Flora and phytogeographical significance of the islands Chrisi, Koufonisi and nearby islets (S Aegean, Greece)

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Abstract


An annotated floristic catalogue is provided for the islands Chrisi (Gaidouronisi), Koufonisi and the nearby islets Mikronisi, Strongili, Makrouli and Trachilos, all off SE Kriti. Critical use is made of literature data, and hitherto unpublished records, mostly from 1997 through 2000, add substantially to the first full vascular plant inventory of the islands. The total numbers of vascular plant taxa currently known from each island are as follows (accepted taxon records from literature, if extant, in brackets): Chrisi 275 (162), Mikronisi 71 (21), Koufonisi 273 (71), Strongili 110, Makrouli 115, Trachilos 96. Most noteworthy are Suaeda palaestina and Ononis vaginalis (currently with their single localities in Europe); Allium brachyspathum, Astragalus boeticus, A. peregrinus, Galium recurvum, Hippocrepis antisiliquosa, Lagurus ovatus subsp. nanus, Ononis diffusa, Orobanche grisebachii, Schoenoplectus litoralis (new records or confirmations for the Cretan area as a whole, or for the territory of Kriti proper including offshore islands); and Chlamydophora tridentata, Frankenia corymbosa and Hymenolobus procumbens (new regional records for the E part of Kriti and its offshore islands). The N African, pronouncedly thermophilous phytogeographical element is fairly well represented in the investigated area, thence Koufonisi in particular must be considered the driest and hottest SE European island. The principal habitats encountered in each of the islands are outlined and the present conditions for nature conservation discussed.

Introduction

The islands off the SE coast of Kriti, Chrisi (Gaidouronisi) and Koufonisi, are known to harbour several plant species of S Mediterranean, N African and W Irano-Turanian distribution, which are otherwise rare or missing in Kriti or in the whole of Greece and the Aegean. The geographical position at the far southern end of the Aegean may be the reason why the islands received early attention by botanical travellers. Only Chrisi, however, an easily accessible island opposite the town of Ierapetra (Fig. 1), was visited already in the first half of the 19th century (by Heldreich; Raulin 1869) while, until recently, the only known botanical facts regarding Koufonisi were communicated by Gandoger (Cousturier & Gandoger 1916) and Rechinger (1943b).
Rechinger (1943b, 1951) provided also a plant list of Mikronisi, an islet nearby Chrisi. For the other islets treated here, viz. Strongili, Makrouli and Trachilos, all situated close to Koufonisi, this contribution provides the first floristic account.

The aims of the present paper are (1) to bring together unpublished floristic records, independently made by the authors, during short visits in the last 10 years, which add substantially to what is known from literature; (2) to compile and to make critical use of literature information; (3) to provide, by means of our joint contributions, from different seasons, a full floristic inventory, i.e., an estimated 90 % or more of the total vascular plant species composition of the islands; (4) to predict climatic gradients in the Cretan area on the basis of varying joint occurrences of the most thermophilous species.

Study area

Easternmost and SE Kriti are among the driest and hottest areas of Greece and Europe. Direct meteorological information is lacking for the islands Chrisi (situated leeward of Mts Dikti and Thriptis) and Koufonisi. Ierapetra, the coastal town 14 km to the north (Fig. 1) receives a little
more than 400 mm of annual precipitation: Pennas (1977) gives an average of 545 mm for the period 1938-75 while figures of 458 mm and 432 mm (communicated by Brullo & Guarino 2000 and Rackham & Moody 1996, respectively) include, though not explicitly, more recent, and drier, periods. Even less precipitation can be taken for granted further E, along the SE edge of Kriti. Rackham & Moody (1996: 35) estimate less than 300 mm, a value which is plausible particularly for Koufonisi, 5 km off the coast of Kriti, and its nearby islets.

Relevant geographical and ecological parameters for each island are given in Table 1. All islands are actually uninhabited but abandoned fields can be found on Chrisi and Koufonisi (scattered on the former, to a greater extent on the latter island), suggesting an economical basis for an unknown population number in the past. On Koufonisi, remnants of an ancient theatre evidence more than a mere rural civilization in antiquity. The island of Chrisi, the name of which evolved in the recent past from “Donkey’s Island” (Gaidouronisi) to “Golden [beach]” (Chrisi), became recently inhabited again seasonally, due to an increasing beach tourism made possible by a regular boat traffic from Ierapetra during summer. Grazing by sheep and goats has been ceased although practiced for centuries on some of the islands but, owing to the absence of sweet water, only seasonally in springtime. The islands Makrouli and Strongili are said to be still grazed by sheep sometimes; Trachilos and Mikronisi perhaps never were. We found rabbit faeces on Strongili, Makrouli and Trachilos. On Mikronisi exists a sea-gull colony (*Larus cachinnans*), which causes eutrophication.

**Methods**

All literature and unpublished sources available were used for the present floristic catalogue, either directly or through Rechinger’s (1943a) *Flora Aegaea* (Table 2). Literature data have largely been taken from a database on the flora of the S Aegean islands established and attended by one of us (R. Jahn). This database and the programme DMAP were employed for the preparation of Fig. 2. For the catalogue, we followed a critical approach: all literature reports from the study area have been used and the taxon names nomenclaturally updated, but records were considered reliable only if supported by voucher specimens preferably revised by later scholars, or by various independent observations. An attempt was made to exclude dubious records, misidentified or mislabelled specimens. Only the original data of botanists who actually visited the islands were taken into consideration. The works of Turland & al. (1993) and Jahn & Schönfelder (1995), which were compiling as far as concerns the islands off SE Kriti, were used for comparison only. Our own extensive unpublished records, both field observations and herbarium specimens, were treated accordingly (Table 2). Annotations were made on numerous taxa.
Table 2. Data sources (in chronological sequence), and history of floristic exploration of Chrisi and the Koufonisia. – Abbreviation = Reference abbreviations of collectors’ names as used in the catalogue; Islands: Chr-Chrisi, Kou-Koufonisi, Mak-Makrouli, Mik-Mikonisi, Str-Strongili, Tra-‘Trachilos; v.sp. = voucher specimens; obs. = field observations. Herbarium abbreviations are according to Holmgren & al. (1990); for private herbaria: Be = E. Bergmeier, Freiburg; Bo = N. Böhling, Kirchheim; Ch = L. Chilton, Hunstanton; Gr = W. Greuter, Berlin; Ja = R. Jahn, Radebeul; Kalh = H. Kalheber, Runkel; Ky = Z. Kypriotakis, Iraklio; Ma = A. Mayer, Roma; Zi = M. Zimmermann, Ulm.

<table>
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<tr>
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<th>Evaluated reference</th>
<th>Evaluation</th>
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<th>Date</th>
<th>v.sp.</th>
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</table>
In the catalogue, collectors’ and/or observers’ references are abbreviated as given in Table 2; bold-type letters refer to records supported by voucher specimens, normal-type letters to records explicitly or presumably based on field observations only, italics denote doubtful records. The references per island for each taxon are given in chronological order. Taxon names preceded by a question mark represent unreliable records. Abbreviated island names, underlined in the catalogue, are as follows: Chr = Chrisi, Kou = Koufonisi, Mak = Makrouli, Mik = Mikronisi, Str = Strongili, Tra = Trachilos. The floristic catalogue includes a synopsis indicating the status per island (in the sequence Chr, Mik, Kou, Str, Mak, Tra): = recorded as new or presence confirmed; = literature record accepted, not seen by us; * = taxonomic status questionable; = literature record not accepted by us; = not found. The catalogue serves as a basis for a quantitative survey of taxon numbers on the islands (Table 4).

Floristic catalogue

Pteridophyta

Sinopteridaceae

Cheilanthes acrostica (Balbis) Tod. – Ky-BeDi

Gymnospermae

Cupressaceae

Juniperus macrocarpa Sm. – He-Co-Re-Za-Gr-Ch-Ky-Ja-BrGu-Bö-BeDi

J. phoenicea L. – Chr: Co-Re-Ch-Ky-Ja-BrGu-Bö-BeDi; Kou: Ga

Heldreich (in Raulin 1869: 555) mentioned “2 trees” of pine on Chrisi, and W. Greuter (pers. comm.) observed pine, in 1966, in the S part of the central dune portion. The most recent records are by Brullo & Guarino (2000) and Paragamian (2000: 17, including a photograph captured “the island’s few pines”).

Pinaceae

Pinus halepensis subsp. brutia (Ten.) Holmboe – He-Re-Gr-Ch-BrGu

Heldreich (in Raulin 1869: 555) mentioned “2 trees” of pine on Chrisi, and W. Greuter (pers. comm.) observed pine, in 1966, in the S part of the central dune portion. The most recent records are by Brullo & Guarino (2000) and Paragamian (2000: 17, including a photograph captured “the island’s few pines”).

Dicotyledones

Aizoaceae

Carpobrotus edulis (L.) N. E. Br. var. rubescens Druce – Ja-BeDi

Once planted near a house at the NW coast of Chrisi, now locally naturalized.

