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Diversity of aestival plant communities of irrigated garden croplands in Cretan villages*

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Abstract

A numerical classification of 36 relevés of the spontaneous plants occurring in irrigated garden croplands in Crete revealed three plant communities with different species combinations described here as new: *Solano nitidibaccati-Amaranthetum powellii*, *Amaranthetum blitoidis-viridis* und *Digitario sanguinalis-Cyperetum rotundi*. The associations show distinct local distribution patterns and differ in their ecological preferences. Similarities with and differences to other aestival plant communities of Mediterranean and Balkanic croplands are outlined. The proportion of alien species established in Cretan gardens totals up to about one third – more than in all other known plant communities in Crete. A comparison with a list of ruderal plants in the Aegean from the first half of the 20th century suggests that the ruderal vegetation has changed a lot since, and that species of the genera *Chenopodium* and *Amaranthus* have become much more common. Such changes probably result from the expanse of irrigated croplands.

Keywords: Aegean, Alien plants, *Eragrostietalia*, Greece, Irrigation, Mediterranean croplands, Neophytes, Rural gardens, Summer weeds, Vegetation classification.

Schlüsselwörter: Adventivpflanzen, Ägäis, Bewässerungsfeldbau, Dorfvegetation, *Eragrostietalia*, Griechenland, Mediterrane Nutzgärten, Neophyten, Sommerannuelle Unkräuter, Vegetationsklassifikation.

1. Introduction

Irrigated croplands are among the most widespread habitats in Mediterranean landscapes – and also one of the most converted and affected by man. Rural gardens are croplands on a domestic scale cultivated by possibly generations of villagers. In Crete, as elsewhere in much of the European Mediterranean, such gardens are now a relic of former subsistence farming. They served the local needs of vegetable production. As today even small and remote villages became part of extensive food marketing networks the relevance of such gardens is vanishing. Most of what the Cretan agriculture produces and exports is cultivated on a large scale by means of irrigation systems in

* This contribution is dedicated to Dietmar Brandes, phytosociologist and ecologist of synanthropic vegetation and with a focus on alien plants and their ecology, on occasion of his 60th birthday. His perspectives of a Central European botanist on southern European destinations, including Crete, have often been both inspiring and enlightening to me.

plastic greenhouses (tomatoes, aubergines, bananas, cucumbers), on fields (melons, potatoes) and in plantations (olives, grapes, citrus fruit). This market-driven agriculture has increased enormously during the last two to three decades. It depends on water resources from deep wells, artificial lakes and the exploitation of sources and rivers. The water is pumped and piped through hose lines for sometimes kilometres. Whilst also depending on irrigation, rural gardens frequently use nearby surface waters diverted through aquifers, or simply the local water supply is utilized. Village gardens in Crete may exceed 400-600 m² but in order to keep labour within reasonable limits often less than 100 m² are currently cultivated. The gardens are situated next to the houses or clustered at the margins of the villages. Typically a variety of vegetables and culinary herbs are cultivated in neat separate patches or sometimes in mixed ones (Fig. 1). Common summer crops grown in Cretan gardens include beans (*Phaseolus vulgaris* and *Ph. lunatus*, φασολιά), tomatoes (*Lycopersicon esculentum*, ντοματιά), aubergine (*Solanum melongena*, μελιτζάνα), amaranth (*Amaranthus blitum*, βλίτο), zucchini (*Cucurbita pepo* var. *giromontii*, κολοκυθιά), moreover cucumbers (*Cucumis sativus*, αγγουριά), cabbage (*Brassica oleracea* vars. *capitata* and *italica*, λάχανο and μπρόκολο), lettuce (*Lactuca sativa* var. *romana*, μαρούλι), okra (*Abelmoschus esculentus*, μπάμιες), onions (*Allium cepa*, κρεμμύδι), artichokes (*Cynara cardunculus*, αγκινάρα), potatoes (*Solanum tuberosum*, πατάτα), maize (*Zea mays*, καλαμπόκι), melons (*Cucumis melo*, πεπόνι), peppers (*Capsicum annuum*, πιπεριά), and many others.

The weedy vegetation of Mediterranean irrigation croplands differs from that of rainfed agricultural land by the prevalence of summer-annual plants germinating with rising temperatures in spring. The phenological peak of flowering and fruiting is aestival and autumnal rather than vernal. More natural habitats with good water supply during summer such as springs, shores and wet marshes are different in being less subjected to mechanical disturbance, in their generally higher plant cover and lower proportion of annual plants. Similar to the vegetation of irrigated croplands are further the plant communities of nitrophilous annual weeds in non-cultivated sites.

Although assemblages of weedy plants are particularly common in the warmer parts of Europe and especially in the Mediterranean they have not been studied much in the eastern Mediterranean and the southern Balkan peninsula. More than 50 years ago, OBERDORFER (1954) provided a pioneer work on this kind of vegetation with phytosociological data from northern Greece, to which little was added since. In Crete, BRANDES (2002) contributed to the knowledge of mural vegetation in settlements, and the plant communities associated with cereal crops were treated in recent papers by BERGMEIER (2005, 2006). However, the aestival vegetation of irrigated croplands of Greece and the Aegean has not been studied before in details of species composition, ecology and distribution. This alone being sufficient reason for the present study, it was further prompted by the assumption that irrigated gardens were probably the first suitable habitats for the naturalization of a large number of alien weeds (Figs. 2-4). Some of these neophytes, under the present conditions of agro-

economic globalization, turned out to become invasive, or might embark on such a career in future. The present study attempts to fill the lack of knowledge and to approach the following questions:

- Are there different plant communities in rural gardens as a result of different habitat and bioclimatical conditions in spite of the invariably levelling effect of the fundamental environmental factor "summerly irrigation"? And if so, which factors are vital for the differences between communities?
- Which alien, and potentially invasive, species occur in rural gardens? Is there any evidence of floristic change over the last decades, of invasiveness of taxa now common in gardens and fields?
- As neophytes have proved to be able to expand more or less rapidly one might expect any habitat-related differentiation between communities to be due to indigenous species rather than to introduced ones. Do alien species turn out to be less habitat-specific than indigenous ones in the same array of communities?

