NAT. CROAT. | VOL. 23 | No 1 | 189–218 | ZAGREB | June 30, 2014

original scientific paper / izvorni znanstveni rad

VASCULAR FLORA OF THE ANCIENT OLIVE GROVES OF APULIA (SOUTHERN ITALY)

Enrico Vito Perrino[1,2] & Generosa Calabrese[2]

[1]University of Bari, Botanical Garden Museum, via E. Orabona 4, 70126 Bari, Italy (enricoperrino@yahoo.it, perrino@iamb.it)

[2]CIHEAM, Agronomic Mediterranean Institute of Bari, via Ceglie 9, 70010 Valenzano (Bari), Italy

Perrino, E.V. & Calabrese, G.: Vascular flora of the ancient olive groves of Apulia (southern Italy). Nat. Croat., Vol. 23, No. 1, 189–218, 2014, Zagreb.

A floristic study of the vascular flora of ancient olive groves of Apulia (Italy) was carried out from 2009 to 2012. Research was mainly focussed on the fields and the ecological infrastructures of four olive groves. In total, 408 taxa were identified, of those, 332 species, 73 subspecies and 3 cultivated varieties were classified into 275 genera and 74 families. Only 18 taxa out of the 408 were considered important from a conservation point of view. These 18 taxa were analysed more thoroughly, the topography of the collecting site, plant community, population density and relationships with the habitats being recorded, according to Directive 92/43/EEC. The work was planned and carried out with the aim of providing tools for improving the conservation and management of the olive groves of Apulia.

Key words: ancient olive groves, Apulia, floristic study, vascular flora, 92/43/EEC Directive

Perrino, E.V. & Calabrese, G.: Vaskularna flora starih maslinika Apulije (južna Italija). Nat. Croat., Vol. 23, No. 1, 189–218, 2014, Zagreb.

U razdoblju od 2009. do 2012. istraživana je vaskularna flora starih maslinika Apulije (Italija). Istraživanje se usredotočilo na polja i ekološku infrastrukturu četiri maslinika. Sveukupno je zabilježeno 408 svojti, od toga 332 vrste, 73 podvrste i 3 kultivirana varijeteta, smještenih u 275 rodova i 74 porodice. Samo 18 svojti od njih 408 se smatra važnima u smislu zaštite. Tih 18 svojti su podrobnije analizirane, i u skladu s Direktivom 92/43/EEC za njih je zabilježena topografija nalazišta, biljna zajednica, gustoća populacije i suodnos sa staništem. Istraživanje je planirano i izvedeno u cilju pronalaženja načina za poboljšanje zaštite i upravljanja maslinicima u Apuliji.

Ključne riječi: stari maslinici, Apulija, florističko istraživanje, vaskularna flora, Direktiva 92/43/EEC

INTRODUCTION

The olive tree (*Olea europaea* L. ssp. *sativa* Hoffman & Link) is widely considered one of the most important plants in the history and culture of the Mediterranean people.

Today, olive trees are grown in 39 countries worldwide over an area of 8 million hectares and this makes the olive tree the most extensively cultivated temperate fruit crop in the world (FAO, 2002). Since 1992, olive production has increased by 44% and in 2002 in 29 countries worldwide oil production was 2.4 million tons. The leading oil producer countries are also the overall olive producing countries, because most of the olive crop is used for oil. Over 75% of the world's olive oil is produced in just three countries: Spain, Italy and Greece. The top ten countries of world production are: Spain (27%), Italy (20%), Greece (16%), Turkey (11%), Syria (6%), Tunisia (3%), Morocco (3%), Egypt (2%), Algeria (2%) and Portugal (2%). Apulia provides about 40% of the Italian

production (Bartolini *et al*., 2005). These data indicate the importance of olive trees in the world, as well as in Apulia Region.

In Italy, fossilized remains of the olive tree's ancestor, dating from twenty million years ago, were found near Livorno, although actual cultivation here probably did not occur until the fifth century B.C. (Zohary, 1973). Olive trees were first grown in the Eastern part of the Mediterranean and then moved westwards over the millennia. Beginning in 5000 B.C., olive cultivation spread from Crete to Syria, Palestine and Israel; commercial networking and application of new knowledge then brought the olive crop to Southern Turkey, Cyprus and Egypt. Until 1500 B.C., the olive was most densely cultivated in Greece.. With the expansion of the Greek colonies, in the eighth century B.C., the olive culture reached Southern Italy and Northern Africa. Under Roman rule olive trees were planted throughout the Mediterranean basin (Acerbo, 1937; Zohary, 1973; Schäfer-Schuchardt, 1988; Guerci, 2005).

The ancient olive groves are among of the most important elements of the Apulian landscape and are especially evocative of the coast and hills of the Italian peninsula and of the Mediterranean basin (Perrino *et al*., 2012).

In addition to their undeniable cultural and landscape values, these Apulian habitats, have a major environmental importance since they offer shelter to many plant and animal species, some of which are of considerable conservation interest. In fact, the presence of many types of plant communities, such as nitrophilous and subnitrophilous communities, spontaneous grasses, field margins (*Stellarietea-mediae*), annual meadows (*Brachypodietalia distachyi*), perennial thermo-xerophilous grasslands (*Lygeo-Stipetea*), small patches of chasmophytic vegetation (*Asplenietea trichomanis*), nanophanerofitic and chamaephytic garigues (*Cistus-Ericion*), evergreen sclerophyllous scrubs (*Oleo-Ceratonion*) (Perrino *et al*., 2012) and scattered trees as *Ceratonia siliqua* L., *Ficus carica* L., *Laurus nobilis* L., *Prunus dulcis* (Mill.) D.A. Webb and sometimes *Juglans regia* L., *Morus alba* L., *Prunus domestica* L., *Punica granatum* L., *Pyrus communis* L., plus many species of *Quercus* s. l. and *Sorbus domestica* L. (Perrino *et al*., 2011), make the existing agro-ecosystems suitable for hosting several species of amphibians, reptiles, mammals and especially of birds, (Biondi *et al*., 2007).

Considering the history and the spread of olive trees throughout the Mediterranean countries, we might conclude that the olive agro-ecosystems of Apulia are about 2.800 years old (Zohary, 1973) and therefore old enough to deserve a study of the vascular flora that has co-evolved along with and that has contributed to the development and perpetuation in time of such agro-ecosystems.

Aiming at providing tools for improving conservation and management of olive groves of Apulia and with the objective of analysing their biodiversity, putting emphasis on threatened plant species and those of conservation interest, a botanical study of the vascular flora of ancient olive groves of Apulia was undertaken in the frame of the LIFE+ project, continuing previous work on monumental olive groves (Perrino *et al*., 2011).

STUDY AREA

The research work was at first carried out in a number of ancient olive groves, located in different areas of Apulia and representing, as much as possible, the typical agro-environments of the region. Then, four ancient olive groves were selected as located along the coast and falling in four protected areas of the Apulia Region (Southern Italy): the

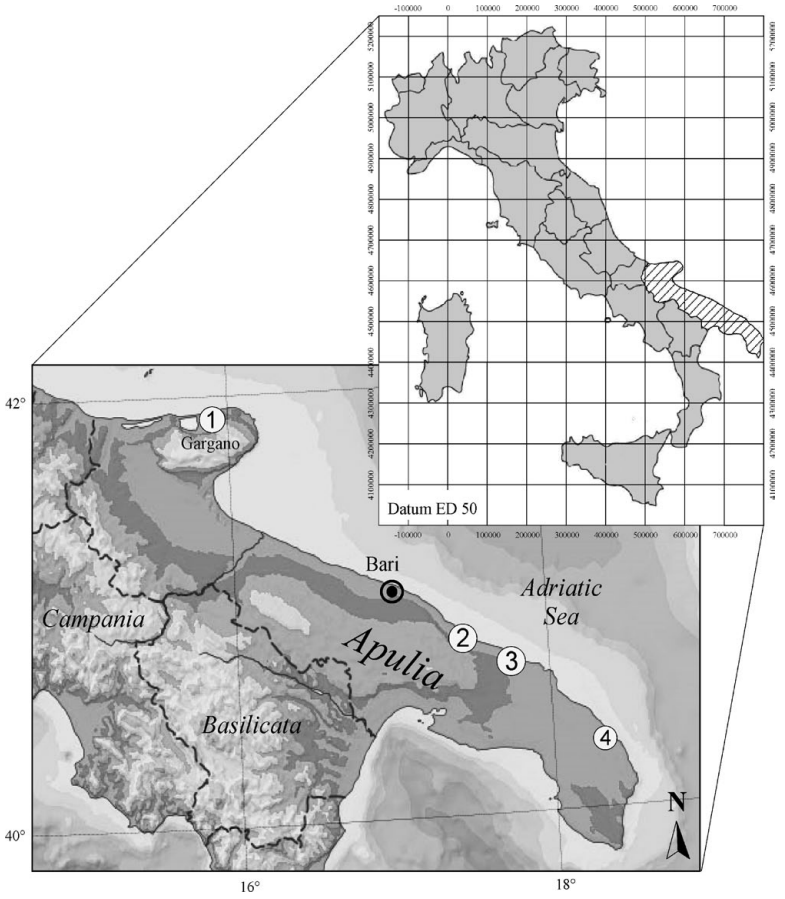

Fig. 1. Geographical position of olive groves surveyed (1: Vico del Gargano; 2: Fasano; 3: Carovigno; 4: Vernole).

Gargano National Park (Vico del Gargano, province of Foggia), the **Dune Costiere tra Torre Canne e Torre San Leonardo Park** (Fasano, province of Brindisi), the **Torre Guaceto State Natural Reserve and Marine Natural Reserve** (Carovigno, province of Brindisi), the **Le Cesine State Natural Reserve** (Vernole, province of Lecce) (Fig. 1). The olive trees in the National Park of Gargano are located on a steep slope by the shore; the olive trees in the **Park of Dune Costiere** are located on the bottom of a ephemeral river and are managed according to organic farming principles; the olive orchards of the **Natural Reserve of Torre Guaceto** are located on flattish land, managed according to organic farming methods; finally the olive trees in the Natural Reserve Le Cesine, traditionally grown, are contiguous to an ephemeral pond and to a stand of *Pinus halepensis* Miller, the reforestation dating back to the early years of the last century. Each olive grove has only few olive trees per hectare, although never less than 48 plants, and is extensively managed. The low impact tillage practices and the presence of man-made and natural infrastructure features, such as dry stone walls, hedgerows, natural patches and trees and shrubs on the field edges, are compatible with an almost permanent gra-

ss cover and do not impede the natural dissemination of the species present, and therefore indigenous plant species have been able to evolve in quite stable plant communities. As a result of such „traditional" management the selected olive groves present common features although each of them shows its own peculiarities from an ecological point of view.

