

VEGETATION HETEROGENEITY OF BLACK ALDER FORESTS IN AND AROUND EL-KALA BIOSPHERE RESERVE, NORTHEASTERN ALGERIA

HETEROGENEIDAD DE LA VEGETACIÓN DE LOS BOSQUES DE ALISO NEGRO EN Y ALREDEDOR DE LA RESERVA DE LA BIOSFERA EL-KALA, NORESTE DE ARGELIA

ABDELDJABAR NECER^{1,2*}, AICHA TADJINE^{1,2}, DJAMILA BELOUAHEM-ABED³, AND MESSAOUD SAOUDI^{1,2}

¹Faculty of Natural and Life Sciences, Department of Biology, University of Chadli Bendjedid, El-Tarf, Algeria

²Laboratory of Functional and Evolutionary Ecology, University of Chadli Bendjedid, El-Tarf, Algeria

³National Institute of Forestry Researches, El-Kala Research Station, El-Tarf, Algeria

* Corresponding author: tabet.necer@gmail.com

Abstract

Background: Despite its ecological importance, the study of Algerian alder forests has been largely neglected, even though they represent the largest ones of their kind in North Africa. Moreover, few measures have been taken towards the protection of these ecosystems.

Questions: How many species are present in the Algerian alder forests? What is the effect of soil properties on species richness and diversity of inventoried plants? Are its spatial patterns related to soil variables variation?

Studied species: Polypodiopsida, Gymnospermae, and Angiospermae.

Study site and dates: El-Kala Biosphere Reserve (KBR) and surroundings, El-Tarf province, northeastern Algeria, from January 2016 to February 2017.

Methods: Twenty-eight localities were sampled using the relevé method. Soil samples were taken from three points at each site. The relationship between species richness and soil factors was statistically evaluated using multiple linear regression and multivariate statistical analysis.

Results: The inventory showed a total of 352 species that belong to 236 genera and 89 families. According to NMDS ordination, black alder forests were classified into two groups (marshy and hilly forests, and fluvial forests), in relation to plant species richness. No linear relationships between species richness and soil parameters were observed, except for OM ($P = 0.013$).

Conclusion: The present study demonstrated a relatively high plant diversity characterizing alder forests of this region. To some extent, such diversity is related to the heterogeneous distribution of plant species among different habitat types. Those factors that affect its zonation were identified, for this ecosystem, our study revealed that vegetation diversity is related to the spatial variation of soil variables.

Key words: *Alnus glutinosa*; Biosphere Reserve, Floristic richness, North Africa, Northeastern Algeria.

Resumen

Antecedentes: A pesar de su importancia ecológica, son pocos los estudios sobre los bosques de aliso en Argelia, los cuales constituyen los más grandes en África del Norte. Además, estos ecosistemas carecen de medidas de protección.

Preguntas: ¿Cuántas especies están presentes en los bosques de aliso argelinos? ¿Qué efecto tienen los factores abióticos (características de suelo) sobre la riqueza de especies y la diversidad de plantas? ¿Están relacionados sus patrones espaciales con la variación de los factores edáficos?

Especies estudiadas: Polypodiopsida, Gymnospermae y Angiospermae.

Sitio y años de estudio: Reserva de la Biosfera El-Kala (KBR), provincia de El-Tarf, nordeste de Argelia, desde enero de 2016 hasta febrero de 2017.

Métodos: Se muestreó la vegetación en 28 sitios de bosques de aliso negro (*Alnus glutinosa* (L.) Gaertn.). Además, se tomaron muestras de suelo de tres puntos en cada sitio. La relación entre la riqueza de especies y los factores ambientales se evaluó mediante regresión lineal múltiple y análisis estadístico multivariado.

Resultados: El inventario contiene en total 352 especies pertenecientes a 236 géneros y 89 familias. De acuerdo con los resultados de la ordenación NMDS, los bosques de aliso negro se clasificaron en dos grupos (bosques de pantano y de colina, y bosques fluviales), en relación con la riqueza de especies. No se observó ninguna relación lineal entre la riqueza de especies y los parámetros de suelo, excepto para MO ($P = 0.013$).

Conclusión: El presente estudio demostró que existe una diversidad de plantas relativamente alta en los bosques de aliso de esta región. En gran medida, esta diversidad está relacionada con la distribución heterogénea de las especies entre los diferentes hábitats. Se logró identificar cuáles factores afectan su zonación: para este ecosistema, nuestro estudio reveló que la diversidad de la vegetación está relacionada con la variación espacial de las variables edáficas.

Palabras clave: *Alnus glutinosa*; África del Norte; nordeste de Argelia; Reserva de la Biosfera; Riqueza florística.

Black alder (*Alnus glutinosa* (L.) Gaertn.) forests are ecosystems naturally widespread across all of Europe, from southern Scandinavia to the Mediterranean countries, including some regions of North Africa, namely northern Morocco and northeastern Algeria (Jalas & Suominen 1976, Kajba & Gracan 2003). Black alder forest is one type of broadleaved forest, and it has a broad but highly scattered distribution (it represents less than 1 % of forest cover in most countries). Despite this spatial configuration, the total population size of this species is not yet thought to approach threshold values to warrant its inclusion in a threatened category. Thus, the species is listed as Least Concern in the IUCN Red List (Shaw *et al.* 2014).

Black alder forest is a particular kind of wetland forest. Black alder occurrence is closely related to water availability and high atmospheric humidity during all phases of its reproductive cycle (Bensimon 1985). It commonly occurs in hilly regions, alongside streams and rivers banks, in damp marshy woods and riverside woodlands (Shaw *et al.* 2014). According to Claessens (2003), black alder forests occur in three main types of wetlands: (i) marshy or swampy sites with sodden soil throughout the year, which constitute the Alnetum community; (ii) riverside sites in which the soil in the rooting zone is well aerated during the growing season (Alno-Padion community); and (iii) hilly sites with high soil humidity (Carpinion community).

Black alder is recognized as an important contributor to forest structure in other wetland ecosystems, and it contributes to the services which they offer (Claessens 2003). For example, *Alnus glutinosa* plays a key role in biodiversity maintenance by offering habitats for specific flora and fauna, both on the tree itself and in the flooded root system (Dussart 1999). This ecosystem contributes to water filtration and purification in flooded soils (Pinay & Labroue 1986, Schnitzler-Lenoble & Carbiener 1993) because the root system of black alder helps control floods and stabilize riverbanks (Piégay *et al.* 2003).

In Algeria, few studies have been conducted on alder forests. This is regrettable, as these forests constitute the largest ones in North Africa (Belouahem *et al.* 2011, Bensettiti & Lacoste 1999, Géhu *et al.* 1994), and few measures have been taken to protect these ecosystems. In fact, only two sites benefit from indirect conservation measures, based on freshwater bird richness (alder forests of Tonga, and those of Ain Khiair, were classified as RAMSAR sites in 1983 and 2002, respectively).

Identifying species composition and the existing species assemblages, and examining how these species are distributed across the alder forest region in northeastern Algeria, are necessary steps prior to investigating the functioning and dynamics of these ecosystems. Algerian black alder forests represent an extremely original ecosystem of northern affinity throughout North Africa (Géhu *et al.* 1994) and are characterized by particular geomorphologic, edaphic, and climatic conditions (Morgan 1982). Hence, the main aims of this study were: (1) to inventory the floristic composition of alder forests in El-Kala Biosphere Reserve and its surroundings, (2) to investigate the effect of abiotic factors

(soil properties) on species richness and diversity, and (3) to distinguish plant communities based on species composition and to define spatial patterns of these plant communities.

Materials and methods

Study area. The El-Kala Biosphere Reserve (KBR hereafter) was created in 1983 by governmental decree no. 83-462 of July 23rd, and classified as Biosphere Reserve by UNESCO on December 17th, 1990. KBR is located at the extreme northeast region of Algeria, specifically in the northeast of Numidia area, between 36° 56' N, 36° 34' N, and 8° 12' E, 8° 41' E (Figure 1), and it has a surface of 76,438 ha. Elevation at KBR ranges from 100 m a.s.l. near the Oued El-Kebir river, to 1,202 m a.s.l. at Mount El-Ghorra. KBR is characterized by a Mediterranean climate, with dry hot summers followed by wet warm winters. According to climatic data for 2005–2015, the minimum mean monthly temperature is 10 °C in February, whereas the maximum mean is 25 °C in July. Average total annual precipitation is 656 mm, with four months having precipitation < 30 mm (WorldClim, 2.0; Fick & Hijmans, 2017). Geology of KBR is characterized by two formations: the Quaternary, mainly represented by marine and river deposits, and the Miocene, including conglomerate sands and red clays, concentrated in the southeastern portion of the area (Joleaud 1936). Soils in the KBR are mainly brown washed with a variant of forest humus mull acidic Moder (Joleaud 1936).

Black alder forests of KBR have been widely altered by human activities (*e.g.*, cutting, burning, draining and/or dumping); since that region is immediately close to the sea, those related to tourism and leisure prevail. Thus, being a region with an agricultural vocation, other activities contribute to the disturbance of these areas (*i.e.*, the use of pesticides and the clearing of areas for agriculture).

Vegetation sampling. In order to investigate the floristic composition and spatial patterns of plant species assemblages in alder forests, surveys were conducted between 2016 and 2017 during the peak of vegetation development (spring and summer) (Ozenda 1982). During this time, 28 localities were sampled, which were representative of the three main substrates, *i.e.*, fluvial (Fl), swampy (Sw), and sandy (Sa).

The relevé method developed by the Zürich–Montpellier school for field vegetation studies (Braun-Blanquet 1964) was applied, by using at least the minimum area recommended for these vegetation types (16 m² for marshland vegetation, and 400 m² for species-poor forests). We collected species when encountered for the first time or whenever there was uncertainty on their identity. Specimens were identified using Quézel & Santa (1962).

