

The local endemic flora of Evvia (W Aegean, Greece)

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Abstract

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The local endemic element in the flora of the W Aegean island of Evvia comprises 39 taxa (2.1 % of an estimated total of 1833 taxa). The three centres of endemism on the island are the ophiolitic areas of N Evvia, Mt Dirphis in central Evvia and Mt Ochi and the Cape Kafireas area in S Evvia. The majority of the endemic taxa inhabit limestone and ophiolitic habitats. Schizoendemics (80.8 %) form the largest category, followed by apoendemics (11.5 %) and palaeoendemics (7.7 %). Taxonomical comments on selected taxa are provided. The chromosome number of ten taxa is given for the first time.

Key words: island biogeography, taxonomy, vascular plants, serpentine, chromosome numbers.

Introduction

The Aegean area is an important centre of Mediterranean plant endemism, floristically pioneered by Rechinger (1943, 1944, 1949). In the W Aegean, the flora of the island of Evvia was studied in detail (Rechinger 1961, partly based on Phitos 1960). Much floristic and biosystematic work has subsequently been carried out in Evvia and adjacent regions (e.g. Künkele & Paysan 1981, Akeroyd & Preston 1987, Boratyński & al. 1988, Trigas & Iatrou 2000) and many taxa have been described from the island in the last decades (Phitos 1964, 1965, 1981, Ehrendorfer & Schönbeck-Temesy 1975, Georgiadis 1980, Phitos & Georgiadis 1981, Phitos & Tzanoudakis 1981, Papanikolaou & Kokkini 1982, Tiniakou 1991, Brullo & al. 1997, 2003, Trigas & Tzanoudakis 2000, Trigas & Iatrou 2003, 2005). Endemism in the local flora was analysed by the first author only recently (Trigas 2003). Actually, 1833 taxa (species and subspecies) are known to occur in Evvia. The Greek endemic element includes 178 taxa (9.7 %). Of these, 39 taxa (2.1 % of the total flora) are island endemics of Evvia, discussed in the present paper as to their taxonomy, estimated origin and evolution. For topographical, geological, climatic and edaphic properties of the investigated area (Fig. 1) the reader is referred to Rechinger (1961), Trigas & Iatrou (2000) and Trigas (2003), for paleogeography in particular to Creutzburg (1966), Greuter (1970), Dermitzakis (1990) and Andel & Tzedakis (1996).

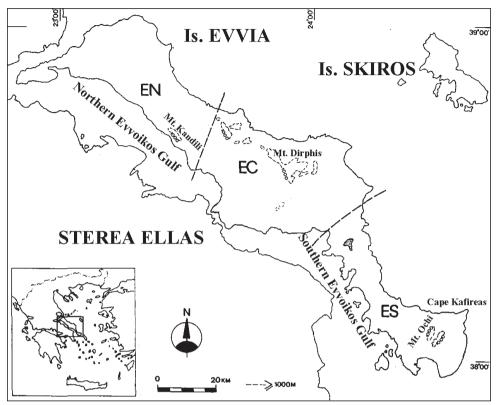


Fig.1. Topographic map of Evvia with the northern (EN), central (EC) and southern (ES) divisions according to Rechinger (1961).

Material and methods

This paper is based on field studies carried out from 1995 to 2003, studies of herbarium specimens (ATH, C, UPA, W), and evaluation of the literature. The collection of plant material and field observations were made in different seasons of the year to fully cover different altitudinal belts and representative types of habitats. Nomenclature follows Tutin & al. (1968-80, 1993), Greuter & al. (1984-89), Strid (1986) and Strid & Tan (1991, 1997, 2002). The classification by cytotaxonomic criteria of the local endemic taxa of Evvia follows Favarger & Contandriopoulos (1961). The karyological studies are based on material collected in nature and cultivated in pots outdoors in the experimental botanical garden of the University of Patras (for laboratory methods applied, see Trigas & Iatrou 2005).

Results and discussion

The endemic flora of Evvia consists of 39 taxa (32 species and 7 subspecies; Table 1) in 14 families and 23 genera. Highly diverse genera with many endemics in the Greek flora (e.g., *Allium*, *Centaurea, Silene, Verbascum, Viola*) are also represented in the endemic flora of Evvia. The chromosome number is known for 27 taxa but not yet studied in the remaining 11 taxa. Of the endemic taxa of Evvia 20 are chamaephytes, 12 hemicryptophytes, 5 geophytes (*Allium* spp., *Geocaryum euboeum*), 1 therophyte (*Ammi topalii*), and 1 phanerophyte (*Quercus trojana* subsp. *euboica*). When referring to age of taxa and times of speciation processes, either taken from literature or derived from own observations, the present authors are aware of the fact that conclusive evaluations may point towards plausibilities rather than proved evidence.

1. Geographical distribution of the endemics

The local endemic taxa of Evvia are not evenly distributed. The highest concentration is observed in central Evvia (21 taxa), followed by N Evvia (18 taxa) and S Evvia (9 taxa). Three centers of endemism can be observed:

a) The ophiolitic regions of N Evvia with 12 local endemics; eight exclusively on serpentine and four on both serpentine and limestone at low altitudes, plus six on limestone or on calcareous quaternary sediments at higher altitudes of Mt Kandili and its surroundings.

b) Mt Dirphis and the nearby mountainous areas of central Evvia whith 18 local endemics; ten at medium and higher altitudes, five (*Allium dirphianum, Asperula suffruticosa, Cruciata taurica* subsp. *euboea, Minuartia dirphya, Silene dirphya*) restricted to the highest peak (Delphi) of Mt Dirphis, plus three (*Allium calamarophilon, Campanula cymaea, Ammi topalii*) at low altitudes and along the coast.

c) Mt Ochi (five taxa at medium and high altitudes) and Cape Kafireas in S Evvia (four taxa at low altitude, partly coastal).

Most (i.e. 30) of the insular endemics of Evvia occur in only one of the three geographical divisions of the island (Fig. 1). Twelve taxa are confined to N Evvia, twelve to central Evvia and six to S Evvia. The distribution of these taxa is limited to very small areas on the mountains or in the lowland. The remaining nine endemics are distributed in two of the three geographical divisions, none expanding from N through S Evvia.

As many as 26 of the insular endemics of Evvia are lowland taxa occuring below 1000 m, eight taxa grow only above 1000 m and 5 taxa are distributed over both altitudinal ranges. A similar altitudinal distribution pattern has been observed in the endemic flora of Peloponnisos (Iatrou 1986, Tan & Iatrou 2001).

2. Edaphic endemism - distribution according to substrate

The strong link of taxa to a specific geological substrate is one of the most important characteristics of the endemic flora of Evvia. The majority of the local endemic taxa (17 taxa or 43.6 %) are exclusively distributed on limestone, viz. Allium dirphianum, A. calamarophilon, Asperula euboea, A. suffruticosa, Campanula constantini, C. cymaea, Chaerophyllum euboeum, Cruciata taurica subsp. euboea, Geocaryum euboeum, Hypericum fragile, Linum goulimyi, Nepeta argolica subsp. dirphya, Senecio eubaeus, Silene dirphya, Verbascum euboicum, Verbascum zuccarinii, Viola dirphya. Nine local endemics (23.1%) grow exclusively on ultramafic rock (serpentine), viz. Alyssum euboeum, Asperula ophiolithica, Centaurea ebenoides, C. euboica subsp. euboica, C. euboica subsp. intermedia, C. mantoudii, Minuartia dirphya, Quercus trojana subsp. euboica, Silene oligantha subsp. pseudoradicosa. Four local endemics grow equally well on serpentine and limestone (Alyssum densistellatum, Bolanthus intermedius, Campanula goulimyi, Scutellaria goulimyi), another four occur exclusively on schist in S Evvia (Allium karistanum, A. runemarkii, Armeria johnsenii, Campanula celsii subsp. carystea). Sideritis euboea and Viola euboea grow on both limestone and schist. Inula subfloccosa is confined to cipolin and marbles, whereas Asperula brachyphylla grows on both schist and cipolin. Finally one species, Ammi topalii, inhabits coastal sands.

