Arne Strid

The Greek mountain flora, with special reference to the Central European element

Abstract

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Strictly arctic-alpine species are rare in Greece, and generally restricted to some of the highest mountain tops in the north, e.g. Varnous, Voras, Timfi, Olimbos, Gramos and Smolikas. Several have their southernmost occurrences on non-calcareous mountains in north central Greece, others in the Rodhopi mountains. Many Central European forest species extend to the northern Pindhos, N. Central and N.E. Greece, fewer to the high mountains of Sterea Ellas or northern Peloponnisos, and practically none to Crete. Anatolian connections follow either a northern route (via Thraki) or a southern route (the S. Aegean island arc); the former species tend to be associated with moist, non-calcareous habitats, the latter are more often plants of dry calcareous rocks. The Italian element is most prominently represented in north-western Greece. Regional and local endemism increases in a southerly direction, culminating in the White Mountains of western Crete. Edaphic endemism is conspicuous in the serpentine areas that extend from north-western Greece to Albania. Local and regional endemics tend to be diploid (frequency of polyploidy 10-15 %); widespread Central European or boreal species have much higher rates of polyploidy (42-48 %).

Introduction

This study is based on a survey of 1520 taxa (species and subspecies) treated in the two volumes of *Mountain flora of Greece* (Strid 1986a, Strid & Tan 1991); the survey includes almost all "full members" (species regularly found above an altitude of 1500-1800 m), and some "associate members" for which sufficient data were available. Data on distribution etc. were transferred to a database, and various statistical calculations made.

Floristic phytogeography in the Aegean area has been thoroughly studied by Rechinger (1950) and Rechinger & Rechinger-Moser (1951), mainly based on *Flora aegaea* (Rechinger 1943). Numerous later studies on individual areas or plant groups, mainly by workers in Lund and Berlin, have largely confirmed the patterns established

by Rechinger. For the mountains, however, little basic quantitative data have been available until the completion of the *Mountain flora.*

Diversity of flora and vegetation in the Greek mountains

The total number of species in the Greek flora is c. 5700, 740 of which are endemic to the country. In the mountain flora the corresponding figures are c. 1600 and 405. Differences in climate and substrate haveresulted in dramatic contrasts between mountains in different parts of the country, ranging from the desert-like uplands of Levka Ori in W. Crete to the wet and forested mountains on the northern borders. Limestone is the dominant substrate of the mountains in S. and Central Greece; in the north there are large tracts of granite, micaceous schist and other non-calcareous substrates. Serpentine or ultramafic rocks with their distinctive flora and vegetation occur in much of N.W. Greece and extend to Albania. Isolated limestone massifs such as Taigetos, Chelmos, Olimbos, and Athos are famous for their spectacular flora rich in local endemics.

Species richness in different parts of Greece

For the purpose of the *Mountain flora,* Greece was divided into eight regions as shown in Fig. 1. Total numbers of mountain taxa in the eight regions are: Crete 217, Peloponnisos 540, Sterea Ellas 751, S. Pindhos 609, N. Pindhos 780, E. Central 278, N. Central 868, North-East 665.

Crete is surprisingly poor in absolute number of species. The highest numbers are in N. Pindhos and N. Central, which are regions of high biotic diversity and a balanced, "continental" flora. The low number for E. Central reflects the fact that this is a somewhat atypical region with only three mountains, none above 2000 m high.

General distribution

With respect to general distribution, taxa were classified into nine broad categories (only a few atypical ones were omitted). Data refer to native distribution (e.g., a native Mediterranean species now introduced in N. America and S. Africa is classified as "Mediterranean").

Percentages of taxa representing the nine different phytogeographical elements are as follows (absolute numbers in brackets):

1. cosmopolitan, widespread in the northern hemisphere, arctic-alpine, or Euro-Siberian: 13.8 % (210);
2. Central & S. European (sometimes extending to the Caucasus and N Iran), a broad category more or less corresponding to the "Central European element" of Balkan authors: 15.5 % (236);
3. Balkanic and Anatolian (including taxa extending somewhat beyond the borders of S. or E. Anatolia): 9.6 % (146);
4. widespread Mediterranean: 7.9 % (120);