The checklist of botanical families and species was organized alphabetically. Taxonomy and nomenclature follow the classification accepted by THE PLANT LIST database (The Plant List 2013), which is based on the APG III classification system for Angiosperms (APG III 2009). The updating and standardizing of species taxonomy and nomenclature according to APG III (2009) were guaranteed by

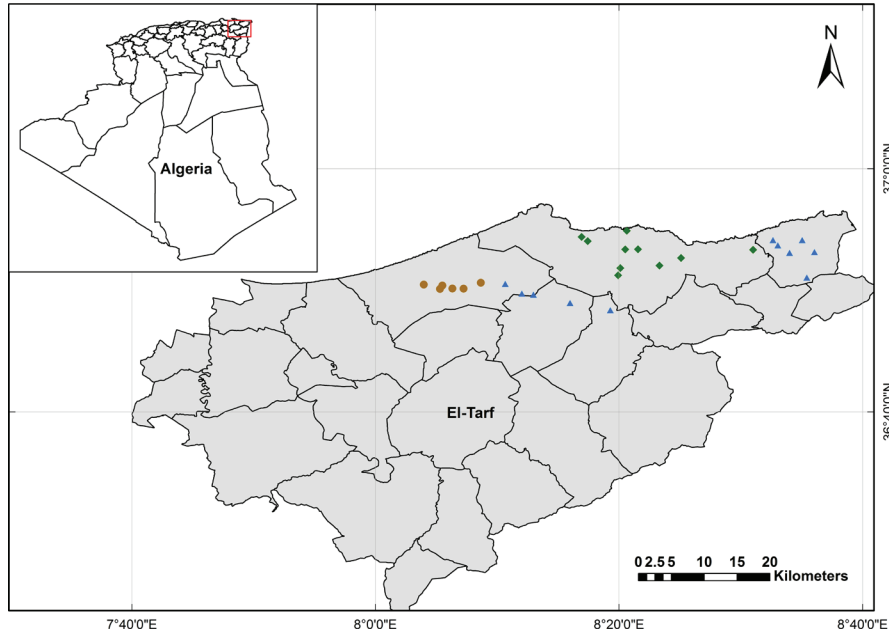


Figure 1. Map showing the location of El-Kala Biosphere Reserve (KBR) in northeastern Algeria (Projection system: GCS WGS 1984, coordinates in decimal degrees). Blue triangles indicate the exact location of fluvial sites (Fl), green polygons indicate swampy sites (Sw) and brown circles indicate sandy sites (Sa).

using the Taxonomic Name Resolution Service v4.0 program (TNRS 2016). Species life forms were assigned based on Whittaker's (1975) classification system, a modified version of Raunkiaer's (1934) original classification scheme, which includes the following categories: helophytes (He), amphiphytes (Am), phanerophytes (Ph), hemicryptophytes (Hec), therophytes (Th), geophytes (G), hydrophytes (Hy), chamaephytes (Ch), and epiphytes (Ep).

Soil sampling. Soil samples were obtained with 5 cm diameter cores taken from three points at each site. The soil was sampled to a depth of 25 cm. The three replicate samples were homogenized by hand mixing; large material (roots, stems, and pebbles) were hand-picked and discarded. Soil samples were air-dried and sieved with a 2 mm mesh for laboratory analyses. Soil analyses included determination of organic matter (OM) using incineration method, and pH electrical conductivity (EC) based on a 1:5 soil-water solution using pH/conductivity meter. Next, Practical Salinity (PS) was obtained from EC, according to Fofonoff & Millard (1983). In addition, total lime (TL) was determined using the titration method called 'calcimétrie de Bernard' (Fichaut 1989).

Data analyses. Plant diversity was evaluated using species richness (SR), defined as the total number of identified species (Magurran 2004). Further, percent relative richness (RR) was calculated for each family as the number of species contained in that family divided by the total number of species (SR). Occurrence frequency (Occ) was calculated for each species as the number of plots in which the species was recorded divided by the total number of sampled plots

(Magurran 2004). Bigot & Bodot (1973) distinguished four species groups according to their occurrences: very accidental species (Vac), with occurrence > 12.5 %; accidental species (Acc), with occurrence varying between 12.5 and 24 %; common species (Cmn), which occur in 25-49 % of records; and constant species (Cst), which are present in 50 % or more of the samples.

Accumulation curves were drawn to evaluate sampling efficiency and to envisage if plant species from the three habitat types (Fl, Sw, Sa) were well represented and could be used for reasonable and significant assessments (Chao & Chiu 2016). For all rarefaction/extrapolation (R/E) curves, we used 500 replicate bootstrapping runs to estimate 95 % confidence intervals, using the "iNEXT" package (Hsieh *et al.* 2016) in R version 3.4.0 (R Core Team 2017). Accumulation curves were calculated using EstimateS software version 9.1.0 (Colwell 2013).

Soil parameters were compared among the three habitat types through linear mixed effects models (LMMs). Diagnostic quantile-quantile plots, used to examine the appropriateness of the models, revealed a good fit of the data to a normal distribution. Response variables were soil properties, habitat as taken as a fixed effect, whereas Season was declared as a random effect. We also used Tukey contrasts for LMMs for post-hoc comparisons of the different habitat types. These analyses were performed using the 'lmer' function of the lme4 package version 1.1-12 (Bates *et al.* 2015), and the 'glht' function of the multcomp package (Hothorn *et al.* 2013) in R.

Multiple linear regression analyses were used to determine the signs of the relationships between species richness (SR)

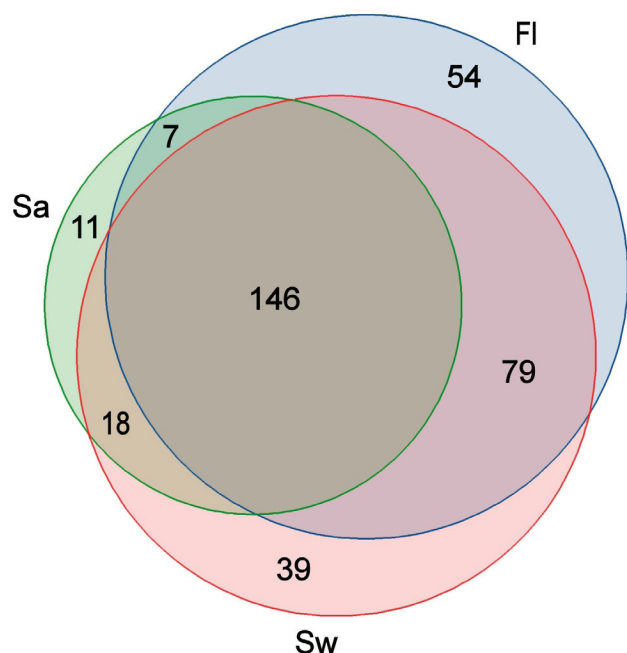


Figure 2. Venn diagram showing the distribution of species richness among the three habitat types. Each circle represents a habitat type (Fl, Fluvial; Sw, Swampy; Sa, Sandy).

and soil characteristics (OM, EC, pH, PS, TL). Analysis of variance for regression was used to assess significance (Kozak *et al.* 2008). Next, Non-metric Multidimensional Scaling (NMDS) was used to set up the spatial pattern in the scattergram. The ordination was fitted using the metaMDS function with Jaccard distances and two dimensions in the vegan package in R (Oksanen *et al.* 2017). Finally, to evaluate whether species were associated with particular habitats, and

thus if they could be considered as indicators of such habitats, we performed an indicator value analysis (Dufrene & Legendre 1997) using the “labdsv” package (Roberts 2016) in R. Taxa were considered good indicators if the indicator value was ± 0.25 (Dufrene & Legendre 1997).

Results

Floristic composition. In total, we identified 354 species belonging to 238 genera and 89 families (Appendix 1). Poaceae (35 species), Fabaceae (31), Cyperaceae (24), Asteraceae (24), Caryophyllaceae (13), Ranunculaceae (13), Lamiaceae (12), Brassicaceae (11), Juncaceae (11), Plantaginaceae (10), and Apiaceae (9) were the most species-rich families, accounting together for 54.51 % of the total species richness. Fifty-four species were exclusive of fluvial sites (Fl), 39 of swampy sites (Sw), and 11 species of sandy sites (Sa); Fl and Sw shared 79 species, Sa and Sw shared 18 species, whilst Sa and Fl shared only seven species (Figure 2). Notably, 146 species occurred in all three habitat types.

Overall, the most species-rich genera were *Carex* (11 species), *Juncus* (10), *Ranunculus* (10), *Trifolium* (9), *Vicia* (5), *Cyperus* (4), *Euphorbia* (4), *Plantago* (4), *Persicaria* (4) and *Silene* (4), accounting together for 18.36 % of all species. Amongst the inventoried species only 13 (3 %) were endemic to North Africa, and two species were endemic to the study region (*Hypericum afrum* (Desf.) Lam. and *Solenopsis laurentia* (L.) C. Presl.).

Life form distribution. Therophytes were the most common life form (127 species, 35.88 %), while 98 species (27.68 %) were Hemicryptophytes, 52 (14.69 %) Phanerophytes, 20 (5.65 %) Geophytes, 19 (5.37 %) Helophytes, 17 (4.80 %) Hydrophytes, 11 (3.11 %) Chamaephytes, and 8 (2.26 %) were Amphiphytes (Figure 3). Bryophytes and Epiphytes were represented by one species only.

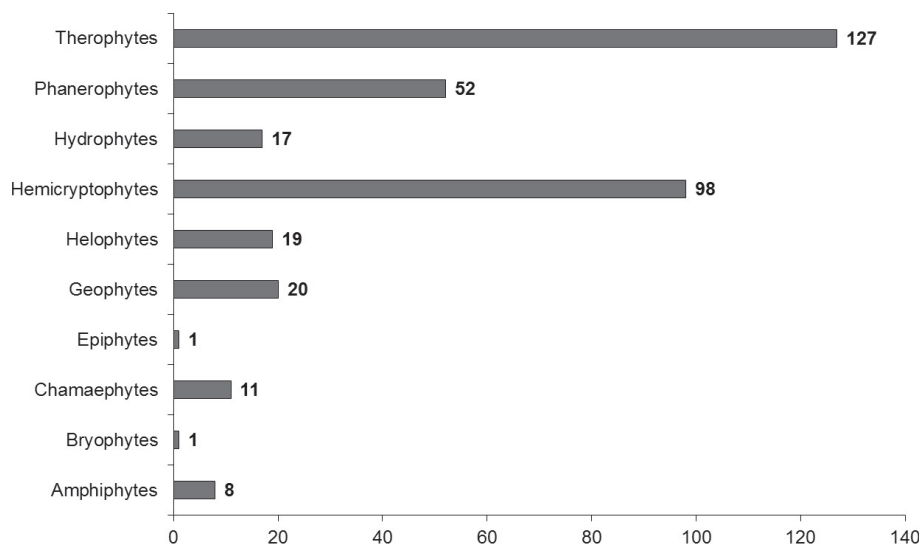


Figure 3. Life form frequency distribution in the flora recorded in the El-Kala Biosphere Reserve, northeastern Algeria.

Diversity and similarity. Species rarefaction curves revealed that the mean observed species richness was highest in fluvial and swampy sites, in contrast with sandy sites (Figure 4a), with 285, 282 and 182 species, respectively (Table 1). There was a strong overlap between fluvial and swampy sites, whilst sandy sites stood out for not having any floristic overlap with the other habitat types (Figure 4A, Table 1).

Figures 4B and 4C show that only four sampling units were necessary to reach 80 % of the estimated species richness for the sandy and swampy habitats, while five were required for the fluvial one.

The ordination based on species presence/absence achieved a stable two dimension solution (stress = 0.154) and enabled us to plot different habitats in a two-dimensional space (Figure 5). Sandy sites were quite homogeneous, concentrated together and visibly separated from the other habitats. Swampy sites were separated from the other habitats

with high heterogeneity and some level of overlapping with the fluvial ones. Finally, fluvial sites were instead poorly clustered and scattered among the others (Figure 5).

