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Native, spontaneously spreading and introduced plants in the Mt. Etna Nuova Gussonea botanic garden (Southern Italy)

Abstract

Poli Marchese, E., Grillo, M., Marchese, M., Margani, I. & Turrisi, R. E.: Native, spontaneously spreading and introduced plants in the Mt. Etna Nuova Gussonea botanic garden (Southern Italy). — *Bocconea* 16(2): 1149-1170. 2003. — ISSN 1120-4060.

The authors examine the results obtained as regards the floristic heritage on the Etnean botanic garden after more than 20 years.

Up until 1995, 464 species had been counted in the garden. Of these, 136 belong to the sponta-neous flora, while 328 species were introduced and come from various parts of the Mt. Etna territory. Of the latter group, some species did not manage to survive after introduction, while about 14% (71 species) became spontaneous. Most of these belong to the basal Mediterranean belt while a small number belong to the mountain-Mediterranean belt.

The results show that after some years of activity, the biodiversity in the garden has increased by about 200% thanks to the ecological adaptability of some of the introduced species. This process was helped by the work required for the running of the garden itself (potting, irrigation, the providing of shade and so on).

Among the introduced species, the higher adaptability is shown by the hemicryptophyte and therophyte life forms which are the most represented (60%) types. As regards the chorology there is a predominance of the Mediterranean s.l. species (about 43%), which have, therefore, a wide ecological valency. Such ecological valency is also shown by the species which spontaneously spread.

Introduction

The Mt. Etna "Nuova Gussonea" botanic garden, which covers a surface of over 10 ha, is situated at 1700 m on the southern face of the volcano in Region lands in the heart of the Mt. Etna natural Park. It was set up in 1979 by means of a convention between the General Forestry Management of the Sicilian Region and the University of Catania.

Although the Etnean garden could be considered similar to other mountain and alpine gardens, it is considerably different in that not only is it situated on an active volcano in the middle of the Mediterranean area but that it has a different structure and function. It is founded on synecological principles and destined to host only species and plant communities belonging to the Mt. Etna territory. As has been pointed out elsewhere (Poli Marchese & Maugeri 1982; Poli Marchese 1986; Poli Marchese & al. 1988a), the garden has various objectives – besides having purely scientific aims regarding the biology and ecology of the Mt. Etna species and plant communities, the garden pursues the aims of

conserving both *in situ* and *ex situ* the plant diversity of the Mt. Etna territory. It also promotes the diffusion of scientific knowledge and plays a leading role in the field of environmental education.

Among the activities carried out in the garden since it was founded, particular attention has been paid to the introduction of species from various locations of the Mt. Etna territory. This activity on which the realization of the garden depends and on which the work of the other sectors (flower-beds, planted forest communities, experimental areas) also depends. The introduction of new species into the garden to increase the biodiversity is of particular importance given that the area is already important for its site and floristic heritage. Located on the Mt. Etna natural Park, this area plays an important role in conservation and in managing the biodiversity within the park.

The purpose of this work is to point out the extent of the plant genetic heritage present in the garden, taking into consideration both the native and the introduced species, and to show which of the introduced species have adapted to the point of spreading spontaneously

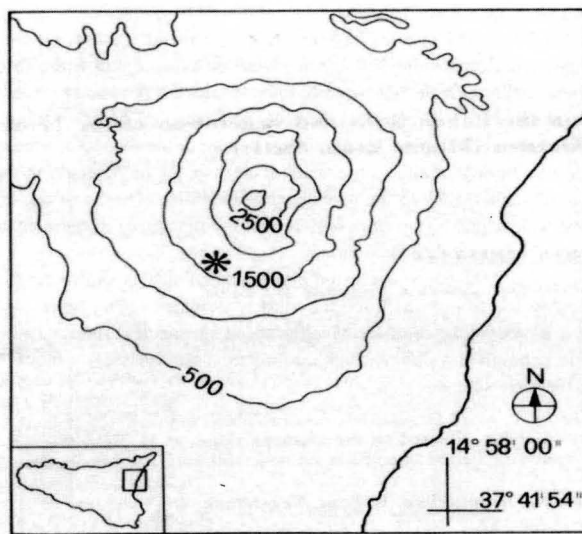


Fig. 1 Localization of Nuova Gussonea botanic garden on Mt. Etna.

within the garden. These species are particularly significant as regards the increase in biodiversity.

Study area

The Nuova Gussonea garden is situated on the southern slopes of the volcano between 1700 and 1750 m a.s.l. in the territory of Ragalna (Catania), inside the B zone of the Mt. Etna natural Park (Fig. 1). The area (over 10 ha) lies in the Regional forest "Giovanni Saletti", in a belt where the forest vegetation, represented by *Pinus nigra* Arnold subsp. *lari-*

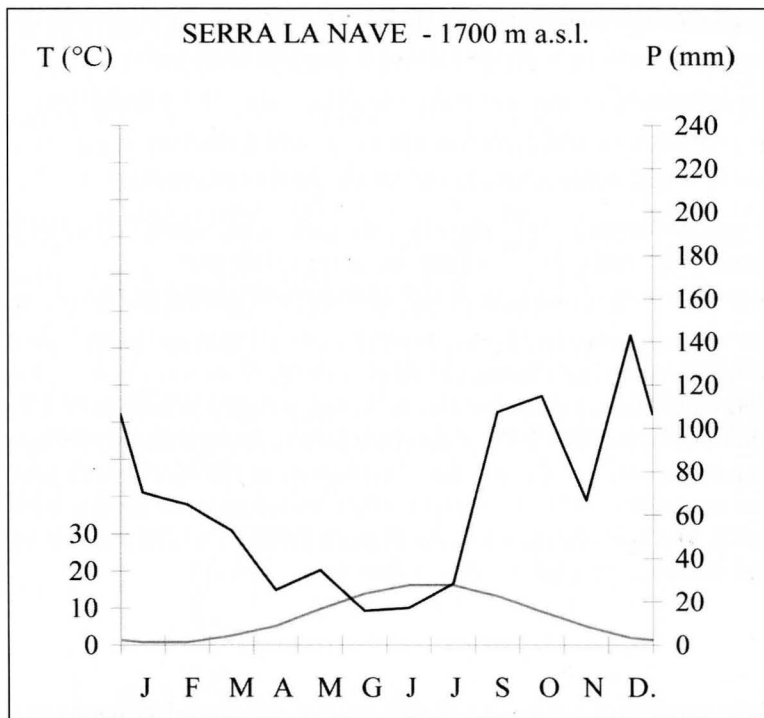


Fig. 2. Ombrothermic diagram of the bioclimatic station of Serra La Nave (1700 m).

cio Maire communities comes into contact with the thorny cushion vegetation of the high Mediterranean belt (*Astragaletum siculi* Poli 1965). The area includes undatable lava flows and is crossed by a lava stream of the sixteenth century, probably 1535 (Romano & al. 1979).

For the climatic characterization of the study area, reference was made to the data recorded at the bioclimatic station of Serra la Nave (1700 m a.s.l.), about 1 km from the garden. From the ombrothermic diagram (Fig. 2), drawn according to Bagnouls and Gaussen's methodology (1957), it can be seen that the average annual rainfall is 755,8 mm, with maximum values in the months of October, December and January and a period of summer drought of about two and a half months (June-August). The average temperature, which in winter does not fall below 0 °C, is 7,7 °C. From this data it can be seen that there is a Mediterranean climate that according to the Bagnouls & Gaussens' classification (1957) can be considered "oroxerotheric", typical of the high Mediterranean mountains.

Method

The study is based on sampling and field observations carried out in the period between 1986 and 2000, using as a reference point a previous work of ours (Poli Marchese & al. 1988a). The data was collected in the period between March and December each year: all

vascular species living in the garden were identified and registered. Each of these was subject to an annual census and for each the following data was recorded:

- native or introduced or spontaneously spreading plants after introduction;
- the year of introduced and of spontaneously spreading plants;
- the place of origin and relative altitude for the introduced species.

Native: species unquestionably present in the given area "native" (Greuter & al. 1984);

Introduced: cultivated species that are not native in the area;

Spontaneous spreading: introduced and spontaneously spreading species.

For each species, moreover, the life form (Raunkier 1934) and chorological type were indicated, mainly taken from Pignatti (1982).

The Tables and Figures show the data collected, grouped in periods of 4-5 years from 1986 – 2000. As far as 1995-2000 is concerned, the data regards only the species which have propagated spontaneously. For the identification of the species well known floristic works were used (Fiori 1923-29; Pignatti 1982), including those dealing with local flora (Strobl 1880). The nomenclature follows Pignatti (1982) – where possible updates from more recent literature were taken into consideration.

Results

The study revealed the presence of 464 species. Of these 136 represent the species belonging to the spontaneous flora of the garden while 328 represent the total number of species introduced over the years, of which 71 have spontaneously spread in the garden (Tables 1, 2).

The species living in the garden belong to 272 genera and 75 families (Table 2).

The introduced species represent 70,68% of all the species and they belong to 80,51% genera and to 90,66% families. They show high diversity. Among the introduced species, those which have propagated spontaneously show the greatest diversity: they belong to a high number of genera belonging to many different families (on average 2 per family).

As regards the introduced species, they represent a percentage – of the garden living plants - of 36,76 families and of 22,83 genera (Table 2).

NATIVE SPECIES

The native flora represents about 30% of all species living on the garden. It also includes some species (marked with * in the Table 1) which spontaneously spread in the garden after the beginning of the work, but were never introduced.