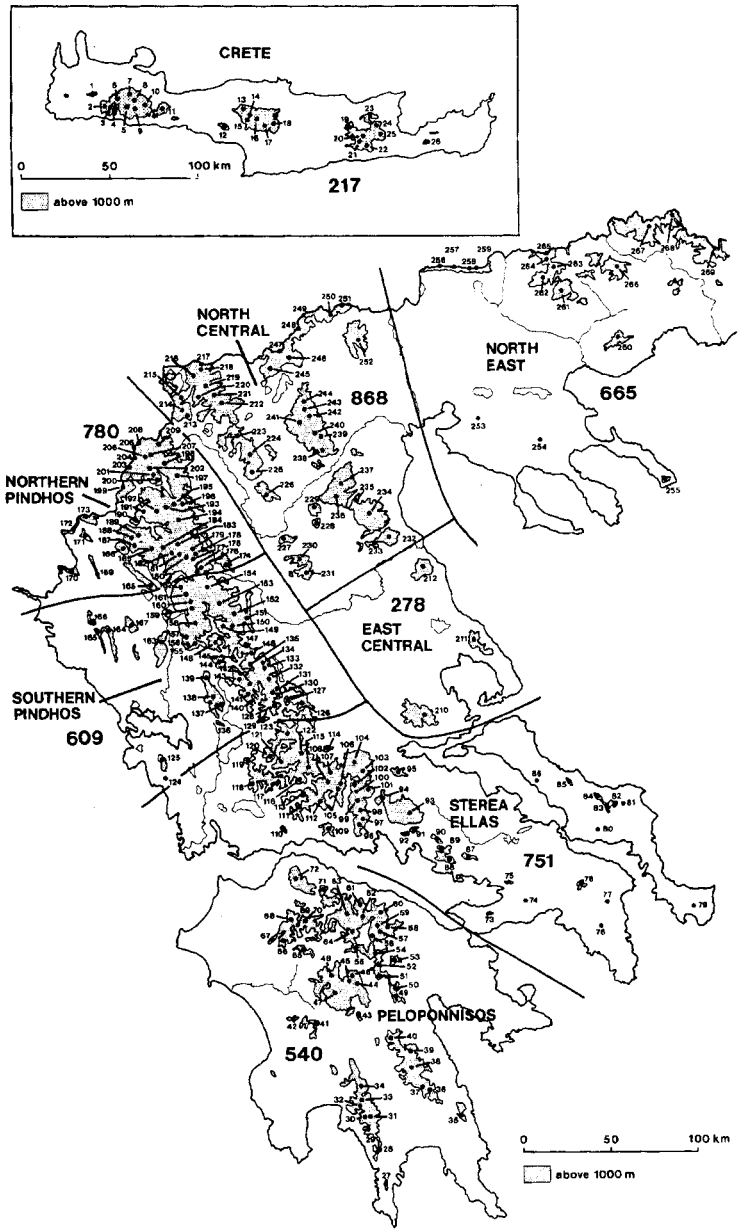

Fig. 1. Map of Greece, indicating the 8 regions discussed in the text. The absolute numbers of mountain taxa (species and subspecies) are indicated for each region. The small numerals refer to a list of mountain names in Strid (1986a). For names and numbers of the 28 mountains used for phytogeographical comparisons, see text.

constitute 2.5-4.4 % of the mountain flora in Peloponnisos, Sterea Ellas, N. Central and N. East, and are practically lacking in S. Pindhos, N. Pindhos and E. Central.

Table 2. Percent frequencies of taxa representing different phytogeographical elements in the floras of 28 Greek mountains. – The numbers (**1-9**) refer to the numbering of the elements in the text; **?** = taxa not belonging to any of the 9 elements, or with distribution insufficiently known; Σ = total number of taxa.

