

THE HYDROPHILOUS VEGETATION OF WESTERN CRETE*

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Introduction

Knowledge of Mediterranean hydrophilous vegetation is generally poor. A survey and classification of hydrophilous communities of the Mediterranean part of France is given by Braun-Blanquet et al. (1952). Zohary (1962) presents a classification of the hydrophilous vegetation types of Israel, which differs considerably from the classification of Braun-Blanquet et al. (l.c.). Unfortunately, the vegetation units distinguished by Zohary are rather insufficiently described which makes it difficult to interpret them in the light of the Braun-Blanquet classification. Salt-marshes of the eastern Mediterranean region have been subjects of phytosociological studies by Oberdorfer (1952), Lavren-tiades (1964) and Wolff (1968).

The island of Crete has been included in the general descriptive and very informative work of Rechinger (1951) on the phytogeography of the Aegean region. The first phytosociological account on the vegetation of Crete, together with a useful vegetation map of the island, was published recently by Zohary & Orshan (1966). These authors presented a treatment of the classes *Quercetea ilicis* and *Aceretea orientalis*. Other classes mentioned by these authors to occur on the island are the *Euphorbieteae dendroides*, *Astragaletea cretica*, *Ammophiletea arenariae*, *Rudereto-Secalinetea*, *Salicornieteae* and the hydrophilous

Populetea and *Phragmitetea*. No observations were published on the latter two classes.*

This paper, which is a condensed and fully revised version of a previously published mimeographed report (Gradstein & Smittenberg 1968), presents a phytosociological account of the hydrophilous vegetation of the western part of the island of Crete: districts Apokoronos, Khidonia, Kissamos, Selinos and Sfakia (Fig. 1). The communities treated belong to the phytosociological classes *Potametea*, *Adiantetea*, *Phragmitetea*, *Juncetea maritimi*, *Molinio-Juncetea*, *Isoeto-Nanojuncetea* and *Alno-Populetea*. Data were obtained during a 1.5 month stay on the island in 1967, 9 April–16 May.

Methods

The vegetation was studied according to the Braun-Blanquet approach (Ellenberg 1956, Braun-Blanquet 1964). Abundance and coverage of each species was measured by means of the Braun-Blanquet scale, and occasionally by means of a simplified Tansley (1946) scale: d (dominant), c (codominant), f (frequent), r (rare).

The system of plant communities in southern France by Braun-Blanquet et al. (1952) served as a basis for syn-taxonomical classification. Due to the fact that hydrophilous communities, like hydrophytes, often have a more or less pluriregional distribution, we could compare our data also with the much more advanced classification of western European hydrophilous communities by Westhoff & Den Held (1969), especially for higher units.

* After completion of the manuscript we received Dr. Greuter's account on the geobotany of the island: "Die Insel Kreta – eine geobotanische Skizze" (Veröff. geobot. Inst. Zürich 55: 141–197, 1975). This important work does not contain new data on hydrophilous communities.

* Nomenclature of vascular plants follows Flora Europaea (1964–1972) and, for taxa not yet treated, Greuter (1973) or Rechinger (1943). Bryophyte nomenclature follows Gams (1957).

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To delimit our vegetation units we have used regional characteristic taxa or combinations of taxa. The term "regional characteristic" is used here in a very general way, indicating that a certain taxon or combination of taxa was found to differentiate a particular vegetation unit on Crete. We believe that our data are not sufficient for distinguishing the traditional Braun-Blanquetian categories of character- and differential taxa. The distinguished vegetation units are called associations if they match with associations described elsewhere. New associations are described only when records are available from more than one locality in the investigated area. Apparently undescribed vegetation units observed in only one locality are called communities.

The same term is applied to units of uncertain affinity within the hierarchic system. In some cases variants are distinguished within associations or communities.

Short description of the island

The island of Crete is ca. 245 km long and 12 to 52 km wide. It is the largest island in the eastern Mediterranean.

The island is situated at ca. 35° N.Lat. A short account on geology, soils and climate was given by Zohary & Orshan (1966), from which source some pertinent data are presented here.

The island is dominated by four mountain ranges. The largest are the Levka Ori in the western part of the island, with peaks up to 2400 m. The mountains generally consist of hard limestones which are porous and often karstic. Other types of rock occur locally, e.g. schists made up of metamorphic triassic rock, which are particularly widespread in the lower mountains of the western part of the island.

town	alt.	mean temperature		mean annual precipitation
		Jan.	Aug.	
Hania	0 m	11,3° C.	25,7° C.	± 600 mm
Iraklio	0 m	12,2° C.	26,5° C.	± 425 mm
Sitia	0 m	?	?	± 350 mm

Fig. 2. Mean temperature and precipitation in Hania (W. Crete), Iraklio (C. Crete) and Sitia (E. Crete). After Zohary and Orshan 1966 (slightly modified).

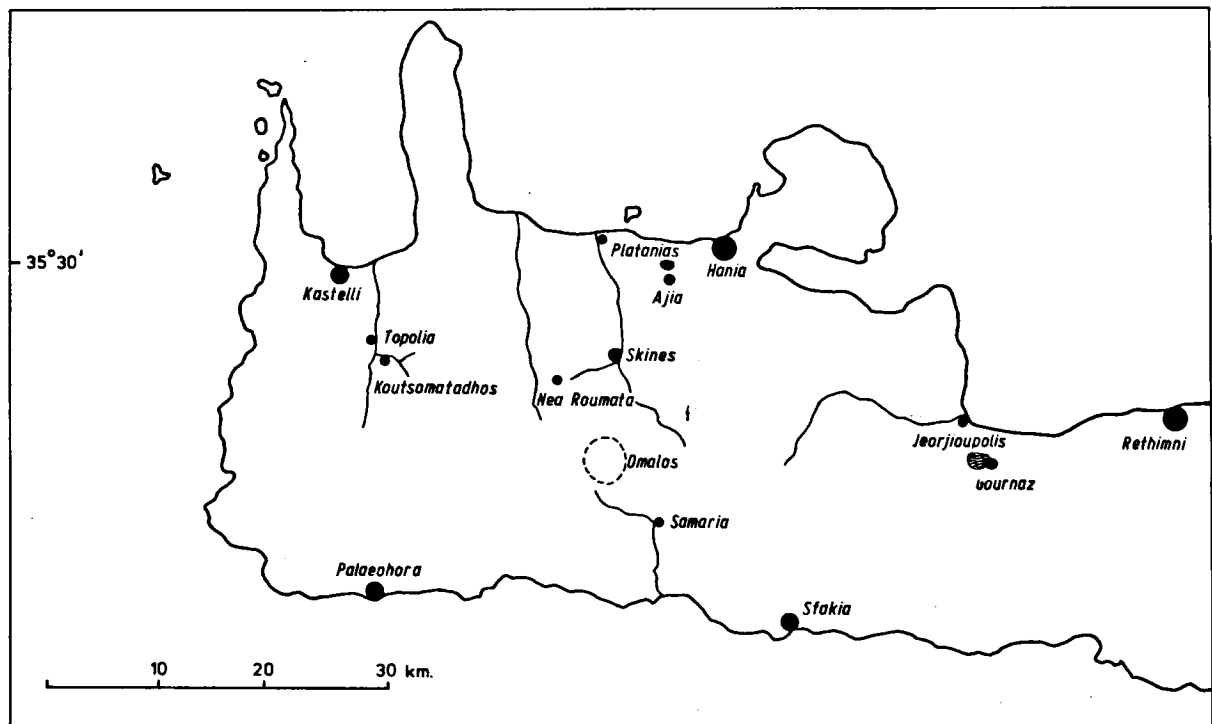


Fig. 1. Map of Western Crete, showing the localities of investigation.

Crete has a Mediterranean climate with a mean annual temperature of 19°C in the lowlands. Frost and snowfall are rare at sea level, but above 1500 m snow can still be seen in May. Precipitation is restricted mainly to the period from late autumn to early spring. It is much higher in the western than in the southern and eastern parts of the island (Fig. 2).

Variation in precipitation may occur over relatively short distances in connection with altitudinal variation. In the relatively humid province of Hania precipitation varies from 1045 mm in the mountains at 800 m, to 425 mm along the southwest coast. The mean annual rainfall and the nature of the substrate largely determine the water-regime of a site and the possible development of hydrophilous vegetation. High annual precipitation and the presence of fairly large areas of well-irrigated schistose substrates in the western part of the island favour the development of hydrophilous vegetations in that region.

Localities (Fig. 1)

1. Jeorjioupolis (district Apokoronos)

A variety of brackish vegetation types is found in the narrow coastal belt at the village of Jeorjioupolis, due to

the presence of numerous brackish springs and rivulets. Vegetation types observed here are: *Scirpetum maritimi et litoralis* and *Juncetum subulato-maritimi* (both common), *Cyperus distachyus-Apium nodiflorum* comm., *Schoenus nigricans-Centaurium pulchellum* comm. and *Festuca arundinacea-Elytrigia elongata* comm.

2. Platania (district Khidonia)

At the North coast near Platania, hydrophilous vegetation is found along the mouth of the river Keritis. Vegetation types studied in this area are: *Scirpetum maritimi et litoralis*, *Apium nodiflori*, *Dorycnio-Caricetum otrubae* and, on steep banks, the *Equisetum telmateia-Arundo donax* comm. Monospecific aquatic vegetation types of *Potamogeton fluitans*, *Zannichellia palustris* ssp. *palustris*, *Ceratophyllum demersum* and *Myriophyllum spicatum*, and fragments of riparian shrubs of *Tamarix* sp., *Nerium oleander* and *Salix* sp. were also seen here. These vegetation types have not been classified by lack of records.

3. Aja (district Khidonia)

Many hydrophilous vegetation types are found at the small, artificial freshwater lake (ca. 0,1 km²) near the village of Aja, occurring in stagnant and running water,

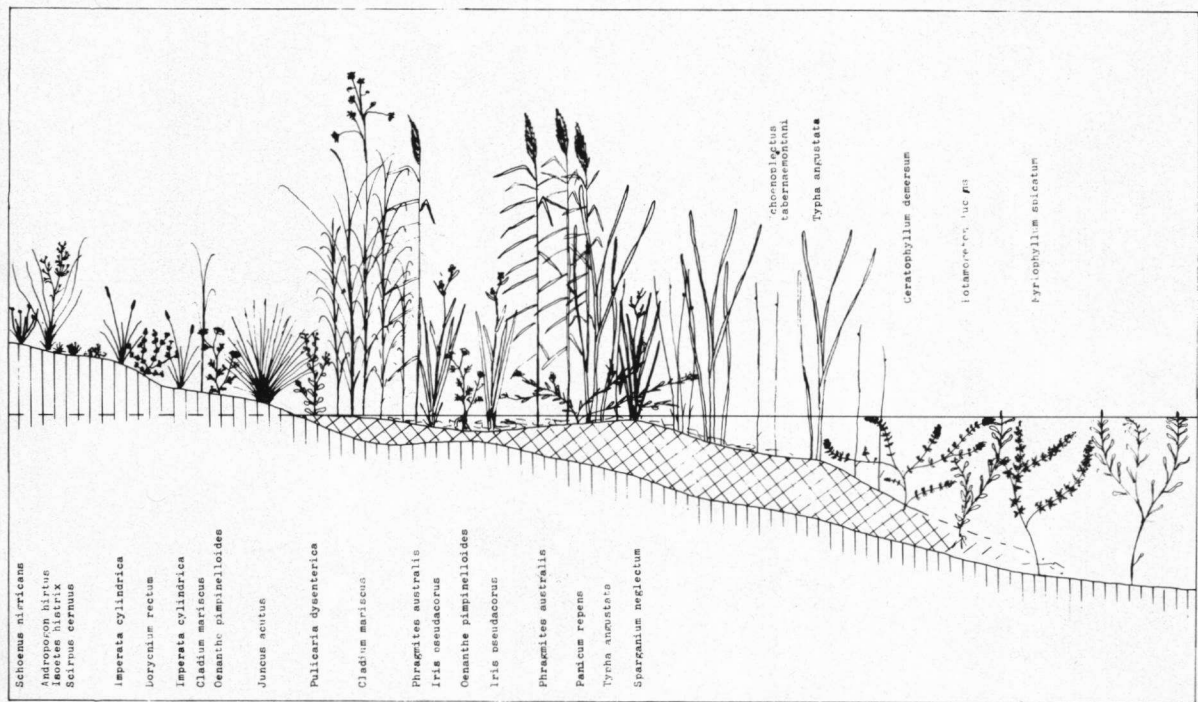


Fig. 3. Zonation of hydrophilous vegetations at the lake near Aja.

on steep or gently sloping banks and on moist slopes surrounding the lake. They belong to the *Potametum lucentis*, *Scirpetum maritimi* (without *Scirpus maritimus*!), *Dorycnio-Cladietum marisci*, *Dorycnio-Caricetum otrubae*, *Apium nodiflorum-Juncus articulatus* comm., *Carex divisa-Oenanthe pimpinelloides* comm. and the therophytic *Junco-Isoetetum hystricis*.

