CLASSIFICATION OF GREEK FAGUS WOODLANDS: A PRELIMINARY SURVEY

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ABSTRACT - Almost 1000 published and unpublished phytosociological relevés of Greek *Fagus* forests are classified and the clusters interpreted with respect to ecology and phytogeography. A synoptic table is presented. Three ecological groups of communities are distinguished, viz. mesophilous, acidic and xerothermic *Fagus* woodlands. Differentiation within each group reveals chiefly phytogeographical as well as further ecological patterns. Geographical distributions and ecological preferences of each community are outlined and some syntaxonomic conclusions briefly discussed.

KEY WORDS - classification, *Fagion*, *Fagus sylvatica*, forests, Greece, vegetation survey

INTRODUCTION

Although beech (*Fagus sylvatica* s.l.) woodlands constitute only 10 % of the total area covered by forests in Greece, and 17.4 % of the broadleaved forest area (Anonymous, 1992; Dafis, 1969), they are of high phytogeographical, ecological and economic significance. *Fagus sylvatica* is a montane element in Greece which is restricted to the Pindos, the Varnous-Vourinos and Voras-Olimbos-Pilion chains and to the mountains of north-eastern Greece (distribution maps in Moulopoulos, 1965, and Strid & Kit Tan, 1997). Beech, or mixed beech-conifer stands often form the timberline, usually around 1800 m a.s.l., depending on region, aspect, substrate and degree of human interference. On Mt Olympus, however, as in few other mountains, there are *Pinus heldreichii* woodlands above the *Fagus* zone. Below montane levels beech is replaced by deciduous oaks. The lowest *Fagus* stands occur in Thraki at the eastern fringes of the Rodopi Mts, occasionally as low as 200 m a.s.l., represented here by *Fagus sylvatica* subsp. *orientalis*. The latter beech taxon which is otherwise widespread in northern Anatolia, Crimea and the Caucasus only just reaches Thraki and eastern Makedonia. For practical reasons in our account, and in accordance with recent floras and taxonomic lists (Greuter *et al*., 1986; Aldén in Strid, 1986; Christensen in Strid & Kit Tan, 1997), the poorly defined *Fagus sylvatica* subsp.

moesiaca which is intermediate between subspp. *orientalis* and *sylvatica* is merged in the latter. As elsewhere in Europe, beech forms mostly either pure or mixed *Fagus-Abies* stands. Other tree species may occur, in certain plant communities, but rarely in large numbers.

The chorological significance of Greek *Fagus* woodlands had already been emphasized by early botanical travellers (*e.g.*, Adamovic, 1906; Mattfeld, 1927; Turrill, 1929; Markgraf, 1942; Regel, 1943). Full species lists and descriptions which were published by Quézel and Contandriopoulos, 1965; Quézel, 1967; Dafis, 1969; Horvat *et al.*, 1974; Barbero and Quézel, 1976; Zoller *et al.*, 1977; Gamisans and Hebrard, 1979 and 1980 shed first light on habitat conditions and species composition but provided limited and geographically scattered material. Later, more detailed monographic studies reflect full phytosociological spectra of beech woodland habitats within certain areas: Raus, 1980, Ossa-Pilion-Mavrovouni; Smiris, 1980, Voras *p.p.*; Adamis, 1989, Bukate Dagh; Bergmeier, 1990, Kato Olimbos; Theodoropoulos, 1991, Chalkidiki *p.p.*; Karagiannakidou, 1993, Chortiatis; Habeck and Reif, 1994, Olympus *p.p.*; Reif and Löblich-Ille, in press, Pieria *p.p.* Mainly these, together with unpublished material from the first author, brings the full number of relevés used in this account close to 1000. Nevertheless, several important Greek beech woodland areas are still poorly represented, and some not at all. However preliminary the results, the classification scheme presented here is considered an important progress to what can be obtained from interpretation of regional studies. Current syntaxa lists of Greek plant communities are highly insufficient as a basis for habitat description in the framework of the Natura 2000 Ecological Network. Therefore, a more thorough classification and accurate descriptions of the forest plant communities (and those of other habitats) are badly needed and of the utmost importance for nature conservation in Greece.

Material and Methods

For the present study 977 relevés have been used which are somewhat unevenly distributed over the Greek *Fagus* area. Almost all published and much unpublished material was used (number of relevés in brackets): Quézel and Contandriopoulos, 1965 [10]; Quézel, 1967 [18]; Dafis, 1969 [108]; Barbero and Quézel, 1976 [39]; Zoller *et al.*, 1977 [23]; Gamisans and Hebrard, 1979 [18]; Gamisans and Hebrard, 1980 [43]; Raus, 1980 [43]; Smiris, 1980 [96]; Adamis, 1989 [82]; Volpers, 1989 [5]; Bergmeier, 1990 [99]; Bergmeier, unpubl. [31]; Theodoropoulos, 1991 [52]; Grigoriadis, 1991 [18]; Karagiannakidou, 1993 [25]; Habeck and Reif, 1994 [61]; Reif and Löblich-Ille, in press. [206]. The TURBOVEG/MEGATAB program was used for input, handling and transformation of vegetation relevés, divisive clustering by TWINSPAN, and for generating the synoptic table (Hennekens, 1996a, b). The cluster scheme proposed by TWINSPAN had to be modified and partly recombined due to several shortcomings. The data basis is, in terms of floristic reliability and completeness, very heterogeneous. Taking this into account, the original relevés had to be revised, obvious or less obvious identification errors corrected, taxonomy and nomenclature updated, and taxa likely to be misidentified had to be merged in similar taxa, or taxon groups, although this process may have corrupted the potential differential value of certain species. A wide delimitation of associations and communities

is preferred here. Further differentiation may be appropriate below association level when working on regional or local scale. For this preliminary survey we refrain from discussing in detail relationships of Greek *Fagus* communities to units outside Greece, nor is it possible here to go further into nomenclature of the syntaxonomic units. This will be subject of a more comprehensive study currently in progress by the authors. Author citations of syntaxa have been omitted therefore. Nomenclature of taxa follows largely either Med-Checklist (Greuter *et al*., 1984, 1986, 1989) or Mountain Flora of Greece (Strid, 1986; Strid and Kit Tan, 1991). Chorological (weighted) spectra have been produced by using the formula: Percentage (%) = A/B x 100, with A being the total constancy of each chorotype in a given community, and B the total constancy of all chorotypes in the community. Information concerning the chorology of species was chiefly taken from Pignatti, 1982, with complementary reference by Raus, 1995, and Strid, 1995.

