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Flora and Vegetation of the Strofilia Coastal Area (NW Peloponnesos – Greece)

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With 4 Figures

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Summary

GEORGIADIS Th., ECONOMIDOU E. & CHRISTODOULAKIS D. 1990. Flora and vegetation of the Strofilia coastal area (NW Peloponnesos – Greece). – Phyton (Horn, Austria) 30 (1): 15–36, with 4 figures. – English with German summary.

Flora and vegetation of the main natural ecosystems of the Strofilia area (NW Peloponnesos) are studied and their ecological situation is discussed. The main vegetation units are the following ones:

The forests of *Pinus pinea, P. halepensis* and *Quercus macrolepis,* which belongs to the zone of Quercetalia ilicis.

The vegetation of sandy beaches and dunes which belongs to the associations of Ammophiletum arenariae and Agropyretum mediterraneum.

The vegetation of salt- and freshwater wetlands and wet meadows, of the hydrophilous natural hedges and bushes, the phrygana, and the nitrophilous vegetation.

450 species of *Pteridophyta* and *Spermatophyta* are listed, including the Greek endemics *Colchicum parlatoris, Centaurea niederi, Petrorhagia graminea* and *Limonium brevipetiolatum. Coris monspeliensis, Cotula coronopifolia* and *Salicornia procumbens* are recorded for the first time for Peloponnesos.

Zusammenfassung

GEORGIADIS Th., ECONOMIDOU E. & CHRISTODOULAKIS D. 1990. Flora und Vegetation des Küstengebietes Strofilia (NW-Peloponnes, Griechenland). – Phyton (Horn, Austria) 30 (1): 15–36, 4 Abbildungen. – Englisch mit deutscher Zusammenfassung.

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Die Flora und die Vegetation der wichtigsten natürlichen Ökosysteme des Strofilia-Gebietes (NW-Peloponnes) werden dargestellt und deren ökologische Situation diskutiert. Die hauptsächlichen Vegetationseinheiten sind folgende:

Die Wälder mit *Pinus pinea, P. halepensis* und *Quercus macrolepis,* die dem Verband Quercetalia ilicis angehören.

Die Vegetation der Sandküsten und Dünen, welche zum Ammophiletum arenariae und Agropyretum mediterraneum gehört.

Die Vegetation der Salz- und Süßwassersümpfe und der nassen Wiesen, die feuchten Hecken und Gebüsche, die Phrygana und die nitrophile Vegetation.

450 Arten an *Pteridophyta* und *Spermatophyta* werden aufgeführt, eingeschlossen die griechischen Endemiten *Colchicum parlatoris, Centaurea niederi, Petrorhagia graminea* und *Limonium brevipetiolatum. Coris monspeliensis, Cotula coronopifolia* und *Salicornia procumbens* werden erstmals für den Peloponnes nachgewiesen.

1. Natural environment

The forest of Strofilia is located at the lowland coastal region of NW Peloponnesos, about 40 km to the SW of Patras. It occupies a coastal zone of about 15 km length, and of an average width of 1500 m. On the East it is bordering to the marshes of Lamia on the West to the sea, on the North to the lagoon of "Prokopos" and on the South to the lagoon of Kotichi (Fig. 1).

The forest consists mainly of *Pinus halepensis, Pinus pinea* and *Quercus ithaburensis* subsp. *macrolepis* (subsequently spelled *Q. macrolepis*). The forestral ecosystem of Strofilia is of great interest, not only because of its composition, but mainly because it belongs to those litoral forests, which have been strongly degraded or even more completely eliminated by human activities all over Europe (GEHU & GEHU 1983). The nonforest ecosystems (sandy hills, fresh- and saltwater wetlands, meadows, sandy beaches and dunes etc.) are also of great interest because of their floristic composition, their variability,their function as refuge for the wild fauna of the area (eg. zone of wetlands, bushes) and their general ecological value.

1.1. Geology and Pedology

Most of the area studied lies on sandy-dune formations, and only an area of about 364 ha (9.4%) is composed of hard limestone. Behind the dunes, nearly all the eastern part of the area, consisting of a strip about 15 km long and 100 to 2500 m wide, is covered by clay deposits of a few centimetres to more than 2 m. Particularly five types of soils can be distinguished in this area showing a close correlation with the vegetation (PAPAMICHOS & ALIFRAGIS in PAPAMICHOS & al. 1986).

a) Soils of seashore sandy zone: The soils of this zone consist of unconnected single grain sandy material. It consists of medium and fine sand with a very small amount of silt. The material is rich in calcium, and easily moved by the strong winds.

b) Soils of *Pinus halepensis* zone: The soils of this zone appear to have sand to loamy sand texture, with 4 to 16% silt plus clay. Usually these soils

