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Some remarks on the flora of walls and ruins in eastern Crete

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1. Introduction

Crete, having an area of about 8730 m², is after Sicily, Sardinia, Cyprus, and Corsica the fifth largest island in the Mediterranean Sea, where it is situated in a central positon between Europe, Asia, and Africa. Crete is characterized by a real Mediterranean climate with hot summers and cool as well as humid winters; the precipitations are between 400 mm and 2000 mm. Due to its isolation from the continent since some million years the amount of endemics is about 10% of the 1800 species of the Cretan flora (JAHN & SCHÖNFELDER 1995).

The filed work was done mainly in the eastern part of Crete. This paper is a further contribution to our research project on the diversity of the European wall vegetation (BRANDES 1987, 1988, 1992a, 1992b, 1995, 1996a, 1996b, 1998, 2001; BRANDES, WEISHAUPT & SCHRADER 1998; BRANDES & BRANDES 1999; BRANDES & SANDER 1995).

2. *Hyoscyamus aureus* communities

Hyoscyamus aureus is a very distinctive, glandular-villous perennial species with golden yellow corolla, which is purple at throat. The east Mediterranean species is known from Turkey (DAVIS 1978), Cyprus, Iraq, Syria, Lebanon, Israel, Jordan, and Egypt. Flora Europaea shows it only for Crete; it is also known from the Greek island Rhodes (Rhodos). *Hyoscyamus aureus* is used to treat toothache, eye inflammation, respiratory disorders, asthma, and headache by Bedouins and Moslem Arabs in Israel even nowadays (DAFNI & & YANIV 1994).

Hyoscyamus aureus is neophytic in Crete (cf. SFIKAS 1989), it is known from the fortifications of Iraklio (TURLAND, CHILTON & PRESS 1993). It grows in the wall joints of the huge Venetian bastion, on wall tops and near the walls ground (tab. 1). Its sociological amplitude lays between the class Asplenietea (especially Parietarietalia) and Stellarietea (especially Chenopodion muralis). The relevés 1 - 7 are equivalent to the subassociation of *Parietaria judaica* of the Hyoscyametum aurei (KARSCHON & WEINSTEIN 1985). The subassociation of *Suaeda vera* (tab. 1, rel. 8 – 9) shows the neighourhood to shores; the mesophilous *Parietaria judaica* is missing in it.

Hyoscyamus aureus grows well in the spare shadow of *Ailanthus altissima* and *Ficus carica*:

> 10 m², inclination 80°S. 22.4.1994. Vegetation cover 30%:
>
> 2.1 *Ailanthus altissima*, + *Ficus carica*;
> 2.1 *Hyoscyamus aureus*, 2.2 *Chenopodium murale*, 1.2 *Phagnalon graecum*, + *Urospermum picroides*, + *Sisymbrium irio*, + *Mercurialis annua*.

The following stand belongs already to Chenopodion murale according to its species composition. It also grows in the shadow of *Ailanthus altissima*:

> Wall base near the arsenal of Iraklio. 22.4.1994. 10 m², vegetation cover 90 %:
>
> 3.3 *Ailanthus altissima*;
> 4.*4 Hyoscyamus aureus*, 3.3 *Parietaria judaica*, 1.2 *Bromus madritensis*, 1.2 *Chenopodium ambrosioides*, 1.1 *Sonchus oleraceus*.

ZOHARY (1973) classified *Hyoscyamus aureus* as a species of the class Varthemietea montanae, occurring in the Hyoscyametum aurei (on ancient walls) and in the Pennisetetum setacei (on steep cliffs).

