N. Stavrou, K. Voskarides & V. Karagiannakidou

Floristic composition and phytogeographical research on the endemic *Cedrus brevifolia* forests in Cyprus

Abstract

Stavrou, N., Voskarides, K. & Karagiannakidou, V.: Floristic composition and phytogeographical research on the endemic *Cedrus brevifolia* forests in Cyprus. — Fl. Medit. 18: 149-170. 2008. — ISSN 1120-4052.

In this study, the vascular flora of the endemic *Cedrus brevifolia* in Pafos' forests in Cyprus was investigated. *Pinus brutia, C. brevifolia* and *Quercus alnifolia* are the main floristic elements of these forests.
The dominance of the Mediterranean element and the remarkable presence of the Eurasiatic – European as well as, of the other chorological elements, give a submediterranean character to the flora. Annual herbs predominate followed by the herbaceous perennials. Therophytes are the most abundant followed by hemicryptophytes, typical of the flora of Mediterranean zone.
Comparative analysis was done between Cedar, Pine and mixed Cedar – Pine forests. The geographical distribution of the floristic elements, according to the altitude and the biotopes they were found, is presented in analytical tables and on the map of the study area. New taxa for this area have also been recorded for the first time.

Key words: *Cedrus brevifolia* forest, SE Mediterranean vegetation, Cyprus flora.

Introduction

The Cyprus cedar, *Cedrus brevifolia* (Hook. f.) Henry, belonging in the family of *Pinaceae*, is together with *Quercus alnifolia* the only endemic trees in Cyprus. Aside from the Cyprus cedar, other three cedar species exist: a) the Lebanese cedar (*Cedrus libani*) which grows mainly in Lebanon, Syria and N.E Turkey, b) the *Cedrus atlantica* which grows in the mountains of Atlas in Morocco, Algeria and c) the *Cedrus deodora* which grows in the West and Central Himalaya in India (Rolley 1950; M'Hirit 1987).

Only minor morphological differences exist between the four species of the *Cedrus* genus and it is therefore believed that they all came from a single species with constant spread beginning east from the Himalayan and ending west to the Atlantas mountains (Holmboe 1914).

The Cyprus cedar represents a significant part of the Cypriot and world flora- vegetation with many management potentials, so its preservation must be ensured in every way.

Inspite that, there are only very few studies mentioning the species in question in its spreading area. Most of them are only based on its value or its rich genetic diversity (Christou 1991) whereas very few take into consideration the flora and the ecology of the area. The floristic elements known so far for the cedar's spreading area, as well as for the whole flora of Cyprus, come mainly from Flora of Cyprus (Meikle 1977, 1985). Of course, since completion of the "Flora of Cyprus" several series have been published summarizing new floristic findings in Cyprus, contributed mainly by J. Chrtek, B. Slavík, G. Hadjikyriakou and R. Hand. Despite that these reports include some plant species from the *Cedrus* area, most of the samples have been collected mainly from road sides and the Cedar valley and not from the inaccessible mountain area. The last (in our knowledge) floristic documentation that was performed specifically for this area, was in 1995 by Charalambous & Christou when a limited collection of species were gathered in a small area in the Cedar Valley.

During the English colonization of the island, the spreading area of cedar began to be under systematic protection. Under the light of this, tree-felling and forest grazing were banned since 1939 (Wild 1979). The areas of Tripylos and the Cedar Valley, covering an area of 823 hectares, have been declared as a preservation area in 1984 for flora and fauna according to Forest Legislation and by decision of the Ministers cabinet (Makris 1995; Christou 1997).

The aims of this research are:

– The taxonomic, by name and bibliography, report of all the floristic elements in the spreading area of *Cedrus brevifolia* mentioned until this day.
– The floristic analysis and determination of the life-form, growth-form and chorological spectra of the flora in the spreading area of *Cedrus brevifolia.*
– The description of all environmental factors contributing to the formation of the area's flora (geology and geomorphology, climate, bio-climate, vegetation).
– The geographic distribution and differentiation of the study's area floristic species, according to the altitude and the biotopes in which they were found in.

Characteristics of the wider Cyprus area

Cyprus is the third largest island in the Mediterranean Sea (South East Mediterranean). The complete presentation of Cyprus's flora was done by the British R.D. Meikle (1977, 1985), consisting the reference book "*Flora of Cyprus"*. The *Flora of Cyprus*, according to a study by Hatzikiriakou & al. (1996), includes 1909 plant taxa, 1486 of which are species, 206 subspecies, 173 varieties, 12 taxon forms and 32 hybrids. Of these taxa, 141 (species, subspecies, varieties) are endemic bringing the percentage of endemic taxa compared to the total of Cyprus's flora up to 7.3% (Della 1999). Recent important bibliographic contributions to the flora of Cyprus include the very comprehensive book *"Trees and shrubs of Cyprus"* (Tsintides & al. 2002) and the much more important (and first) "*Red Data Book for Cyprus"* (Tsintides & al. 2007).

The geologic composition of Cyprus represents a mixture of rock formations that reflect its evolutionary history. Geologically and geomorphologically, it is divided in three parallel zones. These zones represent the Pentadactylos mountains, the Mesaoria plains and the Troodos mountains ("Cyprus encyclopedia" 1987; Pantelas 1997).

Cyprus's climate may be described as arid Mediterranean, with long, dry, very hot summers beginning in May and ending in October and relatively short, cool, wet, winters from

December until March. The Troodos mountain as well as the Pentadactylos mountains exert a great effect on the island's climate. The mean annual rainfall increases from 450 mm in the southwest slopes to 1100 mm in the higher Troodos peaks, whereas in the Mesaoria plain it is reduced to 300-400 mm. The mean annual temperature is 9-13 ˚C.

According to a combination of climate and vegetation (Pantelas 1995), Cyprus is represented with eight rainfall-temperature bioclimatic floors. A more detailed study of the Cyprus bioclimate and vegetation could be based on the bioclimatic taxation mapping and the mapping of the catalytic phyto-communities, done by Pantelas & Barber I Valles (1995).

In general, Cyprus' vegetation could be divided into the following categories: forests, evergreen sclerophyllous shrublands (maquis), phrygana (garigue), pasture land, hydrophilous, halophytic and sandy land. Cyprus's forests consist mainly of Coniferales forests which take up a big area. They are further divided into two major climatic zones (Tsintides 1995): a) *Pinus brutia* zone, b) *Pinus nigra* subsp. *pallasiana* zone.

Methods

The study area

The research area is located in the Pafos' forest which takes up an area of 70.000 hectares in the northwest slopes of the Troodos' mountain, covering areas of Limassol, Nicosia and Pafos' districts. In its greater part it is a natural forest rejuvenating without human interference. *Pinus brutia* dominates throughout this area and forms either pure stands or mixes with other Coniferales species. Several shrub species dominate in the subfloor.

The study area includes only the part of Pafos forest where *Cedrus brevifolia* grows. Its natural spreading covers an area of approximately 700 hectares in an altitude of 900-1400 m in the slopes of Tripylos area (highest area peak 1362 m) and in a plain known as Cedar Valley. It forms pure or mixed stands, where the latter ones are consisted mainly together with *Pinus brutia* (Charalampous 2000).

The geological substrate of the forest is part of the known ophiolite sequence complex of Troodos mountain. It is mainly consisted of vein rocks that are characterized by steep slopes, deep valleys and canyons. More specifically, cedar mostly prospers in soils that have originated from the decomposition of pillow lavas rock formations of diabase type (Pantelas 1997).

Analyzing data from the Government Meteorological Service for the period of 1991-2001 (about Tripylos area) we conclude that the mean minimum temperature (MMT) for the coldest month and the annual rainfall were 3.0 °C and 635 mm respectively. For the period of 1961-1990 the numbers are –1.0 °C and 831 mm respectively. In order to determine the bioclimate, we took into account findings from a recent study done by Pantelas (1995); in this study the bioclimate is divided in eight dinstict rainfall-temperature bioclimate floors.

