Chapter 5

MALACOLOGY AND PALEOENVIRONMENTS OF WESTERN CRIMEA

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INTRODUCTION

Malacological studies were carried out on the western Crimean sites of Kabazi II, Kabazi V, and Starosele. The field investigations, which included sample selections and collection of the fossil remains of small mammals and snails, were conducted in July 1994, July-August 1995, and June 1996. The results of those investigations are used to reconstruct local paleoenvironments in the immediate vicinities of the site. In addition, modern snail species of western Crimea, until now poorly investigated, are compared to the fossil snail fauna to identify evolutionary changes in their morphometric and ecological parameters.

METHODOLOGY

Traditional methods of sample selection were used on sediments from archeological horizons and culturally sterile horizons. The sample selection began with the preliminary screening of sediments through 1.5 mm mesh to identify productive horizons (containing cockleshells of snails or remains of small mammals). At this stage, about 45-64 Kg of sediment were screened from every archeological level and sterile horizon of each site. Once productive horizons were identified, sediments were first screened through 5 mm screens. The selected fraction was then screened through 1.5 mm screens; and the resulting fraction (between 1.5 and 5 mm in size) was washed using the same screens of 1.5 mm. Occasionally, if shells smaller than 1.5 mm were found, a 1 mm screen was also used. This was the case for certain horizons at Starosele and Kabazi V containing very fine sediments. After the resulting sediments were washed and dried, microfaunal and malacological remains were selected.

Because snail shells are very fragile, most were selected directly from the screen during the dry or wet screening. A significant portion of small mammal remains was selected later from the washed and dried concentrate. Only mandibles or other fragile fragments, including large teeth, were selected during the wet screening.

After more than 25 exploratory screenings, the most productive horizons were chosen at Kabazi II (5 horizons), Kabazi V (3), and Starosele (5). From each productive horizon, more than one ton of sediment was screened, followed by wet screening of 110-210 Kg of the dry-screened fraction. Unfortunately, during the summer in Crimea, water is not very accessible, and the dry-screened fractions had to be transported long distances for the final wet screening, then removed to the field camp for drying and sorting.

A large portion of the malacological and microfauna collections was selected earlier (1986-1994) by the archeologists: Dr. Victor Chabai (Kabazi II), Dr. Alexander Yevtushenko (Kabazi V), Dr. Anthony Marks and Dr. Yuri Demidenko (Starosele). During the fieldwork, the author was greatly aided by an assistant, postgraduate Gavril Gylku and also by these archeologists of the Crimean group, to whom we express our sincere appreciation.

The second stage of the research included the laboratory analysis of the selected samples and their identification. At this stage, the major problem was to find and obtain type collections and malacological literature concerning the region. Unfortunately, the modern snail fauna of Crimea is very poorly investigated, and a portion of the fieldwork had to be devoted to developing a type collection of modern Crimean malacological fauna. This focused primarily on the areas surrounding the sites, but also on slopes and water basins of the third range of the Crimean Mountains, as well as the high elevations of the yaila plateau in the coastal Crimean Mountain range. The identification of these collections of modern fauna helped to define the morphometric and ecological parameters of modern and fossil Crimean snail species (Tables 5-1, 5-2).

Further hindering the identification of Crimean snail species is the fact that the last major description of modern species was undertaken in 1918-1925 by Professor I. I. Pusanov. Because he was isolated from the European zoological literature by the Civil War, the local nomenclature of species deviated from that of neighboring regions. Over time, the same species was often identified and described by different authors, usually using different names. This has resulted in a large number of synonymies, and their resolution is hampered by the variations in shell morphometric parameters given by individual authors.

To solve this problem in our investigations, determinants that are more recent were used, where the majority of old Crimean species names (which were described by I. I. Pusanov) are considered synonyms (Table 5-1). It should also be noted that for some modern natio and subspecies of *Helicella*, *Chondrus*, and *Zebrina*, definitive identification is possible only by comparing their anatomical structure. Unfortunately, such an approach is impossible in the identification of fossil remains (because in this case we have only the shells, not the entire organism) and so identification is occasionally limited to species. Often in this study, only the species name is given, and only in rare cases (for example, occasionally for *Chondrus bidens*) are the subspecies or natio forms identified.

Identification of the Crimean collections, both modern and fossil, used the following identification guides and mollusca descriptions: V. Lozek 1964; I. M. Likharev and E. S. Rammelmeier 1952; N. N. Akramovski 1976; J. J. Puissegur 1976; Ya. I. Starobogatov and L. A. Kutikov 1977; A. A. Shileico 1978; A. V. Grossu 1955, 1981, 1983, among others. Because there are also some variations in diagnostic traits used in this work, the descriptive monograph on Eastern European snails, *Continental Mollusks of the USSR* by I. M. Likharev and E. S. Rammelmeier (1952) should be consulted, as they describe most of the known modern Crimean snail species.

Ecology of Snails

Before presenting the Crimean malacological results, the main ecological factors that have an influence on modern snail fauna distribution should be mentioned. The most important environmental factor for snail fauna is climate, usually expressed by two main components: atmospheric precipitation and temperature.

The influence of temperature is very significant for the distribution of snails. There is an important decrease in the number of snail species as one moves from areas with a warm and humid climate to areas with a cold and arid climate. For example, according to I. M. Likharev and E. S. Rammelmeier (1952: 30), on the Russian Plain, the total number of snail species distributed according to ecological zones is: (1) in tundra and tundra-forest zones—19 species; (2) forest zone—80 species; and (3) steppe zone—71 species.

Temperature usually determines not only the distribution, but also the individual morphometric parameters of the snails. The cockleshells of species from the southern zones are usually larger than their northern analogs. The latter are usually smaller and have obviously thinner and finer shells.

For the majority of snail species, humidity is also significant. By this criterion, all snails may be conventionally divided into three main groups:

(1) hydrophiles—includes species which live in very humid conditions, usually near water basins; *Succinea, Oxiloma, Cochlicopa, Vertigo, Vallonia, Caecilioides, Zonitoides, Zenobiella,* etc.;

(2) mesophiles—prefer the relatively humid conditions of forests, flood plain grasses, shrubs, and bushes: *Acanthinula, Vitrea, Clausilia, Helix, Oxychilus, Carichium, Columella, Retinella (Perpolita)*, some species of *Theba*, like *Theba carthusiana*, etc.;

(3) xerophiles—prefer steppe landscapes and open south-facing slopes with sunny exposures: *Zebrina, Chondrus, Helicella, Chondrula, Pupilla*, some species of *Theba*, like *Theba fruticola*, etc.

Crimean snails of the first two groups, hydrophiles and mesophiles, characteristically have thick and shiny shells, usually of very large dimensions (especially *Helix, Theba,* and *Oxychilus*). The xerophile species characteristically have small and thin shells, usually not shiny, but with well-developed pigmentation, and occasionally with evident micro sculpture.

