FLORISTIC INVENTORY AND ANGIOSPERM BIODIVERSITY ASSESSMENT IN THE EASTERN PART OF DJELFA PROVINCE, ALGERIA

KHADER, M.[1] – MEKHLOUFI, M. B.[2*] – BENDOUINA, N.[3]

[1]*Faculty of Natural and Life Sciences, Ziane Achour University of Djelfa, Algeria*
(ORCID: 0009-0006-6229-8588)

[2]*Department of Agronomy, Institute of Natural and Life Sciences, Nouri Bachir University Center, El-Bayadh, Algeria*
(ORCID: 0000-0003-3865-9903)

[3]*Salhi Ahmed University Center, Naama, Algeria*

[*]*Corresponding author*
e-mail: m.mekhloufi@cu-elbayadh.dz; phone: +213-7729-41068

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Abstract. The preparation of regional floras remains a major scientific challenge because of the scarcity of baseline data across many Algerian localities. This study presents a comprehensive floristic inventory of angiosperm species in various habitats of the Djelfa region, located in the Algerian High Plateau. Using a traditional taxonomic approach, plant specimens were collected over multiple seasons and identified using the regional and international floras. A total of 402 plant species belonging to 44 families were recorded in the 54 phytosociological surveys. The Asteraceae family was the most represented, followed by Fabaceae, Caryophyllaceae, and Poaceae, which play key ecological roles in semi-arid environments. A notable proportion of exotic species has been documented, while many native taxa exhibit significant medicinal value. Several rare or narrowly distributed species have been identified, including *Ziziphus lotus*, *Artemisia herba-alba*, *Retama raetam*, *Salsola vermiculata*, *Veronica praecox*, and *Asparagus acutifolius*, underscoring the importance of conservation in the region. Multivariate analyses indicated that soil salinity, electrical conductivity, sodium content, and organic matter were the principal edaphic factors affecting vegetation patterns. Distinct functional plant groups, such as therophytes, psammophytes, and *Stipa tenacissima* grassland species, exhibit clear ecological affinities to specific soil gradients. Major environmental threats affecting flora include climate change, the overexploitation of natural resources, unplanned urbanization, agricultural intensification, and the widespread use of herbicides. Despite these pressures, the eastern part of Djelfa continues to harbor rich floristic diversity. This study emphasizes the urgent need for sustainable conservation strategies and continuous ecological monitoring to safeguard and valorize the unique plant biodiversity of this steppe region.
Keywords: *species richness, vegetation-soil interactions, semi-arid steppe ecosystems, functional plant diversity, rare and useful taxa*

Introduction

The plant biodiversity of the Algerian High Plateau is exceptionally rich and harbors a wide range of species, several of which are endemic and rare. This semi-arid region, characterized by a great diversity of habitats, serves as an important reservoir for the the Algerian flora. However, this biodiversity faces multiple threats owing to the growing impact of human activities, such as climate change, uncontrolled urbanization, overexploitation of natural resources, and intensive herbicide use (Sghaier et al., 2022; Bouchekima et al., 2023). These factors have led to significant regression in natural habitats, which has adversely affected the floristic diversity of the region (Boudour et al., 2022).

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A floristic inventory is a key tool for understanding the composition of plant communities and assessing biodiversity in a given area. Several recent studies have highlighted the importance of conducting such surveys, particularly in ecologically sensitive and poorly documented areas. For example, in north-eastern Algeria, research has revealed the existence of numerous endemic plant species and has recommended increased efforts to document these species before they become threatened by urban expansion and climate change (Sghaier et al., 2022).

This study focused on the eastern part of Djelfa Province, a region that remains botanically underexplored despite its ecological importance. Located at the intersection of steppe and mountainous zones, this area harbors diverse habitats that have not been sufficiently documented in previous floristic surveys. Moreover, it is increasingly exposed to anthropogenic pressures such as overgrazing, agricultural expansion, and urban sprawl. These factors, combined with the lack of updated floristic data, justify the need for a targeted inventory to support biodiversity monitoring and conservation planning in this vulnerable zone.

