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On the vegetation of Patras Area

by

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Introduction

The present paper is the outcome of my studies on the vegetation of Patras, southwest of Greece, during the last few years. Efforts have been centred to present in these few pages, so far as possible, a general picture of the more important communities developed on this area.

For the purposes of this survey the investigated area has been subdivided into separate geographical regions, latitudinally into Northern, Western, Southern, and Eastern. Most of the work has been centred on the coastal plant communities of ammophilous vegetation of the North and West, the xeromorphous low shrubby vegetation of the South, known as Phrygana, and the evergreen sclerophyll *Macchia* vegetation that extends along the coastal zone from Patras to Corinth.

The system of studying the vegetation follows that used by BRAUN-BLANQUET (1951) in constructing tables for the sociability, abundance, cover and frequency of individuals of the species of vascular plants (see attached tables). Symbols are here used to show sociological behaviour of species. The same table is often used for two or more different places. Where the vegetation is divided into layers of different heights, the average height of the tallest components has been given.

Vegetation

The principal feature of the Patras region is the enormous area covered by olive groves, orange-trees, and vineyards, and the relatively small proportion occupied by natural vegetation. Three types of vegetation can be distin-

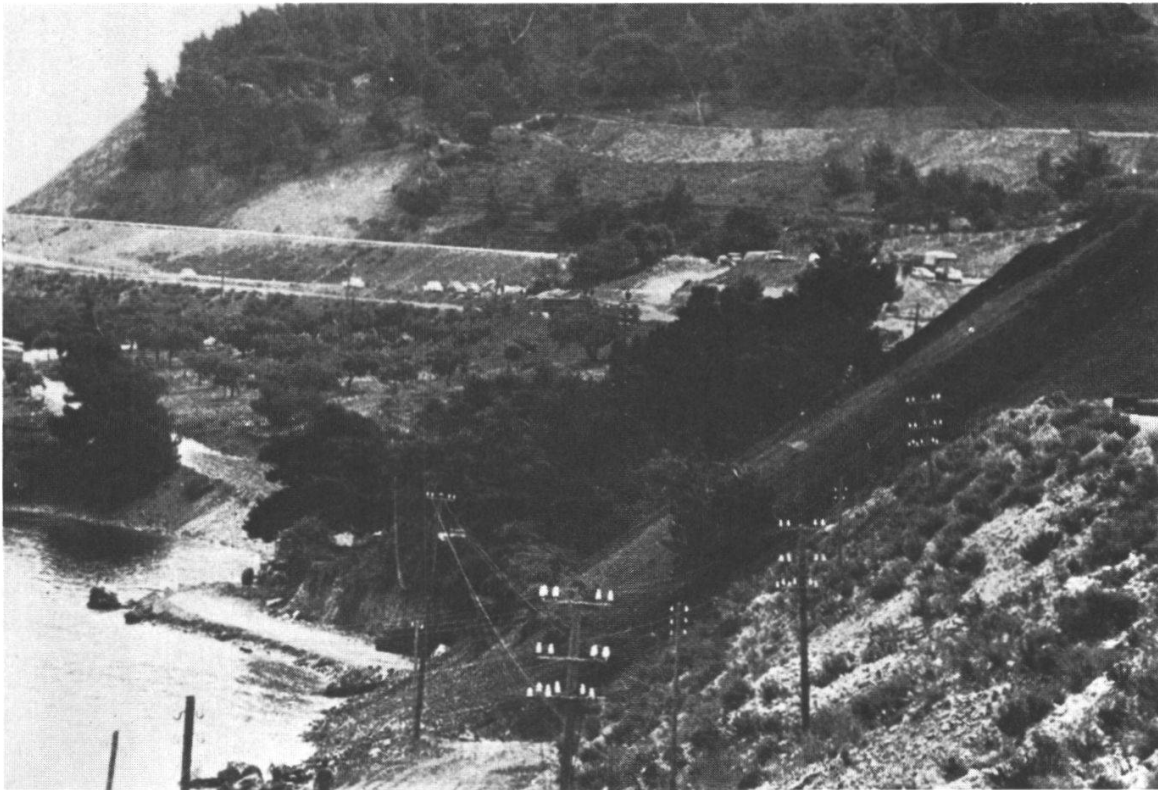


Fig. 1. Aspect of the Phrygana and Macchia vegetation at Psathopyrgos. The Phrygana vegetation in the frontside is dominated by the low shrubs *Coridothymus capitatus* and *Pistacia lentiscus*, while the Macchia vegetation at the extremely backtopside by the evergreen sclerophyll trees, *Quercus coccifera* var. *calliprinos*, *Phillyrea media* and *Pistacia lentiscus*. The soil erosion at the middle is due particularly to the lack of vegetation.

