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## A new subspecies of the trans-Adriatic *Asperula staliana* from the Isole Tremiti: subsp. *diomedea*, and its ecology

### Abstract

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A new Tremiti Islands endemic from coastal limestone rocks is described as *A. staliana* subsp. *diomedea*. Relevés document that - as a weak competitor - it is not linked to a particular plant community. The new subspecies represents the southwesternmost element of a trans-Adriatic group of closely related vicarious, tetraploid ( $2n = 40$ ) island taxa, represented on Biševo (*A. staliana* subsp. *staliana* and subsp. *arenaria*), Vis (*A. staliana* subsp. *issaea*) and Sv. Andrija (*A. visianii*). The group is compared with other taxa of similar ecology and distribution, and briefly discussed in its phytogeographical significance.

### Introduction

During the last decades research on the flora and vegetation of the S. Italian Tremiti Islands has made considerable progress (Cristofolini & al. 1967, Lausi 1971, Pignatti 1971, De Marco & al. 1984, Nimis 1985). One of the more recent, remarkable results was the recognition that an *Asperula* which had formerly been misidentified (e.g., as *A. aristata* var. *flaccida*: Béguinot 1910) belong in fact to *A. staliana* (Lausi 1971, Ehrendorfer in Pignatti 1982).

Biosystematic research on the relic circum-Adriatic polyploid group of *A. staliana* has made steady progress (Korica 1975, 1979, 1981, 1986; Ehrendorfer & Korica 1993). On the Italian side of the Adria, so far, the only known representative of this interesting group was *A. garganica* Huter & al. ex Ehrend. & Krendl, a local diploid endemic from the closely adjacent Gargano Peninsula. A visit to the islands early in July 1986 (by L. = D. Lausi and K. = B. Korica) resulted in the collection of representative samples and in a detailed ecological study of this taxon. The purpose of the present paper is to present some of these results, to describe the local *Asperula* as a new subspecies, endemic to the Tremiti Islands, to discuss its affinities with the other members of the *Asperula staliana* group, and to compare it with other trans-Adriatic Angiosperms.

### Material and methods

The plants of *Asperula* used for this study were collected on the Tremiti Islands on June 22, 1969: S. Nicola (L.); and on July 3-4, 1986: S. Nicola and S. Domino (L. & K.).

LM and SEM photographs were done in Zagreb (Institute Chromos), Ljubljana (Institute of Textile Technology), and Vienna. Chromosome counts (by E. = F. Ehrendorfer) were made on material fixed in a fresh 3:1 mixture of 96 % alcohol and acetic acid, using aceto-carmin and squash techniques. The phytosociological observations were carried out during field work on July 3-4, 1986 (L.). The herbarium material is deposited in the public collections WU, W, TSB, PAL, etc.

### General features and vegetation of the Tremiti Islands

The Tremiti Islands (insulae diomedea) form a little archipelago lying to the N of the Gargano Peninsula (Central Adriatic Sea). The islands, distant from one another only a few hundred meters, are: S. Nicola, S. Domino, Capraia (= Capperia) and Cretaccio (Fig. 1). Another small island, Pianosa, is located 20 miles E of the Archipelago; we did not take it into consideration in this work, since the genus *Asperula* is known to be absent from its flora (Cristofolini & al. 1967).

The geomorphological and lithological features of the Tremiti Islands can be summarized as follows:

- S. Nicola (c. 0.5 km<sup>2</sup>, elevation 75 m) is a flat isle with a high, steep and indented coast line. Its coastal cliffs consist of carbonatic rocks in their lower parts.
- S. Domino (c. 2.0 km<sup>2</sup>, elevation 116 m) consists largely of limestone; only a narrow portion along the NE coast is made up of marls and calcarenites. Cliffs are present only on the NE side.
- Capraia (c. 0.5 km<sup>2</sup>, elevation 56 m) is mainly calcareous, with only a narrow belt of marls along the SE coast. The isle consists of a plateau sloping from NW to SE. The NW coast presents the highest elevations and falls abruptly into the sea, with imposing cliffs.
- Cretaccio (0.04 km<sup>2</sup>, elevation 30 m) is a strongly eroded marly islet, that we did not visit due to its small size and lack of suitable habitats.

The islands have an insular Mediterranean climate, with low mean annual precipitations (c. 470 mm/yr), very mild or absent winter and a slight dry period in summer, mitigated by a relatively high air humidity (De Marco & al. 1984). Today only S. Nicola and S. Domino have permanent settlements.