To address this gap, the present study aimed to establish a floristic inventory of the eastern communes of Djelfa Province using phytosociological survey methods to identify and record angiosperm species across various habitats. Findings from similar studies in nearby regions, such as Tlemcen, have shown that floristic diversity is influenced by both geological substrate heterogeneity and climatic variability (Boudour et al., 2022; Bouchekima et al., 2023).

Despite the recognized floristic richness of the Algerian High Plateaus, significant gaps remain in the botanical documentation of certain regions, particularly in the eastern part of Djelfa Province. This area has not been the focus of detailed floristic studies, and its angiosperm diversity remains largely unrecorded.

Moreover, the combined effects of environmental variability and increasing anthropogenic pressures call for updated, site-specific data to support conservationplanning. Therefore, the objective of this study is to conduct a comprehensive floristic inventory of the angiosperms in this underexplored region, to assess species richness and composition across different habitats, and to contribute to the understanding and preservation of plant biodiversity in the central Algerian steppe.

In conclusion, this study is an important step toward better understanding the angiosperm flora of the eastern Djelfa region and provides a solid foundation for long-term conservation efforts aimed at preserving the region’s unique biodiversity.

Materials and methods

Study area

The study area is located approximately 270 km south of Algiers near the city of Djelfa (provincial capital). Its approximate boundaries lie between 35° 8′ and 34° 27′ N latitude and 3° 28′ and 3° 54′ E longitude, respectively. The elevation ranged from approximately 910 m at the lowest point to 1362 m at the highest point. The region features a steppe environment interspersed with the state-owned Séhari Guebli Forest Massif, one of the most important forest blocks in Djelfa (*Fig. 1*). This massif, part of the Ouled-Naïl Mountains in the Saharan Atlas, represents the last forest barrier against desert encroachment of the desert (Khader et al., 2022). Climatically, the minimum temperature recorded in January is around 0.7 °C, and the mean annual temperature is 6.7 °C, while the maximum temperature reaches 31.2 °C with an average of 23.6 °C.

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The total annual rainfall was approximately 280 mm. These conditions, typical of semi-arid bioclimatic zones with cold winters, notably influence the vegetation and ecological dynamics of the region.

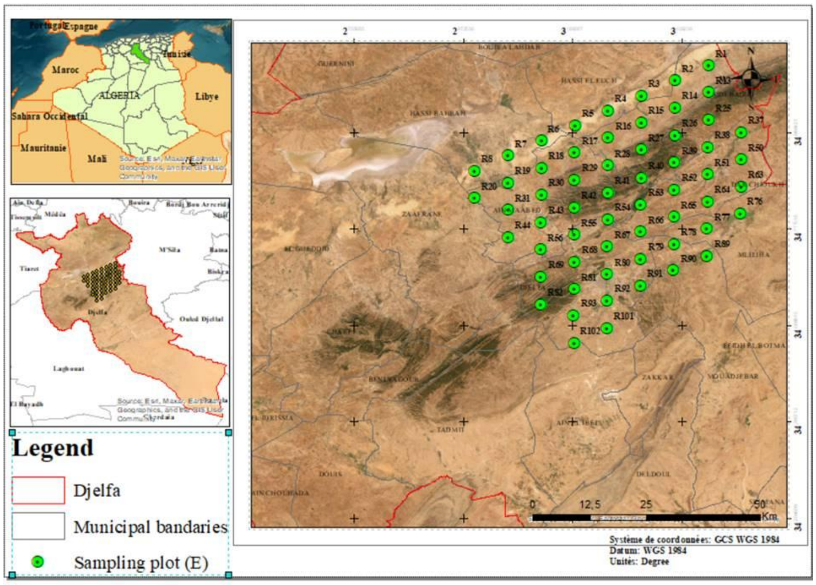

Figure 1. *Floristic sampling design in the northeastern Djelfa region (Algeria), showing the locations of survey plots on a systematic grid*

Floristic sampling design

A systematic stratified sampling strategy was employed using a regular grid overlay across various habitat types, including forest, steppe, cultivated land, degraded zones, and urban peripheries. A total of 54 phytosociological surveys were conducted during multiple seasons from spring 2021 to autumn 2023. Sampling locations were georeferenced using GPS, ensuring spatial representativeness of ecological and topographical gradients. Specimens were collected during spring, summer, autumn, and winter to capture seasonal phenological variations.