The influence of serpentines in speciation processes in plants is well known (Kruckeberg 1951, 1954, 1967, Proctor & Woodell 1975). The serpentines of Evvia, concentrated in the north while being only scattered in the central and southern divisions, are of special interest in terms of phytogeography, in particular with respect to their position at the southeastern periphery of the whole system of serpentine areas in the Balkans, and their insular isolation. The serpentine areas of the Balkan Peninsula represent an ancient core of speciation and act likewise as an important refugial habitat for relict elements. Numerous relict and endemic taxa on various taxonomic levels, predominantly or facultatively found on serpentine, support this view (Stevanović & al.

Table 1. The endemic vascular plant taxa of Evvia, with geographical distribution in the three geographical divisions of Evvia as defined in Fig. 1, altitudinal range, substrate preference and chromosome number. Previously unpublished chromosome numbers are marked with an asterisk.

				Altitude		
Taxon	EN	EC	ES	(m)	Substrate	2n
Allium dirphianum Brullo & al.		+		1400-1500	Limestone	32
A. calamarophilon Phitos & Tzanoud.		+		20-30	Limestone	16
A. karistanum Brullo & al.			+	5-30	Schist	16
A. runemarkii Trigas & Tzanoud.			+	5-20	Schist	16
Alyssum densistellatum T. R. Dudley	+	+		50-700	Limestone-Ophiolite	-
A. euboeum Halácsy	+	+		30-600	Ophiolite	16
Ammi topalii Beauverd		+		0-20	? Sand	-
Armeria johnsenii Papan. & Kokkini			+	5-20	Schist	18*
Asperula brachyphylla Trigas & Iatrou			+	1100-1300	Schist-Cipolin	
A. euboea (Ehrend.) Trigas		+	+	300-800	Limestone	22*
A. ophiolithica Ehrend.	+			50-450	Ophiolite	44*
A. suffruticosa Boiss. & Heldr.		+		1000-1700	Limestone	44*
Bolanthus intermedius Phitos	+			0-50	Limestone-Ophiolite	-
Campanula celsii subsp. carystea Phitos			+	0-600	Schist	34*
C. constantini Beauverd & Topali		+		450-1600	Limestone	34
C. cymaea Phitos		+		0-750	Limestone	34
C. goulimyi Turrill	+			0-450	Limestone-Ophiolite	34
Centaurea ebenoides Heldr.	+			0-700	Ophiolite	20
C. euboica Rech. f. subsp. euboica	+			200-700	Ophiolite	22
C. euboica subsp. intermedia Phitos & Georgiadis	+			200-700	Ophiolite	22
C. mantoudii Georgiadis	+			30-400	Ophiolite	36
Chaerophyllum euboeum Halácsy		+		1000-1200	Limestone	-
Cruciata taurica subsp. euboea (Ehrend.) Ehrend.		+		1000-1700	Limestone	-
Geocaryum euboeum (Rech. f.) Engstrand	+	+		600-1200	Limestone	-
Hypericum fragile Boiss	+	+		0-500	Limestone	18*
Inula subfloccosa Rech. f.			+	150-600	Cipolin	16 (+0-1B)*
Linum goulimyi Rech. f.	+			200-400	Limestone	-
Minuartia dirphya Trigas & Iatrou		+		900-1000	Ophiolite	26
Nepeta argolica subsp. dirphya (Boiss.) Strid & Kit Tan		+		400-1600	Limestone	16
Quercus trojana subsp. euboica (Papaioannou) K. I. Chr.	+			100-600	Ophiolite	-
Scutellaria goulimyi Rech. f.	+			250-700	Limestone-Ophiolite	34
Senecio eubaeus Boiss. & Heldr.	+	+		1000-1400	Limestone	40*
Sideritis euboea Heldr.		+	+	600-1700	Limestone-Schist	32*
Silene dirphya Greuter & Burdet		+		1550-1740	Limestone	24*
S. oligantha subsp. pseudoradicosa (Rech. f.) Greuter	+			50-700	Ophiolite	24
Verbascum euboicum Murb. & Rech. f.	+	+		400-900	Limestone	-
V. zuccarinii (Boiss.) I. K. Ferguson	+			50-400	Limestone	-
Viola dirphya Tiniakou		+		1000-1300	Limestone	40
V. euboea (Halácsy) Halácsy		+	+	800-1700	Limestone-Schist	40

2003). Of the local serpentine endemics of Evvia, four taxa belong to the genus *Centaurea* and two to *Alyssum*. Both genera are among the richest in obligate serpentine endemics in the Balkan Peninsula (Stevanović & al. 2003). The endemism related to ultramafic substrate on Evvia exhibits a mixture of evolutionary recent and older taxa which can be grouped into certain categories with respect to their origin (see also Table 2).

The first category includes endemics the taxonomic relatives of which are distributed in adjacent non-ophiolitic (usually calcareous) areas (*Centaurea euboica, C. mantoudii, Quercus trojana* subsp. *euboica, Silene oligantha* subsp. *pseudoradicosa). Alyssum densistellatum, Bolanthus intermedius* and *Scutellaria goulimyi* which grow on both ophiolite and limestone also belong here. This category is considered to include neoendemics and may represent the result of adaptation of older populations to the special ecological conditions of the ophiolitic substrate. Their differentiation probably took place in recent geological eras or may still be in progress.

The second category includes serpentine taxa the relatives of which are distributed quite far away, mostly in northern regions. *Centaurea ebenoides* and *Campanula goulimyi* belong here, the latter growing on both ophiolitic and calcareous substrates. These taxa seem to have reached Evvia from the north, probably during colder periods.

The third category includes taxa that are taxonomically isolated, or their relatives geographically disjunct, such as *Alyssum euboeum*, *Asperula ophiolithica* and *Minuartia dirphya*. Given the palaeogeography of the region, they seem to have evolved in the distant past, at least during Pliocene. The ophiolitic areas of Evvia, apart from contributing to the evolution of new taxa, Table 2. Classification of the local endemic taxa of Evvia into categories using cytotaxonomic criteria, including corresponding relatives with their distribution ranges. S = schizoendemic, P = palaeoendemic, A = apoendemic; after Favarger & Contandriopoulos (1961).