The principal vegetation formations present are those characteristic of the warmer and semiarid zones of the Mediterranean area (Lausi 1971; Pignatti 1971; De Marco & al. 1984; Brullo & De Marco 1989). The following vegetation types are of relevance to the present study:

- Halophytic vegetation types of coastal rocks (*Crithmo-Staticion* s.l.).
- Vegetation of gentle coastal slopes and the rims of cliffs, dominated by chamaephytes (*Thymelaeo-Helichrysetum*, *Crithmo-Staticion*).
- Macchia with *Pistacia lentiscus* and *Euphorbia dendroides* on rocky slopes with xeric soils (*Oleo-Lentiscetum*, *Oleo-Ceratonion*).
- Halophytic ecocline between *Crithmo-Staticion* and *Oleo-Ceratonion*.
- Anthropogeneous grassland formation (*Thero-Brachypodion*) on basic soils, with a high proportion of annual ruderal (*Chenopodietea*) and segetal (*Secalinetea*) weeds.

The natural vegetation has been modified by the long-lasting impact of man.

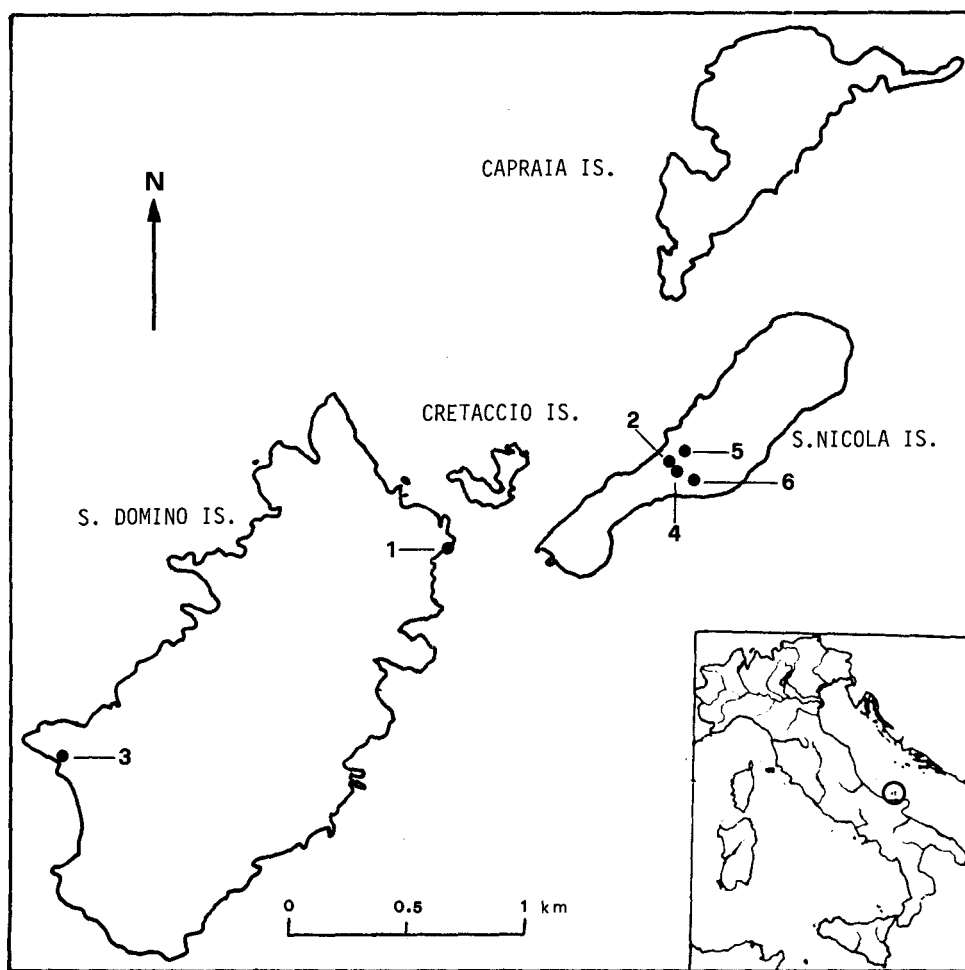


Fig.1. The Isole Tremiti. Dots and numbers refer to localities of *Asperula staliana* subsp. *diomedea* (2 = locus classicus) and location of relevés with populations of this taxon (cf. Table 1).

**Description and affinities of the new endemic subspecies**

Within *Asperula* sect. *Cynanchicae* (DC.) Boiss. (see Ehrendorfer & Krendl 1976) a group of species, to be united under *A. ser. Palaeomediterraneae* (ined.; cf. Ehrendorfer & Korica 1993), can be characterized in the following way: Plants caespitose, with fragile, ± glaucous and often pruinose shoots; stipules lacking or reduced, reaching hardly more than 1/2 of the leaf length at middle stem nodes; corolla tube 2-4(5)x as long as lobes; mericarps ± papillose, 1.5-3 mm long; usually growing in open and rocky habitats near the Mediterranean coast, often ± influenced by salt spray.

The following detailed Latin diagnosis of the *Asperula* taxon from the Tremiti Islands clearly shows that it is a member of *A. ser. Palaeomediterraneae*.

A forthcoming comparison with several other taxa (Ehrendorfer & Korica 1993) will justify its taxonomic treatment as a new subspecies of *A.staliana*.