Relation of diversity to environmental factors. Variation in soil properties among the three habitat types was tested using Tukey contrasts for linear mixed models (LMMs). Soil pH differed significantly among habitat types ($\chi^2 = 9.9941$; $df = 2$; $P = 0.006$). Tukey tests revealed that soil pH differs significantly between swampy and fluvial sites, on one hand, and between swampy and sandy sites, on the other (Figure 6A). Soil organic matter (MO) was highly different among the three habitat types ($\chi^2 = 2498.4$; $df = 2$; $P < 0.001$). Post-hoc analysis showed that OM was highly different among the three habitat types (Fl-Sw, Sw-Sa, Fl-Sa; Figure 6B), in contrast with the other soil parameters, which showed homogeneity among habitats.

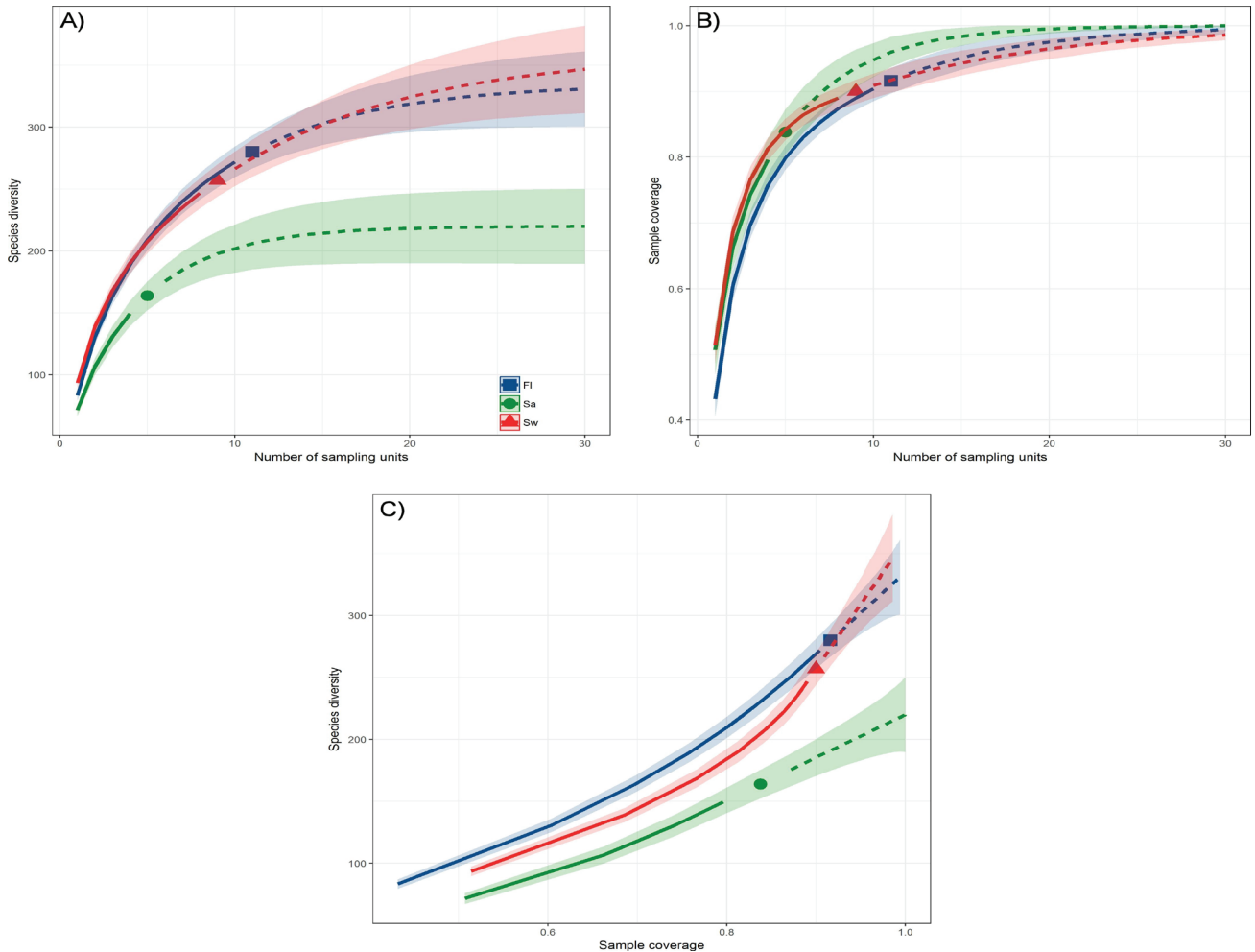


Figure 4. A. Sample-based rarefaction and extrapolation for plant species richness. B. Sample coverage as a function of sample size. C. Coverage-based rarefaction and extrapolation for plant species richness. Number of sampling units indicates the cumulative number of plots. Continuous and discontinuous lines in all panels represent rarefaction and extrapolation, respectively; the shaded areas represent the 95 % confidence interval. Fl, Fluvial sites; Sw, Swampy sites; Sa, Sandy sites.

Table 1. Summary of plant diversity at each habitat type (Fl = Fluvial; Sw = Swampy; Sa = Sandy, CI = Confidence interval, SD = Standard deviation).

	Fl	Sw	Sa
S(est) Mean $\pm$ SD	285 $\pm$ 5.85	282 $\pm$ 8.94	182 $\pm$ 7.59
95% CI Lower Bound	273.54	264.48	167.12
95% CI Upper Bound	296.46	299.52	196.88
Chao 2 Mean $\pm$ SD	323.82 $\pm$ 11.77	393.47 $\pm$ 29.91	266.42 $\pm$ 25.25
95% CI Lower Bound	306.7	348.48	229.57
95% CI Upper Bound	354.44	468.9	331.84
Jack 1 Mean $\pm$ SD	355.58 $\pm$ 18.59	373.8 $\pm$ 19.75	251.17 $\pm$ 8.11
Jack 2 Mean	366.72	425.53	288.37
Bootstrap Mean	321.07	323.05	213.18

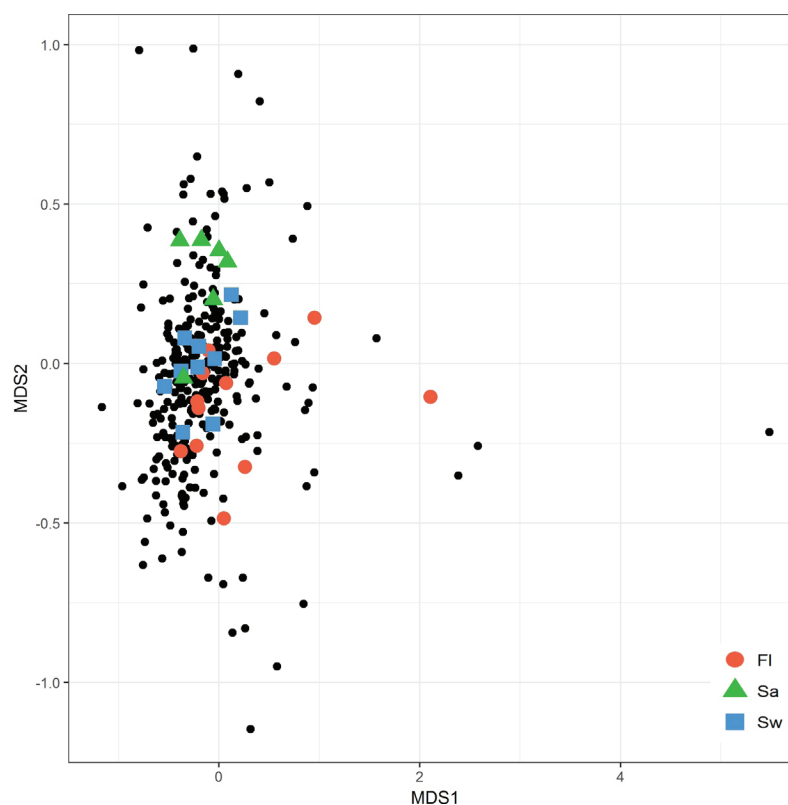
Multiple linear regression analyses showed no linear relationships between species richness and soil parameters, except for OM ($P = 0.013$) (Table 2). ANOVA results confirmed this results, as significant variation in species richness was observed in relation to OM, but not with the four other parameters, namely pH, TL, EC, and PS (Table 3).

Indicator species analysis. Ten plant species were highly (indicator value > 0.25) and significantly ($P < 0.05$) indica-

tive of the three habitat types in the total dataset (Table 4). Among them, five were indicators of swampy sites, three more were indicators of the sandy habitat, and only two species were indicators of fluvial sites.

Discussion

Through this investigation, we were able to produce a substantial checklist of the vascular flora occurring in alder forests of

**Figure 5.** Non-metric multidimensional scaling ordination (NMDS) biplot of habitat (color figures) and species (black dots). FI, Fluvial sites; Sw, Swampy sites; Sa, Sandy sites.

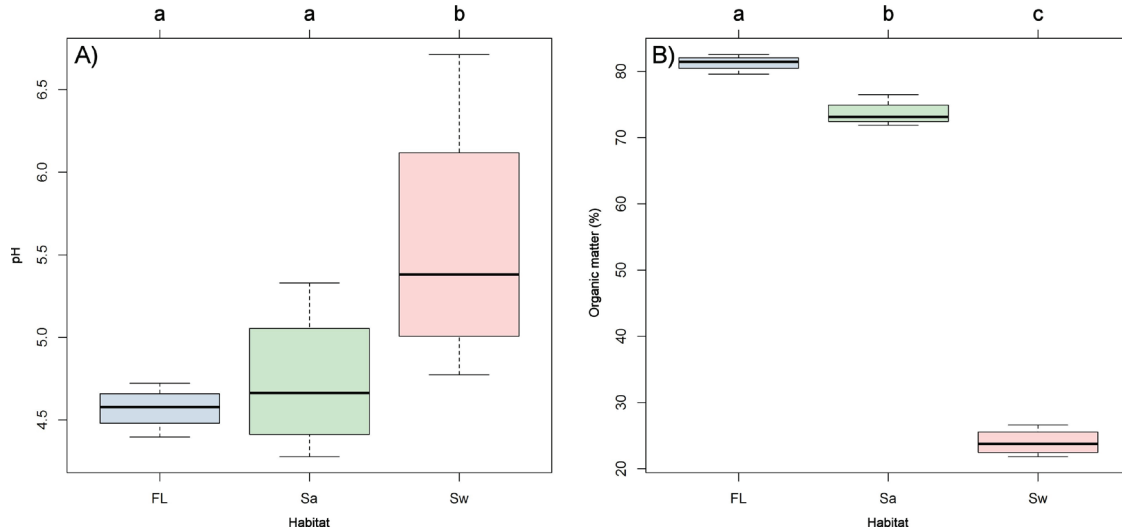


Figure 6. A. Box-plots of variation in pH and B. Organic matter ($\pm$ 95 % CI) in the three sampled habitats. The letters indicate the statistical groupings (Tukey's post-hoc tests); box-plots with the same letter are not significantly different.

KBR. This checklist contributes to our understanding of those species that can thrive in these forest type, which characteristically become flooded for a long time every year, thus representing one of the exceptional wetlands in North Africa.