Alliam calamarophilon S A. drexificam Thessalia, Is. Scialubas A. drephinaum S Evria S Evria A. drephinaum S A. perointinaum S Vanatolia A. karistanum S A. periodicaum SW Anatolia A. karistanum S A. periodicaum SW Anatolia A. runemarkii S A. periodicaum SW Anatolia A. runemarkii S A. foreitationum Staly A. runemarkii S A. moticaum Thessalia, IS. Sciathos A. runemarkii S A. moticaum Thessalia, IS. Sciathos A. exboeum P - A moticaum subsp. montonum E Burope, W Asia A. exboeum P - Sciatage - Anmeria johnsenii S A. careexers C & E Mediferranean A. euboca S A. tanida sl. Anatolia, Is, Lavos A. euboca S A. tanigitia Stevas Ellas, Finados A. euboca S A. tanigitia Stevas Ellas, Finados A. euboca S C. ruperita aggr. Thessalia, Stevas Ellas, Finados A. euboca S C. ruperita aggr. Thessalia, Stevas Ellas, Finados A. euboca S C. calviagar. Stevas Ellas	Taxon	Category	Corresponding relatives	Distribution range of relatives
A. dryhnaum A. erythnaum Chalkáliki A. dryhnaum A. savii Mediterranean A. karstamm S A. perutakenyli S haly A. karstamm S A. perutakenyli S haly A. ranemarkii S S. A. perutakenyli S haly A. ranemarkii S S. A. furgetterin Cyreniaia A. ranemarkii - Calkafaliki A. ranemarkii - Calmarophion A. perutakenyli S S. A. calmarophion A. perutakenyli - Calmarophion A. anderon - Calmarophion A. andero - Cal	Allium calamarophilon	s	A. thessalicum	Thessalia, Is, Sciathos
A. drophionmom - normarkii S. Evvia A. karvistanum - A. sovi Mediterranean A. karistanum - A. endidacyofi S. Buly A. numenarkii - A. endidacyofi S. Buly A. numenarkii - A. divistanum - Calakidoin A. numenarkii - A. divistanum - Calakidoin A. numenarkii - A. divistanum - Calakidoin A. euboean - A. nortenums tubp, montanum - E. Canatoin A. euboean - A. nortenums tubp, montanum - E. Europe, W Asia A. euboean - A. nortenums tubp, montanum - E. Europe, W Asia A. euboean - A. nortenums tubp, montanum - E. Europe, W Asia A. euboean - A. nortenums tubp, montanum - E. Europe, W Asia A. euboean - A. nortenums tubp, montanum - E. Europe, W Asia A. euboean - A. nortenum - E. Europe, W Asia A. euboean - A. nortenum - S. Erece Ellas, S. Pindos A. ophiolithica A. tuberosan - M. tuba A. subironsan A. tuberosan - M. tuba Bolanthus intermedius - A. tuberosan	F			
A. durikanum A. savii Mediteramean A. karistanum S A. calidicyon E. & C. Anatolia, Iran A. karistanum S S S S A. ranemarkii S A. greateri Creanica A. ranemarkii S A. inestalicum Thessilia, I.S. Sciathos A. superior C.BaldxQi C.Evvia A. superior C.BaldxQi C.Evvia A. montonum subsp. montanum E. Lorope, W.Asia - entercomit P - - entercomit P - - entercomit P - - anticolarity chinescrii S A. canecorer - deuboea S A. numgieri - deuboea S A. numgieri - deuboea S A. numgieri - deuboea - A. temploita - deuboea - A. temploita <td></td> <td></td> <td></td> <td></td>				
A. calidicityon E. & C. Anutolia, Iran A. runemarkii S S. Italy A. exportacem Charlicickii C. Evria A. exboeum P - A. montaruum subsp. montaruum E. Europe, W. Asia A. exboeum P - A. montaruum subsp. montaruum E. Europe, W. Asia A. exboeum P - A. morta forhesenii S. A. canescens C. & E. Mediterranean A. philofila Sterea Ellas, S. Pindos A. anungieri A. philofila Sterea Ellas, S. Pindos A. anuagieri A. subrevat A. tatata Sterea Ellas, S. Pindos A. numgieri S. B. Periosata Mit. Alataa Bolonthus intermedius - B. genecasia B. genecasia A. takaa Sterea Ellas, Evria, Else, Else, Evria, Else, Else, Evria, Else, Else, Evria, Else, Evria, Else, Else, Evria, Else, Else, Evria, Else, Else	A. dirphianum			
A. ranomarkii S A. calidicicyon E. & C. Anatolia, Iran A. ranomarkii S S. Inty A protadocpylic S. Inty A. renomarkii S S. A. hossaficum Thessalia, Is. Sciathos A. exbocum C. Bavian C. Evvia Alyssam dexistellatum – A. montenums subsp. montanum E. Europe, W. Asia A. euboeum P – Isolated A. euboeum P – Isolated A. euboeum P – Isolated A. morisi S A. cancescens C. & E. Molitermean A. providual Isolated Isolated Isolated A. providual Isolated Isolated Isolated A. abbreviatu Isolated S. Peloponnisos A. autical s. Isona Isolated Isolated A. ophiolithica – A. tenaforial S. G. Crediti aggr. Bolanthus intermedius – B. generaciolitis S. G. Crediti aggr. C. comata S. C. Crediti aggr. Crease Ellas, Evvia, Isolatis C. contain S. C. Crediti aggr. Thessalia, Sterne Ellas, W. Acgenn C. contain S. C. Crediti aggr. Thessalia, Sterne Ellas, W. Acgenn C. contain S. C. Crediti aggr. </td <td>A. karistanum</td> <td>s</td> <td>A. peroninianum</td> <td>SW Anatolia</td>	A. karistanum	s	A. peroninianum	SW Anatolia
A. ranomarkii S. A. perateri Cyremia A. ranomarkii S. A. thessilicam Thessilia, IS. Sciathos A. disposition C. Evia Chalkidiki Alyssum densistellatum - A. colamarophilon C. Evia A. euboeum P - Isolatadj - A. euboeum P - Isolatadj - A. euboeum P - Isolatadj - A. euboeum S. A. cancescens C. & E. Mediterranean Aspendia brachyphylla - A. dubreviau Strene Ellas, N. Phonos A. euboeu - A. huida S1. Strene Ellas, N. Phonos A. euboeu - A. huida S1. Strene Ellas, Neaponnice A. euboria - A. euroficita Strene Ellas, Neaponnice A. dubra - A. euroficita Strene Ellas, Neaponnice A. dubra - A. euroficita Strene Ellas, Neaponnice A. dubra - A. euroficita Strene Ellas, Neaponnice C. constantini S C. constantini Strene Ellas, Neaponnice C. constantini S C. constantini Strene Ellas, Neapen, M. Athos C. constantini S C. constantini Strene Ellas, Neapen, M. Ath				
A. runemarkii S A. fressaficum Thessafile, Is, Sciathos A. runemarkii S A. fressaficum Thessafile, Is, Sciathos A. euboeum P - [Isolated] - A. euboeum P - [Isolated] - Anmeria Johasenii S A. canescens C & E. Weiderranean Amreria Johasenii S A. canescens C & E. Weiderranean Apprala brachyphylla - A. abbreviata Is, Naxos, Is, Amorgos A. euboea S A. innurgieri S Peloponnisos A. euboea S A. innurgieri S Peloponnisos A. euboea - A. intera (Isolata), Is, Samos A. subernau A. subernau - A. intera Sterca Ellas, S. Peloponnisos A. subernau - A. intera Sterca Ellas, Evia, Is, Naxos Bolanthus intermedius - B. geneciton E Sterca Ellas, Evia, Is, Naxos C. cornau S C. rupeerris aggr. Thessafia, Sterca Ellas, Naxos C. cornau S C. cornau S C. celaini aggr. Thessafia, N Greece C. conau			A. pentadactyli	
A erythracian C. Elvisia Alyssam densistellatum - A contanum subsp. montanum A cabocan P - Armeria johnsonii S A canescens A mareria johnsonii S A canescens A cabocan A canescens C & E Mediterranean Armeria johnsonii S A canescens C & E Mediterranean A endocan S A canescens C & E Mediterranean A cabocan A mungieri S Peloponnisos A cabocan A mungieri S Peloponnisos A cabocan A mungieri S Peloponnisos A caboran A terra filia S Vira (S Nanotolia, Is, Samos A subrosan - A subrosan A caboran B graccas E Strea Ellas, Evina, Is, Navos Bolanthus intermedius - B graccas E Strea Ellas, Evina, Is, Navos C constantini S C caparstris aggr. Thessalia, Strea Ellas, Weagan C constantini S C cachia iggr. S Greece, Waggean, M Athos C carbaican S C cachia iggr. S Greece, Waggean, M Athos C carbaican S C cachia inggr. S Greece, Waggean, M Athos C carbaican S C cachia Peloponnisos, Streace Ellas, Thessalia C coranatican C C carbai				
A. cidamaraphilam C. Evvia A. dyssam dexistellatam – A. duboeum P - [isolatcd] – Armari topaliti – A. marius bashs, montaruam E Europe, Wasia Armari topaliti – Armari topaliti – Armari topaliti – Armari topaliti – A. aphiofula – Armari topaliti – A. aphiofula – A. abbreviata Is. Nacos, Is. Amorgos A. phiofula – A. euboea S A. aphiofula – A. eutobea – A. subfraticos – Bolanthus intermedius – B. graccus E Sterea Ellas, Fivia, Is. Nacos C. comata S C rupestris aggr. C. constantini S C rupestris aggr. C. constantini S C crediti aggr. C. constantini S C crediti aggr. C. constantini A C pelia C. conantouli A C coninitica <t< td=""><td>A. runemarkii</td><td>S</td><td>A. thessalicum</td><td>Thessalia, Is. Sciathos</td></t<>	A. runemarkii	S	A. thessalicum	Thessalia, Is. Sciathos
Alysian densistellation - A montanum subsp. montanum E Europe, W Asia A cuboeun P - [Isolated] Armeria johnsonii S A canexcens C & E Mediterranean Asperula brachyphylla - A pinifolia Sterze Ellas, S Pindos A cuboeun S A murgieri S Peloponnisos A cuboea S A murgieri S Peloponnisos A cuboea - A suberosa Mitada sl. A cuboea - A suberosa Mitada sl. A cuboea - - A suberosa A cuboea - - A suberosa A suberosa - - A suberosa A suberosa - - S Estera Ellas, Evia, Nacos Bolanthus intermedius - - B graccus S Greece, W Agegan, M Athos C constantini S C crapestris aggr. Thessalia, Sterae Ellas, Weagean C costantinii S C caebia Peloponnisos, E sterae Ellas, Tersa ellas, Neloponnisos C cuboica S C caebia Peloponnisos, E sterae Ellas, Veagean C costantini S C rapestris aggr. Thessalia, Neforece C goulinyi S C caebia S Greece, W Agegan, M Athos			A. erythraeum	Chalkidiki