Plant identification and taxonomic validation

Collected plant specimens were identified using standard taxonomic keys from the Flora Europaea, Med-Checklist, and regional Algerian floras. All scientific names were validated against the International Plant Name Index (IPNI) to ensure nomenclatural consistency. Voucher specimens were deposited in the herbarium of the Djelfa University.

Land use mapping

Land use analysis was based on 2022 Landsat 8 satellite imagery processed in ArcGIS 10.8. Land cover classes included steppe vegetation (*Artemisia herba-alba, Stipa tenacissima, Lygeum spartum*), cropland, reforested areas, degraded lands, bare soils, and urban zones. The classification accuracy was verified through field surveys and photo interpretation. The resulting land use map provided context for vegetation patterns and anthropogenic pressures.

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Soil sampling and physicochemical analysis

Soil samples were collected at 0–30 cm depth in each floristic plot. Physicochemical analyses were conducted following international standards (ISO 10390 for pH, ISO 11261 for total nitrogen). Parameters analyzed included:

- Electrical Conductivity (EC) – for salinity assessment
- pH (in KCl)
- Organic Matter (OM) – via Walkley-Black method
- Total Nitrogen (TN) – by Kjeldahl digestion
- Calcium Carbonate ($CaCO_3$) – by volumetric analysis
- Sodium (Na^+) content – by flame photometry.

  These data supported the interpretation of environmental gradients affecting plant distributions.

Biodiversity indices

Plant diversity was quantified using the Shannon–Wiener diversity index (H′) and Pielou's evenness index (J′), calculated using the formulas:

- $H' = -\Sigma$ (pi × ln pi)
- $J' = H' / \ln S$

where pi is the proportional abundance of species i, and S is species richness. Calculations were performed using the software PAST version 4.03.

Multivariate statistical analysis

Principal Component Analysis (PCA) was used to explore relationships between floristic composition and soil parameters. Sampling adequacy was confirmed by the Kaiser–Meyer–Olkin (KMO) index (0.513) and Bartlett's test of sphericity ($\chi^2 = 177.013$; df = 28; $p < 0.001$). Variables with the highest communalities included EC (0.781), total salinity (0.778), and sodium content (0.696), indicating their major role in shaping plant community structure. Biplots and dendrograms generated using R software were used to visualize ecological clusters and environmental gradients.

This methodological framework ensures the reproducibility of the study and provides a solid foundation for ecological monitoring and biodiversity conservation in semi-arid steppe ecosystems.

Sampling design and vegetation inventory

Sampling points were selected based on a stratified ecological approach to ensure the representativeness of the main habitat types within the study area. Prior to fieldwork, preliminary assessment using satellite imagery and topographic maps helped identify zones of ecological interest. Sampling plots were then distributed across key environmental gradients, including altitude, soil type, vegetation cover, and land use. Within each selected site, plots were located in areas with homogeneous vegetation structure and positioned to avoid zones heavily disturbed by recent human activity.

Floristic surveys were conducted using classical phytosociological methods to inventory angiosperm species across the various habitats. Field sampling took place over multiple seasons and involved a stratified layout covering both proximal and distal zones to capture the diversity and variability of the vegetation. Plant specimens collected in the field were identified using both regional and international floras, and all

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species names were validated using the International Plant Name Index (IPNI), ensuring taxonomic accuracy and consistency.

Results and discussion

Floristic richness and seasonal distribution

A total of 402 species across 44 families were recorded (See *Appendix A*). This list was analyzed in terms of species richness, biological spectra, morphological types, and familial composition for each season. Floristic richness was primarily distributed across two seasons, spring, summer, and summer. In the combined spring–summer period, 375 species were observed, and seven species were found in summer alone, whereas spring accounted for 19 species. The autumn-winter period is represented by only a single species. This seasonal distribution indicated a generally high floristic richness during spring and summer; whereas winter was marked by a much poorer flora (only one species was recorded). In contrast, the autumn season, with 19 species, exhibited a moderate floristic diversity.