3. Parietario lusitanico-Veronicetum cymbalariae BRULLO & MARCENÒ 1985

Parietaria lusitanica is very common in the European parts of the Mediterranean area. In Crete it grows in the joints of old walls in the villages together with *Veronica cymbalaria*, *Umbilicus horizontalis, Oxalis pes-caprae,* and *Mercurialis annua* (tab. 2). Often it is associated by *Sedum litoreum* s.l., especially in the joints of those walls, which are relatively humid in winter and spring. We observed both *Sedum litoreum ssp. litoreum* and the endemic *Sedum litoreum ssp. praesidis*. The community grows on walls of old rural buildings as well as on isolated walls and retaining walls.
A close related *Parietaria lusitanica - Veronica cymbalaria* community was described by BRULLO & MARCENÒ (1985) from Sicily as Parietario lusitanico-Veronicetum cymbalariae. This association belongs to the order Geranio-Cardaminetalia. Although our community has a distinct floristical note by the presence of *Sedum litoreum*, the Cretan modification (geographical race ?) should be summarized under the association Parietario lusitanico-Veronicetum cymbalariae.

4. Stands with *Hyoscyamus albus*

Hyoscymus albus has a wide distribution in the mediterranean area, especially in the southern parts. SEGAL (1969) has already described the "Hyoscyametum albi" as an association belonging to the Parietarion alliance. BARTOLO & BRULLO (1986) proposed the very similar Parietario-Hyoscyametum from Sicily.

Especially in the southern part of the Mediterranean region (Algarve, Tunisia) this species grows in the walls of old fortifications without the mesophilous *Parietaria judaica* (BRANDES 1992, BRANDES & BRANDES 1999). The same is valid for Crete.

5. Some remarks to *Parietaria judaica* on Crete

Parietaria judaica is widespread on wall feet in ancient villages; the species combination is, due to the linear character very heterogenous. The following relevés show this situation in an traditional village in Eastern Crete.

Limnes, shadowed wall foot of an house: area 3m x 0,2m, vegetation cover 85%:

> 4.4 *Parietaria judaica*, 1.2 *Galium aparine*, 1.2 *Urtica urens*, 1.2 *Oxalis pes-caprae*, + *Sisymbrium officinale*, + *Geranium molle*, + *Bromus madritensis*, + *Avena barbata*, +° *Alcea spec.*, + *Capsella bursa-pastoris*.

In Ierapetra, the most southern city in Europe, the following species are to be found together with *Parietaria judaica* in the city forming small skirts along walls and houses:

Aster squamatus, Conyza canadensis, Galium aparine, Lactuca serriola, Nicotiana glauca, Pipthatherum miliaceum, Poa annua, Senecio vulgaris, Sinapis alba, Sonchus oleraceus, Stellaria media, Urospermum picroides, Urtica urens.

Parietaria judaica grows only seldom in walls of eastern Crete. The same is valid for other dry areas in the mediterranean region (e.g. Andalucia or Tunisian Sahel) in contrary to more humid areas in the submediterranean zone. Larger stands of *Parietaria judaica* are however to be found on debris in the cities because of the presumably higher water supply.

Ierapetra. 30 m², vegetation cover 100 %:

4.3 *Parietaria judaica* [height max. 100 cm];
3.3 *Lavatera cretica*, 2.2 *Hordeum leporinum*, 1.1 *Bromus diandrus,* + *Sonchus oleraceus*, 1.1 *Ricinus communis*.

In cities the further succession leads sometimes to shrubberies dominated by *Nicotiana glauca* or – more seldom – by *Ricinus communis*, which both do not affect the herb layer:

Shrub layer:
4.4 *Nicotiana glauca* [height 4 m], 2.2 *Ficus carica* [height 5 m],

herb layer:
2.3 *Parietaria judaica*, 2.2 *Sisymbrium irio*, 1.1 *Sonchus oleraceus*, + *Hordeum leporinum*.

6. Vegetation of ruins of dwelling houses

In the Mediterranean region houses fallen into ruins are part of the typical settlements. This is also valid for Cretan villages, because obviously there is a high rural exodus. Occupied houses are surrounded by quitted and often dilapidated ones. On the (flat) roofs of quitted houses grow mostly poor therophytic communities with *Coronilla scorpioides*, *Erodium malacoides, Trifolium stellatum*, *Stipa* div. spec., *Vulpia* div. spec. Often *Plantago afra* [= *Plantago psyllium*] is dominant; if the soil layer is a bit thicker species like *Serapias spp*., *Asphodelus aestivus*, and even *Chrysanthemum coronarium* are able to establish.