The native flora is mainly made up (Fig. 3) of hemicryptophytes, which constitute a percentage of 41% followed by the therophytes with values of 39%; the geophytes and the chamephytes, 8% and 7% respectively; the nano-phanerophytes and the phanerophytes are present with a very low percentage (2%). From this data it can be seen that the native flora of the garden is mainly made up of hemicryptophytes, a life form frequently found in mountain areas. The presence of a high percentage of therophytes shows the xeric conditions of environment, characterized, as already pointed out, by a very dry climate. Their presence

List of native (N), introduced (I) and become spontaneous species (S)													
Chorological types	L.F.	Families	I			II			III			IV	
			N	I	S	N	I	S	N	I	S	N	S
Endem. (Etnean)	CH	<i>Cerastium tomentosum</i> L. var. <i>aetneum</i> Janka	*			*	*	*				*	
Cosmop.	T	<i>Cerastium semidecandrum</i> L.	*			*		*				*	
Paleotemp.	T	<i>Herniaria microcarpa</i> C. Presl	*			*		*				*	
S - Medit.	T	<i>Petrorhagia velutina</i> (Guss.) P. W. Ball et Heywood	*			*		*				*	
Euro-Medit.	T	<i>Petrorhagia prolifera</i> (L.) P. W. Ball et Heywood	*			*		*				*	
Endem. S. It., Sic.	H	<i>Petrorhagia saxifraga</i> (L.) Link ssp. <i>gasparrini</i> (Guss.) Pign.	*			*		*				*	
Euro-Medit.	H	<i>Petrorhagia saxifraga</i> ssp. <i>saxifraga</i>	*			*		*				*	
Steno-Medit.	H	<i>Paronychia argentea</i> Lam.				*		*					
Euro-Medit.	T	<i>Polycarpon tetraphyllum</i> L.						*					*
Submedit. - Subatl.	H	<i>Sagina subulata</i> (Schwartz) Presl						*				*	
Eurosiber.	H	<i>Saponaria officinalis</i> L.	*			*		*	*	*		*	
S - Mountain-Medit.	H	<i>Saponaria sicula</i> Rafin.	*			*		*				*	
Endem. (Etnean)	T	<i>Scleranthus aetnensis</i> Strobl	*			*		*				*	
Endem. (Etnean)	H	<i>Scleranthus perennis</i> L. ssp. <i>vulcanicus</i> (Strobl) Béguinot	*			*		*				*	
SW-Medit.	T	<i>Silene coeli-rosa</i> (L.) Godron	*			*		*					
Steno - Medit.	T	<i>Silene colorata</i> Poirlet ssp. <i>colorata</i>				*		*					
Paleotemp.	T	<i>Silene conica</i> L. ssp. <i>conica</i>	*			*		*				*	
Subcosmop.	T	<i>Silene gallica</i> L.				*		*					
Euro-Medit.	H	<i>Silene italica</i> (L.) Pers. ssp. <i>italica</i>	*			*		*				*	
Steno-Medit.	H	<i>Silene latifolia</i> Poirlet				*		*					
N-Mountain-Medit.	H	<i>Silene sicula</i> Ucria	*			*		*					
Southeurop.-Centroasiat.	H	<i>Silene viridiflora</i> L.						*					*
Subcosmop.	H	<i>Silene vulgaris</i> (Moench) Garcke ssp. <i>vulgaris</i>	*			*		*				*	
Cosmop.	T	<i>Stellaria media</i> L. Vill. ssp. <i>media</i>						*				*	
		RANUNCULACEAE											
Europeo - Caucas.	P	<i>Clematis vitalba</i> L.	*			*		*					
Steno-Medit.	T	<i>Delphinium halteratum</i> S. et S.				*		*				*	
Steno-Medit.	H	<i>Ranunculus bullatus</i> L.	*			*		*					
Mountain-Medit.	H	<i>Ranunculus millefoliatus</i> Vahl	*			*		*				*	
NW-Medit.	H	<i>Ranunculus monspeliacus</i> L. ssp. <i>saxatilis</i> (Balbis) Rouy	*			*		*					
NE-Medit.	H	<i>Ranunculus neapolitanus</i> Ten.	*			*		*					
Eurasiat.	H	<i>Thalictrum minus</i> L.	*			*		*				*	
		BERBERIDACEAE											
Endem. S. It., Sic.	NP	<i>Berberis aetnensis</i> Presl.	*			*		*				*	
		PAEONIACEAE											
Europeo - Caucas.	G	<i>Paeonia mascula</i> (L.) Miller ssp. <i>mascula</i>	*					*					
		GUTTIFERAE											
Steno-Medit.	H	<i>Hypericum hircinum</i> L.				*		*				*	
Steno-Medit.	H	<i>Hypericum perforatum</i> L.	*			*		*					
Subcosmop.	H	<i>Hypericum perforatum</i> L. ssp. <i>perforatum</i>	*			*		*				*	
		LAURACEAE											
Steno-Medit.	P	<i>Laurus nobilis</i> L.	*										
		PAPAVERACEAE											
E-Medit. sinantr.	T	<i>Papaver rhoeas</i> L. ssp. <i>rhoeas</i>						*					
Circumb.	H	<i>Chelidonium majus</i> L.	*										*
Subcosmop.	T	<i>Fumaria officinalis</i> L.						*					
		CRUCIFERAE											
Oroph.-SW-Europ.	H	<i>Alliaria petiolata</i> (Bieb.) Cavara et Grande				*		*				*	
NE-Medit.	T	<i>Alyssum minutum</i> Schlecht	*			*		*				*	
Cosmop.	T	<i>Arabidopsis thaliana</i> (L.) Heynh	*			*		*				*	
Oroph. Medit.	H	<i>Arabis collina</i> Ten.				*		*	*	*		*	
S-Europ.	H	<i>Arabis turrita</i> L.	*			*		*				*	
Steno-Medit.	T	<i>Arabis verna</i> (L.) R. Br.				*		*	*	*		*	
Endem. S. It., Sic., Sard.	H	<i>Arabis rosea</i> DC.				*		*					
S-Medit.-Turan.	T	<i>Biscutella didyma</i> L.	*			*		*				*	
N-Medit.	T	<i>Bunias erucago</i>				*		*				*	
Cosmop. (sinantr.)	H	<i>Capsella bursa-pastoris</i> (L.) Medicus						*				*	

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Chorological types	L.F.	Families	I			II			III			IV
			N	I	S	N	I	S	N	I	S	N
Cosmop.	T	<i>Cardamine hirsuta</i> L.							*			*
Oroph.-N-Medit.	T	<i>Cardamine glauca</i> Sprengel	*			*			*			
N-Medit.	T	<i>Cardamine graeca</i> L.				*			*			
Circumbor.	H	<i>Cardamine flexuosa</i> With.							*			
Circumbor.	T	<i>Erophila verna</i> (L.) Chevall. ssp. <i>praecox</i> (Steven) P. Fourn.	*		*			*			*	
Endem. (Sicilian)	H	<i>Erysimum bonannianum</i> C. Presl	*		*			*			*	
Steno-Medit.	H	<i>Isatis tinctoria</i> L. var. <i>canescens</i> DC.	*		*			*			*	
Steno-Medit.	H	<i>Lobularia maritima</i> (L.) Desv.				*						
Circumbor.	T	<i>Raphanus raphanistrum</i> L.				*						
Subcosmop.	T	<i>Sysimbrium officinale</i> (L.) Scop.				*			*			
		RESEDACEAE										
Steno-Medit.	T	<i>Reseda alba</i> L.							*	*		
		CRASSULACEAE										
Medit.-Atl.	G	<i>Umbilicus rupestris</i> (Salisb.) Dandy	*		*			*			*	
Steno-Medit.	CH	<i>Sedum amplexicaule</i> DC. ssp. <i>tenuifolium</i> (Sm.) Greuter	*		*			*			*	
Europeo-Caucas.	CH	<i>Sedum acre</i> L.							*			
Submedit.-Subatl.	T	<i>Sedum cepaea</i> L.							*			
Steno-Medit.	T	<i>Sedum stellatum</i> L.				*			*			
Mountain-Medit.	T	<i>Sedum aetnense</i> Tineo	*						*			
Euro-Medit.-Subatl.	T	<i>Sedum rubens</i> L.	*		*			*			*	
SE-Europ. (Pontic)	T	<i>Sedum hispanicum</i> L.							*		*	
SW-Medit.	T	<i>Sedum caeruleum</i> L.							*			
		SAXIFRAGACEAE										
Medit. - Atl.	H	<i>Saxifraga granulata</i> L.	*		*				*			
		ROSACEAE										
Subcosmop.	H	<i>Agrimonia eupatoria</i> L.	*		*				*			
Oroph. NE-Medit.	H	<i>Aremonia agrimonioides</i> (L.) DC				*		*	*			
E-Medit.	P	<i>Crataegus azarolus</i> L.	*		*			*	*			
Paleotemp.	P	<i>Crataegus monogyna</i> Jacq. ssp. <i>monogyna</i>	*		*			*	*			
Cosmop.	H	<i>Fragaria vesca</i> L.	*		*			*	*		*	
Circumbor.	H	<i>Geum urbanum</i> L.	*		*			*	*		*	
C. Europ.-Caucas.	P	<i>Malus sylvestris</i> Miller							*		*	
Adv.	P	<i>Malus domestica</i> Borkh.	*									
Europeo-Caucas.	P	<i>Prunus spinosa</i> L.							*			
SE-Europ.	H	<i>Potentilla calabra</i> Ten.	*		*			*	*		*	
W-Medit.	H	<i>Potentilla hirta</i> L.	*		*			*	*			
Adv.	P	<i>Pyrus communis</i> L.							*			
Paleotemp.	NP	<i>Rosa canina</i> L.	*		*			*	*		*	
Oroph. NE-Medit.	NP	<i>Rosa heckeliana</i> Tratt.	*		*			*	*		*	
Circumbor.	NP	<i>Rubus idaeus</i> L.	*		*			*	*		*	
Euro-Medit.	NP	<i>Rubus ulmifolius</i> Schott	*		*			*	*			
Endem. S. It., Sic.	NP	<i>Rubus cupanianus</i> Guss.				*		*	*			
Euro-Medit.-W-Asiat.	H	<i>Sanguisorba minor</i> Scop. ssp. <i>muricata</i> (Grenl) Briq.	*		*			*	*			
Europ.	P	<i>Sorbus aucuparia</i> L.	*		*							
Endem. S. It., Sic.	P	<i>Sorbus aucuparia</i> L. ssp. <i>praemorsa</i> (Guss.) Nyman							*			
Paleotemp.	P	<i>Sorbus aria</i> (L.) Crantz							*			
		LEGUMINOSAE										
Endem. (Etnean)	NP	<i>Adenocarpus complicatus</i> (L.) Gay ssp. <i>commutatus</i> (Guss.) Coutinho var. <i>bivonii</i> (C. Presl) Zangheri	*		*			*	*		*	
Endem. (Etnean)	CH	<i>Astragalus siculus</i> Biv.	*		*			*	*		*	
Steno-Medit.	P	<i>Calicotome infesta</i> (Presl) Guss.	*		*			*	*			
S-Europ.-W-Asiat.	P	<i>Cercis siliquastrum</i> L.				*		*	*			
W- & C. Medit.	P	<i>Cytisus villosus</i> Pourret	*		*			*	*		*	
Endem. S. It., Sic.	P	<i>Genista aetnensis</i> (Biv.) DC.	*		*			*	*		*	
Paleotemp.	H	<i>Lathyrus pratensis</i> L.	*		*			*	*		*	
Euro-Medit.	T	<i>Lathyrus aphaca</i> L.				*		*	*			
NE-Medit.	G	<i>Lathyrus grandiflorus</i> S. et S.	*		*			*	*		*	
Europeo-Caucas.	H	<i>Lathyrus sylvestris</i> L.	*		*			*	*		*	