The zonation of the hydrophilous shore vegetation is schematically shown in Fig. 3.

4. Topolia (district Kissamos)

In the neogene limestone hills at Topolia (100 m) spring-wood vegetation belonging to the *Platanus orientalis-Equisetum telmateia* community is locally seen. The riparian *Platanetum orientalis* is well-developed here along the river Giflos.

5. Koutsomatadhos (district Kissamos)

Several hydrophilous vegetation types are present along

rivulets in the well-irrigated schistose mountains at Koutsomatadhos (250 m), e.g. *Oxyrrhynchietum rusciforme* (a monospecific moss-community), *Apietum nodiflorum*, *Caricetum creticae* and *Castanea sativa* community (Fig. 4). At springs the *Acrocladio-Adiantetum* is found.

6. Fasas valley between Skines and Nea Roumata (district Selinos)

The Fasas valley (150–300 m), which was explored previously by K. H. Rechinger in 1942 (Rechinger 1944) and W. Greuter in 1962 (Greuter 1973), is probably the most humid valley of Crete. In the upstream part of the valley three vegetation types of the *Brachypodio-Holoschoenion* all. nov. are seen along the river, while steep, dripping wet schistose rocks harbour the *Acrocladio-Adiantetum* and many rare bryophytes (Gradstein 1971).

7. Omalos (district Selinos)

The Omalos (1000–1100 m.) is a vast mountain plain in

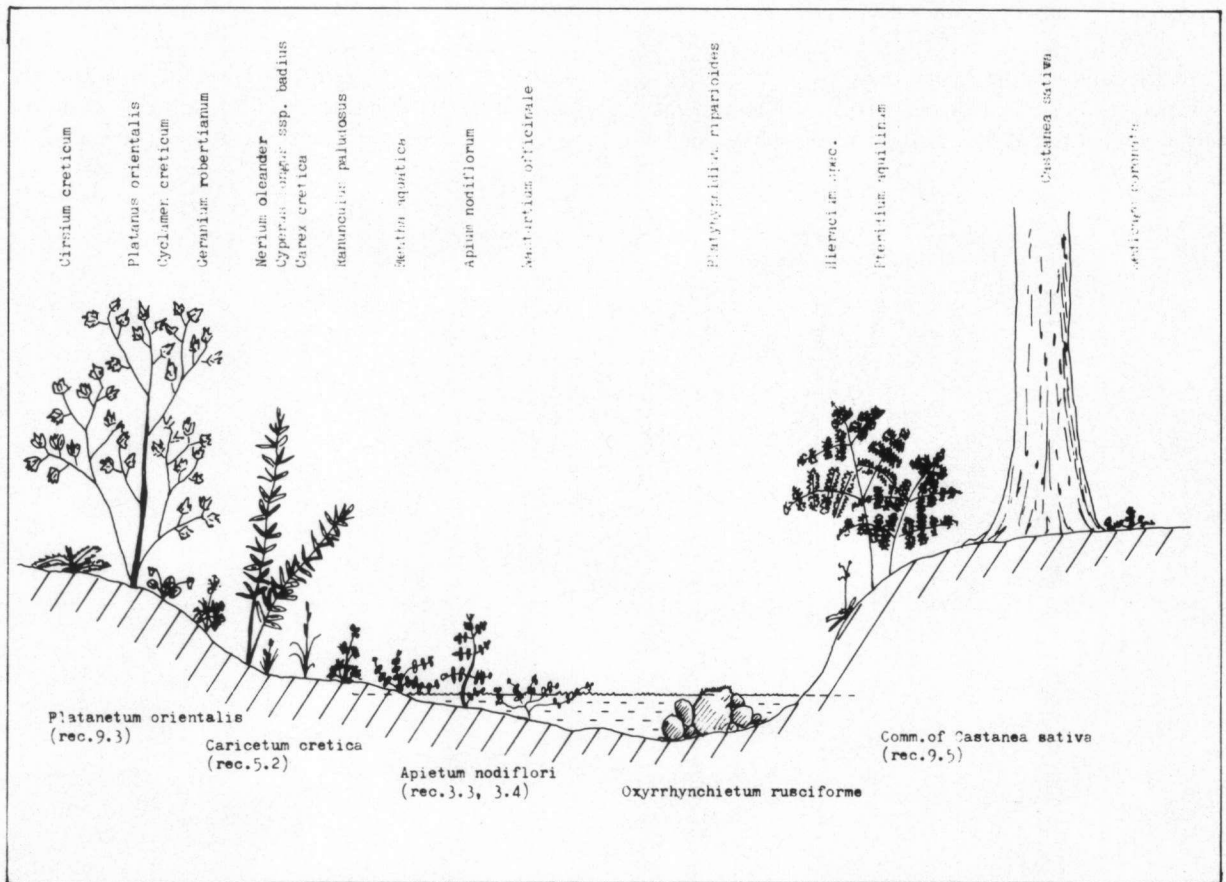


Fig. 4. Zonation of riparian communities at Koutsomatadhos.

the Levka Ori, where thousands of sheep are grazing part of the year. Hydrophilous vegetation types observed here included the *Ranunculetum peltati* and the *Montia fontana* ssp. *chondrosperma* comm.

8. Gorge of Samaria (district Sfakia)

In the 18 km long gorge of Samaria, which extends from the Omalos to the South coast, a spring vegetation belonging to the *Eucladio-Adiantetum* was studied.

Description of plant communities

POTAMETEA R. Tüx. et Preising 1942 (Table 1)

Communities belonging to this class were observed in pools, irrigation ditches, rivers and in the fresh-water lake at Ajia. On the basis of vegetation-records available, four communities are distinguished. The classification follows the treatment of the *Potametea* in Westhoff & Den Held (1969).

	Potametum lucentis									Comm. P.pect.& F.antip.						
	Comm.P.trich.& C.demersum												Ranunculetum peltatis			
	var. P.lucens									var.Chara						
Nr.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Locality	A	A	A	A	A	A	A	A	A	A	A	A	J	0	0	0
Surface (m ²)	50	10	4	6	4	4	4	4	1	1	1	1	8	-	-	-
Waterdepth (cm)	200	130	45	40	40	45	45	45	30	20	20	15	10	30	10	5
Limnophytes:height (cm from bottem)	200	130	10	15	15	20	5	20	10	10	20	8	-	32	12	15
cover (%)	75	100	15	5	40	70	90	95	85	90	60	20	90	100	100	50
Heloph.:height (cm from watersurface)	-	-	0	0	0	0	0	0	-5	0	4	8	-	-	-	10
cover (%)	-	-	20	40	1	5	1	1	1	1	5	5	-	-	-	10
Characteristic taxa (Limnophytes)																
Potamogeton lucens L.	5	4	1	+	1	1	-	+	+	-	-	-	-	-	-	-
Myriophyllum spicatum L.	2	4	-	+	+	2	2	1	5	2	1	1	-	-	-	-
Ceratophyllum demersum L.	5	2	2	1	3	3	2	2	1	1	+	+	-	-	-	-
Potamogeton trichoides Cham.	()	-	1	1	2	2	4	4	+	2	4	2	-	-	-	-
Zannichellia palustris L.	-	-	-	-	1	1	2	4	1	3	()	-	-	-	-	-
Chara spec.	-	-	-	-	-	-	-	-	-	+	()	2	-	-	-	-
Potamogeton pectinatus L.	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-
Fontinalis antipyretica (L.) Hedw.	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
Algae	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
Ranunculus peltatis Schrank.	-	-	-	-	-	-	-	-	-	-	-	()	-	5	4	2
Ranunculus lateriflorus D.C.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3
Companions (Helophytes)																
Sparganium neglectum Beeby	-	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-
Nasturtium officinale R.Br.	-	-	1	3	+	1	+	+	+	-	+	-	-	-	-	-
Alisma lanceolatum With.	-	-	-	-	-	-	-	-	-	+	+	1	-	-	-	-
Apium nodiflorum (L.) Lag.	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Rumex conglomeratus Murrey	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Polygonum salicifolium Brouss.et Willd.	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Carex divisa Huds.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2

MAGNOPOTAMION Den Hartog et Segal 1964

Potamogeton lucensis Hueck 1931

c.t.*: *Potamogeton lucens*.

This association is common in the lake at Ajia at water-depths of 1–3 meter. The vegetation is composed of three large aquatic species: *Potamogeton lucens*, *Ceratophyllum demersum* and *Myriophyllum spicatum*. The substrate consists of a layer of very weak mud and sapropelium of over 50 cm. in thickness. Above the water-surface the community is recognized from a distance by the inflorescence of *Potamogeton lucens*. In shallow water close to the shore *Potamogeton lucens* is rare. Here the association is replaced by the next community.

PARVOPOTAMION Den Hartog et Segal 1964

Community of *Potamogeton trichoides* and *Ceratophyllum demersum*

c.t.: *Potamogeton trichoides*, *Ceratophyllum demersum*, *Zannichellia palustris*, *Myriophyllum spicatum*.

This community occurs along the shore of the lake of Ajia close to the mouth of the river, in shallow, slowly running water of up to 50 cm deep. The substrate is rather solid and poor in sapropelium. The community is floristically richer than the previous association and great variation in dominance and abundance is observed among the constituting species. The community occurs close to the *Apietum nodiflori*, as is indicated by the presence of *Nasturtium officinale* and *Sparganium*.

Within the community two variants are distinguished:

1. variant with *Potamogeton lucens* in deeper water. *Potamogeton lucens* is small here, and invariably sterile;
2. variant with *Chara*, in very shallow water at the shore. With *Chara* sp., *Ranunculus aquaticus* and *Alisma lanceolatum*.

Community of *Potamogeton pectinatus* and *Fontinalis antipyretica* (Parvopotamion?)

c.t.: *Potamogeton pectinatus*, *Fontinalis antipyretica*.

This community occurs in a brooklet behind the dunes at Jeorjioupolis, in fastly running, brackish water of up to 10 cm deep, on solid, gravelly soil. The vegetation contains several species of Algae which were not identified. The occurrence of the moss *Fontinalis antipyretica* in brackish water is unusual (Welch 1957). The lax and relatively flat-leaved form of this species found here probably is a habitat-modification.

* Characteristic taxon or characteristic combination of taxa.

Dense masses of *Potamogeton pectinatus* also occur in much deeper water in the river at Jeorjioupolis.

CALLITRICHIO-BATRACHION Den Hartog et Segal 1964

Ranunculetum peltati (Sauer) Segal 1967

c.t.: *Ranunculus aquatilis* ssp. *peltatus*.

Fragments of this association occur in artificial drinking-pools with stagnant water, up to 50 cm deep. They were seen in the lowlands and in the mountains up to 1000 m in altitude. *R. aquatilis* ssp. *peltatus* is usually the only flowering plant in this vegetation. At the bank of pools, in shallow water up to 10 cm deep, *R. aquatilis* ssp. *peltatus* grows together with sterile plants of the endemic *Ranunculus lateriflorus* var. *pumilus*. The latter taxon flowers only on drier soil on the edge of the pool in stands of *Carex divisa*. Therefore we cannot consider *R. lateriflorus* a (local) characteristic taxon of the *Ranunculetum peltati*.

ADIANTETEA Br.-Bl. 1947 (Table 2)

ADIANTETALIA Br.-Bl. 1931

ADIANTION Br.-Bl. 1931

c.t.: *Adiantum capillus-veneris*, *Samolus valerandi*.

This is a strictly Mediterranean alliance, comprising communities of low herbs, ferns and bryophytes occurring on moist and shaded rocks or cliffs, near springs. On Crete such communities are common in the mountains up to 800 m. They are easily recognized by the presence of *Adiantum capillus-veneris* or *Samolus valerandi*. It should be noted that *Samolus valerandi* is not a faithful species of this alliance on Crete since it is also seen along the coast in saline communities belonging to the *Phragmitetea* or *Juncetea maritimi*. Possibly two different ecotypes of *Samolus valerandi* are at hand. On the Canary Islands *Samolus valerandi* seems to be entirely confined to the *Adiantion* (Sunding 1972).

Eucladio-Adiantetum Br.-Bl. 1931

c.t.: *Eucladium verticillatum*, *Cratoneuron commutatum*, *Schoenus nigricans*.

