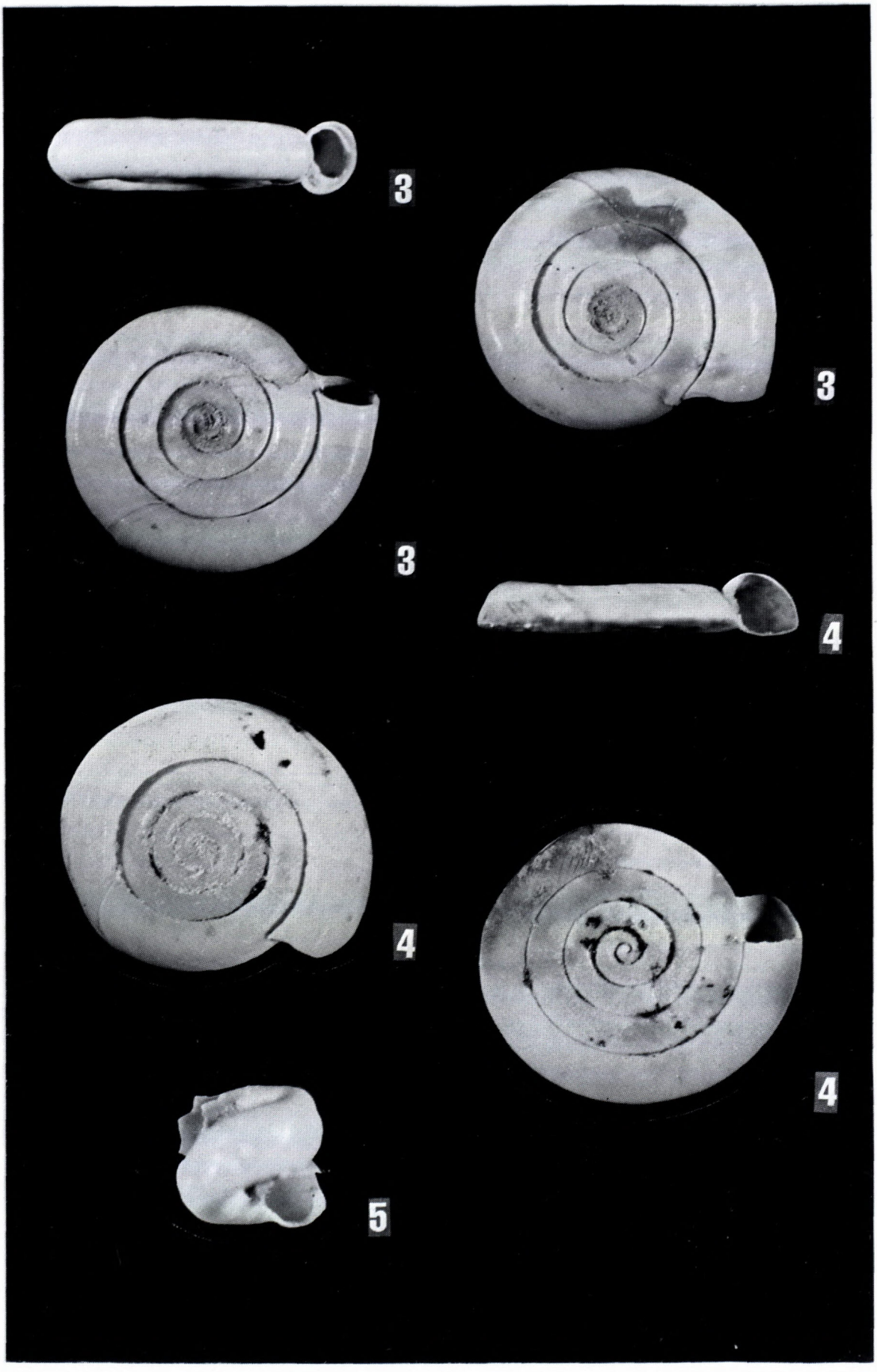
Tab. V.