List of native (N), introduced (I) and become spontaneous species (S)													
Chorological types	L.F.	Families	I			II			III			IV	
			N	I	S	N	I	S	N	I	S	N	S
Pontic	G	<i>Lathyrus venetus</i> (Miller) Wohlf.				*			*				*
Euro-Medit.	T	<i>Lathyrus nissolia</i> L.							*				
W-Medit.	T	<i>Lupinus luteus</i> L.				*			*				
Steno-Medit.	T	<i>Lupinus angustifolius</i> L.				*			*				
E-Medit.	T	<i>Lupinus albus</i> L.				*							
Steno-Medit.	T	<i>Medicago truncatula</i> Gaertner							*				
Steno-Medit.	T	<i>Medicago aculeata</i> Willd.							*				
Subcosmop.	T	<i>Medicago hispida</i> Gaertner							*				
Euro-Medit.-C. Asiat.	T	<i>Medicago minima</i> (L.) Bartal.							*				
Euro-Medit.	T	<i>Ornithopus compressus</i> L.				*			*				*
Euro-Medit.	H	<i>Psoralea bituminosa</i> L.							*				
N Amer.	P	<i>Robinia pseudoacacia</i>	*			*			*				
Euro-Medit.	P	<i>Spartium junceum</i> L.	*			*			*				*
Euro-Medit.	T	<i>Trifolium glomeratum</i> L.							*				
Euro-Medit.	T	<i>Trifolium angustifolium</i> L.				*			*				
(W)-Paleotemp.	T	<i>Trifolium arvense</i> L.	*			*			*				*
W-Paleotemp.	T	<i>Trifolium campestre</i> Schreber	* ₋			* ₋			* ₋				* ₋
Euro-Medit.	T	<i>Trifolium cherleri</i> L.							*				
Medit. Atl.	H	<i>Trifolium incarnatum</i> L. ssp. <i>molinarii</i> (Balbis) Syme	* ₋			* ₋			* ₋				* ₋
Endem. S. It., Sic.	H	<i>Trifolium pratense</i> L. ssp. <i>semipurpureum</i> (Strobl.) Pign.	*			*			*				*
Subcosmop.	H	<i>Trifolium repens</i> L. ssp. <i>prostratum</i> (Biaioletto) Nyman	*			*			*				*
Subcosmop.	H	<i>Trifolium repens</i> L. ssp. <i>repens</i>	*						*				
(W)-Paleotemp.	T	<i>Trifolium striatum</i> L. ssp. <i>striatum</i>							*				
Euro-Medit.	T	<i>Trifolium subterraneum</i> L.							*				
Euro-Medit.	T	<i>Trifolium pallidum</i> L.											
Euro-Medit.	T	<i>Trifolium scabrum</i> L.	* ₋			* ₋			* ₋				* ₋
Euro-Medit.	T	<i>Trifolium stellatum</i> L.				*			*				
Subcosmop.	T	<i>Vicia sativa</i> L.							*	*			*
Subcosmop.	T	<i>Vicia hirsuta</i> (L.) S.F. Gray	*			*			*				*
Euro-Medit.	T	<i>Vicia lathyroides</i> L.	*			*			*				*
S-Europ.	T	<i>Vicia melanops</i> S. et S.				*			*				
Euro-Medit.	T	<i>Vicia narbonensis</i>							*				*
Steno-Medit.	T	<i>Vicia pseudocracca</i> Bertol.	*			*			*				*
Euro-Medit.	T	<i>Vicia villosa</i> Roth ssp. <i>varia</i> (Host) Corb.	*			*			*				*
		GERANIACEAE											
Europeo-Caucas.	H	<i>Geranium sanguineum</i> L.	*						*				*
NE-Medit.	H	<i>Geranium brutium</i> Gasparr.							*				
Euro-Medit.	T	<i>Geranium lucidum</i> L.							*	*			*
Subcosmop.	T	<i>Geranium robertianum</i> L.							*				
Euro-Medit.	T	<i>Erodium moschatum</i> (L.) L'Hér.				*			*				
Subcosmop.	T	<i>Erodium cicutarium</i> (L.) L'Hér.	*			*			*				*
Mountain-Medit.	H	<i>Erodium acaule</i> (L.) Becherer et Th.	*										
		ZYGOPHYLLACEAE											
Cosmop.	T	<i>Tribulus terrestris</i> L.							*				
		LINACEAE											
Euro-Medit.-Subatl.	H	<i>Linum bienne</i> Miller				*			*				
Euri-Medit.	T	<i>Linum tryginum</i> L.							*				
		EUPHORBIACEAE											
Paleotemp.	T	<i>Mercurialis annua</i> L.				*			*				
Endem. S. It., Sic.	CH	<i>Euphorbia ceratocarpa</i> Ten.							*				
Cosmop.	T	<i>Euphorbia helioscopia</i> L.				*			*				
S-Europ.-Pontic	CH	<i>Euphorbia rigida</i> Bieb.	*			*			*				
Steno-Medit.	H	<i>Euphorbia terracina</i> L.				*			*				
Steno-Medit.	NP	<i>Euphorbia characias</i> L.	*			*			*				*
		ANACARDIACEAE											
S-Medit.	P	<i>Rhus coriaria</i> L.							*				
Euro-Medit.	P	<i>Pistacia terebinthus</i> L.				*			*				