d. advocum P - [isolated] - Armei topili - A. majis Medierranean Armeira johnsonii S A. consocons C & E Mediferranean Asperula brachyphylla - A. abbreviata Is. Naxos, Is. Amorgos Asperula brachyphylla - A. abbreviata Is. Naxos, Is. Amorgos A enboea S A. mungieri S Peloponnisos A enboea S A. mungieri S Peloponnisos A ophioithica - A. titlea Streaz Ellas, N Peloponnisos A sufforaccosa M. A. suberosa M. Athos Bolanthus intermedius - B. graccus E Sterea Ellas, Evvia, Is. Naxos Bolanthus intermedius - B. graccus E Sterea Ellas, Neloponnisos C. constrinii S C. codeii tiggr. Tossalia, Sterea Ellas, Nelogean, MI Athos C. constrinii S C. codeii tiggr. Tossalia, Sterea Ellas, Nelogean, MI Athos C. euboica S C. annuelis-loewii Bujarii, M Greece C. eutoica S C. annuelis-loewii Bujarii, M Greece C. eutoica C Carbitica W Sterea Ellas C. eutoica A contaica W Sterea Ellas, N Evoja C. eutoica C <td< td=""><td></td><td></td><td>A. calamarophilon</td><td>C Evvia</td></td<>			A. calamarophilon	C Evvia
Image A. mages Mediteranean Ameria Johnsmiti S A. cansceers C. & Hediteranean Aperula brachyphylla A. abbreviata Is. Naxos, Is. Amorgos A. euboea S A. mitida sl. Sterce Ellas, S Peloponnisos A. euboea S A. mitida sl. Sterce Ellas, N Peloponnisos A. ophiolithica - A. teunofilia SW Anatolia, Is. Lesvos A. subtrova M. Intea Sterce Ellas, N Peloponnisos A. subtrova M. A. subtrova M. A. subtrova A. subtrova M. A. subtrova M. A. subtrova A. subtrova M. A. Suberova M. A. Sonoo A. subtrova B. graccus E. Sterca Ellas, Evvia, E. Thessalia, NGreece C. comtanti S C. constain, Sterce Ellas, W Acgean C. constatini S C. coliti aggr. Thessalia, Sterce Ellas, W Acgean C. constantini S C. coliti aggr. S Greece, W Acgean, M. Athos C. constantini S C. coliti aggr. S Greece, W Acgean, M. Athos C. euboica S C. contanicum	Alyssum densistellatum	_	A. montanum subsp. montanum	E Europe, W Asia
Armeria johnsenii S A. cohrevelata IS. Naxos, Is. Amorgos Asperula brachyphylla - A. abbrevilata IS. Naxos, Is. Amorgos A. euboea S A. mungieri Sterea Ellas, N. Flondos A. euboea S A. mungieri S Peloponnisos A. obioidhica - A. Littea Sterea Ellas, N. Flondos A. utifati s.l. A. mungieri S Peloponnisos A. utifati s.l. SW Anatolia, Is. Samos A. subrersa M. utata Sterea Ellas, N. Peloponnisos Sterea Ellas, N. Peloponnisos Bolanhus intermedius - R. graccus E Sterea Ellas, Evvia, Is. Naxos Bolanhus intermedius - R. graccus E Sterea Ellas, Evvia, Is. Naxos C. constantini S C. constantini S C celsii aggr. C. constantini S C. constantini Bilgaria, N. Greece C. gradunyi S C. celsii aggr. Thessalia, Sterea Ellas, N. Alegean C. euboica S C. argentris aggr. Thessalia, Sterea Ellas, N. Peloponnisos C. euboica S C. argentris aggr. Thessalia, Sterea Ellas, N. Peloponnisos, Estree Ellas, Thessalia C. euboica S C. argentris aggr. S Greece C. gradunyi A C achuia <td< td=""><td>A. euboeum</td><td>Р</td><td>– [isolated]</td><td>_</td></td<>	A. euboeum	Р	– [isolated]	_
Asperulà brachyphylla _ A. Abbreviata Is. Naxos, Is. Anorgos A. auboea S A. pinjóla Steres Ellas, S. Pindos A. auboea S A. mungieri S. Pichopomisos A. ophiodithica _ A. tenufifila Steres Ellas, N. Polopomisos A. ophiodithica _ A. tenufifila Steres Ellas, N. Polopomisos A. subfroxa _ A. tenufifila Steres Ellas, Evvia, Is. Naxos Bolanthus intermedius _ B. graeca Kitta Bolanthus intermedius _ B. graeca Steres Ellas, Evvia, Is. Naxos Companula celsii subsp. carystea S C. celsi aggr. Thessalia, Steres Ellas, W. Aegean C. constantini S C. celsi aggr. Thessalia, Steres Ellas, W. Aegean C. constantini S C. celsi aggr. Thessalia, Steres Ellas, Thessalia C. euboica S C. actinia Pelopomisos C. euboica S C. actinia Pelopomisos C. euboica S C. actinia Pelopomisos C. euboica C C. actinia Steres Ellas, Thessalia C. euboica	Ammi topalii	_	A. majus	Mediterranean
A. euboea A. phifolia Sterce Ellas, S Pados A. euboea S A. mungieri S Peloponnisos A. ophiolithica - A. tenuífolia S Peloponnisos A. ophiolithica - A. tenuífolia S Peloponnisos A. suberosa Mt. Altos Kriti Bolanthus intermedius - B. graecas E Sterce Ellas, Evia, Is. Naxos Bolanthus intermedius - B. graecas E Sterce Ellas, Evia, Is. Naxos Campanula celsi subsp. carystea S C celsir aggr. Tessalia, Sterce Ellas, Weigean C. constantini S C rupestris aggr. Tessalia, Sterce Ellas, Weigean C. constantini S C celsir aggr. S Greece, W Aggean, Mt Athos C. caboica S C cachaia Peloponnisos C. cuboica S C cachaia Peloponnisos, Esterce Ellas, Neceen C. mantoudii A C cachaia Peloponnisos, Esterce Ellas, Thessalia, NE Greece C. mantoudii A C caromaticum C & Europe, Balkan Peninsula C. mantoudii A C pelia Sterce Ellas, Nevia Geocaryum euboicum - C taurica sl. Keitageita Hypericum fragile S I. twerbascifolia subsp. methaned E Peloponnisos, Attera <td>Armeria johnsenii</td> <td>S</td> <td>A. canescens</td> <td>C & E Mediterranean</td>	Armeria johnsenii	S	A. canescens	C & E Mediterranean
A. euboea S A. mindia S.L. esvos A. euboea S A. mungieri S Peloponnisos A. ophiolithica - A. tenufofia S Peloponnisos A. suffruitossa - A. tenufofia S Peloponnisos A. suffruitossa - A. tenufofia S Peroponnisos Bolanthus intermedius - B. graccas E Sterca Ellas, Evvia, Is. Naxos Bolanthus intermedius - B. graccas E Sterca Ellas, Evvia, Is. Naxos Campanula celsi subsp. carystea S C celsi aggr. Tessalia, Sterca Ellas, Wegean, Mt Athos C. cymaea S C rupestris aggr. Thessalia, Sterca Ellas, Wegean C. costantini S C rupestris aggr. Thessalia, Sterce Ellas, Wegean C. cuboica S C achaia Peloponnisos C. cuboica S C achaia Sterce Ellas, Thessalia, NE Greece C. mantoudii A C caromaticum Reloponnisos, Elstera Ellas, Thessalia, NE Greece C. mantoudii A C caromaticum Reloponnisos, Sterce Ellas, Nevia Geocaryum euboicum - C taromaticum Reloponnisos, Sterce Ellas, Nevia Hypericum fragile S H targeteum Mt Killini Inuta subfloccosa S L verbacefolia	Asperula brachyphylla		A. abbreviata	Is. Naxos, Is. Amorgos
A. duboca S A. mungieri S Peloponnisos A. ophiofithica - A. tenufoficia SW Anatolia, Is. Samos A. suffruitossa - A. tenufoficia SW Anatolia, Is. Samos Bolanthus intermedius - B. graecus E Sterca Ellas, Evvia, Is. Naxos Bolanthus intermedius - B. graecus E Sterca Ellas, Evvia, Is. Naxos Campanula celsii subsp. carystea S C celsii aggr. Tesssitia, Sterca Ellas, Wegean, Mt Athos C. cymaca S C rupestris aggr. Tesssitia, Sterca Ellas, Wegean C. constantini S C rupestris aggr. Tesssitia, Sterce Ellas, Wegean C. cuboica S C cachaia Peloponnisos C. cuboica S C acachaia Stercee C. mantoudii A C pelia Sterce Ellas, Tessitia, NE Greece C. mantoudii A C pelia Sterce Ellas, Neva, Reve Geocaryum euboicum - C divaricatum Mt Killini May Sterce Ellas, Nevia Feloponnisos, Attera E Nevia Hypericum fragile S H targeteum Mt Killini Inuta subfloccosa		_	A. pinifolia	Sterea Ellas, S Pindos
A. phiolikica - A. tetrafficia Stera Ellas, N Peloponnisos A. suffruticosa - A. suberosa Mt. Athos Bolanthus intermedius - B. graecus E. Sterca Ellas, Evvia, Is. Naxos Bolanthus intermedius - B. graecus E. Sterca Ellas, Evvia, Is. Naxos Campanula celsii subsp. carystea S. C. celsii aggr. Sterca Ellas, Evvia, Is. Naxos C. constantini S. C. crupsstris aggr. Thessalia, Sterca Ellas, W Acgean C. constantini S. C. crupstris aggr. Thessalia, Sterca Ellas, W Acgean C. constantini S. C. celsii aggr. Sterca Ellas, N Greece C. auboica S. C. cointinica Peloponnisos C. euboica S. C. cointinica N Feloponnisos C. auboica A. C. pelia Sterca Ellas, Thessalia, NE Greece C. auboica S. H. torgeteum C. darbica N Feloponnisos, Esterca Ellas, NE via C. mantoudii A. C. pelia Sterca Ellas, Evvia, Ellas, Thessalia, NE via <td></td> <td></td> <td>A. nitida s.1.</td> <td>Anatolia, Is. Lesvos</td>			A. nitida s.1.	Anatolia, Is. Lesvos
A. suffruitiosa - A. steruifolia SW Anatolia, Is. Samos A. suffruitiosa - A. sterva Mt. Athos Bolanthus intermedius - B. graccus E. Sterca Ellas, Evvia, Is. Naxos Bolanthus intermedius - B. graccus E. Sterca Ellas, Evvia, E. Thessalia, N. Greece Campanula celsii subsp. carystea S C. crostari S Greece, W. Agegan, Mt. Athos C. cynaca S C. rupestris aggr. Thessalia, Stera Ellas, W. Agegan C. constantini S C. crupactris aggr. S Greece, W. Agegan, Mt Athos C. constantini S C. crupactris aggr. Thessalia, Stera Ellas, W. Agegan C. constantini S C. cachaia Peloponnisos, Greece C. suboica S C. achaia Peloponnisos, E Sterea Ellas, Thessalia, NE Greece C. mantoudii A C. caromaticum C Baropacetasia R Greece C. cunoica S C. taurica s.l. Is. Samos, Atatolia to Iran, Caucasus Geocaryum euboicum - C. domaticum M K Killini Hypericum fragile S H. traygetos N Peloponnisos, Stera Ellas, N Evvia Hyperi	A. euboea	S	A. mungieri	S Peloponnisos
