ROMANIAN REVIEW OF REGIONAL STUDIES, Volume II, Number 1, 2006

BIODIVERSITY AND TRANSFORMATION: A CRIMEAN AFFAIR

ADRYI YENA♥, ANTON DRESCHER♣, BOHDAN PROTS♦ AND ERHARD SCHULZ*

ABSTRACT - The Crimean peninsula is a perfect example for the discrepancies between the approach of zonality taking the main vegetation and soil formations mainly as climate dependent and so as natural and the acceptance of an accelerated development of cultural landscapes. Crimea underwent several periods of profound economic ethnic and cultural changes comparable to its present dimension of "transformation", which always affected the exploitation of natural resources. Thus only a few examples of "real steppe" exist between the extensively or intensively settled and cultivated areas. However several reports on intensive cereal cultivation on the Crimean plains during Greek, Hellenistic and Byzanthinian times may shed another light to the assumed natural grassland vegetation (cf. Mack & Carter 2003). Thus the question for the "steppe" as a grassland-chernosem system should be discussed again. The fact of predominance of cultural landscape systems on the peninsula should necessarily be incorporated in all conservation plans. The exclusion of further economic use or its profound change will again start processes of succession, and finally the goal of the preservation of human's modified ecosystem will fail. Moreover the Crimean peninsula perfectly proves the necessity of incorporation of the historical and cultural changes of landscapes in order to understand their development and dynamics for a better and appropriate management.

Key words: Crimean peninsula, biodiversity, landscape evolution.

INTRODUCTION

Crimea and the southern part of Ukraine are known as the area of origin of the concept of zonality. In the second half of the 19th century a systematic soil survey and cartography accompanied the development of new agrarian areas in southern Ukraine and Crimea (Dokutchajev 1893, Glinka 1914). The subsequent discussion of interdependency of vegetation and soil and the discovery of the large belts similar in vegetation and soil subsequently lead to the interpretation scheme of vegetation and soil belts as dependent on the overregional climate and thus of zonality based on the continental transect Crimea-Kola (see also Kubiena 1952, Walter 1943). These authors stressed especially the interdependencies of steppe and chernosem as a basic assumption. Steppe as a term was also defined as the treeless grassland on loess or similar substrates characterised by species of the genera *Stipa* and *Festuca***.** Trees, as Walter (1943, 1968) stressed may only grow on coarse substrates or along rivers.

The Crimean peninsula is a unique European region since it is localised right between the two phytogeographic regions, Circumboreal and Mediterranean (Takhtajan, 1986), on the remote north-eastern edge of Mediterranean and yet on the very south of Ukraine and the whole East Europe. Being well isolated by Black Sea and Sea of Azov, it is surrounded by such floristically diverse regions as East-European plane (from the North), Balkan Peninsula (from the West), Caucasus (from the East) and Asia Minor (from the South). This region proves to be a crossroad for plant migration during previous ages. So Crimea has phytogeographically constrained high diversity of its flora. It is famous as one of the European biodiversity hot spots both in plants and animals (BSP 1999). About 10% of vascular plants are considered as endemics (BSP 1999, Yena 2001).

♥ National Universiti in Simferopol, Crimea
E-mail: yena@ccssu.crimea.ua
♣ Institute of Botany, Karl-Franzens University of Graz, Holteigasse Str. 6, 8010 Graz, Austria,
E-mail: anton.drescher@kfunigraz. ac.at
♦ State Museum of Natural History, National Academy of Sciences of Ukraine, 18, Teatralna Str., Lviv, 79008, Ukraine
E-mail: bprots@hotmail.com
* Geographisches Institut, Am Hubland, 97074 Würzburg, Deutschland,
E-mail: erhard.schulz@mail.uni-wuerzburg.de

It is stressed that the recent economic and social changes, generally called transformations, would threaten the basis of this high biodiversity and that it would be necessary to put urgently under protection the several regions on the peninsula. Another idea is, to create a "Tavrida" National Park, covering most of the mountain areas in order to counteract damages of expanding tourism and forest exploitation (BSP 1999, Yena et al.2000).

Question arises whether the biological inventory is more based on the physical factors or on the dynamics of human impact e.g. of a highly diversified cultural landscape.

During a common excursion through Crimea late spring 2004 discussions arose about the interdependencies between the soil types and the present vegetation and thus about the climatic dependency within the scheme of zonality.

This article will present the examples of different landscape features of regions of Crimea and also will try to involve the cultural and economic history as an evolutional factor in connection with biodiversity.

THE PHYSICAL SETTING

The Crimean peninsula is principally divided into a northern lowland not exceeding 130 m in altitude and a mountain chain consisting of a complicated system of scarps exposing front and backside escarpments cf. **fig. 1.** They are accompanied by young volcanic formations in the Southeast of the Peninsula. These cuestas are developed in Jurassic to Tertiary formations mostly of calcareous material and rise up to 1545 m (Roman Kosh Mt.). The main escarpment is facing to the Southeast with a steep slope to the coast. The Kara-Dag Mts. in the Southeast proves the volcanism of Cretaceous age. These mountains belong to the Caucasian system as its westernmost part (Schönenberg & Neugebauer 1981) separated from its main part by graben-developments during the Tertiary history of the Black Sea.

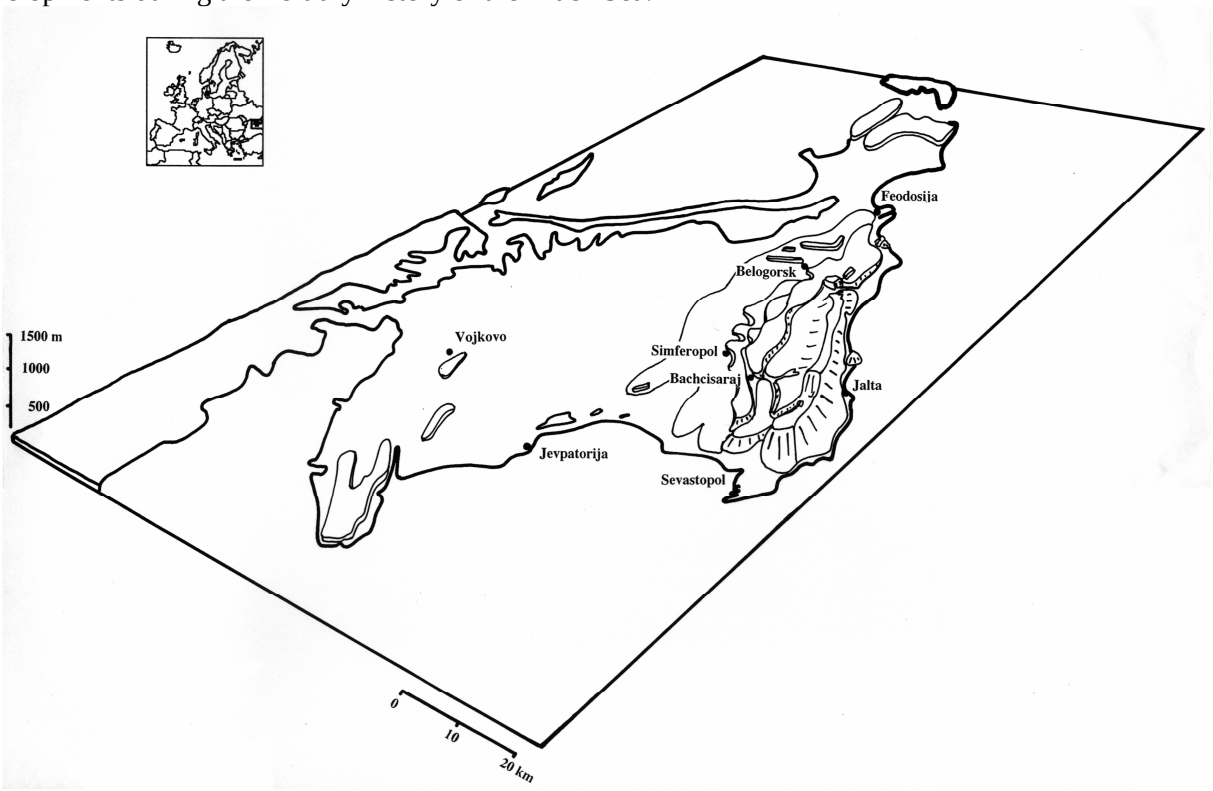

Fig. 1. *Block diagram showing the geomorphology of the Crimean peninsula.*

Also the climatic differences are caused by the geomorphological situation. The mountain chain for example divides the peninsula in two climatic provinces. The North is dominated by a steppe climate providing the region with about 450 mm precipitation by year. However, as the Simferopol diagram shows the influence of the mountain cause a shift to the summer maximum of rainfall and also to severe winter cold. The mountains also provoke an accelerated precipitation in their upper part. On the other hand they protect the southern coastal area against the northern continental air masses and allow a Mediterranean type

climate with the typical formation of winter rain maximum and a summer drought in the western part. North of the mountains at Feodosiya the continental air masses again have their influence causing severe winter temperatures. The series of climate diagrams explains these conditions **(fig. 2).**

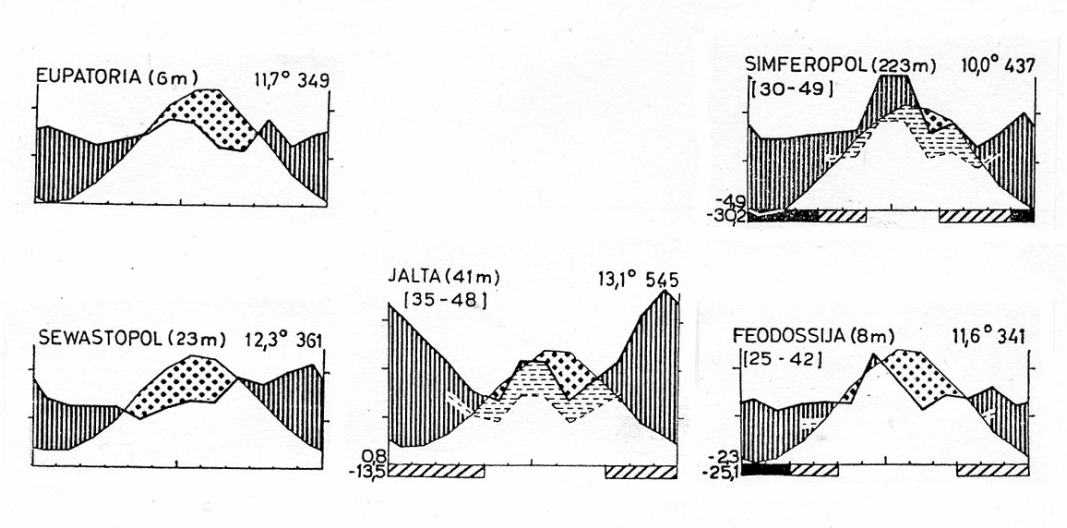

Fig. 2. Climate diagrams from four selected stations of the Crimean Peninsula.