As a rule first the roofs break down, while in general the walls remain for a long time. By this means compartments protected against the wind and at least part-time

shaddowed are formed, having a humidity probably somewhat higher the surronding has. The following species are frequent (in decreasing importance):

> *Parietaria judaica, Lavatera cretica, Urtica pilulifera, Galium aparine, Ficus carica, Piptatherum miliaceum, Oxalis pes-caprae, Sonchus oleraceus, Zantedescia aethiopica, Geranium molle, Hordeum leporinum, Chrysanthemum coronarium, Ecballium elaterium, Avena barbata, Hyoscyamus albus, Mercurialis annua, Geranium purpureum, Stellaria media.*

Malia: interior of a ruin; the walls of which exist up to the 1st floor.
17.4.1994; area 60 m², vegetation cover 95 %:

> 3.4 *Lavatera cretica*, 3.3 *Galium aparine*, 2.3 *Oxalis pes-caprae*, 2.3 *Zantedeschia aethiopica*, 2.2 *Ficus carica*, 2.2 *Piptatherum miliaceum*, 1.2 *Sonchus oleraceus*, 1.2 *Chrysanthemum coronarium*, 1.2 *Geranium molle*, 1.2 *Avena barbata*, 1.2 *Hordeum leporinum*, 1.2 *Parietaria judaica*, 1.2 *Orobanche ramosa*, + *Lycopersicon esculentum*, + *Lolium multiflorum*, + *Ecballium elaterium*, r *Olea europaea* juv.

Vrahasi: interior of a ruin.
21.4.1994; area 40 m², vegetation cover 90 %:

> On the floor: 3.4 *Urtica pilulifera*, 3.3 *Parietaria judaica*, 3.3 *Galium aparine*, 1.2 *Geranium molle*, 1.1 *Lavatera cretica*, +.2 *Hordeum leporinum*, + *Geranium purpureum*, + *Arum concinnatum*.
> In the embrasure: *Ficus carica, Hyoscyamus albus, Mercurialis annua*.

Besides *Ficus carica* shrubs in the villages are seldom take part of the succession inside the ruins, obviously depending on the great distance of suitable sources of diaspores. The conditions however are different with solitary ruins in olive groves. So a ruin between Kato Karouzan and Ano Karouzan was covered by *Ceratonia siliqua, Ficus carica, Hedera helix* and *Rubus sanctus*, whereas *Oxalis pes-caprae* dominated the herb layer.

Ruin of a wind mill near Vrahsi: vegetation exposed to the south. 21.4.1994. Area 8 m², vegetation cover 80 %:

> 4.3 *Ballota pseudodictamnus*, 2.3 *Oxalis pes-caprae* [already dried up], 2.2 *Sarcopoterium spinosum*, 1.2 *Phagnalon graecum*, 1.2 *Malva sylvestris*, 1.1 *Bryonia cretica*, 1.1 *Asphodelus aestivus*, 1.1 *Asparagus aphyllus*, +.2 *Scandix pecten-veneris*, + *Carduus pycnocephalus*, + *Piptatherum miliaceum*.

7. *Euphorbia dendroides* on dry-stone walls

Euphorbia dendroides grows in Crete first of all along the nothern coast in mild areas with sufficient humidity which are situated near to the sea (TURLAND, CHILTON & PRESS 1993). While primary incidences are possibly to be found in steep rocks, the species is able to spread on secondary habitats also due to a certain nitrophily (EICHBERGER 2001). *Euphorbia dendroides* grows often in old dry-stone walls of shepherd refuges as well as at retaining walls of roads. Similar incidences of *Euphorbia dendroides* have been noted by us in Sicily and Corfu.