METHODS

The present study was planned and carried out from 2009 to 2012, in the framework of the Project: LIFE+ Cent.Oli.Med. (LIFE07 NAT/IT000450), for which the protection and sustainable management of biodiversity is of paramount importance for the achievement of the Millennium Development Goals (MDG).

The list of species was built up step by step, on the basis of the several surveys made for floristic analysis and for the evaluation of the level of biodiversity.

Plant analysis was focused on the fields and on the ecological infrastructures. Species were determined according to Tutin *et al*. (1964-80) and Pignatti (1982). Taxa nomenclature follows Conti *et al*., (2005) and subsequent integration (Conti *et al*., 2007), except for the genus *Aegilops* L., for *Taraxacum* Weber and *Thymbra capitata* (L.) Cav. for which van Slageren (1994), Pignatti (1982) and Morales Valverde (1987) were adopted, respectively. The systematics of the families and their arrangement was made according to Smith *et al*. (2006) for the vascular cryptogams megaphylls; according to Haston *et al*. (2007; 2009) for the angiosperms; while for the boundaries, the criteria proposed by Angiosperm Phylogeny Group (Stevens, 2008; APG III, 2009) where taken into consideration. The biological forms and the chorology were named according to Raunkiear (1934). Taxa are listed in alphabetical order and grouped into families according to Pignatti (1982). For species of conservation interest, abbreviations to indicate their vulnerability were used, i.e. **CR:** critically endangered; **EN:** endangered; **VU:** vulnerable; **LR:** lower risk; **NT:** near threatened; **I:** endemic; **Ad:** amphiadriatic, **PI:** phytogeographic interest; **B:** International Convention of Berne, 1979; **CI:** Convention on International Trade in Endangered Species (CITES, 1973); **DH:** Habitat Directive 92/43 EEC; **r:** rare at national and/or regional level; (*) common to the four selected and explored olive groves.

In the case of non-native species additional information is indicated by the following categories: *archaeophyte* (non-native plant species introduced before 1492, i.e. before the era of European colonialism that followed the discovery of America. Conventionally this date is approximated to 1500); *neophyte* (non-native plant species introduced after 1492, i.e. conventionally after 1500, no more observed after 1950); *naturalized* or *stabilized* (non-native species that form stable populations independent of the contribution of new propagules by man); *invasive* (a subset of naturalized species that spread quickly even at a considerable distances from the original sources of propagules); *fortuitous* or *casual* (non-native species that grow and reproduce spontaneously but do not form stable populations and depend on a continuous supply of new propagules provided by man) (Celesti Grapow *et al*., 2010).

The abbreviations related to the biological forms and chorotypes are reported in the *Appendix*. Geographic position (U.T.M. - WGS84), site name, distribution data, motivation of conservation interest, general information on plant communities and the relationships with the habitat of Directive 92/43 EEC (European Commission Dg Environment, 2007; Biondi & Blasi, 2009) are provided only for taxa of conservation interest.

RESULTS AND DISCUSSION

In all, 408 taxa were recorded, including 332 species, 73 subspecies and 3 cultivated varieties (cultivars), belonging to 275 genera and 74 families of vascular flora (Tab. 1). The three most represented families are: *Asteraceae* (12.7%) with 52 taxa, followed by *Poaceae* (11.3%) and *Fabaceae* (11.3%), both with 46 taxa. The other families, each with 20 taxa or less, comprise the remaining 264 taxa.

Tab. 1. Species by family in fields and ecological infrastructures, merged and separately. (1) indicates the presence of one species, counted in „Others".

FAMILY	TAXA					
	FIELDS & ECOLOGICAL INFRASTRUCTURES		FIELDS		ECOLOGICAL INFRASTRUCTURES	
	%	n°	%	n°	%	n°
Asteraceae	12.7	52	13.2	31	13.0	49
Poaceae	11.3	46	13.2	30	11.9	45
Fabaceae	11.3	46	12.4	29	10.9	41
Lamiaceae	4.9	20	2.1	5	5.0	19
Brassicaceae	3.7	15	5.6	13	3.7	14
Caryophyllaceae	3.2	13	3.4	8	2.7	10
Plantaginaceae	2.9	12	3.4	8	2.9	11
Asparagaceae	2.7	11	3.0	7	2.7	10
Boraginaceae	2.7	11	2.6	6	2.7	10
Ranunculaceae	2.7	11	2.1	5	2.7	10
Rubiaceae	2.7	11	3.4	8	2.9	11
Apiaceae	2.2	9	3.4	8	1.9	8
Rosaceae	2.2	9	0.9	2	2.4	9
Caprifoliaceae	2.0	8	1.7	4	2.1	8
Cistaceae	1.7	7	-	-	1.9	7
Convolvulaceae	1.7	7	0.9	2	1.9	7
Euphorbiaceae	1.7	7	1.7	4	1.9	7
Geraniaceae	1.5	6	2.6	6	1.6	6
Papaveraceae	1.2	5	2.1	5	0.8	3
Rutaceae	1.2	5	-	-	1.3	5
Amaryllidaceae	1.0	4	0.9	2	0.8	3
Orchidaceae	1.0	4	0.9	2	1.1	4
Polygonaceae	1.0	4	0.9	2	0.8	3
Scrophulariaceae	1.0	4	0.9	2	1.1	4
Urticaceae	1.0	4	1.7	4	0.8	3
Amaranthaceae	0.7	3	1.3	3	-	(1)

Campanulaceae	0.7	3	0.9	2	0.8	3
Fagaceae	0.7	3	-	-	0.8	3
Gentianaceae	0.7	3	0.9	2	0.5	2
Iridaceae	0.7	3	-	(1)	-	(1)
Malvaceae	0.7	3	1.4	3	0.5	2
Oleaceae	0.7	3	-	(1)	0.8	3
Orobanchaceae	0.7	3	0.9	2	0.8	3
Primulaceae	0.7	3	0.9	2	0.8	3
Adoxaceae	0.5	2	-	(1)	0.5	2
Anacardiaceae	0.5	2	-	(1)	0.5	2
Araceae	0.5	2	0.9	2	0.5	2
Hypericaceae	0.5	2	-	(1)	0.5	2
Juncaceae	0.5	2	-	(1)	0.5	2
Liliaceae	0.7	2	-	-	0.5	2
Linaceae	0.5	2	0.9	2	0.5	2
Moraceae	0.5	2	-	-	0.5	2
Rhamnaceae	0.5	2	-	-	0.5	2
Xanthorrhoeaceae	0.5	2	-	-	0.5	2
Others	7.4	30	9.4	22	8.8	33
Total	100	408	100	233	100	377

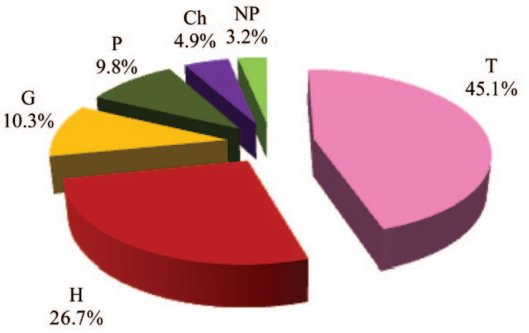

Fig. 2. Life forms in fields and ecological infrasctructures. Ch - chamaephytes; G - geophytes; H - hemicryptophytes; NP - nanophanerophytes; P - phanerophytes; T - therophytes.

Only 27 taxa, 6.6% of the entire flora, are common to all the four olive groves and 59.3% of them are *therophytes* (T). The analysis shows that *therophytes*, with a presence of 45.1%, are significantly dominant within the group of life forms (Fig. 2). This dominance was expected because annual species are prevalent in bioclimatic regions characterized by hot and dry periods with very short growing seasons and because therophytes are more competitive than other biological forms in habitats prone to human-induced

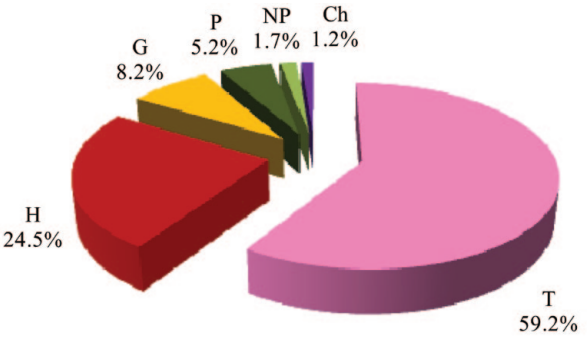

Fig. 3. Life forms in the fields. Ch - chamaephytes; G - geophytes; H - hemicryptophytes; NP - nanophanerophytes; P - phanerophytes; T - therophytes.

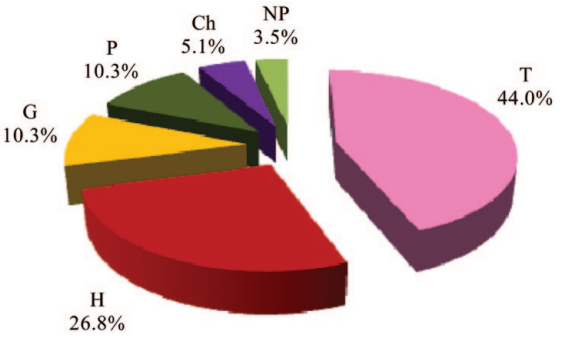

Fig. 4. Life forms in the ecological infrasctructures. Ch - chamaephytes; G - geophytes; H - hemicryptophytes; NP - nanophanerophytes; P - phanerophytes; T - therophytes.

changes (Raunkiaer, 1934). *Therophytes* are followed by *hemicryptophytes* (H) with 26.7%, while *geophytes* (G) and *phanerophytes* (P) occur 10.3% and 9.8% respectively. The occurrence of the other life forms, such as *chamaephytes* (Ch) and *nanophanerophytes* (NP), 4.9% and 3.2% respectively, is very low. The comparison between fields (Fig. 3) and ecological infrastructures (Fig. 4) shows that the *therophytes* are dominant on other biological forms, both in the field (59.2%) and in the ecological infrastructures (44.0%), but in the last the *therophytes* drop significantly to 15.2% in favour of perennial species (H, P, G, Ch, NP). In fact, in seminatural environments, perennial species have a competitive advantage over some species of *therophytes* and altogether increase from 40.8% to 56.0%.

The *Poaceae* and *Fabaceae* are slightly more abundant in the fields (25.6%) than in the ecological infrastructures (22.8%). This relatively small difference (2.8%) between the two areas surveyed, may be explained by assuming that the flora of ecological infrastructures may be influenced more by the flora growing in the natural neighboring habitats.

With a future perspective of making a comparison among olive groves in different areas of the Mediterranean basin (Southern Italy, the Mediterranean coasts of Spain, Southern Balkan Peninsula, Balearic Islands, Crete and Cyprus, etc.), it has been suggested that a key should be provided to simplify the geographical distribution of 32 Me-

Tab. 2. Mediterranean corotypes used and correspondence with Pignatti (1982) geoelements (adapted from Perrino *et al.*, 2011).