List of native (N), introduced (I) and become spontaneous species (S)										
Chorological types	L.F.	Families	I		II		III		IV	
			N	I	S	N	I	S	N	I	S
Paleotemp.	H	<i>Centaureum erythraea</i> Rafn. ssp. <i>erythraea</i>				*		*		
		APOCYNACEAE								
Euro-Medit.	CH	<i>Vinca major</i> L.						*		
		RUBIACEAE								
Subcosmop.	T	<i>Sherardia arvensis</i> L.	*		*		*		*	
W-Mountain-Medit.	H	<i>Galium scabrum</i> L.		*		*		*		
Eurasiat.	H	<i>Galium verum</i> L. ssp. <i>verum</i>		*		*		*		
Endem. C-Medit.	H	<i>Galium aethnium</i> Biv.	*		*		*		*	
Eurasiat.	T	<i>Galium spurium</i> L.	*_		*_		*_		*_	
Eurasiat.	T	<i>Galium aparine</i> L.								*
Euro-Medit.	T	<i>Galium parisiense</i> L.						*	*	
Medit.	T	<i>Galium verticillatum</i> Danth.	*_		*_		*_		*_	
Euro-Medit.	T	<i>Cruciata pedemontana</i> (Bellardi) Ehrend.	*		*		*		*	
Steno-Medit.-Macarones	P	<i>Rubia peregrina</i> L.		*		*		*		
		CONVOLVULACEAE								
Paleotemp.	T	<i>Cuscuta europaea</i> L.						*		*
Steno-Medit.	T	<i>Cuscuta epithymum</i> (L.) L. ssp. <i>kotschyi</i> Desmoulin	*		*		*		*	
SE-Europ.	H	<i>Calystegia sylvatica</i> (Kit.) Griseb.						*		
Cosmop.	G	<i>Convolvulus arvensis</i> L.				*		*		
		BORAGINACEAE								
NE-Steno-Medit.	T	<i>Anchusa cretica</i> Miller	*		*	*	*	*		
Steno-Medit.	H	<i>Anchusa hybrida</i> Ten.	*		*	*	*	*		
Mountain-Medit.	T	<i>Buglossoides gasparrinii</i> (Heldr.) Pign.	*		*		*	*	*	
Euro-Medit.	T	<i>Buglossoides arvensis</i> (L.) Johnston	*		*	*	*	*	*	
Eurosiber.	T	<i>Lithospermum officinale</i> L.				*		*		
Steno-Medit.	T	<i>Cerintho major</i> L.						*		
Euro-Medit.	H	<i>Cynoglossum creticum</i> Miller	*		*		*	*	*	
Euro-Medit.	T	<i>Echium plantagineum</i> L.				*		*		
Europ.	H	<i>Echium vulgare</i> L. var. <i>pustulatum</i> (S. et S.) Fiori	*		*	*	*	*	*	*
NE-Steno-Medit.	T	<i>Myosotis incrassata</i> Guss.	*		*		*	*	*	
Europeo-W-Asiat.	T	<i>Myosotis ramosissima</i> Rochel in Schultes	*		*		*	*	*	
SE-Europ.	G	<i>Symphytum bulbosum</i> Schimper						*	*	*
		VERBENACEAE								
Pantrop. & Subtrop.	H	<i>Lippia nodiflora</i> (L.) Michx.						*		
Cosmop.	H	<i>Verbena officinalis</i> (L.) Mich.				*		*		*
		LABIATAE								
Endem. S. It., Sic.	CH	<i>Acinos granatensis</i> (Boiss. et Reuter) Pign. ssp. <i>aetnensis</i> (Strobi) Pign	*		*		*		*	
Steno-Medit.	H	<i>Ballota nigra</i> L. ssp. <i>uncinata</i> (Fiori et Bég.) Patzak				*		*	*	*
Oroph.-NE-Medit.	CH	<i>Ballota rupestris</i> (Biv.) Vis	*		*		*	*	*	*
Mountain-Medit.	H	<i>Calamintha nepeta</i> (L.) Savi	*		*		*	*	*	*
Circumbor.	H	<i>Clinopodium vulgare</i> L. ssp. <i>arundanum</i> (Boiss.) Nyman	*_		*_		*_		*_	
Paleotemp.	T	<i>Lamium amplexicaule</i> L.	*_		*_		*_		*_	
NW-Mountain-Medit.	H	<i>Lamium flexuosum</i> Ten.						*	*	*
Steno-Medit.	T	<i>Lamium bifidum</i> Cyr.				*		*		
Subcosmop.	H	<i>Marrubium vulgare</i> L.	*		*		*	*	*	
Endem. S. It., Sic.	CH	<i>Micromeria consentina</i> (Ten.) N. Terracc.	*		*		*	*	*	
SE-Medit. (Steno-)	H	<i>Origanum heracleoticum</i> L.				*		*	*	
Steno-Medit.	H	<i>Origanum vulgare</i> L. ssp. <i>viridulum</i> (Martin-Donos) Nyman	*		*		*	*	*	
Steno-Medit.	CH	<i>Prasium majus</i> L.						*	*	
Euro-Medit.	H	<i>Salvia sclarea</i> L.						*	*	
Medit.-Atl.	H	<i>Salvia verbenaca</i> L.	*		*		*	*	*	
NE-Mountain-Medit.	H	<i>Scutellaria columnnae</i> All. ssp. <i>columnnae</i>	*		*		*	*	*	*
Endem. (Sicilian)	H	<i>Scutellaria rubicunda</i> Hornem ssp. <i>linnaeana</i> (Caruel) Rech.						*	*	*
Euri-Medit.	H	<i>Stachys germanica</i> L.						*	*	
Endem. C-Medit.	H	<i>Teucrium siculum</i> (Rafin.) Guss.	*		*		*	*	*	*
Euri-Medit.	CH	<i>Teucrium chamaedrys</i> L.	*		*		*	*	*	*

List of native (N), introduced (I) and become spontaneous species (S)														
Chorological types	L.F.	Families	I			II			III			IV		
			N	I	S	N	I	S	N	I	S	N	I	S
Steno-Medit.	CH	<i>Teucrium flavum</i> L. ssp. <i>flavum</i>	*			*				*				
Endem. S. It., Sic.	CH	<i>Thymus spinulosus</i> Ten.				*				*				
SOLANACEAE														
Cosmop. sinantr.	T	<i>Solanum nigrum</i> L. ssp. <i>nigrum</i>								*	*			
Steno-Medit.	H	<i>Mandragora autumnalis</i> Bertol.	*							*				
SCROPHULARIACEAE														
Europeo-Caucas.	H	<i>Verbascum thapsus</i> L.	*			*				*	*		*	
C & S-Europ.	H	<i>Verbascum pulverulentum</i> Vill.								*				
Euro-Medit.	H	<i>Scrophularia canina</i> L.	*			*				*	*		*	
Paleotemp.	T	<i>Misopates orontium</i> (L.) Rafin.	*			*				*				
SW-Medit.	T	<i>Linaria reflexa</i> (L.) Desf.								*				
SW-Medit.	H	<i>Linaria heterophylla</i> Desf.	*			*				*				
Endem. C-Medit.	H	<i>Linaria purpurea</i> (L.) Miller	*			*	*			*			*	
Subcosmop.	T	<i>Veronica arvensis</i> L.	*			*				*			*	
Eurasiat.	T	<i>Veronica verna</i> L.								*			*	
Euro-Medit.	T	<i>Odontites lutea</i> (L.) Clairv.	*							*				
Medit.-Atl.	T	<i>Parentucellia viscosa</i> (L.) Caruel	*							*				
Euro-Medit.	T	<i>Parentucellia latifolia</i> (L.) Caruel								*				
Euro-Medit.	T	<i>Bellardia trixago</i> (L.) All.				*				*				
OROBANCHACEAE														
Subatl.	T	<i>Orobanche rapum genistae</i> Thuill. ssp. <i>rapum genistae</i>								*				
ACANTHACEAE														
Steno-Medit. -(W)	H	<i>Acanthus mollis</i> L.				*				*				
PLANTAGINACEAE														
Cosmop.	H	<i>Plantago lanceolata</i> L.				*				*				
Steno-Medit.	T	<i>Plantago lagopus</i> L.	*			*				*				
S-Medit.	T	<i>Plantago bellardi</i>	*			*				*				
Steno-Medit.	T	<i>Plantago psyllium</i> L.				*				*				
CAPRIFOLIACEAE														
Euro-Medit.	P	<i>Lonicera etrusca</i> G. Santi	*			*				*				
VALERIANACEAE														
Steno-Medit.	T	<i>Centranthus calcitrapa</i> (L.) DC.				*				*				
Steno-Medit.	CH	<i>Centranthus ruber</i> (L.) DC	*			*				*			*	
Steno-Medit.	CH	<i>Centranthus ruber</i> (L.) DC fo. <i>albina</i>				*				*				
Euro-Medit.	T	<i>Valerianella carinata</i> Loisel.	*			*				*	*		*	
Steno-Medit.	T	<i>Valerianella microcarpa</i> Loisel.								*	*			
DIPSACACEAE														
Euro-Medit.	T	<i>Knautia integrifolia</i> (L.) Bertol.	*			*				*				
Steno-Medit. -(W)	H	<i>Scabiosa maritima</i> L.				*				*				
CAMPANULACEAE														
Steno-Medit. -(W)	T	<i>Campanula dichotoma</i> L.				*								
Mountain-Medit.	H	<i>Jasione echinata</i> Boiss. et Reuter	*			*				*			*	
COMPOSITAE														
S-Medit.	NP	<i>Artemisia arborescens</i> L.				*				*				
Steno-Medit. -(W)	H	<i>Achillea ligustica</i> All.	*			*				*			*	
Euro-Medit.	T	<i>Andryala integrifolia</i> L.	* ₋			* ₋	*			* ₋			* ₋	
E-Medit.	T	<i>Andryala rothia</i> (Pers.) ssp. <i>dentata</i> (S. et S.) Pign.				*				*				
Endem. (Etrian)	CH	<i>Anthemis aetnensis</i> Schouw	*			*	*			*			*	
Endem. S. It., Sic.	T	<i>Anthemis arvensis</i> L. ssp. <i>sphacelata</i> (Presl) Fernandes	*			*				*			*	
Endem. Sic.	H	<i>Bellis perennis</i> L. var. <i>strobliana</i> Bèguinot	*			*				*			*	
Steno-Medit.	H	<i>Carduus macrocephalus</i> Desf. ssp. <i>siculus</i> Franco				*				*				
(Euro-) Medit.-Turan.	H	<i>Carduus pycnocephalus</i> L.				*				*				
Steno-Medit.	H	<i>Carlina corymbosa</i> L.	*			*				*			*	
Steno-Medit.	T	<i>Carlina lanata</i> L.	*			*				*			*	
Endem. (Sicilian)	H	<i>Carlina nebrodensis</i> Guss.	*			*				*			*	
Subcosmop.	T	<i>Centaurea cyanus</i> L.				*				*			*	
Endem. (Sicilian)	H	<i>Centaurea parlatoris</i> Heldr.	*			*				*			*	

