



Syntaxonomical survey of cork oak forests (*Quercus suber* L.) in the province of Tizi Ouzou, Kabylia, Northern Algeria

Rachid Meddour¹ , Ouahiba Sahar¹  & Guy Bouxin²

Key words: *Erico-Quercion ilicis*, floristic composition, Mediterranean evergreen woods, phytosociological analysis, *Quercion suberis*, vascular flora.

Ključne besede: *Erico-Quercion ilicis*, floristična sestava, mediteranski vednozeleni gozdovi, fitocenološka analiza, *Quercion suberis*, flora cevnic.

Corresponding author:
Rachid Meddour
E-mail:
rachid_meddour@yahoo.fr

Received: 28. 1. 2022
Accepted: 2. 4. 2022

Abstract

This study is a contribution to the knowledge of the floristic composition and syntaxonomical significance of *Quercus suber* woodlands of Tizi Ouzou province, which represent the last remnants of ancient forests. The field surveys were taken in several locations representative of cork oak woodlands, using the Braun-Blanquet method. A matrix of 96 phytosociological relevés and 160 plant taxa was treated with clustering analysis and correspondence analysis. These multivariate analyses showed congruent results and allowed the definition of four main clusters of cork oak woodlands, corresponding to four syntaxa according to synecological and syndynamic gradients. They belong to three associations, of which one is newly described, and two subassociations. They are: *Sileno imbricatae-Quercetum suberis* ass. nov., a mesophilous association newly described here, on siliceous soils and in the humid ombrotype; *Cytiso villosi-Quercetum suberis*, a mesophilous association, with two subassociations: *quercetosum canariensis*, and *myrtetosum communis*, this later reported for the first time in the study area, and both localized in the humid ombrotype and confined on markedly acid soils; *Erico arboreae-Myrtetum communis*, thermophilous secondary shrubland association developed in the subhumid ombrotype, on flysch substrates, also identified for the first time in this area. Syntaxonomic, synecological and syndynamic considerations are given for each syntaxon.

Izvešček

Raziskava je prispevek k poznavanju floristične sestave in sintaksonomskega pomena gozdov z vrsto *Quercus suber* v provinci Tizi Ouzou, ki predstavljajo zadnje ostanke nekdanjih gozdov. Terenske raziskave smo naredili na številnih lokacijah najbolj značilnih gozdov hrasta plutovca z Braun-Blanquetovo metodo. Matrico 96 popisov in 160 rastlinskih vrst smo analizirali s klastersko in korespondenčno analizo. Multivariatne analize so pokazale skladne rezultate in opredelili smo štiri glavne skupine gozdov hrasta plutovca, ki se ujemajo s štirimi sintaksoni glede na sinekološke in sindinamske gradiente. Uvrstimo jih v tri asociacije, ena je opisana na novo, in dve sta subasociaciji. To so: *Sileno imbricatae-Quercetum suberis* ass. nov., mezofilna nova asociacija na silikatnih tleh in v vlažnem ombrotipu; *Cytiso villosi-Quercetum suberis*, mezofilna asociacija z dvema subasociacijama: *quercetosum canariensis* in *myrtetosum communis*, slednja je nova v preučevanem območju, obe v vlažnem ombrotipu in omejeni na izrazito kisljih tleh; *Erico arboreae-Myrtetum communis*, termofilna sekundarna grmiščna asociacija, ki se razvija v polvlažnem ombrotipu na flišu in je zabeležena prvič v preučevanem območju. Za vsak sintakson smo podali sintaksonomski, sinekološki in sindinamski opis.

1 Mouloud Mammeri University, Faculty of Biological Sciences and Agronomic Sciences, Tizi Ouzou, Algeria.

2 Haute école Albert Jacquard (HEAJ), Namur, Belgium.

Introduction

The cork oak is one of the most important tree species in the western Mediterranean Basin, where its presence is of high ecological, landscape and socioeconomic importance (Pollastrini et al., 2018). Besides, cork oak habitats are recognised as having both cultural and biodiversity value (Vogiatzakis et al., 2005; Simonson & Allen, 2014). This forest type is home to a large number of typical Mediterranean woodland species, including several plants of importance for conservation (Cano-Ortiz et al., 2021). In Algeria, the cork oak forest is one of the most important forest types, in terms of area covered and livelihoods, extending along the humid littoral zone, mainly in the northeastern Algeria, from the east of Algiers to the Tunisian border. This area belongs to the regional hotspot of biodiversity “Kabylias-Numidia-Kroumiria” (Véla & Benhouhou, 2007), known for its high floristic diversity, high number of endemic species, but also its great loss of habitats (FAO, 2013). Therefore, the cork oak forests show fragmented and discontinuous geographical distribution, suggesting that they are mainly relictual (Badalamenti et al., 2020). In North Africa, Simeone et al. (2010) noted a severe decline that is affecting this oak since the last decades, where its range has been greatly reduced because of a very strong anthropozoogenic pressure (Nsibi et al., 2006; Boussaidi et al., 2010), in particular overgrazing, recurrent fires and over-exploitation of cork and wood in Algeria (Bennadja et al., 2013). The phytosociological knowledge of cork oak forests is hence difficult, because of these disturbances by

humans’ activities (Khelifi, 1987). Nevertheless, no less than six different forest associations have been described so far in Algeria by many authors (Table 1).

Despite their large extent in the Kabylia area and their floristic interest, the cork oak forests have only been the subject of rare relevés in the massif of Beni Ghobri (Azazga, Yakouren) by Veri & Sebastiani (1987), Wojterski (1988) and Zeraia (2019), who think that the cork oak forest with *Cytisus villosus* belongs to *Cytiso villosi-Quercetum suberis*. We do not yet have a validly published association tables (cf. Theurillat et al., 2020) on these cork oak woods and modern syntaxonomic data about them are lacking. Furthermore, to our knowledge, there is no phytosociological contribution concerning the high calcifuge maquis (*Ericion arboreae*), in spite of their great landscape and ecosystem significance (Meddour et al., 2010).

The present contribution is thus intending to contribute to the floristic and phytosociological knowledge of the cork oak forests of Kabylia, in particular in the main forests of Béni Ghobri, Mizrana and Tamgout. We will also give a brief overview of their dynamics (regressive evolution towards secondary shrublands) and draw attention to the cork oak wood of Beni Kouffi (Djurdjura) at the chorological and ecological limits of this territory. On the other hand, we will discuss the accuracy integration of cork oak forest syntaxa to the *Quercion suberis* in Algeria, an area where extremely limited biogeographical and ecological data on cork oak are available (Simeone et al., 2010).

Table 1: Syntaxa of cork oak forests present in Algeria.

Tabela 1: Sintaksoni hrasta plutovca v Alžiriji.

Syntaxa names	Distribution area	Alliances	References
<i>Cytiso triflori-Quercetum suberis</i> Br.-Bl. 1953	Algeria, Tunisia, Italia (+Sardinia)	<i>Quercion suberis</i>	Zeraia (1981, 2019), Iboukassene (2008), Letreuch-Belarouci et al. (2009)
<i>Myrto communis-Quercetum suberis</i> Barbero, Benabid, Quézel & Rivas-Martinez 1981	Portugal, Spain, Morocco, Algeria, Tunisia, Sardinia	<i>Oleo-Quercion rotundifoliae</i>	Zeraia (1981), Wojterski (1988, 1990), Toubal & Toubal (1996), Meddour et al. (2010), Sfaksi (2012)
<i>Telino linifoliae-Quercetum suberis</i> Zeraia 1981	Morocco-Algeria	<i>Oleo-Quercion rotundifoliae</i>	Zeraia (1981), Siab-Farsi (2018)
<i>Pistacio lentisci-Quercetum suberis</i> Khelifi & Sadki 1995	Algeria, Tunisia	<i>Quercion suberis</i>	Khelifi & Sadki (1995), Meddour (2002)
<i>Erico scopariae-Quercetum suberis</i> Khelifi & Sadki 1995	Algeria	<i>Quercion suberis</i>	Khelifi & Sadki (1995), Siab-Farsi (2018)
<i>Genisto numidicae-Quercetum suberis</i> Toubal 1998	Algeria	<i>Quercion suberis</i>	Toubal (1998)

Material and methods

Study area

The study area is the wilaya (province) of Tizi Ouzou, which is located in the north of Algeria, slightly east of Algiers. Its administrative boundaries are to the north, the Mediterranean Sea, with a seafront of 85 km, to the east, the wilaya of Bejaia, to the west, the wilaya of Boumerdes and to the south, the wilaya of Bouira. It is positioned between the longitudes 3°47'42" to 4°43'28" E and the

latitudes 36°26'07" to 36°53'55" N. With a total area of 295793 ha, the wilaya is one of the most forested areas in the country, with a forestland of 64093 ha, corresponding to an afforestation rate of 22% (BNEDER, 2008). The cork oak forests are clearly dominant, they occupy 29458 ha, i.e. 46% of the global forest area of the wilaya, which represent 12.8% of the cork oak national area. They are usually found on deep cool soils originating from acid rocks (sandstones), and in fairly warm (thermo- and mesomediterranean thermotypes) and subhumid–humid ombrotypes, where they represent the climactic forest.

The most important woodlands (Figure 1, Table 2) are located on the coastal area (Mizrana forest), in Tamgout forest and in Beni Ghobri forest. The cork oak forms either monospecific stands (e.g. at Mizrana), or mixed stands with deciduous oaks (e.g. Tamgout and Béni Ghobri) or even with holm oak (Béni Kouffi), in a more continental and dry locations (Meddour, 2010). The eastern coast of the wilaya, in particular in Azeffoun, is degraded and has given way to high maquis with *Erica* and *Arbutus*, at low altitudes, or are replaced by industrial reforestation (pines and eucalyptus plantations).

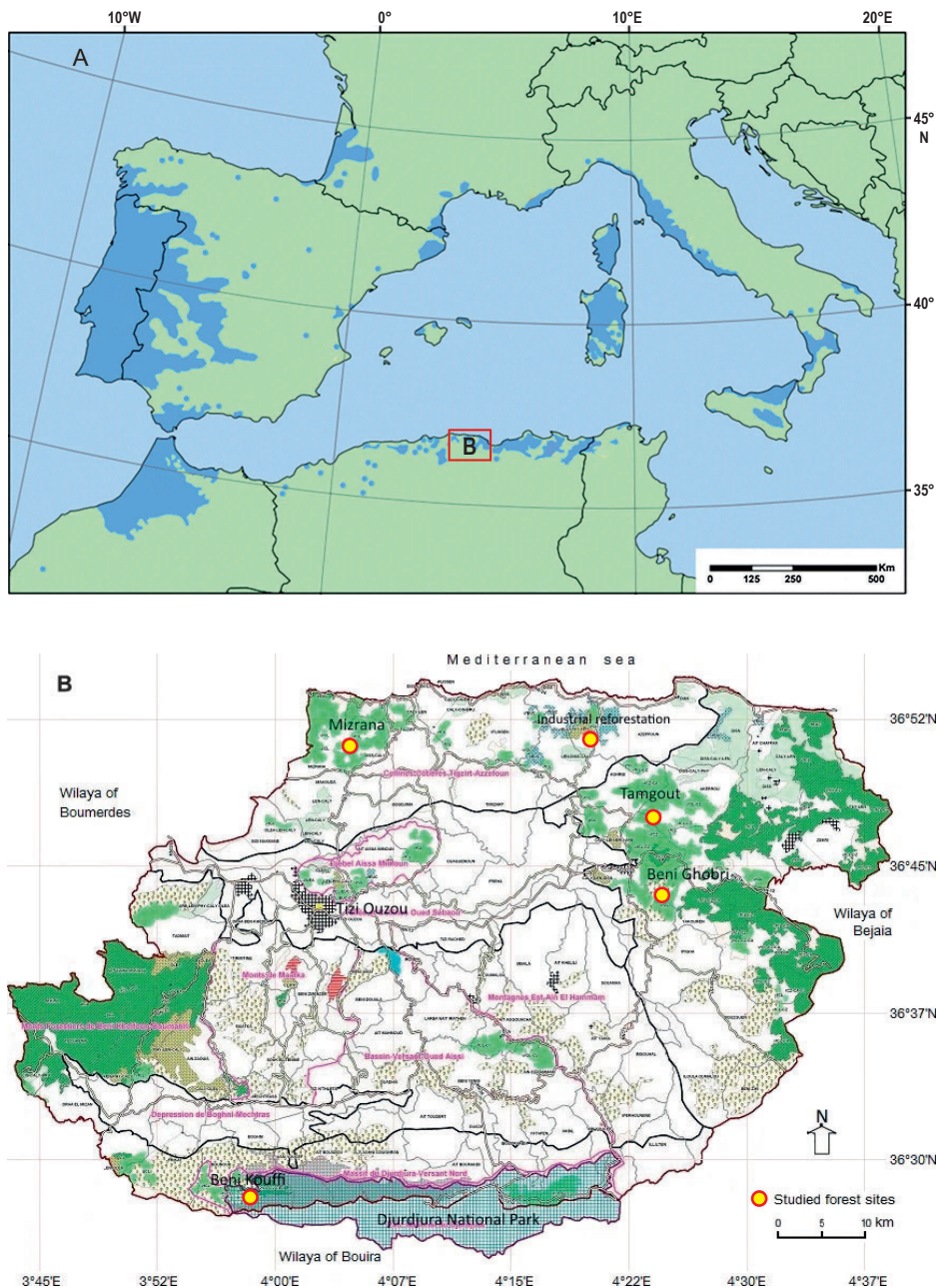


Figure 1: Location of the cork oak forests studied: A. In Algeria and Mediterranean basin (from EUFORGEN, 2009); B. In Kabylia (map extracted from BNEDER (2008)).
Slika 1: Lokacije preučevanih gozdov hrasta plutovca: A. v Alžiriji in mediteranskem bazenu (iz EUFORGEN, 2009); B. v območju Kabylia (karta povzeta iz BNEDER (2008)).

Table 2: Description of cork oak forests studied in the wilaya of Tizi Ouzou (BNEDER, 2008).

Tabela 2: Opis preučevanih gozdov hrasta plutovca v provinci Tizi Ouzou (BNEDER, 2008).

Forests	Area (ha)	Dominant tree species	Highest altitude (m a.s.l.)	Coordinates
Beni Ghobri	6939	<i>Quercus suber</i> , <i>Q. canariensis</i> , <i>Q. afares</i>	1291	4°22'– 4°35'E 36°40'–36°45'N
Tamgout	3829	<i>Quercus suber</i> , <i>Q. canariensis</i> , <i>Q. afares</i>	1278	4°19'– 4°27'E 36°45'–36°50'N
Mizrana	2669	<i>Quercus suber</i> , maquis	895	4°00'– 4°07'E 36°50'–36°53'N
Beni Kouffi	158	<i>Quercus suber</i> , <i>Q. ilex</i>	1140	3°58'– 3°59'E 36°29'–36°30'N
Industrial reforestation (Azeffoun)	436	<i>Eucalyptus</i> spp., <i>Pinus</i> spp., maquis (<i>Q. suber</i>)	845	4°19'– 4°25'E 36°48'–36°53'N

Data collection

The vegetation analysis was performed according to the Braun–Blanquet method (Braun-Blanquet, 1964), completed by Dengler et al. (2008) and Biondi (2011). Fieldwork was carried out from 2006 to 2008 and 2014 to 2016, in cork oak forests and maquis in five representative locations. A dataset of 96 phytosociological relevés, with 221 plant taxa overall, was collected in the forests of Béni Ghobri (60 relevés), Mizrana (10 relevés), Tamgout (13 relevés), Beni Kouffi (7 relevés) and the coastal maquis of the Azeffoun-Aghrib region (6 relevés). They were carried out in homogeneous vegetation, in terms of physiognomy and structure (Serra et al., 2002), and sampled in representative patches of vegetation, avoiding edges and areas showing obvious recent disturbance (Simonson & Allen, 2014).