ACRONYMS	COROTYPES	
	(Pignatti, 1982)	USED IN THIS WORK
Me	Euri-Mediterranean s.s.	Euri-Mediterranean
Ms	Steno-Mediterranean s.s.	Steno-Mediterranean
Ma	Mediterranean atlantic	Atlantic Mediterranean range
Masb	Mediterranean sub-atlantic	
Mea	Euri-Mediterranean atlantic	
Meas	Euri-Mediterranean sub-atlantic	
Msa	Steno-Mediterranean atlantic	
Mem	Euri-Mediterranean macaronesian	Macaronesian Mediterranean range
Mmc	Mediterranean macaronesian	
Mmms	Mediterranean south-macaronesian	
Msm	Steno-Mediterranean macaronesian	
Mes	Mediterranean eastern	Eastern Mediterranean range
Mess	Euri-Mediterrranean south-siberian	
Mse	Steno-Mediterranean eastern	
Mst	Steno-Mediterranean turanian	
Mece	Mediterranean centre-eastern	
Mmne	Mediterranean mountain north-eastern	
Mne	Mediterranean north-eastern	
Met	Euri-Mediterranean turanian	
Mts	Mediterranean south-turanian	
Mt	Mediterranean turanian	
Men	Mediterranean northern	Northern Mediterranean range
Mn	Steno-Mediterranean northern	
Msn	Euri-Mediterranean northern	
Menp	Euri-Mediterranean northern-pontic	
Msd	Mediterranean southern	Southern Mediterranean range
Msdw	Mediterranean south-western	
Mss	Steno-Mediterranean southern	
Mmw	Mediterranean-mountain western	Western Mediterranean range
Mssw	Steno-Mediterranean south-western	
Msw	Steno-Mediterranean western	
Mw	Mediterranean western	
Omw	Orophil-Mediterranean western	
Mm	Mediterranean mountain s.s.	Mediterranean Mountain

diterranean geoelements identified by the following nine chorological types: Medit.-Mountain, Medit.-Macaronesian range, Medit.-Southern range, Medit.-Northern range, Medit.-Eastern range, Medit.-Western range, Medit.-Atlantic range, Euri-Mediterranean and Steno-Mediterranean (Tab. 2). In particular, the Steno-Mediterranean types are the Mediterranean types in the strict sense the range of which does not go over the northern limit of diffusion of the olive trees, while the Euri-Mediterranean types are included within the area of the grapevine (*Vitis vinifera* L.) and therefore they extend to the southern part of Central Europe (Ubaldi, 2003). The Mediterranean-Atlantic are Euri-Mediterranean types, generally mountane ones, whose areal also includes the Atlantic Europe regions. It is possible to distinguish the „Circum-Mediterranean" (distributed around the Mediterranean) types that can be Steno- or Euri-Mediterranean ones and may have predominantly southern distribution (Medit.-Southern), northern distribution (Medit.-Northern), eastern distribution (Medit.-Eastern) or western distribution (Medit.-Western).

The chorological spectrum (Tab. 3) shows that the Mediterranean stock (see sub-total) is well represented (61.5%) and that it is notably higher than that known for Apulia flora (52.0%) (Marchiori *et al*., 2000). It shows also that the presence of the Mediterranean stock in the fields (59.7%) is slightly different from that in the ecological infrastructure (61.9%). In particular, the Steno-Mediterranean types in the ecological infrastructure are slightly higher (23.1%) than those in the fields (20.1%), while the Euri-Mediterranean types are slightly prevaling in the fields (21.8%) than in the ecological infrastructures (19.6%). In any case, both types show percentages always higher than 19.0%, this means that, on average, Steno-Mediterranean types (21.8% of all species) and Euri-Mediterranean types (20.1% of all species) represent about 1/3 of all the Mediterranean types (61.5% of all species).

Taking into consideration the other chorotypes, the most prevalent species are those with wider distribution (14.6% of the total species recorded), their percentage being higher in the fields (21.0%) than in the ecological infrastructures (14.2%). Other chorotypes less present but still worthy of consideration, both in the fields and in the ecological infrastructures, are the Paleotemperate (4.7%) and the Eurasiatic (4.5%) ones. Their percentages change very little or not at all when the fields (from 4.8% to 4.4% respectively) or the ecological infrastructures (from 4.6% to 4.3%) are considered. The following eight categorized chorotypes (Pontic, Eurosiberian, European s.l., Amphi-Adriatic, Endemic, Paleo-Subtropical, Subtropical and Neotropical nat.) show variable percentages going from 0.0-0.4% (occurring for Pontic and Neotropical nat. respectively) in the fields, to a maximum of 4.0% (as for European s.l.) in ecological infrastructures. It worth to note that the European entities range from 1.7% in the fields to 4.0% in the ecological infrastructures. Pontic, Eurosiberian, European s.l., Amphi-Adriatic, Endemic, Paleo-Subtropical, Subtropical and Neotropical types are individually present in very low percentage, but considered as a group they are more present (19.4%) than the species having wider distribution that, when computing together the fields and in the ecological infrastructures, reach only the 14.6%. The just mentioned group is more present in the ecological infrastructures (19.6%) than in the fields (16.2%). The remaining chorotypes reported in the table as „others", appear to be more present in the ecological infrastructures (4.3%) than in the fields (3.1%).

The percentage of the Eastern Mediterranean (6.5%) and Pontic (0.5%) types for both fields and ecological infrastructures may be seen as a similarity or as a strong correlation with the flora of eastern geographical areas and in particular, with that of the Eastern

Tab. 3. Chorological spectrum by fields and ecological infrasctructures, merged and separated. Percentages and number of taxa. It was not possible to fit five of the taxa in a chorotype.

CHOROTYPE	FIELDS & ECOLOGICAL INFRASTRUCTURES		FIELDS		ECOLOGICAL INFRASTRUCTURES	
	%	n°	%	n°	%	n°
Steno-Mediterranean	21.8	88	20.1	46	23.1	86
Euri-Mediterranean	20.1	81	21.8	50	19.6	73
Eastern Mediterranean range	6.5	26	6.6	15	5.9	22
Western Mediterranean range	3.2	13	2.2	5	3.2	12
Southern Mediterranean range	2.7	11	1.7	4	3.0	11
Macaronesian Mediterranean range	2.5	10	3.9	9	2.4	9
Atlantic Mediterranean range	2.2	9	3.1	7	2.1	8
Northern Mediterranean range	1.5	6	0.0	0	1.6	6
Mediterranean-Mountain	1.0	4	0.4	1	1.1	4
Pontic	0.5	2	0.0	0	0.5	2
Euroasiatic	4.5	18	4.4	10	4.3	16
Eurosiberian	1.2	5	1.3	3	1.3	5
European s.l.	4.0	16	1.7	4	4.0	15
Amphi-Adriatic	0.5	2	0.0	0	0.5	2
Endemic	1.0	4	0.4	1	1.1	4
Paleotemperate	4.7	19	4.8	11	4.6	17
Paleo-Subtropical and Subtropical	2.5	10	3.1	7	2.7	10
Neotropical nat.	0.5	2	0.4	1	0.5	2
With widely distribution	14.6	59	21.0	48	14.2	53
Others	4.5	18	3.1	7	4.3	16
Total	**100**	**403**	**100**	**229**	**100**	**373**
Sub-total						
Mediterranean	61.5	248	59.7	137	61.9	231
With widely distribution	14.6	59	21.0	48	14.2	53
From Pontic to Neotropical nat.	19.4	78	16.2	37	19.6	73
Others	4.5	18	3.1	7	4.3	16
Total	**100**	**403**	**100**	**229**	**100**	**373**

Mediterranean basin (Perrino *et al*., 2011), the primary center of origin of the olive tree (Acerbo, 1937; Zohary, 1973; Schäfer-Schuchardt, 1988; Guerci, 2005).

The chorological analysis shows that the olive orchards are agro-ecosystems with a strong Mediterranean characterization and that this characteristic becomes weaker in

the cultivated part of the fields, where species with a wider distribution prevail. This confirms the results achieved in the course of the biological analysis.

In the course of the analysis of such olive groves only twelve non-native species (Celesti-Grapow *et al*., 2010) were found (Tab. 4). *Morus alba* L. and *Opuntia ficus-indica* (L.) Miller were present on the field margins as they were planted by farmers in past years. The first one was introduced before 1500 B.c. and it is a fortuitous species depending on man to be able to form populations. The second, introduced in a more recent period, is considered invasive but its abundance in the agricultural areas is controlled by man. another fortuitous species introduced since ancient time and found in the olive groves is *Raphanus sativus* L. Some other species were found in agricultural areas as a consequence of cultivation and agricultural practices, in particular *Amaranthus retroflexsus* L., *Arundo donax* L., *Chamaesyce maculata* (L.) Small, *Erigeron canadensis* L., *Oxalis pes-caprae* L., *Sorghum halepense* (L.) Pers., *Symphyotrichum squamatum* (Spreng.) G.L. Nesom, which are considered invasive and *Xanthium spinosum* L. which is naturalized. It may be worth noting the occasional presence of *Phacelia tanacetifolia* Benth., recently introduced in our fields and not commonly observed in Apulia. Although 8 out 12 of these non-native species are reported as invasive their presence in terms of abundance was not important, probably because of the low impact exerted by traditional management practices on the overall natural biodiversity of such particular areas, which help in controlling their spread.

Analysis of taxa of conservation interest

The results show the presence of 18 critical taxa: three of those are at risk (Conti *et al*., 1997; Perrino & Wagensommer, 2012), four are endemic, and the others are rare or important for different reasons at regional and/or national level.

Tab. 4. Non-native species found in the olive groves.

TAXON	INTRODUCTION	STATUS IN APULIA REGION
Amaranthus retroflexus L.	Neophyte	Invasive
Arundo donax L.	Archeophyte	Invasive
Chamaesyce maculata (L.) Small	Neophyte	Invasive
Erigeron canadensis L.	Neophyte	Invasive
Morus alba L.	Archeophyte	Fortuitous
Opuntia ficus-indica (L.) Miller	Neophyte	Invasive
Oxalis pes-caprae L.	Neophyte	Invasive
Phacelia tanacetifolia Benth.	Neophyte	–
Raphanus sativus L.	Archeophyte	Fortuitous
Sorghum halepense (L.) Pers.	Archeophyte	Invasive
Symphyotrichum squamatum (Spreng.) G. L. Nesom	Neophyte	Invasive
Xanthium spinosum L.	Neophyte	Naturalized

***Aegilops uniaristata* Vis. [Ad, VU]**

GPS: N4641298, E578448; Place: Fasano (Brindisi); Plant community: annual meadow (*Brachypodietalia distachyi* Rivas-Martínez 1978); altitude: 29 m a.s.l.; Habitat 92/43/EEC: 6220* (subtype 3) „*Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea*" (San Miguel, 2008). Eastern Mediterranean distribution, known in Croatia, Greece (including the islands), Albania and Italy, while it is doubtful in Turkey (Van Slageren, 1994). In Italy it was considered exclusive of Apulia (Groves, 1887; Pignatti, 1982; Bianco *et al*., 1989; Marchiori *et al*., 1993; Caforio & Marchiori, 2006; Perrino, 2011). Currently it is known for Basilicata Region, while it is doubtful for Calabria (Conti *et al*., 2005). It is listed as vulnerable (VU) (Perrino & Wagensommer, 2012) and as at risk of extinction in the Atlas of Species (Scoppola & Spampinato, 2005). The Fasano population counts only three individuals. It seems that the edge of an olive tree grove is one of its favourite habitats (Van Slageren, 1994; Perrino, 2011; Perrino *et al*., 2011).