Mesembryanthemum nodiflorum L. – Chr: Re-Ky-Ja-BrGu-BeDi; Mik: Re-Ky; Kou: Ga-StBa-Ky-Ja-BeDi; Str: BeDi; Mak: Ky; Tra: Ky

Anacardiaceae

Pistacia lentiscus L. – Chr: He-Re-Gr-Ch-Ky-Ja-BrGu-Bö-BeDi; Kou: Ga-Ky-Ja-BeDi; Str: Ky-Ra-Bö-BeDi; Mak: Ky-Ra-Bö-BeDi

Asclepiadaceae

Periploca angustifolia Labill. – Re-Gr-Ch-Ky-Ja-BrGu-Bö-BeDi
Boraginaceae

?Alkanna sieberi DC. – Chr: Co; Kou: Ga
Both of Gandoger's island records may be based on misidentification, or the locality might have been confused.
A. tinctoria (L.) Tausch – BeDi
Anchusa aegyptiaca (L.) DC. – Kou: Ky-BeDi; Str: Ky
Buglossoides arvensis (L.) I. M. Johnston – Chr: Ky; Kou: Ky-BeDi
Echium angustifolium Mill. – Chr: He-Gr-Ky-Ja-BrGu-BeDi; Mik: Re-BeDi; Kou: StBa-Ky-Ja-Bö-BeDi; Str: Ky-Ra-Bö-BeDi; Mak: Ky-Bö-BeDi; Tra: Ky-BeDi
E. arenarium Guss. – Chr: He-Re-Ky-BrGu-Bö-BeDi; Kou: Ky-Ja-BeDi; Str: Ky; Mak: Ky; Tra: Ky
Heliotropium hirsutissimum Rochel – BrGu
Neatostema apulum (L.) M. Johnston – Chr: Ja-BrGu-BeDi; Kou: Ga-BeDi

Cactaceae

Opuntia ficus-indica (L.) Mill. – BrGu – Planted.

Campanulaceae

Campanula erinus L. – Chr: Ky-Ja-BrGu-BeDi; Kou: Ky; Str: Bö

Capparaceae

Capparis spinosa subsp. rupestris (Sm.) Nyman – Kou: Ky-Ra-BeDi; Str: Ky-Ra; Mak: Ky-Ra-BeDi; Tra: Ra-BeDi

Caryophyllaceae

Arenaria leptoclados (Reichenb.) Guss. – Chr: He (“A. serpyllifolia”) – Re-Za-Ky-BrGu-BeDi; Kou: Ky-Ja-BeDi; Str: Ky-BeDi; Mak: Ky-BeDi; Tra: Ky

?Dianthus fruticosus L. – Ja-Bö-BeDi; Str: Ky-Ja-BeDi; Mak: Ky-Bö-BeDi; Tra: Ky-BeDi

Gandoger's record is almost certainly erroneous; Runemark (1980) did not see any voucher specimens, and there is no later record.

Herniaria hirsuta L. – Ky

Minuartia hybrida (Vill.) Schischk. subsp. hybrida – BeDi
Paronychia macrosepala Boiss. – Chr: He-Co-Za-Gr-Ky-Ja-BrGu-Bö-BeDi; Mik: Re-Ky-BeDi; Kou: Ga-StBa-Ky-Ja-BeDi; Str: Ky-Ra-Bö-BeDi; Mak: Ky-Bö-BeDi; Tra: Ky
Specimens have been recognized as var. insularum by Chaudhri (1968).

Petrorhagia dubia (Raf.) G. López & Romo – Ky-BeDi
Polycarpon tetraphyllum (L.) L. – Chr: Ky-BeDi; Mik: Ky-BeDi; Kou: Ga (var. alsinifolium)-Ky-Ja-BeDi; Mak: BeDi
Silene ammophila Boiss. & Heldr. subsp. ammophila – Chr: He-Re-BrGu-BeDi; Kou: Ga

The record from Koufonisi is questionable and was not considered by Greuter (1997a).
S. apetala Wildl. – Chr: Ky-Ja-BrGu-BeDi; Mik: Ky-BeDi; Kou: Ky-Ja-BeDi; Str: Ky-BeDi; Mak: Ky-BeDi; Tra: Ky-BeDi

S. behen L. – Ja
S. gallica L. – BeDi
S. nocturna L. – Chr: Ky-BrGu; Kou: Ky-Ja-BeDi
S. sclerocarpa Dufour – Chr: Ky-BeDi; Kou: Ky-Ja-BeDi
S. sedoides Poir. subsp. sedoides – Chr: He-Re-Za-Ky-Ja-BrGu-Bö-BeDi; Mik: Ky-BeDi; Kou: Ga-StBa-Ky-Ja-Bö-BeDi; Str: Ky-Ra-Bö; Mak: Ky; Tra: Ky
S. succulenta Forssk. subsp. succulenta – Chr: He-Co-Re-Gr-Ch-Ma-Ky-Ja-BrGu-Bö-BeDi; Kou: Ga
Gandoger’s record from Koufonisi is questionable and was not confirmed since. The post-1930 indication by Turland & al. (1993) is probably erroneous.

Spergularia boccoeti (Scheele) Asch. & Graebn. – Re-Ja-BrGu
S. diandra (Guss.) Boiss. – Chr: Re-Ky-BeDi; Kou: StBa-Ky-Ja-BeDi; Tra: Ky
S. salina J. Presl & C. Presl – Ky-BrGu-BeDi
Velezia rigida L. – BeDi

Chenopodiaceae

Arthrocnemum macrostachyum (Moric.) K. Koch – Chr: Re-Za-Gr-Ky-Ja-BrGu-Bö-BeDi; Kou: Ky-Ja-BeDi; Str: Ky-Ra-Bö-BeDi; Mak: Ky-Ra-BeDi; Tra: Ky-Ra-BeDi
Atriplex halimus L. – Chr: Ky-Ja-BrGu; Mik: Re-BeDi; Kou: Re-StBa-Ky-Ja-Ra-Bö-BeDi; Str: Ky-Ra-Bö-BeDi; Mak: Ky-Ra-Bö-BeDi; Tra: Ky-Ra-BeDi
Beta vulgaris subsp. maritima (L.) Arcang. – BeDi

Chenopodium murale L. – Chr: Ky-BeDi; Str: Ky; Tra: BeDi
Salsolea aegaea Rech. f. – Kou: StBa-Ky-Ja-BeDi; Str: Ky-Ra-BeDi; Mak: Ky-Ra-BeDi; Tra: Ky-Bö-Ra

Plants on Koufonisi reach 1.6 m in height, not only 30 cm or 60 cm as given in literature (Aellen 1964, 1993; Freitag 2001; Tan 1997).

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S. palaestina Eig & Zohary – Ky-Ja-BrGu-Bö-BeDi

The occurrence on Koufonisi was recently published as new to Kriti and Greece by Kit Tan & al. in Greuter & Raus (1998: 165).

S. vera Forsk. – Chr: He (“S. maritima”)-BeDi; Tra: Bö-Ra-BeDi

Cistaceae

Cistus parviflorus Lam. – Chr: He; Kou: Ky
Fumana thymifolia (L.) Webb
– Chr: Re-Ky-Ja-BrGu-Bö-BeDi; Kou: Re-StBa-Ky-Ja-Ra-BeDi
Helianthemum salicifolium (L.) Mill.
– Chr: Re-Ky-Ja-BrGu-Bö-BeDi; Kou: Ky-Ja-BeDi
H. stipulatum (Forsk.) C. Chr. – Chr: Za-Ky-Ja-BrGu-Bö-BeDi; Kou: Ga-Re-StBa-Ky-Ja-Ra-Bö-BeDi
Tuberaria lipopetala (Murb.) Greuter & Burdet – Ky-BrGu

Compositae

Aetheorhiza bulbosa subsp. microcephala Rech. f. – Chr: Ky-BrGu-BeDi; Kou: BeDi; Str: BeDi; Mak: BeDi; Tra: Ky-BeDi

?Anthemis ammannus Greuter – Ga
This and the record of the dubious “Anmanthus tomentellus Gand.” should be regarded as erroneous.
A. rigida Heldr. subsp. rigida – Chr: Re-Ky-Ja-BrGu-BeDi; Mak: Re-Ky-BeDi; Kou: Ga-Ky-Ja-BeDi; Str: Ky-Ra-BeDi; Mak: Ky-BeDi; Tra: Ky