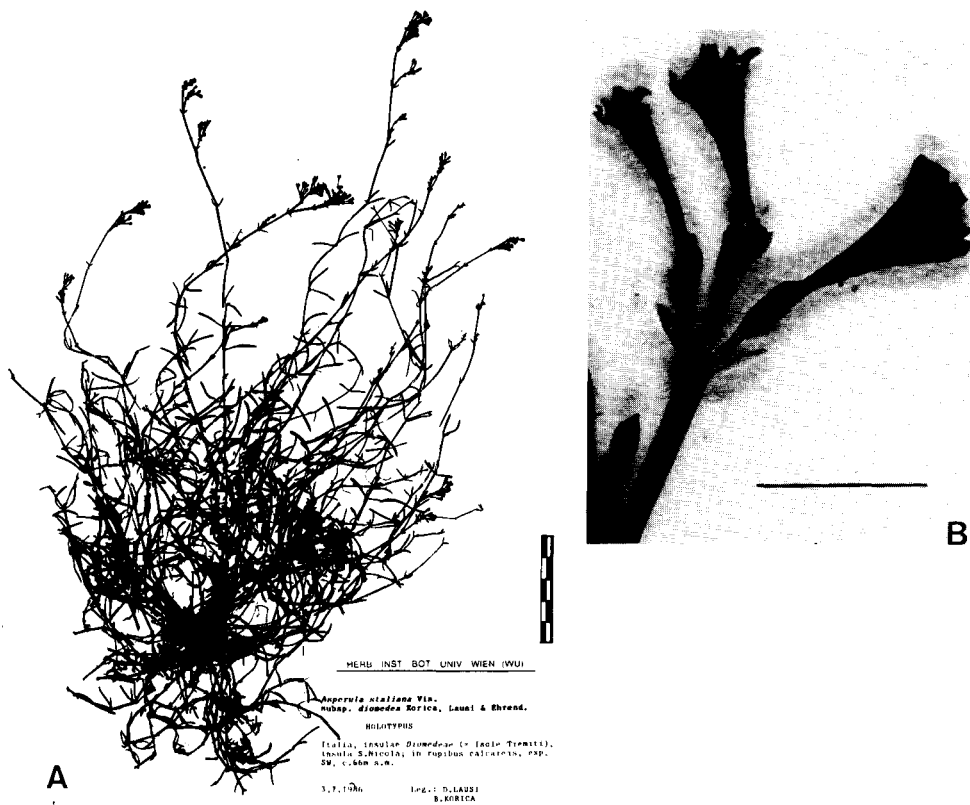


Fig.2. Holotype of *Asperula staliana* subsp. *diomedea*. A: Habit; B: flower detail. Scale units 10 mm in A, 5 mm in B.

*Asperula staliana* subsp. *diomedea* Korica, Lausi & Ehrend., subsp. nov.  
 Icones: Fig.2, 3A,B, 4A-B. — Typus: Italia, insulae diomedae (= Isole Tremiti), insula S. Nicola; in rupibus calcareis ad meridiem et occidentem expositis, c. 66 m s.m.; 3.7.1986, D. Lausi & B. Korica. Holotypus: WU; Isotypi: W, TSB, PAL, etc.

Descriptio : *Planta* radice lignosa, ± caespitosa, fragilis, glauco-viridis, ± pruinosa. *Caules* 15 - 60 cm alti, decumbenti-ascendentes, basi ± lignescentes vel herbacei, haud radicanes et paulum ramosi, supra saepe leviter furcato-ramosi, ± crassiusculi, subquadranguli, glabri, in parte infima saepe sporadice papilloso vel rarius brevissime pilosi; caulium internodia media foliis (1.0-)1.5-4(-5.5)-plo longiora. *Folia* crassiuscula, subcoriacea, inferiora cum stipulis subaequalibus quaterna, media stipulas duplo vel multoties superantes, superiora opposita stipulis obsoletis, acuta vel subacuminata, acumine ± hyalino (0.05-)0.1-0.3 mm longo munita, basin versus ± sensim angustata; *infima* oblanceolata vel obovato-spathulata, 2-10(-13) × (1-)1.3-4(-4.3) mm, lg : lt = 1.2-4.4(-5.2); *inferiora* lineari-oblanceolata, (6.5-)7-15(-24.2) × 1.4-4.3 mm, lg : lt = 4.1-6.9(-8); *media* linearia vel lineari-lanceolata, (5.5-)6-25(-30) × (0.6-)0.7 - 3(-3.3) mm, lt : lg =

7.5-26.4; *superiora* oblongo-lanceolata, 4-11.2 x 0.7-2.4 mm, lg : lt = (4.2-)4.6-5.8(-6.1).