CLASSIFICATION

The synoptic table (table 1) displays seventeen columns representing *Fagus* woodland vegetation types. These may be grouped into three principle ecological units: (1) Mesophilous, (2) Acidic, (3) Xerothermic. Fig. 1a shows the distribution of the mesophilous and xerothermic communities, fig. 1b that of the acidic ones.

1 – 4 Mesophilous beech woodlands
1 – 2 *Geranio striati-Fagetum*
1 subtype (*Campanula trichocalycina*)
2 subtype (*Lathyrus venetus*)
3 *Hordelymus europaeus-Fagus sylvatica* comm.
4 *Picea abies-Fagus sylvatica* comm.

5 – 9 Acidic beech woodlands, *Orthilio secundae-Fagetum*
5 subtype (*Cardamine bulbifera*)
6 subtype (*Deschampsia flexuosa*)
7 subtype (*Pinus sylvestris*)
8 subtype without narrow diff. species
9 subtype (*Vaccinium myrtillus*)

10 – 17 Xerothermic beech woodlands
10 *Pinus heldreichii-Fagus sylvatica* comm.
11 *Pinus nigra-Fagus sylvatica* comm.
12 – 13 *Lathyro alpestris-Fagetum*
12 subtype (*Galium odoratum*)
13 subtype without narrow diff. species
14 *Rubus canescens-Fagus sylvatica* comm.
15 – 17 *Fagus sylvatica* subsp. *orientalis* comm.
15 subtype (*Deschampsia flexuosa*)
16 subtype (*Melica uniflora*)
17 subtype without narrow diff. species

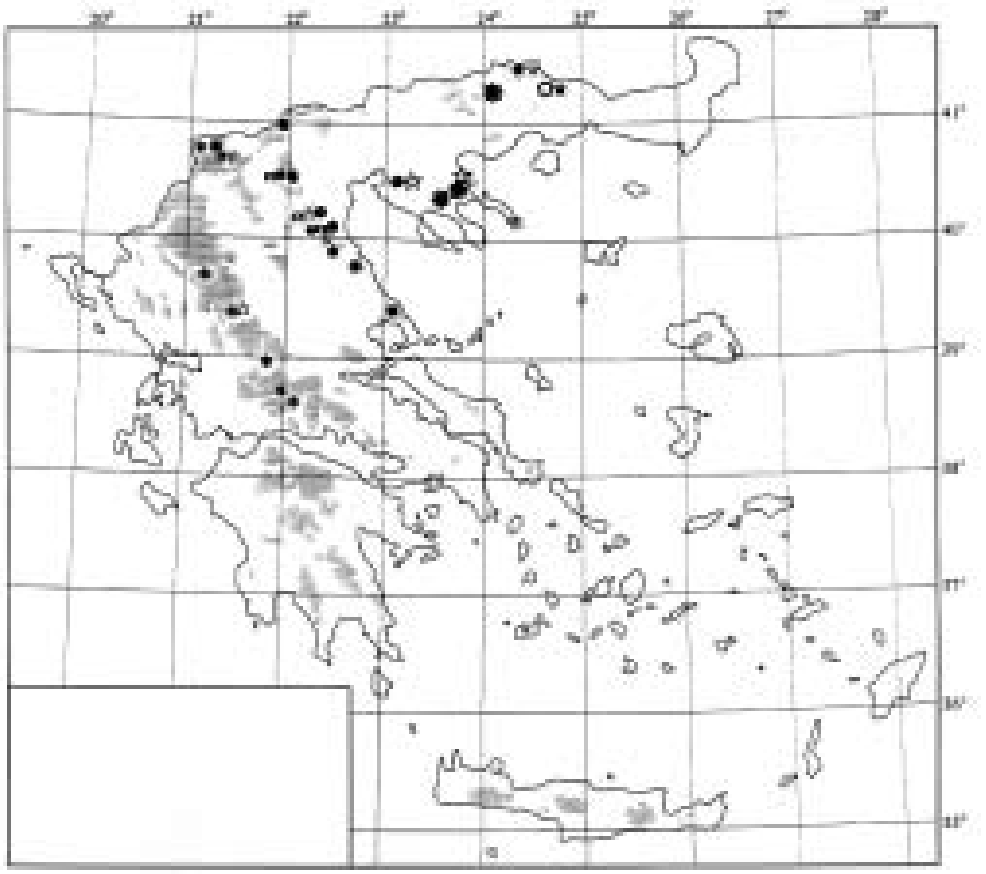

Fig. 1a - Distribution of the Greek Mesophilous and Xerothermic beech woodlands. ❊*Geranio striati-Fagetum*, ☆*Hordelymus europaeus-Fagus sylvatica*, ★*Picea abies-Fagus sylvatica* comm., •*Pinus heldreichii-Fagus sylvatica* comm. *Pinus Nigra-Fagus sylvatica* comm. ✷ *Lathyro alpestris-Fagetum*, ✯ *Rubus canescens-Fagus sylvatica* comm., °*Fagus sylvatica subsp. orientalis* comm.