A. entificitica - A. ternifolia SW Anatolia, Is, Samos A. suffruitosa - A. suberoac Mt. Athos Bolanthus intermedius - B. dynnifolius E Sterea Ellas, Evvia, Is, Naxos Bolanthus intermedius - B. dynnifolius E Sterea Ellas, Evvia, Is, Naxos Campanula celsii subsp, carystea S C. celsii aggr. S Greece, W. Aegean, Mt Athos C. cynaca S C. rupestris aggr. Thessalia, Sterea Ellas, W. Aegean C. constantini S C. cravacensis Y ugoslavia, N Greece C. gonlinyi S C. cachaia Peloponnisos, Esterea Ellas, Thessalia C. euboica S C. cannatican NE Peloponnisos C. mantoudii A C. carinatican NE Peloponnisos C. mantoudii A C. carinatican C Bearope, Blakan Peninsula Geocaryum euboicum - C. caromaticum K Killini Geocaryum euboicum - C. daviaricum M tathos Geocaryum euboicum - C. daviaricum M tathos Hargeteinn H targeteinn M tatiskan Peninsula Inula subfloccos			A. lutea	Sterea Ellas, N Peloponnisos
A. suffruitcosa - A. subérosa Mt. Athos Bolanthus intermedius - B. graecus E Sterea Ellas, Evvia, E Thessalia, N Greece Campanula celsii subsp. carystea S C. cripestris aggr. Thessalia, Sterea Ellas, W Aegean C. constantini S C. rupestris aggr. Thessalia, Sterea Ellas, W Aegean C. constantini S C. cristi aggr. S Greece, W Aegean, Mt Athos C. constantini S C. cristi aggr. Thessalia, Sterea Ellas, W Aegean C. constantini S C. cachai Bulgaria, N Greece C. eutoica S C. cachaia Peloponnisos, E Sterea Ellas, Thessalia C. eutoica S C. cachaia Peloponnisos, E Sterea Ellas, Thessalia C. antoudii A C. caronaticum K Peloponnisos C. mantoudii A C. pelia Sterea Ellas, Thessalia, NE Greece C. nantoudii A C. gravacicum Mt Rithii Hypericum fragile S H. targetoum Mt Athos Hypericum fragile S H. targetoum H. targetoum Inula subfloccosa S I. verbacciofia subsp. methanea' <td< td=""><td>A. ophiolithica</td><td>_</td><td>A. tenuifolia</td><td></td></td<>	A. ophiolithica	_	A. tenuifolia	
AAdideaKritiBolanthus intermedius-BgracusESterea Ellas, Evvia, ENarcosCampanula celsii subsp. carysteaSC. celsii aggr.SGracec, WAlgean, MI AthosC. cynaeaSC. crupestris aggr.Thessalia, Sterae Ellas, WNegeanSC. constantiniSC. crupestris aggr.SSterae Ellas, WNegeanC. constantiniSC. crupestris aggr.SSterae Ellas, WNegeanC. constantiniSC. cachaiBulgaria, NGreeceC. cuboicaSC. cachaiaPeloponnisos, ESterae Ellas, ThessaliaC. cunotudiiAC. cpilaSterae Ellas, Thessalia, NE GreeceC. mantoudiiAC. cpilaSterae Ellas, Thessalia, NE GreeceChaerophyllum eubocum-C. taurica sl.Is. Samos, Anatolia to Iran, CaucasusGeocaryum euboicum-G. divaricatumHt StilliniHypericum fragileSH. tragectonNt TaygetosInula subfloccosaSI. verbascifolia subsp. methaneaiE. Peloponnisos, Sterae Ellas, N EvviaLinum goulimyi-I. leucanthumE Sterae Ellas, C EvviaL. gyaricum<	A. suffruticosa	_		
B. ThymifoliusE Sterez Ellas, Evvia, E Thessalia, N GreeceC. caynacaSC. celsii aggr.S Greece, W Aegean, MI AthosC. constantiniSC. rupestris aggr.Thessalia, Sterea Ellas, W AegeanC. constantiniiSC. celsii aggr.Thessalia, Sterea Ellas, W AegeanC. constantiniiSC. celsii aggr.S Greece, W Aegean, MI AthosC. constantiniiSC. celsii aggr.S Greece, W Aegean, MI AthosC. constantiniiSC. celsii aggr.S Greece, W Aegean, MI AthosC. euboicaSC. cachaiaPeloponnisos, E Sterea Ellas, Thessalia, NG GreeceC. entoicaSC. cachaiaPeloponnisosC. cantoudiiAC. peliaSterea Ellas, Thessalia, NG GreeceC. chacrophyllum eubocum-C. caronaticumC & E Europe, Balkan PeninsulaCruciata taurica subsp. euboea-C. taurica s.l.Is. Samos, Anatolia to Iran, CaucasusGeocaryum euboicum-G. divaricatumM TaygetosInula subfloccosaSI. verbaccifolia subsp. methaneaPeloponnisos, Sterea Ellas, N EvviaLinum goulinyi-L. leucanthumE Sterea Ellas, C EvviaI. gvaricumI. gvaricumI. Sioura, I. SikariaPeloponnisos, Sterea Ellas, N EvviaMinuartia dirphyaSM. vetteteniiM Peloponnisos, Sterea Ellas, N EvviaMinuartia dirphyaSM. vetteteniiI. Sioura, I. SikariaScateflaria goulinyiSS. satifragaN Hapoonisos, E Sterea Ellas, N eviaScateritis euboea			A. idaea	Kriti
B. Thymifolius E Sterea Ellas, Evvia, E Thessalia, N Greece C. compaund celvis iubsp. carystea S C. celvia aggr. S Greece, W Aegean, Mt Athos C. constantini S C. rupestris aggr. Thessalia, Sterea Ellas, W Aegean C. constantini S C. crupestris aggr. Thessalia, Sterea Ellas, W Aegean C. constantini S C. celvisi aggr. S Greece, W Aegean, Mt Athos Centurea ebenoides S C. celvisi aggr. S Greece, W Aegean, Mt Athos Centurea ebenoides S C. cimmanuelis-loewii Bulgaria, N Greece C. euboica S C. cachaia Peloponnisos, E Sterea Ellas, Thessalia, NE Greece C. mantoudii A C. pelia Sterea Ellas, Thessalia, NE Greece C. hacrophyllum euboeum - C. carnica sl. Is. Samos, Anatolia to Iran, Caucasus Geocaryum euboicum - C. drarica sl. Is. Samos, Anatolia to Iran, Caucasus Geocaryum euboicum - C. drarica sl. Is. Samos, Satera Ellas, N Evvia Hypericum fragile S I. verbascifolia subsp. methaneai Peloponnisos, Sterea Ellas, N Evvia Linum goulinyi - L. leacunthum Sterea Ellas, C Evvia Linum goulinyi - L. leacunthum Sterea Ellas, N Evvia Muartia dirphya	Bolanthus intermedius		B. graecus	E Sterea Ellas, Evvia, Is, Naxos
Companda celsii subsp. carystea S C. celsii aggr. S Greece, W. Aegean, Mt Athos C. cymaea S C. rupestris aggr. Thessalia, Sterea Ellas, W. Aegean C. constaintini S C. rupestris aggr. S Greece, W. Aegean, Mt Athos C. guinnyi S C. constaintini S Greece, W. Aegean, Mt Athos C. audinyi S C. constaintini S Greece, W. Aegean, Mt Athos C. caudinyi S C. constaintini S Greece, W. Aegean, Mt Athos C. audinyi S C. constaintini S Greece, W. Aegean, Mt Athos C. caudiniti A C. chaia Peloponnisos, E Sterea Ellas, Thessalia, Necece C. audica W. Sterea Ellas, Thessalia, NE Greece C. cannotudii A C. caromaticum C. Caromaticum Cruciata taurica subsp. euboea - C. caromaticum H. Killini Geocaryum euboicum - G. divaricatum Mt Killini Hypericum fragile S H. typericum N Peloponnisos, Sterea Ellas, N Evvia Inula subfloccosa S I. verbacifolia subsp. parnasica N Peloponnisos, Sterea Ellas, N Evvia Inula subfloccosa S				
C. cymaea S C. rapestris aggr. Thessalia, Stereä Ellas, W Aegean C. constantini S C. rapestris aggr. Thessalia, Stereä Ellas, W Aegean C. goulinyi S C. celsti aggr. S Greece, W Aegean, Mt Athos C. euboica S C. cerinthiaca Yugoslavia, N Greece C. euboica S C. corinthiaca Peloponnisos, E Sterea Ellas, Thessalia C. mantoudii A C. pelia Sterea Ellas, Thessalia, NE Greece C. mantoudii A C. pelia Sterea Ellas, Thessalia, NE Greece C. mantoudii A C. pelia Sterea Ellas, Thessalia, NE Greece C. caromaticum C & E Europe, Balkan Peninsula Geocaryun euboicum - Geocaryun euboicum - C. divaricatum Mt Stillinsi Geocaryun euboicum - G. divaricatum Peloponnisos, Sterea Ellas, N Evvia Hypericum fragile S I. verbascifolia subsp. methaneai E Peloponnisos, Sterea Inula subfloccosa S I. verbascifolia subsp. parnassica N Peloponnisos Sterea Minuartia dirphya S M. vettsteinii E Sterea Ellas, C Evvia Inula subfloccosa <td>Campanula celsii subsp. carystea</td> <td>S</td> <td></td> <td></td>	Campanula celsii subsp. carystea	S		
C. constantini S C. rupestris aggr. Thessalia, Sterea Ellas, W Acgean C. goulinyi S C. celsii aggr. S Greece, W Aegean, Mt Athos Centeurea ebenoides S C. immanuelis-loewii Bulgaria, N Greece C. euboica S C. cachaia Peloponnisos, E Sterea Ellas, Thessalia C. euboica NE Peloponnisos Exerca Ellas, Thessalia, NE Greece C. mantoudii A C. pelia Sterea Ellas, Thessalia, NE Greece C. mantoudii A C. pelia Sterea Ellas, Thessalia, NE Greece Chaerophyllum euboeum - C. aromaticum C. & Europe, Balkan Peninsula Cruciata taurica subsp. euboea - C. davircatum Mt Killini Hypericum fragile S H. tarygeteum Mt Taygetos Inula subfloccosa S I. verbascifolia subsp. parnassica N Peloponnisos, Sterea Ellas, N Evvia Linum goulimyi - L. leucanthum E Sterea Ellas, C Evvia L gvaricum L gyaricum L gyaricum N Peloponnisos, Sterea Ellas, N Evvia Minuarita dirphya S M. argolica subsp. angolica N Peloponnisos, Elserea Ellas, N Evvia Minuarita d		S		
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may have permitted the conservation and survival of some relicts, which have become extinct in adjacent, non-ophiolitic regions.

