Bioclimatic information

Three different bioclimates are encountered in the study area, representing a variety of Mediterranean climatic conditions. Along the Gulf of Evvia, the bioclimate is considered to be warm Mediterranean with between 100 and 125 biologically dry days during its hot, dry period. By contrast, the bioclimate inland is medium Mediterranean, whereas further north on the higher ground it is medium Mediterranean with only 40-75 biologically dry days.

Looking at the geographic distribution of bioclimate types in the study area, there appears to be an overlap of the bioclimatic bands. Thus the areas close to the coast and on the lower slopes are included in the semi-arid bioclimatic band, with average minimum temperature of between 3-7 ^{o} C in its coolest month. Further inland on the higher ground (towards the northern part of the study area) we have the semihumid bioclimatic band with an average temperature of 0-3 ^{o} C during the coolest month.

Geology

The study area, with Mount Kandili in its centre, belongs to the geologically and tectonically important "Zone of the ophioliths", or as it is more usually called, the Subpelagonic Zone of the Internal Hellenides forming part of the Dinaro-tauric branch of the Alpine System.

The Subpelagonic Zone, which comprises also central and part of northern Evvia, occupies the middle of the Greek peninsula and, following the internal curve of the arch formed by the Hellenides mountain series, it extends as far south as the eastern Peloponnese and continues up to Chios and Kos, being interrupted only by the pre-alpine mass of Attica and the Cyclades.

The main feature of the Subpelagonic Zone is the great plutonic ophiolithic masses embedded in sedimentary shale-chert formations overhursted tectonically before the Upper Cretaceous upon metamorphic neritic or pelagian limestones of the Upper Jurassic.

Both the shale-chert formations, which include clayey schists, radiolaterites, marles, fine-grained sandstones with fine-grained limestone intercalations, as well as the limestone substratum upon which they have been overhursted, are products of a sedimentation process, which started at the end of the Palaiozoic and continued until the beginning of the Cenozoic era.

The difference is that the shale chert formations originated from oceanic sediments while the limestones are shallow-sea sediments, typical of the continental margins.

The succession of the shale-chert formations in the western Subpelagonic Zone by neritic limestone further east corresponds to the transition from the oceanic conditions of sedimentation to the neritic of the shallow seas. The Subpelagonic Zone can therefore be considered as the western slope of the Pelagonic platform which separated two trenches: the trench of Pindos in the west and the trench of Axios in the east. Central and part of northern Evvia formed a channel by which the two trenches communicated. The sedimentation process started after the end of the Palaeozoic era, when the great alpine geosyncline extending parallel to the Equator, from the Atlantic to the Pacific Ocean, was transgressed by the Tethys sea.

The emergence of the region coincides with the orogenetic process of the Upper-Jurassic/Lower-Cretaceous due to the collision and subduction of the African lithosparic plate under the European plate, which first affected the Internal Hellenide Zones. Probably the overhursting of the oceanic floor upon the margins of Pelagonia occurred at the end of this period. According to one theory, Pelagonia formed part of the Kimmeridgian Continent, which was separated from the African plate and was joined to the European plate (ophiolithic seam).

The great ophiolithic masses (peridotites) which occur in the broader region of the study originated from the oceanic floor of the Axios trench and were overhursted upon the Euboean channel. The rich magnesite deposits were formed by the alteration of olivine, the main mineral of the peridotites.

From Middle to Upper Cretaceous the region was transgressed again. The final emergence occurred during the orogenetic period from the end of the Cretaceous to the Middle Eocene, characterized by paroxysmic orogenetic activity. The last phase of the orogenetic process started in the Upper Eocene and continued to the Middle Miocene. The emerged area formed Aegais, which covered all the Hellenic space as well as Western Asia Minor.

Before the alpine orogenetic process was completed and immediately after an intensive vertical tectonic activity started which continued up to the Quaternary and which led to the formation of faults and sinks. These were subsequently covered with neocene and quaternary sediments or were transgressed again by the sea (Sinking of Aegeis).

One incident of this tectonic activity after the Alpine orogenesis was the formation of the Gulf of Evvia and the separation of Evvia from the Greek mainland. The steep western slopes of Kandili and the great depth of the northern part of the Gulf of Evvia are due to this fault.

On the slopes of Kandili, the succession of the geological strata described above becomes apparent. We therefore include next the description of the geological cut on the axis passing from the top of Kandili and the centre of the village of Prokopi section .

The substratum is formed by grey or light grey thick-bedded limestones and dolomites of the Middle-Upper Triassic. They have a visible thickness of about 800 m and appear on the western slopes of Mount Kandili and include Clodocoropsis sp. (Kimmeridgian) in abundance.

Above the 800 m line lies a formation of grey to dark grey transgressive limestones of the Kimmeridgian forming the summit cone of the mountain, visible down to an altitude of 500 m on the eastern slope (visible thickness 750 m) and including Megalodon, Gasteropods, Ostracods, Algae (Palaiodasycladus sp.) and Foramifera (Trochalina sp. Miliolidae and Textularidae).