List of native (N), introduced (I) and become spontaneous species (S)										
Chorological types	L.F.	Families	I		II		III		IV	
			N	I	S	N	I	S	N	I	S
SW-Steno-Medit.	H	<i>Centaurea nicaeensis</i> All.				*		*		
Euro-Medit.	T	<i>Carthamus lanatus</i> L.						*		
Cosmop.	H	<i>Cichorium intybus</i> L.	* ₋		* ₋		* ₋		* ₋	
Euro-Medit.-southsiber.	H	<i>Chondrilla juncea</i> L.	*		*		*		*	
Euro-Medit.	T	<i>Chrysanthemum segetum</i> L.				*		*		
Steno-Medit.	T	<i>Chrysanthemum coronarium</i> L.				*		*		
Adv.	T	<i>Conyza bonariensis</i> (L.) Cronq.	* ₋		* ₋		* ₋		* ₋	
Endem. (Sicilian)	H	<i>Crepis leontodontoides</i> All. var. <i>preslii</i> Nic.	*		*		*		*	
Steno-Medit.	T	<i>Crupina crupinastrum</i> (Moris) Vis.		*		*		*		
Oroph.-SE-Europ.	G	<i>Doronicum orientale</i> L.		*		*		*		*
Europ.-Caucas.	H	<i>Hypochoeris radicata</i> L.	*		*	*	*	*	*	*
Oroph. NE-Medit.	H	<i>Hypochoeris cretensis</i> (L.) Chaub. et Bory	*		*		*		*	
SW-Mountain-Medit.	H	<i>Hypochoeris laevigata</i> Ces. P. et G.	*		*	*	*	*	*	*
Steno-Medit.	T	<i>Hypochoeris achyrophorus</i> L.	* ₋		* ₋		* ₋		* ₋	
S-Europ.	CH	<i>Helichrysum italicum</i> (Roth) Don ssp. <i>italicum</i>	*		*		*		*	*
Steno-Medit.	H	<i>Hieracium crinitum</i> S. et S.		*		*		*		*
(C) Europ.-W-Asiat.	H	<i>Inula conyza</i> DC		*		*		*		*
Medit.-Turan.	T	<i>Inula graveolens</i> (L.) Desf.		*						
Euro-Medit.	H	<i>Inula viscosa</i> (L.) Aiton		*		*				
Euri-Medit.-W-Asiat.	H	<i>Lactuca viminea</i> (L.) Presl	*		*		*		*	
Medit.-Atl.	T	<i>Lactuca virosa</i> L.				*		*		*
Euri-Medit.-southsiber.	H	<i>Lactuca seriola</i> L.		*		*		*		*
Paleotemp.	T	<i>Lapsana communis</i> L.						*		*
Mountain-Medit.	H	<i>Leontodon cichoraceus</i> (Ten.) Sanguin.	*		*		*		*	*
Euro-Medit.-southsiber.	T	<i>Oglifa arvensis</i> (L.) Cass.	*		*		*		*	*
Euro-Medit.	T	<i>Oglifa gallica</i> (L.) Chrtek et Holub	*		*		*		*	*
Steno-Medit.	H	<i>Onopordum illyricum</i> L.		*		*		*		*
W-Medit.	CH	<i>Phagnalon saxatile</i> (L.) Cass.						*		*
Eurosiber.	H	<i>Picris hieracioides</i> L.	*		*		*		*	*
Euro-Medit.	T	<i>Picris echioides</i> L.	*		*		*		*	*
Euro-Medit.	T	<i>Rhagadiolus stellatus</i> (L.) Willd.						*		*
Endem. C-Medit.	H	<i>Robertia taraxacoides</i> (Loisel) DC	*		*		*		*	*
SW-Medit.	G	<i>Scorzonera deliciosa</i> Guss.	*		*		*		*	*
Endem. (Sicilian)	CH	<i>Senecio ambiguus</i> (Biv.) DC		*		*				
Endem. S. It. Sic.	CH	<i>Senecio squalidus</i> L. var. <i>chrysanthemifolius</i> Poir.		*		*		*		*
Endem. (Etrurian)	CH	<i>Senecio squalidus</i> L. var. <i>glaber</i> Ucria	*		*		*		*	*
Endem. (Etrurian)	CH	<i>Senecio squalidus</i> L. var. <i>aetnensis</i> (Jan) Fiori	*		*	*	*		*	*
SW-Medit.	H	<i>Scolymus grandiflorus</i> Desf.				*				
Medit.-Turan.	H	<i>Silybum marianum</i> (L.) Gaertner						*		*
Endem. (Sicilian)	H	<i>Tanacetum siculum</i> (Guss.) Strobl	*		*		*		*	*
Paleotemp.	H	<i>Taraxacum laevigatum</i> (Willd.) DC	*		*		*		*	*
Steno-Medit.	H	<i>Tolpis virgata</i> (Desf.) Bertol. ssp. <i>virgata</i>						*		*
Steno-Medit.	H	<i>Tragopogon crocifolius</i> L.	*		*		*		*	*
Paleotemp.	G	<i>Tussilago farfara</i> L.				*		*		*
Euro-Medit.-C.-W	H	<i>Urospermum dalechampii</i> (L.) Schmidt B.				*		*		*
Euro-Medit.	H	<i>Urospermum picroides</i> (L.) Schmidt				*				*
S-Europ.	T	<i>Xanthium italicum</i> Moretti						*		*
LILIACEAE										
Euro-Medit.	G	<i>Allium vineale</i> L.	*		*		*		*	*
Euro-Medit.	G	<i>Allium ampeloprasum</i> L.		*						
Steno-Medit.	G	<i>Allium subhirsutum</i> L.	* ₋		* ₋	*	* ₋		* ₋	* ₋
Steno-Medit.	G	<i>Allium tenuiflorum</i> Ten.	*		*		*		*	*
Steno-Medit.	G	<i>Asparagus acutifolius</i> L.						*		*
Steno-Medit. -(W)	CH	<i>Asparagus albus</i> L.						*		*
E-Medit.	G	<i>Asphodeline lutea</i> (L.) Rchb.	*		*		*		*	*
Paleo-Subtrop.	H	<i>Asphodelus fistulosus</i> L.						*		*
Steno-Medit.	G	<i>Asphodelus microcarpus</i> Salzm. et Viv.	*							

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			N	I	S	N	I	S	N	I	S	N	I	S
Endem. S. It., Sic.	G	<i>Colchicum alpinum</i> Lam. et DC var. <i>parvulum</i> (Ten.) Fiori	*			*			*			*		
Euro-Medit.	G	<i>Leopoldia comosa</i> (L.) Parl.		*		*			*			*		
Submedit.	G	<i>Muscari botryoides</i> (L.) Miller							*					
Euro-Medit.	G	<i>Ornithogalum umbellatum</i> L.							*					
Eurasiat.	G	<i>Polygonatum multiflorum</i> (L.) All.							*					
Euro-Medit.	G	<i>Ruscus aculeatus</i> L.	*			*			*				*	
Euro-Medit.	G	<i>Scilla autumnalis</i> L.							*					
Paleo-Subtrop.	NP	<i>Smilax aspera</i> L.	*			*			*					
AMARYLLIDACEAE														
W – Steno-Medit.	G	<i>Sternbergia colchiciflora</i> W. et K. Feliciae var. <i>aetnensis</i> (Guss.) Fiori	*			*			*	*		*		
Mountain-Medit.	G	<i>Sternbergia lutea</i> (L.) Ker-Gawl.	*			*			*					
DIOSCOREACEAE														
Euro-Medit.	G	<i>Tamus communis</i> L.							*					
IRIDACEAE														
Endem. C-Medit.	G	<i>Crocus longiflorus</i> Rafin.	*			*			*					
N-Medit. (Steno-)	G	<i>Hermodactylus tuberosus</i> (L.) Salisb.				*			*					
JUNCACEAE														
Euro-Medit.	H	<i>Luzula forsteri</i> (Sm.) DC	*			*			*					
Endem. S. It., Sic.	H	<i>Luzula sieberi</i> Tausch ssp. <i>sicula</i> (Parl.) Pign.	*			*			*					
GRAMINACEAE														
Paleo-Subtrop.	T	<i>Aira caryophylla</i> L. ssp. <i>caryophylla</i>	*			*			*			*		
Eurasiat.	H	<i>Anthoxanthum odoratum</i> L.	*			*			*			*		
Euro-Medit.-Turan.	T	<i>Avena barbata</i> Potter							*	*		*		
Euro-Medit.	T	<i>Bromus madritensis</i> L.							*	*		*		
Subcosmop.	T	<i>Bromus hordeaceus</i> L.				*			*			*		
Paleo-Subtrop.	T	<i>Bromus rigidus</i> Roth							*			*		
Paleotemp.	T	<i>Bromus tectorum</i> L.	*			*			*			*		
Paleotemp.	H	<i>Brachypodium sylvaticum</i> (Hudson) Beauv.	*			*	*		*			*		
Eurasiat.	H	<i>Brachypodium pinnatum</i> Beauv.							*	*		*		
Paleo-Subtrop.	T	<i>Briza maxima</i> L.				*			*			*		
Eurosiber.	H	<i>Calamagrostis epigejos</i> Roth	*			*			*			*		
Euro-Medit.	T	<i>Cynosurus echinatus</i> L.	*			*			*			*		
Euro.-Caucas.	H	<i>Cynosurus cristatus</i> L.		*		*			*			*		
Steno-Medit.	T	<i>Cynosurus elegans</i> Desf.							*			*		
Paleotemp.	H	<i>Dactylis glomerata</i> L.	*			*			*			*		
Euro-Medit.-Turan.	T	<i>Dasypyrum villosum</i> (L.) Borbás							*	*		*		
Euro-Medit.	H	<i>Festuca circummediterranea</i> Patzke	*			*			*			*		
Euro.-Caucas.	H	<i>Festuca heterophylla</i> Lam.				*			*			*		
Euro-Medit.	T	<i>Lagurus ovatus</i> L.							*	*		*		
Circumbor.	H	<i>Lolium perenne</i> L.				*			*			*		*
Euro-Medit.-Turan.	H	<i>Melica ciliata</i> L.	*						*			*		
Steno-Medit.-Turan.	H	<i>Oryzopsis miliacea</i> (L.) Asch. et Schweinf. ssp. <i>miliacea</i>	*_			*_			*_			*_		
Endem. C-Medit.	G	<i>Phleum ambiguum</i> Ten.	*			*			*			*		
Cosmop.	T	<i>Poa annua</i> L.	*_			*_			*_			*_		
Paleotemp.	H	<i>Poa bulbosa</i> L.	*			*			*			*		
Circumbor.	H	<i>Poa pratensis</i> L.	*			*			*			*		
Euro-Medit.	H	<i>Poa sylvicola</i> Guss.							*			*		*
Endem. (Etnean)	H	<i>Poa violacea</i> Bellardi ssp. <i>aetnensis</i> (Presl.) Ciferri et Giac.	*			*			*	*		*		
Paleo-Subtrop.	T	<i>Polypogon monspeliensis</i> (L.) Desf.				*			*			*		
Mountain-Medit.	H	<i>Secale strictum</i> (Presl) Strobil	*			*			*			*		
Subcosmop.	T	<i>Vulpia myuros</i> (L.) Gmelin							*			*		*
ARACEAE														
Steno-Medit.	G	<i>Arum italicum</i> Miller				*			*			*		
Steno-Medit.	G	<i>Biarum tenuifolium</i> (L.) Schott				*			*			*		*
Steno-Medit.	G	<i>Arisarum vulgare</i> Targ.-Tozz.				*			*			*		
CYPERACEAE														
Steno-Medit.	H	<i>Carex distachya</i> Desf.	*						*			*		