*Bracteae* elongato-ovatae, acuminatae, basi liberae vel  $\pm$  connatae, ovario  $\pm$  aequilongae vel ad duplo longiores, extus haud carinatae. *Inflorescentia* leviter ramosa, elongata, inflorescentiis partialibus cymosis paucifloris, spiculi- vel capituliformibus. *Flores* sessiles, rarius brevissime pedicellati (pedicellis ad 1 mm longis). *Corollae* hypocrateriformes vel tubuloso-infundibuliformes, extus  $\pm$  squamuloso-verrucosae, (5.5-) 6.5-8.5(-9.0) mm longae, lilacino-roseae vel albae, lobis (1.5-)1.7-2(-2.5) mm longis, oblongo-linearibus,  $\pm$  acuminatis, appendicibus  $\pm$  semilunaribus, tubo (3.5-)4-6(-7) mm longo, lobos 2-4-plo superante. *Antherae* oblongo-lineares. *Stigmata* breviter claviformia. *Ovaria* oblonga vel (ob)ovata, superficie verrucis oblongis maioribus provisa. *Numerus chromatosomalium*:  $2n = 40$ .

Distributio: Italia, insulae diomedea (= Isole Tremiti): S. Nicola, S. Domino, Cretaccio (?).

Habitat: In rupestribus calcareis vel margaceis plerumque littoralibus.

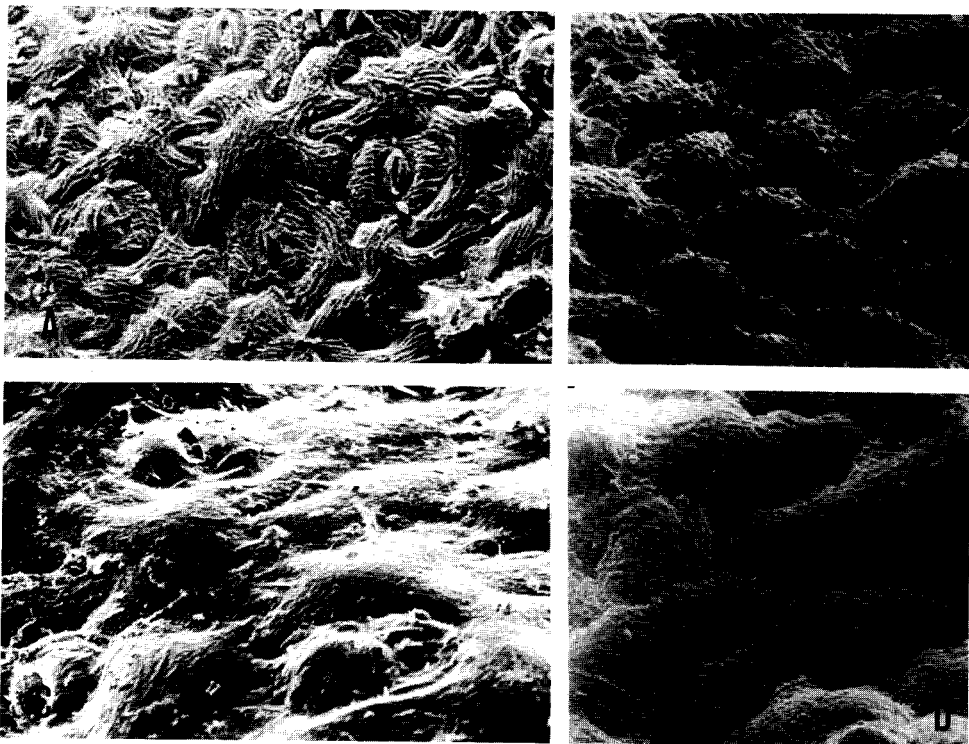


Fig. 3. SEM photographs of the leaf epidermis (upper side) in *Asperula staliana*. A: lower stem leaf and B: basal leaf of subsp. *diomedea*; C: lower stem leaf and D: basal leaf of subsp. *staliana*.

The tetraploid chromosome number  $2n = 40$  has been established for *Asperula staliana* subsp. *diomedea* from the type locality population. The base number  $x = 10$  is characteristic for all members of *A.* sect. *Cynanchicae*.

In respect to the distribution we (L. & K.) have verified the occurrence of *A. staliana* subsp. *diomedea* on the Tremiti Islands S. Nicola and S. Domino, as well as its obvious absence from Capraia. This is in line with the indications for "*A. aristata* var. *flaccida*" in Béguinot (1910) who also mentions it for the island of Cretaccio (which we have not visited). For the latter locality a verification would be welcome. On the Adriatic islands of Pianosa and Palagruža no plants of this taxon (or any other member of *Asperula*) have ever been recorded.