Overlying is a schist-chert formation of terra-cotta colour with a visible thickness of 250 m, which together with the extensive peridotite masses are overthrusted before the Upper Cretaceous on the Upper Jurassic formation.

These peridotite formations of the Kimmeridgian show a differing degree of serpentinization and weathering from place to place. They appear above the alluvial deposits of unconsolidated sand and gravel of the Kereus bed on the right bank. Their thickness is estimated at 800 m.

The lower part of the eastern slope from an altitude of 200 m downwards is formed by a layer of undivided neogene sediments consisting in the lower parts of lacustrine sediments of travertine-like limestones, marles, clays and sandstones. Locally at their base there are conglomeratic breccias with a great percentage of magnesite fragments and pebbles, and in the upper parts of fluviatile-terrestrial deposits of conglomeratic breccia and clayey-sandy material mainly of red colour.

The alluvial deposits of the Kereus valley above the river bed consist of loose clayey-sandy material, terra-rosa with gravel, and material of torrential terraces of a height up to 3 m.

Hydrology

The peridotite formations constitute an impermeable substratum. However, the upper layers of the peridotite masses, which show a high degree of fracturing, weathering, and serpentinization, are permeable. This gives rise to a number of springs of low flux found by the beds of ravines where the peridotite appears unaltered.

The marles and clays of the Neocene and the Quaternary are also impermeable, becoming semipermeable if they contain coarse-sized materials. The small springs which appear at the line of contact with the peridotite mass are of little importance.

The important water reservoirs are formed within the alluvial deposits of the Kereus valley on the peridotite substratum. These shallow water tables are alimented by the river water, the neocene formations, and the carstic paleozoic limestones. The water table is found at a depth of 5-10 m below the surface. The water flow at the point of contact between the peridotite substratum and the neocene formation has been the main cause of the landslides which occurred at the open magnesite mines near Troupi. A problem concerning the ground water is the high concentration of Mg which has adverse effects on human, animal, and plant life, but no systematic studies have so far been undertaken. The conductivity map drawn by the Land Reclamation Service shows that the salt concentration is lower in the water originating from wells in the alluvial deposits. Since groundwater is used both for supplying drinking water to the communities and for irrigation, Mg-concentration could pose a problem for a more intensive use of this resource.

Soil characteristics

Soil is formed as a result of the weathering of base rock, and the effect of the vegetation and the climatic conditions, which are favourable to pedogenesis. The types of soil which have been formed upon limestone are poor and chalky or clayey in texture, deep and fertile in many places,particularly in areas with a northern orientation. Locally the soil has disappeared because of fire, grazing and the absence of plant cover (destruction of vegetation). The situation has resulted in the exposure of the limestone layer, and the soil is stony and infertile in these locations.

Soils which have been formed as a result of the weathering of peridotites usually feature only a few species of plant; this can be attributed to the presence of large amounts of Mg, toxic concentrations of Cr, Ni, Mg and Al and low concentrations of CA, N, P and K. However, like many other types of woodland soil found over peridotites in Greece, the soil in the study area is of particular economic interest due to the ability of the black pine, mainly, but also of the Aleppo pine, to grow in remarkable and productive clusters on this soil. Analysis of a soil section carried out in the Mandoudi area by the soil pedology laboratory of the Athens Institute of Forestry Research confirms the general soil characteristics in the study area, which are the result of the weathering of peridotites, as mentioned above.

Relatively vigorous biological activity is observed in the soil overlying both limestone and peridotites. Nitrification (i.e. the conversion of ammoniac salts into nitrates) through the action of microorganisms occurs mainly in the organic layers of soil, which are thus enriched by organic material (leaves, twigs, branches, etc.) and form the surface layer of the forest floor. The humus thus created is the chalky Mull-Moder type.

Finally it should be noted that on gentle north-facing slopes which have a satisfactory amount of plant cover the soil is deep and fertile, and soil humidity is maintained at a satisfactory level. The quality of the soil varies according to the degree of weathering of the bedrock, the orientation and gradient of the slope, the depth of the soil, the creation of humus, enrichment of the topsoil and the extent to which timber-felling is carried out.

APPENDIX II: ECOLOGICAL VALUE OF THE AREA

Flora

A major part of the study area is woodland; approximately four-fifths of the area is forested, while the rest consists of cultivated and fallow land, pastures, mines and two villages.

In the lower part of the Kereus valley there is a beautiful forest of plane-trees (Platanus orientalis). Parasol pines (Pinus pinea) also occur sporadically in this area; these appear to have been imported into the area, since their natural habitat is close to coastal marshes.

Near the river are a number of hills which are covered by bushes and the so-called Mediterranean maquis, and by Aleppo pines (Pinus halepensis); these grow as high as 800 metres above sea level, on the slopes of Mount Kandili.

