Zeitschrift: Botanica Helvetica
Herausgeber: Schweizerische Botanische Gesellschaft
Band: 98 (1988)
Heft: 2

Artikel: Vegetation and altitudinal zones of Mount Menikion, NE Greece
Autor: Karagiannakidou, V. / Kokkini, S.
DOI: https://doi.org/10.5169/seals-68579

Botanica Helvetica 98/2, 1988

0253-1453/88/020149-12 $ 1.50+0.20/0

Vegetation and altitudinal zones of Mount Menikion, NE Greece

V. Karagiannakidou and S. Kokkini

Institute of Systematic Botany and Phytogeography, Department of Biology, University of Thessaloniki, 540 06 Thessaloniki, Greece

Manuscript accepted June 23, 1988

Abstract

Karagiannakidou, V. and Kokkini S. 1988. Vegetation and altitudinal zones of Mount Menikion, NE Greece. Bot. Helv. 98: 149–160.

The present horizontal and vertical arrangement of vegetation zones on Mount Menikion (NE Greece) is described and mapped. Four different, altitudinally vicarious vegegation zones, viz. Ostryo-Carpinion orientalis, Quercion frainetto, Fagion moesiacae and Daphno-Festucetalia, are found on Mt. Menikion due to the geomorphological and edaphic climatic factors. The observed modifications of the original vegetation pattern by irrational human exploitation, particularly by extensive grazing for many years, is emphasized.

Key words. Vegetation, NE Greece, Disturbance of zonal pattern.

1. Introduction

Mount Menikion is located in NE Greece (east of the city of Serres) and is bordered by the plains of Serres (to the south) and Drama (to the east). It is connected, through Mt. Vrondous (to the north) with the mountains of NE Greece and interbalkanic massif.

The different slopes of the mountain show a remarkable dissimilarity in respect to their vegetation patterns. Thus, the E and NE slopes are mainly covered by forest formations while the vegetation of the W and SW slopes is poor and composed of evergreen shrubs and subalpine grasses.

Although there are several important references concerning the arrangement of vegetation zones in Greece (e.g. Dafis 1975; Horvat et al. 1974; Raus 1979, 1980; Voliotis 1976a, 1976b) many local problems need further investigation. This paper aims to contribute to the knowledge of the present horizontal and vertical vegetation pattern of Mt. Menikion.

1.1. Relief-climate-soil

Mount Menikion lies in a NE–SE direction and extends over an area of 380 km^2. The highest peaks in the range lie to the west (Karagioz Lofos 1963 m, and Kouskoura 1629 m). There is also another peak to the east (1453 m). In contrast to the majority of

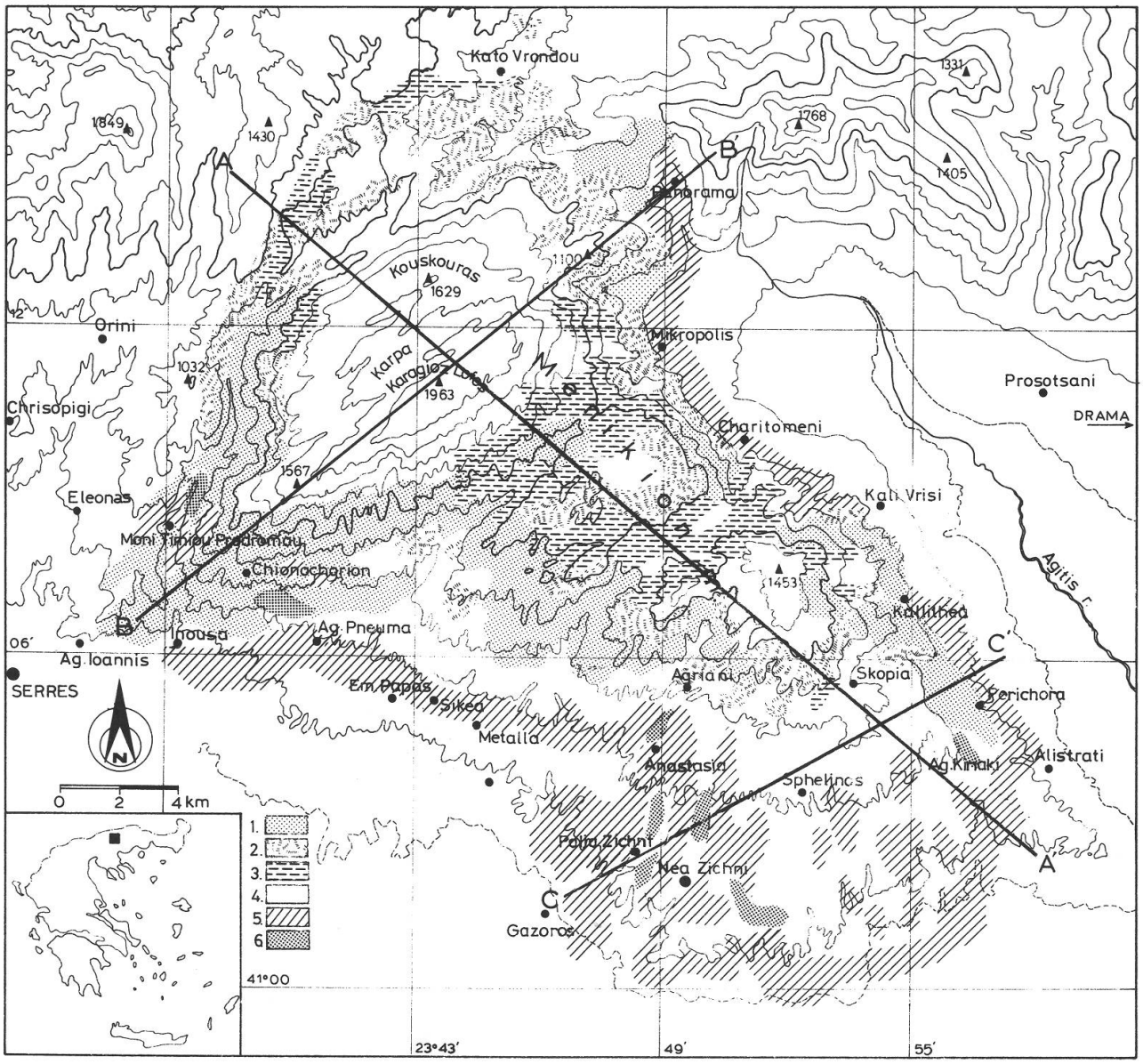

Fig. 1. Topographical map and zonal vegetation pattern of Mount Menikion. – 1 Ostryo-Carpinion orientalis zone. 2 Quercion frainetto zone. 3 Fagion moesiacae zone. 4 Daphno-Festucetalia zone (above 1100 m) and meadows in clearings and openings of forests (below 1100 m). 5 Cultivated lands. 6 Introduced vegetation. A–A′, B–B′, C–C′ profiles see Fig. 5.