This variation in floristic richness between seasons is consistent with the results of several recent studies on factors influencing plant diversity. Many researchers have noted that wet seasons, particularly spring and summer, in semi-arid climates promote greater floristic diversity due to improved water availability, which facilitates plant growth and reproduction. Conversely, dry periods such as autumn and winter limit the survival of many plant species, leading to a decline in floristic richness.

Thus, the low floristic richness observed during the winter period can be attributed to less favorable growth conditions, such as lower temperatures and limited water availability. This pattern is consistent with the findings of Alatalo et al. (2017) and Sutcliffe et al. (2020), who reported a marked decline in plant diversity under dry and cold seasonal conditions in arid and semi-arid ecosystems. Furthermore, prolonged drought periods combined with intense human pressure, such as overgrazing, can further reduce biodiversity and help explain floristic poverty during winter.

Other researchers, such as Zhang et al. (2023), have also highlighted that wet seasons favor rich floristic diversity but that pressure from human activities and extreme climatic conditions (e.g., drought) have a major impact on plant community composition. Thus, the influence of the dry season and anthropogenic activities appears to be a key factor in the dynamics of species richness, significantly altering the structure and composition of the plant communities.

Overall biological spectrum

The biological spectrum of life forms shows that therophytes are the predominant and best-represented plant life forms, constituting approximately 50.12% of the flora. This was followed by hemicryptophytes (20.20%), chamaephytes (16.46%), geophytes (6.73%) and phanerophytes (5.74%). Other life forms, such as hemiparasites (0.25%) and nanophanerophytes (0.50%), were present but only marginally represented (*Fig. 2*).

The dominance of therophytes (annual plants) reflects the adaptation of the flora to a semi-arid climate, as annuals can complete their life cycle under favorable conditions and survive unfavorable periods as seeds. The substantial presence of hemicryptophytes (perennial herbs with buds at the ground level) and chamaephytes (small shrubs) further indicates adaptation to grazing pressure and aridity, as these forms can resist harsh

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conditions, such as hemicryptophytes through protected basal buds and chamaephytes through woody stems and drought tolerance. Geophytes (perennial plants with underground storage organs) represent a smaller fraction, relying on bulbs or tubers to survive seasonal stress, whereas true phanerophytes (tall shrubs/trees) and nanophanerophytes (dwarf shrubs) are few, which is consistent with the scarcity of tall woody vegetation in open-steppe environments. Hemiparasitic plants are extremely rare, reflecting their specialized ecology and dependence on specific host species. This biological structure is closely linked to the floristic phenology, which is dominated by spring-summer flowering species (93.3%), followed by spring (4.7%), summer (1.7%), and autumn-winter flowering species (0.2%). This seasonal distribution illustrates the adaptation of plant species to local climatic conditions by concentrating their reproductive cycle during the most favorable periods for growth (*Fig. 2*).

