

The molluscs and their habitats in Sashtinska Sredna Gora Mts. (Southern Bulgaria)

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The aim of this study was to investigate the mollusc species diversity of Sashtinska Sredna Gora Mts. (Southern Bulgaria) in detail, and to obtain some data on the distribution of the malacofauna both in habitats and in geographical areas of this mountain. The survey was carried out during the period of 20 Oct 2007 – 12 Nov 2008. Total 49 localities were examined, and their co-ordinates were given, 78 mollusc species were registered in the study area, from which 75 were new records for Sashtinska Sredna Gora Mts. Seventeen molluscan habitats were studied separately, from which the forests on river banks dominated by *Salix* sp. and *Alnus glutinosa*, open grassy terrains with short vegetation, and oak forests showed the highest species diversity. Considering the base rock type molluscan communities were separated in two main groups: a complex of species in the limestone areas, and another one inhabiting the volcanic/non limestone terrains. The artificial substrate even considered as a calcium source, in our area had played a little role on diversity. It held a species complex not so close related to the limestone faunas than with the volcanic base rock ones, on which it was situated.

Key words: *Gastropoda*, *Bivalvia*, diversity, rocks, limestone, volcanic, Balkans

Introduction

There was insufficient information on the malacofauna of one not so high mountain of Bulgaria – the Sashtinska Sredna Gora Mts. (maximal height of 1604 m alt.) (HUBENOV, 2005). Only a few papers were published and a number of species recorded. DAMJANOV & LIKHAREV (1975) reported *Pomatias elegans* (O.F. Müller 1774) for the “central part of Sredna Gora Mountain” (which possibly means Sashtinska Sredna Gora Mts., see “Material and Methods”), and *Bulgarica denticulata* (Olivier 1801) near Bogdan Peak. WIKTOR (1983) found *Lehmannia nyctelia* (Bourguignat 1855) at Koprivshitz town, *Deroceras bureschi* (H. Wagner 1934) near Bogdan Hut, and *Arion subfuscus* (Draparnaud 1801) in both localities mentioned. Recently GEORGIEV & STOYCHEVA (2008) registered the freshwater *Bythinella opaca* (Gallenstein 1848) near the village of Dijulevo.

The aim of our study was to investigate the species diversity of the Sashtinska Sredna Gora Mts. in detail, and to obtain some data on the distribution of the malacofauna both in habitats and in geographical areas of this mountain.

Material and Methods

Sashtinska Sredna Gora Mts. are situated in the south of the country (Fig. 1), bordering with the Stara Planina Mts. in the north and with the Thracian Lowland in the south. To the west and east it is close to the Ichtimanska and Sarnena Sredna Gora Mountains, respectively, as these three

mountains are parts of one large massif named the Sredna Gora Mts. This ridge is divided on its three parts by two rivers: Topolnitsa (between the Ichtimanska and Sashtinska Sredna Gora) and Stryama (between the Sashtinska and Sarnena Gora). Sashtinska Sredna Gora Mts. is the highest one from the three massifs, with its highest point – Bogdan Peak (1604 m a.s.l.), and it has the most expressive and steep ridge. The mountain is consisted mainly by volcanic rocks, but a few limestone “islands” also present at its central and north-eastern parts. The forests are dominated mainly by *Quercus* spp. in the low hills and *Fagus sylvatica* in the high parts of the massif. The human population of the mountain is not big and is located in small villages and few towns.