the Greek mountains, there are no steep isolated peaks in this location; in general slopes are moderate and summits rounded (Fig. 1).

From a geological point of view, Menikion belongs to the Rodopi crystalline massif. De Boer (1970) distinguishes two series in this massif: the lower series consists of white-grey, fractured marbles, while the upper one consists of alternating strata of marbles and gneisses. Igneous rocks occur east of the village of Eleona and particularly around the Timios Prodomos monastery. Neogen sediments occur at lower elevations between the villages of Alistrati, Agriani and Charitomeni. Quaternary deposites appear in the plains over the Neogen sediments (Vavliakis 1981), (Fig. 2).

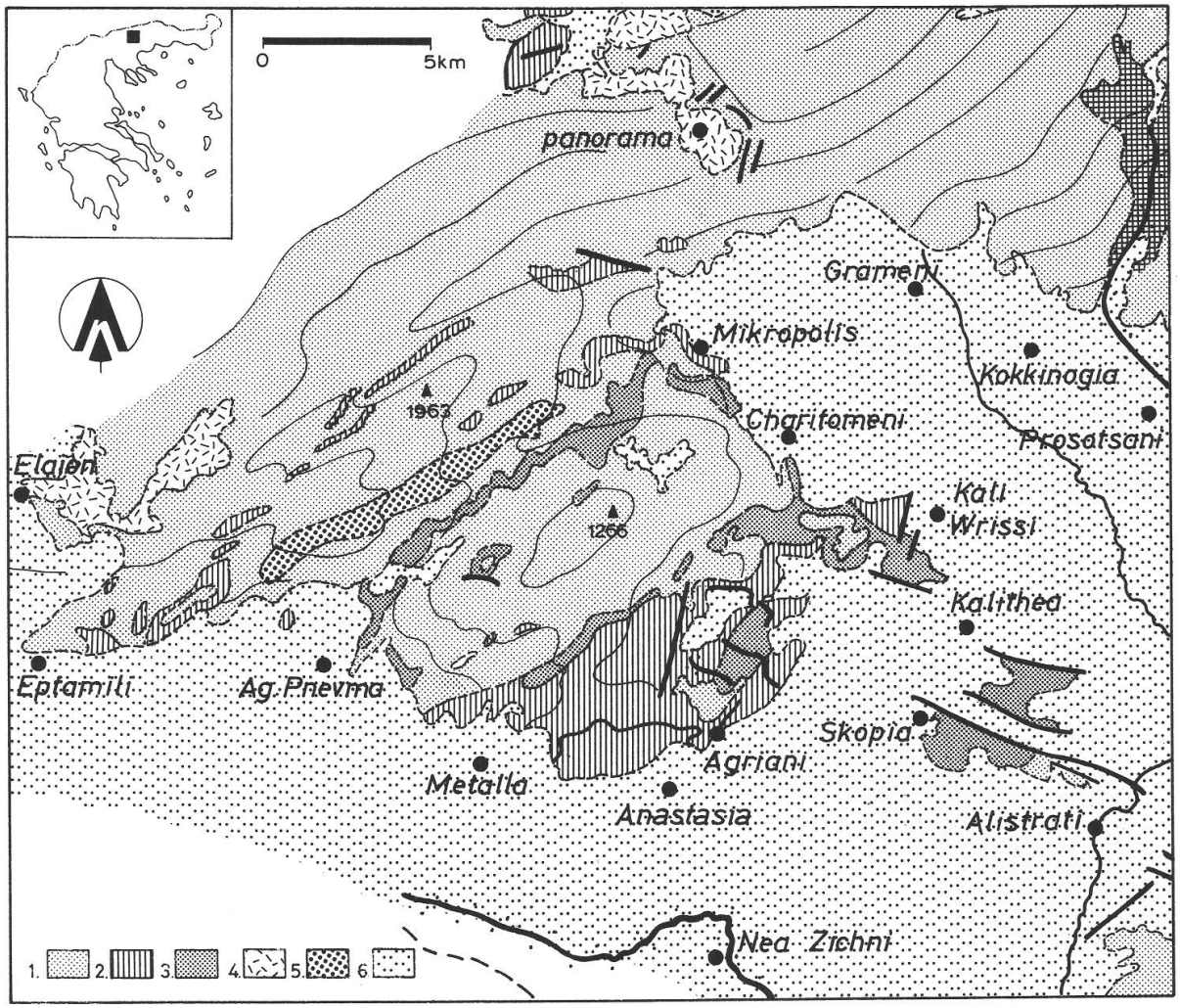

Fig. 2. Geological map of Mount Menikion (De Boer 1970). – 1 marble. 2 gneiss. 3 mica-schists with amphibolites. 4 granodiorite. 5 crystalline marble/gneiss. 6 tertiary and quaternary.