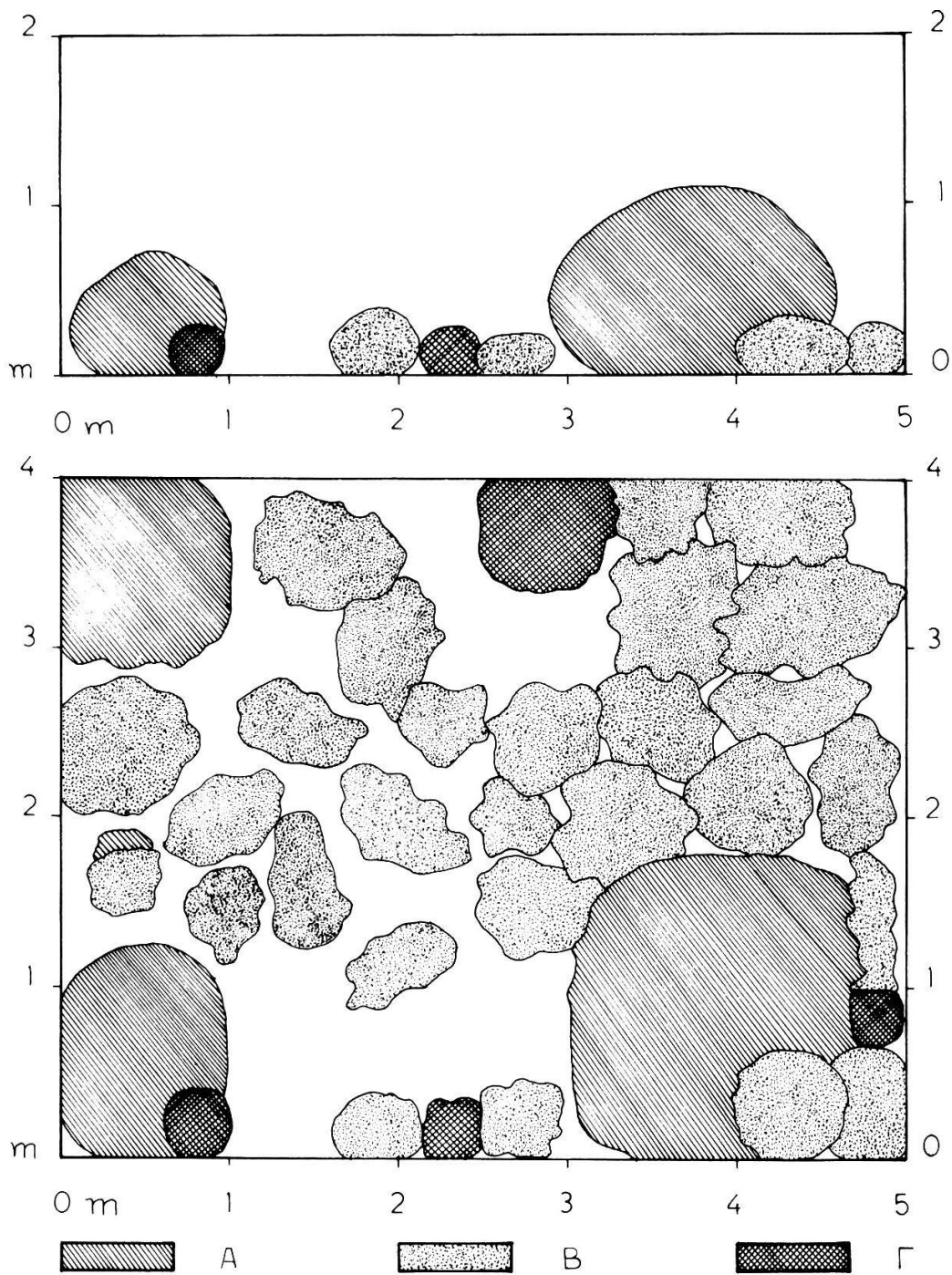


Fig. 2. Phrygana vegetation at Riganocampos, southwest of Patras.
 above: section of one of the unit areas
 below: view from above (same area as above)
 A *Genista acanthoclada* var. *graeca*
 B *Poterium spinosum*
 C *Coridothymus capitatus*

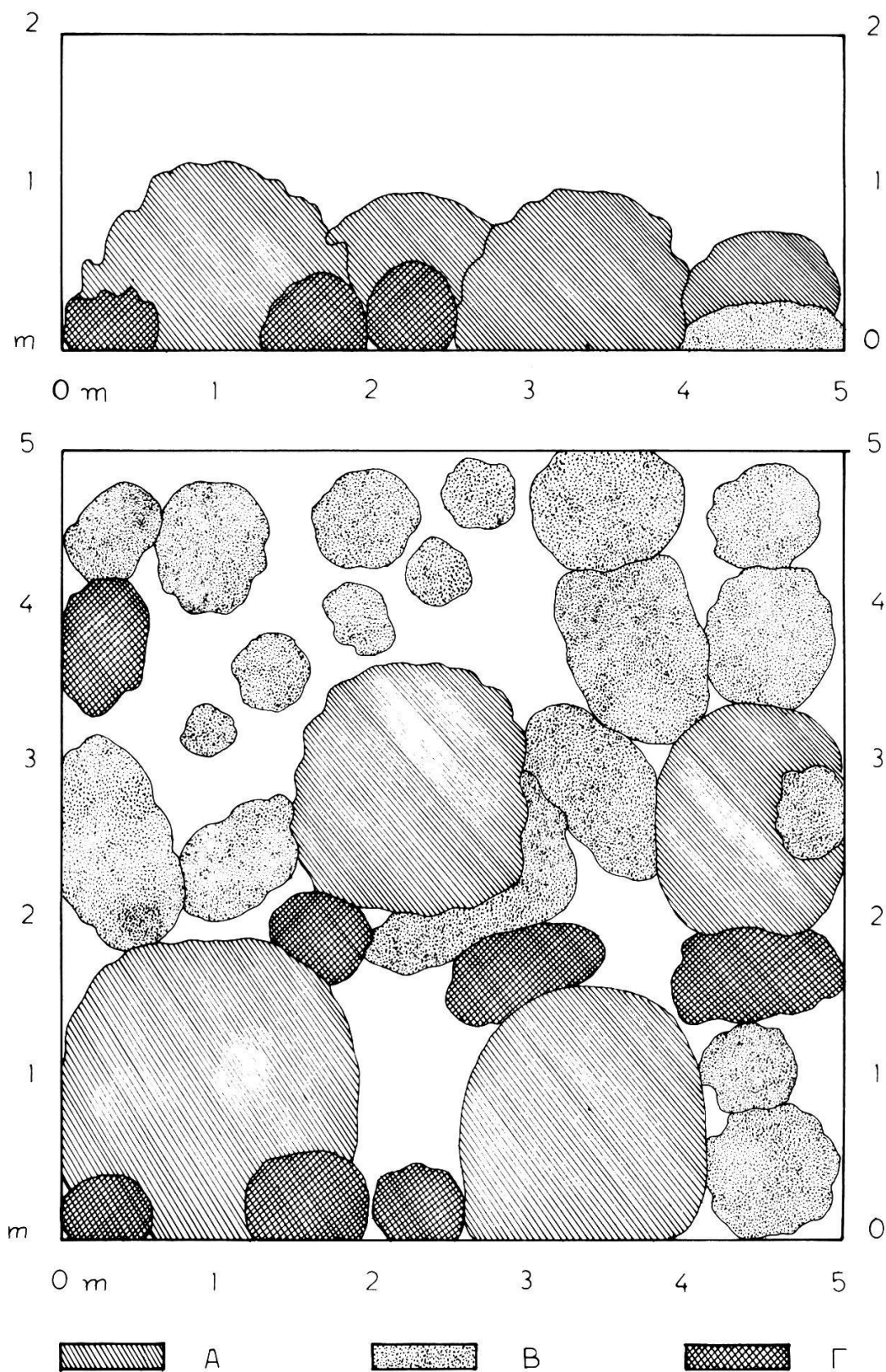


Fig. 3. Phrygana vegetation at Riganocampos, southwest of Patras.
 above: section of another unit area
 below: view from above (same area as above)
 A *Genista acanthoclada* var. *graeca*
 B *Poterium spinosum*
 C *Coridothymus capitatus*

guished: a) the ammophilous vegetation of the sea-coasts, b) the xeromorphous vegetation of low shrubs, known as "Phrygana", and c) the evergreen sclerophyll shrubby vegetation of "Macchia".

According to BRAUN-BLANQUET's system of classification, the ammophilous vegetation may be classified under the classes *Cakiletea maritima* Tx. et Prsg. 1950 and *Ammophiletea* Br.-Bl. et Tx. 1933, the Phrygana vegetation under the class *Thero-Brachypodietea* Br.-Bl. 1947, and the Macchia vegetation under the class *Quercetea ilicis* Br.-Bl. 1947 (BRAUN-BLANQUET 1933, BRAUN-BLANQUET et al. 1951, TÜXEN 1950).

In the following text each of the mentioned type of vegetation will be discussed:

a. Coastal ammophilous vegetation

Most of the north coastal Patras area consists of bare sand-flats with large quantities of pebbles and cobbles. However there are some places along them with considerable changes in the composition of soil particles and the amount of decaying leaves and other plant materials. These places are covered by individuals of *Salsola kali*, *Euphorbia peplis*, or by plant groups of *Cakiletea* class, which, as they become higher and more sandy are colonized by the rhizomatous geophyte *Agropyrum junceum* ssp. *mediterraneum**; and the chamaephyte *Polygonum maritimum*. Such changes in the vegetation result in an enormous effect upon the sand dune formation. It has been found that, as a result of the environmental modification, changes have also taken place in the vegetation. Under such conditions the flat sandy shores with *Cakiletea* plant groups develop on low sandy dunes with plant groups of *Agropyretum mediterraneum* association, at or near coastal areas exposed to sea winds, as are those of west and southwest shores of the investigated area.