The survey was carried out during the period of 20 Oct 2007 – 12 Nov 2008. Material was gathered from 49 localities in the mountain (Fig. 1, Table 1). All molluscs were collected by the authors, and were studied by means of the standard procedures (KERNEY et al. 1983). The material collected was identified following ZHADIN (1952), DAMJANOV & LIKHAREV (1975), KERNEY et al. (1983), WIKTOR (1983), HAUSDORF (2000), GLÖER & MEIER-BROOK (2003). The following mollusc habitats were considered for this study (Table 2): Freshwater habitats: streams (st), termal springs (ts), canals (can), medium sized rivers (riv), standing waters as small ponds and micro dams (sw), Land habitats: river bank forests dominated by *Salix* sp. and *Alnus glutinosa*, sometimes with *Ulmus* sp. and *Juglans regia* (Sf), littoral vegetation on water basins banks as *Typha* sp. and *Phragmites australis* (lv), short grass vegetation

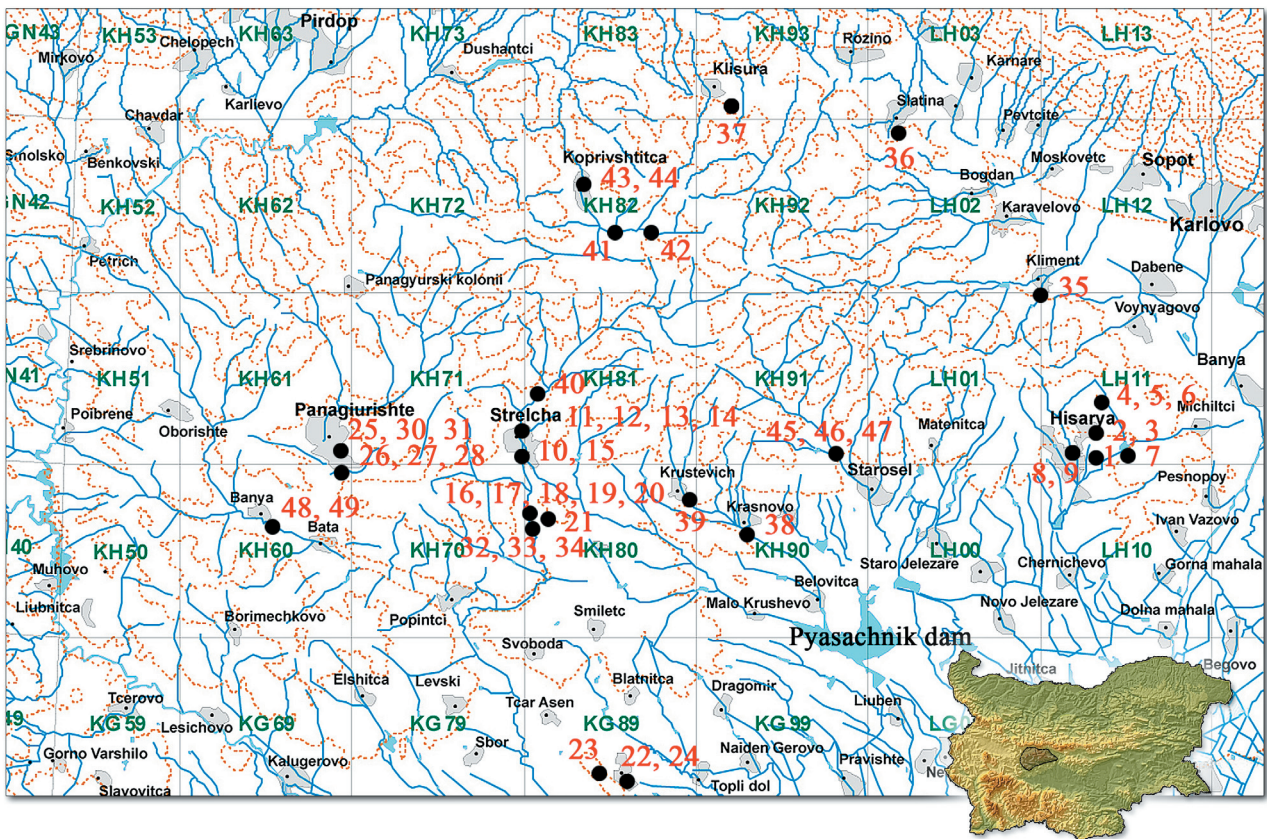


Fig. 1. Study Area – position of the Sashtinska Sredna Gora Mts. and the localities examined for mollusk species.