The *Euphorbia dendroides* stands of the phrygana of Crete are often placed into the Salvio fruticosae-Phlomidetum lanatae (class Cisto-Micromeretea), whereas EICHBERGER (2001) proposes an alternative integration to Phlomido fructicosae-Euphorbietum dendroidis, which he places into the class Quercetea ilicis.

8. Conclusions

The vegetation of walls of buildings often is very poor in species, shurely a result of the annual painting at Easter. In general the following rule for the species number and/or vegetation cover of walls is also valid for Crete:

> walls of buildings < isolated walls < retaining walls.

Alien species in the wall vegetation of Crete are:

Ailanthus altissima
Aeonium arboreum
Aloe vera
Antirrhinum majus
Aster squamatus
Centranthus ruber

Cymbalaria muralis
Hyoscyamus aureus
Ipomoea cf. acuminata
Matthiola incana
Mesembryanthemum crystallinum
Nicotiana glauca
Oxalis pes-caprae
Plumbago auriculata
Solanum pseudocapsicum
Tropaeolum majus

There is a high level of relict endemism among the Cretan chasmophytes to be stated (TURLAND, CHILTON & PRESS 1993), but only few species are able to establish themselves in artifical habitats like walls:

Aristolochia cretica
Arum purpureospathum
Campanula saxatilis ssp. saxatilis
Centaurea raphanina ssp. raphanina
Petromarula pinnata
Sedum litoreum ssp.praesidis
Senecio gnaphalodes
Verbascum arcturus

9. Preliminary checklist of the wall flora of Crete

A compilation of own observations and literature (JAHN & SCHÖNFELDER 1995; TURLAND, CHILTON & PRESS 1993)

Adiantum capillus-veneris L.
Aeonium arboreum (L.) Webb. & Berth.
Ailanthus altissima (Miller) Swingle
Aloe vera (L.) Burm. fil. [inconstant]
Anogramma leptophylla (L.) Link
Antirrhinum majus L.
Arabis verna (L.) R.Br.
Aristolochia cretica Lam.
Aristolochia parviflora Sm.

Aristolochia sempervirens L.
Artemisia arborescens L.
Arum concinnatum Schott
Arum purpureospathum Boyce
Asplenium ceterach L. *ssp. ceterach*
Asplenium scolopendrium L. *ssp.antri-jovis* (Kümmerle) Brownsey & Jermy
Aster squamatus (Sprengel) Hieron.

Beta maritima L.
Biscutella didyma L.
Bromus diandrus Roth
Bromus madritensis L.
Bryonia cretica L. *ssp. cretica*

Calendula arvensis L.
Campanula cretica (A. DC.) D. Dietr.
Campanula erinus L.
Campanula saxatilis L. *ssp. saxatilis*
Capparis spinosa L. *ssp. spinosa var. canescens* Cosson
Capparis spinosa L. ssp. *rupestris* (Sm.) Nyman
Centaurea raphanina Sm. *ssp. raphanina*
Centaurea redempta Heldr.
Centranthus ruber (L.) DC.
Cheilanthes acrostica (Balbis) Tod.
Cheilanthes maderensis Lowe
Chenopodium murale L.
Chrysanthemum coronarium L.
Clematis cirrhosa L.
Cosentinia vellea (Aiton) Tod. [= *Cheilanthes catanensis*]
Cymbalaria longipes (Boiss. & Heldr.) A. Cheval.

Cymbalaria muralis P.Gaertner, B. Meyer & Scherb. *ssp. muralis*

Diplotaxis viminea (L.) DC.

Ephedra foemina Forskål [= *E. campylopoda*]
Epilobium lanceolatum Sebastiani & Mauri
Erodium malacoides (L.) L'Hér.
Euphorbia dendroides L.

Ferula communis L.
Ficus carica L.
Fumaria capreolata L.

Galium murale (L.) All.
Geranium molle L.
Geranium lucidum L.