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Asteriscus aquaticus (L.) Less.
  – Chr: Gr-Ky-Ja-BrGu-BeDi; Kou: StBa-Ky-Ja-BeDi
  For nomenclature see Greuter (1997b).
Atractylis cancellata L. – Chr: Re-Ky-Ja-BrGu-Bö-BeDi; Kou: Ga-StBa-Ky-Ja-BeDi; Str: Ky-Bö-BeDi; Mak: Ky-BeDi
Bellium minutum (L.) – Chr: Ky-Ja; Mik: Ky; Kou: Ky-BeDi; Str: Ky-BeDi; Mak: Ky-BeDi; Tra: Ky
Calendula arvensis L. – Kou: Ky-BeDi; Str: BeDi; Mak: Ky-BeDi
?Carduus bicolor Vis. – Chr: Co; Kou: G
  The plants seen by Gandoger might have been C. pycnocephalus (see next).
C. pycnocephalus L. – Chr: He-Ky-BrGu-BeDi; Kou: StBa-Ky-Ja-BeDi
Carlinia barnebiana B. L. Burtt & P. H. Davis – Ja
  The species was found exclusively near the NW corner of Koufonisi, together with C. sitiens (see next), but differing in the striking compact habit.
C. sitiens Rech. F.
  – Kou: Ky-Ja-BeDi; Str: Ky-Bö; Mak: Ky-Bö-BeDi; Tra: BeDi
  Vouchers from Makrouli and Strongili (Bö10437, 10440) determined by E. Vitek; field observations of BeDi and Ky refer to the genus.
C. lanata L. – Chr: Gr-Ky-Ja-BrGu; Kou: Ky-Ja-Ra; Str: Ra; Tra: Ky
Carthamus lanatus subsp. baeticus (Boiss. & Reut.) Nyman
  – Chr: BeDi; Kou: Ja-Bö-BeDi
  For some observations the identification is considered provisional, owing to plants in pre-flowering stage.
C. leucoecalos Sm. – Ky-Ja-Ra-BeDi
?C. boissieri Halácsy – Chr: BrGu; Kou: Ga
  Confusion with other Carthamus species cannot be excluded.
Centaura aegialophila Wagenitz – Chr: Co-Ky-BeDi; Kou: Ga
  A very rare species on Chrisi, and on Koufonisi apparently missing now, if ever there.
Chlamydocephora tridentata (Delile) Less. – Chr: Ky-BeDi; Mik: Ky; Kou: BeDi; Str: Ky-BeDi; Mak: Ky-BeDi; Tra: Ky-BeDi
  The species was known to occur in the Cretan area only on the islands of Gavdos (Bergmeier & al. 1997) and Gavdopoula (unpubl.); new record for the E part of Kriti + islands.
Chrysanthemum coronarium L. – BeDi
Cichorium endivia subsp. divaricatum (Schousb.) P. D. Sell
  – BrGu (C. pumilum Jacq.)
  The nomenclature is according to Wagenitz & Bedarff (1989).
C. spinosum L. – Chr: He-Gr-Ky-BrGu-BeDi; Kou: Re-Ky-Ja-BeDi; Mak: Ky
Crepis cretica Boiss. – Chr: He-Co-Re-Ky-Ja-BrGu-BeDi; Kou: Ga-StBa-Ky-Ja-BeDi; Str: Ky-Bö; Mak: Ky-BeDi
C. foetida L. – Re-BeDi
C. multiflora Sm. – Chr: Ky-BeDi; Kou: Ky; Str: BeDi; Mak: BeDi
C. tybadiensis Vieth. – BeDi
C. vesicaria L. – Ky
Cynara cornigera Lindl. – Chr: Ky-BrGu-BeDi; Mik: Re-BeDi; Kou: Ga-Ky-Ja-Bo-BeDi; Str: BeDi; Mak: Ky-Ra-Bö-BeDi; Tra: Ky-Ra-BeDi
Dittrichia viscosa (L.) Greuter – Ch
Filago aegaea Wagenitz subsp. aegaea – Chr: Za-Ky-Ja-BrGu-BeDi; Mik: Ky-BeDi; Kou: Ky-Ja-BeDi; Str: Ky-BeDi; Mak: Ky-BeDi; Tra: Ky
F. cretensis subsp. cycladum Wagenitz – Str: BeDi; Mak: BeDi
F. pygmaea L. – Ja
Geropogon hybridus (L.) C. H. Schultz – Ky
Hedypnois rhagadiooides subsp. tubaeformis Ten. (incl. subsp. cretica (L.) Hayek) – Chr:
Helichrysum conglobatum (Viv.) Steud.

- Ch: Gr-Ky-BeDi; Kou: StBa-Ky-Ja-BeDi; Str: Ky-BeDi

\[\text{Hyoseris lucida} \] L. \text{–} BrGu

The record of this species which, in the Cretan area, is otherwise restricted to the west, cannot be accepted without voucher specimen.

H. scabra L. \text{–} Ch: BrGu-BeDi; Mik: Ky; Str: Ky; Tra: Ky

Hypochaeris acharophorae L. \text{–} Ch: Ky-Ja-BrGu-BeDi; Mik: Ky; Kou: Ky-BeDi; Str: Ky-BeDi; Mak: Ky-BeDi; Tra: Ky

H. glabra L. \text{–} Ky

Leontodon tuberosus L. \text{–} Ch: Ky-BrGu; Kou: StBa-Ky-Ja-BeDi; Tra: Ky

Pallenis spinosa (L.) Cass. \text{–} Ch: He; Kou: StBa-Ja-BeDi

For nomenclature see Greuter (1997b).

Phagnalon graecum Boiss. & Heldr. \text{–} Ch: Re-Ch-Ky-Ja-BrGu-Bö-BeDi; Mik: BeDi; Kou: StBa-Ky-Ja-Ra-Bö-BeDi; Str: Ky-BeDi; Mak: Ky-Ra-Bö-BeDi; Tra: Ky-BeDi

Picnomon acarna (L.) Cass. \text{–} Ky-Ja-BeDi

?Reichardia intermedia (Sch. Bip.) Cout. \text{–} Ga

Gandoger’s record cannot be trusted owing to possible misidentification or locality confusion.

R. orientalis (L.) Hochr. \text{–} Ch: Re-Ky-Ja-BrGu-BeDi; Mik: Ky; Kou: Ga-Re-StBa-Ky-Ja-BeDi; Str: Ky-BeDi; Mak: Ky-BeDi; Tra: Ky-BeDi

R. picroides (L.) Roth \text{–} Ch: Ky-BrGu (var. maritima Fiori); Mik: Re-Ky-BeDi; Kou: Re-Ky-Ja-BeDi; Tra: Ky

Scolymus hispanicus L. \text{–} Ch: Ja-BrGu-BeDi; Kou: Re

Scorzoner a cretica Willd. \text{–} Ch: Re-Ky-Ja-BrGu-BeDi; Mik: Re-Ky-BeDi; Kou: Ga-StBa-Ky-Ja-BeDi; Mak: Ky-BeDi; Tra: Ky

Senecio leucaanthemifolius Poir. \text{–} Ch: BrGu-BeDi; Kou: Ky-BeDi; Str: BeDi; Mak: BeDi; Tra: BeDi

Plants match, in quantitative characters, var. leucaanthemifolius but ligulate florets are lacking.

S. vulgaris L.

- Ch: Ky-Ja-BeDi; Mik: Ky; Kou: Ky-Ja-BeDi; Mak: Ky-BeDi; Tra: Ky

Sonchus oleraceus L. \text{–} Ch: Re-Ky-Ja-BrGu-BeDi; Mik: Re-BeDi; Kou: Ky-Ja-BeDi; Str: Ky-BeDi; Mak: Ky-BeDi; Tra: Ky-BeDi

Records of S. tenerrimus L. by Rechinger (1943b, 1951) are assigned here.

Stephananthus tuberosus (Jacq.) Grossh. \text{–} Ch: Ky-BeDi; Kou: Ky


- Ch: Gr-Ky; Kou: Ky

Tragopogon sinuatus Avé-Lall. \text{–} Ch: BeDi; Kou: Ky-Ja-BeDi

Urosernum picroides (L.) F. W. Schmidt \text{–} Ch: Ky-Ja-BeDi; Mik: Ky; Kou: StBa-Ky-Ja-BeDi; Mak: Ky-BeDi

Convolvulaceae

Convolvulus althaeoides L. \text{–} Ch: BeDi; Kou: Ga-StBa-Ky-Ja-BeDi

?C. oleifolius Desr. \text{–} Ga

Not confirmed by us. Although occurrence not unlikely, Gandoger’s record is not accepted here unless substantiated by recent herbarium material.
Cressa cretica L. – Chr: Za-Gr-Ky-Bö-BeDi; Mik: Re; Str: Ra
   The record from Mikronisi is somewhat doubtful for ecological reasons and might perhaps be referable to the opposite coastal part of Chrisi.
Cascula palaestina Boiss. – Chr: Ky; Kou: Ky-BeDi; Mak: BeDi; Tra: Ky
   The genus (without species identification) was also recorded from Chrisi by N. Böhling.
C. planiflora Ten. – BeDi

Crassulaceae

Sedum litoreum Guss. – Chr: Ky-BeDi; Mik: Ky; Kou: StBa-Ky-Ja-BeDi; Str: Ky-Ra-Bö-BeDi; Mak: Ky-BeDi; Tra: Ky
S. rubens L. – Chr: BeDi; Kou: Ja-BeDi; Str: BeDi; Mak: BeDi; Tra: BeDi

Tillaea alata Viv. – Kou: BeDi; Str: BeDi; Mak: BeDi

Umbilicus horizontalis (Guss.) DC. – Chr: Ky-BeDi; Mik: BeDi; Kou: Ky-BeDi; Mak: Ky-BeDi; Tra: BeDi

Cruciferae

?Arabidopsis pumila (Willd.) N. Busch – Ga
   Gandoger’s record (as “Sisymbrium pumilum”) was already considered impossible by Rechinger (1943a: 207).
Biscutella didyma L.
   – Chr: Ky-BeDi; Kou: Ky-BeDi; Str: BeDi; Mak: Ky-BeDi; Tra: Ky-BeDi

Brassica tournefortii Gouan
   – Chr: Ch-Ky-Ja-BrGu-BeDi; Kou: Ga-StBa-Ky-BeD

Cakile maritima Scop.
   – Chr: Re-Ch-Ma-Ky-Ja-BrGu-BeDi; Kou: Ky-Ja-BeDi

Carrichtera annua (L.) DC. – Ky-Ja-BrGu

Clypeaster japonicus L. – Kou: Ky-BeDi; Mak: BeDi; Tra: Ky

?Didesmus aegyptius (L.) Desv. – Ga
   Not seen by us in the area investigated. Although occurrence not unlikely, Gandoger’s record is not accepted here unless substantiated by recent herbarium material.

?Erophila praecox (Steven) DC. – BrGu
   The record is not accepted here since this species can never be reliably determined on material found in the end of August when Chrisi was visited by Brunello & Guarino (2000).

