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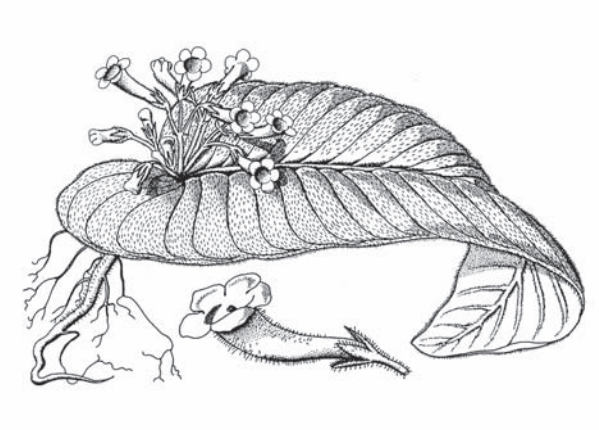

Veröffentlichungen aus dem
Institut für Pflanzenwissenschaften
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Andriy V. Yena
Floristic endemism in the Crimea

Anton Drescher, Bohdan Prots & Andriy V. Yena
Notes on Crimean Flora
(botanical excursion on the Crimean peninsula)

Graz, 12. Februar 2007

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Hofrat Prof. Dr. Karl FRITSCH

(* 24.2.1864 in Wien, † 17.1.1934 in Graz)

Karl FRITSCH studierte nach einem Jahr in Innsbruck an der Universität Wien Botanik und wurde dort 1886 zum Dr.phil. promoviert; 1890 habilitierte er sich. Nach Anstellungen in Wien wurde FRITSCH 1900 als Professor für Systematische Botanik an die Universität Graz berufen, wo er aus bescheidenen Anfängen ein Institut aufbaute. 1910 wurde er Direktor des Botanischen Gartens, 1916 wurde das neu errichtete Institutsgebäude bezogen. Aus der sehr breiten wissenschaftlichen Tätigkeit sind vor allem drei Schwerpunkte hervorzuheben: Floristisch-systematische Studien, besonders zur Flora von Österreich, monographische Arbeiten (besonders über *Gesneriaceae*) und Arbeiten zur systematischen Stellung und Gliederung der Monocotylen. An Kryptogamen interessierten ihn besonders Pilze und Myxomyceten.

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Floristic endemism in the Crimea

Andriy V. Yena[1]

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Abstract: The Crimea serves as a model for studying narrow regional endemism. During the past 150 years, the estimates show considerably varying numbers.
According to the author's recent taxonomic and phytogeographical revision of the Crimean flora, 127 species and subspecies are stated as endemic for the peninsula. The comparison of endemics in selected regions of similar size lead to the conclusion that this is a rather plausible estimate. An annotated list of the Crimean endemics is given.

Zusammenfassung: Die Krim kann als Modellregion für Studien über den regionalen Endemismus dienen. Im Laufe der vergangenen 150 Jahre schwankten die Schätzungen über die Anzahl der Endemiten in einem weiten Bereich.
Basierend auf den jüngsten taxonomischen und pflanzengeographischen Revisionen des Autors werden 127 Arten bzw. Unterarten als endemisch für die Halbinsel Krim eingestuft. Abschließend wird eine annotierte Liste der Endemiten der Halbinsel Krim präsentiert.

Key Words: Crimea; endemics, taxonomy, phytogeography.

[1] National Agrarian University, Southern Branch "Crimean Agrotechnological University", Agrarnoye, 95492 Simferopol, The Crimea, Ukraine; e-mail: yena@crimea.edu

1. Introduction

The Crimea is the southernmost region of Ukraine, an island-like peninsula surrounded by the Black Sea and the Sea of Azov. It is 26 860 km^2 in size and divided into two main landscapes – the plain and the mountains (up to 1545 m). The Crimea is situated right between the pole and the equator, with the border between the Circumboreal and Mediterranean floristic region running through it (Takhtajan 1986). Being a crossroads of plant migrations in the Circumpontic area, the peninsula possesses a taxonomically and chorologically diverse vascular flora. That is why the Crimea has attracted many generations of Russian and Ukrainian botanists, beginning with C. I. Hablitz (1785). Since then, there were 32 efforts by 24 florists to assess the Crimean phytodiversity level. As we can see on fig. 1, the historical sequence of floristic estimates shows a clear upward trend, reaching a plateau after the works by V. N. Golubev (1996). Despite considerable changes in species lists, the current estimates, based on the most recent revision of the Crimean vascular flora, fluctuate around 2700 taxa (Yena 2005a).
Traditionally, studying an isolated flora raises the question of its endemism. The Crimean flora has served as a model for studying endemism during the last 150 years. The very term "endemic" was first applied to the Crimean flora by C. C. Steven (1856). Since then, the estimates of the number of narrow regional endemics have been revised 36 times by 16 florists, and furiously debated during subsequent years (Yena 2001a). These assessments of the number of endemics have varied from 10 to 300 species. It seems to be a unique case in floristics, when the level of a regional endemism has been revised so many times with such discrepant results. Fig. 2 shows those wavering estimates of the Crimean narrow endemism.
The author has contributed to a fundamental revision of the Crimean endemism on the basis of newest taxonomical and chorological data obtained from the field, herbaria and

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literature, with the aim to overcome disagreements and parochialism in this subject, and to make the data on the Crimean endemism more realistic and comparable. So finally we are facing the crucial question: what is the true level of the Crimean endemism?

2. Material and methods

Both chorionomic and scale approaches can be applied to determine the endemism of a given area (Yena 2004). We follow Tan & Strid (2001), who proposed a convenient scale scheme of categories based on the linear distance between the two most remote localities of any endemic species, with category steps based on the factor $\sqrt{10}$. As to the Crimea, two of the categories of endemics proposed by these authors appear to be appropriate: local endemics (the distance between the most remote localities does not exceed 50 km), and narrow regional endemics (the distance is 51–167 km). The size of the next endemic category – broad regional endemics – exceeds the size of the Crimea (distance between the most remote localities 168–500 km). Therefore, we did not take into account such endemics that occur in adjacent regions as well.

In this work, the Crimean endemics are also classified as neo- or paleo-endemics, resp., in accordance with Favarger & Contandriopoulos (1961), who found that the relative age of taxa is mirrored by the existence or absence of closely related species and subspecies.

In order to check the validity of the newly established level of the Crimean narrow endemism, we have employed a comparative phytogeographical approach, comparing our estimate of endemism in the Crimea with those of European-Mediterranean regions of similar size, where the number of narrow regional endemics is known precisely.

The renewed list of the Crimean endemics presented here preferably follows a nomenclatural standard. It is based on the "moderately narrow" species concept in the thoroughly compiled checklist of vascular plants of Ukraine (Mosyakin & Fedoronchuk 1999), with certain changes and additions.

3. Results

The long-lasting isolation of Soviet botany together with the power of "splitters" in "home taxonomy" have led to an overestimation of regional endemism during the last decades. Only ten years ago, the endemic flora of the Crimea was estimated at 279 species (Golubev 1996), an estimate that put the Crimean peninsula on a par with areas of high endemism such as Sardinia or Sicily (Yena & Raimondo 2003). But our recent investigations (Yena 2001a, 2003, 2005b) have concluded that the flora of the Crimea comprises 127 endemic species and subspecies. Of the other 152 former endemics, 1/3 was found to occur also outside of the Crimea and 2/3 were "dethroned" for taxonomic reasons.

Many of those species grow in the Caucasus as well [e.g., *Alcea novopokrovskyi* Iljin, *Alyssum calycocarpum* Rupr., *Crambe mitridatis* Juz., *Eremurus tauricus* Steven, *Euphorbia kotovii* Klokov, *Heracleum pubescens* (Hoffm.) M. Bieb., *Matricaria tzvelevii* Pobed.]. Some species have a wider distribution, comprising also Southern Ukraine [e.g., *Centaurea aemulans* Klokov, *Juncus fominii* Zoz, *Linaria sabulosa* Czern. ex Klokov, *Melica monticola* Prokud., *Otites krymensis* (Kleopov) Klokov]. Even one of the famous Crimean spring flowers, *Galanthus plicatus* M.Bieb., cannot be regarded as a narrow regional endemic any longer, for it is also known from the Russian Black Sea Coast and from Turkey now (Zernov 2002, Özhatay et al. 1999).

Many taxa referred to as endemics do not deserve taxonomic recognition, e.g., from the genera *Cirsium* Mill., *Cruciata* Mill., *Euphrasia* L., *Thymus* L., *Scutellaria* L., *Sideritis* L., and *Stipa* L. For example, in *Thymus* we have only one Crimean endemic now, whereas 9 other taxa previously recognized as endemics are simply glabrous or downy-leaved forms of other widespread species (Gogina 1990). After a century of discussions around its origin and taxonomic rank, *Pinus pityusa* Steven var. *stankewiczii* Sukacz. should now be regarded as a variety of *P. brutia* Ten. and named *P. brutia* var. *pityusa* (Steven) Silba (Yena et al. 2005). Unfortunately we have to synonymize another famous Crimean spring flower, *Cyclamen kuznetzovii* Kotov & Czernova, with *C. coum* Mill., for there are no relevant characters to distinguish it at all (Yena 2001a).

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Meantime some endemic taxa that were considered "doubtful" [e.g., *Lepidium turczaninowii* Lipsky, *Trachomitum venetum* (L.) Woodson subsp. *tauricum* (Pobed.) Greuter & Burdet] proved to be good species or subspecies, resp. (Yena 2001b). These two taxa have even been presumed extinct until rediscovered by the author in 1996.

Some rules of geographical gradients of various floristic indexes have been clearly shown by florists (Whittaker et al. 2001, Strid & Tan 1992, Tan & Strid 2001). In fact the level of the Crimean endemism fits well into the known phytogeographical coordinates, especially if we consider the relationship between latitude and diversity. We can accept that a latitudinal gradient of narrow regional endemism exists as well (Yena 2003), and that at the very least "the degree of endemism follows the same latitudinal trend as species richness" (Major 1988: 128, see also Gaston 2003).

To compare the Crimean endemism properly, we should take data from similar-sized regions, better well isolated geographically, but situated in adjacent territories. Due to the lack of accurate data, we are able to compare only a few areas such as the Ukrainian Carpathians, Turkish Thracia, Albania, Sardinia, Sicily, Peloponnesus, Israel, and Sinai. All of them are 20 000–30 000 km^2 in size and have floras of 2000–3000 species (except for Sinai with *c.* 1000 spp.). Biogeographically these regions are divided into two groups. A "northern", predominantly submediterranean group displays levels of endemism ranging from 0.8 to 4.8 % (with endemic density ranging from 0.07 to 0.48 spp./100 km^2). A "southern", true mediterranean group shows levels of endemism ranging from 7.4 to 12% (0.79 to 1.15 spp./100 km^2). As we can see from the numbers given above, the Crimea has a level of endemism at 4.8%, and 0.48 endemic spp./100 km^2, similar to other submediterranean areas rather than mediterranean ones, suggesting that this modern estimate of plant endemism is probably close to accurate.

Nevertheless the list of the Crimean endemics will be amended in the future. First of all, taxonomically problematic species should be thoroughly investigated. We also expect to add some more new taxa from promising genera that have been poorly studied until now (e.g., *Allium* L., *Bupleurum* L., *Limonium* Mill., *Verbascum* L., *Taraxacum* Weber). Maybe the Crimean representatives of some widely distributed species will prove to be endemic subspecies (e.g., *Galanthus plicatus* M.Bieb., *Genista depressa* M.Bieb.). However, we anticipate that the level of the Crimean endemism will range between 100 and 130 species and subspecies.

4. List of the Crimean narrow endemics

* nomenclatural deviations (Yena 2001a) from Mosyakin & Fedoronchuk (1999)
** recently described species (see references)
\+ local endemic
\# narrow regional endemic
/\ neoendemic
/\/\ paleoendemic

Aceraceae

1. **Acer hyrcanum* Fischer & C.A. Meyer subsp. *stevenii* (Pojark.) E. Murray # /\

Alliaceae

2. *Allium albiflorum* Omelczuk # /\
3. ***Allium nathaliae* Seregin (Seregin 2004) # /\

Apiaceae

4. *Heracleum ligusticifolium* M. Bieb. # /\
5. *Rumia crithmifolia* (Willd.) Koso-Pol. (the only narrow endemic genus) # /\/\
6. *Seseli gummiferum* Pall. # /\
7. *Seseli lehmannii* Degen + /\
8. *Trinia biebersteinii* Fedoronczuk + /\

Apocynaceae

9. **Trachomitum venetum* (L.) Woodson subsp. *tauricum* (Pobed.) Greuter & Burdet + /\

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Asphodelaceae

10. *Eremurus jungei* Juz. (taxonomically still problematic) + /\
11. *E. thiodanthus* Juz. (taxonomically still problematic) + /\

Asteraceae

12. *Anthemis dubia* Steven # /\
13. *A. jailensis* Zefir. + /\
14. *A. monantha* Willd. (incl. *A. parviceps* Dobrocz. & Fed. ex Klokov) # /\
15. *A. sterilis* Steven # /\
16. *A. tranzscheliana* Fed. + /\
17. *Artemisia dzevanovskyi* Leonova + /\
18. *Centaurea caprina* Steven # /\
19. *C. fuscomarginata* (K.Koch) Juz. # /\
20. **C. ovina* subsp. *steveniana* (Klokov) Dostál (taxonomically still problematic) # /\
21. **C. sterilis* Steven subsp. *semijusta* (Juz.) Dostál + /\
22. **C. sterilis* Steven subsp. *sterilis* (taxonomically still problematic) # /\
23. **C. sterilis* subsp. *vankovii* (Klokov) Dostál + /\
24. *Cirsium laniflorum* (M.Bieb.) M.Bieb.
    (incl. *C. sublaniflorum* Soják, *C. tauricum* Soják) # /\
25. *Hieracium uczanssuense* Ueksip + /\
26. *Jurinea sordida* Steven (taxonomically still problematic) # /\
27. *Lagoseris purpurea* (Willd.) Boiss. (incl. *L. callicephala* Juz.) # /\
28. *Senecio tauricus* Konechn. + /\
29. *Tanacetum paczoskii* (Zefir.) Tzvelev # /\
30. *Taraxacum bachczisaraicum* Tzvelev + /\
31. *T. hybernum* Steven (incl. *T. pobedimoviae* Schischk.) # /\
32. *T. pseudomurbeckianum* Tzvelev + /\
33. *T. tauricum* Kotov + /\
34. *Tephroseris jailicola* (Juz.) Konechn. + /\