More detailed ecological classification of modern European snails was undertaken by the French investigator Jean-Jacques Puissegur (1976: 16). He distributed all species of snails into the following ten groups:

Group 1	F1 - Forestry, conventional, without precision.
	F2 - Forestry, humid and warm
Group 2	f(m) - Semi-forestry (mesophilic)
	f(s) - Semi-forestry (steppic)
	f(h) - Semi-forestry (hydrophilic)
Group 3	FH - Forestry, very hydrophilic
Group 4	S -Steppic
	Sr - Steppic on rocks
	S(f) - Steppic (forestry)
Group 5	D - Terrain découvert (open rocks)
	D(r) - Terrain découvert (with rocks)
Group 6	X - Xerothermic
Group 7	M - Mesophilic
	Mfr - Mesophilic, with forests, bushes, and rocks
	M(h) - Mesophilic (hydrophilic)
Group 8	H - Hydrophilic (near the water)
Group 9	P - Paludal
Group 10	A1 - all freshwater mollusks of different types of basins (stagnates, torrents, etc.).

Unfortunately, not all of these groups and subgroups are represented in our collections, which include only a very small area and the relatively short time interval of the Upper Pleistocene. The investigated Crimean species may be attributed to seven groups (see Table 5-3).

The distribution presented in Table 5-3 was in turn used to compose diagrams showing the ecological niches of snails in modern samples and archeological levels at Kabazi II, Kabazi V, and Starosele (figs. 5-1–5-4). The diagrams display the major changes of the ecological composition of snails on the individual and species levels. In the cases where the total number of shells in the sample was less than 30 or 40, such types of diagrams are not representative, and they were therefore not drawn up for the small samples from Kabazi V and also for some very poor samples from the sondage at Kabazi II.

TABLE 5-1
Modern Snails of Western Crimea, Nomenclature, and Size Data (mm)

		Shell Parameters			Aperature Parameters	
Name of species, author, and year of first description	*Synonymies and year of description*	*Height*	*Width*	*Whorls*	*Height*	*Width*
Helix (Helicogena) lucorum taurica (Kryn.), 1833	*Helix radiossa* Rossmassler, 1838	40-47	41-49	4.5-5	30-35.5	27.5-30
H. (H.) vulgaris Rossm., 1839		27-36	30-38	4	23-25	19-22
Theba carthusiana Mull., 1774	*Helix carthusiana* Draparnaud, 1801	7.5-10	10-16	5.5-6	6-7	7-9
Theba fruticola (Kryn.), 1833		12-15	16-20	6.5-7	7-8	8-11
Helicella (Helicopsis) dejecta Cr. et J., 1832	*Helicella arenosa* Krynickii, 1836	6-11	9-18	5-6	6-7	8-10
	Helicella substriata Clessin, 1881					
H. (H.) gireorum Lindh., 1926		7-8	11.5-13	5	6-7	8-9
H. (H.) retowski Clessin., 1883		5-7	8-10	5-5.5	4-5	6-7
H. (H.) filimargo (Kryn.), 1833		7.5-11	12-17	5-6	6-7	7-9
H. (Xeropicta) Krynickii (Kryn.), 1883	*Xeropicta (Heliomanes) Orianda* Pusanov, 1926	6.5-9	12-15	5-5.5	6-7	8-10
Oxychilus (Schistophallus) deilus (Bourg.), 1857	*Hyalinia Krynickii* Clessin, 1883	7-7.5	13-17	6-6.5	5-7	8-9
Oxychilus (Oxychilus) diaphanellus (Kryn.), 1833	*Hyalinia taurica* Clessin, 1881	3.5-4	7-8.5	6-7	3-3.5	4-5
	Hyalinia zonulata Westerlund, 1886					
	Hyalinia (Polita) Pusanov, 1925					
Vitrea subeffusa var. depressa (Bttg.), 1879	*Hyalinia Kamia* Pusanov, 1925	1.6	3.5	4		
V. iphigeniae Lindh., 1926		2.25	4.5	4		
V. pygmaea Bttg., 1880	*Vitrea (Crystallus) etrusca* Lindholm, 1926	0.7-1	1.5-2	3.5-4		
V. diaphana (Stud.), 1820	*Helix hyalina* Ehrmann, 1933	2	4	5-6		
Zebrina (Buliminus) cylindricus Mke., 1828	*Chondrus lineatus* Krynickii, 1833	23-30	7.5-10	9-10	7-8.5	6-7
	Buliminus (Zebrina) cylindricus Pusanov, 1925					
Z. (B.) subulata (Rssm.), 1837	*Buliminus (Brephulus)* Kobelt, 1902	10-14	2.5-3	10-11	6-7.5	5-6
Chondrus (Buliminus) bidens (Kryn.), 1833	*Buliminus (Brephulus) bidens* Pusanov, 1925	12-20	5-6	8-10	5	3
Ch. (B.) bidens attenuatus (Kryn.), 1833	*Buliminus (B.) bidens attenuatus* Pusanov, 1925	10-14	4-4.5	7-11	3-4	2-2.5
Chondrula tridens Mull., 1774	*Chondrus galiciensis* Clessin, 1879	10-12	4-5	6-8	3.5	2.5-3
Ch. tetrodon (Mort.), 1854	*Buliminus (Chondrula) Kollyi* Retowski, 1889	11-16	4-6	7.5-9	3.2	2.3-2.8
	Clausilia (Clausiliastra) laminata Pusanov, 1925					
Clausilia (Cochlodina) laminata (Moel.), 1774	*Cochlodina laminata* (Mout.), Lich.& Ramm., 1952	15-17	3.9-4.1	10-12	3.5-4	2.5-3
Clausilia (Mentissa) gracilicosta (Rossm.), 1836	*Lacinaria (M.) gracilicosta* (Rssm.), Lich.& Ramm., 1952	18-19	4-4.5	11-13	3.5-4	2.3-2.8
	Clausilia (Mentissa) canalifera Zgl., Pusanov, 1925					
Cl. (Mentissa) canalifera (Rossm.), 1836	*Lacinaria (M.) canalifera* (Rssm.), Lich.& Ramm., 1952	16-20	3.5-4	11-13	3.5-4	2.5-3
Pupilla muscorum (L.), 1758	*Pupa marginata* Draparnoud, 1801	3-3.5	1.75	6-6.5	1-1.2	1-1.3
P. triplicata (Stud.), 1820	*Pupilla signata var. parvula* Moussom, 1876	2.3-2.75	1.3-1.5	5-6	0.9	0.8
Vallonia pulchella Mull., 1774	*Vallonia costellata* (Al. Br.) Sanberger, 1875	1.3	2.5	3-3.5		
Succinea (Oxiloma) elegans Risso., 1826		16.2	8-9	2.5-3		
Retinella (Perpolita) radiatula Alder., 1830	*Hyalinia radiatula* Taylor, 1908	2-2.2	3.5-4.5	3.5-4		
Caecilioides acicula (Mull.), 1774	*Caecilianella (Aciculina) praeclara* Westerlund, 1898	4.5-5.5	1.3-1.4	5.5-6		
Ca. raddei Bttg., 1879	*Cochlicopa (Hohenwartiana)* Pilsbury, 1909	4.8-5	1.5	5.5	2.1	2.3
Carichium minimum Mull., 1774		1.5-2.1	0.8-1	4.5		
Collumella columella (Mart.), 1830	*Pupa gredleri* Clessin, 1872	2.8-3.5	1.35-1.48	7-7.5	0.85	0.75
C. edentula (Drap.), 1805		2.25-2.6	1.3-1.4	6-6.5	0.8	0.7
Acanthinula (A.) aculeata (Mull.), 1774		1.8-2.1	2-2.3	4		
Cochlicopa lubrica Mull., 1774	*Buliminus subcylindricus* Ehrmann, 1933	5.5-6	2.5-2.7	5.5-6	2.5	1.75
Pisidium casertannum Poli., 1881	*Pisidium ovutum* Clessin, 1884	6	5			
Limnaea (Gulnaria) pygmaea Pusanov, 1925		6.5	4.5	3	4.3	3