Diplotaxis viminea (L.) DC. – Ky

Hirschfeldia incana (L.) Lagr.-Foss. – Ky-Ja-BeDi

Hornungia procumbens (L.) Hayek – Chr: Ky-BeDi; Mik: Ky; Str: Ky-BeDi; Mak: BeDi; Tra: Ky-BeDi
   The nomenclature is according to Appel & Al-Shehbaz (1997). This is a new record for the E part of Kriti and offshore islands.
Malcolmia chia (L.) DC. – Chr: Ky-BeDi; Mik: Ky; Kou: Ga-Ky-BeDi

M. flexuosa (Sm.) Sm. – Chr: He-Re; Kou: Ky-Ja-BeDi; Str: Ky-BeDi; Mak: Ky-BeDi; Tra: BeDi

M. nana (DC.) Boiss. – Chr: Ky-BeDi; Kou: Ky-Ja-BeDi

Rapistrum rugosum (L.) All.
   – Ga-Re (var. orientale [L.] Arcang.)-StBa-Ky-BeDi

Cucurbitaceae

Bryonia cretica L. – Ky-BeDi

Ericaceae

Erica manipuliflora Salisb. – Chr: Re-Gr-Ch-Ky-Ja-BrGu-Bö-BeDi; Kou: Ga-StBa-Ky-Ja-Ra-BeDi

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Euphorbiaceae

Andrachne telephioides L. subsp. telephioides – Ky
Euphorbia acanthothamnus Boiss. – Ky-BeDi
E. exigua L. – Chr; Ky-BeDi; Kou; BeDi
E. paralias L. – Chr; Ky-Ja-BrGu-Bö-BeDi; Kou; Ky-BeDi
E. peplus L. – Chr; Re-Za-Ch.Ma-BrGu; Kou; Ky
E. peplus L. – Chr; Ky-BeDi; Mik; Ky-BeDi; Kou; Ga-Ky-BeDi; Str; Ky-BeDi; Mak; Ky-BeDi; Tra; Ky
Mercurialis annua L. – Chr; He-Ky-Ja-BeDi; Mik; Ky-BeDi; Kou; StBa-Ky-Ja-BeDi; Str; Ky-BeDi; Mak; Ky-BeDi; Tra; Ky-BeDi

Frankeniaceae

Frankenia corymbosa Desf. s.l. – Kou; Ky; Tra; Ky-Bö-Ra
This is the second record for Krifi and Greece (see Böhling & al. in Greuter & Raus 1999: 55). The affinities of the local populations and the taxonomy of the variable species require further investigations.
F. hirsuta L. – Chr; He-Gr-Ky-BrGu-Bö-BeDi; Mik; Re; Str; Ky; Mak; Ky
F. pulverulenta L. – Chr; He-Re-BrGu; Mik; Re-Ky; Kou; Ky

Gentianaceae

?Blackstonia acuminata (Koch & Ziz) Domin subsp. acuminata – BrGu
Almost certainly recorded in error for B. perfoliata (see next).
B. perfoliata (L.) Huds. – Chr; Ky-BeDi; Kou; Ga
Gandoger’s record from Koufonisi cannot be accepted unless confirmed.
Centaurium pulchellum (Sw.) Druce – Chr; Co-Ky-BeDi; Kou; Ga-StBa-Ky-BeDi; Str; Ky; Mak; Ky; Tra; Ky
C. spicatum (L.) Fritsch – Bö
C. tenuiflorum (Hoffmanns. & Link) Fritsch subsp. tenuiflorum – Chr; Ja-BrGu-BeDi; Kou; Ja-BeDi

Geraniaceae

Erodium cicutarium (L.) L’Hér. s.l. – Chr; He-Re-Ky-BrGu-BeDi; Mik; Ky; Kou; Ky-BeDi; Str; Ky-BeDi; Mak; Ky-BeDi; Tra; Ky
E. crassifolium L’Hér. – Ky-Ja-BeDi
E. laciniatum (Cav.) Willd. subsp. laciniatum – Chr; Za-Ky-Ja-BrGu-BeDi; Kou; Ga-Ky-Ja-BeDi
E. malaccoides (L.) L’Hér. – Chr; Ky-BeDi; Mik; Ky-BeDi; Kou; Ky-Ja-BeDi; Str; Ky-BeDi; Mak; Ky-BeDi; Tra; BeDi (cf.)
E. neuradifolium Delile – BeDi
Geranium molle L. – BeDi
G. purpureum Vill. – Ky-BeDi
G. rotundifolium L. – Chr; Ky-BeDi; Kou; Ky-BeDi; Mak; BeDi

Guttiferae

?Hypericum empetrifolium Willd. – He
Heldreich’s record (Rechinger 1943a: 262) could not be confirmed and may originate somewhere else.

Labiateae

Ajuga iva (L.) Schreb. – Chr; Ky-Ja-BeDi; Kou; Ky-Ja-BeDi
Coridothymus capitatus (L.) Reichenb. f. – Chr: He-Re-Gr-Ch-Ky-Ja-BrGu-Bö-BeDi; Kou: StBa-Ky-Ja-Ra-BeDi; Str: Ra; Mak: Ky-Ra-Bö-BeDi; Tra: Ky-Ra
A frequent constituent of phrygana on most islands, but on Strongili only a single shrub on the very top of the islet.

Prasium majus L. – Chr: He-Ky-Ja-BrGu-Bö-BeDi; Mik: Ky; Kou: Ky-Ja-BeDi; Mak: Ky-BeDi; Tra: Ky

Salvia verbenaca L. – Chr: BeDi; Kou: StBa-Ky-Ja-BeDi

?S. viridis – Chr: Ja-BeDi

Teucrium brevifolium Schreb. – Chr: Re-Gr-Ch-Ky-Ja-BrGu-Bö-BeDi; Kou: Ky-BeDi

T. alpestre Sm. – He (var. majus Boiss.)-Gr-Ky-Ja

T. capitatum L. – Chr: He (“T. polium L.”)-Re-Ky-BrGu-BeDi; Kou: Re-Ky-Ja-Ra-BeDi; Str: Ky-Ra-BeDi; Mak: Ky-Ra-Bö-BeDi; Tra: Ky-Ra

The taxonomic status of the Teucrium populations on the investigated islands remains to be clarified. Varietal rank (T. polium var. dumulosum Rech. f.) was given by Rechinger (1943), and recently species rank (T. dumulosum [Rech. f.] Bruullo & Guarino) by Bruullo & Guarino (2000). Another open question is whether or not the populations on Charsi and on the Koufonisia islands belong to different taxa (Rechinger 1943b for Koufonisi: T. polium var. intermediate Čelak.).

Leguminosae

Anthyllis hermanniae L. – Chr: He-Re-Gr-Ch-Ky-Ja-BrGu-BeDi; Kou: Re-StBa-Ky-Ja-Ra-BeDi

?Astragalus echinatus Murray – Chr: Co; Kou: Ga

Doubts remain whether the species seen by Coustaurier & Gandoger (Rechinger 1943: 317, sub A. pentaglottis L.) is now extinct or had erroneously been assigned to the islands treated here.

A. boeticus L. – Ky

The species was recorded for the Cretan area more than 150 years ago by Heldreich near Chania (Rechinger 1943a: 317) but was not confirmed for the Cretan area after 1930 (Chilton & Turland 1997).

A. hamosus L. – Chr: Ky-BeDi; Mik: BeDi

A. pelecinus (L.) Barneby – Ky-BeDi

A. peregrinus Vahl – Chr: Ky-Zi-BeDi; Kou: Ga (var. kouphoënsis [Gand.] Hayek)-StBa-Ky-Ja-BeDi; Mak: Ky-BeDi (cf.)

This species was not recorded for Kriti + islands since 1930 (Chilton & Turland 1997).

A. sinaicus Boiss. – Re-Ky-BeDi

Collected by R. Jahn also along the coasts of S Central and SE Kriti.

Bituminaria bituminosa (L.) C. H. Stirt. – Ky-BeDi

Ceratonia silqua L. – Ch-BrGu-BeDi

The species occurs very scattered in Pistacia scrub in the W part of Chrsi.

Coronilla scorpioides (L.) W. D. J. Koch – Chr: Ky-Ja-BrGu-BeDi; Kou: Ky

Ebenus cretica L. – Chr: Ky-BeDi; Kou: Ky

In both islands, only single plants occur very locally in the phrygana.

Hedysarum spinosissimum L. – Chr: Ky-BeDi; Kou: Ky-Ja-BeDi

Hippocrepis ciliata Willd. – Ky-Ja-BrGu-BeDi

H. cyclocarpa Murb. – Chr: BeDi; Kou: Ja-BeDi
Not confined to the southern islets but also present on Kriti (Akr. Mavros near Vai; R. Jahn, unpubl.) and on Dragonada (Dionysades; Bergmeier & Dimopoulos 2001).

_H. unisiliquosa_ L. subsp. unisiliquosa – Ky

New to Kriti + islands; the species was known in the S Aegean only from a Pichler collection of 1880 originating from Karpathos (Lassen in Greuter & Raus 1987).

_Hymenocarpos cincinnatus_ (L.) Savi – Chr; Ky-Ja-BeDi; Kou: Ky-Ja-BeDi

?_Lathyrus clymenum_ L. – Ga

Not seen by us in the area investigated. The former presence of this species on Koufonisi is not improbable considering the extent of arable fields in the past. The taxon was assigned to var. _articulatus_ (L.) Arcang. by Gandoger.