Boraginaceae

35. *Echium popovii* Dobrocz. (taxonomically still problematic) # /\

Brassicaceae

36. *Alyssum kotovii* A. Iljinskaja + /\
37. *Lepidium turczaninowii* Lipsky + /\/\
38. *Sobolewskia sibirica* (Willd.) P.W. Ball # /\

Campanulaceae

39. **Adenophora lilifolia* (L.) Ledeb. ex A.DC. subsp. *taurica* Sukacz.
    (taxonomically still problematic) + /\
40. *Campanula sibirica L. subsp. taurica (Juz.) Fed.
    [incl. C. charkeviczii Fed.; C. talievii Juz.; C. taurica Juz.] # /\

Capparaceae

41. **Cleome ornithopodioides* L. subsp. *canescens* (Steven ex DC.) Tzvelev + /\

Caryophyllaceae

42. *Cerastium biebersteinii* DC. # /\
43. *Dianthus marschallii* Schischk # /\
44. *Minuartia adenotricha* Schischk. # /\
45. *M. eglandulosa* (Fenzl) Klokov (taxonomically still problematic) + /\
46. *M. euxina* Klokov (taxonomically still problematic) + /\
47. *M. hirsuta* (M. Bieb.) Hand.-Mazz. # /\
48. *M. taurica* (Steven) Graebn. # /\
49. *Silene jailensis* N.I. Rubtzov +/\/\

Cistaceae

50. *Helianthemum stevenii* Rupr. ex Juz. & Pozdeeva # /\

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Convolvulaceae

51. **Convolvulus calvertii* Boiss. subsp. *tauricus* (Bornm.) Smoljian. (incl. *C. bracteosus* Juz.) # /\
52. *C. sericocephalus* Juz. # /\

Dipsacaceae

53. *Cephalaria demetrii* Bobrov (taxonomically still problematic) + /\
54. *Scabiosa praemontana* Privalova # /\

Euphorbiaceae

55. *Euphorbia goldei* Prokh. (taxonomically still problematic) # /\

Fabaceae

56. *Anthyllis biebersteiniana* Popl. # /\
57. *A. taurica* Juz. # /\
58. *Astragalus setosulus* Gontsch. # /\
59. *A. similis* Boriss. # /\
60. *A. suprapilosus* Gontsch. # /\
61. *A. tauricus* Pall. # /\
62. *Genista taurica* Dubovik (taxonomically still problematic) # /\
63. *Lotus tauricus* Juz. # /\
64. *Medicago saxatilis* M. Bieb. + /\
65. *Onobrychis jailae* Czernova # /\
66. *O. pallasii* (Willd.) M. Bieb. # /\/\

Hyacinthaceae

67. *Bellevalia lipskyi* (Miscz.) E. Wulff # /\

Lamiaceae

68. *Lamium glaberrimum* (K. Koch) Taliev +/\/\
69. *Salvia demetrii* Juz. # /\
70. **Satureja montana* L. subsp. *taurica* (Velen.) P.W. Ball # /\
71. **Sideritis syriaca* L. subsp. *catillaris* (Juz.) Gladkova # /\
72. **S. syriaca* subsp. *taurica* (Steph. ex Willd.) Gladkova # /\
73. **Teucrium montanum* L. subsp. *jailae* (Juz.) Soó # /\
74. *Thymus dzevanovskyi* Klokov & Des.-Shost. # /\

Liliaceae

75. *Gagea aipetriensis* Levichev + /\
76. *G. callieri* Pascher # /\

Linaceae

77. **Linum austriacum* L. subsp. *marschallianum* (Juz.) Greuter & Burdet # /\
78. *L. pallasianum* Schult. # /\

Malvaceae

79. *Alcea taurica* Iljin # /\

Poaceae

80. **Agropyron cristatum* (L.) Beauv. subsp. *ponticum* (Nevski) Tzvelev # /\
81. **Elytrigia caespitosa* (K. Koch) Nevski subsp. *nodosa* (Nevski) Tzvelev # /\
82. **E. strigosa* (M. Bieb.) Nevski subsp. *strigosa* # /\
83. *Koeleria biebersteinii* M. Kaleniczenko # /\
84. *K. taurica* M. Kaleniczenko # /\
85. **Poa sterilis* M. Bieb. subsp. *biebersteinii* (H. Pojark.) Tzvelev + /\
86. *P. taurica* H. Pojark. # /\
87. **Stipa eriocaulis* Borb. subsp. *lithophila* (P. Smirn.) Tzvelev # /\

Primulaceae

88. **Androsace villosa* L. subsp. *taurica* (Ovcz.) Fed. # /\
89. **Primula veris* L. subsp. *intermedia* Hricak (*P. macrocalyx* Bunge p.p.) # /\

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Ranunculaceae

90. **Pulsatilla halleri* (All.) Willd. subsp. *taurica* (Juz.) K. Krause # /\
91. **Ranunculus brutius* Ten. subsp. *crimaeus* (Juz.) A. Jelen. + /\
92. **R. caucasicus* M. Bieb. subsp. *pavlii* Jelen. & Derv.-Sok. # /\
93. **Ranunculus dissectus* M. Bieb. subsp. *dissectus* + /\

Rosaceae

94. *Alchemilla arcuatiloba* Juz. +/\
95. *A. buschii* Juz. +/\
96. *A. camptopoda* Juz. +/\
97. *A. crebridens* Juz. +/\
98. *A. exuens* Juz. +/\
99. *A. hirsutissima* Juz +/\
100. *A. jailae* Juz. +/\
101. *A. languescens* Juz. +/\
102. *A. phegophila* Juz. +/\
103. *A. tytthantha* Juz. +/\
104. *Cotoneaster tauricus* Pojark. # /\
105. *Crataegus ceratocarpa* Kossych # /\
106. *C. dipyrena* Pojark. # /\
107. *C. pojarkovae* Kossych +/\
108. *C. sphaenophylla* Pojark. +/\
109. *C. stankovii* Kossych +/\
110. *C. taurica* Pojark. # /\
111. *Potentilla depressa* Willd. ex Schlecht. # /\
112. *P. taurica* Willd. ex Schlecht. # /\
113. *Sorbus tauricola* Zaikonn. # /\

Rubiaceae

114. **Asperula supina* M.Bieb. subsp. *caespitans* (Juz.) Pjatunina [incl. *A. aemulans* V.Krecz. ex Klokov] # /\
115. *G. xeroticum* (Klokov) Soó (taxonomically still problematic) # /\

Santalaceae

116. ***Thesium krymense* Romo, Didukh & Boratyński (Romo, Didukh & Boratyński, 2004) # /\

Saxifragaceae

117. *Saxifraga irrigua* M. Bieb. # /\/\

Scrophulariaceae

118. *Euphrasia taurica* Ganesch. ex Popl. # /\
119. *Scrophularia exilis* Popl. +/\
120. *S. goldeana* Juz. (taxonomically still problematic) # /\
121. **Veronica incana* L. subsp. *hololeuca* (Juz.) A. Jelen. + /\
122. **V. taurica* Willd. subsp. *taurica* # /\
123. **V. taurica* Willd. subsp. *bordzilowskii* (Juz.) A. Jelen. (taxonomically still problematic) + /\

Solanaceae

124. *Solanum zelenetzkii* Pojark. (taxonomically still problematic) # /\

Thymelaeaceae

125. *Daphne taurica* Kotov +/\/\

Tiliaceae

126. *Tilia dasystyla* Steven # /\

Valerianaceae

127. *Valerianella falconida* Schvedtsch. # /\

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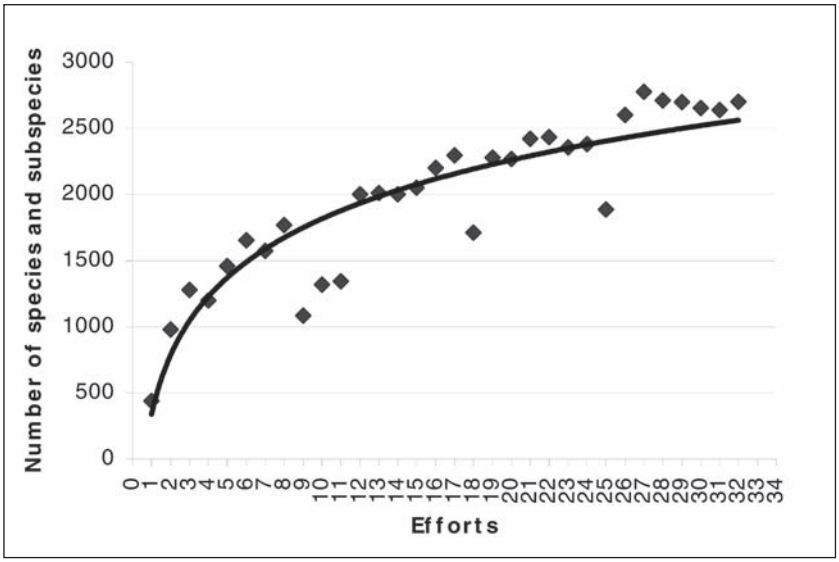

Fig. 1: Historical consequence of estimates of floristic diversity in the Crimea (1785–2005).

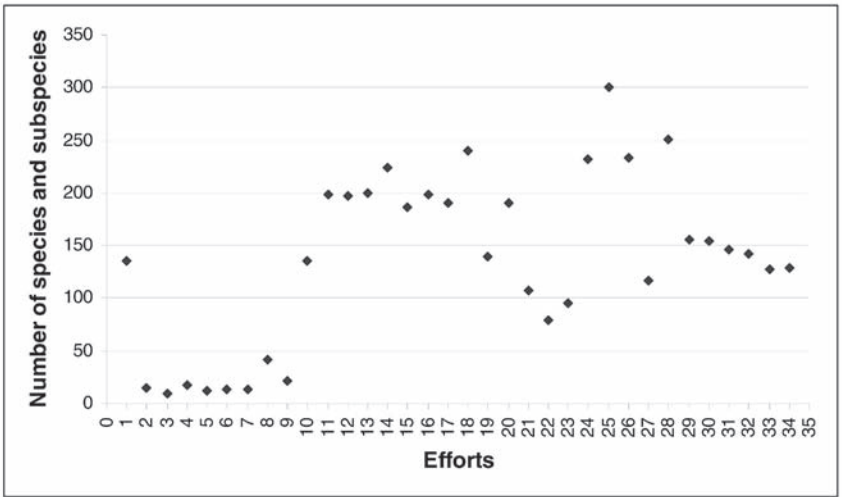

Fig. 2: Historical consequence of estimates of narrow endemism in the Crimea (1856–2005).

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Notes on Crimean Flora
(Botanical Excursion on the Crimean Peninsula, 2004)

Anton Drescher*, Bohdan Prots** & Andriy Yena***

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Abstract: Annotated plant lists and information on soil and land use of the major Crimean biodiversity hotspots are presented. The floristical diversity of the Crimea is analysed. Nature conservation, historical, cultural, and sustainable development considerations are discussed. An extensive list of literature on the Crimean environment is attached.

Zusammenfassung: Annotierte Artenlisten informieren über Böden und Veränderungen der Landnutzung von Gebieten hoher Biodiversität. Die floristische Vielfalt der unterschiedlichen Standorte wird analysiert und Probleme des Naturschutzes, der geschichtlichen und kulturellen Vielfalt sowie Möglichkeiten der nachhaltigen Nutzung werden diskutiert. Eine ausführliche Literaturliste bildet den Abschluss.

Key Words: Crimea, floristic diversity, hot-spots, soil descriptions, nature conservation, bibliography on Crimean nature

*Institute of Plant Sciences, Karl-Franzens University of Graz,
Holteigasse 6, A-8010 Graz, AUSTRIA; e-mail: anton.drescher@uni-graz.at
**State Museum of Natural History, NAS of Ukraine, Teatralna Str. 18,
Lviv 79008, UKRAINE; e-mail: bprots7@fastmail.fm
*** National Agrarian University, Southern Branch "Crimean Agrotechnological University",
Agrarnoye, Simferopol 95492, UKRAINE; e-mail: yena@crimea.edu

Itinerary of the excursion (fig.1)
28.05.2004: Travel from Graz to Simferopol (Crimea, Ukraine);
29.05.: Flora and vegetation of the Crimean Plain steppe (sites 1,2);
30.05.: Flora and vegetation of the southwestern Crimean foothills (sites 3–8);
31.05.: Flora and vegetation of the eastern Crimean foothills (sites 9–11);
01.06.: Flora and vegetation of the Main Crimean Ridge: Chatyrdag northern slope, and Yaila plateau (sites 12–15);
02.06.: Flora and vegetation of the West Crimean submediterranean coast: Nikitsky Botanical Garden, and "Martyan Cape" Reserve (sites 16–18);
03.06.: Flora and vegetation of the East Crimean submediterranean coast: Karadag Nature Reserve (sites 19, 20);
04.06.: Seashore flora and vegetation, western coast of the peninsula, 2 km south of Eupatoria (site 21);
05.06.: departure Simferopol-Graz.

Participants of the excursion:
Brenner Martina, Carli Anton, Dippold Friderun, Drescher Anton, Gussmark Christa, Haubenwallner Ulrike, Julius Eike, Kammerer Helmut, Leinfellner Christine, Marktl Barbara, Prots Bohdan, Prügger Johannes, Schulz Erhard, Stradner Dennis, Trummer Emanuel, Wilde Uta, Yena Andriy.

The scientific part of the excursion was planned by A. Yena, the technical part has been implemented by A. Yena, B. Prots, and A. Drescher.

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Fig. 1: The itinerary of the botanical excursion to the Crimean peninsula, 29.05.–04.06.2004 (triangle and number on the map correspond to the location and visited site)

1. Introduction

Floristically the Crimean peninsula is an unique European region. It is situated right between two phytogeographic regions, Circumboreal, and Mediterranean (Takhtajan 1986), on the northeastern edge of the Mediterranean and yet in the very south of Ukraine and Eastern Europe in general. Being well isolated by the Black Sea and the Sea of Azov, it is surrounded by such floristically diverse regions as the East European Plain in the North, the Balkans in the West, the Caucasus in the East and Asia Minor in the South. This region has proved to be a crossroads for plant migration during previous ages. So, Crimea has a high, phytogeographically constrained biodiversity. It is famous as one of the European plant diversity hot spots (Biodiversity Support Program 1999).

The aim of the international excursion was to visit the plant diversity hot spots of the Crimea, to survey plants and soil conditions as well as to indentify environmental and cultural problems. The historical background of the region was taken into consideration.