Element:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**?**	Σ
Levka Ori	8.3	7.7	14.2	15.9	3.0	2.4	8.9	26.6	10.0	3.5	169
Psiloritis	9.2	6.7	15.8	16.7	2.5	0.0	6.7	38.3	1.7	2.4	120
Dhikti	9.0	5.7	13.1	18.9	0.8	0.8	7.4	37.7	3.3	3.3	122
Taigetos	12.3	11.6	12.9	18.9	3.1	9.7	17.0	6.6	3.8	4.1	318
Parnon	11.7	13.9	12.6	20.2	4.5	10.4	12.6	6.7	1.8	5.6	223
Menalon	6.8	9.8	15.2	22.0	6.1	11.4	16.7	6.1	0.0	5.9	132
Killini	11.4	12.1	15.9	15.2	5.5	10.4	19.7	5.9	1.4	2.5	289
Chelmos	12.0	14.3	14.8	15.7	5.3	14.0	17.1	4.2	0.8	1.8	357
Parnassos	13.3	15.0	10.4	16.7	5.6	15.7	15.7	3.9	0.7	3.0	414
Iti	20.1	18.2	11.1	14.2	5.0	14.8	11.3	1.3	0.3	3.7	379
Timfristos	15.9	16.9	10.1	16.9	6.0	16.4	12.3	1.0	0.5	4.0	397
Voutsikaki	16.7	15.8	9.5	17.2	7.2	21.7	9.1	0.0	0.0	2.8	221
Peristeri	16.6	18.3	7.6	14.5	7.6	22.3	7.6	0.3	0.0	5.2	290
Mavrovouni	18.7	19.1	5.8	10.8	5.8	25.3	7.5	3.7	0.0	3.3	241
Timfi	18.3	20.5	7.5	13.3	7.5	23.0	5.8	0.6	0.6	2.9	361
Smolikas	24.2	21.0	8.4	11.2	6.8	19.6	3.8	1.4	1.0	2.6	499
Gramos	21.0	22.4	8.5	8.8	5.9	25.5	4.0	1.1	0.6	2.2	353
Ossa	17.2	19.5	14.2	17.8	3.0	20.1	4.7	0.0	0.0	3.5	169
Varnous	27.0	25.9	7.6	10.6	5.7	20.2	1.1	0.0	0.4	1.5	263
Vourinos	15.6	23.6	9.6	14.4	3.2	23.6	3.6	0.0	2.4	4.0	250
Olimbos	20.1	20.3	8.6	14.4	5.1	18.4	5.5	0.2	4.3	3.1	487
Vermion	26.7	21.7	10.3	11.1	4.0	20.1	2.9	0.3	0.0	2.9	378
Voras	29.7	24.4	9.0	10.5	3.1	19.0	1.3	0.0	1.0	2.0	390
Athos	15.7	21.9	17.1	13.3	1.4	14.3	5.2	1.4	6.2	3.5	210
Belles	24.4	29.5	11.0	9.6	5.8	16.7	0.6	0.6	0.0	1.8	156
Vrondous	38.3	25.0	7.7	10.2	3.6	13.8	0.5	0.0	0.0	0.9	196
Falakron	24.2	27.1	13.4	10.1	1.8	19.9	0.4	0.4	0.0	2.7	277
Rodhopi	37.4	26.5	8.7	8.2	1.8	14.6	0.9	0.0	0.5	1.4	219

A similar survey of the frequency of taxa representing the nine different phytogeographical elements is presented for 28 individual mountains (Table 2 and Fig. 2). The first two distributional elements (widespread taxa and Central European taxa) together constitute 47-64 % of the flora of non-calcareous mountains in northern Greece (Varnous, Voras, Belles, Vrondous, and Falakron); as predicted, the frequency decreases in a southerly direction, down to c. 16 % in the mountains of Crete. The three massifs of Crete have remarkably high frequencies of single-area endemics (26.6 % to 38.3 %) and, in the case of the Levka Ori, of single-mountain endemics. Greek endemics, single-area endemics and single-mountain endemics together constitute c. 46 % of the flora of the