Geranium robertianum L. *ssp. purpureum* (Vill.) Nyman

Hedera helix L.
Hordeum leporinum Link
Hyoscyamus albus L.
Hyoscyamus aureus L.
Hypericum perforatum L.

Lactuca serriola L.
Lamarckia aurea L.
Lamium amplexicaule L.
Lavatera cretica L.
Linaria micrantha (Cav.) Hoffmanns. & Link
Lonicera etrusca G. Santi

Matthiola incana (L.) R. Br. *ssp. incana*
Matthiola tricuspidata (L.) R.Br.
Medicago coronata (L.) Bartal.
Medicago disciformis DC.
Mercurialis annua L.
Mesembryanthemum crystallinum L.

Nerium oleander L. *ssp. oleander*
Nicotiana glauca R.C.Graham

Oxalis corniculata L.
Oxalis pes-caprae L.

Parietaria cretica L.
Parietaria judaica L.
Parietaria lusitanica L. *ssp. lusitanica*

Petromarula pinnata (L.) A. DC.
Phagnalon graecum Boiss. & Heldr.
Piptatherum miliaceum (L.) Cosson
Plantago afra L.
Polypodium cambricum L.
Pteris vittata L.
Ptilostemon chamaepeuce (L.) Less.

Ranunculus sprunerianus Boiss.
Reichardia picroides (L.) Roth
Reseda alba L.

Sagina maritima G. Don.
Salsola aegaea Rech. fil.
Santolina chamaecyparissus L.
Satureja juliana L.
Satureja myrtifolia (Boiss. & Hohen.) Greuter & Burdet
Scrophularia lucida L.
Scrophularia peregrina L.

Sedum litoreum Guss. *ssp. litoreum*
Sedum litoreum Guss. *ssp. praesidis*
Sedum sediforme (Jacq.) Pau
Selaginella denticulata (L.) Spring
Senecio gnaphalodes Sieber
Senecio vulgaris L.
Sisymbrium irio L.
Sisymbrium officinale (L.) Scop.
Sisymbrium polyceratium L.
Smilax aspera L. *ssp. mauretanica* (Poiret) Arcangeli
Solanum pseudocapsicum s. l.
Sonchus oleraceus L.

Spergula bocconei (Scheele) Graebner
Stellaria media (L.) Vill.
Stipa capensis Thunb.
Suaeda vera Forskål ex J.F.Gmelin

Thelygonum cynocrambe L.

Umbilicus horizontalis (Guss.) DC.
Umbilicus parviflorus (Desf.) DC.
Urospermum picroides (L.) Scop. ex F. W. Schmidt

Valantia muralis L.
Verbascum arcturus L.
Veronica cymbalaria Bodard
Veronica polita Fries
Veronica trichadena Jordan & Fourr.

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Fig. 1: *Hyoscyamus aureus* in wall joints of the Venetian bastion in Iraklio.

Fig. 2: Parietario lusitanico-Veronicetum cymbalariae.

Fig. 3: Parietario lusitanico-Veronicetum cymbalariae, facies of *Sedum litoreum*.

Fig. 4: *Parietaria judaica* on wall feet in ancient villages.

Fig. 5: *Nicotiana glauca* in ruins in Ierapetra.

Fig. 6: *Ballota pseudodictamnus* community near Vrahasi.

Fig. 7*: Euphorbia dendroides* on the top of a shephard's refuge.

Tab. 1: *Hyoscyamus aureus* community.