Columns 1 and 2: The units represent different subtypes of the mesophilous *Geranio striati-Fagetum* which is restricted almost exclusively to the Pindos chain, i.e., the western part of the *Fagus* distribution range in Greece. Phytogeographical connections to the southern Apennine beech forests are evident by the presence of species such as *Campanula trichocalycina*, *Campanula foliosa*, *Geranium versicolor* and *Geranium reflexum*. Flysch is said to be the geological bedrock of all Pindos beech forest stands documented so far. However, number and quality of relevés from the Pindos area are limited, and with further thoroughly sampled material the differentiation into two clusters suggested here (with *Campanula trichocalycina* as the most relevant differential species) may break down. Chorologically, the western

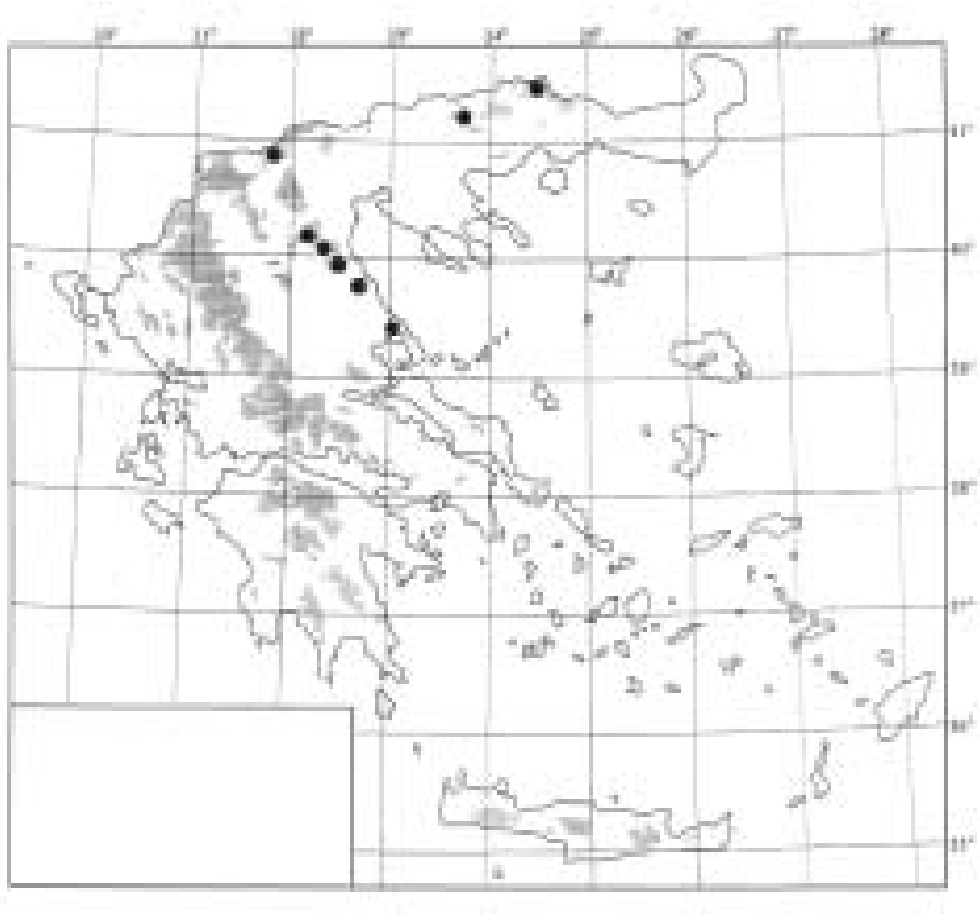

Fig. 1b - Distribution of the Greek Acidic beech woodlands. *Orthilio secundae-Fagetum*

Greek mesophilous beech forests differ significantly from the other mesophilous Fagus woodlands (columns 3 and 4) which are more northerly distributed. In the *Geranio-Fagetum*, Mediterranean plus Balkanic species are twice as much represented than in the latter communities (24.6-26.2 % as against 12.0-12.7 %) while the Eurasiatic-Circumboreal element is much less important in the *Geranio-Fagetum* (6.4-6.6 % *vs*. 15.3-20.1 %) (Table 2).

Column 3: Further east the *Geranio-Fagetum* is replaced by another mesophilous beech woodland community which is provisionally termed here *Hordelymus-Fagus* community. Zonal stands are known chiefly from base-rich soil on volcanic tuff in the Voras range near the border of Greece and FYR Makedonia. Stands with similar species composition can be found locally in the Rodopi and in ravines of Pieria and Kato Olimbos.

Column 4: The most extensive Greek beech woodlands exist in the Rodopi

mountain range along the Greek-Bulgarian frontier. Bedrock is mostly siliceous. The *Picea-Fagus* community occurs locally, at high altitudes, in depressions and along rivulets. Species indicating excellent water supply grow together with acidophytes. Spruce (*Picea abies*) at its southern limits of distribution in Europe forms mixed stands with beech and fir (*Abies x borisii-regis*).

Column 5 to 7: The majority of Greek acidic beech forests are assigned to the *Orthilio secundae-Fagetum*. Most Rodopi beech and beech-fir forests belong here. Column 5 represents stands with *Cardamine bulbifera* and *Galium odoratum* which are fairly well water supplied while species composition in column 6 with high constancy of *Deschampsia flexuosa* suggests somewhat drier conditions. Column 7 is a rare beech forest type approaching *Vaccinio-Piceetea* vegetation. It can be found on dry upper slopes and hilltops of the Rodopi Mts and is characterized by *Pinus sylvestris* and other species of pine woodlands.

