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A survey on conservation status of *Petagnaea gussonei* (Apiaceae), an endemic species to Nebrodi Mountains (Sicily, Italy)

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Riassunto. *Petagnaea gussonei* (Sprengel) Rauschert (Apiaceae) è una specie endemica dei Monti Nebrodi (Sicilia) inclusa in diverse liste di piante da proteggere. Al fine di fornire informazioni sul suo stato di conservazione, sono stati calcolati gli indici di antropizzazione, analizzata la qualità delle acque e determinata la fauna di macroinvertebrati nell'area in cui la specie vive. I risultati ottenuti confermano che *P. gussonei* vive in habitat particolarmente vulnerabili che richiedono interventi di conservazione.

Abstract. *Petagnaea gussonei* (Sprengel) Rauschert (Apiaceae) is an endemic species of Nebrodi Mountains, Sicily, Italy, included in various lists of endangered species. In order to provide information on its conservation status, a field investigation aimed to evaluate the index of anthropisation, quality water and biological communities was carried out in the area where the species lives. Results of the investigation confirm that *P. gussonei* lives in a rather vulnerable area that needs protection action.

Key words: Conservation, Endangered species, Italy, *Petagnaea gussonei*, Sicily

Introduction

Petagnaea gussonei (Sprengel) Rauschert (= *Petagnia saniculifolia* Guss.) is a perennial herbaceous species belonging to a monospecific genus of Apiaceae (Pimenov & Leonov 1993) (Fig. 1). *P. gussonei* is endemic to Nebrodi Mountains in Sicily, Italy, where it lives in restricted areas near rivulets. The plants usually reproduce asexually through stolons rising as horizontal branches from the base of plants and generating new plants from buds at their tips. Such a reproductive mechanism allows the plants to colonize wet edges of rivulets. The number of individuals and populations is correlated with amount of water. The plants typically grow on the lower edge of moisture-loving vegetation belts bordering shaded woodland mountain rivulets or small streams not drying out in the summer; water soaked substrate and calm water stream are required by the plants (Brullo *et al*. 1976).

P. gussonei is listed in Appendix I of Bern Convention (ratified by Italy in 1997) and in Appendix II of Habitats Directive 92/43/EEC. It is also included in several regional Red-Lists of species deserving special protection (Conti *et al.* 1992, 1997).

Information on conservation status of *P. gussonei* is available for some populations (De Castro *et al.* 2007; Gianguzzi *et al.* 2004). With the present study we carried out a field investigation on further populations of *P. gussonei* in order to provide additional informa-