Number of the relevé	1	2	3	4	5	6	7	8	9	10
Habitat	W	W	W	P	T	W	W	W	W	W
Exposition	W	N	N	E	N	N	E	S	S	S
Inclination [°C]	90	90	90	-	-	80	80	85	85	85
Area [m²]	25	10	30	2	10	10	20	10	20	20
Vegetation cover [%]	30	15	40	80	25	35	20	25	30	30
Number of species	2	2	3	3	3	2	2	5	4	4
Hyoscyamus aureus	3.2	2.1	3.2	2.2	2.2	+	2.2	1.2	2.1	2.2
Parietaria judaica [D]	1.1	1.1	2.2	4.4	2.2	3.2	1.1	.	.	.
Ficus carica	.	.	1.1	.	.	.	.	.	.	.
Chrysanthemum coronarium	.	.	.	+	.	.	.	.	.	.
Matthiola incana	.	.	.	.	2.1	.	.	.	.	.
Suaeda vera	.	.	.	.	.	.	.	2.1	2.2	1.1
Phagnalon graecum	.	.	.	.	.	.	.	1.1	+	1.1
Capparis spinosa	.	.	.	.	.	.	.	2.1	+	.
Sisymbrium irio	.	.	.	.	.	.	.	+	.	.
Nicotiana glauca	.	.	.	.	.	.	.	.	.	2.1

All relevés from Iraklio (April 1994).

Habitat: W = wall, P = pavement near the base of the wall, T = top of the wall.

Tab. 2: *Parietaria lusitanica Veronica cymbalaria* community (Parietario-Veronicetum cymbalariae Brullo & Marcenò 1985).

Number of the relevé	1	2	3	4	5	6	7	8	9	10	11	12	13
Area [m²]	3	2	2	2	4	3	2	3	5	2	3	2	2
Vegetation cover [m²]	10	10	25	10	15	10	25	15	10	5	45	10	60
Number of species	2	2	6	5	5	4	6	5	6	5	8	3	6
Association:													
Veronica cymbalaria	1.1	1.1	+	+	1.1	+	+	1.1	1.1	.	1.1	.	1.1
Order Geranio-Cardaminetalia hirsutae:													
Parietaria lusitanica	1.1	1.1	1.2	2.1	2.2	2.2	1.2	2.2	1.1	1.1	1.1	1.1	3.3
Thelygonum cynocrambe	.	.	2.2	+	.	.	.	.	.	.	.	.	.
Geranium purpureum	.	.	.	+	.	.	.	.	.	.	.	.	.
Class Asplenietea:													
Umbilicus horizontalis	.	.	1.2	.	.	+	+	1.1	+	+	1.1	+	.
Sedum litoreum [incl. *ssp. praesidis*]	.	.	.	.	.	.	.	.	.	+.2	1.1	2.1	3.3
Ceterach officinarum	.	.	.	.	.	.	1.1	.	.	.	3.3	.	.
Cheilanthus maderensis	.	.	.	.	.	.	2.2	.	.	.	1.1	.	.
Class Stellarietea:													
Oxalis pes-caprae	.	.	.	+	.	.	.	1.1	1.1	.	+	.	.
Mercurialis annua	.	.	+	.	.	.	+	.	1.1	.	.	.	.
Bromus madritensis	.	.	1.2	.	.	.	.	.	.	.	.	.	1.2
Sonchus oleraceus	.	.	.	.	+	.	.	.	.	+	.	.	1.1
Lamium amplexicaule	.	.	.	.	+	.	.	.	.	.	.	.	.
Senecio vulgaris	.	.	.	.	.	+	.	.	.	.	+	.	.
Stellaria media	.	.	.	.	.	.	.	+.2	.	.	.	.	.
Lactuca serriola	.	.	.	.	.	.	.	.	.	+	.	.	.
Others:													
Biscutella didyma	.	.	.	.	+	.	.	.	.	.	.	.	.
Musci indet.	.	.	.	.	.	.	.	1.2	.	.	.	.	.
Parietaria judaica	.	.	.	.	.	.	.	.	+	.	.	.	.
Geranium molle	.	.	.	.	.	.	.	.	.	.	.	.	+

No. 1-3, 6: Vrahasi. No. 4, 5, 11: Limnes. No. 7: Kastelli. No. 8: surroundings of Kastelli. No. 9, 10: Kritsa.No. 12, 13: Mohos.