According to Quézel (1978), the most diverse families represented in the Mediterranean North African flora are Poaceae, Fabaceae, Cyperaceae, Asteraceae, Juncaceae, Ranunculaceae, and Brassicaceae, and our results agree with this statement. However, a noticeable discrepancy arises when comparing our study with that of Ghahreman *et al.* (2006), conducted in the northeastern Mediterranean region (Caspian lowlands), in which they report Rosaceae, Papilionaceae, Asteraceae, Cyperaceae, Brassicaceae, Lamiaceae, Scrophulariaceae, Apiaceae, Ranunculaceae, Aspidiaceae, Polygonaceae, and Liliaceae as the families having the largest species richness. Moreover, in terms of genera our results also differ from those reported by the same study, in which Asteraceae (11 genera), Poaceae (10 genera), Rosaceae (9 genera), Lamiaceae (8 genera), Apiaceae (5 genera) and Liliaceae (5 genera) were reported to be the best-represented families, and Carex (9 species), Rubus (6), Cardamine (5), Ranunculus (5), Veronica (5), Polystichum (4), Dryopteris (3), Equisetum (3), Geranium (3), Poa (3), and Solanum (3)

were listed as the most speciose genera in alder forests. In turn, Bensettiti (1995) stated that the high abundance of Poaceae and Cyperaceae in alder forests reflects the degradation of some parts of these habitats into marshy prairies.

The life form spectrum of the KBR flora, dominated by therophytes, characteristically reflects the influence of the Mediterranean bioclimate (Medjahdi *et al.* 2009). Raunkiaer (1934) defined the Mediterranean climate type as a 'therophyte climate' (as therophytes are plants that remain in the soil as seeds during a certain period, whereas the vegetative parts are annual). This definition is based on the fact that all species with this life form account for over 50 % of the Mediterranean flora (Raven 1971). This proposition of Raunkiaer was confirmed by Cain (1950) in California, and by Quézel (1978) in North Africa. Nonetheless, this generalization was refuted in Chile, the Cape Region of South Africa and South Western Australia, where therophytes are normally absent and only appear in the immediate post-fire periods or after abundant rains (Blondel & Aronson 1995). In northeastern Mediterranean alder forests (Caspian lowlands), Ghahreman *et al.* (2006) found that geophytes were the dominant life form, accounting for 30 % of studied flora, followed by phanerophytes (22 %), therophytes (21 %), hemicryptophytes

Table 2. Multiple linear regression models used to test the dependence of diversity variables on environmental variables.

Diversity measure	Independent variables	Estimate	SE	<i>t</i>	<i>F</i>	<i>R</i> ² _{adj}
Species richness	EC	-17,577.715	21,592.463	0.424	0.08	0.180
	pH	-571.11	299.307	0.069		
	TL	-134.385	166.441	0.428		
	MO	-13.462	5.021	0.013		
	PS	43,944.74	48,410.323	0.373		

Table 3. ANOVA results of the multiple linear regression

Diversity measure	Independent variables	Mean $\pm$ SE	df	Sum sq	Mean sq	F	P
Species richness	EC	0.491 $\pm$ 0.006	1	170	169.9	0.049	0.826
	pH	4.95 $\pm$ 0.088	1	12,761	12,760.8	3.697	0.067
	TL	2.568 $\pm$ 0.072	1	35	34.9	0.010	0.920
	MO	59.187 $\pm$ 5.083	1	23,145	23,144.9	6.705	0.016
	PS	0.214 $\pm$ 0.003	1	2,844	2,844.4	0.824	0.373
	Residuals		22	75,941	3,451.9		

(17 %), hydrophytes (9 %), and chamaephytes (1 %). Usually, the high incidence of therophytes in plant communities is a result of increasing aridity (Barbero *et al.* 1989), and as in the present study, therophytes were the most common life form; their ample presence can be attributed to the habitats characterized by seasonal immersion/flooding, which are favorable to the development of annual plants capable of germinating and growing faster under harsh conditions (Hammada *et al.* 2004). Therefore, and due to their low ecological requirements, therophytes inhabit numerous habitats types (Gomaa 2012). In addition, the therophyte life form represents the eventual phase of degradation in xeric habitats, as it is frequently linked to environmental perturbations by grazing (Quézel 2000). The high rate of hemicryptophytes in all habitats is typical for pasture flora (Vitasović-Kosić & Britvec 2007). In turn, the low percentage of chamaephytes in alder forests reflects the low light intensity in the understory and the occurrence of long flood periods in these habitats (Thomas 1975).

According to the NMDS results, we were able to classify our study sites into two major groups, namely the marshy and the hilly (swampy-sandy) black alder forests, and the fluvial forests, in relation to plant species richness. This result is not surprising since Thomas (1975) had already shown that this dichotomy is the result of differences in the

length of the flood period (seven to twelve months for hilly and marshy forests, whilst inundation only occurs during the flood season in fluvial alder forests), water level and light intensity. The spatial arrangement of the vegetation in this type of wetlands is not accidental; rather, it is the result of the interaction of numerous ecological factors, including abiotic, biotic, or anthropogenic (Alvarez-Rogel *et al.* 2007, Minggagud & Yang 2013).

Soil supply levels are important variables for plant diversity and community structure. Some features of plant community organization, such as composition and diversity of plant functional types, also affect plant productivity, maintenance, and soil fertility (Tilman *et al.* 1996). Soil pH is a relevant factor for plant development; it affects nutrient availability, toxicity, and microbial activity, and it exerts a direct effect on the protoplasm of plant root cells (Larcher 1980, Marschner 1986). Gould & Walker (1999) found a correlation between plant richness and pH; in their model, species richness declined when soil pH was at its acidic and alkaline extremes, which may be related to the nutrient availability and toxicity. In acidic soils, Al³⁺, Cu²⁺, Fe³⁺, Mn²⁺ ions increase to toxic levels for the bulk of plant species (Wolf 2000). Alkaline soils (pH > 8) have a tendency to be poor in Zn, Fe, Cu, K and Mn (Marschner 1986). Different plant species may not be as adaptable and thus they could need a narrow range of pH to live (Leskiw 1998). There is evidence that forest soils must be somewhat acidic for the nutrient resource to be stable (Leskiw 1998); yet, this does not seem to be the case in the present study, as no significant relationship was found between soil pH and richness.

Our study revealed a significant effect of soil organic matter on species richness. Soil organic matter contributes to soil fertility by providing nutrients and increasing both cation exchange and water holding capacity (Brady & Weil 1999). Few species can tolerate nutrient deficiency (Austin 2002). As resource availability increases, more species can persist and henceforth species richness increases.

The study of the vegetation of black alder forests in KBR allowed us to produce a more complete inventory of the plant community, and to better understand the distribution of vegetation across the area, as well as to identify those factors that affect its zonation. For this ecosystem, our study revealed a vegetation of relatively high diversity that is related to the variation of soil parameters. Black alder forests of KBR are predominantly disturbed by human activities, especially

Table 4. Plant species with a significant indicator value at El-Kala Biosphere Reserve, northeastern Algeria. Habitat type abbreviations as in Table 2.

Species	Habitat type	Indicator value	P
<i>Stellaria media</i>	Fl	0.416	0.009
<i>Rosa sempervirens</i>	Fl	0.416	0.014
<i>Cotula coronopifolia</i>	Sw	0.578	0.007
<i>Genista ferox</i>	Sw	0.469	0.013
<i>Anthoxanthum odoratum</i>	Sw	0.423	0.023
<i>Fumaria capreolata</i>	Sw	0.375	0.047
<i>Clematis cirrhosa</i>	Sw	0.300	0.043
<i>Vicia narbonensis</i>	Sa	0.476	0.017
<i>Dipsacus fullonum</i>	Sa	0.416	0.020
<i>Raphanus raphanistrum</i>	Sa	0.365	0.048

those related to tourism and leisure (e.g., cutting, burning, draining and/or dumping), which explains the degradation state of the ecosystem. Hence, more conservation efforts focused on these habitats should be made, supplemented with quantitative studies, in order to reduce anthropic activities and their impacts on the El-Kala Biosphere Reserve.

Acknowledgements

We would like to thank the team of the Laboratory of Functional and Evolutionary Ecology, University of Chadli Bendjedid (El Tarf, Algeria), for their support in specimen processing. We also thank Professor Jorge A. Meave (Plant Ecology and Diversity Group, UNAM), for its helpful comments on the manuscript. We also thank two anonymous referees for the English edition review. Authors also thank Dr. Idriss Bouam for his assistance in statistical analyses. This research received no specific grant from any funding agency.