This community occurs on moist and rather shaded limestone rocks. The mosses in this community are often encrusted in chalk tuff. A good example of this community was seen at a spring in the Gorge of Samaria. The *Eucladio-Adiantetum* has been reported from the Yugoslavian coast and the western Mediterranean region (Sunding 1972).

TABLE 2 ADIANTETEA

	Eucladio-Adiantetum		Acrocladio-Adiantetum		
			var. Eurh.	var. Scirpus cernuus	
Nr.	1	2	3	4	5
Locality	S	S	K	F	F
Surface (m ²)	4,5	2	0,3	2	2
Exposition	S	S	NW	N	NW
Inclination (°)	20	30	25	90	20
Herb-layer height (cm)	10	10	-	2	75
cover (%)	80	75	-	90	80
Moss-layer cover (%)	75	20	-	90	80
Characteristic taxa					
<i>Adiantum capillus-veneris</i> L.	5	2	f	2	+
<i>Samolus valerandi</i> L.	+	+	f	1	1
<i>Eucladium verticillatum</i> (Brid.) B.S.G.	1	1	-	-	-
<i>Cratoneuron commutatum</i> (Hedw.) Roth	4	1	-	-	-
<i>Schoenus nigricans</i> L.	()	4	-	-	-
<i>Acrocladium cuspidatum</i> (Hedw.) Lindb.	-	-	r	3	5
<i>Pellia fabbroniana</i> Raddi	-	-	c	4	1
<i>Eurhynchium praelongum</i> (Hedw.) B.S.G.	-	-	[c]	-	-
<i>Scirpus cernuus</i> Vahl.	-	-	-	+	+
<i>Lathyrus neurolobus</i> Boiss. et Heldr.	-	-	-	1	1
Companions					
<i>Cyclamen creticum</i> Hildebr.	+	1	-	-	-
<i>Hedera helix</i> L.	+	+	-	-	-
<i>Carex halleriana</i> Asso.	-	+	-	-	-
<i>Brachypodium sylvaticum</i> (Huds.) R. et S.	1	+	-	-	-
cf. <i>Leontodon tuberosus</i> L.	+	1	-	-	-
<i>Carex distans</i> L.	+	+	-	-	+
<i>Arisarum vulgare</i> Targ. - Tozz.	+	-	-	-	-
<i>Oenanthe pimpinelloides</i> L.	-	+	-	-	-
<i>Agrostis semiverticillata</i> (Forsk.) Christ.	-	-	-	1	-
<i>Philonotis marchica</i> (Hedw.) Brid.	-	-	-	1	-
<i>Pohlia cruda</i> (Hedw.) Lindb.	-	-	-	1	-
<i>Juncus articulatus</i> L.	-	-	-	+	-
<i>Rubus sanctus</i> Schreb.	-	-	-	+	-
<i>Luzula forsteri</i> (L.) D.C.	-	-	-	+	-
<i>Anagallis tenella</i> L.	-	-	-	-	1
<i>Eleocharis multicaulis</i> Sm.	-	-	-	-	+
<i>Juncus effusus</i> L.	-	-	-	-	+
<i>Listera ovata</i> (L.) R. Br.	-	-	-	-	+
<i>Anthoxanthum odoratum</i> L.	-	-	-	-	+
<i>Erica arborea</i> L.	-	-	-	+	+
<i>Cistus incanus</i> L. ssp. <i>creticus</i> (L.) Heywood	-	-	-	-	+

Acrocladio-Adiantetum ass. nov.

c.t.: *Acrocladium cuspidatum* (= *Calliergonella cuspidata*), *Pellia endiviaefolia*.

Ecologically the *Acrocladio-Adiantetum* differs from the previous association by its occurrence on schistose rocks. Typical calciphilous bryophytes, e.g. *Eucladium verticillatum* and *Cratoneuron commutatum*, are lacking in this community. Several neutrophilous species are present instead, such as *Acrocladium cuspidatum*, *Eurhynchium praelongum* (both very rare on Crete) and *Pellia endiviaefolia*.

Two variants are distinguished: 1. variant of *Eurhynchium praelongum*, on rather eutrophic, loamy soil covering schists at an artificial spring near Koutsomatadhos; 2. variant of *Scirpus cernuus*, on the basis of steep N.-exposed schistose rocks along the road in the Fajas valley. This variant is richer in species than the previous variant. Differential species are *Scirpus cernuus*, *Lathyrus neurolobus* and several species of bryophytes.

PHRAGMITETEA R. Tüx. et Preising 1942

NASTURTIO-GLYCERETALIA Pignatti 1953

(Syn.: *Glycerio-Sparganion* Br.-Bl. et Sissing 1942 s.1.)

APIUM NODIFLORI Segal, in Westhoff & Den Held 1969 (Table 3)

Apietum nodiflori Br.-Bl. 1931 (sub nom. *Heliosciadietum nodiflori*)

c.t.: *Nasturtium officinale*, *Apium nodiflorum*, *Veronica anagallis-aquatica*, *Mentha aquatica*.

The *Apietum nodiflori* occurs in bands along rivers and rivulets, in shallow running water, in the lowlands and in the lower mountains. It prefers a muddy and almost permanently wet soil. *Apium nodiflorum* and *Nasturtium officinale* are always present and either of them may be the dominating species. *Apium nodiflorum* is probably the most common hydrophilous species of Crete. It is a companion species of several other communities. In the lowlands this is also true for *Mentha aquatica*, which is a frequent companion species of *Holoschoenetalia* communities (Table 6). *Nasturtium officinale* and *Veronica anagallis-aquatica* probably are faithful species of the *Apietum nodiflori* on Crete.

At the lake of Ajia in the mouth of the river a variant with *Sparganium neglectum* occurs on rather solid soil. This variant resembles the *Glycerio-Sparganietum* Koch from western Europe, but differs in the absence of *Glyceria*

fluitans. This species has not yet been reported from the Aegean region.

Community of *Apium nodiflorum* and *Polygonum salicifolium*

c.t.: *Polygonum salicifolium*, *Apium nodiflorum*, *Typha angustata*.

This is a floristically rich community occurring along the shore of the lake at Ajia near the mouth of the river, in 6–15 cm deep, slowly running water. The soil is muddy and permanently wet due to the artificial control of the waterlevel of the lake throughout the year. The community differs from the *Apietum nodiflori* in the absence of *Nasturtium officinale* and by the presence of *Polygonum salicifolium*, *Typha angustata* and by several *Holoschoenetalia* taxa, e.g. *Rumex conglomeratus*, *Oenanthe pimpinelloides* and *Galium constrictum*.

Community of *Cyperus distachyus* and *Apium nodiflorum*.

c.t.: *Cyperus distachyus*, *Apium nodiflorum*, *Typha angustata*, *Samolus valerandi*, *Lemna minor*.

This community occurs in brackish swamps near springs just behind the dunes at Jeorjioupolis. Physiognomically the community is characterised by the low and dense mats of *Cyperus distachyus* alternating with higher tufts of *Typha angustata*. The community is surrounded by monospecific stands of *Juncus heldreichianus* and is grazed by mules. The Cretan *Cyperus distachyus*–*Apium nodiflorum* community resembles the community of *Cyperus distachyus* and *Polypogon monspeliensis* described by Wolff (1968) from the Lagoons of the Mesolonghi in Greece. According to Wolff that community occurs in a brackish habitat periodically flooded by fresh water. The ecology of both vegetation-types needs further study before anything definite can be said about their syntaxonomic position.

PHRAGMITETALIA Koch 1926

PHRAGMITION Koch 1926 (Table 4)

On Crete belts of the common reed (*Phragmites australis*) are rare and restricted to the lowlands, especially the river deltas which do not completely dry up in summer. Floristically the Cretan reed belts differ from the western European reed stands by the presence of the mediterranean species *Panicum repens* and *Typha angustata*. The Cretan reed belts are generally rather poor in species.

TABLE 3 APION NODIFLORI

	Apietum nodiflori									Comm. Apium & Polygonum				Comm. Apium & Cyperus						
Nr.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Locality	P	P	K	K	T	A	A	A	A	A	A	A	A	J	J	J	J	J	J	J
Surface (m ²)	6	8	2,5	1,5	20	6	25	25	100	8	15	8	4	12	6	3	12	12	6	6
Waterdepth (cm)	0	0	-	2	15	10	-	-	-	3	10	-	-	8	3	20	-	-	3	3
Herb-layer height (cm)	40	125	40	30	-	175	125	125	100	100	150	150	100	100	175	100	150	75	100	200
cover (%)	75	100	90	75	-	95	90	100	100	90	90	75	60	80	75	5	50	50	50	100
Characteristic taxa																				
<i>Apium nodiflorum</i> (L.)Lag.	1	1	5	4	r	1	1	+	+	3	1	2	2	4	2	+	.	.	5	
<i>Nasturtium officinale</i> R.Br.	4	5	1	1	f	5	5	4	2	+	.	.	.	.	.	.	.	.	.
<i>Mentha aquatica</i> L.	.	1	2	+	1	1	2	1	1
<i>Veronica anagallis-aquatica</i> L.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Polygonum salicifolium</i> Brouss.et Willd.	+	+	1	1	1	1
<i>Typha angustata</i> Bory et Chaub.	+	.	+	1	1	+	1	+	1	2	+	2
<i>Cyperus distachyus</i> All.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	+	3	4	2
<i>Samolus valerandi</i> L.	.	.	.	+	f	+	3	+	.	.	3	+
<i>Lemna minor</i> L.	+	1	+	.	.	.	+
Companions																				
<i>Sparganium neglectum</i> Beeby	.	.	.	.	.	.	2	3	3	.	2	1	1	.	.	.	.	.	.
<i>Phragmites australis</i> (Cav.) Trin. ex Steud.	.	.	.	.	.	1	.	.	.	+	.	.	.	.	.	.	.	.	.
<i>Panicum repens</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.	.	.
<i>Schoenoplectus tabernaemontani</i> (Gmel.) Palla	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
<i>Scirpus maritimus</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.
<i>Dorycnium rectum</i> (L.) Ser.	.	+	.	.	f	.	.	.	3	+	.	.	.	.	.	.	.	.	.
<i>Lythrum junceum</i> Banks et Solander	1	.	.	.	f	.	.	.	.	.	.	1	.	+	2	.	+	+	.
<i>Oenanthe pimpinelloides</i> L.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.
<i>Galium constrictum</i> Chaub.	.	.	.	.	.	.	.	.	.	+	.	1	.	.	.	.	.	.	.
<i>Cyperus longus</i> L. ssp. badius (Desf.) Murb.	.	.	+	.	.	.	.	.	.	.	2	(	.	.	.	.	.	.	.
<i>Rumex conglomeratus</i> Murrey	.	.	+	.	.	+	+	.	.	+	+	.	2	.	.	.	.	.	.
<i>Convolvulus arvensis</i> L.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	.	.	.	.	.
<i>Mentha spicata</i> L.	.	.	.	.	d	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Juncus articulatus</i> L.	.	.	.	.	f	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Cirsium creticum</i> Lam. Urv.	.	.	.	.	f	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Carex otrubae</i> Podp.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
<i>Agrostis semiverticillata</i> (Forsk.) Christ.	.	.	.	.	.	.	.	.	.	1	3	.	1	.	+	.	.	.	+
<i>Epilobium hirsutum</i> L.	.	.	.	.	.	.	.	.	4	.	1	+	+	.	.	.	.	.	.
<i>Juncus inflexus</i> L.	.	.	.	.	.	.	.	.	.	.	1	3	.	.	.	.	.	.	.
<i>Polygonum monspeliensis</i> (L.) Desf.	1	,	,	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
<i>Plantago lanceolata</i> L.	1	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
<i>Ranunculus marginatus</i> D'Urv.	2	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Ranunculus paludosus</i> Poiret	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Equisetum ramosissimum</i> Desf.	.	.	.	.	f	.	.	.	.	.	+	.	.	.	.	.	.	.	.
<i>Festuca arundinacea</i> Schreb.	.	.	.	.	.	.	2	+	.	.	.	.	.	.	.	.	.	.	.
<i>Arundo donax</i> L.	+	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
<i>Galium aparine</i> L.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
<i>Juncus bufonius</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.
<i>Atriplex hastata</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.
<i>Chara spec.</i>	.	.	.	.	f	.	.	.	.	.	.	.	.	.	.	.	4	.	.
Record 2: <i>Salix spec.</i> +, 3: <i>Allium subhirsutum</i> L. +, 4: <i>Adiantum capillis-veneris</i> L. +, <i>Carex cretica</i> Gradst. et Kern +, 5: <i>Equisetum telmateia</i> Ehrh. r, 10: <i>Panicaria dypterica</i> (L.) Bernh. +, 17: <i>Eu,horbia pubescens</i> Vahl. +.																				