Columns 8 and 9: In the Pieria Mts of north central Greece acidophytes such as *Luzula luzuloides* and *Deschampsia flexuosa* reach their southern borderline on the Balkan peninsula. Both columns represent oligotrophic beech forests in east central, north central and parts of north-eastern Greece which, for phytogeographical reasons, lack *Luzula* and *Deschampsia*. Relevés arranged in columns 8 and 9 are but weakly differentiated by the presence or absence of *Vaccinium myrtillus* which indicates soil conditions towards fairly moist moder and raw humus. No acidophilous beech woodlands have become known to date from the Pindos range. In the *Orthilio-Fagetum*, the European phytogeographical elements (Euro-Siberian, European-Caucasian, Central European) are clearly dominating (51-61 %) whilst the Mediterranean elements are poorly represented (5.4-8.7 %) (Table 2).

The most widespread ecological group of beech woodland communities, and documented by almost half of the relevés available, can be termed xerothermic. Most limestone beech forests belong here but similar species combinations can be met with on various siliceous substrata, particularly at lower altitudes. In parts of north and east central Greece the acidophilous *Orthilio-Fagetum* and the thermophilous *Lathyro alpestris-Fagetum* co-occur but the latter is found some 3-400 m lower. The chorological analysis of the *Lathyro-Fagetum* reveals relatively low percentages of the European (44 % *vs*. 51-61 % in *Orthilio-Fagetum*) and high proportions of the Mediterranean elements (16.4-17.6 % *vs*. 5.4-8.7 % in *O.-F.*) (Table 2).

Columns 10 and 11 represent limestone beech forests which have been described from Mt Olympus but may well occur in other mountain ranges with crystalline limestone. The *Pinus heldreichii* community (column 10) is distinct by high constancy of panzer pine (*Pinus heldreichii*) and other species related to pine forests. It is both ecologically and floristically approaching the *Staehelino-Pinetum heldreichii* which forms the timberline vegetation of Mt Olympus. The *Pinus heldreichii-Fagus* community occurs up to c. 1900 m a.s.l. Its stands are among the highest beech occurrences in Greece. Similarly the *Pinus nigra-Fagus* community (column 11) forms a link between *Lathyro alpestris-Fagetum* and *Ostryo-Carpinion*. It occurs on rocky limestone slopes at lower altitudes than the *Pinus heldreichii-Fagus* community. The stands represent ecological borderline situations of *Fagus sylvatica*. This is indicated by the restrained competitive position of beech which occurs in mixed stands with, *e.g.*, *Pinus nigra*, *Acer hyrcanum*, *Fraxinus ornus* and *Acer pseudoplatanus*.

Columns 12 and 13: The *Lathyro alpestris-Fagetum* shows a much wider geographical range. It is documented by a comparatively large number of relevés, the former column representing habitats with better water supply, the latter indicating drier conditions. The *Lathyro alpestris-Fagetum* is well equipped with species of both *Fagetalia* and *Quercetalia pubescenti-petraeae*.

Column 14: is similar but some differential species (*Quercus frainetto*, *Helleborus cyclophyllus*) show close relationship to *Quercus frainetto* stands (*Quercion confertae*) and others (*Rubus canescens*, *Galium aparine*) indicate disturbance by grazing. Most relevés assigned here to the *Rubus canescens-Fagus sylvatica* communiy originate from a limited area in the Chalkidiki but similar stands can be expected elsewhere.

Columns 15 to 17: While the *Rubus canescens-Fagus* community may be estimated as intermediate between the phytosociological orders *Fagetalia* and *Quercetalia pubescenti-petraeae*, the relevés gathered in columns 15-17 are in fact closer to the latter, in spite of beech being the dominant tree species. The beech taxon involved is *Fagus sylvatica* subsp. *orientalis*, together with «*moesiaca*»-forms varying towards it. All material of the last three columns in the synoptic table originates from Bukate Dagh, Thraki, in the far north-east of Greece. *Fagetalia* species are mostly missing except in the *Melica uniflora* subtype with species such as *Galium odoratum*, *Cardamine bulbifera* and *Symphytum ottomanum* which indicate balanced water supply.

SYNTAXONOMY

The *Geranio striati-Fagetum* of the Pindos may be included with similar beech woodlands of southern Italy in what is known as *Geranio striati-Fagion* or, rather at suballiance level, *Geranio-Fagenion* within alliance *Fagion sylvaticae*. This alliance includes in our opinion all European mesophilous beech woodland communities but not acidic and xeric ones. Hence the *Hordelymus-Fagus* community is also included into *Fagion* but represents another suballiance which is known from Moesia, i.e., eastern Serbia and Bulgaria. It is traditionally, and invalidly, termed «*Fagion moesiacum*». It should be restricted to mesophilous beech forests in the moesic phytogeographic zone and is distinguished from both carpathic *Symphyto cordati-Fagenion* and illyric *Aremonio-Fagenion* mainly by lacking character species, in this respect similar to Central European *Asperulo-Fagenion* woodlands. There seems to be no valid name for both suballiance and community at association level. The acidophilous *Orthilio secundae-Fagetum* forms part of the alliance *Luzulo-Fagion*. Geographical differential species are largely missing within *Luzulo-Fagion* woodlands in the Southern Balkans. In contrast to this, Greek thermophilous beech forests such as *Lathyro alpestris-Fagetum* are generally rich in geographical differential species. The *Doronico orientalis-Fagenion* is, therefore, an appropriate circumscription for beech forests of thermophytic habitats in the hellenic region. We consider this suballiance part of the thermophilous *Fagus* forests known as *Cephalanthero-Fagion* which are widespread particularly between southern Central Europe and the mountains of the Northern Mediterranean. Even more pronounced thermophilous are *Fagus* woodlands of north-eastern Greece dominated by *Fagus sylvatica* subsp. *orientalis*. Such

units should be kept outside *Fagetalia* order and are better placed within *Quercetalia pubescenti-petraeae*.