The advent of the rhizomatous geophyte *Agropyrum junceum* ssp. *mediterraneum* on the low dunes promotes further growth in height of the dunes which, as this rising takes place, results in changes in the environment so that

* *Agropyrum junceum* exists in two ecosubspecies, ssp. *mediterraneum* and ssp. *boreoatlanticum* (SIMONET and GUINOCHE 1938), which differ in physiognomy and also in their ecological requirements, the former being characteristic of less fine sandy soils than the later. Further, ssp. *mediterraneum* is widespread throughout the Mediterranean, whilst ssp. *boreo-atlanticum* is restricted to the north-west and to some extent to the west coasts of Europe.

different other ammophilous species, e. g. the rhizomatous geophytes *Sporobolus pungens*, *Galilea mucronata*, and *Ammophila arenaria*, as well as the bulb geophyte *Panocratium maritimum*, can enter the area.

Coastal sand belts, therefore, may extend vertically from about sea level with *Cakiletea* plant groups (Table I) up to the extreme upper limit of the higher dunes with plant groups of the *Ammophiletum arundinaceae* association (Table III), where they will abut on normal land vegetation or cultivations.

In conclusion it may be noted that the north coast beaches possess the poorest ammophilous vegetation, whilst the west coast beaches, with their high sand dunes, have the richest.

The main coastal area at the north is dominated by *Salsola kali*, *Matthiola tricuspidata*, *Euphorbia peplis*, *Polygonum maritimum*, and *Eryngium maritimum*, accompanied by *Cakile maritima*, *Atriplex hastata*, *Cynodon dactylon*, *Beta maritima* at sand-flat beaches, and by *Agropyrum junceum* ssp. *mediterraneum*, *Euphorbia paralias*, and *Anthemis tomentosa* ssp. *eu-tomentosa* at low level dunes. All the above mentioned species constitute the dominant pioneer community *Salsola kali* - *Matthiola tricuspidata*, that occurs on the beach, between Patras and Corinth (Table I). The soil throughout this area consists, particularly, of coarse sand and gravel.

The main coastal area at the west and southwest is dominated by plant groups of *Agropyretum mediterraneum* or *Ammophiletum arundinaceae* association (Tables II and III). There are some interesting high level sand dunes at Kalogrea beach and Kounoupelaki beach (Table III, nos 1 - 8 and 15 - 19), though the main interest of this area is provided by the Kaiafa and Zacharo coast (Table II, nos 13 - 17 and 18 - 22, and LAVRENTIADES 1964). Most of the area at Kalogrea and Kounoupelaki beach is covered by high level dunes, where the dominant species is the rhizomatous geophyte *Ammophila arenaria* (Table III). The soil throughout is very sandy, and it is rare to find even one gravel.

b. Phrygana vegetation

This is one of the most widespread type of vegetation in Greece, occurring with much the same range of variation in nearly all the islands and coasts of Greece, where it represent valuable potential vegetation (RECHINGER u. RECHIN-

GER-MOSER 1951, KNAPP 1965, ECONOMIDOU 1969, LAVRENTIADES 1969).

It is confined to strongly arid areas and so occurs most frequently on the low level hill groups around Patras and between Patras and Corinth (Fig. 1).

Numerous examples of this type of vegetation development in Patras region or along the coasts between Patras and Athens could be quoted. But one of the best representation of this type of vegetation occurs southward of Patras, at the foot of the mountain Panachaikon.

There exist a vast area, locally called "Riganocampos", which at present is dominated by the low xeromorphous shrubs, *Poterium spinosum*, *Coridothymus capitatus*, and *Genista acanthoclados* (Table IV). The more or less calcareous parent rock (limestone) is overlain by neogenic to quaternary formations, consisting of conglomeratic sandy marls and pelits. Such soils are extremely arid for other plants, except the xeromorphous plants, to grow in them. The vegetation here is homogeneous and covers the 70 - 80 per cent and more rarely the 90 per cent of the total area (Table IV, and Fig. 2 and 3). Its aspect is given by *Poterium spinosum* or *Poterium spinosum-Coridothymus capitatus-Genista acanthoclados* or *Poterium spinosum-Coridothymus capitatus*. In some areas too, aspect may be given by *Phlomis fruticosa* (Table IV, nos 7 - 12). The height of *Poterium spinosum*, *Coridothymus capitatus*, and *Genista acanthoclados* ranges between 0.30 - 0.35 m, 0.30 - 0.35 m, and 0.75 - 0.85 m, respectively, although in *Coridothymus capitatus* and *Genista acanthoclados* may reach 0.60 and 1.00 m, respectively (Fig. 2.). The list of species found is an indication of the occurrence at this area of the association *Poterium spinosum-Coridothymus capitatus*, which is common at the lower levels wherever the rocks have a high calcium content. It seems likely that this association has a phytogeographical relationship to similar associations found in some islands of Greece (KNAPP 1965, LAVRENTIADES 1969).

A similar development of limestone vegetation in areas of low-level alluvial deposits occurs frequently in the eastern lowlands, near Vernadeika. This area is located 30 - 50 m above sea level and of a distance of one to two Kilometers from the sea. The vegetation here covers 90 - 100 per cent of the total area of quadrats (Table V, nos 16 - 25). The principal feature of this vegetation is the densely crowded prevailing shrubs, *Pistacia lentiscus*, *Calycotome villosa*, *Smilax aspera*, *Quercus coccifera* var. *calliprinos*, and *Myrtus communis*, which grow 1.5 - 2.0 m tall and straight and usually lose their lower branches as a

result of insufficient light. They formed dense patches by the mentioned species include inside few spontaneously growing common species of the local vascular plants, especially those occurring chiefly or only on calcareous rocks with some quantities of black humus. The most important species among these are *Brachypodium pinnatum* and *Teucrium flavum*, which appear to have a specific need for high calcium status and humus. These plant groups are surrounded by a mantle, which is formed by the low shrubs, *Cistus incanus*, *Anthyllis vulneraria*, *Coridothymus capitatus*, *Teucrium flavum*, *Dorycnium hirsutum*, *Cuscuta globularis* (on *Coridothymus* plants), and others. The height of this mantle ranges between 0.30 - 0.50 m. In some ravines too may also occur the hygrophilous species, *Erianthus ravennae*, *Arundo donax* and *Carex glauca*.

In the north-east, *Coridothymus capitatus*-*Anthyllis hermanniae* communities are often well represented (Fig. 1), and may pass into mixtures of Phrygana and Macchia vegetation on wet and deep ground. A list from such vegetations is given on Table V (nos 16 - 34). These Phrygana and Macchia complexes illustrate the close relationships which can exist between vegetation types normally found separately, and emphasise the lack of clear distinction between these classical sub-divisions of calcareous-forming vegetation. The aspect here is given by *Pistacia lentiscus*, a shrub of about 1.5 to 2.0 m and even more 2.50 m in height. In some areas too the aspect may be also given by *Pistacia lentiscus*-*Myrtus communis*-*Calycotome villosa* or *Calycotome villosa*-*Myrtus communis*-*Coridothymus capitatus*, and more rarely by *Pistacia lentiscus*-*Calycotome villosa*. The height of mentioned plants which grow on this area ranges around the following values:

<i>Coridothymus capitatus</i>	0.30 - 0.40 m
<i>Cistus incanus</i>	0.70 - 0.75 m
<i>Anthyllis vulneraria</i>	0.60 - 0.70 m
<i>Pistacia lentiscus</i>	1.50 - 2.00 m (up to 2.50 m)
<i>Myrtus communis</i>	0.65 - 1.50 m.

c. Macchia vegetation

Extensive areas of Macchia vegetation occur in the slippery slopes of series of hills which run along the north coasts of Peloponnesos, between Patras and Corinth, and these must be regarded as the typical representa-

tives of this vegetation.