On the higher slopes of Mount Kandili there is a clearly-defined vegetation belt which consists almost entirely of Cephalonian firs (Abies cephalonica). Between the two zones of Abies cephalonica and Pinus halepensis, lower down, small forests or stands of Black pine (Pinus nigra) often grow. But as the Cephalonian pine appears quite frequently at lower altitudes than its natural limit of 700-800 metres, mixed groupings of all three kinds of conifer mentioned above are observed. This is not at all a common phenomenon in Greece, and it is, therefore, of considerable ecological interest.

On the higher slopes of Mount Kandili, where one would naturally expect to find forests of fir trees, there are bare meadows, which are without doubt the result of past forest fires and grazing.

The presence of single trees and several stands of oaktrees (Quercus pubescens, subsp. anatolica, Quercus ilex, etc.) probably indicates that there were mixed forests of oaks and conifers in this area in the past, which used to be a common phenomenon in the Mediterranean zone.

In the present dense forests, and also in the thick undergrowth, the mossy vegetation is poor. Most species of mossy plant grow:

(1) in the bare meadows, on the rocks and on the peaks of Mount Kandili;
(2) in the uncultivated fields and grazing land around the village of Prokopi; and
(3) in openings or clearings in the forest.

From a botanical point of view, the area to the east of the River Kereus is of no particular interest, with the exception, of course, of a giant plane-tree, and the two mines on the site of which several serpentinophilous plants grow (Map 2).

Botanical interest is centred on:

(1) the ridge of Mount Kandili
(2) the outlet of the Derveni Gorge, which is also the entrance to the estate, travelling north from Chalkis;
(3) the meadows to the south-east of Dafnoussa;
(4) the area south-west of Dafnoussa (Geroporta, Niobela, etc.)
(5) the hills to the west and north of Prokopi, and the surrounding meadows;
(6) the mine at Gerorema; and
(7) the mine at Paraskevorema.

In the first of the above areas (the ridge), many rare plants endemic to Greece are to be found, such as Cerastium candidissimum, Crocus laevigatus, Inula parnassica, etc. Other examples, endemic to Evvia, are Verbascum tomentosum, Senecia euboeus, etc. There are also plants rarely found anywhere else in the country, such as Colchicum boissieri.

In the second area (the gorge), two very rare species of campanula grow on the rocks. One of these is Campanula goulimyi, endemic to northern Evvia but found only in a very small area; the other is Campanula incurva, which has large and striking flowers and is endemic to the eastern part of Evvia.

The third area (the meadows) contains several rare types of orchid and other interesting plants.

In the fourth area some interesting examples of serpentinophilous plants are to be found, due to the type of base rock.

The fifth area (the hills around Prokopi) contains a wide variety of bushes, small trees, maquis and climbing and mossy plants, concentrated in a relatively small area. Some rare species of plant have also been observed, such as Stachys terragona, which is endemic to eastern Greece.

In the sixth area (Gerorema mine) there are serpentinophilous species, such as Leptoplax emarginata, and various types of Alyssum. It is evident that where mining activities have been abandoned, the natural flora and fauna of the area has been restored.

The last area (Paraskevorema mine) contains a huge plane-tree, probably the oldest in Greece. The natural regeneration of plants on the aggregates and the presence of serpentinophilous plants are of particular interest.

In addition to the above area, there are three further zones outside the Prokopi-Dafnoussa estate which are of particular botanical interest.

The first of these includes the hills around the village of Mandoudi, where the locally endemic species of Bolanthus intermedius (which was recently added to the list of endangered European plants) grows in serpentine and magnesian subsoil, as does Alyssum euboeum, which is endemic to northern Evvia. The second area of interest lies between the Monastery at Galataki and the town of Limni where the rare Centaurea ebenoides, endemic to the north of Evvia, grows, again in serpentine subsoil, along with other interesting plants which thrive on this soil type. The third area, which is located on Mount Kandili, beyond the southern boundaries of the estate, lies in the region of Dafnonta Forest and is called Lefkes. Here on one slope grows a small forest of Populus tremula, which is probably the only example in the whole of Evvia; beneath the poplars grow the poplar peonies (Paeonia mascula subst. hellenica), one of the rarest and most beautiful plant species in Greek flora.

The rare plants found in the above areas could perhaps be transplanted at points within the study area where the soil is of a similar composition.

There is no doubt that the estate is a small botanical paradise. The conservation of its rare flora can be attributed to the relatively small amount of human intervention that has occurred there. Its considerable ecological value has led to its being included in the EEC CORINE Programme's network of Greek biotopes with rare and interesting flora, together with the Galataki Monastery-Limni area further north.

To date, 103 areas of Greece have been designated as areas with interesting flora; they have been divided into 6 categories, according to their value. Mount Kandili and the Kereus valley have been placed in the third category.

Most of the information concerning the area's flora was gathered during field trips, and in many cases it was the first time that data on this area had been collected. Information from existing literature and from forest management reports was also used.

List of plants in the area of Mount Kandili and the Kereus Valley

The rare species are marked by an asterisk. The region of growth appears after the name of each plant.