TABLE 5-2
Modern Snail Species of Western Crimea and their Preferred Habitats

Name of species, author, year of first description	*Specific landscapes and preferred biotopes*	*Region*
Helix (Helicogena) lucorum taurica (Kryn.), 1833	humid broad-leaved forests, shrubs, and bushes	Crimean Mountains
H. (H.) vulgaris Rossm., 1839	dry landscapes with grass, trees, shrubs, and bushes	Crimean steppe and mountainous northern coast of Black Sea
Theba carthusiana Mull., 1774	slope shrubs and mesophytic grasses of the flood plain	Crimea and N-W coast of Black Sea
Theba fruticola (Kryn.), 1833	shrubs and dry steppes of sunny slopes	Crimea and N-W coast of Black Sea
Helicella (Helicopsis) dejecta Cr. et J., 1832	xerophytic steppes	Crimea and N-W coast of Black Sea
H. (H.) gireorum Lindh., 1926	xerophytic steppes	Crimean steppes of the Bakchisarai zone
H. (H.) retowski Clessin., 1883	xerophytic steppes	Crimean Mountains
H. (H.) filimargo (Kryn.), 1833	xerophytic steppes	Crimean and northern coast of Black Sea
H. (Xeropicta) Krynickii (Kryn.), 1883	xerophytic steppes	Crimean and northern coast of Black Sea
Oxychilus (Schistophallus) deilus (Bourg.), 1857	humid broad-leaved forests, shrubs, and bushes	Crimean Mountains
Oxychilus (Oxychilus) diaphanellus (Kryn.), 1833	humid broad-leaved forests, shrubs, and bushes	Crimean Mountains
Vitrea subeffusa var. depressa (Bttg.), 1879	broad-leaved forests, shrubs, and bushes	Crimean Mountains
V. iphigeniae Lindh., 1926	broad-leaved forests, shrubs, and bushes	Crimean Mountains
V. pygmaea Bttg., 1880	broad-leaved forests, shrubs, and bushes	Crimean Mountains, Caucasus, Iran
V. diaphana (Stud.), 1820	broad-leaved forests, shrubs, and bushes	Crimean and Carpathian Mountains
Zebrina (Buliminus) cylindricus Mkc., 1828	steppe regions	Crimea, Moldova, Romania, etc.
Z. (B.) subulata (Rssm.), 1837	slope grasses and small bushes	Crimean Mountains
Chondrus (Buliminus) bidens (Kryn.), 1833	xerophytic steppes	Crimean steppes and slopes
Ch. (B.) bidens attenuatus (Kryn.), 1833	xerophytic steppes	boreal zone of Europe
Chondrula tridens Mull., 1774	slope grasses and bushes	Crimean and Carpathian Mountains
Ch. tetrodon (Mort.), 1854	slope grasses and bushes	Crimean and Carpathian Mountains
Clausilia (Cochlodina) laminata (Moel.), 1774	broad-leaved and coniferous forests, shrubs, and bushes	Crimean Mountains
Clausilia (Mentissa) gracilicosta (Rossm.), 1836	calcareous rocky slopes, coniferous forests and bushes (esp. Juniperus)	Crimean Mountains
Cl. (Mentissa) canalifera (Rossm.), 1836	broad-leaved and coniferous forests, small trees, shrubs and bushes	Crimean Mountains
Pupilla muscorum (L.), 1758	mesophytic grasses, bushes, and calcareous rocky slopes	boreal zone of Europe
P. triplicata (Stud.), 1820	steppe grasses, bushes, and calcareous rocky slopes	boreal zone of Europe
Vallonia pulchella Mull., 1774	very humid places, near water, mountain and forest zones	boreal zone of Europe
Succinea (Oxiloma) elegans Risso., 1826	very humid places, around water basins, on water grasses	boreal zone of Europe
Retinella (Perpolita) radiatula Alder., 1830	forest bedding and mesophytic grasses of flood plains	boreal zone of Europe
Caecilioides acicula (Mull.), 1774	underground (10-40 cm depth), carbonate and humid soils of forests	Crimean, Caucasian, Carpathian Mountains
Ca. raddei Bttg., 1879	in cowes, in the 780 rock crack, and in the soil of forests or bushes	Crimean, Caucasus, Iran, and Middle Asia
Carichium minimum Mull., 1774	very humid places near water in forests	Eurosibiric forests
Collumella columella (Mart.), 1830	humid forests, bushes, and mesophytic grasses	forest zone of Europe
C. edentula (Drap.), 1805	forests, bushes, and mesophytic grasses	boreal zone of Europe
Acanthinula (A.) aculeata (Mull.), 1774	forest bedding and bushes	boreal zone of Europe
Cochlicopa lubrica Mull., 1774	humid places near water	boreal zone of Europe
Pisidium casertannum Poli., 1881	fresh water basins	South Ukraine
Limnaea (Gulnaria) pygmaea Pusanov, 1925	fresh water basins	Crimean zone

Other important factors affecting snail distribution are the topographic relief and type of soils. The most favorable conditions for snails are on calcareous soils. Calcareous soils are usually porous in structure, and contain enough useful elements for cockleshell construction, as well as for the nutrition of the snails themselves.

Vegetation also significantly affects the distribution of most snails. The majority of snails are phytophagous. All phytophagous snails may be divided into two main groups based on which types of plants they prefer: (1) species which live on mushrooms and the rotting remains of plants: Pupilidae, Valloniidae, Clausiliidae, *Euconulus, Carichium*, etc. and (2) species which live on not only mushrooms, but also the green parts of plants: Helicidae, Eulotidae, Succineidae, Enidae (Chondrulinae), etc.

Usually, snails are not very mobile, so their distribution is closely tied to their surrounding climatic and ecological conditions, making the use of malacological data of prime importance in the reconstruction of the paleoenvironments of Paleolithic sites and general climatic changes during the Quaternary.

KABAZI II

From Kabazi II, six samples were selected from Unit II, six samples from Unit III, and one sample from Unit IV (Table 5-4). In addition, 21 samples from the sondage (excavated in 1986) and materials which were selected earlier by the archaeologists were processed (Table 5-5). Because the number of remains overall in the sediment was not very high and each sample contained only a small number of shells, samples from different field seasons and different depths were combined into four comparable complexes which correspond to the major archeological units of Kabazi II (Figs. 5-1, 5-2, Table 5-4). (The description of archeological units, and their subdivision into levels, can be found in Chabai 1998b, c, d.)

At the time of the deposition of the upper part of Unit III, steppe fauna predominated (samples IIIa-IIId). The presence of *Helix (Helicogena) lucorum taurica* (Kryn.) and *H. (H.) vulgaris* Rossm. in the sample IIIe may serve as a good indicator of relatively more humid and warm conditions. Also, the presence of two shells of *Vitrea subeffusa* (Bttg.), which are usually characteristic of humid stands of forest or bushes near the water, should be noted.

Relatively more humid conditions than those of the present day during the deposition of Unit III suggest that there were areas surrounding the site with a high level of ground water or, perhaps, temporary springs. If the geological structure of the area and the mineral composition of slope rocks are taken into consideration, such assumptions look probable. Calcareous rocks surround Kabazi II, but some horizons have a finer lithological composition and a higher level of cementation. Usually, such types of calcareous rock absorb a large quantity of water during rains (or during the winter) and become good sources of fresh water springs for a long time.