Plot size varies from 100 to 250 m², due to the heterogeneity of the tree stands (Frosch & Deil, 2011). The cover-abundance scale proposed by Braun-Blanquet (1964), which combines an estimate of the number of individuals from each species and the area they cover in the plot, was considered. The following site parameters were noted for each plot: altitude, slope, exposure, substrate, total cover of the vegetation (in %), as well as some estimated anthropic parameters (grazing, fires, etc.). All the vascular plant species present in a given plot (Roselt/OSS, 2007) were recorded. They were identified using the *Flora of Algeria* (Quézel & Santa, 1962–1963) and their taxonomic nomenclature updated according to Dobignard & Chatelain (2010–2013) and African Plant database (APD, 2021). The accepted scientific names and authors of all plants mentioned in the text are provided in tables 3 to 6.

With regard to syntaxonomy, the principles contained in the International Code of Phytosociological Nomenclature (Theurillat et al., 2020), were followed. Authors of all syntaxa mentioned in the text are according to Mucina et al. (2016) and Meddour et al. (2017). The names and authors of all syntaxa mentioned in the text are provided in a syntaxonomic scheme. The bioclimatic characterization is in accordance with Rivas-Martínez et al. (2011).

Data analysis

Before the treatment, the cover-abundance values were converted into quantitative values according to the ordinal scale proposed by Gillet (2000). Sporadic species, occurring in only one relevé of the dataset (i.e. 61 taxa), were excluded from statistical processing. To the global matrix that altogether includes 96 relevés and 160 taxa, were applied the techniques of multivariate analysis using the R statistical software, package ‘ca’ and package ‘cluster’ (R Development Core Team, 2020). The phytosociological relevés were treated with a correspondence analysis (see Chessel et al., 2003), and classified using hierarchical clustering analysis, based on a dissimilarity index (khi² distance) between relevés and the Ward’s minimum variance method as agglomeration criterion. Lastly, the relevés on the phytosociological tables were arranged according to the results of the hierarchical clustering (see e.g., Poldini et al., 2020). In the synoptic column of the tables, roman numbers are used for the presence classes (see Géhu & Rivas-Martinez, 1981).

Results and discussion

Discrimination of plant communities by numerical analyses

The diagram of axes 1–2 of the correspondence analysis allows to discriminate a compact cluster A of 7 relevés, standing out significantly from all the other relevés, along axis 1 (10.08% of the variance) that reflects the continentality (Figure 2).

This cluster relates to the mountain cork oak forest, located on the northwestern slope of Djurdjura in Beni Kouffi. It is the most continental community, at the meso-mediterranean thermotype, belonging to the *Quercetalia ilicis* and the *Balansaeo-Quercion rotundifoliae*. A second cluster, cluster B, grouping 6 relevés stands out clearly. This cluster B corresponds to relevés of sublittoral maquis (Aghrib-Azeffoun), with or without cork oak, generally forming a thermomediterranean pre-forest mantle of cork oak woods, belonging to the *Pistacio-Rhamnetalia alat-*

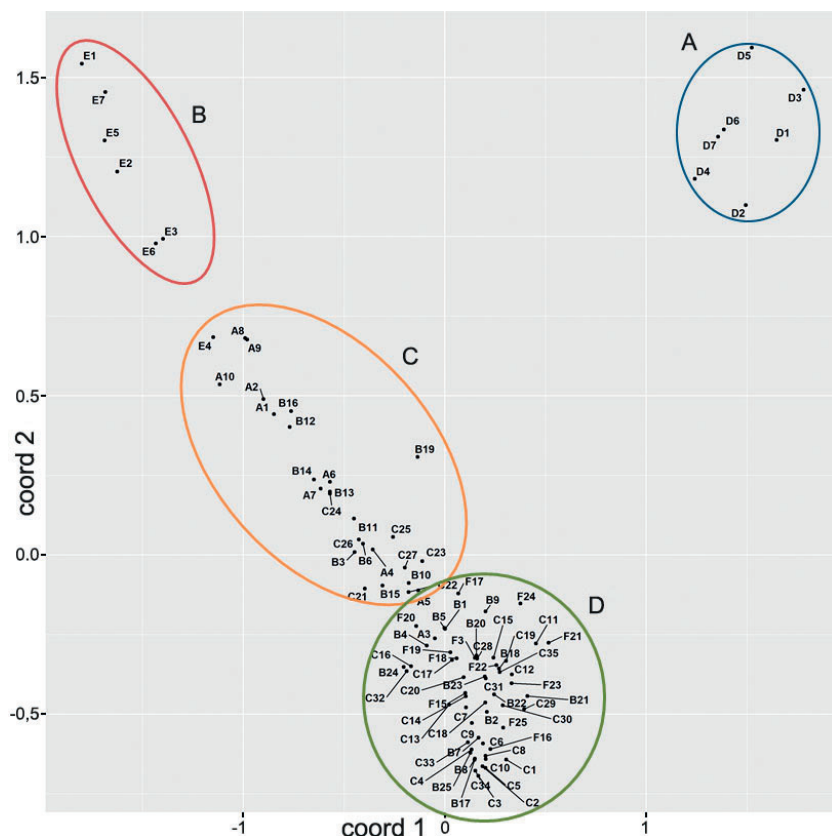


Figure 2: Ordination diagram (correspondence analysis) of the data matrix of cork oak forests (96 relevés x 160 species). Axes 1 and 2 (18.39% of the covariance matrix).

Slika 2: Ordinacijski diagram (korespondenčna analiza) podatkovne matrice gozdom hrasta plutovca (96 popisov x 160 vrst). Osi 1 in 2 (18.39% kovariančne matrice).

erni and the *Ericion arboreae*. Two other clusters are individualized, a cluster C (26 relevés), and a large cluster D, bringing together the greater part of the relevés (57). These clusters are distributed along axis 2 (8.31% of the variance), which obviously reflects a synecological and dynamic gradient (bioclimate, altitude, thermophilia / mesophilia, openness of the stand, anthropization). The cluster C, in an intermediate position, corresponds to relevés of sublittoral forest of cork oak (Mizrana) or further internal but at low altitudes (Tamgout, Béni Ghobri), more thermophilic than the next one, part of the *Quercetalia ilicis* and the *Erico-Quercion ilicis*, at the mesomediterranean thermotype. The cluster D is that of the most mesophilous and alticolous cork oak woodlands in Tamgout and Beni Ghobri, evolving on deep forest soils, in a humid ombrotype and cool climate, at mesomediterranean thermotype. This latter is also part of the *Erico-Quercion ilicis*, in contact with the zeen oak forests, where the presence of a group of differential species of *Quercetalia pubescentis* sensu lato is noticed.

The species presenting the strongest relative contributions to axis 1 makes it possible to highlight two floristic groups, with precise mesological and syndynamic significance, faced along this axis. On the negative side, there is a group of taxa with thermoheliophilic tendency,

linked to cluster B (*Pistacia lentiscus*, *Phillyrea latifolia*, *Ampelodesmos mauritanicus*, *Myrtus communis*, *Olea europaea*, *Erica arborea*, *Arbutus unedo*, etc.), at the thermomediterranean thermotype, and as well some species of the calcifuge matorrals (*Cistus monspeliensis*, *Genista ulicina*, *Lavandula stoechas*), indicating recurrent fires. On the positive side, we distinguish a floristic-ecological group, linked to cluster A (mixed forest of *Quercus suber* and *Q. ilex* in Djurdjura mountain, at mesomediterranean thermotype), comprising many mesophilous and humicolous species (*Cephalaria mauritanica*, *Festuca triflora*, *Juniperus oxycedrus*, *Conopodium glaberrimum*, *Silene imbricata*, etc.), which show likewise strong contributions to the positive side of axis 2. On the negative side of this latter, we discriminate a floristic-ecological group of species presenting the strongest contributions to this axis, linked to cluster D (*Quercus canariensis*, *Q. suber*, *Cytisus villosus*, *Rubus ulmifolius*, *Prunus avium*, *Brachypodium sylvaticum*, *Carex halleriana*, etc.).

On the other hand, the dendrogram (khi² distance, Ward's method) obtained from the hierarchical clustering analysis of the same data matrix, makes it possible to distinguish four main clusters of relevés (Figure 3). This analysis leads to results congruent with those of the correspondence analysis, since we outlined on this dendrogram

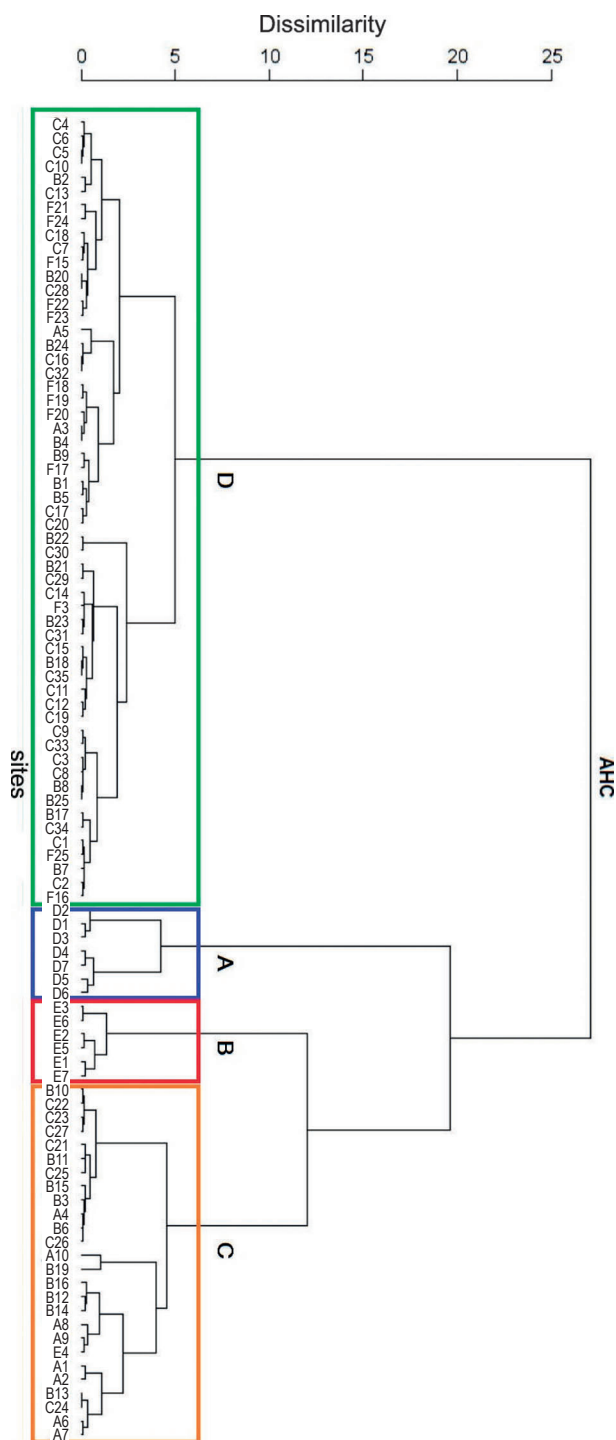


Figure 3: Dendrogram of the hierarchical clustering based on KHI^2 distance and Ward's minimum variance method of the data matrix of cork oak forests (96 relevés x 160 species). Four clusters (A, B, C and D) are highlighted.

Slika 3: Dendrogram hierarhičnega klasteriranja na osnovi razdalje KHI^2 in Wardove metode minimalne variance podatkovne matrice gozdov hrasta plutovca (96 popisov x 160 vrst). Označeni so štirje klasteri (A, B, C in D).

the clusters A, B, C and D, comprising respectively 7, 6, 26 and 57 relevés, corresponding to the same plant communities.

Syntaxonomic and synecological interpretation of cork oak plant communities

The phytosociological interpretation of plant communities highlighted by correspondence analysis and cluster analysis led to the identification of four communities, which were classified in one class, as underlined in the following syntaxonomic scheme.

QUERCETEA ILICIS Braun-Blanquet ex A. de Bolòs & O. de Bolòs in A. Bolòs y Vayreda 1950

Quercetalia ilicis Braun-Blanquet ex Molinier 1934.

Balansaeo glaberrimae-Quercion rotundifoliae Barbero, Quézel & Rivas-Martínez ex Rivas-Martínez et al. 2011

Sileno imbricatae-Quercetum suberis ass. nov.

Erico arboreae-Quercion ilicis S. Brullo, Di Martino & Marcenó 1977

Cytiso villosi-Quercetum suberis Braun-Blanquet 1953 *nom. mut. propos.* Meddour, Meddour-Sahar, Zeraia & Mucina 2017

Quercetosum canariensis El Afsa 1978.

Myrtetosum communis Khelifi 1987

Pistacio lentisci-Rhamnetalia alaterni Rivas-Martínez 1975

Ericion arboreae (Rivas-Martínez ex Rivas-Martínez, Costa & Izco 1986) Rivas-Martínez 1987

Ericenion arboreae Rivas-Martínez, Costa & Izco 1986

Erico arboreae-Myrtetum communis Quézel, Barbero, Benabid, Loisel & Rivas-Martínez 1988

Ass. *Sileno imbricatae-Quercetum suberis* ass. nov. [cluster A, Table 3, the nomenclatural type, holotypus, is relevé 3 in Table 3] (Syntaxonomic synonym: *Festuco triflorae-Quercetum suberis* Meddour 2010 *nom. inval.* (Art. 1))

This cork oak forest is located near Ait Ali village above Beni Kouffi in the northwestern Djurdjura, between 900 and 1100 m a.s.l. approximately, on a siliceous substrate (pudding stones and sandstones). In sunny slopes, it still constitutes scarce remnants in the area of mesomediterranean holm oak woods. It occurs as low and clear forest, 6–8 m tall on average and a cover vegetation of around

60–70%. The tree stratum consists essentially of *Quercus suber*, but *Quercus ilex* subsp. *ballota* is present as isolated individuals. At the level of the shrub layer, *Cytisus villosus* generally constitutes a relatively homogeneous understorey, with significant cover (80%). We note the lack of the

usual sclerophyllous shrubs (e.g. *Arbutus unedo*), which are undoubtedly eliminated by the winter cold at this altitudinal belt (Barbero & Loisel, 1983) and a relative continentalization.

Table 3 (Tabela 3): *Sileno imbricatae-Quercetum suberis* ass. nov.