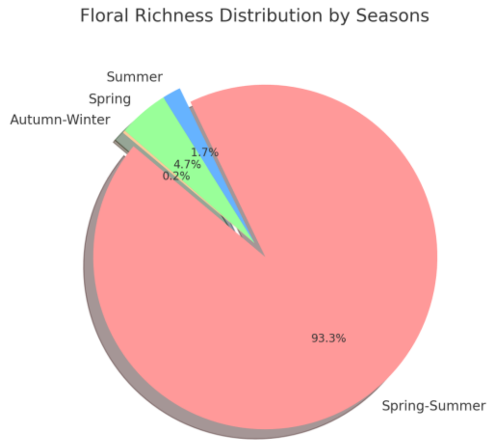

Figure 2. *Floristic richness by season across all sampled stations*

This map highlights the clear dominance of steppe formations dominated by *Artemisia herba-alba*, an emblematic species of the semi-arid zones of northern Algeria that is widely recognized for its drought resistance and pastoral value (Khelil et al., 2018; Noumi et al., 2021). These formations are primarily concentrated in the northern and central parts of the region. Steppes dominated by Lygeum spartum and Stipa tenacissima were also well-represented, suggesting the presence of sandy or gypseous soils (*Fig. 3*). These perennial grasses are commonly utilized for traditional weaving and play a key role in soil stabilization (Bencherif et al., 2022). Reforested areas (shown in green in the southern and central parts) reflect the ongoing restoration and anti-desertification efforts implemented under national and international environmental programs (FAO, 2020). Additionally, cultivated zones (blue-hatched areas), although limited in extent, denote areas of targeted agriculture located in more favorable microenvironments, often benefiting from irrigation or relatively fertile soils (Bouras et al., 2019). The presence of scattered zones of land degradation, bare soil, and clearing reflects the cumulative effects of overgrazing, extended drought periods, and unsustainable land-use practices (Djamai et al., 2017; Meddi et al., 2020). This land-use overview underscores the complex dynamics that shape steppe environments and highlights the urgent need for integrated natural resource management to promote ecological sustainability in these vulnerable regions.

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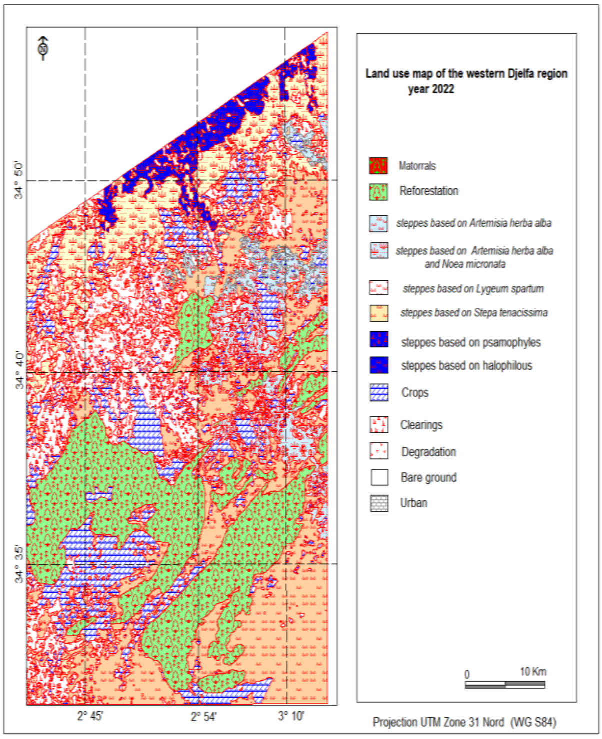

Figure 3. *Land use map of the western Djelfa region (year 2022)*

The analysis of soil properties in the study area provides further insight into vegetation patterns. Principal component analysis (PCA) of the soil physico-chemical parameters indicated moderate sampling adequacy, with a Kaiser–Meyer–Olkin (KMO) index of 0.513, which is at the lower threshold, but is still considered acceptable for PCA based on recent guidelines (Taherdoost et al., 2022). Bartlett's sphericity test was highly significant ($\chi^2 = 177.013$; df = 28; $p < 0.001$), confirming the presence of significant correlations among the soil variables (Field, 2018). Among the soil variables examined, electrical conductivity (EC) and total salinity exhibited the highest communalities (extraction values of 0.781 and 0.778, respectively), indicating their strong contribution to the overall variance in the dataset. This is in line with the findings of Qadir et al. (2019), who emphasized the central role of salinity indicators in characterizing soil functionality under arid and semi-arid conditions. These findings are also supported by Mekhloufi et al. (2002), who reported very high salinity in the study area, particularly during drought periods. Sodium (Na) content and organic matter (OM) also showed relatively high representation (0.696 and 0.580, respectively), whereas variables such as pH (KCl) total $CaCO_3$, and total nitrogen (TN) contributed minimally (each <0.4), suggesting a marginal influence or redundancy. These results underscore the predominant role of salinity and conductivity related parameters in shaping soil profiles in semi-arid ecosystems, supporting the recent classifications of salt-affected soils (Rengasamy, 2016). The PCA biplot confirms the strong loading of Total Salinity and EC on the first principal component (explaining 29.65% of variance) and their clear opposition to variables like total $CaCO_3$ and OM, which load more on the second component (28.43%) (*Fig. 4*). These findings suggest the existence of two major environmental gradients that influence plant community structure: a salinity/conductivity gradient and an organo-mineral fertility gradient.