The snail fauna of Unit II predominates in steppe xerophiles, such as *Helicella (Helicopsis) dejecta* Cr. et Jan., *H. (H.) Retowski Clessin, H. (Xeropicta) krynickii* (Kryn.), and *Chondrus (Buliminus) bidens* (Kryn.). These indicate that during the deposition of Unit II, steppe landscapes and arid climate conditions existed near the site. The small dimensions of *Helicella* and the predominance of small and very thin shells of *Chondrus (Buliminus) bidens natio attenuatus* Kryn., suggest that the climate was more arid and probably more cold than present-day conditions. Only the presence of *Vitrea pygmaea* Bttg., *Chondrula tridens* Müll., and *Helix (Helicogena) vulgaris* Rossm. indicates that some bushes or small trees were near site (fig. 5-1).

TABLE 5-3
Ecological Groups of Western Crimean Snails

I. Fresh water fauna
Limnaea pygmaea
Pisidium casertanum

II. Hydrophile fauna
Cochilicopa lubrica
Columella edentula
Succinea elegans
Carichium minimum
Vallonia pulchella

III. Fauna of forest areas (humid)
Acanthinula aculeata
Vitrea diaphana
Vitrea iphigeniae
Columella columella
Retinella radiatula

IV. Fauna of semi-forest areas (mesophiles)
Clausilia gracilicosta
Clausilia canalifera
Clausilia laminata
Oxychilus diaphanelus
Oxychilus deilus
Vitrea pygmaea
Vitrea subeffusa

V. Fauna of mesophytic steppes with small trees, bushes, & shrubs
Helix lucorum taurica
Helix vulgaris
Theba carthusiana
Zebrina cylindricus
Chondrula tridens
Chondrula tetrodon

VI. Fauna of xerophytic steppes (xerothermic)
Helicella dejecta
Helicella gireorum
Helicella Retowski
Helicella filimargo
Helicella (Xeropicta) Krynikii
Zebrina subulata
Chondrus bidens
Theba fruticola

VII. Rocky and soil fauna
Caecilioides acicula
Caecilioides raddei
Pupilla muscorum
Pupilla triplicata

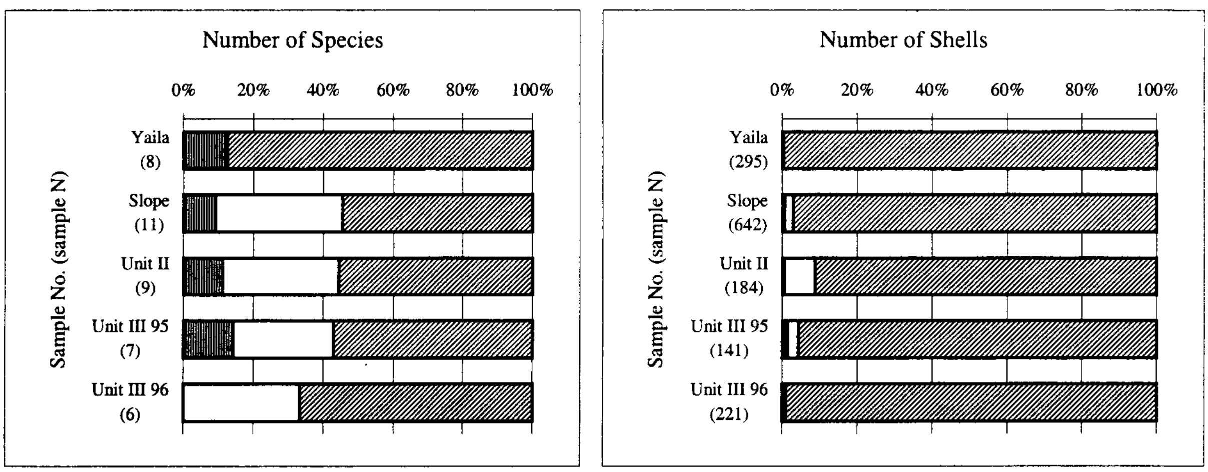

Fig. 5-1—Kabazi II, 1994-1996, cumulative number of species and number of shells by unit (see key, Table. 5-3).

TABLE 5-4

Kabazi II, Fossil and Modern Snails

Excavations	*1994*	*1995*													*1996*			*Modern*	
Archeological Unit and Sample No.	*II*	*IIa*	*IIb*	*IIc*	*IId*	*IIIa*	*IIIb*	*IIIc*	*IIId*	*IIIe*	*IIIf*	*IV*	*M-5 II/11*	*M6 II/ 10-583*	*III/2*	*II/10*	*III/1*	*Yaila Plateau*	*Near Site*
Helix (Helicogena) lucorum taurica (Kryn.)	–	–	–	–	–	–	–	–	–	3	–	–	–	–	–	–	–	–	-
H. (H.) vulgaris Rossm.	–	–	2	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	-
Theba fruticola (Kryn.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	11	2
Helicella (Helicopsis) dejecta Cr. et J.	35	5	5	9	6	–	24	14	3	5	6	–	–	–	153	–	4	6	22
H. (H.) gireorum Lindh.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5
H. (H.) retowski Clessin.	1	1	2	1	1	–	2	–	–	4	–	–	–	–	3	–	1	24	1
H. (Xeropicta) Krynickii (Kryn.)	5	9	14	20	–	1	36	34	–	–	–	–	–	–	32	–	–	2	10
Oxychilus (Schistophallus) deilus (B.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4
O. (O.) diaphanelus (Kryn.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	-
Vitrea subeffusa (Bttg.)	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	-
V. pygmaea Bttg.	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	-
Zebrina (Buliminus) cylindricus Mke.	–	–	1	–	1	–	–	–	–	–	–	–	–	1	–	4	1	–	1
Chondrus (Buliminus) bidens (Kryn.)	6	2	1	–	1	–	1	1	1	3	–	1	2	–	24	–	2	243	27
Ch. (B.) bidens natio pygmaea (Kryn.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6	4
Ch. (B.) bidens attenuatus Kryn.	–	13	13	14	2	–	–	–	–	–	–	–	–	–	–	–	–	2	-
Chondrula tridens Müll.	3	–	3	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
Ch. tetrodon (Mort.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Total	51	30	41	44	11	1	65	49	4	16	6	1	2	1	213	4	8	295	64

TABLE 5-5

Kabazi II, Fossil Snails from 1986 Sondage

Depth (cm)	*289-303*	*303-315*	*745-760*	*779-780*	*795*	*820*	*830-831*	*840*	*854*	*860*	*880*	*890*	*902-906*	*915*	*920*	*925*	*933-940*	*950-956*	*965-973*	*980*
Sample No.	*609*	*610*	*611*	*612*	*613*	*614*	*615*	*616*	*617*	*618*	*619*	*620*	*621*	*622*	*623*	*624*	*625*	*626*	*627*	*628*
Helix (Helicogena) lucorum taurica (Kryn.)	9	–	1	2	2	2	8	2	4	4	10	5	11	6	5	1	16	4	2	–
H. (H.) vulgaris Rossm.	3	–	–	–	1	–	1	–	3	–	4	–	2	3	1	–	7	1	2	–
Theba fruticola (Kryn.)	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	1	–	–
Helicelia (Helicopsis) dejecta Cr. et J.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	–
Vitrea pygmaea Bftg.	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
Zebrina (Buliminus) cylindricus Mke.	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Chondrus (Buliminus) bidens (Kryn.)	1	4	1	–	1	–	–	–	–	–	3	2	26	15	23	24	84	83	92	5
Ch. (B.) bidens natio pygmaea (Kryn.)	48	2	–	–	–	–	–	–	–	–	–	1	–	1	1	2	12	8	11	–
Clausilia (M.) gracilicosta Rossm.	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
Cl. (M.) canalifera Rossm.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–
Total	63	6	2	2	4	2	9	2	7	4	21	8	39	25	30	27	120	98	108	5