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Zusammenfassung

Fast 1000 veröffentlichte und noch unveröffentlichte pflanzensoziologische Aufnahmen von griechischen Buchenwäldern werden klassifiziert und unter ökologischen und pflanzengeographischen Aspekten interpretiert. Eine synoptische Tabelle zeigt drei ökologische Hauptgruppen von Gesellschaften, die man als mesophil, azidisch und xerotherm bezeichnen kann. Innerhalb jeder dieser Gruppen lassen sich mehrere floristisch differenzierte Gesellschaften unterscheiden. Sich abzeichnende geographische Verbreitungsmuster und ökologische Präferenzen jeder Gesellschaft werden umrissen und einige syntaxonomische Schlußfolgerungen gezogen.

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TABLE 1

SYNOPTIC TABLE OF FAGUS WOODLAND COMMUNITIES IN GREECE

Column	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Number of relevés	15	26	120	25	53	37	10	102	46	35	44	167	140	76	16	18	48
Campanula trichocalycina	93	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus brutius	47	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Geranium versicolor	73	96	.	.	.	.	.	.	.	.	2	.	1	.	.	.	.
Geranium reflexum	27	19	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Geocaryum spec.	27	15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lilium chalcedonicum	7	23	.	.	.	.	.	.	.	.	7	4	4	.	.	.	.
Acer opalus subsp. obtusatum	7	23	.	.	.	.	.	.	.	.	2	3	5	.	.	.	.
Stachys sylvatica	.	12	30	4	4	.	.	.	.	.	2	4	1	4	.	.	.
Lamium galeobdolon group	.	12	67	20	25	5	.	7	.	.	.	10	.	.	.	.	.
Hordelymus europaeus	.	8	57	12	4	.	.	.	.	.	.	.	1	.	.	.	.
Urtica dioica	7	23	57	12	11	.	.	1	.	.	.	7	3	.	.	.	.
Anemone ranunculoides	.	.	35	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Achillea grandifolia	.	.	23	.	.	.	.	.	.	.	.	4	5	5	.	.	.
Anemone nemorosa	.	4	48	40	.	.	.	.	7	.	.	2	1	.	.	.	.
Paris quadrifolia	.	8	23	12	2	.	.	.	.	.	.	.	.	.	.	.	.
Oxalis acetosella	.	8	48	76	9	11	.	1	2	.	.	1	.	.	.	.	.
Dryopteris filix-mas	.	15	56	68	28	5	10	3	2	.	.	29	2	.	.	17	.
Symphytum ottomanum + tuberosum	27	15	9	64	.	5	10	.	.	.	.	3	1	.	.	50	10
Pulmonaria officinalis + rubra	.	15	38	60	2	.	.	.	2	3	2	10	1	.	.	.	.
Picea abies	.	.	.	80	.	5	20	.	13	.	.	.	.	.	.	.	.
Senecio nemorensis group	7	8	.	52	4	.	.	.	.	.	.	.	.	.	.	.	.
Geranium macrorrhizum	.	.	5	48	2	8	.	1	.	.	9	1	1	.	.	.	.
Polygonatum verticillatum	.	.	2	44	.	.	.	1	2	.	.	.	.	.	.	.	.
Dryopteris dilatata	.	.	1	40	.	.	.	.	.	.	11	.	.	.	.	.	.
Soldanella rhodopaea	.	.	.	24	.	.	.	.	2	.	.	.	.	.	.	.	.
Geum urbanum	80	46	56	.	6	3	.	.	.	3	5	5	6	24	.	.	2
Acer pseudoplatanus	20	31	9	8	.	3	.	.	.	.	30	7	2	.	.	.	.
Stellaria montana	27	19	18	32	2	.	.	.	.	.	.	14	5	4	.	.	.
Doronicum austriacum	13	12	5	24	.	.	.	.	.	.	.	.	.	.	.	.	.
Scrophularia scopolii	20	27	13	16	.	.	.	.	.	.	.	8	.	9	.	.	2
Calamintha grandiflora	53	50	8	.	19	.	.	2	.	43	2	35	13	3	.	.	.
Cardamine bulbifera	100	73	56	64	62	3	10	3	2	17	5	37	2	42	.	30	4
Galium odoratum	80	69	93	48	49	.	.	.	4	46	.	35	1	4	.	50	.
Epilobium montanum	80	69	70	40	53	14	20	19	11	.	.	14	9	.	.	.	.
Athyrium filix-femina	47	23	35	72	26	.	.	1	2	.	.	11	1	.	.	.	.
Milium effusum	7	27	29	36	4	.	.	.	.	.	.	8	2	.	.	22	.
Orthilia secunda	.	.	3	32	68	65	50	91	93	80	55	10	12	3	.	.	.
Luzula luzuloides	.	.	3	80	49	68	90	23	22	.	.	1	1	.	19	17	.
Vaccinium myrtillus	.	.	.	64	6	49	100	.	100	23	.	2	1	.	.	.	.
Calamagrostis arundinacea	.	.	.	48	2	27	90	.	.	.	.	.	.	.	.	.	.
Luzula pilosa	.	.	3	.	32	14	.	17	4	.	.	4	.	.	.	.	.
Deschampsia flexuosa	.	.	.	.	9	92	90	.	2	.	.	2	1	.	44	.	.
Pyrola media	.	.	.	.	8	5	20	3	.	.	.	.	.	.	.	.	.
Pinus sylvestris	.	.	.	4	.	.	90	.	.	.	.	1	1	.	.	.	.
Vaccinium vitis-idaea	.	.	.	.	.	.	80	.	.	.	.	.	.	.	.	.	.
Brukenthalia spiculifolia	.	.	.	.	.	.	30	.	.	.	.	.	.	.	.	.	.
Rosa pendulina	.	.	.	8	2	.	40	.	.	40	7	.	.	.	.	.	.
Pyrola chlorantha	.	.	.	4	.	3	30	.	13	20	5	.	.	.	.	.	.
Pyrola minor	.	.	.	4	2	3	30	.	2	17	.	.	.	.	.	.	.
Sorbus aucuparia	.	.	1	36	.	.	10	.	7	57	.	1	.	.	.	.	.
Corallorhiza trifida	.	.	.	20	23	5	.	14	2	54	11	2	.	.	.	.	.
Euphorbia amygdaloides-heldreichii	.	.	1	.	2	.	.	.	.	63	16	5	2	.	.	.	.
Cardamine graeca	.	.	.	.	6	.	.	.	.	54	2	1	2	36	.	6	2
Polystichum lonchitis	.	.	.	4	2	.	.	.	.	37	.	.	.	.	.	.	.
Euonymus verrucosus	.	.	.	.	.	.	.	.	.	37	2	.	1	.	.	.	.
Cotoneaster nebrodensis	.	.	1	.	.	.	.	.	.	34	7	.	.	.	.	.	.
Sorbus aria s.l.	.	.	.	.	.	3	.	.	.	43	23	.	.	.	.	.	.
Pinus heldreichii	.	.	.	.	.	.	.	.	.	43	32	.	1	.	.	.	.
Solidago virgaurea	.	4	1	.	.	.	.	1	2	26	27	1	9	.	.	.	.
Sesleria robusta	.	.	.	.	.	.	.	.	.	14	30	.	1	.	.	.	.
Knautiia mbigua + drymeia	.	23	.	.	.	.	.	.	.	20	43	.	2	.	.	.	.