2. Materials and methods

Crete is the biggest island of the South Aegean. Climatic conditions are pronouncedly Mediterranean throughout the island but there is a clear west-east gradient with subhumid-oceanic conditions prevalent in the west, and subarid climate in the east. The highest peaks of Crete reach almost 2500 m but deep soils suitable for agriculture are restricted to the lowlands and foothills and to a few mountain basins and plains (oropedio) the highest of which (Katharo) being at 1100 m. For the present study 36 vegetation relevés were sampled in rural gardens from almost as many villages distributed all over Crete (Fig. 5, App. 1). Field studies were carried out in 2006 (August 20 through September 3) and 2007 (September 2-5). The size of the relevé plots was more or less uniform at (16-) 25 m². Location, co-ordinates, altitude, cover of spontaneous plants and soil texture were noted. The cultivated garden crops as far as recognizable in summer were also recorded, although not exhaustive beyond the plot margins. All spontaneously occurring plant species were recorded and the cover of each estimated using the BRAUN-BLANQUET scale (KENT & COKER 1992, DIERSCHKE 1994). Species growing above-ground only in winter/spring have not been ascertained. Herbarium specimens were collected of almost all species found (though not necessarily from within the plots) and deposited in the author's private herbarium in Göttingen. The nomenclature of the taxa follows JAHN & SCHÖNFELDER (1995) and TURLAND & CHILTON (2007), for species of the genus *Amaranthus* RAUS (1997), and for grasses BÖHLING & SCHOLZ (2003).

The relevés were entered and edited in the phytosociological database TURBOVEG (HENNEKENS & SCHAMINÉE 2001) and numerically classified using the TWINSPAN tool (with 3 pseudospecies cut levels) of the program JUICE (TICHÝ 2002). Of the classified units three were found interpretable, one in the first hierarchical level, and

the other two in the second division. As no such catalogue for Greece and the Aegean exists, no attempt was made to assign the taxa to syntaxonomical categories. The classified plant communities, hitherto unknown, were formally described as associations and the Code of Phytosociological Nomenclature was applied (WEBER et al. 2000). On the basis of supra-regional character and differential species it was possible to assign the three communities to syntaxa of alliance and higher level.

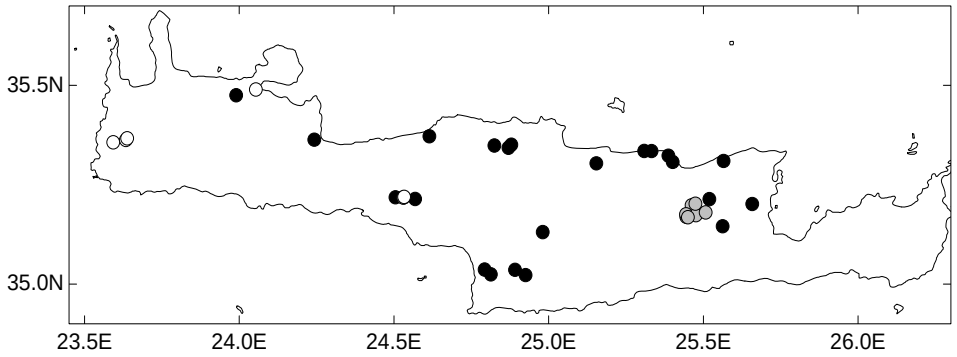

Fig. 5: Plot map of the three Cretan plant communities of rural garden croplands. Grey dots, *Solano nitidibaccatae-Amaranthetum powellii*; black dots, *Amaranthetum blitoidis-viridis*; white dots, *Digitario sanguinalis-Cyperetum rotundi*.

Abb. 5: Karte der Nachweise der drei Pflanzengesellschaften dörflicher Nutzgärten in Kreta. Graue Punkte: *Solano nitidibaccatae-Amaranthetum powellii*; schwarze Punkte: *Amaranthetum blitoidis-viridis*; weiße Punkte: *Digitario sanguinalis-Cyperetum rotundi*.

3. Results

3.1. Plant communities

The association *Solano nitidibaccati-Amaranthetum powellii* is significant for rural gardens on the oropedio (polje) of Lasithi (an extensive plateau in the Dikti range in eastern central Crete) (Fig. 5). Characteristic species are the tall competitive weeds *Amaranthus powellii*, *Datura stramonium* and *Solanum physalifolium* var. *nitidibaccatum* (Table 1, Fig. 2). The latter species was recorded as new to Crete only few years ago but might have become established much longer and is now common on all three cultivated mountain plateaus visited by me. Other abundant and constant species in this plant community are *Amaranthus hybridus*, *Chenopodium album*, *Convolvulus arvensis* and *Echinochloa crus-galli*. The relevés originate from different villages between 810 and 880 m in all parts of the oropedio (App. 1). The association was also recorded from irrigated potato fields in the same area, as well as from arable fields (but not gardens) on the plateaus of Katharo (1110 m) and further west on Gious Kambos (775 m) belonging to the prefecture of Rethymno. The soils on the Lasithi plateau are loamy to sandy-loamy.

Fig. 1: Rural vegetable garden arranged in patches on a terraced slope in Kefali W of Elos (W Crete). 25 April 2007.

Abb. 1: Dörfliche Gemüsebeete an einem terrassierten Hang in Kefali westlich Elos (West-Kreta). 25. April 2007.

Fig. 2: *Datura stramonium* and *Amaranthus powellii* on irrigated croplands on the Lasithi plateau (Crete). 20 August 2006.

Abb. 2: *Datura stramonium* und *Amaranthus powellii* auf einem bewässerten Feld auf der Lasithi-Hochebene (Kreta). 20. August 2006.

Fig. 3: *Eragrostis cilianensis* overtops persil in a garden near Lagou on the Lasithi plateau. It is one of the less common C4 grasses in Cretan gardens, but occurs sometimes abundantly in the *Solano nitidibaccatae-Amaranthetum powellii*. 3 September 2007.

Abb. 3: *Eragrostis cilianensis* überragt Petersilie in einem Garten bei Lagou auf der Lasithi-Hochebene. Es ist eines der weniger häufigen C4-Gräser in den Gärten Kretas, doch ist es regelmäßig im *Solano nitidibaccatae-Amaranthetum powellii* zu finden.

Fig. 4: *Amaranthus graecizans* is one of the few presumably indigenous amaranths. Nevertheless, much like the introduced species it is restricted to irrigated and aestival ruderal sites. Here seen in a potato allotment near Pinakiano (EC Crete). The digitate spikes on the right belong to *Digitaria sanguinalis*. 3 September 2007.