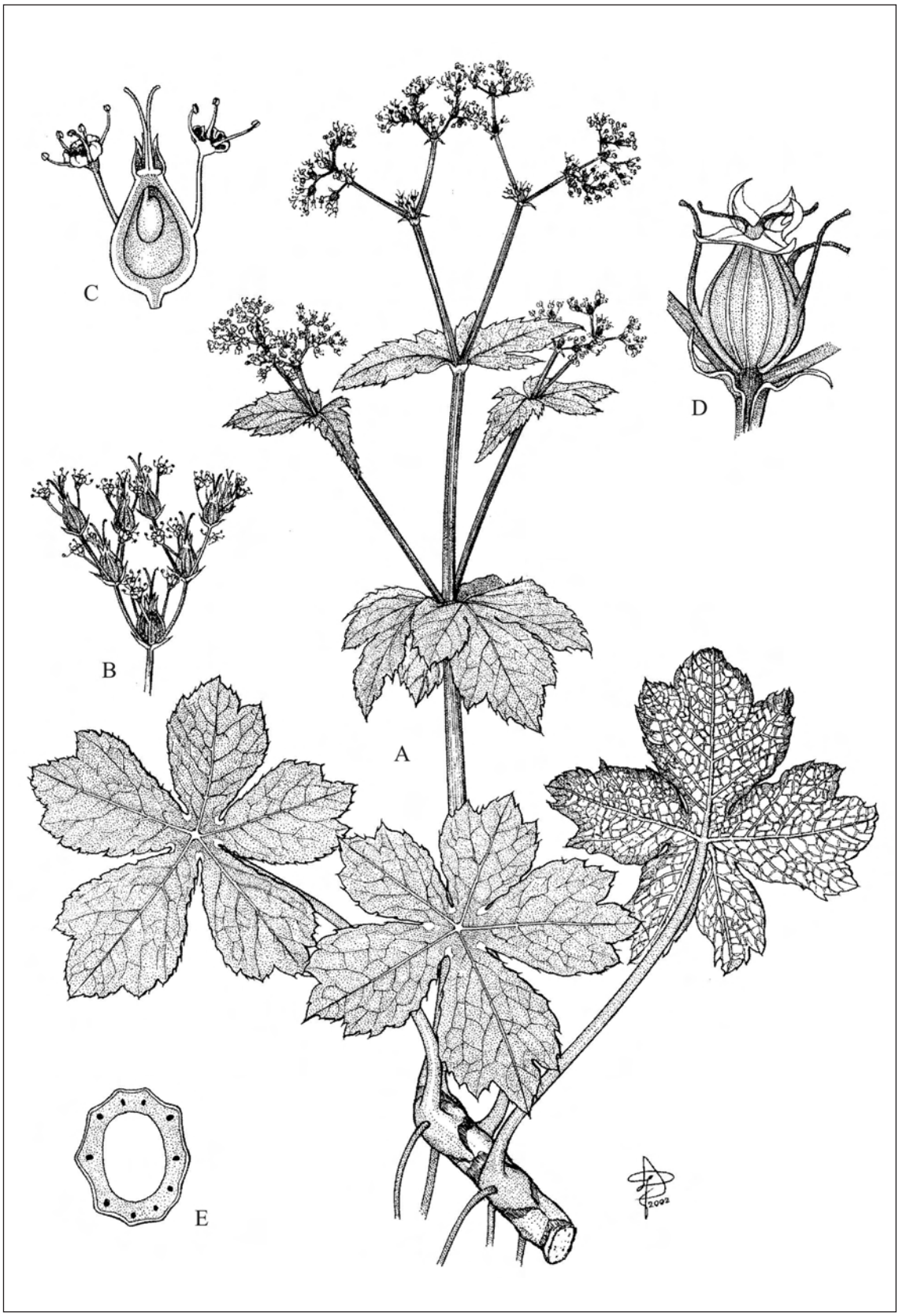


Fig. 1 - Iconography of *Petagnaea gussonei*. **A**. Habitus (x 0.8); **B**. Umbel (x 0.48); **C**. Umbellula (x 1.6); **D**. Fruit (x 4); **E**. Stem section (x 8). (After GIANGUZZI *et al*. 2004).

tion on the conservation status of the species. With this aim, analyses of land use, quality water and biological communities were performed.

Methodology

Study area. Geographical and ecological features as well as the protection status of sites investigated are summarised in Table 1.

Nebrodi Mountains are the central sector of the orographical chain extending along the northern and central Sicily as natural extension of Apennine Ridge. Nebrodi are part of the National Park of Nebrodi, instituted in 1993, that includes some populations of *P. gussonei* (Fig. 2).

The area of *P. gussonei* covers a territory of approximately 400 km^2, extending between Trearie Mount (east) and Lake Biviere di Cesarò (west), with a maximum concentration of populations in the basin of the rivers Zappulla and Rosmarino, on the Tyrrhenian side, and Flascio, in the inner side. Populations are distributed between 240 and 1400 m. Soils are hydromorphic, prevalently on flysch (Lentini *et al.* 2000). The following three climatic bands are reported by Gianguzzi *et al.* (2004) for the area where *P. gussonei* occurs (Table 1): a thermomediterranean band in the Valley floor (Tyrrhenian side), with lower sub-humid ombrotype, temperature ranging from 6.5 to 17 °C and precipitations 600-800 mm; a mesomediterranean band in hilly area and between 900 and 1100 m, with high sub-humid ombrotype, temperature 13-16 °C and precipitations 800-1000 mm in hilly zone and > 1000 mm in sub-mountain zone; a supramediterranean band in sub-mountain and mountain area over 1350 m with variable ombrotype between sub-humid and humid zone, temperature 8-13 °C and precipitations 800-1000 mm in sub-mountain zone and > 1000 mm in mountain zone.