The serpentinophytes of Evvia show intense phytogeographical connections with the neighbouring ophiolitic regions of adjacent continental Greece. Several serpentine endemics are distributed to the serpentine areas of northern Evvia, eastern Sterea Ellas and/or eastern Central Greece (e.g. *Allium euboicum, Daphne euboica, Ferulago serpentinica, Onosma euboica, Scorzonera serpentinica*). The phytogeographical connection with the extensive ophiolitic regions of N Greece is evidently weaker.

Besides ophiolitic substrate the presence of marble and cipolin strips within the extensive schist areas of S Evvia is as well a case of ecological isolation concerning *Inula subfloccosa* and *Stachys euboica* (the latter, considered endemic to S Evvia, has recently been discovered in the Meteora area of Thessaly, according to Kamari & al. 2003).

3. Classification of the endemics after cytotaxonomic critera

Favarger & Contandriopoulos (1961) systematized the cytotaxonomic study of endemic taxa and their vicarious congeners in order to better understand their evolutionary history and distinguish "passive" endemism of palaeo- and patroendemics from "active" endemism of schizo- and apoendemics. Our karyological data allow such a classification for 27 of the 39 local endemic taxa of Evvia (Table 2). The majority represents schizoendemics (80.8 %) while the categories of apoendemics (11.5 %) and palaeoendemics 7.7 %) follow by distance (patroendemics absent). The dominance of schizoendemics and apoendemics in the endemic flora of Evvia shows that endemism has originated in Evvia mainly in an "active" way. The cytotaxonomic classification of the endemic plants of Peloponnisos (Iatrou 1986) gained similar results (palaeoendemics 7.8 %, patroendemics 0.0 %, schizoendemics 86.3 %, apoendemics 5.9 %).