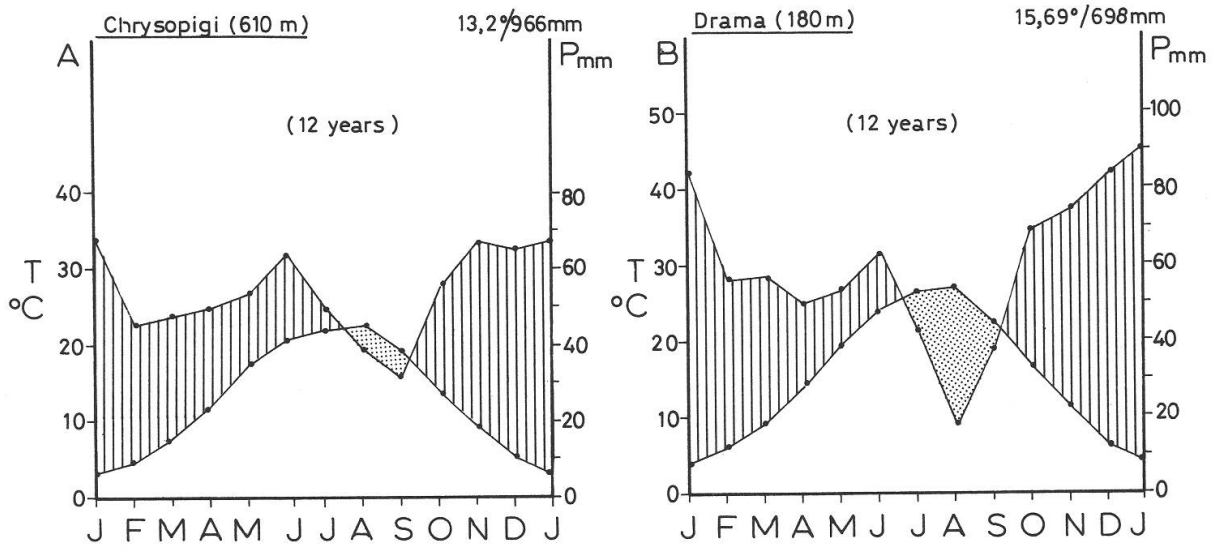

Fig. 3. Ombrothermic diagrams of the two meteorological stations. – A: Chrisopigi (41°06′North, 23°33′East) and B: Drama (41°04′North, 24°08′East).

Data for the climate of the Menikion region were obtained from the metereological stations of Chrisopigi and Drama (Fig. 3). According to Balafoutis (1977), the inland areas of N Greece have an intermediate climate type between those of the mediterranean and the continent.

Using Emberger climagram (1955, 1959), it was determined that Mt. Menikion belongs to different climatic zones. The high altitudes (above 1500 m) belong to the very humid zone, with frost in winter, while the lower altitudes belong to the humid or subhumid zones with cold or mild winter climate (Fig. 4).

The soil is sandy silt (Nakos 1977) and is derived form metamorphic rocks (mainly limestones and gneisses), (Fig. 2). It has a depth of 0.10–0.30 m (up to 0.50 m in the east side). In the steep slopes the soil is minimal and the parent material appears again. Soil erosion is evident near the villages of Agriani, Mikropoli and Charitomeni, due to the steep slopes and the southern exposure.

2. Material and methods

The vegetation analysis is based on our phytosociological measurements (unpublished data) according to the standard method of Braun-Blanquet (1964). Efforts were made to achieve a homogeneity in sampling plots, with respect to the soil surface and the stand structure. All the measurements were made in areas where grazing is permitted. The sampling of plants was carried out during May–July and September–October of 1985–1986.

The nomenclature and classification of the reported vegetation units follow Horvat et al. (1974) and Dafis (1973, 1975), while the nomenclature of the mentioned taxa is according to Strid (1986) or Tutin et al. (1964–1980); the names of the taxa authors have been omitted for practical purposes. Voucher specimens are deposited in the Herbarium of the Institute of Systematic Botany and Phytogeography of the University of Thessaloniki (TAU).

Chartography is based on our observations and data obtained from aerial-photographs (taken in 1975) which were provided by the Institute of Forest Research of Northern Greece. The final map is presented in a scale of 1 : 200 000.

3. Flora

The most important references to the flora (higher plants) of Mt. Menikion are those of Rechinger (1939), who mentions 164 taxa and Strid (1986) in which up to 76 taxa are reported. Recently, Karagiannakidou and Kokkini (1987) listed 552 taxa occurring on Mt. Menikion, which belong to 69 families and 250 genera.

Different chorological elements are present in the flora of Mt. Menikion. The majority of them are distributed to the north and northeastern areas (balkan, europian and eurasiatic elements). Some mediterranean taxa occur at the lower altitudes, e.g. *Rhus coriaria, Pistacia terebinthus, Cercis siliquastrum, Cistus incanus* and *Quercus coccifera* which grow up to 1300 m on the SW side of Mt. Menikion.

The abundance of the balkan taxa (c. 22% of the floristic elements) shows that there is a close relationship between the flora of Mt. Menikion and that of the northern Balkan Peninsula. Most of them grow at high altitudes (above 1000 m), such as *Achillea ageratifolia, Centaurea napulifera* ssp. *nyssana, Hieracium pannosum, Senecio macedonicus, Erysimum drenowskii, Trachelium jacquinii, Dianthus viscidus, Cerastium decalvans, Sempervivum kindingeri, Carex kitaibeliana* and others. *Syringa vulgaris,* a Balkan endemic taxon, is common on the E slope of Mt. Menikion at an altitude between 700 and 1100 m.

The mountains of Menikion, Pangeon and Rodopi (NE Greece) represent the southernmost limit of its distribution (cf. Strid & Papanicolaou 1981).

Among the boreal species growing on Mt. Menikion are *Asplenium ruta-muraria, Agrostis stolonifera, Holcus lanatus, Koeleria macrantha, Vaccinium myrtillus, Coronilla varia* and *Rhinanthus minor*. The arctic-alpine and subalpine species *Alopercurus gerardii, Arctostaphylus uva-ursi, Prenanthes purpurea, Thesium alpinum* and *Campanula glomerata* ssp. *serotina* were also found growing on Mt. Menikion. Their occurrence could be interpreted as Pleistocene relicts (see also Voliotis 1976 b).

4. Vegetation

4.1. Zonal vegetation pattern

Mount Menikion participates in four different, altitudinally vicarious vegetation zones (Figs. 1, 4).