Literature cited

- Álvarez-Rogel J, Jiménez-Cárceles FJ, Roca MJ, Ortiz R. 2007. Changes in soils and vegetation in a Mediterranean coastal salt marsh impacted by human activities. *Estuarine Coastal and Shelf Science* **73**: 510-526.
DOI: <http://doi.org/10.1016/j.ecss.2007.02.018>
- APG III [Angiosperm Phylogeny Group III]. 2009. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III. *Botanical Journal of the Linnean Society* **161**: 105-121.
DOI: <http://doi.org/10.1111/j.1095-8339.2009.00996.x>
- Austin MP. 2002. Spatial prediction of species distribution: an interface between ecological theory and statistical modelling. *Ecological Modelling* **157**: 101-118.
DOI: [http://doi.org/10.1016/S0304-3800\(02\)00205-3](http://doi.org/10.1016/S0304-3800(02)00205-3)
- Barbero M, Bonin G, Loisel R, Quézezel P. 1989. *Sclerophyllous Quercus* forests of the Mediterranean area: Ecological and ethological significance. *Bielefelder Ökologische Beiträge* **4**: 1-23.
- Bates D, Maechler M, Bolker B, Walker S. 2015. Fitting linear mixed-effects models using lme4. *Journal of Statistical Software* **67**: 1-48. DOI: <http://doi.org/10.18637/jss.v067.i01>
- Belouahem D, Belouahem F, Benslama M, Bélair G, Muller SD. 2011. Alder forests of Numidia (N.E. Algeria): Floristic biodiversity, vulnerability and conservation. *Compte Rendues Biologies* **334**: 61-73.
DOI: <http://doi.org/10.1016/j.crv.2010.10.005>
- Bensettiti F, Lacoste A. 1999. Les ripisylves du Nord de l'Algérie Essai de synthèse synsystématique à l'échelle de la Méditerranée occidentale. *Ecologia Mediterranea* **25**: 13-39. available online in: https://ecologia-mediterranea.univ-avignon.fr/wp-content/uploads/sites/25/2017/07/Ecologia_mediterranea_1999-25_1_01.pdf (Accessed: July 2016).
- Bensettiti F. 1995. *Contribution à l'étude phytosociologique des ripisylves du Nord de l'Algérie. Essai de synthèse à l'échelle de la Méditerranée occidentale*. PhD.Thesis Univ. de Paris-Sud Centre Orsay.
- Bensimon C. 1985. Male sterility in *Alnus glutinosa* (L.) Gaertn. *Silvae Genetica* **34**: 69-72.
- Bigot L, Bodot P. 1973. Contribution à l'étude biocénotique de la garrigue à *Quercus coccifera* – Composition biotique du peuplement des invertébrés. *Vie et Milieu* **23**: 229-249.
- Blondel J, Aronson J. 1995. Biodiversity and ecosystem function in the Mediterranean basin. In: Davis GW, Richardson DM. (eds.). *Human and non-human determinants in Mediterranean type ecosystems. The function of biodiversity*. Berlin: Springer-Verlag, 45-119.
DOI: http://doi.org/10.1007/978-3-642-78881-9_2
- Brady NC, Weil RR. 1999. *The Nature and Properties of Soils*. London: Prentice Hall Publishers. ISBN-13: 978-0133254488.
- Braun-Blanquet J. 1964. *Pflanzensoziologie*. 3. Aufl. Wien-New York: Springer Verlag.
- Cain SA. 1950. Life-forms and phytoclimate. *Botanical Review* **16**: 1-32.
- Claessens H. 2003. The alder populations of Europe. *Forestry Commission Bulletin* **126**: 5-14.
- Colwell R. 2013. EstimateS: Statistical estimation of species richness and shared species from samples. Version 9.1.0. Available at <http://purl.oclc.org/estimates> (Accessed: July 2016).
- Dufrene M, Legendre P. 1997. Species assemblages and indicator species, the needs for a flexible asymmetrical approach. *Ecological Monographs* **67**: 345-366.
DOI: [http://doi.org/10.1890/0012-9615\(1997\)067%5b0345:SAAIST%5d2.0.CO;2](http://doi.org/10.1890/0012-9615(1997)067%5b0345:SAAIST%5d2.0.CO;2)
- Dussart G. 1999. The ecological implications of loss of alder trees. Consolidates Progress Report of the EU Concerted Action, FAIR5-CT97-3615.
- Fichaut B. 1989. Morphosédimentologie de la partie occidentale de la rade de Brest. *Norvès* **144**: 377-390
- Fick, S.E. and R.J. Hijmans, 2017. Worldclim 2: New 1-km spatial resolution climate surfaces for global land areas. *International Journal of Climatology*. WorldClim 1.4 (current conditions) by www.worldclim.org (Accessed: July 2016).
- Fofonoff NP, Millard RC. 1983. Algorithms for Computation of Fundamental Properties of Seawater. *Technical Papers in Marine Science (UNESCO)* **44**: 53
- Géhu JM, Kâabeche RM, Gharzouli. 1994. L'aulnaie glutineuse de la région d'El Kala (la Calle), Annaba, Algérie: une remarquable irradiation biogéographique européenne en Afrique du Nord. *Fitosociologia* **27**: 67-71.
- Ghahraeman A, Naqinezhad AR, Hamzeh'ee B, Attar F, Assadi M. 2006. The flora of threatened black alder forests in the Caspian lowlands, northern Iran. *Rostaniha* **7**: 5-30.
- Gomaa NH. 2012. Composition and diversity of weed communities in Al-Jouf province, northern Saudi Arabia. *Saudi Journal of Biological Sciences* **19**: 369-376.
DOI: <http://doi.org/10.1016/j.sjbs.2012.05.002>
- Gould WA, Walker MD. 1999. Plant communities and landscape diversity along a Canadian Arctic river. *Journal of Vegetation Science* **10**: 537-548. DOI: <http://doi.org/10.2307/3237188>
- Hammada S, Dakki M, Tattou MI, Ouyahya S, Fennane M. 2004. Analyse de la biodiversité floristique des zones humides du Maroc - Flore rare, menacée et halophile. *Acta Botanica Malacitana* **29**: 43-66.

- Hothorn T, Bretz F, Westfall P, Heiberger RM & Schuetzenmeister A. 2013. Simultaneous Inference in General Parametric Models. R Package Version 1.3- 1. <<http://cran.r-project.org/web/packages/multcomp>> (Accessed: July 2016).
- Hsieh TC, Ma KH, Chao A. 2016. iNEXT: an R package for rarefaction interpolation and extrapolation for species diversity (Hill numbers). *Methods in Ecology and Evolution*. 7: 1451-1456. DOI: <http://doi.org/10.1111/2041-210X.12613>
- Jalas J, Suominen J. 1976. Atlas Florae Europaeae; 3: Salicaceae to Balanophoraceae. Helsinki. ISBN: 951-9108-02-5.
- Joleaud L. 1936. Etude géologique de la région de Bône et de la Calle. *Bulletin du service de la Carte géologique d'Algérie Imp.* Algiers.
- Kajba D, Gracan J. 2003. EUFORGEN Technical Guidelines for genetic conservation and use for Black Alder (*Alnus glutinosa*). Rome: International Plant Genetic Resources Institute.
- Kozak A, Kozak R A, Staudhammer CL, Watts SB. 2008. Introductory Probability & Statistics: Applications for Forestry & the Natural Sciences. Cambridge, UK: Cambridge University Press. ISBN-13: 978-1780640518
- Larcher W. 1980. *Physiological Plant Ecology*. New York: Springer-Verlag. ISBN 978-3-540-43516-7
- Leskiw LA. 1998. Land capability classification for forest ecosystems in the oil sands region. Alberta: Cumulative environmental Management Association. Fort McMurray.
- Magurran AE. 2004. *Measuring biological diversity*. Oxford: Wiley-Blackwell. ISBN: 9780632056330
- Marschner H. 1986. *Mineral nutrition of higher plants*. London: Academic Press. ISBN 9780124735408
- Medjahdi B, Tattou MI, Barkat D, Benabdelli K. 2009. La flore vasculaire des monts de Trara (Nord-Ouest algérien). *Acta Botanica Malacitana* 34: 57-75.
- Minggagud H, Yang J. 2013. Wetland plant species diversity in sandy land of a semi-arid inland region of China. *Plant Biosystems* 147: 25-32. DOI: <http://doi.org/10.1080/11263504.2012.737865>
- Morgan NC. 1982. An ecological survey of standing waters in North West Africa: II. Site descriptions of Tunisia and Algeria. *Biological Conservation* 24: 83-113. DOI: [http://doi.org/10.1016/0006-3207\(82\)90062-3](http://doi.org/10.1016/0006-3207(82)90062-3)
- Oksanen J, Blanchet FG, Friendly M, Kindt R, Legendre P, McGlinn D, Minchin PR, O'Hara RB, Simpson GL, Solymos P, Stevens MHH, Szoecs E, Wagner H. 2017. vegan: community ecology package. R package version 2.4-3. Available at: <https://cran.r-project.org/web/packages/vegan/index.html>
- Ozenda P. 1982. *Les végétaux dans la biosphère*. Paris: Doin. ISBN-13: 978-2704003990
- Piégay H, Pautou G, Ruffioni C. 2003. *Les forêts riveraines des cours d'eau. Ecologie, fonctions et gestion*. Paris: Institut pour le développement forestier.
- Pinay G, Labroue L. 1986. Une station d'épuration naturelle des nitrates transportés par les nappes alluviales: l'aulnaie glutineuse. Paris: *Comptes rendus de l'Académie des Sciences*.
- Quézel P. 2000. *Réflexions sur l'évolution de la flore et de la végétation au Maghreb méditerranéen*. Paris: Ibis Press.
- Quézel P, Santa S. 1962. Nouvelle Flore de l'Algérie et des régions méridionales I, II. Paris : CNRS.
- Quézel P. 1978. Analysis of the flora of Mediterranean and Saharan Africa. *Annals of the Missouri Botanical Garden* 65: 479-534. DOI: <http://doi.org/10.2307/2398860>
- R Core Team. 2017. R: A language and environment for statistical computing. R Foundation for Statistical Computing <<https://cran.r-project.org>>
- Raunkiaer CC, Fausbøll AI, Gilvert-Carter H, Tansley AG. 1934. *The life forms of plants and statistical plant geography. being the collected papers of C. Raunkiaer* Oxford: Clarendon press.
- Raven P. 1971. Relationships between Mediterranean floras. In: Davis PH, Harper PC, Hedge IC. (eds.). *Plant life in south-west Asia*. Edinburgh: Botanical Society of Edinburgh.
- Roberts DW. 2016. labdsv: ordination and multivariate analysis for ecology. R package version 1.8-0. <<http://ecology.msu.montana.edu/labdsv/R/>> (Accessed: July 2016).
- Schnitzler-Lenoble, A, Carbiener R. 1993. Les forêts galeries d'Europe. *La Recherche* 255: 694-700.
- Shaw K, Roy S, Wilson B. 2014. *Alnus glutinosa*, common Alder In: The IUCN Red List of Threatened Species 2014: e.T63517A3125479. DOI: <http://doi.org/10.2305/IUCN.UK.2014-3.RLTS.T63517A3125479.en>.
- The Plant List. 2013. The Plant List. A working list of all plant species. Version 1.1. <<http://www.theplantlist.org/>> (Accessed: July 2016).
- Thomas JP. 1975. *Ecologie et dynamisme de la végétation des dunes littorales et des terrasses sableuses quaternaires de Jijel à El Kala (Est algérien)*. BSc. Thesis. Montpellier. Université des Sciences et Techniques de Montpellier.
- Tilman D, Wedin D, Knops J. 1996. Productivity and sustainability influenced by biodiversity in grassland ecosystems. *Nature*. 379: 718-720. DOI: <http://doi.org/10.1038/379718a0>
- TNRS [Taxonomic Name Resolution Service]. 2016. *Taxonomic Name Resolution Service V. 4.0*. iPlant collaborative. <<http://tnrs.iplantcollaborative.org>> (accessed August, 2014).
- Vitasović-Kosić I, Britvec M. 2007. Plant Diversity of Pastures on the Family Farms in the Southern Part of Istria (Croatia). *Agriculturae Conspectus Scientificus*. 72: 141-147.
- Whittaker RH. 1975. *Communities and ecosystems*. New York: MacMillan. ISBN-13: 978-0024273901
- Wolf B. 2000. The fertile triangle. The interrelationship of air, water, and nutrients in maximizing soil productivity. New York: Food Products Press. ISBN-13: 978-1560228783

Associated editor: Salvador Arias

Author Contributions: AT conceived the ideas, designed the methodology and reviewed the draft; AN led the writing for the manuscript, carried out fieldwork and analyzed the data; DB-A and MS helped in fieldwork. All authors contributed critically to the drafts and gave final approval for publications.

Appendix 1. Systematic list of plant species inventoried in the El-Kala Biosphere Reserve (northeastern Algeria), along with their life form, frequency of occurrence (Occ) and scale of occurrence (Occ scale) (Acc: Accidental, Cmn: Common, Cst: Constant, Vac: very accidental). Life forms: He, Helophyte; Am, Amphiphyte; Ph, Phanerophyte; Hec, Hemicryptophyte; Th, Therophyte; G, Geophyte; Hy, Hydrophyte; Ch, Chamaephyte; Ep, Epiphyte.