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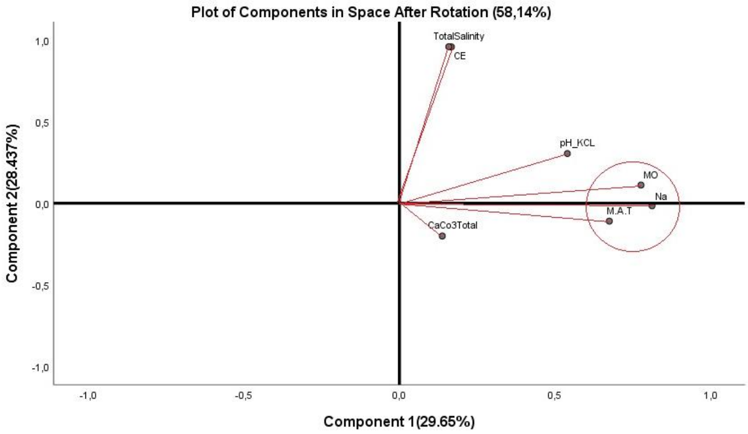

Figure 4. *Edaphic structuring of steppe flora: evidence of salinity and fertility gradients from principal component analysis (EC: ElectricalConductivity, OM: Organic Matter, TN: Total Nitrogen, $CaCO_3$: Calcium Carbonate, Na: Sodium PCA / ACP: Principal Component Analysis, KMO: Kaiser–Meyer–Olkin Index)*

This interpretation aligns with recent ecological frameworks emphasizing the role of abiotic stress and resource availability in shaping functional plant responses (Garnier et al., 2016), and is particularly supported in semi arid environments by Abd El-Ghani et al. (2020).

Overall, multivariate analyses (*Fig. 5*) revealed a significant relationship between vegetation distribution, reflected in species richness, family composition, life-form types, and measured edaphic parameters. The ordination plot shows a strong clustering of specific plant functional types in relation to soil characteristics. Notably, annual and therophytic species, along with psammophytes (sand-adapted species) and certain hemicryptophytes, were clearly grouped in the lower-left quadrant of the factor space, indicating their preference for poorly developed, unstable soils with high abiotic stress levels. These results are consistent with recent studies emphasizing trait-based responses of plants to soil harshness and disturbance regimes (de Bello et al., 2021).