2. Physical settings

The Crimean peninsula is located in the very south of Ukraine between 44°23' and 46°15' N and 32°29' and 36°39' E. It belongs to the southern deformed boundary of the East European platform. The peninsula is principally divided into the northern lowland (not exceeding 130 m a.s.l.) and the mountain range in the south. The Scythian plate, the southernmost part of Fennosarmatia, is of Variscian origin and represents a peneplain. It is covered by neogene sediments. The mountain ranges in the south were formed during the alpidic cycle. This westernmost part the Caucasian system is separated from its main part by graben developments during the tertiary history of the Black Sea (Schönenberg & Neugebauer 1981). They consist of a complicated system of two ridges of cuestas (Crimean Foothills), exposing front escarpments and the Main Crimean Ridge (Glavnaya Krymskaya Duga or Holovna

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Kryms'ka Duha) of tectonic origin, accompanied by old volcanic formations in the southern and southwestern parts of the Peninsula. These mostly calcareous ridges originate from Jurassic to Tertiary and rise up to 1545 m (Roman Kosh Mt.). The upper parts of the main ridge shaped like plateaus are called yailas. The main escarpment is facing to the southeast with a steep slope to the coast. The Karadag area in the southeast represents one of the examples of Jurassic volcanism. After that, four major tectonic events up to the change from Pliocene to Quarternary have been distinguished (Saintot et al. 1999).
The climatic differences are caused by this geomorphological situation. The mountain chain divides the peninsula in two climatic provinces. The North is dominated by a steppe climate (316–466 mm precipitation per year). However, as the Simferopol diagram shows, the influence of the mountain chain causes a summer maximum of rainfall and also a severe winter cold (see climatic diagrams, fig. 2). The mountains also provoke an increased precipitation in the upper part. On the other hand, they also protect the southern coastal area against the northern continental air masses. It thus makes possible to form a submediterranean type of climate with winter rain maximum and a summer drought. The continental air masses can cause severe winter temperatures in the southeastern coast of the Crimea. The selected climate diagrams and table 1 explain these conditions (fig. 2, table 1). This pattern reflects the gradients of precipitation, and temperature, modified by the local elevation and exposition. The catena of vegetation belts in the mountain range differs between north and south exposed parts of the slopes, corresponding to the climatic features.

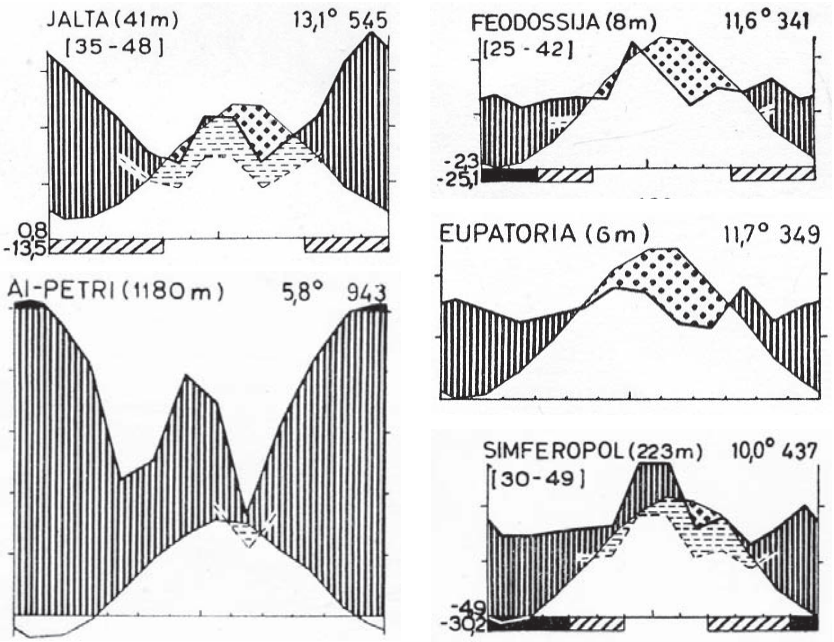

Fig. 2: Selected climatic diagrams of the Crimea (Walter & Lieth 1964).

Geomorphological and climatic conditions make a strong impact on the habitat diversity. Seven major habitat zones have been identified for the Crimean peninsula: semi-desert steppe, and saline lands; true steppe; premontane forest steppe; forests of the northern slope; mountain meadow steppes of the yailas; forests of the southern slope; submediterranean

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vegetation of the south coast (Biodiversity Support Program 1998). The vegetation map of the Crimea is presented on fig. 56, which underlines the extreme diversity of vegetation types of the peninsula.

Geographical area	Average temperature, °C		Days without frost	Precipitation, mm/per year
	June	January		
Flat plain Crimea				
Central Crimean Plain	+22.0 – +23.0	-1.5 – -2.2	170–185	425–480
Kerch Peninsula	+23.0 – +23.5	0 – -1.3	200–225	350–420
Mountainous Crimea				
Foothill	+22.0 – +22.3	-1.5 – +2.0	150–240	350–600
Main mountain range	+15.0 – +21.0	-4.0 – 0	150–180	600–1200
Southern Coast	+23.0 – +24.5	+2.0 – +4.0	230–260	350–650

Table 1: Climatic characteristics of geographical areas of the Crimea.

3. Methods

All surveyed sites were indentified using the Global Positioning System (GPS). The description of soil profiles follows Blum et al. (1996). The floristic nomenclature is based on Mosyakin & Fedoronchuk (1999), except for some endemics revised by Yena (2001, 2003). Synonyms given in brackets follow Tutin et al. (1968, 1972, 1976, 1980, 1993). Species lists of the sites are given in alphabetical order, separately for each layer. Annotations on ecological characteristics and distribution ranges are presented for selected species. The plant invasion terminology is based on Richardson et al. (2000), and Protos (2003). Topographic maps have been used in scales of 1:50,000, 1:100,000 and 1:200,000 (Topographic maps… 2002–2004). The geographical names (which are in Russian) are used in accordance to these maps. The Ukrainian analogues of the names are given in brackets. The problem of geographical names originates in the complicated history of the peninsula, and the three languages used in the autonomous region. After the census of 2001, almost 80% of the population uses Russian, around 10% Ukrainian, and 9.5% Crimean Tatarian (Köck et al. 2004).

Abbreviations used:

* collected for herbarium GZU
E endemic plant of the Crimea
P.p. "problem plant"
RDB-UA Red Data Book of Ukraine

4. Itinerary and observed habitats

28.05.2004
Journey: Graz–Salzburg–Nürnberg–Frankfurt Airport by train.
Flight take-off: 23:50

29.05.2004
Arrival at Simferopol airport (Crimea, Ukraine) at 02:30, the customs clearance took us around 2 hours. Our guides Andriy Yena, and Bohdan Prots were already waiting for several hours. We reached the Hotel "Tavriya" by minibus (arrival at 05:30). After a short period for recovering we started the first excursion.

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Travel from the Hotel “Tavrya” to Agrarnoye (Ahrarne) in the northern surroundings of Simferopol: 12:00–12:30

Flora and Vegetation of the Crimean Plain Steppe

Site № 1: Northern surroundings of Simferopol, vicinity of the National Agrarian University, Southern Branch “Crimean Agrotechnological University” in Simferopol; [49°51’20”N/58°41’55”E]; ca. 240 m a.s.l.; forb steppe (fig. 57)

The **dominant grasses** are:
Festuca rupicola
Stipa capillata (RDB-UA)
**Stipa eriocaulis* subsp. *lithophila* (E) (RDB-UA)

Further species:
**Achillea millefolium agg.*
Agropyron pectinatum
**Ajuga chia*
**Alyssum rostratum*
**Amygdalus nana*
**Anthemis ruthenica*
Arenaria serpyllifolia
**Asperula stevenii*
Astragalus officinalis
**Astragalus onobrychis*
Bromus riparius
**Centaurea orientalis*
Cerinthe minor
Convolvulus arvensis
Convolvulus cantabrica (fig. 6)
**Dianthus marschallii* (E)
Eryngium campestre
Euphorbia agraria (fig. 3)
Euphorbia virgata
Ferulago taurica
Filipendula vulgaris (F. hexapetala)
Galatella villosa
**Haplophyllum suaveolens*
Dasypyrum villosum
Hieracium cf. bauhinii
**Jurinea sordida* (E)
Jurinea stoechadifolia
Koeleria brevis
Koeleria cristata
Linum austriacum subsp. *austriacum*
Linum lanuginosum
**Linum linearifolium*
Marrubium praecox
Medicago minima
Minuartia euxina (E)
Leopoldia comosa
**Nonea pulla*
**Onosma polyphylla* (RDB-UA)
Ornithogalum ponticum
**Paeonia tenuifolia* (RDB-UA)
Phlomis taurica
Polygala major (fig. 4)
Reseda lutea
**Sanquisorba minor*
Salvia nutans (fig. 5)
Scabiosa praemontana (E)
**Scorzonera crispa*
Silene conica
Sisymbrium orientale
Stachys recta subsp. *atherocalyx*
**Teucrium chamaedrys*
Teucrium polium
Thalictrum minus
**Thesium arvense*
Vinca herbacea
**Vincetoxicum laxum*
Viola arvensis

Grindelia squarrosa (an alien of North American origin) is higly invasive in the Crimea since the 1980s. It spreads mainly along roadsides.

Discussion at the site:
The area around the settlement is grazed by sheep and cattle. The dung proves at least a moderate grazing. The use of fire is reported. The herbaceous vegetation is dominated by the grasses *Stipa capillata*, *S. eriocaulis* and *Festuca rupicola* (*F. sulcata*). Beside that the characteristic species *Salvia nutans* (fig. 5), *Centaurea orientalis, Tragopogon dubium, Linum austriacum, L. linearifolium, Scorzonera crispa, Ornithogalum ponticum, Phlomis taurica, Thymus dzevanovskyi* and a lot of geophytes present a colourful, species-rich tall grass steppe. Grazing around the settlements is proved by the indicative species *Eryngium campestre* and *Euphorbia virgata*. An area of about 5 hectares of this steppe is under protection (Local Nature Reserve), grazing is not excluded (fig. 57).

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Figs. 3, 4: *Euphorbia agraria* (left figure) and *Polygala major* (right figure) are frequent species of the site (photos E. Trummer & B. Marktl).

Two observed soil profiles along a ditch show the catena from Kastanosem (with lacking Ca^{2+} in the whole profile) to Chernosem-Rendzina (A–C) on weathered calcareous parent material (fig. 6).

Fig. 5: The characteristic steppe species *Salvia nutans* in blossom (left, photo E. Trummer & B. Marktl).
Fig. 6: The soil profile of the forb steppe (right, photo B. Prots).

Travel from Agrarnoye north to Voykovo town (near Sarybash Hills): 15:00–16:00.

Between Stachanovka and Voykovo we observed remnants of a grazed *Stipa* steppe (west of the road). The plain near Voykovo in the northwestern part of the peninsula is characterised by the *Artemisia* semi-desert. The vegetation cover is about 60–70% and less species-rich than at the previous site. It is dominated by *Artemisia taurica*. Grasses are less frequent. *Stipa capillata* as well as *Festuca rupicola* play a subordinate role. The

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showy geophytes *Adonis vernalis, Phlomis tuberosa* and the biennial-perennial herbaceous *Salvia aethiopis* (fig. 7) can be recognised even from a far distance. Between them there are patches with bare soil and these are covered only by mosses and small annual species (recovering stage).

Site № 2: Vicinity of Voykovo (near Sarybash Hills); [45°35'23''N/33°51'30''E]; ca. 85 m a.s.l.; *Artemisia* steppe (fig. 58).

Dominant species:
*Artemisia taurica
*Peganum harmala (P.p.)

Grasses:
**Aegilops cylindrica*
**Aegilops triuncialis*
**Agropyron pectinatum*
Bromus arvensis
**Bromus tectorum*
**Poa bulbosa*
**Stipa capillata* (RDB-UA)

Figs. 7, 8: Two characteristic species of heavily grazed *Artemisia* steppe, *Salvia aethiopis* (left) and *Thymus dzevanovskyi* (right) (photos E. Trummer & B. Marktl).

Accompanying species:
**Achillea leptophylla*
**Adonis aestivalis* agg. (cf. *flammula)*
**Alyssum rostratum*
Androsace maxima subsp. *turczaninovii*
**Cardaria draba* (P.p.)
Conringia orientalis
Convolvulus arvensis
Echium italicum
**Erodium cicutarium*
Eryngium campestre
Euphorbia glareosa
**Euphorbia seguierana*
**Herniaria besseri*
Lamium amplexicaule
Marrubium praecox
Medicago minima
**Minuartia glomerata*
**Phlomis tuberosa*
**Ranunculus oxyspermus*
Salvia aethiopis (fig. 7)
Salvia nemorosa
Salvia nutans
**Thlaspi perfoliatum*
**Thymus dzevanovskyi* (E, fig. 8)
Trigonella monspeliaca
**Vicia sativa* s.l.
**Viola arvensis*

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Discussion at the site:
The old farm building (former "kolkhos") located in the background leads to the assumption of more or less heavy grazing by cattle in the past (fig. 59). The intensive grazing by cattle might be one of the reasons for the suppression of tussock grasses and the dominance of *Artemisia taurica* and *Peganum harmala*.
The "Stone of Karakhodja" is a megalithic archaeological monument 9 km north from Voykovo, another evidence of at least 4000–5000 years of human impact on the area. This is a plane outcrop of Sarmatian limestone of 60 m^2 with strange signs that look like an ancient map. A hundred of hollows 5 to 25 cm in diameter, together with single or doubled, straight or curved lines that cross at various angles make a specific, still unreadable system. There exist only a few similar monuments of rock art in Great Britain, and France.

On the road embankment:
Bromus arvensis
Carex cf. *praecox*
Consolida orientalis (P. p.)
Convolvulus arvensis

Travel back to Simferopol

30.05.2004
Travel: Simferopol – Bakhchisaray

Flora and Vegetation of the Southwestern Crimean Foothills

Site № 3: South west part of the Crimea, foothills of the Crimean Mountains, Bakhchisaray

Visit of the Khan's Palace (figs. 9, 10).

Fig. 9: Yard inside of the Khan's Palace with overgrazed hills in the background (photo E. Trummer & B. Markt).