The area is dominated by deciduous forests with *Quercus virgiliana* Ten., *Q. cerris* L. and *Fagus sylvatica* L., often replaced by kernels and chestnuts as dominant elements of the agricultural landscape. *P. gussonei* vegetation is referable to *Petagnaeetum gussonei* Brullo et Grillo (Brullo & Grillo 1978) [*Mycelido-Stachidion sylvaticae* Passarge (1967) 1979, *Circaeo-Stachydetalia sylvaticae* Passarge 1967, *Galio-Urticetea* Passarge former Kopecky 1969], a complex coenosis (herbaceous, orophilous, sciophilous, and acidophilus) located in undergrowth together with other rare Sicilian species, such as *Carex remota* L., *Rhynchocorys elephas* (L.) Griseb., *Petasites hybridus* L., *Athyrium filix-foemina* (L.) Roth, *Circaea lutetiana* L., *Heracleum pyrenaicum* Lam. subsp. *cordatum* (Presl) Pedr. et Pign., *Lysimachia nemorum* L., and others (Gianguzzi & La Mantia 2004).

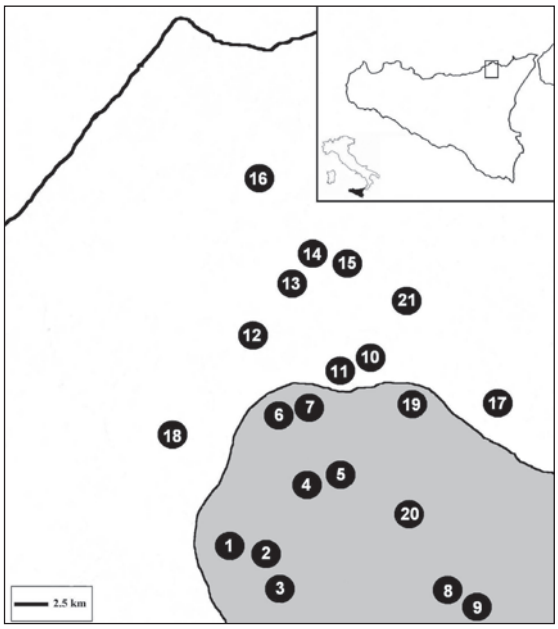


Fig. 2 – Map of distribution of *Petagnaea gussonei* populations studied in Sicily, Italy. Numbers indicate population sites as listed in Table 1. Grey area indicates the territory included in the National Park of Nebrodi.

Land use analysis. 21 sites were investigated (Table 1 and Fig. 2). The land use data were established by means of anthropisation index (Ia) obtained from CORINE (COoRdination of Information on Environment) Land Cover database (Krynitz 2000). The index was already positively applied to some *P. gussonei* populations by De Castro *et al.* (2007). CORINE category for land use was retrieved for 1 km radius area, around each sampling site, using 1:10000 vegetational cartographic data published in Gianguzzi *et al.* (2004,

2008). The index was calculated as Ia = $\Sigma k_i p_i$, where k_i is the specific coefficient for each CORINE land use category and p_i is the relative frequency of each category. The *k* values were attributed to different categories as follows: 1 - natural woods (with *F. sylvatica*, *Q. cerris*, *Q. virgiliana* (Ten.) Ten., *Ostrya carpinifolia* Scop.); 2 - meadows and shrubbery; 3 - agricultural areas (hazel, olive, orange groves, and reforestation species); 4 - urban areas (including road system). The index ranges from 1 (minimum change in land use) to 4 (maximum change in land use for human dominated systems).

Quality water analysis. From Autumn 2005 to Autumn 2008, eleven out of 21 sites investigated for the land use were chosen to monitor the water quality. The following sites were chosen for this analysis: 1, 3, 6, 8, 9, 10, 12, 13, 14, 16, and 17 (see Table 1). The crustacean *Daphnia magna* was used for a test aiming to measure pollutants. *D. magna* is extensively used for tests related to aquatic toxicology for its small size, short life cycle and amenability to lab culture. The test was performed according to the International Organization for Standardization (ISO 6341, 1989) and to De Castro *et al.* (2007).

Biological communities analysis. From Autumn 2005 to Autumn 2008, the same eleven sites investigated for the quality water were monitored for their biological communities. For this purpose, an analysis of macro-invertebrates assessment was performed (Table 2). A previous similar analysis resulted to be indicative showing that specific macro-invertebrate can be utilized as bioindicators being sensitive to altered or not altered waters (Brown *et al.* 1997). Sampling of macro-invertebrates was carried out according to the procedure described by De Castro *et al.* (2007). Macro-invertebrates collected material was placed in plastic containers and fixed with ethanol (70%). Taxonomic classification was performed by using identification keys (Sansoni 1988; Campaioli *et al.* 1994).