As **fig. 3** shows, the peninsula is also divided in the (formerly extended) steppe- and semi desert part in the lowlands - today for the most transformed into agrarian fields or less into pastures - and the forest- or scrubland (shyblyak)-part of the mountain chains (Yena V. 1961, Yena et al. 2004). These forests, respectively their remains, may be explained as a system of altitudinal belts with a vegetation changing from mixed forests of *Quercus pubescens, Q. petraea, Carpinus orientalis, Pinus nigra* subsp. *pallasiana* in the lower one (up to about 400-500 m) to a beech-hornbeam forest belt reaching to about 1400 m and an open scrubland and pasture on the plateau-like top of the ridge, so-called “yailas”. Shrubs of *Juniperus sabina, J. haemisphaerica* and a relatively sparse cover of dwarf shrubs, herbs and grasses dominate these “yailas”. Partly they expose open surfaces of recently uncovered karsts. The SSE-exposed slopes in the “Crimean Sub Mediterranean zone” show a completely different tree species composition in the altitudinal belts: the upper one is dominated by *Pinus*-formations, with *Q. petraea* down to the coast a small fragmental belt of a submediterranean shrubs is formed by *Quercus pubescens, Juniperus excelsa, J. oxycedrus, Arbutus andrachne, Pistacia mutica, Jasminum fruticans, Ruscus ponticus* and other mediterranean elements. The later however is transformed into a kind of macchia-like coenosis with scattered remains of dense stands.

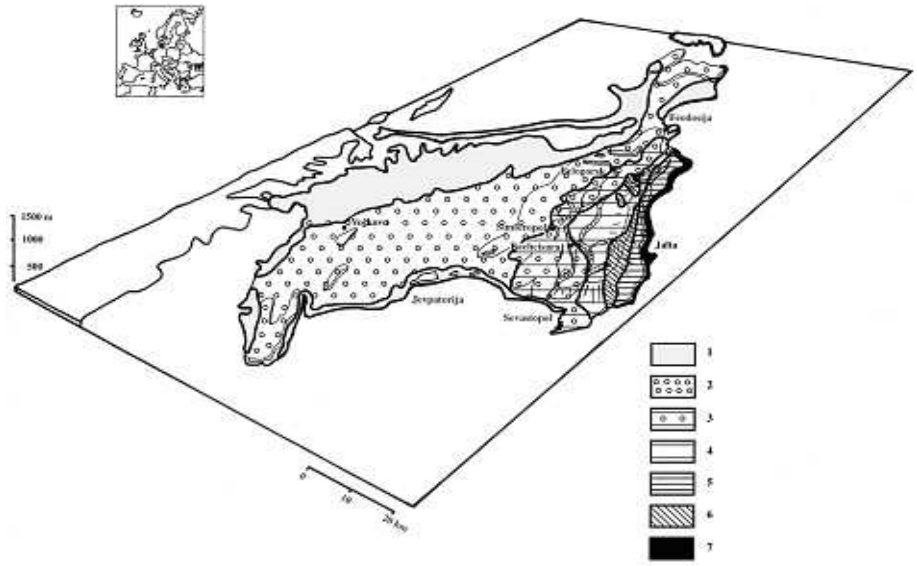

Fig. 3.Landscape and vegetation types on the Crimean peninsula (after BSP 1999).

The International soil map (UNESCO/FAO 1978) shows a further division by the soil cover. The lowlands are dominated by kastanosems in the northernmost arid part. The southern plains as well as the N-exposed gentle slopes are characterised by chernosems or of gleysols in the centre. In contrast to that the S-exposed slopes are described as the area of eutric cambisols **(fig. 4).** This repartition also seems to fit with the general assumption of interdependency steppe-chernosem and forest-cambisol (cf. Walter 1943, 1968).

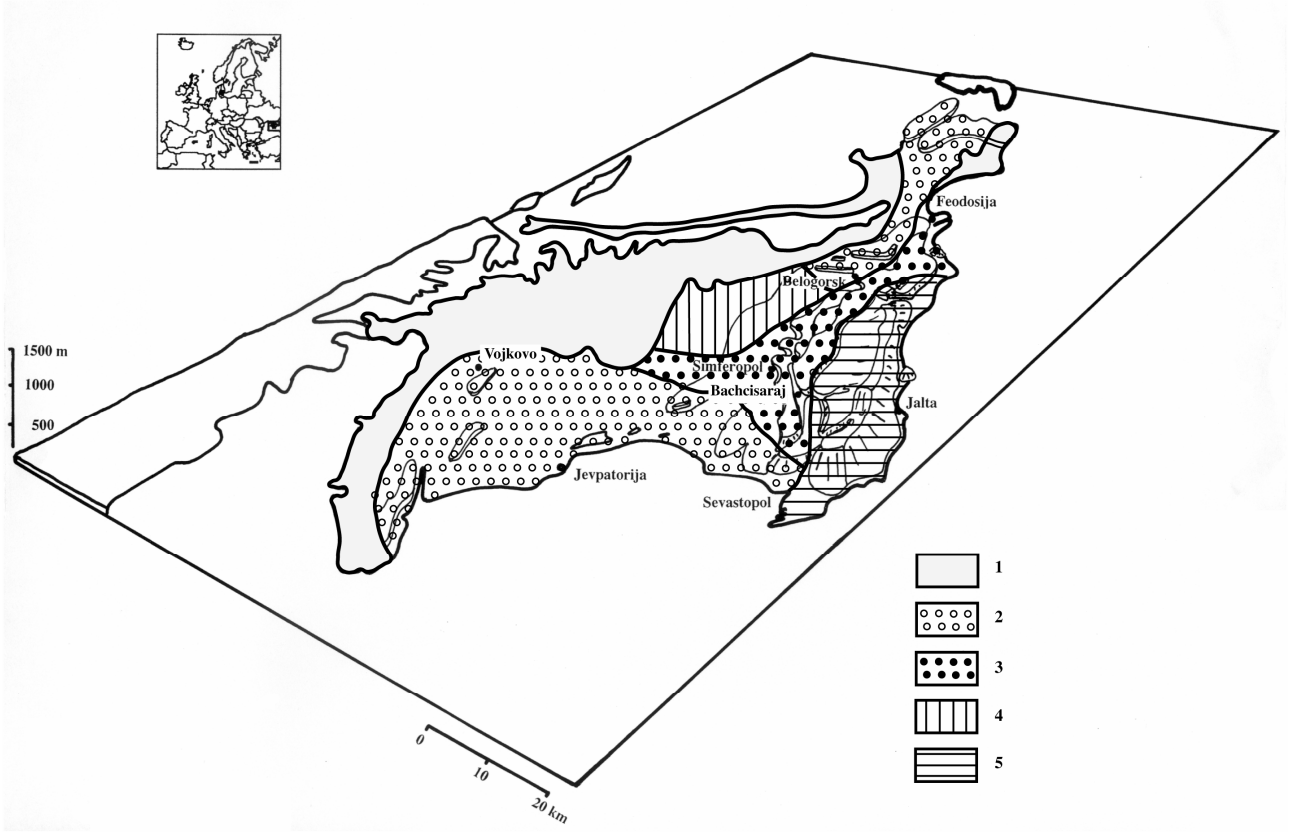

Fig.4. The repartition of soil types on the Crimean peninsula (after UNESCO-FAO 1979).

As the colleagues around the Biodiversity Support Program stated (BSP 1999), about 2700 plant species can be found on the Crimean Peninsula and about 10% of them are considered as endemic to Crimea. The mountain chain represents the centre of this biodiversity and thus most of the protected or areas proposed for protection are located in the mountains, which should be incorporated in the "Tavrid`a" National Park (Yena et al. 2000).

THE ECONOMIC EXPLOITATION AND THE PROBLEM OF TRANSFORMATION

Crimea today is an autonomous part of Ukraine. Thus, it belongs to the countries called under "transformation", meaning the profound economic changes in Central and Eastern Europe with a sudden breakdown of the old economic system - after a long-lasting decline – and an overtopping of another economic system without a buffering process for the population.

Industrial activities declined, the former collective agricultural units collapsed for their greater part and several cellules of private activities are active – more on subsistence and less for the market economy as in other "transformation countries" (Benedek 2003). However, we shall not forget that already during the last thousand years many severe changes of the social and economic situation took place, which were at least as important as the present „transformation"(**cf. fig. 5**). The general division of the peninsula, shaped by the physical setting, is also present in the different historical development during the last millennium. The two figures showing the centre of Bakhchisaray city with the Khans palace **(fig. 6**) and the Genovese fortress at Sudak **(fig. 7)** shall remind to these principal different cultural and economic divisions of Crimea during the last millennium, which influenced the landscapes evolution.

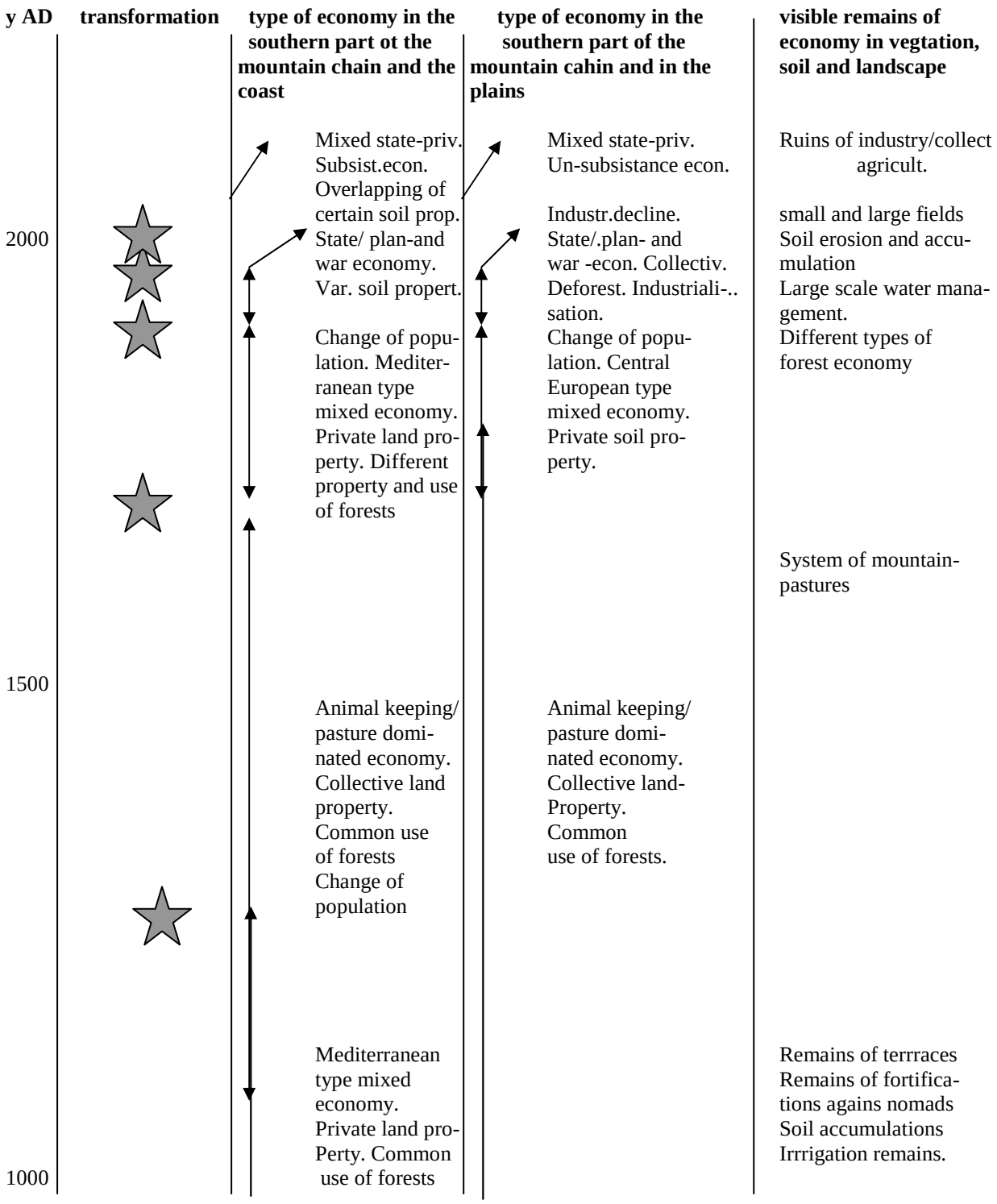

Fig. 5. Scheme of the economic and cultural history of Crimea during the last thousand years (after Black 2000, Cordova, Lehman 2004, Duby 1994).