Taking into account the climagram of Fig. 4 and the mediterranean climate characters (Mavromatis 1980) we have found the following relationships between the bioclimatic and vegetation zones: The subhumid bioclimatic zone with a mild winter, occurs at the lower altitudes of the mountain. It is in these altitudes that the Ostryo-Carpinion zone occurs, which has a slight midmediterranean character ($40 < x < 75$, where x is the number of biologically dry days). The subhumid bioclimatic zone, with a cold winter, extends to the higher altitudes of the submountainous and mountainous areas. The corresponding vegetation zone is that of Quercion frainetto which has a submediterranean character ($0 < x < 40$). The humid bioclimatic zone, with a cold winter, characterizes the higher mountainous areas. It is related to the Fagion moesiacae zone which shows a submediterranean and partly centraleuropean character ($0 < x < 40$ or $x = 0$). Finally, the very humid bioclimatic zone, with a cold or frosty winter, occurs in the highest mountainous areas; it is connected to the Daphno-Festucetalia zone which has an axeric character ($x = 0$).

4.2. Zone of submediterranean semi-evergreen forests (Ostryo-Carbinion orientalis zone)

The Ostryo-Carpinion orientalis Horvat 58 zone occurs mainly on calcareous rocks on the SW and E side of Mt. Menikion (Figs. 1, 5). The structure and the composition of this zone is quite different on the E and W side of the mountain. The largest part of the SW slopes are characterized by the dominance of *Quercus coccifera* (Fig. 6). This evergreen oak grows near the villages of Inousa and Chionochorio, at the altitude between 300 to 600 m and 1300 m (Coccifero-Carpinetum orientalis (Oberdorfer 48) Horvat 54). Other shrubs occurring in this area are those more or less protected against grazing, *Juniperus oxycedrus, Crataegus monogyna, Cistus incanus,* ssp. *incanus* and *Daphne oleoides*. Apart from the extended appearance of *Quercus coccifera,* the associations of *Quercus coccifera-Carpinus orientalis* and *Quercus occifera-Juniperus oxycedrus* (Karagiannakidou 1983, Raus 1980) occur sporadically above the villages of Agriani, Anastasia and Mikropolis. On the other hand, the E slopes of the mountain are characterized by the dominance of *Carpinus orientalis* growing at an altitude between 700–900 (–1100 m).

The richest vegetation of Ostryo-Carpinion zone appears above the village of Mikropolis. The horizontal and vertical distribution of the zone is often interrupted by deciduous oak shrub clusters, for example above the villages of Agriani and Anastasia. Among the shrub species occurring in the zone are: *Corylus avellana, Fraxinus ornus, Ostrya*

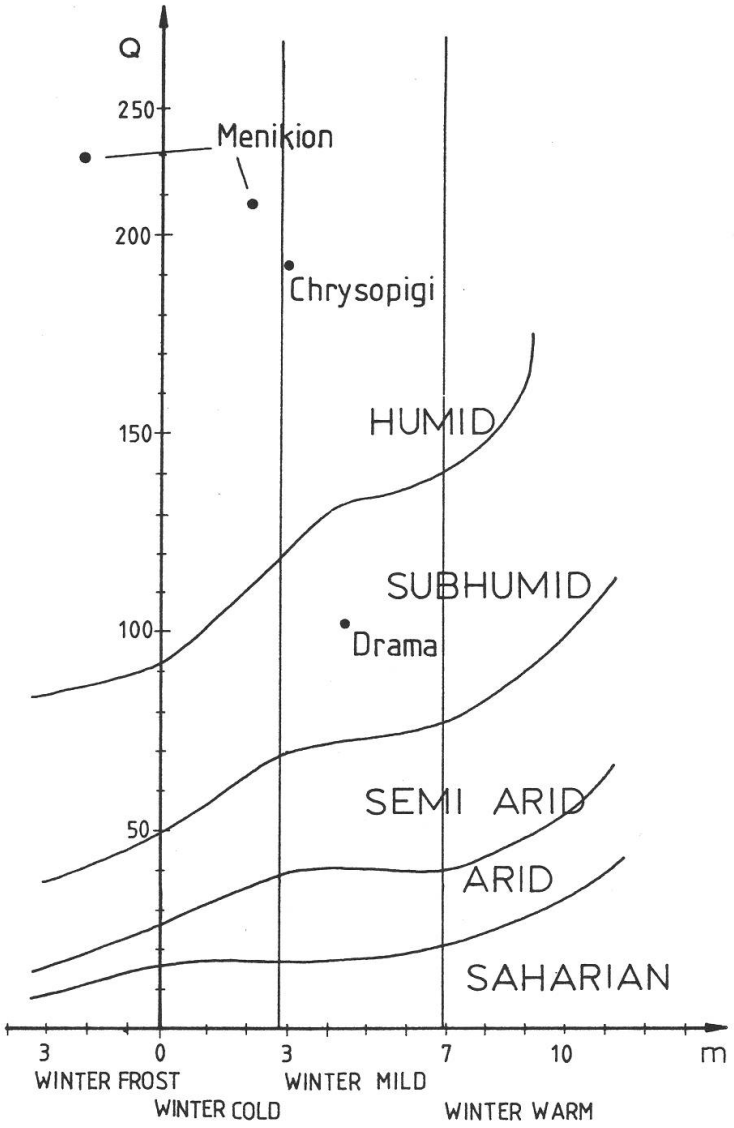

Fig. 4. Emberger's climagram.

carpinifolia, Syringa vulgaris, Juniperus oxycedrus, Cornus mas, Crataegus monogyna, Quercus pubescens and others. Common small shrubs and chamaephyte species are: *Dorycnium pentaphyllum, Thymus sibthorpii, T. atticus, Teucrium chamaedrys, T. polium, Satureja pilosa* etc. The most common herbs in this zone are several taxa of Poaceae: *Bromus madritensis, Cynodon dactylon, Brachypodium sylvaticum, Aegilops geniculata, Lolium perenne,* of Lamiaceae: *Melissa officinalis, Mentha spicata, Origanum vulgare, Clinopodium vulgare,* of Caryophyllaceae: *Arenaria leptoclados, Petrorhagia thessala, Velezia rigida, Silene conica* ssp. *conica* and other taxa of the genera *Campanula, Hypericum, Verbascum, Caucalis, Knautia, Galium, Rumex, Ranunculus, Scrophularia, Digitalis, Veronica, Ferulago* etc.