***Asyneuma limonifolium* (L.) Janch. subsp. *limonifolium* [Ad, PI, NT]**

GPS: N4641293, E578442; Place: Fasano (Brindisi); Plant community: garigues; altitude: 31 m a.s.l.; Habitat 92/43/EEC: not identified. Paleoegeic species of phytogeographic interest, present on both coasts of the Adriatic Sea (Francini Corti, 1966). Its distribution includes the north-eastern Mediterranean area (Greuter *et al*., 1984; Castroviejo *et al*., 2010). In Italy, it is known in Apulia and eastern Basilicata. The station of Fasano, after those of Monopoli (Bianco & Sarfatti, 1961; Cavallaro *et al*., 2007; Perrino & Signorile, 2009) and Polignano a Mare (Perrino & Signorile, 2010; Vita & Forte, 1990), is the western limit of its distribution. Some authors (Brullo *et al*., 1994), on the basis of specimens collected in Punta Palascia (Otranto - Lecce), have shown the existence of a karyological correspondence of these populations with those of Greece and Turkey. The observed population consists of a few individuals. In Apulia, the taxon is considered Near Threatened (Perrino *et al*., 2012).

***Barlia robertiana* (Loisel.) Greuter [CI]**

GPS: N4641171, E578340; Place: Vico del Gargano (Foggia); Plant community: uncultivated community (*Stellarietea mediae* R. Tüxen, Lohmeyer & Preising ex Rochow 1951); altitude: 214 m a.s.l.; Habitat 92/43/EEC: not identified. In Italy, this big orchid is known in the southern territories, while it is lacking in some central and northern regions. Both variants, with purple to greenish shades and whitish tepals, the latter being more rare, were observed.

***Crepis brulla* Greuter [I]**

GPS: N4641265, E578408; Place: Vico del Gargano (Foggia); Plant community: uncultivated community (*Stellarietea mediae* R. Tüxen, Lohmeyer & Preising ex Rochow 1951); altitude: 200 m a.s.l.; Habitat 92/43/EEC: not identified. Endemic species exclusive to the southern Italy (Apulia, Basilicata and Calabria) (Conti *et al*., 2005). Found in several types of vegetation, but always with only a few individuals.

***Crepis corymbosa* Ten. [I]**

GPS: N4519987, E710627; Place: Fasano (Brindisi); Plant community: annual meadow (*Brachypodietalia distachyi* Rivas-Martínez 1978); altitude: 34 m a.s.l.; Habitat 92/43/EEC: 6220* (subtype 3) „*Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea*" (San Miguel, 2008). It is endemic in central and southern Italy, Ionian Islands, Corfu and

Kefalonia (Pignatti, 1982). It is observed within the annual meadows and, more rarely, within the scrubland communities. The fruit (achene) of this species can be easily confused with those of other species of the same genus.

***Cyclamen hederifolium* Aiton [CI]**

GPS: N4641079, E578410; Place: Vico del Gargano (Foggia); Plant community: uncultivated community (*Stellarietea mediae* R. Tüxen, Lohmeyer & Preising ex Rochow 1951); altitude: 224 m a.s.l.; Habitat 92/43/EEC: not identified. A species common in all of the Italian Regions, included in the CITES list. A cew observed individuals spreading from nearby woods.

***Epilobium parviflorum* Schreb. [r]**

GPS: N4473077, E782136; Place: Le Cesine (Vernole - Lecce); Plant community: humid grasslands; altitude: 6 m a.s.l.; Habitat 92/43/EEC: 6420 „*Mediterranean tall humid herb grasslands of the Molinio-Holoschoenion*". It is a widely distributed (Paleotemperate) taxon, rare in Italy. It grows in muddy wet habitats, such as Le Cesine olive grove, where it grows on the vegetation marging, between the wetland and the field.

***Erica forskalii* Vitm. [VU]**

GPS: N4472988, E782234; Place: Le Cesine (Vernole - Lecce); Plant community: garigue; altitude: 7 m a.s.l.; Habitat 92/43/EEC: not identified. Mediterranean eastern species, known in Italy, ex Yugoslavia, Albania, Bulgaria, Greece, Crete, Eastern Aegean Islands, Turkey, Cyprus, Lebanon, Syria, Israel and Jordan (Greuter *et al*., 1986). In Italy, it is known only in Southern Apulia (Brullo *et al*., 1986; Conti *et al*., 2005). Observed in the scrub vegetation, bordering the olive grove.

***Gagea granatellii* Parl. [VU]**

GPS: N4520081, E710649; Place: Fasano (Brindisi); Plant community: annual meadow (*Brachypodietalia distachyi* Rivas-Martínez 1978); altitude: 31 m a.s.l.; Habitat 92/43/EEC: 6220* (subtype 3) „*Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea*" (San Miguel, 2008). Endemic taxon of western Mediterranean area (Tison, 1998; Peruzzi *et al*., 2012). In Italy it has been found in central and southern regions (Conti *et al*., 2005; Peruzzi & Gargano, 2005; Conti *et al*., 2007). It is included in the Red Regional List of Apulia and Sicily, with the status of vulnerable (VU), while in Abruzzo, Marche, Molise and Basilicata it is at lower risk (LR). Few individuals were found in an annual meadow.

***Gagea mauritanica* Durieu [CR]**

GPS: N4520081, E710695; Place: Fasano (Brindisi); Plant community: annual meadow (*Brachypodietalia distachyi* Rivas-Martínez 1978); altitude: 32 m a.s.l.; Habitat 92/43/EEC: 6220* (subtype 3) „*Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea*" (San Miguel, 2008). This species is endemic to western Mediterranean (Peruzzi & Tison, 2007). In Italy is documented only to Apulia and Sicily Regions (Peruzzi *et al*., 2009). Only two individuals seen in vegetation like that of *G. granatelli*.

***Helianthemum jonium* Lacaita [I]**

GPS: N4520146, E710764; Place: Fasano (Brindisi); Plant community: garigue (*Helianthemum jonii-Fumanetum thymifoliae* Taffetani & Biondi 1992); altitude: 30 m a.s.l.; Habitat 92/43/EEC: not identified. Endemic species to Morocco (Ruiz De La Torre, 1956) and central and southern Italy (Emilia Romagna, Apulia, Basilicata and Molise) (Conti *et al*.,

2005). The population grows into *Thymbra capitata* (L.) Cav. garigue. In some cases, isolated individuals are found in scrub vegetation.

***Muscari parviflorum* Desf. [PI, r] (Fig. 5)**

GPS: N4509660, E645633; Place: Torre Guaceto (Carovigno - Brindisi); Plant community: uncultivated community (*Stellarietea mediae* R. Tüxen, Lohmeyer & Preising ex Rochow 1951); altitude: 27 m a.s.l.; Habitat 92/43/EEC: not identified. Species of phytogeographical interest, with central and eastern Mediterranean distribution, extended from Spain and northern Africa to western Asia (Tutin *et al*., 1980). It is rare in many regions of Italy (Conti *et al*., 2005). The station of Torre Guaceto is the first found for the province of Brindisi, the second in Apulia after that of Salento (Mele *et al*., 2001). The population of the Torre Guaceto olive grove counts about 100 individuals, but in the territory may be larger.

***Ophrys incubacea* Bianca [CI]**

GPS: N4520177, E710787; Place: Fasano (Brindisi); Plant community: uncultivated community (*Stellarietea mediae* R. Tüxen, Lohmeyer & Preising ex Rochow 1951); altitude: 28 m a.s.l.; Habitat 92/43/EEC: not identified. It is a relatively common species in grasslands and uncultivated communities, but rare in olive groves.

***Orchis palustris* Jacq. [CI, EN] (Fig. 6)**

GPS: N4473078, E782160; Place: Le Cesine (Vernole - Lecce); Plant community: humid grasslands; altitude: 6 m a.s.l.; Habitat 92/43/EEC: 6420 „*Mediterranean tall humid herb grasslands of the Molinio-Holoschoenion*". Euroasiatic species (if it includes *O. elegans*) or Euri-Mediterranean (if it includes *O. palustris* s.s.) (Alessandrini & Medagli, 2008), which, in Italy, shows a scattered distribution (Conti *et al*., 2005). The population shows few individuals, that grow in the same habitat of *Epilobium parviflorum*.

***Orchis purpurea* Huds. [CI]**

GPS: N4641017, E578387; Place: Vico del Gargano (Foggia); Plant community: uncultivated community (*Stellarietea mediae* R. Tüxen, Lohmeyer & Preising ex Rochow 1951) and scrub vegetation (*Oleo-Ceratonion siliquae* Br.-Bl. 1936 em. Rivas Martínez 1975); altitude: 240 m a.s.l.; Habitat 92/43/EEC: not identified. Eurasiatic species, found in Europe and in Turkey, unique for its size it may reach a meter of height. Rare in Apulia, it was observed at the margins of the olive groves, road banks and forest oak (Del Fuoco, 2003). The flower looks like an old countryside woman (with a hat and wide skirt) and is called the lady orchid.

***Satureja cuneifolia* Ten. [PI]**

GPS: N4520145, E710764; Place: Fasano (Brindisi); Plant community: garigue (*Cisto-Ericion* Horvatić 1958); altitude: 29 m a.s.l.; Habitat 92/43/EEC: not identified. Amphi-Adriatic (Greuter *et al*., 1986), in Italy found only in Apulia and Basilicata Regions (Conti *et al*., 2005). The observed population is well preserved.

***Scrophularia lucida* L. [Ad, PI]**

GPS: N4520019, E710650; Place: Fasano (Brindisi); Plant community: rocky slopes (*Campanulion versicoloris* Quezel 1964); altitude: 34 m a.s.l.; Habitat 92/43/EEC: 8210 „*Calcareous rocky slopes with chasmophytic vegetation*". It is a casmophyte of Amphi-Adriatic and phytogeographic interest; known in France, Italy, Greece and the Aegean Islands (Crete and Karpathos). In Italy, it is known only in Apulia and Basilicata, while it is

uncertain in Piemonte (Conti *et al*., 2005). It was observed on the drystone walls bordering the valley of the field.