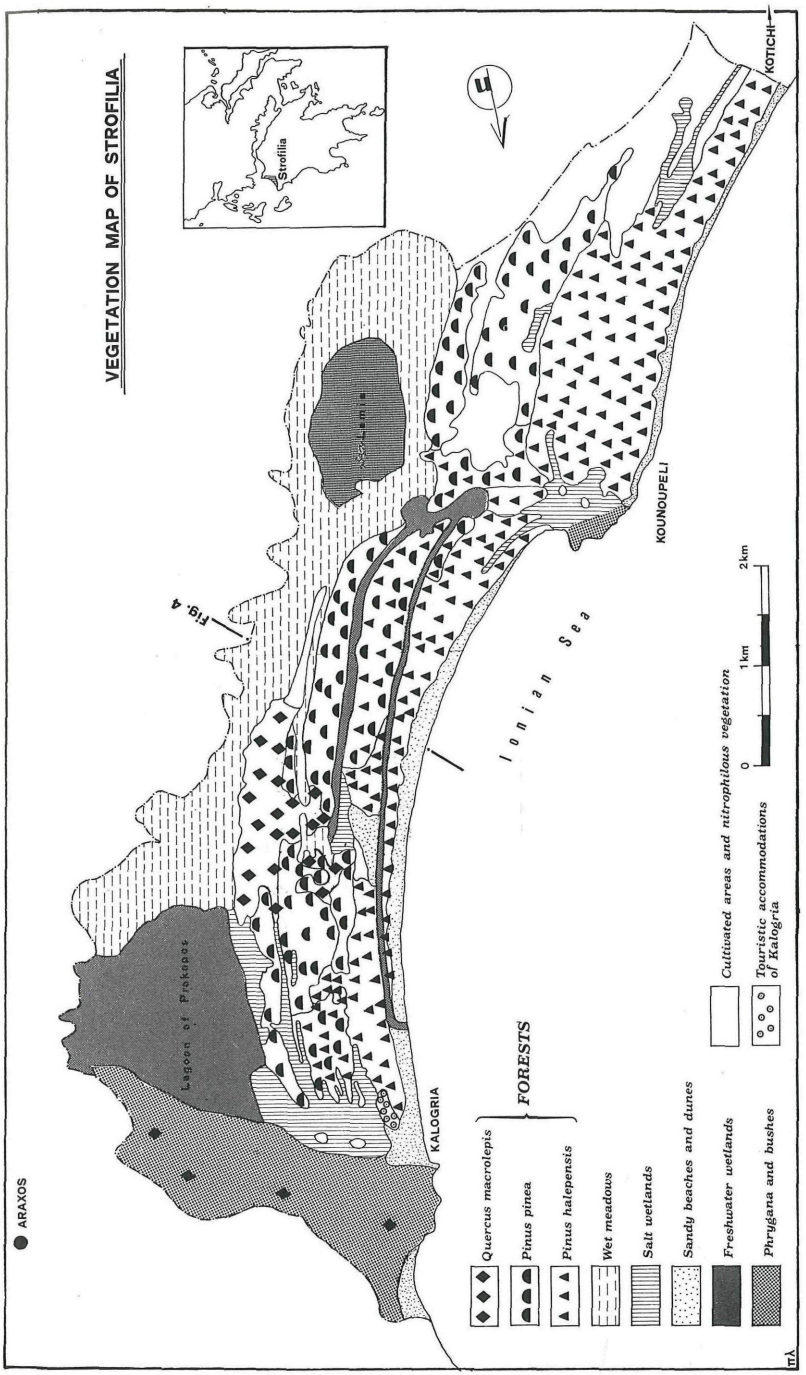

Fig. 1. Vegetation map of Strofilia.

are structureless, except the surface layer, from 2 to 6 cm depth, which is rich in humus and has a weak granular or crumby structure. Typical characteristics of these soils are: their high pH which varies from 7.5 to 8.3 and their high content of free calcium and other carbonates (up to 40%).

c) Soils of *Pinus pinea – Quercus macrolepis* zone: These soils are more developed than those of the *Pinus halepensis* zone. They usually show two horizons: the upper one between 15 and 25 cm, a loamy sand enriched with organic material (2–3%) and weak platy structure. The lower horizon between 25 and 35 cm is weakly impregnated and coloured by organic material (0.3–0.4%), without structure, pH 6.0 to 6.6, without calcium carbonate and very often contains soft iron and manganese concretions. The C-horizon between −40 to −60 cm consists of sandy parent material, containing more than 15% $CaCO_3$, pH more than 8.0 and many hard unregular Ca concretions.

d) Soils of fine deposits and associated saline soils: This type is found in the eastern treeless inner part and is usually flooded during winter and spring. The surface layer, 10 to 140 cm thick, consists of fine lake sediments (clay). Below this horizon sea sands with many shells are deposited, pH 7.8 to 8.6, 5–30% free $CaCO_3$ and high salinity.

e) Soils of the hard limestone zone: They are found in the NW part of the forest, and in the SW part (Kounoupeli). They have clayey to loamy texture and strong fine granular of angular structure, pH 6.7, without Ca carbonates. Their depth changes between a few centimetres up to 40 cm.

Table 1

Climatic data for the station of Araxos: Period 1961–1980.

	Temperature °C					Rainfall		
	Mean	Mean max.	Mean min.	Absolute max.	Absolute min.	Mean	Maxi-mum	Mini-mum
January	10,3	13,8	6,4	22,0	−3,8	98,7	222,0	12,7
February	10,7	14,4	6,4	25,0	−4,5	85,0	180,3	22,6
March	12,2	15,9	7,4	29,0	−2,5	66,3	164,6	10,2
April	15,5	19,5	9,8	28,2	1,4	40,6	103,7	1,4
May	19,9	24,3	13,1	36,5	5,8	21,8	70,3	0,0
June	24,1	28,6	16,8	37,0	8,4	9,8	60,2	0,0
July	26,7	31,3	18,8	40,0	10,0	2,6	19,0	0,0
August	27,1	31,7	19,5	40,5	11,6	5,7	64,5	0,0
September	23,8	28,5	17,4	37,0	3,0	35,2	62,3	0,0
October	19,2	23,4	14,1	32,2	4,4	92,9	234,9	8,0
November	15,1	19,1	10,7	28,2	−1,2	118,0	376,6	13,6
December	11,9	15,4	7,9	24,6	−1,2	129,9	327,6	31,8

They represent soil remnants (preserved from erosion) onlying limestone bedrock.

1.2. Climate

The main climatic factors reflecting to the vegetation growth e.g. temperature and rainfall, are given in Tab. 1 and Fig. 2. The bioclimate of the area is illustrated by the xerothermic index (MAVROMMATIS 1980), and the coefficient of Emberger (EMBERGER 1955, 1959). According to the xerothermic index (x) the area belongs to a weak Thermomediterranean Type (115 biologically dry days). The dry period lasts from early May to late September (Fig. 2). The long dry and warm summer combined with the strong dominant W and SW winds, often creates very favourable conditions for forest fires.

According to the Emberger-coefficient the area belongs to the sub-humid bioclimatic zone with mild winters almost free of frost and snow (Fig. 3).