4.3. Zone of winter deciduous oak forests (Quercion frainetto zone)

The Quercion frainetto Horvat 54 zone is located on metamorphic rocks of the E and SE slopes of the mountain. The higher limits of the oak forests are 1300 to 1350 m (above

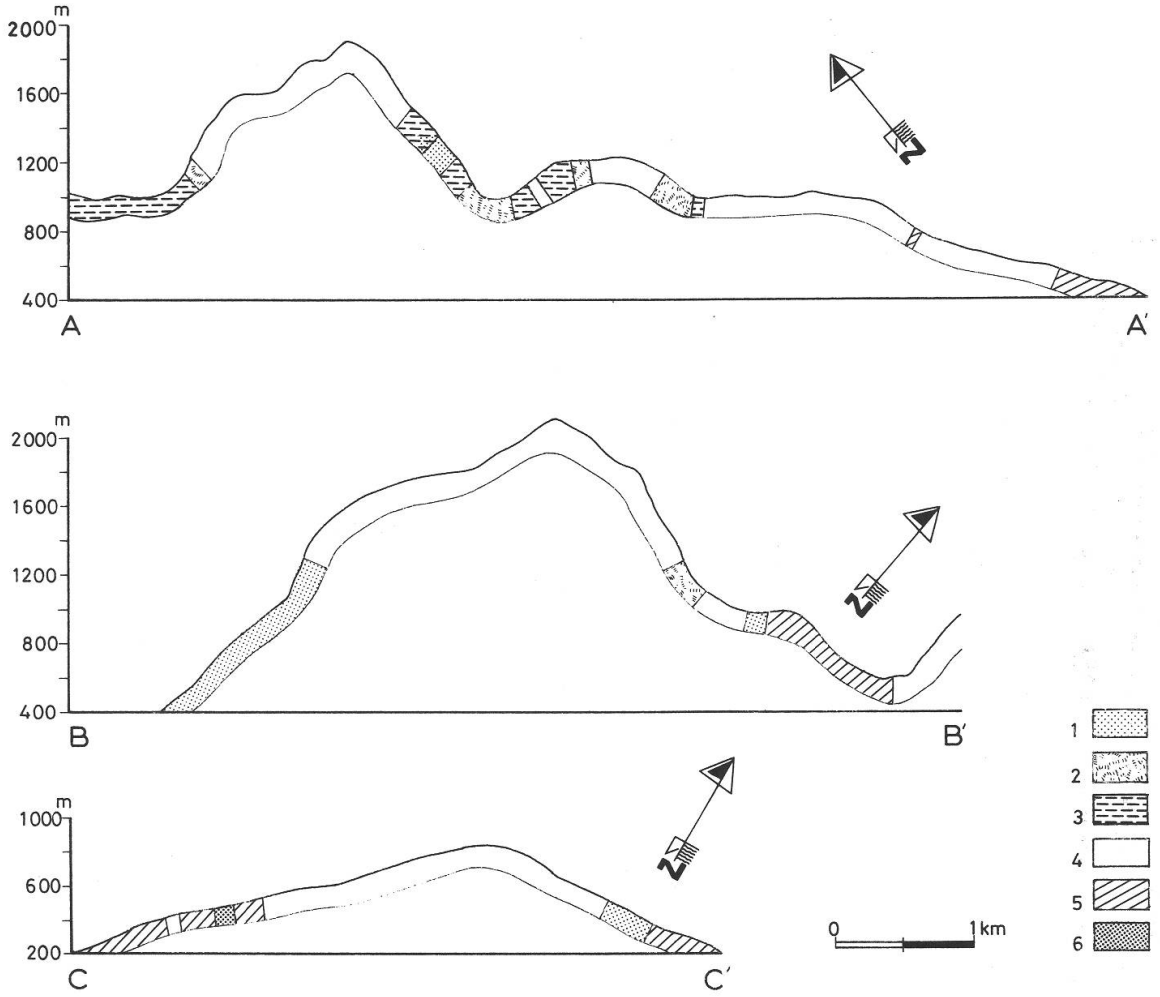

Fig. 5. Altitudinal vegetation pattern of Mount Menikion. – 1 Ostryo-Carpinion orientalis zone. 2 Quercion frainetto zone. 3 Fagion moesiacae zone. 4 Daphno-Festucetalia zone (above 1100 m) and meadows in clearings and openings of forests (below 1100 m). 5 Cultivated lands. 6 Introduced vegetation.

Mikropolis and Agriani) while the lower limits are 400–600 m. The oak forests present a scattered pattern at the lower altitudes (Figs. 1, 2, 5) due to cultivation, cleared land and grazing.

Apart from the two deciduous oak species, *Quercus pubescens* and *Quercus frainetto,* several other woody species apear within the zone: *Juniperus oxycedrus, Sorbus domestica, Corylus avellana, Acer obtusatum, Fraxinus ornus, Crataegus monogyna, Castanea sativa* and *Tilia tomentosa.* In particular, the two latter species are distributed only in the more or less wet areas of the E slopes, with N, NE exposure, (above Mikropolis and Charitomeni) at an altitude between 700–1100 m (Tilio-Castanetum Dafis 66); in that area, *Ostrya carpinifolia, Fraxinus angustifolius* and *Betula pendula* also appear.