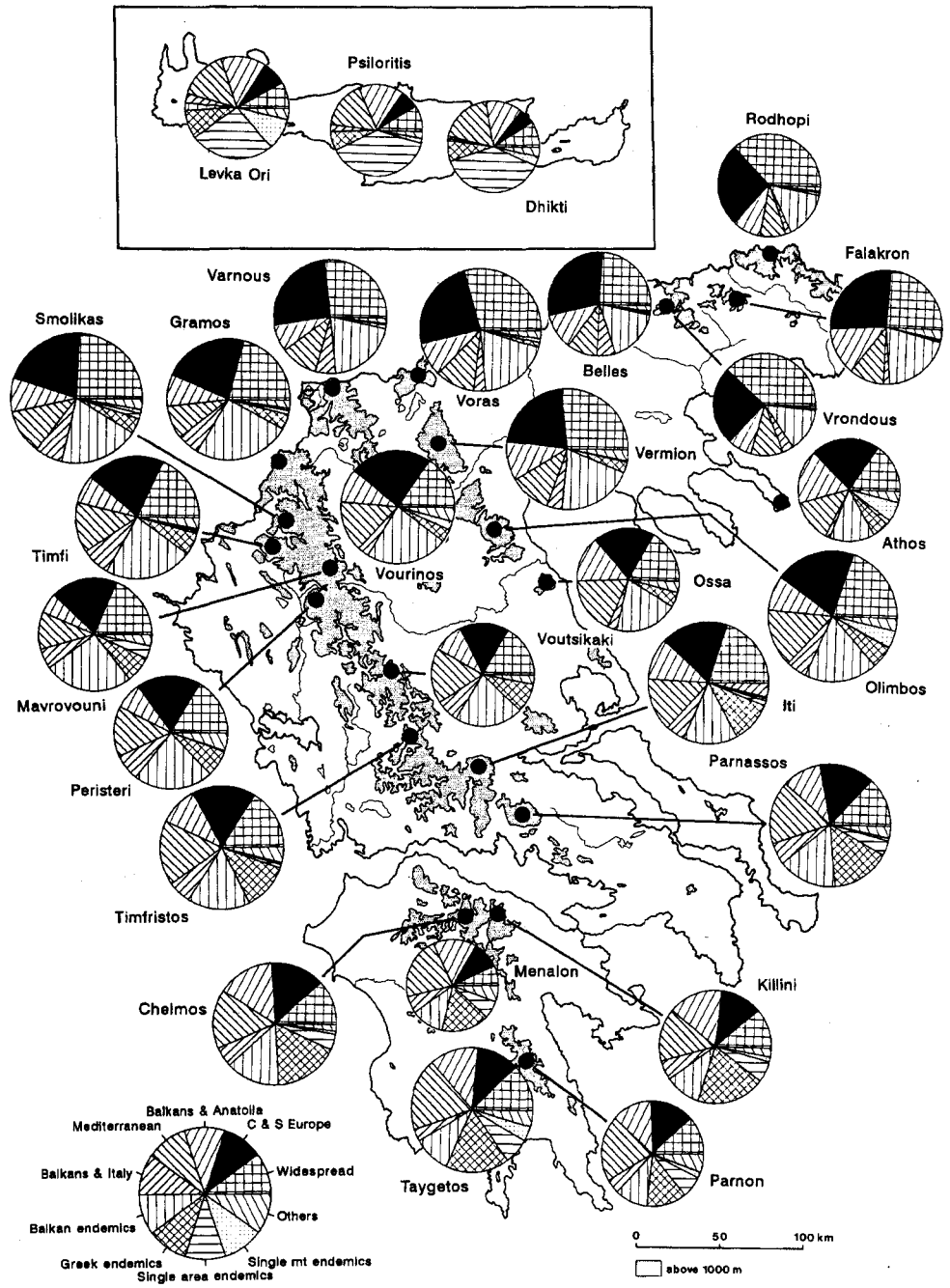

Fig. 2. Pictorialized diagram showing the frequencies of taxa representing different phytogeographical elements on 28 Greek mountains. The area of each pie is proportionate to the total number of taxa on the mountain.

individual mountains of Crete. In the North-East, the isolated limestone massif of Mt Athos has a relatively low frequency of widespread and Central European taxa (37.6 %) as compared, for instance, to the non-calcareous Rodhopi mountains (63.9 %); on the other hand, the Anatolian element is much more prominently represented on Mt Athos (17.1 %) than in the Rodhopi (8.7 %).

Arctic-alpine or boreal taxa in northern Greece

The first two distribution elements in Table 1-2 are very broad ones, comprising different subelements of widespread holarctic taxa. Strictly arctic-alpine species are rare in Greece, and generally restricted to some of the highest mountain tops in the northern parts of the country (Varnous, Voras, Timfi, Olimbos, Gramos, Smolikas); a few of them reach Sterea Ellas (Iti, Vardhousia, Parnassos), and practically none extend to Peloponnisos and Crete.

Several arctic-alpine or boreal taxa as well as taxa of the Alps and Carpathians have their southernmost occurrences on non-calcareous high mountains in N. Central Greece, usually on Mts Voras and/or Varnous, sometimes extending to Vermion, Gramos or Smolikas. The list includes at least the following: *Apiaceae: Ligusticum mutellina; Asteraceae: Achillea clusiana, Adenostyles alliariae, Hieracium alpicola, Leontodon autumnalis, Senecio abrotanifolius* subsp. *carpathicus, Senecio subalpinus; Campanulaceae: Phyteuma orbiculare; Caryophyllaceae: Stellaria uliginosa; Cyperaceae: Carex canescens, Carex lasiocarpa, Carex limosa, Eriophorum angustifolium, Eriophorum vaginatum, Rhynchospora alba; Ericaceae: Vaccinium uliginosum* subsp. *microphyllum, V. vitis-idaea; Fabaceae: Trifolium badium; Gentianaceae: Gentiana punctata; Juncaceae: Juncus trifidus, Luzula alpinopilosa; Onagraceae: Epilobium palustre; Poaceae: Agrostis canina, Agrostis rupestris; Rosaceae: Alchemilla gorcensis, Alchemilla straminea; Saxifragaceae: Saxifraga pedemontana* subsp. *cymosa, Saxifraga rotundifolia* subsp. *heucherifolia, Saxifraga stellaris* subsp. *alpigena; Scrophulariaceae: Rhinanthus minor, Veronica bellidioides; Violaceae: Viola palustris.*