The climatic data originate from the Araxos-station which is located about 5 km NE of Strofilia forest at an altitude of 14 m above sea level.

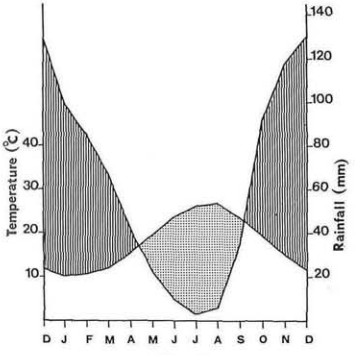

Fig. 2

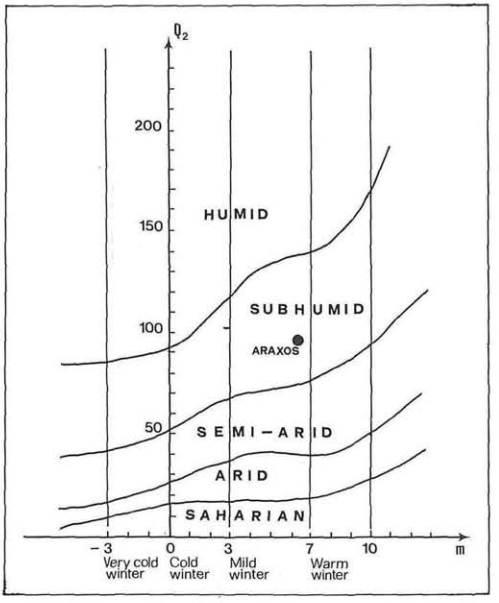

Fig. 3

Fig. 2. Climate diagram of Araxos Meteorological Station (Strofilia area).

Fig. 3. Biological classification of the Strofilia area (with the meteorological station of Araxos) according to EMBERGER. – m = mean temperature of the coldest month of the year. – Q = pluviometric quotient according to EMBERGER.

2. The vegetation types of the Strofilia area

No special work on the vegetation of the Strofilia-Lamia-Kounoupeli area exists. Of course there are some for the wider area of Western Peloponnesos: BEUERMANN 1956, LAVRENDIADES 1956, 1964. Some additional data contributing to the knowledge of this area's vegetation have been given by ECONOMIDOU 1981, GEORGIADIS & CHRISTODOULAKIS 1984.

The studied area is characterized by a large variety of biotopes and types of vegetation alternating in space, mainly because of the difference in soil humidity, soil composition and microrelief. As a result many succession-stages in space and many more ecotones are formed. After a detailed study of the air-photographs and several plant samplings, the following ecosystems with specific vegetation units have been distinguished and mapped in large scale (Fig. 1):

1. Forests
2. Sandy beaches and dunes
3. Salt- and freshwater-wetlands and wet meadows
4. Hydrophilous natural hedges and bushes
5. Phrygana and bushes
6. Nitrophilous vegetation

2.1. Forests

The three main species of the tree-layer are: *Pinus halepensis, Pinus pinea* and *Quercus macrolepis.* In the forest we do not have generally a continuous shrubby undergrowth because of tourism and grazing. The species of the shrub-layer are elements of the maquis and phrygana vegetation, and are described in the units phrygana and bushes, and hydrophilous natural hedges and bushes. The area which is covered by each one of the tree species in hectares, as well as the rate of coverage in relation to the total extent of the studied area (1921.35 ha), is the following:

	Hectares	Rate %
Pinus halepensis	988.04	51.42
Pinus pinea	329.27	17.14
Quercus macrolepis	61.60	3.21

A zonation of the forest stands of the three species from the coast towards inland has been observed and is presented in Fig. 1 and 4. Generally, *P. halepensis* covers the outer zone towards the sea, while *P. pinea* the intermediate and *Quercus macrolepis* the inner one.

Sometimes the stands of these species are mixed. *P. pinea* is the most important of the three forestral species, which are dominating this area. It has highest demands on climatic and soil conditions and is the most valuable from the aesthetic point of view. Nowadays it is subject to a gradual reduction. The presence of very old trees (90–200 years) in relation

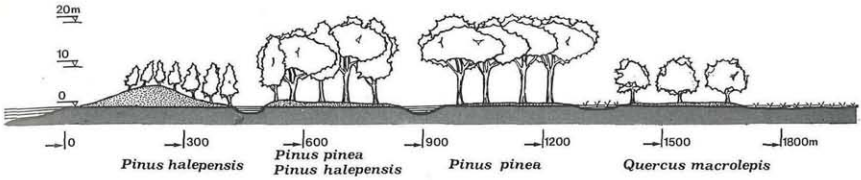

Fig. 4. Transect of Strofilia forest from W to E between Kounoupeli and Kalogria (see Fig. 1).

to the considerable absence of young individuals reveals an abnormal regeneration of *P. pinea*, due to human activities during the last decades.

RECHINGER 1951 considers the forest of *Pinus pinea* in the Aegean region a relic of cultivation from the Enetian years and characterizes them as subspontaneous. According to RIKLI 1943 *Pinus pinea* in western Peloponnesos is indigenous.

On the basis of pollen analysis WRIGHT 1972 reports that the coastal pine exists in the region since 300 BC.

Even more *P. pinea* seems to grow naturally in the area of Strofilia for the following three reasons:

– This stand lies inside the geographical area of distribution of *P. pinea* (RIKLI 1943).

– The ecological conditions of this stand are the preferable ones for this taxon.

– The huge extension of the *P. pinea* forests advocates non artificial situation.

P. halepensis is observed to be in a dynamic stage and extends continuously, because of lower ecological demands. Therefore we do have an increase of *P. halepensis* forest while *P. pinea*-area declines. *P. halepensis* appears in all age-classes and has a high frequency of regeneration.

Q. macrolepis clusters are more or less stable and don't extend any more, because of past and present human exploitation. The existance of scattered individuals of *Q. macrolepis* for away and around the main forest contribute to the assumption of larger forest area in the past.