In some places quite large areas may be covered by a growth of *Quercus cocci-fera* var. *calliprinos*, *Phillyrea media*, *Pistacia lentiscus*, *Smilax aspera*, *Rubia peregrina*, and *Ruscus aculeatus*, e. g. by Psathopyrgos and Achaia Clauss, but generally the areas are very small in comparison with those of southwest Peloponnesos.

Data from 34 list quadrats on exposed north and northwest and sheltered north and north-west slopes in the hills of eastern areas of Patras, and between Patras and Aegion (Table V), revealed the fact that the dominant species with the highest frequency in the Macchia vegetation are *Pistacia lentiscus*, *Quercus cocci-fera* var. *calliprinos*, *Phillyrea media*, *Smilax aspera*, *Rubia peregrina*, and *Ruscus aculeatus*. Although the dominant vegetation of Macchia belt is provided by the above mentioned evergreen sclerophyll species, herbs may play a considerable part in the general physiognomy.

This is particularly true of the Macchia vegetation, which extends on the coastal slippery slopes of hills at Psathopyrgos, where there is an extensive development of certain herbs growing exclusively in such habitats. The dominant species here *Pistacia lentiscus*, *Quercus cocci-fera* var. *calliprinos*, *Phillyrea media*, *Smilax aspera*, *Rubia peregrina*, *Ruscus aculeatus*, *Arbutus andrachne*, *Coronilla emerus*, *Colutea arborescens*, and others, form a uniform vegetation, followed by the herbs *Brachypodium ramosum*, *Teucrium chamaedrys*, *Asplenium adiantum nigrum* ssp. *onopteris*, *Selaginella denticulata*, *Hypericum empetrifolium* and others. An *Arbutus andrachne* association with rich representation of *Hypericum empetrifolium*, *Selaginella denticulata*, *Brachypodium ramosum*, *Teucrium chamaedrys*, *Asplenium adiantum nigrum* ssp. *onopteris* appears to be equivalent to the general Macchia association occurring elsewhere (Table V, nos 1 - 15). The altitudinal range of 150 m to 200 m, excluding list 16 - 34, makes this a submontane association. Soils are mesotrophic. These consist of slide rocks and deposits of variable humus content. The underlying original parent stone is limestone.

In most places there is a considerable accretion though some erosion also occurs. The occurrence of soil erosion near Psathopyrgos is due not only to soil texture but also to the lack of vegetation (Fig. 1). The underlying motherstone is fairly deep calcareous and also resembles that of most lowland slopes. Apart from the high degree of soil calcium carbonate content, the other important characteristic common to this Macchia vegetation soil is the

abundance of humus derived particularly of decaying leaves. It is usually 0.10 to 0.20 m deep. In some places too there is a considerable amount of stones 0.10 to 0.15 m in diameter, which may cover 25 per cent of the total area. Humus affects the water content and the pH value of soil. It increases the water capacity and decreases the pH value. It has, therefore, secondary effects upon the composition and the cover of vegetation.

The richness of the vegetation depends to a large extent upon the origin and depth of the humus. In places where there is abundant humus, there is extreme vegetative development giving rise to *Bryophytes* and to the plants *Selaginella denticulata*, *Polypodium vulgare*, *Ceterach officinarum* that appear especially around the roots of evergreen sclerophyll trees. To what extent the vegetation is dependent upon the humus is difficult to say. A study of this relationship should be of considerable interest.

Apart from the effect of soil moisture and the humus upon the vegetation development and vegetation cover, there may be the influence of light. Light intensity effects upon the germination of seeds of many sunloving plants. It is evident that many herb plants are absent from the shady ground because they cannot withstand the intensity of competition from tall shrubs and trees. It has been found that the sunloving plants *Cercis siliquastrum*, *Calycotome villosa*, *Olea europea* var. *oleaster*, *Cistus incanus* are very rare or absent from the shady grounds, while they are abundant at the sunny areas. On the other hand the herb vegetation is much richer at sunny areas than in shadow ones.

In the Macchia vegetation of the slopes that are located by the coastal village Psathopyrgos three principal layers can be easily recognized that may be further subdivided: a) The herb layer, b) the shrub layer, and c) the tree layer. The herb layer is dominated by the species *Hypericum empetrifolium*, *Teucrium chamaedrys* and *Brachypodium ramosum*, the shrub layer by *Quercus cocci-fera* var. *calliprinos*, *Phillyrea media*, *Coronilla emerus*, *Pistacia lentiscus*, *Hypericum empetrifolium* and *Ruscus aculeatus*, and the tree layer, that extends to 3 - 3.5 m in height, by the evergreen sclerophyll trees *Quercus cocci-fera* var. *calliprinos*, *Phillyrea media*, *Pistacia lentiscus*, *Coronilla emerus*, *Arbutus andrachne*, *Pistacia terebinthus*, *Colutea arborescens*, and others. The average height of the prevailing species found in each layer is given below:

Macchia vegetation at Psathopyrgos, near Patras

List of dominant species	L a y e r s		
	Tree layer in meters	Shrub layer in meters	Herb layer in meters
<i>Arbutus andrachne</i>	3.0 - 4.0	.	. .
<i>Pistacia terebinthus</i>	2.5 - 3.5	.	. .
<i>Colutea arborescens</i>	2.5 - 3.0	.	. .
<i>Quercus calliprinos</i>	3.0 - 3.2	0.5 - 1.0	. .
<i>Phillyrea media</i>	3.0 - 3.5	. 1.0	. .
<i>Coronilla emerus</i>	2.0 - 3.0	. 1.0	. .
<i>Pistacia lentiscus</i>	2.5 - 3.0	. 1.0	. .
<i>Quercus ilex</i>	3.0 - 3.5	0.8 - 1.0	. .
<i>Osyris alba</i>	. .	. - 1.0	. .
<i>Micromeria juliana</i>	. .	0.4 - 0.5	. .
<i>Ruscus aculeatus</i>	. .	. 0.5	. .
<i>Hypericum empetrifolium</i>	. .	0.4 - 0.5	. .
<i>Teucrium chamaedrys</i>	. .	. .	0.30 - 0.40
<i>Brachypodium ramosum</i>	. .	. .	0.35 - 0.40
<i>Asplenium onopteris</i>	. .	. .	0.30 - 0.35
<i>Cyclamen neapolitanum</i>	. .	. .	0.20 - 0.25
<i>Scilla maritima</i>	. .	. .	0.15 - 0.20
<i>Ceterach officinarum</i>	. .	. .	0.15 - 0.20

Lianas are very few at this vegetation. The more important among these are *Smilax aspera*, which is frequently found under its varietas *mauritanica*, and it can grow to 1 - 2 m in height, the rarely found *Lonicera implexa*, and the highly growing *Rubia peregrina*, which in some cases may be extend to 2 - 3 m in height, and the most rarely found climber *Calystegia sepium*, which occurs particularly around the edges of the vegetation. The occurrence of bulbous plants, *Scilla maritima*, *Cyclamen neapolitanum* and *Allium subhirsutum* is probably due to the large amount of humus that in many places forms 10 - 20 cm thick layer. It derives particularly from decaying leaves of *Arbutus unedo*, *Quercus coccifera* var. *calliprinos* and *Phillyrea media*.