_L. saxatilis_ (Vent.) Vis. – Ky-BeDi

_Lotus cytisoides_ L. – Chr; BeDi; Mik: BeDi; Kou: Ga-Ky-BeDi; Str: BeDi; Mak: Ky-BeDi; Tra: Ky

_L. edulis_ L. – Chr; Ky-Ja-BrGu-BeDi; Mik: BeDi; Kou: StBa-Ky-Ja-BeDi; Str: Ky; Mak: Ky; Tra: Ky

_L. halophilus_ Boiss. & Spruner – Chr; Co-Re-Ky-Ja-BrGu-Bö-BeDi; Kou: Ga-StBa-Ky-Ja-BeDi; Str: Ky-Ra-BeDi; Mak: Ky-BeDi

_L. peregrinus_ L. – Chr; Ky-Ja-BrGu-BeDi; Mik: Ky; Kou: Ky-BeDi

_L. tetragonolobus_ L. – Ky-BeDi

?_Medicago arabica_ (L.) Huds. – BrGu

The fruits that, in the end of August, Brullo & Guarino (2000) reported as belonging to _M. arabica_ could have been confused for another _Medicago_ species.

_M. coronata_ (L.) Bartal. – Chr; Ky-Ja-BrGu-BeDi; Mik: Ky-BeDi; Kou: Ky-Ja-BeDi; Str: Ky-Bö-BeDi; Mak: Ky-Bö-BeDi; Tra: Ky-BeDi

_M. disciformis_ DC. – Chr; Ky-BeDi; Kou: Ky-Ja-BeDi; Tra: Ky

_M. littoralis_ Loisel. – Chr; Co-Ky-Ja-BrGu-BeDi; Mik: Ky-BeDi; Kou: Ga-StBa-Ky-Ja-BeDi; Mak: Ky-BeDi

The species is variable on Koufonisi: collections include a form with unarmed fruits which grows associated with the typical form and was referred by Gandoger to var. _breviseta_ DC.

_M. marina_ L. – Chr; Ky-Ja-BrGu-Bö-BeDi; Kou: Ga-StBa-Ky-Ja-BeDi

_M. minima_ (L.) L. – Chr; Ky-Ja-BeDi; Kou: Ky-Ja-Ra-BeDi; Tra: Ky-Ra

_M. monspeliaca_ (L.) Trautv. – Chr; Gr-Ky; Mik: Ky; Kou: Ky-BeDi; Str: Ky-Ra-BeDi; Mak: Ky-BeDi

_M. truncatula_ (Retz.) Willd. – Ja

_Melilotus indicus_ (L.) All. – BeDi

?_Onobrychis aequidentata_ (Sm.) D’Urv. – BrGu

Record probably in error for _O. caput-galli_ (see next).

_O. caput-galli_ (L.) Lam. – Chr; Ky-Ja-BeDi; Kou: StBa-Ky-Ja-BeDi

_O. diffusa_ Ten. – Ky-Ja-BeDi

The species was not recorded for the Cretan area since 1930 (Chilton & Turland 1997).

_O. hispanica_ L. f. subsp. _hispanica_ – He-RE-Za-Gr-Ch-Ma; Ky-BrGu-Bö-BeDi

Also reported by Förther & Podlech (1991) based on a Sieber collection at M.

_O. ornithopodioides_ L. – Ky-Ja-BrGu-BeDi

_O. reclinata_ L. s.l. – Chr; Re-Ky-Ja-Zl-BrGu-BeDi; Kou; Ga-StBa-Ky-Ja-BeDi; Str: Ky; Mak: Ky; Tra: Ky

_O. sieberi_ DC. – StBa-Ky-Ja-BeDi

_O. vaginalis_ Vahl – Ky

This is a new record for the Cretan area, the whole of Greece, and Europe.

_Scorpionius muricatus_ L. – Chr; Ky-BeDi; Kou: Re-StBa-Ja-BeDi; Str: Ky-BeDi; Mak: Ky-BeDi; Tra: Ky

All plants seen by us belong to var. _subvillosus_ (L.) Fiori.
The occurrence on Chrisi would not be unlikely but requires confirmation, owing to the late recording time (end of August; Brullo & Guarino 2000) which hardly permits a reliable determination.
This record by Gandoger (Rechinger 1943a: 488) is almost probably based on a misidentification.

O. mutelii F. W. Schultz – Chr: Ky-BeDi; Kou: Ga-StBa
Specimens from Chrisi (Ky 8565) and from Koufonisi (Strid 17633) were determined by H. Uhlich.

O. cf. nana (Reut.) Beck – Ky

The specimen Ky 8591 (det. H. Uhlich) is of poor quality, and the occurrence of this taxon in the area needs confirmation by appropriate herbarium material.

O. pubescens d’Urv. – Mik: Ky; Kou: Ga-Ky-BeDi
Specimens from Mikronissi and Koufonisi (Ky 8545, 8590) were determined by H. Uhlich.

Oxalidaceae

Oxalis pes-caprae L. – Chr: Ky-BeDi; Kou: Ky-BeDi; Mak: BeDi; Trag: BeDi

The adventive species has become established and occurs scattered on most islands but on Makrouli it was only found in a single locality in the northern part.

Papaveraceae

Fumaria officinalis L. subsp. officinalis – Ky

F. sp. – Kou: BeDi; Trag: Ky-BeDi

Plants found, probably different from F. officinalis, were not in an identifiable stage.

Glaucium flavum Crantz – He-Ky-BrGu-BeDi

Hypecoum procumbens L. subsp. procumbens – Ga-Ky-BeDi

Papaver argemone subsp. nigrotinctum (Fedde) Kadereit – Ky-BeDi

The taxon was only recently recorded for the Cretan area by Sfikas (1986) and by Chilton (Chilton & Turland 1997: 69). The determination of the specimen Be 99-C9a was confirmed by J. W. Kadereit.

P. purpureomarginatum Kadereit – Ky

P. rhoeas L. – StBa-Ky-BeDi

Plantaginaceae

Plantago africana L. – Chr: Ky-Ja-BrGu-Bö; Mik: Ky-BeDi; Kou: Ky-Ja-BeDi; Str: Ky-Ra-Bö-BeDi; Mak: Ky-Bö-BeDi; Trag: Ky-BeDi

P. albicans L.

– Chr: He-Co-Re-Za-Gr-Ky-Ja-Zi-BrGu-Bö-BeDi; Kou: Ga-StBa-Ky-Ja-BeDi

P. amplexicaulis Cav.

– Chr: Zi; Kou: StBa-Ky-Ja-Bö-BeDi; Str: Ky; Mak: Ky-BeDi; Trag: Ky

P. bellardii All. – Chr: Ky-Ja-BeDi; Kou: Ky-Ja-BeDi; Str: Ky-Ra-BeDi

Plants seen may be assigned to subsp. deflexa (Pilger) Rech. f.

P. cretica L. – Chr: Ky-BrGu-BeDi; Kou: Ga-BeDi

P. lagopus L. – StBa-Ky-Ja-BeDi

P. weldeni Reichenh. – Chr: Gr-Ky-Ja-Zi-BrGu-BeDi; Mik: Re-Ky-BeDi; Kou: StBa-Ky-Ja-Bö-BeDi; Str: Ky-Ra-Bö-BeDi; Mak: Ky-Bö-BeDi; Trag: Ky-BeDi

Plumbaginaceae

Limoniastrum monopetalum (L.) Boiss. – Chr: He-Re-Za-Gr-Ch-Ky-Ja-BrGu-Bö-BeDi; Kou: Ky; Str: Ky-Ra-Bö-BeDi; Mak: Ky-Ra-BeDi

On Koufonisi, there is but a single individual near Aj. Nikolaos; the species is more frequent on Strongili and Makrouli.

?Limonium chrisianum Brullo & Guarino – BrGu

Vouchers of this recently described species (Brullo & Guarino 2000) are currently not available in CAT (Brullo, in litt.); thus, owing to the unreliability of several identifications of species from
Chrisi, by Brullo & Guarino, the taxonomic status of this species which seems to be close to, or conspecific with, *L. rigidum* A. Mayer, remains an open question (M. Erben, in litt.).

*L. echioides* (L.) Mill. – Chr: He-Re-Gr-Ch-Ky-Ja-BrGu-Bö-BeDi; Mik: Re-BeDi; Kou: Ky-Ja-BeDi; Str: Ky-Bö-BeDi

A voucher specimen from Strongili (Bö 10434) was confirmed by R. Artelari.

*L. graecum* (Poir.) Rech. f. agg. – Chr: Gr-Ky-Ja-Ma-BrGu-Bö-BeDi; Mik: Re-Ky-BeDi; Str: Ky-Ra-Bö-BeDi; Mak: Ky-Ra-BeDi; Tra: Ky-Bö-Ra-BeDi

A voucher specimen from Strongili (Bö 10432) was determined by R. Artelari. Brullo & Guarino (2000) recorded *L. roridum* (Sm.) Brullo & Guarino from Chrisi; however, the identity of this species which is distinct from *L. graecum* remains to be clarified (M. Erben, in litt.).

*L. hyssopifolium* (Girard) Rech. f. – Chr: Bö; Kou: Ga-Ky-Ja-BeDi

The identification of a specimen from Chrisi (Bö 8384) is provisional; another one from Koufonisi (Bö 10454) was determined by R. Artelari.