In Evvia, the category of palaeoendemics is represented by Alyssum euboeum and Verbascum zuccarinii. As compared to other Aegean areas rich in palaeoendemics (e.g. the S Aegean area; Greuter 1972, 1975), this is only a very small number, possibly caused by the relatively recent isolation of Evvia from continental Greece, and the immigration and successful competition of northern taxa during the glacial periods. Palaeooendemics are ancient taxa showing little variation and a distribution often of a relictual type, corresponding to the remains of a once larger area (Cardona & Contandriopoulos 1979). V. zuccarinii belongs to this category as its population presents low morphological diversity and is taxonomically isolated, without close relatives in the Balkan Peninsula and Anatolia, its closest relative being V. pyramidatum M.Bieb. from the Caucasus. A. euboeum is a possibly palaeoendemic species well adapted to the harsh environmental conditions of the ophiolitic rocks and is locally common, although scattered and restricted in distribution. Its morphological variability is remarkable and seems to depend, to some extent, on different composition of the ophiolitic rocks it colonizes. It has no close relatives in Alyssum sect. Odontarrhena (C. A. Mey.) W. D. J. Koch in the Balkans, and an Anatolian origin seems more probable for this species, supported by morphological similarities with A. condensatum Boiss. & Hausskn. s.l. from Anatolia, Syria, Lebanon and N Iraq.

Patroendemics constitute, together with palaeoendemics, the ancient element of a flora. Despite the existence of some patroendemics in the Aegean there is none among the local endemic taxa of Evvia that can safely be classified as such using cytotaxonomic criteria. Patroendemics were also not reported in the endemic flora of Peloponnisos (Iatrou 1986).

With 21 taxa, schizoendemics form the largest group in the endemic flora of Evvia. Some of them are taxa of recent origin and their evolution is still in progress. Others, similarly to palaeoendemics, have an old origin.

Allium karistanum and Minuartia dirphya are considered to be schizoendemic taxa of an old origin (relictual schizoendemics), and probably Hypericum fragile, Sideritis euboea, Asperula euboea and Centaurea ebenoides are also to be included in this category. Allium karistanum, together with A. callidictyon, A. peroninianum, A. greuteri and A. pentadactyli, form a group of species with a remarkable disjunction over the Mediterranean (see distribution map in Brullo &

al. 1997). Their ecological preferences and some of their morphological features indicate that they are probably relics of a xerothermic flora linked with the Messinian period (5-6 m.y. B.P.) when the Mediterranean climate was uniformly xeric and these geophytes probably had a wide distribution (Brullo & al. 1997). The geographical distribution of Minuartia dirphya and its corresponding species, *M. wettsteinii* and *M. parnonia* is less scattered (Trigas & Iatrou 2005). This pattern indicates that the origin of these species goes back at least to Pliocene, characterising them as palaeo-schizoendemics. Hypericum fragile belongs to Hypericum sect. Taeniocarpium Jaub. & Spach which has a wide distribution range throughout Europe eastwards to Israel and E Siberia. The representatives of this section in Greece, H. fragile and H. taygeteum, have very restricted distribution ranges, indicating a relictual status. Sideritis euboea and S. raeseri, although distributed in neighbouring areas (Fig. 2), show morphological differences that indicate long isolation. S. syriaca subsp. syriaca, endemic to Crete, appears to be the closest relative of S. euboea at least morphologically. The distribution ranges of both latter species also indicate an old origin. The species related to *Centaurea ebenoides* (Table 2) are distributed in the central part of the Balkan Peninsula, hence it has probably a northern origin. However, striking morphological differences of *C. ebenoides* from its corresponding species indicate long isolation.

Schizoendemics the corresponding taxa of which are distributed in closely neighbouring areas are supposed to have a relatively recent origin (neoschizoendemics). Their morphological differentiation is usually weak and they are often classified at subspecific level. The majority of the endemics of Evvia belong here (*Allium calamarophilon, A. runemarkii, Armeria johnsenii, Campanula celsii* subsp. carystea, C. constantini, C. cymaea, C. goulimyi, Centaurea euboica, Inula subfloccosa, Nepeta argolica subsp. dirphya, Scutellaria goulimyi, Senecio eubaeus, Silene oligantha subsp. pseudoradicosa, Quercus trojana subsp. euboica and Silene dirphya). Their corresponding taxa (Table 2) usually have restricted distribution ranges. The subspecific differentiation of Centaurea euboica subsp. euboica and C. euboica subsp. intermedia, both growing on serpentine in N Evvia, was presumably triggered by fragmentation of the ophiolitic areas of N Evvia by intercalary calcareous rocks and by differences in their chemical composition.

The category of apoendemics includes *Centaurea mantoudii*, *Viola dirphya* and *Viola euboea*. *C. mantoudii* is an auto- or allotetraploid (2n = 4x = 36; Georgiadis 1980, Trigas 2003) and it seems to originate from the diploid *C. pelia* (2n = 2x = 18) that spreads widely in areas adjacent to the range of *C. mantoudii*. *V. dirphya* is also tetraploid (2n = 4x = 40; Tiniakou 1991), probably originating from the widely distributed diploid *V. reichenbachiana* (2n = 2x = 20; Livaniou-Tiniakou 1991) via auto- or allopolyploidy. Both taxa can be considered neopolyploids, according to Favarger (1975) and Greilhuber & Ehrendorfer (1988), with their relative diploid taxa distributed in closely neighbouring areas. *V. euboea* is tetraploid (2n = 4x = 40; Erben 1985), of an allopolyploid origin (Erben 1996), and its ancestral taxa are very difficult to identify within the extremely difficult complex of *Viola* sect. *Melanium*. It seems to be a mesopolyploid according to Favarger (1975; see also Table 2).

4. Origin and geographic affinities of the endemic flora of Evvia

The allocation of the regional endemics of Evvia to the present distribution ranges of their related taxa may elucidate their origin and geographic affinities, grouped into different categories.

The first, and largest, category includes taxa that seem to have developed in either continental or insular (Aegean) Greece. The "continental" group includes *Allium calamarophilon, A. runemarkii, Asperula euboea, Bolanthus intermedius, Campanula celsii* subsp. *carystea, Centaurea ebenoides, C. euboica, C. mantoudii, Geocaryum euboicum, Hypericum fragile, Inula subfloccosa, Nepeta argolica* subsp. *dirphya, Senecio eubaeus, Silene oligantha* subsp. *pseudoradicosa, Viola euboea* and *Verbascum euboicum,* the "insular" group contains *Asperula suffruticosa, Campanula cymaea, C. constantini* and *C. goulimyi.*

The second category includes endemic taxa that seem to originate from widely distributed taxa, some populations of which underwent speciation in Evvia. Alyssum densistellatum, Ammi topalii, Armeria johnsenii, Chaerophyllum euboeum, Quercus trojana subsp. euboica, Scutellaria

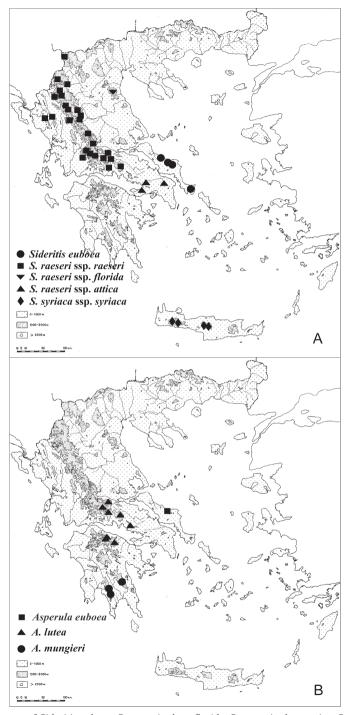


Fig. 2. A: Total range of *Sideritis euboea*, *S. raeseri* subsp. *florida*, *S. raeseri* subsp. *attica*, *S. syriaca* subsp. *syriaca* and distribution range of *S. raeseri* subsp. *raeseri* in Greece; B: total range of *Asperula euboea*, *A. lutea* and *A. mungieri*.

goulimyi, Silene dirphya and *Viola dirphya* belong here. In some cases (Fig. 3) the widely distributed related taxa expand to the north of Evvia. In all cases the endemic taxa show strong morphological similarities to their relatives and they should be considered of a relatively recent origin.