***Stipa austroitalica* Martinovský subsp. *austroitalica* [I, B, DH]**

GPS: N4520082, E710696; Place: Fasano (Brindisi); Plant community: perennial grasslands; altitude: 32 m a.s.l.; Habitat 92/43/EEC: not identified. Endemic species of high conservation interest. The subsp. *austroitalica,* one of the four subspecies (Moraldo & Ricceri, 2003), was found with few isolated individuals.

FLORISTIC LIST

POLYPODIIDAE

DENNSTAEDTIACEAE

Pteridium aquilinum (L.) Kuhn subsp. *aquilinum* - G - C

PTERIDACEAE

Adiantum capillus-veneris L. - G - Pn

ASPLENIACEAE

Ceterach officinarum Willd. - H - Ese

PINIDAE

PINACEAE

Pinus halepensis Miller - P - Ms

MAGNOLIIDAE

LAURACEAE

Laurus nobilis L. - P - Ms

ARACEAE

Arisarum vulgare Targ.-Tozz. - G - Ms

Arum italicum Miller subsp. *italicum* - G - Ms

DIOSCORACEAE

Tamus communis L. - G - Me

COLCHICACEAE

Colchicum cupanii Guss. - G - Ms

SMILACACEAE

Smilax aspera L. - NP - Tps

LILIACEAE

Gagea granatellii (Parl.) Parl. - G - Msd - **VU**

Gagea mauritanica Durieu - G - Mssw - **CR**

ORCHIDACEAE

Barlia robertiana (Loisel.) Greuter - G -Ms - **CI**

Ophrys incubacea Bianca - G - Ms - **CI**

Orchis palustris Jacq. - G - Me - **CI** - **EN**

Orchis purpurea Huds. - G - Ea - **CI**

IRIDACEAE

Gladiolus italicus Mill. - G - Me
Hermodactylus tuberosus (L.) Mill. - G - Msn
Romulea columnae Sebast. & Mauri - G - Ms

XANTHORRHOEACEAE
Asphodelus fistulosus L. - H - Tpsp
Asphodelus ramosus L. subsp. *ramosus* - G - Ms

AMARYLLIDACEAE
Allium ampeloprasum L. - G - Me
**Allium roseum* L. - G - Ms
Allium subhirsutum L. - G - Ms
Allium trifoliatum Cirillo - G - Mse

ASPARAGACEAE
**Asparagus acutifolius* L. - NP - Ms
Charybdis pancration (Steinh.) Speta - G - Msm
Loncomelos narbonensis (Torm. in L.) Raf. - G - Me
Muscari commutatum Guss. - G - Mece
Muscari comosum (L.) Mill. - G - Me
Muscari neglectum Guss. ex Ten.- G - Me
Muscari parviflorum Desf. - G - Mece - **PI** - **r**
Ornithogalum comosum L.- G - Mm
Ornithogalum gussonei Ten. - G - Ms
Ornithogalum umbellatum L. - G - Me
Ruscus aculeatus L. - Ch - Me

JUNCACEAE
Juncus articulatus L. - G - Cb
Juncus hybridus Brot. - T - Ma

CYPERACEAE
Isolepis cernua (Vahl) Roem. & Schult. - T - Cs

POACEAE
Achnatherum bromoides (L.) P. Beauv. - H - Ms
Aegilops ovata Auct. - T - Mst
Aegilops uniaristata Vis. - T - **Ad** - **VU**
Agrostis stolonifera L. - H - Cb
Aira caryophyllea L. subsp. *caryophyllea* - T - Tps
Arundo donax L. - G - Cs - *archaeophyte invasive*
Arundo plinii Turra - G - Ms
**Avena barbata* Pott. ex Link - T - Me
Avena sativa L. - T
Brachypodium retusum (Pers.) P. Beauv. - H - Msw
Brachypodium sylvaticum (Huds.) P. Beauv. - H - Tmp
**Briza maxima* L. - T - Tps
Briza minor L. - T - Cs
Bromus diandrus Roth - T - Tpsp
Bromus hordeaceus L. - T - Cs
Bromus madritensis L. - T - Me

**Catapodium rigidum* (L.) C.E. Hubb. - T - Me
Cynodon dactylon (L.) Pers. - G - C
Cynosurus echinatus L. - T - Me
Dactylis glomerata L. subsp. *glomerata* - H - Tmp
Dactylis glomerata L. subsp. *hispanica* (Roth) Nyman - H - Ms
Dasypyrum villosum (L.) P. Candargy - T - Met
Digitaria sanguinalis (L.) Scop. - T - Cs
Hordeum murinum L. - T - Cb
Hordeum murinum L. subsp. *leporinum* (Link) Arcang. - T - Cb
Hyparrhenia hirta (L.) Stapf subsp. *hirta* - H - Tpp
Lagurus ovatus L. subsp. *ovatus* - T - Ms
Lolium perenne L. - H - Cb
Lolium rigidum Gaudin - T - Tpsp
Parapholis incurva (L.) C.E. Hubb. - T - Ma
Phalaris minor Retz. - T - Tpsp
Phalaris paradoxa L. - T - Ms
Phleum pratense L. - H - Cb
Piptatherum miliaceum (L.) Coss. subsp. *miliaceum* - H - Mst
Piptatherum miliaceum (L.) Coss. subsp. *thomasii* (Duby) Freitag - H - Ms
Poa annua L. - T - C
Poa bulbosa L. - H - Tmp
Polypogon monspeliensis (L.) Desf. - T - Tps
Rostraria cristata (L.) Tzvelev - T - Cs
Setaria viridis (L.) Beauv. - T - Cs
Sorghum halepense (L.) Pers. - G - Ctr - *archaeophyte invasive*
Stipa austroitalica Martinovský subsp. *austroitalica* - H - **B** - **DH - I**
Stipa capensis Thunb. - T - Ms
Trachynia distachya (L.) Link - T - Ms
Vulpia ciliata Dumort. - T - Me
Vulpia ligustica (All.) Link - T - Ms

PAPAVERACEAE

Fumaria capreolata L. subsp. *capreolata* - T - Me
Fumaria officinalis L. - H - Mem
Fumaria parviflora Lam. - T - Mt
Papaver hybridum L. - T - Mt
**Papaver rhoeas* L. subsp. *rhoeas* - T - Mes

RANUNCULACEAE

Anemone hortensis L. subsp. *hortensis* - G - Mn
Clematis cirrhosa L. - P - Mst
Clematis vitalba L. - P - Eca
Delphinium halteratum Sm. subsp. *halteratum* - T - Ms
Nigella arvensis L. - T - Me
Nigella damascena L. - T - Me
Ranunculus bullatus L. - H - Ms
Ranunculus ficaria L. - G/H - Ea
Ranunculus millefoliatus Vahl - H - Mm

Ranunculus neapolitanus Ten. - H - Mmne
Ranunculus sardous Crantz - T -Me

CRASSULACEAE
Sedum rubens L. - T - Meas

ZYGOPHYLLACEAE
Tribulus terrestris L. - T - C

FABACEAE
Acacia cyanophylla Lindley - P - Aus
Anagyris foetida L. - P - Mss
Anthyllis vulneraria L. subsp. *maura* (Beck) Maire - H - Mssw
Astragalus hamosus L. - T - Mt
Bituminaria bituminosa (L.) C.H. Stirt. - H - Me
Calicotome villosa (Poir.) Link - P - Ms
Ceratonia siliqua L. - P - Mss
Coronilla scorpioides (L.) W.D.J. Koch - T - Me
Dorycnium hirsutum (L.) Ser. - Ch - Me
Emerus major Mill. subsp. *emeroides* (Boiss. & Spruner) Soldano & F. Conti - NP
Hippocrepis ciliata Willd. - T - Ms
Lathyrus cicera L. - T - Me
Lathyrus ochrus (L.) DC. - T - Ms
Lathyrus sylvestris L. subsp. *sylvestris* - H - E
Lotus corniculatus L. - H - C
Lotus edulis L. - T - Ms
Lotus ornithopodioides L. - T - Ms
Lupinus cosentinii Guss. - T - Mw
Medicago arabica (L.) Huds. - T - Mw
Medicago minima L. - T - Tscm
Medicago orbicularis (L.) Bartal. - T - Me
Medicago polymorpha L. - T - Me
Medicago truncatula Gaertn. - T - Ms
**Melilotus sulcata* Desf. - T - Msd
Onobrychis aequidentata (Sm.) D'Urv. - T - Mse
Onobrychis caput-galli (L.) Lam. - T - Ms
Ononis reclinata L. - T - Mts
Ononis viscosa (L.) subsp. *breviflora* (DC.) Nyman - T - Mw
Scorpiurus muricatus L. - T - Me
Spartium junceum L. - P - Me
Sulla capitata (Desf.) B.H. Choi & H. Ohashi - T - Msw
Tetragonolobus purpureus Moench - T - Ms
Trifolium campestre Schreb. - T - Mmpw
Trifolium lappaceum L. - T - Me
Trifolium pratense L. - T - Cs
Trifolium resupinatum L. - T - Tmp
Trifolium scabrum L. subsp. *scabrum* - T - Me
Trifolium squarrosum L. - T - Me
Trifolium stellatum L. - T - Me

Trifolium tomentosum L. - T - Tmp
Trigonella monspeliaca L. - T - Me
Vicia hybrida L. - T - Me
Vicia lutea L. - T - Me
Vicia sativa L. - T - Cs
Vicia sativa L. subsp. *macrocarpa* (Moris) Arcang. - T - Cs
Vicia villosa Roth. - T - Me

ROSACEAE
Geum urbanum L. - H - Cb
Mespilus germanica L. - P - Esp
Prunus avium L. subsp. *avium* - P - P
Prunus dulcis Miller D.A. Webb - P - Msd
Pyrus spinosa Forssk. - P - Ms
Rosa sempervirens L. - NP - Ms
Rubus canescens DC. - NP - Men
**Rubus ulmifolius* Schott - NP - Me
Sanguisorba minor Scop. - H - Tmp

RHAMNACEAE
Paliurus spina-christi Miller - P - Ese
Rhamnus alaternus L. subsp. *alaternus* - P - Me

MORACEAE
Ficus carica L. - P - Mt
Morus alba L. - P - Ase - *archaeophyte fortuitous*

URTICACEAE
Mercurialis annua L. - T - Tmp
Parietaria judaica L. - H - Mem
Urtica dioica L. subsp. *dioica* - H - Cs
Urtica urens L. - T - Cs

FAGACEAE
Quercus cerris L. - P - Mn
Quercus ilex L. subsp. *ilex* - P - Ms
Quercus pubescens Willd. subsp. *pubescens* - P - Esep