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The medieval settlement of Bakhchisarai was situated along the caravan road from Chersonesos to the north on the steep right river bank of the Churuksu River. It was founded in the late XVth century and was famous for its gardens and vineyards.
In 1503 the Khan Mengli-Girey started the construction of the Khan's palace on the opposite river bank. It was the residence of the Crimean Khanate (state) for almost 200 years. Today it represents the only remnant of the Tatar period after their deportation and the destruction of their cultural heritage in 1944 by Stalin.

The complex of buildings is surrounded by a wall and consists of a palace (fig. 9), which can be visited partly, two mosques, and a cemetery (fig. 10). The buildings are grouped around a garden. The palace itself and the garden as well are characterised by several decorative fountains, partly of marble, like the famous "Fountain of Tears" that was glorified by the Russian poet A. Pushkin. In the cemetery, used since 1532, members of the Khan family lie buried. Very impressive are the marble tombstones of the Girey family with bas-reliefs showing tulips, lilies, sowbreads, and other flowers (fig. 10).

The visit of the Khan's Palace was followed by a small snack in the Tatar restaurant on the Churuksu river ("shashlyk", "chebureki" and "shaurma" dishes).
The vegetation along the Churuksu River is dominated by planted trees like *Populus ×italica, Aesculus hippocastanum, Acer negundo* (P.p.)*, Ailanthus altissima* (P.p.). Along the river bank *Parietaria officinalis, *Nasturtium officinale* and **Symphytum tauricum* are abundant.

Fig. 10: Ancient tomb stones of the cemetery within the Khan's Palace (photo B. Prots).

Travel: Bakhchisaray – Tankovoye (Tankove)

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Site № 4: 2 km northwest of Tankovoye [44°39'42"N/33°47'42"E]; ca. 110 m a.s.l.; road embankment

**Achillea millefolium agg.*
Artemisia absinthium
**Cardaria draba* (P. p.)
**Centaurea depressa*
(vicariant of *C. cyanus* in the Crimea)
**Convolvulus arvensis*
Eryngium campestre
**Euphorbia helioscopia*
Linum austriacum subsp. austriacum
Medicago lupulina
Melilotus officinalis
Onosma polyphylla (RDB-UA)
**Potentilla recta* agg.
**Salvia nemorosa*
Sanguisorba minor
**Silene dioica* s.l.
**Stachys germanica*
Teucrium polium
**Vicia sativa* s.l.

Travel: from Tankovoye to the Chiornaya (Chorna) river valley

Site № 5: Northwest of Tankovoye [44°39'29"N/33°46'52"E]; ca. 110–115 m a.s.l.; rendzina on limestone debris; mosaic of dry grassland and scrub (fig. 60)

Shrubs:
Berberis vulgaris
Cornus sanguinea
**Juniperus oxycedrus*
**Ligustrum vulgare*
**Paliuris spina-christi*
**Pyrus communis*
**Pyrus elaeagnifolia*
Rhamnus cathartica
**Rosa horrida* (fig.12)
**Ulmus minor*

Figs. 11, 12: The characteristic species *Linum tenuifolium* (left) and *Rosa horrida* (right) of site no. 5 (photos E. Trummer & B. Marktl).

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Dry grassland species:
**Aegilops triuncialis*
**Acinos arvensis*
Allium rotundum
**Alyssum tortuosum*
Androsace maxima
Anthemis tinctoria subsp. *tinctoria*
**Asphodeline lutea* (RDB-UA, fig. 62);
Bromus cappadocicus
**Carex liparocarpus*
**Bromus erectus*
Centaurea orientalis
Cephalaria coriacea
Convolvulus cantabrica
Cruciata taurica
**Crupina vulgaris*
Eryngium campestre
Euphorbia glareosa
Gypsophila glomerata
**Haplophyllum suaveolens*
Iris pumila
**Jurinea sordida* (E, fig. 61);
Linaria austriaca
Linum austriacum
Linum ponticum
Linum tenuifolium (fig. 11)
**Melica ciliata* subsp. *monticola*
Minuartia glomerata
Ononis arvensis
Phlomis tuberosa
Potentilla longifolia
Sanguisorba minor
**Scabiosa praemontana* (E)
Seseli arenaria
Seseli dichotoma
**Sideritis syriaca* subsp *catillaris* (E)
Silene conica
Stachys recta
Teucrium chamaedrys
Thlaspi macranthum
Thymus tauricus
**Veronica taurica (E)*

Travel: along the Chiornaya river

Site № 6: Southeast of Tankovoye [44°34,269'N/33°43,256'E]; ca. 150–160 m; rendzina on limestone; "shiblyak" vegetation type (figs. 13, 63)

Fig. 13: "Shiblyak" covers a large forest area in the Crimea (photo E. Trummer & B. Marktl).

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"Shiblyak" is a submediterranean xerophilous, deciduous, degraded, woody vegetation of shrub-like trees and shrubs (figs. 13, 63). It originated from true oak forests in the low, and middle mountain belts after centuries of selective cutting and coppicing. The key taxa are *Quercus pubescens* and *Carpinus orientalis* (fig. 64). Between the patches of shrub vegetation, open areas with tussocks of *Melica monticola* are located.

Tree and shrub species:
**Carpinus orientalis* (fig. 64)
Cotoneaster tauricus (E)
**Jasminum fruticans*
**Juniperus excelsa* (RDB-UA)
Paliuris spina-cristi
**Pistacia mutica* (RDB-UA)
Pyrus elaeagnifolia
**Quercus pubescens*

Dwarf shrubs:
Fumana procumbens
Ruscus ponticus (R.aculeatus)

Grasses and Herbs:
**Achillea millefolium* agg.
**Asparagus verticillatus*
**Carex halleriana*
**Centaurea stoebe (C.rhenana)*
Comperia comperiana
(very rare orchid; RDB-UA)
Convolvulus cantabrica
Eryngium campestre
**Euphorbia myrsinites*
Euphorbia virgata
**Fibigia clypeata*
**Galium* cf. *mollugo*
Iris pumila
**Jurinea sordida* (E)
**Lasiagrostis bromoides (Stipa brom.)*
Medicago orbicularis
**Melica ciliata* subsp. *monticola*
Minuartia glomerata
**Orlaya grandiflora*
Ornithogalum ponticum
**Potentilla recta*
Salvia horminum
Sanguisorba minor
Sedum cf. *hispanicum*
**Sideritis montana*
Stachys germanica (fig. 65).
**Teucrium polium*
**Thesium ramosum*
**Tragopogon pratensis*
**Veronica taurica* (E)
**Vicia tenuifolia*

Travel: along the Chiornaya river to Chiernorechie (Chornorichia) village

Site № 7: Near the village of Chiernorechie [44°33'15"N/33°40'50"E]; ca. 150–160 m a.s.l.; alluvial soil; arable field of *Triticum aestivum* (fig. 66)

The colourful, luxuriant weed vegetation is dominated by *Papaver rhoeas* together with *Centaurea depressa* and *Consolida orientalis* (fig. 14).

Species list:
**Achillea millefolium* agg.
Beta trigyna (fig. 15)
**Bifora radians* (P.p., fig. 68)
**Centaurea depressa*
Cirsium arvense (P.p)
Consolida orientalis (P.p)
**Convolvulus arvensis*
Euphorbia helioscopia
**Galium spurium* (P.p)
Hordeum bulbosum
Lactuca serriola
Lolium perenne (P.p.)
**Malva* sp. (fig. 15)
Mercurialis annua
Papaver rhoeas (P.p., figs. 14, 66)
**Ranunculus arvensis* (fig. 67).
**Roemeria hybrida*
(very rare Mediterranean weed)
Stachys annua
Vicia cf. *villosa*
**Vicia cracca* (fig. 14).

In the lateral part of the valley on the slope down to the road:
**Arum elongatum*
Berberis vulgaris

Travel: Chiernorechie – Sevastopol' (Sevastopil') – historical Greek settlement of Chersonesos (Khersones): 18:00–19:15

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Fig. 14: Mosaic of the dominant weed species *Papaver rhoeas* and *Vicia cracca* (photo J. Prügger).

Fig. 15: *Beta trigyna,* and *Malva* sp. on roadside near the site (photo J. Prügger).

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Site № 8: Sevastopol' – Chersonesos; 0–30 m a.s.l.; historical site, degraded vegetation, antique theatre and ruins (fig. 69)

The outstanding importance of Chersonesos among the ancient cities is not only due to its long history of almost two millennia, but also to the extensive chora and hinterland, that are still preserved. It could maintain a relatively high degree of autonomy despite the dominance of different cultures through the centuries.

Fig. 16: Upper part of St. Volodymyr Church in Chersonesos, the place of origin of Ukrainian Christianity (photo E. Trummer & B. Marktl).

Chersonesos was founded 422–421 BC around two hundred years after the beginning of Greek colonisation in the Crimea (first settlement: Pantikapaion in the eastern Crimea). In the decades following 350 BC the chora of Chersonesos was divided into equal lots, which are still visible in many places. The area was inhabited for more than 2000 years and played an important role. After a short period of Late Scythian reign, the Romans came to power until 250 AD, when Goths from northern Europe moved to the Crimea, and started to attack Roman provinces. Around 370 AD, 40 years after the transfer of the Imperial Residence from Rome to Constantinople, the Huns moved westward, invaded the Crimea and destroyed Gothic, and Greek communities. Between 670 and 850, the Khazar Khanate gained for the first time hegemony over the Crimea until around 850. Prince Volodymyr of Kyiv besieged Chersonesos 988–989 and was baptized there. Finally the Kyivian Rus' (Kyivska Rus') converted to Christianity. The St. Volodymyr Church was restored on this place recently to commemorate this event (fig. 16). Beginning with the XIIIth century, the Italians established trade colonies, and the Genoese dominated the Black Sea trade for several decades. After the Black Death, that decimated the population of Caffa (the modern Feodosiya) severely, also the population of the settlement of Chersonesos declined. After several incursions by the Tatars of the Golden Horde, Chersonesos was destroyed in 1399. In 1427, the Crimean Tatar Khanate was established, which lasted till 1738, when the Russian Tsarina Catherine II abolished the Crimean Khanate and annexed its territory.
The first archeological excavations in Chersonesos date back to 1827 and are being carried on until today. The importance of the site is based on the different cultural horizons covering a large area, and is underlined, e.g., by the only amphitheatre in the Crimea (fig. 69). This long lasting history demonstrates the impact of the various tribes in this area.

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Figs. 17, 18: *Ephedra distachya* subsp. *distachya* (left) and *Zygophyllum fabago* (right) are common species on Chersonesos' ruins (photos B. Prots).

Among ruins:
Ailanthus altissima (P.p.)
Amygdalus communis
Avena fatua
**Beta trigyna*
Cercis siliquastrum (suspected alien)
**Ephedra distachya* subsp. *distachya* (fig. 17)
Ficus carica (escaped from cultivation)
**Fraxinus oxycarpa*
Geranium pusillum
Lagurus ovata
Lycium barbarum (P.p.)
Papaver rhoeas (P.p.)
Parietaria officinalis
Pistacia mutica (RDB-UA)
Prunus spinosa
Rumex patientia
**Zygophyllum fabago* (P.p., fig. 18)

Travel: Sevastopol – Simferopol (19:15–21:00)

31.05.2004

Travel from Simferopol to the east – Krimskaya Rosa (Kryms'ka Rosa)

Between Krimskaya Rosa and the river Burulcha, large fields of *Lavandula angustifolia* were observed on both sides of the road. The names of the villages "Krimskaya Rosa" ("Crimean Rose") and "Aromatnoye" (Aromatne, "Aromatic") refer to the production of aromatic oils.

Travel: Krimskaya Rosa – Bielogorsk (Bilohors'k)

The region is dominated by large fields of wheat. The embankments along the road are covered with *Cotinus coggygria, Tamarix tetrandra* and *T. smyrnensis*. In the background huge afforestations of degraded pastures with *Pinus pallasiana* (above 500 m with *P. hamata*) can be seen.

Road embankments:
Artemisia taurica
Cardaria draba (P.p.)
Consolida orientalis
Diplotaxis tenuifolia
Euphorbia virgata
Marrubium praecox
Rapistrum rugosum
Salvia nemorosa
Stachys germanica

Flora and Vegetation of Eastern Crimean Foothills

Site № 9: "Akkaya" (white rock) near Bielogorsk; [45°06'04''N/34°37'34''E]; ca. 163 m a.s.l.; limestone debris (figs. 19, 70)

The gently inclined lower part of the rendzina slope is covered by a dense dry grazed meadow.

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Fig. 19: "Akkaya" as a highly attractive place for botanists (photo B. Prots).

Species list:

**Ajuga chia*
Asphodeline taurica
**Astragalus tauricus*
**Campanula sibirica* subsp. *taurica* (E)
**Cephalaria coriacea*
Convolvulus calvertii
subsp. *tauricus* (E, fig. 72)
Crataegus monogyna
Diplotaxis tenuifolia (W)
Eryngium campestre
Euphorbia seguierana
Hedysarum tauricum (fig. 71)
**Helianthemum georgicum*
(*H.canum* subsp. *stevenii*)
Koeleria lobata
**Leontodon asper*
Linum austriacum
**Linum lanuginosum*
(L.hirsutum subsp. *hirsutum)*
Marrubium praecox
**Medicago campestris*
**Myosotis arvensis*
Nonea pulla
Onosma polyphylla (RDB-UA)
Phlomis tuberosa
Potentilla erecta s. l.
Pyrus communis
Salvia nutans
Sanguisorba minor
Sideritis siriaca subsp. *taurica* (E)*
Tanacetum paczoskii (E)
Teucrium polium
Thalictrum minus
Verbascum phoeniceum

Steep upper parts of the slopes with calcareous lithosols:

**Asperula supina* subsp. *supina*
Astragalus onobrychis
**Convolvolus calvertii*
subsp. *tauricus* (E, fig. 72)
**Cornus sanguinea* var. *australis*
**Cruciata taurica*
Crupina vulgaris
Euphorbia petrophila
Hedysarum tauricum (fig. 71)
**Inula oculus-christi*
**Lagoseris purpurea* (E, RDB-UA, fig. 20b)
Linum linifolium
Onosma polyphylla (RDB-UA)
Peganum harmala (P.p.)
Pinus pallasiana
Polygala major
**Rhamnus cathartica*
**Scutellaria orientalis*
Seseli dichotomum
**Asperula taurica*

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Pinus pallasiana was planted with the intention to stabilise the soil and decrease the erosion (fig. 20a).

Fig. 20a: Results of the afforestation program on the slopes of "Akkaya" (photo E. Trummer & B. Marktl); 20b: *Lagoseris purpurea* (right, photo J. Prügger).