Kabazi II, 1986 Sondage

Malacological data from the 1986 Sondage indicate that during the Upper Pleistocene, the climatic conditions and the vegetation around the site were exposed to significant changes. Kabazi II during this time was situated in steppe with small trees and bushes. The bush stands underwent important modifications, given the oscillation in the number and in the morphometric parameters of mesophile species such as *Helix (Helicogena) lucorum taurica, H. (H.) vulgaris, Theba fruticola, Clausilia (Mentissa) canalifera, Cl. (M.) gracilicosta, Vitrea pygmaea*, etc. (Table 5-5 and fig. 5-2).

Relatively more favorable climatic conditions correspond to the samples 609 (depth=289-303 cm below datum), 615-619 (depth 830-880 cm), 620 (depth 890 cm), 621, 622 (depth 902-915 cm), and 625 (depth 933-940 cm), when the bush-small tree stand was evidently larger. The significant predominance of the xerophiles *Chondrus (Buliminus) bidens, Ch. (B.) bidens natio pygmaea*, and *Helicella (Helicopsis) dejecta* in samples 610 (depth 303-315 cm), 611-614 (depth 745-820 cm), 623-624 (depth 920-925 cm), 626-629 (depth 950-990 cm), indicates that, during the sedimentation of these horizons, a steppic landscape predominated (fig. 5-2).

It should be noted that a number of the samples from the sondage are very homogenous and not representative enough. This is probably due to an incomplete selection in this area (carried out by the archeologists), and they therefore do not reflect the true composition of the malacological fauna, nor do they permit the full reconstruction of paleoenvironmental conditions. In the cases where the archeologists collected the samples, usually only the large-size representatives of snails were selected. These tend to be mesophile warmth-loving species, whose shells are always bigger than xerophile cold-loving snail species.

Kabazi V

Unfortunately, the samples from Kabazi V are too small and not very representative (Table 5-6). This fact confirms that Kabazi V is a buried rockshelter; further supported by the presence in Unit III of one small shell of *Caecilioides raddei* (Bttg.), which usually prefers cracks of calcareous rocks in the humid walls of caves and rockshelters. During the deposition of Units II and III, a steppe-forest landscape surrounded the site. Steppic conditions are indicated by the presence of xerophile *Helicella (Helicopsis) dejecta, H. (Xeropicta) krynickii*, and *Chondrus (Buliminus) bidens*. The presence of mesophile species such as *Vitrea subeffusa, Clausilia (Mentissa) gracilicosta*, and *Caecilioides raddei* indicates the existence of small trees and bushes near the site. The presence *Vitrea subeffusa* and *Caecilioides raddei* may also serve as a good indicator of ground water or springs in the vicinity of the site. This may be due, in part, to the hygroscopic nature of calcareous rock, which absorbs and preserves rain or snow water for long time.

A comparison of the species composition of modern fauna around Kabazi V with the fossil fauna from Unit II indicates that the fossil fauna is more mesophilic. None of the above-mentioned mesophile species of Unit II are found in the modern day fauna on the sunny slope around the site (Fig. 5-3). This indicates that, during the deposition of Unit II, the area around Kabazi V experienced conditions that were more humid. The author spent many fruitless hours in the vicinity of Kabazi V looking for the cockleshells of *Clausilia* or other mesophiles. In the modern fauna of these sunny slope landscapes, *Chondrus bidens* (311), *Theba fruticola* (21), and *Helicella (Helicopsis) dejecta* (7) absolutely predominate, and confirm the semiarid climatic conditions of the present-day xerophytic steppe landscape.

TABLE 5-6
Kabazi V, Fossil and Modern Snails

	1994	*1995*			*1996*	*Modern*	
	II	*II*	*III/II*	*III*	*III*	*Near Site*	*Alma Flood Plain*
Helix (Helicogena) lucorum taurica (Kryn.)	–	–	–	–	–	–	21
H. (H.) vulgaris Rossm.	–	–	–	–	–	–	12
Theba carthusiana Müll.	–	–	–	–	–	–	18
Theba fruticola (Kryn.)	–	–	–	–	–	21	6
Helicella (Helicopsis) dejecta Cr. et J.	–	1	–	–	1	7	–
H. (H.) gireorum Lindh.	–	–	–	–	–	–	22
H. (H.) retowski Clessin.	–	–	–	–	–	1	32
H. (Xeropicta) Krynickii (Kryn.)	–	3	3	1	–	1	–
Oxychilus (Schistophallus) deilus (B.)	–	–	–	–	–	–	1
O. (O.) diaphanelus (Kryn.)	–	–	–	–	–	–	3
Vitrea subeffusa (Bttg.)	–	1	–	1	–	–	–
V. pygmaea Bttg.	–	–	–	–	–	–	2
Zebrina (Buliminus) cylindricus Mke.	1	–	–	2	–	–	26
Chondrus (Buliminus) bidens (Kryn.)	–	4	1	3	–	311	16
Ch. (B.) bidens natio pygmaea (Kryn.)	–	–	–	–	–	8	–
Ch. (B.) bidens attenuatus Kryn.	–	–	–	–	–	3	–
Chondrula tridens Müll.	–	–	–	–	–	1	–
Ch. tetrodon (Mort.)	–	–	–	–	–	–	3
Clausilia (M.) gracilicosta Rossm.	–	3	–	–	–	–	–
Cl. (Mentissa) canalifera Rossm.	–	–	–	–	–	–	2
Caecilidoides raddei Bttg.	–	–	–	–	1	–	–
Limnaea (Gulnaria) pygmaea Pusanov	–	–	–	–	–	–	2
Total	1	12	4	7	2	353	166

STAROSELE

A total of 20 samples were collected from Starosele, including from Level 1 (2 samples), Level 2 (1), Level 3 (6), Level 4 (9), one sample from the sterile horizon between Level 2 and 3, and one sample from the pond silt between Levels 3 and 4. Two samples of modern fauna were also collected: one from the Kanly-Dere Valley, where the site is located, and one from the neighboring plateau. In general, the preservation of fossil snail shells at Starosele is much better than at Kabazi II. The majority of samples are also more diverse and numerous in comparison to Kabazi II and Kabazi V (Tables 5-4–5-7).