TABLE 4 PHRAGMITION

	Scirpetum maritimi											Scirpetum maritimi et litoralis									
												var.inops					var.convolutus				
Nr.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Locality	A	A	A	A	A	A	A	A	A	A	A	J	J	J	J	P	P	P	P	P	
Surface (m ²)	25	6	10	25	15	15	16	16	20	100	15	24	25	15	10	50	50	50	-	-	
Waterdepth	25	3	35	30	40	65	25	15	-	25	10	-	-	-	2	-	-	-	-	-	
Height (cm)	100	100	150	150	?	?	300	300	250	350	350	300	150	175	100	400	400	350	300	?	
Cover (%)	35	40	10	10	35	80	78	80	50	15	40	50	60	30	15	100	100	90	100	?	
Characteristic taxa																					
Phragmites australis (Cav) Trin.ex Steud.	-	-	-	-	-	-	1	1	2	2	1	2	1	1	1	3	2	2	C	C	
Iris pseudacorus L.	3	3	2	-	-	-	-	2	1	+	-	-	-	-	-	-	-	-	C	f	
Schoenoplectus tabernaemontani (Gmel.) Palla	1	1	-	2	2	1	1	1	1	1	1	-	-	-	-	-	-	-	-	-	
Panicum repens L.	-	2	-	-	-	-	3	2	2	+	3	-	-	-	-	-	-	-	-	-	
Sparganium neglectum Beeby	+	-	+	-	2	5	2	+	-	-	-	-	-	-	-	-	-	-	-	-	
Typha angustata Bory et Chaub.	+	-	-	1	+	+	1	+	-	-	-	-	+	-	1	-	-	-	-	-	
Scirpus maritimus L.	-	-	-	-	-	-	-	-	-	-	-	3	4	1	2	3	2	2	5	5	
Convolvulus arvensis L.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	1	f	f	
Pulicaria dysenterica (L.) Bernh.	-	-	-	-	-	-	-	2	-	+	-	-	+	-	-	1	1	1	r	-	
Euphorbia pubescens Vahl.	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	2	f	-	
Companions																					
Juncus acutus L.	-	-	-	-	-	-	-	-	+	-	-	+	-	3	-	-	-	-	r	f	
Carex extensa Good.	-	-	-	-	-	-	-	-	-	-	-	2	-	+	-	-	-	-	-	-	
Aster tripolium L.	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	
Atriplex cf. hastata L.	-	-	-	-	-	-	-	-	-	-	-	-	+	1	-	-	-	-	-	-	
Polygonum monspeliensis (L.) Desf.	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	
Apium nodiflorum (L.) Lag.	-	-	-	-	-	-	-	+	2	-	+	-	-	-	1	-	-	-	-	-	
Mentha aquatica L.	-	+	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	
Polygonum salicifolium Brouss.et Willd.	-	-	-	-	-	-	+	1	1	+	1	-	-	-	-	1	-	3	-	-	
Eleocharis palustris (L.) R.etSch.	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	f	
Hydrocotyle vulgaris L. ssp.palustris L.	-	-	-	+	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	
Ceratophyllum demersum L.	-	-	-	1	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Dorycnium rectum (L.) Ser.	-	+	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	4	1	-	
Lythrum junceum Banks et Solander	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	
Oenanthe pimpinelloides L.	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	
Galium constrictum Chaub.	-	1	-	-	-	-	-	1	1	-	1	-	-	-	-	-	-	-	r	-	
Rumex conglomeratus Murrey	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	r	r	
Carex otrubae Podp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	f	-	
Cladium mariscus (L.) R.Br.	+	+	1	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	f	-	
Cynodon dactylon (L.) Pers.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C	
Equisetum ramosissimum Desf.	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	f	-	
Epilobium hirsutum L.	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	
Eurhynchium speciosum (Brid.)Jur.	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Record 3: Utricularia cf. vulgaris L. 1, 9: Poa trivialis L. ssp.silvicola Hack 1, Juncus inflexus L. 1, Juncus effusus L. +, 10: Nerium oleander L. 1, 11: Trifolium repens L. +, 12: Samolus valerandi L. +, Juncus subulatus Forsk. 1, Tamarix spec. +, 14: Lotus uliginosus Schkuhr. +, 15: Inula viscosa (L.) Aiton +, 18: Arundo donax L. 1																					

Scirpetum maritimi R. Tüx. 1937

c.t.: *Scirpus tabernaemontani*, *Phragmites australis*,
Panicum repens, *Sparganium neglectum*.

The reed belts along the shore of the freshwater lake at Ajia apparently belong to this association because of the presence of the faithful species *Schoenoplectus tabernaemontani*. We did not see *Scirpus maritimus* there. The reed vegetation occurs in shallow, stagnant water up to 60 cm deep. The substrate consists of a weak and almost impassable layer of decaying plant material up to 1 m in thickness. *Phragmites australis* thrives best in water of 15–30 cm deep whereas *Panicum repens* is more common in shallow water close to the shore. *Schoenoplectus tabernaemontani* is evenly distributed throughout the reed belt. Between the *Phragmites* belt and the *Potamatum lucentis* of the open water (Fig. 3), a narrow zone of *Schoenoplectus tabernaemontani*, *Typha angustata* and *Sparganium neglectum* is seen. This vegetation develops at water depths of 30–60 cm on a very weak layer of plant material washed ashore, and can be considered an initial phase of the *Scirpetum maritimi*. On firmer substrate *Mentha aquatica*, *Epilobium hirsutum* and *Hydrocotyle vulgaris* may get established in this zone. *Phragmites* is virtually lacking here.

Locally stands with *Iris pseudacorus* occur, both within the reed belt and within the stands of *Cladium mariscus*. The facies of *Iris* is probably due to a disturbance of the soil, viz. the presence of an old trail.

Scirpetum maritimi et litoralis Br.-Bl. 1931

c.t.: *Scirpus maritimus*, *Phragmites australis*.

This association comprises the coastal reed belts of Crete, occurring in brackish riverdeltas in stagnant or slowly running water. It differs from the previous association mainly by the absence of *Scirpus tabernaemontani*, *Panicum repens* and *Sparganium neglectum*. Two variants are distinguished here: 1. variant *inops*, which was seen in the brackish marshes near Jeorjioupolis close to the river. Among the companions there are several halophilous species, e.g. *Juncus heldreichianus*, *Carex extensa* and *Atriplex* cf. *hastata*; 2. variant of *Convolvulus arvensis*, differing from the previous variant by the presence of *Convolvulus arvensis*, *Pulicaria dysenterica* and *Euphorbia pubescens*. This variant occurs along the mouth of the river Keritis at Platania and inhabits a less brackish habitat than the variant *inops*, as is obvious from the smaller number of halophilous companions. In fact, this variant shows a distinct relationship to the *Dorycnio-Caricetum otrubae* (*Holoschoenetalia*).

MOLINIO-JUNCETEA Br.-Bl. 1947

HOLOSCHOENETALIA Br.-Bl. 1947

c.t.: *Juncus articulatus*, *Juncus effusus*, *Dorycnium rectum*, *Lythrum junceum*, *Oenanthe pimpinelloides*, *Galium constrictum*, *Cirsium creticum*, *Rubus sanctus*, *Cyperus longus* ssp. *badius*, *Carex distans*.

Published accounts on eastern Mediterranean communities belonging to the *Holoschoenetalia* are virtually non-existing. Yet a considerable number of hydrophytic communities on Western Crete apparently belongs to this Mediterranean order. According to Braun-Blanquet et al. (1952: 127) the *Holoschoenetalia* are comprised of "prairies à végétations assez dense et élevées qui exigent une humidité temporaire élevée, mais supportent le dessèchement-estival". Floristically the Cretan communities differ considerably from the western Mediterranean communities of *Holoschoenetalia*. Of nine faithful species of class and order listed by Braun-Blanquet only four species are present in Cretan *Holoschoenetalia*: *Juncus articulatus*, *Oenanthe pimpinelloides*, *Juncus inflexus* and *Imula viscosa*. On Crete the latter two species are restricted in their occurrence to lowland communities. Among the ten characteristic taxa of the *Holoschoenetalia* listed above four taxa occur frequently in almost all Cretan communities described here: *Dorycnium rectum*, *Lythrum junceum*, *Oenanthe pimpinelloides*, *Galium constrictum*. *Dorycnium rectum* (= *Bonjeania recta* apud Br.-Bl.) and *Galium constrictum* are also seen in S. France, but there the species are apparently restricted to one or two communities within the order (Braun-Blanquet et al., l.c.).

The Cretan *Holoschoenetalia* comprise two groups of communities which differ considerably in floristic composition and in distribution. Therefore we have decided to describe these groups as new alliances: the *Brachypodio-Holoschoenion*, occurring in the (lower) mountains, and the *Dorycnio-Rumicion conglomeratae*, occurring in the lowlands only.

BRACHYPODIO-HOLOSCHOENION all. nov. (Table 5)

c.t.: *Holoschoenus romanus*, *Brachypodium sylvaticum*,
Mentha spicata s.l., *Lathyrus neurolobus*.

This alliance comprises communities occurring in the hills and lower mountains between 150 and 400 m at springs or along rivulets. The soils are wet or humid and do not entirely dry up in summer.

The communities of this alliance are negatively characterised by the absence of characteristic species of the

TABLE 5 BRACHYPODIO-HOLOSCOENION

	Caricetum cretica				Comm. Holosch. & Eleocharis				Comm. Holosch. & Osmunda		Comm. Equisetum Cyperus	
	1	2	3	4	5	6	7	8	9	10	11	12
Nr.												
Locality	K	K	F	F	F	F	F	F	F	F	T	T
Surface (m ²)	0,25	1,5	1,2	1	9	2	10	16	8	12	12	4
Exposition	-	-	-	-	SE	-	M	∴	SE	N	E	E
Inclination (°)	-	-	-	-	20	-	5	5	20	45	2	1
Herb-layer height (cm)	10	50	30	30	75	50	40	10	300	150	75	100
cover (%)	30	80	25	80	100	80	80	75	100	100	50	30
Moss-layer cover (%)	5	5	10	5	-	-	-	-	-	-	-	-
Characteristic taxa Order												
Juncus articulatus L.	-	-	-	-	+	+	-	-	-	-	-	-
Juncus effusus L.	-	-	-	-	+	+	-	+	f	-	-	-
Dorycnium rectum(L.) Ser.	-	-	-	-	1	+	+	-	-	1	-	+
Lythrum junceum Banks et Solander	-	-	-	-	-	-	-	-	r	-	1	+
Oenanthe pimpinelloides L.	+	-	-	-	-	+	-	+	-	-	-	-
Galium constrictum Chaub.	-	-	1	+	+	1	2	2	-	-	-	-
Cirsium creticum (Lam.) Urv.	+	2	-	-	-	-	-	-	-	-	-	-
Rubus sanctus Schreb.	+	+	-	-	-	-	-	-	+	1	-	+
Cyperus longus L. ssp. badius (Desf.) Murb.	-	2	-	-	-	-	4	-	-	-	2	2
Carex distans L.	-	-	-	-	1	-	-	-	-	-	-	1
Characteristic taxa Alliance												
Holoschoenus romanus (L.) Fritch.	+	-	-	2	4	1	1	3	f	3	-	1
Brachypodium sylvaticum (Huds.) R. et S.	-	-	+	2	2	-	-	+	-	+	-	-
Mentha spicata L.	-	-	+	+	-	-	+	-	r	-	1	+
Lathyrus neurolobus Boiss. et Heldr.	-	-	1	1	1	-	2	1	r	-	-	-
Characteristic taxa lower syntaxa												
Carex cretica Gradst. et Kern	2	2	+	3	-	-	-	-	-	-	-	-
Eurhynchium speciosum (Brid.) Jur.	2	1	+	1	-	-	-	-	-	-	-	-
Eleocharis multicaulis Sm.	-	-	-	-	1	4	+	1	-	-	-	-
Hydrocotyle vulgaris L.	-	+	+	-	3	2	2	2	-	-	-	-
Osmunda regalis L.	-	-	-	-	-	-	-	-	f	2	-	-
Equisetum telmateia Ehrh.	-	-	-	-	-	-	-	-	-	-	3	2
Companions												
Carex pendula Huds.	1	-	-	-	-	-	-	-	-	-	-	-
Apium nodiflorum (L.) Lag.	-	1	2	-	-	1	1	1	-	-	-	-
Fuirena pubescens Kunth.	-	-	-	-	-	-	-	-	f	-	-	-
Adiantum capillis-veneris L.	+	-	-	+	-	-	-	-	-	-	+	-
Samolus valerandi L.	-	-	-	-	-	-	-	-	-	-	1	-
Pellia fabbrioniana Raddi.	+	-	-	+	-	-	-	-	-	-	-	-
Platanus orientalis L.	-	-	-	-	-	-	-	-	6)	-	(-
Rhagadiolus stellatus (L.) Willd.	1	-	-	-	-	-	-	-	-	-	-	-
Nerium oleander L.	1	+	-	-	-	-	-	-	f	+	+	-
Acrocladium cuspidatum (Hedw.) Lindb.	-	-	-	-	-	3	-	-	-	-	-	-
Pteridium aquilinum (L.) Kuhn	-	-	-	-	-	-	-	-	r	2	-	-
Medicago coronata (L.) Bartal	-	1	-	-	-	-	-	-	-	-	-	-
Carex flacca Schreb.	-	+	-	-	-	-	-	-	-	-	+	-
Ranunculus paludosus Poiret	2	2	-	-	-	-	-	-	-	-	-	-
Allium subhirsutum L.	+	1	-	-	-	-	-	-	-	-	-	-
Erica arborea L.	-	-	-	-	-	-	-	-	r	+	-	-
Anagallis tenella L	-	-	-	-	-	1	-	-	-	-	-	-
Athyrium filix-femina (L.) Roth.	-	-	-	-	2	-	-	-	-	+	-	-
Agrostis semiverticillata (Forsk.) Christ.	-	-	-	-	-	-	-	-	-	-	1	-
Equisetum ramosissimum Desf.	-	-	-	-	-	-	-	-	-	-	+	+
Coronilla cretica L.	-	-	-	-	-	-	-	-	f	-	-	-
Record 1: Hedera helix L. +, Tordylium apulum L. +;												
Record 2: Mentha aquatica L. +;												
Record 3: Fossombronia angulosa (Dicks) Raddi +, Trichostomum mutabile Bruch. +;												
Record 4: Carex divulea Stokes +, Plantago major L. +;												
Record 7: Poa cf. palustris L. +;												
Record 8: Anthoxanthum odoratum L. +;												
Record 9: Arbutus andrachne L. +;												
Record 10: Cistus incanus L. ssp. creticus (L.) Heywood +, Calycotome villosa (Poir.) Link.+, Rubia peregrina L. +, Brachypodium ramosum (L.) R. et S. +;												
Record 12: Dactylis cf. hispanica Roth. +.												