Relevé number	1	2	3	4	5	6	7	Fr.
Relevé number (field)	D2	D1	D3	D4	D7	D5	D6	
Altitude (x 10 m a.s.l.)	99	105	100	95	106	108	108	
Aspect	N	N	N	N	SW	SW	SW	
Slope (%)	50	30	50	60	30	40	40	
Cover (%)	60	60	70	70	70	60	70	
Area (x 10 m ²)	25	25	25	25	25	25	25	
Location	BK	BK	BK	BK	BK	BK	BK	
Number of taxa	52	45	49	37	28	33	25	
Diagnostic species of the association								
<i>Quercus suber</i> L.	4	4	4	4	4	4	4	V
<i>Silene imbricata</i> Desf.	+		+	+	+	+	+	V
<i>Cephalaria mauritanica</i> Pomel		+	1	+	1	2	2	V
<i>Euphorbia cuneifolia</i> Guss.	+			+	1		1	III
<i>Andryala laxiflora</i> DC.			+	+		+		III
<i>Silene patula</i> Desf. subsp. <i>patula</i>				+		+		II
Species of <i>Balansaeo glaberrimae-Quercion rotundifoliae</i>								
<i>Festuca triflora</i> Desf.	2	+	+	1	+	+	+	V
<i>Quercus ilex</i> subsp. <i>ballota</i> (Desf.) Samp.	+		+	+		+	+	IV
<i>Arabis pubescens</i> (Desf.) Poir.		+	+		+	+	+	IV
<i>Conopodium glaberrimum</i> (Desf.) Engstrand	+	+	2					III
Species of <i>Quercetalia</i> and <i>Quercetea ilicis</i>								
<i>Cytisus villosus</i> Pourr.	4	4	4	4		4	1	V
<i>Calicotome spinosa</i> (L.) Link	+	1	+	3	3	2	3	V
<i>Galium tunetanum</i> Lam.	+	+	+	+	1	+	+	V
<i>Cynosurus elegans</i> Desf. subsp. <i>elegans</i>	+	+	+	+	2		1	V
<i>Pulicaria odora</i> (L.) Rchb.		+	+	+	+		+	IV
<i>Crataegus monogyna</i> Jacq.	+	+	+	+			+	IV
<i>Galium scabrum</i> L.	+	+	1		+		+	IV
<i>Juniperus oxycedrus</i> L. subsp. <i>oxycedrus</i>				1	1	2	1	III
<i>Eryngium tricuspdatum</i> subsp. <i>bovei</i> (Boiss.) Breton	+	+	+			+		III
<i>Moebria trinervia</i> subsp. <i>pentandra</i> (Gay) Nyman	+	1	+					III
<i>Geranium purpureum</i> Vill.	1	+	+					III
<i>Plagius maghrebicus</i> Vogt & Greuter	+	+						II
<i>Asplenium onopteris</i> L.	+		+					II
<i>Cyclamen africanum</i> Boiss. & Reut.	1		+					II
<i>Daphne gnidium</i> L.				+		+		II
<i>Erica arborea</i> L.					+			I
<i>Ampelodesmos mauritanicus</i> (Poir.) T. Durand & Schinz	+							I
<i>Carex halleriana</i> Asso					+			I
<i>Piptatherum miliaceum</i> (L.) Coss.		+						I
<i>Pteridium aquilinum</i> (L.) Kuhn in Kerst. subsp. <i>aquilinum</i>							+	I
<i>Osyris alba</i> L.				+				I

Relevé number	1	2	3	4	5	6	7	Fr.
Transgressive taxa of <i>Quercetea pubescentis</i>								
<i>Lamium flexuosum</i> Ten. subsp. <i>flexuosum</i>	+	+	+					III
<i>Rubus ulmifolius</i> Schott	2	2						II
<i>Rosa canina</i> L.	+		1					II
<i>Prunella vulgaris</i> L.	+		+					II
<i>Alliaria petiolata</i> (M. Bieb.) Cavara & Grande		+	+					II
Other species								
<i>Dactylis glomerata</i> L.	1	1	1	1	1	1	1	V
<i>Biscutella didyma</i> L.	+	+	+	+	+	+	+	V
<i>Myosotis ramosissima</i> Rochel subsp. <i>ramosissima</i>	+	1	+		+	+	+	V
<i>Hypochaeris laevigata</i> (L.) Ces., Pass. & Gibelli	+	+		+	+	+	+	V
<i>Briza maxima</i> L.			+	1	1	+	1	IV
<i>Andryala integrifolia</i> L.	1	1	1	1	1			IV
<i>Hyoseris radiata</i> L.	+	1	+		+	+		IV
<i>Cistus salviifolius</i> L.				+	+	+	+	III
<i>Lavandula stoechas</i> L.				+	+	+		III
<i>Aira caryophyllea</i> L. subsp. <i>caryophyllea</i>					+	1	+	III
<i>Thymus numidicus</i> Poir.	+		+	1				III
<i>Legousia falcata</i> (Ten.) Janch. subsp. <i>falcata</i>	+	2	1		+			III
<i>Sinapis pubescens</i> L. subsp. <i>pubescens</i>		1			+	+	+	III
<i>Daucus carota</i> L. subsp. <i>carota</i>	+	+	+			+		III
<i>Sedum pubescens</i> Vahl	+	+	+			+		III
<i>Filago pyramidata</i> L.	+	+		+		+		III
<i>Avena sterilis</i> L. subsp. <i>sterilis</i>	1	1	1					III
<i>Galactites tomentosus</i> Moench			+	+	+			III
<i>Umbilicus rupestris</i> (Salisb.) Dandy			+	+	+			III
<i>Silene coelirosa</i> (L.) A. Br.	+		+		+			III
<i>Lolium rigidum</i> Gaudin	1	1	1					III
<i>Bellis sylvestris</i> Cirillo		+	+			+		III
<i>Veronica arvensis</i> L.			+		+			II
<i>Sixalix atropurpurea</i> subsp. <i>maritima</i> (L.) Greuter & Burdet			+	+				II
<i>Fumaria capreolata</i> L. subsp. <i>capreolata</i>			+	+				II
<i>Torilis arvensis</i> (Huds.) Link		+	+					II
<i>Anisantha rubens</i> (L.) Nevski		1		+				II
<i>Filago argentea</i> (Pomel) Chrtek & Holub	+			+				II
<i>Gastridium ventricosum</i> (Gouan) Schinz & Thell.	+					+		II
<i>Catapodium rigidum</i> (L.) C.E. Hubb.		+	+					II
<i>Scolymus hispanicus</i> L.			+			+		II
<i>Sedum acre</i> subsp. <i>neglectum</i> (Ten.) Murb.				+			+	II
<i>Sherardia arvensis</i> L.	+	+						II

Sporadic species: *Genista tricuspidata* Desf. + (1), *Galium aparine* L. + (4), *Avena barbata* Pott ex Link subsp. *barbata* + (1), *Sonchus oleraceus* L. + (3), *Stellaria pallida* (Dumort.) Piré + (1), *Campanula rapunculus* L. + (3), *Leontodon tuberosus* L. + (2), *Anthemis pedunculata* Desf. subsp. *pedunculata* + (2), *Arenaria serpyllifolia* L. subsp. *serpyllifolia* + (1), *Crucianella angustifolia* L. + (4), *Eryngium dichotomum* Desf. + (2), *Ferula communis* L. + (1), *Helichrysum fontanesii* Cambess. + (3), *Herniaria glabra* L. + (1), *Knautia mauritanica* Pomel + (1), *Linaria multicaulis*

subsp. *heterophylla* (Desf.) A. Sutton + (4), *Medicago polymorpha* L. + (1), *Ornithogalum baeticum* Boiss. + (1), *Plantago coronopus* L. subsp. *coronopus* + (6), *Poa bulbosa* L. subsp. *bulbosa* 1 (6), *Silene vulgaris* (Moench) Garcke + (4), *Trifolium pratense* L. subsp. *pratense* + (1), *Veronica agrestis* L. + (2), *Viola odorata* L. + (1), *Epipactis tremolsii* Pau + (2), *Ranunculus spicatus* subsp. *blepharicarpos* (Boiss.) Grau + (1), *Ammoides atlantica* (Coss. & Dur.) H. Wolff + (6).

Location: Beni Kouffi (Djurdjura).

This syntaxon belongs to *Quercetea* and *Quercetalia ilicis* as evidenced by the presence of several characteristic species (*Quercus ilex* subsp. *ballota*, *Galium scabrum*, *Moehringia pentandra*, *Geranium purpureum*, *Juniperus oxycedrus*, etc.). With the constant presence of *Quercus ilex* subsp. *ballota*, a group of species usually found in cool, quite mountainous holm oak woods, appear in this association. They are *Juniperus oxycedrus*, *Rosa canina*, and more significantly endemics, such as *Festuca triflora*, *Conopodium glaberrimum*, *Arabis pubescens* and *Silene patula*. They are all lacking in the climactic cork oak forests of northeastern Algeria. Even though the noteworthy absence of *Phlomis bovei*, it is plainly a community of *Balansaeo glaberrimae-Quercion rotundifoliae*, to which it is sound to relate this type of cork oak forest. In this case, we propose a new association, *Sileno imbricatae-Quercetum suberis* ass. nov., which is characterized by an original specific combination: *Quercus suber*, *Silene imbricata*, *Euphorbia cuneifolia*, *Andryala laxiflora*, and two transgressive species of holm oak woods and acidiphilic Atlas cedar woods at supra-mediterranean thermotype (*Cephalaria mauritanica* and *Silene patula*).

This mountainous association of residual cork oak, which we describe for the first time from the Djurdjura massif, is synendemic to Algeria. On the synecological viewpoint, Zeraia (1981) recognises that the presence of *Quercus ilex* subsp. *ballota*, corresponds to a relative drying up of the habitat, linked to the degradation of the cork oak wood at its ecological marginality. Thus, synecological and synfloristic affinities of this Djurdjuran association are much closer with some cork oak/holm oak woods, developing at altitude on the Tellian Atlas (see Zeraia, 1981, 2019; Babali, 2004; Letreuch-Belarouci et al., 2009; Miara et al., 2012, 2020). This association is also reminiscent of *Teucrio afrae-Quercetum suberis* Barbero, Benabid, Quézel & Rivas-Martinez 1981, which is a mixed cork oak wood, with *Quercus ilex* subsp. *ballota*, growing at high altitude (above 1000 m a.s.l.), on siliceous sandstones in the Rif, likewise integrated into *Balansaeo-Quercion rotundifoliae* (Barbero et al., 1981).

Ass. *Cytiso villosi-Quercetum suberis* Braun-Blanquet 1953 nom. mut. propos. Meddour, Meddour-Sahar, Zeraia & Mucina 2017 *quercetosum canariensis* El Afsa 1978 [cluster D, Table 4]

In the Beni Ghobri and Tamgout forests, above 600–700 m a.s.l., on northern slopes, with increasing cool humidity, the Zeen oak (*Quercus canariensis*) begins to mix with *Quercus suber* (Figure 4 B & D).

This mixed forest colonizes the north and east facing slopes, in high altitudinal position (650–950 m a.s.l.), on

deep and relatively cool soils, in upper mesomediterranean thermotype, and in temperate humid ombrotype, on the Numidian sandstones. The soils are most often sandy, with clayey intercalations, and strewn with scree and the humus is mull, acidic, rich in organic matter, with a podzolic tendency (Durand, 1951).

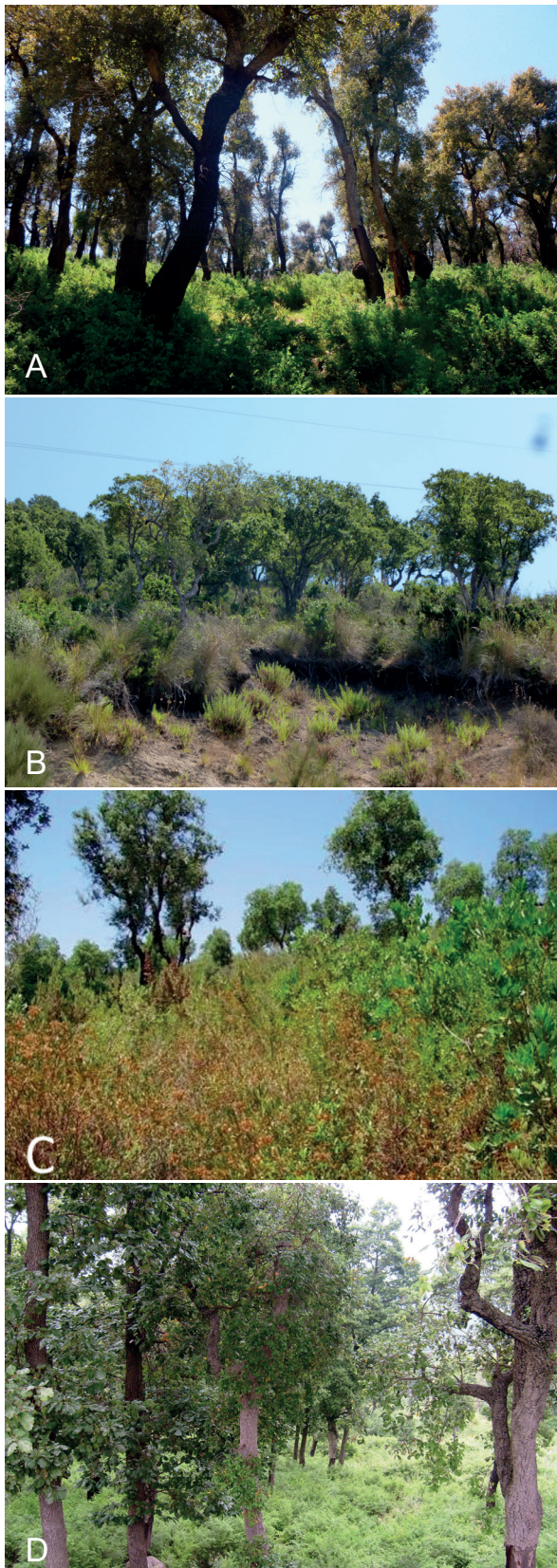
These edaphoclimatic conditions are very favourable to *Quercus canariensis*, which is present almost everywhere and regenerates easily.

This mixed oak wood arises in tall forest, 10–12 m on average in height, locally reaching 14–15 m; it is fairly dense to dense, with the canopy providing a cover of 50–80%. In the tree layer, *Quercus canariensis* reaches an average height of 17 m, and *Prunus avium* is quite common under these conditions. The shrub layer is homogeneous and represented mainly by *Cytisus villosus*, which is the most mesohygrophilic shrub of the Fabaceae present in cork oak woods, *Erica arborea*, *Rubus ulmifolius* and *Crataegus monogyna*.

It should be noted in this humid community the preponderance of mesophilic forest species, characteristics of *Quercetea ilicis* and *Quercetalia ilicis*, and those of *Erico-Quercion ilicis* (*Cytisus villosus*, *Pulicaria odora*, *Plagius maghrebinus*, *Clinopodium arundanum*, etc.), to which obviously belongs this association of cork oak with *Cytisus villosus*. The constancy of the Zeen oak makes it possible to relate this community to *quercetosum canariensis* subassociation, with as differential species: *Quercus canariensis*, *Prunus avium*, *Ficaria verna* subsp. *grandiflora*, *Vicia ochroleuca* subsp. *atlantica*, *Lamium flexuosum* (cf. El Afsa, 1978; Zeraia, 1981; Khelifi, 1987).

This subassociation is characterized by an enrichment of many transgressive taxa of *Quercetea pubescentis* (e.g. *Prunella vulgaris*, *Luzula forsteri*, *Viola reichenbachiana*, etc.), which reflect the mesohygrophilous character of *quercetosum canariensis*, regarding other subassociations of *Cytiso-Quercetum suberis* (in particular *myrtetosum communis*, see below). Their presence clearly illustrates the favourable mesophyllous conditions that exist in this mixed oaks wood (Quézel, 1956; Aimé et al., 1986). In the neighbouring Akfadou massif, these forest species find their ecological optimum in Zeen oak forest (see Laribi et al., 2008). The peculiarity of this subassociation, conserving a mesophilous mountain flora of *Quercetea pubescentis*, is certainly of great phytogeographical significance. This is also the case for other cork oak woods, both in Kroumiria (Braun-Blanquet, 1953), and in Sardinia (Bacchetta et al., 2004), where they harbour floristic elements of *Quercus-Fagetetea sylvaticae*.