(shg), tall grass vegetation as *Urtica* sp., *Mentha* sp. and others (tg), agricultural lands (al), bush vegetation dominated mainly by *Paliurus spina-christii*, *Rosa* sp. and *Prunus spinosa* (bv), broad leaf xeric forests dominated by *Quercus* sp., sometimes with sub-dominant *Carpinus orientalis* (Qf), *Carpinus betulus* forest (Cf), *Fagus sylvatica* forests, sometimes with sub-dominant *Carpinus betulus* (Ff), park forests in urbanized areas (pf), house yards (hy), unknown habitat: specimens found only in river deposits (rd).

Sorensen qualitative similarity index (S) was evaluated to compare the faunas of different sites (DAJO, 1975). Cluster analysis was used to investigate the relationship between the mollusc communities on different types of base rock terrains in the area under study by computer program Statistica for Windows 7.0 by unweighted pair group average qualitative measure.

Results and Discussion

A total of 78 mollusc species were registered in the study area, from which 75 were new records for the Sashtinska Sredna Gora Mts. (Table 2). We did not find the species reported from the mountain as: *Pomatias elegans*, *Bulgaria denticulata*, and *Deroceras bureschi*. Summing these species with those collected in present study, we found that till now 81 species of molluscs are known for this mountain. A few freshwater species we found at the nearby pre-mountains south of the study area (but not in the mountain), in Pyasachnik Dam (UTM-grid LG09, see Fig. 1), could possibly also be expected and in the higher terrains: *Viviparus acerossus* (Bourguignat, 1862), *Radix auricularia* (Linnaeus, 1758), and *Dreissena polymorpha*

(Pallas, 1771).

For comparison at the nearby rich on limestone the Sarnena Sredna Gora Mts., GEORGIEV & GEORGIEV (2002, 2003, 2004), and GEORGIEV (2003, 2005) found a total of 5 species of *Bivalvia*, 12 freshwater and 67 land species of gastropods both in urban and natural habitats (total 84 species of molluscs). After these studies we found and another three new taxa for this mountain: *Vertigo antivertigo* (Draparnaud, 1801) (27 Oct 2007, deposits of the Bedechka River, north of the Stara Zagora town), *Chondrina avenacea* (Bruguiere, 1792) (22 Mar 2008, north of the Novo Selo village), and *Anodonta anatina* (Linnaeus, 1758) (15 Nov 2008, a pond in the Starozagorski Bani resort). So, for now 87 species of molluscs are known for the Sarnena Gora Mts., with 6 more than in the Sashtinska Sredna Gora Mts. found during present study. The Sorensen qualitative measure showed 69% of similarity between the faunas in the two mountains discussed.

The richest diversity of mollusc species in our study area held the forests on the river banks dominated by *Salix* sp. and *Alnus glutinosa* (n = 24 sp., 30.8% from all registered), open grassy terrains with short vegetation (n = 22 sp., 28.2%), and the oak forests (n = 20 sp., 25.6%). The other habitats were very poor on mollusc taxa having a diversity ranging between 2 and 14 species. From the freshwater habitats we found that richest were the medium sized rivers in the mountain with 9 species (snails and mussels).

As a whole the results showed that habitats of the Sashtinska Sredna Gora Mts. were relatively poor on mollusc species comparing with data of GEORGIEV (2005) for the large limestone areas of the Sarnena Sredna Gora Mts.