As shown in Table V, vegetation cover varies between 75 per cent and 85 per cent. It seems likely that *Pistacia lentiscus*, *Rubia peregrina*, *Ruscus aculeatus*, *Smilax aspera*, *Phillyrea media*, *Teucrium chamaedrys*, *Brachypodium ramosum*, *Selaginella denticulata* and *Hypericum empetrifolium* are the most frequently found species, and *Arbutus andrachne* is more frequent than *Arbutus unedo*.

Next in order of abundance are the species *Cistus incanus*, *Asplenium adiantum nigrum* ssp. *onopteris*, *Pistacia terebinthus*, *Coronilla emerus*, *Scilla maritima* and *Colutea arborescens*. A study of the thickness of the trunk in the different species has revealed the fact that, in *Arbutus andrachne* it ranges between 5 - 7 cm in diameter, although in some cases may be waving around 15 - 20 cm in diameter, and in *Quercus calliprinos* between 4 - 5 cm in diameter, and more rarely between 6 - 7 cm.

Summarizing, it may be concluded that Macchia vegetation in Patras area, and generally of the north coast of Peloponnesos, can be considered as rich in shadeloving plants and poor in sunloving plants. That is probably due not only to soil conditions but also to the exposure, inclination, and climatic conditions. To what extent all these ecological factors affect the vegetation is difficult to say. A study of this problem should be of considerable interest.

Résumé

Dans le présent travail sont examinées les plus importantes associations des plantes qui se rencontrent sur la région du Patras.

Sur les plages sablonneuses et caillouteuses du Nord se rencontrent associations ammophiles de la classe *Cakiletea maritimae*. Cette classe est représentée dans cette région par l'association *Salsola kali-Matthiola tricuspidata* (ass. nov., Tableau I). Sur les dunes littorales des côtes d'ouest du Patras se rencontrent groupements des plantes de l'association *Agropyretum mediterraneum* et de l'association *Ammophiletum arundinaceae*. L'association *Agropyretum mediterraneum* apparaît principalement sur les dunes d'une hauteur de 1 à 1.5 m (Tableau II), tandis que l'association *Ammophiletum arundinaceae* sur les dunes dont la hauteur dépasse les 1,5 mètres (Tableau III).

Sur sol calcaire meuble et profond, en particulier dans des terrains pierreux arides, en bordure des champs, sur le flanc des collines, dans le fond des ravins où la terre fine s'accumule entraînée par le ruissellement, se rencontrent de nombreux groupements xériques des phrygana. Ce type de la végétation est représentée par l'association *Poterium spinosum-Coridothymus capitatus* (Tableau IV) et par l'association *Coridothymus capitatus, Anthyllis hermanniae* (ass. nov., Tableau V).

Les groupements qui comprennent de nombreuses espèces ligneuses à feuilles toujours vertes, qui constituent la végétation ligneuse plus ou moins xérique des *Quercetea ilicis*, sont très bien développés le long du cordon des collines littorales qui intermédiaires entre de la région du Patras et de la région du Corinth. Ce type de la végétation est caractérisé particulièrement par l'abondance des espèces dominantes: *Pistacia lentiscus*, *Phillyrea media*, *Quercus coccifera* var. *calliprinos*, *Smilax aspera*, *Rubia peregrina* et *Ruscus aculeatus* (Tableau V).

Zusammenfassung

Die vorliegende Abhandlung befasst sich mit der Untersuchung der Pflanzengesellschaften der Litoralzonen und der Phrygana- und Macchienvegetationsstufe der Umgebung von Patras in Griechenland. Es werden sowohl die Unterschiede in der floristisch-soziologischen Struktur erfasst, als auch die unterschiedlichen Standortsfaktoren untersucht.

Die untersuchten Vegetationen liessen sich in vier physiognomische Vegetationstypen einteilen, welche in den Tabellen I-V angeführt werden.

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Table I.-Class Cakiletea maritimae Tx. et Prsg. 1950
(Alliance Euphorbion reptis Tx. 1950).

Number of stand examined		Ass. Salsola kali-Matthiola tricuspidata (ass. nov.).																				e o c o s e n s i t a
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Size of stand, square meters		4	4	4	8	6	12	6	4	24	24	9	9	4	6	6	3	10	8	12	24	III V II II II I
Altitude of sand dune, meters		0,5	0,5	0,5	0,5	0,5	0,7	0,7	0,7	0,5	1	0,5	0,5	0,5	0,5	0,5	1	1,2	1,2	1,1	1,1	
Distance from sea, meters		5	5	5	5	5	15	15	15	12	10	10	10	10	10	10	10	10	8	7	12	
Orientation of stand		NE	NE	NE	NE	NE	NW	NW	NE	—	—	NW	NW	NW	NW	NW	N	N	N	N	N	
Inclination of stand		16	12	12	12	12	11	12	11	0	0	2	2	2	1	1	1	2	2	2	28	
Cover of vegetation %		20	25	20	30	25	20	25	30	25	30	30	25	30	35	30	35	60	30	20	35	
Number of species		6	7	9	5	7	10	10	11	8	8	6	7	6	9	6	6	6	10	6	7	
<u>Characteristic species of the Association:</u>																						
H ²	Matthiola tricuspidata R. Br.	+2	+	1.2	1.1	1.2	+	.	.	+	2.2	+2	.	+2	2.2	+2	+2	.	.	.	.	III
T	Salsola kali L.	+	+	+	2.2	.	1.2	1.2	.	+2	1.1	2.2	2.2	1.1	1.1	1.1	2.2	+	2.2	2.2	+	V
T	Anthemis tomentosa L. ¹	+2	+2	1.1	.	+2	.	.	.	+	2.2	.	.	.	.	.	+2	.	+2	.	.	II
T	Beta maritima L.	+	+	+2	+2	1.2	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	II
Gr	Cynodon dactylon Pers.	.	2.2	1.2	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	II
T	Atriplex hastata L.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	+2	.	I
<u>Characteristic species of the Alliance:</u>																						
T	Euphorbia peplis L.	.	.	.	.	.	+2	+	+	.	.	1.1	1.1	1.1	1.1	1.1	1.1	.	+2	+2	+	III
Ch h	Polygonum maritimum L.	+2	+	.	1.1	.	.	.	+2	1.2	+	.	+	.	+2	.	.	.	1.2	1.2	1.2	III
<u>Differential species of the Alliance:</u>																						
T	Glaucium flavum Cr.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	I
<u>Characteristic species of the Class:</u>																						
T	Salsola kali L.	+	+	+	2.2	.	1.2	1.2	.	+2	1.1	2.2	2.2	1.1	1.1	1.1	2.2	+	2.2	2.2	+	V
T	Cakile maritima Scop.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	+2	.	I
<u>Companion species of the Ammophiletea Class:</u>																						
Gr	Agropyrum junceum Beauv. ²	.	.	.	.	.	.	.	.	2.2	.	.	.	.	.	.	.	3.3	+	+	2.2	II
H	Eryngium maritimum L.	.	.	.	.	+2	+	.	+	1.1	1.2	+2	.	+2	+2 (pl)	.	+	+	.	+2	.	III
H	Euphorbia paralias L.	.	.	.	.	.	.	.	.	.	.	.	.	(+)	.	.	.	.	+	+	.	I
Ch h	Medicago marina L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	I
Gr	Sporobolus pungens Kunth.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	.	.	.	I
<u>Indifferent companion species:</u>																						
T	Pholiurus incurvatus Hitchc.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	I
H	Inula viscosa L.	.	.	.	.	.	.	+2	+	.	.	.	.	.	.	.	+	.	.	.	.	I
T	Xanthium strumarium L.	.	.	+	.	.	.	.	.	.	.	.	.	.	(+)	.	.	.	.	.	(pl)	I
Gr	Agropyrum sp.	.	.	.	.	.	+	+	1.1	.	.	.	.	.	.	.	.	.	.	.	.	I
H(Ch)	Holcus lanatus L.	.	.	.	.	.	+	+	+2	.	.	.	.	.	.	.	.	.	.	.	.	I
H ²	Chondrilla juncea L.	.	.	.	.	.	+	+2	.	.	.	.	.	.	.	.	.	.	.	.	.	I
T	Polygonum aviculare L.	.	.	.	.	.	.	+	+2	.	.	.	.	.	.	.	.	.	.	.	.	I
T Ch h	Medicago litoralis Rohde.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
T	Lagurus ovatus L.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
H ²	Echium italicum L.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
T	Polycarpon tetraphyllum L. ³	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
T	Phleum arenarium L.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Ch h	Crithmum maritimum L.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Gr	Agropyrum littorale Dum.	.	.	.	.	.	.	+2	.	.	.	.	.	.	.	.	.	.	.	.	.	I