JUGLANDACEAE
Juglans regia L. - P - Assw

BETULACEAE
Ostrya carpinifolia Scop. - P - P

OXALIDACEAE
**Oxalis pes-caprae* L. - G - Afs - *neophyte invasive*

EUPHORBIACEAE
Chamaesyce maculata (L.) Small - T - An - *neophyte invasive*
Euphorbia characias L. - NP - Ms
Euphorbia exigua L. subsp. *exigua* - T - Me
**Euphorbia helioscopia* L. subsp. *helioscopia* - T - C
Euphorbia peplus L. - T - Esb
Euphorbia segetalis L. - T - Mw

Euphorbia terracina L. - T - Ms

PHYLLANTHACEAE

Andrachne telephioides L. - Ch - Me

VIOLACEAE

Viola reichenbachiana Jordan ex Boreau - H - Esb

LINACEAE

Linum bienne Mill. - H - Me

Linum strictum L. - T - Ms

HYPERICACEAE

Hypericum perforatum L. - H - Tmp

Hypericum triquetrifolium Turra - H - Mse

GERANIACEAE

Erodium cicutarium (L.) L'Her - T/H - Cs

Erodium malacoides (L.) L'Hér. subsp. *malacoides* - T - Ms

Geranium dissectum L. - T - Cs

**Geranium molle* L. - H - Cs

Geranium purpureum Vill. - T - Me

Geranium rotundifolium L. - T - Tmp

ONAGRACEAE

Epilobium parviflorum Schreb. - H - Tmp - **r**

MYRTACEAE

Myrtus communis L. subsp. *communis* - P - Ms

ANACARDIACEAE

Pistacia lentiscus L. - P - Mss

Pistacia terebinthus L. subsp. *terebinthus* - P - Me

RUTACEAE

Citrus aurantium L. - P - Cn

Citrus limon (L.) Burm. f. cultivar *femminello* - P - Hi

Citrus sinensis (L.) Osbeck cultivar *biondo comune del Gargano* - P - Cn

Citrus sinensis (L.) Osbeck cultivar *duretta del Gargano* - P - Cn

Ruta chalepensis L. - Ch - Mss

MALVACEAE

Althaea hirsuta L. - T - Me

Malva cretica Cav. - T - Ms

Malva sylvestris L. subsp. *sylvestris* - H - Esb

THYMELAEACEAE

Daphne gnidium L. - P - Msm

CISTACEAE

Cistus creticus L. - NP - Mec

Cistus monspeliensis L. - NP - Ms

Cistus salviifolius L. - NP - Ms

Fumana laevipes (L.) Spach - Ch- Ms

Fumana thymifolia (L.) Spach ex Webb - Ch - Ms

Helianthemum jonium Lacaita - Ch - **I**

Helianthemum salicifolium (L.) Mill. - T - Me

RESEDACEAE
Reseda alba L. - T - Ms
CAPPARACEAE
Capparis spinosa L. - Np - Ea
BRASSICACEAE
Biscutella didyma L. subsp. *apula* Nyman - T - Mts
Capsella bursa-pastoris (L.) Medik. subsp. *bursa-pastoris* - H - C
Cardamine hirsuta L. - T - C
Diplotaxis erucoides (L.) DC. subsp. *erucoides* - T- Msw
Diplotaxis tenuifolia (L.) DC. - H - Masb
Erophila verna (L.) DC. - T - Cb
Lepidium draba (L.) Desv. subsp. *draba* - G/H - Mt
Moricandia arvensis (L.) DC - T - Ms
Raphanus raphanistrum L. - T - Cb - *archaeophyte fortuitous*
Raphanus sativus L. - T
Rapistrum rugosum (L.) Arcang. - T - Me
Sinapis alba L. - T - Mes
Sinapis arvensis L. subsp. *arvensis* - T - Ms
Sisymbrium irio L. - T - Tm
Thlaspi arvense L. - T - Asw
SANTALACEAE
Osyris alba L. - NP - Me
POLYGONACEAE
Rumex acetosa L. subsp. *acetosa* - H - Cb
Rumex buchephalophorus L. subsp. *buchephalophorus* - T - Mmc
Rumex crispus L. - H - Cs
Rumex pulcher L. - H/T - Me
CARYOPHYLLACEAE
Arenaria serpyllifolia L. subsp. *serpyllifolia* - T - Cs
**Cerastium glomeratum* Thuill. - T - Cs
Minuartia verna (L.) Hiern subsp. *attica* (Boiss. & Spruner) Graebn. - Ch - Me
Petrorhagia dubia (Raf.) G. Lopez & Romo - G - Msd
Petrorhagia prolifera (L.) P.W. Ball. & Heywood - T - Me
Petrorhagia saxifraga (L.) Link subsp. *gasparrinii* (Guss.) Greuter & Burdet - H - Me
Sagina apetala Ard. subsp. *apetala* - H - Me
Silene conica L. - H - Tmp
Silene italica (L.) Pers. - H - Me
Silene latifolia Poiret - T/H - Ms
Silene nocturna L. - T - Mmms
Silene vulgaris (Moench) Garcke - H
Stellaria media (L.) Vill. subsp. *media* - T - C
AMARANTHACEAE
Amaranthus retroflexus L. - T - C - *neophyte invasive*
Beta vulgaris L. - H - Me
Chenopodium hybridum L. - T - Cb
PORTULACACEAE

Portulaca oleracea L. subsp. *oleracea* - T - Cs

CACTACEAE

Opuntia ficus-indica (L.) Miller - P - Nen - *neophyte invasive*

ERICACEAE

Erica forskalii Vitm. - Ch/NP - Mes - **VU**

PRIMULACEAE

**Anagallis arvensis* L. - T - Me
Cyclamen hederifolium Aiton - G - Msn - **CI**
Samolus valerandi L. - H - Cs

RUBIACEAE

Asperula aristata L. - H/Ch - Mm
Galium aparine L. - T - Ea
Galium lucidum All. - H - Me
Galium palustre L. subsp. *elongatum* (C. Presl.) Lange - H - Me
Galium spurium L. - T - Ea
Galium verrucosum Huds. - T - Ms
Galium verum L. - H - Ea
**Rubia peregrina* L. - P - Msm
**Sherardia arvensis* L. - T - Cs
Theligonum cynocrambe L. - T - Ms
Valantia muralis L. - T - Ms

GENTIANACEAE

Blackstonia perfoliata (L.) Huds. subsp. *perfoliata* - T - Me
Centaurium erythraea Rafn - H - Tmp
Centaurium pulchellum (Sw.) Druce subsp. *pulchellum* - T - Tmp

APOCYNACEAE

Cynanchum acutum L. subsp. *acutum* - P - Tpsp

BORAGINACEAE

Alkanna tinctoria (L.) Tausch subsp. *tinctoria* - H - Ms
Borago officinalis L. - T - Me
Buglossoides arvensis (L.) I. M. Johnst. - T - Me
Buglossoides purpureocaerulea (L.) I.M. Johnst. - H - Esp
**Cerinthe major* L. - T - Ms
Cynoglossum creticum Mill. - H - Me
Echium parviflorum Moench - T -Ms
Echium plantagineum L. - T/H - Me
Heliotropium europaeum L. - T - Met
Myosotis arvensis (L.) Hill subsp. *arvensis* - T - Easw
Phacelia tanacetifolia Benth. - T - An - *neophyte*

CONVOLVULACEAE

Calystegia sepium (L.) R. Br. subsp. *sepium* - H - Tmp
Calystegia sylvatica (Kit.) Griseb. - H - Ese
Convolvulus althaeoides L. - H - Ms
Convolvulus arvensis L. - G - C
Convolvulus cantabrica L. - H - Me
Convolvulus elegantissimus Mill. - H - Mse

Cuscuta epithymum L. - T - Eat

SOLANACEAE

Solanum nigrum L. - T - C

OLEACEAE

Fraxinus ornus L. subsp. *ornus* - P - Menp
**Olea europaea* L. - P - Ms
Phillyrea latifolia L. - P - Ms

PLANTAGINACEAE

Kickxia spuria (L.) Dumort. - T - Ea
Linaria reflexa (L.) Desf. - T - Msdw
Linaria vulgaris Mill. subsp. *vulgaris* - H - Ea
Misopates orontium (L.) Raf. subsp. *orontium* - T - Tmp
Plantago afra L. - T - Ms
Plantago bellardii All. - T - Msd
Plantago lagopus L. - T - Ms
Plantago lanceolata L. - H - Ea
Plantago major L. - H - Cs
Plantago serraria L. - H - Ms
**Veronica hederifolia* L. - T - Ea
**Veronica polita* Fries - T - Cs

SCROPHULARIACEAE

Scrophularia lucida L. - H/Ch - Mm - **Ad** - **PI**
Scrophularia peregrina L. - T - Ms
Verbascum pulverulentum Vill. - H - Ecs
Verbascum sinuatum L. - H - Me

LAMIACEAE

Acinos alpinus (L.) Moench - Ch - Oes
Ajuga chamaepitys (L.) Schreber - T - Me
Calamintha nepeta (L.) Savi - H - Oes
Clinopodium vulgare L. - H - Cb
Lamium amplexicaule L. - T - Tmp
Lycopus europaeus L. - H - Cb
Marrubium vulgare L. - H - Cs
Micromeria graeca (L.) Benth. ex Rchb. subsp. *graeca* - Ch - Ms
Origanum vulgare L. subsp. *viridulum* (Martin-Donos) Nyman - H - Ea
Prasium majus L. - Ch - Ms
Rosmarinus officinalis L. - NP - Ms
Salvia verbenaca L. - H - Msa
Satureja cuneifolia Ten. - Ch - Msn - **PI**
Satureja montana L. - Ch - Omw
Sideritis romana L. subsp. *romana* - T - Ms
Stachys germanica L. subsp. *salviifolia* (Ten.) Gams. - H - Mne
Teucrium capitatum L. subsp. *capitatum* - Ch - Ms
Teucrium flavum L. - Ch - Ms
Teucrium scordium L. - H - Eca
Thymbra capitata (L.) Cav. - Ch - Mse

OROBANCHACEAE

Bartsia trixago L. - T - Me
Parentucellia latifolia (L.) Caruel - T - Me
Parentucellia viscosa (L.) Caruel - T - Mea

ACANTHACEAE
Acanthus spinosus L. - H - Mse

VERBENACEAE
Verbena officinalis L. - H - C

CAMPANULACEAE
Asyneuma limonifolium (L.) Janch. subsp. *limonifolium* - H - Ad - PI - NT
Legousia hybrida (L.) Delarbre - T - Ma
Legousia speculum-veneris (L.) Chaix - T - Me