List of native (N), introduced (I) and become spontaneous species (S)										
Chorological types	L.F.	Families	I		II		III		IV	
			N	S	N	S	N	S	N	S
Euro-Medit.	H	<i>Carex divulsa</i> Stokes			*					
Medit.-Atl.	H	<i>Carex otrubae</i> Podp.		*		*		*		*
ORCHIDACEAE										
Steno-Medit.	G	<i>Barlia robertiana</i> (Loisel.) Greuter		*		*		*		
Eurasiat.	G	<i>Cephalanthera longifolia</i> (L.) Fritsch		*		*		*		
Eurasiat.	G	<i>Cephalanthera rubra</i> (L.) Rich.		*		*		*		
Europ.-Caucas.	G	<i>Dactylorhiza latifolia</i> (L.) H. Baumann et Kuenkele	*		*		*	*	*	
Steno-Medit.	G	<i>Dactylorhiza romana</i> (Sebast.) Soò		*		*		*		
Paleotemp.	G	<i>Epipactis helleborine</i> (L.) Crantz		*		*		*		
Endem. C. & S. It., Sic.	G	<i>Epipactis meridionalis</i> H. Baumann et Lorenz						*		
Europ.-Caucas.	G	<i>Epipactis microphylla</i> (Ehrh.) Swartz						*		
Endem. (Etrnean)	G	<i>Epipactis muelleri</i> Godfery ssp. <i>cerritae</i> Grasso						*		
Medit.-Atl. (Euro-)	G	<i>Hyphantoglossum hircinum</i> (L.) Sprengel				*		*		
Euro-Medit.	G	<i>Limodorum abortivum</i> (L.) Swartz		*		*		*		
Steno-Medit.	G	<i>Neotinea maculata</i> (Desf.) Stearn		*		*		*		
Eurasiat.	G	<i>Neottia nidus-avis</i> (L.) Rich.		*		*		*		
Endem. C.-Medit.	G	<i>Orchis papilionacea</i> L. ssp. <i>grandiflora</i> (Boiss.) H. Baumann	*					*		
Endem. C.-Medit.	G	<i>Orchis brancifortii</i> Biv.-Bern.	*			*		*		
Steno-Medit.	G	<i>Orchis italica</i> Poirlet	*					*		
W-Steno-Medit.	G	<i>Orchis longicornu</i> Poirlet	*			*		*		
Europ.-Caucas.	G	<i>Orchis morio</i> L.	*					*		
Endem. (Sicilian)	G	<i>Orchis commutata</i> Tod.								
Euro-Medit.	G	<i>Orchis tridentata</i> Scop.	*			*		*		
C-Medit.	G	<i>Ophrys lunulata</i> Parl.						*		
Euro-Medit.	G	<i>Ophrys tenthredinifera</i> Willd.	*					*		
Endem. (Sicilian)	G	<i>Ophrys discors</i> Bianca						*		
Steno-Medit.	G	<i>Serapias lingua</i> L.						*		
Euro-Medit.	G	<i>Serapias vomeracea</i> (Burm.) Briq.				*				

is favoured also by the existence of very superficial soils like those wide-spread on the lava stream crossing the garden area.

As regards the chorology (Fig. 4) the most widespread types are represented by the Endemics (*sensu* Pignatti 1982), which cover a percentage of 19,4%. The species given as endemics by Pignatti include the Mt. Etna endemic species (about 5% of the total of this chorotype) the endemics of Sicily, the endemics of Southern Italy and Sicily, the endemics of Southern Italy, Sicily and Sardinia, the central Mediterranean endemics. The Euro-

Table 2. Number and percentage of species, genera and families of native, introduced and become spontaneous species.

SPECIES LIVING ON THE GARDEN			
Total number of species (464)			
Total number of genera (272)			
Total number of families (75)			
	Number and % of species	Number and % of genera	Number and % of families
Native species	136 (29,31%)	108 (39,70%)	35 (46,66%)
Introduced species	328 (70,68%)	219 (80,51%)	68 (90,66%)
Spontaneous species	71 (14,66%)	50 (18,38%)	25 (33,33%)
Spontaneous species		22,83%	36,76%
		(among the introduced species)	(among the introduced species)

Mediterraneans and Steno-Mediterraneans are well represented with a percentage of 18,65% and 15,67% respectively, followed by the cosmopolitans with 12,68%; the mountain-Mediterraneans with 9,95%; and the Paleotemperates with 9,70%. The other chorotypes are represented by a lower percentage. The significant presence of the Mediterranean s.l. species is in accordance with the data known for all the island of Sicily (Nimis 1984). The Euroasiatic species, like the Circumboreals, are part of the Sicilian flora that, coming from the mainland manage to spread into the Mediterranean region, where there are mountainous ranges. They are frequent in mountainous regions like Mt. Etna, where they can find very favourable environmental conditions (Arcidiacono & Giardina 2000).

INTRODUCED SPECIES

The introduction into the garden of species from other sites of the Mt. Etna territory has been a very interesting activities during the garden management. The number of introduced species has steadily increased - up to 1986, 148 species had been introduced (see Poli Marchese & al. 1988a); from 1986 to 1991 219 were introduced and between 1991 and 1995 292 species were introduced. They represent a percentage of 45%, 66% and 89% respectively of the total species present in each period. With reference to all introduced species, only 328 are survived.

As regards the life forms of the introduced species, it can be seen that in the various periods considered there is a prevalence of hemicryptophytes, with a percentage of 38%, followed by the therophytes with 22%. The remaining 40% is made up of geophytes, phanerophytes and chamephytes, the last of which has the lowest percentage (Fig. 5).

As regards the chorology of these species, with reference to the years of observation, it can be seen from the chorological spectrum (Fig. 6) that the Steno-Mediterraneans and Euro-Mediterraneans are the best represented types, with average percentages altogether of 51%. This value is much higher than the value (34,32%) for the same types of native species; the value (20%) of the Euroasiatics s.l. is also higher than that for the native species. This data shows the higher ecological valency of these chorological types.

INTRODUCED SPECIES THAT HAVE BECOME SPONTANEOUS

Following their introduction, many species managed to spread spontaneously and some have spread steadily (Table 2). Other species like *Lactuca serriola*, *Cnidium silaifolium*, *Marrubium vulgare*, *Anchusa cretica*, *Anchusa hybrida* and *Euonymus europaeus*, having spread successfully during some years (for example 1991 and 1995), later failed to do so (see Table 3). In general the number of species to have spread spontaneously increased sharply over the years to reach maximum values in 2000 (Fig. 7). This phenomenon is being observed in order to identify the species that show the greatest tendency to spread and also to identify the causes that determine and influence this.

The spontaneously spreading species have different origins and different ecological roles. As well as the synantropic species or those with a wide ecological valency, other species of the spontaneous vegetation of the mountain-Mediterranean belt are present; this vegetation is represented in the garden by *Pinus laricio* communities. Other species belong to the basal Mediterranean belt, therefore to more thermophilous natural vegetation.

From the life form spectrum (Fig. 8), it can be seen that the spontaneously spreading

Table 3. List of introduced species become spontaneous in the periods: I (until 1986); II (1987-1991); III (1992-1995); IV (1996-2000).