By taking into consideration the above findings, the research area falls under the semi-wet moist bioclimate floor, with a mean annual rainfall of 600-900 mm and the minimum temperature of the coldest month 0-3 °C. In order to determine the bioclimate we also followed: a) Bagnouls & Gaussen method (1957) and b) Emberger method (1930, 1955,

1971), which represent the most widely accepted methods for the Mediterranean region. From the rainfall-temperature chart of the area (Fig. 1), we can conclude that the biologically dry period for the Stavros of Psokas Meteorology Station is ranging from June to September. The presence of a dry-warm period is a diagnostic element of Mediterranean climates and therefore the dry months are expected.

The vegetation in the area of Tripylos as well as in the Cedar Valley is of great diversity, a fact attributed by many researchers to the rich in relief substrate of the area which creates a huge variety of habitats (Appendix 1). In the west part of the area one can only find pure *Pinus brutia* stands, whereas in an altitude of 900 m in a deep valley crossed by a river, is the Cedar Valley covered only by cedars and riverbank vegetation. In the east and mainly in the northeast side of the Tripylos peak, huge areas covered by pure cedar stands, mixed pine - cedar stands (pines dominated) and mixed cedar - pine stands (cedars dominated) can be found.

The shrub subfloor and the openings that disturb the continuity of the forest's formations, play a significant role in the area's presentation of plants. The endemic *Cistus* species and some phryganic species dominate in these openings. In the south and southeast sector, *Quercus alnifolia* dominates (shrub height of 2.5 m in many occasions), which represents a characteristic species in the formation of the *Querco alnifoliae-Pinetum brutiae* and *Querco alnifoliae-Crepidetum frasii* phyto- communities that are included in the area. One can come across the first phyto-community in an altitude of up to 1100 m, with *Quercus alnifolia, Pinus brutia, Astragalus lusitanicus, Teucrium kotschyanun, Salvia fruticosa, Sedum cyprium* and others as dominant species. The latter phytocommunity is found in many forest areas and its characteristic species are: *Quercus alnifolia, Crepis*

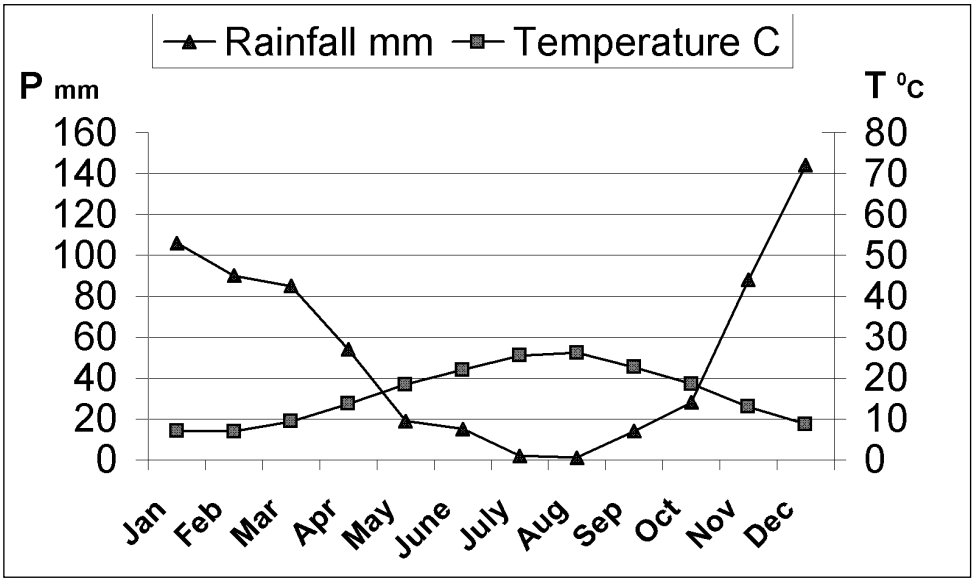


Fig. 1. Rainfall-Temperature diagram of Tripylos study area.

frasii, Lecokia cretica, Acer obtucifolium, Clematis cirhosa and *Cedrus brevifolia*. According to Barbero and Quezel (1979), cedar forests belong to the *Querco alnifoliae-Crepidetum frasii* phyto-community, which seems to respond to the semi-wet temperate and cool bioclimate of the area (Pantelas & Barber I Valles 1995).

Experimental design

In order to study the flora of the area, we used approximately 1000 plant samples, which were gathered in the area, as well as bibliographical references for that area. Sample collection took place in two season periods. The first took place beginnings of July 2001 and the second beginnings of May 2002. Both times, a compass and a GPS (G.P.S-Geographical Position System) were used, in order to pinpoint the exact location of each sample. The collection area had pure cedars stands, mixed cedar-pine stands (cedar dominated) and mixed pine-cedar (pines dominated). Samples were gathered from a total of 23 plots, which cover the biggest part of the study area. (Appendix 1).

A more detailed analysis of the floristic elements and their spread was attemted, to detect any differences among the several regions of the wider study area. On that basis, we divided the study area in 6 biotopes based on the vegetation map on which the 23 collection plots are depicted; the criterion used was the differentiation of the dominant flora. Each biotope includes a number of collection plots and is characterized by the dominant forest species. The 6 biotopes are symbolized with the capital letters A, B, C, D, E and F and correspond to: A) Pure cedar forests, B) Pure pine forests, C) Mixed cedar–pine forest (cedars dominate), D) Mixed pine-cedar forest (pines dominate), E) Cedars reforest, F) The area near the "Cedar Valley" where cedars dominate. Each biotope includes the following collection plots: A: 1,2-3,4,5, ,15,17,18,19,22, B: 10,11,12, C: 13,14,16, D: 8,20,21, E: 9, F: 6,7,23. Altitudes of the collection plots are listed in the Appendix 2.

For the classification of taxa, *Flora of Cyprus* (Meikle 1977, 1985), *Flora of Turkey and East Aegean Islands* (Davis 1965-1988), *Flora of Palestina* (Post 1933, 1935) and *Flora Europaea* (Tutin & al. 1964-1980) were mainly used. Additionally, we used *Flora Hellenica* (Strid & Tan 1997), *Flora d'Italia* (Pignatti 1982) and the book 'The Cyprus Flora in Checklist' (Della 1999). The plant names are according to *Flora of Cyprus* and we used *Flora of Turkey* for families and taxa that were not mentioned in the former. All samples are gathered and listed in the herbarium of Systematic Botany and Phytogeography laboratory in the department of Biology of the Aristotle University of Thessaloniki.

Listing plant taxa into life-forms has been performed according to Raunkiaer system (1934). For determining spectra (life-form, chorological and growth forms) we also used the common method of Raunkiaer for flora studies. For listing taxa in chorological unities we mainly used *Flora d'Italia's* divisional system, whereas for a number of endemic taxa and for taxa of eastern origin that were not included in it, we used *Flora of Cyprus* and *Flora of Turkey*. We included in our analysis some further plant species (they are not included in our collection samples) that were found in the study area by Charalampous & Christou (1995), Meikle (1977, 1985), Chrtek & Slavic (2001) and Hadjikyriakou (2007). We used these data to construct a more detailed plant list for our statistical analysis.

All statistics were performed through Excel statistical package, where diagrams and tables were constructed for better evaluation of the results. A correlation analysis of the

floristic elements in the area with the floristic elements of Palestinian flora was performed as well (Post 1933, 1935).

Results and Discussion

Plant list

A total of 205 taxa belong to the flora of the spreading area of *Cedrus brevifolia* in Cyprus and are mentioned in the plant list (*Pteridophyta* and *Spermatophyta*), in the Appendix section. Listing taxing units (family, genus, species), into the four major taxing units (*Pteridophyta*, *Gymnospermae*, *Dicotyledonae*, *Monocotyledonae*) was done evolutionarily for families and alphabetically for genus and species. Growth form, life form, chorological type and collection plots (1-23) in which they were found are marked for every taxon in plant list.

Floristic analysis

Of the 1000 samples that were collected in the area and from the bibliographic references for the area (Meikle 1977, 1985; Charalampous & Christou 1995; Della, 1999; Chrtek & Slavic 2001; Hadjikyriakou 2007), appears that 205 taxa grow in the study area (177 species, 17 subspecies and 11 varieties – plant list). The great majority of them are Angiosperms (96.59%), 74.15% of which belong to *Dicotyledonae* and 22.44% to *Monocotyledonae*. A limited percentage are *Pteridophyta* and *Gymnospermae* (Table 1).