Abb. 4: *Amaranthus graecizans* ist eine der wenigen indigenen *Amaranthus*-Arten. Gleichwohl ist die Art wie die eingeführten Gattungsvertreter auf sommerliche Ruderalstellen und Bewässerungskulturen beschränkt. Das Foto stammt aus einem Garten bei Pinakiano im östlichen Zentral-Kreta, wo Kartoffeln angebaut werden. Die fingerförmigen Ähren rechts gehören zu *Digitaria sanguinalis*. 3. September 2007.

The association *Amaranthetum blitoidis-viridis* is the most common and widespread of rural gardens in Crete (Fig. 5). *Amaranthus blitoides* (including var. *reverchonii* which seems to be of no taxonomic value) and *A. viridis* are the most characteristic species of this plant community (Table 1). *Heliotropium hirsutissimum*, *Chrozophora tinctoria* and *Amaranthus albus* are also significant but are more prominent in fields than in gardens. *Amaranthus blitum* occurs in gardens both cultivated and spontaneously (and it is not always possible to ascertain the status). Apart from the given amaranths *Solanum nigrum* and *Portulaca oleracea* are common and sometimes subdominant. The association was recorded chiefly in the villages of the northern coastal plain of central Crete, on the lower slopes, as well as on the Mesará plain in southern central Crete. The soils are very often redloamy, especially in the coastal lowlands, but sandy soils also occur. Occurrences from medium levels (above 400 m) are rare and their assignation to this community is disputable. The *Amaranthetum blitoidis-viridis* was also found on irrigated melon fields and in young olive plantations. As it commonly occurs outside rural gardens it has become one of the most abundant plant communities in Crete and is certainly much more common than the garden records suggest.

The association *Digitario sanguinalis-Cyperetum rotundi* occurs at medium levels on the moister western sides and foothills of the mountain ranges Lefka Ori (community of Elos) and Psiloritis (community of Spili). There is an additional record from Souda near the northwest coast which was sampled in a copiously irrigated vegetable garden semi-shaded by lemon trees. Significant species in comparison to the other associations are *Cyperus rotundus*, *Mercurialis annua*, *Setaria viridis* and *S. faberi* (only near Elos). Particularly common and sometimes subdominant are *Amaranthus hybridus* and *Digitaria sanguinalis*. The plant community was found common elsewhere in citrus plantations. The soils are mostly sandy or loamy-sandy from weathered quartzite.

3.2. Species composition

Within the 36 relevés 102 spontaneous (non-cultivated) plant taxa were recorded, of which 36 were found in 4 or more sample plots (constancy > 10 %), and 12 species in 12 plots or more (constancy > 33 %). The most common genera were *Amaranthus* (11 species), *Setaria* (5 species), *Chenopodium* and *Solanum* (4 species each), and *Heliotropium* (3 species). The most frequent species were *Chenopodium album* (occurred in 83 % of the plots), *Amaranthus hybridus* and *Sonchus oleraceus* (75 %), *Solanum nigrum* (72 %), and *Digitaria sanguinalis* (64 %). Dominant species were not found but the following occurred as subdominant, i.e. with 25-50 % cover, in one or more plots: *Amaranthus blitoides* var. *reverchonii*, *Amaranthus hybridus*, *Convolvulus arvensis*, *Cyperus rotundus*, *Datura stramonium*, *Digitaria sanguinalis*, *Portulaca oleracea*, *Setaria verticillata*, and *Solanum villosum* subsp. *miniatum*.

The following constitute first records for the flora of Crete (*Chamaesyce serpens*, *Setaria faberi*, BERGMEIER 2007) or represents the first post-1930 record according to TURLAND & CHILTON (2007): *Hibiscus trionum* (relevé 33, Appendix 1). Whilst other species found in rural gardens occur also in irrigated fields and fallows the long-established archaeophyte *Hibiscus trionum* and the probably recently introduced neophyte *Setaria faberi* seem to be the only species which are currently restricted to this kind of habitat in Crete.

3.3. Alien plants

As concerns number of species, constancy and abundance, alien plants constitute a very significant group of species in rural gardens. Out of 36 species with more than 10 % constancy 12 species should be considered introductions of historical or recent times (neophytes). All the other taxa were noted for Crete already by 19th century collectors such as GANDOGER and HELDREICH (RECHINGER 1943), but several are in fact unlikely to be native although the period of introduction is unknown. Some might constitute very early naturalizations (archaeophytes) in Crete.

The association *Solano nitidibaccati-Amaranthetum powellii* comprises 18 frequent species (i. e., constancy > 33%), of which 8 are introduced plants; the *Amaranthetum blitoidis-viridis* comprises 16 species with 6 introduced ones, while the *Digitario sanguinalis-Cyperetum rotundi* includes 3 alien out of 15 frequent species. The alien species ratio is thus 20-44 %.

The total number of differential species (i.e., characteristic for one association or differentiating one or two associations against the rest) is 19 species (Table 2, upper part from *Amaranthus powellii* through *Sorghum halepense*) of which 7 are introduced plants (37 %). Alien species are thus more or less equally represented among the differential species.

4. Discussion

4.1. Differentiation of the plant communities

In spite of the levelling effect of irrigation on the habitat, the three associations show different habitat preferences, and they occur in different parts of Crete. The *Solano nitidibaccatae-Amaranthetum powellii* is a plant community of montane croplands. As far as known to date, the association is restricted to the Lasithi plateau and, with lesser abundance, to two other mountain plains. Its regional distribution coincides strikingly with the extent of potato cultivation on a field-scale. The main characteristic species, *Solanum physalifolium* and *Amaranthus powellii*, are known in literature as

scattered components of ruderal or field weed communities. They have been introduced into most parts of Europe as far north as southern Sweden and southern Finland. *Amaranthus powellii* was found in the Upper Rhine valley chiefly in maize fields (HÜGIN 1986) and in the Pannonian region of southern Moravia as a weed in root-crop fields (LOSOSOVÁ 2004).