Pr - near Prokopi
U - unknown
SZ - summit zone
MZ - medium zone
D - Derveni

1. Acinos alpinus - subsp. meridionalis	SZ.
2. Ajuga orientalis	MZ.
3. Alyssum chalcidicum	Pr.
4. Alyssum murale	Pr.
5. Althaea hirsuta	Pr.
6. Althaea (Alcea) rosea	Pr.
7. Apium nodiflorum	Pr.
8. Allium margaritaceum	U.
9. Agrostis alba	U.
10. Abies cephalonica	SZ.
11. Arbutus unedo	MZ.
12. Alkanna graeca - subsp. graeca	Pr.
13. Anthyllis hermanie	Pr.
14. Acanthus spinosus	Pr.
15. Arbutus adrachne	MZ.
16. Ailanthus altissima (non endemic)	Pr
17. Anagallis arvensis (with red flowers)	Pr.
18. Anagallis arvensis (with blue flowers)	Pr.
19. Anchusa azurea	Pr.
20. Anchusa undulata - subsp. hybrida	MZ.-SZ.
21. Agrimonia eupatoria	Pr.
22. Agrostema githago	Pr.
23. Anthemis cotula	Pr.
24. Anthemis auriculata	Pr.
25. Anthemis cretica - subsp. cretica	SZ.
26. Anthemis altissima	Pr.
27. Anemone blanda	Pr.-MZ.
28. Anemone pavonina	MZ.
29. Alnus glutinosa	U.
30. Aubrieta deltoiedea	MZ.-SZ.
31. Bellis silvestris	Pr.-MZ.
32. Buglossoides purpureocaerulea	MZ.
33. Clematis viticella	U.
34. Corydalis densiflora	SZ.
35. Capparis ovata	Pr.-MZ.
36. Cardamine graeca	MZ.
37. Cotinus coggygria	MZ.
38. Cerastium Candidissimum *	SZ.
39. Campanula goulimyi *	D.
40. Campanula incurva *	D.
41. Centaurea melitensis	MZ.
42. Centaurea triumfetti-subsp. cana	SZ.
43. Centaurea euboica - subsp. euboica *	MZ.
44. Colchicum parnassicum *	SZ. - MZ.

45. Cyperus glauca	U
46. Colchicum boissieri •	SZ.
47. Crataegus monogyna -subsp. monogyna	Pr- MZ.
48. Crocus laevigatus	MZ. - SZ..
49. Corydothymus capitatus	MZ.
50. Calycotome villosa	MZ.
51. Cistus salviaefolius	MZ. - Pr.
52. Cistus villosus -subsp. creticus	MZ.- Pr.
53. Celtis australis	Pr.
54. Cercis siliquastrum	MZ.
55. Convolvulus arrensis	Pr. - MZ.
56. Convolvulus altheoides subsp. tenuissimus	Pr. - MZ.
57. Centaurium pulchellum	Pr.
58. Centaurium sp.	MZ.-SZ
59. Cichorium indibus	Pr.
60. Chrysanthemum segetum	Pr.
61. Consolida orientalis -subsp. phrygia •	Pr.
62. Clinopodium vulgare	Pr.
63. Cytinus ruber	MZ.
64. Cytinus pippocistis	MZ.
65. Daphne euboica •	MZ.
66. Daphne laureola	MZ.
67. Doronicum orientale (caucasicum)	MZ.-SZ.
68. Dianthus corymbosus	MZ.
69. Daphne gnidium	Pr.-MZ.
70. Dracungulus vulgaris	Pr.
71. Dorycnium hirsutum	Pr.-MZ.
72. Dorycnium pentaphyllum	Pr.-MZ.
73. Dipsacus fullonum	Pr.
74. Dactylis glomerata	Pr.
75. Euphorbia exigua	Pr.
76. Euphorbia myrsinites - subsp. myrsinites	MZ.-SZ.
77. Eryngium campestre	Pr.
78. Echinops graecus	MZ.
79. Echinops sphaerocephalus	MZ.
80. Epilobium hirsutum	SZ.-MZ
81. Ebenus sibthorpii •	U.
82. Erica arborea	MZ.
83. Erica manipuliflora (verticillata)	MZ.
84. Echium italicum	Pr.
85. Echium vulgare	Pr.
86. Fritillaria euboica •	U.
87. Fumana pinatzii •	SZ.
88. Fraxinus ornus	MZ.
89. Genista acanthoclada	Pr. -MZ.
90. Galium lucidum	Pr.
91. Gagea amblyopetala	U.
92. Gagea graeca	MZ.
93. Geranium asphodeloides	MZ.
94. Geranium columbinum	MZ
95. Hornungia petraea	U.
96. Hypericum perforatum	MZ.
97. Huetia (Freyera) sp.	U.
98. Hieracium florentinum	U.
99. Hieracium pannosum	U.