The composition of the forest reveals the following units:

2.1.1. Forest of *Pinus halepensis*

This forest is the best developed in the area and the denser one. We may recognize two layers below the tree canopy.

A) The herb layer is dominated by the following species: *Stipa bromoides, Brachypodium sylvaticum, Piptatherum miliaceum, Briza maxima, Lagurus ovatus, Carlina corymbosa, Linum bienne, Bellis perennis, Anemone coronaria, Pulicaria vulgaris, Hypochoeris achyrophorus, Pteridium aquilinum.*

B) The vegetation cover of the shrub layer varies between 50% and 70%. It is dominated by *Pistacia lentiscus, Myrtus communis, Quercus coccifera, Juniperus phoenicea, Smilax aspera, Ruscus aculeatus, Rubus ulmifolius, Erica manipuliflora, Olea europaea* var. *sylvestris.*

On some places where the forest is not so dense some phryganic species become dominant like *Salvia fruticosa, Teucrium capitatum, Satureja graeca, Anthyllis hermanniae, Cistus creticus, Cistus salviifolius, Coridothymus capitatus.*

Juniperus phoenicea is abundant near the seaside, becomes less frequent towards inland, and is absent in the *Quercus macrolepis* forest.

2.1.2. Forest of *Pinus pinea* and *Pinus halepensis*

A) The herb layer dominated by *Dactylis glomerata, Stipa bromoides, Cynosurus echinatus, Briza maxima, Lagurus ovatus, Anthoxanthum odoratum, Brachypodium retusum, Asphodelus microcarpus, Romulea bulbocodium, R. linaresii, Carlina corymbosa, Anemone pavonina, A. coronaria, Hypochoeris achyrophorus, Daucus carota, Knautia integrifolia, Rubia peregrina, Pteridium aquilinum.*

B) The vegetation cover of the shrub layer varies up to 30%. The dominant species are: *Pistacia lentiscus, Myrtus communis, Quercus coccifera, Smilax aspera, Ruscus aculeatus, Juniperus phoenicea, Pistacia terebinthus, Phillyrea latifolia.*

2.1.3. Forest of *Pinus pinea*

A) The herb layer is dominated by *Stipa bromoides, Briza maxima, Carlina corymbosa, Linum bienne, Ranunculus ficaria, Romulea linaresii, R. bulbocodium, Asphodelus aestivus, Lagurus ovatus, Torilis nodosa, Dactylis glomerata, Anemone pavonina, A. coronaria, Pulicaria vulgaris, Verbascum blattaria, Erodium cicutarium, Bellis perennis, Pteridium aquilinum, Arisarum vulgare.*

B) The vegetation cover of the shrub layer varies up to 50%, dominated by *Myrtus communis, Pistacia lentiscus, Smilax aspera, Juniperus phoenicea, Ruscus aculeatus, Rubus ulmifolius, Prasium majus.*

In the northern part of the forest grazing and human activities have destroyed the shrub layer. The herb layer remained and is dominated by *Asphodelus aestivus.*

2.1.4. Forest of *Quercus macrolepis*

The shrub layer has disappeared due to human activities and intensive grazing. Hence we recognize a herb layer only below the tree canopy of *Quercus macrolepis,* dominated by *Asphodelus aestivus, Pteridium aquilinum, Carlina corymbosa, Asparagus acutifolius, Anthoxanthum odoratum, Briza maxima, Cynosurus echinatus, Dactylis glomerata, Dasypyrum villo-*

sum, Desmazeria rigida, Lagurus ovatus, Hordeum murinum, Smyrnium rotundifolium, Ranunculus ficaria, Bellis perennis, Erodium cicutarium, Romulea linaresii, Salvia verbenaca, Verbascum sinuatum, Rhagadiolus stellatus, Trifolium pratense, Knautia integrifolia, Anemone coronaria.

2.1.5. Forest of *Pinus pinea* and *Quercus macrolepis*

A) The herb layer is dominated by *Stipa bromoides, Asphodelus aestivus, Pteridum aquilinum, Linum bienne, Carlina corymbosa, Anthoxanthum odoratum, Briza maxima, Cynosurus echinatus, Dactylis glomerata, Dasypyrum villosum, Lagurus ovatus, Hordeum murinum, Smyrnium rotundifolium, Ranunculus ficaria, Erodium cicutarium, Romulea linaresii, Knautia integrifolia.*

B) The vegetation cover of the shrub layer varies up to 20%, dominated by *Myrtus communis, Pistacia lentiscus, Quercus coccifera, Ruscus aculeatus, Smilax aspera, Asparagus acutifolius.*

From a phytosociological point of view the dominance of *Pistacia lentiscus, Myrtus communis, Juniperus phoenicea* and *Quercus coccifera* in *Pinus halepensis* and *P. pinea* forest places them in the alliance of Oleo-Ceratonion and especially in the association of Oleo-Lentiscetum. At the same alliance have been placed the *P. halepensis* and *P. pinea* forest of Euboea by KRAUSE & al. 1963. BARBERO & QUEZEL 1976 believe also that *P. halepensis* forests develope mainly in Oleo-Ceratonion and when they appear in Quercion ilicis-zone they are of secondary origin.

Concerning the *Quercus macrolepis* forest we believe that it is a relic-element in the area, which is very difficult to classify, because of the lack of the shrub layer. MATTHÄS 1988 considers also the *Q. macrolepis* forests of Crete as relics from the Tertiary. ZOHARY & ORSHAN 1966 placed these forests in the association of Quercetum macrolepidis, which belongs to the alliance of Quercion ilicis creticum.

Grazing, fires, recreational and agricultural activities lead to a continous degradation and reduction of the forest area. Therefore the management of the forest must attain the following:

1. The forests total conservation and development by:
– limitation of fires
– limitation of grazing
– limitation of uncontrolled recreation activities and
2. The conservation of the ecological equilibrium of the three main forest species by the protection and regeneration mainly of *Pinus pinea* as well as *Quercus macrolepis.*

2.2. Sandy beaches and dunes

The sandy beach of the area is well developed and has a mean width of about 100 m. Usually it is flat but the dominating strong W and SW winds contribute to the formation of dunes up to 10 m high.