Finally, this subassociation establishes a transition between the sclerophyllous evergreen forests (*Cytiso villosi-Quercetum suberis typicum*), and the deciduous forests of



the same region (*Rubo incanescens-Quercetum canariensis cytisetosum villosi* and *Plagio maghrebini-Quercetum canariensis*) (cf. Quézel, 1956; Aimé et al., 1986; Meddour, 1993; Laribi et al., 2008), growing in a humid ombrotype, temperate to cool, and above 800–900 m a.s.l.. Moreover, the floristic comparison of these three syntaxa clearly shows their great synfloristic affinities, including almost all the forest plant species having their optimum in the upper mesomediterranean thermotype.

Ass. *Cytiso villosi-Quercetum suberis* Braun-Blanquet 1953 nom. mut. propos. Meddour, Meddour-Sahar, Zeraia & Mucina 2017 myrtetosum *communis* Khelifi 1987 [cluster C, Table 5]

This mesophilic community with a thermophilic tendency, appears in some forests of the littoral, mostly in Mizrana (Figure 4 A), in Tamgout and Beni Ghobri (150–650 m a.s.l.), where it is lower than the previous subassociation (*Cytiso-Quercetum suberis quercetosum canariensis*). It grows mainly in the thermomediterranean and lower mesomediterranean thermotypes, in subhumid to humid temperate ombrotypes, on Numidian sandstones and scree of these sandstones.

This cork oak forest type is generally found in pure stand, with an average height of 8–12 m, sometimes higher (15 m). The tree layer is constituted almost solely by *Quercus suber*, which provides a variable cover (50–90%). *Zeen oak* can be locally present by natural regeneration; *Prunus avium* is very rare. The frutescent layer, 1.5–2.5 m in height, is generally dense (70–90% of vegetation cover). The abundance of *Cytisus villosus* and many Mediterranean type shrubs (*Erica arborea*, *Arbutus unedo*, *Phillyrea latifolia*, *Myrtus communis*, *Crataegus monogyna*, *Viburnum tinus*, *Ruscus hypophyllum*, *Daphne gnidium*, *Calicotome spinosa*, etc.) characterize it.

Figure 4: Some images of different types of cork oak forests studied: A. Mesomediterranean humid cork oak forest (*Cytiso villosi-Quercetum suberis myrtetosum communis*) at Mizrana forest. B. Mesomediterranean subhumid cork oak forest (*Cytiso villosi-Quercetum suberis quercetosum canariensis*) at Tamgout forest. C. Thermomediterranean subhumid maquis (*Erico arboreae-Myrtetum communis*) at Azzefoun, coastal area. D. Mesomediterranean humid cork oak forest (*Cytiso villosi-Quercetum suberis quercetosum canariensis*) at Beni Ghobri forest. All photos R. Meddour.

Slika 4: Slike razliĉnih tipov preuĉevanih gozdov hrasta plutovca: A. mezomediterranski vlaĉni gozdovi hrasta plutovca (*Cytiso villosi-Quercetum suberis myrtetosum communis*) v gozdu Mizrana. B. mezomediterranski polvlaĉni gozdovi hrasta plutovca (*Cytiso villosi-Quercetum suberis quercetosum canariensis*) v gozdu Tamgout. C. termomediterranska polvlaĉna makija (*Erico arboreae-Myrtetum communis*) pri kraju Azzefoun, obalno obmoĉje. D. mezomediterranski vlaĉni gozd hrasta plutovca (*Cytiso villosi-Quercetum suberis quercetosum canariensis*) v gozdu Beni Ghobri. Vse fotografije R. Meddour.

We can subordinate this community of cork oak with *Cytisus villosus*, where Myrtle and Ericaceae (*Arbutus unedo* and *Erica arborea*) co-dominate in the understory, to the subassociation *Cytisus villosi-Quercetum suberis myrtetosum communis*, since the transgressive species of *Oleo-Quercion rotundifoliae* (*Myrtus communis*, *Rubia peregrina*, *Smilax aspera*, *Ruscus hypophyllum*) are well represented here. However, we noticed the great rarity of *Clematis cirrhosa*, *Arisarum vulgare*, *Teucrium pseudoscorodonia* and *Olea europaea* subsp. *europaea*, which are more optimal in the subhumid ombrotpe and thermomediterranean thermotype. It is possible to classify among the diagnostic species of this unit: *Myrtus communis*, *Phillyrea latifolia*, *Lonicera implexa* and *Piptatherum miliaceum*, since they are uncommon in *quercetosum canariensis*, at their ecological marginality. For instance, the upper altitudinal limit of *Myrtus communis* is located around 600–700 m a.s.l., altitude from which, it becomes rare and *Cytisus villosus* replaces it in the understory.

This *myrtetosum* subassociation can partly be recognised in the “association with *Quercus suber* and *Arbutus unedo*”, and specifically in its “subassociation with *Myrtus communis*”, described in Northern Morocco by Sauvage (1961).

Otherwise, in Morocco, the *Myrto communis-Quercetum suberis*, thermomediterranean association of *Oleo-Quercion rotundifoliae*, is declined in several subassociations, of which *myrtetosum communis* (Barbero et al., 1981), where *Arbutus unedo* and *Erica arborea* are frequent. The syndynamic and synfloristic links between these various syntaxa deserve an in-depth comparative study in North Africa.

Ass. *Erica arborea*-*Myrtetum communis* Quézel, Barbero, Benabid, Loisel & Rivas-Martinez 1988 [cluster B, Table 6]

This secondary coastal shrubland (“maquis”) develops from practically sea level (50–60 m a.s.l.) to around 400 m a.s.l., in the region of Aghrib-Azefoun (Figure 4 C), on flysch alternating sandstone and clay, locally clayey, as evidenced by the preponderance of oleaster (relevés 5 and 6). It reaches its ecological optimum in the thermomediterranean thermotype, warm to temperate subhumid ombrotpe. This association occurs either in medium or high thicket, 2–3 m in height, dense or even thick (cover of 80–100%), or in wooded scrub, where the cork oak is residual, and the forest character is rarely achieved.

Table 6 (Tabela 6): *Erica arborea*-*Myrtetum communis* Quézel, Barbero, Benabid, Loisel & Rivas-Martinez 1988.

Relevé number	1	2	3	4	5	6	Fr.
Relevé number (field)	E3	E6	E2	E5	E1	E7	
Altitude (x 10 m a.s.l.)	6	5	25	6	25	40	
Aspect	E	N	E	NE	S	S	
Slope (%)	5	20	45	45	20	25	
Cover (%)	80	90	80	90	100	90	
Area (x 10 m ²)	10	10	10	10	10	10	
Location	Az	Az	Ag	Az	Ag	Ag	
Number of taxa	15	16	14	14	13	13	
Diagnostic species of the association and <i>Ericion arboreae</i>							
<i>Erica arborea</i> L.	2	2	3	2	2	2	V
<i>Myrtus communis</i> L.	2	1	2	1	2	1	V
<i>Genista ulicina</i> Spach	+	+	+	+	+	1	V
<i>Arbutus unedo</i> L.	1	1	+	+			IV
Species of <i>Quercetea ilicis</i> and <i>Pistacio lentisci-Rhamnetalia alaterni</i>							
<i>Pistacia lentiscus</i> L.	1	2	3	3	4	3	V
<i>Phillyrea latifolia</i> L.	3	2	3	1	3	3	V
<i>Ampelodesmos mauritanicus</i> (Poir.) T. Durand & Schinz	2	2	2	2	+	1	V
<i>Calicotome spinosa</i> (L.) Link	+	+		+	2	1	V
<i>Olea europaea</i> L. subsp. <i>europaea</i>		+	+		3	3	IV
<i>Eryngium tricuspdatum</i> subsp. <i>bovei</i> (Boiss.) Breton	+				+	+	III
<i>Cerantonia siliqua</i> L.			+	+			II
<i>Quercus suber</i> L.			+	+			II
<i>Pulicaria odora</i> (L.) Rchb.			+		+		II
<i>Asparagus acutifolius</i> L.	+	+					II
<i>Smilax aspera</i> L.	+	+					II

Relevé number	1	2	3	4	5	6	Fr.
<i>Daphne gnidium</i> L.		+	+				II
<i>Lonicera implexa</i> Aiton				+			I
<i>Rosa sempervirens</i> L.		+					I
Species of <i>Cisto-Lavanduletea stoechadis</i>							
<i>Cistus monspeliensis</i> L.	3	2	2	3	3	2	V
<i>Lavandula stoechas</i> L.	2	+	1	1	1	1	V
<i>Cistus salvifolius</i> L.	1					+	II
Other species							
<i>Rubus ulmifolius</i> Schott	+	+					II
<i>Asphodelus ramosus</i> L. subsp. <i>ramosus</i>					+		I
<i>Briza maxima</i> L.						+	I
<i>Dittrichia viscosa</i> (L.) Greuter				+			I

Locations: Ag: Aghrib, Az: Azeffoun.

Sclerophyllous shrubs, such as *Erica arborea*, *Myrtus communis*, *Pistacia lentiscus*, *Phillyrea latifolia*, *Arbutus unedo*, *Calicotome spinosa*, are omnipresent, and *Cistus monspeliensis*, *Lavandula stoechas*, *Genista ulicina* organise a sub-stratum of 1–1.5 m tall.

At the level of this pre-forest community, the diagnostic species of *Quercetea ilicis* and *Pistacio-Rhamnetalia alaterni* are numerous and in particular various thermo-heliophilic species, such as *Arbutus unedo*, *Pistacia lentiscus*, *Ampelodesmos mauritanicus*, *Calicotome spinosa*, *Myrtus communis*, *Daphne gnidium*, etc. The species of *Cisto-Lavanduletea* are represented by *Cistus monspeliensis*, *Cistus salvifolius* and *Lavandula stoechas*.

This association is characterized by the following diagnostic species, comprising transgressive species of the *Ericion arboreae*: *Erica arborea*, *Myrtus communis*, *Arbutus unedo*, to which we join as a local differential species *Genista ulicina* that clearly finds its ecological optimum in this community. It belongs to the typical *Ericenion arboreae* Rivas-Martínez, Costa & Izco 1986 suballiance, growing exclusively on siliceous substrata, at thermo- and mesomediterranean thermotypes (Torres et al., 2002), not hitherto recognised in Algeria.

Quézel et al. (1988) first described the *Erico-Myrtetum* in the Moroccan Rif. In Algeria, it was then recognised in the Traras massif on the Oran coast (Hadjadj-Aoul & Loisel, 1999; Medjahdi & Letreuch-Belarouci, 2017) and in Taza National Park (Sfaksi, 2012). Elsewhere, Brullo et al. (2008) and Guarino et al. (2017) describe it from Sicily.

On the dynamic point of view, this high scrubland with Ericaceae (*Erica arborea*, *Arbutus unedo*) derives from coastal cork oak forests with *Myrtus communis*, belonging to the *Myrto communis-Quercetum suberis*, climactic forest association, on siliceous substrate, at thermomediterranean thermotype. This low-altitude association has strongly regressed following excessive cuttings and repeated fires,

on the Kabylia coastal area. Thus, *Erico-Myrtetum* association makes it possible to reconstitute the potential vegetation and to recognise the climactic forest community, which is increasingly difficult to meet nowadays in the field, moreover in the thermomediterranean thermotype (Quézel et al., 1988). In terms of management, it must always be borne in mind that shrublands are substitution communities, that in the end, if not disturbed (e.g. by wildfires, grazing, etc.), are possibly replaced by potential forest vegetation (Farris et al., 2007).

About the integration of cork oak associations to alliances: *Erico-Quercion ilicis* vs. *Quercion suberis*

On the syntaxonomical standpoint, the forest associations of cork oak are integrated, according to many authors, into various alliances of *Quercetalia ilicis*, giving to local chorological, edaphic and climatic factors in their Mediterranean range (Blasi et al., 1997). According to Agrillo et al. (2018), in their comparative description of the European *Q. suber* woodlands types, there are four groups defined corresponding to distinct biogeographical regions and alliances:

- i) the Western Iberian Peninsula group includes the alliance *Oleo sylvestris-Quercion rotundifoliae*,
- ii) the Cantabrian and Aquitanian groups include the alliance *Quercion broteroi*,
- iii) the Catalan-Provençal group is linked to *Quercion ilicis*,
- iv) the Tyrrhenian Italian coast and main islands group are linked to the alliances *Erico-Quercion ilicis* and *Fraxino orni-Quercion ilicis*.

In North Africa, there is no synthesis carried out on all the plant communities of cork oak woodlands in this area. In Morocco, Taleb & Fennane (2019) linked the plant communities of cork oak to the *Oleo sylvestris-Quercion*

rotundifoliae. In Algeria (and Tunisia), all the cork oak forest associations, present in the mesomediterranean thermotype (cf. Table 1), were usually affiliated by the authors to *Quercion suberis* (see e.g., Siab-Farsi, 2018). This alliance is now subordinated to *Quercion ilicis*, a thermophilous alliance typical of Valencian-Catalan-Provençal biogeographic district (Agrillo et al., 2018), as a suballiance *Quercenion suberis* (Loisel 1971) Rameau in Bardat et al. 2001. They are finally included in the *Oleo sylvestris-Quercion rotundifoliae* by Meddour et al. (2017). Even so, this solution is no longer suitable.

Hence, the *Erico arboreae-Quercion ilicis*, alliance described by Brullo et al. (1977) in Sicily, more exactly in Pantelleria off the coast of Tunisia, currently encompasses several associations of cork oak woods of Sicily and Italian coastal areas (Tyrrhenian), including *Cytiso villosi-Quercetum suberis* (Bacchetta et al., 2004). This acidophilous alliance substitutes the basophilous *Quercion ilicis* (Agrillo et al., 2018).

In Kabylia-Numidia-Kroumiria area, *Quercus suber* woodlands exhibit a clear “eastern” biogeographical character making them very different from those of the Iberian Peninsula and Southern France, where *Quercus ilex* is almost in spatial contact. In addition, Frosch & Deil (2011) have shown that the Algerian associations of *Quercus suber* are clearly distinguished from those of the SW of Spain (Andalusia) and the North-West of Morocco (belonging to the *Oleo-Quercion*). Their distinct floristic composition is due to a number of species occurring only in the Algerian datasets, e.g. *Clinopodium vulgare* subsp. *arundanum*, *Cyclamen africanum*, *Cynosurus effusus*, and *Eryngium tricuspdatum* subsp. *bovei*.

All these considerations lead us to affiliate the cork oak associations growing in Northeastern Algeria-Tunisia, at the level of alliances, to the *Erico arboreae-Quercion ilicis*. This alliance admits as diagnostic species: *Pulicaria odora*, *Cytisus villosus*, *Melica arrecta*, *Erica arborea*, *Arbutus unedo*, *Clinopodium vulgare* subsp. *arundanum*, *Teline monspessulana*, *Teline linifolia*, *Teucrium siculum*, *Poa sylvicola*, *Adenocarpus grandiflorus* (Brullo et al., 1977; Brullo & Marceno, 1985; Guarino et al., 2017). We must add as local differential species, some endemic plants, viz. *Plagius maghrebicus*, *Eryngium tricuspdatum* subsp. *bovei*, and *Teucrium kabylicum* (replacing *T. siculum*). In particular, the *Cytiso-Quercetum suberis* (with its two subassociations described here) is integrated to the *Erico-Quercion ilicis* for the first time in the present study, by waiting for a synthesis on all cork oak associations described in Algeria-Tunisia. In fact, the presence of *Erico-Quercion ilicis* in Kabylia-Numidia-Kroumiria is of particular relevance, suggesting that interesting biogeographical links exist with Sicily and Tyrrhenian region (cf. Hamel et al., 2020).