Table 1. Localities of gathering the mollusks from Sashtinska Sredna Gora Mountain. Abbreviations: loc. = locality, UTM-grid = UTM-grid 10x10 km, alt. = altitude, nm = not measured.

loc.	date	landmark	UTM-grid	GPS co-ordinates	alt.
1	20 Oct 2007	Hisarya town, residential area of Miromir	LH 10	42°29'17.9" N, 24°42'56.3" E	282
2	20 Oct 2007	north-east of Hisarya town	LH 11	42°29'34.0" N, 24°43'03.7" E	282
3	20 Oct 2007	north of locality №2	LH 11	nm	nm
4	20 Oct 2007	north-east of Hisarya town	LH 11	42°30'48.8" N, 24°43'59.4" E	336
5	21 Oct 2007	north-east of Hisarya town	LH 11	42°31'10.5" N, 24°43'59.4" E	388
6	21 Oct 2007	Hisarya town – northern part	LH 11	nm	nm
7	21 Oct 2007	south-east of Hisarya town	LH 11	nm	nm
8	21 Oct 2007	central part of Hisarya town	LH 10	42°29'49.7" N, 24°42'24.8" E	349
9	21 Oct 2007	near the railway station of Hisarya town	LH 10	42°30'19.8" N, 24°42'05.1" E	370
10	03 Nov 2007	Streltcha town, near Streltchenska Luda Yana River	KH 80	42°30'02.2" N, 24°19'29.5" E	431
11	03 Nov 2007	north of Streltcha town, near Streltchenska Luda Yana River	KH 81	nm	nm
12	03 Nov 2007	north of Streltcha town	KH 81	42°31'20.1" N, 24°19'30.9" E	415
13	03 Nov 2007	north of Streltcha town	KH 81	42°31'56.9" N, 24°19'51.5" E	470
14	03 Nov 2007	Streltcha town, west tributary of Streltchenska Luda Yana River	KH 80	42°31'23.1" N, 24°19'17.0" E	422
15	03 Nov 2007	near the railway station of Streltcha town	KH 80	42°29'34.0" N, 24°19'53.0" E	399
16	24 Nov 2007	west of the railway station of Dijulevo village	KH 80	42°27'07.2" N, 24°21'58.6" E	472
17	24 Nov 2007	a small pond west of Dijulevo village	KH 80	42°27'13.3" N, 24°20'34.1" E	422
18	24 Nov 2007	a small pond west of Dijulevo village	KH 80	42°27'15.6" N, 24°20'27.1" E	393
19	24 Nov 2007	west of Dijulevo village, a tributary of Luda Yana River	KH 80	42°27'13.5" N, 24°20'18.7" E	362
20	24 Nov 2007	west of Dijulevo village, Luda Yana River	KH 80	42°26'55.5" N, 24°20'02.1" E	325
21	24 Nov 2007	railway station of Dijulevo village	KH 80	nm	nm
22	08 Mar 2008	railway station of Ovchepoltzi village	KG89	nm	nm
23	08 Mar 2008	west of railway station of Ovchepoltzi village	KG89	42°20'21.5" N, 24°22'34.1" E	500
24	08 Mar 2008	east of railway station of Ovchepoltzi village	KG89	nm	nm
25	29 Mar 2008	Panagyurishte town	KH60	42°29'21.5" N, 24°11'52.2" E	475
26	29 Mar 2008	south of Panagyurishte town	KH60	42°29'15.2" N, 24°11'47.8" E	478
27	29 Mar 2008	south of Panagyurishte town	KH60	42°29'12.1" N, 24°11'35.5" E	476
28	29 Mar 2008	south of Panagyurishte town, Panagyurska Luda Yana River	KH60	42°29'02.4" N, 24°11'23.5" E	478
29	29 Mar 2008	south of locality №28	KH60	42°28'44.5" N, 24°11'10.4" E	481
30	29 Mar 2008	near the railway station of Panagyurishte town	KH60	42°29'28.9" N, 24°11'52.3" E	470
31	29 Mar 2008	near the railway station of Panagyurishte town	KH60	42°29'30.4" N, 24°11'53.1" E	471
32	17 Apr 2008	west of Dijulevo village	KH 80	42°27'16.1" N, 24°21'14.3" E	558
33	17 Apr 2008	west of Dijulevo village	KH 80	42°27'00.5" N, 24°21'46.6" E	521
34	17 Apr 2008	south of Dijulevo village	KH 80	nm	nm
35	16 Aug 2008	village of Kliment	LH01	42°36'06.6" N, 24°41'19.5" E	382
36	16 Aug 2008	near village of Slatina	LH02	42°41'03.6" N, 24°35'19.1" E	515
37	16 Aug 2008	east of Klisura town	KH92	42°41'58.1" N, 24°30'41.5" E	588
38	18 Oct 2008	south of Krasново village	KH90	42°27'32.5" N, 24°29'24.5" E	325
39	18 Oct 2008	village of Krastevitch	KH80	42°28'45.5" N, 24°26'26.3" E	341
40	18 Oct 2008	north of Streltcha town	KH81	42°34'35.2" N, 24°21'01.1" E	954
41	18 Oct 2008	near the road to Barikadite Hut	KH82	42°36'11.3" N, 24°23'32.0" E	996
42	18 Oct 2008	east of locality №41	KH82	42°35'20.9" N, 24°24'49.4" E	979
43	18 Oct 2008	central part of Koprivshitzta town	KH82	42°38'17.4" N, 24°21'40.0" E	935
44	18 Oct 2008	north-east part of Koprivshitzta town	KH82	42°38'27.9" N, 24°21'45.4" E	940
45	5 Nov 2008	north of Starosel village, near Pyasachnik river	KH91	42°30'39.2" N, 24°32'23.6" E	344
46	5 Nov 2008	north of Starosel village, beneath the Manev Dol dam's wall	KH91	42°30'35.5" N, 24°32'21.1" E	351
47	5 Nov 2008	Manev Dol dam	KH91	42°30'19.3" N, 24°32'4.6" E	363
48	12 Nov 2008	east of Banja village	KH60	42°27'26.1" N, 24°09'31.1" E	454
49	12 Nov 2008	north of locality №48	KH60	nm	nm