The *Amaranthetum blitoidis-viridis* is most common in the lowlands where it was found in all four Cretan prefectures. It is the most thermophilous of the three associations. It resembles the *Heliotropio-Chrozophoretum*, a summer weed community of non-irrigated fields and fallows which was described from the Greek mainland (OBERDORFER 1954), the *Tribulo-Amaranthetum* described from Croatia (HORVAT et al. 1974), and the *Chrozophoro-Kickxietum integrifoliae* from vineyards in Sicily (BERNHARDT 1986). However, the *Amaranthetum blitoidis-viridis* differs in being apparently more water demanding (Table 2). It may have substituted the *Heliotropio-Chrozophoretum* in places with copious water supply. Whilst all the relevant species of the Cretan *Amaranthetum blitoidis-viridis* occur elsewhere in Mediterranean countries, the species composition seems to be unique and shows no close affinities to communities of similar habitats in the western and central Mediterranean. However, it might well turn out to be more widespread once more information on the aestival ruderal vegetation of the eastern Mediterranean becomes available.

Present records suggest that the *Digitario sanguinalis-Cyperetum rotundi* is restricted to the western and north-western parts of Crete. It seems to be correlated to areas favourable for citrus cultivation although the plant community is by no means confined to citrus plantations. With the *Oxalido cernuae-Cyperetum rotundi*, POLI (1966) described a decidedly similar association from Sicilian citrus plantations ('agrumeti'). It has been treated by BRULLO & MARCENO (1985) under the name *Fumario-Cyperetum rotundi* Horvatić 1960 which was originally described as occurring on sandy soils on Dalmatian islands (Horvat et al. 1974). Similar are also the *Amarantho lividi-Eragrostietum barrelieri* from Sicilian vineyards (BRULLO & MARCENO 1985) and the Hibisco-Sorghetum halepensis Horvatić et Hodak 1960 said to occur according to Horvat et al. (1974) on not too dry soils in the coastal lowlands of Croatia (Tab. 2). As the *Digitario-Cyperetum rotundi* occurs only in the moister parts of Crete the more favourable water supply in the soil during the pre-irrigation phase seems to be vital for the development (germination, root growth) of this association and its diagnostic plants.

Tab. 1 (next page): Relevé table of the plant communities of garden croplands in Crete. Alien species (A) are tagged according to YANNITSAROS (1991) and TURLAND & CHILTON (2007). Association names are shortened to Sn-Ap (*Solano nitidibaccatae-Amaranthetum powellii*), Ab-v (*Amaranthetum blitoidis-viridis*), and Ds-Cr (*Digitario sanguinalis-Cyperetum rotundi*).

Tab. 1: Differenzierte Tabelle der Aufnahmen von Nutzgärten in Kreta. Die Einstufung als Adventivarten (mit A markiert) folgt YANNITSAROS (1991) und TURLAND & CHILTON (2007). Assoziationsnamen sind abgekürzt: Sn-Ap (*Solano nitidibaccatae-Amaranthetum powellii*), Ab-v (*Amaranthetum blitoidis-viridis*), Ds-Cr (*Digitario sanguinalis-Cyperetum rotundi*).

Association		Sn-Ap								Ab-v																	Ds-Cr						
Serial number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Number of species		17	17	13	16	18	13	17	13	15	15	15	12	17	13	11	20	13	25	12	17	16	12	14	9	9	12	15	11	11	13	15	19	11	14	20	10
Status																																					
Amaranthus powellii	A	1	+	1	1	+	1	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solanum nitidibaccatum[1]	A	1	1	2	1	2	+	3	2	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Capsella bursa-pastoris		1	1	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Datura stramonium	A	.	3	+	r	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.
Polygonum aviculare		+	.	+	.	+	.	+	.	.	.	.	.	.	.	+	+	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Eragrostis cilianensis	A	.	.	1	1	1	.	+	.	.	.	.	.	.	.	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Amaranthus blitoides	A	.	.	.	.	.	.	.	.	.	.	1	2	2	1	+	2	2	2	r	.	1	1	+	.	.	.	3	.	+	.	.	.	.	.	.	.
Amaranthus viridis	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	2	.	2	1	2	+	2	2	1	1	.	.	.	.	.	.	.
Cynodon dactylon		.	.	.	.	.	.	.	.	+	2	2	.	.	.	.	1	1	1	+	.	1	.	.	.	.	+	.	2	.	.	.	.	.	.	+	.
Heliotropium hirsutissimum		.	.	.	.	.	.	+	.	.	.	1	.	.	2	+	1	+	2	.	.	.	.	1	+	.	.	.	r	.	.	.	.	.	.	.	.
Cyperus rotundus		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	+	1	1	.	1	2	1	3	+
Mercurialis annua		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	1	.
Setaria viridis		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	+	2	2	.
Echinochloa crus-galli		1	1	.	1	2	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	2	.	.	1	1	.
Veronica persica	A	1	.	1	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.
Solanum nigrum		.	.	.	.	.	.	1	+	2	r	1	1	1	+	+	+	+	+	1	+	+	1	1	.	1	2	1	.	r	.	+	+	.	+	1	1
Portulaca oleracea		.	.	.	.	.	.	.	.	.	.	+	.	.	.	2	.	+	1	.	1	r	2	3	2	1	2	.	1	+	+	1	+	1	1	.	1
Solanum villosum ssp. *miniatum*		.	.	.	.	.	.	.	.	+	.	1	r	+	.	.	1	.	2	.	1	.	1	.	.	.	.	+	.	+	3	+	.	.	r	.	.
Sorghum halepense		.	.	.	.	.	.	.	.	1	.	.	2	.	.	.	+	2	1	1	.	+	.	.	.	.	.	2	.	.	.	.	2	2	+	1	.
Chenopodium album		1	2	1	1	1	2	2	2	2	2	+	1	+	+	1	+	+	1	1	.	1	1	1	r	.	.	1	.	+	+	+	.	+	r	.	2
Digitaria sanguinalis[2]		1	1	.	2	2	2	.	2	.	.	.	2	1	+	.	.	.	+	.	+	1	1	2	.	.	1	.	1	1	3	2	3	.	2	2	1
Sonchus oleraceus		+	1	+	1	.	+	.	+	+	+	1	+	+	+	+	+	1	1	.	1	.	+	1	+	.	+	.	+	.	+	.	1	+	+	1	.
Convolvulus arvensis		1	1	2	1	1	3	1	.	+	.	.	+	.	.	1	+	.	.	1	.	2	.	1	.	+	1	.	2	.	1	.	1	.	+	1	.
Amaranthus hybridus	A	1	2	.	.	2	+	.	2	+	+	+	1	2	2	1	2	.	+	r	.	1	.	2	+	.	.	+	.	+	2	2	1	3	2	2	2
Amaranthus retroflexus	A	.	.	.	.	1	.	+	+	+	2	.	2	+	+	1	2	+	r	1	1	+	.	2	.	.	.	2	.	.	.	1	2	.	+	2	.
Setaria verticillata[3]	(A)	.	.	.	+	1	.	.	1	.	.	.	.	2	.	.	.	3	+	.	+	2	1	.	2	1	2	1	2	1	2	.	2	.	.	1	.
Tribulus terrestris		.	+	+	.	.	.	.	.	+	.	.	1	.	.	+	.	.	.	.	.	r	.	.	+	.	1	1	.	.	.	.	.	.	.	.	.
Amaranthus graecizans		.	+	.	.	1	.	+	.	.	+	.	2	.	+	+	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Malva sylvestris		.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	+	1	.	r	.	+	.	+	.	.	+	.	.	.	1	.
Amaranthus blitum		.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	2	.	+	.	1	2	.	+	.	+	.	+	.	.	.	.	.	.	2
Chrozophora tinctoria		.	.	.	.	.	.	.	.	.	.	r	+	1	+	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lactuca serriola		.	.	.	.	.	+	.	.	.	r	+	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Chondrilla juncea		+	.	.	.	.	.	.	.	+	1	.	.	.	.	+	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sonchus asper ssp. *glaucescens*		.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Amaranthus albus		.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	+	2	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chenopodium opulifolium		.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1	.	r	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Raphanus raphanistrum		.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Senecio vulgaris		.	+	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cuscuta campestris	A	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Medicago arabica		.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Conyza bonariensis	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+
Abutilon theophrasti	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	+	.	.	.	.	.	.	.	1	.