Another group of taxa belonging to the same phytogeographical elements extend southwards to the Rodhopi mountains, sometimes with scattered occurrences elsewhere in northern Greece. The list includes the following: *Asteraceae: Achillea millefolium, Inula hirta, Senecio germanicus; Campanulaceae: Campanula persicifolia; Chenopodiaceae: Chenopodium foliosum; Cyperaceae: Carex digitata, Carex flava; Fabaceae: Trifolium spadiceum; Hypericaceae: Hypericum maculatum; Liliaceae: Polygonatum verticillatum; Pinaceae: Picea abies, Pinus sylvestris; Plantaginaceae: Plantago media* subsp. *media; Ranunculaceae: Aquilegia vulgaris; Rosaceae: Alchemilla monticola, Rosa pimpinellifolia; Scrophulariaceae: Euphrasia hirtella, Melampyrum sylvaticum, Veronica chamaedrys* subsp. *chamaedrys; Thymelaeaceae: Daphne mezereum.*

A somewhat smaller group of such widespread taxa extend southwards to Mts Falakron and/or Olimbos, and may have scattered occurrences on other limestone mountains in northern Greece. The following may be mentioned: *Apiaceae: Peucedanum offici-*

nale; Asteraceae: Carlina acaulis subsp. *simplex; Caryophyllaceae: Minuartia setacea, Silene saxifraga; Iridaceae: Gladiolus palustris; Liliaceae: Erythronium dens-canis; Linaceae: Linum perenne* subsp. *alpinum; Poaceae: Koeleria eriostachya, Poa molinerii; Rosaceae: Dryas octopetala, Potentilla cinerea; Santalaceae: Thesium alpinum; Scrophulariaceae: Linaria alpina.*

A few representatives of these elements extend southwards to Mt Timfi and may or may not have scattered occurrences on other limestone mountains in northern Greece. This list includes: *Brassicaceae: Rorippa islandica; Fabaceae: Astragalus vesicarius; Poaceae: Alopecurus aequalis; Rosaceae: Geum reptans; Saxifragaceae: Saxifraga oppositifolia.* Particularly remarkable is the occurrence of the arctic-alpine *Saxifraga oppositifolia;* the only Greek locality for this species is on limestone rocks near the summit of Gamila in Mt Timfi.

The Central European forest element

Typical forest species have been excluded from the *Mountain flora,* which by definition comprises only species regularly found above 1800 m or in open, treeless habitats above c. 1500 m. Nevertheless, some forest species ascend to subalpine levels in ravines, meadows, etc., and have thus been included in the *Flora.* The Central European element in the forest flora of Greece is treated elsewhere (Raus, this volume), and only some general features will be mentioned here.

Fagus forest is widespread in the mountains of northern Greece, generally in the cloud belt between c. 800 and 1800 m, extending southwards to Mt Oxia in Sterea Ellas (*oxiá* = beech, in Greek), often in pure stands or sometimes mixed with other broad-leaved deciduous species. Many of the shrubs and herbs associated with *Fagus* forest follow its distribution, and the flora and vegetation has a distinctly Central European character. *Pinus nigra* and *Abies* species often grow in mixed stands on somewhat drier slopes throughout the Greek mainland. *Picea abies* occurs in almost pure, virgin stands in the central Rodhopi mountains near the Bulgarian border (its southernmost locality). Coniferous forest becomes progressively more prominent at the expense of broad-leaved deciduous forest as one moves south along the mountains of Greece. On Peloponnisos practically all montane forest is dominated by *Pinus nigra* and *Abies cephalonica;* the remnants of montane forest that still exist in Crete (especially in the Levka Ori) consist of *Cupressus sempervirens* and *Pinus brutia.* Deciduous forests as well as their corollary herbs and grasses are practically lacking in the mountains of Crete.

The Anatolian element

The Anatolian element in the Greek mountain flora has been discussed elsewhere (Strid 1986b). Between 51 % and 61 % of the taxa found in the eight different regions of Greece also occur in Turkey, whereas preliminary data indicate that only 17-20 % of the mountain taxa of S.W. and S. Central Anatolia are also present in Greece.

Taking a narrower view of the Anatolian element, one will find a number of Anatolian taxa occurring in the North-East and sometimes also in the N. Central regions, but not elsewhere in Greece. They tend to be meadow or woodland species often associated with non-calcareous substrates.

In the south, a small group of Anatolian mountain taxa occurs in Crete but not elsewhere in Greece. Rather more numerous are Anatolian taxa bypassing Crete and reappearing in the mountains of Peloponnisos and Sterea Ellas. These southern taxa tend to prefer arid, rocky habitats and are usually found on limestone, occasionally on serpentine or other substrates. Some of them show wide disjunctions and must be considered relict elements in the European flora (e.g., *Arnebia densiflora, Juniperus drupacea*).