In Level 4, xerophile steppe elements predominate; *Helicella dejecta* Cr. et Jan., *H. (Xeropicta) krynickii* (Kryn.), *Chondrula bidens* (Kryn.) comprise 57.8% of the total number of individuals (Fig. 5-4). Nevertheless, this predominance may be only happenstance, because for such a large sample (467 shells) the proportions of mesophile (33%) and hydrophile forms (6%) are also very high. This species composition indicates a more humid climate than exists at the present day. The presence of shells of *Columella edentula* (Drap.) (3), *Retinella (Perpolita) radiatula* Alder. (3), *Vallonia pulchella* Müll. (12), *Caecilioides acicula* (Müll.) (1), and *Acanthinula aculeata* (Müll.) (1) indicates that conditions were also relatively colder than today. Taking into consideration that 50% of species (9 of 18) represent mesophilic and hydrophilic inhabitants of forests and semi-forest areas, the steppic landscape was evidently more limited in the immediate area as compared to today.

It is very interesting to mention here two mussels of *Pisidium casertanum* Poli., a freshwater mollusk which prefers small torrents clean and rich in oxygen. Their presence indicates that during the time of Level 4, there was a permanent torrent of spring water near the site. This conclusion is further confirmed by the presence of *Caecilioides acicula* (Müll.), *Acanthinula aculeata* (Müll.), and *Columella edentula* (Drap.), which prefer to live in humid places near water.

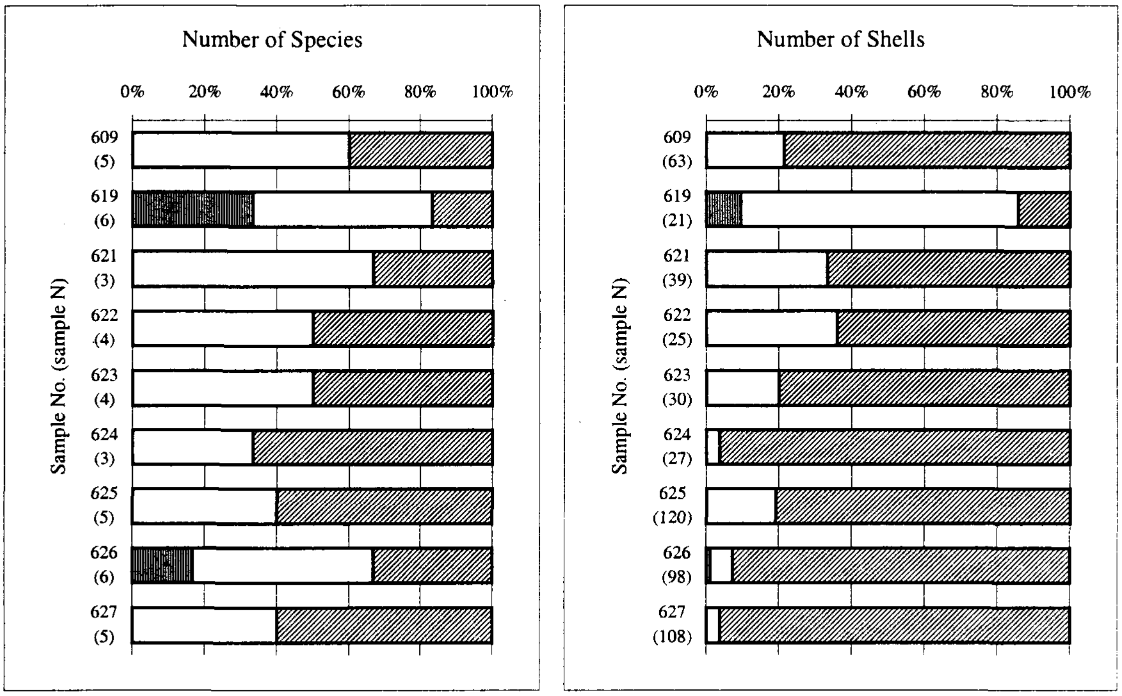

Fig. 5-2—Kabazi II, 1986 sondage, cumulative number of species and number of shells by depth (see key, Table 5-3).

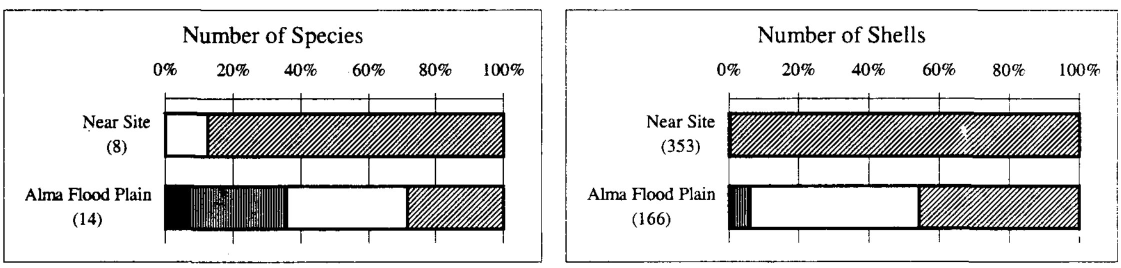

Fig. 5-3—Kabazi V, modern samples of snails (see key, Table 5-3).

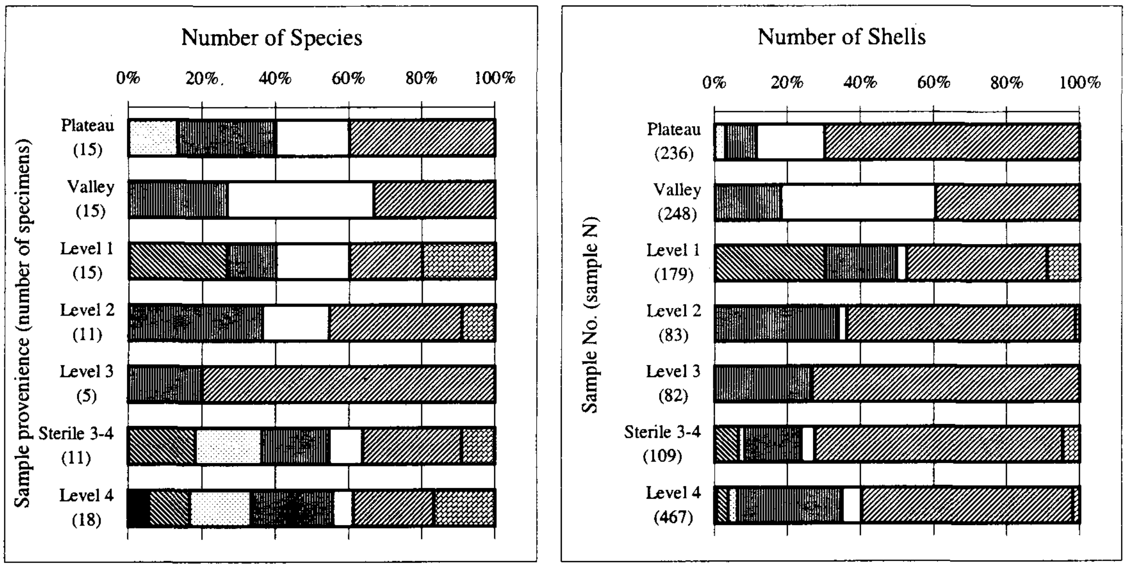

Fig. 5-4—Starosele, cumulative number of species and number of shells of modern and fossil snails (see