Results and Discussion

CORINE categories and Ia values obtained from the land use analysis are summarised in Table 1 and Fig. 3, respectively. Values of the Ia range from 1.27 (site 2) to 3 (site 16), with a mean value of 2.26 (Table 1). Data are indicative of a low occurrence of native forest formations, except for mountain stations of the National Park of Nebrodi (Table 1 and Fig. 3). These stations correspond to the following sites: site 2, with *Q. cerris* or *F. sylvatica* (75%); site 4, with a dominance of *Q. cerris* (60%); site 5, with *Q. cerris* (45%). In the other sites, a high percentage of grasslands and shrubberies occur, as for example in the sites 8, 9 and 20 (Table 1 and Fig. 3). Also, agricultural areas are very considerable with hazel and chestnut groves (sites 10, 13, 14, 15, 17, 19, and 21) (Table 1 and Fig. 3). In the latter sites, *P. gussonei* grows on the borders of the rivulets inside hazel groves. However, the species is much sensitive to the anthropic impact; in fact, populations have the tendency to become less frequent, as for example in the site 10 (Table 1), where the rivulet is partially enclosed in the urban centre; in this site, a high index was reported, corresponding to 2.86 with 88% of agricultural areas and 15% only of natural woods forests formed by *Salix alba* L., *Populus nigra* L. and *Q. virgiliana* (Ten.) Ten. (Table 1 and Fig. 3).

Results obtained by mean of *Daphnia* bioassay indicate that waters are not toxic, toxicological values for each site being not significant (TU < 0.001).

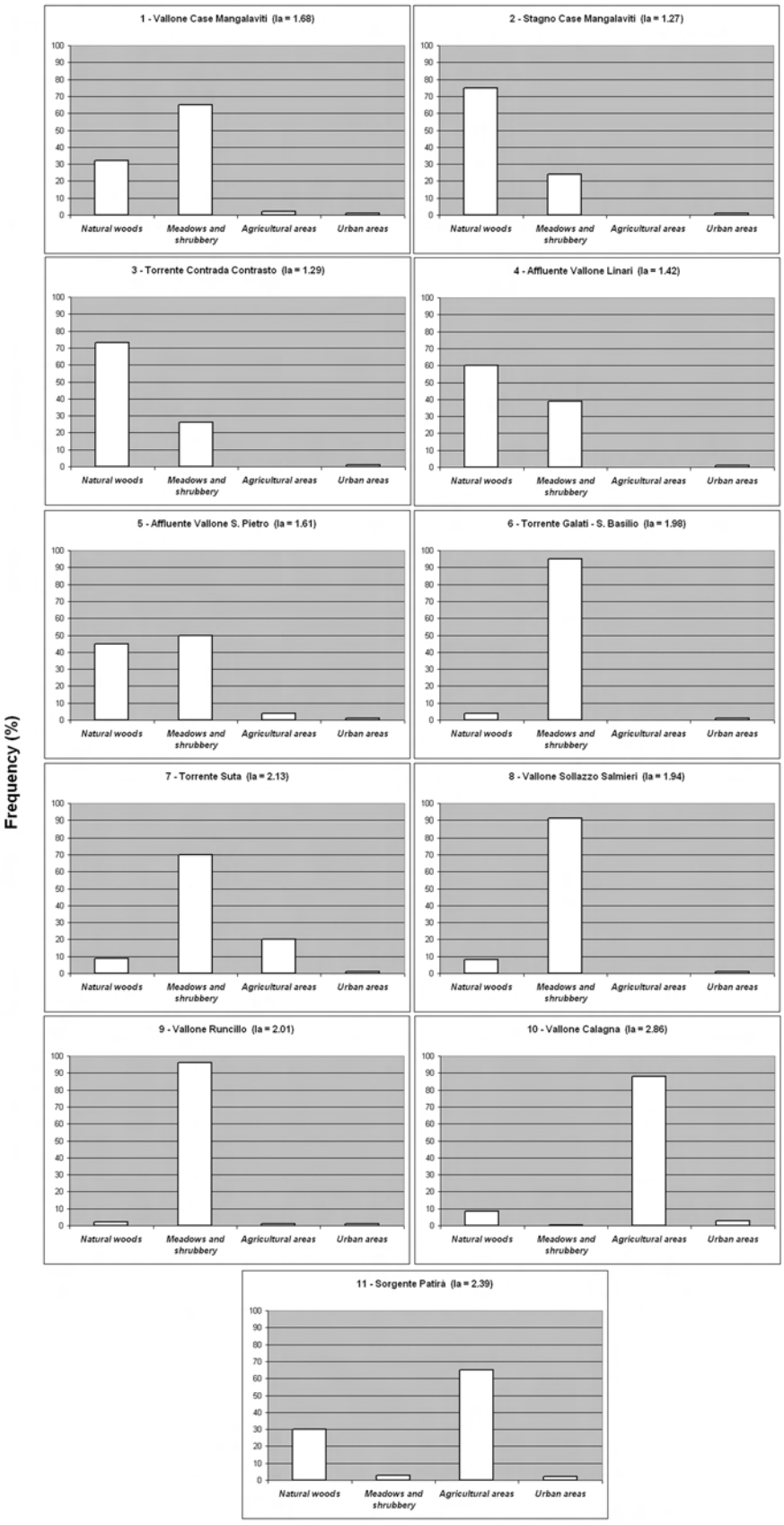
The analysis of macro-invertebrates communities (Tables 2) show the occurrence of taxa belonging to Coleoptera, Diptera, Lumbricidae and Odonati, which are typical of habitats with organic contamination (Brown *et al.* 1997). For example, occurrence of grubs of Syrphidae (Diptera) constitute the characteristic fauna of septic tanks and sewages. Instead, several sites have structured community for the presence of different specimens typical of well oxygenized and unpolluted environments (i.e., Ephemeroptera and Plecoptera). On this basis, the following pollution values for each site are possible to deduce:

- Environment not polluted or however not altered in notable way (sites 1, 6, 8, 13, 14).
- Environment with moderate symptom of pollution (site 3).
- Environment polluted or however altered

Table 1 - Geographical and ecological features, and anthropisation Index (Ia) of *Petagnaea gussonei* investigated sites.

Code	Site	Municipality	Altitude (m) Slope - Exposure	Climatic belt **	Protection status ***	Ia
1*	Vallone Case Mangalaviti	Longi	1040-1260 1-20° - W	Supramediterranean (lower-damp)	Area A of Nebrodi Park SIC 030038 SPA 030043	1.68
2	Stagno Case Mangalaviti	Longi	1295-1305 0-2° - W	Supramediterranean (lower-damp)	Area A of Nebrodi Park SIC 030038 SPA 030043	1.27
3*	Torrente Contrada Contrasto	Longi	1220-1360 1-20° - NW	Supramediterranean (lower-damp)	Area A of Nebrodi Park SIC 030038 SPA 030043	1.29
4	Affluente Vallone Linari	Galati Mamertino	1045-1200 1-10° - NE	Supramediterranean (lower-damp)	Area B of Nebrodi Park SPA 030043	1.42
5	Affluente Vallone S. Pietro	Galati Mamertino	1040-1050 1-5° - N	Supramediterranean (lower-damp)	Area B of Nebrodi Park SPA 030043	1.61
6*	Torrente Galati - S. Basilio	Galati Mamertino	920-930 1-8° - W	Supramediterranean (lower-damp)	Area B of Nebrodi Park SIC 030002 SPA 030043	1.98
7	Torrente Suta	Galati Mamertino	890-930 1-3° - NW	Supramediterranean (lower-damp)	Area B of Nebrodi Park SIC 030002 SPA 030043	2.13
8	Vallone Sollazzo Salmieri	Tortorici	1230-1400 1-6° - NE	Mesomediterranean (lower-damp)	Area A of Nebrodi Park SIC 070007 SPA 030043	1.94
9	Vallone Runcillo	Tortorici	1230-1400 1-6° - NE	Mesomediterranean (lower-damp)	Area A of Nebrodi Park SIC 070007 SPA 030043	2.01
10*	Vallone Calagna	Tortorici	490-660 1-6° - N	Mesomediterranean (lower-damp)	RNO SIC 030002 SPA 030043	2.86
11	Sorgente Patirà	Tortorici	660-790 1-6° - NE	Mesomediterranean (lower-damp)	SIC 030002 SPA 030043	2.39
12*	Torrente Fiumetto	Galati Mamertino	500-700 1-6° - E	Mesomediterranean (lower-damp)	SIC 030002 SPA 030043	2.71
13	Fiumara Tortorici (affluent 1)	S. Salvatore di Fitalia	250-540 3-9° - NE	Mesomediterranean (higher-subdamp)	None	2.86
14	Fiumara Tortorici (affluent 2)	S. Salvatore di Fitalia	250-540 3-9° - E	Mesomediterranean (higher-subdamp)	None	2.82
15	Fiumara Tortorici (affluent 3)	S. Salvatore di Fitalia	250-540 3-9° - NE	Mesomediterranean (higher-subdamp)	None	2.86
16*	Castell'Umberto	Castell'Umberto	600 15° - NW	Mesomediterranean (higher-subdamp)	None	3
17*	Torrente Monte Cuculone	Ucria	820-860 5-15° - N	Mesomediterranean (lower-damp)	None	2.77
18	Torrente Crocetta	Longi	730-850 5-10° - E	Mesomediterranean (lower-damp)	None	2.14
19	Torrente Potame	Tortorici	700-710 5-8° - NW	Mesomediterranean (lower-damp)	None	2.91
20	Vallone Arcangelo	Galati Mamertino	1150-1250 5-8° - NW	Supramediterranean (lower-damp)	Area A of Nebrodi Park SIC 030038 SPA 030043	1.77
21	Torrente S. Biagio	S. Salvatore di Fitalia	435-460 5-8° - NW	Mesomediterranean (higher-subdamp)	None	2.96

* Sites also analysed by De Castro *et al.* (2007)
** After Gianguzzi *et al.* (2004)
*** Area A: Integral Reserve; Area B: General Reserve; RNO: Natural Reserve; SIC: Communitarian Importance Area; SPA: Special Protection Area


1 - Vallone Case Mangalaviti (Ia = 1.68)
2 - Stagno Case Mangalaviti (Ia = 1.27)
3 - Torrente Contrada Contrasto (Ia = 1.29)
4 - Affluente Vallone Linari (Ia = 1.42)
5 - Affluente Vallone S. Pietro (Ia = 1.61)
6 - Torrente Galati - S. Basilio (Ia = 1.98)
7 - Torrente Suta (Ia = 2.13)
8 - Vallone Sollazzo Salmieri (Ia = 1.94)
9 - Vallone Runcillo (Ia = 2.01)
10 - Vallone Calagna (Ia = 2.86)
11 - Sorgente Patirà (Ia = 2.39)
Natural woods
Meadows and shrubbery
Agricultural areas
Urban areas
Frequency (%)
CORINE land use categories

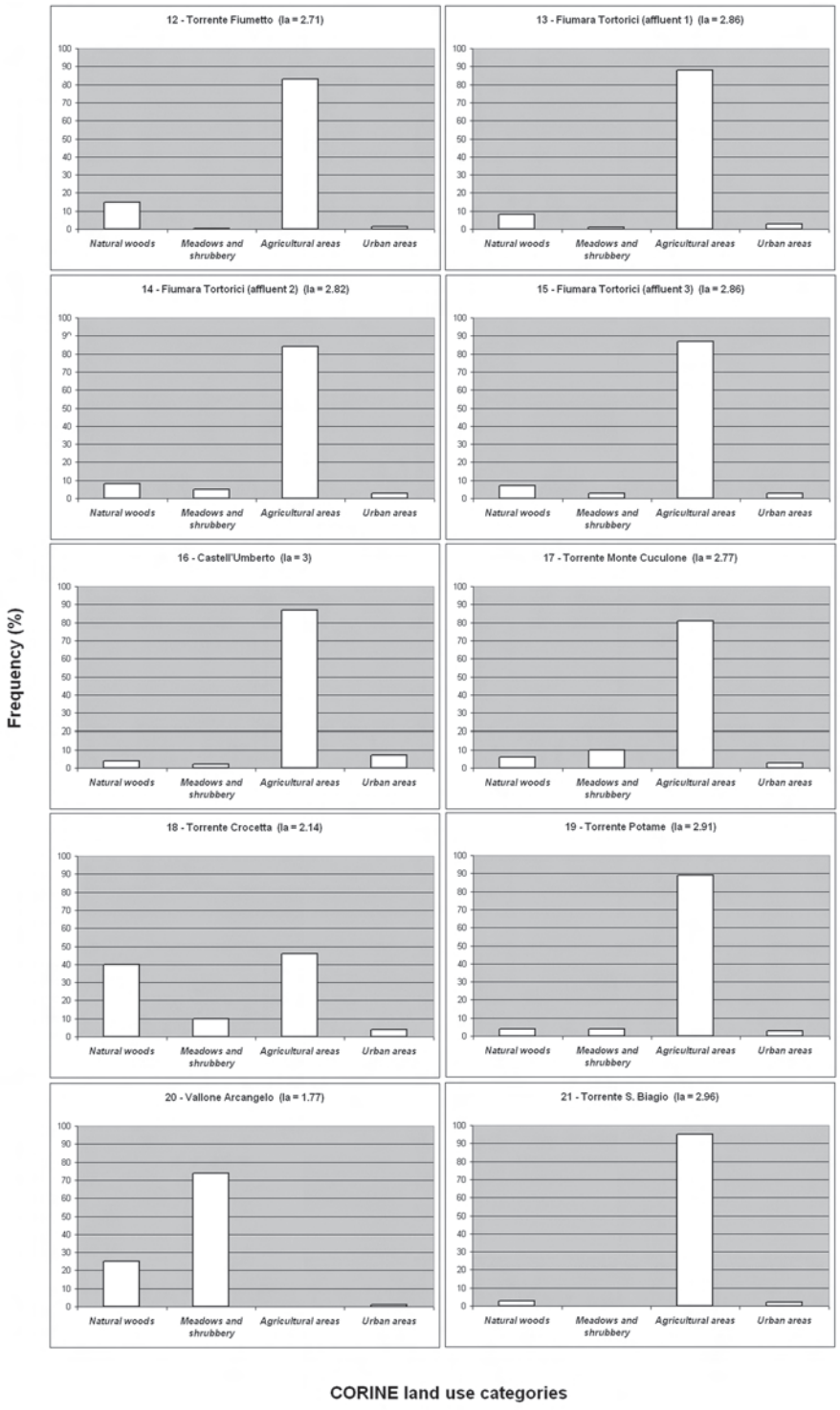


Fig. 3 – Frequency of CORINE land use categories and index of anthropisation (Ia) values of 21 investigated sites.

(site 3, 9, 10, 12, 16, 17).

By comparing indexes of anthropisation with data obtained for macro-invertebrates in each site, a positive correlation appears (except for sites 10, 12 and 16). If the test of the *Daphnia* bioassay is negative for the examined rivulets (i.e., no macro-pollutant), the results obtained for macro-invertebrates might be interpreted as a potential sign of danger.

Overall data show that *P. gussonei* grows in

Table 2 - Occurrence of macro-invertebrates taxa in the examined sites.

	Sites										
	1	3	6	8	9	10	12	13	14	16	17
Anellida											
Hirudinea											
Limnatis sp.	X							X			
Oligochaeta											
Lumbricidae										X	X
Artropoda											
Coleoptera											
Elminthidae						X	X				
Helodidae		X									
Diptera											
Cordyluridae				X						X	
Ceratopogonidae										X	
Chironomus sp.			X			X	X				X
Dixidae		X			X					X	
Syrphidae					X						
Tabanidae		X					X				
Ephemeroptera											
Baetis sp.	X	X	X								X
Electrogena sp.	X		X								
Odonati											
Tarnetrum sp.				X							
Plecoptera											
Capnia sp.	X	X	X					X	X		
Xantoperla sp.								X	X		
Trichoptera											
Hydropsychidae											X
Philopotamidae			X						X		
Gastropoda											
Ancylus sp.	X							X	X		

a very vulnerable habitat, confirming what already reported (De Castro *et al.* 2007). A lot of previously known stations (Gussone 1827; Lojacono Pojero 1891) have not been confirmed lately (Gianguzzi *et al.* 2004). Damages to *P. gussonei* habitat are due to the picking up of the rivulets and water tables for civil and agriculture use, as well as to herbicides employed for hazel groves (Gianguzzi 2002). Additional damages are caused by the construction of new roads, deforestations, reforestations by using exotic plants, unauthorized dumps, fires, and so on.