Discussion on afforestation program:
The Akkaya is an example for 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 subsequent tree-planting – mainly pine trees – is used all over the Mediterranean basin from Spain to Algeria, mostly with comparable results. Isolated trees survive for a certain time, but a humus layer is rarely developed (Artiyshenko & Mishnev 1978). However, regeneration processes are visible on the slopes. The bare limestone is colonised by single tussock grasses or dwarf shrubs with an extensive root system. So little by little the surface is colonised, and organic litter is accumulated around these shrubs or tussocks forming islands of rendzina. The 'colonisation front' of shrubs, herbs, and grasses is visible from a far distance. The upper slope is still susceptible to erosion and overgrazing (fig. 20a).

Site № 10: Krasnaya (Krasna) valley near Bielogorsk – Paleolithic settlements of the Neanderthals [45°06'55''N/34°36'45''E]; ca. 191 m a.s.l.; limestone debris with vegetation (figs. 21, 73)

The cliff shows remnants of carstic caves (fig. 21). Huge rocks and smaller stones were scattered all over the slope below the cliff by earthquakes. This is the reason why the artefacts of the Neanderthal people are scattered on the slope, and not preserved in the caves. The moderately grazed area shows an extremely high diversity of plant species (300–400 taxa). The dominant vegetation type is dry grassland.

Below the cliff on partly shaded places the following woody species form a dense canopy:
Clematis vitalba
Euonymus europaea
Prunus spinosa (P.p.)
Rhamnus cathartica
Rosa canina s.l.
Rubus caesius
**Ulmus minor*
Vitis sylvestris

Heavily grazed parts show open vegetation with:
**Agropyrum pectinatum*
**Carex liparocarpos*
**Dactylis glomerata* s.l.
Galium album
**Galium ruthenicum*
**Goniolimon rubellum*
**Helichrysum graveolens*
**Silene conica*
**Vinca herbacea*

Areas with less shallow soil are occupied by:
**Ajuga chia*
**Celtis glabrata*
**Inula oculus-christi*
**Linaria genistifolia*
**Sideritis montana*
**Teucrium chamaedrys*
**Thalictrum minus*

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Fig. 21: Scattered limestone rocks create a high diversity of habitats on Paleolithic settlements (photo E. Trummer & B. Marktl).

On fringes *Paeonia tenuifolia* (RDB-UA, fig. 74) is an ornamental in spring. On scattered rocks we found **Paronychia cephalotes,* and **Scrophularia rupestris*.

The species listed below form the characteristic parts of dry/semi-dry meadow communities:

Agrimonia eupatoria
Allium paniculatum
Anthemis ruthenica
**Anthriscus cerefolium* subsp. *trichosperma*
Aristolochia clematitis
Artemisia taurica
Arum elongatum
Asparagus verticillatus
Astragalus onobrychis
Astragalus tauricus
Brachypodium sylvaticum
**Bromus briziformis*
Calamintha nepeta
Campanula sibirica subsp. *taurica* (E)
Carduus uncinatus
**Carex praecox (C.caryophyllea)*
Centaurea depressa
Centaurea orientalis
**Chaenorhinum minus*
**Clinopodium vulgare*
Convolvulus cantabrica
Cornus mas
**Cynoglossum germanicum*
**Dianthus marschallii* (E)
Echium vulgare (P.p.)
Elaeagnus angustifolia
Eryngium campestre
Filipendula vulgaris
Fragaria vesca
Galium tenuissimum
Geum urbanum (P.p.)
**Helichrysum graveolens* (fig. 75)
Jurinea sordida (E)
Lapsana communis
Ligustrum vulgare
Linum austriacum
Medicago orbicularis
Onopordum acanthium (P.p.)
Origanum vulgare
Phlomis tuberosa
**Potentilla erecta* s.l.
Reseda lutea
Salvia nutans
Satureja montana subsp. *taurica* (E)
Seseli dichotomum
Stachys cretica
Taraxacum erythrospermum
T. serotinum
Thymus moldavicus
Verbascum orientale
Viola arvensis
Viola hirta

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Site № 11: Biyukkarasu river ("Big Black Waters" river) near Bielogorsk [45°07'10"N/ 34°35'50"E]; 191 m a.s.l.; gravelly island in the river with a mixture of riparian and ruderal species (fig. 76)

Great parts of the fossil river bed are covered by loess, which was probably transported by the river (fig. 24). The soil type is chernozem. The land use of the area is dominated by arable fields and orchards.
In the active zone the natural river dynamics lead to the development of gravel bars and gravel islands (fig. 22), which show a relatively low density of vegetation cover (maximum 50%).

Species list:

Acer negundo (P.p.)
Achillea millefolium agg.
**Alopecurus myosuroides*
Artemisia vulgaris
**Calepina irregularis*
Clematis vitalba
Conium maculatum (P.p., wide spread in the Crimea since 1990s, fig. 22)
Convolvulus arvensis
Cornus sanguinea
Echium vulgare
Epilobium hirsutum
Equisetum arvense
Equisetum ramosissimum
Equisetum telmateia
Conyza canadensis (P.p.)
Festuca pratensis
Lactuca serriola
Lathyrus platyfolius
Lolium perenne (P.p.)
Lycopus europaeus
Medicago lupulina
Melilotus officinalis
Mentha longifolia ×piperita
Papaver rhoeas (P.p.)
Persicaria lapathifolia
Phalaris arundinacea
Phragmites australis
Plantago lanceolata
Populus ×italica
Ranunculus repens
Reseda lutea
Rubus caesius
Rumex conglomeratus (P.p.)
**Salix alba*
Salix alba × fragilis
**Salix purpurea*
**Salix triandra* subsp. *amygdalina*
Sonchus asper
Ulmus minor
Vicia cracca

Fig. 22: An ideal spot for a training course on riparian vegetation (photo E. Trummer & B. Marktl).

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Figs. 23, 24: *Conium maculatum* on island of the Biyukkarasu river (left) and a riverbank profile (right, photos E. Trummer & B. Marktl).

1.06.2004

Travel: Simferopol – Dobroye (Dobre) village – Chatyrdag

Flora and Vegetation of the Main Crimean Ridge

Site № 12: Chatyrdag Massif [44°48'30''N/34°14'40''E]; 640 m a.s.l.; exposition 15°N, mixed broadleaved forest (figs. 25, 77)

Fig. 25: Broadleaved mixed forest stand on slopes of the Chatyrdag Massif (photo E. Trummer & B. Marktl)

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The broadleaved forest stand (coppice with standard) shows a canopy cover up to 70–80%. Every 20–25 years, the upper canopy is coppiced (*Acer campestre, Quercus petraea* and especially *Carpinus orientalis* with coppice shoots of the 2nd and 3rd generation can be seen on fig. 25).

The owner of 90% of the forest area is the state. Parts of it are leased to private persons (farmers). Small scale cutting for firewood is the predominant forest use. Since around 15 years people have started heating with gas. Before that, wood was imported from Russia. Twigs and leaves have been used for feeding cattle and goats. However, in the forest there are no signs of pollarding.

Soil profile:
This stand represents a mosaic of rendzina with brown forest soil. Litter of *Carpinus* shows a much faster decomposition because of the humid microclimate. The humus erosion seems to be an important factor on this site. Charcoal in a depth of 20 cm is a sign of former burning. HCl-test showed no Ca^{2+} in the entire soil profile. The low depth of the profile is probably correlated with intensive use of the stand.

Species list:
Acer campestre
Acer hyrcanum ssp.stevenii (E)
**Allium cyrillii* (fig. 26)
**Arum orientale* (RDB-UA, fig. 79)
Bromus ramosus
Carpinus betulus
Carpinus orientalis
Convallaria majalis
Cornus mas
Crataegus monogyna
Crocus angustifolius (RDB-UA)
Dentaria quinquefolia
Dictamnus gymnostylis
Euonymus latifolia
Euonymus verrucosa
Galium aparine (P.p.)
Galium mollugo
Geranium sanguineum
Hedera helix
Hypericum perforatum
**Lathyrus aureus* (fig. 78)
Lathyrus niger
**Lathyrus tuberosus*
**Melampyrum arvense*
Mercurialis perennis
**Poa nemoralis*
Polygonatum latifolium
**Potentilla micrantha*
**Quercus petraea* s.l.
Rosa canina s.l.
Scutellaria altissima
Sorbus torminalis
Symphytum tauricum (fig. 27)
**Tanacetum corymbosum*
subsp. *corymbosum*
Teucrium chamaedrys
**Tilia begoniifolia (T. caucasica)*
Vincetoxicum hirundinaria
**Vincetoxicum scandens*
Viscum album (often on trees; *Loranthus europaeus* is absent in the Crimea!)

Figs. 26, 27: *Allium cyrillii* (left) and *Symphytum tauricum* (right) in the forest stands of the Chatyrdag Massif (photos E. Trummer & B. Marktl)

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Site № 13: Chatyrdag Massif [44°47'3"N/37°15'31"E]; ca. 850 m a.s.l.; vegetation of the montane belt (fig. 28)

The altitudinal belt between 700 and 800 m a.s.l. is occupied by beech forest of *F. sylvatica* s.l. (fig. 28). The trees forming the canopy seem to be less tall than in comparable stands in central Europe. Shrubs occur only in gaps, under a closed canopy they are missing. The stands we visited are less species-rich than in the mixed oak forests of the lower belt. The structure resembles the managed central European beech forest types in the Prealps.
Taxonomically, *F. sylvatica* has been divided into two subspecies: *F. sylvatica* subsp. *sylvatica* and *F. sylvatica* subsp. *orientalis* (confined to southeastern Europe, and western Asia). Intermediate forms between subspecies *sylvatica* and *orientalis* have been described as species under the names *F. ×taurica* Popl. (accepted by Mosyakin & Fedoronchuk 1999), and *F. moesiaca* (K.Malý) Czecz. (Tutin et al. 1993).

Soil profile:
It is identified as a brown forest soil or luvisol with a crumbly structure. The humus layer is about 5 cm thick, the complete humus catena (O_l, O_f and O_h-layers) is developed. The discussion about the age of the profile was controversial.

Species list:
Alliaria petiolata
Arum elongatum
Arum orientale (RDB-UA, fig. 79)
Atropa belladonna (RDB-UA)
Carpinus betulus
**Dentaria quinquefolia*
**Dryopteris filix-mas*
Euonymus europaea
Euonymus latifolia
Fagus ×taurica
**Ficaria verna (Ranunculus ficaria)*
Galanthus plicathus (RDB-UA)
Galium aparine (P.p.)
Galium mollugo agg.
Galium odoratum
Geranium robertianum
Hedera helix
Mercurialis perennis
**Moehringia trinervia*
Neottia nidus-avis (RDB-UA)
Pinus kochiana
Poa nemoralis
Polygonatum latifolium
Primula acaulis
Cerasus avium (Prunus avium)
Sambucus nigra
**Scrophularia scopolii*
Ulmus glabra
Urtica dioica

Fig. 28: *Fagus sylvatica* s.l. stands on the northern slopes of the Chatyrdag Massif (photo B. Prots)

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Site №14: Chatyrdag Massif, yaila plateau; [44°48'02"N/34°17'26"E]; 985–1000 m a.s.l., yaila (fig. 80)

Yaila ("Jaila", "Yayla", in Tatarian "summer mountain pasture") is the plateau-like deforested high-mountain karst surface of the Main Crimean Range. It is covered with a specific "mountain meadow steppe" and scattered trees (fig. 80). The site has a very high diversity, about 500 species. The flora of the yailas is rich in narrow endemics. No grazing has been permitted on these stands since 1917 (Yena et al. 2004). This is one of the reasons why a large number of species of the primary vegetation could survive. Soil erosion in the eastern yailas increased as a consequence of previous overgrazing. After the end of grazing, the succession to woody vegetation started.

Due to heavy rain we visited the "Emine Bair Khosar" cave first (fig. 29).

After the cave excursion we had a walk on Yaila steppe (fig. 80).

The plateau is characterized by karst phenomena. Caves and depressions are characteristic for this type of chemical weathering. Groups of *Populus tremula* show the better water capacity of the soil in these small depressions.

Fig. 29: Magnificent creations in the "Emine Bair Khosar" cave in the Chatyrdag Massif (photos B. Prots)

Species list:

Acer hyrcanum subsp. *stevenii* (E)
Ajuga genevensis
Allium paniculatum
Allium saxatile
**Androsace villosa* subsp. *taurica* (E)
**Anthyllis biebersteiniana* (*A.vulneraria* subsp. *pulchella;* fig. 82)
**Asperula supina* subsp. *caespitans* (E)
Asplenium ruta-muraria
**Bromus erectus*
Carex humilis
**Carex michelii*
**Cerastium biebersteinii* (E; RDB-UA)
Cerastium schmalhausenii
Ceterach officinarum
**Cotoneaster integerrimus* (fig. 31)
**Cornus mas*
**Crategus monogyna*
**Cruciata taurica*
**Erysimum cuspidatum*
Filipendula vulgaris
Fragaria vesca
Geranium sanguineum
Heliotropium suaveolens
**Juniperus hemisphaerica* (*J. communis* subsp. *hemisphaerica*)
Juniperus sabina
**Koeleria brevis (K.lobata)*
**Luzula multiflora*
Minuartia hybrida
**Minuartia taurica* (E)
Muscari neglectum (fig. 81)
**Orchis morio* (RDB-UA)
**Ornithogalum fimbriatum*
**Paronychia cephalotes*
**Pedicularis sibthorpii*
Poa taurica (E)
**Polygala minor*
Populus tremula
**Potentilla depressa*
Potentilla umbrosa

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**Prunus spinosa*
Pulsatilla halleri subsp. *taurica* (E) (RDB-UA)
**Rosa pimpinellifolia*
Sanguisorba minor
Saxifraga irrigua (E, fig. 30)
**Saxifraga tridactylites*
**Scleranthus annuus* subsp.*annuus*
**Scorzonera crispa* (*S.austriaca* subsp. *crispa)*
**Sedum acre*
Sedum album
Sedum hispanicum
**Sorbus graeca*
Stipa capillata (RDB-UA)
Stipa eriocaulis subsp. *lithophila* (E) (RDB-UA)
**Stipa pulcherrima*
**Tephroseris jailicola* (E)
Thalictrum minus
**Thymus dzevanovskyi* (E)
Thymus tauricus
Trinia glauca
**Veronica gentianoides*
Veronica nemorosa
Veronica taurica (E)


Figs. 30, 31: *Saxifraga irrigua* (endemic, left) and *Cotoneaster integerrimus* (right) on the Chatyrdag Yaila (photos E. Trummer & B. Marktl)

Soil profile:
Soil is recovering slowly after the end of grazing, however rendzina is still dominant as a consequence of overgrazing.