100.Helleborus cyclophyllus	MZ
101. Hypericum empetrifolium	MZ.
102. Hypochoeris cretensis	Pr.
103. Ilex aquifolium •	MZ.
104. Inula parnassica •	MZ.- SZ.
105. Juniperus oxycedrus	MZ.
106. Juniperus phoenicea	M.Z.
107. Juniperus exelsa	MZ.
108. Knautia sp.	SZ.
109. Lilium chalcedonicum •	MZ.
110. Linum gallicum	U.
111. Linum goulimyi •	U.
112. Laurus nobilis	U.
113. Lavatera punctata	U.
114. Lonicera implexa	Pr.
115. Lathyrus laxiflorus	MZ. -SZ.
116. Lotus stenodon	Pr.
117. Minuartia verna - subsp. attica	MZ.- ZK.
118. Muscari commutatum	MZ
119. Myrtus communis	Pr.
120. Myosotis silvatica	MZ. - SZ.
121. Micromeria graeca	MZ.
122. Nerium oleander	Pr.
123. Orchis laxiflora	MZ.
124. Orchis provincialis - subsp. procincialis	MZ.
125. Orchis quadripunctatus	MZ.
126. Orchis provincialis	U.
127. Origanum scabrum-subsp. pulchrum •	U.
128. Olea europaea-subsp. oleaster	MZ.
129. Ophrys lutea - subsp. murbeckii	MZ.-SZ.
130. Ophrys scolopax-subsp. scolopax	Pr.
131. Ononis spinosa	Pr.
132. Origanum heracleoticum	Pr.
133. Orlaya daucoides	MZ.
134. Potentilla recta	MZ.-SZ.
135. Prunus mahaleb	U.
136. Platanus orientalis	Pr.-MZ.
137. Pinguicula hirtiflora	U.
138. Populus tremula	MZ.
139. Pinus pinea	Pr.
140. Paliurus spina-christi	MZ.-Pr.
141. Pinus nigra	MZ.
142. Phillyrea latifolia	MZ.-Pr.
143. Phlomis samia	U.
144. Pinus halepensis	Pr.-MZ.
145. Pistacia lentiscus	Pr.-MZ.
146. Pistacia terebinthus	Pr.-MZ.
147. Prunus spinosa	MZ.
148. Polygala nicaeensis - subsp. mediterranea	MZ
149. Papaver rhoeas	Pr.
150. Populus nigra	Pr.
151. Prunella vulgaris	Pr.
152. Pulicaria odora	Pr.
153. Parentu cellia viscosa	Pr.
154. Quercus coccifera	Pr.-MZ.

155. Quercus pubescens(lanuginosa)-subsp-anatolica	MZ.
156. Quercus cerris	U.
157. Quercus ilex	MZ.
158. Rhus coriona	MZ.
159. Ruscus aculeatus	Pr.
160. Rhus cotinus	MZ.
161. Rubus fruticosus	Pr-MZ.
162. Romunculus trilobus	Pr.
163. Rosa sempervirens	Pr.
164. Rubia peregrina	Pr.
165. Rubus saxatilis	Pr.
166. Spartium junceum	MZ.
167. Senecio euboeus *	SZ.
168. Senecio integrifolius-subsp. integrifolius	U.
169. Scolimus hispanicus	MZ.-Pr.
170. Scorzonera serpentinica *	U.
171. Salix alba	Pr.-MZ.
172. Scutellaria velenofski-subsp-goulimyi *	ZK.
173. Stachys tetragona *	Pr.
174. Salvia triloba	MZ.
175. Satureja thymbra	MZ.
176. Sarcopoterium spinosum	MZ.-Pr.
177. Stachys germanica-subsp. heldreichii	ZK.
178. Scabiosa sicula	U.
179. Scrophularia canina-subsp. bicolor	Pr.
180. Smilax aspera	Pr.-MZ.
181. Thymus teucrioides	MZ.-SZ.
182. Turica cretica	U.
183. Thesium humile	U.
184. Teucrium polium	MZ.
185. Tordylium apulum	Pr.
186. Trifolium physodes	Pr.
187. Trifolium repens-subsp.repens	Pr.
188. Tordylium officinale	Pr.
189. Trifolium resupinatum	Pr.
190. Trifolium lappaceum	Pr.
191. Ulmus montana	U.
192. Verbascum tomentosum	U.
193. Vicia grandiflora	Pr.-Z
194. Vicia pinetorum *	MZ.
195. Viola alba-subsp. thessala	Pr. - MZ.
196. Verbena officinalis	Pr.

Of the rare species marked by asterisks the following 3 are locally endemic:

1. **Centaurea euboica-subsp.euboica**
2. Fumana pinatzii
3. Scorzonera serpentinica.

The 8 endemic plants of Evvia are:

1. Campanula goulimyi
2. Daphne euboica
3. Fritillaria euboica
4. Origanum scabrum-subsp. pulchrum
5. Senecio euboeus

6. Scutellaria velenovski-subsp. goulimyi
7. Verbascum tomentosum
8. Linum goulimyi.

The 7 endemic plants of Greece are:

1. Cerastium candidissimum
2. Campanula incurva
3. Colchicum parnassicum
4. Ebenus sibthorpii
5. Inula parnassica
6. Stachys tetragona.
7. Vicia pinetourum

The following 3 species are rare:

1. Consolida orientalis-subsp. phrygia
2. Ilex aquifolium
3. Lilium chalcedonicum.

Rare plants outside the study area:

1. Alyssum euboeum, Mandoudi area
2. Bolanthus intermedius, Mandoudi area
3. Centaurea ebenoides, Limni area
4. Paeonia Mascula-subsp-hellenica, Dafnonta Forest.