In the entire group of taxa that we found, 123 taxa in the existing bibliography (89 are in the Flora of Cyprus; 31 are in the listing done by Charalampous & Christou (1995); 2 are in Chrtek & Slavic (2001) and 1 in Hadjikyriakou (2007). Additionally, 61 taxa have been found by our research for the first time in this area.

Factors such as the bad weather conditions and the inaccessibility of the area in some sites (deep, steep canyons) are to be blamed for the relatively small sample number and surfaces. Another factor that might have influenced the number of taxa found in the area is the extreme weather conditions. In addition to that, an unexpected drought of the cedars has been observed in the last two years (before the collecting period). A study that has been performed to identify the reasons of that phenomenon, it was concluded that the main cause was the diminution of the annual rainfall of the last four years in combination with the increased temperatures during the summer months. This phenomenon has importaltly influenced the herbaceous vegetation of the area (Christou & al. 2001).

Table 1. Analytical data concerning the main chloristic elements of *Cedrus brevifolia* forest.

Systematic units	Families	Genera	Species	Sub-species	Varieties	Taxa	%
Pteridophyta	3	4	3	1	0	4	1.95
Gymnosperms	2	3	3	0	0	3	1.46
Dicotyledonae	38	105	126	15	11	152	74.15
Monocotyledonae	7	36	45	1	0	46	22.44
TOTAL	**50**	**148**	**177**	**17**	**11**	**205**	**100**

LIFE-FORM SPECTRA

The percentage of plant life forms in the area expresses satisfactorily its climatic conditions and constitutes the life form or biological spectrum. The life form spectrum of the research area flora is depicted in Table 2.

Therophytes dominate the area with a percentage of 49.76%, and the hemicryptophytes (which dominate in the mild temperate areas) follow with 24.39%. The dominance of therophytes is an indication of the Mediterranean climate in this area and of its influence on the vegetation life-forms. The relatively high percentage of hemicryptophytes corre-

Table 2. Life-form spectrum of *Cedrus brevifolia* forest in the study area.

Life-form spectrum	**Number of taxa**	**%**
Chamaephytes (Ch)	**4**	**1.95**
Sub-shrubs (Ch suffr)	4	1.95
Geophytes (G)	**22**	**10.73**
Bulbous (G bulb)	12	5.85
Rhizomatous (G rhiz)	9	4.39
With root buds (G rad)	1	0.49
Hemicryptophytes (H)	**50**	**24.39**
Scapose (H scap)	30	14.63
Caespitosous (H caesp)	8	3.90
Rosette like (H ros)	5	2.44
Biennial (H bienn)	7	3.42
Phanerophytes (P)	**27**	**13.17**
Mega-phanerophytes (MP)	13	6.34
Nano- phanerophytes (NP)	12	5.85
Climbing (P lian)	2	0.98
Therophytes (T)	**102**	**49.76**
Scapose (T scap)	94	45.85
Parasitic (T par)	2	0.98
Crawling (T rept)	4	1.95
Caespitosous (T caesp)	2	0.98
Total	**205**	**100**

sponds to the mild climate of the broader region. The phanerophytes follow with a participation percentage of 13.17%. Even though this is low for forests, it is justified by the fact that the study area includes mostly pure conifers stands that are characterized by a small contribution percentage of trees and bushes (especially in ophiolite rocks). Lastly, we have the geophytes (10.73%), with a reasonable percentage for a Mediterranean region.

Growth form spectra

The term "growth form" is used to mean the entire development and structure of floristic elements, which are connected by the life span and the work they need in order to complete their biological cycle. The growth form is related directly with the environment and it is the result of the ecologic adaptation of the plants (Fig. 2).

As regards the growth forms of the flora elements in the area, the ones that dominate are the annual and biennial plants, with a participation percentage of 53.66%. This percentage corresponds to the therophytes, which are known to outnumber other elements in purely Mediterranean areas like our own.

Chorological spectra

A great number of factors have contributed to the modulation of the vegetation character in the spreading area of *Cedrus brevifolia,* such as geo-historical facts, climatic changes, geological background, geographic position and human activities. As a result of the interactions between the factors mentioned above, the appropriate conditions were cre-

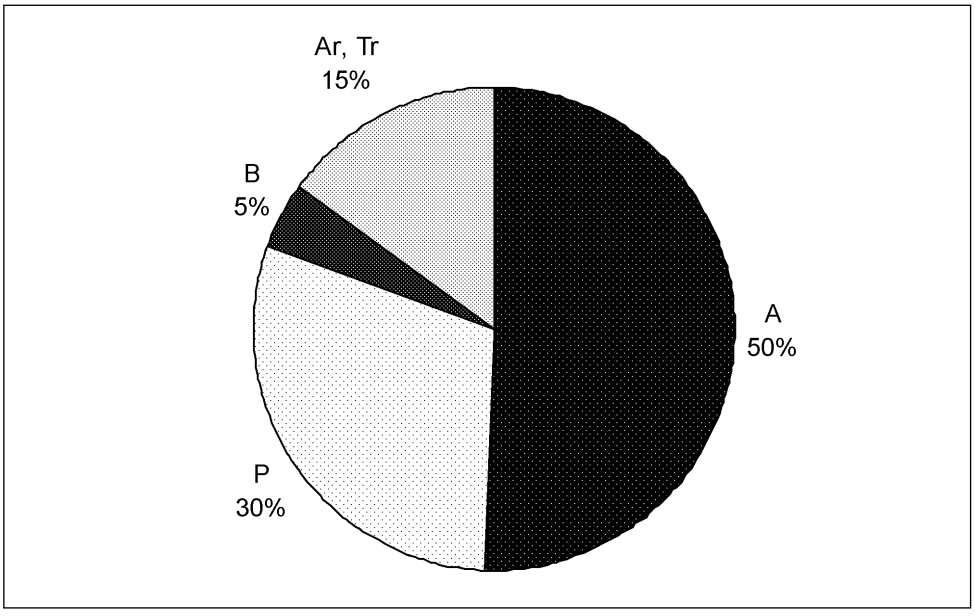


Fig. 2. Growth-spectrum of *Cedrus brevifolia* forest in the study area (A: annual, B: biennial, P: perennial, Tr: tree, Ar: shrub).

ated for the installation in the area of plant species with specific chorological origins. The phytogeographical analysis of the vegetation elements that constitute the flora of the research area, shows that plant taxa with different origin participate in the composition of the flora in the region of *Cedrus brevifolia.* The percentage of the elements in each unit was used for the definition of the chorological spectrum (Table 3).

From our results, it appears that Mediterranean elements are dominant with a percentage of 56.6% followed by the Eurasiatic-European elements with a smaller percentage of 22.4%. Endemic elements have a significant participation percentage of 10.7%, a fact that once again highlights the rich endemism of the area. Finally, the percentage of Cosmopolitan-Subcosmopolitan floristic elements is also important (8.8%).

According to the aforementioned, the study area that includes the forests of *Cedrus brevifolia* in Cyprus can be chorologically included in the wider Mediterranean area of the Euro-Asiatic space. This is due to the fact that apart from the main domination of the Mediterranean geo-elements there is also a dominance of Eurasiatic and European elements. Further analysis of the Mediterranean elements, for a more analytical evaluation of the Mediterranean unity, reveals a dominance of the Euri-Medit versus the Steno-Medit elements with a percentage of 43.1% and 38.1% respectively. Their evaluation was performed on the basis of their participation percentage in the 6 biotopes –areas in which we divided the greater study area on the criterion of dominant vegetation type (Table 4).

Analysis of the richest families

As regards the 50 families of the flora, the richest in species number of *Dicotyledonae* include 105 taxa, whereas the corresponding ones in *Monocotyledonae* include 35 taxa. The families of *Gramineae*, *Compositae* and *Fabaceae* stand out with a larger participation number in genus and species. The single most populated family in taxa, among all, is the *Gramineae* that includes a total of 28 taxa with a participation percentage of 13.66%. The twelve most populated families in the area count for the highest percentage (≈ 68%) of the total number of taxa (Table 5).

Table 3. Chorological spectrum of *Cedrus brevifolia* forest in the study area.