[1] *Solanum physalifolium* var. *nitidibaccatum*

[2] *Digitaria sanguinalis* and *D. ciliaris* are difficult to distinguish in the field. While the former seems to be abundant the latter might also occur in gardens.

[3] *Setaria verticillata* and *S. adhaerens* are treated as separate species by some authors (e.g., Böhling & Scholz 2003). The latter species is apparently less common but might have been overlooked in gardens and noted under *S. verticillata*.

Other species, found in one or two plots: 1: *Persicaria orientalis* (A) +, *Cota altissima* +, *Malva parviflora* +, *Papaver rhoeas* +, *Orobanche nana* +; 2: *Rumex pulcher* r, *Melilotus sulcatus* +, *Daucus carota* 1, *Trifolium resupinatum* r; 3 and 4: *Lamium amplexicaule* +; 6: *Conium maculatum* +, *Melilotus sulcatus* r, *Ranunculus sardous* +; 7: *Heliotropium suaveolens* 1, *Lepidium draba* 2, *Cota altissima* +, *Anthemis cotula* +; 8: *Anthemis cruentus* (A) +, *Orobanche nana* +; 9: *Heliotropium europaeum* +; 10: *Papaver rhoeas* +; 11: *Chenopodium vulvaria* +, *Sinapis alba* subsp. *mairei* +; 12: *Epilobium parviflorum* r; 13: *Xanthium orientale* subsp. *italicum* (A) 2, *Cichorium intybus* 2, *Sambucus ebulus* 1, *Xanthium spinosum* (A) 2, *Avena sterilis* +; 14: *Xanthium orientale* subsp. *italicum* (A) 1, *Capparis sicula* 1; 15: *Malva parviflora* +; 16: *Ailanthus altissima* (A) r, *Echallium elaterium* 2, *Lythrum junceum* r, *Torilis arvensis* subsp. *arvensis* r; 17: *Calendula arvensis* r; 18: *Anagallis arvensis* +, *Lotus ornithopodioides* 1, *Xanthium spinosum* (A) +, *Verbascum sinuatum* +; 19: *Amaranthus deflexus* 1; 20: *Chenopodium vulvaria* +, *Cichorium intybus* +, *Echinochloa colonum* (A) +, *Mirabilis jalapa* (A) r, *Symphyotrichum squamatum* (A) r; 21: *Ballota nigra* subsp. *uncinata* r; 23: *Amaranthus caudatus* (A) 1; 24: *Chamaesyce canescens* r; 26: *Glaucium flavum* r, *Mesembryanthemum crystallinum* r, *Heliotropium europaeum* 1; 27: *Eleusine indica* (A) r; 28: *Solanum elaeagnifolium* (A) 1, *Chamaesyce serpens* (A) 1; 30: *Galium aparine* +, *Phytolacca americana* (A) r; 31: *Setaria faberi* (A) +, *Parietaria judaica* 1, *Ballota nigra* subsp. *uncinata* r; *Amaranthus caudatus* (A) 1; 32: : *Setaria faberi* (A) +, *Parietaria judaica* 1, *Piptatherum miliaceum* +, *Beta vulgaris* +, *Chenopodium vulvaria* 1, *Paspalum distichum* (A) 2; 33: *Anagallis arvensis* +, *Hibiscus trionum* r, *Equisetum telmateia* r; 35: *Galactites tomentosa* 1, *Setaria pumila* 1, *Geranium rotundifolium* r; 36: *Eleusine indica* (A) +, *Pteridium aquilinum* 1.

Tab. 2: Synoptic table with constancy values (in per cent) of taxa in the 3 Cretan associations of garden croplands, *Solano nitidibaccatae-Amaranthetum powellii* (Sn-Ap), *Amaranthetum blitoidis-viridis* (Ab-v), and *Digitario sanguinalis-Cyperetum rotundi* (Ds-Cr). For comparison, species combinations of the somewhat similar Balkanic *Heliotropio-Chrozophoretum* (1) (OBERDORFER 1954), the *Hibisco-Sorghetum halepensis* (2), the *Tribulo-Amaranthetum* (3), the Sicilian *Oxalido cernuae-Cyperetum rotundi* (4) (POLI 1966) and the *Fumario-Cyperetum rotundi* (5) are also attached (2, 3, and 5 after Horvat et al. 1974 from the N Adriatic lowlands). Roman numerals indicate constancy values 1-20 %, 21-40 %, 41-60 %, etc. Only species with more than 40 % (at least III) constancy in at least one column are included.