Fig. 14	*Bathyomphalus concortus* incomplete individual Borehole PZ-7, depth: 5,0 - 5,4 m	
Fig.15	*Armiger crista cristatus*	width: 2,0 mm
	Borehole PZ-7, depth: 3,0 - 3,4 m	hight: 0,5 mm
Fig. 16	*Armiger crista nautileus*	width: 1,9 mm
	Borehole PZ-7, depth: 3,0 - 3,4 m	hight: 0,5 mm
Fig. 17	*Pisidium obtusale*	hight: 1,2 mm
	Borehole PZ-4, depth: 4,6 - 5,0 m ;	d: 1,5 mm

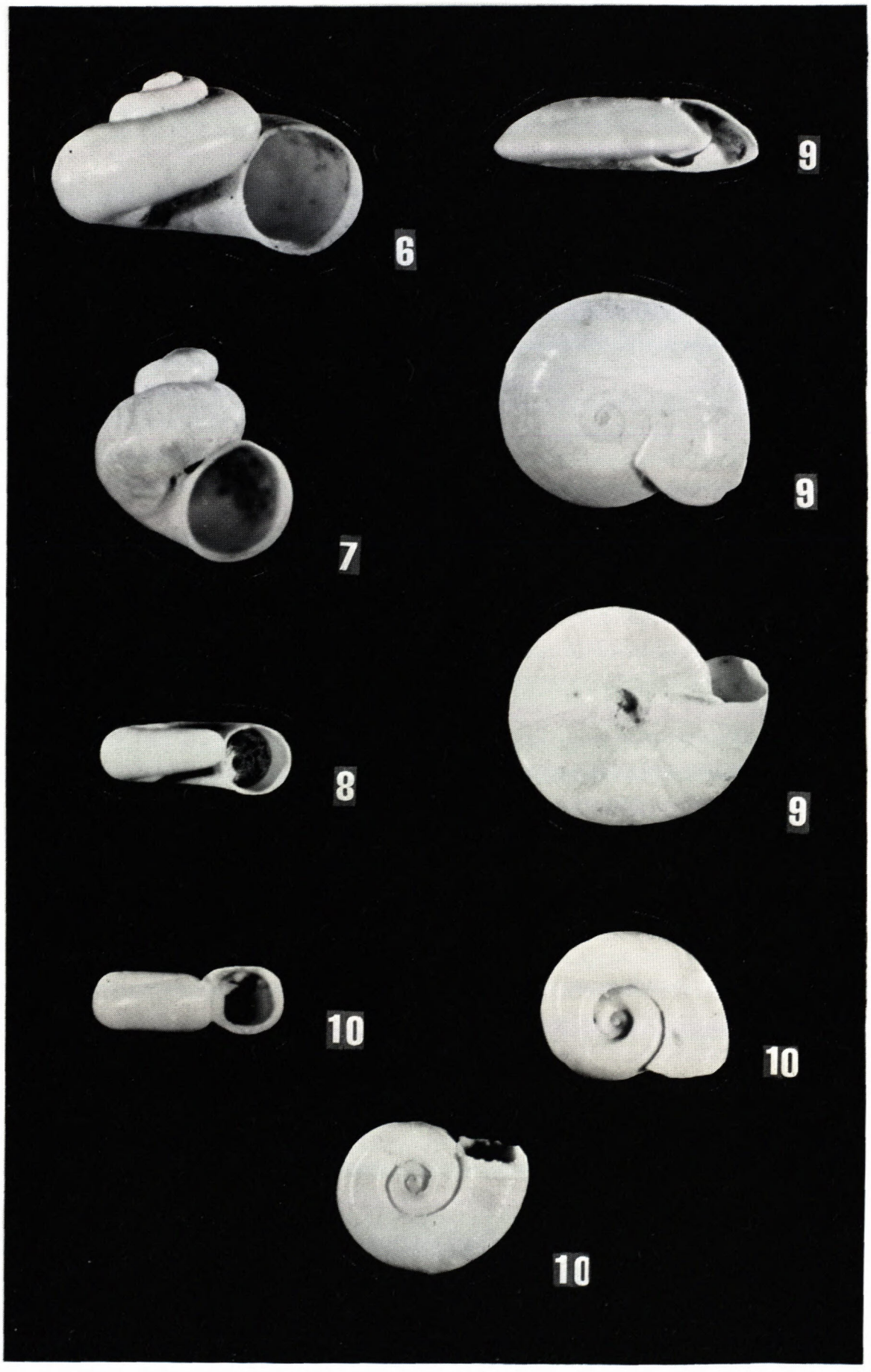
Tab. I



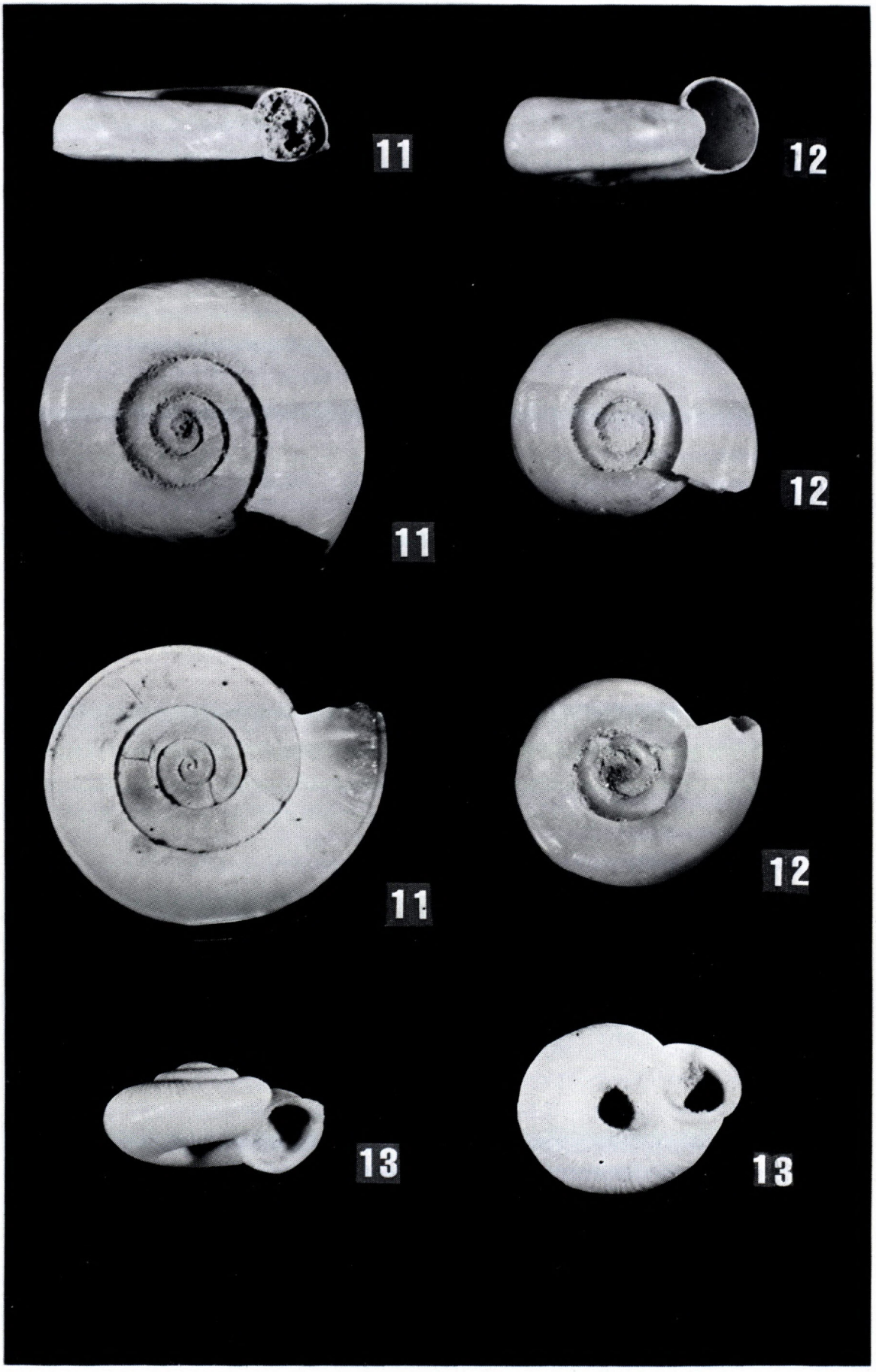
Tab. II



Tab. III



Tab. IV



Tab. V