Dorycnio-Rumicion conglomeratae. The only faithful species of the alliance seems to be *Brachypodium sylvaticum*. The endemic *Lathyrus neurolobus* is a typical hygrophytic species of the lower mountains in Western Crete; it occurs also in the *Acrocladio-Adiantetum* (*Adiantion*).

Caricetum creticae ass. nov.

(*Carex cretica*-*Eurhynchium speciosum* consociation, in Gradstein & Kern 1968)

c.t.: *Carex cretica*, *Eurhynchium speciosum*.

This is a riparian community of small herbs and mosses, occurring on rather sunny, flat banks of rivulets in schist-mountains at 250–350 m. The *Caricetum creticae* forms a narrow belt between the *Apietum nodiflori* and the woodland communities of *Platanus orientalis* or *Castanea sativa*, and is accompanied by a number of species from these contiguous communities (Fig. 4). On rather steep banks, where the *Apietum nodiflori* is lacking, the association is hardly developed as a separate community. Here *Carex cretica* occurs scattered at the edge of the running water together with *Carex remota*, in the shade of plane trees.

Community of *Holoschoenus romanus* and *Eleocharis multicaulis*

c.t.: *Eleocharis multicaulis*, *Holoschoenus romanus* ssp. *australis*, *Hydrocotyle vulgaris*.

This community was observed in the Fasas valley east of Lagous, on a slope along the southern branch of the river near the spring. It represents a rare type of “spring-marsh” vegetation, apparently not yet reported from other Mediterranean regions. The soil is muddy or almost peaty and is flooded by the spring and by the rivulet. The community covers a fairly large area and is rather poor in species. Bryophytes are almost lacking. *Eleocharis multicaulis* is most abundant close to the spring. Here the community borders the *Acrocladio-Adiantetum* as is seen by the presence of *Acrocladium* and *Anagallis tenella*. Further downstream in running water the community is replaced by almost pure stands of *Cyperus longus* ssp. *badius*.

Community of *Holoschoenus romanus* and *Osmunda regalis*

c.t.: *Osmunda regalis*, *Holoschoenus romanus* ssp. *australis*, *Rubus sanctus*.

Like the previous community this vegetation was only seen in the Fasas valley, at springs on steep river banks in the macquis. The soil is permanently wet and permeated by numerous roots of herbs and shrubs. The vegetation is dense and scrubby and contains several elements of the

surrounding macquis, viz. *Erica arborea* and *Pteridium aquilinum*.

Community of *Equisetum telmateia* and *Cyperus longus*
c.t.: *Cyperus longus* ssp. *badius*, *Equisetum telmateia*. This vegetation borders the community of *Equisetum telmateia* and *Platanus orientalis* (*Platanion*) at a spring in the valley near Topolia. In contrast with the other communities of the *Brachypodio-Holoschoenion* this community occurs in a limestone area on periodically desiccating soil. At the time of our visit the soil was almost dry, and the vegetation was slightly disturbed due to grazing by mules. *Lythrum junceum*, *Cirsium creticum* and *Mentha spicata* frequently occur in this community.

DORYCNIO-RUMICION CONGLOMERATAE all. nov.
(Table 6)

c.t.: *Rumex conglomeratus*, *Poa trivialis* ssp. *silvicola*, *Trifolium repens*, *Orchis laxiflora*, *Pulicaria dysenterica*, *Inula viscosa* (aff.: *Lotus uliginosus*, *Juncus inflexus*, *Epilobium hirsutum*).

In the lowlands of Western Crete several hydrophytic communities occur in “dynamic” habitats undergoing considerable periodic changes in waterlevel or moisture of the soil. Ecologically and floristically these communities are related to the *Agropyro-Rumicion crispis* from Western and Central Europe (cf. Westhoff & Den Held 1969: 107–111). We also see a relationship to the *Magnocaricion* in which we had tentatively placed some of these communities (Gradstein & Smittenberg 1968). However, true *Magnocaricion* communities seem to be lacking on Crete. We have decided to place these lowland communities in a separate alliance of *Holoschoenetalia*, characterised by a number of wide-spread hygrophytic species. *Holoschoenus romanus* occurs only rarely in the lowlands and is a characteristic species of the previous alliance.

Dorycnio-Caricetum otrubae ass. nov.

c.t.: *Carex otrubae*, *Dorycnium rectum*, *Convolvulus arvensis*, *Lythrum junceum*, *Juncus effusus*, *Carex hispida*, *Cyperus longus* ssp. *badius*.

This association is not uncommon in ditches at roadsides or along lakes and pools, on muddy soil drying up in summer. The association occurs on several places around the lake near Ajia. Well-developed stands were also seen in a freshwater pool at the coast near Jeorjioupolis. Fragments of the association, characterised by the occurrence of i.a. *Carex otrubae*, *Dorycnium rectum* and *Carex hispida*,

TABLE 6 DORYCNIO-RUMICION CONGLOMERATAE

Nr.	Dorycnio-Caricetum otrubae											Dorycnio-Cladietum					
												var. Lythrum					
Locality	P	P	A	A	A	A	A	G	G	G	G	A	A	A	A	A	G
Surface (m ²)	12	15	100	-	16	8	8	15	5	8	10	8	8	6	5	12	12
Waterdepth (cm)	-	-	5	-	-	3	-	-	-	25	25	-	-	-	-	-	-
Height (cm)	100	150	200	-	175	125	125	150	70	200	250	100	200	100	75	175	250
Cover (%)	90	60	100	-	80	80	35	99	80	80	80	90	20	80	80	70	100
Characteristic taxa Order																	
Juncus articulatus L.	-	-	+	-	-	-	-	-	-	-	-	-	1	-	-	-	
Juncus effusus L.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Dorycnium rectum (L.) Ser.	4	3	-	f	2	3	1	d	1	-	+	3	1	2	2	1	4
Lythrum junceum Banks et Solander	+	1	-	1	-	1	1	r	1	-	1	1	1	-	1	-	1
Oenanthe pimpinelloides L.	-	-	-	-	-	-	-	-	-	-	-	2	+	+	1	-	-
Galium constrictum Chaub.	-	-	1	-	1	1	1	r	+	-	+	-	1	+	-	-	-
Cirsium creticum (Lam.) Urv.	-	-	-	r	-	+	+	-	+	-	-	1	1	-	-	+	-
Rubus sanctus Schreb.	-	-	-	-	+	-	-	f	-	-	-	+	-	-	-	+	-
Cyperus longus L. ssp. badius (Desf.) Murb.	-	-	-	-	2	1	r	2	-	2	-	+	-	-	-	-	-
Carex distans L.	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-
Characteristic taxa Alliance																	
Rumex conglomeratus Murrey	-	1	1	r	2	1	-	-	-	-	-	-	-	-	-	+	-
Poa trivialis L. ssp. silvicola Hack	-	-	+	r	1	1	1	-	2	-	1	1	-	-	+	-	-
Trifolium repens L.	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Orchis laxiflora Lmk.	-	-	-	r	+	-	-	-	-	-	-	-	-	+	+	-	-
Pulicaria dysenterica (L.) Bernh.	-	1	1	r	2	1	-	-	-	-	-	-	-	-	-	+	-
Inula viscosa (L.) Aiton	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-
Characteristic taxa lower syntaxa																	
Carex otrubae Podp.	-	-	-	r	+	-	2	f	+	+	1	-	-	-	-	-	-
Convolvulus arvensis L.	+	-	-	-	-	+	+	-	1	+	1	-	-	-	-	-	-
Carex hispida Willd.	-	-	-	f	-	+	+	-	-	2	-	2	+	-	-	-	-
Cladium mariscus (L.) R.Br.	-	-	-	-	-	-	1	-	-	-	-	2	3	3	2	2	4
Apium nodiflorum (L.) Lag.	1	1	+	-	-	1	+	-	-	-	-	-	-	-	-	-	-
Schoenoplectus tabernaemontani (Gmel.) Palla	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sperganium neglectum Beeby	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Eleocharis palustris (L.) R. et Sch. ssp. pal.L.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carex divisa Huds.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Serapias lingua L.	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Imperata cylindrica (L.) P.B.	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3	-	-
Briza maxima L.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arundo donax L.	-	-	-	-	-	-	-	-	+	2	1	-	-	-	-	-	+
Equisetum telmateia Ehrh.	+	+	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Oxalis pes-caprae L.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Companions																	
Holoschoenus romanus (L.) Fritch ssp. australis ^{Greuter}	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Juncus inflexus L.	-	-	3	f	-	-	-	-	-	-	+	-	-	-	-	-	-
Epilobium hirsutum L.	-	-	5	f	-	-	-	-	-	-	-	-	-	-	-	-	-
Fuirena pubescens Kunth.	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Samolus valerandi L.	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
Nerium oleander L.	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-
Phragmites australis (Cav.) Trin. ex Steud.	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
Panicum repens L.	-	-	-	-	-	-	-	-	3	-	+	-	2	-	-	-	-
Scirpus maritimus L.	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
Iris pseudacorus L.	-	-	-	-	-	-	-	-	4	1	-	-	1	+	-	-	-
Euphorbia pubescens Vahl.	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Mentha aquatica L.	1	1	-	-	-	+	-	-	-	-	-	+	+	-	+	-	-
Typha angustata Bory et Chaub.	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	+
Polygonum salicifolium Brouss. et Willd.	1	1	+	r	1	+	-	-	-	-	-	1	2	+	-	-	3
Juncus heldreichianus Marsson ex Parl.	-	-	-	f	-	-	-	-	-	-	-	-	-	-	-	-	-
Medicago coronata (L.) Bartal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carex divulea Stokes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Equisetum ramosissimum Desf.	-	1	1	-	-	+	-	f	-	-	-	-	-	-	-	-	-
Plantago lanceolata L.	-	+	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
Vicia sativa L.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Galium aparine L.	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Anagallis arvensis L.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ranunculus neapolitanus Ten.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Record 23: Hydrocotyle vulgaris L. 1, 24: Agrostis semiverticillata (Forsk) Christ. +, 25: Polygomon monspeliensis (L.) Desf. +, 30: Ranunculus muricatus L. +, Alisma lanceolatum With. 2, 33: Ranunculus marginatus D'Urv. +, 34: Linum bienne Miller +, Myosotis cf. collina Hoffm. +, Avena barbata Brot. +, Gladiolus segetum Ker.-G. +, Carex flacca Schreb. 1, 35: Festuca gigantea Vill. f, Anthoxanthum odoratum L. f, Vulpia ciliata (Danth.) Link. f, Scirpus cernuus Vahl. f, Lotus uliginosus Schkuhr f, Briza minor L. f, Parentuella viscosa (L.) Caruel. f, Hieracium spec. r, 36: Bromus spec. 1, Geranium robertianum L. 1, Mentha spicata s.l. L. +, 39: Dactylis cf. hispanica Roth. +, Origanum spec. +																	