The third category includes taxa which originate E of Evvia, viz. in Anatolia or even further east, including *Asperula brachyphylla*, *A. ophiolithica*, *Cruciata taurica* subsp. *euboea* and probably *Alyssum euboeum*. These are old taxa usually well differentiated from their relatives, which seem to have arrived in Evvia via the central Aegean. The distribution of *A. brachyphylla* and its congeners is the only clear evidence for this migration route (see distribution map in Trigas & Iatrou 2003).

In the S Aegean area, especially in Crete, many eastern species are confined to high altitudes (Carlström 1987), reflecting the climatic conditions of the migration periods. Two insular endemics of Evvia of an eastern origin (*Asperula brachyphylla, Cruciata taurica* subsp. *euboea*) are confined to high altitudes, whereas *Asperula ophiolithica* and *Alyssum euboeum* (exclusively on serpentine in N Evvia) are lowland species the relatives of which are usually growing on lime-stone at moderate and high altitudes (up to 3000 m) in Anatolia. According to Brooks (1987), the serpentines of Evvia, found mostly at low altitude, support a flora that includes plants distributed, outside Evvia, further north or at higher altitudes. This disjunct distribution is a typical character of serpentine floras elsewhere, where competitive pressure restricts some plants either to the edaphically harsh environment of ultramafites, or to the climatically harsh environment of regions further north or at higher altitudes.

Finally, a fourth category is represented by *Allium karistanum* which, with its relative taxa, seem to constitute remnants of an old xerophytic flora widely distributed in the Mediterranean area during the Messinian.

5. Comments on selected taxa

Asperula euboea (Ehrend.) Trigas

The Asperula populations that grow on cliffs in central Evvia were originally described as a subspecies of A. lutea (A. lutea subsp. euboea Ehrend. in Rechinger 1961). Ehrendorfer & Krendl (1976) divided A. lutea into four subspecies distributed in S Greece, viz. A. lutea subsp. lutea (Sterea Ellas and N Peloponnisos), A. lutea subsp. euboea (endemic to central Evvia), A. lutea subsp. rigidula (E Sterea Ellas, Evvia, Peloponnisos) and A. lutea subsp. mungieri (endemic to Mts Taigetos and Parnon in S Peloponnisos), both the latter later recognized as independent species (Schönbeck-Temesy & Ehrendorfer 1991, Tan & Iatrou 2001). The Asperula populations of Central Evvia, too, belong to a clearly distinct species, A. euboea (Ehrend.) Trigas (Trigas 2003), which grows in a specialized habitat (i.e. shady vertical limestone cliffs) and differs from its relative taxa in habit and in several morphological characters. It seems to be more closely related to A. mungieri Boiss. & Heldr. than to A. lutea Sm. s. str., differing from the former by its dense caespitose habit, shorter stems, longer hyaline apex of leaves and dull yellow corolla (whitish, purple or brownish-purple in A. mungieri), and from the latter by its dense caespitose habit, longer, acicular, ± falcate leaves and a shorter inflorescence.

Fumana pinatzii Rech. f.

Fumana pinatzii was described from Evvia (Rechinger 1956); according to the description, it does not show remarkable taxonomic differences in single characters from *F. arabica* (L.) Spach, a widespread species of the Mediterranean region, except the number of seeds in the capsule (6 instead of 12 in *F. arabica*).

In the locus classicus of *Fumana pinatzii* (the Limni area in N Evvia), we collected many specimens of the local *Fumana* populations growing abundantly in the ophiolitic areas. The study of these specimens, and their comparison with the type specimen, confirmed the absence of morphological differences between *F. pinatzii* and *F. arabica* from various places in Greece. The

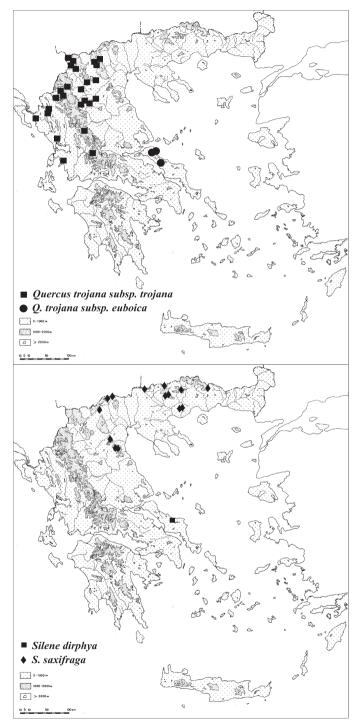


Fig. 3. A: Total range of *Quercus trojana* subsp. *euboica*, and distribution range of *Q. trojana* subsp. *trojana* in Greece; B: total range of *Silene dirphya* and distribution range of *S. saxifraga* in Greece.

specimens from N Evvia were found to contain 6, 9 or 12 seeds per capsule. No morphological differences linked with different number of seeds per capsule were found. According to Heywood (1968), specimens of *F. arabica* from the Kiklades islands have sometimes 6 seeds per capsule, while the number of seeds in *F. arabica* is (6-)8-12. The inclusion of *F. pinatzii* within the variation and as a synonym of *F. arabica* is therefore appropriate.

Colchicum pinatziorum Rech. f.

The description of *Colchicum pinatziorum* (Rechinger 1961) was based on a specimen of Pinatzis collected on Mt Kandili in N Evvia, at an altitude of c. 1000 m. The species, according to the description and the type specimen seen, shows only slight taxonomic differences from *C. boissieri* Orph. which is distributed in Sterea Ellas, the island of Chios and W Anatolia (Tan & Iatrou 2001). The differences of Pinatzis's specimen from specimens of *C. boissieri* collected in Sterea Ellas are confined to the slightly more slender perianth segments and the smaller anthers (c. 2 mm long).

During a visit to Mt Kandili we found large populations of *Colchicum* growing in *Abies cephalonica* woodland at altitudes of 850 to 1050 m. The study of the specimens revealed a considerable variation in the size of the perianth segments (4-12 mm wide) and anthers (2.2-3.6 mm long). These measurements fit well (or only slightly extend beyond) the dimensions given for C. *boissieri*. We did not find any other morphological difference between the specimens of Mt Kandili and genuine *C. boissieri*. This is true also for the leaves, which originally were not described in *C. pinatziorum*. We therefore propose to sink *C. pinatziorum* into synonymy of the more widespread *C. boissieri*.

Crepis dioscoridis subsp. euboica Rech. f.

Crepis dioscoridis s.l. is a very polymorphic species distributed in SE Europe. Subspecies were described by Babcock (1947), but these were based on very limited material, and further information is required before their status can be confirmed (Sell 1976).

Crepis dioscoridis subsp. *euboica* was described by Rechinger (1961) from central Evvia and related by him to *C. dioscoridis* subsp. *tubiformis* (Halácsy) Babc. Specimens of *C. dioscoridis* s.l. collected by us in central Evvia do not show stable differences with specimens of *C. dioscoridis* s.l. collected in E Sterea Ellas. Size of leaves and length of stems clearly correspond with modifying ecological parameters of the habitat. Subspecific rank for the populations of *C. dioscoridis* from Evvia is therefore not justified.

Concluding remarks

Restricted distribution ranges, and the strong link to specific geological substrates are important characteristics of the endemic flora of Evvia. The abundance of schizoendemics and the presence of apoendemics emphasize the "active" evolution of endemic taxa on the island. The majority of the endemics belong to groups that seem to have differentiated in situ. Northern and eastern elements, although low in number, have further enriched the local endemic flora.

Endemics form a significant group of taxa for setting conservation priorities. The insular endemics of Evvia, many of them with extremely narrow distribution ranges, are subject to a number of serious threats. Almost 50 % of them are considered facing a high risk of extinction in the wild and therefore fulfill the criteria of inclusion in the categories of "Critically Endangered", "Endangered" or "Vulnerable", according to the IUCN Red List Categories and Criteria (IUCN 2001, Trigas 2003). Their conservation should be of priority in any future environmental plans in the area.

Acknowledgement

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