From the diploid *A. garganica* the new *A. staliana* subsp. *diomedea* differs by ascending (not  $\pm$  erect), often more robust and taller stems (often  $> 20$  cm), basal and lower stem leaves in whorls of 4 with  $\pm$  similar stipules (not  $\pm$  exstipulate), middle stem leaves larger (often  $> 14 \times 1$  mm), flowers  $\pm$  sessile (pedicels never  $> 1$  mm),  $\pm$  pink-lilac to white (never with a greenish hue), usually longer than 6.5 mm. In the tetraploid *A. visianii* the middle stem leaves are even larger (often  $> 20 \times 2.5$  mm), the pink and  $\pm$  greenish flowers are longer (mostly 8-10 mm), with lobes 4-5 times longer than the tube. Similarities are much more obvious in comparison with *A. staliana* and its subspecies with respect to basal and lower stem leaves and stipules, very short pedicels, size of flowers, ovary and fruit epidermis, and tetraploid chromosome number. *A. staliana* subsp. *arenaria* and subsp. *issaea* are more erect, have greenish to bluish but hardly pruinose shoots and are less fragile, while subsp. *staliana* and subsp. *diomedea* share the ascending and fragile habit as well as bluish green and  $\pm$  pruinose shoots. The two latter subspecies differ from each other mainly as follows: subsp. *diomedea* has a less succulent habit, somewhat longer stipules at middle stem nodes and longer bracts (up to 2 times longer than the ovaries) in contrast to the mostly quite succulent subsp. *staliana* with reduced middle stem stipules and bracts never longer than the ovaries.

SEM analyses reveal further diagnostic details of *A. staliana* subsp. *diomedea* and its allies. The leaf epidermis (Fig. 3) is conspicuously wrinkled in the Tremiti populations but rather smooth in subsp. *staliana*. The postfloral ovary epidermis generally has a  $\pm$  warty appearance in *A. sect. Cynanchicae* (Fig. 4). These warts may be more roundish or elongate, and have a complex surface microstructure. This consists of prominent tubercles in subsp. *diomedea* (Fig. 4A-B) and in *A. garganica*, of lower humps in subsp. *staliana* (Fig. 4C) and of more irregular rugosities in *A. visianii* (Fig. 4D).

#### Phytosociological evaluation and ecology of *Asperula staliana* subsp. *diomedea*

In Table 1 the relevés of the investigated *Asperula* stands (see map, Fig. 1) are ordered accordingly to decreasing presence of the halophytic taxa characteristic of the *Crithmo-Staticion* vegetation. Table 1 does not allow to identify a single peculiar association, but the vegetation of the stands may be interpreted as follows:

- Rel. 1: *Crithmo-Staticetum* s.l., on a low marly, rocky coast.
- Rel. 2: As rel.1, but growing on high, compact, subvertical S-exposed carbonatic rocks, which are also colonized by a peculiar halo-, skio- and non-nitrophilous lichen community dominated by *Rocella phycopsis*, *Dirina repanda*, and *Opegrapha grumulosa* (*Dirinetum repandae roccelletosum*: Nimis 1986).
- Rel. 3: Ecocline between *Crithmo-Staticion* and *Oleo-Ceratonion* (*Pistacio-Pinetum halepensis*, present only on S. Domino: De Marco & al. 1984). This relevé represents stands of *A. staliana* subsp. *diomedea* located on the flat, rocky rim of the cliffs.
- Rel. 4: As rel.2, but N-exposed, and hence lacking the lichen synusia *Dirinetum repandae*.

- Rel. 5: This stand is characterized by a low number of halophytes and a high incidence of therophytes characteristic of anthropogeneous grasslands (*Thero-Brachypodium*). *A. staliana* subsp. *diomedea* is present also in the grasslands on the plateau of S. Domino, with reduced vitality.
- Rel. 6: Rocky cliffs without halophytic taxa. Taxa characteristic of macchia vegetation are prevalent.

In conclusion it seems that *A. staliana* subsp. *diomedea* is not linked to a single plant association. It thrives best within ecocline conditions on rocks between *Crithmo-Staticion* and *Oleo-Ceratonion*, and therefore seems to be a weak competitor.

We could not find *A. staliana* subsp. *diomedea* on the isle of Capraia, notwithstanding the presence of habitats similar to those occupied by the species on the other islands. This may be due to the presence on Capraia of a large colony of birds (*Calonectris diomedea diomedea* Scop.) and resulting strong accumulation of nitrates on the rocks located along the rim of the cliffs.

The lichen synusia covering these rocks is dominated by nitrophilous species, such as *Caloplaca hepiana*, *C. aurantia*, *C. citrina*, *Verrucaria nigrescens*, *Calendariella medians* and *Xanthoria calcicola* (Nimis 1986).

We have compared the phytosociological relevés of *A. staliana* subsp. *diomedea* with those presented for the other six taxa of the group, occurring along the coasts of the N, C and E Adriatic (Korica 1986).

A multivariate analysis of the 26 species shared, reveals greatest similarities with the accompanying vegetation of *A. visianii* on Sv. Andrija, decreasing towards that of the other *A. staliana* subspecies on Biševo and Vis, and being most diverse from that of *A. borbasiana* and *A. woloszczakii* on the Kvarner islands.