1. ssp. tomentosa Hayek.
2. ssp. mediterraneum.
3. var. alsinefolium Hayek.

Table II. -Association *Agropyretum mediterraneum* Br.-Bl. 1933 .

Number of stand examined		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	e c o s t e r i c
Size of stand, square meters		32	24	48	48	80	60	80	60	36	60	50	50	12	12	12	18	18	48	48	48	48	48	
Altitude of sand dune, meters		1	1	0,5	0,7	0,7	0,7	1	0,5	0,8	0,8	1	1	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,2	1,2	1,3	
Distance from sea, meters		15	15	10	15	15	15	15	16	15	15	20	25	20	20	20	20	20	30	30	30	30	15	
Orientation of stand		N	E	0	0	E	SW	SW	E	0	0	0	0	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	
Inclination of stand		19	11	0	0	10	8	8	8	0	0	0	0	24	25	20	15	12	14	10	8	15	15	
Cover of vegetation %		30	40	20	40	20	20	40	30	40	20	45	40	50	40	40	45	35	30	30	30	50	40	
Number of species		12	16	9	9	7	6	11	6	10	8	8	9	8	9	9	10	10	7	7	6	6	7	

Characteristic species of the Association :																								
Gr	<i>Agropyrum junceum</i> Beauv. ¹	1.1	+	1.2	2.2	+	+	1.2	.	2.2	+2	+2	1.2	+2	+2	+2	+2	1.2	+2	+2	.	+2	1.2	V
Gr	<i>Galilea mucronata</i> Parl.	.	.	.	.	.	.	.	.	.	.	.	.	1.2	+2	1.2	+2	1.2	.	.	.	.	.	II
Gr	<i>Sporobolus pungens</i> Kunth.	+2	+	2.2	3.3	2.2	1.2	1.2	2.2	2.2	+2	3.3	2.2	.	+2	.	.	.	+2	1.1	1.2	+2	.	IV
Ch h	<i>Diotis maritima</i> Sm.	1.2	2.2	.	.	.	.	.	.	.	.	.	.	4.4	3.3	3.2	3.2	3.3	.	.	.	.	.	II
H	<i>Echinophora spinosa</i> L.	.	.	+2	+	+2	.	+2	+2	+2	+	.	.	.	+	+2	+	+2	.	.	.	.	.	III
Ch h	<i>Convolvulus soldanella</i> L.	.	.	.	.	+2	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I

Characteristic species of the Alliance :																								
Ch h	<i>Medicago marina</i> L.	.	.	+2	+2	+2	.	+2	+2	+2	.	.	.	2.2	1.2	+2	+2	1.2	+2	.	.	.	.	III
Gb	<i>Pancreatum maritimum</i> L.	.	.	.	+	.	.	.	.	.	.	.	.	2.2	1.2	+2	+2	1.2	.	.	.	.	.	II

Characteristic species of the Class :																								
H	<i>Euphorbia paralias</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	+2	+	+	+2	1.2	2.2	2.2	2.2	2.2	III
H	<i>Eryngium maritimum</i> L.	.	.	+	1.2	1.2	2.2	2.2	+2	2.2	+	+2	+2	+	.	.	.	+2	1.1	1.1	+2	1.1	+2	IV

Companion species of the Cakiletea maritimae Class :																								
T	<i>Xanthium strumarium</i> L.	.	.	+2	+2	+	.	+2	+	2.2	+2	+2	1.2	.	.	.	.	.	.	.	.	.	.	III
T	<i>Euphorbia peplis</i> L.	(+)	.	(+2)	.	.	.	+2	+2	.	.	+2	+2	.	.	.	.	.	.	.	.	.	.	II
T	<i>Cakile maritima</i> Scop.	.	.	1.2	.	.	.	+2	.	(+)	1.2	+	.	.	.	.	.	.	.	.	.	.	.	II
T	<i>Anthemis tomentosa</i> L. ²	.	.	.	.	.	.	+2	.	.	.	.	.	+2	.	.	.	.	.	.	.	.	.	I
T	<i>Salsola kali</i> L.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	I
Ch h	<i>Polygonum maritimum</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	I

Companion species of the high level dunes :																								
T	<i>Daucus pumillus</i> Ball.	1.2	1.2	.	.	.	.	.	.	.	.	.	.	.	+2	1.2	1.2	1.2	1.2	.	+2	.	.	II
Gr	<i>Ammophila arenaria</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+2	.	.	2.2	1.2	+2	3.3	3.2	II
Ch l	<i>Centaurea sonchifolia</i> L.	1.1	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	I
H ²	<i>Silene nicaeensis</i> All.	+2	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
T	<i>Vulpia fasciculata</i> Fritsch.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I