Tab. 2: Übersichtstabelle mit Stetigkeitswerten (in Prozent) der Taxa der drei Assoziationen in Nutzgärten Kretas, *Solano nitidibaccatae-Amaranthetum powellii* (Sn-Ap), *Amaranthetum blitoidis-viridis* (Ab-v) und *Digitario sanguinalis-Cyperetum rotundi* (Ds-Cr). Zum Vergleich wurden die Artenverbindungen der ähnlichen Assoziationen *Heliotropio-Chrozophoretum* (1) vom südlichen Balkan (OBERDORFER 1954), des *Hibisco-Sorghetum halepensis* (2), des *Tribulo-Amaranthetum* (3), des *Oxalido cernuae-Cyperetum rotundi* Siziliens (4) (POLI 1966) und des *Fumario-Cyperetum rotundi* (5) hinzugefügt (2, 3 und 5 aus Kroatien und Dalmatien nach HORVAT et al. 1974). Die römischen Ziffern bezeichnen Stetigkeitswerte von 1-20 %, 21-40 %, 41-60 %, usw. Es werden nur Arten mit Stetigkeitswerten von mehr als 40 % (bzw III-V) wenigstens in einer Spalte berücksichtigt.

Association	Sn-Ap	Ab-v	1	2	3	Ds-Cr	4	5
Number of relevés	8	21	14	18	21	7	15	20
Mean number of species per plot	15.5	14.0	?	?	?	14.6	?	?
Amaranthus powellii	100	.	.	.	.	.	.	.
Solanum physalifolium var. *nitidibaccatum*	100	10	.	.	.	.	.	.
Capsella bursa-pastoris	75	.	.	x	x	.	II	II
Datura stramonium	50	.	I	x	x	14	.	II
Polygonum aviculare	50	19	I	x	x	14	.	IV
Eragrostis cilianensis	50	10	II	x	x	.	I	III
Amaranthus blitoides	.	67	.	.	.	.	.	.
Amaranthus viridis	.	48	.	.	.	.	.	.
Cynodon dactylon	.	48	V	x	x	14	IV	II
Heliotropium hirsutissimum	13	43	IV	.	.	.	.	.
Cyperus rotundus	.	14	I	.	.	86	IV	IV
Mercurialis annua	.	5	.	x	x	43	V	III
Setaria viridis	.	5	II	x	x	43	I	V
Echinochloa crus-galli	75	5	I	.	.	57	I	.
Solanum nigrum	25	90	I	x	x	71	IV	IV
Portulaca oleracea	.	62	III	x	x	86	III	III
Solanum villosum ssp. *miniatum*	.	48	.	.	.	43	.	III
Sorghum halepense	.	38	I	x	x	57	II	II
Chenopodium album	100	81	II	x	x	71	III	IV
Digitaria sanguinalis	75	52	I	x	x	86	I	IV
Sonchus oleraceus	75	76		x	x	71	II	III
Convolvulus arvensis	88	48	III	x	x	57	III	IV
Amaranthus hybridus	63	71	.	.	.	100	.	.
Amaranthus retroflexus	38	67	II	x	x	57	III	II
Setaria verticillata agg.	38	57	I	x	x	43	V	II
Veronica persica	50	.	I	.	.	29	I	.
Tribulus terrestris	25	33	IV	x	x	.	I	II
Amaranthus graecizans	38	29	IV	x	x	.	.	IV
Amaranthus blitum	.	38	.	.	.	14	III	.
Amaranthus albus	.	24	V	x	x	.	.	I
Chrozophora tinctoria	.	29	IV	.	x	.	.	.
Malva parviflora	13	5		.	.	.	IV	.
Heliotropium europaeum	.	10	IV	x	x	.	I	II
Xanthium spinosum	.	10	IV	x	x	.	.	I
Chamaesyce species	.	5	IV	.	x	.	.	.
Chenopodium opulifolium	.	19	III	.	.	.	.	.
Hypericum triquetrifolium	.	.	III	.	.	.	.	.
Salsola kali ssp. *ruthenica*	.	.	III	.	.	.	.	.
Fumaria capreolata	.	.	.	.	.	.	IV	.
Avena sterilis	.	5	.	.	.	.	III	.
Urtica pilulifera	.	.	.	.	.	.	III	.
Oxalis pes-caprae	.	.	.	.	.	.	III	.
Galinsoga parviflora	.	.	.	.	.	.	III	.
Stellaria media	.	.	.	.	.	.	III	.
Sonchus tenerrimus	.	.	.	.	.	.	III	.
Parietaria officinalis	.	.	.	.	.	.	III	.
Arisarum vulgare	.	.	.	.	.	.	III	.
Fumaria parviflora	.	.	.	.	.	.	.	V
Fumaria officinalis	.	.	.	x	x	.	.	IV
Euphorbia peplus	.	.	.	x	x	.	.	III

4.2. The wider context – syntaxonomic comments

Although the species composition of the three Cretan associations of garden weeds is distinct they have much in common with the citrus and vineyard vegetation described from Sicily (POLI 1966, BRULLO & MARCENO 1985) and other parts of the Mediterranean and western Balkans (e.g., Horvat et al. 1974). Similar plant communities rich in *Amaranthus* species occur as far north as Alsace and southern Germany (MÜLLER 1983, HÜGIN 1986, RENNWALD 2002), the Czech Republic and Slovakia (KROPÁČ 2006). The floristic similarities prompt me to assign the plant communities of Cretan gardens to the same phytosociological order and alliance of widespread aestival annual weed vegetation as elsewhere in the Mediterranean and the Balkans, following the syntaxonomic consideration of POLI (1966). I follow the careful study of KROPÁČ (2006) in adopting his nomenclature of the syntaxa of higher ranks, leading to the following syntaxonomic scheme:

Class: *Stellarietea mediae* Tx., Lohmeyer et Preising in Tx. ex von Rochow 1951
Order: *Eragrostietalia* J. Tüxen ex Poli 1966
Alliance: *Eragrostion* Tx. ex Oberdorfer 1954
Associations:
Solano nitidibaccati-Amaranthetum powellii ass. nov. (Holotypus Tab. 1, relevé 4)
Amaranthetum blitoidis-viridis ass. nov. (Holotypus Tab. 1, relevé 18)
Digitario sanguinalis-Cyperetum rotundi ass. nov. (Holotypus Tab. 1, relevé 35)