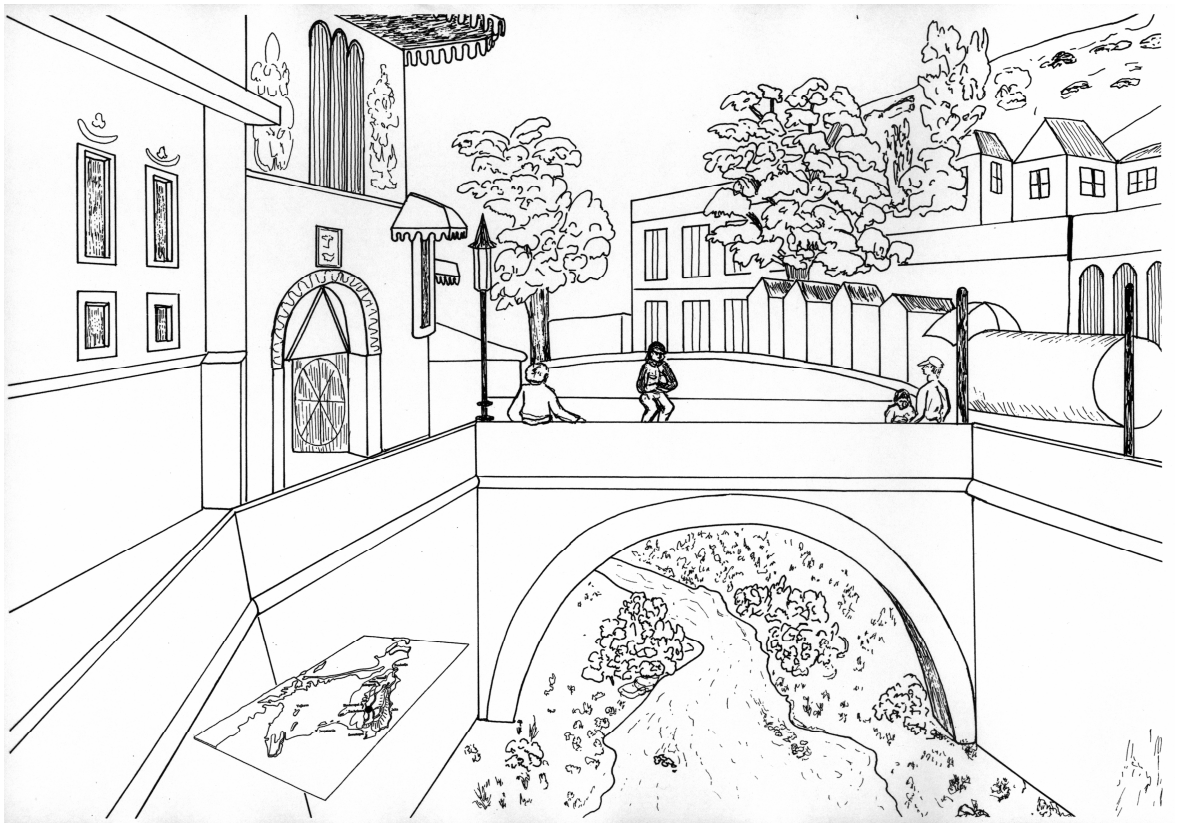

Fig. 6. The entrance of the Khan palace and the centre of Bakhchisaray representing the long lasting tradition of animal keeping /Tartar economy

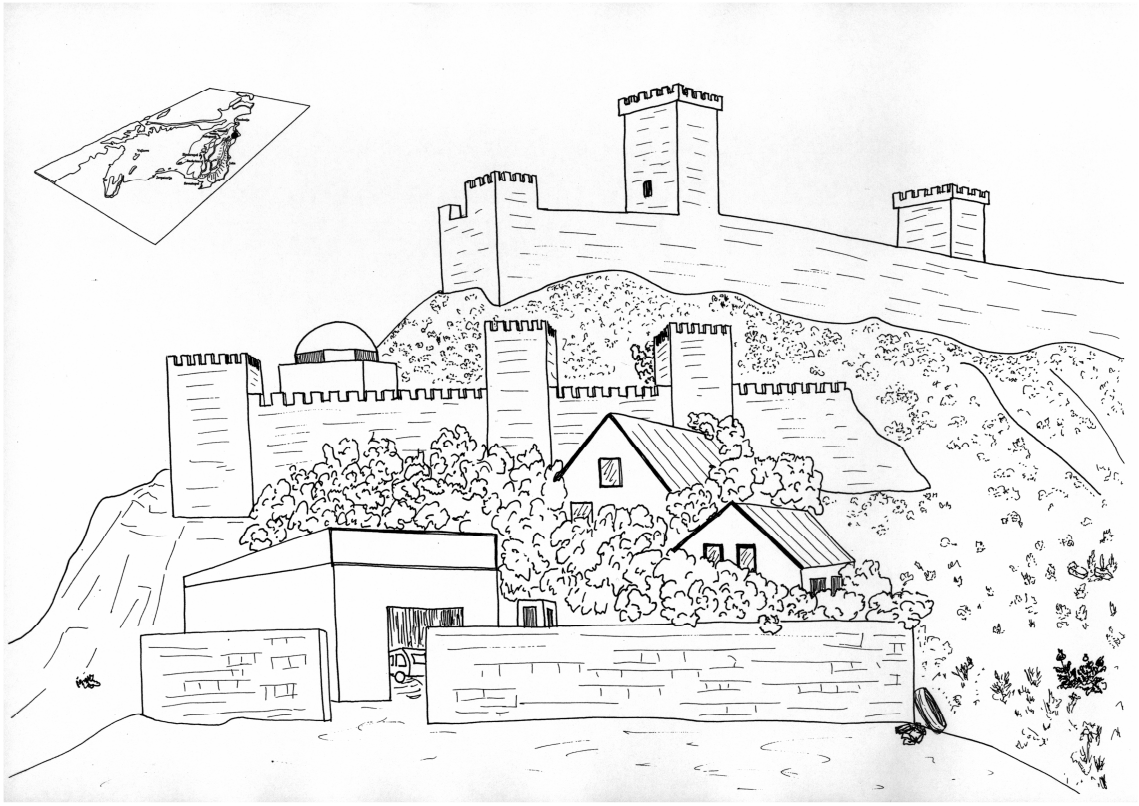

Fig.7. The Genovese fortress at Sudak indicating the long lasting Mediterranean-type economy in the south western part of Crimea.

A PREHISTORIC PHASE

consists of earliest evidences of human impact from the early Paleolithic on (Zuk, 1995). Thus, Crimea belongs to areas of human evolution and early anthropogenic transformation through fire using, animal hunting and plant collecting. A long lasting period of Greek and later Hellenistic colonisation was typical for several coastal areas (Mack and Carter 2003) however during the last millennium; there is a lot of information on the different cultural and economic developments of the peninsula, which may be differentiated into at least five phases**.**

1st Phase

Up to the 14th century the southern coast and mountains were colonised, exploited and characterized by a Mediterranean economy (cf. Cordova & Lehmann 2004, Cordova et al 2001, Mack & Carter 2003). The Greek city and harbour of Chersones, the predecessor of the present Sevastopol, was economically based on trade and on the Mediterranean land use comprising viticulture, arboriculture, pastures as well as intensive exploitation of forests as energy source. The southern part of Crimea was incorporated into the Roman – later Byzanthinian Empire. From the 13th century onward Italian cities established trade colonies along the northern coast of the Black Sea; the Genoeses dominated the trade, which is visible in the several remains of fortresses (**fig. 7)** Crimea was part of the transcontinental web of trade roads between the Silk Road and the Mediterranean and Middle European trade system (Duby 1994). In a certain way it was underlined by the plague expansion starting 1347 in Caffa, the modern Feodosiya. After the siege by the Mongols and the infection by plague caused by corpses thrown into the city, the Genoeses retreated and took home the disease to implant it definitely into the trade web of Europe

During that period a population with Scythian roots and later on nomads or animal keepers of Mongolian and Turkish origin settled the plains and the northern gentle slopes. Common for these regions was the general predominance of animal keeping, a collective land ownership as the legal base of land use incorporating also arboriculture and restricted agriculture in the valleys and alluvial plains (Pallas 1999). In this period we have to assume the rising importance of the summer pasture in the upper part of northern slopes and thus the installation of the "yaila" system; a special type of transhumance. On the other hand, both in the Mediterranean and in the nomad and later on Islamic tradition the exploitation of forests was free, however regulated as areas belonging to the different tribes. Between both economies there were intensive contacts still visible in the remains of protection walls on different mountain passes (cf. Mack & Carter 2003).

2nd Phase (end of 14th to end of 18th century)

The conquest of Chersones in 1399 marked the definite change in the economic situation of Crimea. The final conquest by the Mongols and the subsequent installation of the Crimea-Khanate with an expansion far into the Ukrainian steppe regions brought an end to the economic and political division of Crimea. Even there were Genoese trading colonies up to the end of the 15th century the population of the southern part either emigrated or did integrate into the new system. Thus, the peninsula came under a consistent system of exploitation characterised by the predominance of animal keeping and the Islamic legislation of having the land as collective property, however the exploitation of forests for free or for individual organisation. There is evidence, that cereal production for commercial issues was widespread in the northern lowlands around the Black Sea and also within Crimea (Black 2000, Duby 1994). Certainly the "yaila" system was expanded during this period since the Crimean mountains were the only pastureland accessible for the Tartars in the entire sub region.

3rd Phase (end of 18th to the beginning of 20th century)

The predominance of the animal keeping/nomad economy ended with the definite conquest of Crimea by the Russians and the official termination of the Crimean Khanate in1783. Compared with the situation at the end of the 14th century this change was much more important and definitely transferred the peninsula into a completely different economic system. The population changed by the massive exodus of the Crimean tartars and deportation of Greeks and subsequent a resettlement by invited colonists took place. This was accompanied by a principal change of legislation. Private land property was introduced and accompanied by a change to the predominance of agricultural land use.

The agrarisation reached a first maximum in the 1870ies in parallel to the extension of agriculture in the Ukrainian steppe regions. This was the time of a beginning scientific land survey finally leading to the idea of zonality (s.a.).

However, the first half of the 20th century also an extension of the "yaila" summer pasture reaching to dimensions of 125,000 sheep or 5-6 sheep/ha during summer (Walter 1943).