Family (RA %) Species	Life form	Occ (%)	Occ scale
Acanthaceae (0.28)			
<i>Acanthus mollis</i> L.	He	7.1	Vac
Alismataceae (0.56)			
<i>Alisma plantago-aquatica</i> L.	Am	75	Cst
<i>Baldellia ranunculoides</i> Parl.	Am	10.7	Vac
Alliaceae (0.28)			
<i>Allium triquetrum</i> L.	He	78.6	Cst
Amaranthaceae (0.56)			
<i>Alternanthera sessilis</i> (L.) DC.	He	39.3	Cmn
<i>Amaranthus graecizans</i> L. subsp. <i>sylvestris</i> (Vill.) Asch.	Am	7.1	Vac
Anacardiaceae (0.28)			
<i>Pistacia lentiscus</i> L.	Ph	35.7	Cmn
Apiaceae (2.54)			
<i>Apium crassipes</i> Rchb.f.	Am	14.3	Acc
<i>Apium nodiflorum</i> (L.) Lag.	Am	78.6	Cst
<i>Daucus carota</i> L. subsp. <i>maritimus</i> Batt.	Hec	28.6	Cmn
<i>Daucus carota</i> L. subsp. <i>maximus</i> (Desf.) Ball.	He	60.7	Cst
<i>Daucus virgatus</i> (Poir.) Maire	Hec	17.9	Acc
<i>Eryngium barrelieri</i> Boiss.	He	3.6	Vac
<i>Oenanthe globulosa</i> L.	Hc	3.6	Vac
<i>Torilis arvensis</i> (Huds) Link.	Th	3.6	Vac
<i>Torilis nodosa</i> (L.) Gaertn.	Th	3.6	Vac
Apocynaceae (0.28)			
<i>Nerium oleander</i> L.	Ph	39.3	Cmn
Araceae (1.41)			
<i>Arum italicum</i> Mill.	G	14.3	Acc
<i>Arisarum vulgare</i> O. Targ. Tozz. subsp. <i>exertum</i> Maire & Weiller	G	57.1	Cst
<i>Colocasia esculenta</i> (L.) Schott.	G	17.9	Acc
<i>Lemna minor</i> L.	Hy	28.6	Cmn
<i>Wolffia arrhiza</i> (L.) Horkel ex Wimm.	Hy	7.1	Vac
Araliaceae (0.28)			
<i>Hedera helix</i> L.	Ph	85.7	Cst
Areaceae (0.28)			
<i>Chamaerops humilis</i> L.	Ph	21.4	Acc
Aristolochiaceae (0.28)			

Family (RA %) Species	Life form	Occ (%)	Occ scale
<i>Aristolochia paucinervis</i> Pomel	He	3.6	Vac
Asparagaceae (0.85)			
<i>Asparagus acutifolius</i> L.	Ph	21.4	Acc
<i>Prospero autumnale</i> (L.) Speta	G	7.1	Vac
<i>Ruscus hypophyllum</i> L.	Ch	39.3	Cmn
Aspleniaceae (0.28)			
<i>Asplenium adiantum-nigrum</i> L.	He	7.1	Vac
Asteraceae (6.78)			
<i>Anthemis arvensis</i> L.	Th	21.4	Acc
<i>Aster squamatus</i> (Spreng.) Hieron.	Hec	35.7	Cmn
<i>Bellis annua</i> L.	Hec	92.9	Cst
<i>Centaurea calcitrapa</i> L.	Hec	10.7	Vac
<i>Centaurea napifolia</i> L.	Hec	3.6	Vac
<i>Chamaemelum mixtum</i> All.	Th	75	Cst
<i>Coleostephus myconis</i> (L.) Cass ex Rchb.	Th	32.1	Cmn
<i>Conyza bonariensis</i> (L.) Cronquist.	Th	17.9	Acc
<i>Cotula coronopifolia</i> L.	He	50	Cst
<i>Crepis vesicaria</i> subsp. <i>taraxacifolia</i> (Thuill.) B.Boivin	Hec	10.7	Vac
<i>Dittrichia graveolens</i> (L.) Greuter	Th	7.1	Vac
<i>Dittrichia viscosa</i> L. Greuter	Ch	14.3	Acc
<i>Echinops spinosissimus</i> Turra	Hec	7.1	Vac
<i>Filago pygmaea</i> L.	Th	7.1	Vac
<i>Galactites tomentosa</i> Moench	Th	60.7	Cst
<i>Hypochaeris radicata</i> subsp. <i>platylepis</i> (Boiss.) Jahand. & Maire	Hec	32.1	Cmn
<i>Lactuca viminea</i> J. Presl & C. Presl	Hec	14.3	Acc
<i>Logfia gallica</i> Coss. & Germ.	Th	7.1	Vac
<i>Plagius maghrebinus</i> Vogt and Greuter	Th	3.6	Vac
<i>Scolymus hispanicus</i> L.	Hec	17.9	Acc
<i>Senecio leucanthemifolius</i> Poir.	Th	17.9	Acc
<i>Sonchus asper</i> (L.) Hill.	Th	3.6	Vac
<i>Tolpis barbata</i> (L.) Gaertn.	Th	14.3	Acc
<i>Xanthium spinosum</i> L.	Th	25	Cmn
Athyriaceae (0.28)			
<i>Athyrium filix-femina</i> (L.) Roth.	Hec	64.3	Cst
Betulaceae (0.28)			
<i>Alnus glutinosa</i> (L.) Gaertn.	He	100	Cst
Boraginaceae (1.98)			
<i>Borago longifolia</i> Poir.	Th	3.6	Vac

Alder forests in El-Kala, Algeria

Family (RA %) Species	Life form	Occ (%)	Occ scale
<i>Borago officinalis</i> L.	Th	7.1	Vac
<i>Cerinth major</i> L.	Th	10.7	Vac
<i>Echium plantagineum</i> L.	Hec	50	Cst
<i>Myosotis ramosissima</i> Rochel.	Th	14.3	Acc
<i>Myosotis sicula</i> (Guss).	Th	7.1	Vac
<i>Pardoglossum cheirifolium</i> (L.) E.Barbier & Mathez	Hec	39.3	Cmn
Brassicaceae (3.11)			
<i>Alliaria petiolata</i> (M.Bieb) Cavara & Grande	Hec	25	Cmn
<i>Biscutella didyma</i> L.	Th	14.3	Acc
<i>Brassica procumbens</i> O.E. Schultz	Th	10.7	Vac
<i>Capsella bursa-pastoris</i> (L.) Medik.	Th	14.3	Acc
<i>Cardamine hirsuta</i> L.	Th	3.6	Vac
<i>Malcolmia ramosissima</i> Thell.	Th	10.7	Vac
<i>Nasturtium officinale</i> R. Br.	Hec	71.4	Cst
<i>Raphanus raphanistrum</i> L.	Th	17.9	Acc
<i>Rorippa amphibia</i> Besser	Hec	3.6	Vac
<i>Sinapis arvensis</i> L.	Th	32.1	Cmn
<i>Sinapis pubescens</i> L. subsp. <i>pubescens</i>	Th	10.7	Vac
Callitrichaceae (0.28)			
<i>Callitriche obtusangula</i> Le Gall ex Hegelm.	Hy	85.7	Cst
Campanulaceae (1.41)			
<i>Campanula alata</i> Desf.	Am	3.6	Vac
<i>Campanula dichotoma</i> L.	Th	14.3	Acc
<i>Campanula rapunculus</i> L.	Hec	3.6	Vac
<i>Legousia falcata</i> (Ten.) Fritsch	Th	3.6	Vac
<i>Solenopsis laurentia</i> C. Presl.	Th	50	Cst
Caprifoliaceae (0.85)			
<i>Dipsacus fullonum</i> L.	He	14.3	Acc
<i>Fedia cornucopiae</i> (L.) Gaertn.	Th	25	Cmn
<i>Viburnum tinus</i> L.	Ph	7.1	Vac
Caryophyllaceae (3.67)			
<i>Cerastium glomeratum</i> Thuill.	Th	46.4	Cmn
<i>Cerastium semidecandrum</i> L.	Th	42.9	Cmn
<i>Illecebrum verticillatum</i> L.	Th	7.1	Vac
<i>Paronychia argentea</i> Lamk.	Hec	25	Cmn
<i>Polycarpon tetraphyllum</i> L.	Th	21.4	Acc
<i>Silene coeli-rosa</i> (L.) Godr.	Th	50	Cst
<i>Silene colorata</i> Poir.	Th	10.7	Vac

Family (RA %) Species	Life form	Occ (%)	Occ scale
<i>Silene gallica</i> L.	Hec	17.9	Acc
<i>Silene vulgaris</i> subsp. <i>vulgaris</i> (Moench.) Garcke.	Hec	3.6	Vac
<i>Spergula arvensis</i> L.	Th	35.7	Cmn
<i>Spergula fallax</i> E.H.L. Krause	He	17.9	Acc
<i>Spergularia bocconei</i> (Sheele) Asch. & Graetn.	Th	21.4	Acc
<i>Stellaria media</i> (L.) Vill	Th	85.7	Cst
Ceratophyllaceae (0.28)			
<i>Ceratophyllum demersum</i> L.	Hy	14.3	Acc
Chenopodiaceae (0.28)			
<i>Chenopodium album</i> L.	He	14.3	Acc
Cistaceae (0.85)			
<i>Cistus monspeliensis</i> L.	Ph	3.6	Vac
<i>Cistus salviifolius</i> L.	Ch	21.4	Acc
<i>Halimium halimifolium</i> Willk	Ph	14.3	Acc
Compositae (0.28)			
<i>Hyoseris radiata</i> L.	Hec	17.9	Acc
Convolvulaceae (0.85)			
<i>Calystegia sepium</i> (L.) R.Br	Ph	82.1	Cst
<i>Convolvulus althaeoides</i> L.	G	3.6	Vac
<i>Convolvulus arvensis</i> L.	G	3.6	Vac
Crassulaceae (0.28)			
<i>Umbilicus rupestris</i> (Salisb.) Dandy	Hec	7.1	Vac
Cupressaceae (0.56)			
<i>Juniperus oxycedrus</i> L.	Ph	10.7	Vac
<i>Taxodium distichum</i> (L.) Rich.	Ph	3.6	Vac
Cyperaceae (6.78)			
<i>Carex distans</i> L.	Hec	3.6	Vac
<i>Carex divulsa</i> Stoks.	Hec	7.1	Vac
<i>Carex elata</i> All.	Hec	28.6	Cmn
<i>Carex flacca</i> Shreb.	Hec	7.1	Vac
<i>Carex paniculata</i> L.	Hec	3.6	Vac
<i>Carex pendula</i> Huds.	Hec	25	Cmn
<i>Carex pseudocyperus</i> L.	Hec	7.1	Vac
<i>Carex punctata</i> Gaudin	Hec	42.9	Cmn
<i>Carex remota</i> L.	Hec	92.9	Cst
<i>Carex sylvatica</i> Huds. subsp. <i>pau</i> A. Bolòs & O- Bòlos	Hec	3.6	Vac
<i>Carex vulpina</i> L.	Hec	3.6	Vac
<i>Cladium mariscus</i> (L.) Pohl.	G	25	Cmn