Among the commonest herbaceous species growing in the Quercion frainetto zone are: *Campanula persicifolia, Brachypodium sylvaticum, Helleborus cyclophyllus, Primula vulgaris, Geum urbanum, Poa nemoralis, Anthemis tinctoria.*

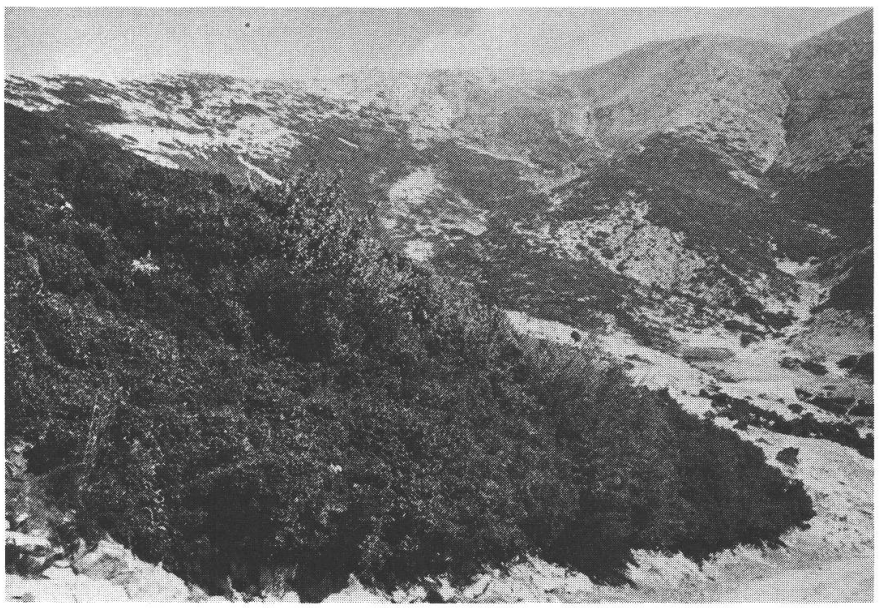

Fig. 6. *Quercus coccifera* growing above the village of Chionochorio, at appr. 1300 m (photo taken by the authors, July 1986).

4.4. Zone of nontane beech forests (Fagion moesiacae zone)

The Fagion moesiacae Dafis 69 zone is confined to the E side of the mountain and in particular it occurs on schists, gneisses and partly limestone rocks. The temperature limitation of the beechwood zone is from c. 600 m (warm-limit) to its cold-limit of up to 1650 m above Mikropolis and up to 1350 m above the villages of Agriani and Anastasia (Figs. 1, 2, 5, 7).

Fagus sylvatica ssp. *sylvatica* the main forest species forms coppice stands 5–7 m tall. This makes it difficult to identify the distinction between the tree and shrub layers. According to Aldén (1986), intermediate plants between *F. sylvatica* ssp. *sylvatica* and *F. sylvatica* ssp. *orientalis* occur in NE Greece. Similar plants have also been found growing on Mt. Menikion.

Penetration by *Quercus* deciduous species and of *Castanea sativa* into the beech forest is often observed on the lower slopes of the S, SW and SE meridian exposures. Other woody species occurring in the tree and shrub layer are: *Ostrya carpinifolia, Fraxinus ornus, Carpinus orientalis, Ulmus minor, Cornus mas, Prunus insitia, Juniperus oxycedrus, J. communis, Crataegus monogyna, C. orientalis,* and *Chamaecytisus eriocarpus.* In the herbaceous understorey a lot of species grow e.g. *Poa nemoralis, Mycelis muralis, Luzula sylvatica, Euphorbia amygdaloides, Galium sylvaticum, Lathyrus laxiflorus, Brachypodium sylvaticum, Veronica chamaedrys, Calamintha sylvatica, Viola tricolor* ssp. *macedonica* etc.

4.5. Zone of subalpine grasslands (Daphno-Festucetalia zone)

The zone of subalpine grasslands (Daphno-Festucetalia Quézel 64) occurs mainly on calcareous rocks of the W side of Mt. Menikion, at an altitude higher than 110 m (Figs. 1, 2, 5) and extends over an area of 32.7 acres (Papanastasis et al. 1986).

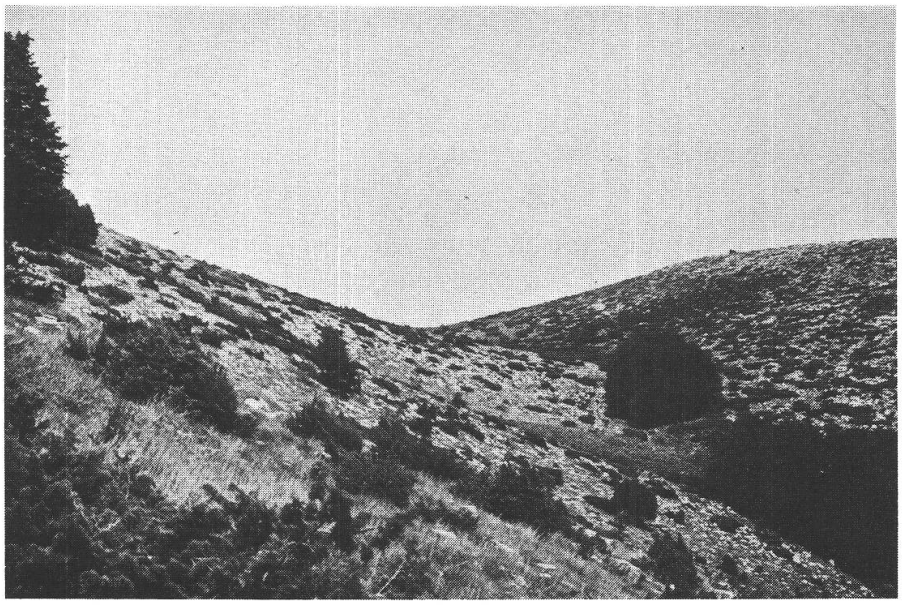

Fig. 7. Higher limits of the beechwood above the village of Mikropolis, at appr. 1650 m (photo taken by the authors, July 1986).

Most of the taxa growing there are hemicryptophytes and geophytes. The mixed compositions of herbaceous and short woody species form cushions or mats and have a mean height 50–70 cm. Representative taxa of the subalpine grasslands are: *Festuca graeca, F. macedonica, F. paniculata, Astragalus angustifolius, A. depressus, Thymus cherlerioides, T. thracicus, Trifolium alpestre, Stipa pulcherrima, Sesleria coerulans, Brachypodium pinnatum, Bromus riparius, Galium rhodopeum, Dianthus gracilis* ssp. *gracilis, Euphorbia baselicis, Anthyllis aurea, Genista tinctoria, Onobrychis alba, Coronilla varia* and others. In spite of their different floristic composition, these meadows are green during the summer because of optimal plant growth during this period (June–July); plants growing in similar meadows of S Greece have their optimum growth during spring (April–May), (Papanastasis 1981, Quézel 1964).