The Italian element

The Italian element is most prominently represented in the Pindhos range; it decreases progressively in Sterea Ellas and Peloponnisos, and is practically non-existent in Crete. Connections between the Greek and Italian mountain floras clearly follow a northern, Adriatic route. In addition to the taxa classified as members of the Italian element, a fairly large number are widespread in Central Europe and extend southwards to S. Italy and Central Greece; they have been classified as members of the Central European element.

Endemism

Greek endemics, single-area endemics and single-mountain endemics together constitute 26.7 % of the total mountain flora of Greece. There are large regional differences with respect to the frequency of narrow endemism. When scored for the eight regions, these three categories together constitute the following percentages of the flora (absolute numbers in brackets):

Crete	41.9 %	(91 of 217)	N. Pindhos	8.2 %	(64 of 780)
Peloponnisos	26.5 %	(143 of 540)	E. Central	5.8 %	(16 of 278)
Sterea Ellas	21.6 %	(162 of 751)	N. Central	8.3 %	(72 of 868)
S. Pindhos	10.0 %	(61 of 609)	North-East	6.3 %	(42 of 665)

These figures tend to underestimate the frequency of narrow endemism in northern and central Greece where many taxa occur across the borders to Albania, the former Jugoslavia or Bulgaria, and have thus been classified as Balkan endemics. Taxa restricted to the Balkan Peninsula or parts thereof constitute 46.5 % or nearly half of the mountain flora of Greece. Scored for the eight different regions, the percentages of such taxa are:

Crete	44.2 %	(96 of 217)	N. Pindhos	30.1 %	(235 of 780)
Peloponnisos	38.0 %	(205 of 540)	E. Central	24.1 %	(67 of 278)
Sterea Ellas	36.5 %	(274 of 751)	N. Central	30.6 %	(266 of 868)
S. Pindhos	30.2 %	(184 of 609)	North-East	26.4 %	(176 of 665)

Floristic similarities between some of the eight regions

Floristic connections between Crete and Peloponnisos in terms of shared Greek endemics are remarkably weak. Connections between Peloponnisos and Sterea Ellas are much stronger, and the Gulf of Korinthos scarcely appears as a phytogeographical border at all. No less than 44 Greek endemics are restricted to the two regions just south and north of the gulf. In the north, the valley of the Vardar or Axios river is a fairly strong phytogeographical barrier between the N. Central and North-East regions.

Floristic similarities between individual mountains

Occurrence or non-occurrence of the 1520 taxa was scored for 28 selected mountains (cf. numbers in Fig. 1), viz.: Crete: Levka Ori (2-10), Psiloritis (13-18), Dhikti (19-25); Peloponnisos: Taigetos (28-34), Parnon (36-40), Menalon (44-48), Killini (56-59), Chelmos (62-64); Sterea Ellas: Parnassos (93), Iti (104), Timfristos (123); S. Pindhos: Voutsikaki (incl. Kazarma, 133-134), Peristeri (161-162); N. Pindhos: Mavrovouni (incl. Milea, Pirostia, Fleka, and Aftia, 178-181), Timfi (188-189), Smolikas (192), Gramos (incl. Kato Arena, Epano Arena, Kiafa and Souflikas, 201-207); E. Central: Ossa (212); N. Central: Varnous (216-219), Vourinos (226), Olimbos (234), Vermion (238-244), Voras (246-249); North-East: Athos (255), Belles (256-259), Vrondous (262), Falakron (266), Rodhopi (267-269).

Total numbers of taxa for the 28 mountains are shown in Table 2 (last column). These numbers reflect differences in altitude, area and biotic diversity of the mountains, but also differences in the degree of floristic exploration. Numbers for some mountains, especially Menalon, Varnous, Belles and Rodhopi, are undoubtedly too low. The highest numbers are found on large and relatively well explored massifs, such as Parnassos, Timfristos, Smolikas, Olimbos and Voras. The Cretan mountains, well known for their unique flora rich in endemics, are remarkably poor in absolute numbers of taxa, reflecting the dry and harsh conditions. The two largest and floristically richest mountains on Peloponnisos (Taigetos and Chelmos) each have more than twice as many taxa as the average for the three Cretan massifs, and Smolikas and Olimbos have more than three times as many.