A zone bare of vegetation is formed between the sea and the first 50 m, because this area is covered by the seawaves during winter. Next to this zone there are sandheaps and chines where the Ammophiletum arenariae is the predominate association. The species dominating here are the following ones: *Ammophila arenaria, Pseudorlaya pumila, Ononis variegata, Echinophora spinosa, Medicago marina, Pancratium maritimum, Eryngium maritimum, Euphorbia paralias, Otanthus maritimus*. Just behind the dunes there exists the type of Agropyretum mediterraneum, but in a poor variety because of the intensive human activities (concentration of swimmers, parking etc.). The following species are dominating: *Elymus farctus, Sporobolus pungens, Echinophora spinosa, Otanthus maritimus* etc. Except the above associations included in the class of Ammophiletea also the ammonitrophilous vegetation of Cakiletea appears, without forming typical plant communities, in flat areas with a lot of marine grasses, algae and intensive human presence.

We consider that all the human influences effecting this area must be limited or prohibited, according to circumstances. The visit and stay must be allowed in some strictly determined areas. The circulation of the vehicles must be allowed only up to a definite point, but not on the dunes. The constructions must also be in accordance to the environment, and made only in some areas and after the contribution of an ecologist to the initial study.

2.3. Salt- and freshwater wetlands and wet meadows

Behind the wide band of *Pinus halepensis, P. pinea* and *Quercus macrolepis* forests extend a mosaic of salt wetlands, lagoons, marshes and wet meadows. Small variations in soil humidity, or microrelief cause different types of vegetation.

In the lower parts of this area, where the content in Sodium chloride is high, the vegetation consists of halophytic species like *Arthrocnemum macrostachyum, Puccinelia festuciformis, Limonium brevipetiolatum, Limonium virgatum, Sarcocornia perennis, S. fruticosa, Juncus acutus, Plantago crassifolia, Cressa cretica, Aeluropus littoralis, Salicornia europaea, Suaeda maritima, Parapholis filiformis, Inula crithmoides, Atriplex portulacoides* etc.

In some zones brackish ponds are formed mainly during spring. At the deeper parts of these ponds plenty of *Ruppia maritima* is growing and in fewer quantities *Sarcocornia perennis* and *Aeluropus littoralis* as well. There is an abundance of *Chara* sp. growing at the hems of these ponds. Next to that exists, during spring, a zone of *Triglochin bulbosa, Limonium brevipetiolatum, Sarcocornia perennis, S. fruticosa, Arthrocnemum macrostachyum* and *Juncus acutus* which usually form meadows with 100% of vegetation cover.

The lake of Prokopou is characterized by two aquatic sociations of *Phragmites australis* and of *Scirpus maritimus*. The pure sociation of

Phragmites is very well developed and extends to the northern parts of the lake, while the consociation of *Scirpus maritimus* is well developed in the most shallow western parts, which are dry during summer.

In Strofilia we have noticed an interference or a predominance of *Asphodelus microcarpus* in the wet meadows, which is an indicator that the area has been grazed and is grazed even today.

In the Lamias' Marsh the associations of Scirpetum maritimi, Scirpetum litoralis, Alismetum and pure populations of *Scirpus maritimus, Eleocharis palustris, Scirpus litoralis* and *Beckmannia eruciformis* are developed.

The complete study and description of the associations Arthrocnemetum, Salicornietum europaeae, Juncetum maritimi and Juncetum acuti, Scirpetum maritimi, Scirpetum litoralis, Alismetum and sociations of *Scirpus maritimus, Phragmites australis, Eleocharis palustris* and *Scirpus litoralis* is given by the authors in PAPAMICHOS & al. (ed.) 1986.

Similar ecosystems, in the Greek area have been described by LAVRENTIADES 1956, 1963, 1975, WOLFF 1968, GRADSTEIN & SMITTEMBERG 1977, BABALONAS 1980, ECONOMIDOU 1981 and SZIJJ (ed.) 1981, 1983.

The human influence on the ecosystem consists in the circulation of any type of vehicle without any limitation, the construction of roads at the saltwater wetlands, the deposition of any type of rubbish, the intensive grazing all over the area, resulting in the loss of floral and faunal variability and their reduction to monotonous meadows.

Grazing could be allowed only at some marginal areas of the meadows and the forests, in such a way that the ecological equilibrium of the area could not be overthrown and aesthetics of the landscape not to be changed.

2.4. Hydrophilous natural hedges and bushes

The area between Kalogria and Kounoupeli consist of a mosaic of hollows and elevations, with variation in soil humidity and vegetation. In the lower parts grows the *Arthrocnemum* while in the higher ones some thickets of *Pistacia lentiscus* and *Juniperus phoenicea* develop followed by mainly hydrophilous species.

Sometimes the above thickets show the form of natural hedges, especially at the edge of the Strofilia forest. The composition of sclerophyllous and hydrophilous species like *Myrtus communis, Juncus acutus, Tamarix hampeana, Mentha microphylla, Oenanthe fistulosa, Althaea officinalis, Cynanchum acutum, Smilax aspera, Vitex agnus-castus, Phillyrea latifolia, Juncus heldreichianus, Schoenus nigricans, Prasium majus* gives an impression of the stands.

In the wider area of Strofilia also some hydrophilous forest remains have been noticed such as *Fraxinus angustifolia* subsp. *oxycarpa* and *Ulmus minor*. It usually has the shape of a bush or of a small tree 3–4 m high, the cover of bushstratum (100%) gives the impression of natural hedges. The

formation as fringe of the forest communities is the reason why they are not mapped in detail in Fig. 1.

Close to the saltwater wetlands the natural hedges change their species composition. They loose characteristically *Fraxinus angustifolia* and *Ulmus minor, Tamarix hampeana* becomes more frequent, forming a type of Vitici-Tamaricetum.