Conclusions

In the present contribution, Kabylia *Quercus suber* woodlands have been described for the first time in terms of their floristic composition and ecological significance. The wide ecological amplitude shown by the cork oak in Kabylia area leads to the phytocoenotic diversity of its woodlands that are assigned to three associations, with a newly described synendemic one (*Sileno imbricatae-Quercetum suberis*), and two subassociations, affiliated to one class, two orders, and three alliances. Apart from the *Cytiso villosi-Quercetum suberis*, they are identified for the first time in Kabylia area.

From the phytogeographical point of view, it is important to recognise for the first time the existence in Algeria of the *Erico arboreae-Quercion ilicis* alliance that replaces the usually described *Quercion suberis* alliance in NE Algerian-Tunisian cork oak woodlands.

The regressive evolution of the cork oak forest, under the impact of anthropozoic disturbances, leads to high scrub of the *Ericion arboreae* (*Erico-Myrtetum*), in the study area and probably in all the area of *Erico-Quercion ilicis* within the Kabylia-Numidian sector (Northeastern Algeria). More specifically, we are able to relate to *Eri-cenion arboreae* suballiance the high and dense maquis with *Arbutus unedo* and *Erica arborea*, which originate from coastal cork oak woodlands with *Myrtus communis*, and are not sufficiently studied in Algeria.

The growth of these evergreen forests is threatened by high fire frequency and overgrazing, particularly in the thermomediterranean coastal area. Moreover, the remnant cork oak forest of Djurdjura, located in a protected area, is seriously threatened by wildfires. In face of such threats, we provided information on both the floristic composition and synecology to help establishing management and conservation measures that are highly required to contrast the predictable future decline of the cork oak forests in the southern coast of Mediterranean basin.

Acknowledgements

We would like to thank forestry technicians of forest districts of Tizi Ouzou province for their help in the fieldwork. We thank the reviewers for significantly improving the quality of the manuscript and for providing us with useful suggestions.

Rachid Meddour  <https://orcid.org/0000-0003-2936-2470>

Ouahiba Sahar  <https://orcid.org/0000-0002-7466-2926>

References

- Aimé, S., Bonin, G., Chaabane, A., Loisel, R., & Saoudi, H. (1986). Notes phytosociologiques nord-africaines. Contribution à l'étude phytosociologique des zénaies du littoral algéro-tunisien. *Ecologia Mediterranea*, 12(3-4), 113–131. <https://doi.org/10.3406/ecmed.1986.1178>
- Agrillo, E., Alessi, N., Jiménez-Alfaro, B., Casella, L., Angelini, S., Argagnon, O., Crespo, G., Fernández-González, F., Monteiro-Henriques, S., Silva Neto, C., & Attorre, F. (2018). The use of large databases to characterize habitat types: the case of *Quercus suber* woodlands in Europe. *Rendiconti Lincei. Scienze Fisiche e naturali*, 29(2), 283–293. <https://doi.org/10.1007/s12210-018-0703-x>
- APD (2021, December 21). *African Plant Database*. Conservatoire et Jardin botaniques de la Ville de Genève and South African National Biodiversity Institute. Retrieved from <http://www.ville-ge.ch/musinfo/bd/cjb/africa>
- Babali, B., 2014. *Contribution à une étude phytoécologique des monts de Moutas (Tlemcen-Algérie occidentale): Aspects syntaxonomique, biogéographique et dynamique*. [Thèse de Doctorat, Université Abou Bakr Belkaid, Tlemcen].
- Bacchetta, G., Bagella, S., Biondi, E., Farris, E., Filigheddu, R., & Mossa, L. (2004). A contribution to the knowledge of the order Quercetalia ilicis Br.-Bl. ex Molinier 1934 of Sardinia. *Fitosociologia*, 41(1), 29–51.
- Badalamenti, E., Scalenghe, R., La Mantia, T., Bueno, R.S., Sala, G., Pizzurro, G.M., Giaimo, A., & Pasta, S. (2020). The cork oak in the Mountains of Palermo (Italy): ecological insights from the south-eastern edge of its distribution range. *iForest – Biogeosciences and Forestry*, 13, 336–344. <https://doi.org/10.3832/ifer3360-013>
- Barbero, M., Quézel, P., & Rivas-Martinez, S. (1981). Contribution à l'étude des groupements forestiers et préforestiers du Maroc. *Phytocoenologia*, 9(3), 311–412. <https://doi.org/10.1127/phyto/9/1981/311>
- Barbero, M., & Loisel, R. (1983). Les chênaies vertes du sud-est de la France méditerranéenne. Valeurs phytosociologiques, dynamiques et potentielles. *Phytocoenologia*, 11(2), 225–244. <https://doi.org/10.1127/phyto/11/1983/225>
- Bennadja, S., de Belair, G., & Tlili Ait Kaki, Y. (2013). La subéraie de la Numidie orientale: une source de biodiversité. *Quad. Bot. Amb. Appl.*, 24, 49–53.
- Biondi, E. (2011). Phytosociology today: Methodological and conceptual evolution. *Plant Biosystems*, 145 (Sup. 1), 19–29. <https://doi.org/10.1080/11263504.2011.602748>
- Blasi, C., Filesi, L., Fratini, S., & Stanisci, A. (1997). Le cenosi con sughera nel paesaggio tirrenico laziale (Italia centrale). *Ecologia Mediterranea*, 23(3-4), 21–32. <https://doi.org/10.3406/ecmed.1997.1834>
- BNEDER (2008). *Etude d'Inventaire Forestier National. Rapport sur la caractérisation des formations forestières. Wilaya de Tizi Ouzou*. Alger : Bureau National d'Etudes pour le Développement Rural.
- Boudy, P. (1955). *Economie forestière Nord-Africaine. IV. Description forestière de l'Algérie et de la Tunisie*. Paris, France: Larose.
- Boussaidi, N., Ncibi, R., Hasnaoui, I., & Ghrabi Gammar, Z. (2010). Impacts des facteurs orographiques et anthropiques sur la régénération naturelle du chêne liège (*Quercus suber*) dans la région de Kroumirie, Tunisie. *Revue Écologie (Terre Vie)*, 65, 1–8.
- Bouxin, G. (2021). *Analyse statistique des données de végétation (ASDV)*. Retrieved from <http://users.skynet.be/Bouxin.Guy/ASDV.htm>
- Braun-Blanquet, J. (1953). Irradiations européennes dans la végétation de la Kroumirie. *Vegetatio*, 4(3), 182–194.
- Braun-Blanquet, J. (1964). *Pflanzensoziologie. Grundlagen der Vegetationsforschung*. Wien, Austria: Springer-Verlag.
- Brullo, S., Di Martino, A., & Marcenò, C. (1977). La vegetazione di Pantelleria (Studio fitosociologico). *Pubbl. Inst. Bot. Univ. Catania*, 1–111.
- Brullo, S., & Marcenò, C. (1985). Contributo alla conoscenza della classe Quercetea ilicis in Sicilia. *Not. Fitosoc.*, 19(1), 183–229.
- Brullo, S., Gianguzzi, L., La Mantia, A., & Siracusa, G. (2008). La classe *Quercetea ilicis* in Sicilia. *Bollettino Accademia Gioenia Sci. Nat.*, 41(369), 1–80.
- Cano, E., Musarella, C.M., Cano-Ortiz, A., Piñar-Fuentes, J.C., Rodriguez Torres, A., del Rio Gonzalez, S., Pinto Gomes, C.J., Quinto-Canas, R., & Spampinato, G. (2019). Geobotanical study of the microforests of *Juniperus oxycedrus* subsp. *badii* in the Cnertal and Southern Iberian Peninsula. *Sustainability*, 11(4), 1111. <https://doi.org/10.3390/su11041111>
- Cano-Ortiz, A., Musarella, C.M., Piñar Fuentes, J.C., Quinto Canas, R., Pinto Gomes, C.J., Spampinato, G., Ighbareyeh, J.M.H., del Río, S., & Cano, E. (2021). Forest and Arborescent Scrub Habitats of Special Interest for SCIs in Central Spain. *Land*, 10, 183. <https://doi.org/10.3390/land10020183>
- Chessel, D., Dufour, A.B., & Thioulouse, J. (2003). *Analyse des correspondances simples*. Retrieved from <http://pbil.univlyon1.fr/R/stage/stage4.pdf>
- Dengler, J., Chytrý, M., & Ewald, J. (2008). Phytosociology. In S.E., Jørgensen & B.D., Fath Eds.). *Encyclopedia of Ecology* (pp. 2767–2779). Oxford, UK: Elsevier. <https://doi.org/10.1016/B978-008045405-4.00533-4>
- Dobignard, A., & Chatelain, C. (2010–2013). *Index synonymique et bibliographique de la Flore d'Afrique du Nord*. Genève, Switzerland: Conservatoire et Jardin botaniques de la Ville de Genève.
- Durand, J.H. (1951). Sur quelques sols de la forêt d'Akfadou et des environs de Yakouren. *Annales Agronomiques*, 2, 110–127.
- El Afsa, M. (1978). *Ecologie, phytosociologie, régénération et production des subéraies tunisiennes*. [Thèse de doctorat, Université d'Aix-Marseille III].
- EUFORGEN (2009). Distribution map of cork oak (*Quercus suber*). Retrieved from www.euforgen.org
- FAO (2013). *State of the Mediterranean forests 2013*. Rome, Italy: Food and Agriculture Organization.
- Farris, E., Secchi, Z., & Filigheddu, R. (2007). Phytosociological study of the shrub and pre-forest communities of the effusive substrata of NW Sardinia. *Fitosociologia*, 44(2), 55–81.
- Frosch, B., & Deil, U. (2011). Forest vegetation on sacred sites of the Tangier Peninsula (NW Morocco) – discussed in a SW-Mediterranean context. *Phytocoenologia*, 41(3), 153–181. <https://doi.org/10.1127/0340-269X/2011/0041-0503>

- Géhu, J.M., & Rivas-Martínez, S. (1981). Notions fondamentales de phytosociologie. In H., Dierschke (Ed.). *Syntaxonomie. Ber. Int. Symp. Int. Vereinigung Vegetationsk* (pp. 5–33). Vaduz: Cramer.
- Gillet, F. (2000). *La Phytosociologie synusiale intégrée. Guide méthodologique*. Université de Neuchâtel, Institut de Botanique.
- Guarino, R., Cusimano, D., Ilardi, V., & Pasta, S. (2017). Syntaxonomic list of the vegetation units. In R., Guarino & S., Pasta (Eds.). *Botanical excursions in Central and Western Sicily. Field guide for the 60th IAVS symposium* (pp. 281–370). Palermo, Italy: Palermo University Press.
- Hadjadj-Aoul, S., & Loisel, R. (1999). Syntaxonomie des peuplements algériens du Thuya de Berbérie (*Tetraclinis articulata* (Vahl) Masters). Les peuplements forestiers et préforestiers. *Documents Phytosociologiques*, N.S., 19, 229–285.
- Hamel, T., Saci, A., & de Bélaïr, G. (2020). Redécouverte d'un subendémique tyrrhénien, *Tuberaria acuminata* (Viv.) Grosser, en Numidie (Nord – Est algérien). *Bulletin de la Société Linnéenne de Provence*, 71, 243–248.
- Iboukassene, S. (2008). *Dynamique de la végétation des forêts à Quercus suber anthropisées du Nord-Est de l'Algérie (Parc National d'El-Kala)*. [Thèse de doctorat, Université Catholique Louvain, Louvain-la-Neuve].
- Khelifi, H. (1987). *Contribution à l'étude phytocécologique et phytosociologique des formations à chêne liège dans le Nord-est algérien*. [Mémoire de Magister, USTHB, Alger].
- Khelifi, H., & Sadki, N. (1995). Esquisse géobotanique des régions de Collo, Skikda, et Annaba (Nord-Est algérien). Large area vegetation surveys. Bailleul 1994. *Colloques Phytosociologiques*, 23, 594–615.
- Lapie, G. (1909). Etude phytogéographique de la Kabylie du Djurdjura. *Revue de Géographie Annuelle*, 3, 1–156. <https://doi.org/10.5962/bhl.title.36980>
- Laribi, M., Derridj, A., & Acherar, M. (2008). Phytosociologie de la forêt caducifoliée à chêne zéen (*Quercus canariensis* Willd.) dans le massif d'Ath Ghobri-Akfadou (Grande Kabylie, Algérie). *Fitosociologia*, 45(2), 77–92.
- Letreuch-Belarouci, A., Medjahdi, B., Letreuch-Belarouci, N., & Benabdelli, K. (2009). Diversité floristique des subéraies du parc national de Tlemcen (Algérie). *Acta Botanica Malacitana*, 34, 77–89. <http://dx.doi.org/10.24310/abm.v34i0.6913>
- Meddour, R. (1993). Analyse phytosociologique de la chênaie caducifoliée mixte de Tala Kitane (Akkfadou, Algérie). *Ecologia Mediterranea*, 19(3–4), 43–51.
- Meddour, R. (2002). Bioclimats, étages et séries de végétation de l'Atlas blidéen (Algérie). *Phytocoenologia*, 32(1), 101–128. <http://dx.doi.org/10.1127/0340-269X/2002/0032-0101>
- Meddour, R. (2010). *Bioclimatologie, Phytogéographie et Phytosociologie en Algérie. Exemple des groupements forestiers et préforestiers de la Kabylie Djurdjurenne*. [Thèse de Doctorat, Université Mouloud Mammeri, Tizi Ouzou].
- Meddour, R., Meddour-Sahar, O., Derridj, A., & Géhu, J.M. (2010). Synopsis des groupements végétaux forestiers et préforestiers de la Kabylie djurdjurenne (Algérie). *Revue Forestière Française*, 62, 295–308.
- Meddour, R., Meddour-Sahar, O., Zeraia, L., & Mucina, L. (2017). Syntaxonomic synopsis of the forest and tall scrub vegetation of Northern Algeria. *Lazaroa*, 38(2), 127–163. <http://dx.doi.org/10.5209/LAZA.53272>
- Medjahdi, B., & Letreuch-Belarouci, A. (2017). Typologie phytosociologique des formations forestières et préforestières des monts des Trara (Ouest-Algérien). *Documents Phytosociologiques*, Série 3, 6, 132–171.
- Miara, M.D., Hadjadj-Aoul, S., & Decocq, G. (2020). Diversité phytosociologique et séries dynamiques de la végétation de l'Atlas tellien occidental de Tiaret (N-O Algérie). *Ecologia Mediterranea*, 46(1), 97–116. <https://doi.org/10.3406/ecmed.2020.2102>
- Mucina, L., Bültmann, H., Dierßen, K., Theurillat, J.-P., Raus, T., Čarni, A., Šumberová, K., Willner, W., Dengler, J., Gavilán García, R., Chytrý, M., Hájek, M., Di Pietro, R., Iakushenko, D., Pallas, J., Daniëls, F.J.A., Bergmeier, E., Santos Guerra, A., Ermakov, N., Valachovič, M., Schaminée, J.H.J., Lysenko, T., Didukh, Y.P., Pignatti, S., Rodwell, J.S., Capelo, J., Weber, H.E., Solomeshch, A., Dimopoulos, P., Aguiar, C., Hennekens, S.M., & Tichý, L. (2016). Vegetation of Europe: Hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities. *Applied Vegetation Science*, 19(Sup. 1), 3–264. <https://doi.org/10.1111/avsc.12257>
- Nsibi, R., Souayah, N., Khouja, L.M., Khaldi, A., & Bouzid, S. (2006). Impacts des facteurs biotiques et abiotiques sur la dégradation de subéraie tunisienne. *Geo-Eco-Trop*, 30(1), 25–34.
- Poldini, L., Vidali, M., Castello, M., & Sburlino, G. (2020). A novel insight into the remnants of hygrophilous forests and scrubs of the Po Plain biogeographical transition area (Northern Italy). *Plant sociology*, 57(2), 17–69. <https://doi.org/10.3897/pls2020572/01>
- Pollastrini, M., Chiavetta, U., Cutini, A., Casula, A., Maltoni, S., Dettori, S., & Corona, P. (2018). Indicators for the assessment and certification of cork oak management sustainability in Italy. *iForest – Biogeosciences and Forestry*, 11, 668–674. <https://doi.org/10.3832/ifer2587-011>
- Quézel, P. (1956). Contribution à l'étude des forêts de chênes à feuilles caduques d'Algérie. *Mém. Soc. Hist. Nat. Afr. Nord*, N.S., 1, 1–57.
- Quézel, P., & Santa, S. (1962–1963). *Nouvelle Flore de l'Algérie et des régions désertiques méridionales*, 2 tomes. Paris, France: CNRS.
- Quézel, P., Barbero, M., Benabid, A., Loisel, R., & Rivas-Martínez, S. (1988). Contribution à l'étude des groupements préforestiers et des matorrals rifains. *Ecologia Mediterranea*, 14(1-2), 77–122. <https://doi.org/10.3406/ecmed.1988.1208>
- R Core Team (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing. Retrieved from <https://www.R-project.org/>
- Rivas-Martínez, S., Sáenz S.R., & Penas, A. (2011). Worldwide bioclimatic classification system. *Global Geobotany*, 1, 1–634.
- Rodríguez-Guitián, M.A., Amigo, J., Real, C., & Romero Franco, R. (2020). Cork oak forests in the NW Iberian Peninsula: phytosociological reassessment and new proposals. *Plant Biosystems* <https://doi.org/10.1080/11263504.2020.1810809>
- Roselt/OSS (2007). *Guide Roselt/OSS pour l'étude et le suivi de la flore et de la végétation*. Collection Roselt/OSS, Tunis.
- Sauvage, C. (1961). Recherches géobotaniques sur les subéraies marocaines. *Travaux de l'Institut Scientifique Chérifien, Rabat, Série Botanique*, 21, 1–462.
- Serra, G., Bacchetta, G., & Loddo, S. (2002). Relationships between soils, climate and vegetation in *Quercus suber* L. formations of the