Table 2. Mollusc species and their habitat and locality distribution in the Sashinska Sredna Gora Mts. Abbreviations of habitat types are mentioned in the text, and for base rock in text of Fig. 2.

Species	Habitat																Base rock			Locality			
	str	ts	riv	can	sw	shg	tg	bv	al	Sf	Qf	Cf	Ff	Pf	pf	lv	hy	rd	lim		vol	art	
Gastropoda																							
<i>Bythinella</i> cf. <i>opaca</i> (M. von Gallenstein)	*																			*			18
<i>Carychium minimum</i> O.F. Müller, 1774									*											*			7, 28, 34
<i>Carychium tridentatum</i> (Risso, 1826)											*									*			18
<i>Acroloxus lacustris</i> (Linnaeus, 1758)					*															*			47
<i>Radix labiata</i> (Rossmassler, 1835)	*	*																		*	*		29, 48
<i>Galba truncatula</i> (O.F. Müller, 1774)	*		*	*	*															*			10, 22, 24
<i>Ancylus fluviatilis</i> O.F. Müller, 1774	*																			*			29, 41
<i>Planorbis planorbis</i> (Linnaeus, 1758)			*	*																*	*		2, 7, 15, 24, 28, 34, 48
<i>Anisus leucostomus</i> (Millet, 1813)			*																	*			28
<i>Gyraulus albus</i> (O.F. Müller, 1774)			*		*															*	*		2, 7, 24, 28
<i>Physella acuta</i> (Draparnaud, 1801)	*	*	*	*	*															*	*		2, 7, 10, 15, 18, 24, 28, 34, 47, 48
<i>Aplexa hypnorum</i> (Linnaeus, 1758)				*																*			15
<i>Cochlicopa lubrica</i> (O.F. Müller, 1774)									*								*			*			24, 28, 34, 48
<i>Cochlicopa lubricella</i> (Rossmassler, 1835)									*	*							*			*			3, 13, 18, 24, 35, 46
<i>Cochlicopa nitens</i> (Gallenstein, 1852)																		*		*			34
<i>Vertigo substriata</i> (Jeffreys, 1830)						*					*									*	*		14, 18
<i>Vertigo antivertigo</i> (Draparnaud, 1801)																		*		*			24, 28
<i>Vertigo pygmaea</i> (Draparnaud, 1801)																		*		*			20
<i>Truncatellina cylindrica</i> (Ferussac, 1821)						*	*			*										*	*		8, 12, 26, 28, 34, 46
<i>Pupilla muscorum</i> (Linnaeus, 1758)						*														*	*		20, 27, 28
<i>Agardhiella macrodonta</i> (Hesse, 1916)																		*		*			28
<i>Vallonia costata</i> (O.F. Müller, 1774)						*			*											*	*		7, 9, 15, 24, 28, 34, 37
<i>Vallonia pulchella</i> (O.F. Müller, 1774)						*	*													*	*		9, 10, 12, 15, 26, 34
<i>Vallonia emmianensis</i> (Gredler, 1856)																		*	*	*	*		18, 28
<i>Acanthimula aculeata</i> (O.F. Müller, 1774)																		*	*	*	*		20, 28, 34
<i>Merdigera obscura</i> (O.F. Müller, 1774)									*											*	*		29, 34, 48
<i>Zebrina detrita</i> (O.F. Müller, 1774)						*	*	*	*											*	*		16, 26, 49
<i>Mastus rossmaessleri</i> (L. Pfeiffer, 1846)										*										*	*		8, 18
<i>Chondrula tridens</i> (O.F. Müller, 1774)						*											*		*	*	*		15, 24