4th Phase (1920ies to 1980ies)

The communist revolution finally brought a reversal of the legislative holding ground again as collective property together with a forced collectivisation of agrarian and industrial production as well as the forcing of a general collective economy. After a decline of production during the civil war and subsequent repression in the late 1920ies and early 1930ies Crimea was faced again to a general division. After the brutal extradition of the Tatars, Germans, Greeks and others during the Second Wold War the bigger part of the Crimean territory was resettled by Russians. They replaced the Tatar's system of agriculture by large scale land use (soviet style collective farms so-called "kolkhoz"). The decision to establish a centre of tourism for the whole Soviet Union in the 50ties brought another pattern of exploitation to the peninsula. It was characterised by regression of agrarian land use in the south and extension of settlements and recreation resorts. In contrast, the northern part underwent a rising extension of agrarian exploitation and its intensification by an increasing use of fertilisers and pesticides parallel to a forced industrialisation.

5th Phase (1990ies)

The economic decline of the Soviet Union, its final collapse and the establishment of the Ukrainian state has incorporated Crimea again to the system of further "transformation". The mixture of "wild" capitalism and soviet style management has dominated the economy. Furthermore, the greater part of survived Tatar population has returned back and the traditional land use started to be re-established.

This short historical revue shows that the peninsula was subject to regular and profound changes of economic system, often leading to real transformations of land use and creating problems and developments even more difficult to the respective populations as at present times. It also shows that Crimea at least during the last millennium was under a increasing human impact and pressure diminishing the unexploited areas to minimal relicts. Consequently this led to a diversified cultural landscape system with ruderalisation as leading process. Ruderalisation is meant both in the restricted sense as the extension of animals and plants bound to areas of human activities but also in the broad sense as the general extension of man made ecosystems and the degradation of these ecosystems with an enforced colonising and reorganisation behaviour (Frey & Lösch 1998, Fleischer & Schulz 2001). Finally it all leads to a reduction or fragmentation of near natural areas and less exploited ecosystems and to the extension of colonisers supported by these pressures.

THE REGIONAL SETTING

The steppe system

In Agrarnoye near Simferopol a surface of about 5 ha got protected for its high floristic diversity. However it is located near the area of dense secondary settlements and agrarian fields **(fig. 8).** The herbaceous vegetation is dominated by the grasses *Stipa eriocaulis* and *Festuca rupicola* (=*F. sulcata*). Beside that the characteristic herbs *Salvia nutans, Centaurea orientalis, Tragopogon dubium, Linum austriacum, L. flavum, Scorzonera crispa, Ornithogalum ponticum, Phlomis taurica, Thymus dzevanovskyi* and a lot of geophytes present a colourful, species rich tall grass steppe. The area around the settlements is grazed by sheep and moderately by cattle proved by the existence of *Eryngium campestre* and *Euphorbia virgata.* The exceptional use of fire is reported too.

The soil situation is quite characteristic. The upper part of a gentle slope was covered by a kastanosem of about 1 m depth. On the lower part of this slope the erosion material of the topsoil did rearrange to a pseudo-chernosem also showing the typical chalk nodules and balls.

The situation of that the steppe plot is quite comparable to other few steppe relicts in the centre of the peninsula. In general the steppe surfaces are surrounded by more or less intensively exploited fields or by settlements. They are covered by the Ukrainian Nature Conservation Law (see BSP 2001). However, it is

still stated, that some of these steppe plots are ”virgin” and should be connected by bio-corridors in order to maintain persistence migration of species (see Bokov et al. 2000).

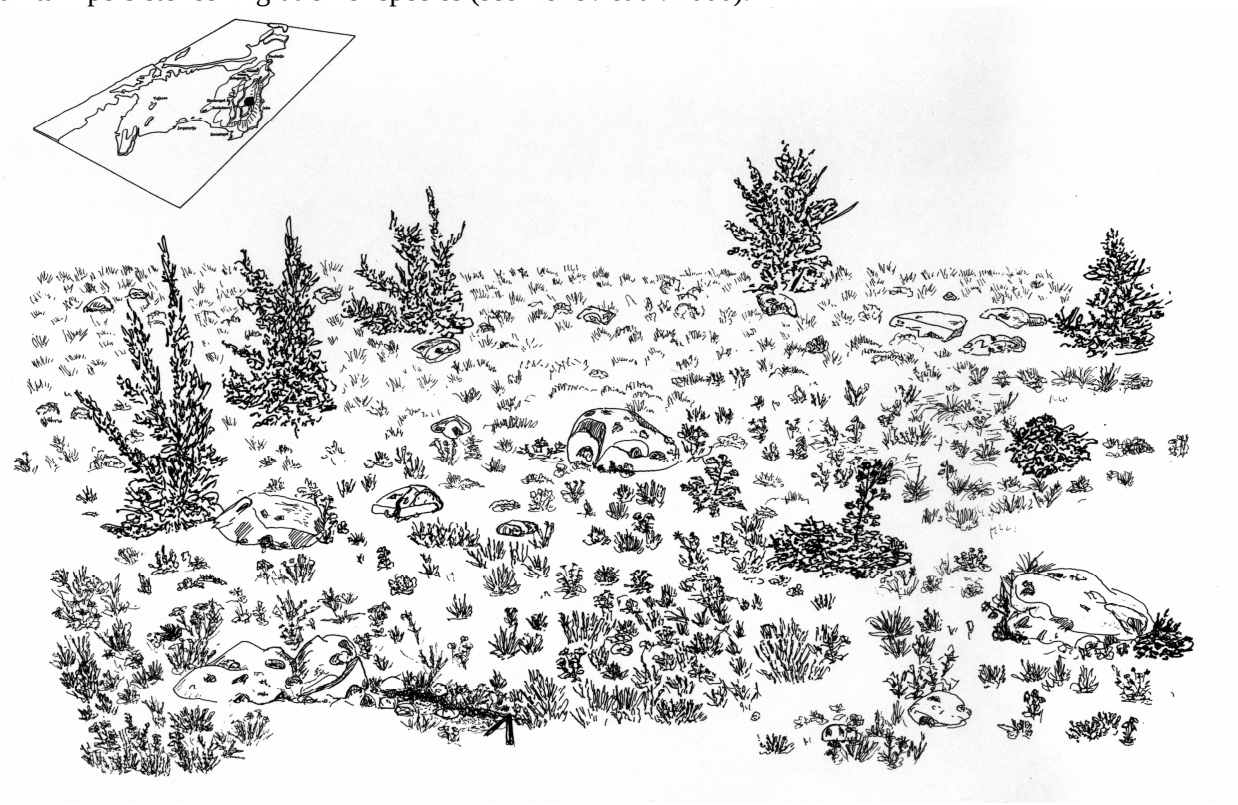

Fig. 8. The steppe remains at Agrarnoye near Simferopol showing the general situation of smaller protected areas in an intensively exploited environment.

The plains near Voykovo in the northwestern part of the peninsula are characterised by the *Artemisia*-semidesert. The vegetation cover is less dense (about 60-70%) and less species rich than the preceding site and is dominated by *Artemisia taurica*. Grasses are less frequent and *Stipa capillata* with F*estuca rupicola* play a subordinate role. The showy geophytes *Adonis vernalis, Phlomis tuberosa* and the biennial-perennial herbaceous *Salvia aethiopis* can be seen from far distance. Between them there are patches of bare soil or which are only with mosses and small annual species as a recovering stage. This and farm buildings in the background lead to the assumption of more or less heavy grazing by cattle compared with the steppe plot close to Agranoye mentioned above **(cf. fig. 9).**

This site is also known for an archaeological monument Kara-Khodia representing engravings on the rocky surface thought to be of bronze-age. The soil cover was not further developed as to a rendzina. In all it represents an intensively or even overexploited system comparable to the North African semi deserts known as a pasture system (Le Houerou 1969).

The Chatyr-Dag-“Yaila” transect

Five sites between the northern slope of the Chatyr-Dag Mts. and Cape Martyan shall explain the altitudinal zonation of vegetation as well as the general situation on the mountain pastures.

The **figs 10-12** illustrate the Northern slope of the Chatyr-Dag Mts.

Above the agrarian and settlement zone on the foothills a belt of mixed oak forests (a) dominates the lower part of the slopes up to an elevation of about 500-700 m. Climbing up this altitudinal belt is followed by a smaller one built of beech forests (b). The plateau and the upper part of the slopes are covered by a mosaic of pseudo alpine grassland and shrubby formations of “yaila” (c).

(a) The mixed oak forest exposes the features of an intensive exploitation showing the typical structure of coppiced forests. The cutting intervals are around 20-30 years and apparently the wood was used for the domestic needs of the surrounding villages **(fig. 10).**

The dominant tree species are *Quercus petraea, Q.* cf. *dalechampii, Acer campestre, Carpinus orientalis, Tilia caucasica, Ulmus minor*, important shrub species are *Cornus mas* and *Evonymus latifolia.*

Characteristic for the herbaceous layer are *Lathyrus niger, L. tuberosus, Polygonatum latifolium, Potentilla micrantha,* the grasses *Bromus ramosus* and *Poa nemoralis* and the geophytes *Arum maculatum* s.l., *Crocus angustifolius, Dentaria quinquefoli, Allium cyrillii. Hedera helix* also is present everywhere here.

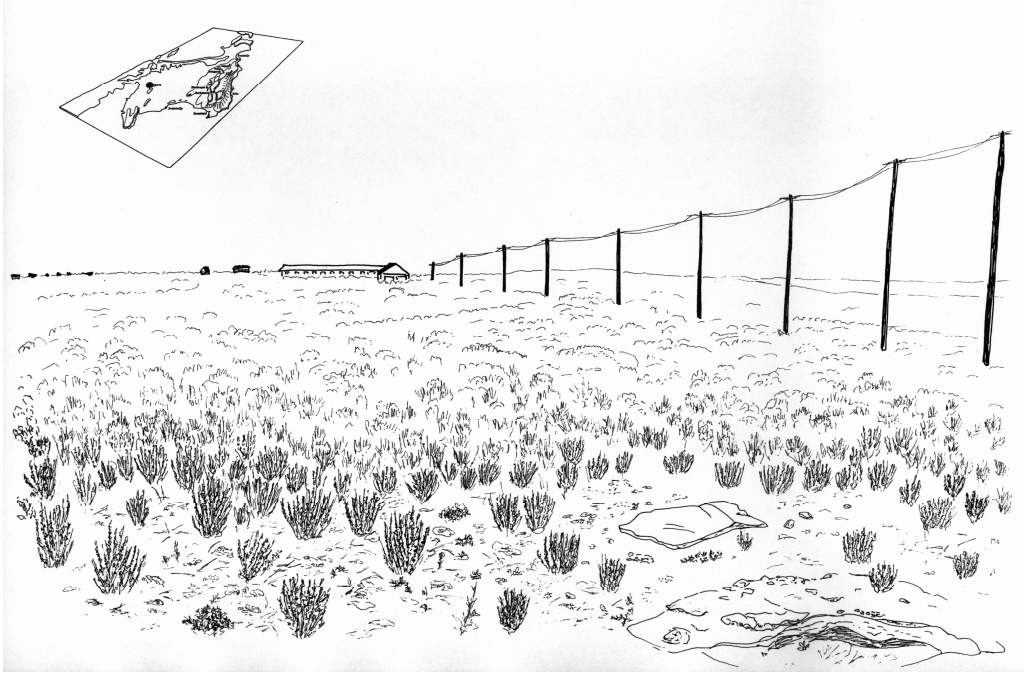

Fig. 9. The Artemisia-semi desert near the Voykovo showing an intensively overgrazed ecosystem comparable to the semi deserts south of the Mediterranean.

Fig. 10. The North Slope of the Chatyr-Dag Mts. showing the zonation of the mixed oak and beech forests and the open "yaila" pastures.