List of introduced species become spontaneous		I	II	III	IV
Chorological types	L.F.				
NE-Steno-Medit.	T			.....
Medit.-Macarones	T			.....
Steno-Medit.	T			.....
Euro-Medit.	T			.....
Cosmop. sinantr.	T			.....
Steno-Medit.	T			.....
Steno-Medit.	T			.....
Circumb.	T			.....
Euro-Medit.	T			.....
Euro-Medit.	T			.....
Cosmop.	T			.....
Medit.-Atl.	T			.....
Paleotemp.	T			.....
SE-(Pontic)	T			.....
Oroph.-SW-Europ.	T			.....
Cosmop.	T			.....
Euro-Medit.	T			.....
Steno-Medit.	T			.....
Subcosmop.	T			.....
Eurasiat.	T			.....
Euro-Medit.	T			.....
Steno-Medit.	H			.....
Euro-Medit.-southsiber.	H	---	---	.....
Subcosmop.	H			.....
SE-Europ.	H			.....
Euro-Medit.	H			.....
Europ.	H			.....
Eurosiber.	H			.....
Oroph.-Medit.	H			.....
Steno-Medit.	H			.....
Europeo-Caucas.	H			.....
Steno-Medit.	H			.....
Subcosmop.	H			.....
Steno-Medit.	H			.....
(C.) Europ.-W-Asiat.	H			.....
Southeurop.-Centroasiat.	H			.....
Europ.-Caucas.	H			.....
Circumbor.	H			.....
Euro-Medit.	H			.....
Subcosmop.	H			.....
Steno-Medit.	H			.....
Mountain-Medit.	H			.....
NW-Mountain-Medit.	H			.....
NW-Mountain-Medit.	H			.....
Euro-Medit.-Atl.	H			.....
Endem. sic.	H			.....
Endem. C.-medit.	H			.....
Europeo-Caucas.	H			.....
W-Europ.	H			.....
Circumbor.	H			.....
Adv.	H			.....
Cosmop.	H			.....
Circumbor.	H			.....
Eurasiat.	H			.....
Circumbor.	H			.....
Cosmop.	H			.....
Steno-Medit.	H			.....
SE-Europ.	G			.....
Steno-Medit.	G			.....
Oroph.-SE-Europ.	G			.....
Paleotemp.	G			.....
Pontic	G			.....
Euro-Medit.	G			.....
Oroph.-NE-Medit.	CH			.....
Steno-Medit.	NP			.....
Circumbor.	NP			.....
Eurasiat.	P			.....
C.-Europ.	P	---	---	.....
Euro-Medit.	P			.....
Euro-N-Medit.	P			.....
C.Europ.-Caucas.	P			.....

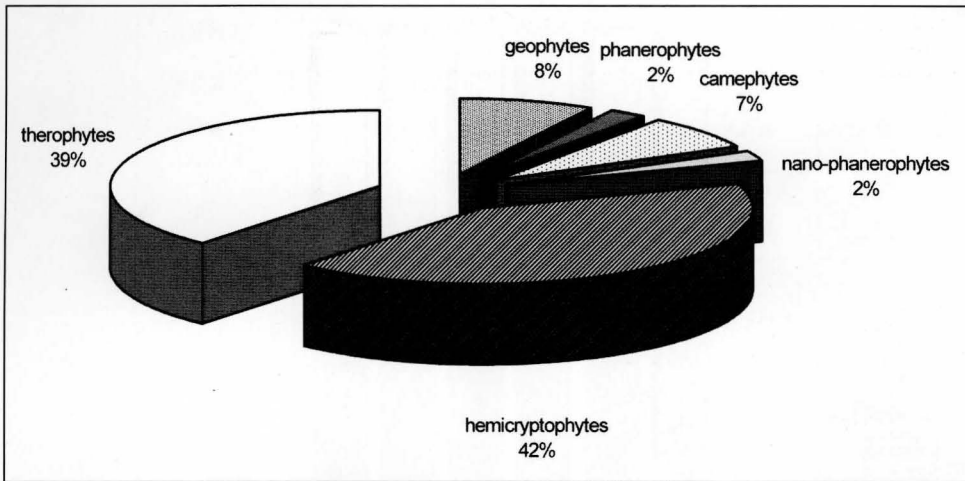


Fig. 3. Life form spectrum of native species.

species (71 species), about 1/5 of the total species registered in the garden, are mostly hemicryptophytes (53%). The therophytes constitute 28%, while the phanerophytes and geophytes 7% and 8% respectively. The nano-phanerophytes and the chamaephytes are represented with minimal values (between about 1 and 3%). Among the hemicryptophytes, worthy of note are *Arabis collina*, *Cynoglossum creticum*, *Ballota nigra* subsp. *uncinata*,

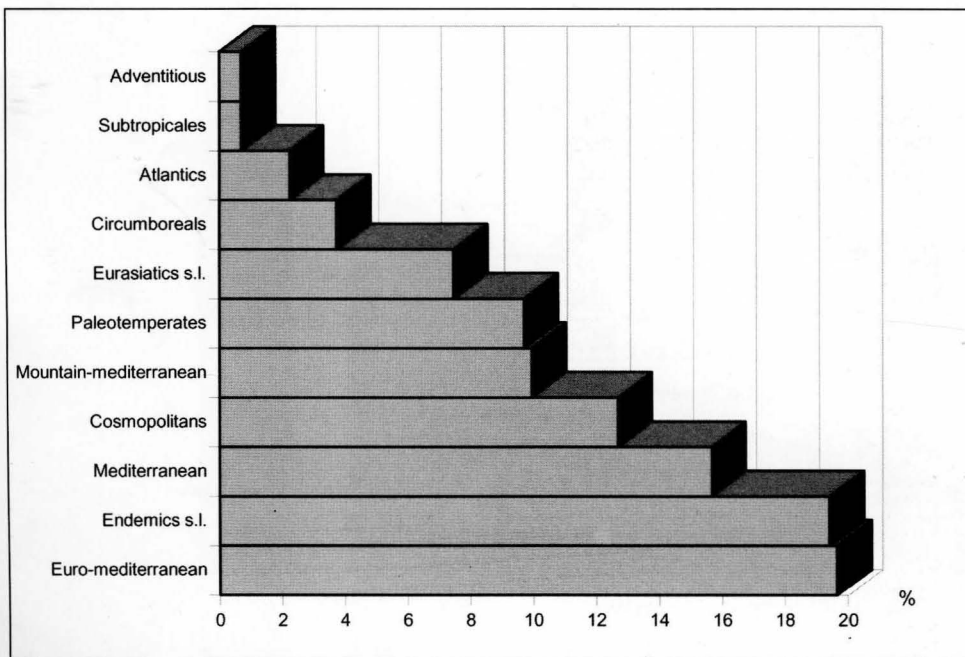


Fig. 4. Chorological types of native species.

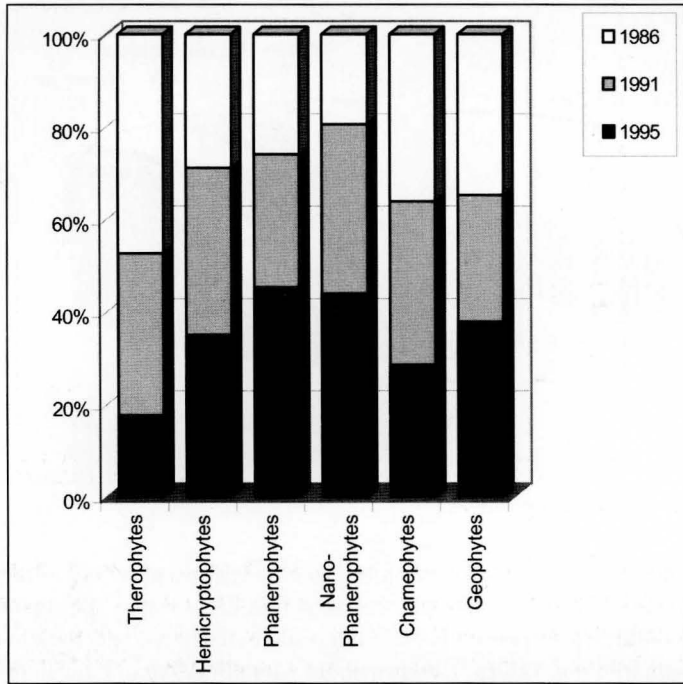


Fig. 5. Life form spectrum of introduced species, at different periods.

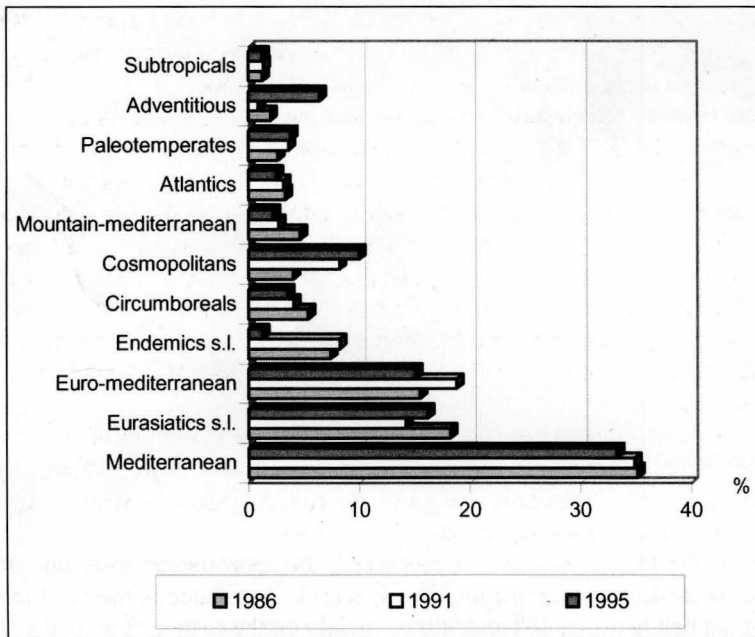


Fig. 6. Chorological types of introduced species, at different periods.