Chorological units	**Number of taxa**	**%**
Endemic	22	10.73
Mediterranean	116	56.59
European	9	4.39
Eurasiatic	37	18.05
Subcosmopolitan	14	6.83
Cosmopolitan	4	1.95
Others	3	1.46
Total	**205**	**100**

Table 4. Analytical presentation of Mediterranean flora spectrum (absolute numbers and percentage) of the six biotopes of *Cedrus brevifolia* forest in the study area.

Mediterranean units	**A:** Pure cedar forests		**B:**Pine forests		**C**: Mixed cedar- pine forests		**D**: Mixed pine-cedar forests		**E:** Reforest with cedar		**F:** Valley with cedar forests	
	SUM OF TAXA	**%**	**SUM OF TAXA**	**%**	**SUM OF TAXA**	**%**	**SUM OF TAXA**	**%**	**SUM OF TAXA**	**%**	**SUM OF TAXA**	**%**
1.Medit-Mont	4	7.8	2	10.5	0	13.3	3	13.6	2	18.2	2	9.5
2. Euri- Medit	23	45.1	5	26.3	7	46.6	8	36.6	2	18.2	8	38.0
3. Steno-Medit	19	37.2	6	31.6	1	20.0	7	31.8	4	36.3	7	33.3
4. Centro-Medit	1	1.9	1	5.3	1	6.7	1	4.5	1	9.1	1	4.8
5. Medit-Pont	1	1.9	0	0.0	0	0	0	0	0	0	0	0
6. Medit-Atl	1	1.9	1	5.3	1	6.7	1	4.5	1	9.1	1	4.8
7. Medit-Turan	2	3.8	4	21.0	1	6.7	2	9	1	9.1	1	4.8
8. East-Medit	0	0	0	0	0	0	0	0	0	0	1	4.8
Total	**51**	**100**	**19**	**100**	**15**	**100**	**22**	**100**	**11**	**100**	**21**	**100**

Table 5. The richest families of the flora in the study area (taxa number ≥5).

Families	Genera	Species	Sub-Species	Varieties	Sum	%
Ranunculaceae	2	3	-	2	5	2.44
Cruciferae	9	11	-	2	13	6.34
Caryophylaceae	7	10	3	-	13	6.34
Geraniaceae	2	6	-	-	6	2.93
Fabaceae	7	15	-	2	17	8.29
Umbeliferae	5	5	-	-	5	2.44
Rubiaceae	4	10	-	-	10	4.88
Compositae	15	17	1	-	18	8.78
Boraginaceae	5	3	2	-	5	2.44
Lamiaceae	12	10	2	1	13	6.34
Liliaceae	7	7	-	-	7	3.41
Gramineae	19	28	-	-	28	13.66
Total	**94**	**125**	**8**	**7**	**140**	**68.29**

These families are also referred to in Flora of Cyprus as the most populated in the Cypriot flora (Meikle 1977, 1985). In addition, the Cyprus area is included in the holarctic kingdom in which the specific families seem to dominate.

The 12 richest in number species families of *Dicotyledonae* and *Monocotyledonae* in the study area are shown in Table 5. We also performed an analysis of the life-form, chorological and growth (ecological) spectrum of these 12 families. There is a clear presence of the scapose therophytes (≈ 58%) in almost all of the families but mostly in the Gramineae, Fabaceae and Cruciferae families, a fact that is further supported by the relatively dry climatic conditions, which dominate in the area. On the other hand, the chamaephytes only seem to exist in two of the families (*Lamiaceae- Compositae*) with a low participation percentage, whereas the hemicryptophytes are found in an increased percentage versus the chamaephytes. In particular, the scapose type (H scap ≈ 18%) is most dominant.

From the chorological spectrum analysis for the 12 richest in number species families of the area, the mediterranean elements seem to dominate, whereas the eurasiatic, endemic and subcosmopolitan follow with a lower participation percentage. The annual taxa dominate in the aforementioned families, a fact justified by the superior number of the therophytes life-form.

Table 6 depicts the chorological types, life-forms and growth-forms spectra in detail, in absolute numbers and percentages for the 6 biotopes of collection. A uniform distribution is observed according to these spectra without obvious differentiations. The mediterranean elements are dominant in all biotopes, followed by the endemic with a similar impressive participation percentage. The annual plants have an increased percentage and there is also an intense presence and participation of therophytes in all biotopes.

Table 6. Analytical presentation of life-form, chorological and growth spectra (absolute numbers and percentage) of the six biotopes of *Cedrus brevifolia* forest in the study region.

	A: Pure cedar forests		**B:**Pine forests		**C**: Mixed cedar- pine forests		**D**: Mixed pine-cedar forests		**E:** Reforest with cedar		**F:** Valley with cedar forests	
Chorological units	**SUM OF TAXA**	**%**	**SUM OF TAXA**	**%**	**SUM OF TAXA**	**%**	**SUM OF TAXA**	**%**	**SUM OF TAXA**	**%**	**SUM OF TAXA**	**%**
Endemic	9	11.1	9	28.1	8	27.6	2	17.9	7	33.3	7	18.0
Mediterranean	51	63.0	19	59.4	15	51.7	22	56.4	11	52.4	21	53.8
European	4	4.9	1	3.1	1	3.5	4	10.3	1	4.8	2	5.1
Eurasiatic	12	14.8	1	3.1	3	10.3	3	7.7	2	9.5	6	15.4
Subcosmopolitan	5	6.2	2	6.3	2	6.9	2	5.1	0	0	2	5.1
Cosmopolitan	0	0	0	0	0	0	1	2.6	0	0	1	2.6
Life forms	**SUM OF TAXA**	**%**	**SUM OF TAXA**	**%**	**SUM OF TAXA**	**%**	**SUM OF TAXA**	**%**	**SUM OF TAXA**	**%**	**SUM OF TAXA**	**%**
Chamaephytes Ch	1	1.2	1	3.1	0	0	1	2.6	1	4.8	1	2.6
Geophytes G	5	6.2	3	9.4	3	10.4	3	7.7	3	14.3	5	12.8
Hemicryptophytes H	19	23.5	4	12.5	4	13.8	10	25.6	3	14.3	6	15.8
Phanerophytes P	7	8.6	7	21.9	5	17.2	6	15.4	5	23.8	14	35.9
Therophytes T	49	60.5	17	53.1	17	58.6	19	48.7	9	42.8	13	33.3
Growth forms	**SUM OF TAXA**	**%**	**SUM OF TAXA**	**%**	**SUM OF TAXA**	**%**	**SUM OF TAXA**	**%**	**SUM OF TAXA**	**%**	**SUM OF TAXA**	**%**
Ar / Tr (Trees)	9	11.1	9	28.1	6	20.7	8	20.5	7	33.3	14	35.9
P (Perrenial)	21	25.9	6	18.8	7	24.1	11	28.2	6	28.6	10	25.6
B (Biennial)	2	2.5	1	3.1	1	3.5	2	5.1	1	4.8	3	7.7
A (Annual)	49	60.5	16	50	15	51.7	18	46.2	7	33.3	12	30.8
Total	**81**	**100**	**32**	**100**	**29**	**100**	**39**	**100**	**21**	**100**	**39**	**100**

Altitudinal gradation of floristic elements - Floristic connections

Sample collection took place in almost all of the altitudes where cedars can be found. The area was divided in three zones with different altitudes. These are: (1) 900- 1150 m, (2) 1151-1300 m, and (3) 1301-1450 m. One can observe that most of the plant taxa are found in the range of 1151-1300m, whereas in the lower altitudes -where the Cedar Valley is- the taxa number is diminished.

The increased number of plant taxa found in the range of 1150-1300m, is attributed to the fact that most cedars are found in that specific altitude and take over most of that area. Therefore, most of our collections took place in that altitude. The diminution of the taxa number on the mountaintop and the valley is justified by the adverse ecological conditions that dominate in these areas, combined with the difficult passage of the valley area.

When correlating the floristic elements of the study area to the floristic elements of Palestinian flora, 51% of plant taxa appear to be common, a fact exposing the floristic connections between the two floras. The explanation lies in the close proximity of the two areas and the fact that both belong to the same climate zone (eastern Mediterranean region).