Site № 15: Yaila Plateau; [44°47'51''N/34°17'18''E]; 980–985 m a.s.l., woodlands of the upper part of the Chatyrdag Yaila slopes (figs. 32, 83).

Snowdrift is a main factor for the development of woodland on this stand.

Species list:
Acer campestre
**Ajuga genevensis*
Carpinus betulus
Convallaria majalis
Cornus mas
**Cotoneaster integerrimus*
Crataegus monogyna
**Euphorbia amygdaloides*
Fagus ×taurica
Festuca rupicola
Galium odoratum
**Gentiana cruciata*
Geum urbanum
Lamium maculatum
**Melica nutans*
Melica taurica
Mercurialis perennis
Ornithogalum fimbriatum
Poa nemoralis
Polygonatum latifolium
Polygonatum multiflorum
Potentilla micrantha
Primula acaulis
**Quercus petraea* s.l.
**Q.dalechampii*
**Tilia begoniifolia (T. caucasica)*

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Fig. 32: Group visit of woodlands of the upper part of the Chatyrdag Yaila slopes in a heavy rain (photo E. Trummer & B. Marktl).

2.06.2004

Travel: Simferopol-Alushta.

Alushta is situated in a wide amphitheatre-like landscape (Yena et al. 2004). On the southern coast near Gurzuf the intrusive massif of Ayudag is widely visible. It represents one of the rocks of the Cimmeridian magmatic cycle along the south coast phase (Nalivkin 1973). Both Alushta and Gurzuf were founded by Byzantines in the 5th century AD.

Travel: Alushta–Yalta

Flora of the West Crimean submediterranean Coast

Site № 16: Nikitsky Botanical Garden and the Arboretum (figs. 84, 85)

History
The first settlement in the area of the village of Nikita was founded by Greek colonists, like many other settlements in the southern part of the Crimean peninsula.
In 1811, by the order of Tsar Alexander I, "The edict of the establishment of the Imperial Botanical Garden in the Crimea using public cost" was signed. In 1812, 5 acres of land were bought near Nikita (6 km east of Yalta). The Finnish botanist Christian Steven (1781–1863) was appointed as the first manager of the Nikitskiy Botanical Garden (NBG). During the following 14 years Steven gathered more than 450 plant species and hybrids from all around the world.

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Steven transferred his herbarium collection to Helsinki University, where it is still stored. Later the Russian botanist E. Wulff founded a new herbarium at NBG in 1914.
At present the Garden belongs to the Ukrainian Academy of Agrarian Sciences. On 13 January 2000 the NBG was given the status of the National Research Centre of Ukraine to promote the development of science on preserving plant diversity. The staff numbers about 1000, among them are 130 research scientists. It has strong scientific and business links with other botanical gardens and commercial plant nurseries.
Established on picturesque terraces on slopes descending to the Black Sea, the NBG is considered one of the finest gardens in Europe. Today it covers an area of 147,9 hectares (together with associated gardens in the Crimean and Kherson regions around 880 hectares). Its parks comprise more than 28 000 species, and forms of plants from around the world. Many trees and plants originate from the region, for example the amazing 1000 years old *Pistacia mutica* or the 500 years old *Quercus pubescens* and *Taxus baccata*. During its existence the Nikitsky Botanical Garden has introduced more than 360 species into culture. The Garden hosts about half a million visitors annually.

Arboretum
The Arboretum of the Nikitsky Botanical Garden (fig. 85) covers about 40 hectares. It consists of four parts (parks): Upper, Lower, Seaside, and “Montedor”.
Usually the excursions in Nikitsky Garden begin in the Upper Park, which houses several giant tree species. The visitors are attracted by the shape of a great beautiful avenue of cypresses (*Cupressus sempervirens*). It is one of the most common trees in the Mediterranean basin and has been planted in 1886. This species was introduced twice in the Crimea, first by ancient Greek settlers, and a second time in the 18th century. The huge giant sequoiadendron (*Sequoiadendron giganteum*) on the opposite side of the avenue was planted already in 1858, five years after the introduction in Europe. Near the rosary another giant tree *Sequoia sempervirens* offers welcome shade for visitors during hot days. In this part of the garden, a 500 years old oak *Quercus pubescens* reminds of the former local relict forests.
The Lower Park is the oldest part of the park. It was founded in 1812. A large number of the tree species (*Pinus halepensis, Sequoia sempervirens, Cedrus atlantica, Cedrus deodara, Quercus ilex, Cupressus sempervirens,* etc.) planted between 1812–1861 are still in good state. Fruit trees like *Olea europaea, Ficus carica, Punica granatum, Eriobotrya japonica,* etc., were also very important during the initial period of the garden. This is one of the few places in the Crimea where olive trees survived the Soviet revolution period of 1917. Apparently olive cultivation here did not develop like in the Mediterranean countries, because the olive was designated as a “bourgeois” tree. For some reason other fruit trees, like fig, almond and others were not labelled in this way. So, the fresh home-grown figs and almonds are on sale in the Crimean markets, but not olives. The old trees of small-fruited strawberry-tree (red strawberry-tree) *Arbutus andrachne* are the most interesting here. Beside the fruit trees, a Californian oak, *Quercus agrifolia,* was planted in 1860. This species is still very rare in silviculture, and cannot be met anywhere else in Ukraine.
The Seaside Park is best protected by the neighbouring mountain crests, the climate is milder here, therefore all the warmth demanding palms like *Trachycarpus martiana, Chamaerops humilis, Phoenix canariensis* and others as well as numerous brightly blooming subtropical shrubs are presented in this part of the garden. It was established between 1912 and 1914 for the centenary of the founding of the garden.
West of the Seaside Park, the park “Montedor” is situated on the Cape Montedor, where indigenous species like downy oak or tall junipers grow together with relic and exotic coniferous species. Here one can also admire the plantings of Pitsunda pine (*Pinus brutia* var. *pityusa* (*Pinus pityusa* var. *stankewiczii*) included in the Ukrainian Red Data Book). The plantations of this tree are located at the Cape Aya in the west, and in the Novy Svet in the east.

The most abundant trees in the arboretum:

Arbutus andrachne (RDB-UA)	*Juniperus sabina*
Aucuba japonica	*Laurus nobilis*
*Cedrus atlantica (*incl. f. *pendula)*	*Magnolia grandiflora*
Cupressus sempervirens and other species	*Nerium oleander*

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Olea europaea
Pinus spec. (large collection)
Pistacia mutica (RDB-UA)
Platanus orientalis
Quercus ilex
Quercus pubescens
Rosa spec. (large collection)
Taxus baccata (RDB-UA)
Trachycarpus fortunei
Viburnum tinus

Walk from the Botanical Garden to the Nature Reserve "Cape Martyan"

Along the roadside between the carpark of the garden and the reserve the following species have been observed:
Ailanthus altissima (P.p.)
Bituminaria bituminosa
Bupleurum fruticosum (P.p.)
Carpinus orientalis
**Cistus tauricus* (RDB-UA)
**Clematis flammula*
Fraxinus ornus
Juniperus excelsa (RDB-UA) (stabilise the steep slope)
Juniperus oxycedrus
Rhamnus alaternus
Ruscus ponticus

Soil profile:
The exposures along the road show submediterranean "Terra fusca" (A_h–B_vT–C_v-) soil profiles. Parts of the steep slope show features of a landslide, the B-horizon is missing. The A-horizon is 5 to 6 cm thick, and covered by a thin humus layer.

Fig. 33: Urbanization makes serious changes of the Nikita Botanical Garden vicinities and seashore (photo B. Prots).

The view point ("Tsar Place", 110 m a.s.l.) gives a panoramic view of the surroundings of the southern part of the Nikita Botanical Garden (fig. 33).

A fragment of the moist and shadowed place:
Carex pendula
Juncus inflexus
**Phalaris minor*
Solanum nigrum

Through the reserve we were guided by the Senior Research Scientist of the Nikitsky Botanical Garden, Dr. Yekateryna Krainyuk.

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Site №17: Nature Reserve "Cape Martyan" (figs. 35, 36, 86, 87).

East of the Seaside Park the "Cape Martyan" Nature Reserve with an area of 120 hectares is located. More than 500 species – rare trees, shrubs and grasses – grow under natural conditions.
The Nature Reserve is situated of 300 m a.s.l. and surrounded by a fence (fig. 34). Access is possible only at two places, usually not open to the public. The Protected Area 'Cape Martyan' was founded in 1973. Around 20% of the Crimean Mountain Flora occur here, including 537 flowering plants (40 of them rare, 30 of them endemic to the Crimea), 3 fern species, e.g., *Adiantum capillus-veneris,* RDB-UA), 35 moss species, 259 lichen species, and *c.* 200 basidiomycete fungi .
One part is reported as a virgin juniper forest, with tree individuals up to 500–600 years old (fig. 87). The population of about 3000 individuals of small-fruited strawberry trees is one of the largest in the Crimea. Three relic tree species (*Juniperus excelsa, Arbutus andrachne,* and *Pistacia mutica*) and all orchids (e.g., lizard orchid *Himantoglossum caprinum*) are included in the Ukrainian Red Data Book.

Fig. 34: Group entered into the Nature Reserve "Cape Martyan", which is protected by a fence (photo E. Trummer & B. Markt l).

The fauna of the reserve is also very original. There are 15 species of mammals, and 150 species of birds. 11 species of the fauna are included in the Ukrainian Red Data Book, Crimean gecko and leopard woodsnake are on the International Red Data List. The area of the Black Sea, which is adjoined to the Cape Martyan is also under protection. More than 200 species of fish, molluscs and crabs live here. In the summer there is little shadow in the juniper forest, the air is heated, and loud singing of cicadas can be heard everywhere. The Reserve is a unique monument of the ancient Crimean nature.
Highest priority is dedicated to the habitat of *Juniperus excelsa* (fig. 87), which grows here naturally together with *J. oxycedrus* and *Quercus pubescens*. The forest management has been terminated due to the establishment of the reserve. Originally *Juniperus* had a wider distribution and formed a belt on the southern Crimean coast. Today the population at Cape Martyan still shows a well preserved age structure and a sufficient regeneration.

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In the Nature Reserve only a few alien species like *Bupleurum fruticosum* (escaped from the Nikitsky Botanical Garden, first reported in the 1950s) occur. The open woodlands in the Reserve are dominated by *Quercus pubescens* and evergreen tree species.

Species list:

Achnatherum bromoides
Arbutus andrachne (RDB-UA, fig. 37, 86)
Arceuthobium oxycedri
Buxus sempervirens (alien)
Carpinus orientalis
Cistus tauricus (RDB-UA)
Clematis flammula
Colutea cilicica
Coronilla emeroides
Dictamnus gymnostylis (fig.88)
Hedera helix
Hesperis steveniana
Jasminum fruticans
**Juniperus excelsa* (RDB-UA)
Juniperus oxycedrus
Pistacia mutica (RDB-UA, fig. 38)
Rhamnus alaternus (suspected alien)
**Ruscus ponticus* (high abundance, fig. 40)

Arbutus andrachne is the only aboriginal evergreen tree of *Angiospermae* in the Crimea. The severe drought in 1993/94 provoked a fall of leaves of *Arbutus*. Along the seashore the situation was less problematic. The seeds are dispersed by birds, an important factor for the survival of the population.
Another interesting endemic, *Taraxacum hybernum* flowers during autumn, and early winter, sprouting of leaves occurs after flowering. During the Soviet period, the plant was used for gaining natural rubber, but the production was not successful.

Figs. 35, 36: High plant, and animal diversity in the "Cape Martyan" is caused by a broad range of environmental conditions: extreme dryness (south slope, left) and moisture of running stream (right, photos B. Prots).

On rocks:

Elytrigia scythica
**Elytrigia nodosa*
Epipactis helleborine (RDB-UA)
Fumana procumbens
Fumana viscidula
Lathyrus aphaca
Limodorum abortivum (RDB-UA)
Rhus coriaria (Shumac, Sicilian sumac, valuable spice in East)
Seseli dichotomum
Teucrium chamaedrys
Thymus callieri

Soil profile:

As a consequence of the preserved stand a very thick weathering horizon is developed.

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The soil type is related to “Terra fusca” (fig. 39). The column structure is regularly connected with high clay content. The orange to reddish colour proves that the weathering horizon has developed during warmer and moister conditions than today. The profile shows no sign of human activity over a long period (no eroded horizons).

Discussion on soil profile:
The soil cover consists of a mosaic of cambisols or rendzinas, in this case more a histic rendzina showing disturbances in the surface formation. The thick O_l/O_f-layer in creases the fire risk during the hot season.

Figs. 37, 38: Extreme rare trees of Ukraine, *Arbutus andrachne* (left) and *Pistacia mutica* (right) (photos B. Prots)

Fig. 39: Upper part of the soil profile of the Nature Reserve “Cape Martyan” (left, photo B. Prots).
Fig. 40: The dominant *Ruscus ponticus* in the “Cape Martyan” (right, photo B. Prots).

Additional species list:
Aegonychon purpureocaeruleum (*Buglossoides purpurocaerulea*)
Bituminaria (Psoralea) bituminosa
Brachypodium rupestre
Bromus sterilis
Carex cuspidata
Carpinus orientalis
Cirsium laniflorum (E)
Cotinus coggygria
Dactylis glomerata
Festuca rupicola s.l.
Laser trilobum
Ligustrum vulgare
Limodorum abortivum (RDB-UA)
Medicago falcata
Orobus laxiflorus
Polygala major
Ruscus ponticus (seeds have been used as a surrogate for coffee; fig. 40)
Sorbus torminalis

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Site № 18: Yaltinskiy Mountain Forest Reserve; [44°31'5''N/34°11'5''E]; 510–530 m; Exposition: S to SW (figs. 41, 89)

Drive to the southwest exposed slopes of the Yaltinskaya (Yaltynska) Yaila up to 500 m a.s.l.

The total number of vascular plants in the Reserve amounts to 1400 species. *Carpinus orientalis* is one of the dominant deciduous woody species at altitudes between 300–400 m a.s.l. Starting from 500 m a.s.l. upwards, the vegetation cover changes, and *Pinus pallasiana* becomes more prominent, on steep slopes with rendzina soils even dominant (fig. 41). Deciduous tree species are restricted to the lowest parts of the slopes with colluvial soils.