Correlated with this distance related gradient of decreasing floristic similarity there is also a decrease in average corolla length, an important differential character. All this signals evolutionary divergence.

## Discussion

*Asperula staliana* subsp. *diomedea* represents the southwesternmost element of a trans-Adriatic series of vicarious eco-geographical island races (Korica 1975, 1979, 1981, 1986). Northeastward it links with subsp. *staliana* on the W coast of Biševo, with subsp. *arenaria* Korica in the interior of this island, and with subsp. *issaea* Korica on the NW coast of Vis. Indications for *A. staliana* Vis. on the isle of Hvar still need verification.

The northernmost element of this series is *A. visianii* Korica on Sv. Andrija (= Svetac). All taxa of this trans-Adriatic group are tetraploid with  $2n = 40$  chromosomes (Korica 1986 and unpubl.) and represent remnants of a relatively recent and advanced evolutionary stratum.

In contrast, there are a few even more isolated and disjunct diploid taxa in the Adriatic-Ionian area which can be regarded as relics of a more ancient, initial phase of evolutionary differentiation of the group: *A. woloszczakii* Korica on several of the Croatian N Adriatic Kvarner Islands (Krk, Prvić, Grgur and Goli), *A. garganica* Huter & al. ex Ehrend. & Krendl on the Italian Gargano peninsula, and *A. naufraga* Ehrend. & Guterm. (ined.) on the Greek Ionian Island of Zakynthos (Ehrendorfer & Gutermann 1993).

In addition to these Adriatic-Ionian elements *Asperula* ser. *Palaeomediterraneae* (ined.) also includes several other highly disjunct diploid members in the W.Mediterranean: *A. crassifolia* L. (= *A. tomentosa* Ten.) on Capri and the Is. Sirenuse (Li Galli), *A. deficiens*

Table 1. Vegetational relevés of stands with *Asperula staliana* subsp. *diomedea* from the Tremiti Islands (cf. Fig. 1.). 1: S. Domino, Cala delle Arene (marls and calcarenites); 2: S. Nicola, La Tagliata (carbonatic rocky slope) (*locus classicus*); 3: S. Domino, Architiello Bay (carbonatic rocky rim of the cliff); 4: S. Nicola, La Tagliata (carbonatic rocky slope and narrow ridges); 5: S. Nicola, rocky SE border of the Pianoro di S. Nicola; 6: S. Nicola, carbonatic rocky cliff of the Tagliata. Nomenclature follows Pignatti (1982). Life forms symbols (Ch = chamephyte, G = geophyte, H = hemicryptophyte, NP = nanophanerophyte, T = terophyte) are given in the left-hand column.

Relevé No.	1	2	3	4	5	6
Height above sea level (m)	10	25	10	15	15	10
Size of relevé (m <sup>3</sup> )	15	60	30	60	60	45
Slope exposure	S	SW	NE	NW	SE	S
Inclination (°)	10	80	5	70	80	60
Total cover (%)	70	20	30	30	30	50
Ch <i>Asperula staliana</i> subsp. <i>diomedea</i>	2	1	2	1	2	+
H <i>Limonium cancellatum</i> agg.	1	+	+	1	+	
H <i>Daucus gingidium</i> subsp. <i>polygamus</i>	+	+	+	1		
Ch <i>Lotus cytisoides</i>	1	+	+			
T <i>Catapodium marinum</i>	+	+				
Ch <i>Crithmum maritimum</i>	+				+	
NP <i>Thymelaea hirsuta</i>	2					
H <i>Plantago holosteum</i> var. <i>scopulorum</i>	+					
T <i>Mesembryanthemum nodiflorum</i>	+					
T <i>Senecio leucanthemifolius</i>	+					
T <i>Parapholis incurva</i>	+					
NP <i>Atriplex halimus</i>	+					1
NP <i>Suaeda fruticosa</i>	+					+
G <i>Agropyron pungens</i>	1					
G <i>Allium paniculatum</i>	+					
Ch <i>Helichrysum italicum</i> var. <i>pseudolitoreum</i>		1				
Ch <i>Alyssum leucadeum</i>		+				
Ch <i>Centaurea diomedea</i>		+				
Ch <i>Lobularia maritima</i>				+		
H <i>Reichardia picroides</i>	+	+	+	+	+	+
H <i>Dactylis hispanica</i>	1	+	+	+	+	+
T <i>Lagurus ovatus</i>	1	1		+		+
H <i>Oryzopsis miliacea</i>	+	+	+			+
NP <i>Pistacia lentiscus</i>	1		1			1
T <i>Catapodium rigidum</i>		+	+	+	+	+
Ch <i>Micromeria graeca</i>		+		1	1	1
H <i>Parietaria diffusa</i>		1		+	1	
H <i>Hyoseris baetica</i>		+		+	+	
T <i>Valantia muralis</i>		+			+	+
H <i>Brachypodium ramosum</i>			+		+	+
Ch <i>Teucrium polium</i> subsp. <i>capitatum</i>				+	+	
T <i>Hypochoeris achyrophorus</i>				+	+	
T <i>Trifolium scabrum</i>				+		+
T <i>Lophochloa cristata</i>					+	+
T <i>Avena barbata</i>						+
T <i>Sonchus oleraceus</i>	+					
T <i>Senecio vulgaris</i>	+					
T <i>Bromus sterilis</i>		+				