Conclusions

The analysis of the flora of the endemic forests of *Cedrus brevifolia* in Cyprus leads us to the following concluding remarks:

1. 205 taxa are reported from the forests of *Cedrus brevifolia* which one of special floristic and phytogeographical interest. They belong to 50 families, 148 genera, 177 species, 17 subspecies and 11 varieties. Of these, 89 species are recorded in Flora of Cyprus (Meikle 1977, 1985) and 61 are reported for the first time in the study area. The Gymnosperms constitute 1.46%, the Monocotyledones 22.44% and Dicotyledones 74.15% of the whole flora (Table 1).

2. The twelve families richest in number of taxa of the flora are: *Gramineae* (13.66%), *Compositae* (8.78%), *Fabaceae* (8.29%), *Cruciferae* (6.34%), *Caryophyllaceae* (6.34%), *Lamiaceae* (6.34%), *Rubiaceae* (4.88%), *Liliaceae* (3.41%), *Geraniaceae* (2.93%), *Ranunculaceae* (2.44%), *Boraginaceae* (2.44%) and *Umbelliferae* (2.44%). These 12 families take up only 24% of the total family number but they cover 68% of the total of the species of the flora, of the study area (Table 5).

3. The percentage of the Mediterranean element in the chorological spectra ranges from 51.7% to 63.0% and the Eurasiatic and European elements from 6.2% to 20.5%. This demonstrates the submediterranean character of the flora of endemic forests of *Cedrus brevifolia* in Cyprus (Table 6). The percentage of the endemism in the area is also increased since endemic plants take up 11% of the total flora. We concluded that 22 floristic elements are endemic out of which 2 are included in the Verne Convention and 11 in the list of the I.U.C.N. (Iatrou & Della, 1996).

4. The most common life-form in all biotopes – areas, that the plant samples were collected (Table 6, Appendix 1- vegetation map) is the Therophytes (33.3 – 58.6 %) followed by Hemicryptophytes (12.5 – 25.6 %) (Tables 2 and 6). Of the ecology growth forms, a superiority of the annual plant taxa is concluded (50%) followed by the herbaceous peren-

nial (30%). The superiority of the Therophytes as well as the annual plants is a strong indication of the Mediterranean climate that dominates in the study area with intense dry and warm conditions (Fig. 1). The high percentage of the Phanerophytes in all biotopes (15.4 – 35.9 %) and especially in the valley with cedars demonstrates the forest character of these life forms and the better soil conditions in the valley. It is also verified by the analysis of the growth forms, the biotic and the chorological spectra of the six biotopes – area that seem to follow the spectrum models of the total area flora (Tables 2 -3, Fig. 2).

5. The phytogeographical character of the flora of the forests *Cedrus brevifolia* is incorporated to the mediterranean vegetation zone of the Eurasiatic region because the mediterranean elements that participate (Steno-Medit 20 – 37.2 %, Euri-Medit 18.2 – 46.6 %, Tables 3 - 4) are in high percentage.

6. From the altitudinal distribution of the plant taxa in the study area, it seems that most of them appear to be in the range of 1150 – 1300 m. This can be explained by the fact that the main cedar spread lies in these particular altitudes and takes up great spaces in the research area.

Unfortunately, botanic research in Cyprus is very restricted mainly because of the lack of botanists in private and government universities. There are many interesting and unique plant habitants in Cyprus (endemism found in our research is a proof) where negligible research has been done. *Cedrus brevifolia* is found only in Cyprus and we have to protect it with stricter legislations like our neighbor countries do (Israel, Lebanon and others) with *Cedrus libani* forests. Detailed knowledge of plant communities improves management of shrublands and forest ecosystems and contributes to the protection and preservation of the natural environment.

Acknowledgements

The help of Dr. Andreas Christou and Mr. Mihalis Makris (Cyprus Forestry Department) was valuable in order to have access in Pafos' cedar forests. We also thank Dr. Andrie Panayiotou for linguistic contribution.

References

Bagnouls, F. & Gaussen, P. 1957: Les climats biologiques et leur classification. – Ann. Geogr. N. **355**, LXVIe annee: 193-220.

Barbero, M. & Quezel, P. 1979: Contribution a l'etude des groupements forestiers de Chypre. – Doc. Phytosociol. **4.**

Charalampous, A. 2000: Inventory of tree vegetation and regeneration at Tripylos Nature Reserve. – Nicosia.

Charalampous, A. & Christou, K. A. 1995: A draft collection and classification of plant species in Tripylos area. – Nicosia.

Christou, K. A. 1991: The Genetic and Taxonomic Status of Cyprus Cedar. – MSc Thesis, MAICh, pp. 96, Chania.

— 1997: Conservation of Cyprus cedar (*Cedrus brevifolia. Hook*) genetic resources. – in Abstracts of the XI World Forestry Congress, 13-22 October 1997. – Antalya- Turkey.

—, Hatzikiriakou, H., Nikolaou, G. 2001: Die- back of Cyprus cedar at Pafos forest. – in Abstracts of the World Congress for Forests Study, 27 August – 1 September 2001, Thessaloniki – Greece.

Chrtek, J. & Slavík, B. 2001: Contribution to the flora of Cyprus. 5. – Acta Univ. Carol., Biol. **45:** 267-293.

Cyprus encyclopedia eds. 1987: Cyprus encyclopedia. – Diagoras eds, Cyprus.

Davis, P. H. 1965-1988: Flora of Turkey and the East Aegean Islands, **1-10.** - Edinburgh.

Della, A. 1999: The Cyprus Flora in Checklist Format. Native or naturalized- Cultivated- Endemics- Rarities- Additions. - International Plant Genetic Resources Institute (I.P.G.R.I) and Agricultural Research Institute – Cyprus.

Emberger, L. 1930: La vegetation de la region mediterraneenne. Essai d'une classification des groupments vegetaux. – Rev. Gen. Bot. **42:** 641-662, 705-721.

Emberger, L. 1955: Une classification biogeographique des climats. – REV Trav. Lab Geob. Zool. Fac. Sc. Montpellier 7: 3-43.

—, 1971: Considerations complementaires au sujet des recherchers bioclimatiques et phytogeographiques, ecologiques. – Pp. 291-301 in Travaux de botanique et d'ecologie., France.

Hadjikyriakou, G. 2007: Symvoli sti meleti tis chlorides tis Kyprou 8 – Dasoponos **30:** 7-10.

—, Orfanos, G., Georgiou, K., Kadis, K. 1996: Flora of Cyprus 10 years after "Flora of Cyprus" edition. – Pp. 213-217 in Abstracts of the Sixth Congress of Hellenic Botany Society- Cyprus Biological Society, 6-11 of April 1996, Paralimni – Cyprus.

Holmboe, J. 1914: Studies on the Vegetation of Cyprus. – Bergens Museums skrifter, Ny Rekke, Norway.

Iatrou, G. & Della, A. 1996: Cytological studies of the Cyprus flora endemic taxa. – P. 207 In Abstracts of the Sixth Congress of Hellenic Botany Society- Cyprus Biological Society, , 6-11 of April 1996, Paralimni – Cyprus.

M' Hirit, O. 1987: Etat actual des connaissances sur le Cedre. Element pour un programme de recherche. – Rapport Comite, C.F.A/ C.E.F/ C.F.P.O, Silva Mediterranea.

Makris, M. 1995: Managing Protected Areas: The Cyprus Network of Protected Areas relating to biological resources. – Msc Thesis, pp. 147, University of Edinburgh.

Meikle, R. D. 1977: Flora of Cyprus, **1.** – London.

—, 1985: Flora of Cyprus, **2.** – London.

Pantelas, V. 1995: Cyprus bioclimate and phytosocieties. – Nicosia.

—, 1997: Wild flowers and other plants of Cyprus land. – Cyprus.

—, Barber, I., Valles, A. 1995: Bioclimatic Classification of Cyprus. Comparative study of the bioclimatic classification systems. – Nicosia.

Pignatti, S. 1982: Flora d' Italia, **1-3.** – Bologna.

Post, G. E. 1933, 1935: Flora of Syria, Palestine & Sinai, **1-2**. – Beirut.

Raunkiaer, C. 1934: The life- forms of plants and statistical plant geography. – Oxford.