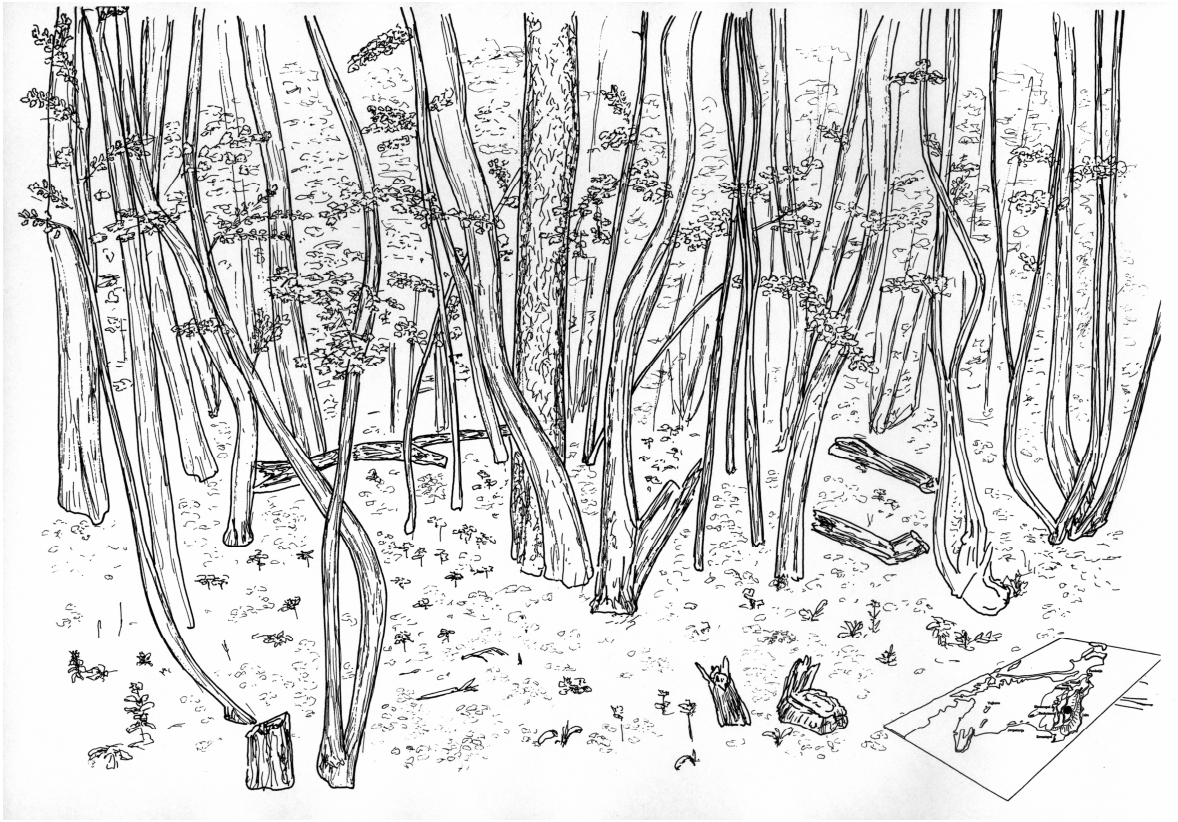

Fig. 11. The mixed oak forest in the lower part of the Chatyr-Dag Mts. The characteristic signs of regular and short time wood cutting as the basket like resprouting of trees are visible.

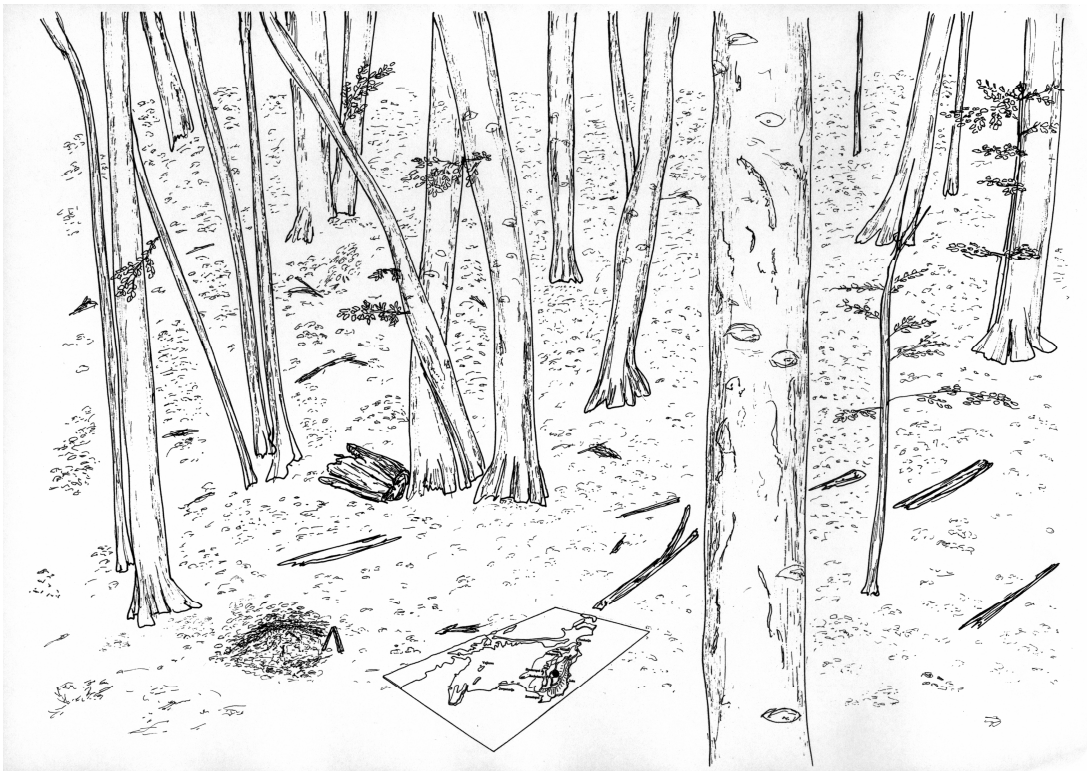

Fig. 12. The beach forest in the middle part of the Chatyr-Dag slope. The different generations of the monotypic beech forest are visible. The forest was regularly exploited for fire wood.

This mixed oak forest system is also characterised by a brown forest soil/cambisol cover, showing the typical phenomena of a forest soil with O_l/O_f layers and the Ah/Bv/C-horizons, which are known for the mixed oak forests in Central Europe.

Between an altitude of 700 and 900 m a.s.l. both the mixed oak forest and beech forests alter depending on the exposition of the slope.

(b) The beech forest occure in altitudes between 700 and 1400 m and shows predominantly stands grown from seedlings, more or less even aged **(fig. 11).** Beside *Fagus silvatica* subsp. *moesiaca, Ulmus glabra* and *Prunus avium* are elements of the tree layer. Shrubs are usually missing except in gaps, where *Sambucus nigra* appears. The herbaceous vegetation is dominated by ferns (e.g. *Dryopteris filix-mas),* in spring *Ranunculus ficaria, Galanthus plicatus, Galium odoratum* and *Primula vulgaris* and *P. veris* form an early flowering aspect. In summer some large perenninal herbs, like *Mercurialis perennis, Scrophularia scopolii* appear.
Like the mixed oak forest this area is also covered by brown forest soils or cambisols with a well developed and differentiated humus layer.
Cordova et al. (2001) reported that these beech forests were exploited for firewood during the soviet time.

(c) The open surfaces on the upper parts of Chatyr-Dag Mts. are covered by a characteristic mixture of shrub- or sub shrub-, grass- and herb formation with a vegetation cover often not exceeding 70% **(fig. 12).**
Singular juniper bushes give them the typical feature of a mountain pasture on karst known from various regions of Europe. Some elements of the species rich herb vegetation are *Stipa pulcherrima, Carex humilis, Ajuga genevensis, Thymus tauricus, Teucrium jailae, Potentilla depressa, Alchemilla ssp., Trinia gluca, Saxifraga irrigua, S. tridactylites, Pulsatilla taurica, Cruciata taurica, Orchis morio, Thalictrum minus, Minuartia taurica, Paronychia cephalotes, Geranium sanguineum* and among many others the showy endemic *Cerastium biebersteinii.* The patchy vegetation mosaic depends on the variating depth of the soil cover and the surface morphology. Slight depression have a much better water supply and support the regeneration of tree species like *Populus tremula, Fagus silvatica* subsp. *moesica, Acer stevenii, Juniperus communis* subsp. *hemishaerica* and *J. sabina* a.o. However, it was interesting to observe the development of individuals of *Acer* or *Sorbus* species in the centre of juniper bushes protected against browsing. This again sheds a light on the general regeneration potential of tree species in the ecosystem.
Very often a bare rock was exposed featuring opened karsts. The round shape of the rocks and rocky surfaces testify a former complete soil cover only recently uncovered to the present dimensions. Thus the present soil type was a rendzina.
This vegetation type covers large surfaces in the mountain chain of the Main Crimean Ridge and taken in account the historical information it represents a typical mountain pasture shaped during centuries. To explain the high percentage of endemic species (up to 40 to 60 taxa) still two different theories are discussed. For the one the permanent stress of plants and vegetation, their isolation caused by overexploitation and so restriction to isolated places and small populations and for the other hand by some „general rules“ of forming biodiversity hot-spots like this in open rocky places of sub-alpine and alpine belts (Tribsch 2003, Yena, 1999).
The floristic richness of the systems is evident but the explanation only by the special physical setting is too short (BSP 1999, Cordova et al. 2001).

The **fig. 13** and **14** illustrate the southern slope of the Chatyr-Dag Mts. down to the Sub Mediterranean. Below the remnants of the beech forest belt there is a remarkable change in vegetation and climate.