Figs. 41, 42: *Pinus pallasiana* stand (left) and *Paeonia daurica* (right) in the Yaltinskiy Mount-Forest Reserve (photos E. Trummer & B. Marktl).

Upper tree layer:
Fagus ×taurica
Pinus kochiana
Pinus pallasiana (dominant; called as "lungs of the Crimean resort"; suffer from the fire; figs. 41, 89)

Lower tree and shrub layers:
Acer campestre
Carpinus orientalis
Clematis vitalba
Cornus mas
Crataegus monogyna
**Evonymus verrucosa*
Frangula alnus
Hedera helix
Jasminum fruticans
Juniperus oxycedrus
Ligustrum vulgare
Prunus mahaleb
**Pyracantha coccinea*
Quercus pubescens
Rubus fruticosus agg.
**Sorbus domestica*
Sorbus torminalis

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Herb layer:
Aegonychon purpureocaeruleum
(Buglossoides purpurocaerulea)
Brachypodium pinnatum
**Carex flacca*
**Carex halleriana*
**Centaurea declinata*
**Cephalanthera longifolia* (RDB-UA)
Cirsium laniflorum (E)
Clinopodium vulgare
**Cruciata taurica* subsp *taurica*
Dorycnium intermedium
Euonymus verrucosa
**Euphorbia amygdaloides*
Filipendula vulgaris
**Galium album*
Geranium sanguineum
Hieracium cf. murorum
Lathyrus aureus
Neottia nidus-avis (RDB-UA)
**Paeonia daurica* (RDB-UA, fig. 42)
(*P. mascula* subsp *triternata*)
**Platanthera bifolia* (RDB-UA)
Polygala major
**Polygonatum odoratum*
Primula acaulis (P. vulgaris)
Prunus mahaleb
Pteridium aquilinum subsp. *brevipes*
Pyrola chlorantha (glacial relict)
Quercus pubescens
Salvia grandiflora
**Laser trilobum (Siler trilobum)*
Sorbus torminalis
**Tamus communis*
**Teucrium chamaedrys*
**Vicia cracca*

Soil profile:
The calcareous bedrock is covered with litter of needles (O_l, O_f). There is no O_h-horizon, and a humus rich horizon A_h is only present in thin layers. Besides the warm, and moist conditions, high activity of mites, and ground beetles are the reason for a quick decay of litter. The soil type is Moder-Rendzina, (AC-Profile).

Pinus pallasiana is well adapted to periodical fire due to its thick bark. This has been seen on the forest edge of this site. The bark is black but the trees are still growing.

Drive back to Simferopol.

3.06.2004

Drive from Simferopol to the east via Bielogorsk, and Koktebel to the Karadag Mountain.

Flora and Vegetation of the East Crimean submediterranean Coast

Site № 19: Karadag Nature Reserve ("nature reserve","Zapovidnyk" in Ukrainian, "Zapovyednik" in Russian – IUCN category I – strict nature reserve/wilderness area):, 44°55'01"N/35°12'28"E; 63 m a.s.l. (at the starting point near the office of the Reserve; figs. 43, 46, 47, 90, 91).

The reserve was founded in 1979 and comprises a total area of 2000 hectares (plus *c.* 900 hectares of the adjacent sea area). Karadag is a dead volcano of Jurassic age. It houses around 1200 species of vascular plants. This is about half of the species occurring all over the Crimean peninsula (including 8 *Stipa* species).

Visitors are allowed to enter the area of the reserve only in the course of a guided tour. Dr. Michail Beskaravayny, an ornithologist, guided us on a 7 km path through a landscape of mesozoic/tertiary volcanic origin. The path begins at the village of Kurortnoye, continues across the reserve leading to the Sphinx point (highest point of our tour: 352 m a.s.l.; fig. 46) and ends in the village of Koktebel. The weathering process shaped rock formations up to 330 m high. The lower parts of the reserve are dominated by *Quercus pubescens*. Around the middle of the 20th century wild boar and squirrel were introduced in the Crimea. The alien tree *Acer tataricum* was recorded first at the Karadag Nature Reserve in 1985. Since that time it occurs sporadically, sometimes causing problems for native species.

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Fig. 43: Some forest areas of the northern part of the Karadag Nature Reserve have been afforested by *Pinus pallasiana* plantations after destructions by fire (photo B. Prots).

Figs. 44, 45: *Cotinus coggygria* (left) and *Sedum hispanicum* (right) in the southern part of the Karadag Nature Reserve (photos E. Trummer & B. Marktl).

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Along the path through meadows, orchards and scrub we observed the following species:

Acer tataricum (P.p.)
Agrimonia eupatoria
Anthriscus cerefolium
Artemisia taurica
Beta trigyna
Centaurea orientalis
Centaurea solstitialis
Convolvulus cantabrica
Cotoneaster tauricus (E)
Dactylis glomerata
**Dianthus capitatus*
Eryngium campestre
Fraxinus excelsior
Fraxinus oxycarpa
Jasminum fructicans
Juniperus excelsa (RDB-UA)
Koeleria lobata
Limonium latifolium
Linaria genistifolia
Onosma polyphylla (RDB-UA)
**Petrorhagia prolifera*
**Pistacia mutica* (RDB-UA)
**Silene otites* subsp.*wolgensis*
**Stipa lessingiana* subsp. *lessingiana* (RDB-UA)
Veronica teucrium

First stop: 44°55'04''N, 35°13'12''E; 136 m a.s.l.

In the rocky part:

Acer hyrcanum subsp. *stevenii* (E)
**Acer tataricum*
Aegonychon purpureocaeruleum
**Agropyrum cristatum* subsp. *ponticum* (E)
**Allium cyrilli*
Anacamptis pyramidalis (RDB-UA, fig.93)
Anthemis tranzscheliana (E)
**Artemisia caucasica*
Arum orientale
**Centauria diffusa*
Cornus mas
Cotinus coggygria (fig.44)
**Crataegus pojarkovae* (*Crataegus laciniata* subsp. *pojarkovae*) (E; RDB-UA)
Echium popovii (E, fig.92)
**Ephedra distachia* subsp. *distachia*
Fragaria vesca
**Fraxinus oxycarpa* s.l.
Geranium molle
Hesperis steveniana
**Isatis littoralis*
Juniperus oxycedrus
Lamium maculatum
**Onosma taurica*
Ornithogalum woronowii
**Milium vernale*
**Pyrus elaeagnifolia*
**Pseudolysimachion spicatum*
**Quercus* cf. *dalechampii*
**Quercus pubescens*
Salvia aethiopis
**Scandix pecten-veneris*
Sedum hispanicum (fig. 45)
Stachys germanica
**Stipa ucrainica* (RDB-UA)
Tanacetum corymbosum
Teucrium chamaedrys
Tragopogon pratensis
**Vicia angustifolia*
**Vicia sativa*
**Ulmus minor*

Figs. 46, 47: Wind and sea impact on south seashore rocks: Sphinx point (left) and Golden Gate (right) of the Karadag Nature Reserve (photos B. Prots).

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Drive to the southwest to Sudak, an old Genoese fortress (fig. 48).

The town was founded in 212 AD right on the Great Silk Route. “Sudak” is derived from the ancient Irani word “sugda”, which means “saint”. The town entered the Byzantine Empire, then Seljukian Turkey, Golden Horde, Venice dominance, Genoese dominance, Ottoman Empire, Russian Empire. There are remnants of a famous fortress that is traditionally called Genoese because the most important period of its history was connected with Genoese dominance (XIV–XV century).

Fig. 48: Settlements of the city of Sudak on foothill of the Genoese fortress (photo B. Prots).

Drive to the north to cross the Crimean Mountain Range.

Site № 20: North of Sudak, [44°57’912’’N/34°57’79’’E], 400 m a.s.l.; thermophilous mixed deciduous forest

The thermophilous forest is dominated by *Quercus pubescens, Q. petraea* s.l., *Fraxinus oxycarpa* s.l.*, Tilia cordata,* and *Carpinus orientalis*. The lower part of the slope is situated near a small river.

Species list:

Acer campestre
Aegonychon purpureocaeruleum
**Ajuga laxmanii*
**Anacamptis pyramidalis* (RDB-UA)
Arum orientale
**Carex digitata*
Carpinus betulus
Carpinus orientalis
Cephalanthera longifolia (RDB-UA)
Cornus mas
Cotinus coggygria
Crocus angustifolius (RDB-UA)
**Dactylis glomerata*
**Dentaria quinquefolia*

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Dictamnus gymnostylis
**Epipactis helleborine* agg. (RDB-UA)
Euonymus verrucosa
Euphorbia amygdaloides
Fagus ×taurica
**Fraxinus oxycarpa* s.l.
Galanthus plicatus (RDB-UA)
Galium aparine
Galium mollugo agg.
Geum urbanum
Hedera helix
Laser trilobum
**Lathyrus aureus*
Lathyrus niger
Lathyrus tuberosus
Ligustrum vulgare
Listera ovata (RDB-UA)
Mercurialis perennis
Neottia nidus-avis (RDB-UA)
**Ophioglossum vulgatum* (RDB-UA)
Ornithogalum vulgaris
Paeonia daurica (RDB-UA)
**Piptatherum virescens*
(Oryzopsis virescens)
Platanthera chlorantha (RDB-UA)
Poa nemoralis
**Polygonatum latifolium*
**Polygonatum odoratum*
Prunus armeniaca (naturalized)
Prunus avium
**Quercus petraea* s.l.
Rhamnus frangula
**Smyrnium perfoliatum*
Sorbus torminalis
**Tilia begoniifolia*
**Vincetoxicum scandens*
**Viola hirta* agg.

Seashore Flora and Vegetation

4.06.2004

Site № 21: Western coast, south of Eupatoriya, 45°11,100'N/33°26,008'E; 1 m a.s.l., seashore vegetation (figs. 49, 50, 94).

The sandy bar south of Eupatoriya represents the beach-belt system of overused sandy coasts. The littoral consists of a zone of algae and mussel shells, and an offshore part spoiled by garbage left behind by visitors and transported by the tides.

In the upper part of dunes:
Anthemis dubia (E)
**Astragalus varius* (fig. 95)
**Elytrigia elongata*
**Ephedra distachya*
**Eryngium maritimum*
Goniolimon rubellum
Gypsophila paniculata
Leymus racemosus
**Limonium meyeri*

Figs. 49, 50: Seashore vegetation stands dominated by *Elymus elongatus* (left) and *Cakile euxina* (right) near Eupatoriya (photos B. Prots).

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It is a typical ruderal seashore ecosystem with still many rare elements of coastal flora, which is driven by permanent natural stress and human impact. Therefore, the coastal system represents the most endangered group of the Crimean vegetation because of the following reasons: (1) linearity of stands, (2) restricted ecology, and (3) general threat of being transformed into a tourist resort area (Czopik & Yena 1999).

Other species found there:

**Alyssum tortuosum* (fig. 96)
**Anthemis sterilis* (E)
**Artemisia arenaria*
Asparagus maritimus
Astragalus varius
Astrodaucus littoralis (RDB-UA)
**Cakile euxina (C. maritima* subsp. *euxina)*
Centaurea caprina (E)
**Convovulus lineatus* (fig. 51)
Crambe maritime (fig. 52)
Cynanchum acutum
**Echium italicum*
**Elymus elongatus*
Erysimum maritimum
Euphorbia paralias
**Euphorbia segueriana*
Gypsophila paniculata
Gypsophila trichotoma
**Lactuca tartarica*
**Linaria sabulosa* (RDB-UA)
**Plantago lanceolata*
**Senecio vernalis*
Tournefortia sibirica (Argusia sibirica)

Figs. 51, 52: *Convovulus lineatus* (left, photo E. Trummer & B. Marktl) and *Crambe maritima* (right, photo B. Prots) as a component of seashore vegetation near Eupatoria.

Visit: Eupatoriya and Karaim temple

Eupatoriya is the cultural centre of the west coast of the peninsula. In the VIth century BC, the settlement Kerkinitida was founded by Greek colonists. Remnants of walls from this period as well as from the Scythian period are preserved. The city lost its importance after being conquered by the Huns. At the end of the XVth century, the settlement was again fortificated, now well known under the name of Geslev. The name Eupatoriya was given by Catherine II, although the new settlement was located on the opposite side of the bay.
Today the cultural life is extraordinary. As an example the Karaims need to be mentioned. They are of turkish origin with their own religion and language. They probably are derived

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from Khasars. Their religion is based on the Old Testament and close to the Jewish, but rejects the interpretations of the Talmud. It also contains elements from Christian and Islamic tradition. The language belongs to the Turk family. Since 1837 Eupatoriya is the spiritual centre of the Karaims, but unfortunately the number of members is decreasing rapidly. Today only 2000 members of this group are left. The Eupatorian Karaim temple (figs. 53, 54, 55) is the single religious remnant of the Karaim tradition.

Fig. 53: Entrance into the Karaim cultural centre area in Eupatoriya (photo B. Prots).

Figs. 54, 55: The yard of the Karaim cultural centre (left) and Karaim temple (right) in Eupatoriya (photos B. Prots).

5.06.2004

Flight departure Simferopol – Graz in the early morning

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5. Floristic diversity of the Crimean peninsula

The Crimea is a globally and regionally important centre of biodiversity. The region's vascular flora, numbering *c.* 2700 species (incl. 127 endemics, Yena 2005a), represents 60% of the Ukrainian flora. In addition, *c.* 300 species of bryophytes and 486 species of macromycetes (Sarkina 2001) are reported, as well as 897 species of lichens (Khodosovtsev 2004).

The Crimea is one of the nine European regions – and the only area in Ukraine – that has been designated by the International Union for Conservation of Nature (IUCN) as a centre of exceptional floristic diversity (WWF & IUCN 1994). The Red Data Book of Ukraine lists 439 species of vascular plants (Shelyag-Sosonko 1996), 173 (39.4%) of which are found in the Crimea (Yena 1999).

The history of study on the vascular flora of the Crimea began with the first list of species by Hablitz in 1785. It can be divided into eight periods represented by the outstanding florists Hablitz, Pallas (XVIII century), Bieberstein, Steven, Aggeyenko (XIX), Wulff, Rubtzov, Golubev (XX) (Yena 2005b). Despite considerable changes in the number of species and subspecies during the last decades, a new revision of the Crimean vascular plant diversity estimates 2700 taxa.

The Crimea's plant diversity is similar to that of Sicily (Italy) and Peloponnese (Greece) or areas of comparable size in the Mediterranean basin.