T A B L E 6 (continued)

marisci								Comm. Apium J.articulatus				Comm. C.div.& Oen.pimp var. Eleocho.				Comm. E. talm. Arundo donax						
var.inops								26	27	28	29	30	31	32	33	34	35	36	37	38	39	Nr.
18	19	20	21	22	23	24	25	A	A	A	A	A	A	A	A	A	A	P	P	A	A	Locality
10	10	100	16	25	16	20	10	16	15	100	25	9	12	8	9	8	25	8	20	15	6	Surface (m ²)
10	10	10	5	10	-	3	10	10	15	20	-	10	-	-	-	-	-	-	-	-	-	Waterdepht
250	300	300	175	350	175	600	200	50	90	150	175	90	70	90	75	60	60	500	500	60	50	Height
100	80	75	50	100	90	80	100	60	75	100	100	40	30	80	90	85	80	60	15	95	80	Cover
-----								-----				-----				-----				Characteristic taxa Order		
-								2 2 1 2				-				-				Juncus articulatus		
-								-				-				-				Juncus effusus		
+								1 1				2 2 1				+				Dorycnium rectum		
-								-				+				1 f				Lythrum junceum		
1								-				+				5 c				Oenanthe pimpinelloides		
-								1				2 2				1				Galium constrictum		
-								-				-				-				Cirsium creticum		
+								-				-				-				Rubus sanctus		
-								-				-				-				Cyp. longus ssp. badius		
-								-				-				c				Carex distans		
-----								-----				-----				-----				Charact. taxa Alliance		
+								+				+				+				Rumex conglomeratus		
-								1 2 2				1 1 1				-				Poa trivialis		
-								2 1 1				2 3				+				Trifolium repens		
-								-				+				+				Orchis laxiflora		
+								-				-				1 f				Pulicaria dysenterica		
-								-				-				1				Inula viscosa		
-----								-----				-----				-----				Charact. taxa lower syntaxa		
-								-				-				c				Carex otrubae		
-								-				-				-				Convolvulus arvensis		
-								-				-				-				Carex hispidula		
5								-				-				-				Cladium mariscus		
5								-				-				-				Apium nodiflorum		
5								-				-				-				Schoenoplectus tabernaemontani		
3								-				-				-				Sparganium neglectum		
5								-				-				-				Eleocharis palustris		
4								-				-				-				Carex divisa		
3								-				-				-				Serapias lingua		
2								-				-				-				Imperata cylindrica		
-								-				-				-				Briza maxima		
-								-				-				-				Arundo donax		
-								-				-				-				Equisetum telmateia		
-								-				-				-				Oxalis pes-caprae		
-----								-----				-----				-----				Companions		
-								-				-				2				Holoschoenus rom. ssp. austr.		
-								-				-				-				Juncus inflexus		
-								-				-				-				Epilobium hirsutum		
-								-				-				-				Fuirenia pubescens		
-								-				-				-				Samolus valerandi		
-								-				-				-				Nerium oleander		
-								-				-				-				Phragmites australis		
-								-				-				-				Panicum repens		
-								-				-				-				Scirpus maritimus		
-								-				-				-				Iris pseudacorus		
-								-				-				-				Euphorbia pubescens		
-								-				-				-				Mentha aquatica		
-								-				-				-				Typha angustata		
-								-				-				-				Polygonum angustata		
-								-				-				-				Juncus heldreichianus		
-								-				-				-				Medicago coronata		
-								-				-				-				Carex divulsa		
-								-				-				-				Equisetum ramosissimum		
-								-				-				-				Plantago lanceolata		
-								-				-				-				Vicia sativa		
-								-				-				-				Galium aparine		
-								-				-				-				Anagallis arvensis		
-								-				-				-				Ranunculus neapolitanus		

Record 1: Eupatorium glandulosum H., B. et K. +, 2: Nasturtium officinale R. Br. +, Eleocharis palustris R. et Sch. ssp. uniglumis (Link) Hartm. +, 5: Lathyrus neurolobus Boiss. et Heldr. +, 6: Lathyrus neurolobus Boiss. et Heldr. +, 8: Phalaris nodosa L. r, Oryzopsis miliacea (L.) Asch-Schw. r, Elytrichia spec. f, Lotus uliginosus Schkuhr r, 9: Sonchus glaucescens Jordan +, 12: Agrostis semiverticillata (Forsk.) Christ 1, Sonchus glaucescens Jordan 1, Cynodon dactylon (L.) Pers. 1, 13: Anagallis tenella L. 1, Gaudinia fragilis (L.) Pal. 1, 19: Festuca arundinacea Schreb. 1

are often present in ditches in the coastal areas where the soil may be slightly brackish.

The *Dorycnio-Caricetum otrubae* is somewhat related to the *Cypero-Caricetum otrubae* R. Tüx. described from Spain, which was placed in the *Magnocaricion* (Tüxen & Oberdorfer 1958). *Cyperus longus* and *Carex otrubae* are typical for both associations. Otherwise the two associations differ entirely in floristic composition.

Dorycnio-Cladietum marisci ass. nov.

c.t.: *Cladium mariscus*.

At Ajia and at Jeorjioupolis vegetations with *Cladium mariscus* occur, on gradually sloping, wet soil. The soil does not dry up in summer which may partly be caused by percolation of ground water. At Ajia the association forms a rather wide belt between the wet *Scirpetum maritimi* (*Phragmition*) and the dryer community of *Carex divisa* and *Oenanthe pimpinelloides* (*Dorycnio-Rumicion*).

Two variants are distinguished: 1. variant of *Lythrum junceum*, comprising drier phases of the association in which *Cladium* occurs scattered, together with several species of *Holoschoenetalia*. *Dorycnium rectum*, *Lythrum junceum* and *Oenanthe pimpinelloides* are particularly common here. This variant is found on rather solid soil in up to 20 cm deep, stagnant water. 2. variant *inops*, a facies of *Cladium mariscus* occurring next to the previous variant in deeper water (up to 40 cm). This variant is hardly different from monospecific *Cladium mariscus* communities, well-known from atlantic and continental Europe, which are generally put in the *Magnocaricion* Koch (cf. Westhoff & Den Held 1969).

The Cretan "*Cladietum marisci*", described here as a new association *Dorycnio-Cladietum marisci*, may best be compared with the western-mediterranean *Gentianeto-Mariscetum* Mol. & Talon 1950 (*Holoschoenetalia*), which is characterised by e.g. *Gentiana pneumonanthe* and *Mariscus serratus* (= *Cladium mariscus*). The reason for putting the *Gentianeto-Mariscetum* in the *Holoschoenetalia* in stead of the *Magnocaricion* was given by Braun-Blanquet et al. (1952: 134) as follows: "Au point de vue évolutif, elle [*Gentianeto-Mariscetum*] forme la transition entre les *Phragmitetalia* et les *Holoschoenetalia* Avec l'augmentation de l'humidité, *Mariscus serratus* devient de plus en plus envahissant et exclut toutes les espèces caractéristiques. Le groupement se rapproche alors du *Mariscetum serrati* W. Koch, mais sans pouvoir y être assimilé. La même remarque s'applique au groupements à *Mariscus* signalé par Horvatic de la Dalmatie et par Rivas Goday et Asensio Amor de l'Espagne". In our

opinion this remark is also true for the Cretan *Dorycnio-Cladietum marisci*.

Community of *Apium nodiflorum* and *Juncus articulatus*
c.t.: *Juncus articulatus*, *Apium nodiflorum*, *Eleocharis palustris*, *Schoenoplectus tabernaemontani*, *Sparganium neglectum*.

This community occurs at the eastern side of the lake near Ajia in an area of flooded arable fields, on muddy soil in 10–20 cm deep water. *Juncus articulatus* and *Eleocharis palustris* are the most characteristic species in this habitat. The abundance of *Apium* and the presence of *Schoenoplectus tabernaemontani* and *Sparganium neglectum* indicate a close relationship to the *Phragmitetalia*.

Community of *Carex divisa* and *Oenanthe pimpinelloides*
c.t.: *Carex divisa*, *Oenanthe pimpinelloides*, *Orchis laxiflora*.

This community occurs near Ajia on the edges of a pool and along the northern bank of the lake. It is a humid prairie of rather low sedges, rushes, and grasses, in which several species of orchids occur, e.g. *Serapias lingua* and *Orchis laxiflora*. The vegetation thrives on humid, loamy soil which superficially dries up in summer. The community forms a colourful belt between the wet *Phragmition* and the drier prairies on the slopes surrounding the lake.

Two variants are distinguished: 1. variant of *Eleocharis palustris*, on relatively wet soil. Differential species are *Eleocharis palustris*, *Dorycnium rectum*, *Poa trivialis*, and *Trifolium repens*. *Carex divisa* has its optimal occurrence in this variant. 2. variant of *Serapias lingua*; drier than the previous variant from which it differs by the presence of *Serapias lingua*, *Imperata cylindrica*, *Briza maxima*, and several elements of the prairies. *Oenanthe pimpinelloides* is most abundant in this variant.

Community of *Equisetum telmateia* and *Arundo donax*
c.t.: *Equisetum telmateia*, *Arundo donax*, *Oxalis pes-caprae*, *Rubus sanctus*, *Rumex conglomeratus*.

Equisetum telmateia is a characteristic species of shaded, sloping habitats with almost permanent humidity due to percolation of groundwater. Near Topolia at ca. 200 m the species was seen once in a springgrove community with *Platanus orientalis*. Near the coast at Platania and Ajia the species grows next to stands of the bamboo-reed (*Arundo donax*) on steep gravelly river-banks or (at Ajia) along the lake at the base of the dam. The community of *Equisetum telmateia* and *Arundo* is placed in the *Dorycnio-Rumicion* because of the frequent occurrence of

TABLE 7 JUNCETALIA MARITIMI

	Comm. Festuca & Elytrichia									
	Junc. subulato-maritimi						Comm. Schoenus et Centaurium			
	1	2	3	4	5	6	7	8	9	10
Nr.	1	2	3	4	5	6	7	8	9	10
Locality	G	G	G	G	G	G	G	G	G	G
Surface (m ²)	25	36	36	12	8	25	25	36	25	50
Height (cm)	80	80	90	200	100	50	60	100	200	150
Cover (%)	50	40	40	95	25	25	25	80	100	100
Characteristic taxa										
Juncus subulatus Forsk.	1	2	2	-	2	-	-	-	-	-
Juncus maritimus Lamk.	2	2	2	4	1	3	-	-	-	-
Juncus heldreichianus Marsson ex Parl.	{	{	{	{	{	{	1	4	2	2
Aster tripolium L.	-	+	+	-	1	1	-	1	-	-
Carex extensa Good.	-	+	+	+	1	3	+	1	-	+
Schoenus nigricans L.	-	-	-	-	-	-	5	5	5	-
Centaurium pulchellum (Schwartz) Druce	-	-	-	-	-	-	1	1	1	-
Blackstonia perfoliata L.	-	-	-	-	-	-	+	+	-	-
Inula viscosa (L.) Aiton	+	-	+	-	-	1	+	1	1	1
Festuca arundinacea Schreb.	-	-	-	-	-	-	-	-	-	5
Elytrichia elongata (Host.) Nevski	2	+	2	-	-	-	-	-	-	3
Companions										
Atriplex hastata L.	-	+	1	+	-	-	-	-	-	-
Polygonum monspeliensis (L.) Desf.	-	-	-	+	+	-	-	+	-	-
Samolus valerandi L.	-	-	-	1	-	1	-	+	-	-
Apium graveolens L.	1	-	-	-	-	-	-	-	-	-
Plantago coronopus L.	-	-	-	-	-	-	1	-	-	-
Elytrichia juncea (L.) Nevski	-	-	-	-	-	-	-	2	-	-
Lythrum junceum Banks et Solander	()	-	+	+	-	-	1	2	-	1
Carex divisa Huds.	2	-	2	-	-	-	-	-	-	-
Lotus uliginosus Schkuhr.	+	-	1	-	-	-	+	-	-	1
Cladium mariscus (L.) R.Br.	-	-	-	1	-	-	-	-	-	-
Arundo donax L.	-	-	-	1	+	1	()	+	-	-
Phragmites australis (Cav) Trin.ex Steud.	-	1	1	-	-	-	+	-	-	-
Panicum repens L.	-	-	-	-	-	-	-	+	1	-
Apium nodiflorum (L.) Lag.	-	-	-	2	-	-	-	-	-	-
Scirpus cernuus Vahl.	1	+	+	-	-	-	-	-	-	-
Juncus bufonius L.	-	+	+	-	-	-	-	-	-	-
Crepis spec.	-	-	-	-	-	-	1	1	-	-
Briza minor L.	-	-	-	-	-	-	-	1	-	-
Record 1: Eromus racemosus L. +, 2: Spargularia marina L. +, 7: Polygonum maritimum Willd. +, Cynodon dactylon (L.) Pers. +, Caudinia fragilis (L.) Pal. +, Silene gallica L. +, 10: Scirpus maritimus L. +, Dorycnium rectum (L.) Ser. +, Rumex conglomeratus Murray +, Ranunculus cf. muricatus L. +										

Holoschoenetalia elements, e.g. *Rubus sanctus*, *Rumex conglomeratus*, *Poa trivialis*, and *Oenanthe pimpinelloides*. Pure stands of *Arundo*, which are commonly seen along dikes and ditches in arable fields, do not belong here. Their syntaxonomic position is uncertain.