Rolley, J. 1950: Forests conditions in Syria and Lebanon. – Unasylva **2:** 2.

Strid, A. & Tan, K. 1997: Flora Hellenica, **1.** – Germany.

Tsintides, T.C. 1995: Endemic plants of Cyprus. – Cyprus.

—, Christodoulou C. S., Delipetrou P., Georghiou K. 2007: The red data book of the flora of Cyprus. – Cyprus.

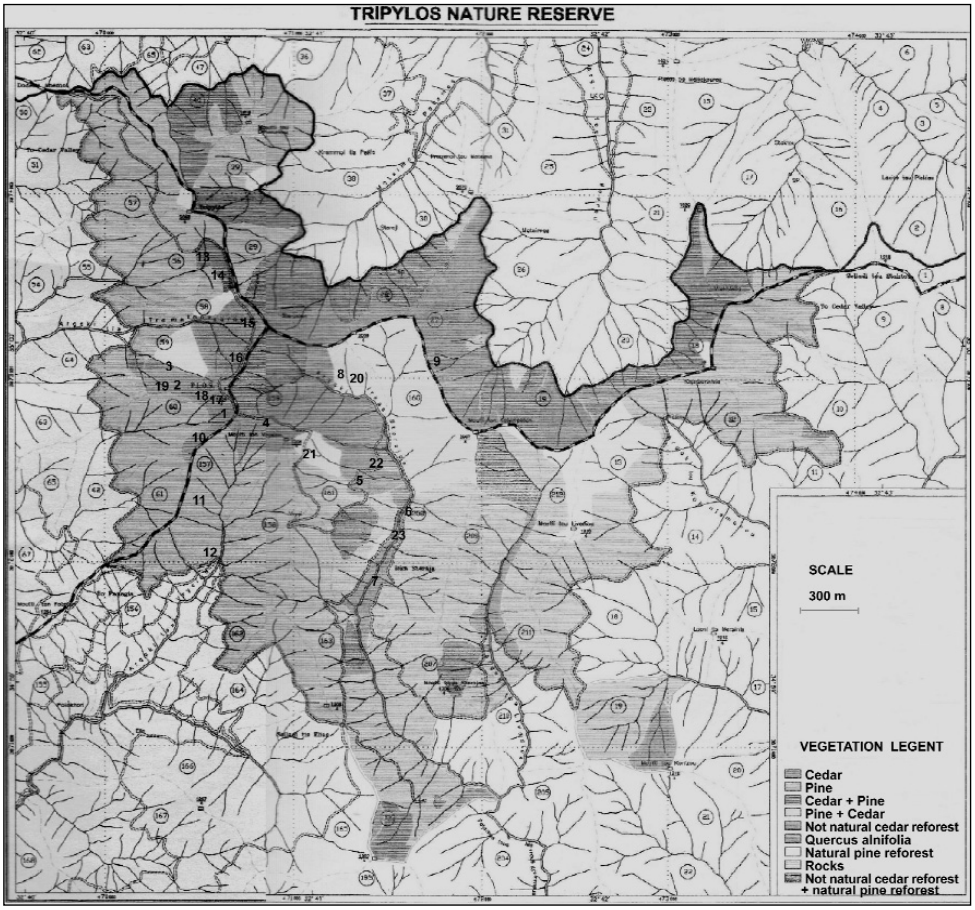
—, Hadjikyriakou G. N., Christodoulou C. S. 2002: Trees and shrubs in Cyprus. – Cyprus.

Tutin, T. G., Heywood, V. H., Burges, N. A., Moore, D. M., Valentine, D. H., Walters, S. M., Webb, D. A. 1968-1993: Flora Europaea, **1-5. -** London.

Wild, A. E. 1979: Reports on the Forests in the South and West of the Island of Cyprus. – London.

Addresses of the authors:
Niki Stavrou[1], Konstantinos Voskarides[1,2], Vasiliki Karagiannakidou[1]
[1]Laboratory of Systematic Botany and Phytogeography, School of Biology, Aristotle University of Thessaloniki, Thessaloniki, Greece
Emails: nistavrou@hotmail.com, vkarag@bio.auth.gr
[2](Present address) Department of Biological Sciences, University of Cyprus, Nicosia, Cyprus. Email: kvoskar@cing.ac.cy

Appendix 1. Vegetation map.



Appendix 2. Plant list

Taxa	Life forms and growth forms	Chorology	Plot area number #
PTERIDOPHYTA			
Dennstaedtiaceae			
1.*Pteridium aquilinum*	G rhiz/ P	Paleotemp	5,7, 23
Aspidiaceae			
2.*Cystopteris fragilis*	H caesp/P	Cosmopol	ME
3.*Dryopteris pallida ssp. libanotica*	H scap/ P	Eurasiat	7
Aspleniaceae			
4. *Asplenium ceterach*	H ros/ P	Euras- Temp	CH
SPERMATOPHYTA			
GYMNOSPERMS			
Pinaceae			
5.*Cedrus brevifolia*	MP scap/ Tr	Endemic	-----
6.*Pinus brutia*	MP scap/Tr	Medit- Mont	-----
Cupressaceae			
7.*Juniperus oxycedrus*	NP caesp-scap/ Tr-Ar	Euri Medit	ME
ANGIOSPERMS DICOTYLEDONAE			
Ephedraceae			
8.*Ephedra major*	NP/ Ar	Steno-Medit	ME
Ranunculaceae			
9.*Clematis cirrhosa*	NP scap/ Ar	Steno- Medit	CH
10.*Ranunculus cadmicus var. cyprius*	H scap/ P	Endemic	CH
100.*Valantia hispida**	T scap/ A	Steno- Medit	22
Valerianaceae			
101.*Valeriana italica**	H scap/ P	East- Medit	23
102.*Valerianella orientalis*	T scap/ A	Steno-Medit	ME
103.*Valerianella coronata**	T scap/ A	Euri- Medit	18
Dispacaceae			
104.*Pterocephalus multiflorus ssp. multiflorus*	T scap/ A	Endemic	CH
Compositae			
105.*Anthemis plutonia*	H scap/ P	Endemic	-----
106.*Bellis perennis*	H ros / P	Europ, Caucas- Circumbor	ME
107.*Carthamus lanatus ssp. boeticus**	T scap/ A	Euri-Medit	2-3
108.*Centaurea aegialophila*	H scap/ P	Steno- Medit	1,8
109.*Cephalorrhynchus cypricus*	H scap/ P	Endemic	CH
110.*Crepis fraasii*	H scap/ P	Centro- Europ	13,15, 17,20,22
111.*Crepis reuteriana**	H scap/ P	Centro- Europ	18,21
112.*Crepis sancta**	T scap /A	Turan,Euri Medit	2-3,5, 8,10,11,12
113.*Filago arvensis**	T scap/ A	Medit- Europ	8,11,12, 14,16,17
114.*Helichrysum italicum*	Ch suffr/Ar	S- Europ	4,8,9, 12,23
115.*Hypochaeris glabra**	T scap/ A	Euri – Medit	15,17,22
116.*Inula viscosa**	H scap/ P	Euri- Medit	5
117.*Mycelis muralis**	H scap/ P	Europ- Caucas	17,21
118.*Picnomon acarna*	H scap/ P	Steno-Medit	1,2-3,5,9
119.*Rhagadiolus edulis**	T scap/ A	Euri- Medit	19,23
120.*Senecio leucanthemifolius*	T scap/ B	Steno- Medit	-----
121.*Senecio vulgaris*	T scap/A	Euri-Medit	CH