Description of Forest Vegetation

Around the forested area at Kokkalaki on the coast of the Gulf of Evvia there are Aleppo pines and evergreen maquis with broad, hard leaves. The evergreen and broadleaved types of maquis either from the undergrowth of the stands of Aleppo pines, or else they occur, alone, as ground-cover wherever the depth and humidity of the soil are not favourable to the growth of the Aleppo pine. The soil is limestone and there are steep gradients. The soil quality is moderate to poor, and this is partly due to the area's southern exposure. To the south and inland, towards Achladi, stands of fir mingle with the Aleppo pines on the higher slopes. The undergrowth contaiins bushes of Thymus sp., Calycotone villosa, Cistus sp., etc. The stands of pine trees are between 55-75 years old.

The pine forest gives way (horizontally inland, and perpendicularly as the ground rises) to meadows of mountain acacia on Mount Kourvelo, and stands of firs at Grouspes, alongside Dafnonta Forest, and on Mount Stroungitsa towards the forest area at Galataki Monastery.

There are dense unmingled stands of fir trees here and there at Grouspes, though for the most part their incidence is more scattered; on lower ground they occur in mixed stands with the black pine. The stands of fir trees are between 90-150 years old. The mossy vegetation features oregano (Origanum vulgare) and Cretan cistus (Cistus villosus).

Towards Mount Drakotourla, mixed stands of fir and black pine predominate, which cover the 550-1,150 m above sea level zone. The undergrowth consists of broad-leaved evergreens. To the north-west of Mount Drakotourla towards Mount Stroungitsa, at a height of 700-800 metres, there are mixed stands of fir with Aleppo pine. The presence of black pines is restricted by poor ground quality, the general degradation of the area and their southern exposures; the area in question has become degraded mainly because of deficiencies in the soil, and it will have to be protected through the imposition of a regime of complete protection (no intervention whatsoever).

The stands of fir and the meadows on the north-eastern slopes of Mount Kourvelo give way to clusters of black pine towards the peak of Mount Stavros. Indeed, although there are still mixed stands of black pine and fir, the dominant species of tree is now the black pine. The northern exposure ensures adequate humidity and a relatively good soil quality, with the result that the black pine grows alongside the fir on higher ground (600-700 m), and the Aleppo pine on lower ground (300-400 m). There are also stands of plane-trees along the river banks.

To the north and north-east of Mount Lagovouni, the Aleppo pine predominates, while along the edge of the area where the stands of Aleppo pine and fir grow there are mixed stands of trees, the Aleppo pine being the predominant species at this level (200-600 m); the main rock type is of limestone with clay-shale in places. The mainly north-facing slopes are favourable to the growth of the fir in the higher zone, with an undergrowth consisting of ferns (Pteridium aquilinum) and Heleborus cyclophylus, and the formation of streams with plane-trees along the banks. The Aleppo pine is characteristically surrounded by undergrowth consisting of brown evergreens mainly holm-oak, arbutus, box-thorn, esparto, etc. These are interspersed mainly with plants of the borom evergreen family. Regeneration of the Aleppo pine is satisfactory and the age of the pine stands is between 80 and 100 years.

To the west of this area, approximately 22 hectares of the land are being mined.

The area lying between Dafnoussa, Roda, Phaliraki, Skalorachi, Agios Ioannis, Prokopi, Pefkias, Katsilismeno and Livadorachi contains mainly Aleppo pines.

In the northern section (from Mount Skalorachi northwards), and east of the road linking Agios Ioannis, Prokopi, Pefkias and Katsilismeno the predominant species of tree is the Aleppo pine with the occasional appearance, either singly or in stands, of oak (Quercus pubescens) and scattered examples of Umbrella pine (Pinus pinea). The undergrowth consists mainly of evergreen, broad-leaved species such as holm-oak, holly, box thorn, arbutus, etc.

The quarries at Gerorema and Paraskevorema are situated in this area, occupying 179 ha and 32 ha. respectively.

The main type of rock found in this area consists of peridotites, the serpentinisation of which created deposits of magnesite. The presence of serpentine gives rise to a different kind of flora (plants which thrive on serpentine soil). In addition to the peridotites there are also limestone and alluvial deposits, mainly alongside the river. To the north of the olive grove there is also a short stretch of flysh.

The average age of the stands of Aleppo pine in this area is between 55-65 years; they are all about the same age since most of the trees in the area were destroyed in a forest fire in 1922.

Forest Fires

The forests in this area have been subjected to many forest fires in their time. Although vegetation has grown back, degradation of the ecosystem has followed the grazing of the burnt areas. These burnt areas are located in the parts of the forest where the Aleppo pines grow unaccompanied by other species, as well as on lower slopes. The fires proved the Aleppo pine to be a species with a high fire tolerance - much higher than that of any existing stands of downy oak (Quercus pubescens). Thus forest fires have resulted in the prevalence of the Aleppo pine at the expense of other kinds of tree.