JUNCETEA MARITIMI Br.-Bl. 1931 (Table 7)

JUNCETALIA MARITIMI Br.-Bl. 1931 Alliance?

Juncetum subulato-maritimi ass. nov.

c.t.: *Juncus subulatus*, *Juncus maritimus*, *Juncus heldreichianus*, *Carex extensa*, *Aster tripolium*.

This association occurs on brackish alluvial soils along the Cretan coast. The toplayer of the soil desiccates in summer, showing a pattern of cracks. Physiognomically this community is characterised by dense and floristically rather poor mats of *Juncus maritimus* and *J. subulatus*, mixed with larger tufts of *J. heldreichianus*. The vegetation is often grazed by mules.

At Jeorjioupolis and at Vai in eastern Crete we saw vast stands of this association in brackish swamps near the beach. Rechanger (1951) reports stands belonging to this association from Iráklio and Ajos Nikoláos.

Communities of *Juncus heldreichianus* ("acutus") and *J. maritimus* have been recorded from many different areas in the Mediterranean region: France, Venice, Palestine, Egypt and the Canary Islands (Wolff 1968, Sunding 1972). No attempt has been made so far to clarify the syntaxonomic position of these communities. The confusion existing in the application of the specific epitheta "acutus", "maritimus", and "heldreichianus" to the *Juncus* species in this vegetation (Greuter 1973: 70) makes this task even more difficult. Some communities have been assigned to the rather heterogenic *Juncetum maritimi* Pignatti 1953. The Cretan community is well distinguished from the *Juncetum maritimi* by the presence of *Juncus subulatus* and therefore is described here as a new association. The *Juncetum subulato-maritimi* is floristically related to the *Scirpetum maritimi et litoralis*, and to the coastal scrub of *Tamarix* spp. (not studied).

Community of *Schoenus nigricans* and *Centaurium pulchellum*

c.t.: *Schoenus nigricans*, *Centaurium pulchellum*, *Blackstonia perfoliata*, *Inula viscosa*, *Carex extensa*.

This is a typical gradient community which forms a narrow belt at the foot of the dunes near Jeorjioupolis,

adjacent to the *Juncetum subulato-maritimi*. The community is richer in species than the *Juncetum subulato-maritimi*. *Schoenus nigricans* is the dominating species. The community has affinity to the west-mediterranean *Plantaginion crassifoliae* Br.-Bl. 1931. Records of similar communities at the west coast of the Peloponnesos are given by Lavrentiades (1964: 276).

Community of *Festuca arundinacea* and *Elytrigia elongata*
c.t.: *Festuca arundinacea*, *Elytrigia elongata*.

Like the previous community this vegetation was only seen at the coast near Jeorjioupolis. The community of *Festuca* and *Elymus* constitutes a meadow of robust grasses between the *Juncetum subulato-maritimi* and the surrounding arable fields. The soil was rather uneven and dried up at the time of our visit. The presence of *Lythrum junceum*, *Dorycnium rectum* and *Rumex conglomeratus* indicates a relationship to the *Dorycnio-Caricetum otrubae* (*Holoschoenetalia*).

ISOETO-NANOJUNCETEA Br.-Bl. & R. Tüx. 1943

ISOETALIA Br.-Bl. 1931

ISOETION Br.-Bl. 1931 (Table 8)

This alliance comprises micro-communities of several species of *Isoetes* and of minute therophytes which are not uncommon in the Mediterranean region and are often overlooked. The communities develop in winter and early spring on hillsides and on tracks in small depressions. The soil in these depressions is humid from late autumn to early spring, favoring germination of the characteristic therophytic species. Seven associations were provisionally assigned to this alliance by Braun-Blanquet (1936). Three of them were only known from N. Africa. Pietsch (1973) lists fourteen associations from the European Mediterranean region. Runemark (1971, p. 6-7) reported communities belonging to this alliance from the Central Aegean area.

Junco-Isoetetum hystricis Allorge 1922

c.t.: *Juncus capitatus*, *Isoetes hystrix*, *Juncus bufonius*,
Euphorbia exigua, *Radiola linoides*, *Briza minor*.

This community was seen on hillsides in the Fasas valley on humid loamy soil in a *Cistus phrygana*, and in a humid meadow of *Andropogon hirtus* and *Imperata cylindrica* along the lake of Ajia. The association was originally described from N. Africa. The Cretan community differs from the N. African community by the absence of *Laurentia*

TABLE 8 ISOETION

Junco-Isoetum hystricis																																																																																																																																																																																																																																																									
Nr.	1	2	3	4	5	6	7	8	9																																																																																																																																																																																																																																																
Locality	F	F	A	A	A	A	A	A	A																																																																																																																																																																																																																																																
Surface (m ²)	0,5	0,25	0,5	0,5	1	0,25	0,12	9	4																																																																																																																																																																																																																																																
Exposition	E.	N	-	-	-	-	-	S	S																																																																																																																																																																																																																																																
Inclination (°)	3°	5°	-	-	-	-	-	3°	2°																																																																																																																																																																																																																																																
Height (cm)	-	-	25	25	25	25	30	80	75																																																																																																																																																																																																																																																
Cover (%)	-	-	5	25	30	15	30	40	50																																																																																																																																																																																																																																																
Characteristic taxa	<table border="1" style="border-style: dashed; width: 100%;"> <tbody> <tr> <td>Juncus capitatus C.E. Weig</td> <td>fr</td> <td>r</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>+</td> <td>-</td> <td>-</td> </tr> <tr> <td>Isoetes hystrix Bory</td> <td>r</td> <td>r</td> <td>-</td> <td>2^a</td> <td>1</td> <td>1</td> <td>2</td> <td>1</td> <td>1</td> </tr> <tr> <td>Euphorbia exigua L.</td> <td>fr</td> <td>fr</td> <td>-</td> <td>1</td> <td>+</td> <td>1</td> <td>1</td> <td>-</td> <td>-</td> </tr> <tr> <td>Radiola linoides Roth.</td> <td>-</td> <td>fr</td> <td>-</td> <td>+</td> <td>1</td> <td>1</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>Juncus bufonius L.</td> <td>-</td> <td>-</td> <td>+</td> <td>+</td> <td>1</td> <td>+</td> <td>+</td> <td>+</td> <td>1</td> </tr> <tr> <td>Briza minor L.</td> <td>-</td> <td>-</td> <td>1</td> <td>+</td> <td>1</td> <td>-</td> <td>-</td> <td>1</td> <td>1</td> </tr> </tbody> </table>									Juncus capitatus C.E. Weig	fr	r	1	1	1	1	+	-	-	Isoetes hystrix Bory	r	r	-	2 ^a	1	1	2	1	1	Euphorbia exigua L.	fr	fr	-	1	+	1	1	-	-	Radiola linoides Roth.	-	fr	-	+	1	1	-	-	-	Juncus bufonius L.	-	-	+	+	1	+	+	+	1	Briza minor L.	-	-	1	+	1	-	-	1	1																																																																																																																																																																																				
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Companions	<table border="1"> <tbody> <tr> <td>Vulpia ciliata (Danth.) Link</td> <td>c</td> <td>d</td> <td>+</td> <td>1</td> <td>-</td> <td>1</td> <td>+</td> <td>-</td> <td>+</td> </tr> <tr> <td>Aira capillaris Host.</td> <td>-</td> <td>fr</td> <td>+</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>+</td> </tr> <tr> <td>Linum bienne Miller</td> <td>-</td> <td>fr</td> <td>1</td> <td>+</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>Centaurium maritimum (L.) Fritch.</td> <td>r</td> <td>r</td> <td>1</td> <td>+</td> <td>1</td> <td>+</td> <td>+</td> <td>-</td> <td>-</td> </tr> <tr> <td>Scirpus cernuus Vahl.</td> <td>-</td> <td>-</td> <td>+</td> <td>+</td> <td>+</td> <td>-</td> <td>1</td> <td>1</td> <td>2^a</td> </tr> <tr> <td>Plantago bellardii Allione</td> <td>r</td> <td>fr</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>Bellis annua L.</td> <td>c</td> <td>r</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>Anagallis arvensis L.</td> <td>r</td> <td>-</td> <td>+</td> <td>-</td> <td>-</td> <td>1</td> <td>+</td> <td>+</td> <td>-</td> </tr> <tr> <td>Lotus corniculatus L.</td> <td>r</td> <td>-</td> <td>+</td> <td>+</td> <td>+</td> <td>-</td> <td>-</td> <td>1</td> <td>1</td> </tr> <tr> <td>Compositae vegetative</td> <td>-</td> <td>-</td> <td>-</td> <td>+</td> <td>+</td> <td>+</td> <td>+</td> <td>1</td> <td>1</td> </tr> <tr> <td>Anthoxanthum odoratum L.</td> <td>-</td> <td>-</td> <td>-</td> <td>1</td> <td>-</td> <td>+</td> <td>-</td> <td>1</td> <td>1</td> </tr> <tr> <td>Carex flacca Schreb. ssp. serratula Gr.</td> <td>-</td> <td>-</td> <td>1</td> <td>+</td> <td>1</td> <td>-</td> <td>-</td> <td>1</td> <td>1</td> </tr> <tr> <td>Briza maxima L.</td> <td>-</td> <td>-</td> <td>+</td> <td>1</td> <td>+</td> <td>-</td> <td>+</td> <td>-</td> <td>-</td> </tr> <tr> <td>Ranunculus spec.</td> <td>-</td> <td>-</td> <td>-</td> <td>1</td> <td>2a</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>Parentucellia viscosa (L.) Caruel</td> <td>-</td> <td>-</td> <td>-</td> <td>+</td> <td>+</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>Holoschoenus romanus Fritch ssp. austr.Gr.</td> <td>-</td> <td>-</td> <td>-</td> <td>+</td> <td>+</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>Ornithogalum cf. narbonense L.</td> <td>-</td> <td>-</td> <td>-</td> <td>+</td> <td>+</td> <td>+</td> <td>-</td> <td>-</td> <td>+</td> </tr> <tr> <td>Andropogon hirtus L.</td> <td>-</td> <td>-</td> <td>+</td> <td>+</td> <td>-</td> <td>-</td> <td>+</td> <td>3</td> <td>-</td> </tr> <tr> <td>Imperata cylindrica (L.) P.B.</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>+</td> <td>2a</td> <td>3</td> </tr> <tr> <td>Oenanthe pimpinelloides L.</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>+</td> <td>-</td> <td>-</td> <td>1</td> <td>1</td> </tr> <tr> <td>Serapias lingua L.</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>+</td> <td>-</td> <td>+</td> <td>-</td> </tr> <tr> <td>Orchis laxiflora Lmk.</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>+</td> <td>+</td> <td>+</td> <td>+</td> </tr> <tr> <td>Dorycnium rectum (L.) Ser.</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>1</td> </tr> <tr> <td>Panicum repens L.</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>1</td> </tr> </tbody> </table>									Vulpia ciliata (Danth.) Link	c	d	+	1	-	1	+	-	+	Aira capillaris Host.	-	fr	+	1	1	1	1	1	+	Linum bienne Miller	-	fr	1	+	1	1	1	1	1	Centaurium maritimum (L.) Fritch.	r	r	1	+	1	+	+	-	-	Scirpus cernuus Vahl.	-	-	+	+	+	-	1	1	2 ^a	Plantago bellardii Allione	r	fr	-	-	-	-	-	-	-	Bellis annua L.	c	r	-	-	-	-	-	-	-	Anagallis arvensis L.	r	-	+	-	-	1	+	+	-	Lotus corniculatus L.	r	-	+	+	+	-	-	1	1	Compositae vegetative	-	-	-	+	+	+	+	1	1	Anthoxanthum odoratum L.	-	-	-	1	-	+	-	1	1	Carex flacca Schreb. ssp. serratula Gr.	-	-	1	+	1	-	-	1	1	Briza maxima L.	-	-	+	1	+	-	+	-	-	Ranunculus spec.	-	-	-	1	2a	-	-	-	-	Parentucellia viscosa (L.) Caruel	-	-	-	+	+	-	-	-	-	Holoschoenus romanus Fritch ssp. austr.Gr.	-	-	-	+	+	-	-	-	-	Ornithogalum cf. narbonense L.	-	-	-	+	+	+	-	-	+	Andropogon hirtus L.	-	-	+	+	-	-	+	3	-	Imperata cylindrica (L.) P.B.	-	-	-	-	-	-	+	2a	3	Oenanthe pimpinelloides L.	-	-	-	-	+	-	-	1	1	Serapias lingua L.	-	-	-	-	-	+	-	+	-	Orchis laxiflora Lmk.	-	-	-	-	-	+	+	+	+	Dorycnium rectum (L.) Ser.	-	-	-	-	-	-	-	-	1	Panicum repens L.	-	-	-	-	-	-	-	-	1
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<p>Record 1: Serapias laxiflora Schaub r; 2: Silene colorata Poir. r, Tordylium apulum L. r ; 3: Sagina apetala Ard., Gnaphalium cf. uliginosum L. + ;8: Medicago coronata (L.) Barta + ; 9: Juncus acutus L. + , Mentha aquatica L. + .</p>																																																																																																																																																																																																																																																									