These hedges and bushes are "relics" of previous hydrophilous forests and consequently constitute a natural inheritence, the conservation of which is imposed by scientific, educational and national reasons. In these hedges and bushes a lot birds take refuge and small preys build their nests.

2.5. Phrygana and bushes

At the north of Strofilia lowlands and north of the Prokopou lake extends a hill range of considerable elevation covered by phrygana and bushes. South of Kounoupeli also some hilly area is covered by bushes.

In phrygana *Phlomis fruticosa* is predominating while in bushes *Juniperus phoenicea* and *Pistacia lentiscus* prevail. Phrygana is located on dry rocky calcareous substrates, on slopes with a high degree of inclination (60%). They have elements of Cisto-Micromerietea and Thero-Brachypodietea.

Here we found mainly the species *Phlomis fruticosa, Salvia fruticosa, Phagnalon graecum, Satureja graeca, Satureja juliana, Lagurus ovatus, Urginea maritima, Asphodelus aestivus, Hyparrhenia hirta, Carlina corymbosa, Coridothymus capitatus, Psoralea bituminosa, Reichardia picroides, Trifolium scabrum* etc.

At the upper parts of these hills some tree individuals of *Quercus macrolepis* slip in while the substratum remains almost with the same floral composition.

The bushes of the wider area belong, in general, to Oleo-Ceratonion phase with *Juniperus phoenicea* (DEBAZAC 1969), but are enriched with many elements of Cisto-Micromerietea.

These ecosystems are characteristically mediterranean with predomination of xerophytes, mainly of hard leaf and evergreen plant species. Especially in this area hospitate some endemic plants such as *Centaurea niederi* and *Petrorhagia graminea.*

Their substrate is usually limestone and this is the reason that makes these ecosystems, mainly that of Kalogria, to be threatened from the expansion of the existing quarry or the establishment of new ones.

2.6. Nitrophilous vegetation

In Kalogria, Kounoupeli at the wider area of the wet meadows and at places which previously have been cultivated, nitrophilous species and species following agricultural activities have been noticed to be growing like *Lolium rigidum, Galactites tomentosa, Scolymus hispanicus, Ononis*

spinosa, Petrorhagia velutina, Trifolium campestre, T. resupinatum, T. scabrum, Avena sterilis, Daucus carota, Dactylis glomerata, Dasypyrum villosum, Verbascum sinuatum, Bellardia trixago, Rumex pulcher, Lolium multiflorum, Raphanus raphanistrum, Silene gallica, Cynodon dactylon, Silybum marianum, Lavatera punctata, Phleum subulatum, Herniaria hirsuta, Polycarpon diphyllum, Anthemis arvensis, Aira elegantissima, Chrysanthemum segetum, Sherardia arvensis, Sisymbrium officinale, Capsella bursa-pastoris etc.

Finally the coastal rocky areas are characterized by *Limonium virgatum, Coridothymus capitatus, Linum strictum, Valantia muralis, Crucianella latifolia* and *Trifolium lappaceum.*

3. Flora

The variety of vegetation units is caused by a rich flora which includes about 450 species of *Pteridophyta* and *Spermatophyta.* There is also a rich flora of fungi, lichens, mosses and algae which are not included in our plant list.

For the study many samples have been gathered and collections have been made in all the extent of the studied area and at different seasons of the year. Herbarium specimens are deposited at UPA.

For the identification of the species the following Florae have been used: Flora Europaea (TUTIN & al. 1964–1980), Flora of Turkey (DAVIS 1965–1988), Flora d'Italia (PIGNATTI 1982), the Flora of Greece (HALACSY 1900–1908), the Flora of Balkans (HAYEK 1924–1933) etc.

Nomenclature follows that of Flora Europaea except for the part revised by Med-Checklist 1 and 3 (GREUTER & al. 1984, 1986), where the latter is followed.

From the plant list we can outline the presence of:

– The endemic species of Peloponnesos: *Colchicum parlatoris,* which was found in many areas of Peloponnesos, mainly at Chelmos, Taygetos, Messenia and at the area of Kalogria.

– The Greek endemics: *Centaurea niederi, Petrorhagia graminea* and *Limonium brevipetiolatum.*

C. niederi which was known only from the Mesolongion area, was found for the first time at this NW side of Peloponnesos and has the same chromosome number (2n=18) as the plants of Mesolongion area (GEORGIADIS 1983). It is a local Greek endemic, which has found shelter in the calcareous rocks and was rescued in an unapproachable place of Kalogria. The extent of this population that is not so big, is in danger because of the extension of the quarries in the area.

Petrorhagia graminea is a greek endemic spread in Epirus and Peloponnesos. At Kalogria it prefers the calcareous rocks and is found between phrygana elements.

Limonium brevipetiolatum is a new endemic of the Greek flora, which was described recently (ARTELARI & ERBEN 1986) from the Ionian Islands (Levkas). This species occurs also in the wet- and salt-meadows of the Kalogria area. It is closely related to *L. angustifolium* and the main criterium of its distinction is the high grade of polyploidy (hexaploid). It is found on the Ionian Islands and in West-Peloponnesos and shows the phytogeographical connection between these areas.

We also can outline the first find of some species in Peloponnesos:

Coris monspeliensis: known from the central and west mediterranean area, was found for the first time in Greece (GEORGIADIS & CHRISTODOULAKIS 1984).

Cotula coronopifolia: was not reported from Greece. We observed it in the humid places of Mesolongion area (SEVERIN & al. in SZIJG 1983) and Kalogria.

Salicornia procumbens: known only from England, Ireland and Turkey, was found in Kalogria for the first time.