*L. virgatum* (Willd.) Fourr. – He (Statice oleifolia [Mill.] Sm.)-Gr-BrGu-BeDi

Polygonaceae

*Emex spinosa* (L.) Campd. – Chr: Ky-BeDi; Kou: Ga-Ky-Ja-BeDi

*Polygonum maritimum* L. – Chr: Re-Ma-Ky-BrGu-BeDi; Kou: Ky

*Rumex bucephalophorus* subsp. *aegaeus* Rech. f. – Chr: Co-Re-Ky-BrGu-BeDi; Mik: Re-BeDi; Kou: Ga-Re-StBa-Ky-Ja-BeDi; Str: Ky-BeDi; Mak: Ky-BeDi; Tra: Ky-BeDi

*R. pulcher* L. s.l. – BeDi

Primulaceae

*Anagallis arvensis* L.

– Chr: Ky-Ja-BrGu-BeDi; Kou: StBa-Ky-Ja-BeDi; Mak: BeDi

All plants seen by us belong to var. *caerulea* (L.) Gouan.

*Asterolinon linum-stellatum* (L.) Duby – Chr: Ky-Ja; Kou: BeDi

Rafflesiaceae

*Cytinus hypocistis* (L.) L.

Gandoger’s record was not confirmed and may originate elsewhere.

Ranunculaceae

*Adonis microcarpa* subsp. *cretica* (Huth) Vierh. – Ky-BeDi

We found red- and yellow-flowered plants.

*Clematis cirrhosa* L. – BeDi

*Nigella duroleri* Vierh. – Chr: Zi-BeDi; Kou: Ky-Ja-BeDi

*N. funarifolia* Kotschy – Ja

*Ranunculus asiaticus* L. – Chr: Ky; Kou: BeDi

All plants seen in flower belong to var. *albus* Hayek.

*R. paludosus* Poir. – Chr: BrGu; Kou: BeDi

Resedaceae

*Reseda lutea* L. – Ga-StBa-Ky

Rhamnaceae

*Rhamnus lycoides* subsp. *oleoides* (L.) Jahand. & Maire

– Kou: Ky-Ra-BeDi; Mak: Ky
Rosaceae
Sanguisorba minor Scop. – StBa
Sarcopoterium spinosum (L.) Spach – Chr: Ky-BrGu; Kou: Ky-Ja-Ra-BeDi; Mak: Ky-Ra-BeDi

Rubiaceae
Galium aparine L. – Chr: Ky-BeDi; Kou: Ky-Ja-BeDi
G. murale (L.) All.
– Chr: Ky-BrGu; Mik: Ky; Kou: Ky-Ja-BeDi; Str: BeDi; Mak: BeDi; Tra: Ky
G. recurvum DC. – Ky-BeDi
In the Cretan area, this species was only found on Chrisi (Bergmeier & Dimopoulos in Greuter & Raus 1999).
G. setaceum Lam. – Za-Ky-Ja-BeDi
Sherardia arvensis L. – BeDi

Santalaceae
Thesium humile Vahl – Ky-Ja-BeDi

Scrophulariaceae
Cymbalaria microcalyx (Boiss.) Wettst. – Ky
A single plant was found, which Z. Kypriotakis assigns to subsp. microcalyx; in the S Aegean area this subspecies is only known from Wr Kriti.
Linaria simplex (Willd.) DC. – Chr: Ky-BeDi; Mak: Ky
Misopates orontium (L.) Raf. – Chr: Co (Antirrhinum nanum Gand.)-Ky-Ja-BrGu-BeDi; Kou: Ga
Ga (A. nanum)–Ky-BeDi; Str: BeDi; Mak: Ky-BeDi
Parentucellia latifolia (L.) Caruel – Chr: Ky-BrGu-BeDi; Kou: Ga-Ky

Solanaceae
Lycium schweinfurthii Dammer – Chr: Za-Gr-Ch-Ky-Ja-BrGu-BeDi; Mik: Ky-BeDi; Kou: Ga
StBa-Ky-Ja-BrGu-BeDi; Str: Ky-Ra-BeDi; Mak: Ky-Ra-BeDi; Tra: Ky-Ra-BeDi

Tamaricaceae
Tamarix parviflora DC. – StBa-Ky-BeDi
There are several small native stands scattered on sand dunes.
T. cf. smyrnensis Bunge – Gr-BeDi
Scattered trees were found in various coastal sites, not identified by us with certainty; most or all of them may originate from planting.

Theligionaceae
Theligionum cynocrambe L. – Mik: Ky; Str: BeDi; Mak: BeDi; Tra: BeDi

Umbelliferae
?Bupleurum gaudianum Snogerup – BrGu

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The record is almost probably based on a misidentification of *B. semicompositum* (see next); the figure in Brullo & Guarino (2000) depicts the latter species, certainly not *B. gaudianum*.

*B. semicompositum* L. – Chr: Re-Ky-Ja-Bö-BeDi; Kou: Ky-Ja-BeDi; Str: Ky-Ra-Bö; Mak: Ky; Tra: Ky

*Critchum maritimum* L. – Chr: BrGu; Kou: BeDi; Tra: Ky

*Daucus guttatus* Sm. – Chr: BrGu; Kou: Ga; Str: Bö; Mak: Bö

*Eryngium campestre* L. – Ja

*Eryngium maritimum* L. – BeDi

*Daucus involucratus* Sm. – Chr: Ky-Ja-BeDi; Kou: Ky-Ja-BeDi; Str: Ky

*Eryngium campestre* L. – Ja

*Eryngium maritimum* L. – Ky-Ja

*Lagoecia cuminoides* L. – Chr: Ky-BeDi; Kou: Ky-BeDi

*Orlaya daucoides* (L.) Greuter – BeDi

*Orlaya daucoides* (L.) Greuter – BeDi

*Pseudorlaya pumila* (L.) Grande – Chr: Co-Re-Ky-Ja-BrGu-BeDi; Kou: Ga-StBa-Ky-Ja-BeDi

*Scandix australis* L. – BeDi

Scandix australis L. – BeDi

*S. pecten-veneris* L. – Chr: Ky-BrGu-BeDi; Kou: Ky

*Torilis nodosa* (L.) Gaertn. – Chr: Ky-BeDi; Kou: Ky-Ja-Bö-BeDi; Str: BeDi; Mak: Ky-BeDi

*Urticaceae*

*Parietaria cretica* L. – Chr: Ky-BrGu-BeDi; Mik: Ky-BeDi; Kou: Ky-BeDi; Str: Ky-BeDi; Mak: Ky-BeDi; Tra: Ky-BeDi

*Valerianaceae*

*?Centranthus calcitrapae* (L.) Dufr. – Ga

*Valerianella discoidea* (L.) Loisel. – Kou: Ga; Tra: Ky

*Zygophyllaceae*

*Fagonia cretica* L. – Ch-Ky-Ja-Bö-BeDi

*Zygophyllum album* L. f. – Chr: Re-Za-Gr-Ch-Ky-Ja-BrGu-Bö-BeDi; Kou: Ga-Re-StBu-Ky-Ra-BeDi; Mak: Ky-Ra-BeDi

*Monocotyledones*

*Agavaceae*

*Agave americana* L. – Ky-BrGu-BeDi

*Alliaceae*

*Allium brachyspathum* Brullo & al. – Bö

This taxon was recently described as new from Karpathos (Brullo & al. 2001, see also Tzanoudakis 2001), and is given here for the first time for Kriti and offshore islands.
A. rubrovittatum Boiss. & Heldr. – Chr Ky-Ja-BrGu-Bö-BeDi; Mik: Re-Ky; Kou: Ky-Ja-BeDi; Str: Ky-BeDi; Mak: Ky-BeDi; Tra: Ky-BeDi

A. staticiforme Sm. – Chr: Ky; Mik: BeDi; Tra: K

Earlier records for the Cretan area were considered erroneous by Greuter & al. (1985: 46) but the species was given for the Nomos of Iraklio by Jahn & Schönfelder (1995) based on Tzanoudakis & Vosa (1988), and Tzanoudakis & al. (1991).

A. sp. – Kou: Bö-Ra; Tra: Bö-Ra-BeDi

Specimens under cultivation in B, still undetermined.

Amaryllidaceae
Narcissus serotinus L. – Ky

Pancratium maritimum L. – Chr: Ch-Ky-Ja-BrGu-Bö-BeDi; Kou: Ky-Ja-Ra-BeDi; Str: Ky; Mak: Ky-Ra-BeDi

Araceae
Arisarum vulgare Targ.-Tozz. – Chr: Ky-Ja-BeDi; Kou: Ky-BeDi; Str: BeDi; Mak: BeDi; Tra: Ky

Asparagaceae
Asparagus aphyllus subsp. orientalis (Baker) P. H. Davis – Ch: BrGu; Kou: BeDi

The dot for Chrisi in the map provided by Turland & al. (1993) is based on a printing error (N. Turland, pers. comm.); the Chrisi record from Brullo & Guarino (2000) is considered doubtful.

A. horridus L. – Chr: Ch-Ky-Ja-BrGu-Bö-BeDi; Mik: Re-Ky-BeDi; Kou: StBa-Ky-Ja-Ra-Bö-BeDi; Str: Ky-Ra-Bö-BeDi; Mak: Ra-Bö-BeDi; Tra: Ky-Ra-BeDi

Asphodelaceae
Asphodelus ramosus L. – BeDi

Colchicaceae
Colchicum cousturieri Greuter – Chr: Co-Re-Ky-Ja-BrGu-BeDi; Mik: Ky-BeDi; Kou: Ga

The species was given under the misapplied names “C. variegatum” and “C. cupanii” by Rechinger (1943a-b).