- Sulcis-Iglesiente (Southern Sardinia, Italy). *Options méditerranéennes*, Série A, 50, 127–133.
- Sfaksi, N. (2012). *Suivi de la dynamique paysagère au sein d'un espace naturel protégé : cas du Parc National de Taza (wilaya de Jijel, Algérie)*. [Mémoire de Magister, Université Ferhat Abbas, Sétif].
- Siab-Farsi, B. (2018). *Les végétations naturelles du Mont Chenoua: biodiversité, syntaxonomie et cartographie*. [Thèse de doctorat, ENSA, El Harrach, Alger].
- Simeone, M.C., Vessella, F., Salis, A., Larbi, H., Schirone, A., Bellarosa, R., & Schirone, B. (2010). Biogeography of North African cork oak (*Quercus suber* L.). Integrated Protection in Oak Forests. *IOBC/wprs Bulletin*, 57, 1–8.
- Simonson, W.D., & Allen, H.D. (2014). Cork oak (*Quercus suber* L.) forests of western Mediterranean mountains: a plant community comparison. *Ecologia Mediterranea*, 40(1), 35–48. <https://doi.org/10.3406/ecmed.2014.1268>
- Taleb, M.S., & Fennane, M. (2019). Vascular plant communities of Morocco. Phytosociology, ecology and geography. *Geobotany studies*, Springer. <https://doi.org/10.1007/978-3-319-93704-5>
- Theurillat, J.P., Willner, W., Fernandez-Gonzalez, F., Bültmann, H., Carni, A., Gigante, D., Mucina, L., & Weber, H. (2020). International Code of Phytosociological Nomenclature. 4th edition. *Applied vegetation science*, 24(1), e12491 <https://doi.org/10.1111/avsc.12491>
- Torres, J.A., Valle, F., Pinto, C., Garcia-Fuentes, A., Salazar, C., & Cano, E. (2002). *Arbutus unedo* L. communities in southern Iberian Peninsula mountains. *Plant ecology*, 160(2), 207–223.
- Toubal, O. (1998). Le *Prunetum aviae*, le *Genistetum numidicae* et le *Chamaeropetum humilii*, trois associations qui caractérisent la végétation numidienne (Edough, N.E Algérie). *Itinera Geobotanica*, 10, 213–226.
- Toubal, O., & Toubal, A. (1996). Diversité et dynamisme de la végétation de l'Edough (NE Algérie). Relation avec la lithologie. *Colloques Phytosociologiques*, 24, 585–599.
- Véla, E., & Benhouhou, S. (2007). Evaluation d'un nouveau point chaud de biodiversité végétale dans le Bassin méditerranéen (Afrique du Nord). *Comptes Rendus Biologies*, 330(8), 589–605. <https://doi.org/10.1016/j.crvi.2007.04.006>
- Veri, L., & Sebastiani, G. (1987). Structure and evolution of the Mediterranean maquis in Italian and North African forests. Second contribution: the maquis-*Quercus suber* forests. *Acta Botanica Croatica*, 46, 123–142.
- Vogiatzakis, I.N., Griffiths, G.H., & Bacchetta, G. (2005). Human impacts on *Quercus suber* habitats in Sardinia: Past and present. *Botanika Chronika*, 18(1), 293–300.
- Wojterski, T. (1988). *Guide de l'excursion internationale de phytosociologie. Algérie du Nord*. Association internationale pour l'étude de la végétation & INA – El Harrach. Göttingen: Glotze Druck.
- Wojterski, T.W. (1990). Degradation stages of the oak forests in the area of Algiers. *Vegetatio*, 87, 135–143.
- Zeraia, L. (1981). *Essai d'interprétation des données écologiques, phénologiques et de production subéroligneuse dans les forêts de chêne liège de Provence cristalline et d'Algérie*. [Thèse doctorat, Université d'Aix-Marseille III].
- Zeraia, L. (2019). *Biodiversité de la végétation forestière et steppique de l'Algérie*. Mauritius: Editions Universitaires Européennes.

Appendix

Geographical coordinates of the relevés and coded localities (Ag: Aghrib, Az: Azzefoun, BG: Beni Ghobri, BK: Beni Kouffi, M: Mizrana, T: Tamgout).

Geografske koordinate popisov in oznake lokalitet (Ag: Aghrib, Az: Azzefoun, BG: Beni Ghobri, BK: Beni Kouffi, M: Mizrana, T: Tamgout).

Table	Relevé number	Altitude (m a.s.l.)	Latitude	Longitude	Locality
3	1	990	36°28'37"N	3°59'01"E	BK
3	2	1050	36°28'28"N	3°58'20"E	BK
3	3	1000	36°28'34"N	3°58'27"E	BK
3	4	950	36°28'46"N	3°59'04"E	BK
3	5	1060	36°28'30"N	3°58'44"E	BK
3	6	1080	36°28'17"N	3°58'32"E	BK
3	7	1080	36°28'29"N	3°58'45"E	BK
4	1	720	36°46'03"N	4°24'23"E	BG
4	2	670	36°42'24"N	4°24'52"E	BG
4	3	750	36°45'07"N	4°29'04"E	BG
4	4	650	36°43'39"N	4°23'18"E	BG
4	5	730	36°42'37"N	4°25'44"E	BG
4	6	880	36°44'04"N	4°25'04"E	BG
4	7	690	36°45'46"N	4°25'57"E	BG
4	8	670	36°43'28"N	4°24'38"E	BG
4	9	730	36°44'33"N	4°30'23"E	BG
4	10	830	36°43'30"N	4°25'28"E	BG
4	11	540	36°43'46"N	4°22'38"E	BG
4	12	760	36°44'41"N	4°26'29"E	BG
4	13	840	36°43'30"N	4°26'23"E	BG
4	14	700	36°44'59"N	4°26'16"E	BG
4	15	700	36°45'12"N	4°24'02"E	BG
4	16	750	36°49'45"N	4°23'31"E	T
4	17	820	36°44'12"N	4°28'46"E	BG
4	18	820	36°44'08"N	4°28'28"E	BG
4	19	860	36°44'06"N	4°25'21"E	BG
4	20	850	36°43'57"N	4°25'08"E	BG
4	21	730	36°44'33"N	4°28'39"E	BG
4	22	660	36°43'35"N	4°24'04"E	BG
4	23	850	36°50'29"N	4°04'14"E	M
4	24	600	36°45'10"N	4°23'26"E	BG
4	25	730	36°48'47"N	4°23'14"E	T
4	26	840	36°42'51"N	4°26'25"E	BG
4	27	770	36°42'23"N	4°25'04"E	BG
4	28	770	36°45'12"N	4°25'13"E	BG
4	29	770	36°44'47"N	4°28'54"E	BG
4	30	770	36°44'44"N	4°29'59"E	BG
4	31	730	36°42'39"N	4°27'04"E	BG
4	32	880	36°44'17"N	4°25'15"E	BG
4	33	720	36°43'15"N	4°24'57"E	BG
4	34	840	36°44'02"N	4°24'02"E	BG
4	35	730	36°43'50"N	4°27'55"E	BG
4	36	510	36°47'17"N	4°24'15"E	T
4	37	730	36°46'43"N	4°25'05"E	BG
4	38	870	36°43'10"N	4°26'04"E	BG
4	39	730	36°42'44"N	4°27'22"E	BG
4	40	780	36°43'49"N	4°28'05"E	BG
4	41	850	36°43'55"N	4°25'19"E	BG

Table	Relevé number	Altitude (m a.s.l.)	Latitude	Longitude	Locality
4	42	690	36°44'48"N	4°29'41"E	BG
4	43	660	36°45'21"N	4°25'43"E	BG
4	44	710	36°42'30"N	4°27'15"E	BG
4	45	710	36°45'17"N	4°24'58"E	BG
4	46	860	36°43'12"N	4°25'56"E	BG
4	47	710	36°44'38"N	4°26'54"E	BG
4	48	840	36°44'11"N	4°24'28"E	BG
4	49	760	36°48'55"N	4°27'11"E	T
4	50	870	36°42'59"N	4°26'12"E	BG
4	51	760	36°42'59"N	4°25'09"E	BG
4	52	880	36°44'30"N	4°24'09"E	BG
4	53	760	36°42'32"N	4°27'29"E	BG
4	54	940	36°44'30"N	4°24'37"E	BG
4	55	900	36°48'29"N	4°25'20"E	T
4	56	870	36°43'20"N	4°25'55"E	BG
4	57	740	36°44'59"N	4°23'57"E	BG
5	1	650	36°49'17"N	4°23'15"E	T
5	2	550	36°43'57"N	4°22'52"E	BG
5	3	540	36°41'41"N	4°25'10"E	BG
5	4	530	36°45'58"N	4°23'53"E	BG
5	5	580	36°42'45"N	4°24'19"E	BG
5	6	670	36°50'15"N	4°23'57"E	T
5	7	540	36°43'05"N	4°23'42"E	BG
5	8	600	36°50'43"N	4°26'54"E	T
5	9	590	36°39'37"N	4°27'21"E	BG
5	10	650	36°51'12"N	4°05'16"E	M
5	11	580	36°47'05"N	4°26'16"E	T
5	12	550	36°41'13"N	4°24'50"E	BG
5	13	150	36°52'40"N	4°06'32"E	M
5	14	600	36°45'37"N	4°24'34"E	BG
5	15	690	36°48'22"N	4°24'39"E	T
5	16	210	36°47'28"N	4°29'18"E	T
5	17	330	36°50'21"N	4°21'14"E	T
5	18	400	36°51'59"N	4°04'04"E	M
5	19	200	36°53'01"N	4°04'50"E	M
5	20	170	36°25'56"N	4°05'52"E	M
5	21	350	36°51'51"N	4°05'31"E	M
5	22	250	36°52'59"N	4°03'39"E	M
5	23	270	36°46'42"N	4°27'04"E	T
5	24	600	36°44'27"N	4°23'26"E	BG
5	25	680	36°49'58"N	4°05'22"E	M
5	26	400	36°52'25"N	4°05'25"E	M
6	1	60	36°53'48"N	4°18'03"E	Az
6	2	50	36°53'54"N	4°18'04"E	Az
6	3	250	36°53'56"N	4°17'58"E	Ag
6	4	60	36°50'59"N	4°20'23"E	Az
6	5	250	36°51'40"N	4°19'52"E	Ag
6	6	400	36°50'24"N	4°19'51"E	Ag

Table 4 (Tabela 4): *Cytiso villosi-Quercetum suberis* Braun-Blanquet 1953 *nom. mut. propos.* Meddour, Meddour-Sahar, Zeraia & Mucina 2017 *quercetosum canariensis* El Afsa 1978.