Table 2. Continued.

<i>Chondrula microtragus</i> (Rossmassler, 1848)																		*	*	3, 6, 8, 21, 24, 26, 34, 48, 49
<i>Laciniaria plicata</i> (Draparnaud, 1801)																		*	*	13, 18, 20, 28, 35, 39, 43, 48
<i>Balea biplicata</i> (Montagu, 1803)																		*	*	10, 11, 28, 29, 35
<i>Yestia ranojevici</i> (Pavlovic, 1912)																		*	*	31, 40
<i>Succinea oblonga</i> (Draparnaud, 1801)																		*	*	14, 18, 24, 29, 34, 46
<i>Oxyloma elegans</i> (Risso, 1826)																		*	*	3, 7
<i>Cecilioides acicula</i> (O.F. Müller, 1774)																		*	*	24, 28, 34
<i>Arion lusitanicus</i> Mabilie, 1868																		*	*	10, 15
<i>Arion subfuscus</i> (Draparnaud, 1805)																		*	*	39, 43
<i>Arion silvaticus</i> Lohmander, 1937																		*	*	10, 41
<i>Euconulus fubus</i> (O.F. Müller, 1774)																		*	*	20, 28
<i>Vitrina pellucida</i> (O.F. Müller, 1774)																		*	*	44
<i>Vitrea pygmaea</i> (O. Boettger, 1880)																		*	*	28
<i>Vitrea vereae</i> Irikov, Georgiev et Riedel, 2004																		*	*	20
<i>Aegopinella minor</i> (Stabile, 1864)																		*	*	34, 35, 42
<i>Oxychilus translucidus</i> (Mortillet, 1854)																		*	*	2, 7, 10
<i>Oxychilus glaber</i> (Rossmassler, 1835)																		*	*	6, 12, 13, 18, 28, 34, 39, 43, 44, 48
<i>Oxychilus inopinatus</i> (Ulieny, 1887)																		*	*	10, 26, 28, 30
<i>Zonitoides nitidus</i> (O.F. Müller, 1774)																		*	*	3, 7, 15, 24, 25, 28, 34, 35, 45, 48
<i>Daudebardia rufa</i> (Draparnaud, 1805)																		*	*	20, 29, 34, 35
<i>Tandonia kusceri</i> (H. Wagner, 1931)																		*	*	8, 10, 13, 14, 15, 29
<i>Tandonia budapestensis</i> (Hazay, 1881)																		*	*	3
<i>Tandonia cristata</i> (Kaleniczzenko, 1851)																		*	*	5, 17, 33, 34
<i>Punctum pygmaeum</i> (Draparnaud, 1801)																		*	*	18
<i>Limax cinereoniger</i> Wolf, 1803																		*	*	42
<i>Limax maximus</i> Linnaeus, 1758																		*	*	19, 44
<i>Limax graecus</i> Simroth, 1889																		*	*	14, 39
<i>Limax flavus</i> Linnaeus, 1758																		*	*	10
<i>Lehmannia nycetelia</i> Bourguignat, 1856																		*	*	44
<i>Deroceras sturanyi</i> (Simroth, 1894)																		*	*	3, 10, 14, 34
<i>Deroceras turcicum</i> (Simroth, 1894)																		*	*	3, 11, 12, 17, 34
<i>Deroceras reticulatum</i> (O.F. Müller, 1774)																		*	*	10, 11, 14, 18, 28, 39