TABLE 5-7
Starosele, Fossil and Modern Snails

				1994						1995												Modern	
				H24	G20	G21	G21	H23	K22			G19	F22	F22									
	Height	Diameter	Whorls	1	3a	3b	4a	4b	4c	1	2	3a	3b	3c	3-4a	3-4b	3-4c	4a	4b	4c	4d	Plateau	Valley
Helix (Helicogena) lucorum taurica (Kryn.)	40-47	41-49	4.5-5	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	38
H. (H.) vulgaris Rossm.	27-30	29-38	4	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	32
Theba carthusiana Müll.	6-10	10-12	5-6	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	11
Theba fruticola (Kryn.)	10-15	15-20	6-7	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	29	27
Helicella (Helicopsis) dejecta Cr. et J.	6-11	9-18	5-6	2	5	3	–	–	3	25	6	–	1	3	8	2	3	12	9	16	3	48	14
H. (H.) gireorum Lindh.	7-8	11-13	5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	7
H. (H.) retowski Clessin.	5-6	8-10	5-5.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	7
H. (Xeropicta) Krynickii (Kryn.)	7.5-11	12-17	5-6	1	–	4	–	–	–	33	30	–	4	8	3	–	4	20	30	32	10	12	–
Oxychilus (Schistophallus) deilus (B.)	7-7.5	13-17	6-6.5	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	16
Vitrea subeffusa (Bttg.)	1	3.5	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	2	3	7	12
V. iphigeniae Lindh.	2	25	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	2	3	1	4	–
V. pygmaea Bttg.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	5	–	1	1	–	–
V. diaphana (Stud.)	2	4	5-6	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–
Zebrina (Buliminus) cylindricus Mke.	24-37	7-9	9-10	–	–	–	–	–	–	–	–	–	–	–	–	4	–	22	3	–	–	5	18
Z. (B.) subulata (Rossm.)	10-14	2.5-3	10-11	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	10	–
Chondrus (Buliminus) bidens (Kryn.)	12-20	5-6	8-10	–	11	4	4	3	2	8	15	3	9	4	8	25	21	16	51	53	4	61	43
Ch. (B.) bidens natio pygmaea (Kryn.)	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
Chondrula tridens Müll.	10-12	4-5	6-7	1	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	23	4
Ch. tetrodon (Mort.)	11-16	4-6	7-9	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	16	2
Clausilia laminata (Moel.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–
Clausilia (Mentissa) gracilicosta (Rossm.)	18-19	4-4.5	11	–	12	6	1	–	–	3	8	1	3	–	10	2	3	14	12	23	30	7	13
Cl. (Mentissa) canalifera (Rossm.)	16-20	3.5-4	13	7	–	–	–	–	–	25	16	–	–	–	–	–	–	–	–	–	–	2	4
Cl. sp. indent	–	–	–	–	–	–	–	–	1	–	2	–	–	–	–	–	–	18	20	–	–	–	–
Pupilla muscorum (L.)	3-3.5	1.75	6.5	–	–	–	–	–	–	4	–	–	–	–	–	–	–	1	2	1	–	–	–
P. triplicata (Stud.)	2.4-2.8	1-1.6	5-6	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	–	4	–	–	–
Vallonia pulchella Müll.	1.2-1.3	2.4-2.5	3-3.5	–	–	–	–	–	–	45	–	–	–	–	6	–	–	–	–	12	–	–	–
Succinea (Oxiloma) elegans Risso.	12-24	6-10	2.5-3	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
Retinella (Perpolita) radiatula Alder.	2	3.5-4	3.5-3.7	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–
Caecilioides acicula (Mull.)	4.5-5.5	1.3-1.4	5.5-6	–	–	–	–	–	–	2	1	–	–	–	–	–	–	–	–	1	–	–	–
Ca. raddei Bttg.	–	–	–	–	–	–	–	–	–	10	–	–	–	–	–	–	–	–	–	–	–	–	–
Carichium minimum Müll.	–	–	–	–	–	–	–	–	–	5	–	–	–	–	–	–	–	–	–	–	–	–	–
Collumella columella (Mart.)	2.8-3.5	1-1.5	7-7.5	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–
C. edentula (Drap.)	2.3-2.8	1-1.4	6-6.5	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	1	1	–	–	–
Acanthinula (A.) aculeata (Mull.)	1.8-2	2-2.3	4	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	1	–	–
Cochlicopa lubrica Müll.	5.7-7	2.4-2.8	5.5-6	–	–	–	–	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–
Pisidium casertannum Poli.	2.9-3.4	2-2.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	–	–	–
Total				11	28	17	5	3	6	168	83	4	18	15	42	36	31	112	135	153	53	236	248

The shell samples from the sterile horizon (pond silt) between cultural Levels 3 and 4 are smaller than Level 4, totaling only 109 shells of 11 species. In these samples, the number of xerophile steppic elements increase (68.1%), as do species which live in the cracks of rocks or in calcareous soils (4.5%) (Fig. 5-4).

All samples from cultural Level 3 of Starosele are fairly homogenous. Here, there are only two ecological groups of snails: xerophile steppe fauna—73% of the total number of individuals (82), and mesophile semi-forest fauna—27 %. Such a composition of snails may indicate that the climate was becoming increasingly arid beginning from cultural Level 4 and culminating in Level 3.

Probably, the level of ground water during this time had decreased, because in all samples from Level 3, mesophile species which live near the water are absent. This fact adds weight to an interpretation of changing climate in the direction of increasing aridity, but it could also merely reflect the downcutting of the canyon bottom and the resultant elevational drop of surface water.

In the malacological fauna of Level 2, steppic xerophiles predominate, such as *Helicella (Xeropicta) krynickii* (Kryn.) (30), *H. (Helicopsis) dejecta* Cr. et Jan. (6), and *Chondrus (Buliminus) bidens* (Kryn.) (15). But in comparison with Level 3, there is an increase in the total number of mesophile species and individuals *Clausilia (Mentissa) gracilicosta* Rossm. (18), *Oxychilus (Schistophalus) deilus* (B.) (2), *Helix (Helicogena) lucorum taurica* (Kryn.) (1), and *Theba fruticola* (Kryn.) (1). This relatively large diversity of mesophiles may indicate changing climatic conditions towards higher humidity. During the sedimentation of Level 2, steppe landscapes predominated, but were more limited than during the time of Level 3. The forest and bush areas were larger than in the time of Level 3, but evidently, more limited compared with the time of Level 1. The process of increasing humidity from Level 3 to Level 1 is easily observed in the comparative diagram of the site (fig. 5-4).

In Level 1, there are a large number of forest mesophiles: *Clausilia (Mentissa) canalifera* Rossm. (25), *Cl. (M.) gracilicosta* Rossm. (3), *Vallonia pulchella* Müll. (45), *Caecilioides raddei* Bttg. (10), *C. acicula* (Müll.) (2), *Carichium minimum* Müll. (5), and *Cochlicopa lubrica* Müll. (3). These species may serve as reliable indicators for the continued increase in humidity, and that the annual amount of precipitation reached its culmination—these fauna indicate more humid conditions than previously seen at the site, as well as more humid conditions than the present day. Probably, this horizon corresponds to one of the Late Würm interstadials, when the climate of this region was more humid, but relatively colder, than today.

CORRELATIONS AND CONCLUSIONS

The essential peculiarity of Crimean snails is their very high level of endemism (more than 30% of species), which has provoked huge problems in correlating them with neighboring continental regions of the north coast of the Black Sea. Prof. I. I. Pusanov (1926) described 108 species of modern snails on the Crimean Peninsula. Not long afterwards, I. M. Likharev and E. S. Rammelmeier (1952) described 110 species, but 20 of these are freshwater mollusks.