11.*Ranunculus chius var leiocarpus*	T scap/ A	Euri-Medit	ME
12.*Ranunculus kykkoensis*	H scap/ P	Endemic	CH
13.*Ranunculus paludosus* *	H scap/ P	Euri- Medit	15,22
Papaveraceae			
14.*Papaver postii*	T scap/ A	Steno- Medit	ME
15.*Papaver purpureomarginatum*	T scap/ A	Steno- Medit	CH
Fumariaceae			
16.*Corydalis rutifolia*	G rhiz/ P	W. Asiat- Anatol	ME
17.*Fumaria petteri ssp. thuretii*	T scap/ A	Balkan- Rs (K)	ME
Cruciferae			
18.*Alyssum foliosum*	T scap/ A	NE- Medit	CH
19.*Alyssum minutum*	T scap/ A	NE-Medit	CH
20.*Alyssum umbellatum*	T scap/ A	Steno- Medit	ME
21.*Arabis kennedyae*	T scap- H bien A-B	Endemic	CH
22.*Arabis purpurea*	T scap- H bien A-B	Endemic	4,16
23.*Arabis verna**	T scap- H bien A-B	Steno- Medit	15,17, 18,22, 23
24.*Cardamine hirsuta*	T scap/A	Cosmopol	CH
25.*Clypeola jonthlaspi var hispida*	T scap/A	Steno-Medit	CH
26.*Erophila verna*	T scap/ A	Circumbor	CH
27.*Sisymbrium officinale*	T scap/ A	Paleotemp (Subcosmopol)	13
28.*Teesdalia coronopifolia*	T scap/A	Euri-Medit	CH
29.*Thlaspi perfoliatum var. stylatum*	T scap/ A	Paleotemp	22
30.*Turritis laxa*	H bienn/B	Medit- Mont	CH
Cistaceae			
31.*Cistus creticus var. creticus*	NP/ Ar	Steno-Medit	-----
32.*Cistus salvifolius*	NP/ Ar	Centro-Medit	-----
122.*Tussilago farfara*	G rhiz/P	Paleotemp	CH
Campanulaceae			
123.*Campanula peregrina*	H bien/B-P	Steno-Medit	ME
124.*Legousia falcata*	T scap/A	Steno-Medit	15
125.*Solenopsis minuta ssp. nobilis*	H ros/ P	Steno- Medit	5
Ericaceae			
126.*Arbutus andrachne*	MP/ Tr- Ar	Steno- Medit	5,6,7,8
Oleaceae			
127.*Olea europea*	MP caesp- Pscap Ar- Tr	Steno- Medit	CH
Primulaceae			
128.*Anagallis arvensis ssp. foemina**	T rept/ A	Euri- Medit	7
129.*Cyclamen cyprium**	G bulb/P	Endemic	22,23
Boraginaceae			
130.*Alkanna tinctoria**	H scap/ P	Steno- Medit	23
131.*Anchusa undulata. ssp. hybrida*	H bien/ B	Steno- Medit	ME
132.*Buglossoides arvensis ssp. gasparini*	T scap/ A	Euri- Medit	22
133.*Cynoglossum creticum*	H bien/B	Euri- Medit	ME
134.*Myosotis ramosissima*	T scap/ A	Europ-W Asia	13,15, 17,18,22,23
Solanaceae			
135.*Hyoscyamus pussillum**	T scap- H bien A-B	Eurasiat	22
Scrophulariaceae			
136.*Parentucellia latifolia**	T scap/A	Euri- Medit	15,17,18
137.*Veronica cymbalaria*	T scap/ A	Euri- Medit	17,23
Orobanchaceae			
138.*Orobanche ramosa var. brevispicata*	T par/ A	Paleotemp	ME
139.*Orobanche orientalis**	T par/ A	Steno- Medit	23

Violaceae			
33.*Viola alba*	H ros/ P	Euri- Medit	ME
34.*Viola arvensis**	T scap/ A	Eurasiat	22
35.*Viola heldreichiana*	T ros / A	E.- Medit	15,18,21,22
36.*Viola sieheana*	H ros/ P	Eurasiat	HA
Caryophyllaceae			
37.*Arenaria leptoclados**	T scap/ A	Paleotemp	20
38.*Cerastium brachypetalum**	T scap/ A	Euri- Medit	14,15,20
39.*Cerastium fragillimum*	T scap/ A	Steno- Medit	ME
40.*Cerastium illyricum ssp pilosum*	T scap/A	Steno- Medit	8,15,17, 20,22
41.*Holosteum umbellatum*	T scap/ A	Paleotemp	ME
42.*Kohlrauschia velutina**	T scap/A	Steno- Medit	5,11, 12,15,17,19,22
43.*Minuartia hybrida**	T scap/ A	Paleotemp	15,17,22
44.*Silene galataea*	H caesp/ P	Endemic	ME
45.*Silene laevigata*	T scap/ A	Endemic	9,11,15,22
46.*Silene papillosa**	T scap/ A	Steno- Medit	15
47.*Silene vulgaris * ssp. macrocarpa*	H scap/ P	Paleotemp (Subcosmopl)	1
48.*Stellaria cilicica*	H bien/ B	Steno- Medit	17,19,22
49.*Stellaria media ssp. media*	H bien/ B	Cosmopol	18,21,23
Illecebraceae			
50.*Scleranthus annus ssp. delortii*	T scap-H bien A-B	Paleotemp	ME
Cuttiferae			
51.*Hypericum lanuginosum var. lanuginosum*	H scap/ P	W. Asiat- Anatol (Syr, Pal, Lib)	CH
Geraniaceae			
52.*Erodium cicutarium*	T scap/ A	Euri- Medit	17,18
53.*Geranium columbinum**	T scap/ A	Europeo- Sud-Siber	17
Verbenaceae			
140.*Verbena officinalis*	H scap/ P	Paleotemp (Cosmopol)	5
Lamiaceae			
141.*Acinos exiguus*	Ch suffr/ Ar	Steno - Medit	17,22
142.*Ajuga orientalis*	H scap/ P	Euro-Medit, Mont	18,20
143.*Clinopodium vulgare*	H scap/ P	Circumbor	ME
144.*Lamium amplexicaule*	T scap/ A	Paleotemp	CH
145.*Mentha longifolia ssp. cyprica*	H scap/ P	Endemic	1
146.*Micromeria chionistrae*	Ch suffr/ Ar	Endemic	CH
147.*Origanum dubium*	H scap/P	Saharo	CH
148.*Prunella vulgaris*	H scap/ P	Steno- Europ	ME
149.*Scutellaria cypria var. elatior*	H scap/ P	Endemic	-----
150.*Stachys cretica*	H scap/ P	Medit	ME
151.*Teucrium kotschyanum*	NP/ Ar	Steno- Medit	7,11
152.*Teucrium scordium ssp. scordium*	H scap/ P	Europeo- Caucas	ME
153.*Thymus integer*	NP scap/ Tr-Ar	Endemic	8,12,13, 15,20
Polygonaceae			
154.*Rumex pulcher ssp. cassius*	H scap- T scap P- A	Euri-Medit	ME
Aristolochiaceae			
155.*Aristolochia sempervirens*	P lian/ Ar	Steno- Medit	ME
Euphorbiaceae			
156.*Euphorbia veneris*	Ch suffr/ P	Endemic	CH
Platanaceae			
157.*Platanus orientalis*	MP scap/ Tr	NE, Medit- Mont	5
Fagaceae			
158.*Quercus alnifolia*	MP scap/Ar	Endemic	-----
159.*Quercus infectoria ssp. veneris*	MP scap/ Ar	Steno- Medit	ME

54.*Geranium dissectum**	T scap/ A	Eurasiat(Subcosmop)	22
55.*Geranium lucidum**	T scap/ A	Euri- Medit	15,18, 21,23
56.*Geranium purpureum**	T scap/ A	Euri- Medit	15,17, 18,19,21,23
57.*Geranium pusillum**	T scap/ A	Europeo- W. Asiat	-----
Aceraceae			
58.*Acer obtusifolium*	MP scap/ Tr	Europ	5,23
Anacardiaceae			
59.*Pistacia terebinthus*	MP caesp- scap Tr- Ar	Euri- Medit	6
60.*Rhus coriaria*	MP caesp/ Ar	Steno- Medit	5,9
Fabaceae			
61.*Hymenocarpos circinnatus**	H scap/ A	Steno-Medit	15
62.*Lathyrus aphaca*	T scap/ A	Euri-Medit	13,15
63.*Lens ervoides*	T scap/ A	Steno- Medit, Pont	15
64.*Medicago polymorpha var. vulgaris*	T scap/ A	Subcosmop	ME
65.*Trifolium arvense*	T scap/ A	Paleotemp	13,14,15, 17,18,19
66.*Trifolium dubium**	T scap/ A	Europ-Caucas	13,14, 15,17,19,22
67.*Trifolium hirtum**	T scap/ A	Euri-Medit	13,14,20,22
68.*Trifolium striatum*	T scap/ A	Paleotemp	ME
69.*Trifolium subterraneum*	T rept/ A	Euri- Medit	CH
70.*Trifolium suffocatum*	T scap/ A	Steno- Medit	ME
71.*Trifolium tomentosum**	T rept/ A	Paleotemp	17
72.*Vicia hirsute*	Tscap/A	Paleotemp (Subcosopol)	ME
73.*Vicia lathyroides**	T scap/ A	Euri- Medit	------
74.*Vicia lunata*	T scap/ A	Steno- Medit	ME
75.*Vicia narbonensis* F. *var. narbonensis*	T scap/ A	Euri- Medit	ME
76.*Vicia tenuifolia**	T scap/ A	Euri- Medit	13,14
77. *Astragalus lusitanicus*	NP / P	Eurasiat	CS