(a) As **fig. 2** describes a general Mediterranean climate, however field observation or reports (cf. Walter 1943) show the importance of cool air masses creating regular fog in the upper parts of the mountain chain. The southern slope is dominated by *Pinus*-woodlands. Broadleaved elements *Acer campestre, Quercus pubescens, Sorbus torminalis, S. domestica* are rare. *Pinus niger* subsp. *pallasiana* is characteristic for the middle altitudes, however *Pinus kochiana* occurs scattered, but there are different opinions about their importance in former times. Characteristic elements of the herb layer are *Brachypodium rupestre, Buglossoides purpurocaerulea, Clinopodium vulgare, Centaurea declinata,*

Tamus communis, Geranium sanguineum, Salvia grandiflora, Euphorbia amygdaloides, Filipendula vulgaris, Cephalanthera longifolia, Pyrola chlorantha a.o. Very often the *Pinus* stems expose the signs of forest fires (**fig. 13).**

The soil cover is done by a mosaic of cambisols or rendzinas, in this case more a histic rendzina showing disturbances in the surface formation. The thick Ol/Of layer also lead to an accumulation of inflammable material and thus they accelerates the fire risk during the hot season and also for accidental fires during all seasons

(b) Near the coast characteristic Mediterranean vegetation appears (**fig. 14**). Soil erosion and frequent fire shaped the mosaic of bush and tree groups (*Carpinus orientalis, Cotinus coggygria, Arbutus andrachne, Ruscus ponticus, Juniperus excelsa, J. oxycedrus* a.o.) leaving an important part of the surface free or covered by colonisers, like *Cistus tauricus, Achnatherum bromoides, Fumana* ssp. and others. The composition of the field layer of this submediterranean vegetation type in the fully protected area of Cape Martyan consists of small or dwarf shrubs (*Fumana viscidula, F. procumbens, Thymus callieri, Teucrium chamaedrys*) broadleaved shrub/tree species, like *Pistacia mutica, Quercus pubescens, Ligustrum vulgare* and needle trees (*Juniperus excelsa, J. oxycedrus*). Grasses, like *Brachypodium rupestre, Dactylis glomerata, Festuca rupicola,* or *Bromus sterilis* and orchids, like *Limodorum abortivum Cephalanthera damasonium, Epipactis helleborine* etc. play an eminent role in the field layer between the groups of trees and shrubs together with typical Mediterranean elements, like *Bituminaria bituminosa, Melilotus neapolitanus, Rhagadiolus edulis*

Here again some elements, like *Cistus tauricus* or *Dictamus albus* announce that the vegetation is fire-prone. Repeated forest fires are well reported (cf. BSDP 1999, E. Kraynyuk frdl. oral communication). This vegetation with single shrub individuals in rocky escarpments is typical for these steep slopes descending to the coast with an increasing presence of *Arbutus andrachne.*

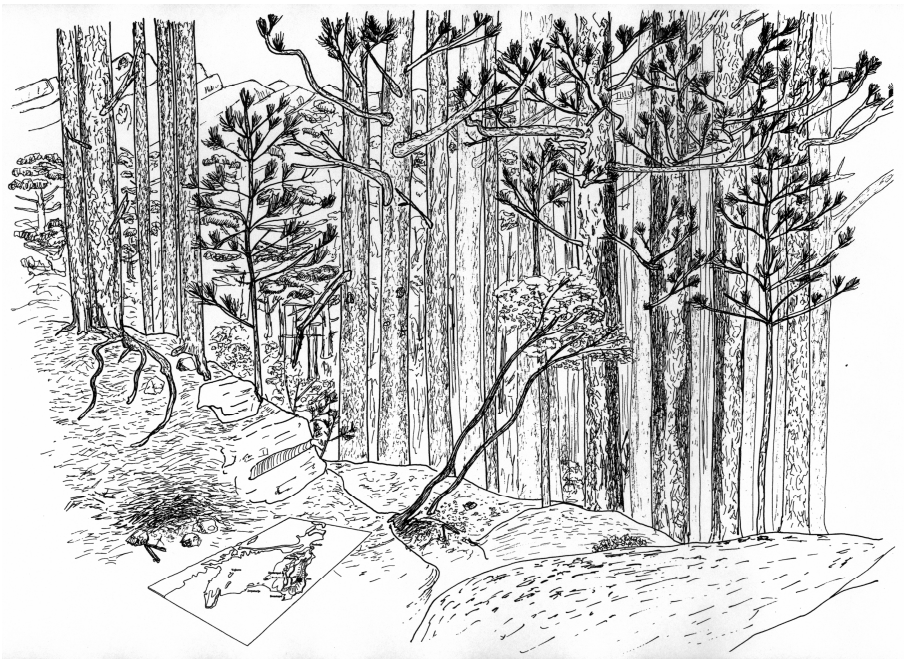

Fig. 13. The Pinus nigra ssp. pallasiana-forest on the southern slope of the Chatyr-Dag Mts. Note the indicators of frequent fire in the forest stands.

Corresponding to the diversified erosion situation the soil cover is shaped as a mosaic of bare rocky surfaces, rendzinas, poorly developed Mediterranean cambisols (chromic cambisols or terra fusca), and also rarely rhodochromic cambisols (terra rossa) with their characteristic dense, plastic or even prismatic B horizons. However, it seems to be that these soil profiles result of a colluvial development originating from old karsts-fillings and subsequently being incorporated into a terra rossa-like soil formation. Several of these soil profiles show clear signs of superposition indicating different phases of soil erosion.

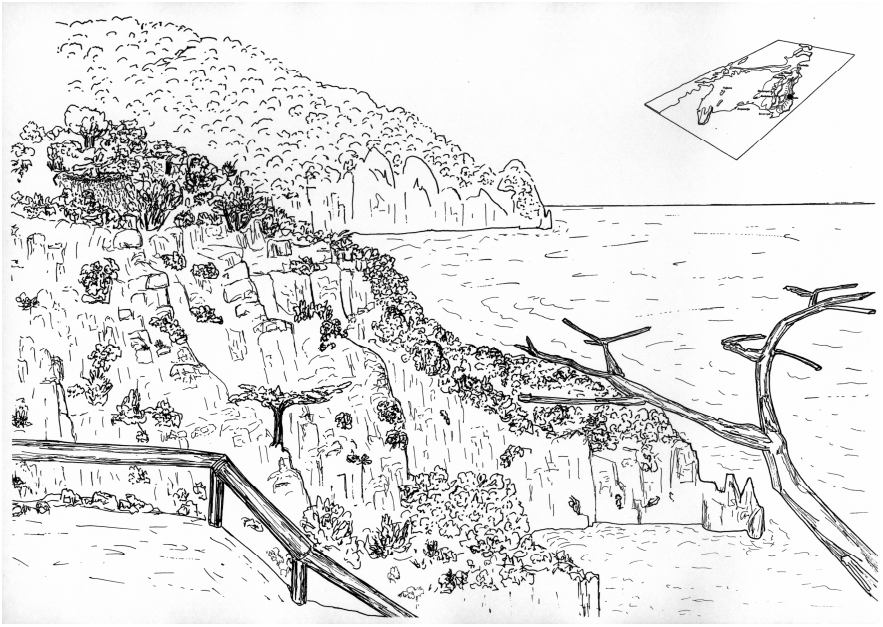

Fig. 14. The Macchia like vegetation near the Cape Martyan at the south-western coast of Crimea. The intensive soil erosion is visible.

The coastal system

Near Eupatoria the conflict situation between ideas of conservation based on floristic richness and the present intensive human impact as well as future development plans for tourism is obvious **(fig. 15).**

The sandy barr south of Eupatoria exposes the general beach-belt system of overused sandy coasts having flood zones with some algae or mussel shells leading over to the plastic and metal garbage transported by the floods conjoint to the glass and plastic garbage left by visitors. The upper part is done by a fixed dune system colonised by *Leymus racemosus, Elytrigia elongata, Gypsophila paniculata, Limonium meyeri, Goniolimon rubellum, Ephedra distachya, Crambe maritima, Astragalus varius, Anthemis dubia, Eryngium maritimum* a.o.

The centre of this fixed dune belt has scattered ruins of concrete constructions leading directly to the main road and railway. In all it is a typical ruderal ecosystem with still many rare elements of coastal flora (s.a.), which mainly is ruled by permanent natural stress and human impact. Nevertheless the coastal system with its characteristic steno-flora represents the most endangered group of Crimean vegetation out of the following reasons: the linearity of stands, their restricted ecology and the general threat of being transformed into a tourist resort area(Czopik & Yena, 1999).

The alluvial vegetation

The azonal vegetation type along a river could be analysed on the example of the Biyuk-Karazu River. It drains the Ak-Kaya region in the south-eastern part of the plains near the town of Belogorsk. The river did cut his bed through a thick loess cover and gravel layers and today it flows on the exposed limestone **(fig. 18).** The loess cover directly intermingles with the erosion material on the gentle lower parts of the glacis. Only in the cuttings of this river we could see a notable chernosem development on the loess terraces.

The woody vegetation of the alluvial vegetation is composed of *Salix* species (*S. alba, S. purpurea, S. triandra), Ulmus minor, Viburnum opulus*, and the alien *Acer negundo.*

The young island surface is covered by *Equisetum telmateia, Phalaroides arundinacea, Phragmites australis, Persicaria lapathifolia, Calepina irregularis, Artemisia vulgaris, Festuca* spec., *Rubus caesius* and some ruderal plants. Despite the neighbourhood to Belogorsk and the intensive fruit tree plantations on the loess terraces – with the exception of *Acer negundo* – no greater anthropogenic disturbance could be detected. This may be due to the small dimension of the river.

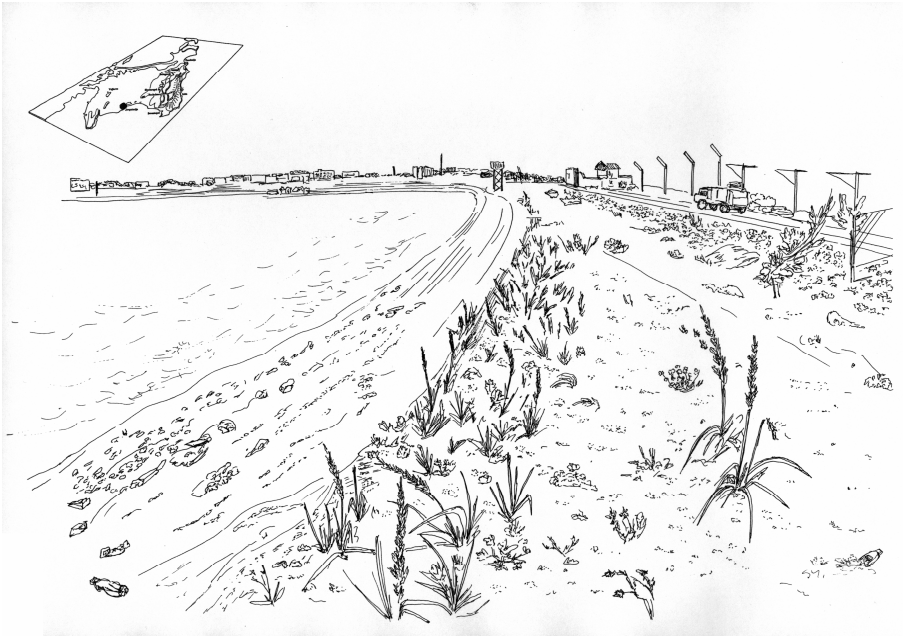

Fig. 15. The sand barr south of Eupatoria. The different belts of coastal sedimentation are visible. The ruderal character of this ecosystem is obvious near the main traffic lines.

Degeneration-regeneration - The Ak-Kaya-Region

North of Belogorsk a prominent fault shaped the cuesta in limestone of Sarmatian age. The main features are the steep escarpment in contrast to wide and long reaching glacis with a direct contact to the fluvial terraces in the surrounding alluvial plain. However another feature is interesting too. The glacis are for a greater part artificially terraced and on some plots afforested with pine trees (*Pinus nigra* subsp. *pallasiana*) (cf. **fig. 17**). Soil cover almost vanished. In some protected places a thin rendzina is preserved but the most of that region shows the bare limestone. Thus, the Ak-Kaya exposes the general scheme of degradation by deforestation and overgrazing and the mechanistic way of fighting against the severe soil erosion. The scheme of terracing and a subsequent tree planting – mostly Pine-trees - is used all over the Mediterranean basin from Spain to Algeria, for the most with comparable results. Isolated trees survive for a certain time, but a soil cover is rarely developed (see also Artiyshenko & Mishnev 1978). However, when regarding more precise the auto-regeneration processes are evident. The bare limestone is colonised by single tussock grasses or dwarf shrubs with an extended root system. So little by little the surface is colonised and in islands organic matter is accumulated around these shrubs or tussocks forming islands of rendzina-development. If one looks from the upper slopes to the plain **(fig. 18),** the colonisation "front" of shrubs herbs and grasses is visible. Its upper part is still susceptible to erosion and overgrazing, however there is the process of auto regeneration visible against the prominent failure of mechanical measurement.