3.1. Check-list of *Pteridophyta* and *Spermatophyta*

Pteridophyta

Polypodiaceae

Asplenium ceterach
Cheilanthes velea
Pteridium aquilinum

Selaginellaceae
Selaginella denticulata

Gymnospermae

Cupressaceae
Juniperus oxycedrus
J. phoenicea
Cupressus sempervirens

Pinaceae
Pinus halepensis
P. pinea

Dicotyledones

Amaranthaceae
Amaranthus albus

Anacardiaceae
Pistacia lentiscus
P. terebinthus subsp. *terebinthus*

Araliaceae
Hedera helix

Aristolochiaceae
Aristolochia rotunda

Asclepiadaceae
Cynanchum acutum subsp. *acutum*
Periploca graeca

Betulaceae
Alnus glutinosa

Boraginaceae
Alkanna tinctoria subsp. *tinctoria*
Anchusa hybrida
A. officinalis
Cerinthe retorta
Echium angustifolium subsp. *angustifolium*
E. italicum

E. plantagineum
Heliotropium europaeum
H. supinum
Lithospermum purpurocaeruleum
Myosotis ramosissima subsp. *ramosissima*
M. cf. *scorpioides*

Campanulaceae
Campanula erinus
C. versicolor
Solenopsis laurentia

Capparaceae
Capparis spinosa

Caprifoliaceae
Lonicera implexa

Caryophyllaceae
Arenaria leptoclados
Cerastium brachypetalum
C. glomeratum
Corrigiola litoralis subsp. *litoralis*
Herniaria hirsuta
Moenchia mantica
Petrorhagia glumacea
P. graminea
P. velutina
P. prolifera
Polycarpon tetraphyllum subsp. *diphyllum*
Silene bellidifolia
S. colorata subsp. *colorata*
S. gallica
S. nicaeensis
S. sedoides
Spergularia bocconii
Velezia rigida

Chenopodiaceae
Arthrocnemum macrostachyum
Atriplex prostrata
A. portulacoides
Chenopodium album
C. opulifolium
Salicornia europaea
S. procumbens
Salsola kali subsp. *kali*
S. soda
Sarcocornia fruticosa
S. perennis
Suaeda maritima

Cistaceae
Cistus creticus
C. salviifolius
Fumana thymifolia
Tuberaria guttata

Compositae
Aetheorhiza bulbosa
Anthemis arvensis
A. cotula
A. tomentosa
Aster squamatus
A. tripolium
Atractylis gummifera
Bellis annua
B. perennis
Calendula arvensis
Carlina corymbosa
Centaurea niederi
C. solstitialis
C. sonchifolia
Chamaemelum mixtum
Chondrilla juncea
Chrysanthemum segetum
Conyza canadensis
Cotula coronopifolia
Crepis foetida
C. neglecta
Dittrichia viscosa
Galactites tomentosa
Hedypnois cretica
Helichrysum stoechas
Hypochoeris achyrophorus
H. glabra

H. radicata
Inula crithmoides
Leontodon hispidus
L. tuberosus
Logfia gallica
Onopordon illyricum
Otanthus maritimus
Pallenis spinosa
Phagnalon graecum
Pulicaria vulgaris
Reichardia picroides
Rhagadiolus stellatus
Scolymus hispanicus
Senecio vulgaris
Silybum marianum
Sonchus asper
Tolpis virgata
Tragopogon crocifolius
Urospermum picroides
Xanthium strumarium

Convolvulaceae
Calystegia sepium subsp. *sepium*
C. soldanella
Convolvulus arvensis
Cressa cretica

Crassulaceae
Sedum litoreum

Cruciferae
Aurinia saxatilis
Biscutella didyma
Bunias erucago
Cakile maritima
Capsella bursa-pastoris
Cardamine hirsuta
Coronopus squamatus
Malcolmia flexuosa
M. nana
Matthiola tricuspidata
Nasturtium officinale
Raphanus raphanistrum
Sisymbrium officinale

Dipsacaceae
Cephalaria sp.
Dipsacus sp.
Knautia integrifolia
Lomelosia brachiata
Pterocephalus plumosus

Ericaceae
Arbutus unedo
Erica arborea
E. manipuliflora

Euphorbiaceae
Euphorbia exiqua
E. paralias
E. peplis
E. peplus
E. terracina

Fagaceae
Quercus coccifera
Q. ithaburensis subsp. *macrolepis*

Gentianaceae
Blackstonia perfoliata
Centaurium erythraea subsp. *erythraea*
C. maritimum
C. spicatum
C. tenuiflorum

Geraniaceae
Erodium cicutarium
Geranium dissectum
G. robertianum subsp. *purpureum*
G. rotundifolium

Guttiferae
Hypericum perfoliatum
H. spruneri

Labiatae
Ajuga iva
Coridothymus capitatus

Lycopus europaeus
Mentha spicata subsp. *condensata*
M. pulegium
Phlomis fruticosa
Prasium majus
Prunella vulgaris
Salvia fruticosa
S. sclarea
S. verbenaca
S. viridis
Satureja graeca
S. juliana
Sideritis purpurea
Teucrium capitatum
T. divaricatum
T. scordium subsp. *scordioides*

Leguminosae
Anthyllis hermanniae
Astragalus hamosus
Calicotome villosa
Coronilla emerus subsp. *emeroides*
Cercis siliquastrum
Dorycnium hirsutum
Glycyrrhiza glabra
Hymenocarpus circinnatus
Lathyrus aphaca
L. clymenum
L. setifolius
Lotus angustissimus
L. corniculatus
L. edulis
Medicago coronata
M. disciformis
M. littoralis
M. marina
M. minima
M. orbicularis
M. polymorpha
Melilotus indica
Ononis reclinata
O. spinosa
O. variegata
Ornithopus compressus
O. pinnatus
Psoralea bituminosa
Scorpiurus muricatus
Spartium junceum
Trifolium angustifolium
T. arvense
T. aureum
T. campestre
T. lappaceum
T. ligusticum
T. nigrescens
T. pratense
T. resupinatum
T. repens
T. scabrum
T. stellatum
T. tomentosum
T. vesiculosum
Vicia cracca
V. lutea
V. villosa

Linaceae
Linum bienne
L. catharticum
L. pubescens
L. strictum subsp. *strictum*
L. trigynum
Radiola linoides