Indifferent companion species:																								
H	<i>Silybum marianum</i> L.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+2	+	+	+	+	II
Gr	<i>Holoschoenus romanus</i> Fritsch.	2.2	1.2	.	+2	.	+2	.	.	(+2)	.	.	.	.	.	.	.	.	.	.	.	.	.	II
T	<i>Scleropoa rigida</i> Gris.	.	.	+2	.	.	+2	+2	.	+2	.	.	.	.	.	.	.	.	.	.	.	.	.	I
H	<i>Inula viscosa</i> L.	.	.	.	+	.	.	.	.	+2	.	.	.	.	.	.	.	.	.	.	.	.	+	I
T	<i>Pholurus incurvatus</i> Hitchc.	.	.	.	.	.	.	+2	.	.	.	.	.	.	.	.	.	.	.	.	+2	.	.	I
P	<i>Tamarix parviflora</i> DC.	.	.	.	.	.	.	.	.	.	+2	.	(+)	.	.	.	.	.	.	.	.	.	.	I
T	<i>Lagurus ovatus</i> L.	+2	+2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
T	<i>Hedypnois rhagadioloides</i> Willd.	1.1	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
H	<i>Lotus cytisoides</i> L.	+	(+2)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
T	<i>Nigella aristata</i> S.S.	+2	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
H ²	<i>Chondrilla juncea</i> L.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
P	<i>Pinus halepensis</i> Mill.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	I
H	<i>Alkana tinctoria</i> Tsch.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	I
Gr	<i>Cynodon dactylon</i> Pers.	.	.	.	.	.	.	.	.	.	.	.	+2	.	.	.	.	.	.	.	.	.	.	I
Gr	<i>Juncus maritimus</i> Lam.	.	.	.	.	.	.	.	.	.	.	.	+2	.	.	.	.	.	.	.	.	.	.	I
H ² H	<i>Scolymus hispanicus</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	(+)	.	.	.	.	.	.	.	.	.	I
T	<i>Bromus maximus</i> Desf.	.	(+2)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I

1. ssp. mediterraneum.
2. ssp. tomentosa Hayek.

Table III. -Association Ammophiletum arundinaceae Br.-Bl.(1921)1933.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	o c c e s s e n s i a	
Number of stand examined	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		
Size of stand, square meters	24	24	24	48	48	48	48	48	18	18	18	18	18	16	20	20	24	20	25		
Altitude of sand dune, meters	3	2,5	2	1,5	2	2,5	3	2,5	8	7,5	8	8	7	8	2	1,5	2	3	3		
Distance from sea, meters	50	60	70	100	80	100	100	100	50	55	60	60	50	45	10	9	8	9	10		
Orientation of stand	0	0	0	0	NW	SW	NW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	0		
Inclination of stand	0	0	0	0	45	43	45	23	28	5	5	45	14	12	33	45	32	30	0		
Cover of vegetation %	30	30	30	35	20	60	30	30	30	30	30	30	35	55	30	45	30	30	30		
Number of species	10	10	11	17	15	16	15	19	11	11	10	12	10	11	9	8	9	8	8		
Characteristic species of the Association :																					
Gr	Ammophila arenaria Lk.																				III
Ch 1	Centaurea sonchifolia L.																				III
TH ²	Echium hispidum S.S.																				III
T	Daucus pumillus Ball.																				III
T	Malcolmia sp.																				II
H ²	Silene nicaensis All.																				I
H ²	Verbascum pinatifidum Vahl.																				II
T	Ononis variegata L.																				II
H ²	Euphorbia terracina L.																				II
H	Inula crithmoides L.																				I
P	Tamarix parviflora DC.																				II
T	Vulpia fasciculata Fritsch.																				I
Characteristic species of the Alliance :																					
Ch h	Medicago marina L.																				V
Gb	Pancratium maritimum L.																				IV
Characteristic species of the Class :																					
H	Euphorbia paralias L.																				V
H	Eryngium maritimum L.																				III
Companion species of the Agropyretum mediterraneum associations:																					
Gr	Agropyrum junceum Beauv. ¹																				IV
Gr	Galilea mucronata Parl.																				IV
H	Echinophora spinosa L.																				IV
Gr	Sporobolus pungens Kunth.																				II
Ch h	Convolvulus soldanella L.																				I
Companion species of the Cakiletea maritima Class. :																					
T	Euphorbia peplis L.																				I
T	Xanthium strumarium L.																				I
Indifferent companion species:																					
T	Haynaldia villosa Schur.																				II
H	Inula viscosa L.																				I
T	Hypochoeris glabra L.																				I
T	Scleropoa rigida Gris.																				I
T	Pholiurus incurvatus Hitchc.																				I
H ²	Chondrilla juncea L.																				I
T	Lagurus ovatus L.																				I
Hlr	Erianthus ravennae Pal.																				I
H	Lotus cytisoides L.																				I
H	Cichorium glabratum Presl.																				I
	Medicago sp.																				I
Gr	Holoschoenus romanus Fritsch.																				I
P	Pinus halepensis Mill.																				I
T	Hedypnois rhagadioloides Willd.																				I
H	Carlina corymbosa L.																				I
P Ch 1	Coridothymus capitatus Rechb.																				I
T	Erodium laciniatum Willd.																				I
Gb	Scilla sp.																				I
H ²	Centaureum umbellatum Gilib.																				I

1. ssp. mediterraneum.

Table IV. -Association *Poterium spinosum* - *Coridothymus capitatus*
(Class Thero-Brachypodietea Br.-Bl.1947).