ASTERACEAE
Achillea millefolium L. - H - Esb
**Anthemis arvensis* L. - T/H - Cs
Bellis annua L. subsp. *annua* - T - Msm
Bellis sylvestris Cirillo - H - Ms
**Calendula arvensis* (Vaill.) L. - T - Me
Calendula officinalis L. - T/H
Carduus pycnocephalus L. subsp. *pycnocephalus* - H - Mt
Carlina corymbosa L. - H - Ms
Centaurea nicaeensis All. - H - Mssw
Chondrilla juncea L. - H - Me
Cichorium intybus L. - H - Tmp
Cirsium arvense (L.) Scop. - G - Ea
Cota tinctoria (L.) J. Gay - H/Ch - Ecp
Crepis brulla Greuter - T - **I**
Crepis corymbosa Ten. - T - **I**
Crepis leontodontoides All. - H - Mmw
Crepis vesicaria L. - T/H - Masb
Crupina crupinastrum (Moris) Vis. - T - Ms
Dittrichia viscosa (L.) Greuter - H - Me
Erigeron canadensis L. - T - Avv. - *neophyte invasive*
Eupatorium cannabinum L. - H - Tmp
Galactites elegans (All.) Soldano - H - Ms
Glebionis coronaria (L.) Spach - T - Ms
Glebionis segetum (L.) Fourr. - T - Me
Helichrysum italicum (Roth) G. Don - Ch - Es
Hyoseris scabra L. - T - Ms
Hypochaeris achyrophorus L. - T - Ms
Inula conyzae (Griess.) Meikle - H - Easw
Klasea flavescens (L.) Holub - H - Msdw
Lactuca serriola L. - H/T - Mess
Leontodon crispus Vill. subsp. *crispus* - H - Es
Leontodon hispidus L. - H - Eca
Leontodon tuberosus L. - H - Ms
Matricaria chamomilla L. - T - Cs
Onopordum illyricum L. - H - Ms

Pallenis spinosa (L.) Cass. subsp. *spinosa* - H - Me
**Picris hieracioides* L. - H - Esb
Pulicaria dysenterica (L.) Bernh. - H - Me
**Reichardia picroides* (L.) Roth - H - Ms
Rhagadiolus stellatus (L.) Gaertn. - T - Me
Senecio leucanthemifolius Poir. subsp. *leucanthemifolius* - T - Ms
Senecio vulgaris L. - T - C
Sonchus asper (L.) Hill - T - Ea
**Sonchus oleraceus* L. - T - Ea
Sonchus tenerrimus L. -T - Ms
Symphyotrichum squamatum (Spreng.) G. L. Nesom - T/H - Nen - *neophyte invasive*
Taraxacum officinale Weber - H - Cb
Tragopogon porrifolius L. - H - Me
Tripolium pannonicum (Jacq.) Dobrocz. - H - Ea
Urospermum dalechampii (L.) F. W. Schmidt - H - Me
Urospermum picroides (L.) Scop. ex F.W. Schmidt - T - Me
Xanthium spinosum L. - T - Ams - *neophyte naturalized*

ADOXACEAE
Sambucus nigra L. - P - Eca
Viburnum tinus L. subsp. *tinus* - P - Ms

CAPRIFOLIACEAE
Centranthus calcitrapae (L.) Dufr. subsp. *calcitrapae* - Ch - Ms
Centranthus ruber (L.) DC. subsp. *ruber* - Ch - Ms
Dipsacus fullonum L. - H - Me
**Knautia integrifolia* (L.) Bertol. subsp. *integrifolia* - T - Me
Lonicera implexa Aiton subsp. *implexa* - P - Ms
Scabiosa columbaria L. - H - Ea
Sixalis atropurpurea (L.) Greuter & Burdet ssp. *grandiflora* (Scop.) Sold. & Conti - H - Ms
Valerianella muricata (Stev. ex M. Bieb.) J.W. Loudon - T - Ms

ARALIACEAE
Hedera helix L. subsp. *helix* - P - Meas

APIACEAE
Ammoides pusilla (Brot.) Breistr. - T - Ms
**Daucus carota* L. subsp. *carota* - H - Cs
Eryngium campestre L. - H - Me
Foeniculum vulgare Miller - H - Msd
**Scandix pecten-veneris* L. - T - Cs
Smyrnium olusatrum L. - H - Ma
Tordylium apulum L. - T - Ms
Tordylium officinale L. - T - Mne
Torilis arvensis (Huds.) Link - T - Cs

CONCLUSION

The vulnerability of the agro-ecosystems of olive groves was already pointed out in a previous paper (Perrino *et al.*, 2011). The results of the present study provide further information that can help to improve conservation and management of plant biodiver-

Fig. 5. *Muscari parviflorum* Desf. in the olive grove of Torre Guaceto.

Fig. 6. *Orchis palustris* Jacq. in the olive grove of Le Cesine.

sity and especially of plant species at risk and/or having a conservation interest that found their niches in olive groves. So ancient olive trees are important not only for the beautiful landscape they form, for olive production, efficient carbon dioxide sequestration and for their ability to face climatic changes, but also because the groves in which they grow conserve entire agro-ecosystems, in which several endangered plant, animal and microbial species may survive and provide speciation, adaptation, evolution and development. Studying the flora of olive groves will enable us to build a database capable of providing a tool for improved conservation of agro-biodiversity as an expression of such agro-ecosystems. Greater agro-biodiversity will improve conservation of endangered plant species and/or of species of conservation interest that due to high anthropic pressures appear to be at high risk of extinction (18 taxa). Information for understanding

how critical the risk is, and, to some extent, for taking actions for an adequate protection, conservation and management have been pointed out.

These data suggest that there is need to extend the study to other olive groves of Apulia, to other regions of Italy and to the Mediterranean basin, in order to have a more comprehensive picture of the vascular flora and further to improve our knowledge of olive grove agro-ecosystems. Appropriate planning and sustainable management of olive groves would help in meeting both the economic and social objectives of olive production while achieving a proper conservation of the related ecosystems.

ACKNOWLEDGEMENT

The authors wish to thank the Mediterranean Agronomic Institute of Bari (Italy), as coordinating beneficiary of the project LIFE+ Cent.Oli.Med. (LIFE07 NAT/IT/000450), which made the present study possible. Also, we wish to thank the owners of the investigated olive orchards for providing access to their fields, farms and facilities. Thanks are due to the Botanical Garden Museum of the University of Bari, Italy, for the availability of the herbarium and of the library. Finally, authors wish to thank the referees for their valuable comments and suggestions.

Received November 1, 2012

REFERENCES

Acerbo, G., 1937: La marcia storica dell'olivo nel Mediterraneo. Atti Società per il Progresso delle Scienze. Riun. XXV, Vol. **1**, Fasc. 2, 1-22.

Alessandrini, A. & Medagli, P., 2008: *Orchis palustris* Jacq. Inform. Bot. Ital., **40**, suppl. 1, 93-95.

APG III, 2009: An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants. Apg III. Bot. J. Linn. Soc., **161**, 105-121.

Bartolini, G., Prevost, G., Messesi, C. & Carignani, G. (Eds.), 2005: Olive Germplasm: cultivars and world-wide collections. Seed and Plant Genetic Resources Service. FAO. http://apps3.fao.org/wiews/olive/authors.jsp.

Bianco, P., Medagli, P. & D'Emerico, S., 1989: Nuovi dati distributivi e osservazioni morfologiche su *Aegilops uniaristata* Vis. (*Gramineae*), entità mediterraneo-orientale riaccertata per la flora italiana. Webbia, **43** (1), 19-24.

Bianco, P. & Sarfatti, G., 1961: Stazioni di roccia a Monte S. Nicola (Monopoli, Puglia) con osservazioni sull'areale di *Campanula versicolor* Sib. et Sm., *Carum multiflorum* Boiss e *Scrophularia lucida* L. Nuovo Giorn. Bot. Ital., **68** (1-2), 21-35.

Biondi, E., Biscotti, N., Casavecchia, S. & Marrese, M., 2007: „Oliveti secolari": habitat nuovo proposto per l'inserimento nell'Allegato I della Direttiva (92/43 CEE). Fitosociologia, **44** (2), suppl**. 1,** 213-218.

Biondi, E. & Blasi, C., (Eds.), 2009: Manuale Italiano di interpretazione degli habitat della direttiva 92/43 EEC. http://vnr.unipg.it/habitat/index.jsp.

Braun-Blanquet, 1932: Plant sociology. McGraw Hill, London.

Brullo, S., Guglielmo, A., Pavone, P. & Terrasi, M.C., 1994: Numeri cromosomici per la Flora Italiana: 1334. Inform. Bot. Ital., **26** (2-3), 211-213.

Brullo, S., Minissale, P., Spampinato, G. & Signorello, P., 1986: Studio fitosociologico delle garighe ad *Erica manipuliflora* del Salento (Puglia meridionale). Arch. Bot. Ital., **62**, 201-214.

Caforio, F. & Marchiori, S., 2006: Nuove segnalazioni e specie rare per la flora infestante le colture della Puglia. Inform. Bot. Ital., **38** (1), 37-40.

Cappelletti, C., 1976: Trattato di botanica. Utet, Torino.

Castroviejo, S., Aldasoro, J.J. & Alarcón, M., with contributions from Hand R., 2010: *Campanulaceae*. In: Euro+Med Plantbase - the information resource for Euro-Mediterranean plant diversity. http://www.emplantbase.org/home.html.

Cavallaro, V., Angiulli, F., Forte, L. & Macchia, F., 2007: Indagine floristica di Lama Belvedere (Monopoli-Bari). Inform. Bot. Ital., **39 (1)**, 204.

Celesti Grapow, L., Pretto, F., Carli, E. & Blasi, C., (Eds.), 2010: Flora vascolare alloctona e invasiva delle regioni d'Italia. Ministero dell'Ambiente e della Tutela del Territorio e del Mare. Casa Editrice Università La Sapienza, Roma, pp. 208.

Conti, F., Abbate, G., Alessandrini, A. & Blasi, C., 2005: An Annotated Checklist of the Italian Vascular Flora. Palombi Editori, Roma.

Conti, F., Alessandrini, A., Bacchetta, G., Banfi, E., Barberis, G., Bartolucci, F., Bernardo, L., Bouvet, D., Bovio, M., Del Guacchio, E., 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., Scortegagna, S., Selvi, F., Soldano, A., Tinti, D., Ubaldi, D., Uzunov, D. & Vidali, M., 2007: Integrazione della checklist della flora vascolare italiana. Natura Vicentina, (**10**) (2006), 5-74.

Conti, F., Manzi, A. & Pedrotti, F., 1997: Liste Rosse Regionali delle Piante d'Italia. World Wildlife Fund (WWF) Italia. Società Botanica Italiana (SBI). Centro Interdipartimentale Audiovisivi e Stampa, Univ. Camerino, pp 139.

Convention on International trade in endangered species of wild fauna and flora - Cites), 1973: signedin Washington 3 March 1973. http://www.cites.org/.