Buxus sempervirens	.	4	.	.	.	.	.	.	.	14	50	.	.	.	.	.	.
Acer opalus subsp. hyrcanum	.	.	1	4	.	.	10	1	2	14	73	8	5	.	.	22	.
Fraxinus ornus	.	8	.	.	2	3	10	1	.	9	80	19	9	12	.	.	.
Pinus nigra	.	4	.	.	6	16	.	4	18	9	48	2	4	1	.	.	.
Convallaria majalis	.	4	.	.	.	.	.	.	.	6	43	.	.	.	.	.	.
Mercurialis ovata +perennis	.	8	1	.	.	.	.	.	.	6	55	4	1	.	.	.	.
Cephalanthera damasonium	.	23	.	.	.	.	.	2	.	.	46	2	3	5	.	.	.
Lonicera trilobum	.	4	.	.	.	.	.	.	.	.	36	.	.	1	.	.	.
Hippocrepis emerus subsp. emeroides	.	.	.	.	.	.	.	.	.	3	27	.	1	.	.	.	.
Taxus baccata	.	.	1	.	.	.	.	1	.	.	27	5	1	.	.	.	.
Listera ovata	.	.	1	.	.	.	.	.	.	.	27	1	1	4	.	.	.
Juglans regia	.	.	3	.	.	.	.	.	.	.	25	.	1	4	.	.	.
Frangula rupestris	.	.	.	.	.	.	.	.	.	6	25	.	.	.	.	.	.
Ostrya carpinifolia	.	4	2	.	.	3	10	.	.	.	39	25	6	.	.	.	.
Daphne laureola	13	31	.	.	.	.	.	1	4	43	77	43	11	.	.	.	.
Cephalanthera rubra	.	15	10	.	2	3	.	4	9	34	73	25	36	1	.	6	6
Lathyrus alpestris	.	.	6	.	9	22	.	14	13	.	34	44	31	.	.	.	.
Primulaa caulis	13	4	5	.	.	.	.	2	.	.	64	32	19	9	.	28	10
Rubus canescens	.	4	3	.	2	.	.	1	2	11	2	6	6	76	.	.	.
Galium aparine	.	.	12	.	6	.	.	2	.	.	.	14	6	55	13	28	4
Anthemis tinctoria s.l.	.	.	.	.	.	3	.	.	.	.	.	.	6	50	.	6	2
Quercus frainetto	.	4	.	.	.	.	.	.	.	.	2	2	13	46	.	.	.
Muscari neglectum	.	.	.	.	.	.	.	.	.	.	.	.	1	40	.	.	.
Allium paniculatum	.	.	.	.	.	.	.	.	.	.	.	1	.	34	.	.	.
Silene coronaria	.	.	4	.	.	.	.	.	.	.	.	3	5	28	6	6	2
Lamium maculatum	.	.	3	8	.	.	.	.	.	.	.	.	.	26	.	.	.
Silene vulgaris	.	.	6	.	.	.	.	2	.	3	.	4	6	25	.	.	.
Crataegus monogyna	.	.	.	.	.	.	.	.	.	.	2	1	3	22	.	.	.
Lathyrus latifolius	7	50	14	.	13	14	.	14	4	.	68	64	66	55	19	28	35
Melica uniflora	13	42	4	4	6	5	10	.	.	.	25	54	18	12	.	61	.
Campanula trachelium	13	19	3	.	.	.	.	2	4	.	23	21	11	51	.	39	4
Lathyrus venetus	13	66	1	.	.	.	.	4	2	.	21	41	20	20	.	.	.
Epipactis gracilis +helleborine	13	27	15	.	6	3	10	13	7	.	16	41	29	38	.	.	.
Clinopodium vulgare	20	27	21	.	8	5	.	3	2	3	18	22	31	33	.	.	.
Brachypodium sylvaticum	47	19	3	.	6	.	.	3	7	.	27	12	21	32	6	.	4
Helleborus cyclophyllus	20	31	.	.	.	.	.	.	.	.	.	7	16	53	.	.	.
Digitalis viridiflora	.	23	3	.	.	.	.	2	2	.	.	3	4	33	.	.	.
Trifolium pignantii	.	27	.	.	.	8	.	3	.	6	23	14	16	20	.	.	.
Cyclamen hederifolium	.	.	2	.	2	.	.	1	2	.	71	41	32	46	.	.	.
Physospermum cornubiense	.	8	3	.	.	3	.	5	16	3	50	44	39	21	.	6	6
Hedera helix	.	8	3	.	2	3	.	1	.	3	68	40	21	36	.	.	2
Asplenium adiantum-nigrum+onopteris	.	4	3	.	.	3	.	1	.	.	27	23	22	55	.	.	2
Viola alba+ odorata	.	.	16	.	6	.	.	4	2	.	34	36	31	46	.	39	19
Ilex aquifolium	.	.	3	.	2	.	.	3	2	.	43	34	21	34	.	17	6
Rosa arvensis	.	.	3	.	.	.	.	.	.	.	23	14	13	53	.	.	.
Clematis vitalba	.	4	.	.	.	.	.	.	.	.	50	11	6	29	.	.	.
Cephalanthera longifolia	.	4	.	.	2	.	.	4	.	6	46	14	9	37	.	.	17
Polygonatum odoratum	.	4	4	4	.	.	.	.	.	3	46	25	6	17	.	.	.
Asplenium trichomanes	.	.	.	4	2	5	.	1	4	3	39	9	11	9	.	.	.
Juniperus oxycedrus	.	.	.	.	.	3	.	.	.	.	25	1	6	26	6	.	2
Castanea sativa	.	4	.	.	2	.	.	1	9	.	9	25	14	9	.	.	.
Lathyrus niger	.	4	.	.	.	.	.	.	.	.	2	29	14	4	.	.	.
Silene italica	.	.	8	.	2	.	.	.	.	.	.	11	29	37	6	.	2
Hieracium bracteolatum	.	.	.	.	.	.	.	2	11	.	.	5	16	37	.	.	.
Fagus sylvatica subsp. orientalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	100	100	100
Hypericum cerastoides	.	.	.	.	.	.	10	.	.	.	.	.	.	.	19	17	40
Hypericum spec.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	25	.	15
Hieracium projectanse pseuderiopus	7	4	2	.	.	5	.	3	2	.	.	3	9	.	94	17	.
Luzula forsteri	20	8	3	.	13	27	.	17	18	3	5	46	64	75	94	17	75
Doronicum orientale	47	4	1	.	2	14	.	14	13	3	14	22	55	87	75	33	21
Campanula persicifolia	.	.	11	.	2	11	10	4	7	3	21	13	17	54	100	61	48
Sorbus torminalis	.	8	.	.	.	.	.	.	.	.	25	26	19	16	19	39	10
Dactylis glomerata s.l.	.	4	4	4	.	3	.	.	.	.	11	13	19	38	31	33	4
Lapsana communis	.	12	19	.	6	.	.	.	2	.	2	22	26	57	56	50	29
Quercus petraea s.l.	.	.	.	.	2	.	20	.	7	.	2	13	14	33	13	39	33
Melittis melissophyllum subsp. albida	.	4	.	.	.	.	.	.	.	.	11	10	21	.	.	17	8
Hypericum montbretii	.	.	.	.	.	.	.	.	.	.	.	1	4	12	44	.	8
Fagus sylvatica subsp. sylvatica	100	100	98	100	100	97	90	100	100	100	96	100	96	100	.	.	.
Abies x borisii-regis	40	50	28	72	13	14	40	26	82	94	50	28	34	3	.	.	.
Luzula sylvatica	33	23	16	52	19	54	10	32	80	94	30	40	20	16	.	.	.