The following is a catalogue of the area's major fires:

1922 — The largest fire in the recent history of the forest, in which 1,700 ha. were burnt (almost half of the area of the forest). This fire occurred in the area east of an imaginary line connecting Skathistra - Agios Ioannis - Prokopi - Skourtzorachi - Lytsitsa - Stavros.

1935 Approximately 550 ha. were burnt along the most northerly edge of the area (north of a line between Elaionas - Agios Ioannis - Skathorachi).

1942 The area on the eastern bank of the River Kereus was burnt; in this instance the river acted as a fire corridor, preventing the spread of the fire to the western bank. Twenty-year-old pine trees were destroyed in the fire.

1947 An area west of the River Kereus and north-east of a line between Prokopi and Drazi was burnt.

1948 An area near Mount Toufes was destroyed by fire.

1979 Approximately 113 ha. were burnt near Paliomandra.

1980 40 ha. at Pefkia and 50 ha. at Katsilismeno were destroyed.

1980-81 200 ha. of pine trees were burnt on Psili Rachi.

Vegetation zones

According to the vegetation map of Greece (Mavromatis, 1980) the following features are encountered in the area:

(a) the warm mediterranean formation of the Eastern Mediterranean (Oleo ceratonion) on the lower slopes and near the coast
(b) the Balkan type of 2 oaks (Quercium ilicis)
(c) in the higher zone there are mixed stands of Cephalonian fir and black pine, which are occasionally joined by Aleppo pine. The co-existence of these three types of tree in the same place is quite remarkable considering their different biological and ecological requirements.

Along the River Kereus grow plane-trees of some considerable age (100-150 years); there are examples of these scattered at some distance from the river, which could indicate that this plane forest covered a much wider area in the past but that its size was diminished by human intervention and activities in the area (agricultural cultivation, construction of roads, quarrying, etc.)

According to the breakdown of vegetation zones in Greece (Dafis 1976), and Horvat's structure of Vegetation in South-Eastern Europe, the study area extends from the Oleo-ceratonion sub-zone to the Abietion cephalonicae and Pinion nigrae sub-zones of the Fagetalia zone.

Vegetation Zone Quercetalia ilicis

This zone contains two sub-zones, the Oleo-ceratonion on the lower ground and near the coast, and the Quercion ilicis; the latter sub-zone has some excellent examples of stands of Aleppo pine.

Oleo-ceratonion Sub-Zone

This sub-zone occupies of the driest and lowest lying areas. It occurs mainly in the Oleo-lentiscetum growth-space, while the other growth-space of this sub-zone (Oleo-ceratonictum) is considerably restricted and is characterized mainly by certain types of phrygana, Corydothymus capitatus (thyme), Sarcopoterium spinosum (thorny broom), Genista acanthoclada, Cistus sp. etc.

The growth-space of the Oleo-lentiscetum sub-zone starts above the level of the Oleo-ceratonietum, and thereafter the Aleppo pine predominates, with undergrowth of bushes with hard, broad leaves.

This growth-space is distinguished by the presence of oak-trees which occur alone in unmixed stands

alongside streams, and here and there in conjunction with arbutus, box-thorn, holm-oak and heather on stony or rocky ground.

Generally speaking, the Oleo-ceratonion sub-zone in the area is distinguished by the presence of maquis, with oak-trees (Quercus ilex) here and there. Apart from the oak and the Aleppo pine, examples of conifers are also to be found in the area, as well as some plane-trees and especially some hydrophilous species of plant. Bushes encountered in this sub-zone include prickly broom (Calycotome villosa), prickly juniper (Juniperus oxycedrus), mastic (Pistacia lentiscus) and types of heather.

These bushes, especially holm-oak and mastic, also grow further up in the Quercion ilicis sub-zone.

Quercion ilicis sub-zone
There are higher levels of moisture in the soil and humidity in the air in this sub-zone and thus the phyrgana now give way to hard and broad-leaved bushes forming the undergrowth to Aleppo pines and also growing in the open spaces. There are few carstic areas. The two growth-spaces of this sub-zone (Adrachno-quercetum and Orno quercetum ilicis) are not easily distinguishable and the vegetation has a uniform appearance. The environment here is ideal for the Aleppo pine. In one part of this sub-zone the plant colonies are considerably degraded; they are largely dependent on the soil conditions (depth, humidity), and so on south-facing slopes, heathers (Erica manipuliflora and Erica arborea) occur, whereas Strawberry trees and Spanish broom grow where conditions are more favourable. In more humid areas the downy oak (Quercus pubescens), and box-thorn occur.

This sub-zone extends to an altitude of approximately 500 metres above sea level - considerably higher than usual.