Convention on the Conservation of European Wildlife and Natural Habitats, 1979: adopted in Berne 19 September 1979. http://conventions.coe.int/ Treaty/en/Treaties/Word/104.doc.

Del Fuoco, C., 2003: Orchidee del Gargano. Edizioni del Parco, Foggia.

European Commission DG Environment, 2007: Interpretation manual of European Union habitats (version EUR27). European Commission DG Environment, Brussels.

FAO, 2002: Classification, origin, diffusion and history of the olive. FAO book.

Francini Corti, E., 1966: Aspetti della vegetazione pugliese e contingente paleoegeico meridionale della Puglia. Ann. Acc. Ital. Sci. For., **15**, 137-193.

Greuter, W., Burdet, H.M. & Long, G. (Eds.), 1984: Med-Checklist, Vol. **1**., Ed. Cons. Jard. Botanique, Genève.

Greuter, W., Burdet, H.M. & Long, G. (Eds.), 1986: Med-Checklist, Vol. **3**., Ed. Cons. Jard. Botanique, Genève.

Groves, E., 1887: Flora della costa meridionale della Terra d'Otranto. Giorn. Bot. Ital., **19**, 110-219.

Guerci, A., 2005: L'ulivo tra scienza ed empirismo. Antrocom, Vol. **1** (3), 243-247.

Haston, E., Richardson, J.E., Stevens, P.E., Chase, M.W. & Harris, D.J., 2007: A linear sequence of Angiosperm Phylogeny Group II families. Taxon, **56** (1), 7-12.

Haston, E., Richardson, J.E., Stevens, P.E., Chase, M.W. & Harris, D.J., 2009: The Linear Angiosperm Phylogeny Group (LAPG) III: a linear sequence of the families in APG III. Bot. J. Linn. Soc., 161, 128-131.

IUCN, 2011: Guidelines for Using the IUCN Red List Categories and Criteria. Version 9.0. Prepared by the Standards and Petitions Subcommittee. http://www.iucnredlist. org/documents/RedListGuidelines.pdf.

Marchiori, S., Medagli, P., Mele, C., Scandura, S. & Albano, A., 2000: Caratteristiche della flora vascolare pugliese. Cahiers Options méditerranénnes, **53**, 67-75.

Marchiori, S., Medagli, P., Sabato, S. & Ruggiero, L., 1993: Remarques chorologiques sur quelques taxa nouveaux ou rares dans le Salento (Pouilles, Italie). Inform. Bot. Ital., **25** (1), 37-45.

Mele, C., Medagli, P. & Marchiori, S., 2001: Notula 1042. Inform. Bot. Ital., **33** (2), 424.

Moraldo, B. & Ricceri, C., 2003: Alcune novità tassonomico-nomenclaturali sul genere *Stipa* L. (*Poaceae*) in Italia. Webbia, **58** (1), 103-111.

Perrino, E.V., 2011: New data on *Aegilops uniaristata* Vis. in Italy. Nat. Croat., **20** (1), 117-123.

Perrino, E.V., Calabrese, G., Ladisa, G. & Tartaglini, N., 2012: Vegetation of monumental olive orchards of Apulia: preliminary data. IX National Congress of Biodiversity, Bari 6-7 september 2012.

Perrino, E.V., Calabrese, G., Ladisa, G., Viti, R. & Mimiola, G., 2011: Primi dati sulla biodiversità della flora vascolare di oliveti secolari in Puglia. Inform. Bot. Ital., **43** (1), 39-64.

Perrino, E.V. & Signorile, G., 2009: Costa di Monopoli (Puglia): check-list della flora vascolare. Inform. Bot. Ital., **41** (2), 263-279.

Perrino, E.V. & Signorile, G., 2010: Dati preliminari sulla flora vascolare del litorale di Polignano a Mare (Puglia). Acts of the 105° Congress of the Italian Botanical Society. Reggio Calabria 17-19 setember 2010.

Perrino, E.V. & Wagensommer, R.P., 2012: Schede per una Lista Rossa della Flora vascolare e crittogamica Italiana: *Aegilops uniaristata* Vis. Inform. Bot. Ital., **44** (1), 201-203.

Perrino, E.V., Wagensommer, R.P. & Medagli, P., 2012: Schede per una Lista Rossa della Flora vascolare e crittogamica Italiana: *Asyneuma limonifolium* (L.) Janch. subsp. *limonifolium*. Inform. Bot. Ital., **44** (2), 414-416.

Peruzzi, L. & Gargano, D., 2005: Distribuzione del genere *Gagea* Salisb. (*Liliaceae*) in Calabria. Inform. Bot. Ital., **37** (2), 1117-1124.

Peruzzi, L., Gestri, G. & Pierini, B., 2012: Distribution of the genus *Gagea* (*Liliaceae*) in Sardinia. Fl. Medit., **21**, 261-272.

Peruzzi, L., Scuderi, L. & Raimondo F.M., 2009: Distribution of the genus *Gagea* (*Liliaceae*) in Sicily. Fl. Medit., **19**, 25-47.

Peruzzi, L. & Tison, J.M., 2007: Typification of six critical Mediterranean *Gagea* Salisb. (*Liliaceae*) taxa. Candollea, **62** (2), 173-188.

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

Raunkiear, C., 1934: Life forms of plants and statistical plant geography. Oxford University Press, Oxford.

Ruiz De La Torre, J., 1956: La vegetatión natural del norte de Marruecos y la elección de especies para su repoblación forestal. Centro Investigaciones Esperiencias Forestales, Larache.

San Miguel, A., 2008: Management of Natura 2000 habitats. 6220 *Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea*. European Commission.

Schäfer-Schuchardt, H., 1988: L'oliva la grande storia di un piccolo frutto. Regione Puglia, Assessorato all'Agricoltura, Cooperativa Grafica Italiana, Bari.

Scoppola, A. & Spampinato, G., 2005: Atlante delle specie a rischio di estinzione. Versione 1.0. CD-Rom enclosed to the volume. In: Scoppola, A., & Blasi, C. (Eds.), Stato delle conoscenze sulla flora vascolare d'Italia. Palombi Editori, Roma.

Shannon, C.E. & Weaver, W., 1949: The mathematical Thoery of Comunication. University of Illinois Press, Urbana.

Smith, A.R., Pryer, K.M., Schuettpelz, E., Korall, P., Schneider, H. & Wolf, P.G., 2006: A classification for extant ferns. Taxon, **55** (3), 705-731.

Stevens, P.F., 2008: Angiosperm Phylogeny Website, Version 9, June 2008 [and more or less continuously update since]. www.mobot.org/MOBOT/research/APweb/.

Tison, J.M., 1998: *Gagea granatellii* (Parl.) Parl. en France. Le Monde des Plantes, **462**, 1-6.

Tutin, T.G., Heywood, V.H., Burges, N.A., Moore, D.M., Valentine, D.H., Walters, S.M. & Webb, D.A., (Eds.), 1964-80: Flora Europaea, **1-5** (1nd edition). University Press, Cambridge.

Ubaldi, D., 2003: Flora, fitocenosi e ambiente (Elementi di Geobotanica e Fitosociologia. Clueb, Bologna.

van Slageren, M.W., 1994: Wild wheats: a monograph of *Aegilops* L. and *Amblyopyrum* (Jaub. & Spach) Eig (*Poaceae*). Wagningen Agricoltural University, International Center for Agricoltural Research in the Dry Areas, **9** (7), pp. 513.

Vazzana, C. & Raso, E., 1997: Una metodologia europea per la progettazione e realizzazione di un agroecosistema a basso o nullo impatto ambientale. S.I.T.E. Notizie, Boll. Soc. Ital. Ecol., **17**, 51-54.

Vita, F. & Forte, L., 1990: Un lembo di vegetazione da tutelare la lama di macchialunga. Umanesimo della Pietra Verde, **(5)**, 34-38.

Zohary, D., 1973: Geobotanical Foundations of the Middle East. Gustav Fischer Verlag, Stuttgart.

APPENDIX

Abbreviations of biological forms and chorologic types

Biological forms. Ch - chamaephytes; P - phanerophytes; G - geophytes; H - hemicryptophytes; NP - nanophanerophytes; T - therophytes.

Chorologic types. A - Atlantic; Ad - Amphi-Adriatic; Afs - south-African; Ams - southern American; Ase - eastern Asiatic; Aus - Australian; Ascm - centre Asiatic-Medit.; Assw - south-western Asiatic; Asw - western Asiatic; Avv - adventitious; C - Cosmopolitan; Cb - Circumboreal; Cn - China; Cs - Subcosmopolitan; Ctr - Thermocosmopolit; E - European; Ea - Euroasiatic; Easw - western European-Asiatic; Eat - Euroasiatic temperate; Ec - central-European;

Eca - European-Caucasic; Ecca - central-European Caucasic; Ecs - south-central European; Es - southern European, Esb - Eurosiberian; Ese - south-eastern European; Esep - south-eastern European Pontic; Esesp - southern European and southern Siberian Pontic; Esp - southern European Pontic; Hi - Himalaya; I - Endemic; Ma - Medit.-Atlantic; Masb - Medit.-Subatlantic; Me - Euri-Medit.; Mea - Euri-Medit.-Atlantic; Meas - Euri-Medit.-Subatlantic; Mec - central-Medit.; Mece - centre-eastern Medit.; Mecw - central-Medit. western; Mem - Euri-Medit.-Macaronesian; Menp - northern Euromedit.-Pontic; Mess - Euri-Medit. southern-Siberian; Met - Euri-Medit.-Turanian; Mne - north-eastern Medit.; Mm - Medit.-Mountain; Mmc - Medit.-Macaronesian; Mmms - southern Medit.-Macaronesian; Mmne - north-eastern Medit.-Mountain; Mmw - western Medit.-Mountain; Mn - northern Medit.; Ms - Steno-Medit.; Msa - Steno-Medit.-Atlantic; Msd - southern Medit.; Msde - south-eastern Medit.; Msdw - south-western Medit.; Mse - eastern Steno-Medit.; Msm - Steno-Medit.-Macaronesian; Msn - northern Steno-Medit.; Msp - Steno-Medit. Pontic; Mss - southern Steno-Medit.; Mssw - south-western Steno-Medit.; Mst - Steno-Medit.-Turanian; Msw - western Steno-Medit.; Mt - Medit.-Turanian; Mts - southern Medit.-Turaniano; Mw - western Medit.; Nen - Neotropical nat.; - Oes - Orophil south-European; Oesec - Orophil European-Caucasic south-eastern; Omne - north-eastern Orophil-Medit.; Omw - western Orophil-Medit.; P - Pontic; Pn - Pantropical; Tmp - Paleotemperate; Tmpw - western Paleotemperate; Tpp - Paleotropical; Tps - Subtropical; Tpsp - Paleo-Subtropical.