Some of the pioneer elements of the limestone debris with lithosols are *Asperula supina* subsp. *caespitans, Onosma polyphylla, Euphorbia petrophila, Crupina vulgaris, Lagoseris purpurea, Linum flavum, Jurinea sordida a.o.*

The gentle lower part of the slope shows a more or less dense dry meadow with *Koeleria lobata, Convolvulus calvertii* subsp. *tauricus, Ajuga chia, Cephalaria coriacea, Linum lanuginosum, L. austriacum, Phlomis tuberosa, Potentilla erecta, Sanguisorba minor, Tanacetum paczoskii, Teucrium polium, Verbascum phoeniceum* a.o. including single shrubs like *Crataegus monogyna, Rosa canina and R. turcica*.

From the escarpment along runnels or in depressions regularly shrubs or trees build up groups or some extended stands of *Carpinus orientalis, Quercus pubescens, Rhamnus cathartica, Ulmus minor* a.o. It underlines the general potential of tree growing and development of tree vegetation also in the arid parts of the peninsula (cf. **fig. 19**.)

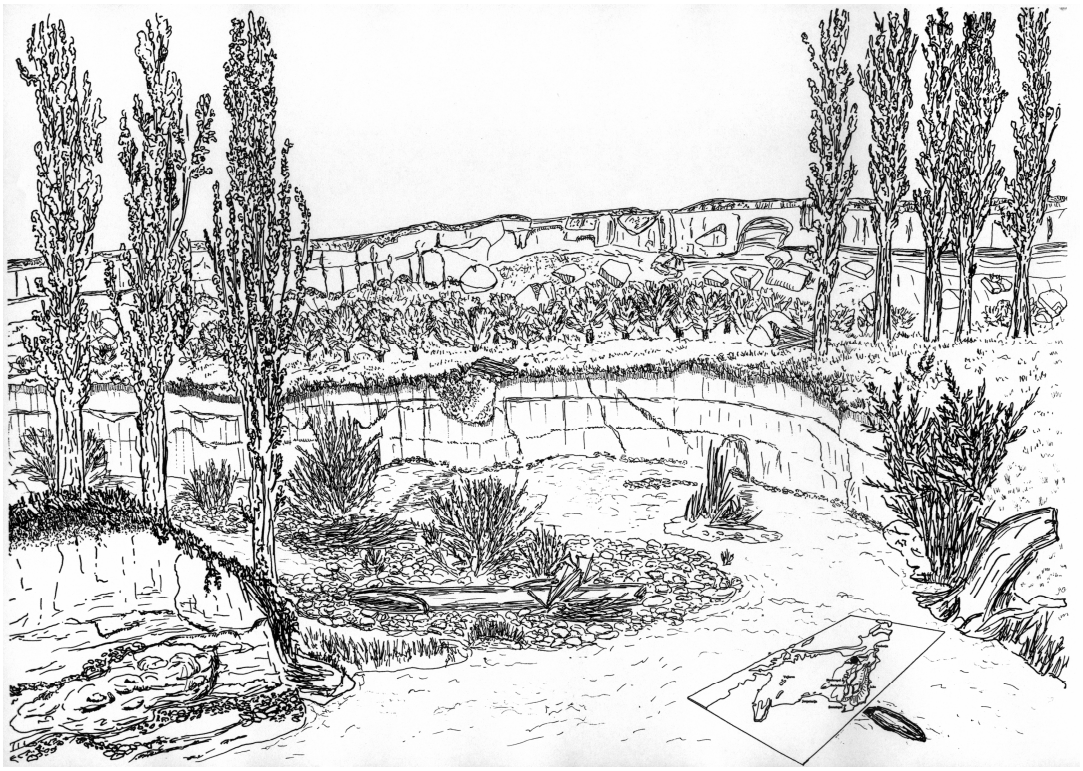

Fig.16. The valley of Biyuk-Karasu River. The great blocks in front of the Ak-Kaya escarpment indicate the tectonic activity in this region. The loess terraces show a chernosom-soil profile. The river did cut through these loess covers and actually flows on the exposed limestone.

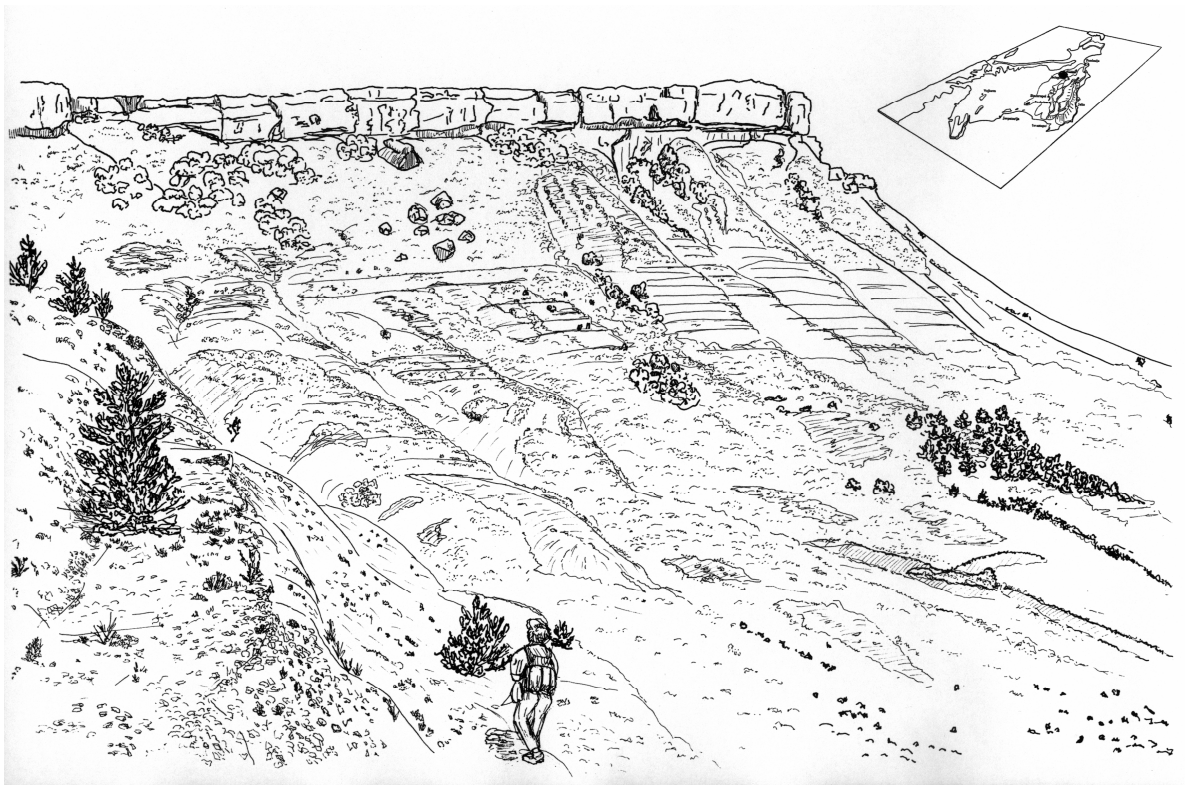

Fig.17. The escarpment of Ak-Kaya. The artificial terracing and plantation of Pinus trees in order to stop soil erosion are visible.

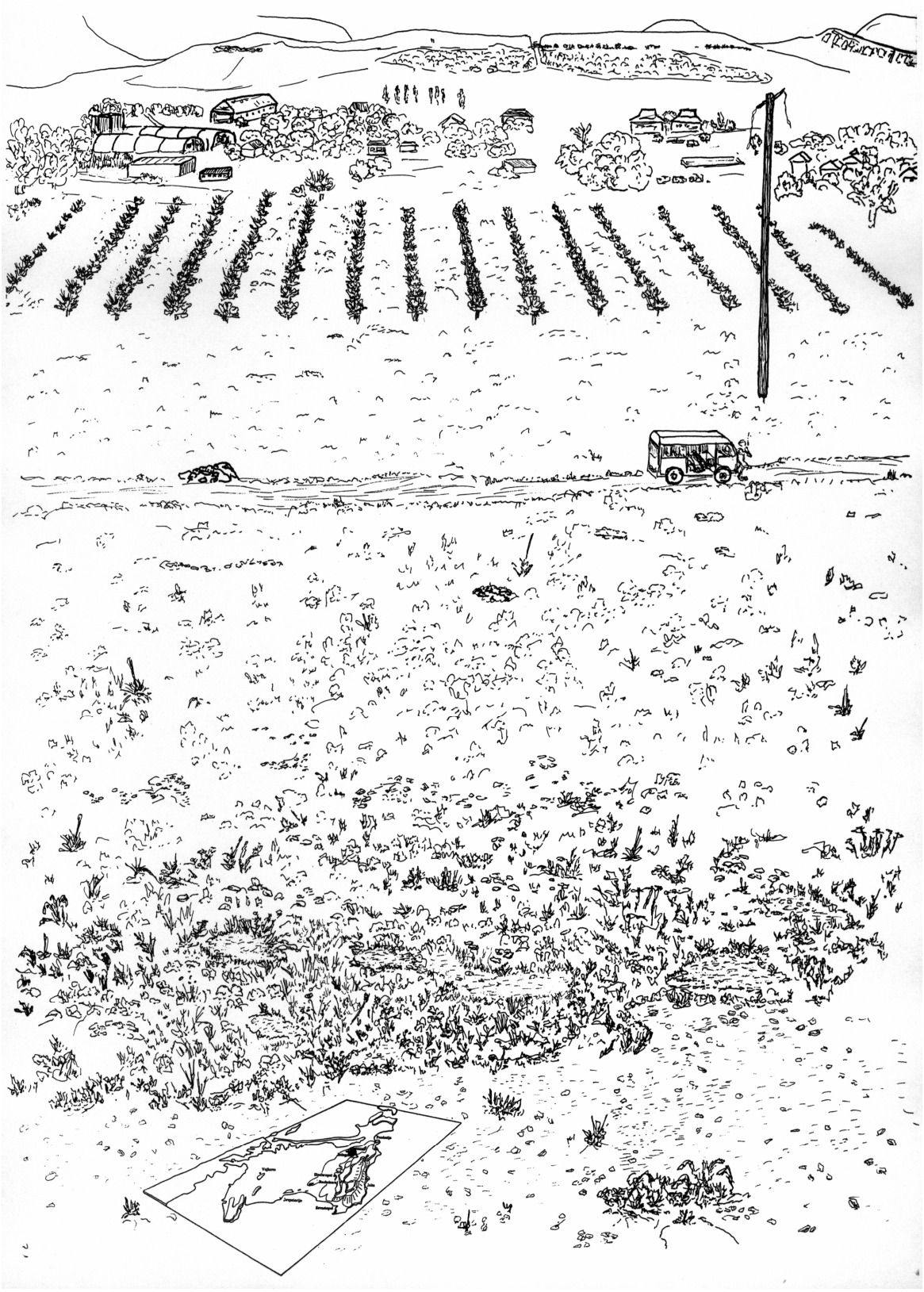

Fig. 18. View from the middle part of the Ak-Kaya escarpment to the flood plain of Biyuk-Karasu River and the northernmost cuestas of Crimea. The sequence of colonising of dwarf shrubs like Thymus and Teucrium as an auto-regeneration is visible. The renewed tree plantations indicate activities of the agrarian cooperatives.