Galium rotundifolium	73	42	17	.	74	65	.	81	64	40	11	68	69	18	.	.	.
Fragaria vesca	20	58	58	12	32	8	80	14	2	26	59	35	29	78	.	.	.
Sanicula europaea	47	58	54	12	26	8	.	1	4	29	71	58	16	11	.	.	.
Geranium robertianum + purpureum	40	39	60	28	4	.	10	.	.	.	.	18	4	25	.	.	4
Veronica officinalis	20	.	28	28	13	24	40	20	20	.	.	6	10	18	.	.	2
Primula veris	.	39	8	.	8	3	10	1	.	3	11	15	6	29	.	.	.
Epilobium angustifolium	27	8	33	4	11	.	10	8	2	.	.	2	3	3	.	.	.
Arum maculatum + orientale	33	.	1	.	.	.	.	.	.	.	.	2	.	30	.	17	2
Polypodium vulgare	.	.	6	8	8	24	.	6	9	3	27	14	14	15	.	.	.
Symphytum bulbosum	27	19	1	.	2	.	.	.	.	3	5	7	2	30	.	.	.
Polystichum aculeatum + setiferum	40	42	16	20	13	.	.	.	.	29	18	38	6	16	.	28	.
Saxifraga rotundifolia	53	8	5	44	8	3	.	2	4	49	21	14	10	11	.	.	.
Juniperus communis	.	8	1	4	15	32	50	3	22	3	9	5	4	20	.	.	.
Potentilla micrantha	7	15	3	28	64	57	40	30	16	43	39	52	61	12	.	.	2
Rubus idaeus	27	42	73	68	21	14	30	15	2	.	2	5	2	.	.	.	.
Prenanthes purpurea	.	8	12	60	13	5	.	18	47	21	14	15	2	1	.	.	.
Campanula spatulata s.l.	.	4	1	.	4	27	.	1	4	.	2	15	31	.	.	.	.
Silene multicaulis s.l.	.	4	3	.	4	27	.	15	18	.	.	6	24	4	.	.	.
Festuca drymeja	.	.	18	.	34	16	10	25	16	57	68	62	24	.	.	.	.
Monotropa hypopitys	.	4	.	20	19	19	20	34	22	.	7	14	14	.	.	6	.
Euonymus latifolius	.	.	2	.	4	.	.	1	.	9	21	13	3	.	.	.	.
Cardamine impatiens subsp. pectinata	27	8	3	.	4	3	.	.	.	.	.	10	4	.	.	.	.
Lilium martagon	.	23	.	.	.	.	.	.	.	23	.	1	1	8	.	.	.
Campanula patula subsp. abietina	33	12	.	4	.	3	.	.	2	.	2	2	2	.	.	.	.
Carex digitata	.	.	.	24	4	8	10	2	4	.	2	7	3	.	.	.	.
Hieracium racemosum	.	.	.	.	.	5	.	3	2	26	11	2	5	.	.	.	.
Mycelis muralis	93	69	88	76	94	60	20	83	18	60	46	86	75	61	31	89	50
Poa nemoralis	87	65	75	44	79	81	20	60	29	17	23	77	82	93	94	83	81
Aremonia agrimonioides	53	54	54	64	57	49	60	36	18	89	93	69	46	71	25	50	50
Neottia nidus-avis	27	65	27	24	60	35	10	62	20	34	59	52	39	33	25	28	29
Pteridium aquilinum	7	73	15	8	36	22	20	16	16	14	55	73	74	82	31	28	92
Moehringia trinervia	27	27	23	4	43	11	10	18	4	.	.	28	10	45	6	56	19
Festuca heterophylla	7	12	18	8	17	16	30	4	4	3	5	35	37	40	56	39	42
Hieracium murorum	7	4	3	12	15	35	40	23	53	51	32	34	31	46	44	6	.
Veronica chamaedrys	40	46	38	8	64	46	.	38	18	3	34	74	78	82	13	11	15
Viola riviniana + reichenbachiana	53	65	42	8	40	24	60	23	20	29	71	70	37	86	31	72	75
Galium laevigatum + mollugo group	.	19	3	.	.	11	20	7	.	6	9	28	34	3	25	6	10
Rubus hirtus + spec.	7	19	73	4	9	.	.	3	2	34	48	37	21	5	.	11	2
Myosotis sylvatica s.l.	87	27	16	.	11	5	10	6	2	.	5	13	15	55	38	50	19
Euphorbia a. subsp. amygdaloides	.	15	42	68	9	11	80	2	4	.	2	26	11	.	.	67	31
Cystopteris fragilis	.	8	27	.	6	.	.	1	4	.	.	14	10	3	13	39	2
Epilobium lanceolatum	.	.	2	.	6	3	10	1	.	.	2	17	9	7	.	17	23
Ajuga reptans	27	27	25	28	8	5	10	2	.	.	7	18	4	12	.	39	8
Platanthera chlorantha + bifolia	7	4	.	.	.	.	.	1	2	.	2	7	8	29	25	6	6
Anthoxanthum odoratum	.	.	.	.	.	14	.	.	.	.	.	1	9	32	6	.	.
Poa bulbosa	.	.	.	.	.	11	.	.	2	.	.	1	9	25	31	6	4
Bromus benekenii + ramosus	33	46	18	4	6	.	.	2	.	3	5	6	4	.	.	17	2
Hieracium bauhini + piloselloides	.	.	.	.	6	35	.	2	18	.	.	1	9	16	.	.	.
Lamium garganicum s.l.	33	31	3	.	.	.	.	.	.	.	.	4	3	3	.	39	.
Ferula sylvatica	.	4	.	.	.	.	.	.	4	3	27	.	1	3	.	.	.
Trifolium medium s.l.	20	39	4	.	.	.	20	2	.	.	.	2	1	5	13	6	.