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Relevé Number (Field)	C4	C6	C5	C10	B2	C13	F21	F24	C18	C7	F15	B20	C28	F22	F23	A5
Altitude (x 10 m a.s.l.)	72	67	75	65	73	88	69	67	73	83	54	76	84	70	70	75
Slope (%)	10	10	5	5	10	30	7	15	10	40	10	20	10	5	10	10
Aspect	NE	NE	NE	NE	N	W	NW	NW	N	NW	NW	NW	N	NW	NW	SE
Cover (%)	80	60	80	90	75	50	50	50	50	60	50	70	80	80	80	90
Area (x 10 m ²)	20	20	20	20	20	20	10	10	20	20	10	20	20	10	10	25
Location	BG	BG	BG	BG	BG	BG	BG	BG	BG	BG	BG	BG	BG	BG	BG	T
Number of taxa	24	20	27	23	36	32	19	12	27	17	20	25	23	15	20	26
Differential species of the subassociation																
<i>Quercus canariensis</i> Willd.	1	+	+	+						1	+	+	+			+
<i>Prunus avium</i> (L.) L.	1														+	+
<i>Ficaria verna</i> subsp. <i>grandiflora</i> (Robert) Hayek								+								+
<i>Lamium flexuosum</i> Ten. subsp. <i>flexuosum</i>												+				+
<i>Vicia ochroleuca</i> subsp. <i>atlantica</i> (Pomel) Greuter & Burdet	+			1									+	+		
Diagnostic species of the association and <i>Erico-Quercion ilicis</i>																
<i>Quercus suber</i> L.	5	4	5	5	4	3	3	3	3	4	3	4	4	3	3	3
<i>Cytisus villosus</i> Pourr.	2	2	2	2	4	1			4	1	1	3	3			2
<i>Erica arborea</i> L.	1	+			2	2			2	1	1	3	3	+	1	3
<i>Clinopodium vulgare</i> subsp. <i>arundanum</i> (Boiss.) Nyman				1	1	1			1	1						+
<i>Pulicaria odora</i> (L.) Rchb.		+		+	1	+		1	1		+	1		+	+	1
<i>Plagius maghrebinus</i> Vogt & Greuter				1	1	+	+		1	1	+	+	+	+	+	1
<i>Arbutus unedo</i> L.	1					+										2
<i>Eryngium tricuspdatum</i> subsp. <i>bovei</i> (Boiss.) Breton						+						+	+			
<i>Teucrium kabylicum</i> Batt.					1				1							+
<i>Melica arrecta</i> G. Kunze						+										
Species of <i>Quercetalia</i> and <i>Quercetea ilicis</i>																
<i>Asparagus acutifolius</i> L.	1		+		1	1			1	+	1	2	2		1	+
<i>Galium scabrum</i> L.	1	+	1	1	1		+	+	1	1	+			+	+	
<i>Rubia peregrina</i> L.	1	1	1													2
<i>Daphne gnidium</i> L.				1		+		+			+	+	+			
<i>Asplenium onopteris</i> L.	+		1							+		+	+			
<i>Calicotome spinosa</i> (L.) Link				+		1				1	1	2	2			
<i>Geranium purpureum</i> Vill.	+				1		+	+	1						+	1
<i>Carex halleriana</i> Asso					1	+			1							
<i>Rosa sempervirens</i> L.		1	+	1	2				1			+	+	+	+	
<i>Carex distachya</i> Desf.		1			1		+		1		+					
<i>Arisarum vulgare</i> subsp. <i>hastatum</i> (Pomel) Dobignard				1	1		+									
<i>Smilax aspera</i> L.			1													
<i>Cyclamen africanum</i> Boiss. & Reut.	1							+	+						+	
<i>Cynosurus elegans</i> Desf. subsp. <i>elegans</i>							+									
<i>Preridium aquilinum</i> (L.) Kuhn in Kerst.		+	1	1		3	+									
<i>Clematis flammula</i> L.			1	1	1				1							
<i>Ruscus hypophyllum</i> L.	1		1				+									
<i>Piptatherum miliaceum</i> (L.) Coss.			2							2						+
<i>Ampelodesmos mauritanicus</i> (Poir.) T. Durand & Schinz																
<i>Aristolochia fontanesii</i> Boiss. & Reut.						+										+
<i>Teucrium pseudoscorodonia</i> Desf.											+					
<i>Rhaponticoides africana</i> (Lam.) M.V. Agab. & Greuter								+						+	+	
<i>Lonicera etrusca</i> G. Santi																
<i>Olea europaea</i> L. subsp. <i>europaea</i>																

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	Fr.		
B24	C16	C32	F18	F19	F20	A3	B4	B9	F17	B1	B5	C17	C20	B22	C30	B21	C29	C14	F3	B23	C31	C15	B18	C35	C11			
82	82	86	85	73	66	85	60	73	84	77	77	77	77	73	88	72	84	73	51	73	87	73	78	85	69			
15	15	30	20	15	7	30	25	30	5	20	20	20	20	15	30	15	10	15	10	15	10	15	20	10	10			
SW	SW	N	N	NW	NW	NW	SE	NE	N	SE	SE	SE	SE	NW	N	NW	N	NW	NE	NW	NE	NW	N	N	NE			
50	80	80	80	80	80	90	70	50	80	70	70	70	70	70	80	80	80	80	80	75	90	70	60	80	80			
20	25	20	10	10	10	25	25	20	10	20	20	20	20	20	20	20	20	20	10	20	20	20	20	20	20			
BG	BG	BG	BG	BG	BG	M	BG	T	BG	BG	BG	BG	BG	BG	BG	BG	BG	BG	T	BG	BG	BG	BG	BG	BG			
19	17	18	17	21	21	24	18	21	23	26	27	23	21	23	20	31	26	14	19	31	28	28	14	14	29			
							1	1	+	+				+	+	+	+			1	1	+	1	1	III			
	+	+	+																		+	+	+		+	II		
				+	+											+	+				+	+	+	+	+	II		
														+	+						+	+	+		+	I		
														+	+	+	+				2	2				I		
3	3	3	3	3	3	4	3	3	3	4	4	4	4	3	3	4	4	3	3	4	4	4	4	4	4	V		
3	3	3	1	2	1	4	3	3	2	3	3	3	3	1	1	4	4	1	5	3	3	3	3	3	1	V		
4	4	4	2		+	2	1	2		4	4	4	4	2	2	1	1	2	+	3	3	3	2	2	+	V		
+	+	+				+	1	+	+	1	1	1	1			+	+		2	+	+	+			+	III		
1			+	+	+			+		1	+	1	+	1		+				1					1	III		
				+	+	2		+						+	+	+	+	+	1							III		
1	1	1			1	3	2														+	+	+			II		
								+		1	1	1	1								+	+	+		+	II		
			+		+					+	+	+	+							+						II		
																										+		
2	2	2	1	1		1	1		+					+	+	+	+	+	1	+	+	+				IV		
			+	+				+	+	1	1	1	1			2	2			+	+	+	+	+		IV		
3	1	2		+	+		1	+		+	1	+	1							+	+	+				III		
+	+	+		+	+		1		+	+	+	+	+	+	+			+					+	+		III		
										+	+	+	+	+	+					+	+	+				III		
			+			2	3	+	2	2	2	1	1			+	+			1	1	1	+	+	+	III		
						+			+							1	1		1	+	+	+			+	II		
							1			2	2	2	2	2	2	2	2	3	2		2	2	2		1	II		
																										II		
+	+	+		+					+																	II		
																										II		
3	1	2	+						+											+	+	+				II		
			+		+	1															+	+	+			II		
										1												+	+	+	1	1	1	II
				+																						I		
+	+	+																								I		
						+															+					I		
							1	1			1	1	1													I		
									+																	I		
																										+		
																										+		
																										r		
																										r		

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
<i>Phillyrea latifolia</i> L.	+															1
<i>Myrtus communis</i> L.																
<i>Moehringia trinervia</i> subsp. <i>pentandra</i> (Gay) Nyman																
<i>Phlomis bovei</i> de Noé subsp. <i>bovei</i>																
<i>Viola alba</i> subsp. <i>dehnbardtii</i> (Ten.) W.Becker																
Transgressive taxa of <i>Quercetea pubescentis</i>																
<i>Rubus ulmifolius</i> Schott	3	2	1	1	3	1	+	+	3	+		1	1			
<i>Crataegus monogyna</i> Jacq.	2	+	1	1	2	1			2	+		2	2			2
<i>Dioscorea communis</i> (L.) Caddick & Wilkin	1	1	1			+	+	+			+					
<i>Brachypodium sylvaticum</i> (Huds.) P.Beauv.	2	1	+	1	1			+	1		+			+		
<i>Prunella vulgaris</i> L.	1	1	1		1				1							
<i>Viola reichenbachiana</i> Jordan ex Boreau				+	+	+										
<i>Luzula forsteri</i> (Sm.) DC.	+															
<i>Galium tunetanum</i> Lam.							+									
<i>Scutellaria columnae</i> All. subsp. <i>columnae</i>	+															
<i>Geum urbanum</i> L.				1						1						
<i>Potentilla micrantha</i> Ramond ex DC. in Lam. & DC.			+									+				
<i>Polystichum aculeatum</i> (L.) Roth				1												
<i>Asperula laevigata</i> L.																
<i>Prunus insititia</i> L.	2		1													
<i>Epipactis tremolsii</i> Pau			+													
<i>Arum italicum</i> Mill. subsp. <i>italicum</i>																
<i>Agrimonia eupatoria</i> L. subsp. <i>eupatoria</i>				1												
<i>Geranium atlanticum</i> Boiss. & Reut.																
<i>Viola odorata</i> L.									+							
Species of <i>Cisto-Lavanduletea stoechadis</i>																
<i>Cistus salvifolius</i> L.					2	2		+	2	1	+	+	+		1	2
<i>Genista tricuspidata</i> Desf.					1	1			1	1				2	1	
<i>Hypericum australe</i> Ten.						+					+	+	+			+
<i>Lavandula stoechas</i> L.						+										
Other species																
<i>Asphodelus ramosus</i> L. subsp. <i>ramosus</i>	1	+		1	2	2			2	+	1	2	2			1
<i>Dactylis glomerata</i> L.					2	+	2	+	1					+	1	
<i>Trifolium campestre</i> Schreb. in Sturm			1	1	1				1							
<i>Galactites tomentosus</i> Moench												+	+			1
<i>Linaria reflexa</i> (L.) Chaz. subsp. <i>reflexa</i>					+		+		+			+	+			
<i>Sanguisorba minor</i> Scop. subsp. <i>minor</i>						1					+					
<i>Tolpis virgata</i> (Desf.) Bertol.				1	+				+							
<i>Allium triquetrum</i> L.																
<i>Myosotis ramosissima</i> Rochel subsp. <i>ramosissima</i>														+	+	
<i>Vicia sativa</i> L. subsp. <i>sativa</i>				1			+							+		
<i>Veronica arvensis</i> L.																
<i>Galium aparine</i> L.			1													
<i>Rumex crispus</i> L. subsp. <i>crispus</i>						+										
<i>Briza maxima</i> L.					1				1							
<i>Euphorbia medicaginea</i> Boiss. var. <i>medicaginea</i>		1														
<i>Aira cupaniana</i> Guss.						+										
<i>Andryala integrifolia</i> L.												+	+			
<i>Plantago serraria</i> L.							+									
<i>Carex remota</i> L.								+								+
<i>Mentha pulegium</i> L.						+										
<i>Gladiolus dubius</i> Guss.						+										
<i>Fedia graciliflora</i> Fisch. & C. A. Mey.					+											

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
<i>Centaureum erythraea</i> Rafn						+						+	+			
<i>Anthericum baeticum</i> (Boiss.) Boiss.																
<i>Lamium amplexicaule</i> L. subsp. <i>amplexicaule</i>																
<i>Lysimachia arvensis</i> (L.) U. Manns & Anderb.					+											+
<i>Avena barbata</i> Pott ex Link subsp. <i>barbata</i>																
<i>Prospero autumnale</i> (L.) Speta					+											
<i>Daucus carota</i> L. subsp. <i>carota</i>																
<i>Cardamine hirsuta</i> L.																
<i>Euphorbia peplus</i> L.																
<i>Origanum floribundum</i> Munby																
<i>Dittrichia viscosa</i> (L.) Greuter																
<i>Sonchus oleraceus</i> L.																
<i>Kundmannia sicula</i> (L.) DC.																
<i>Phalaris aquatica</i> L.																
<i>Gladiolus italicus</i> Mill.																
<i>Blackstonia perfoliata</i> subsp. <i>grandiflora</i> (Viv.) Maire												+	+			
<i>Fumaria capreolata</i> L. subsp. <i>capreolata</i>							+									+
<i>Sixalix atropurpurea</i> subsp. <i>maritima</i> (L.) Greuter & Burdet												+	+			
<i>Simethis mattiazzi</i> (Vand.) G. López & Ch. E. Jarvis											+					+
<i>Silene vulgaris</i> (Moench) Garcke																

Table 4 : to be continued

Relevé number	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	Fr.
Relevé Number (Field)	C12	C19	C9	C33	C3	C8	B8	B25	B17	C34	C1	F25	B7	C2	F16	
Altitude (x 10 m a.s.l.)	66	71	71	86	71	84	76	87	76	88	76	94	90	87	74	
Slope (%)	10	15	5	30	5	35	25	25	10	10	25	7	25	25	5	
Aspect	SE	N	NE	N	NE	N	NW	NW	NE	N	N	NW	NW	NE	NE	
Cover (%)	80	80	60	80	70	70	60	50	90	75	80	80	80	50	50	
Area (x 10 m ²)	20	20	25	20	20	20	20	20	20	20	20	10	20	20	10	
Location	BG	BG	BG	BG	BG	T	BG	BG	BG	BG	BG	BG	T	BG	BG	
Number of taxa	29	26	24	21	14	27	20	21	28	26	38	14	13	23	17	
Differential species of the subassociation																
<i>Quercus canariensis</i> Willd.	+		1	4	2	1	2	4			2		3	3		III
<i>Prunus avium</i> (L.) L.				2	1	1	+	2	+	+	+			2	+	II
<i>Ficaria verna</i> subsp. <i>grandiflora</i> (Robert) Hayek	+										+	1				II
<i>Lamium flexuosum</i> Ten. subsp. <i>flexuosum</i>											+			+	+	I
<i>Vicia ochroleuca</i> subsp. <i>atlantica</i> (Pomel) Greuter & Burdet																I
Diagnostic species of the association and <i>Erico-Quercion ilicis</i>																
<i>Quercus suber</i> L.	4	4	4	4	5	4	3	2	4	4	3	3	3	4	3	V
<i>Cytisus villosus</i> Pourr.	4	4	3	4	2	3	2	4	2	2	3	1	2	4		V
<i>Erica arborea</i> L.	3	2	1	2	1	1	1	2	3	3	1	1	1	2		V
<i>Clinopodium vulgare</i> subsp. <i>arundanum</i> (Boiss.) Nyman						1	+		+	+			+			III
<i>Pulicaria odora</i> (L.) Rechb.	1		+					+			+	+			+	III
<i>Plagius maghrebicus</i> Vogt & Greuter			1		+						+		+			III
<i>Arbutus unedo</i> L.			1	+			+	+	+	+				+		II
<i>Eryngium tricuspdatum</i> subsp. <i>bovei</i> (Boiss.) Breton	+	+		+				+						+		II
<i>Teucrium kabylicum</i> Batt.	+		+									+				II
<i>Melica arrecta</i> G. Kunze									1	2			+	1		+
Species of <i>Quercetalia</i> and <i>Quercetia ilicis</i>																
<i>Asparagus acutifolius</i> L.	+	+	1	1	+	+		1	+	+	+			1	+	IV
<i>Galium scabrum</i> L.	+	+	1		+	+		+	+	+	+	+	+		+	IV
<i>Rubia peregrina</i> L.	+	+	1	1	1	+	+	1	1	1	+			1		III