Lythraceae
Lythrum hyssopifolia
L. junceum
L. salicaria

Malvaceae
Alcea rosea
Althaea officinalis
Lavatera bryoniifolia
L. punctata

Myrtaceae
Myrtus communis

Oleaceae
Fraxinus angustifolia subsp. *oxycarpa*
Ligustrum vulgare
Olea europaea var. *sylvestris*
Phillyrea latifolia

Onagraceae
Epilobium hirsutum

Oxalidaceae
Oxalis pes-caprae

Papaveraceae
Papaver apulum

Plantaginaceae
Plantago bellardii
P. coronopus
P. crassifolia
P. lagopus
P. lanceolata
P. major

Plumbaginaceae
Limonium brevipetiolatum
L. virgatum
Plumbago europaea

Polygonaceae
Polygonum cf. *aviculare*
P. cf. *hydropiper*
P. maritimum
P. patulum
Rumex acetosella
R. bucephalophorus
R. conglomeratus
R. crispus
R. pulcher

Portulacaceae
Portulaca oleracea

Primulaceae
Anagallis arvensis
Asterolinon linum-stellatum
Coris monspeliensis
Samolus valerandi

Ranunculaceae
Anemone coronaria
A. pavonina
Clematis vitalba
Delphinium peregrinum
Nigella damascena
Ranunculus ficaria
R. neapolitanus
R. sardous
R. trichophyllus

Rhamnaceae
Paliurus spina-christi
Rhamnus alaternus

Rosaceae
Agrimonia eupatoria
Crataegus monogyna
Prunus spinosa
Pyrus amygdaliformis
Rosa canina
Rubus ulmifolius

Rubiaceae
Crucianella latifolia
Galium intricatum
Rubia peregrina
Sherardia arvensis

Salicaceae
Salix alba

Santalaceae
Thesium humile

Scrophulariaceae
Bellardia trixago
Kickxia commutata
Linaria cf. *pelisseriana*
Misopates orontium

Parentucellia latifolia
P. viscosa
Verbascum blattaria
V. sinuatum
Veronica anagallis-aquatica

Solanaceae
Solanum nigrum

Tamaricaceae
Tamarix hampeana

Ulmaceae
Celtis australis
Ulmus minor

Umbelliferae
Apium inundatum
Ammi majus
Bupleurum glumaceum
Crithmum maritimum
Daucus carota
Echinophora spinosa
Eryngium maritimum
Foeniculum vulgare
Oenanthe fistulosa
O. pimpinelloides
O. silaifolia
O. tenuifolia
Pimpinella tragium subsp. *lithophila*
Pseudorlaya pumila
Smyrnium rotundifolium
Torilis nodosa

Urticaceae
Parietaria cretica
Urtica pilulifera
U. urens

Valerianaceae
Valerianella eriocarpa

Verbenaceae
Lippia nodiflora
Vitex agnus-castus

Vitaceae
Vitis vinifera

Zygophyllaceae
Tribulus terrestris

Monocotyledones

Alismataceae
Alisma lanceolatum
Alisma plantago-aquatica

Amaryllidaceae
Pancratium maritimum

Araceae
Arisarum vulgare
Arum sp.

Cyperaceae
Carex distachya
C. distans
C. divisa
C. extensa
C. flacca
C. vulpina
Cyperus capitatus
C. longus
Eleocharis palustris
Schoenus nigricans
Scirpus cernuus
S. holoschoenus
S. litoralis
S. maritimus
S. setaceus

Gramineae
Aegilops neglecta
Aeluropus littoralis
Aira elegantissima
Alopecurus creticus

A. utriculatus
Ammophila arenaria
Andropogon distachyos
Anthoxanthum odoratum
A. ovatum
Arundo donax
Avena barbata
A. sativa
A. sterilis
Beckmannia eruciformis
Brachypodium distachyon
B. retusum
B. sylvaticum
Briza maxima
B. minor
Bromus diandrus
B. fasciculatus
B. hordeaceus
B. intermedius
B. madritensis
B. rigidus
B. sterilis
Chrysopogon gryllus
Crypsis aculeata
C. schoenoides
Cutandia maritima
Cynodon dactylon
Cynosurus echinatus
Dactylis glomerata
Dasypyrum villosum
Desmazeria marina
D. rigida
Elymus elongatus
E. farctus
E. pycnanthus
Gaudinia fragilis
Holcus lanatus
Hordeum bulbosum
H. hystrix
H. murinum
Hyparrhenia hirta
Imperata cylindrica
Lagurus ovatus
Lamarckia aurea
Lolium multiflorum
Lolium rigidum
Lophochloa cristata
Panicum repens
Parapholis filiformis
P. incurva
Paspalum paspalodes
Phalaris minor
Phleum subulatum
Phragmites australis
Piptatherum coerulescens
P. miliaceum
Poa annua
Polypogon maritimus
P. monspeliensis
Puccinellia festuciformis
Saccharum ravennae
Sporobolus pungens
Stipa bromoides
S. capensis
Vulpia myuros

Iridaceae
Gladiolus illyricus
Iris pseudacorus
I. spuria
Romulea bulbocodium
R. linaresii

Juncaceae
Juncus acutus
J. articulatus
J. bufonius
J. fontanesii
J. heldreichianus
J. hybridus
J. maritimus

Juncaginaceae
Triglochin bulbosa

Lemnaceae
Lemna minor

Liliaceae
Allium chamaemoly
A. guttatum
Asparagus acutifolius
Asphodeline lutea
Asphodelus aestivus
Colchicum parlatoris
Ornithogalum collinum
Ruscus aculeatus
Scilla autumnalis
Smilax aspera
Urginea maritima

Orchidaceae
Orchis coriophora
O. laxiflora
Serapias lingua
S. vomeracea subsp. *laxiflora*
S. vomeracea subsp. *orientalis*

Ruppiaceae
Ruppia maritima

Typhaceae
Typha angustifolia

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