Species with constancy of 20% or less in each column have been omitted

TABLE 2

CHOROLOGICAL (PHYTOGEOGRAPHICAL) SPECTRA (IN %) AND MEAN ALTITUDE (IN M A.S.L.) OF THE FAGUS WOODLAND SYNTAXA IN GREECE (A: BALKAN, B: MEDITERRANEAN (SENSU LATO), C: EUROPEAN (SENSU LATO), D: EURASIATIC TEMPERATE, E: EURASIATIC-CIRCUMBOREAL, F: COSMOPOLITAN-SUBCOSMOPOLITAN)

Phyt community	A	B	C	D	E	F	Mean altitude
1. Geranio-Fagetum (subtype 1)	9.6	15.0	44	19.1	6.6	5.5	1543
2. Geranio-Fagetum (subtype 2)	11.3	14.9	41.4	16.9	6.4	9.0	1438
3. Hordelymus-Fagus comm.	3.7	8.3	40.1	18.4	15.3	14.3	1331
4. Picea abies-Fagus comm.	9.6	3.1	45.1	13.4	20.1	8.8	1565
5. Orthilio-Fagetum (subtype 1)	4.0	8.7	56.0	13.6	9.1	8.5	1425
6. Orthilio-Fagetum (subtype 2)	9.5	6.1	60.9	9.8	11.2	2.5	1376
7. Orthilio-Fagetum (subtype 3)	8.4	5.4	50.9	6.6	21.5	7.2	1313
8. Orthilio-Fagetum (subtype 4)	8.6	8.4	57.2	9.6	12.5	3.7	1425
9. Orthilio-Fagetum (subtype 5)	11.6	6.4	51	9.2	19.5	2.3	1283
10. Pinus heldreichii-Fagus comm.	12.8	14.1	48.5	9.2	13.3	2.2	1644
11. Pinus nigra-Fagus comm.	14.2	21.5	36.8	15.2	7.5	4.6	993
12. Lathyro-Fagetum (subtype 1)	9.6	16.4	44.7	17.2	4.6	7.4	1000
13. Lathyro-Fagetum (subtype 2)	14.1	17.6	44.1	13.5	4.0	6.6	1021
14. Rubus canescens-Fagus comm.	10.4	20.4	40.9	16.6	3.0	8.7	944
15. Fagus orientalis comm. (subtype 1)	18.6	12.1	47.3	17.4	-	4.4	679
16. Fagus orientalis comm. (subtype 2)	12.2	11.6	50.8	17.9	1.2	6.3	703
17. Fagus orientalis comm. (subtype 3)	10.2	16.9	49.2	14.3	0.2	9.1	756