Alder forests in El-Kala, Algeria

Family (RA %) Species	Life form	Occ (%)	Occ scale
<i>Cyperus esculentus</i> L.	Th	21.4	Acc
<i>Cyperus flavescent</i> L.	Th	3.6	Vac
<i>Cyperus fuscus</i> L.	Th	14.3	Acc
<i>Cyperus longus</i> L. subsp <i>eu-longus</i> Asch & Gr.	Hec	39.3	Cmn
<i>Eleocharis palustris</i> (L.) Roem. & Schult.	Hec	14.3	Acc
<i>Fimbristylis squarrosa</i> Vahl	Th	3.6	Vac
<i>Fuirena pubescens</i> (Lam.) Kunth	Hec	14.3	Acc
<i>Isolepis cernua</i> (Vahl) Roemer & Schultes	Th	67.9	Cst
<i>Isolepis pseudosetacea</i> (Daveau) Gand.	Th	10.7	Vac
<i>Schoenoplectus corymbosus</i> (Roem. & Schult.) A.Raynal	Th	3.6	Vac
<i>Schoenoplectus lacustris</i> (L.) Palla	Hy	17.9	Acc
<i>Scirpoides holoschoenus</i> (L.) Soják	Hec	7.1	Vac
Dioscoreaceae (0.28)			
<i>Dioscorea communis</i> (L.) Caddick & Wilkin	G	57.1	Cst
Dryopteridaceae (0.28)			
<i>Thelypteris interrupta</i> (Willd.) Iwats.	G	17.9	Acc
Equisetaceae (0.28)			
<i>Equisetum ramosissimum</i> Desf.	G	10.7	Vac
Ericaceae (0.56)			
<i>Erica arborea</i> L.	Ph	42.9	Cmn
<i>Erica scoparia</i> L.	Ph	25	Cmn
Euphorbiaceae (1.69)			
<i>Chamaesyce peplis</i> (L.) Prokn.	Th	7.1	Vac
<i>Euphorbia biumbellata</i> Poir.	Ch	7.1	Vac
<i>Euphorbia helioscopia</i> L.	Th	3.6	Vac
<i>Euphorbia paralias</i> L.	Ch	7.1	Vac
<i>Euphorbia terracina</i> L.	Ch	3.6	Vac
<i>Ricinus communis</i> L.	Ph	10.7	Vac
Fabaceae (8.76)			
<i>Acacia dealbata</i> Link	Ph	7.1	Vac
<i>Acacia melanoxylon</i> R.Br	Ph	3.6	Vac
<i>Biserrula pelecinus</i> L.	Ph	3.6	Vac
<i>Calicotome villosa</i> (Poir.) Link.	Ph	57.1	Cst
<i>Cytisus villosus</i> Pourr.	Ph	35.7	Cmn
<i>Dorycnium rectum</i> Ser.	Hec	60.7	Cst
<i>Erophaca baetica</i> Boiss.	Ph	7.1	Vac
<i>Genista ferox</i> (Poir.) Dum. Cours	Ph	28.6	Cmn
<i>Lotus biflorus</i> Desr.	Th	14.3	Acc

Family (RA %) Species	Life form	Occ (%)	Occ scale
<i>Lotus edulis</i> L.	Th	3.6	Vac
<i>Lupinus angustifolius</i> L.	Th	21.4	Acc
<i>Lupinus luteus</i> L.	Th	3.6	Vac
<i>Medicago orbicularis</i> (L.) Bartal.	Th	3.6	Vac
<i>Melilotus infestus</i> Guss.	He	10.7	Vac
<i>Ornithopus pinnatus</i> (Mill) Druce.	Th	28.6	Cmn
<i>Retama raetam</i> subsp. <i>bovei</i> (Spach.) Talavera & P.E. Gibbs	Ph	3.6	Vac
<i>Scorpiurus vermiculatus</i> L.	Th	3.6	Vac
<i>Trifolium angustifolium</i> L.	Th	10.7	Vac
<i>Trifolium arvense</i> L.	Th	3.6	Vac
<i>Trifolium campestre</i> Schreb.	Th	25	Cmn
<i>Trifolium micranthum</i> Viv.	Th	3.6	Vac
<i>Trifolium pratense</i> L.	Hec	3.6	Vac
<i>Trifolium repens</i> L.	Hec	92.9	Cst
<i>Trifolium resupinatum</i> L.	Th	7.1	Vac
<i>Trifolium squarrosum</i> L.	Th	7.1	Vac
<i>Trifolium subterraneum</i> L.	Th	3.6	Vac
<i>Vicia altissima</i> Desf.	Th	3.6	Vac
<i>Vicia hirsuta</i> (L.) Gray.	Th	7.1	Vac
<i>Vicia narbonensis</i> L.	Th	25	Cmn
<i>Vicia sativa</i> L.	Th	28.6	Cmn
<i>Vicia sativa</i> L. subsp. <i>nigra</i> (L.) Ehrh.	Th	3.6	Vac
Fagaceae (0.85)			
<i>Quercus canariensis</i> Willd.	Ph	10.7	Vac
<i>Quercus coccifera</i> L.	Ph	25	Cmn
<i>Quercus suber</i> L.	Ph	50	Cst
Funariaceae (0.28)			
<i>Funaria hygrometrica</i> Hedw.	Bryophyte	32.1	Cmn
Gentianaceae (0.56)			
<i>Centaurium erythraea</i> Rafn.	Hec	14.3	Acc
<i>Schenkia spicata</i> (L.) Mans.	G	3.6	Vac
Geraniaceae (1.41)			
<i>Erodium botrys</i> (Cav.) Bertol.	Th	57.1	Cst
<i>Erodium cicutarium</i> (L.) l'Hér	Th	17.9	Acc
<i>Geranium dissectum</i> L.	Th	42.9	Cmn
<i>Geranium molle</i> L.	Th	35.7	Cmn
<i>Geranium robertianum</i> L.	Th	3.6	Vac
Hypericaceae (0.56)			

Alder forests in El-Kala, Algeria

Family (RA %) Species	Life form	Occ (%)	Occ scale
<i>Hypericum afrum</i> Lam.	He	60.7	Cst
<i>Hypericum perforatum</i> L.	He	21.4	Acc
Hypolepidaceae (0.28)			
<i>Pteridium aquilinum</i> (L.) Kuhn.	G	89.3	Cst
Iridaceae (1.13)			
<i>Iris planifolia</i> (Mill.) Fiori & Paol.	G	3.6	Vac
<i>Iris pseudacorus</i> L.	G	78.6	Cst
<i>Iris unguicularis</i> Poir.	G	3.6	Vac
<i>Romulea bulbocodium</i> (L.) Sebast. & Maur.	G	7.1	Vac
Isoetaceae (0.56)			
<i>Cephaloceraton histrix</i> (Bory & Durieu) Gennari	Hec	10.7	Vac
<i>Isoetes velata</i> A. Braun.	Hy	25	Cmn
Juncaceae (3.11)			
<i>Juncus acutus</i> L.	Hec	10.7	Vac
<i>Juncus articulatus</i> L.	Hec	7.1	Vac
<i>Juncus bufonius</i> L.	Th	10.7	Vac
<i>Juncus bulbosus</i> L.	Hec	17.9	Acc
<i>Juncus capitatus</i> Weigel	Th	21.4	Acc
<i>Juncus conglomeratus</i> L.	Hec	17.9	Acc
<i>Juncus effusus</i> L.	Hec	46.4	Cmn
<i>Juncus heterophyllus</i> Dufour	He	14.3	Acc
<i>Juncus maritimus</i> Lam.	G	53.6	Cst
<i>Juncus tenageia</i> Ehrh. ex L.f.	Hec	60.7	Cst
<i>Luzula forsteri</i> DC.	Hec	3.6	Vac
Lamiaceae (3.39)			
<i>Calamintha nepeta</i> (L.) Savi.	Hec	3.6	Vac
<i>Lamium bifidum</i> Cirillo	Hec	7.1	Vac
<i>Lamium purpureum</i> L.	Th	3.6	Vac
<i>Lavandula stoechas</i> L.	Ch	10.7	Vac
<i>Lycopus europaeus</i> L.	Hec	75	Cst
<i>Mentha aquatica</i> L.	Hec	14.3	Acc
<i>Mentha pulegium</i> L.	Hec	75	Cst
<i>Mentha suaveolens</i> Ehrh.	Hec	96.4	Cst
<i>Prunella vulgaris</i> L.	Hec	7.1	Vac
<i>Stachys arvensis</i> L.	Th	42.9	Cmn
<i>Stachys marrubifolia</i> Viv.	Th	7.1	Vac
<i>Vitex agnus-castus</i> L.	Ch	3.6	Vac
Lauraceae (0.28)			

Family (RA %) Species	Life form	Occ (%)	Occ scale
<i>Laurus nobilis</i> L.	Ph	39.3	Cmn
Lentibulariaceae (0.28)			
<i>Utricularia vulgaris</i> L.	Hy	7.1	Vac
Linaceae (0.28)			
<i>Linum usitatissimum</i> L. subsp. <i>angustifolium</i> (Huds) Thell.	Th	7.1	Vac
Lythraceae (0.85)			
<i>Lythrum hyssopifolia</i> L.	Th	3.6	Vac
<i>Lythrum junceum</i> Banks & Sol.	Th	100	Cst
<i>Lythrum salicaria</i> L.	Hec	71.4	Cst
Malvaceae (0.56)			
<i>Lavatera cretica</i> L.	Th	7.1	Vac
<i>Lavatera olbia</i> L.	Ch	7.1	Vac
Moraceae (0.28)			
<i>Ficus carica</i> L.	Ph	78.6	Cst
Myrsinaceae (0.85)			
<i>Anagallis arvensis</i> L.	Th	60.7	Cst
<i>Anagallis crassifolia</i> Thore	Am	10.7	Vac
<i>Anagallis monelli</i> L.	Th	7.1	Vac
Myrtaceae (0.85)			
<i>Eucalyptus camaldulensis</i> Dehnh.	Ph	7.1	Vac
<i>Eucalyptus gomphocephala</i> D.C	Ph	3.6	Vac
<i>Myrtus communis</i> L.	Ph	57.1	Cst
Nymphaeaceae (0.28)			
<i>Nymphaea alba</i> L.	Hy	7.1	Vac
Oleaceae (0.85)			
<i>Fraxinus angustifolia</i> Vahl.	Ph	64.3	Cst
<i>Olea europaea</i> L. subsp. <i>oleaster</i> (Hoffmanns & Link) Negodi.	Ph	17.9	Acc
<i>Phillyrea latifolia</i> L.	Ph	35.7	Cmn
Onagraceae (0.85)			
<i>Circaea lutetiana</i> L.	G	3.6	Vac
<i>Epilobium hirsutum</i> L.	Hec	3.6	Vac
<i>Ludwigia palustris</i> (L.) Elliot	Th	82.1	Cst
Orobanchaceae (0.28)			
<i>Bellardia trixago</i> (L.) All.	Th	10.7	Vac
Osmundaceae (0.28)			
<i>Osmunda regalis</i> L.	Hec	64.3	Cst
Oxalidaceae (0.85)			
<i>Oxalis corniculata</i> L.	Hec	50	Cst