Cyperaceae
Cyperus capitatus Vandelli – Ga-Re-StBa-Ky-Ja-Bö-BeDi

Schoenoplectus litoralis (Schrad.) Palla – Ky-BeDi

The species was not recorded for Kriti after 1930 (Chilton & Turland 1997).

Gramineae
Aegilops biuncialis Vis. – Chr: Ky-BeDi; Kou: Ky-Ja-BeDi

Aeluropus lagopoides (L.) Thwaites – Gr-Ch-Ky-Ja-BrGu-Bö-BeDi

Bo 8386 was determined by H. Scholz.

Arundo pliniana Turra – Re (A. plinii Turra)-Ch (“A. donax”)-BeDi

The tall grass occurs in moderately saline habitats in the E part of Chrisi; the identification is based on field observation and in need of confirmation.

Aristida caerulescens Desf. – Ky

Avellinia michelii (Savi) Parl. – Ky-BrGu
Avena barbata Link subsp. barbata – Chr: Co-Ky-Ja-BeDi; Kou: Ga-StBa-Ky-Ja-BeDi; Str: Ky-BeDi; Mak: Ky; Tra: Ky-BeDi
A. sterilis L. – Chr: Re-BrGu; Kou: Ky
Material collected or seen in August is hardly suitable for a reliable identification of A. ludo-viciana Durieu (as given by Brullo & Guarino 2000).
Brachypodium distachyon (L.) P. Beauv. – Chr: Re-Ky-Ja-BrGu-Bö-BeDi; Kou: StBa-Ky-Ja-Bö-BeDi; Mak: Ky-BeDi; Tra: BeDi
B. maxima L. – Chr: BrGu-BeDi; Kou: Ky-Ja-BeDi
Bromus fasciculatus C. Presl – Chr: Ky-Ja-BrGu-BeDi; Mik: BeDi; Kou: StBa-Ky-Ja-BeDi; Str: Ky-BeDi; Mak: BeDi
A specimen from Strongil (Bö 10439) was determined by H. Scholz.
B. intermedium Guss.
– Chr: Ky-Ja-BeDi; Kou: StBa-Ky-Ja-Bö-BeDi; Str: Ky-Bö
B. madritensis subsp. hausseknechttii (Boiss.) H. Scholz
– Chr: Ky; Kou: Ja-BeDi; Mak: BeDi
All field observations refer to B. madritensis L. s.l.
B. rubens L. – Chr: He-Ky-Ja-BrGu-Bö-BeDi; Mik: Ky-BeDi; Kou: Ky-Ja-BeDi; Str: Ky-Bö; Tra: Ky-BeDi
A specimen from Chrisi (Bö 8395) was determined by H. Scholz.
B. scoparius L. – Chr: BrGu; Kou: Ja
Annual brome grasses can hardly be reliably identified on material observed in August; therefore confusion with B. intermedium is possible as far as the record for Chrisi is concerned (Brullo & Guarino 2000).
B. sterilis L. – Chr: BeDi; Kou: Ky-BeDi; Mak: Ky
Catapodium baleareicum (Willk.) H. Scholz – Chr: Ky-BrGu (“C. marimum”)-BeDi; Kou: Ky-Ja-BeDi; Tra: Ky
The taxonomy and nomenclature is according to Scholz (2000).
C. rigidum (L.) C. E. Hubb. – Chr: Ky-Bö; Kou: Ky-Ja-BeDi; Mak: BeDi
Catandia maritima (L.) Barbey – Chr: Ky-Ja-BeDi; Kou: Ky-Ja
Cynodon dactylon (L.) Pers.
– Chr: Ky-Ja-BrGu-BeDi; Kou: Ky; Str: Ky-Ra-BeDi
Dactylis glomerata L. – Kou: Ky-BeDi; Str: Ky-Ra-BeDi; Mak: Ky-Bö
Generally, subsp. hispanica (Roth) Nyman was recorded but subsp. hackelii (Asch. & Graebn.)
Cif. & Giacom was identified on Strongil by Th. Raus.
Elytrigia bessarabica (Savul. & Rayss) Dubovik – Bö
A voucher specimen (Bö 8385) was determined by H. Scholz.
E. juncea (L.) Nevski – Chr: Ky-Ja-BeDi; Kou: Ky-Ja-BeDi
?E. rechingeri (Ranemark) Holub – BrGu
The identification by Brullo & Guarino (2000) is considered erroneous due to possible confusion with either E. bessarabica or E. juncea.
Gastridium phleoides (Nees & Meyen) C. E. Hubb.
– Chr: BeDi; Kou: Ga (“G. scabrum”)-BeDi
Hordum leporinum Link
– Chr: Ky-BrGu-BeDi; Kou: StBa-Ky-BeDi; Str: Ky; Tra: Ky-BeDi
H. marinum Huds. – Ky
Hyparrhenia hirta (L.) Stapf – Chr: Ky-Bö-BeDi; Mik: Re-Ky-BeDi; Kou: StBa-Ky-Ja-BeDi; Str: Ky-Ra-Bö-BeDi; Mak: Ky-Ra-Bö-BeDi; Tra: Ky
Lagarus ovatus L. subsp. ovatus – Chr: He-Ky-BeDi; Kou: Ga-StBa-Ky-Bö-BeDi; Str: Ky-Ra-Bö; Tra: Ky
Field observations included under the type subspecies, as well as Strid 17588 from Koufoni, refer to the species sensu lato.
Lagarus ovatus subsp. nanus (Guss.) Messeri – Chr: Ky-Ja; Kou: Ky-Ja
Voucher specimens (Jahn s.n.) have been confirmed by H. Scholz. The subspecies is new to Kriti and offshore islands; it was also found on the Cretan mainland (R. Jahn, unpubl.).

*Lolium rigidum* subsp. *lepturoides* (Boiss.) Sennen & Mauricio

– Ga (“L. strictum”) – *BeDi*

*Lygeum spartum* L.

– *Kou*: Ga-Re-StBa-Ky-Ja-Ra-Bö-BeDi; *Str*: Ky-Ra-BeDi; *Mak*: Ky-Ra

*Melica minuta* L. – Ky-BeDi

*Parapholis incurva* (L.) C. E. Hubb. – *Chr*: Ky-BrGu-BeDi; *Kou*: Ky-Ja-BeDi; *Mak*: Ky; *Tra*: Ky

*P. marginata* Runemark – BrGu-BeDi

*Phleum crysoides* (d’Urv.) Franch. subsp. *crypsoides* – *Chr*: Ky-Ja-BrGu-BeDi; *Kou*: Ky-Ja-BeDi; *Str*: Ky-BeDi; *Tra*: BeDi

*Piptatherum miliaceum* (L.) Coss. subsp. *miliaceum* – *Chr*: Ky-Ja-BrGu-Bö-BeDi; *Kou*: Ky-Ja-Bö-BeDi

*Polypogon maritimus* Willd. s.l. – Ky-BrGu (*P. subspathaceus* Req.)-BeDi

Scholz (1991: 139) underlines the specific status of *R. cristata*. This is a dubious record (Brullo & Guarino 2000), possibly only representing a form of *R. spreitzenhoferi*.

The late-season (August) record is not accepted here due to possible confusion with *P. subspathaceus* Scholz (1991: 139). Whether or not both taxa occur sympatrically on Chrisi still remains to be verified by sufficient herbarium material.

*Psilurus incurvus* (Gouan) Schinz & Thell. – *Chr*: Ky-Ja-BrGu-BeDi; *Kou*: Ky-Ja-BeDi; *Str*: Ky-Ra-Bö; *Mak*: Ky; *Tra*: Ky

*Rostraria cristata* (L.) Tzvelev – *Chr*: He-Ky-BrGu-BeDi; *Mik*: Re-BeDi; *Kou*: StBa-Ky-Ja-BeDi; *Str*: Bö-BeDi-Ra; *Mak*: Bö-BeDi; *Tra*: BeDi

The voucher Bö 10435 from Strongili was determined by H. Scholz.

*R. hispida* (Savi) Đoan – BrGu

This is a dubious record (Brullo & Guarino 2000), possibly only representing a form of *R. cristata*.

*Stipa capensis* Thunb. – *Chr*: Ja-BrGu-Bö-BeDi; *Mik*: BeDi; *Kou*: StBa-Ky-Ja-BeDi; *Str*: Ky; *Mak*: Ky; *Tra*: Ky

The voucher Bö 8389 from Chrisi was determined by H. Scholz.

*Triplachne nitens* (Guss.) Link – *Chr*: Re-Za-Ky-Ja-BrGu-BeDi; *Kou*: Ga-Ky-Ja-BeDi; *Str*: Ky-Ra; *Mak*: Ky

*Vulpia ciliata* Dumort. – *Chr*: BrGu; *Kou*: Ky-BeDi

*V. fasciculata* (Forssk.) Fritsch

– *Chr*: Ky-Ja-BrGu-BeDi; *Kou*: Ga-StBa-Ky-Ja-BeDi

**Hyacinthaceae**

*Bellevalia sitiaica* Tzanoud. & Kyrioptakis – Ja

Due to the late season, the voucher is a somewhat poor fruiting specimen with large, shortly pedicelled capsules typical for this species.