The Crimean flora includes 6 species of Equisetophyta, 34 Polypodiophyta, and 13 Pinophyta. No Lycopodiophyta have been recorded. The Magnoliophyta contain more than 100 families. The most species-rich families are presented in table 2.

Phytogeographically, the Crimean vascular flora can be divided into 35 geographical elements. The most important among them are Pontic, Holarctic, Palearctic, but more than half of the flora belongs to the Mediterranean group (in a broad sense, Golubev 1996). Many taxa are considered as relicts of the Tertiary (or pre-glacial), and the Quarternary (glacial). Some species very common throughout the Holarctic but very rare in the Crimea are Quarternary relicts, e.g., *Equisetum fluviatile, Trientalis europaea, Lamium album,* and *Betula pendula*. Some Tertiary relicts have got restricted populations, among them *Cheilanthes acrosticha, Arabis verna, Pinus pityusa,* and *Arbutus andrachne*. The flora of the Crimean Mts. contains 90% of the peninsula's vascular plants.

№	Family	Number of genera	Number of species, and subspecies (incl. native)
1.	*Asteraceae**	86	332 (309)
2.	*Fabaceae*	37	246 (235)
3.	*Poaceae**	83	223 (215)
4.	*Rosaceae*	26	155 (148)
5.	*Brassicaceae**	55	144 (136)
6.	*Lamiaceae*	33	135 (122)
7.	*Caryophyllaceae*	32	104 (102)
8.	*Scrophulariaceae*	20	99 (94)
9.	*Apiaceae**	48	96 (91)
10.	*Cyperaceae**	8	64 (63)

Table 2: Ten richest families of the Crimean flora (Golubev 1996; Yena et al., 2004)

Eight species have become extinct in the Crimea: *Pteris cretica* (suspected alien, the only evidence from XIXth century), *Ornithogalum boucheanum*, *Caltha palustris* (leg. Steven in XIXth century), *Iberis pinnata*, *Calystegia soldanella*, *Echinophora sibthorpii*, *Cymbochasma borysthenica* (extinct in the middle of XXth century), and *Zingeria biebersteiniana*. Not surprisingly, two taxa (*Calystegia soldanella*, *Echinophora sibthorpii*) strictly coastal, and critically endangered in Ukraine anyway.

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The ratio between native and aliens is 12:1 (excluding ephemerophytes). The spread of alien species continues. Some species were found just in the early XXIth century (*Phalacroloma annuum* subsp. *annuum*, *Echinocystis lobata*, *Impatiens parviflora*) (Yena 2004a, 2004b).
Endemics are the most unique, valuable and fragile part of any regional flora. The Crimean Peninsula serves as an illustrative and instructive example of the substantial taxonomic and geographic difficulties connected to regional endemics. Estimates of the number of Crimean endemics have been revised more than 30 times during the last 150 years. They varied between 10 and 300 species. Recent investigations (Yena 2001a, 2003) stated that the flora of the Crimea includes 127 endemic species, and subspecies. Many of them are neo-endemics (young taxa), like *Campanula sibirica* subsp. *taurica*, several *Centaurea* species, *Sideritis syriaca* subsp. *taurica*, *Stipa eriocaulis* subsp. *lithophila*. A few taxa are considered to be paleo-endemics with no closely related species in the region (*Rumia crithmifolia, Lamium glaberrimum, Saxifraga irrigua, Daphne taurica*). The richest genera in endemic species are *Anthemis, Centaurea, Minuartia, Crataegus* (5–7 species of each genus); Alchemilla is rich in endemic microspecies (10); previous data on high endemism of *Stipa, Thymus,* and *Rubus* are disclaimed.
All but two Crimean endemics are taxa of the mountains. Being on the margin of the mediterranean climatic zone, the Crimea possesses levels of endemism similar to those of other submediterranean areas (e.g., Central Balkan Mountains), rather than truly mediterranean regions (e.g., Sicily). Nonetheless, the level of endemism in the Crimea is the highest for any region of Ukraine and contrasts with the Carpathian mountain system with only 16 endemics (Tasinkevych 2003).

6. Nature Conservation

The Crimea is an extremely attractive place for tourism. In 2005, more than 6 million people visited this “museum of nature”, which leads to major ecological problems. The number of protected areas accounts for more than 160, that is about 5% of the peninsula’s territory. Among these protected areas, there are six Nature Reserves (Crimean, Yaltinskiy, Martyan Cape, Karadag, Kazantip and Opuk), 35 Local Reserves, 74 Nature Monuments, 38 Landscape Architectural Monuments (including memorials, parks, and botanical gardens), and nine protected stows. Most of them are located in the Crimean Mts. and the Crimean submediterranean region, the landscapes with the most unique, and fragile nature.
The establishment of the National Park “Tavrida” has been proposed since the 1960s by V. G. Yena (Yena et al. 2004). It should implement sustainable principles for regional management. The National Park “Tavrida” will raise the proportion of protected area in the Crimea to the IUCN-recommended level, i.e., 10% of the whole peninsula.

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Fig. 56: Vegetation map of the Crimea: Colour code: 1–5: agricultural fields of different regions, 6: genuine forb-Stipa steppe of foothills of the Crimean mountains, 7: meadow steppe with *Stipa* spp., 8: mountain meadow steppe, 9: floodplain meadow of steppe zone with vegetation of salty habitats, 10: vegetation of solonchak, and semi-deserted steppe in complex of poor forb-steppe, 11: vegetation of steppes, and meadows on salty soils, 12: forests with *Quercus pubescens,* and transformed types with *Carpinus*, 13: scattered forest of *Quercus petraea* in complex of savanna habitat types, 14: forests with *Quercus petraea* in complex with *Fraxinus* sp. and *Acer* sp., 15: *Fagus* forests in complex with *Carpinus,* and *Acer hyrcanum* subsp. *stevenii*, 16: forests with *Pinus* spec., especially *P. pallasiana,* and *P. kochiana*, 17: *Juniperus*-dominated scattered habitats, 18: urbanized habitats (Atlas of the Autonomous Republic of the Crimea. Version 4.1 CD. Institute Peredovykh technolohiy, 2000–2003).

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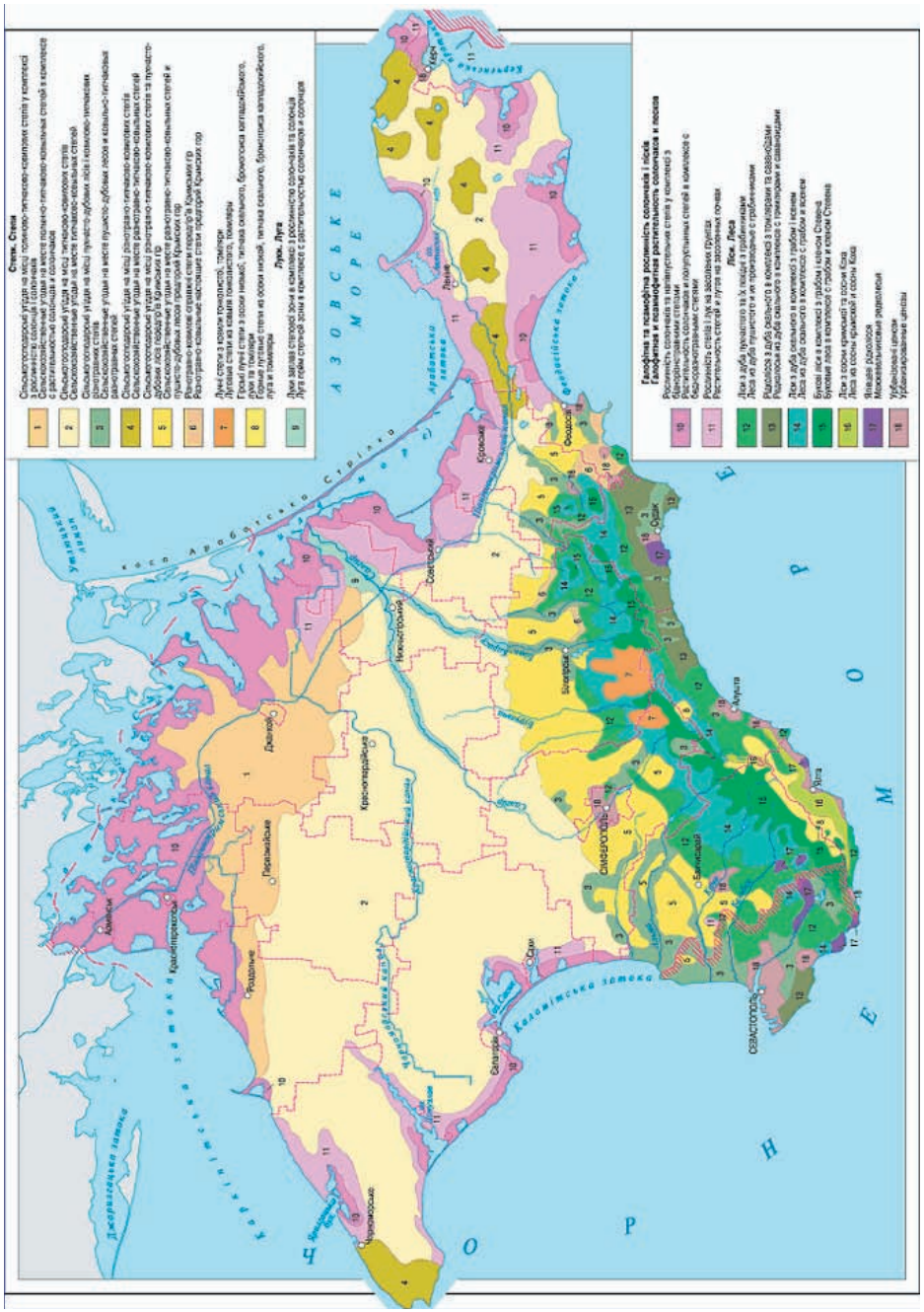

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Fig. 57: Forb steppe (northern surroundings of Simferopol, site № 1, photo J. Prügger).

Fig. 58: *Amygdalus nana* fruct. (northern surroundings of Simferopol, site № 1, photo J. Prügger).

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Fig. 59: *Artemisia* steppe (vicinity of the village of Voykovo, site № 2, photo E. Trummer & B. Marktl)

Fig. 60: Mosaic of dry grassland and scrub (northwestern part of the village of Tankovoye, sites №4, 5, photo E. Trummer & B. Marktl)

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Figs. 61, 62: *Jurinea sordida* (endemic plant of the Crimea, left figure) and *Asphodeline lutea* (Red Data Book of Ukraine, right figure, sites № 4, 5, photos E. Trummer & B. Marktl)

Fig. 63: "Shiblyak" vegetation type (south eastern part of the village of Tankovoye, site № 6, photo E. Trummer & B. Marktl)

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Figs. 64, 65: *Carpinus orientalis* (key species of "shiblyak", left figure) and *Stachys germanica* (widespread species of the ground layer, right figure, site № 6, photos E. Trummer & B. Marktl)

Fig. 66: Arable field of *Triticum aestivum* with luxuriant weed vegetation, dominated by *Papaver rhoeas* (near the village of Chiernorechie, site № 7, photo J. Prügger)

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Figs. 67, 68: *Ranunculus arvensis* (rare European weed species, left figure) and *Bifora radians*, right figure, (site № 7, photos E. Trummer & B. Marktl).

Fig. 69: Chersonesos (Sevastopol), antique ruins (site № 8, photo E. Trummer & B. Marktl)

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Fig. 70: Limestone debris of "Akkaya" (white rock) near Bielogorsk (site № 9, photo E. Trummer & B. Marktl)

Figs. 71, 72: *Hedysarum tauricum* (left figure) and *Convolvolus calvertii* subsp. *tauricus* (endemic of the Crimea, right figure, site № 9, photos E. Trummer & B. Marktl).

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Fig. 73: Limestone debris with dry grassland vegetation, and Paleolithic settlements of the Neanderthals (near Bielogorsk, site №10, photo E. Trummer & B. Marktl).

Figs. 74, 75: Fruits of *Paeonia tenuifolia* (Red Data Book of Ukraine, left figure); *Helichrysum graveolens* (right figure, site № 10, photos E. Trummer & B. Marktl)

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Fig. 76: Gravelly island with a mixture of riparian and ruderal species in the river channel of Biyukkarasu near Bielogorsk (site № 11, photo E. Trummer & B. Marktl)

Fig. 77: Northern slopes of the Chatyrdag Forest Massif (site № 12, photo E. Trummer & B. Marktl)

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Figs. 78, 79: *Lathyrus aureus* (forest edge plant, left figure) and *Arum orientale* (Red Data Book of Ukraine, right figure, site № 12, 13, photos E. Trummer & B. Marktl)

Fig. 80: Yaila plateau of the Chatyrdag Massif with *Cerastium biebersteinii* (site № 14, photo J. Prügger)

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Figs. 81, 82: *Muscari neglectum* (left figure) and *Anthyllis biebersteiniana* (right figure, site № 14, photos E. Trummer & B. Marktl)

Fig. 83: Woodland of the upper part of the Chatyrdag Yaila slopes (site № 15, photo E. Trummer & B.Marktl)

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Fig. 84: Administration building of the Nikitsky Botanical Garden (site № 16, photo B. Prots)

Fig. 85: Part of the Arboretum of the Nikitsky Botanical Garden (site № 16, photo J. Prügger)

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Fig. 86: Slopes of the Nature Reserve “Cape Martyan” (site № 17, photo J. Prügger)

Figs. 87, 88: Old *Juniperus excelsa* (Red Data Book of Ukraine, left figure) and attractive *Dictamnus gymnostylis* (right figure, site № 17, photos E. Trummer & B. Marktl)

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Fig. 89: Slopes of the Yaltinskiy Mountain Forest Reserve with dominant *Pinus pallasiana* (site) № 18, photo E. Trummer & B. Marktl)

Fig. 90: View of the northern part of the Karadag Nature Reserve (site № 19, photo B. Prots)

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Fig. 91: South part of the Karadag Nature Reserve (site № 19, photo E. Trummer & B. Marktl)

Figs. 92, 93: *Echium popovii (*endemic species of the Crimea, left figure) and *Anacamptis pyramidalis* (Red Data Book of Ukraine, right figure, site № 19, photos E. Trummer & B. Marktl)

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Fig. 94: Seashore vegetation (south of Eupatoria, site № 21, photo J. Prügger)

Figs. 95, 96: *Astragalus varius* (left figure) and *Alyssum tortuosum* (right figure), typical representatives of the Crimean seashore vegetation, site № 21, photos E. Trummer & B. Marktl

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