Sub-Mediterranean Vegetation Zone Quercatalia pubescentis
This zone does is nowhere present in the study area; it is a transitional vegetation zone between thermophilous and psychrophilous Mediterranean conifers and can virtually be shared between these two zones: it is characterised by expansion of Aleppo pine on the higher, colder slopes, and of fir and black pine on the lower slopes. It is considered to lie between 300-700 metres above sea level and it contains mixed stands of Aleppo pine, black pine and fir. The most frequent type of tree grouping changes with altitude from the Aleppo pine to black pine to fir, with here and there mixed stands of two or all three species together (Vromoremma, Akonistis, Lykoremma, Botza, Stroungitsa, etc.)

These groupings are usually to be found on mainly north-facing slopes where the humidity is favourable to all three species; as a result there are streams at these locations, often with plane-trees. The soil is calcareous and the undergrowth consists of broad-leaf evergreens and mossy plants, with the prolific presence of ferns (Pteridium aquilinum,), which are typical of areas with better quality soil, etc.

Sub-Mediterranean Mountain Conifer Zone Fagetalia
The coolest and most humid area of the forest lies in this zone. The predominant species here are the Cephalonian fir (Abies cephal.) and the black pine. The zone is considered to extend to the lower slopes where conifers mingle with Aleppo pines, forming mixed stands. The lower limits of this zone coincide with the disappearance of the Aleppo pine and the prevalence of mixed stands of black pine and fir. The zone extends as far as the limits of the forest, at a height of approximately 1,200 m above sea level on Mount Kourvelo.

The only sub-zone that occurs is Abietum cephalonicae, where the predominant species is the Cephalonian fir. As frequently happens in the southern part of Greece, there are reservations about the inclusion of the fir in the Fagetalia, since according to ecological criteria the lowest section of this zone coincides with the Quercatalia pubescentis zone. The appearance of scattered examples of the downy oak (Quercus pubescens) supports the view that these forests are growing on the site of ancient oak forests.

The stands of black pine growing in the same geographic area extend further down than the Fagetalia, overlapping into a large part of the Quercetalia pubescentis zone and creating a special phytosociological

sub-zone of Pinion nigrae which cannot really be included with either the Fagetalia or the Quercetalia pubescentis.

The Pinion nigrae sub-zone constitutes a transitional zone between formations of phytosociological and the growth-space. The growth-space of Abietum cephallonicae and Pinetum nigrae contains the corresponding species of tree; the former appears between 700-1,200 metres above sea level while the latter grows at between 500-900 metres above sea level.

Extraforestal Zone Astrogalo-Acantholimonetalia
In the higher mountain zone beyond the limits of the forest there is a vegetation zone which consists of bushy and mossy plants; it has suffered considerable degradation as a result of soil degradation and the harsh conditions in which these plant colonies grow. This zone is of botanic interest only. It is of no value from a hydrological viewpoint, nor from one of soil protection or forest production.

Azonic Vegetation
The formation of streams within the forest and the creation of special growing conditions have resulted in the appearance of a particularly hydrophilous type of vegetation along these streams. These plant colonies established themselves in this area because of the particularly humid environment and because of special features of the terrain (alluvial silt deposits).

The bed of the River Kereus is one of the most significant growth areas for azonic vegetation. The plane-trees seen here grow on alluvial deposits and extend down to the lower slopes of the forested area. Growing conditions here are favourable: the gradients are not steep (5-10%), and the northern orientation ensures adequate moisture and satisfactory conditions for the decomposition of the forest floor. The soil is of a sandy and pebbly consistency. The plane-trees are between 30 and 150 years old, and regeneration is in places satisfactory.

The presence of the plane-trees along the River Kereus affords protection to the riverbed and prevents it from breaking up under the pressures of winter torrents and flood waters.

Vegetation in the Area of the Mines

The surface extraction of magnesite from the mines located on the eastern boundary of the study area has caused considerable disturbance both to the ecosystem and to the relief of the area. The smooth pine-covered hillsides have been abruptly replaced by bare mounds of aggregate criss-crossed by gullies, and small seasonal lakes have been created in places. Some of these lakes were formed from rain-water which collects in existing depressions, while others were created for the express purpose of retaining the sludge from the mines. In other words, they act as precipitation tanks before the water overflows into the nearby river.

Despite all these enormous changes, the natural vegetation in the area shows no sign of dying. On the contrary, the experienced eye of a naturalist would discern signs which indicate that as soon as mining activities in the area cease, the place will very quickly be full of wild life again.

On the oldest heaps of aggregates and along the road-sides various serpentinophilous plants (e.g. Leptoflax emarginata, Alyssum euboeum, and one of the sub-species of Allysum murale) have already sprung up from seeds carried there from the neighbouring slopes. Examples of Stachys cretica, mollis. Convolvulus cantabrica, Anthemis parnassica, among others, are to be found nearby.

Small reed-beds of fragmented clusters of tamarisk (Tamarix parviflora) are also to be found in the seasonal marshes.

However, the most important phenomenon is the establishment of the plane-tree (Platanus orientalis) not only on the banks of the marshes, but also on the sleeper slopes of the hills which were thought to be totally infertile. The seeds are carried on the wind from nearby gullies where plane-trees grow in abundance: