ISSN 2280-1855

PLANT SOCIOLOGY

formerly FITOSOCIOLOGIA

Volume 49 (2) - December 2012

RIVISTA SEMESTRALE - POSTE ITALIANE S.P.A. - SPED. ABB. POST - D.L. 353/2003 - (CONV. IN L. 27/02/2004 N. 46) ART. 1, COMMA 2, DCB ANCONA | TASSA RISCOSSA - TAXE PERÇUE - CMPP AN |
EDITO DALLA SOCIETÀ ITALIANA DI SCIENZA DELLA VETEGAZIONE ONLUS - PAVIA - DIRETTORE RESPONSABILE PROF. E. BIONDI - VOLUME 2 - II° SEMESTRE 2012

Journal of the Italian Society for Vegetation Science

Plant Sociology, Vol. 49, No. 2, December 2012, pp. 3-28
DOI 10.7338/pls2012492/01

PLANT SOCIOLOGY
©Italian Society for Vegetation Science

Phytosociological characterization of the *Juniperus phoenicea* L. subsp. *turbinata* (Guss.) Nyman formations in the Italo-Tyrrhenian Province (Mediterranean Region)

L. Gianguzzi, V. Ilardi, O. Caldarella, D. Cusimano, P. Cuttonaro, S. Romano
Department of Environmental Biology and Biodiversity, University of Palermo, Via Archirafi 38 - I-90123 Palermo. Italy.

Abstract
The *Juniperus phoenicea* subsp. *turbinata* formations of the Italo-Tyrrhenian biogeographical province (Mediterranean Region), are analyzed on the basis of literature data and unpublished relevés. The floristic-synecological characterization of the identified phytocoenoses, confirmed by multivariate analysis on a synoptic basis, has allowed their breakdown in four different alliances of the order *Pistacio lentisci-Rhamnetalia alaterni*: 1) *Periplocion angustifoliae*, with the association *Periploco angustifoliae-Juniperetum turbinatae*; 2) *Juniperion turbinatae*, with the associations *Junipero turbinatae-Quercetum calliprini, Rusco aculeati-Quercetum calliprini, Phillyreo angustifoliae-Juniperetum turbinatae, Asparago albi-Juniperetum turbinatae, Asparago acutifolii-Juniperetum macrocarpae* subass. *juniperetosum turbinatae*; 3) *Oleo sylvestris-Ceratonion siliquae*, with the associations *Oleo sylvestris-Juniperetum turbinatae, Chamaeropo humilis-Juniperetum turbinatae, Euphorbio characiae-Juniperetum turbinatae, Teucrio fruticantis-Juniperetum turbinatae, Calicotomo infestae-Juniperetum turbinatae* and *Ampelodesmo mauritanici-Juniperetum turbinatae*; 4) *Ericion arboreae*, with the only association *Erico arboreae-Juniperetum turbinatae*. The following new syntaxa are also described: a) *Oleo sylvestris-Juniperetum turbinatae loniceretosum implexae* subass. nova (various coastal localities of Corsica); b) *Calicotomo infestae-Juniperetum turbinatae typicum* (southern and western coasts of Sicily) and *phlomidetosum fruticosae* subass. nova (coasts of southern Calabria); c) *Ampelodesmo mauritanici-Juniperetum turbinatae* ass. nova, in turn diversified in the *myrtetosum communis* subass. nova (Calabrian-Lucanian coastal belt, at Maratea, and Sorrentine-Amalfitana Peninsula, in Campania) and *cistetosum cretici* subass. nova (located in the hinterland of Sicily, on Sicani Mountains).

Keywords: Habitat Directive 92/43/EEC; *Juniperus phoenicea* subsp. *turbinata*; Mediterranean Region; Multivariate analysis; Phytosociology; *Quercetea ilicis*.

Introduction

With regard to nomenclatural aspects, *Juniperus phoenicea* L. subsp. *turbinata* (Guss.) Nyman has a somewhat controversial and debated position. Some authors consider it a separate species (*Juniperus turbinata* Guss.) from *J. phoenicea* s.s. [syn: *J. phoenicea* L. subsp. *lycia* auct.; *J. lycia* auct. non L.; *J. oophora* G. Kunze], on the basis of phytochemical, morphological and biogeographical surveys (Lebreton & Thivend, 1981; Lebreton, 1983; Lebreton & Rivera, 1988; Lebreton & Pérez de Paz, 2001). In more recent contributions, other authors do not confirm the taxonomical rank of species (Adams *et al*., 2002; Farjon, 2005; Boratyński *et al*., 2009; Mazur *et al*., 2010; Dzialuk *et al*., 2011).

Juniperus phoenicea subsp. *turbinata* has a circummediterranean distribution (Franco do Amaral, 1986, 1993; De Marco *et al*., 1989; Caneva *et al*., 2004; Asensi *et al*., 2007; Mazur *et al*., 2010), with marginal digitations to east (Asia Minor, Lebanon, Jordan and Arabian Peninsula) and to west, where goes up to the northern coasts of the Iberian Peninsula, as well as to the central-western Canary Islands and Madeira (Rivas-Martínez *et al*., 1993); these latter populations were previously described as *J. turbinata* subsp. *canariensis* (Guyot) Rivas-Martínez, Wildpret & Pérez de Paz, taxon subsequently placed in synonymy with the subspecies at issue (Farjon, 2005).

In the Italo-Tyrrhenian Province (Rivas-Martínez *et al*., 2002, 2004, 2011), *Juniperus phoenicea* subsp. *turbinata* is quite well represented, although with a fragmentary distribution. It affects the entire western coastal area of the Italian Peninsula up to the southern part of Calabria, including several Tyrrhenian islands; it is also present in the southern and western part of Sicily, in Pantelleria, Linosa and Lampedusa islands, as well as in Sardinia and Corsica.

The species tends to characterize microwoods and maquis aspects with an edapho-xerophilous character, predominantly tied to rocky outcrops of various geolithological kinds (limestones, calcarenites, volcanites, granites, etc.), in subrupicolous stations with a very high tilt (up to 70-80 %); however, sometimes these juniper formations are also dominant on dunes, as in the southern part of Sardinia, for example at Chia (Bacchetta *in verbis*). More rarely the entity plays also a gregarious role, as in the case of the juniper formations of dune sandy areas and paleodunes dominated by *Juniperus macrocarpa*. Under the bioclimatic aspect, such formations find the optimum between the infra- and thermomediterranean

Corresponding author: Lorenzo Gianguzzi. *Department of Environmental Biology and Biodiversity, University of Palermo, Via Archirafi 38 - I-90123 Palermo; Italy; e-mail: lorenzo.gianguzzi@unipa.it*

bioclimatic belts with dry-semiarid ombrotype, with marginal penetrations in the mesomediterranean-lower subhumid, as it occurs for example in Sardinia (Bacchetta *et al.*, 2009, 2010); in this island they tend sometimes to go up to hilly and sub-mountain areas, as it takes place for example in the Sulcis (Camarda *et al.*, 1995; Mossa *et al.*, 1996; Bacchetta, 2006). However, in Sardinia the entity usually does not go over an altitude of 300 metres, located in stations close to the sea with an oceanic climate, in contrast with *J. phoenicea* subsp. *phoenicea*, typical of mountain stations with a continental climate (Bacchetta *in verbis*).

With regard to the same juniper formations of central-southern Apennines and Sicily, it is likely that they were part of the thermo-xerophilous sclerophyllous scrub aspects of the Tertiary Period which, as a result of glacial events, were irreversibly undermined from the inner primary sites by the new and more invasive microthermal coenoses with a prevalence of mitteleuropean species (Pignatti, 1994; Giacomini, 1958), and relegated in more xeric and sheltered environments of the coast. This is the case of a population of *Juniperus phoenicea* subsp. *turbinata* recently discovered in the hinterland of Sicily, isolated on Sicani Mountains along the gorges of the Sosio River, and just interpreted as a residual station (Gianguzzi *et al.*, 2007). The phytosociological study of this vegetation, here confined in a particularly isolated and intact habitat (rocky needles and calcareous scree slopes), placed at a considerable distance from the southern coast, has raised the problem of its syntaxonomical characterization, in relation to analogous communities so far known for the coastline. This has inspired the present work, that reviews the *Juniperus phoenicea* subsp. *turbinata* formations of the entire Italo-Tyrrhenian Province, on the basis of the critical analysis of bibliographic data and unpublished relevés, characterizing their floristic-structural, synecological and distributive aspects. They are maquis formations of particular phytogeographical interest, quite vulnerable and threatened, and just included among the habitat natural types of community interest of the known Directive 92/43/EEC ("2250*: Coastal dunes with *Juniperus* spp."; "5210: Arborescent matorral with *Juniperus* spp.")

Material and Methods

In order to rebuild an updated synoptic framework of the *Juniperus phoenicea* subsp. *turbinata* formations for the biogeographical area in question, literature data have been analyzed (for a total of 285 relevés, carried out during the last forty years); the complete list of references and their sources are reported in Tab. 1. To these data, other unpublished tables (Tab. 3 and 7) relative to field relevés performed in the regional area have been added, of which four in Linosa Island (Channel of Sicily) and nine in the Sosio Valley (Sicani Mts.). Additional general data of a general nature for the entire surveyed territory have been also derived from the works of Biondi (1999), Brullo *et al.* (2001) and Blasi (2010).

The analysis of the vegetation was carried out according to the phytosociological method of the Zurich-Montpellier Sigmatist School (Braun-Blanquet, 1964), updated on the basis of the latest acquisitions (Biondi, 1994, 2011; Biondi *et al.*, 2004, 2011; Blasi *et al.*, 2000; Géhu & Rivas-Martínez, 1981; Rivas-Martínez, 2005; etc.). The biogeographical and bioclimatic characterization, used in the description of the syntaxa and of the vegetation series, follows Rivas-Martínez *et al.* (2001a, b, 2011) and Blasi *et al.* (2010). For the taxonomic nomenclature, the recent checklists of Conti *et al.* (2005, 2007) and Giardina *et al.* (2007) have been followed, as well as Flora iberica (Castroviejo *et al.*, 1986-2012), besides some more specific reviews cited in the bibliography. For the syntaxonomical treatment, the criteria of the International Code of Phytosociological Nomenclature (Weber *et al.*, 2000) and the scheme proposed by Rivas-Martínez *et al.* (2001c, 2002) up to the alliance level, have been followed. The floristic-synecological characterization of the identified coenoses has been moreover carried out through the critical comparison with what reported in the specialistic bibliography, quoted in the text.

For the determination of the species, reference has been made to Flora Sicula (Lojacono-Pojero, 1888-1909), Flora Analitica d'Italia (Fiori & Paoletti, 1900-1902, 1907-1908), Flora d'Italia (Pignatti, 1982) and Flora Europaea (Tutin *et al.*, 1964-80, 1993).

For the rebuilding of the synoptic framework (Tab. 2), 33 phytosociological tables have been overall considered, discriminating the various groups of "character" and "differential" species within the syntaxa of various rank, besides the most representative "companion" species. Because they are formations quite different under the floristic and synecological aspect, the hierarchical classification of the coenoses within the order *Pistacio lentisci-Rhamnetalia alaterni* – of which *Juniperus phoenicea* subsp. *turbinata* is considered as a characteristic (Rivas-Martínez *et al.*, 2002: 544) – has been validated through cluster analysis (UPGMA), based on Euclidean distance measurements, performed by Syntax 2000 (Podani, 2001). In particular, the building of the matrix has been made taking into account only the "character" and "differential" species of the alliances *Periplocion angustifoliae, Juniperion turbinatae, Oleo sylvestris-Ceratonion siliquae* and *Ericion arboreae*, as the only

Tab. 1 - Phytosociological relevés sources already published used in this study (numbering of the syntaxa corresponds to that reported in the text).

Syntaxa	**Bibliographic reference and location of relevés**
Periplocion angustifoliae (Tab. 4)	Bartolo *et al*. (1988, Tab. 1): Channel of Sicily (Lampedusa Island)
1a) *Periploco angustifoliae-Juniperetum turbinatae* Bartolo *et al*. 1988 subass. *typicum*	
1b) subass. *brassicetosum insularis* Gianguzzi 1999	Gianguzzi (1999, Tab. 1): Channel of Sicily (Pantelleria Island at Punta del Curtigliolo)
Juniperion turbinatae (Tab. 5)	Bartolo *et al*. (1982, Tab. 32) and Brullo *et al*. (2009, Tab. 2a): southern Sicily (S. Croce di Camerina at Boschetto di Passo Marinaro)
2) *Junipero turbinatae-Quercetum calliprini* Bartolo, Brullo & Marcenò 1982	
3) *Rusco aculeati-Quercetum calliprini* Mossa 1990	Bartolo *et al*. (1992, Tab. 6, sub *Junipero-Quercetum calliprini*): south-western Sardinia (Buggeru, Portixeddu, and Porto Pino); Agostini & Sanfilippo (1970, Tab. 3, rel. 3 and 11-14, sub *Oleo-Lentiscetum*): south-western Sardinia (Porto Pino); Mossa (1990, Tab. 6): south-western Sardinia (Balle Bausu, Portixeddu, S. Nicolò and Nicolò)
4) *Phillyreo angustifoliae-Juniperetum turbinatae* Arrigoni, Nardi & Raffaelli 1985	Vagge & Biondi (1999, Tab. 9): Tuscan Archipelago (Elba Island) and coasts of Tuscany (between Punta Ala and Orbetello); Arrigoni *et al*. (1985, Tab. 34): Tuscany (Maremma Park)
5) *Asparago albi-Juniperetum turbinatae* Riv.-Mart., Biondi, Costa & Mossa 2003	Bartolo *et al*. (1989, Tab. 7, sub *Phillyreo angustifoliae- Juniperetum turbinatae*): southern Sardinia (Chia and Torre Salinas)
6) *Asparago acutifolii-Juniperetum macrocarpae* (R. & R. Molinier) O. De Bolòs 1962 subass. *juniperetosum turbinatae* Géhu & Biondi 1994	Molinier & Molinier (1955, pag. 31): northern Sardinia (Capo Testa at S. Teresa); Géhu & Biondi (1994, Tab. 61, rel.21-23): Corsica (Porto Vecchio Acciaju, rel. 21; Dune de Tallone and Diane, rel. 22; Cala de Rosa Pina, rel. 23)
Oleo-Ceratonion siliquae (Tab. 6)	Caneva *et al*. (1981, Tab. 11): south-western Sardinia (S. Antioco Island); De Marco *et al*. (1989, Tab. 11): central-eastern Sardinia (Cala Gonone); Biondi & Mossa (1992, Tab. 70): southern Sardinia (Cagliari on Capo S. Elia promontory); Camarda *et al*. (1995, Tab. 9, rel. 53, sub *Oleo Euphorbietum dendroidis* Trinajstic 1973): south-western Sardinia (Sulcis-Iglesiente); Mossa *et al*. (2000, Tab. 11): south-eastern Sardinia (Capo Carbonara Reserve); Biondi & Bagella (2005, Tab. 70): north-eastern Sardinia (La Maddalena Archipelago)
7) *Oleo sylvestris-Juniperetum turbinatae* Arrigoni, Bruno, De Marco & Veri 1985 *in* De Marco, Dinelli & Caneva 1985 *corr*. 1992	
7e) *loniceretosum implexae* subass. nova	Géhu & Biondi (1994, Tab. 62): southern Corsica (Propriano, Santa Giulia, Île Piana, Le Pertusato, Bonifacio, Pointe de Sperone) and northern Corsica (Cap Corse, Nonza, Marina de Barcaggio); Paradis & Tomasi (1991, Tab. 7, rel. 57): northern Corsica (Barcaggio)
8) *Chamaeropo humilis-Juniperetum turbinatae* De Marco, Dinelli & Caneva 1985 *corr*. 2001	Biondi *et al*. (2001, Tab. 56): north-western Sardinia (Nurra at Cala della barca, Capo Caccia, Cala Dragonara, Tramariglio, Porticciolo, Porto Ferro, Baratz Lake, Porto Palmas); Caneva *et al*. (1981): south-western Sardinia (S. Antioco Island)
9) *Euphorbio characiae-Juniperetum turbinatae* Biondi, Filigheddu & Farris 2001	Biondi *et al*. (2001, Tab. 55): north-western Sardinia (Nurra at Capo Falcone, Bagaglino, Stintino, Punta Negra, Argentiera-Porto Palmas, Lampiano, Asinara Island)
10) *Teucrio fruticantis-Juniperetum turbinatae* Arrigoni, Nardi & Raffaelli 1985	De Dominicis *et al*. (1988, Tab. 11): Tuscany (Punta Ala); Foggi *et al*. (2008, Tab. 19): Tuscan Archipelago (Pianosa Island)
11a) *Calicotomo infestae-Juniperetum turbinatae* Brullo, Gianguzzi, La Mantia & Siracusa 2009 *typicum*	Brullo *et al*. (2009, Tab. 3d): coasts of north-western Sicily (Alcamo Marina) and southern Sicily (Capo Bianco, Torresalsa and Cava Randello)
11b) *phlomidetosum fruticosae* subass. nova	Mercurio & Spampinato (1999, Tab. 3, sub *Oleo-Juniperetum turbinatae*) and Brullo *et al*. (2001, Tab. 11, sub *Oleo-Juniperetum turbinatae*): Calabria along the Ionian coastal belt of the Aspromonte (Condofuri Marina, in Vadicamo locality)
12a) *Ampelodesmo mauritanici-Juniperetum turbinatae* ass. nova *myrtetosum communis* subass. nova	Cancellieri (2008, Tab. 11, col. 1-3, sub *Oleo-Juniperetum turbinatae*): Campania (Sorrentine-Amalfitana Peninsula); Caneva *et al*. (2004, Tab. 1): Calabrian-Lucanian Tyrrhenian coast between Acquafredda and Capo Scalea (islets of Dino, Castrocucco and S. Nicola Arcella, cliffs of Fiuzzi and Acquafredda)
Ericion arboreae (Tab. 8)	Biondi & Bagella (2005, Tab. 71): north-eastern Sardinia (Maddalena Archipelago); Camarda *et al*. (1995, Tab. 10, rel. 63, sub *Pistacio Juniperetum oxycedri* Camarda *et al*. 1995): south-western Sardinia (Sulcis-Iglesiente); Landi *et al*. (2007, Tab. 2, sub *Erico arboreae-Juniperetum phoeniceae* De Marco *et al*. 1985): Tuscan Archipelago (Montecristo Island, at Cala Fortezza and Cala Cappel del Prete); Stanisci *et al*. (2005, Tab. 6, rel. 6-7): Ponza Island (Montagnella and Lucia Rosa); Foggi *et al*. (2006, Tab. 38, rel. 20, 1 and 4, sub *Anthyllido barbae-jovis· Juniperetum turbinatae*): Tuscan Archipelago (Elba Island at Nisporto and Enfola)
13) *Erico arboreae-Juniperetum turbinatae* De Marco, Dinelli & Caneva 1985 *corr.*	

"faithful indicators" of the ecological peculiarities of the syntaxa. All other species – characteristics of order and class, as well as the companions – have been instead excluded, inasmuch not discriminating and whose "value" could have anyhow affected the overall numerical evaluations, negatively interfering on the proper syntaxonomical attribution of the columns/associations.

Due to the unevenness of the data, to bring them back on the same scale has been considered necessary, adopting the criterion of the "weighted average". The value "16" has been therefore attributed to each "package" of species of the four alliances, equivalent to the total of the "discriminating" entities reported in Tab. 2, and moreover multiple of the number of "character" species of each alliance, respectively equal to two (*Periplocion angustifoliae*), one (*Juniperion turbinatae*), eight (*Oleo sylvestris-Ceratonion siliquae*) and four (*Ericion arboreae*). Distributing in this way the value "16" for the respective number

Tab. 2 - Simplified synoptic table – relative only to the characteristic species of the four alliances of the order *Pistacio lentisci-Rhamnetalia alaterni*, in which the *Juniperus phoenicea* subsp. *turbinata* associations were divided – by which the matrix used for the cluster analysis was derived (references in the text); for the number of columns/association and the relative bibliographic references, see Tab. 4-8, related to the respective alliances.

Table number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Relevé number	8	8	8	2	19	5	7	7	10	6	1	3	13	10	10	1	7	15	20	13	26	18	8	4	10	7	8	3	12	9	9	7	3
Association number	1a	1b	2	3	3	3	4	5	6	1	6	6	7	7	7	7	7	7e	8	8	9	10	10	10	11	11	12a	12a	12a	12b	13	13	13
Guide species																																	
Juniperus phoenicea L. subsp. turbinata (Guss.) Nyman	V	V	V	2	V	V	III	V	V	V	1	3	V	V	V	1	V	V	V	V	V	V	V	4	V	V	V	3	V	V	V	V	3
Char. alliance *Periplocion angustifoliae*																																	
Periploca laevigata Aiton subsp. angustifolia (Labill.) Markgraf	IV	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lycium intricatum Boiss.	II	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Char. alliance *Juniperion turbinatae*																																	
Juniperus macrocarpa Sm.	.		II	2	V	II	I	V	II	I	I	3	I	.	.	.	.	.	I	I	.	.	II	.	.	.	.	.	.	.	.	.	.
Char. alliance *Oleo-Ceratonion*																																	
Olea europaea L. var. sylvestris (Mill.) Lehr	V	II	IV	2	.	I	.	III	I	II	1	1	V	IV	II	1	II	V	II	V	II	I	V	2	I	IV	V	.	IV	II	.	I	.
Euphorbia dendroides L.	.	V	.	.	.	.	.	.	.	.	.	.	I	V	V	1	I	I	.	I	I	I	.	.	.	III	.	3	II	.	.	I	.
Asparagus albus L.	.	.	.	.	.	.	I	.	.	.	.	.	V	IV	II	1	IV	IV	.	IV	III	.	.	.	.	.	I	I	.	.	.	.	.
Chamaerops humilis L.	.	.	V	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	V	I	.	.	.	III	.	.	.	.	.	.	.
Teucrium fruticans L.	V	.	V	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.	III	II	.	3	.	.	.	.	.
Clematis cirrhosa L.	II	.	.	1	I	I	.	.	.	.	.	2	V	V	.	1	I	II	I	V	.	.	.	.	.	.	.	.	.	.	.	.	.
Teucrium flavum L. subsp. flavum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.	III	.	.	I	.
Ceratonia siliqua L.	II	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	I	.	.	.
Char. alliance *Ericion arboreae*																																	
Erica arborea L.	.	.	.	.	.	I	.	.	I	.	1	.	.	.	.	.	.	II	I	.	I	I	.	.	.	.	.	.	.	.	III	V	3
Myrtus communis L. subsp. communis	.	.	.	.	.	.	.	III	III	.	.	.	.	.	.	.	1	.	III	I	.	I	.	.	I	I	.	1	.	IV	IV	II	2
Arbutus unedo L.	.	.	.	.	.	I	I	.	I	.	.	2	.	.	.	II	.	.	.	I	I	.	.	.	.	.	.	.	III	III	II	I	1
Pulicaria odora (L.) Rchb.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	II	I	.	.	I	.	I	1

of characters, "16" has been attributed to "weigh" the only species of the *Juniperion turbinatae* (*Juniperus macrocarpa*), "8" to each of the two species of the *Periplocion angustifoliae* (*Periploca laevigata* subsp. *angustifolia* and *Lycium intricatum*), "4" to the four species of the *Ericion arboreae* (*Erica arborea, Arbutus unedo, Pulicaria odora* and *Myrtus communis* subsp. *communis*) and, finally, "2" to the eight species of the *Oleo sylvestris-Ceratonion siliquae* (*Olea europaea* var. *sylvestris, Euphorbia dendroides, Asparagus albus, Chamaerops humilis, Teucrium fruticans, Clematis cirrhosa, Teucrium flavum* subsp. *flavum* and *Ceratonia siliqua*).

Moreover, the value "0" has been used to indicate the absence of a species in the cell of the matrix, and the value "1" to the presences of the entities in the columns in which they do not play the role of "characters"; e.g. it is the case of *Erica arborea* (such as discriminant of the *Ericion arboreae*) in the ambit of a column/association attributed to the *Juniperion turbinatae,* as well as *Chamaerops humilis* or *Asparagus albus* (characteristics of the *Oleo sylvestris-Ceratonion siliquae*) in a column/association referred to the *Ericion arboreae*.

For each considered syntaxon a diagnostic card has been redacted (synonyms, holotypus, phytosociological tables of reference, character species, structure and ecology, bioclimate, vegetation series and distribution), in which some floristic-syntaxonomical notes, derived from critical analysis of the processed phytosociological data, are also reported.

Syntaxonomical scheme

QUERCETEA ILICIS Br.-Bl. 1947
PISTACIO LENTISCI-RHAMNETALIA ALATERNI Rivas-Martínez 1975
Periplocion angustifoliae Rivas-Martínez 1975
Periploco angustifoliae-Juniperetum turbinatae Bartolo, Brullo, Minissale & Spampinato 1988
subass. *typicum*
subass. *brassicetosum insularis* Gianguzzi 1999
Juniperion turbinatae Rivas-Martínez 1975 corr. 1987
Junipero turbinatae-Quercetum calliprini Bartolo, Brullo & Marcenò 1982
Rusco aculeati-Quercetum calliprini Mossa 1990
Phillyreo angustifoliae-Juniperetum turbinatae Arrigoni, Nardi & Raffaelli 1985
Asparago albi-Juniperetum turbinatae Rivas-Martínez, Biondi, Costa & Mossa 2003
Asparago-Juniperetum macrocarpae (R. & R. Molinier) O. De Bolòs 1962
subass. *juniperetosum turbinatae* Géhu & Biondi 1994
Oleo sylvestris-Ceratonion siliquae Br.-Bl. 1936 ex Guinochet & Drouineau em. Rivas-Martínez 1975
Oleo sylvestris-Juniperetum turbinatae Arrigoni, Bruno, De Marco & Veri 1985 in De Marco, Dinelli & Caneva 1985 corr. 1992
subass. *euphorbietosum dendroidis* De Marco, Dinelli & Caneva 1985
subass. *helichrysetosum tyrrhenici* De Marco, Dinelli & Caneva 1985 corr.
subass. *juniperetosum macrocarpae* De Marco, Dinelli & Caneva 1985
subass. *quercetosum ilicis* De Marco, Dinelli & Caneva 1985
subass. *loniceretosum implexae* subass. nova
Chamaeropo humilis-Juniperetum turbinatae De Marco, Dinelli & Caneva 1985 corr. 2001
subass. *euphorbietosum dendroidis* De Marco, Dinelli & Caneva 1985
subass. *anthyllidetosum barbae-jovis* Biondi, Filigheddu & Farris 2001
subass. *arbutetosum unedonis* Biondi, Filigheddu & Farris 2001
Euphorbio characiae-Juniperetum turbinatae Biondi, Filigheddu & Farris 2001
Teucrio fruticantis-Juniperetum turbinatae Arrigoni, Nardi & Raffaelli 1985
Calicotomo infestae-Juniperetum turbinatae Brullo, Gianguzzi, La Mantia & Siracusa 2009
subass. *typicum*
subass. *phlomidetosum fruticosae* subass. nova
Ampelodesmo mauritanici-Juniperetum turbinatae ass. nova
subass. *myrtetosum communis* subass. nova
subass. *cistetosum cretici* subass. nova
Ericion arboreae (Rivas-Martínez ex Rivas-Martínez, Costa & Izco 1986) Rivas-Martínez 1987
Erico arboreae-Juniperetum turbinatae De Marco, Dinelli & Caneva 1985 corr.

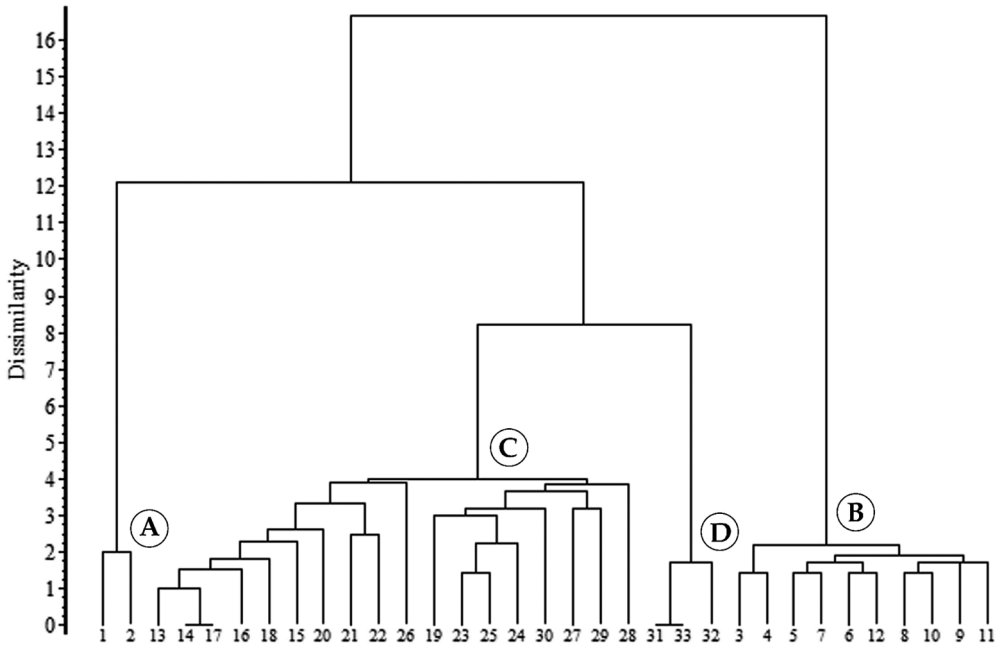

Fig. 1 - Dendrogram obtained through the comparison with the associations reported in the synoptic scheme of Tab. 1 (cluster analysis, UPGMA) based on Euclidean distance measures performed by Syntax 2000 (Podani, 2001).

Results and Discussion

The results of multivariate analysis performed on the *Juniperus phoenicea* subsp. *turbinata* formations of the Italo-Tyrrhenian Province confirm the allocation of the identified phytocoenoses in four main groups (Fig. 1), corresponding to the aforementioned alliances, in turn reported in the syntaxonomical scheme:

PISTACIO LENTISCI-RHAMNETALIA ALATERNI Rivas-Martínez 1975, Anales Inst. Bot. Cavanilles 31: 213

Synonym: *Quercetalia calliprini* Zohary 1955, Geobotany: 338.
Structure and ecology: Microwoods and maquis dominated by *Juniperus phoenicea* subsp. *turbinata* – which is considered as a character species of the order (Rivas-Martínez *et al.*, 2002) – of the infra-thermomediterranean bioclimatic belts with ombrotype ranging from lower-semiarid dry to lower subhumid, with penetrations in the mesomediterranean, referred to the alliances *Periplocion angustifoliae* (aspects on rocky substrates in extremely xeric environments), *Juniperion turbinatae* (on sands and dunes), *Oleo sylvestris-Ceratonion siliquae* (on rocky substrates), *Ericion arboreae* (on substrates poor in carbonates).

A) **Periplocion angustifoliae** Rivas-Martínez 1975, Anales Inst. Bot. Cavanilles 3 (2): 216.

Tables: Tab. 2, col. 1-2; Tab. 4.
Characteristic species: *Periploca laevigata* subsp. *angustifolia*, *Lycium intricatum*.
Structure and ecology: *Juniperus phoenicea* subsp. *turbinata* formations of the inframediterranean bioclimatic belt with semiarid-dry ombrotype, with considerable frequency of summer-deciduous species.

1) *Periploco angustifoliae-Juniperetum turbinatae* Bartolo, Brullo, Minissale & Spampinato 1988, Boll. Acc. Gioenia Sci. Nat., 21 (334): 163.

Holotypus: Rel. 1, Tab. 1, Bartolo *et al.* (1988).
Characteristic/Differential species: *Juniperus phoenicea* subsp. *turbinata* (dom.), *Periploca laevigata* subsp. *angustifolia, Lycium intricatum, Phagnalon saxatile*.
Floristic/Syntaxonomical notes: For its frequency (see Tab. 3 and 4), *Phagnalon saxatile* is also indicated among the differential species of the syntaxon.
Structure and ecology: Juniper formation with a marked xerophilous character, dominated by *Juniperus phoenicea* subsp. *turbinata*, to which *Periploca laevigata* subsp. *angustifolia* is steadily associated; it prefers coastal stations characterized by rocky substrates, calcareous or volcanic.
Bioclimate: Infra-thermomediterranean, with ombrotype ranging from semiarid to upper dry.

1a) *typicum* Bartolo, Brullo, Minissale & Spampinato

1988
Holotypus: Rel. 1, Tab. 1, Bartolo *et al*. (1988).
Table: Tab. 4, col. 1.
Differential species: *Teucrium fruticans, Melica minuta, Clematis cirrhosa*.
Vegetation series: Edapho-xerophilous Sicilian (Lopadusan), carbonate, inframediterranean semiarid series of the turbinate juniper (*Periploco angustifoliae-Junipero turbinatae sigmetum*).
Distribution: Lampedusa Island (Bartolo *et al*., 1988), with other reports for Tunisia (Brullo *et al*., 2009) and for Khrisi Island, south of Crete (Brullo & Guarino, 2000).

1b) *brassicetosum insularis* Gianguzzi 1999, Braun-Blanquetia, 22: 22.
Holotypus: Rel. 1, Tab. 4, Gianguzzi (1999).
Tables: Tab. 3; Tab. 4, col. 2.
Characteristic species: *Brassica insularis*, *Senecio cineraria* subsp. *bicolor*.
Floristic/Syntaxonomical notes: It replaces the typus in coastal cliff environments of volcanic nature, as chasmophilous edaphic vicariant. The subassociation – already described for Pantelleria Island (Gianguzzi, 1999) – is also reported for Linosa Island (Tab. 3), although *Brassica insularis* is absent; this is based on the frequency of *Senecio cineraria* subsp. *bicolor*, already indicated as character species of the syntaxon (Gianguzzi l.c.).
Bioclimate: Inframediterranean semiarid.
Vegetation series: Edapho-xerophilous Sicilian (Cosyrense-Pelagic), volcanic, infra-thermomediterranean semiarid series of the maritime turbinate juniper (*Periploco angustifoliae-Junipero turbinatae brassicetoso insularis sigmetum*).
Distribution: Coastal cliffs of Pantelleria Island, between Punta del Formaggio and Balata dei Turchi (Gianguzzi, 1999; Fig. 2); Linosa Island, on Mount Nero (La Mantia, 2003).

B) **Juniperion turbinatae** Rivas-Martínez 1975 corr. Rivas-Martínez 1987, Mem. Mapa Ser. Veg. España: 165.
Synonym: *Juniperion lyciae* Rivas-Martínez 1975, Anales Inst. Bot. Cavanilles 31: 215.
Tables: Tab. 2, col. 3-12; Tab. 5.
Characteristic species: *Juniperus macrocarpa*.
Floristic/Syntaxonomical notes: *Juniperus phoenicea* subsp. *turbinata* – as a typical entity of coastal rocky substrates, rarely on sand or paleodunes – is considered as discriminating only of the order *Pistacio lentisci-Rhamnetalia alaterni* (Rivas-Martínez *et*

Tab. 3 - *Periploco angustifoliae-Juniperetum turbinatae* subass. *brassicetosum insularis*: Channel of Sicily on Linosa Island, at Mount Nero (21.4.2001).

Relevé Number	1	2	3	4
Altitude (m a.s.l.)	107	90	80	73
Slope (%)	15	20	25	20
Exposition	W	W	NE	E
Surface (m^2)	80	80	90	80
Total coverage (%)	85	90	85	80
Average Height Shrubby Layer (m)	1,2	1,3	1,2	1,5
Number of Species	24	13	13	11
Guide species				
Juniperus phoenicea L. subsp. turbinata (Guss.)	1.2	1.2	2.2	1.2
Char. alliance *Periplocion angustifoliae*				
Periploca laevigata Aiton subsp. angustifolia (Labill.)	1.2	2.2	2.2	2.2
Lycium intricatum Boiss.	r	.	+	.
Char. subass. *typicum* and *brassicetosum insularis*				
Phagnalon saxatile (L.) Cass.	+.2	1.2	1.2	1.2
Senecio cineraria DC. subsp. bicolor (Willd.) Arcang.	1.2	.	+	+
Char. order *Pistacio lentisci-Rhamnetalia alaterni* and class *Quercetea ilicis*				
Pistacia lentiscus L.	3.3	4.5	4.5	4.4
Asparagus acutifolius L.	1.2	+.2	1.2	1.2
Prasium majus L.	+.2	+	+	+
Euphorbia dendroides L.	+	.	1.2	2.2
Olea europaea L. var. sylvestris (Mill.) Lehr	1.2	+	.	1.2
Ruta chalepensis L.	+	.	.	+
Rubia peregrina L. subsp. longifolia (Poir.) O. Bolòs	1.2	.	.	.
Asparagus aphyllus L.	+	.	.	.
Companions				
Hyparrhenia hirta (L.) Stapf	1.2	2.2	+	.
Pancratium linosae Soldano & F. Conti	+.2	+	+	.
Lobularia maritima (L.) Desv. subsp. maritima	+	+	+	.
Charybdis pancration (Steinh.) Speta	+	.	+	+
Lotus edulis L.	+	+	.	.
Sonchus bulbosus (L.) Kilian & Greuter	+	+	.	.
Silene gallica L.	+	+	.	.
Allium subhirsutum L.	+	.	.	.
Astragalus boeticus L.	+	.	.	.
Reichardia tingitana (L.) Roth	+	.	.	.
Daucus gingidium L. subsp. polygamus (Gouan) Onno	+	.	.	.

Tab. 4 - Simplified synoptic table (sporadic species were not considered) of the associations of juniper formations referred to the alliance *Periplocion angustifoliae* (Fig. 3): 1. *Periploco angustifoliae-Juniperetum turbinatae* subass. *typicum*, Channel of Sicily on Lampedusa Island, by Bartolo *et al.* (1988), Tab. 1; 2. *Periploco angustifoliae-Juniperetum turbinatae* subass. *brassicetosum insularis*, Channel of Sicily on Pantelleria Island (Punta del Curtigliolo: by Gianguzzi, 1999; Tab. 1) and Linosa Island (Mount Nero: Tab. 2).

Table number	1	2
Relevé number	8	8
Association number	1a	1b
Guide species		
Juniperus phoenicea L. subsp. turbinata	V	V
Char. ass. (subass. *typicum*) and alliance		
Periploca laevigata Aiton subsp. angustifolia (Labill.) Markgraf	IV	V
Lycium intricatum Boiss.	II	II
Phagnalon saxatile (L.) Cass.	I	V
Char. subass. *typicum* (1a) and *brassicetosum* (1b)		
Teucrium fruticans L.	V	.
Melica minuta L.	IV	.
Clematis cirrhosa L.	II	.
Senecio cineraria DC. subsp. bicolor (Willd.) Arcang.	.	IV
Brassica insularis Moris	.	III
Char. order *Pistacio lentisci-Rhamnetalia alaterni*		
Olea europaea L. var. sylvestris (Mill.)	V	II
Pistacia lentiscus L.	V	V
Prasium majus L.	V	V
Asparagus acutifolius L.	V	III
Asparagus aphyllus L.	V	I
Euphorbia dendroides L.	.	V
Arisarum vulgare Targ.-Tozz.	II	.
Ceratonia siliqua L.	II	.
Ruta chalepensis L.	.	II
Char. class *Quercetea ilicis*		
Rubia peregrina L. subsp. longifolia	V	III
Smilax aspera L.	II	I
Phillyrea latifolia L.	III	III
Lonicera implexa Aiton	.	II
Ampelodesmos mauritanicus (Poir.)	I	.
Char. class *Cisto-Micromerietea*		
Rosmarinus officinalis L.	I	II
Coridothymus capitatus (L.) Rchb.	III	.
Cistus monspeliensis L.	.	II
Micromeria graeca (L.) Benth. subsp. graeca	.	II
Lavandula stoechas L.	.	II
Fumana laevipes (L.) Spach	I	.
Cistus parviflorus Lam.	I	.
Coronilla valentina L.	I	.
Companions		
Hyparrhenia hirta (L.) Stapf	II	V
Asphodelus ramosus L. subsp. ramosus	III	II
Charybdis pancration (Steinh.) Speta	III	II
Lotus cytisoides L.	III	II
Dactylis glomerata L. subsp. hispanica (Roth) Nyman	.	III
Allium subhirsutum L.	.	I

al., 2002: 544). Therefore, the only real characteristic species of the alliance in question – which frames only the aspects of psammophilous maquis – is considered *Juniperus macrocarpa*, typical element of dune formations, but not always halophilous; in Sardinia, for example, sometimes it is also found on the shore of water courses in inland areas (Bacchetta *in verbis*).

Structure and ecology: *Juniperus phoenicea* subsp. *turbinata* formations of the thermo- and mesomediterranean bioclimatic belts with semiarid-dry ombrotype, tied to sandy coasts and dunes, with significant frequency of psammophytes.

2) *Junipero turbinatae-Quercetum calliprini* Bartolo, Brullo & Marcenò 1982, Quaderni C.N.R., ser. AQ/1/226: 30.

Holotypus: Rel. n. 7, Tab. 32, Bartolo *et al.* (1982).

Table: Tab. 5, col. 3-4.

Characteristic/Differential species: *Quercus calliprinos* (dom.), *Juniperus phoenicea* subsp. *turbinata, Ephedra fragilis, Chamaerops humilis, Calicotome infesta, Teucrium fruticans*.

Floristic/Syntaxonomical notes: Apart from the species proposed by the authors, for their frequency *Chamaerops humilis, Calicotome infesta* and *Teucrium fruticans* are also indicated among the differentials of the syntaxon; indeed, they are entirely absent in the analogous Sardinian association of the *Rusco aculeati-Quercetum calliprini*, in the past referred to this syntaxon (Mossa, 1989; Bartolo *et al.*, 1992). Moreover, in accordance with Giardina *et al.* (2007), the Sicilian populations of the genus *Phillyrea* are exclusively attributed to *P. latifolia* L. (incl. *P. stricta* Bert. + *P. media* L. s.l.) and not to *P. angustifolia* Auct. Fl. Sic. not L.

Structure and ecology: Microwoods with *Quercus calliprinos* and *Juniperus phoenicea* subsp. *turbinata*, typical of sandy substrates and paleodunes also very distant from the sea.

Bioclimate: Thermomediterranean dry, from lower to upper.

Vegetation series: Psammophilous-paleodune Sicilian (Camarino-Pachinense), thermomediterranean dry series of the maritime turbinate juniper (*Junipero turbinatae-Querco calliprini sigmetum*).

Distribution: The phytocoenosis has been described for the southern part of Sicily, with residual and often degraded nuclei, circumscribed to the territories of Niscemi, Caltagirone, Vittoria and Scoglitti (Furnari, 1965; Bartolo *et al.*, 1982; 1988; Raimondo *et al.*, 1990; Brullo *et al.*, 1993, 2009).

3) *Rusco aculeati-Quercetum calliprini* Mossa 1990, Ann. Bot. 48: 299.

Synonym: *Junipero turbinatae-Quercetum calliprini* (in: Mossa, 1989; Bartolo *et al.*, 1992).

Holotypus: Rel. 1, Tab. 6, Mossa (1990).

Table: Tab. 5, col. 5-7.

Characteristic/Differential species: *Quercus calliprinos* (dom.), *Juniperus phoenicea* subsp. *turbinata* (dom.), *Ruscus aculeatus, Phyllirea angustifolia*.

Floristic/Syntaxonomical notes: Based on what has been shown in the previous note, *Phillyrea angustifolia* is proposed as a further differential of the syntaxon.

Structure and ecology: Microwoods with *Quercus calliprinos* and *Juniperus phoenicea* subsp. *turbinata*, sometimes up to 20 metres high (Bacchetta *in verbis*), floristically quite rich and evolved, typical of sandy substrates and paleodunes also very distant from the sea.

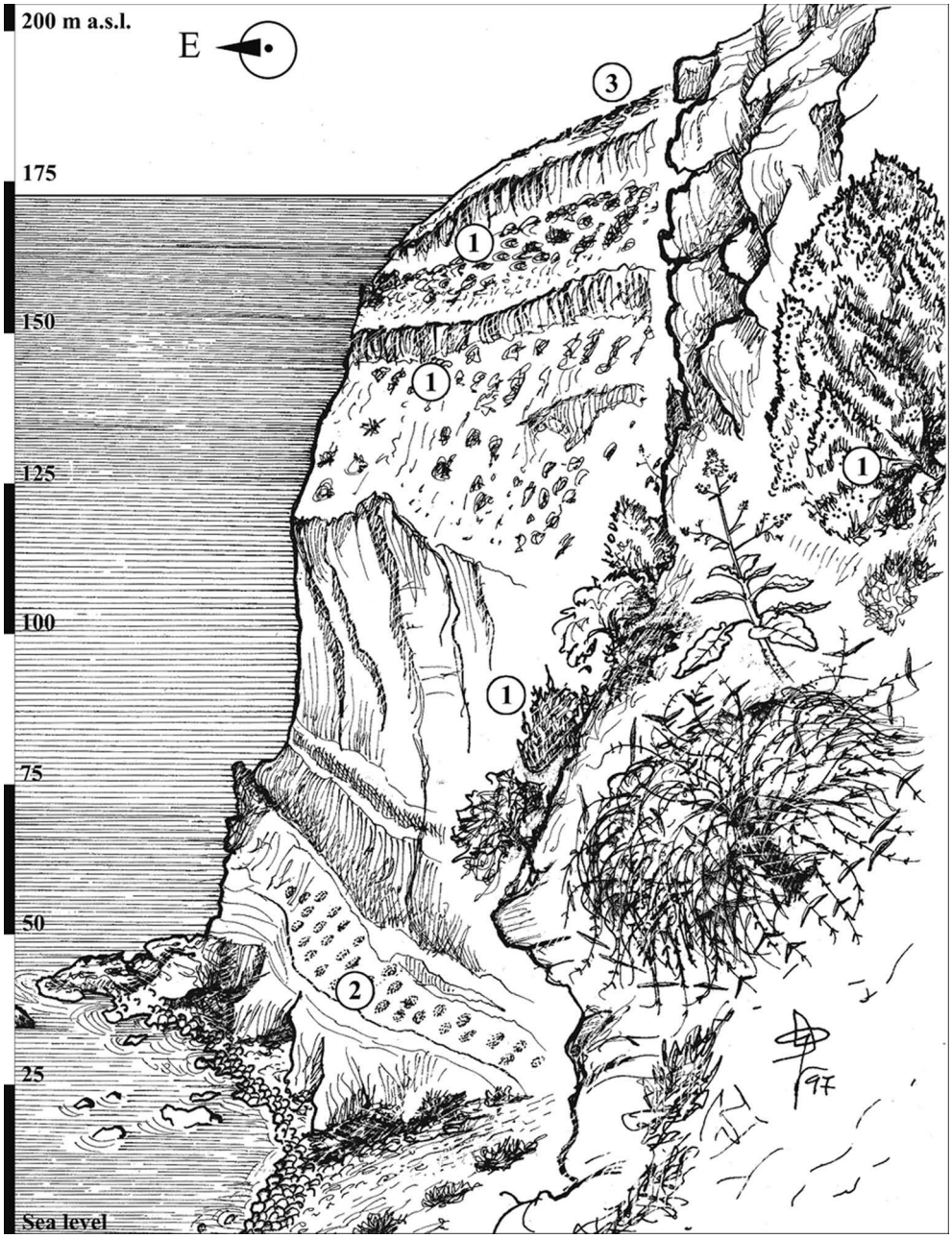

Fig. 2 - Schematic transect of the coastal plant landscape of Pantelleria Island (Channel of Sicily), in which the *Juniperus phoenicea* subsp. *turbinata* formation fits (by Gianguzzi 1999, modif.): 1. *Juniperus phoenicea* subsp. *turbinata* and *Periploca laevigata* subsp. *angustifolia* maquis (*Periploco angustifoliae-Juniperetum turbinatae* subass. *brassicetosum insularis*); 2. *Helichrysum errerae* var. *errerae* pulvinous community (*Matthiolo pulchellae-Helichrysetum errerae* Brullo, Di Martino & Marcenò 1977); 3. *Rosmarinus officinalis, Erica arborea* and *Genista aspalathoides* low maquis (*Genisto aspalatoidis-Rosmarinetum officinalis* Gianguzzi 1999).

Bioclimate: Thermomediterranean dry, from lower to upper, up to lower mesomediterranean subhumid.
Vegetation series: Psammophilous-paleodune southern Sardinian, thermomediterranean dry series of the maritime turbinate juniper (*Rusco aculeati-Querco calliprini sigmetum*).
Distribution: The association is indicated by various authors for the south-western part of Sardinia (Agostini & Sanfilippo, 1970; Mossa, 1989, 1990; Bartolo *et al*., 1992), in particular in the Sulcis (Porto Botte, Is Solinas and Porto Pino) and in the Iglesiente (Portixeddu di Buggerru, coastline north of Capo Pecora, Is Arenas). Other citations concern the Cixerri Valley (Villamassargia, Siliqua and Uta), Campidano (Mogoro) and Sarrabus-Gerrei, along the coast between Capo Ferrato and Tertenia (Bacchetta *et al*., 2009, 2010).

4) *Phillyreo angustifoliae-Juniperetum turbinatae*

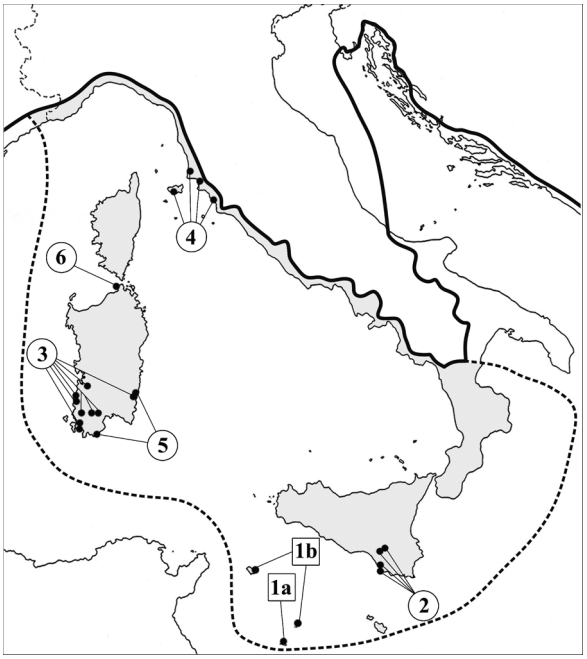

Fig. 3 - Distribution of the associations relative to the alliances *Periplocion angustifoliae* (squares) and *Juniperion turbinatae* (circles) in the Italo-Tyrrhenian Province, according to the nomenclature reported in the text: 1. *Periploco angustifoliae-Juniperetum turbinatae* subass. *typicum* (a) and subass. *brassicetosum insularis* (b); 2. *Junipero turbinatae-Quercetum calliprini*; 3. *Rusco aculeati-Quercetum calliprini*; 4. *Phillyreo angustifoliae-Juniperetum turbinatae*; 5. *Asparago albi-Juniperetum turbinatae;* 6. *Asparago acutifolii-Juniperetum macrocarpae* subass. *juniperetosum turbinatae*. The entire line indicates the Eurosiberian Region, the dashed line the Italo-Tyrrhenian Province (Mediterranean Region).

Arrigoni, Nardi & Raffaelli 1985 corr. Bartolo *et al.* 1992, Coll. Phytosoc. 19: 256-257.
Holotypus: Rel. 209, Tab. 34, Arrigoni *et al.* (1985)
Table: Tab. 5, col. 8-9.
Characteristic/Differential species: *Juniperus phoenicea* subsp. *turbinata* (diff. dom.), *Phillyrea angustifolia, Daphne sericea, Myrtus communis* subsp. *communis, Clematis flammula, Tamus communis* and *Erica multiflora*.
Floristic/Syntaxonomical notes: In addition to the character species indicated by the aforecited authors, given their frequency also *Daphne sericea, Myrtus communis* subsp. *communis*, *Clematis flammula, Tamus communis* and *Erica multiflora* are indicated among the differentials of the coenosis. Instead, they are entirely absent in the analogous Sardinian association of the *Asparago albi-Juniperetum turbinatae* (Rivas-Martínez *et al.*, 2003), in the past attributed to this syntaxon (Bartolo *et al.*, 1992; Biondi, 1999; Foggi *et al.*, 2006; Vagge & Biondi, 1999).
Structure and ecology: More or less dense and evolved maquis dominated by *Juniperus phoenicea* subsp. *turbinata* and *Pistacia lentiscus*, with considerable frequency of *Phillyrea angustifolia*. It settles on the more inner consolidated dunes, in stations sheltered from the sea agents.
Bioclimate: Thermo-mesomediterranean, with dry-subhumid ombrotype.
Vegetation series: Psammophilous Tuscan-Maremman, thermo-mesomediterranean subhumid series of the maritime turbinate juniper (*Phillyreo angustifoliae-Junipero turbinatae sigmetum*).
Distribution: The association was described by Arrigoni *et al.* (1985) for the coasts of the Tuscan Maremma and south of Cala di Forno, where it was subsequently detected also by Vagge & Biondi (1999). These latter authors report it also for the shoreline of Cecina, the Tombolo of Feniglia and Elba Island, where it is also cited by Foggi *et al.* (2006).

5) *Asparago albi-Juniperetum turbinatae* Rivas-Martínez, Biondi, Costa & Mossa 2003, Fitosoc. 40 (1): 38.
Synonym: *Phillyreo angustifoliae-Juniperetum turbi-*

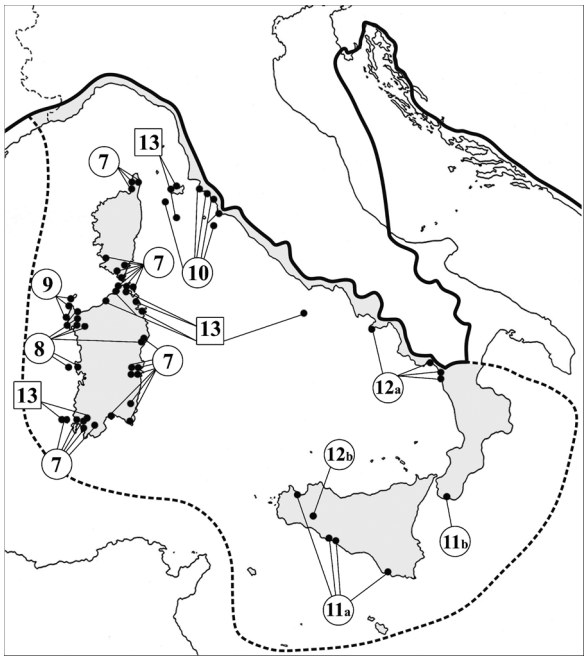

Fig. 4 - Distribution of the associations relative to the alliances *Oleo sylvestris-Ceratonion siliquae* (circles) and *Ericion arboreae* (squares) in the Italo-Tyrrhenian Province, according to the nomenclature reported in the text: 7. *Oleo sylvestris-Juniperetum turbinatae* s.l.; 8. *Chamaeropo-Juniperetum turbinatae* s.l.; 9. *Euphorbio characiae-Juniperetum turbinatae*; 10. *Teucrio fruticantis-Juniperetum turbinatae*; 11. *Calicotomo infestae-Juniperetum turbinatae* subass. *typicum* (a) and subass. *phlomidetosum fruticosae* (b); 12. *Ampelodesmo mauritanici-Juniperetum turbinatae* subass. *myrtetosum communis* (a) and subass. *cistetosum cretici* (b); 13. *Erico arboreae-Juniperetum turbinatae*. The entire line indicates the Eurosiberian Region, the dashed line the Italo-Tyrrhenian Province (Mediterranean Region).

Tab. 5 - Simplified synoptic table of the *Juniperus phoenicea* subsp. *turbinata* associations referred to the alliance *Juniperion turbinatae* (Fig. 3): 3. *Junipero turbinatae-Quercetum calliprini*, southern Sicily at Boschetto di Passo Marinaro (S. Croce di Camerina, prov. Ragusa), by Bartolo *et al*. (1982), Tab. 32; 4. *Junipero turbinatae-Quercetum calliprini*, southern Sicily at Boschetto di Passo Marinaro (S. Croce di Camerina, prov. Ragusa), by Brullo *et al*. (2009), Tab. 2a; 5. *Rusco aculeati-Quercetum calliprini*, south-western Sardinia at Buggeru, Portixeddu and Porto Pino, by Bartolo *et al*. (1992, sub *Junipero-Quercetum calliprini*), Tab. 6; 6. *Rusco aculeati-Quercetum calliprini*, south-western Sardinia at Porto Pino, by Agostini & Sanfilippo (1970), Tab. 3, rel. 3 and 11-14 (sub *Oleo-Lentiscetum*); 7. *Rusco aculeati-Quercetum calliprini*, south-western Sardinia at Balle Bausu, Portixeddu, S. Nicolò and Nicolò, by Mossa (1990), Tab. 6; 8. *Phillyreo angustifoliae-Juniperetum turbinatae*, Elba Island (Tuscan Archipelago) and coastal tract between Punta Ala and Orbetello, by Vagge & Biondi (1999), Tab. 9; 9. *Phillyreo angustifoliae-Juniperetum turbinatae*, Maremma Park (Tuscany), by Arrigoni *et al*. (1985), Tab. 34; 10. *Asparago albi-Juniperetum turbinatae*, southern Sardinia at Chia and Torre Salinas, by Bartolo *et al*. (1989; sub *Phillyreo angustifoliae-Juniperetum turbinatae*), Tab. 7; 11. *Asparago acutifolii-Juniperetum macrocarpae* subass. *juniperetosum phoeniceae*, northern Sardinia in Capo Testa locality at S. Teresa, by Molinier & Molinier (1955), pag. 31; 12. *Asparago acutifolii-Juniperetum macrocarpae* subass. *juniperetosum phoeniceae*, Corsica (by Géhu & Biondi, 1994; Tab. 61, rel. 21-23), in the following localities: Porto Vecchio Acciaju (rel. 21), Dune de Tallone and Diane (rel. 22), Cala de Rosa Pina (rel. 23).

Table number	3	4	5	6	7	8	9	10	11	12
Relevé number	8	2	19	5	7	10	6	7	1	3
Association number	2	2	3	3	3	4	4	5	6	6
Guide species										
Juniperus phoenicea L. subsp. turbinata (Guss.) Nyman	V	2	V	V	III	V	V	V	1	3
Char. alliance *Juniperion turbinatae*										
Juniperus macrocarpa Sm.	II	2	V	II	I	II	I	V	1	3
Char. or diff. association										
Ephedra fragilis Desf.	V	2	.	.	.	.	.	.	.	.
Chamaerops humilis L.	V	2	.	.	.	.	.	.	.	.
Calicotome infesta (C. Presl in J. & C. Presl) Guss. subsp.	IV	1	.	.	.	.	.	.	.	.
Teucrium fruticans L.	V	2	.	.	.	.	.	.	.	.
Quercus calliprinos Webb	V	2	V	V	V	.	.	.	.	.
Ruscus aculeatus L.	.	.	II	I	IV	I	.	.	.	1
Pinus halepensis Mill.	.	.	I	IV	.	I	.	.	.	.
Carex distachya Desf.	.	.	II	.	I	.	.	.	.	.
Phillyrea angustifolia L.	.	.	V	V	IV	V	V	V	1	2
Daphne sericea Vahl	.	.	.	.	.	II	IV	.	.	.
Myrtus communis L. subsp. communis	.	.	.	.	.	III	III	.	.	.
Clematis flammula L.	.	.	.	.	.	II	III	.	.	.
Tamus communis L.	.	.	.	.	.	II	III	.	.	.
Erica multiflora L. subsp. multiflora	.	.	.	.	.	II	II	.	.	.
Asparagus aphyllus L.	.	.	.	.	.	.	.	V	.	.
Prasium majus L.	V	2	III	II	.	.	.	V	.	.
Rhamnus lycioides L. subsp. oleoides (L.) Jahand. & Maire	.	.	.	.	.	.	.	II	.	.
Char. order *Pistacio lentisci-Rhamnetalia alaterni*										
Pistacia lentiscus L.	V	2	IV	V	V	V	V	V	1	3
Olea europaea L. var. sylvestris	IV	2	.	I	.	I	II	III	1	1
Rhamnus alaternus L.	III	2	I	.	IV	IV	IV	.	.	.
Asparagus acutifolius L.	V	.	II	V	V	I	.	.	1	1
Arisarum vulgare Targ.-Tozz.	IV	.	.	.	.	I	I	.	1	.
Clematis cirrhosa L.	.	1	I	I	.	.	.	.	.	2
Arbutus unedo L.	.	.	.	I	I	I	.	.	.	2
Calicotome villosa (Poir.) Link	.	.	.	II	.	I	.	I	.	.
Erica arborea L.	.	.	.	I	.	I	.	.	1	.
Euphorbia characias L.	II	.	.	.	.	.	.	.	1	.
Rosa sempervirens L.	.	.	.	.	.	I	I	.	.	.
Asparagus horridus L.	.	.	.	.	II	.	.	.	.	.
Ceratonia siliqua L.	I	.	.	.	.	.	.	.	.	.
Pulicaria odora (L.) Rchb.	.	.	.	I	.	.	.	.	.	.
Asparagus albus L.	.	.	.	.	.	.	.	1	.	.
Teucrium flavum L. subsp. glaucum (Jordan et Fourr.)	.	.	.	.	.	.	.	.	1	.
Char. class *Quercetea ilicis*										
Rubia peregrina L. subsp. longifolia (Poir.) O. Bolòs	IV	.	IV	II	V	V	V	V	1	3
Smilax aspera L.	III	2	IV	V	V	V	V	I	1	3
Lonicera implexa Aiton	III	2	.	.	III	III	II	.	1	1
Osyris alba L.	.	.	I	I	I	I	.	III	.	1
Phillyrea latifolia L. (+ P. media L.*)	V	.	.	.	II*	I*	I	.	1*	1
Quercus ilex L. subsp. ilex	II	1	I	.	.	I	.	.	.	.
Daphne gnidium L.	II	.	.	.	.	II	III	.	.	.
Cyclamen repandum Sm.	I	.	.	.	I	.	.	.	.	.
Carex hallerana Asso	.	.	.	.	I	.	.	.	.	.
Quercus suber L.	.	.	.	.	.	.	.	.	.	2
Char. class *Cisto-Micromerietea*										
Rosmarinus officinalis L.	III	1	III	V	.	II	I	.	1	.
Cistus salviifolius L.	I	.	V	II	.	I	II	.	.	1
Cistus creticus L. subsp. creticus	I	2	V	.	.	.	.	.	.	.
Cistus creticus L. subsp. eriocephalus (Viv.) Greuter & Burdet	.	.	.	.	.	II	.	I	.	.
Companions										
Piptatherum miliaceum (L.) Coss. subsp. miliaceum	IV	2	.	IV	I	.	I	.	1	.
Asphodelus ramosus L. subsp. ramosus	II	1	II	V	.	.	.	.	1	.
Dactylis glomerata L. subsp. hispanica (Roth) Nyman	IV	.	II	IV	.	.	.	III	.	.
Allium subhirsutum L.	III	.	.	.	.	I	II	.	.	.

natae Arrigoni, Nardi e Raffaelli 1985 (in: Bartolo *et al*., 1989 (1992); Biondi, 1999).

Holotypus: Rel. 7, Tab. 7, Bartolo *et al*. (1992, sub *Phillyreo angustifoliae-Juniperetum turbinatae*).

Table: Tab. 5, col. 10.

Characteristic/Differential species: *Juniperus phoenicea* subsp. *turbinata* (dom.), *Phillyrea angustifolia, Asparagus aphyllus, A. albus, Prasium majus, Rhamnus lycioides* subsp. *oleoides*; according to Bacchetta (*in verbis*), also the endemics *Arum pictum* L. and *Bryonia marmorata*, quite frequent in the coenosis, should be added.

Structure and ecology: More or less dense and evolved maquis dominated by *Juniperus phoenicea* subsp. *turbinata*, *Phillyrea angustifolia* and *Pistacia lentiscus*, settled in backdune stations sheltered from the sea agents, often in contact with the halophilous vegetation of swampy depressions.

Bioclimate: Thermomediterranean dry.

Vegetation series: Psammophilous Sardinian, thermomediterranean dry series of the maritime turbinate juniper (*Asparago albi-Junipero turbinatae sigmetum*).

Distribution: The association is indicated for the south Sardinia, in particular for the localities of Chia and Torre Salinas (Bartolo *et al*., 1992; Biondi, 1999).

6) *Asparago acutifolii-Juniperetum macrocarpae* (R. & R. Molinier) De Bolòs 1962, El paisaje vegetal Barcelonés: 42, Tab. 3 rel. 4. Univ. Barcelona
- *juniperetosum turbinatae* Géhu & Biondi 1994, Braun-Blanquetia, 13: 110 (Tab. 61, col. 21-23)
Synonym: *Oleo-Lentiscetum* subass. with *Juniperus phoenicea* (= *J. phoenicea* subsp. *turbinata*) in Molinier & Molinier in Arch. Bot. (Forlì) 30: 31, 1955 (basion.).
Syntypi: Tab. 61, rel. 18-25 (in Géhu & Biondi, 1994).
Table: Tab. 5, col. 11-12.
Characteristic/Differential species: ass.: *Juniperus macrocarpa, Asparagus maritimus*; subass.: *Juniperus phoenicea* subsp. *turbinata*.
Structure and ecology: High maquis with a prevalence of *Juniperus phoenicea* subsp. *turbinata* and high presence of *Juniperus macrocarpa*, tied to coastal sandy substrates; according to the interpretation of the same authors (Géhu & Biondi, 1994), it constitutes an aspect of the *Asparago-Juniperetum macrocarpae*, located in more inner and sheltered areas.
Bioclimate: Thermo-mesomediterranean from upper dry to lower subhumid.
Vegetation series: Psammophilous Sardinian-Corsican, thermo-mesomediterranean dry series of the maritime turbinate juniper (*Asparago-Junipero macrocarpae juniperetoso turbinatae sigmetum*)**.**
Distribution: The coenosis, already reported by Molinier & Molinier (1955: 30) for the most extreme part of the northern Sardinia (Capo Testa at Santa Teresa), is indicated by Géhu & Biondi (1994) for the eastern Corsica, where they cite it for the localities of Porto Vecchio Acciaju (rel. 21), Diane in the Dune de Tallone (rel. 22) and Cala de Rosa Pina (rel. 23).

C) **Oleo sylvestris-Ceratonion siliquae** Br.-Bl. 1936 ex Guinochet & Drouineau em. Rivas-Martínez 1975
***Table*s**: Tab. 2, col. 13-30; Tab. 6.
Characteristic/Differential species: *Olea europaea* var. *sylvestris, Euphorbia dendroides, Asparagus albus, Chamaerops humilis, Teucrium fruticans, Clematis cirrhosa, Teucrium flavum* subsp. *flavum, Ceratonia siliqua*.
Structure and ecology: *Juniperus phoenicea* subsp. *turbinata* formations of the thermo- and mesomediterranean bioclimatic belts with dry-subhumid ombrotype, located in stations of the coastline and sometimes of the interior, on rocky substrates of various nature – tendentially neutro-basiphilous – with considerable frequency of lithophilous species.

7) *Oleo sylvestris-Juniperetum turbinatae* Arrigoni, Bruno, De Marco & Veri 1985 (in De Marco *et al.*, 1985, Not. Fitosoc. 22: 44) corr. Biondi & Mossa 1992 (Doc. Phytosoc. 14: 9)
Synonyms: *Oleo-Juniperetum phoeniceae* Arrigoni, Bruno, De Marco & Veri (in De Marco *et al.*, 1985); *Clematido-Lentiscetum* Gamisans & Muracciole 1985 *juniperetosum phoeniceae* Gamisans 1991 p.p.
Holotypus: Rel. 42, Tab. 1, De Marco *et al.* (1985).
Table: Tab. 6, col. 13-19.
Characteristic/Differential species: *Juniperus phoenicea* subsp. *turbinata*, *Olea europaea* var. *sylvestris*, *Euphorbia dendroides*.
Floristic/Syntaxonomical notes: *Clematis cirrhosa*, quite common within this juniper formation (De Marco *et al.*, 1985), is indicated as a further differential of the coenosis.
Structure and ecology: More or less dense maquis-bush dominated by *Juniperus phoenicea* subsp. *turbinata*, typical of more or less compact substrates, both carbonate and siliceous, with a coastal gravitation and more sporadically also in the interior: *Olea europaea* var. *sylvestris*, *Asparagus albus, Euphorbia dendroides, Pistacia lentiscus, Phillyrea angustifolia, Clematis cirrhosa* and, in the herbaceous layer, *Brachypodium retusum*, are among the other most representative species.
Bioclimate: Dry thermomediterranean with penetrations up to the lower mesomediterranean upper dry-lower subhumid.
Vegetation series: Edapho-xerophilous Sardinian-Corsican, indifferent edaphic, thermo-mesomediterranean dry-subhumid series of the maritime turbinate juniper (*Oleo sylvestris-Junipero turbinatae sigmetum*; Biondi & Bagella, 2001; Bacchetta *et al.*, 2009, 2010).
Distribution: The association has a centre of Sardinian-Corsican gravitation; in Sardinia it was diversified in four subassociations (De Marco *et al.*, 1985) – as better specified after (subass. a-d) – while the aspects of Corsica (Géhu & Biondi, 1994) are referred to a new subassociation (subass. e: *loniceretosum implexae*).

In Sardinia (Bacchetta *et al.*, 2010), these juniper formations are quite widespread, reported, in particular, along the north-eastern coasts of the Gallura, in the eastern ones of the Gulf of Orosei and of the Ogliastra (between S. Maria Navarrese and Barisardo), in the southern ones of the Sulcis-Iglesiente and of the Sarrabus-Gerrei; sporadic presences are reported also in the interior, on carbonate substrates of Punta Sebera, Barbusi and Mt. Tasua (in the Sulcis) and Mt. Marganai (in the Iglesiente). In bibliography phytosociological relevés are reported for S. Pietro Island (De Marco & Mossa, 1980, sub *Oleo-Lentiscetum*: Tab. 1, rel. 6-9, 12-14 and 20) and S. Antioco Island (Caneva *et al.*, 1981) – subsequently used by Arrigoni *et al.* (in De Marco *et al.*, 1985) for the description of the coenosis *(*sub *Oleo-Juniperetum phoeniceae*) –, the promontory of Capo S. Elia (Biondi & Mossa, 1992), Capo Carbonara (Mossa *et al.*, 2000), the Maddalena Archipelago (subass. *typicum*) and Caprera Island (subass. *euphorbietosum dendroidis*) (Biondi & Bagella, 2005);

a further relevé referable to the same phytocoenosis is reported for the Sulcis-Iglesiente area (Camarda *et al*., 1995, sub *Oleo-Euphorbietum dendroidis*, Tab. 9, rel. 53). In Corsica the aforecited aspects of juniper formation are mostly represented along the southern coasts and in the extreme north (Géhu & Biondi, 1994).

7a) *euphorbietosum dendroidis* De Marco, Dinelli & Caneva 1985 [Not. Fitosoc. 22 (1985): 44]
Holotypus: Rel. 62, Tab. 1, De Marco *et al*. (1985).
Characteristic/Differential species: *Euphorbia dendroides*.
Structure and ecology: It replaces the typus in subrupicolous environments more xeric and less affected by sea breezes.
Distribution: More or less frequent especially in Sardinia, together with the typus (De Marco *et al*., 1985; Biondi & Bagella, 2005; Bacchetta *et al*., 2009).
Vegetation series: Edapho-xerophilous Sardinian, calcicolous, thermo-mesomediterranean of the turbinate juniper (*Oleo sylvestris-Junipero turbinatae euphorbietoso dendroidis sigmetum*).

7b) *helichrysetosum tyrrhenici* De Marco, Dinelli & Caneva 1985 corr. [Not. Fitosoc. 22 (1985):44]
Holotypus: Rel. 35, Tab. 5, Lorenzoni (1974).
Characteristic/Differential species: *Helichrysum microphyllum* (Willd.) Camb. subsp. *tyrrhenicum* Bacchetta, Brullo & Giusso and other entities of the *Crithmo-Limonietea*.
Floristic/Syntaxonomical notes: Based on the recent attribution of the dominant species of *Helichrysum* (Bacchetta *in verbis*) to *H. microphyllum* subsp. *tyrrhenicum* (Angiolini *et al*., 2005) and not to *H. italicum* (De Marco *et al*., 1985), the name of the subassociation is corrected as *helichrysetosum tyrrhenici*.
Structure and ecology: It replaces the typus on low rocky coasts, more subjected to the action of the sea breezes.
Distribution: Along the coasts of the north-eastern and southern part of Sardinia (De Marco *et al*., 1985).
Vegetation series: Edapho-xerophilous north-eastern and southern Sardinian, calcicolous, thermomediterranean series of the turbinate juniper (*Oleo sylvestris-Junipero turbinatae helichrysetoso tyrrhenici sigmetum*).

7c) *juniperetosum macrocarpae* De Marco, Dinelli & Caneva 1985 [Not. Fitosoc. 22 (1985): 44]
Holotypus: Rel. 1, Tab. 3, Agostini & Sanfilippo (1970).
Characteristic/Differential species: *Juniperus macrocarpa* and species of the class *Ammophiletea*.
Structure and ecology: It replaces the subass. *typicum* on low rocky coasts characterized by the presence of local sandy accumulations by the wind.
Vegetation series: Edapho-xerophilous Sardinian, coastal, thermomediterranean series of the turbinate juniper (*Oleo sylvestris-Junipero turbinatae juniperetoso macrocarpae sigmetum*).
Distribution: Reported for the south-western Sardinia (De Marco *et al*., 1985).

7d) *quercetosum ilicis* De Marco, Dinelli & Caneva 1985 [Not. Fitosoc. 22 (1985): 45]
Holotypus: Rel. 23, Tab. 1, De Marco *et al*. (1985).
Characteristic/Differential species: *Quercus ilex* and, subordinately and locally, *Q. suber, Q. calliprinos* and *Pinus halepensis*.
Structure and ecology: It constitutes the freshest aspect, representing the transitional stage towards the forestal formations dominated by the aforementioned species.
Vegetation series: Edapho-xerophilous Sardinian, indifferent edaphic, thermomediterranean series of the turbinate juniper (*Oleo sylvestris-Junipero turbinatae quercetoso ilici sigmetum*).
Distribution: It is found, together with the typus (De Marco *et al*., 1985), in very limited coastal stretches of Sardinia (Bacchetta *in verbis*).

7e) *loniceretosum implexae* subass. nova hoc loco
Synonyms: *Oleo-Juniperetum turbinatae* Arrigoni *et al*. 1985 sensu Géhu & Biondi (1994); *Clematido-Lentiscetum* Gamisans & Muracciole 1985 subass. *juniperetosum phoeniceae* p.p.
Holotypus: Rel. 11, Tab. 62, Géhu & Biondi (1994).
Characteristic/Differential species: *Lonicera implexa, Clematis flammula*.
Structure and ecology: Coastal high maquis with *Juniperus phoenicea* subsp. *turbinata*, typical of areas with a thermomediterranean climate, in particular on calcareous cliffs exposed to marine winds (Géhu & Biondi, 1994), but also on not carbonate lithologies (Bacchetta *in verbis*).
Vegetation series: Edapho-xerophilous Corsican, indifferent edaphic, thermomediterranean series of the turbinate juniper (*Oleo sylvestris-Junipero turbinatae loniceretoso implexae sigmetum*).
Distribution: It represents the aspect reported for Corsica (Géhu & Biondi, 1994), located along the southern coasts (Propriano, Santa Giulia, Île Piana, Le Pertusato, Bonifacio, Pointe de Sperone) and in the extreme north (Cap Corse, Nonza, Marina de Barcaggio); a further relevé ascribable to the same phytocoenosis – although floristically depleted – is reported by Paradis & Tomasi (1991; Tab. 7, rel. 57), always for the Barcaggio area (Cap Corse).

8) *Chamaeropo humilis-Juniperetum turbinatae* De Marco, Dinelli & Caneva 1985 (Not. Fitosoc. 22: 44)
Synonym: *Oleo-Juniperetum phoeniceae* Arrigoni, Bruno, De Marco & Veri 1975 subass. *chamaeropeto-*

Tab. 6 - Simplified synoptic table of the *Juniperus phoenicea* subsp. *turbinata* associations referred to the alliance *Oleo sylvestris-Ceratonion siliquae* (Fig. 4): 13. *Oleo-Juniperetum turbinatae*, south-western Sardinia on S. Antioco Island, by Caneva *et al.* (1981), Tab. 11; 14. *Oleo-Juniperetum turbinatae,* central-eastern Sardinia at Cala Gonone, by De Marco *et al.* (1989), Tab. 11; 15. *Oleo-Juniperetum turbinatae,* southern Sardinia at Capo S. Elia promontory (Cagliari), by Biondi & Mossa (1992), Tab. 70; 16. *Oleo-Juniperetum turbinatae*, south-western Sardinia in the Sulcis-Iglesiente, by Camarda *et al.* (1995), Tab. 9, rel. 53 (sub *Oleo-Euphorbietum dendroidis* Trinajstic 1973); 17. *Oleo-Juniperetum turbinatae*, south-eastern Sardinia at Capo Carbonara Reserve, by Mossa *et al.* (2000), Tab. 11; 18. *Oleo-Juniperetum turbinatae*, north-eastern Sardinia on the Maddalena Archipelago, by Biondi & Bagella (2005), Tab. 70; 19. *Oleo-Juniperetum turbinatae loniceretosum implexae* subass. nova, southern Corsica (Fautea at Lavu Santu, Santa Giulia, Ile Piana Pertusato) and northern Corsica (Capo Corso), by Géhu & Biondi (1994), Tab. 62; *. *Oleo-Juniperetum turbinatae* subass. *loniceretosum implexae* subass. nova, northern Corsica at Barcaggio (Cap Corse), by Paradis & Tomasi (1991), Tab. 7, rel. 57; 20. *Chamaeropo-Juniperetum turbinatae,* north-western Sardinia in various localities of the Nurra, by Biondi *et al.* (2001), Tab. 56; 21. *Chamaeropo-Juniperetum turbinatae,* south-western Sardinia on S. Antioco Island, by Caneva *et al.* (1981); 22. *Euphorbio characiae-Juniperetum turbinatae*, north-western Sardinia in various localities of the Nurra, by Biondi *et al.* (2001), Tab. 55; 23. *Teucrio fruticantis-Juniperetum turbinatae,* by Arrigoni *et al.* (1985), Tab. 7; 24. *Teucrio fruticantis-Juniperetum turbinatae*, Tuscany at Punta Ala (Grosseto), by De Dominicis *et al.* (1988), Tab. 11; 25. *Teucrio fruticantis-Juniperetum turbinatae*, Tuscan Archipelago on Pianosa Island, by Foggi *et al.* (2008), Tab. 19; 26. *Calicotomo infestae-Juniperetum turbinatae,* coasts of north-western Sicily (Alcamo Marina) and southern Sicily (Capo Bianco, Torresalsa and Cava Randello), by Brullo *et al.* (2009), Tab. 3d; 27. *Calicotomo infestae-Juniperetum turbinatae* (sub *Oleo-Juniperetum turbinatae*), Calabria along the Ionian coastal belt of the Aspromonte (Condofuri Marina, in Vadicamo locality), by Mercurio & Spampinato (1999), Tab. 3, and Brullo *et al.* (2001), Tab. 11; 28. *Ampelodesmo mauritanici-Juniperetum turbinatae myrtetosum* communis subass. nova (sub *Oleo-Juniperetum turbinatae*), Campania along the coastal belt of the Sorrentine-Amalfitana Peninsula, by Cancellieri (2008), Tab. 11, col. 1-3; 29. *Ampelodesmo mauritanici-Juniperetum turbinatae myrtetosum communis* subass. nova, various localities of Calabrian-Lucanian Tyrrhenian coast between Acquafredda and Capo Scalea (islets of Dino, Castrocucco and S. Nicola Arcella, cliffs of Fiuzzi and Acquafredda), by Caneva *et al.* (2004), Tab. 1. 30. *Ampelodesmo mauritanici-Juniperetum turbinatae cistetosum cretici* subass. nova, hinterland of Sicily on Sicani Mts. (along the gorges of the Sosio River), Tab. 7.

sum Arrigoni, Bruno, De Marco & Veri 1975
Holotypus: Rel. 1, Tab. 11, Caneva *et al.* (1981).
Table: Tab. 6, col. 20-21.
Characteristic/Differential species: *Juniperus phoenicea* subsp. *turbinata, Chamaerops humilis, Phillyrea angustifolia, Asparagus albus*.
Floristic/Syntaxonomical notes: From the synoptic comparison among the tables referred to the *Oleo-Juniperetum turbinatae* and those ones attributed by some authors to the association in question (Caneva *et al.*, 1981; Biondi *et al.*, 2001), a remarkable floristic affinity emerges, apart from the high frequency in this latter of *Chamaerops humilis*; on this basis, Rivas-Martínez *et al.* (2003) put the two syntaxa in synonymy, probably to be referred to two distinct subassociations. Here – given the physiognomic-structural peculiarities of the *Chamaeropo humilis-Juniperetum turbinatae* – to keep distinct the two syntaxa is considered opportune, in agreement with some other authors who have recently been interested in the problem (Asensi *et al.*, 2007; Bacchetta *et al.*, 2009, 2010).
Structure and ecology: More or less dense maquis-bush dominated by *Juniperus phoenicea* subsp. *turbinata*, typical of sedimentary substrates of variuos kinds (Mesozoic and Miocene limestones, marls, sandstones), with a coastal centre of gravitation. Among the most representative species, there is the mediterranean dwarf Palm (*Chamaerops humilis*), besides to *Phillyrea angustifolia, Pistacia lentiscus* and *Prasium majus*.
Bioclimate: Thermomediterranean with lower-upper dry ombrotype.
Vegetation series: Edapho-xerophilous western Sardinian, calcicolous, thermo-mesomediterranean dry series of the maritime turbinate juniper (*Chamaeropo humilis-Junipero turbinatae sigmetum*).
Distribution: S. Antioco Island (Caneva *et al.*, 1981), Nurra (Biondi *et al.*, 2001), Capo Caccia Peninsula, Punta Giglio, Alghero - La Speranza shoreline, Sinis from Su Pallosu to Arutas Island, Capo Mannu, Mal di Ventre Island, carbonate coasts of Porto Torres (Balai) and northern part of the Gulf of Orosei, at Caletta di Osalla (Bacchetta *et al.*, 2009).

8a) *euphorbietosum dendroidis* De Marco, Dinelli & Caneva 1985 [Not. Fitosoc. 22 (1985):44]
Holotypus: Rel. 11, Tab. 11, De Marco *et al.* (1985).
Characteristic/Differential species: *Euphorbia dendroides*.
Structure and ecology: It replaces the typus in subrupicolous environments more xeric and less affected by sea breezes.
Vegetation series: Edapho-xerophilous western Sardinian, calcicolous, thermo-mesomediterranean dry series of the maritime turbinate juniper (*Chamaeropo humilis-Junipero turbinatae euphorbietoso dendroidis sigmetum*).
Distribution: More or less frequent, together with the typus (De Marco *et al.*, 1985).

8b) *anthyllidetosum barbae-jovis* Biondi, Filigheddu & Farris 2001 [Fitosoc. 38 (2) suppl. 2: 62]
Holotypus: Rel. 17, Tab. 56, Biondi *et al.* (2001).
Characteristic/Differential species: *Anthyllis barba-*

Table number	13	14	15	16	17	18	19	*	20	21	22	23	24	25	26	27	28	29	30
Relevé number	13	10	10	1	7	15	20	1	13	26	18	8	4	10	7	8	3	18	9
Association number	7	7	7	7	7	7	7e	7e	8	8	9	10	10	10	11	11	12a	12a	12b
Guide species																			
Juniperus phoenicea L. subsp. turbinata (Guss.) Nyman	V	V	V	1	V	V	V	1	V	V	V	V	4	V	V	V	3	V	V
Char. and/or diff. ass. and alliance *Oleo-Ceratonion*																			
Olea europaea L. var. sylvestris (Mill.) Lehr	V	IV	II	1	II	V	II	(I)	V	II	I	V	2	I	IV	V	.	II	IV
Euphorbia dendroides L.	I	V	V	1	I	I	.	.	I	I	I	.	.	.	III	.	3	.	II
Asparagus albus L.	V	IV	II	1	IV	IV	.	.	IV	III	.	.	.	.	I	I	.	.	I
Clematis cirrhosa L.	V	V	.	1	I	II	I	.	V	.	.	.	.	.	.	.	.	.	.
Chamaerops humilis L.	.	.	.	.	.	.	.	.	V	V	I	.	.	.	III	.	.	.	.
Euphorbia characias L.	.	.	.	.	.	I	.	.	.	II	V	.	.	.	.	.	.	.	.
Teucrium fruticans L.	.	.	.	.	.	.	.	.	.	.	.	V	.	III	II	.	3	.	.
Coronilla valentina L.	.	.	.	.	.	.	.	.	.	.	.	I	.	IV	.	.	1	II	.
Calicotome infesta (C. Presl in J. & C. Presl) Guss. subsp. infesta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	IV	V	.	.	.
Ephedra fragilis Desf.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	.	.	.	.
Teucrium flavum L. subsp. flavum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.	.	III
Phlomis fruticosa L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	.	.	.
Emerus major Mill. subsp. emeroides (Boiss. & Spruner) Soldano & Conti	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	III	I
Phillyrea latifolia L.	.	V	.	1	.	I	I	.	.	.	.	II	.	.	III	.	.	IV	V
Erica multiflora L. subsp. multiflora	.	.	.	.	.	.	.	1	.	.	.	II	.	.	III	II	.	III	V
Myrtus communis L. subsp. communis	.	.	.	1	.	III	I	.	.	.	I	.	.	I	I	.	1	IV	.
Clematis flammula L.	.	.	.	.	.	.	II	1	.	.	I	.	1	.	.	.		III	.
Cistus creticus L. subsp. creticus	.	.	.	.	.	.	.	1	.	.	.	.	.	.	I	.	.	.	V
Micromeria graeca (L.) Benth. subsp. graeca	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	.	.	.	V
Cistus creticus L. subsp. eriocephalus (Viv.) Greuter & Burdet	.	.	.	.	.	.	.	.	.	.	I	.	.	I	.	.	.	.	.
Fumana laevipes (L.) Spach	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V
Char. order *Pistacio lentisci-Rhamnetalia alaterni*																			
Pistacia lentiscus L.	V	IV	V	1	V	V	V	1	V	V	V	V	4	V	V	V	3	V	V
Prasium majus L.	V	III	IV	1	V	I	I		V	V	V	V	4	IV	II	.	.	II	IV
Phillyrea angustifolia L.	II	.	I	.	.	V	III	1	II	V	I	I	2	.	.	.	.	I	.
Arisarum vulgare Targ.-Tozz.	II	V	IV	.	IV	II	I	.	II	IV	II	V	.	V	.	.	.	.	.
Rhamnus alaternus L.	.	.	.	.	.	II	II	.	.	III	.	I	3	I	I	V	1	II	IV
Calicotome villosa (Poir.) Link	III	.	.	.	.	.	I	.	IV	I	II	.	1	.	.	.	.	.	.
Arbutus unedo L.	.	.	.	II	.	.	.	.	I	I	.	.	.	.	.	.	.	III	III
Ruta chalepensis L.	.	.	I	.	I	.	.	.	.	I	I	.	.	I	.	.	.	.	.
Juniperus macrocarpa Sm.	I	.	.	.	.	.	I	.	.	I	.	II	.	.	.	.	.	.	.
Erica arborea L.	.	.	.	.	.	II	I	.	.	I	I	.	.	.	.	.	.	.	.
Pulicaria odora L.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	I	1	I	.
Asparagus aphyllus L.	I	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.
Anagyris foetida L.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	I	.
Ceratonia siliqua L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	I	.
Anthyllis barba-jovis L.	.	.	.	.	.	.	.	.	.	I	.	.	2	.	.	.	.	.	.
Rosa sempervirens L.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
Pinus halepensis Mill.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	1	.	.
Char. class *Quercetea ilicis*																			
Asparagus acutifolius L.	V	IV	I	.	IV	II	V	.	IV	II	II	.	2	III	IV	I	.	II	IV
Rubia peregrina L. subsp. longifolia (Poir.) O. Bolòs	V	I	.	1	IV	IV	V	.	V	IV	IV	III	3	IV	II	.	.	III	I
Smilax aspera L.	V	.	.	1	II	II	V	1	V	IV	II	.	4	.	.	.	.	III	.
Lonicera implexa Aiton	II	.	.	.	.	.	IV	1	II	II	I	.	1	I	I	.	.	IV	I
Quercus ilex L. subsp. ilex	.	I	.	1	.	.	I	.	.	I	.	II	2	.	.	.	.	IV	I
Carex distachya Desf.	I	I	.	.	.	.	.	.	II	I	.	.	1	I	.	.	.	I	.
Tamus communis L.	.	.	.	.	.	.	I	.	.	I	I	.	1	III	I	.	.	.	I
Ampelodesmos mauritanicus (Poir.) Durand & Schinz	.	.	I	.	.	.	.	.	.	.	.	I	.	.	III	.	3	III	V
Ruscus aculeatus L.	II	.	.	.	.	.	II	.	I	I	I	.	.	.	.	.	.	I	.
Osyris alba L.	II	.	.	.	.	.	II	.	II	.	.	.	.	.	.	II	.	.	.
Carex hallerana Asso	.	I	.	.	.	II	I	.	III	.	.	.	.	.	.	.	.	.	.
Cyclamen repandum Sm.	.	II	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.
Daphne gnidium L.	.	.	.	.	.	.	I	.	.	.	I	.	.	.	.	.	.	.	.
Pistacia terebinthus L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	I
Quercus suber L.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.
Daphne sericea Vahl	.	.	.	.	.	.	.	.	.	.	.	II	.	.	.	.	.	.	.
Cyclamen hederifolium Aiton subsp. hederifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
Asplenium onopteris L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.
Viburnum tinus L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	I	.
Selaginella denticulata (L.) Spring	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.
Char. class *Cisto-Micromerietea*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rosmarinus officinalis L.	II	I	.	.	.	.	II	1	II	I	I	III	1	II	II	.	3	I	.
Cistus monspeliensis L.	II	.	.	.	I	III	.	.	II	II	I	IV	1	.	.	.	.	.	.
Cistus salviifolius L.	.	.	.	.	I	.	II	.	I	I	II	.	.	.	II	.	.	II	.
Dorycnium hirsutum (L.) Ser.	II	.	.	.	.	.	I	.	I	.	.	II	.	I	.	.	.	I	.
Coridothymus capitatus (L.) Rchb.	I	.	III	.	.	.	.	.	I	.	.	.	.	.	III	.	.	.	.
Genista corsica DC.	.	.	II	.	.	II	.	.	.	I	I	.	.	.	.	.	.	.	.
Phagnalon saxatile (L.) Cass.	.	.	.	1	II	.	.	.	.	.	.	.	.	.	III	.	.	.	I
Fumana thymifolia (L.) Spach	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	I
Cytinus hypocistis (L.) L. subsp. hypocistis	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	I
Fumana arabica (L.) Spach	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Companions																			
Brachypodium retusum (Pers.) P. Beauv.	V	V	II	.	III	V	.	.	V	I	III	IV	2	III	I	.	2	V	.
Allium subhirsutum L.	II	V	V	1	.	I	I	.	II	I	.	V	1	II	.	I	.	.	IV
Asphodelus ramosus L. subsp. ramosus	IV	IV	I	.	I	II	II	.	IV	I	I	.	.	.	I	.	1	.	IV
Dactylis glomerata L. subsp. hispanica (Roth) Nyman																			
(+ Dactylis glomerata L. subsp. glomerata*)	III*	.	.	.	.	I	.	.	III	.	I	II*	1*	II	.	.	.	.	.
Charybdis pancration (Steinh.) Speta	.	IV	.	.	.	.	.	.	.	I	.	.	.	.	I	.	.	II	V
Piptatherum miliaceum (L.) Coss. subsp. miliaceum	.	.	.	.	.	.	I	.	.	I	II	.	1	.	.	.	.	.	.
Lotus cytisoides L.	I	.	.	.	.	.	.	.	I	.	I	.	.	.	.	.	.	.	.
Hyparrhenia hirta (L.) Stapf	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	II	III
Helichrysum italicum s.l.	.	.	.	.	.	.	.	.	.	I	III	.	.	.	.	.	.	.	.
Carex flacca Schreb. subsp. erythrostachys (Hoppe) Holub	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	III
Acanthus mollis L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.

jovis, Euphorbia dendroides, Ruta chalepensis.
Structure and ecology: It represents a cliff aspect, sometimes located in little steep areas.
Vegetation series: Edapho-xerophilous northern Sardinian, calcicolous, thermo-mesomediterranean dry series of the maritime Phoenicean Juniper (*Chamaeropo humilis-Junipero turbinatae anthyllidetoso barbaejovis sigmetum*).
Distribution: Capo Caccia Peninsula (Biondi *et al*., 2001).

8c) *arbutetosum unedonis* Biondi, Filigheddu & Farris 2001 [Fitosoc. 38 (2) suppl. 2: 62]
Holotypus: Rel. 25, Tab. 56, Biondi *et al*. (2001).
Characteristic/Differential species: *Arbutus unedo, Quercus ilex, Lonicera implexa, Carex distachya, Cyclamen repandum, Arum pictum*.
Structure and ecology: Aspect tied to quartziferous sandstones and eolic sands, on deep and evolved soils, placed in contact with the aspects of *Erico-Arbutetum*, such as maquis association of degradation of the holm oak formation.
Vegetation series: Edapho-xerophilous northern Sardinian, neutro-acidophilous, thermo-mesomediterranean series of the maritime turbinate juniper (*Chamaeropo humilis-Junipero turbinatae arbutetoso unedonis sigmetum*).
Distribution: Syntaxon reported for the Nurra at Cala Viola and at the Baratz Lake (Biondi *et al*., 2001).

9) *Euphorbio characiae-Juniperetum turbinatae* Biondi, Filigheddu & Farris 2001 [Fitosoc. 38 (2) suppl. 2: 61]
Holotypus: Rel. 3, Tab. 55, Biondi *et al*. (2001).
Table: Tab. 6, col. 22.
Characteristic/Differential species: *Juniperus phoenicea* subsp. *turbinata, Euphorbia characias, Calicotome villosa*.
Structure and ecology: More or less dense maquis-bush dominated by *Juniperus phoenicea* subsp. *turbinata*, typical of Paleozoic schists, in the summit areas of the cliffs and on the deposits of the fluvial alluvions preceding the sandy shoreline (Biondi *et al*., 2001). *Pistacia lentiscus, Prasium majus* and *Rubia peregrina* are among the other most representative species.
Bioclimate: Upper thermomediterranean with upper dry ombrotype.
Vegetation series: Edapho-xerophilous north-western Sardinian, calcifuge, thermomediterranean dry series of the turbinate juniper (*Euphorbio characio-Junipero turbinatae sigmetum*; Biondi *et al*., 2001; Bacchetta *et al*., 2009, 2010).
Distribution: Stintino Peninsula, Piana Island, western metamorphic Nurra (Argentiera up to Porto Ferro), southern part of Asinara Island, in the Fornelli Plain (Biondi *et al*., 2001; Bacchetta *et al*., 2009, 2010).

10) *Teucrio fruticantis-Juniperetum turbinatae* Arrigoni, Nardi & Raffaelli 1985
Synonyms: *Teucrio fruticantis-Juniperetum phoeniceae* Arrigoni, Nardi & Raffaelli 1985; *Teucrio fruticantis-Juniperetum turbinatae* corr. Asensi, Díez-Garretas, Quézel & Quézel 2007 (Phytocoenologia 37 (3-4): 612)
Holotypus: Rel. 124, Tab. 7, Arrigoni *et al*. (1985).
Table: Tab. 6, col. 23-25.
Characteristic/Differential species: *Juniperus phoenicea* subsp. *turbinata, Teucrium fruticans, Prasium majus*.
Floristic/Syntaxonomical notes: For its fequency, *Coronilla valentina* is also indicated among the differentials of the phytocoenosis.
Structure and ecology: High maquis-bush, more or less dense, dominated by *Juniperus phoenicea* subsp. *turbinata*, typical of sheer cliffs of carbonate nature, in absence of soil for strong inclination of the slopes (Biondi, 1999).
Bioclimate: Thermo-mesomediterranean, with dry-subhumid ombrotype.
Vegetation series: Edapho-xerophilous Tuscan-Maremman, calcicolous, mesomediterranean subhumid series of the turbinate juniper (*Teucrio fruticantis-Junipero turbinatae sigmetum*).
Distribution: The association was described by Arrigoni *et al*. (1985) for the coasts of the Tuscan Maremma and indicated by the same authors also for Giannutri Island, in the Tuscan Archipelago (Arrigoni & Di Tommaso, 1981); the phytocoenosis was subsequently reported for other Maremman localities – e.g. at Punta Ala (De Dominicis *et al*., 1988; Biondi, 1999) –, for the rocky coasts south of the Argentario (Arrigoni & Di Tommaso, 1997) and for Pianosa Island (Foggi *et al*., 2008).

11) *Calicotomo infestae-Juniperetum turbinatae* Brullo, Gianguzzi, La Mantia & Siracusa 2009 [Boll. Accad. Gioenia Sci. Nat. Cat. 41 (369): 25]
Holotypus: Rel. 7, Tab. 3d, Brullo *et al*. (2009).
Table: Tab. 6, col. 26-27.
Characteristic species: *Juniperus phoenicea* subsp. *turbinata*, *Calicotome infesta*.
Structure and ecology: Coastal maquis-bush dominated by *Juniperus phoenicea* subsp. *turbinata* settled on substrates of various kinds (calcarenites; marly, sandstone-marly or clayey limestones), on steep slopes with shallow and immature soils. It is considered a central-southern vicariant phytocoenosis of the *Oleo-Juniperetum turbinatae* (Brullo *et al*., 2009).
Bioclimate: Thermomediterranean dry from lower to upper.
Distribution: The association is indicated for the southern and north-western coasts of Sicily (Brullo *et al*., 2009) and of Calabria, south of the Aspromonte (Mer-

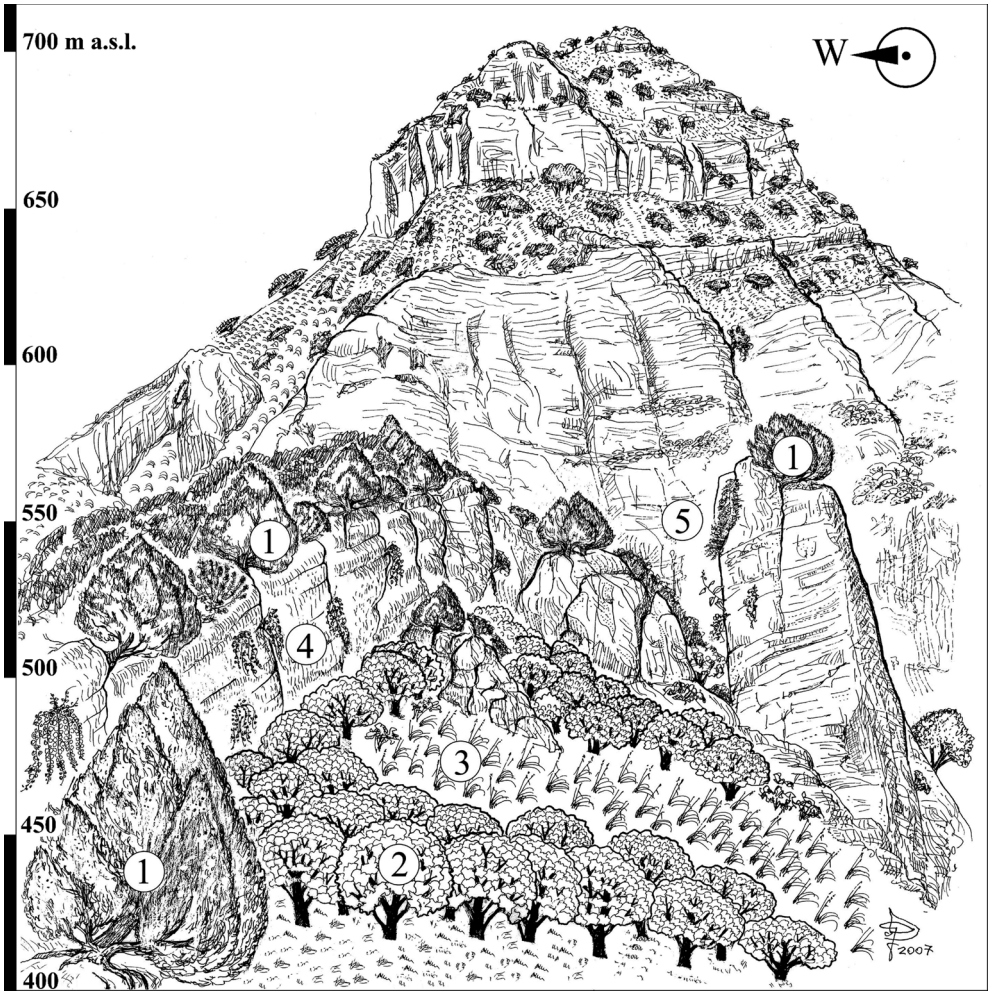

Fig. 5 - Schematic transect of the plant landscape of the Sicilian hinterland (Sicani Mts.), in which the relictual juniper formation with *Juniperus phoenicea* subsp. *turbinata* fits: 1. *Juniperus phoenicea* subsp. *turbinata* maquis (*Ampelodesmo mauritanici-Juniperetum turbinatae cistetosum cretici* subass. nova); 2. *Quercus ilex* subsp. *ilex* woodland (*Pistacio lentisci-Quercetum ilicis* Brullo & Marcenò 1985); 3. *Ampelodesmos mauritanicus* grassland (*Helictotricho convoluti-Ampelodesmetum mauritanici* Minissale 1995); 4. *Capparis rupestris* chasmophytic community (*Capparietum rupestris* O. Bolòs & Molinier 1958); 5. *Polypodium cambricum* subsp. *serrulatum comophilous* community (*Polypodietum serrati* Br.-Bl. in Br.-Bl., Roussine & Nègre 1952).

curio & Spampinato, 1999; Brullo *et al*., 2001).

11a) subass. *typicum*
Holotypus: Rel. 7, Tab. 3d, Brullo *et al*. (2009).
Distribution: Sicily, where it partially became extinct, as a result of the urbanization of the coastal areas (Di Martino & Sortino, 1970); relictual strips are circumscribed to the following localities: Alcamo Marina, Capo Bianco and Torresalsa (La Mantia, 2003), Cava Randello (Turrisi *et al*., 2002, sub *Oleo-Juniperetum turbinatae*).
Vegetation series: Coastal Sicilian (Drepano-Agrigentine-Ragusane), edapho-xerophilous, calcicolous, thermomediterranean dry series of the turbinate juniper (*Calicotomo infestae-Junipero turbinatae sigmetum*).

11b) *phlomidetosum fruticosae* subass. nova hoc loco
Holotypus: Rel. 5, Tab. 3, Mercurio & Spampinato (1999).
Synonyms: *Oleo-Juniperetum turbinatae* sensu Mercurio & Spampinato (1999), and sensu Brullo *et al*. (2001); *Calicotomo infestae-Juniperetum turbinatae* sensu Brullo *et al*. (2009) p.p.
Distribution: Coasts of the southern Calabria, at Condofuri (RC), in Vadicamo locality (Mercurio & Spampinato, 1999; Brullo *et al*., 2001).
Vegetation series: Coastal Calabrian-Ionian, edapho-xerophilous, thermomediterranean dry series of the turbinate juniper (*Calicotomo infestae-Junipero turbinatae phlomidetoso fruticosae sigmetum*).

12) *Ampelodesmo mauritanici-Juniperetum turbinatae* ass. nova hoc loco
Synonym: *Oleo-Juniperetum turbinatae* sensu Caneva *et al*. (2004).

Holotypus: Rel. 6, Tab. 7.
Table: Tab. 6, col. 28-30.
Characteristic/Differential species: *Juniperus phoenicea* subsp. *turbinata, Phillyrea latifolia, Ampelodemos mauritanicus, Erica multiflora, Emerus major* subsp. *emeroides*.
Floristic/Syntaxonomical notes: Besides *Phillyrea latifolia* and *Emerus major* subsp. *emeroides* – relatively frequent in the coenosis, unlike the other investigated juniper formations –, in the floristic connotation of this association the structural role played by *Erica multiflora* and *Ampelodesmos mauritanicus* is considered somewhat significant. Indeed, these two species usually characterize secondary formations, in particular garrigues of the *Cisto cretici-Ericion manipuliflorae* Horvatic 1958 (*Erica multiflora*) or grasslands of the *Avenulo cincinnatae-Ampelodesmion mauritanici* Minissale 1995 (*Ampelodesmos mauritanicus*); however, in this juniper formation they find favorable conditions, related to the particular morphology and to the accentuated steepness of the sites, which do not allow any progress of the coenosis toward a denser maquis. The two entities take therefore part in the floristic composition of this coenosis, interpreted like a relict formation of preglacial epoch, settled in a refuge-habitat.
Structure and ecology: Maquis-bush dominated by *Juniperus phoenicea* subsp. *turbinata* typical of calcareous substrates, located in stations with a rough morphology, with a coastal-hilly centre of gravitation. In the coenosis there are various entities of the alliance *Oleo sylvestris-Ceratonion siliquae* and of the order *Pistacio lentisci-Rhamnetalia alaterni* (*Olea europaea* var. *sylvestris, Prasium majus, Pistacia lentiscus, Rhamnus alaternus*), as well as of the class *Quercetea ilicis* (*Rubia peregrina, Phillyrea latifolia, Asparagus acutifolius, Rhamnus alaternus*, etc.).
Bioclimate: Thermo-mesomediterranean with dry-subhumid ombrotype.
Distribution: The association was detected in the interior of Sicily, in particular on Sicani Mts. (Gianguzzi *et al*., 2007); the physociological relevés reported for the Lucanian coasts of the Tyrrhenian side, at Maratea (Caneva *et al*., 1985), as well as for the coastal areas of the Sorrentine - Amalfitana Peninsula (Campania), by Cancellieri (2008, sub *Oleo-Juniperetum turbinatae*), are also referred to this syntaxon.

12a) *myrtetosum communis* subass. nova hoc loco
Synonym: *Oleo-Juniperetum turbinatae* sensu Caneva *et al*. (2004).
Holotypus: Rel. 15, Tab. 1, Caneva *et al*. (2004).
Table: Tab. 6, col. 28-29.
Characteristic/Differential species: *Myrtus communis* subsp. *communis*, *Clematis flammula*.
Floristic/Syntaxonomical notes: For their frequency, the aforecited entities are proposed as differentials species of the Calabrian - Lucanian subassociation.
Bioclimate: Thermo-mesomediterranean with dry-subhumid ombrotype.
Vegetation series: Coastal - insular Calabrian - Lucanian Tyrrhenian, edapho-xerophilous, calcicolous, thermo-mesomediterranean dry series of the turbinate juniper (*Ampelodesmo mauritanici-Junipero turbinatae myrtetoso communis sigmetum*).
Distribution: Coasts between the northern Calabria and Lucania, between Acquafredda and Capo Scalea (islets of Dino, Castrocucco and S. Nicola Arcella, cliffs of Fiuzzi and Acquafredda), on sedimentary rocky substrates of carbonate nature with a prevalence of limestones and dolomite-limestones of the Triassic (Caneva *et al*., 1997, 2004). The relevés reported for the coastal belt of the Sorrentine-Amalfitana Peninsula (Campania), by Cancellieri (2008, sub *Oleo-Juniperetum turbinatae*), are also referred to the same phytocoenosis.

12b) *cistetosum cretici* subass. nova hoc loco
Holotypus: Rel. 6, Tab. 7.
Tables: Tab. 6, col. 30; Tab. 7.
Characteristic/Differential species: *Cistus creticus, Micromeria graeca* subsp. *graeca, Fumana laevipes*.
Floristic/Syntaxonomical notes: The aforecited character entities of the alliance *Cisto cretici-Ericion manipuliflorae*, are indicated as "transgressive-differential" species of the Sicilian subassociation, in accordance with the concept expressed by Poldini & Sburlino (2005).
Bioclimate: Thermomediterranean with dry ombrotype.
Vegetation series: Hilly Sicilian, edapho-xerophilous, calcicolous, thermomediterranean dry series of the turbinate juniper (*Ampelodesmo mauritanici-Junipero turbinatae cistetoso cretici sigmetum*).
Distribution: Sicilian hinterland (Sicani Mts.), along the ravines of the Sosio River (Gianguzzi *et al*., 2007; Fig. 4).

D) *Ericion arboreae* (Rivas-Martínez ex Rivas-Martínez, Costa & Izco 1985) Rivas-Martínez 1987, Mem. Mapa Ser. Veg. España: 166.
Structure and ecology: *Juniperus phoenicea* subsp. *turbinata* formations of the thermo- and mesomediterranean bioclimatic belts with dry-subhumid ombrotype, located in coastal and insular stations, fresh also in summer and interested by wet currents, on siliceous substrates or also carbonate but leached (Rivas-Martínez *et al*., 2002).
Floristic/Syntaxonomical notes: As evidenced in the synoptic framework (Tab. 2), in these aspects of juniper formation *Erica arborea* plays an important structural role, accompanied usually by other mesophilous species, as well as calcifuge of the *Pistacio lentisci-*

Rhamnetalia alaterni (*Arbutus unedo, Myrtus communis* subsp. *communis, Pulicaria odora*), matched to a concomitant absence or rarity of the thermophilous elements of the *Oleo sylvestris-Ceratonion siliquae*, in particular *Olea europaea* var. *sylvestris*, *Euphorbia dendroides, Asparagus albus, Chamaerops humilis, Teucrium fruticans, Clematis cirrhosa, Teucrium flavum* subsp. *flavum* and *Ceratonia siliqua*.
Table: Tab. 2, col. 31-33.

13) *Erico arboreae-Juniperetum turbinatae* De Marco, Dinelli & Caneva 1985 (Not. Fitosoc. 22: 44) corr. Biondi & Bagella 2005 (Fitosoc. 42 (2) suppl. 1: 56)

Synonyms: *Erico-Juniperetum phoeniceae* De Marco, Dinelli & Caneva 1985; *Oleo-Lentiscetum* sensu De Marco & Mossa (1980, Tab. 12, p.p.); *Pistacio-Juniperetum oxycedri* sensu Camarda *et al*., 1995 p.p. (Tab. 10, rel. 63); *Anthyllido barbae-jovis-Juniperetum turbinatae* Foggi *et al*. 2006 p.p. (Tab. 38, rel. 1, 4, 20).
Holotypus: Rel. 12, Tab. 1, De Marco & Mossa (1980).
Table: Tab. 8, col. 31-33.
Characteristic/Differential species: *Erica arborea, Arbutus unedo, Asparagus acutifolius*.
***Floristic/Syntaxonomical notes*:** Some relevés published by Foggi *et al*. (2006, Tab. 38, rel. 1, 4 and 20) for Elba Island (sub *Anthyllido barbae-jovis-Juniperetum*

Tab. 7 - *Ampelodesmo mauritanici-Juniperetum turbinatae* ass. nova *cistetosum cretici* subass. nova: hinterland of Sicily on Sicani Mts. (along the Sosio River at Valle Vite): rel. 1-6 (10.01.2007), rel. 7-9 (4.05.2007).

Relevé number	1	2	3	4	5	6	7	8	9		
Altitude (m a.s.l.)	330	335	400	420	430	420	400	410	420		
Slope (%)	30	30	20	15	60	60	65	60	55		
Exposition	SW	SW	S	SE	E	SW	SW	SW	S		
Surface (m^2)	70	80	70	80	80	80	80	60	80		
Total coverage (%)	80	80	80	90	90	85	75	75	75		
Arboreal layer coverage (%)	-	-	30	40	30	30	20	15	10		
Shrubby layer coverage (%)	80	80	60	70	75	70	70	70	75		
Herbaceous layer coverage (%)	40	45	60	35	20	30	35	30	35		
Average height (m)	1,8	1,8	2,5	2,8	2,1	2,2	2,2	2,2	2,1		
Number of species	19	29	23	17	15	21	22	18	16	Presences	Constancy
Char. and diff. ass.											
Juniperus phoenicea L. subsp. turbinata (Guss.) Nyman	2	2	4	5	5	4	4	3	4	9	V
Phillyrea latifolia L.	1	2	2	2	1	1	2	2	1	9	V
Erica multiflora L. subsp. multiflora	4	4	3	2	1	4	3	4	3	9	V
Ampelodesmos mauritanicus (Poir.) Durand & Schinz	2	3	3	3	1	2	2	1	2	9	V
Char. subass. *cistetosum creticae*											
Cistus creticus L. subsp. creticus	1	1	1	2	1	1	2	2	2	9	V
Micromeria graeca (L.) Benth. subsp. graeca	+	1	+	1	1	1	1	+	1	9	V
Fumana laevipes (L.) Spach	+	1	1	1	+	1	1	+	1	9	V
Char. alliance *Oleo-Ceratonion* and order *Pistacio lentisci-Rhamnetalia alaterni*											
Pistacia lentiscus L.	2	3	1	2	1	1	+	1	1	9	V
Prasium majus L.	+	+	+	.	+	1	.	.	+	6	IV
Olea europaea L. var. sylvestris (Mill.) Lehr	1	1	1	.	.	1	1	.	1	6	IV
Teucrium flavum L. subsp. flavum	1	2	1	1	.	1	.	.	.	5	III
Euphorbia dendroides L.	.	.	.	.	1	1	.	.	.	2	II
Char. class *Quercetea ilicis*											
Asparagus acutifolius L.	+	1	+	+	.	+	.	+	1	7	IV
Rhamnus alaternus L.	1	1	1	.	1	1	1	.	.	6	IV
Arbutus unedo L.	+	1	1	.	.	1	.	.	.	4	III
Cyclamen hederifolium Aiton	+	+	.	.	.	.	.	.	.	2	II
Rubia peregrina L. subsp. longifolia (Poir.) O. Bolòs	.	+	.	.	.	.	.	.	.	1	I
Quercus ilex L. subsp. ilex	.	.	.	1	.	.	.	.	.	1	I
Emerus major Mill. subsp. emeroides (Boiss. & Spruner) Soldano & Conti	.	.	.	1	.	.	.	.	.	1	I
Lonicera implexa Aiton	.	.	.	.	.	1	.	.	.	1	I
Pistacia terebinthus L.	.	.	.	.	.	.	1	.	.	1	I
Ingr. alliance *Cisto-Ericion* and class *Cisto-Micromerietea*											
Fumana thymifolia (L.) Spach ex Webb	.	1	.	.	.	.	1	2	1	4	III
Fumana arabica (L.) Spach	.	.	+	.	.	.	.	.	.	1	I
Phagnalon saxatile (L.) Cass.	.	.	.	.	.	.	+	.	.	1	I
Cytinus hypocistis (L.) L. subsp. hypocistis	.	.	.	.	.	.	+	.	.	1	I
Companions											
Charybdis pancration (Steinh.) Speta	+	+	1	1	+	+	+	+	+	9	V
Asphodelus ramosus L. subsp. ramosus	+	+	+	+	.	.	1	+	+	7	IV
Sedum sediforme	1	+	+	.	.	.	1	+	+	6	IV
Allium subhirsutum L.	.	1	+	1	+	+	.	.	.	5	III
Hyparrhenia hirta (L.) Stapf	.	+	2	.	.	+	.	+	.	4	III
Prospero autumnale (L.) Speta	.	+	+	1	+	.	.	.	.	4	III
Carex flacca Schreb. subsp. erythrostachys (Hoppe) Holub	+	+	+	.	.	+	.	.	.	4	III
Lomelosia cretica (L.) Greuter & Burdet	.	.	.	.	1	1	.	.	+	3	II
Ranunculus bullatus L.	.	+	+	+	.	.	.	.	.	3	II
Asperula aristata L. subsp. scabra (J. & C. Presl) Nyman	.	.	.	.	.	.	+	+	.	2	II
Erysimum metlesicsii Polatschek	.	.	.	.	.	.	+	+	.	2	II
Seseli bocconi Guss.	.	.	.	.	.	.	+	+	.	2	II
Anthyllis vulneraria L. subsp. maura (Beck) Maire	.	.	.	.	.	.	+	+	.	2	II
Andropogon distachyos L.	.	1	.	.	.	.	.	.	.	1	I
Avenula cincinnata (Ten.) Holub	.	+	.	.	.	.	.	.	.	1	I
Orchis italica Poir.	.	+	.	.	.	.	.	.	.	1	I
Melica uniflora Retz.	.	+	.	.	.	.	.	.	.	1	I
Arabis collina Ten.	.	.	.	.	.	.	+	.	.	1	I

Tab. 8 - Synoptic table of the *Juniperus phoenicea* subsp. *turbinata* formations of the alliance *Ericion arboreae* in the Italo-Tyrrhenian Province (Fig. 4): 31. *Erico arboreae-Juniperetum turbinatae*, Maddalena Archipelago (north-eastern Sardinia), by Biondi & Bagella (2005), Tab. 71; 32. *Erico arboreae-Juniperetum turbinatae*, various localities of the south-western Sardinia (Sulcis-Iglesiente: by Camarda *et al.* 1995, Tab. 10, rel. 63, sub *Pistacio-Juniperetum oxycedri* Camarda *et al.* 1995), of the Tuscan Archipelago (Montecristo Island, between Cala della Fortezza and Cala Cappel del Prete: by Landi *et al.*, 2007, Tab. 2, sub *Erico arboreae-Juniperetum phoeniceae* De Marco *et al.* 1985) and of Ponza Island (Montagnella and Lucia Rosa localities: by Stanisci *et al.*, 2005, Tab. 6, rel. 6-7); 33. *Erico-Juniperetum turbinatae*, Elba Island (Tuscan Archipelago), in Nisporto and Enfola localities [by Foggi *et al.* (2006), Tab. 38, rel. 20, 1 and 4, sub *Anthyllido barbae-jovis-Juniperetum turbinatae*].

Table number	31	32	33
Association number	13	13	13
Relevé number	9	7	3
Guide species			
Juniperus phoenicea L. subsp. turbinata (Guss.) Nyman	V	V	3
Char. and diff. alliance *Ericion arboreae* and ass. *Erico-Juniperetum*			
Erica arborea L.	III	V	2
Myrtus communis L. subsp. communis	IV	II	3
Arbutus unedo L.	II	I	1
Pulicaria odora L.	.	I	1
Char. order *Pistacio lentisci-Rhamnetalia alaterni*			
Pistacia lentiscus L.	V	III	3
Rhamnus alaternus L.	III	II	3
Calicotome villosa (Poir.) Link	I	I	1
Phillyrea angustifolia L.	V	II	.
Olea europaea L. var. sylvestris (Mill.) Lehr	.	I	.
Euphorbia dendroides L.	.	I	.
Teucrium flavum L. subsp. flavum	.	I	.
Clematis flammula L.	.	I	.
Char. class *Quercetea ilicis*			
Smilax aspera L.	III	I	2
Rubia peregrina L. subsp. longifolia (Poir.) O. Bolòs	II	II	3
Phillyrea latifolia L.	I	III	1
Asparagus acutifolius L.	III	II	3
Arisarum vulgare Targ.-Tozz.	II	V	.
Prasium majus L.	I	II	.
Carex hallerana Asso	I	I	.
Osyris alba L.	I	I	.
Lonicera implexa Aiton	.	II	2
Quercus ilex L. subsp. ilex	.	II	1
Cyclamen repandum Sm.	.	I	.
Euphorbia characias L.	.	I	.
Daphne sericea Vahl	.	I	.
Asplenium onopteris L.	.	I	.
Ampelodesmos mauritanicus (Poir.) Durand & Schinz	.	.	1
Tamus communis L.	.	.	1
Daphne gnidium L.	.	.	1
Char. class *Cisto-Micromerietea*			
Cistus monspeliensis L.	II	I	1
Rosmarinus officinalis L.	.	III	2
Genista thyrrena Vals. subsp. pontiana Brullo & De Marco	.	II	.
Genista corsica DC.	I	.	.
Dorycnium hirsutum (L.) Ser.	.	.	1
Cistus creticus L. subsp. eriocephalus (Viv.) Greuter & Burdet	.	.	1
Companions			
Brachypodium retusum (Pers.) P. Beauv.	II	.	3
Helichrysum italicum s.l.	I	I	.
Carex flacca Schreb. subsp. erythrostachys (Hoppe) Holub	.	I	1
Asphodelus ramosus L. subsp. ramosus	.	III	.
Dactylis glomerata L. subsp. glomerata	.	.	1
Allium subhirsutum L.	.	.	1

turbinatae) are also referred to this association. They are *Juniperus phoenicea* subsp. *turbinata* aspects located along the coast on acid intrusive substrates and silicate rocks (Enfola locality: rel. 1 and 4) and on north-facing limestones (Nisporto locality: rel. 20) probably leached, inasmuch subject to humid currents. Indeed, the character calcifuge species of the *Ericion arboreae* (*Erica arborea, Myrtus communis, Pulicaria odora* and *Arbutus unedo)* are present, with *Anthyllis barba-jovis* absent in two out of three relevés.

Structure and ecology: More or less dense maquis dominated by *Juniperus phoenicea* subsp. *turbinata* and *Erica arborea*, typical of acid igneous substrates or acidified soils by leaching, located on northern slopes exposed to the winds, where the temperature drops significantly also during the summer season (Biondi & Bagella, 2005). Among the other most representative species there are *Myrtus communis* subsp. *communis*, *Pistacia lentiscus, Phillyrea angustifolia*, and, in the herbaceous layer, *Brachypodium ramosum* and *Arisarum vulgare*.

Bioclimate: Thermomediterranean with dry-subhumid ombrotype.

Vegetation series: Insular Tyrrhenian, edapho-xerophilous, calcifuge, thermomediterranean dry series of the turbinate juniper (*Erico arboreae-Junipero turbinatae sigmetum*).

Distribution: The association is reported for: a) the volcanics rocks of Ponza Island, at Montagnella and Lucia Rosa (Stanisci *et al.*, 2005, sub *Erico arboreae-Juniperetum phoeniceae*); b) the acid intrusive magmatic rocks of Elba Island, in particular at Enfola, Punta Polveraia, between Colle di Palombaia and Punta Cavoli (Foggi *et al.*, 2006, sub *Anthyllido barbae-jovis-Juniperetum*, p.p.); c) the granite substrates of Montecristo Island (Tuscan Archipelago; Landi *et al.*, 2007); the metamorphic substrates of Sardinia, where it is indicated for the north-western part of San Pietro Island (De Marco & Mossa, 1980), the Maddalena Archipelago and the opposite shoreline (Biondi & Bagella, 2005), Capo Testa and the adjacent shoreline, Costa Paradiso, Gulf of Marinella, Gulf Aranci and Molara Island (Bacchetta *et al.*, 2009; Bacchetta *et al.*, 2010). A further relevé ascribable to the coenosis is still reported for the south-western Sardinia, in the Sulcis-Iglesiente area (from Camarda *et al.*, 1995, sub *Pistacio-Juniperetum oxycedri* Camarda *et al.*, 1995, Tab. 10, rel. 63).

Conclusions

The *Juniperus phoenicea* subsp. *turbinata* formations are well represented in the entire coastal belt of the Italo-Tyrrhenian Province, where they show however a quite discontinuous and fragmented distribution. From a physiognomic-structural point of view, these formations constitute more or less dense maquis vegetation (Fig. 6), sometimes evolving up to bush and microwoods, as it occurs for example in some typologies of Sardinia.

Fig. 6 - 1. Twigs with galbuli of *Juniperus phoenicea* subsp. *turbinata* on Sicani Mts. (Sicily); 2. Aspects of the association *Periploco angustifoliae-Juniperetum turbinatae* on volcanic cliffs of Salta la Vecchia (Pantelleria Island, Channel of Sicily); 3. *Junipero turbinatae-Quercetum calliprini maquis*, settled on fossil dunes at Buggerru-Portixeddu (south-western Sardinia); 4. *Chamaeropo-Juniperetum turbinatae* vegetation, at Capo Caccia Peninsula (north-western Sardinia); 5-7. Vegetation referred to the association *Ampelodesmo mauritanici-Juniperetum turbinatae* (Sicily, Sicani Mts.), with close-ups of long-standing specimens of *Juniperus turbinata*, typical of relictual strips located at the top of rocky spikes.

Besides on a biogeographical basis, these formations differ also under the floristic and phytosociological aspect, in relation to climatic factors (from the inframediterranean semiarid to the mesomediterranean subhumid bioclimatic belt) and edaphic (sandstones, limestones, calcarenites, metamorphites, volcanics, etc.).

The comparative analysis of the coenoses, carried out on the basis of the available literature data and of unpublished relevés – also validated on a statistical basis – has allowed their breakdown in four different alliances, in turn diversifiable on a syntaxonomical (Rivas-Martínez *et al.* 2001c, 2002), ecological, as well as floristic basis, as follows:

1) *Periplocion angustifoliae* (formations of the inframediterranean semiarid-dry bioclimatic belt, with considerable frequency of summer-deciduous species, in particular *Periploca laevigata* subsp. *angustifolia*), with the association *Periploco angustifoliae-Juniperetum turbinatae*; 2) *Juniperion turbinatae* (communities of the thermo- and mesomediterranean bioclimatic belt with semiarid-dry ombrotype, tied to sandy coasts and paleodunes, with significant frequency of psammophytes, in particular *Juniperus macrocarpa*), with the associations *Junipero turbinatae-Quercetum calliprini, Rusco aculeati-Quercetum calliprini, Phillyreo angustifoliae-Juniperetum turbinatae, Asparago albi-Juniperetum turbinatae, Asparago acutifolii-Juniperetum macrocarpae* subass. *juniperetosum turbinatae*; 3) *Oleo sylvestris-Ceratonion siliquae* (formations of the thermo- and mesomediterranean bioclimatic belt with dry-subhumid ombrotype, linked to compact coastal rocky substrates of various kinds, with considerable frequency of lithophilous species), with the associations *Oleo sylvestris-Juniperetum turbinatae, Chamaeropo humilis-Juniperetum turbinatae, Euphorbio characiae-Juniperetum turbinatae, Teucrio fruticantis-Juniperetum turbinatae, Calicotomo infestae-Juniperetum turbinatae* and *Ampelodesmo mauritanici-Juniperetum turbinatae*; 4) *Ericion arboreae* (communities of the thermo- and mesomediterranean bioclimatic belt with dry-subhumid ombrotype, tied to rocky coasts quartzitic or also carbonate, but with leached soils, with significant frequency of calcifuge species, in particular *Erica arborea*), with the only association *Erico arboreae-Juniperetum turbinatae*.

In the light of the aforementioned considerations, and in agreement with other authors (Rivas-Martínez *et al.*, 2001c, 2002; Bacchetta *et al.*, 2009), the role of *Juniperus phoenicea* subsp. *turbinata* as characteristic species of the order *Pistacio-Rhamnetalia alaterni* has to be reaffirmed, and not so much of alliance (e.g. *Juniperion turbinatae*, one of which real discriminating is instead *J. macrocarpa*).

Among the coenoses taken under review, one of them (*Ampelodesmo mauritanici-Juniperetum turbinatae*) represents a new association, described for the interior of Sicily and the Calabrian-Lucanian Tyrrhenian coastal belt, as well as for the coastal belt of the Sorrentine-Amalfitana Peninsula. It assumes a particular phytogeographical importance, because of its extreme localization, the residual significance and the naturalistic-environmental value. Indeed, though it is known that *Juniperus phoenicea* subsp. *turbinata* tends potentially to reach a great longevity, to observe individuals of large size is by now very rare, as instead it occurs within the aforementioned biotopes, where multi-centuries old individuals are also present.

Under the conservative aspects, the surveyed juniper formations are usually reduced to strips of residual vegetation; this is due to the relictuality itself of the ceonoses or to the extreme environmental decay determined by the man along the entire coastal belt where the stations are located (urbanization, leveling of the dunes, fires, deforestation, etc.). Given the peculiarity and the rarity of these formations, they are included among the habitat natural types of community interest of the known Directive 92/43/EEC ("2250*: Coastal dunes with *Juniperus* spp."; "5210: Arborescent matorral with *Juniperus* spp."). In this regard, the important researches with a phytosociological character, made by the "Working Group for vegetation" of the Italian Botanical Society [Biondi (ed.), 2007; Biondi *et al.*, 2009, 2012], are also to be mentioned.

Anyway, a more adequate protection of these sites – duly detailed in the present paper – in order to avoid the further erosion of the biodiversity itself, by now arrived at particularly critical levels, would be appropriate; this is for example the case of the *Calicotomo infestae-Juniperetum turbinatae*, whose coenosis is somewhat localized in the coastal belt of Sicily, on very small surfaces placed within highly urbanized areas, and therefore greatly at risk of disappearance in the short term.

Acknowledgments

The authors wish to thank: Prof. E. Biondi (Polytechnic University of Marche) and Prof. G. Bacchetta (University of Cagliari), for the useful suggestions and the critical review of the paper; Prof. Giulia Caneva (University of Roma Tre), Prof. Simonetta Fascetti (University of Basilicata), Prof. Bruno Foggi (University of Florence) and Prof. Mauro Raffaelli (University of Florence), for the provided bibliograhic data; Prof. Raffaele Giancarlo (University of Palermo, Department of Mathematics, Computer Science Section), for suggestions concerning the statistical evaluation of data. This research was supported by a contribution from "Ricerca d'Ateneo ex 60%", University of Palermo.

References

Adams R.P., Pandey R.N., Rezzi S. & Casanova J., 2002. Geographic variation in the Random Amplified Polymorphic DNAs (RAPDs) of *Juniperus phoenicea, J. p.* var. *canariensis, J. p.* subsp. *eumediterranea,* and *J. p.* var. *turbinata*. Biochemical Systematics and Ecology 30: 223-229.

Agostini R. & Sanfilippo E., 1970. Ricerche storiche, fitosociologiche e dendrometriche sulla pineta naturale di pino d'Aleppo a Porto Pino (Sardegna sud-occidentale). Annali dell'Accademia Italiana di Scienze Forestali 29: 177-208.

Angiolini C., Bacchetta G., Brullo S., Casti M., Giusso Del Galdo G. & Guarino R., 2005. The vegetation of mining dumps in SW-Sardinia. Feddes Repertorium 116 (2005) 3-4: 243-276.

Arrigoni P.V. & Di Tommaso P.L., 1981. Carta della vegetazione dell'Isola di Giannutri (Provincia di Grosseto). C.N.R., Collana del Programma Finalizzato "Promozione Qualità dell'Ambiente" AQ/1/130: 1-39. Roma.

Arrigoni P.V., Nardi E. & Raffaelli M., 1985. La vegetazione del Parco naturale della Maremma (Toscana) con carta a scala 1: 25.000. Dipartimento di Biologia Vegetale di Firenze. Arti Grafiche Giorgi & Gambi. Firenze, 39 pp.

Arrigoni P.V. & Di Tommaso P.L., 1997. La vegetazione del Monte Argentario (Toscana meridionale). Parlatorea 2: 5-38.

Asensi A., Díez-Garretas B., Quézel M. & P., 2007. Plant communities of *Juniperus turbinata* Guss. subsp. *turbinata* in the Mediterranean Region. A biogeographical, bioclimatical and syntaxonomical survey. Phytocoenologia 37 (3-4): 599-623.

Bacchetta G., 2006. Flora vascolare del Sulcis (Sardegna Sud-Occidentale, Italia). Guineana 12. Universidad del País Vasco, Leioa, 369 pp.

Bacchetta G., Bagella S., Biondi E., Farris E., Filigheddu R. & Mossa L., 2009. Vegetazione forestale e serie di vegetazione della Sardegna (con rappresentazione cartografica alla scala 1:350.000). Fitosociologia 46 (1) suppl. 1: 1-82.

Bacchetta G., Bagella S., Biondi E., Farris E., Filigheddu R. & Mossa L., 2010. Carta delle serie di vegetazione della regione Sardegna: 471-495. In Blasi C., La vegetazione d'Italia, Carta delle Serie di vegetazione, scala 1:500.000. Roma. Palombi & Partner S.r.l.

Bartolo G., Brullo S. & Marcenò C., 1982. La vegetazione costiera della Sicilia sud-orientale. Contributo alla interpretazione delle fasce di vegetazione delle coste mediterranee. C.N.R., Collana del Programma Finalizzato "Promozione Qualità dell'Ambiente" AQ/1/226: 1-49. Roma.

Bartolo G., Brullo S., Minissale P. & Spampinato G., 1988. Flora e vegetazione dell'Isola di Lampedusa. Bollettino dell'Accademia Gioenia di Scienze Naturali 21 (334): 119-255.

Bartolo G., Brullo S., De Marco G., Dinelli A., Signorello P. & Spampinato G., 1989 (1992). Studio fitosociologico sulla vegetazione psammofila della Sardegna meridionale. Colloques Phytosociologiques 19: 251-273.

Biondi E., 1994. The phytosociological approach to landscape study. Annali di Botanica (Roma) 52: 135-141.

Biondi E., 1999. Diversità fitocenotica degli ambienti costieri italiani. In Bon M., Sburlino G. & Zuccarello V. (Eds.), Aspetti ecologici e naturalistici dei sistemi lagunari e costieri. Arsenale Editrice: 39-105.

Biondi E. (ed.), 2007. Conservazione e recupero degli habitat costieri. Analisi e metodologie a confronto. In collaborazione con la Società Botanica Italiana (gruppo di lavoro per la vegetazione). Fitosociologia 44 (1), 180 pp.

Biondi E., 2011. Phytosociology today: Methodological and conceptual evolution. Plant Biosystems 145 suppl. 1: 19-29.

Biondi E. & Bagella S., 2005. Vegetazione e paesaggio vegetale dell'Arcipelago di La Maddalena (Sardegna nordorientale). Fitosociologia 42 (2) suppl. 1: 3-99.

Biondi E., Blasi C., Burrascano S., Casavecchia S., Copiz R., Del Vico E., Galdenzi D., Gigante D., Lasen C., Spampinato G., Venanzoni R. & Zivkovic L., 2009. Manuale Italiano di interpretazione degli habitats della Direttiva 92/43/CEE. Società Botanica Italiana. Ministero dell'Ambiente e della Tutela del Territorio e del Mare. D.P.N. http://vnr.unipg.it/habitat.

Biondi E., Burrascano S., Casavecchia S., Copiz R., Del Vico E., Galdenzi D., Gigante D., Lasen C., Spampinato G., Venanzoni R., Zivkovic L. & Blasi C., 2012. Diagnosis and syntaxonomic interpretation of Annex I Habitats (Dir. 92/43/EEC) in Italy at the alliance level. Plant Sociology 49 (1): 5-37.

Biondi E., Casavecchia S. & Pesaresi S., 2011. Phytosociological synrelevés and plant landscape mapping: From theory to practical application. Plant Biosystems 145 (2): 261-273.

Biondi E., Feoli E. & Zuccarello V., 2004. Modelling environmental responses of plant associations: A review of some critical concepts in vegetation study. Critical Reviews in Plant Sciences 23 (2): 149-156.

Biondi E., Filigheddu R. & Farris E., 2001. Il paesaggio vegetale della Nurra (Sardegna nord-occidentale). Fitosociologia 38 (2) suppl. 2: 3-105.

Biondi E. & Mossa L., 1992. Studio fitosociologico del promontorio di Capo S. Elia e dei Colli di Cagliari (Sardegna). Documents Phytosociologiques 14: 1-44.

Blasi C. (ed.), 2010. La vegetazione d'Italia, Carta delle serie di vegetazione, scala 1:500.000. Palombi & Partner S.r.l., Roma.

Blasi C., Carranza M.L., Frondoni R. & Rosati L., 2000. Ecosystem classification and mapping: A proposal for Italian landscapes. Applied Vegetation Science 3: 233-242.

Boratyński A, Lewandowski A, Boratyńska K, Montserrat J.M. & Romo A., 2009. High level of genetic differentiation of *Juniperus phoenicea* (*Cupressaceae*) in the Mediterranean region: geographic implications. Plant Systematics and Evolution 277: 163-172.

Braun-Blanquet J., 1964. Pflanzensoziologie. Springer, Wien-New York.

Brullo S., Minissale P., Scelsi F. & Spampinato G., 1993. Note fitosociologiche miscellanee sul territorio ibleo (Sicilia sud-orientale). Bollettino dell'Accademia Gioenia di Scienze Naturali 26 (341): 19-48.

Brullo S. & Guarino R., 2000. Contribution to the knowledge of flora and vegetation of Krissi islet (Crete, SE Mediterranean sea). Flora Mediterranea 10: 265-282.

Brullo S., Giusso Del Galdo G., Siracusa G. & Spampinato G., 2001. Considerazioni fitogeografiche sulla vegetazione psammofila dei litorali italiani. Biogeographia 12: 93-137.

Brullo S., Scelsi F. & Spampinato G., 2001. La vegetazione dell'Aspromonte. Studio fitosociologico. Laruffa Ed., Villa San Giovanni (Reggio Calabria), 368 pp.

Brullo S., Giusso Del Galdo G., Minissale P., Siracusa G. & Spampinato G., 2002. Considerazioni sintassonomiche e fitogeografiche sulla vegetazione della Sicilia. Bollettino dell'Accademia Gioenia di Scienze Naturali 35 (361): 325-359.

Brullo S., Gianguzzi L., La Mantia A. & Siracusa G., 2009. La classe *Quercetea ilicis* in Sicilia. Bollettino dell'Accademia Gioenia di Scienze Naturali 41 (369) (2008): 1-77.

Camarda I., Lucchese F., Pignatti S. & Wikus-Pignatti E., 1995. La vegetazione dell'area Pantaleo-Gutturu Mannu-Punta Maxia-Monte Arcosu nel Sulcis-Iglesiente (Sardegna sud-occidentale). Webbia 49 (2): 141-177.

Cancellieri L., 2008. Studio delle serie di vegetazione nel complesso dei Monti Lattari. (Campania). Tesi di Dottorato di Ricerca, Facolta' di Scienze MM. FF. NN., Universita' degli Studi di Roma Tre, 294 pp. Roma.

Caneva G., De Marco G. & Mossa L., 1981. Analisi fitosociologica e cartografia della vegetazione (1:25.000) dell'Isola di S. Antioco (Sardegna sud-occidentale). C.N.R., Collana del Programma Finalizzato "Promozione Qualità dell'Ambiente" AQ/1/124: 1-59. Roma.

Caneva G., Fascetti S. & Gallotta G., 1997. Aspetti bioclimatici e vegetazionali della costa tirrenica della Basilicata. Fitosociologia 32 (1996): 171-188.

Caneva G., De Marco G. & Fascetti S., 2004. La vegetazione a *Juniperus phoenicea* L. subsp. *turbinata* (Guss.) Nyman della costa tirrenica della Basilicata e Calabria settentrionale (Italia meridionale). Colloques Phytosociologiques 28 (1998): 577-589.

Castroviejo S., Laínz M., López González G., Montserrat P., Muñoz Garmendia F., Paiva J. & Petrol J., 1986-2012. Flora Iberica. Plantas vasculares de la Península Ibérica e Islas Baleares. Real Jardin Botanico, C.S.I.C., Madrid.

Chiesura Lorenzoni F. & Lorenzoni G.G., 1977. Distribuzione e sociologia di *Chamaerops humilis* L. con particolare riguardo alla stazione di Capo S. Marco (Sardegna occidentale). Archivio Botanico e Biogeografico italiano 53 (1-2): 55-75.

Conti F., Abbate G., Alessandrini A. & Blasi C., 2005. An annotated checklist of Italian vascular flora. Ministero dell'Ambiente e della Tutela del Territorio (Direzione per la Protezione della Natura) e Dipartimento di Biologia Vegetale dell'Università degli Studi di Roma "La Sapienza", Palombi Editori. 420 pp.

Conti F., Alessandrini A., Bacchetta G., Banfi E., Barberis G., Bartolucci F., Bernardo L., Bonacquisti S., Bouvet D., Bovio M., Brusa G., Del Guacchio E., Foggi B., Frattini S., Galasso G., Gallo L., Gangale C., Gottschlich G., Grünanger P., Gubellini L., Iiriti G., Lucarini D., Marchetti D., Moraldo B., Peruzzi L., Poldini L., Prosser F., Raffaelli M., Santangelo A., Scassellati E., Scortegna S., Selvi F., Soldano A., Tinti D., Ubaldi D., Uzunov D. & Vidali M., 2007. Integrazioni alla checklist della flora vascolare italiana. Natura Vicentina 10 (2006): 5-74.

De Dominicis V., Casini S., Mariotti M. & Boscagli A., 1988. La vegetazione di Punta Ala (Prov. di Grosseto). Webbia 42 (1): 101-143.

De Marco G. & Mossa L., 1980. Analisi fitosociologica e cartografica della vegetazione (1:25.000) dell'Isola di S. Pietro (Sardegna sud-occidentale). C.N.R., Collana del Programma Finalizzato "Promozione Qualità dell'Ambiente" AQ/1/80: 1-34. Roma.

De Marco G., Dinelli A. & Caneva G., 1985. Analisi sintassonomica e fitogeografica comparata delle boscaglie a *Juniperus phoenicea* L. in Sardegna. Notiziario Fitosociologico 22: 39-48.

Di Martino A. & Sortino M., 1970. L'ultimo lembo della macchia dei ginepri. Golfo di Castellammare (TP). Lavori Istituto Botanico Giardino Coloniale Palermo 24: 1-12. Palermo.

Dzialuk A., Mazur M., Boratyńska K., Montserrat J.M., Romo A. & Boratyński A., 2011. Population genetic structure of *Juniperus phoenicea* (*Cupressaceae*) in the western Mediterranean Basin: gradient

of diversity on a broad geographical scale. Annals of Forest Science 68: 1341-1350.

Farjon A., 2005. A monograph of *Cupressaceae* and Sciadopitys. Royal Botanic Gardens, Kew, 643 pp.

Farris E., Pisanu S., Secchi Z., Bagella S., Urbani M. & Filigheddu R., 2007. Gli habitat terrestri costieri e litorali della Sardegna settentrionale: verifica della loro attribuzione sintassonomica ai sensi della Direttiva 43/92/CEE "Habitat". Fitosociologia 44 (1): 165-180.

Filipello S. & Sartori F., 1983 (1980-81). La vegetazione dell'Isola di Montecristo (Arcipelago Toscano). Atti dell'Istituto Botanico e Laboratorio Crittogamico dell'Università di Pavia (6) 14: 113-202.

Fiori A. & Paoletti G., 1900-1902. Flora analitica d'Italia, ossia descrizione delle piante vascolari indigene inselvatichite e largamente coltivate in Italia disposte per quadri analitici. Vol. 2. Tip. del Seminario, Padova. 493 pp.

Fiori A. & Paoletti G., 1907-1908. Flora analitica d'Italia, ossia descrizione delle piante vascolari indigene inselvatichite e largamente coltivate in Italia disposte per quadri analitici. Vol. 4. Tip. del Seminario, Padova. 330 pp.

Foggi B., Cartei L., Pignotti L., Signorini M.A., Viciani D., Dell'Olmo L. & Menicagli E., 2006. Il paesaggio vegetale dell'Isola d'Elba (Arcipelago Toscano). Studio fitosociologico e cartografico. Fitosociologia 43 (1) suppl. 1: 3-95.

Foggi B., Cartei L. & Pignotti L., 2008. La vegetazione dell'Isola di Pianosa (Arcipelago Toscano). Braun-Blanquetia, 41 pp.

Franco Do Amaral J., 1986. Genere Juniperus. In Castroviejo S., Laínz M., López González G., Montserrat P., Muñoz Garmendia F., Paiva J. & Villar L. Flora Iberica. Vol. 1: 186-187. Real Jardìn Botanico C.S.I.C., Madrid.

Franco Do Amaral J., 1993. Genere *Juniperus*. In Tutin T.G., Burges N.A., Charter A.O., Edmondson J.R., Heywood V.M., Moore D.M., Valentine D.H., Walters S.M. & Webb D.A. Flora Europaea. Vol. 1: 47. University Press, Cambridge, 2nd Ed.

Furnari F., 1965. Boschi a *Quercus suber* L. e di *Quercus ilex* L. e le garighe del *Rosmarino-Ericion* in territorio di Santo Pietro. Bollettino dell'Istituto Botanico dell'Università di Catania 3 (5): 1-31.

Géhu J.M. & Biondi E., 1994. Végétation du littoral de la Corse. Essai de synthèse phytosociologique. Braun-Blanquetia 13: 1-156.

Géhu J.M. & Rivas-Martínez S., 1981. Notions fondamentales de phytosociologie. In Dierschke H. (ed.), Syntaxonomie. Ber. Intern. Symposium IV-V: 5-53. J. Cramer, Vaduz.

Giacomini V., 1958. La flora. In Collana Conosci l'Italia 2: 1-127. Touring Club Italiano, Milano.

Gianguzzi L., 1999. Vegetazione e bioclimatologia dell'Isola di Pantelleria (Canale di Sicilia). Braun-Blanquetia 22: 1-70 + 1 carta (scala 1:20.000).

Gianguzzi L., Romano S., Caldarella O. & La Russa E., 2007. Su alcuni aspetti di boscaglia relittuale a *Juniperus turbinata* Guss. nella Valle del Sosio (Monti Sicani, Sicilia centro-occidentale). Atti del 102° Congresso Società Botanica Italiana. Riassunti. Palermo 26-29 Settembre 2007: 406.

Giardina G., Raimondo F.M. & Spadaro V., 2007. A catalogue of plants growing in Sicily. Bocconea 20: 1-582.

Giusso Del Galdo G., Marcenò C., Musarella C.M. & Sciandrello S., 2008. La vegetazione costiera della R.N.O. "Torre Salsa" (Siculiana - AG). Informatore Botanico Italiano 40 (1): 73-89.

La Mantia A., 2003. Su alcune specie relitte della macchia costiera siciliana di possibile utilizzazione nella forestazione ecologica e nelle progettazioni ambientali: *Quercus calliprinos* Webb, *Juniperus turbinata* Guss. e *Juniperus macrocarpa* S. et Sm. Tesi di dottorato. D.A.C.P.A., Università degli Studi di Catania, 134 pp.

Landi M., Zoccola A., Crudele G. & Del Prete C., 2007. Indagine sulla popolazione e caratterizzazione fitosociologica della vegetazione a *Juniperus phoenicea* L. subsp . *turbinata* (Guss.) Nyman dell'Isola di Montecristo (Arcipelago Toscano). Atti della Società Toscana di Scienze Naturali - Memorie s. B 114: 115-123.

Lebreton P. & Thivend S., 1981. Sur une sous-espece du genévrier de phénicie, *Juniperus phoenicea* L. definie à partir de critères biochimiques. Naturalia Monspeliensis, Série Botanique 47: 1-12.

Lebreton P., 1983. Nouvelles données sur la distribution au Portugal et en Espagne des sous-especès du Genévrier de Phénicie (*Juniperus phoenicea* L.). Agronomia Lusitana 42: 55-62.

Lebreton P. & Rivera D., 1988. Analyse du taxon *Juniperus phoenicea* L. sur des bases biochimiques et biometriques. Naturalia Monspeliensis, Série Botanique 53: 17-41.

Lebreton P. & Pérez de Paz P.L., 2001. Définition du genévrier de phénicie (*Juniperus* aggr. *phoenicea*), reconsidéré à ses limites biogéographiques: Méditerranée orientale (Crète et Chypre) et Atlantique (Illes Canaries). Bulletin Mensuel de la Societe Linneenne de Lyon 70 (4): 73-92.

Lojacono Pojero M., 1888-1909. Flora sicula. Vol. I (1-2), II (1-2), III. Tip. Virzì, Palermo.

Lorenzoni G.G., 1974. Principali lineamenti fitosociologici della vegetazione dell'Isola di Tavolara (Sardegna Nord-Orientale). Archivio Botanico e Biogeografico Italiano 50 (1-2): 61-63.

Mazur M., Klajbor K., Kielich M., Sowińska M., Romo A., Montserrat J.M. & Boratyński A., 2010. Intra-specific differentiation of *Juniperus phoeni-*

cea in the western Mediterranean region revealed in morphological multivariate analysis. Dendrobiology 63: 21-31.

Mercurio R. & Spampinato G., 1999. Analisi tipologico-strutturale e fitosociologica della vegetazione a *Juniperus turbinata* Guss. nella Calabria meridionale. Linea Ecologica 1: 32-39.

Molinier R. & Molinier R., 1955. Observation sur la vègètation de la Sardaigne septentrionale. Archivio Botanico Forlì 32: 13-33.

Mossa L., 1989. Su alcuni aspetti della classe *Quercetea ilicis* della Sardegna meridionale. Notiziario Fitosociologico 22 (1985): 125-142.

Mossa L., 1990. La vegetazione forestale del Campo dunale di Buggerru-Portixeddu (Sardegna occidentale). Annali di Botanica (Studi sul Territorio) 48 (suppl. 7): 291-306.

Mossa L., Curreli F. & Fogu M.C., 2000. La vegetazione degli habitats terrestri della riserva marina protetta di Capo Carbonara (Sardegna sud-orientale). Rendiconti del Seminario della Facoltà di Scienze dell'Università di Cagliari Suppl. 70: 163-185.

Paradis G. & Tomasi J., 1991. Apercus phitosociologique et cartographique de la vegetation littorale de Barcaggio (Cap Corse, France): rochers, dunes, etangs et depressions. Documents Phytosociologiques n.s. 13: 175-207.

Pignatti S., 1982. Flora d'Italia. Vol. 1-3. Edagricole, Bologna.

Pignatti S., 1994. Ecologia del paesaggio. UTET, Torino

Podani J., 2001. SYN-TAX 2000. Computer programs for data analysis in ecology and systematics. User's manual. Scientia, Budapest, HU.

Poldini L. & Sburlino G., 2005. Terminologia fitosociologica essenziale. Fitosociologia 42 (1): 57-69.

Raimondo F.M., Gianguzzi L., Venturella G. & Lo Valvo M., 1990. Indagine preliminare sul patrimonio biologico-ambientale delle coste siciliane. Quaderni di Botanica Ambientale e Applicata 1: 131-182.

Rivas-Martínez S., 2005. Notions on dynamic-catenal phytosociology as a basis of landscape science. Plant Biosystems 139: 135-144.

Rivas-Martínez S., Wildpret W. & Peréz de Paz P.L., 1993. Datos sobre *Juniperus phoenicea* aggr. (Cupressaceae). Itinera Geobotanica 7: 509-512.

Rivas-Martínez S., Penas A. & Diaz T.E., 2001a. Biogeographic map of Europe. Cartographic Service. University of Leon, Spain.

Rivas-Martínez S., Penas A. & Diaz T.E., 2001b. Bioclimatic map of Europe (Thermoclimatic belts). Cartographic Service. University of Leon, Spain.

Rivas-Martínez S., Fernández-González F., Loidi J., Lousa M. & Penas A., 2001c. Syntaxonomical checklist of vascular plant communities of Spain and Portugal to association level. Itinera Geobotanica 14 (2): 5-341.

Rivas-Martínez S., Diaz T.E., Fernández-González F., Izco J., Lousa M. & Penas A., 2002. Vascular plant communities of Spain and Portugal. Addenda to the syntaxonomical checklist of 2001. Itinera Geobotanica 15 (1): 5-432, 15 (2): 433-922.

Rivas-Martínez S., Biondi E., Costa M. & Mossa L., 2003. Datos sobre la vegetación de la clase Quercetea ilicis en Cerdeña. Fitosociologia 40 (1): 35-38.

Rivas-Martínez S., Penas A. & Diaz T.E., 2004. Biogeographic map of Europe (scale 1:16.000.000). Cartographic Service. University of Leon, Spain.

Rivas-Martínez S., Rivas Sáenz S. & Penas A., 2011. Worldwide bioclimatic classification system. Global Geobotany 1. 638 pp.

Stanisci A., Feola S. & Blasi C., 2005. Map of vegetation series of Ponza Island (central Italy). Lazaroa 26: 93-113.

Turrisi R.E., Galletti I. & Ilardi V., 2002. Contributo alla conoscenza della vegetazione di Cava Randello. Quaderni di Botanica Ambientale e Applicata 12 (2001): 117-130.

Tutin T.G., Heywood V.H., Burges N.A., Valentine D.H., Walters S.M. & Webb D.A. (Eds.), 1964-1980. Flora Europaea 1-5, Cambridge University Press.

Tutin T.G., Heywood V.H., Burges N.A., Chater A.O., Edmonson J.R., Heywood V.H., Moore D.M., Valentine D.H., Walters S.M. & Webb D.A. (Eds.), 1993. Flora Europaea. Cambridge University Press, Cambridge, London, New York, Melbourne, 2nd Ed., Vol. 1, Lycopodiaceae to Platanaceae: 581 pp.

Vagge I. & Biondi E., 1999. La vegetazione delle coste sabbiose del Tirreno settentrionale italiano. Fitosociologia 36 (2): 61-95.

Valsecchi F., 1966. Ricerche sulla vegetazione litorale della Sardegna: V. Flora e vegetazione del promontorio di Capo Caccia (Sardegna nord-occidentale). Archivio Botanico Forlì 42: 14-45.

Valsecchi F., 1976. Sui principali aspetti della vegetazione costiera della Nurra Nord-occidentale (Sardegna settentrionale). Giornale Botanico Italiano 110 (1-2): 21-63.

Weber H.E., Moravec J. & Theurillat J.-P., 2000. International Code of Phytosociological Nomenclature. 3rd edition. Journal of Vegetation Science 11: 739-768. Translated into Italian by: Scoppola A. Fitosociologia (39) (1) Suppl. 1: 5-48, 2002. Falconara Marittima, Ancona.