Similarity indices were calculated for all possible combinations of two mountains. The index used is:

$$i = 2C : (A + B)$$

where A is the total number of taxa on one mountain, B is the total number of taxa on the other, and C is the number of shared taxa. Such pairwise comparisons resulted in a data matrix with similarity indices varying from 0.022 to 0.760. The data matrix was transformed into a dendrogram (Fig. 3) by means of the NTSYS computer programme using the "Complete linkage" method.

The three Cretan mountains form a distinct group of their own, Psiloritis and Dhikti having the highest similarity index of any pair of mountain in the study. The five

mountains on Peloponnisos (Taigetos, Parnon, Menalon, Killini, and Chelmos) also form a distinct group, Taigetos-Parnon, and Killini-Chelmos being the closest pairs. Six mountains in Sterea Ellas and Pindhos (Parnassos, Iti, Timfristos, Voutsikaki, Peristeri, and Timfi) form a similar group. The mountains of Peloponnisos are related to the latter, and (at a considerably lower level of similarity) to the mountains of Crete.

Three mountains included in the study, viz. Mavrovouni, Smolikas and Vourinos, consist largely of serpentine which is known to support a distinctive flora (see above). In the dendrogram, however, they are joined at relatively low levels of similarity, Mavrovouni and Smolikas being the closest. Smolikas is more similar to Gramos, a large non-calcareous massif immediately to the north, than to any of the two other serpentine mountains.

The two large non-calcareous massifs on the northern borders, Varnous (granite) and Voras (micaceous schist), form a small group of their own. Olimbos and Vermion are also joined at a relatively high level of similarity.

In the North-East the two limestone mountains (Athos and Falakron) are more similar to a small group of mountains in the N. Central region, including Olimbos (also limestone), than to the three non-calcareous mountains (Belles, Vrondous, and Rodhopi), which are geographically closer.

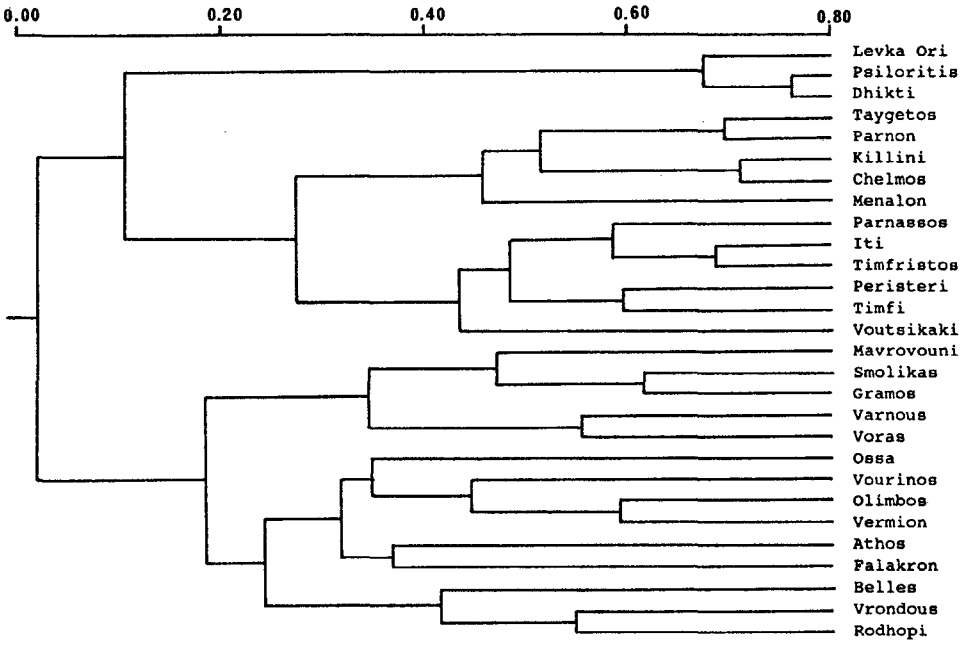

Fig. 3. Dendrogram based on similarity indices from pairwise comparisons between the floras of 28 mountains (as in Fig. 2). Explanation and interpretation in the text.

Chromosome numbers

Chromosome numbers and diploid vs. polyploid status were scored for all taxa for which such information was available. Diploid or polyploid status was generally determined by comparison with chromosome numbers for other taxa in the same genus or group of closely related genera. A *Euphorbia* species with $2n = 36$ was thus scored as polyploid (since within this genus there are several species known to have $2n = 18$), whereas a *Cerastium* species with $2n = 36$ was scored as diploid (since this is the lowest chromosome number level known in the genus, which includes several species with $2n = 72$ or higher). A taxon for which both diploid and polyploid numbers have been reported was scored in both categories. In genera with several basic numbers and aneuploid series it may sometimes be difficult to determine the diploid or polyploid status of a taxon accurately. A few such cases, including the genus *Carex*, were omitted.