Number of stand examined		1	2	3	4	5	6	7	8	9	10	11	12	o o r e s p e c i a	
Size of stand, square meters		9	9	9	9	9	9	9	9	9	9	9	9		
Altitude above sea level, meters		60	60	60	65	65	75	50	55	60	60	60	70		
Orientation of stand		NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW		
Inclination of stand		12	17	12	13	13	14	10	12	16	18	14	14		
Cover of vegetation %		70	75	50	85	80	90	90	80	85	90	95	75		
Number of species		22	22	22	24	23	25	24	24	30	26	27	31		
Characteristic species of the Association :															
P Ch 1	<i>Poterium spinosum</i> L.	3.3	3.3	2.2	4.4	3.3	3.2	2.2	3.3	1.2	3.2	3.2	2.2		V
P Ch 1	<i>Coridothymus capitatus</i> Rohb.	2.2	2.2	2.2	1.2	1.2	2.2	1.2	2.2	1.2	1.2	+2	2.2		V
T	<i>Phleum tenue</i> Schrad.	1.1	+2	+	+	+	1.1	+	+2	1.2	+2	+2	1.2		V
H	<i>Dactylis glomerata</i> L.	1.1	+2	+2	1.1	1.1	+	1.1	+2	1.2	1.1	1.1	1.1		V
H ²	<i>Centaurium umbellatum</i> Gilib.	1.2	1.2	+2	+2	1.2	.	+2	+	+2	.	+	+2		V
T	<i>Onobrychis caput-galli</i> Lmk.	1.1	.	+2	.	.	.	+2	+2	+2	.	+2	+2		III
N P	<i>Genista acanthocladus</i> DC. ¹	+2	+2	+2	1.2	2.2	3.3		III
Ch	<i>Helianthemum vulgare</i> Lam. ²	1.1	1.1	1.1	1.1	1.2	+2	.	.	.	.	.	.	III
H	<i>Aristella bromoides</i> Bertol.	+2	+2	1.1	+2	1.2	.	.	.	.	.	.	.	III
Gp	<i>Cuscuta globularis</i> Bertol.	+2	.	+2	.	+2	+2	.	.	.	.	.	.	II
H	<i>Hypericum perforatum</i> L.	1.1	1.1	1.2	.	.	.	.	.	.	.	.	.	II
T	<i>Trifolium campestre</i> Schreb.	.	.	+	+	+2	1.2	1.2	1.2	1.2	1.2	1.2	+2	V	
N P	<i>Phlomis fruticosa</i> L.	.	.	.	.	.	.	2.2	2.2	3.3	3.3	3.3	+2	III
T	<i>Gaudinia fragilis</i> Beauv.	.	+	.	.	1.1	.	1.2	1.2	1.2	1.2	1.1	1.1	IV	
T	<i>Aegilops Heldreichii</i> Holzm. ³	+2	.	+	.	.	+	.	+2	+2	.	+2	+2	III	
T H ²	<i>Vicia tenuifolia</i> Roth. ⁴	.	.	.	.	.	.	+	1.2	1.2	1.2	1.2	.	III
T	<i>Bromus patulus</i> M.K. ⁵	.	.	.	.	.	1.1	.	+	+	+	+	+2	III
T	<i>Plantago bellardi</i> All.	.	.	.	.	.	.	.	.	+2	+2	.	+2	II
T	<i>Aegilops triaristata</i> Willd.	.	.	.	.	.	+	+2	+2	+2	.	.	+2	III
T	<i>Avena barbata</i> Gott.	.	.	.	.	.	.	+2	.	+2	+2	1.2	+2	III
Characteristic species of the Alliance :															
T	<i>Brachypodium distachyum</i> Beauv.	1.1	+2	+2	1.2	1.2	1.1	1.2	1.2	1.2	1.2	1.1	1.2	V	
Ch 1	<i>Fumana thymifolia</i> Verl. ⁶	1.1	1.1	+2	1.1	1.2	1.2	+2	.	.	.	.	+2	IV
H	<i>Andropogon hirtus</i> L.	.	+2	+2	1.2	+2	+2	+2	+2	.	1.2	.	.	IV	
T	<i>Trifolium scabrum</i> L. ⁷	.	.	.	.	+2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	IV
T	<i>Filago gallica</i> L.	.	+2	+2	+2	+	+	.	.	.	.	.	+2	III
H ²	<i>Tragopogon porrifolius</i> L.	+2	.	.	.	+2	.	.	+	.	.	.	+2	III	
T	<i>Trifolium angustifolium</i> L.	.	.	.	+2	.	.	.	+2	.	.	+2	+2	II	
T	<i>Galium divaricatum</i> Lam. ⁸	.	1.2	.	.	.	.	.	+2	.	.	+2	.	II
T	<i>Bupleurum semidiaphanum</i> Boiss.	.	.	.	.	.	.	.	.	.	.	.	+	I
T	<i>Tremastema palaestinum</i> Janch. ⁹	+	.	.	.	.	.	.	.	.	.	.	.	I
Characteristic species of the Order and Class :															
Gb	<i>Allium arvense</i> Gruss.	.	.	+2	+2	1.1	1.1	+	1.1	+2	+	+2	1.1	V	
T	<i>Arenaria serpyllifolia</i> L.	1.1	1.1	+2	1.1	1.2	1.2	.	.	.	.	.	1.2	III
Ch	<i>Tunica saxifraga</i> Scop.	.	.	.	+	.	1.2	+	+2	+2	+2	.	+2	III	
H ² H	<i>Anthyllis vulneraria</i> L.	+	+	.	.	.	.	.	+2	+2	.	+	+2	III
T	<i>Sideritis purpurea</i> Talbot.	.	+2	+2	+2	+2	+	.	.	.	.	.	.	III
T	<i>Bromus sterilis</i> L.	.	.	+	.	.	.	.	.	+2	+2	+	.	II
T	<i>Hedypnois rhagadioloides</i> Willd. ¹⁰	.	.	.	+	.	.	+	.	+2	.	.	+2	II	
T	<i>Scleropoa rigida</i> Griseb.	.	.	.	.	.	.	.	.	+2	+	+2	.	II
TH ² H	<i>Reichardia picroides</i> Roth. ¹¹	.	.	.	.	.	.	.	.	.	.	.	+	I
T	<i>Linum strictum</i> L.	.	.	.	+	.	.	.	.	.	.	.	.	I
T	<i>Filago spathulata</i> Presl.	.	.	.	.	.	.	.	.	.	.	.	+	I
Companion species :															
H	<i>Poa bulbosa</i> L. var. <i>vivipara</i> Koel.	+2	+2	+2	1.1	1.1	1.1	+2	1.2	+2	1.2	+2	1.2	V	
H	<i>Bryophyta</i>	1.2	1.2	.	1.2	1.2	1.2	2.2	2.2	2.2	.	2.2	1.2	V	
H	<i>Dactylis hispanica</i> Roth.	.	.	.	.	.	1.1	.	.	1.1	1.1	1.1	.	II
T	<i>Gastridium lendigerum</i> Gadu.	.	.	.	.	.	+2	.	.	.	1.2	1.1	+2	II
T	<i>Trifolium arvense</i> L.	.	.	.	.	.	.	.	.	1.2	1.2	+2	.	II
T	<i>Aira capillaris</i> Host.	1.1	.	.	.	+2	.	.	.	.	.	.	.	I
H ²	<i>Pallenis spinosa</i> Cas.	.	.	+	+	.	.	.	.	.	.	.	.	I
H	Lichenes	.	.	.	+2	.	+2	.	.	.	.	.	.	I
T	<i>Linum gallicum</i> L.	.	.	.	.	+2	.	.	.	.	+	.	.	I
T	<i>Pholius incurvatus</i> Hitchc.	.	.	.	.	.	+2	.	.	.	+	.	.	I
H	<i>Oryzopsis miliacea</i> L.	1.2	.	.	.	.	.	.	.	.	.	.	.	I
T	<i>Bromus molliformis</i> Lloyd.	.	+2	.	.	.	.	.	.	.	.	.	.	I
T	<i>Lagurus ovatus</i> L.	.	+2	.	.	.	.	.	.	.	.	.	.	I
H	<i>Micromeria juliana</i> Benth.	.	.	.	+2	.	.	.	.	.	.	.	.	I
P	<i>Pirus amygdaliformis</i> Will.	.	.	.	.	.	.	+	.	.	.	.	.	I
T	<i>Rodigia commutata</i> Spreng.	.	.	.	.	.	.	+	.	.	.	.	.	I
T	<i>Anthemis arvensis</i> L.	.	.	.	.	.	.	+2	.	.	.	.	.	I
N P	<i>Asparagus acutifolius</i> L.	.	.	.	.	.	.	.	.	+	.	.	.	I
T	<i>Lathyrus setifolius</i> L.	.	.	.	.	.	.	.	.	+	.	.	.	I
T, H	<i>Crepis foetida</i> L.	.	.	.	.	.	.	.	.	+	.	.	.	I
P	<i>Clematis flammula</i> L.	.	.	.	.	.	.	.	.	.	+	.	.	I
P	<i>Cupressus sempervirens</i> L.	.	.	.	.	.	.	.	.	.	+	.	.	I
T	<i>Lotus tetragonolobus</i> L.	.	.	.	.	.	.	.	.	.	.	.	+	I

1. var. *graeca* Varr. 7. var. *luanicum* Hal.
 2. " *litorale* Hal. 8. " *asperum* K.Maly.
 3. " *subventricosum* Hayek. 9. " *lyratum* Hayek.
 4. " *stenophylla* Boiss. 10. ssp. *cretica* Hayek.
 5. " *velutinus* A. u. G. 11. var. *spicatum* Pers.
 6. " *glutinosa* Born.