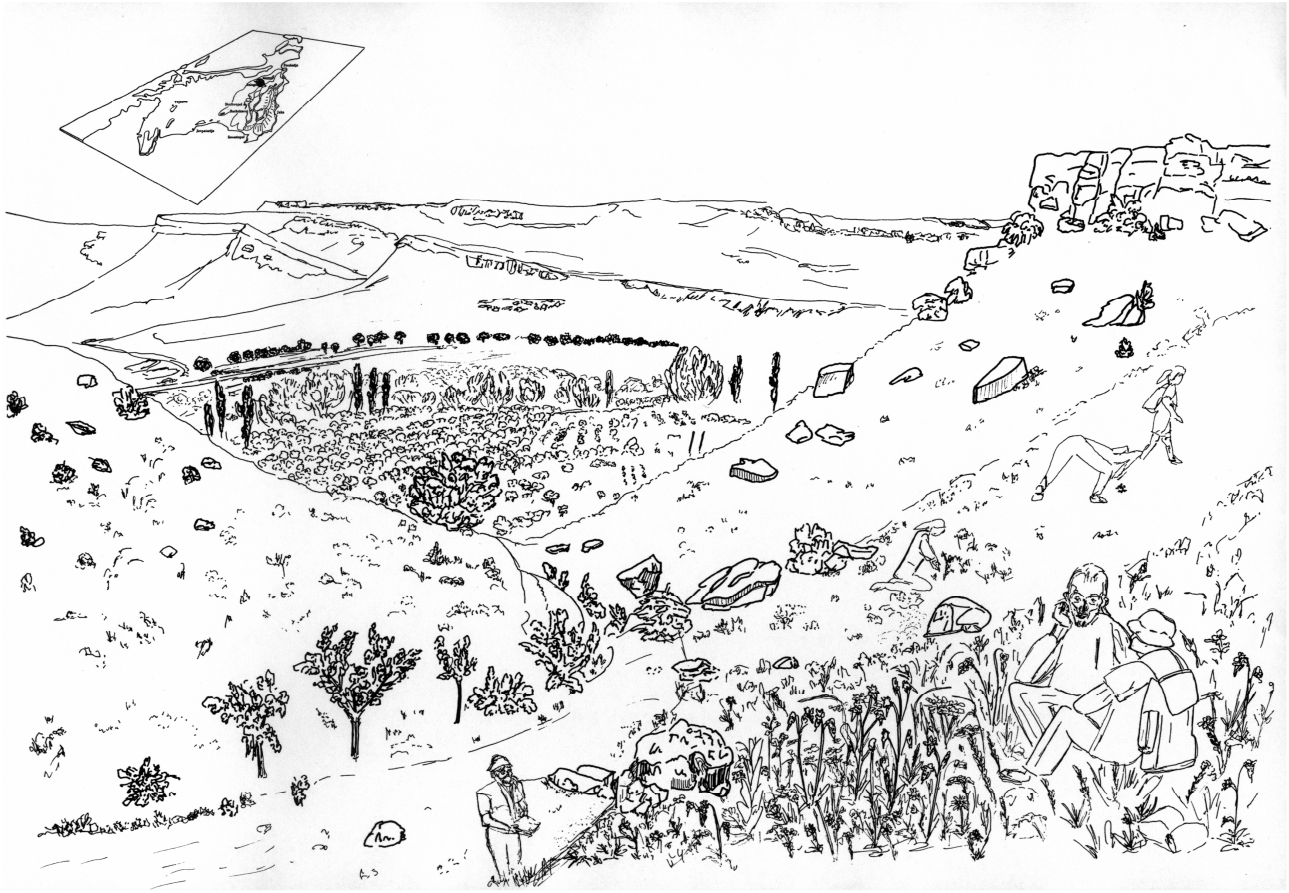

Fig. 19. View from the middle slope of Ak-Kaya escarpment to the north. The system of tree regeneration as well as the intensive agrarian exploitation is visible.

Several prehistoric findings reaching down to Mousterian periods (100–40 ky) proved the long lasting human presence. Settlements in Krasnaya (Red) valley yielded the remains of killed animals together with charcoal and abundant flint tools. Also caves served as refuge points. Thus a repeated human impact may already be retraced to ancient times.

CONCLUSIONS

The Crimean peninsula is a perfect example for the discrepancies between the approach of zonality taking the main vegetation and soil formations mainly as climate dependent and so as natural and the acceptance of an accelerated development of cultural landscapes. Crimea underwent several periods of profound economic ethnic and cultural changes comparable to its present dimension of "transformation", which always affected the exploitation of natural resources. This is visible in the lowlands, which were changed from former prevailing grasslands-steppes into agrarian systems or to extensive pastures. Thus only a few examples of "real steppe" exist between the extensively or intensively settled and cultivated areas. However several reports on intensive cereal cultivation on the Crimean plains during Greek, Hellenistic and Byzanthinian times may shed another light to the assumed natural grassland vegetation (cf. Mack & Carter 2003). Thus the question for the "steppe" as a grassland-chernosem system should be discussed again. The mountain chain is affected in similar dimensions. The signs of severe human impact or even of anthropogenesis are evident in all seen vegetation types. In general, the predominant processes of ruderalisation did provoke a continuous series of disturbances and new sites with ecology of permanent succession. The existence of two floristic regions (Mediterranean and Pontic-Pannonian), high dynamics of human activity, well developed gardening tradition and intercontinental trade connections have stimulated the invasion of alien species, especially, over the last century. Already the profound differences in the geological and geomorphologic setting as well as in the climatic system created a rich and diversified system

of vegetation types. However, this system was intensively exploited and also profoundly changed several times – especially during the last thousand years. The result was a permanent pressure on the natural resources that led to overexploitation; diminishing and extinction of populations, species and even whole ecosystems (cf. the steppe-system). On the other hand it shaped new niches and differentiated ecological conditions, which well could create or preserve remarkable species richness (for example, human induced vegetation types of the “yailas”).

The fact of predominance of cultural landscape systems on the peninsula should necessarily be incorporated in all conservation plans. This would be one of the ways to preserve the character of present landscape and the biodiversity hot spots. The exclusion of further economic use or its profound change will again start processes of succession, and finally the goal of the preservation of human's modified ecosystem will fail. These two approaches should be taken into account in all scales between the creation of extended national parks and the conservation of smaller surfaces, especially when they are already surrounded by intensive exploitation systems. Moreover the Crimean peninsula perfectly proves the necessity of incorporation of the historical and cultural changes of landscapes in order to understand their development and dynamics for a better and appropriate management.

REFERENCES

ARTYSHENKO, A.J., MISHNEV.V.G. (1978), *Istoriya rastitelnosti krimskiky yayli priyay - linskikn sklonov u golotzene*, Moskva, Naukova Dumka, 140 p.

BENEDEK, J. (2003), *Subsistence agriculture in Romanian and the development of rural space*, In: Benedek, J., Schulz, E. (eds) Südosteuropa. Würzburger Geographische Manuskripte, 63,89-97.

BOKOV V.A. et al. (2000), *Education of Local Population and Authorities with a View to Communicate Knowledge about Priority Sites within the Framework of Implementation of the Project "Biodiversity Conservation Needs Assessment in Crimea"*,
www. Ccssu.crimea.ua/tun/magazine/pontida/2000/n2/html

BLACK, J. (ed.) (2000), *Dumont Atlas der Weltgeschichte*, Köln.352 p.

BSP (1999), *Priority setting in conservation. A new approach for Crimea*, Washington 257 p.

CORDOVA, C. E. LEHMAN P.H. (2004), *Holocene environmental change in south western Crimea (Ukraine) in pollen and soil records*, Holocene 15 (in press).

CORDOVA, C.E., RYBAK, A.R., LEHMAN, P.H. (2001), *Vegetation patterns and conservation issues in Southern Crimea. Post Soviet Geography and Economics*, 42,5. 362-385.

CZOPIK ,V., YENA, A. (1999), *Difficulties in mapping the flora of Ukraine: a Crimean example*. Acta Bot. Fennica, 162: 95-98.

DOKUTSCHAJEV, W.W. (1883), *The Russian steppes*, Dept. Agr. Min. of Crown domains for the Worlds Columbian exposition. St.Petersburg.

DUBY, G. (1994), *Atlas historique*, Paris, Larousse, 331 p.

FLEISCHER, K., SCHULZ, E. (2001), *Landschaftsänderung und Krankheit*, in Petermanns Geogr. Mitteilungen, 145,3, 6-15

FREY, W., LÖSCH, R. (1998), *Lehrbuch der Geobotanik*, Stuttgart, G.Fischer, 436p

GLINKA, K. (1914), *Die Typen der Bodenbildung*, Berlin.

KUBIENA, W.L. (1953), *Bestimmungsbuch und Systematik der Böden Europas*, F. Enke Stuttgart, 392p

LE HOUEROU, H.N. (1969), *La végétation de la Tunisie steppique*, Ann.Inst. Nat. Rech.Agronom. 142 Tunis.

MACK, G.R. , CARTER, J.C. (eds) (2003), *Crimean Chersonese: city, museum and environ*, Inst. Of Class. Arch.Univ. of Texas at Austin, Austin, 2311 p.

PALLAS P. S. (1799), *Bemerkungen auf einer Reise in die südlichen Stattshalterschaften des Russischen Reichs...*, Leipzig.

SCHÖNENBERG, R., NEUGEBAUER, J. (1981), *Einführung in die Geologie Europas*, Freiburg, Rombach, 340 p.

TAKHTAJAN, A.L. (1978), *The Floristic Regions of the World*, Nauka Press, Moscow, 248 p. In Russian

TRIBSCH, A., SCHÖNSWETTER, P. (2003), *Patterns of endemism and comparative phylogeography confirm palaeo-environmental evidence for Pleistocene refugia*, Eastern Alps // Taxon. – Vol.52, № 3. – P. 477-497.

UNESCO-FAO (1978), *Soil map of the world*, Paris.
WALTER, H. (1943), *Die Krim. C.V. Engelhard*, Berlin 104 p.
WALTER, H. (1968), *Die Vegetation der Erde. I.*, VEB. G.Fischer, Jena, 1000 p.
WALTER, H., LIETH H. (1965), *Klimadiagramm-Weltatlas*, VEB G. Fischer Jena.
YENA, A.V. (1999), *An essay of comparison of plant endemism in Ukrainian Carpathians and Crimean Mountains*, Problems of eco-stability in Eastern Carpathians. Synevyr, p. 65-67, in Russian.
YENA, A.V. (2001), *Annotated checklist of endemics in Crimean flora*. Ukrainian Botanical Journal [Kyiv, Ukraine], 58, 667-677. [In Russian].
YENA, V. G. (1960), *Physical-geographical zoning of Crimean peninsula*, Vestnik Moskovskogo universiteta (Proc. Of the Moscow Univ.). Geography. 2: 33-43, in Russian.
YENA, V.G., YENA, AL. V., YENA, AN. V. ET AL. (2000), *Scientific and applied approaches of setting the natural national park "Tavrida" and the Great Eco-Ethno-Trail in Crimea Simferopol*, SONAT, 104 p., in Russian.
YENA V.G., YENA AL. V., YENA AN. V. (2004), *Protected landscapes of Crimea*, Simferopol, Business-Inform Press, 2004, 424.
ZUK, S. (1995), *About the early Paleolithic of the Crimea*, Préhistoire Européenne, 7: 47-57.