OBERDORFER (1954) proposed the alliance *Heliotropion* for the aestival annual weed communities of the eastern Mediterranean but this suggestion has not been seized since. The floristic composition would seem insufficiently distinct to warrant an alliance of its own. The name *Diplotaxion erucoidis* should be set aside for the vegetation of summer crops in the western Mediterranean. It resembles much *Eragrostion* vegetation, and the list of species characteristic of the *Diplotaxion erucoidis* (RIVAS-MARTINEZ et al. 2002: 483) includes species common in *Eragrostion* communities and others which are not. In any case, several of the plant communities of Sicilian summer croplands and plantations assigned to the alliances *Diplotaxion erucoidis* and *Panico-Setarion* and to the order *Solano-Polygonetalia* by BRULLO & MARCENO (1985) and BERNHARDT (1986) have much in common with the *Eragrostion* and *Eragrostietalia*. NEZADAL (1989) adopts a wide circumscription of the order *Chenopodietalia muralis* with the *Diplotaxion erucoidis* included. The largely Mediterranean *Chenopodietalia muralis* have indeed many species in common with the *Eragrostietalia* (see RIVAS-MARTINEZ et al. 2002: 483) but occur generally on non-cultivated ruderal sites, also in Crete (BERGMEIER, unpubl.). The differentiation between *Eragrostietalia* and *Chenopodietalia muralis* remains a matter in question, though, and is in need of further study.

4.3. Alien plants and floristic change

"Außerordentlich arm ist die Ägäis an eigentlichen Adventivpflanzen." [The Aegean is exceptionally poor in alien plants proper.] This statement of K. H. RECHINGER (1951) in his 'Phytogeographia Aegaea' certainly does not apply anymore. YANNITSAROS (1991) lists 119 alien taxa in Crete of which 81 were referred to as naturalized or being in the process of naturalization. A more recent record (TURLAND & CHILTON 2007) counts 140 naturalized or possibly naturalized introduced plant species. Hence the proportion of established alien plants in the Cretan flora currently totals to about 7.5 %. However, in gardens the proportion of non-indigenous spontaneous plants is much higher: 31 out of a total of 102 taxa, or 12 out of the 36 most frequent species. The high proportion of neophytes among the differential species of the associations implies that they found and keep their niches and that they are not less habitat-specific and -dependent than the old-established or indigenous species. HÜGIN (1986) draw similar conclusions from his studies on different introduced *Amaranthus* species in the Upper Rhine valley.

According to RECHINGER (1951: 193) in the first half of the 20th century all seven species of *Amaranthus* which he included in a list of ruderal species in the Aegean must have been relatively rare and were known from only very few records. The same was true for all *Chenopodium* species except for *Chenopodium murale* (RECHINGER, op cit). At present, at least 4 of the 7 *Amaranthus* species mentioned by RECHINGER (viz., *A. hybridus*, *A. albus*, *A. graecizans* and *A. viridis*) are common in Crete and locally abundant. The same is true for *A. blitoides* which was not even mentioned by RECHINGER (op cit). *Chenopodium album* and *Ch. opulifolium* are currently much more common in Crete than *Ch. murale*, which RECHINGER (1951: 194) noted as the prevalent representative of the genus in the Aegean, while species of the *Chenopodium album* aggregate were said to be infrequent.

In his list of ruderal species in the Aegean RECHINGER (1951) mentions only 13 out of 36 species currently common in Cretan gardens (in one third or more of the plots). This is a surprisingly low proportion, considering the fact that RECHINGER was quite familiar with the summer flora of the Aegean which he referred to as follows (op cit: 196): Some species can be found exclusively or predominantly on loamy fallows in high summer, namely *Euphorbia chamaesyce*, *Chrozophora tinctoria*, *Heliotropium hirsutissimum* and *H. dolosum* [author's translation]. What RECHINGER noted here is the very plant community described later by OBERDORFER (1954) from northern Greece as *Heliotropio-Chrozophoretum*. In Crete, this plant community fits in the phenological and ecological characterisation outlined by RECHINGER, and it is still rather common and significant in non-irrigated fields. Out of the 20 currently most common garden weeds RECHINGER's list (op cit) mentions only *Convolvulus arvensis*, *Amaranthus graecizans* (Fig. 4), *Amaranthus hybridus*, *Amaranthus retroflexus*, *Cynodon dactylon* and *Heliotropium hirsutissimum*. RECHINGER referred to plants

in ruderal habitats in general and not specifically to garden weeds but we can be quite sure that he would not have passed unnoticed such genera as *Solanum*, *Digitaria*, *Setaria*, *Sorghum*, *Echinochloa* and *Portulaca* if they had appeared to him at least remotely as common as they are today. Taken together, we may conclude significant change in the summer weed flora of croplands, probably as a result of much more intensive irrigation compared to the first half of the 20th century. Obviously, the area of irrigated croplands and in particular olive plantations in Crete increased enormously during the last 20 years, and it seems reasonable to assume that these new habitats were occupied chiefly by expansive native and alien species that were already widespread as a result of garden irrigation.

Zusammenfassung: Die Vielfalt sommerlicher Pflanzengesellschaften in bewässerten dörflichen Nutzgärten Kretas.

Durch eine numerisch-pflanzensoziologische Klassifizierung von 36 Vegetationsaufnahmen aus bewässerten dörflichen Nutzgärten Kretas können drei Pflanzengesellschaften unterschieden und beschrieben werden: *Solano nitidibaccati-Amaranthetum powellii*, *Amaranthetum blitoidis-viridis* und *Digitario sanguinalis-Cyperetum rotundi*. Diese Assoziationen unterscheiden sich floristisch und in ihren ökologischen Ansprüchen und kommen in unterschiedlichen Teilräumen Kretas vor. Sie werden hier erstmals beschrieben und mit Vegetationseinheiten sommerlicher Unkrautbestände aus anderen Teilen des Mittelmeergebietes und des Balkans verglichen. Der Anteil adventiver Arten bei der Artenzusammensetzung der Unkrautgesellschaften kretischer Gärten beträgt etwa ein Drittel – der höchste Wert aller bekannten kretischen Vegetationseinheiten. Ein Vergleich mit floristischen Beobachtungen in der Ägäis aus der ersten Hälfte des 20. Jahrhunderts lässt den Schluss auf beträchtliche Veränderungen in der Ruderalvegetation zu; so sind insbesondere Arten der Gattungen *Chenopodium* und *Amaranthus* offenbar erheblich häufiger geworden, vermutlich als eine Folge der Ausweitung der Bewässerungskulturen.