Alder forests in El-Kala, Algeria

Family (RA %) Species	Life form	Occ (%)	Occ scale
<i>Oxalis floribunda</i> Lehm.	Hec	7.1	Vac
<i>Oxalis pes-caprae</i> L.	Hec	14.3	Acc
Papaveraceae (0.56)			
<i>Fumaria capreolata</i> L.	Th	25	Cmn
<i>Glaucium flavum</i> Crantz.	Hec	3.6	Vac
Phytolaccaceae (0.28)			
<i>Phytolacca americana</i> L.	Hec	17.9	Acc
Plantaginaceae (2.82)			
<i>Kickxia commutata</i> (Rchb.) Fritsch.	Th	21.4	Acc
<i>Linaria flava</i> Desf.	Th	3.6	Vac
<i>Linaria pinifolia</i> Tell.	Th	67.9	Cst
<i>Linaria reflexa</i> Desf.	Th	17.9	Acc
<i>Plantago crassifolia</i> Forssk.	Th	3.6	Vac
<i>Plantago lanceolata</i> L.	Hec	32.1	Cmn
<i>Plantago macrorhiza</i> Poir.	Hec	21.4	Acc
<i>Plantago major</i> L.	Hec	10.7	Vac
<i>Veronica agrestis</i> L.	Th	35.7	Cmn
<i>Veronica anagallis-aquatica</i> L.	Hy	42.9	Cmn
Poaceae (9.88)			
<i>Agrostis stolonifera</i> L.	Am	17.9	Acc
<i>Alopecurus bulbosus</i> Gouan	Hec	14.3	Acc
<i>Anthoxanthum odoratum</i> L.	Hec	32.1	Cmn
<i>Arundo donax</i> L.	Hec	14.3	Acc
<i>Avena sterilis</i> L.	Th	7.1	Vac
<i>Brachypodium distachyon</i> (L.) P.Beauv.	Hec	3.6	Vac
<i>Brachypodium sylvaticum</i> (Huds) P. Beauv.	Hec	14.3	Acc
<i>Briza maxima</i> L.	Th	10.7	Vac
<i>Briza minor</i> L.	Th	25	Cmn
<i>Bromus sterilis</i> L.	Th	3.6	Vac
<i>Catapodium rigidum</i> (L.) C.E. Hubb.	Th	3.6	Vac
<i>Cynodon dactylon</i> (L.) Pers.	Ch	7.1	Vac
<i>Cynosurus elegans</i> Desf.	Th	3.6	Vac
<i>Cynosurus polybracteatus</i> Poir.	Th	21.4	Acc
<i>Dactyloctenium aegyptium</i> (L.) Willd.	Th	3.6	Vac
<i>Digitaria sanguinalis</i> (L) Scop.	Th	32.1	Cmn
<i>Echinochloa crus-galli</i> (L.) P.Beauv.	Th	3.6	Vac
<i>Eragrostis atrovirens</i> (Desf.) Trin. var. <i>fontanesiano</i> Emb.Maire.	Hec	7.1	Vac
<i>Glyceria fluitans</i> (L.) R. Br.	Hy	32.1	Cmn

Family (RA %) Species	Life form	Occ (%)	Occ scale
<i>Holcus lanatus</i> L.	Hec	28.6	Cmn
<i>Hordeum murinum</i> L.	Th	39.3	Cmn
<i>Lagurus ovatus</i> L.	Th	7.1	Vac
<i>Leersia oryzoides</i> (L.) Sw.	He	14.3	Acc
<i>Lolium multiflorum</i> Lam.	Th	17.9	Acc
<i>Mibora minima</i> (L.) Desv.	Th	3.6	Vac
<i>Panicum repens</i> L.	Ch	46.4	Cmn
<i>Paspalum distichum</i> L.	Hec	14.3	Acc
<i>Phragmites australis</i> (Cav.) Steud.	Hy	35.7	Cmn
<i>Piptatherum miliaceum</i> (L.) Coss.	Hec	7.1	Vac
<i>Poa annua</i> L.	Th	57.1	Cst
<i>Poa trivialis</i> L.	Th	57.1	Cst
<i>Polypogon monspeliensis</i> (L.) Desf.	Th	21.4	Acc
<i>Polypogon viridis</i> (Gouan) Breistr.	Th	14.3	Acc
<i>Puccinellia distans</i> (Jacq.) Parl.	Hec	3.6	Vac
<i>Rostraria hispida</i> (Savi) Dogan	Th	10.7	Vac
Polygonaceae (1.98)			
<i>Persicaria decipiens</i> (R. Br.) K. L. Wilson	Th	57.1	Cst
<i>Persicaria hydropiper</i> (L.) Spach	Th	7.1	Vac
<i>Persicaria lapathifolia</i> (L.) Delarbre	Th	89.3	Cst
<i>Persicaria senegalensis</i> (Meisn.) Soják	Th	3.6	Vac
<i>Rumex bucephalophorus</i> L.	Th	7.1	Vac
<i>Rumex conglomeratus</i> Murray	Hec	71.4	Cst
<i>Rumex pulcher</i> L.	Hec	14.3	Acc
Polypodiaceae (0.28)			
<i>Polypodium cambricum</i> L.	Ep	7.1	Vac
Potamogetonaceae (0.56)			
<i>Potamogeton nodosus</i> Poir.	Hy	28.6	Cmn
<i>Potamogeton trichoides</i> Cham. & Schltdl	Hy	10.7	Vac
Primulaceae (0.28)			
<i>Cyclamen africanum</i> Boiss. & Reut.	G	14.3	Acc
Pteridaceae (0.28)			
<i>Adiantum capillus-veneris</i> L.	Hec	7.1	Vac
Ranunculaceae (3.67)			
<i>Clematis cirrhosa</i> L.	Ph	10.7	Vac
<i>Clematis flammula</i> L.	Ph	21.4	Acc
<i>Ficaria verna</i> Huds.	G	25	Cmn
<i>Ranunculus bulbosus</i> L.	Hec	10.7	Vac

Alder forests in El-Kala, Algeria

Family (RA %) Species	Life form	Occ (%)	Occ scale
<i>Ranunculus flammula</i> L.	Hec	21.4	Acc
<i>Ranunculus hederaceus</i> L.	Hy	28.6	Cmn
<i>Ranunculus macrophyllus</i> Desf.	Hec	71.4	Cst
<i>Ranunculus muricatus</i> L.	Th	42.9	Cmn
<i>Ranunculus ophioglossifolius</i> Vill.	Th	67.9	Cst
<i>Ranunculus peltatus</i> subsp. <i>baudotii</i> (Godr.) Meikle ex C.D.K.Cook	Hec	7.1	Vac
<i>Ranunculus sardous</i> Crantz.	Th	32.1	Cmn
<i>Ranunculus sceleratus</i> L.	Th	85.7	Cst
<i>Ranunculus trichophyllus</i> Chaix.	Hy	7.1	Vac
Rhamnaceae (0.28)			
<i>Frangula alnus</i> Mill.	Ph	28.6	Cmn
Rosaceae (2.26)			
<i>Crataegus azarolus</i> L.	Ph	3.6	Vac
<i>Crataegus monogyna</i> Jacq.	Ph	39.3	Cmn
<i>Potentilla reptans</i> L.	Hec	46.4	Cmn
<i>Prunus avium</i> (L.) L.	Ph	17.9	Acc
<i>Rosa canina</i> L.	Ph	3.6	Vac
<i>Rosa sempervirens</i> L.	Ph	17.9	Acc
<i>Rubus ulmifolius</i> Schott.	Ph	96.4	Cst
<i>Sanguisorba verrucosa</i> (Link ex G.Don) Ces.	Hec	3.6	Vac
Rubiaceae (1.13)			
<i>Galium elongatum</i> C.Presl	Hec	60.7	Cst
<i>Galium scabrum</i> L.	Hec	3.6	Vac
<i>Rubia peregrina</i> L.	Hec	78.6	Cst
<i>Sherardia arvensis</i> L.	Th	42.9	Cmn
Salicaceae (1.13)			
<i>Populus nigra</i> L.	Ph	3.6	Vac
<i>Salix alba</i> L.	Ph	50	Cst
<i>Salix atrocinerea</i> Brot.	Ph	21.4	Acc
<i>Salix pedicellata</i> Desf.	Ph	64.3	Cst
Salviniaceae (0.28)			
<i>Salvinia natans</i> (L.) All.	Hy	3.6	Vac
Scrophulariaceae (0.85)			
<i>Scrophularia sambucifolia</i> L. subsp. <i>mellifera</i> Maire	Hec	35.7	Cmn
<i>Scrophularia tenuipes</i> Coss & Durieu	Hec	10.7	Vac
<i>Verbascum sinuatum</i> L.	Hec	10.7	Vac
Selaginellaceae (0.28)			
<i>Selaginella kraussiana</i> (Kunze) A. Braun	He	3.6	Vac

Family (RA %) Species	Life form	Occ (%)	Occ scale
Smilacaceae (0.28)			
<i>Smilax aspera</i> L.	Ph	89.3	Cst
Solanaceae (1.13)			
<i>Datura stramonium</i> L.	Th	28.6	Cmn
<i>Solanum dulcamara</i> L.	Ph	32.1	Cmn
<i>Solanum linnaeanum</i> Hepper & P.-M.L.Jaeger	Hec	10.7	Vac
<i>Solanum nigrum</i> L.	Th	50	Cmn
Sphagnaceae (0.28)			
<i>Sphagnum subsecundum</i> var. <i>auriculatum</i> (Schimp.) Schlieph.	He	3.6	Vac
Tamaricaceae (0.28)			
<i>Tamarix canariensis</i> Willd.	Ph	7.1	Vac
Thymeleaceae (0.28)			
<i>Daphne gnidium</i> L.	Ph	17.9	Acc
Thyphaceae (0.28)			
<i>Sparganium erectum</i> L.	Hy	14.3	Acc
Ulmaceae (0.28)			
<i>Ulmus minor</i> Mill.	Ph	21.4	Acc
Urticaceae (0.56)			
<i>Urtica dioica</i> L.	Hec	14.3	Acc
<i>Urtica membranacea</i> Poir.	Th	3.6	Vac
Verbenaceae (0.28)			
<i>Verbena officinalis</i> L.	Hec	25	Cmn
Violaceae (0.28)			
<i>Viola alba</i> subsp. <i>denhardtii</i> (Ten.) W. Becker.	Th	7.1	Vac
Vitaceae (0.28)			
<i>Vitis vinifera</i> subsp. <i>sylvestris</i> (C.C.Gmel.) Hegi	Ph	67.9	Cst
Xanthorrhoeaceae (0.28)			
<i>Asphodelus aestivus</i> Brot.	Hec	28.6	Cmn