*Charybdis maritima* (L.) Speota agg. – *Chr*: He-Gr-Ky-Ja-BrGu-Bö-BeDi; *Kou*: Ky-Ja-Ra-BeDi; *Str*: Ra-BeDi; *Mak*: Ky-Ra-BeDi; *Tra*: Ky-Ra

Generic nomenclature follows Speota (2001). According to Krenn & al. (2001: 104) and Pfosser & Speota (2001: 235), the hexaploid *Charybdis maritima* s. str. is restricted to the Western Mediterranean, while the plants of the islands off SE Kriti, traditionally listed as *Urginea maritima* (L.) Baker [agg.] or *Drimia maritima* (L.) Stearn [agg.], may belong to the tetraploid *C. aphylla* (Forssk.) Speota, or to an as yet undescribed taxon (Pfosser & Speota 2001: 230); living material is required for identification.

*Muscari comosum* (L.) Mill. – BrGu (*Leopoldia comosa* [L.] Parl.)

The late-season (August) record is not accepted here due to possible confusion with *M. spreitzenhoferi* (see below).

*M. cycladicum* P. H. Davis & D. C. Stuart – Ky-BeDi
Plants from Strongili differ from typical *M. spreitzenhoferi* (see next) in shorter pedicels (to 1 mm) of the fertile flowers, and the presence of numerous sterile flowers with long pedicels. *M. cycladicum* was included in *M. spreitzenhoferi* by Greuter & al. (1985: 47) and therefore omitted by Turland & al. (1993) and Jahn & Schönfelder (1995). It is tentatively separated here in order to remind field botanists to pay attention to the complex around *M. weissii* Freyn, which is still in need of a detailed taxonomic study.

*M. spreitzenhoferi* (Osterm.) Vierh. – Chr: He-Co-Ky-Ja-Bö-BeDi; Mik: Ky-BeDi; Kou: Ga-StBa-Ky-BeDi

A collection from Chrisi (Bö 8382, also under cultivation in B, as “*M. weissii* s.l.”) represents a form intermediate between *M. spreitzenhoferi* and *M. weissii*; both taxa are not always clearly distinguishable (see preceding note, and Davis & Stuart 1984: 251).

*Ornithogalum creticum* Zahar. – Ky

*Prospero autumnale* (L.) Speta agg. – Chr: Ky-BrGu; Kou: Ky-Ra-BeDi; Str: Bö-Ra-BeDi; Mak: Ky-Ra-Bö-BeDi; Trg: Ky-Ra-Bö-BeDi

Generic nomenclature follows Speta (2000); the genus, traditionally listed as *Scilla autumnalis* L. [agg.], is represented on the Koufonisia by a name yet unidentified and probably undescribed taxon, which does not match any of the six new Cretan *Prospero* species described by Speta (2000).

**Iridaceae**

*Gladiolus italicus* Mill. – BeDi

*Gynandriris monophylla* Klatt – Chr: Ky-BrGu; Kou: Ky-Ja-BeDi

*G. sisyrinchium* (L.) Parl. – Ky-BeDi

*Romulea* sp. – Ky

**Juncaceae**

*Juncus heldreichianus* Parl. – Chr: He-Za-Gr-Ch-Ky-Ja-BrGu-BeDi; Kou: Ga-Re; Str: Ky-Ra-BeDi

The records from Chrisi and Koufonisi, listed by Rechinger under “*J. acutus*” and “*J. maritimus*” (Rechinger 1943a, 1943b), belong here.

*?J. bufonius* L. – BrGu

Brullo & Guarino (2000), depending on plants collected or seen in August, probably confused *J. bufonius* with *J. hybridus* (see next).

*J. hybridus* Brot. – Ky-BeDi

**Liliaceae**

*Gagea fibrosa* (Desf.) Schult. & Schult. f. – BeDi

*G. graeca* (L.) A. Terracc. – BeDi

**Orchidaceae**

*Anacamptis pyramidalis* (L.) Rich. – Ky

*Barlia robertiana* (Loisel.) Greuter – Ky

*?Ophrys apifera* Huds. – Ga

The record is not substantiated by herbarium material (Künkele 1979); it may be based on a different species or locality.

*O. cretica* (Vierh.) E. Nelson agg. – Ky, BeDi

*O. fusca* Link agg. – BeDi

*O. tenthredinifera* Willd. – BeDi

*Orchis collina* Banks & Sol. – Ky-BeDi

*O. coriophora* subsp. *fragrans* (Pollini) Sudre – Ky-Ja
O. papilionacea L. – Chr: Ky; Kou: BeDi

Serapis lingua L. – BeDi

S. orientalis E. Nelson – Chr: BeDi; Kou: Ga (“S. vomeracea”)

The Gandoger record is assigned to this species following Künkele (1979).

Potamogetonaceae

?Zostera marina L. – Chr: Co; Kou: Ga

Species identity as well as the exact offshore localities are uncertain.

Floristic and habitat differences among the islands

Coniferous scrub and woodland (Juniperus phoenicea, J. macrocarpa) occurs only on Chrisi, while haloxerophilous scrub (Atriplex halimus, Asparagus horridus, Salsola aegaea, Lycium schweinfurthii) is more prominent on Koufonisi and its nearby islets (Table 3). In the E part of Chrisi one of the few salt marshes in the S Aegean exists, with the halophytes Arthrocnemum macrostachyum and Aeluropus lagopoides predominating. A single small stand of Schoenoplectus litoralis, to our knowledge the only one in Kriti and offshore islands, occurs not far from the NW shore. Extensive perennial grasslands dominated by Lygeum spartum and small areas of inland dunes with native Tamarix stands are unique features of Koufonisi. Steppe-like Lygeum grasslands are indicative vegetation for the driest regions in Europe. Grasslands dominated by annuals indicate formerly cultivated fields. They occur both on Chrisi and Koufonisi but not on the smaller islands. In such places, probably more than 25 years after agriculture has been abandoned, small populations of weeds are still thriving (Convolvulus althaeoides, Gladiolus italicus, Papaver rhoeas, Rapistrum rugosum).

Phytogeography

The N African/S Mediterranean/W Irano-Turanian element is the phytogeographically most striking one in the flora of the islands. It is represented by the following taxa (numbers in brackets):

Chrisi (13): Astragalus peregrinus, Carrichtera annua, Chlamydropoeta tridentata, Fagonia cretica, Gynandriris monophylla, Helianthemum stipulatum, Hippocrepis cyclocarpa, Lycium schweinfurthii, Malva aegyptia, Periplaca angustifolia, Plantago amplexicaulis, Silene succulenta, Zygophyllum album;

Table 3. Principal habitat types of the islands off SE Crete.

<table>
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<th>Chr</th>
<th>Mik</th>
<th>Kou</th>
<th>Str</th>
<th>Mak</th>
<th>Tra</th>
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<td>coastal dunes</td>
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<td>+</td>
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<tr>
<td>inland dunes</td>
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<td>sea cliffs</td>
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<td>+</td>
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<td>+</td>
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<tr>
<td>saltmarsh</td>
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<td>coniferous scrub and woodland</td>
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<tr>
<td>Pistacia scrub</td>
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<tr>
<td>haloxerophilous scrub</td>
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<td>+</td>
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<tr>
<td>abandoned fields</td>
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<td>–</td>
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<td>+</td>
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</tr>
</tbody>
</table>
For Astragalus peregrinus, Chlamydomphora tridentata, Erodium crassifolium, Fagonia cretica, Frankenia corymbosa, Helianthemum stipulatum, Periploca angustifolia and Zygophyllum album we estimate about half or more of the total known population in Greece to be restricted to the study area. Limoniastrum monopetalum (native occurrences only), Suaeda palaestina and Ononis vaginalis are, within Greece and the Aegean, and SE Europe as a whole, restricted to Koufonisi or the study area. Most of these taxa belong to the N African element. Fig. 2 shows that the respective taxa are best represented on the islands S of Kriti, much less along the S and NE coast of the main island, and only scattered elsewhere in the S Aegean. Koufonisi harbours more such species than any other place in Greece and the Aegean, Chrisi slightly less so. Haloxerophilous scrub and Lygeum grasslands, both being best developed on Koufonisi, are the principal habitat types for many of the species belonging to the N African element. The ecological conditions and the distribution of pronouncedly thermophilous species suggest a climatic (precipitation) gradient in Kriti towards the SE, and locally from Chrisi to Koufonisi, with the latter being the driest island and in fact closer to semi-desert conditions than any other place in SE Europe.

Nature conservation

All islands treated here are integrated in the Natura 2000 network of sites of common interest for nature conservation in the European Union (Dafis & al. 1996, Boteva & al. 2001). For Chrisi, a LIFE project was initiated and performed in order to elaborate a conservation and management concept. The latter was apparently of little effect so far, since the most serious impacts continue to grow worse uncontrolled, viz. construction of provisional tourist facilities, illegal camping and pollution of the Juniperus woodland, and unrestricted beach tourism. The tiny population of Silene ammophila subsp. ammophila, endemic to E Crete and rightly included in the Red Data Book of Greece (Phitos in Phitos & al. 1996), is severely threatened by the increasing tourism.

For the island of Koufonisi, luckily an only occasional destination of individual boat trips so far, the situation is less alarming, but random extinctions caused by unintended disturbance,
careless and uncontrolled impact cannot be excluded in the absence of a sound conservation concept that is accepted by the local population. From a botanical point of view, we recommend a strict conservation status in order to safeguard the unique nature (including the archaeological heritage) of Koufonisi and nearby islets, with limited access made possible by individual boat trips only, while prohibiting the construction of tourist facilities of any kind.

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