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Appendix 1: List of localities

Serial number; location: village; administrative levels municipality, eparchia (province), and nomos (prefecture); date (year,month and day); altitude (m); total cover of spontaneous plants (%); co-ordinates (degrees, minutes, seconds): latitude (N), longitude (E).

1; Taverna 'Antonis' near Psychro; Oropedio Lasithiou, Lasithi, Lasithi; 2007 Sept 03; 820; 25; 35°10'10", 25°26'42"
2; Pinakiano; Oropedio Lasithiou, Lasithi, Lasithi; 2007 Sept 03; 810; 60; 35°11'54", 25°27'44"
3; between Plati and Agios Charalambos; Oropedio Lasithiou, Lasithi, Lasithi; 2007 Sept 03; 812; 25; 35°10'31", 25°26'39"
4; between Agios Giorgos and Lagou; Oropedio Lasithiou, Lasithi, Lasithi; 2007 Sept 03; 822; 30; 35°10'24", 25°28'34"
5; Lagou;Oropedio Lasithiou, Lasithi, Lasithi; 2006 Aug 20; 820; 50; 35°12'08", 25°28'28"
6; Psychro; Oropedio Lasithiou, Lasithi, Lasithi; 2007 Sept 03; 813; 70; 35°10'06", 25°27'02"
7; Mesa Lasithi; Oropedio Lasithiou, Lasithi, Lasithi; 2006 Aug 20; 845; 55; 35°10'49", 25°30'28"
8; Rousakiana; Oropedio Lasithiou, Lasithi, Lasithi; 2006 Aug 20; 880; 55; 35°12'50", 25°31'11"
9; 'Gious Kambos' between Spili and Gerakari; Lambi, Agios Vassilios, Rethymno; 2006 Aug 31; 775; 40; 35°12'51", 24°34'07"
10; Katharo plateau near Avdeliakos; Agios Nikolaos, Mirambelou, Lasithi; 2006 Aug 21; 1110; 45; 35°08'44", 25°33'44"
11; Agii Deka; Gortyna, Kenourgio, Iraklio; 2006 Sept 02; 100; 25; 35°01'21", 24°55'33"
12; Myxorouma; Lambi, Agios Vasilios, Rethymno; 2006 Aug 30; 338; 45; 35°13'06", 24°30'18"
13; 2 km W of Georgioupoli; Georgioupoli, Apokoronou, Chania; 2006 Aug 30; 10; 60; 35°21'48", 24°14'34"
14; Kamilari; Tymbaki, Pyrgiotissa, Iraklio; 2006 Sept 01; 55; 30; 35°02'12", 24°47'36"
15; Cheliana; Kouloukona, Mylopotamos, Rethymno; 2006 Aug 22; 200; 40; 35°20'56", 24°49'30"
16; Knossos; Iraklio, Temenos, Iraklio; 2006 Sept 03; 130; 40; 35°18'14"; 25°09'16"
17; between Perio and Mires; Mires, Kenourgio, Iraklio; 2006 Sept 03; 75; 55; 35°02'09", 24°53'29"
18; Viranepiskopi; Arkadi, Rethymno, Rethymno; 2006 Aug 22; 100; 50; 35°22'19", 24°36'52"
19; between Damasta and Drosia; Kouloukona, Mylopotamos, Rethymno; 2006 Aug 22; 300; 15; 35°21'03", 24°52'46"
20; Milatos; Neapoli, Mirambelou, Lasithi; 2007 Sept 02; 30; 20; 35°18'35", 25°33'55"
21; Panassos; Rouva, Kenourgio, Iraklio; 2006 Sept 03; 420; 30; 35°07'51", 24°58'52"
22; between Kamilari and Sivas; Tymbaki, Pyrgiotissa, Iraklio; 2006 Sept 01; 60; 35; 35°01'27"; 24°48'49"
23; Drosia; Kouloukona, Mylopotamos, Rethymno; 2006 Aug 22; 275; 70; 35°20'35", 24°52'13"
24; Koutouloufari; Chersonisos, Pediada, Iraklio; 2006 Aug 22; 30; 40; 35°18'26", 25°24'04"
25; Exo Lakonia; Agios Nikolaos, Mirambelou, Lasithi; 2006 Aug 21; 125; 25; 35°12'05", 25°39'29"
26; Kato Gouves; Gouves, Pediada, Iraklio; 2007 Sept 05; 2; 60; 35°20'06", 25°18'33"
27; Vamvakopoulo; Therissos, Kydonia, Chania; 2006 Aug 26; 90; 70; 35°28'31", 23°59'25"
28; Hotel 'Creta Maris' of Limenas Chersonisou; Chersonisos, Pediada, Iraklio; 2007 Sept 04; 5; 35; 35°19'23", 25°23'14"
29; Analipsi; Chersonisos, Pediada, Iraklio; 2007 Sept 04; 8; 15; 35°20'05", 25°19'58"
30; Souda; Souda, Kydonia, Chania; 2006 Aug 26; 3; 65; 35°29'23", 24°03'14"
31; Elos; Inachori, Kisamos, Chania; 2006 Aug 23; 535; 50; 35°21'45", 23°38'02"
32; Vathi; Inachori, Kisamos, Chania; 2006 Aug 23; 285; 70; 35°21'25"; 23°35'35"
33; Spili; Lambi, Agios Vasilios, Rethymno; 2006 Aug 31; 372; 45; 35°13'05", 24°31'53"
34; Spili; Lambi, Agios Vasilios, Rethymno; 2006 Aug 31; 365; 40; 35°13'03", 24°31'50"
35; Spili; Lambi, Agios Vasilios, Rethymno; 2006 Aug 31; 385; 65; 35°13'10", 24°31'59"
36; Elos; Inachori, Kisamos, Chania; 2006 Aug 23; 470; 35; 35°22'01", 23°38'16"

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