The high number of animals, more than 60,000 goats and sheep, which have grazed in the area for many years (Sivetidis 1970), have altered the species composition of the meadow vegetation (cf. Liakos et al. 1974); this is clearly demonstrated by the dominance of the family Poaceae.

4.6. Meadows in clearings and openings of forests

The development of meadows with a xerothermic character is observed as a consequence of the cutting of clearings of the forests. These meadows occur in clearings and openings of forests, on calcareous and metamorphic rocks as well as on alluvial slopes of the SE and E side of the mountain (Figs. 1, 2, 5).

The meadows at the low altitudes are mainly characterized by the dominance of grasses such as: *Chrysopogon gryllus, Dichanthium ischaemum, Brachypodium sylvaticum* and *Apera spica-venti*. However, similar meadows in deciduous oak- and beech-woods

are characterized by the high abundance of leguminous species such as taxa of the genera *Trifolium, Vicia* and *Lathyrus*.

4.7. Disturbance of the zonal vegetation pattern

Human interference with the vegetation of Greece is historically well documented from ancient times up to the Byzantine period (324–1453) and the Osmanic conquest (1453–1912). Thus, an irrational forest exploitation and illegal land clearing have taken place over a long period in most Greek mountainous areas. Furthermore, intensive grazing and trampling largely damaged the plant coverage in several forest-covered areas, so that even today the regeneration of a natural forest vegetation is prevented (cf. Chloros 1884, Karagiannakidou 1983, Markgraf 1927, Raus 1979, 1980). Data show that Mt. Menikion has been largely over grazed by domestic animals in the past (c. 60,000 head of sheep and goats). Today the number has been decreased (c. 8000 heads) due to the general reduction of the livestock population in Greece (Papanastasis et al. 1986, Sivetidis 1970).

No management of Mt. Menikion forests has been applied to data, although two forests plans were proposed by the Ministry of Agriculture. Only the grasslands have been managed based on a plan developed by Pampoukidis (1978) which included the building of some watering points and shelters for the grazing animals. Small parts of the torrents Gazoros, Palia Zichni, Ag. Pneuma, Ag. Kiriaki and Perichora (on the SE side) were reforested by the Ministry of Agriculture 25–35 years ago, with some conifers (*Pinus brutia* and *Cupressus sempervirens*) and some broad-leaved species (*Robinia pseudoacacia, Populus nigra* and *P. alba*), (Figs. 1, 5).

As a consequence of the uncontrolled clearing of woodland, with its accompanying soil erosion and loss of water-holding capacity, many stands have been invaded from the lower adjacent vegatation zones by secondary plant communities which are resistant to drought. In this way, the secondary formations of evergreen oak form pseudomaquis communities *sensu stricto* and replace natural deciduous forest communities (cf. Adamovic 1906, Raus 1977, 1980, 1981). On the SW slopes of Mt. Menikion pseudomaquis communities actually cover three altitudinal zones. They extend from the Ostryo-Carpinion orientalis through the Quercion frainetto zone up to the lower part of the Fagion moesiacae zone (Figs. 1, 5). On the eastern mountain slopes, where gneisses and schists occur, the Ostryo-Carpinion orientalis vegetation has also gained altitudinally on deciduous forest of the overlying Quercion frainetto zone (above the villages of Agriani and Mikropolis), (Figs. 1, 5). Furthermore, the high number of typical beech-wood species participating in the herb layer of oak-woods shows an obvious invasion of the latter in the Fagion moesiacae zone.

Extensive uniform *Pteridium aquilinum*-stands have replaced the destroyed oak- and beech-woods growing above the villages of Agriani and Mikropolis (between 900–1400 m). According to Horvat et al. (1974) and Raus (1979) these formations do not belong to any forest community but they are present as secondary formation of destroyed deciduous forests (of the Quercion frainetto and Fagion moesiacae zone).

Finally, the timberline of Mt. Menikion has been lowered by the activities of man. As a consequence, the Daphno-Festucetalia zone has been enlarged and extends towards the beech zone at 1600 m (above Mikropolis) or towards the Ostryo-Carpinion zone at 1300 m (above Chionochorio), (Figs. 1, 5–7). It is note worthy that many years ago, Regel (1938) reported the high dependence of timberlines, in many of the greek mountains, on human interference.

5. Conclusions

The absence of the deciduous oak- and beech woods from the W slopes of Menikion, as well as the relatively small forest coverage appearing on its E and SE slopes show that there is an obvious degradation of the natural vegetation. The common reasons responsible for the obscure altitudinal pattern of the vegetation zones in the Greek mountains (uncontrolled clearing of woodlands, extensive grazing) are strongly supported here by the mountain's geomorphology. Since Menikion is an accessible mountain it was a suitable place of refuge for the migration of the inhabitans from the surroundings during the Turkish conquest. Additionally, it is known that the regeneration of natural forest vegetation is very slow in carstic areas without human management (cf. Vavliakis 1981). The remarkable dissimilarity of the vegetation pattern on the different slopes of the mountain could be attributed to the climatic factors (higher temperatures, more drought and warmer winds on the W and SW slopes) in relation to the edaphic and partly petrological factors (Figs. 1, 2, 5–7). It should also be noted that the occurrence of some characteristic mediterranean elements at low altitudes of the mountain (near Ag. Prodromos, 300 m)-though Minikion is far away from the coast-suggest the appearance of the Quercion ilicis zone in the past (cf. Horvat et al. 1974). This is also supported by recent findings, showing the extension of the sea up to the foothills of Mt. Menikion during the early Pliocene period (Vavliakis, pers. comm.).

Furthermore, a comparison between the vegetation pattern of Mt. Menikion and those of neighbouring mountains Lailias (Vrondous) consisting of igneous rocks (Voliotis 1976 b), and Falakron (Boz Dagh of Drama), higher than Menikion at 2232 m (Kitanov 1943), shows that apart from the obvious dissimilarity of the two opposite slopes characterizing Mt. Menikion it is also different from the other two by not participating in the coniferous zones.