michelii, *Cicendia filiformis*, and *Trifolium micranthum*. The latter three species have been reported from the Central Aegean islands by Runemark (l.c.).

NANOCYPERETALIA Klika 1935

NANOCYPERION FLAVESCENTIS Koch 1926

Community of *Montia fontana* ssp. *chondrosperma*
c.t.: *Montia fontana* ssp. *chondrosperma*.

This community was seen once on the Omalos, at ca. 1000 m in running water close to a spring, on rather muddy gravel. The soil is strongly calcareous and probably dries up entirely in summer. The vegetation is floristically heterogeneous and rather ruderal owing to disturbance by sheep, and is made up of scattered growing plants. We recorded *Poa annua* (2b), *Montia* (2a), *Holoschoenus romanus* ssp. *australis* (2a) and *Stellaria media* ssp. *postii* (2a) as the more frequent taxa. Companions are *Ranunculus ficaria* (1), *R. paludosus* (1), *Sagina apetala* (+), *Plantago coronopus* (+) and *Bellis annua* (+). *Poa annua* and *Stellaria media* are particularly indicative of the ruderal character of the vegetation.

The community is apparently very rare in the eastern Mediterranean region since this is the only known locality of *Montia* in the Aegean area. In West and Central Europe *Montia fontana* ssp. *chondrosperma* (Fenzl) Walters (= *Montia fontana* ssp. *fontana* var. *chondrosperma* Fenzl = *Montia verna* Néck.) is considered a characteristic taxon of the alliance *Nanocyperion flavescens* (e.g. Westhoff & Den Held 1969), which is the reason why we have, though tentatively, thus classified the Cretan community.

ALNO-POPULETEA Fukarek 1968 (Table 9)

PLATANION ORIENTALIS I. Karpati 1962

Platanetum orientalis Auct. (cf. Rechinger 1951, Zohary 1962)

c.t.: *Platanus orientalis*, *Cyclamen creticum* (endemic!), *Carex distachya*, *Geranium robertianum*, *Rhagadiolus stellatus*, *Parietaria lusitanica*, *Luzula forsteri*, *Ranunculus ficaria*.

This is the typical riparian woodland which is found in the colline and lower montane zones of the island, both in limestone and in schist areas. Usually the plane-tree groves cover a narrow belt of only 10 to 20 m wide, on either side of brooks and rivers in rather narrow valleys.

In wider valleys the riparian woodland has virtually disappeared due to cultivation of the fertile banks of the rivers. The herb-layer of the *Platanetum* varies considerably in floristic composition due to variation in edaphic conditions and human influence. Record 4 was taken in a rather natural stand, characterised by the occurrence of *Carex remota* and *Galium scabrum*. On Crete these two species are rare and probably restricted to the *Platanetum* of the schist mountains in the westernmost part of the island. The other records were made in stands close to arable fields, as is seen by the presence of ruderal and segetal companions, e.g. *Arum italicum*, *Euphorbia pepus*, *Medicago coronata* and *Ranunculus chaerophyllus*.

The *Platanetum orientalis* seems to be wide-spread and common in the Aegean region (Rechinger 1951).

Community of *Castanea sativa*

c.t.: *Castanea sativa*, *Pteridium aquilinum*.

In the westernmost part of the island (highlands of Elos) the riparian *Platanetum orientalis* is sometimes replaced by groves of *Castanea sativa*. According to Rechinger (1951) *Castanea sativa* is restricted on Crete to this area and is found only on rather acid soils (schists?) along rivulets. The community comprises several characteristic elements of the *Platanetum*, e.g. *Cyclamen creticum*, *Rhagadiolus stellatus*, and *Parietaria lusitanica*.

The herb-layer is locally dominated by *Pteridium aquilinum*, which is a typical species of mediterranean *Castanea* woods.

Community of *Platanus orientalis* and *Equisetum telmateia*

c.t.: *Platanus orientalis*, *Equisetum telmateia*.

This is a typical spring-grove community which was seen only once on a wet and slippery slope at a spring near Topolia, under large trees of *Platanus orientalis*. *Equisetum telmateia* occurs here in a dense stand over an area of at least 300 m². The wet soil is covered by leaves of the plane trees. Only few companion species are seen in this community, most of them taxa of the *Adiantion* (*Adiantum speculum-veneris*, *Samolus valerandi*) or *Holoschoenetalia* (*Dorycnium rectum*, *Rubus sanctus*, *Cirsium creticum*). *Hedera helix* grows abundantly up the stems of the plane trees and locally also covers the soil.

Summary

The hydrophilous plant communities of Western Crete described and classified in this paper belong to the follow-

TABLE 9 PLATANION ORIENTALIS

Nr.	Comm. Platanus & Equisetum					
	Comm. Castanea sativa					6
	Platanetum orientalis				5	
Locality	1	2	3	4		5	6
Surface (m ²)	T	K	K	F	K	T
Tree-layer height (m)	70	50	5	20	50	100
Tree-layer cover (%)	15	12	-	9	15	10
Shrub-layer height (m)	15	10	-	30	5	15
Shrub-layer cover (%)	-	-	4	3	-	-
Herb-layer height (cm)	-	-	10	5	-	-
Herb-layer cover (%)	75	45	75	100	75	75
Moss-layer cover (%)	15	40	80	25	60	30
	5	1	-	-	-	1
Characteristic taxa						
<i>Platanus orientalis</i> L.	2	2	1	2	-	2
<i>Cyclamen creticum</i> Hildebr.	1	1	1	1	+	-
<i>Carex distachya</i> Desf.	+	-	+	+	-	-
<i>Geranium robertianum</i> L.	+	1	1	+	+	-
<i>Rhagadiolus stellatus</i> (L.) Willd.	+	2	1	-	1	-
<i>Parietaria lusetanica</i> L.	+	+	1	-	1	-
<i>Luzula forsteri</i> (L.) DC.	-	+	+	+	+	-
<i>Ranunculus ficaria</i> L.	+	2	+	-	-	-
<i>Castanea sativa</i> Miller	-	-	-	-	1	-
<i>Psidium aquilinum</i> (L.) Kuhn	-	-	-	-	2	-
<i>Equisetum telmateia</i> Ehrh.	-	-	-	-	-	3
Companions						
<i>Nerium oleander</i> L.	+	()	2	2	-	2
<i>Galium aparine</i> L.	1	+	1	+	+	-
<i>Euphorbia characias</i> L.	2	-	-	-	-	+
<i>Melica rectiflora</i> Boiss. et Heldr.	1	-	-	-	-	-
<i>Dryopteris pallida</i> (Bory) Fomin.	1	-	-	-	-	-
<i>Cardamine graeca</i> L.	1	-	-	-	-	-
<i>Brachypodium sylvaticum</i> (Huds.) R. et S.	-	-	-	2	-	-
<i>Rubia peregrina</i> L.	-	-	-	1	-	-
<i>Athyrium filix-femina</i> (L.) Roth.	-	-	-	1	-	-
<i>Carex cretica</i> Gradst. et Kern	-	-	1	+	-	-
<i>Holoschoenus romanus</i> (L.) Fritch.	-	-	1	+	-	-
<i>Carex flacca</i> Schreb.	-	-	-	-	-	1
<i>Hedera helix</i> L.	-	-	-	-	-	1
<i>Eucladium verticillatum</i> (Brid.) B.S.G.	-	-	-	-	-	1
<i>Samolus valerandi</i> L.	-	-	-	+	-	+
<i>Adiantum capillis-veneris</i> L.	-	-	+	+	-	1
<i>Oenanthe pimpinelloides</i> L.	-	+	1	-	-	+
<i>Tordylium apulum</i> L.	-	1	1	+	-	-
<i>Arisarum vulgare</i> Targ.-Tozz.	-	-	+	+	1	-
<i>Cardamine hirsuta</i> L.	+	-	+	-	-	-
<i>Selaginella dentata</i> L.	+	+	-	-	-	+
<i>Carex divulsa</i> Stokes	+	+	-	-	-	-
<i>Melica minuta</i> L.	+	1	-	-	-	-
<i>Ranunculus paludosus</i> Poiret	-	+	2	-	-	-
<i>Arum italicum</i> Mill.	-	+	+	-	-	-
<i>Euphorbia peplus</i> L.	-	1	1	-	1	-
<i>Bromus sterilis</i> L.	-	+	1	-	+	-
cf. <i>Orlaya grandiflora</i> (L.) Hoffm.	-	+	1	-	+	-
<i>Medicago coronata</i> (L.) Bartal.	+	+	+	-	2	-
<i>Veronica cymbalaria</i> Bodard.	+	+	-	-	+	-
<i>Muscari comosum</i> (L.) Miller	-	1	-	-	+	-
<i>Sherardia arvensis</i> L.	-	1	-	-	+	-
<i>Hieracium spec.</i>	-	-	-	-	2	-
<i>Fissidens bryoides</i> Hedw.	+	+	-	-	-	+
<i>Lunularia cruciata</i> (L) Dum.	+	-	-	-	-	+

Rec. 1: *Rhynchostegiella tenella* (Dicks.) Limpr. +, *Fossombronina angulosa* (Dicks.) Raddi +

Rec. 2: *Reboulia hemisphaerica* (L.) Raddi +, *Trichostomum mutabile* Bruch. +, *Bryum cf. donianum* Grev. +

Rec. 4: *Carex remota* L. +, *Galium scabrum* L. +, *Osmunda regalis* L. +

Rec. 6: *Dorycnium rectum* (L.) Ser. +, *Cirsium creticum* (Lam.) Urv. +, *Aloina ambigua* B.S.G. Limpr. +

Southbia stillicidorum (Raddi) Lindb. +, *Anthoceros laevis* L. +, cf. *Leiocola turbinata* (Raddi) Buch. +

ing classes: *Potametea*, *Adiantetea*, *Phragmitetea*, *Molinio-Juncetea*, *Juncetea maritimi*, *Isoeto-Nanojuncetea* and *Alno-Populetea*. Two new alliances and five new associations are described: *Brachypodio-Holoschoenion*, *Dorycnio-Rumicion conglomeratae*, *Dorycnio-Caricetum otrubae*, *Dorycnio-Cladietum marisci* and *Caricetum creticae* (all *Molinio-Juncetea*), *Acrocladio-Adiantetum (Adiantetea)*, and *Juncetum subulato-maritimi (Juncetea maritimi)*.

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