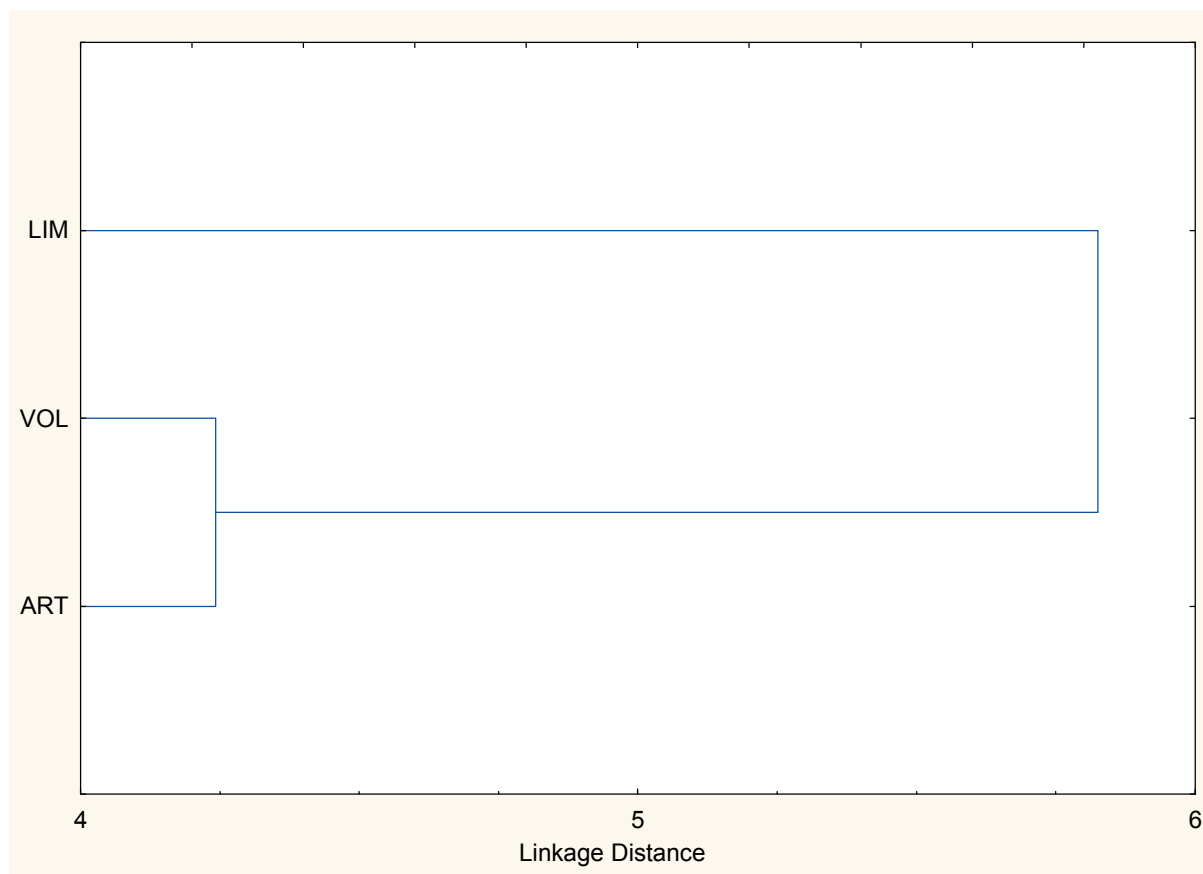


Fig. 2. Cluster analysis used to examine the relationship between mollusk communities placed on different base rock types. Abbreviations: LIM – limestone, VOL – volcanic or non limestone, ART – artificial.

neighboring. In the last one for example at river site forests 53 species were found, in bush areas 41 species, oak forests 37, coniferous forests 22, and in the same sized rivers 17 mollusc taxa. No species in the Sashtinska Sredna Gora Mts. was registered in over 50% of the localities examined, even the widely distributed *Helix lucorum* (24 localities, 49% from all). As many authors correlated the distribution of land molluscs with the presence of calcereous substrates (LOŽEK 1962, ANT 1963), it was evident that despite the similar number of species recorded in both neighboring mountains, in our area the molluscs were rare and scattered for some reason. Such a comparative studies were carried out by SCHILTHUIZEN et al. (2003) for Borneo hills, and authors found that diversities on limestone were similar to those in non-limestone areas. Having such information we compared the mollusk communities in the Sashtinska Sredna Gora Mts. according to the base rock of the habitats. Knowing that some snails are using artificial (mainly building) materials as a source of calcium (LOŽEK 1962, KALISZ & POWELL 2003), we divided three types of “base rock”: limestone, volcanic and artificial materials on volcanic terrains (concrete, mortar, bricks and other). The cluster analysis showed that in our study area the molluscan communities were separated in two main groups: a complex of species in the limestone areas, and another one inhabiting the volcanic rock terrains (Fig. 2). The artificial substrate even considered as a calcium source, in our area had played a little role. It held a species complex not so close related to the limestone faunas ($S = 50\%$) than with the volcanic base rock ones, on which it was situated (S