Relevé number	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	Fr.
<i>Dioscorea communis</i> (L.) Caddick & Wilkin	+		1	+	1	1		+			+			+	+	III
<i>Brachypodium sylvaticum</i> (Huds.) P.Beauv.	+				1	+	+		1	+					+	III
<i>Prunella vulgaris</i> L.						1	+		+		+					II
<i>Viola reichenbachiana</i> Jordan ex Boreau	1					+			+	+	1					I
<i>Luzula forsteri</i> (Sm.) DC.			+						+	+						I
<i>Galium tunetanum</i> Lam.	+															I
<i>Scutellaria columnae</i> All. subsp. <i>columnae</i>					1		+		+	+						+
<i>Geum urbanum</i> L.						1					+					+
<i>Potentilla micrantha</i> Ramond ex DC. in Lam. & DC.									+	+	+					+
<i>Polystichum aculeatum</i> (L.) Roth							+				+					+
<i>Asperula laevigata</i> L.									+	+						+
<i>Prunus insititia</i> L.						+										r
<i>Epipactis tremolsii</i> Pau						+										r
<i>Arum italicum</i> Mill. subsp. <i>italicum</i>											+			+		r
<i>Agrimonia eupatoria</i> L. subsp. <i>eupatoria</i>																r
<i>Geranium atlanticum</i> Boiss. & Reut.			+											+		r
<i>Viola odorata</i> L.																r
Species of Cisto-Lavanduletea stoechadis																
<i>Cistus salvifolius</i> L.		+	+													III
<i>Genista tricuspidata</i> Desf.			1			+										II
<i>Hypericum australe</i> Ten.	+	+	1						+	+	+				+	II
<i>Lavandula stoechas</i> L.																I
Other species																
<i>Asphodelus ramosus</i> L. subsp. <i>ramosus</i>		1		+	1	1		+				+		+		II
<i>Dactylis glomerata</i> L.		+														II
<i>Trifolium campestre</i> Schreb. in Sturm																I
<i>Galactites tomentosus</i> Moench	+															I
<i>Linaria reflexa</i> (L.) Chaz. subsp. <i>reflexa</i>	+											+				I
<i>Sanguisorba minor</i> Scop. subsp. <i>minor</i>															+	I
<i>Tolpis virgata</i> (Desf.) Bertol.			+			1			+	+						I
<i>Allium triquetrum</i> L.		+									+				+	I
<i>Myosotis ramosissima</i> Rochel subsp. <i>ramosissima</i>	+	+														I
<i>Vicia sativa</i> L. subsp. <i>sativa</i>		+									+					I
<i>Veronica arvensis</i> L.											+					I
<i>Galium aparine</i> L.																+
<i>Rumex crispus</i> L. subsp. <i>crispus</i>																+
<i>Briza maxima</i> L.			+													+
<i>Euphorbia medicaginea</i> Boiss. var. <i>medicaginea</i>	+										+	+				+
<i>Aira cupaniana</i> Guss.	+															+
<i>Andryala integrifolia</i> L.	+															+
<i>Plantago serraria</i> L.																+
<i>Carex remota</i> L.																+
<i>Mentha pulegium</i> L.											+					r
<i>Gladiolus dubius</i> Guss.		+														r
<i>Fedia graciliflora</i> Fisch. & C. A. Mey.																r
<i>Centaureum erythraea</i> Rafn																r
<i>Anthericum baeticum</i> (Boiss.) Boiss.																r
<i>Lamium amplexicaule</i> L. subsp. <i>amplexicaule</i>															+	r
<i>Lysimachia arvensis</i> (L.) U. Manns & Anderb.																r
<i>Avena barbata</i> Pott ex Link subsp. <i>barbata</i>		+														r
<i>Prospero autumnale</i> (L.) Speta																r
<i>Daucus carota</i> L. subsp. <i>carota</i>																r
<i>Cardamine hirsuta</i> L.																r

Relevé number	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	Fr.
<i>Euphorbia peplus</i> L.																r
<i>Origanum floribundum</i> Munby																r
<i>Dittrichia viscosa</i> (L.) Greuter																r
<i>Sonchus oleraceus</i> L.																r
<i>Kundmannia sicula</i> (L.) DC.																r
<i>Phalaris aquatica</i> L.																r
<i>Gladiolus italicus</i> Mill.																r
<i>Blackstonia perfoliata</i> subsp. <i>grandiflora</i> (Viv.) Maire																r
<i>Fumaria capreolata</i> L. subsp. <i>capreolata</i>																r
<i>Sixalix atropurpurea</i> subsp. <i>maritima</i> (L.) Greuter & Burdet																r
<i>Simethis mattiazzi</i> (Vand.) G. López & Ch. E. Jarvis																r
<i>Silene vulgaris</i> (Moench) Garcke																r

Sporadic species: *Hedera algeriensis* Hibberd 1 (4), *Ranunculus spicatus* subsp. *blepharicarpos* (Boiss.) Grau + (42), *Arabis turrita* L. + (5), *Sanicula europaea* L. + (49), *Alliaria petiolata* (M. Bieb.) Cavara & Grande + (16), *Stellaria pallida* (Dumort.) Piré + (5), *Cerastium diffusum* Pers. + (5), *Euphorbia paniculata* Desf. + (5), *Oenanthe globulosa* L. + (5), *Aira tenorei* Guss. 1 (42), *Hypericum perforatum* L. 1 (3), *Rumex conglomeratus* Murray + (5), *Campanula rapunculus* L. + (25), *Eryngium triquetrum* Vahl subsp. *triquetrum* + (51), *Holcus lanatus* L. + (25), *Silene latifolia* Poir. + (53), *Trifolium squarrosum* L. subsp. *squarrosum* + (37), *Lysimachia monelli* subsp. *linifolia* (L.) Peruzzi + (16), *Convolvulus tricolor* L. + (23), *Euphorbia biumbellata* Poir. + (16), *Sonchus asper* (L.) Hill subsp. *asper* + (23), *Serapias lingua* L. subsp. *lingua* 1 (6), *Stachys ocymastrum* (L.) Briq. + (16), *Calystegia sepium* (L.) R. Br. + (16), *Rhamnus alaternus* L. subsp. *alaternus* 1 (16), *Torilis africana* Spreng. + (26), *Origanum vulgare* subsp. *glandulosum* (Desf.) Ietswaart + (54), *Bellis sylvestris* Cirillo + (36), *Ornithogalum baeticum* Boiss. + (36), *Euphorbia cuneifolia* Guss. + (8), *Genista ulicina* Spach + (21), *Cistus monspeliensis* L. 1 (36).

Locations: BG: Beni Ghobri, T: Tamgout.

Table 5 (Tabela 5): *Cytisus villosus-Quercetum suberis* Braun-Blanquet 1953 *nom. mut. propos.* Meddour, Meddour-Sahar, Zeraia & Mucina 2017 *myrtetosum communis* Khelifi 1987.

Relevé number	1	2	3	4	5	6	7	8	9	10
Relevé number (field)	B10	C22	C23	C27	C21	B11	C25	B15	B3	A4
Altitude (x 10 m a.s.l.)	65	55	54	53	58	67	54	60	59	65
Aspect	NE	NW	NW	SW	NW	W	SW	NE	W	SE
Slope (%)	15	20	30	10	10	35	5	25	10	10
Cover (%)	70	60	60	50	60	90	70	90	80	70
Area (x 10 m ²)	25	25	25	20	25	25	25	25	25	25
Location	T	BG	BG	BG	BG	T	BG	T	BG	M
Number of taxa	11	34	34	28	27	10	20	8	20	27
Differential species of the subassociation										
<i>Myrtus communis</i> L.		3	2	2	4		3			
<i>Phillyrea latifolia</i> L.		1	1	1	2		2		1	2
<i>Lonicera implexa</i> Aiton		1	+		+		1		1	
<i>Piptatherum miliaceum</i> (L.) Coss.				+	1					+
<i>Pistacia lentiscus</i> L.										
<i>Viburnum tinus</i> L.										
Diagnostic species of the association and the alliance <i>Erico-Quercion ilicis</i>										
<i>Quercus suber</i> L.	4	3	3	4	3	3	3	2	2	4
<i>Erica arborea</i> L.	+	3	3	2	3	4		2	3	3
<i>Arbutus unedo</i> L.	2	+	+	1	1			2	2	3
<i>Cytisus villosus</i> Pourr.	2	2	2	2	1	+	3	1		3
<i>Plagius maghrebicus</i> Vogt & Greuter	+	+	+		+	+			1	1
<i>Eryngium tricuspdatum</i> subsp. <i>bovei</i> (Boiss.) Breton				+		+				
<i>Pulicaria odora</i> (L.) Rechb.		+		+	+		1			1
<i>Clinopodium vulgare</i> subsp. <i>arundanum</i> (Boiss.) Nyman				1	1				+	+
<i>Teucrium kabylicum</i> Batt.				+						
Species of <i>Quercetalia</i> and <i>Quercetea ilicis</i>										
<i>Calicotome spinosa</i> (L.) Link		+	1	2		+				2
<i>Smilax aspera</i> L.		1	+		1		1			
<i>Ampelodesmos mauritanicus</i> (Poir.) T. Durand & Schinz	+					2			2	2
<i>Asparagus acutifolius</i> L.		+	+	1	+		+			2
<i>Rubia peregrina</i> L.			+	+	+	+			2	
<i>Galium scabrum</i> L.	+	+	1		1		+		1	
<i>Lonicera etrusca</i> G. Santi										1
<i>Daphne gnidium</i> L.									1	+
<i>Ruscus hypophyllum</i> L.		+		+	+					
<i>Arisarum vulgare</i> subsp. <i>hastatum</i> (Pomel) Dobignard				+	+					
<i>Carex halleriana</i> Asso							+		1	
<i>Clematis flammula</i> L.		+								
<i>Geranium purpureum</i> Vill.			+	+						
<i>Asplenium onopteris</i> L.		+	1		1					
<i>Rosa sempervirens</i> L.		1							2	
<i>Carex distachya</i> Desf.		1		1	1					
<i>Cyclamen africanum</i> Boiss. & Reut.			+							
<i>Rhamnus alaternus</i> L. subsp. <i>alaternus</i>										
<i>Rhaponticoides africana</i> (Lam.) M.V. Agab. & Greuter										+
<i>Olea europaea</i> L. subsp. <i>europaea</i>										
<i>Clematis cirrhosa</i> L.										
<i>Teucrium pseudoscorodonia</i> Desf.										+
<i>Pteridium aquilinum</i> (L.) Kuhn in Kerst.										+

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	Fr.
B6	C26	A10	B19	B16	B12	B14	A8	A9	E4	A1	A2	B13	C24	A6	A7	
58	55	15	60	69	21	33	40	20	17	35	25	27	60	68	40	
SW	SW	N	NW	NE	NE	E	S	S	E	E	W	NE	SE	NW	N	
30	20	15	10	25	45	30	15	10	50	10	15	40	20	30	25	
80	60	80	70	100	70	90	90	90	100	90	80	70	80	90	60	
25	25	20	25	20	20	25	20	10	10	20	20	25	25	25	25	
T	BG	M	BG	T	T	T	M	M	M	M	M	T	BG	M	M	
34	20	23	46	8	12	10	24	18	13	21	25	12	30	21	33	
1	1	+	+		+	+	1		2			+	1		1	IV
2	2	2	2		+		2	3	2		1	+	3		2	IV
	+	2	1										+	1		II
	1	+													+	II
		2		+		+	2	3	1	3	2	+			2	II
		2	2				2			2	2		+		2	II
3	3	1	2	2	1	2	2	1	2	2	2	2	3	2	3	V
3	2	2	1	5	2	4	4	3	3	4	3	2	3	2	4	V
2	2	+	2		+	+	3		2	3	3	1	+	1	4	V
3	1		1							2	2		+	2	3	IV
1			+		+		1			1	1	1				III
1	+		1	+	+		1	+			+	+	+		1	III
	+	+	1				2	+		+	1					III
1															+	II
+																+
2	1	+	+	1	+	+	1	1	+	2	1	+	2	2		IV
2		2	+					+	1	1	1		2		1	III
		1			+	+	2		1	4	3	+		2		III
1	1	1	+					+			+		+			III
1		+	+							1	1		+		1	III
1												1			+	II
1		1	+				1	+		2	1				1	II
2	+									2	1			1	1	II
		1	+												+	II
		+							+				+			I
							1								+	I
	+	+	+													I
			1												1	I
1															+	I
																I
															1	+
		3									1					+
			+													+
+													+			+
1		+														+
2																r
																r

Osyris alba L.

Transgressive taxa of *Quercetea pubescentis*

<i>Crataegus monogyna</i> Jacq.	+	2	+	+				1	2
<i>Dioscorea communis</i> (L.) Caddick & Wilkin		+	+	+	+		1		
<i>Rubus ulmifolius</i> Schott		+		+	1		1	1	2
<i>Brachypodium sylvaticum</i> (Huds.) P.Beauv.		+	+						
<i>Prunella vulgaris</i> L.		1	1		1				
<i>Quercus canariensis</i> Willd.									1
<i>Agrimonia eupatoria</i> L. subsp. <i>eupatoria</i>									
<i>Prunus insititia</i> L.									
<i>Galium tunetanum</i> Lam.		+							
<i>Polystichum aculeatum</i> (L.) Roth									
<i>Prunus avium</i> (L.) L.									
<i>Lamium flexuosum</i> Ten. subsp. <i>flexuosum</i>									
<i>Viola odorata</i> L.									+
<i>Ranunculus spicatus</i> subsp. <i>blepharicarpos</i> (Boiss.) Grau									
<i>Rubus incanescens</i> (DC.) Bertol.									
<i>Ficaria verna</i> subsp. <i>grandiflora</i> (Robert) Hayek		+							
<i>Asperula laevigata</i> L.		+							
<i>Polypodium cambricum</i> L. subsp. <i>cambricum</i>		+							

Species of *Cisto-Lavanduletea stoechadis*

<i>Cistus salvifolius</i> L.	+		2	1	+	1	+	1	2	2
<i>Genista tricuspis</i> Desf.	+	+	1	+				+	2	1
<i>Cistus monspeliensis</i> L.	+	+		1				+		
<i>Lavandula stoechas</i> L.			+			+		+		1
<i>Genista ulicina</i> Spach									2	
<i>Hypericum australe</i> Ten.				+			+			
<i>Thymus numidicus</i> Poir.									1	

Other species

<i>Asphodelus ramosus</i> L. subsp. <i>ramosus</i>		1		3	+		+			+
<i>Gladiolus dubius</i> Guss.				+						
<i>Allium triquetrum</i> L.		+								
<i>Centaureum erythraea</i> Rafn			+							
<i>Lysimachia arvensis</i> (L.) U. Manns & Anderb.				1						+
<i>Klasea flavescens</i> subsp. <i>mucronata</i> (Desf.) Cantó & Rivas Mart.										
<i>Hyoseris radiata</i> L.			1							
<i>Daucus carota</i> L. subsp. <i>carota</i>				+						
<i>Tolpis virgata</i> (Desf.) Bertol.					+		+			
<i>Briza maxima</i> L.			+	+						
<i>Trifolium campestre</i> Schreb. in Sturm			1							
<i>Mentha pulegium</i> L.							1			
<i>Ononis hispida</i> Desf. subsp. <i>hispida</i>					+					
<i>Ranunculus macrophyllus</i> Desf.		+								
<i>Prospero autumnale</i> (L.) Speta										
<i>Elaeoselinum fontanesii</i> Boiss.										
<i>Plantago serraria</i> L.										

Sporadic species: *Galactites tomentosus* Moench + (7), *Dactylis glomerata* L. + (14), *Andryala integrifolia* L. + (14), *Cynosurus elegans* Desf. subsp. *elegans* + (7), *Sixalis atropurpurea* subsp. *maritima* (L.) Greuter & Burdet + (14), *Fumaria capreolata* L. subsp. *capreolata* + (2), *Fedia graciliflora* Fisch. & C. A. Mey. + (11), *Simethis mattiazzi* (Vand.) G. López & Ch. E. Jarvis + (10), *Stachys ocymastrum* (L.) Briq. 1 (14), *Vicia sativa* L. subsp. *sativa* 1 (24), *Euphorbia medicaginea* Boiss. var. *medicaginea* + (2), *Sanguisorba minor* Scop. subsp. *minor* + (10), *Serapias lingua* L. subsp. *lingua* + (21), *Biscutella didyma* L. 1 (14), *Aira caryophyllea* L. subsp. *caryophyllea* 1 (14), *Torilis africana* Spreng. + (7), *Leontodon tuberosus* L. + (2), *Oenanthe globulosa* L. 1 (9), *Carlina gummifera* (L.) Less. + (25), *Bartsia trixago* L. 1 (11), *Brachypodium distachyum* (L.) P. Beauv. 1 (14), *Brachypodium phoenicoides* (L.) P. Beauv. ex Roem. & Schult. +