Thus, conservation status of *P. gussonei* in the area of the Nebrodi Mountains appears rather vulnerable. It is to be hoped that preventive actions, such as canalizations, septic unit installations, and other similar interventions, be carried out for all the sites resulted polluted. In order to limit imminent risks for this interesting Sicilian endemism, it would be also opportune submitting the various stations to more careful tutelage actions; for example, including inside protected areas of the National Park of Nebrodi the sites today outside the Park (sites 13, 14, 15, 16, and 17) (Table 1).

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Literature Cited

Brown A.V., Aguila Y., Brown K.B., Fowler W.P. 1997. Responses of benthic macroinvertebrates in small intermittent streams to silvicultural practices. Hydrobiologia 347: 119-125.

Brullo S., Grillo M. 1978. Ricerche fitosociologiche sui pascoli dei Monti Nebrodi (Sicilia settentrionale). Notiziario Fitosociologico 13: 26-61.

Brullo S., Grillo M., Guglielmo A. 1976. Osservazioni ecologiche preliminari su *Petagnia saniculifolia* Guss., raro endemismo siculo. Giornale Botanico Italiano 110 (4-5): 293-296.

Campaioli S., Ghetti P.F., Minelli A., Ruffo S. 1994. Manuale per il riconoscimento dei macroinvertebrati delle acque dolci italiane. Provincia Autonoma di Trento.

Conti F., Manzi A., Pedrotti F. 1992. Libro Rosso delle Piante Italiane. TIPAR, Roma.

Conti F., Manzi A., Pedrotti F. 1997. Liste Rosse Regionali delle Piante d'Italia. TIPAR, Roma.

De Castro O., Gianguzzi L., Colombo P., De Luca P., Marino G., Guida M. 2007. Multivariate analysis of sites using water invertebrates and land use as indicators of the quality of biotopes of Mediterranean relic plant (*Petagnaea gussonei*, Apiaceae). Environmental Bioindicators 2 (3): 161-171.

Gianguzzi L. 2002. Osservazioni sulla conservazione in situ di *Petagnaea gussonei* (Spreng.) Rauschert, paleoendemita esclusiva dei Monti Nebrodi (Sicilia nord-orientale). Informatore Botanico Italiano 34: 63-69.

Gianguzzi L., La Mantia A. 2004. Osservazioni fitosociologiche, sinecologiche e sincorologiche sulla vegetazione relittuale a *Petagnaea gussonei* (Galio-Urticetea) nell'area dei Monti Nebrodi (Sicilia nord-orientale). Fitosociologia 41 (1): 165-180.

Gianguzzi L., La Mantia A., Lo Presti R.M. 2004. Distribuzione, ecologia e status conservativo di *Petagnaea gussonei* (Sprengel) Rauschert (Apiaceae). Naturalista Siciliano 19 (1) (Suppl. 4): 205-242.

Gianguzzi L., D'Amico A., Bontempo R., Migliore S. 2008. Nuovi dati distributivi su *Petagnaea gussonei* (Sprengel) Rauschert, paleoendemita dei Monti Nebrodi (Sicilia nord-orientale). Atti del 37° Congresso Nazionale Italiano di Biogeografia. Catania, 7-10 ottobre, 2008.

Gussone G. 1827. Florae Siculae Prodromus sive plantarum in Siciliae ulteriori nascentium enumeratio secundum systema Linneanum disposita. I suppl. Ex Regia Typographia, Napoli.

Krynitz M. 2000. Land Cover. Annual Topic Update 1999. European Environment Agency. Copenhagen.

Lentini F., Catalano S., Carbone S. 2000. Carta geologica della Provincia di Messina (Sicilia nord-orientale), scala 1:50000. Provincia Regionale di Messina, S. El. Ca., Firenze.

Lojacono Pojero M. 1891. Flora sicula. I. Tip. Virzì, Palermo.

Pimenov M.G., Leonov M.V. 1993. The genera of the Umbelliferae. Royal Botanic Gardens, Kew, London.

Sansoni G. 1988. Atlante per il riconoscimento dei macroinvertebrati dei corsi d'acqua italiani. Servizio Protezione Ambiente. Trento.

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