$= 52.1\%$). The limestone and volcanic communities represented the lowest similarity ($S = 34.3\%$). It could be supposed that native calcereous mollusc species from the limestone areas did not succeed as a whole complex to invade the areas occupied by human made calcium rich structures, having restricted populations in small limestone “islands” in the mountain. Here also a complex of factors could be proposed for the possible weak species dispersion like not proper relief specifications and low levels of human transportation. Though a small group of limestone loving species did expand on terrains dominated by artificial sources of calcium as: *Truncatellina cylindrica*, *Mastus rossmaessleri*, *Chondrula tridens*, *Chondrula microtragus*, and even the last we found as few shells on volcanic rocks. Amazing was the single record of *Helicigona trizona balcanica* (1 live juvenile specimen) in a beech forest totally dominated by volcanic rocks. Of course in our paper we do not consider the individual abundance of all the species, which is well known that often correlates with the presence of calcium (HOTOPP 2002, SCHILTHUIZEN et al. 2003), and show only its influence on species diversity in a particular area.

Conclusions

From 78 mollusc species found in the Sashtinska Sredna Gora Mts., 75 were new records for the area. As a whole the habitats were poor in species, which were restricted in localities with scattered distribution. From all habitats studied, forests on the river banks dominated by *Salix* sp. and *Alnus glutinosa*, open grassy terrains with short ve-

getation, and the oak forests showed the highest species diversity. The malacocoenoses established on limestone terrains were not related with those on volcanic base rock. In the study area artificial substrate even considered as a calcium source had played a little role on species richness as a lot of calcereous species found on limestone sites were lacking.

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