It has long been established that the frequency of polyploidy tends to be lower in the Mediterranean area than in Central and N. Europe. Reasons for this are probably manifold, including differences in floral history, distribution patterns, and life form spectra. It could thus be expected that the incidence of polyploidy would be lower in the mountains of southern Greece with their mainly oreo-Mediterranean flora than in the north where the central European element is more prominent. The percentage figures of polyploid taxa are as follows for the eight regions (absolute numbers in brackets):

Crete	31.8 %	(48 of 151)	N. Pindhos	37.8 %	(225 of 595)
Peloponnisos	33.3 %	(141 of 424)	E. Central	36.7 %	(90 of 245)
Sterea Ellas	35.1 %	(200 of 569)	N. Central	37.7 %	(257 of 682)
S. Pindhos	36.9 %	(174 of 485)	North-East	37.3 %	(207 of 555)

The observed differences are surprisingly small, and even the difference between Crete (31.8 %) and N. Pindhos (37.8 %) is not statistically significant ($0.2 > p > 0.1$). Much more dramatic differences appear when diploid vs. polyploid status is scored for taxa representing different distribution types (phytogeographical elements). The same nine broad categories have been used as above, and the figures are as follows:

cosmopolitan, etc.	42.8 %	(77 of 180)	Balkan endemic	26.3 %	(48 of 182)
C. & S. European	48.6 %	(106 of 218)	Greek endemic	20.2 %	(15 of 74)
Balkano-Anatolian	39.6 %	(42 of 106)	single-area end.	15.4 %	(12 of 78)
Mediterranean	32.4 %	(33 of 102)	single-mt end.	10.0 %	(5 of 50)
Balkano-Italian	24.3 %	(10 of 41)			

Here the tendency is quite obvious: Groups of widespread taxa have frequencies of polyploidy around or above 40 %, whereas regional or local endemics have significantly lower frequencies, down to 10-15 % in single-area and single-mountain endemics. If the material is divided into only two categories the figures are:

Widespread taxa	41.4 %	(268 of 647)	Balkan or narrower	20.8 %	(80 of 384)

Conclusions

Absolute numbers of taxa are high in the N. Pindhos (780) and especially in the N. Central region (868), which are areas of high biotic diversity and a balanced, "continental" flora. Numbers decrease as one goes south to Sterea Ellas (751) and Peloponnisos (540). Crete is surprisingly poor in absolute number of species, with only 217 taxa, or exactly one fourth as many as N. Central.

C. 60 % of the taxa found in the Greek mountains are restricted to the Balkan Peninsula plus Anatolia, the Balkan Peninsula plus Italy, or a smaller area; the others are more widely distributed. Greek endemics, single-area endemics, and single-mountain endemics together constitute 26.7 % of the flora.

There are large regional differences with respect to the frequency of narrow endemism. In Crete, 35.5 % of the taxa are restricted to this island; the combined rate of single-area endemics and single-mountain endemics is 10.1 % in Peloponnisos, 6.1 % in Sterea Ellas, and lower in the other regions.

Several widespread arctic-alpine or boreal species have their southernmost occurrences in non-calcareous mountains along the northern borders of Greece, especially Mts Varnous, Voras, and Rodhopi. Central European forest species often extend to Sterea Ellas, sometimes to N. Peloponnisos, but virtually never to Crete. Anatolian taxa are well represented both in the North-East and in southern Greece; taxa representing the northern Anatolian connection are often plants of meadows and montane woodland; those occurring along the South Aegean island arc are more often plants of dry limestone habitats. A considerable number of Anatolian species bypass Crete and reappear in Peloponnisos and Sterea Ellas; some of these are examples of wide disjunctions. Representatives of the Italian element are found particularly in the Pindhos, more rarely in S. Greece.

Floristic connections between Peloponnisos and Sterea Ellas are remarkably strong, those between Crete and Peloponnisos are much weaker. The lowland areas separating the mountains of N. Central and North-East constitute a fairly strong phytogeographical barrier. Clustering of 28 individual mountains based on total floristic similarity demonstrates the combined effects of geographic and edaphic isolation.

An analysis of the frequency and distribution of polyploid taxa clearly demonstrates that frequency of polyploidy is higher in widespread taxa than in regional or local endemics; groups of taxa with total distribution areas extending beyond the Balkan Peninsula have average polyploidy rates of more than 40 %, single-mountain endemics and single-area endemics, of 10-15 %.

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Address of the author:
Prof. Dr Arne Strid, Botanical Laboratory, University of Copenhagen, Gothersgade 140, DK-1123 Copenhagen K, Denmark.