Because our collections of modern and fossil snails represent only a small sector of the second Crimean Mountain range, they include only about 40 species of snails, which comprise a little more than one-third of all modern Crimean species. The importance of these collections lies in the fact that it is the first and only sample of fossil snails from Crimea. Taking into account the relatively large diversity of the represented species, and the large number of individuals from each species (some samples include more than 200-300 cockleshells), the investigated samples, examined in parallel with palynological and mammalian faunal data, may serve as a good basis for the paleoenvironmental reconstructions of the main stages of the evolution of Stone Age hominids and regional climatic oscillations during the Upper Pleistocene.

The results of Quaternary malacological investigations from throughout Europe demonstrated that during last million years, the evolution of snails took place predominantly on the morphs, natio, and subspecies levels. Analyses of Crimean fossil snails confirm this conclusion. The main changes in Crimean snails during the Upper Pleistocene predominantly reflect changes in paleoenvironment (especially changes in climatic conditions) and less the evolutionary transformation of fossil species.

The comparison of the morphometric parameters of fossil and modern snails suggests that none of the species in Crimea evolved into new species during the Upper Pleistocene. Chondrulinae (especially the genus *Chondrus (Buliminus)*), did undergo more evolutionary change, given the number of subspecies distinguished, but such a conclusion needs to be supported by more extensive collections. The changes in *Chondrus bidens*, as seen in the author's studies, may be due at least in part, to this group's very high morphometric parameter variation as a result of differences in relief (slope exposure), soils, and vegetation.

The method of sampling used at all sites was aimed at selecting as many fossil cockleshells as possible from different horizons and from different granulometric fractions of sediments. Because the calcareous soils and the dry, warm climate of Crimea ensure excellent preservation of cockleshells, it is assumed that the selected samples accurately reflect the species composition of Paleolithic-age Crimean snails. The changes in composition of species, and the number of individuals of each species, therefore reflect the major climatic oscillations during the Upper Pleistocene and Holocene of this zone.

Characteristic of the Crimean Upper Pleistocene are the frequent changes of relatively warm and humid associations of snail fauna and relatively cold and arid associations of species. These oscillations may be readily observed in the changing species composition and changing number of individuals in each species in the samples from the 1986 Sondage at Kabazi II (Table 5-5, fig. 5-2).

During the early Upper Pleistocene (Mikulino, or Pryluky, Interglacial), the Crimean snail population consisted of warmth-loving species, including *Helix (Helicogena) lucorum taurica* (Kryn.), *H. (H.) vulgaris* Rossm., *Helicella (Helicopsis) dejecta* Cr. et J., *H. (Xeropicta) krynickii* (Kryn.), *Zebrina (Buliminus) cylindricus* Mke., *Chondrus (Buliminus) bidens* (Kryn.), *Clausilia (Mentissa) gracilicosta* (Rossm.), and *Pupilla muscorum* (L.).

The main environmental changes in the vicinities of Kabazi II, Kabazi V, and Starosele become more evident through the comparison of the species composition at each site (Figs. 5-1–5-4). Such changes may be very well observed at Starosele. For example, the very extensive sample (467 shells) from Level 4 and the underlying sediments indicates that the climate was more humid than it is at the present time. This species composition, when compared to fossil snail fauna from Moldova and southern Ukraine, suggest that Level 4 corresponds to the end of the Mikulino (Pryluky) Interglacial. This conclusion is further supported by the lithological character and composition of the sediments, which are composed of red pedosediments. Fossil soils of this nature are specific to the Mikulino Interglacial. The pedosediment of Level 4 is an erosional product that was transported by water torrents from the plateau above the site. Given the fact that loess or other sediments younger than Mikulino age were not observed either in the Level 4 deposit or below it, very little time must have passed between the formation of the red pedosediment on the plateau and its subsequent deposition below as Level 4. That Level 4 was formed not parallel with the Mikulino soil, but sometime afterwards, is indicated by the appearance of comparatively cold elements for the Crimean zone (*Vitrea pygmaea, Columella edentula, Retinella radiatula, Vallonia pulchella, Acanthinula aculeata*) along with the relatively warm and humid fauna.

During the Early Valdai glaciation (Early Würm), some short phases of warming such as Amersfoort, Brörup, and Odderade, occurred on the north coast of the Black Sea. In the snail fauna of the neighboring zones (from southern Ukraine and Moldova), the number of cryophilic species during these phases became more limited. In Crimea, these warm horizons may correspond the sample numbers 621, 625, and 626 from the Kabazi II sondage, where mesophile snail fauna increase in number. This correlation is only preliminary, however, as these samples are very small and homogenous.

A warmer complex of snail fauna corresponds to the Middle Valdai interstadial, which may be correlated to the fresh water mollusks in the alluvium of the first terraces of the Eastern European Don, Dniepr, Dniester, and Danube rivers. Characteristic of the Middle Valdai thermocomplex are *Lithoglyphus naticoides* C. Pf., *Valvata piscinalis* Müll., *Chondrula tridens* Müll., *Chondrula tetrodon* (Mort.), *Helicella (Helicopsis) dejecta* Cr. et Jan., *Helicella (Xeropicta) Krynickii* (Kryn.), *Chondrus (Buliminus) bidens* (Kryn.), *Zebrina (Buliminus) cylindricus* Mke., *Clausilia (Mentissa) laminata* (Moell.), and *Clausilia gracilicosta* (Rossm.). This thermocomplex may be comparable with the humid fauna from Starosele Level 2, and possibly with the snail fauna from the samples 615-619 from the Kabazi II sondage.

While the snail fauna from Starosele Level 2 is similar to the Middle Valdai thermocomplex, it should be noted that Level 2 contains some cold elements which are also characteristic of the relatively warm interstadials of the Upper Valdai in Crimea. During the second part of the Valdai, the snail fauna of the north coast of the Black Sea are characterized by a cold complex (cryocomplex) which includes *Vallonia pulchella* (Müll.), *Caecilioides acicula* (Müll.), *Ca. raddei* Bttg., *Carichium minimum* Müll., *Succinea elegans* Risso, and *Pupilla muscorum* (L.). During this time, the cooling process appears to have been more intense than in Early Valdai time, on the basis of the reduced number of thermophiles. Unfortunately, the limited collection of fossil faunas from the Crimean Peninsula precludes assigning a typical fauna associated with this cryocomplex.

Another relatively warm and humid complex of snail fauna was found in Starosele Level 1. This complex may correspond to one of the warm Late Valdai interstadials. This correlation is only preliminary, however, due to our limited fossil malacological collection, and until the Crimean climatic oscillations are better understood in relation to global climatic change.

In spite of its geographical situation, the climatic oscillations on the Crimean Peninsula probably possess regional peculiarities and differ from those experienced on the Eastern European Plain. For example, on the north coast of the Black Sea, warming trends are usually accompanied by increasing humidity, and cooling trends are usually accompanied by increasing aridity. On the Crimean Peninsula, in spite of its southern geographical situation and the significant influence of the Black Sea, changes in humidity may be more important than changes in temperature. In Crimea, warm faunal complexes are not always mesophilic (humid), so it is very difficult to correlate Crimean snails faunas with their analogs in the continental zone. Yet, the results of the malacological analyses of Kabazi II, Kabazi V, and Starosele generally confirm paleontological data known from the littoral zone of the Black Sea, including the data of marine and brackish water mollusks.