The field work was supported financially by the Greek Ministry of Agriculture. The English language was corrected by Dr. C. M. Cook.

References

Adamović L. 1906. Über eine bisher nicht unterschiedene Vegetationsformation der Balkanhalbinsel, die Pseudomacchie. Verh. Zool. Bot. Ges. Wien 56: 355–360.

Aldén B. 1986. *Fagus* L. – In Strid A. (ed.), Mountain Flora of Greece 1, Cambridge University Press, Cambridge, pp. 51–52.

Balafoutis Ch. 1977. Contribution of the study of the climate of Makedonia and west Thracie. Diss. Univ. Thessaloniki (in Greek).

Boer H. U. de 1970. Geologisch-petrographische Untersuchungen im Rhodope-Massiv Griechisch-Ostmazedoniens. Geol. Jb. Bd. 88: 43–79.

Braun-Blanquet J. 1964. Pflanzensoziologie. Grundzüge der Vegetationskunde. Wien & New York: Springer.

Chloros N. A. 1884. Waldverhältnisse Griechenlands. Diss. Univ. München.

Dafis S. 1973. Classification of the forest vegetation in Greece. Sci. Annals, Fac. Agric. & Forest. Univ. Thessaloniki 15: 75–88 (in Greek).

Dafis S. 1975. Vegetationsgliederung Griechenlands. Veröff. Geobot. Inst. ETH, Stiftung Rübel, Zürich 55: 23–36.

Emberger L. 1955. Une classification biogéographique des climats. Recueil Trav. Lab. Bot. Géol. Zool. Univ. Montpellier 7: 3–43.

Emberger L. 1959. Orientation actuelle au service de la C.G.V. de le cartographie physiologique appliquée. Bull. serv. Carte Phytogéogr. Sér. B: 5(2).

Horvat I., Glavač V. & Ellenberg H. 1974. Vegetation Südosteuropas. Stuttgart.
Karagiannakidou V. 1983. Site-investigations in Querco-Fagetea class in mt Chortiatis. (Diss.) Sci. Annals, Fac. Phys. & Mathem. Univ. Thessaloniki 222(5): 1–161 (in Greek).
Karagiannakidou V. & Kokkini S. 1987. The Flora of the Mount Menikion, North East Greece. Phyton 27: 267–283.
Kitanov B. 1943. Vărhu rastitelnost'ta planitata Bozǎ-Dagǎ vǎ istočna Makedonija. God. Sofijsk. Univ., Fiz.-Mat. Fak. (Estetv. Istorija) 39(3): 169–291.
Liakos L., Alexandris S. & Papanastasis V. 1974. Fertilization effects on subalpine grasslands in Phalakron mount of Serrai, N Greece. Sci. Annals, Fac. Agric. & Forest. Univ. Thessaloniki 16: 149–179 (in Greek).
Markgraf F. 1927. An den Grenzen des Mittelmeergebietes. Pflanzengeographie von Mittelalbanien. Repert. Spec. Nov. Regni Veg. Beih. 45: 1–217.
Mavromatis G. 1980. The bioclimate of Greece. Dassiki Erevna supp. 1–63+annexe. Athens (in Greek).
Nakos G. 1977. Edaphic map of Greece. Dassiki Erevna. Athens (in Greek).
Pampoukidis P. 1978. Improvement and management plan of mountain rangelands of the village Chionochorio. Forest office. Serrai (in Greek).
Papanastasis V. 1981. Species structure and productivity in grasslands of northern Greece. In Margaris N. S. & Mooney H. A. (eds.), Components of productivity of Mediterranean-climate regions-Basic and applied aspects. T:VS 4, Dr. W. Junk Pub., pp. 205–217.
Papanastasis V., Platis P., Halivopoulos G. & Tepeli A. 1986. Range resources of the district Drama. Inst. Forest Researches. Thessaloniki (in Greek).
Quézel P. 1964. Végétation des hautes montagnes de la Grèce méridiònale. Vegetatio 12: 5–6.
Raus Th. 1979. Die Vegetation Ostthessaliens (Griechenland) I. Vegetations-Zonen und Höhenstufen. Bot. Jahrb. Syst. 100: 564–601.
– 1980. Die Vegetation Osthessaliens (Griechenland) III. Querco-Fagetea and azonale Gehölzgesellschaften. Bot. Jahrb. Syst. 101: 313–361.
– 1982. Phytogeographical circumscription of the Mediterranean area on the Balkan Peninsula and problems of Thessalian pseudomaquis. Ecologia Mediterranea 8: 197–201.
Rechinger K. H. fil. 1939. Zur Flora von Ostmacedonien und Westthrazien. Bot. Jahrb. Syst. 69: 419–552.
Regel C. 1938. Über die Depression der Waldgrenze in Griechenland. Repert. Spec. Nov. Regni Veg. 100: 28–37.
Sivetidis K. 1970. Improvement and management plan of mountain rangelands of the village Chionochorion. Forest Office. Serrai (in Greek).
Strid A. (ed.) 1986. Mountain Flora of Greece I. Cambridge Univ. Press, Cambridge.
Strid A. & Papanicolaou K. 1981. Floristic notes from the mountains of Northern Greece. Nordic J. Bot. 1: 66–82.
Tutin, T. G., Heywood V. H., Burges N. A., Moore D. M., Valentine D. H., Walters S. M. & Webb, D. A. (ed.), 1964–1980. Flora Europaea, I–V. Cambridge.
Vavliakis E. 1981. Study of the planation surfaces, carstic, glacial and periglacial forms of the mount Menikion (NE Greece) from geomorphological and morphogenetic point of view. Sci. Annals Fac. Phys. & Mathem., Univ. Thessaloniki 19: 1–192 (in Greek)
Voliotis D. 1976a. Die Gehölzvegetation und die Vegetationszonierung des nordgriechischen Gebirgszuges Voras-Vermion-Pieria Olymp-Ossa. Bot. Jahrb. Syst. 97: 120–154.
– 1976b. Flora and Vegetation of Mt Lailias, northern Greece. Biol. Gal. Hell. 6: 1–90 suppl. (in Greek).