Relevé No.	1	2	3	4	5	6
T <i>Bromus rubens</i>		+				
T <i>Bromus madritensis</i>		+				
NP <i>Pinus halepensis</i> (shrub)			+			
NP <i>Rosmarinus officinalis</i>			1			
NP <i>Cistus incanus</i>			+			
T <i>Medicago minima</i>				+		
T <i>Cerastium semidecandrum</i>				+		
T <i>Sagina apetala</i>				+		
T <i>Tordylium apulum</i>				+		
T <i>Plantago lagopus</i>					+	
G <i>Cynodon dactylon</i>					+	
NP <i>Artemisia arborescens</i>						1
NP <i>Euphorbia dendroides</i>						1
Ch <i>Prasium majus</i>						1
NP <i>Capparis spinosa</i> var. <i>inermis</i>						+
H <i>Silene vulgaris</i> subsp. <i>angustifolia</i>						+

Table 2. List of species from the relevés with *Asperula staliana* subsp. *diomedea* (Table 1) also occurring with other members of the *A. staliana* group along the Croatian Adriatic coast (Data from Korica 1986). Columns are stands of the following taxa: d = *A. staliana* subsp. *diomedea*; v = *A. visianii*; i = *A. staliana* subsp. *issaea*; a = *A. staliana* subsp. *arenaria*; s = *A. staliana* subsp. *staliana*; b = *A. borbasiana*; w = *A. woloszczakii*.

	d	v	i	a	s	b	w
<i>Limonium cancellatum</i>	*	*			*	*	*
<i>Daucus gingidium</i> subsp. <i>polygamus</i>	*	*			*		
<i>Lotus cytisoides</i>	*	*			*		
<i>Crithmum maritimum</i>	*	*			*		
<i>Plantago holostæum</i> var. <i>scopulorum</i>	*				*	*	*
<i>Helichrysum italicum</i> var. <i>pseudolittoreum</i>	*	*		*	*	*	*
<i>Reichardia picroides</i>	*	*	*	*	*	*	*
<i>Catapodium rigidum</i>	*	*					*
<i>Micromeria graeca</i>	*	*	*	*			
<i>Bromus madritensis</i>	*	*					
<i>Lobularia maritima</i>	*	*					
<i>Pistacia lentiscus</i>	*	*	*	*	*		
<i>Artemisia arborescens</i>	*	*					
<i>Euphorbia dendroides</i>	*	*					
<i>Pinus halepensis</i> (shrub)	*			*	*		
<i>Rosmarinus officinalis</i>	*			*	*		
<i>Cistus incanus</i>	*		*	*	*		
<i>Dactylis hispanica</i>	*	*		*	*	*	*
<i>Oryzopsis miliacea</i>	*			*			
<i>Parietaria diffusa</i>	*	*					*
<i>Brachypodium ramosum</i>	*	*	*	*	*		
<i>Teucrium polium</i>	*						*
<i>Cerastium semidecandrum</i>	*					*	
<i>Cynodon dactylon</i>	*						*
<i>Capparis spinosa</i> var. <i>inermis</i>	*				*		
<i>Silene vulgaris</i> subsp. <i>angustifolia</i>	*	*		*		*	