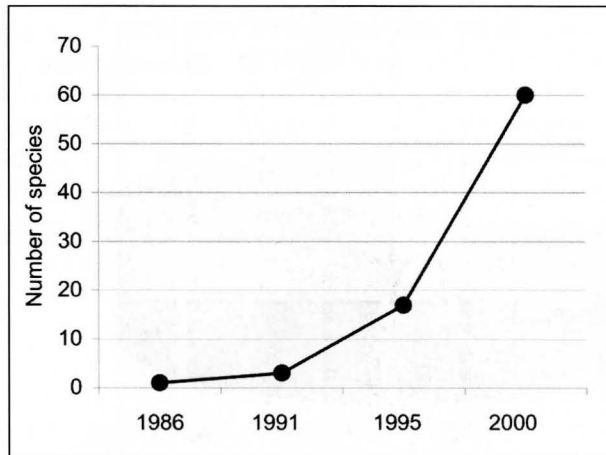


Fig. 7. Number of introduced species become spontaneous at different periods.

Saponaria officinalis and *Teucrium siculum*, which have shown a constant tendency to spread in limited areas of the garden. *Arabis collina*, in particular, is present on Mt. Etna in a fragmentary way and is present mainly on the east-south-eastern slope in the basal Mediterranean belt and in the Mediterranean mountain belt up to 1500 m (Poli Marchese 1991).

Also worthy of mention is *Teucrium siculum*, a central Mediterranean species characteristic of a *Quercus ilex* community (*Quercus-Teucrietum siculi* Gentile 1969). On Mt. Etna this species is distributed discontinuously in an altitudinal belt between 900 and 1400 m. In the botanic garden its presence is limited to the area used as a nursery and in the artificially planted *Quercus ilex* community, in which it is widespread.

The therophytes which have spread are also numerically significant they are mainly present in the area used as a nursery. They manage to persist thanks to the fact that the nursery is protected by cane fencing all year. These are species with a wide ecological valency, often widespread in the garden both accidentally and thanks to programmed introduction. They include *Lapsana communis*, *Cardamine hirsuta*, *Geranium lucidum*, *Ornithopus compressus*, *Fallopia convolvulus*, *Galium aparine*, *Polycarpon tetraphyllum* and *Echium vulgare* var. *pustulatum*. Among the Therophytes, worthy of note is *Arabis verna*, a species recently found on Mt. Etna (Poli Marchese & al. 1988b). At present only three sites are known, all in the same area – the Nicolosi territory – at altitudes between 830 and 920 m.

As regards the Chamephytes, the only species observed to have spread spontaneously is *Ballota rupestris*. It was introduced accidentally and has shown a marked tendency to spread spontaneously in the area of the nursery and, to a limited extent, in a wide clearing in the pine wood, in grassy vegetation.

As far as the Phanerophytes are concerned, the spontaneous spreading of *Euonymus europaeus* is particularly significant. This species is distributed in the Mt. Etna territory in an altitudinal belt between 400 and 900 m, mainly on the eastern face, in the *Quercus ilex*, deciduous oak and chestnut woods (Poli Marchese 1991).

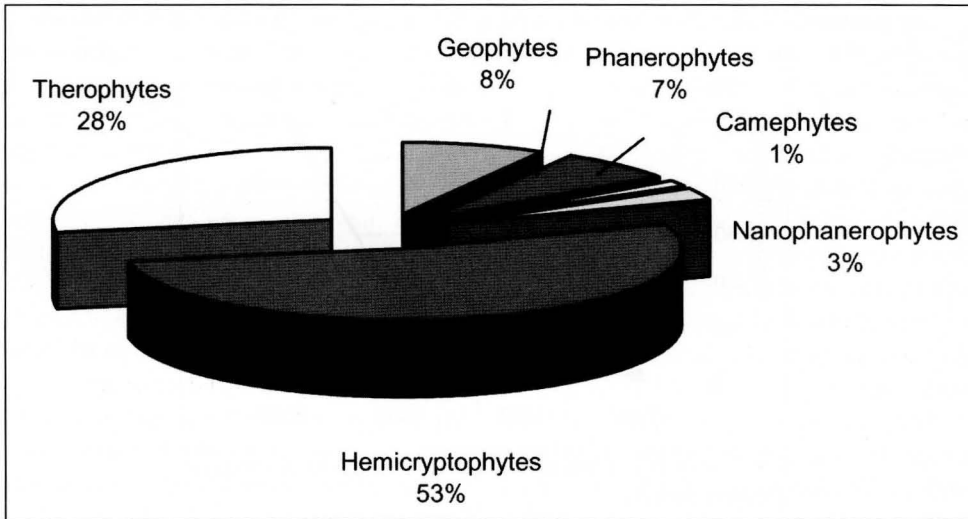


Fig. 8. Life form spectrum of species become spontaneous.

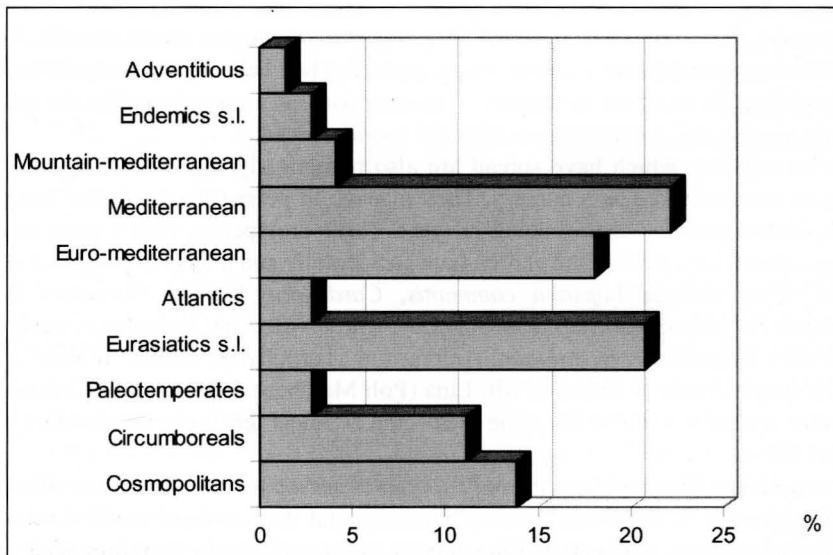


Fig. 9. Chorological types of introduced species become spontaneous.

The presence of *Spartium junceum* among the species which spread spontaneously in the nursery is also significant. This species is situated in a small area of the garden and does not show a marked tendency to spread because of the low winter temperatures. This is a species that on Mt. Etna colonises the lava substrates of the basal Mediterranean belt, where it is widespread up to 1050 m (Poli Marchese & Maugeri 1974). It plays the same ecological role which, at higher altitudes, also in the garden itself, is played by *Genista aetnensis*, a pioneer species widely represented up to the upper altitudinal limits of the forests. Among the other Phanerophytes which have spread spontaneously, mention should be made of *Fraxinus ornus*, a species localized in the basal Mediterranean belt of Mt. Etna, on the eastern face, at altitudes between 1000 and 1400 m (Poli Marchese 1991). This species was introduced in past years into the area of the garden where the *Quercus ilex* and broadleaved deciduous mixed wood was planted. It has spread spontaneously in the area of the nursery.

From a chorological point of view it should be pointed out that the largest percentage of species which spread spontaneously overall belong to the Steno-Mediterranean type, with 22,2%; followed by the Euroasiatics s.l., with 20,8%; the Euro-Mediterraneans, with 18%; the Cosmopolitans and the Circumboreals are present with 13,8% and 11% respectively; and finally, with less than 5%, the Paleotemperates, the Atlantics and the Mountain-Mediterraneans are represented. The Endemic type is represented by 2,7% and the adventitious species by 1% (Fig. 9). The data available show that among the species that have become spontaneous, best represented in the garden are those belonging to the basal Mediterranean belt, made up not only of Steno-Mediterranean species but also of Cosmopolitans.

The Euroasiatic s.l. species, well represented in the European continent, have also shown a great adaptability to live and spread spontaneously. These include *Thalictrum minus*, *Galium aparine*, *Rubus idaeus*, *Chelidonium majus*, *Geum urbanum*, *Epilobium angustifolium*, *Lolium perenne*, *Verbascum thapsus* and *Lathyrus sylvestris*.

Conclusions

This study clearly shows that the introduction of species and the cultivation practices in the garden have produced significant results. They have favoured the maintenance of the flora *in situ* and a notable increase in the biodiversity by means of the introduction of plant species from other areas of the Mt. Etna territory. The floristic heritage of spontaneously spreading species represents about 29% of the plants living in the garden, in which the species richness, therefore, has tripled since 1986. This increase can be considered of a certain importance given that it represents conservation of Mt. Etna flora *ex situ* in an area situated almost at the upper altitudinal limit of the forest, that is in environmental conditions not always favourable to species from other altitudes. The garden can, therefore, be considered to play an important role not only in the conservation of the Mt. Etna flora both *in situ* and *ex situ*, but also as a centre for conservation and, where possible, the spreading of biodiversity (Garbari 1990; Garbari & Raimondo 1990).

It is hoped that these results can be maintained in the future and that work can be continued in the garden to increase the plant biodiversity of species belonging to the Mt.

Etna territory, contributing, in this way, as in other botanic gardens (Garbari 1986, 1996; Del Prete 1996) to the conservation of a highly significant genetic heritage.

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