MONOCOTYLEDONAE			
Orchidaceae			
160.*Dactylorhiza iberica*	G bulb/ P	Gre, Tu, Caucas	23
161.*Limodorum abortivum*	G rhiz/ P	Euri-Medit	ME
162.*Neotinea maculata*	G bulb/ P	Euri- Medit	ME
163.*Platanthera chlorantha*	G bulb/ P	Eurosib	ME
164. *Orchis anatolica*	G bulb/ P	Eurasiat	CS
Iridaceae			
165.*Gladiolus triphyllus*	G bulb/ P	Endemic	-----
166.*Romulea tempskyana*	G bulb/P	Steno- Medit	CH
Dioscoreaceae			
167.*Tamus communis*	G rad/ P	Euri-Medit	ME
Liliaceae			
168.*Asparagus acutifolius*	G rhiz- NP/P-Tr	Steno- Medit	ME
169.*Asphodelus aestivus*	G rhiz/ P	Euri- Medit	5,13, 15,19,22
170.*Colhicum troodi*	G bulb/ P	Paleotemp	ME
171.*Gagea* juliae	G bulb/P	Centro- N. Europ	CH
172.*Ornithogalum chionophilum*	G bulb/ P	Endemic	-----
173.*Smilax aspera*	NP(G rhiz)/Ar	Paleotemp (Subcosmop)	7
174.*Urginea maritima*	G bulb/ P	Steno- Medit	CH
Araceae			
175.*Arum conophalloides*	G rhiz/ P	Steno-Medit	5,18
176.*Arum rupicolum*	G rhiz/P	Centro-Euro	ME
Cyperaceae			
177.*Carex troodi*	G rhiz/ P	Crete	ME
Gramineae			
178.*Aira elegans**	T scap/ A	W. Europ	15
179.*Arrhenatherum album*	H caesp/ P	S. Europ- Medit	ME
180.*Avena barbata**	T scap/ A	Euri- Medit, Turan	11
181.*Avena fatua**	T scap/ A	Eurasiat	8,9,12

Crassulaceae			
78.*Sedum rubens**	T scap/ A	Euri- Medit	20,22
79.*Sedum cyprium*	NP/ Ar	Endemic	CH
80.*Umbilicus rupestris*	G bulb/ P	Medit- Atl	-----
Myrtaceae			
81.*Myrtus communis*	MP caesp/ Ar	Steno- Medit	CH
Umbelliferae			
82.Foeniculum vulgare*	H scap/ B-P	Steno-Medit	1
83.*Lecokia cretica*	H scap/ P	Cret- Anatol, Caucas	15,17,19, 21,22,23,20
84.*Orlaya daucoides*	T scap/ A	Medit- Turan	19,22
85.*Smyrnium connatum*	H bien/ B	Tu- Sy- Pal	ME
86.*Torilis heterophylla*	T scap/ A	Euri- Medit	ME
Rosaceae			
87.*Prunus domestica*	MP scap/ Tr-Ar	Euri- Medit	5,7
88.*Rubus causius**	NP/ Ar	Eurasiat	7
89.*Rubus sanctus*	MP scap/ P	Steno- Medit (Subcosop)	5,7,23
Caprifoliaceae			
90.*Lonicera etrusca*	P lian-caesp/Ar	Steno- Medit	CH
Rubiaceae			
91.*Galium aparine**	T scap/ A	Eurasiat	23
92.*Galium murale**	T scap/ A	Steno- Medit	15,17
93.*Galium parisiense**	T scap/ A	Euri- Medit	18,21,22
94.*Galium peplidifolium*	T scap/ A	Steno- Medit	21,22
95.*Galium recurvum**	T scap/ A	Steno- Medit	22
96.*Rubia laurae*	H scap/ P	Endemic	ME
97.*Rubia tenuifolia*	NP lian/ Ar	Steno- Medit	4,5,12,22,23
98.*Rubia tinctorum**	H scap/ P	W-C. Asiat	5
99.*Sherardia arvensis**	T scap/ A	Euri- Medit Subcosmopol	22
182.*Avena wiestii*	T scap/ A	E. Medit- Anatol, N. Af	ME
183.*Brachypodium distachyum**	T scap/ A	Steno- Medit, Turan	12
184.*Briza humilis*	T scap/ A	S.E Europ, Tur, Pal Caucas, Iran, Irak	CH
185.*Bromus diandrus**	T scap/ A	Euri-Medit	1,2-3
186.*Bromus sterilis**	T scap/ A	Euri- Medit, Turan	-----
187.*Bromus tectorum*	T scap/ A	Paleotemp	ME
188.*Catapodium rigidum*	T scap/ A	Euri- Medit	15
189.*Cynosurus echinatus**	T scap/ A	Euri- Medit	-----
190.*Cynosurus elegans*	T scap/ A	Steno- Medit	ME
191.*Gastridium phleoides**	T scap/ A	Steno- Medit	10
192.*Hyparrhenia hirta**	H caesp/ P	Euri- Medit	12
193.*Lindbergella sintenisii**	T scap/ A	Endemic	10
194.*Melica minuta*	H caesp/ P	Steno- Medit	ME
195.*Micropyrum tenellum*	T scap/A	S. Europ- Medit- Atl	ME
196.*Milium vernale*	T scap/ A	Medit- Mont	-----
197.*Oryzopsis coerulescens*	H caesp/ P	Steno- Medit	ME
198.*Poa alpina**	H caesp/ P	Circumbor	10
199.*Poa bulbosa**	H caesp/ P	Circumbor	5,8,13, 15,18,19,20,22
200.*Psilurus incurvus**	T scap/ A	Euri- Medit	15
201.*Triticum aestivum*	T scap/ A	Cultivated	ME
202.*Triticum durum*	T scap/ A	Cultivated	ME
203.*Triticum turgidum*	T scap/ A	Medit	ME
204.*Vulpia ciliata**	T caesp/ A	Euri- Medit	2-3, 11,17,18
205.*Vulpia myuros**	T caesp/ A	Subcomop	10,15,22

Notes to Appendix 2

Altitutes of collection plots
1. 1400m
2. 1250m
3. 1250m
4. 1300m
5. 1200m
6. 1100m
7. 950m
8. 1300m
9. 1250m
10. 1350m
11. 1200m
12. 1050m
13. 1280m
14. 1280m
15. 1350m
16. 1380m
17. 1400m
18. 1360m
19. 1330m
20. 1300m
21. 1350m
22. 1200m
23. 1100m

* Plants recorded for the first time here.
----- Plants that were found in all the areas.

For plant species not included in our collection samples: CH: recorded by Charalampous and Christou (1995); ME: recorded by Flora of Cyprus (Meikle 1977, 1985); CS: recorded by Chrtek and Slavic (2001); HA: recorded by Hadjikyriakou (2007)
For growth forms: A=annual, B=biennial, P= perennial, Tr= tree, Ar=shrub
For life forms the method of Raunkier was used.
For the chorological type: Steno-Medit.=steno-Mediterranean, Euri-Medit=wide-spread Mediterranean, Medit-Turan= Mediterranean -Turanic, Europ= European, Centro-Europ=European (centre), Eurasiat=Eurasiatic, Eurosib=Eurosiberian, Cosmopol=Cosmopolitan, Subcosmop= Subcosmopolitan, Paleotemp=Paleotemperate, Circumbor=Circumboreale