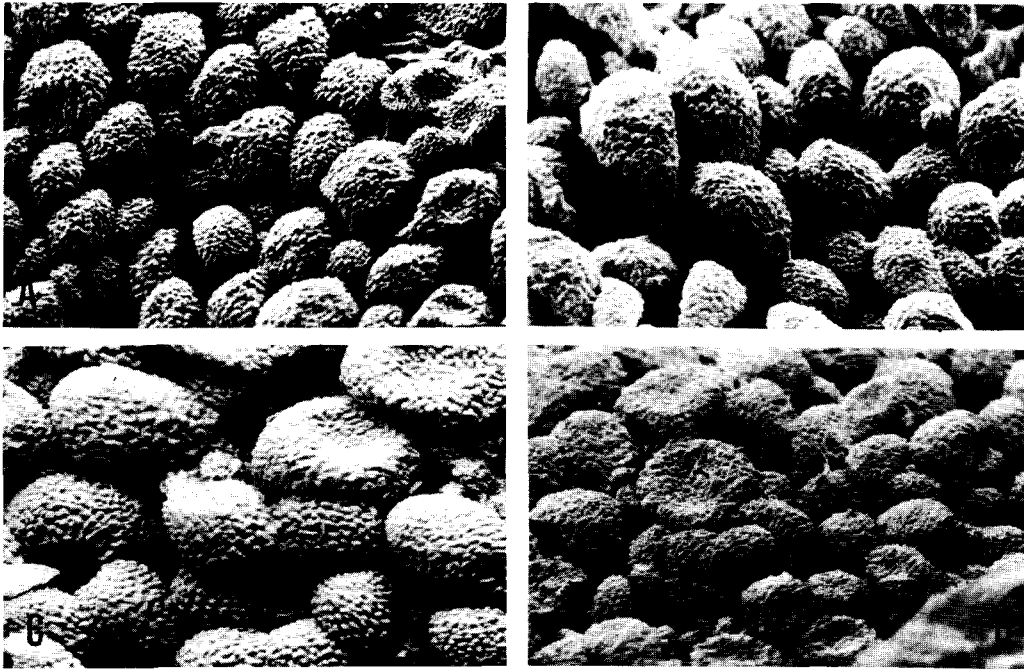


Fig. 4. SEM photographs of ovary epidermis (early postfloral stage). A-B: *Asperula staliana* subsp. *diomedea*; C: *A. staliana* subsp. *staliana*; D: *A. visianii*.

Viv. on Tavolara, a limestone islet off the NE coast of Sardinia, and *A. paui* Font Quer from the Balearic Islands of Ibiza and Formentera, and the adjacent Spanish coast. Between the western and eastern taxa of *A. ser. Palaeomediterraneae*, a somewhat aberrant link is provided by *A. calabra* (Fiori) Ehrend. & Krendl, growing on the S. Italian limestone mountains from M. Terminillo and M. Pollino to M. Mula. This sketch of relationships within *A. ser. Palaeomediterraneae* must suffice for our present discussion of *A. staliana* subsp. *diomedea* (but will be documented in detail in a forthcoming publication: Ehrendorfer & Korica 1993).

Other members of the local florula of the Isole Tremiti exhibit obvious parallels in their distribution, habitat, and evidently also in their evolutionary history, with *A. staliana* subsp. *diomedea* and its relatives (cf. Béguinot 1910; Pignatti 1971, 1982). *Centaurea diomedea* Gasparr., outside of the Tremiti islands, occurs only very locally on coastal limestone rocks of southern Apulia (and on the island of Pianosa ?); it has one relative in the Appennino Abruzzese, *C. tenoreana* Willk., and other closely allied taxa on the southern Balkan Peninsula. *Aurinia leucadea* (Guss.) C. Koch (= *Alyssum leucadeum* Guss.) also inhabits calcareous coastal rocks in a few localities from the Tremiti to Otranto and Gallipoli, but in addition extends over the trans-Adriatic island chain, i.e. Palagruža, Jabuka, Sv. Andrija and Lastovo, from where it links with *A. media* (Host) Schur along the Croatian Adriatic coast. *Brassica incana* Ten. (incl. *B. botteri* Vis., *B. cazzae* Ginzb., *B. mollis* Vis.; see Snogerup & al. 1990) has isolated populations along the limestone coasts of E Sicily, C and S Italy from where it ranges through the Tremiti Island of S. Domino to Palagruža and further to similar island habitats along the Dalmatian coast, e.g. on Korčula, Vis, Sv. Andrija, Kamik, Sušac, and to the Ionian island of Kerkira. *Daphne sericea* Vahl, also a member of coastal limestone habitats, reaches the Tremiti Islands, the Gargano peninsula and other disjunct S Italian and Sicilian localities, radiating from a wider E Mediterranean core area. The aggregate of *Limonium*

*cancellatum* (Bernh.) O.Kuntze, which includes i.a. *L. diomedeam* Brullo on the Isole Tremiti and the closely related *L. vestitum* (Salmon) Salmon on the Dalmatian islets of Pomo and Kamik (Brullo 1988), may serve as an example of amphi-Adriatic obligatory halophytes of calcareous coasts.

The taxa of *Asperula* ser. *Palaeomediterraneae* - in contrast to many other members of *A.* sect. *Cynanchicae*, e.g. *A. aristata* L.f. aggr. - have rather localized, often disjunct and ecologically specialized populations which show little potential of expansion. They probably have not reached their present distribution by long-distance dispersal across the open sea but rather via former land connections or by more local "island hopping". Under such a premise, the group must be at least of late Tertiary origin, when the Italian Peninsula was still widely submerged, when Corsardinia was still in a more E/W position, and when island chains provided a migration route between what are today the Balearic Islands and the W Balkan Peninsula.

In respect to the more recent trans-Adriatic connection demonstrated by *A. staliana*, the strongly lowered sea levels during the cold periods of the Pleistocene must have offered much better migration routes for this and other comparable plant groups with many more island connections than exist today.

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