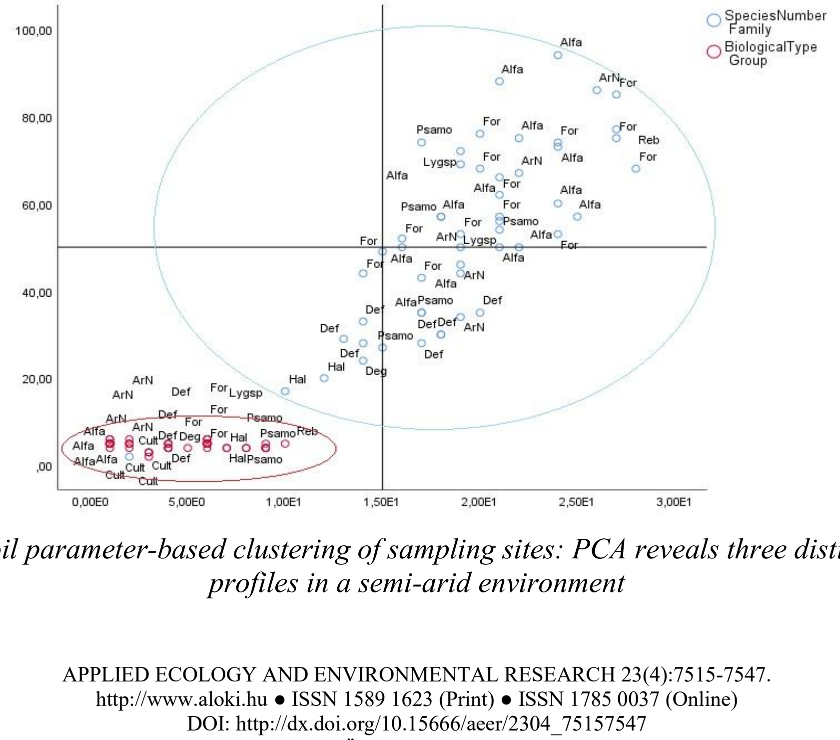

Figure 5. *Soil parameter-based clustering of sampling sites: PCA reveals three distinct edaphic profiles in a semi-arid environment*

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There was also a clear separation of the sampling sites into three distinct clusters based on soil parameters: one group of sites was influenced by high electrical conductivity and total salinity, the second group was characterized by acidic to neutral pH conditions, and the third group was characterized by higher organic matter content and elevated Na levels. These parameters are among the most important determinants in semi-arid environments as they directly govern water availability, nutrient mobility, and species tolerance to stress (Chaves et al., 2009).

When floristic entities (species groups) are superimposed on the environmental variable plot, a clear affinity is revealed: species of the “Alfa” grassland group (e.g., *Stipa tenacissima* L. and other xeric species) are associated with soils of high salinity and conductivity, indicating their value as indicator species of degrading or increasingly arid conditions (Benhouhou et al., 2016). In contrast, psammophytic and halophytic species, as well as annual life forms, are more associated with young soils that are rich in $CaCO_3$ and with moderately disturbed sites (such as those under cultivation or light grazing) (*Fig. 6*).

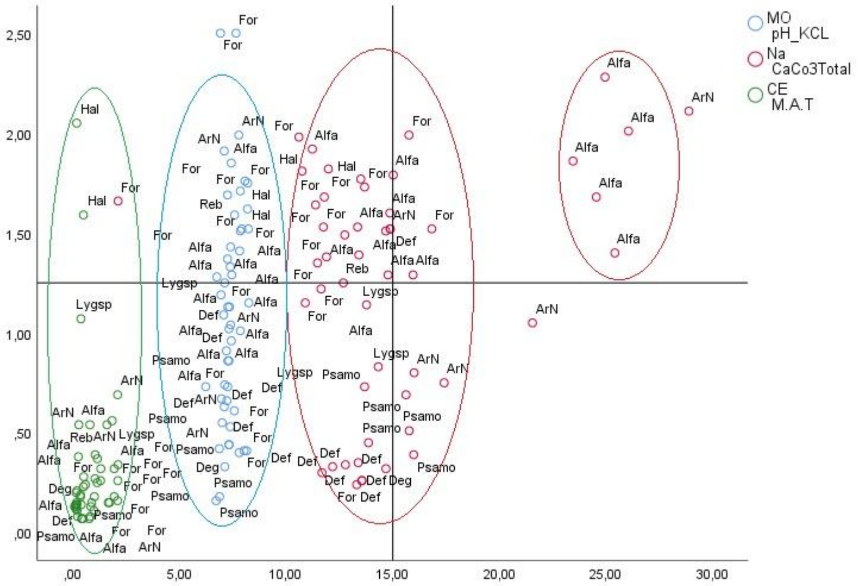

Figure 6. *Soil-driven functional structuring of steppe plant communities: ecological syndromes under aridity and anthropogenic pressure (EC: ElectricalConductivity, OM: Organic Matter, TN: Total Nitrogen, $CaCO_3$: Calcium Carbonate, Na: SodiumPCA / ACP: Principal Component Analysis, KMO:Kaiser–Meyer–Olkin Index)*

These results demonstrate that plant diversity and functional distribution of life-form groups are strongly influenced by edaphic conditions (*Fig. 7*), particularly salinity, electrical conductivity, and levels of sodium and organic matter in the soil. The relationships observed between species groups (e.g., Alfa grassland species, psammophytes, and therophytes) and soil parameters highlight distinct ecological syndromes that are characteristic of steppe ecosystems under arid conditions and human influence.

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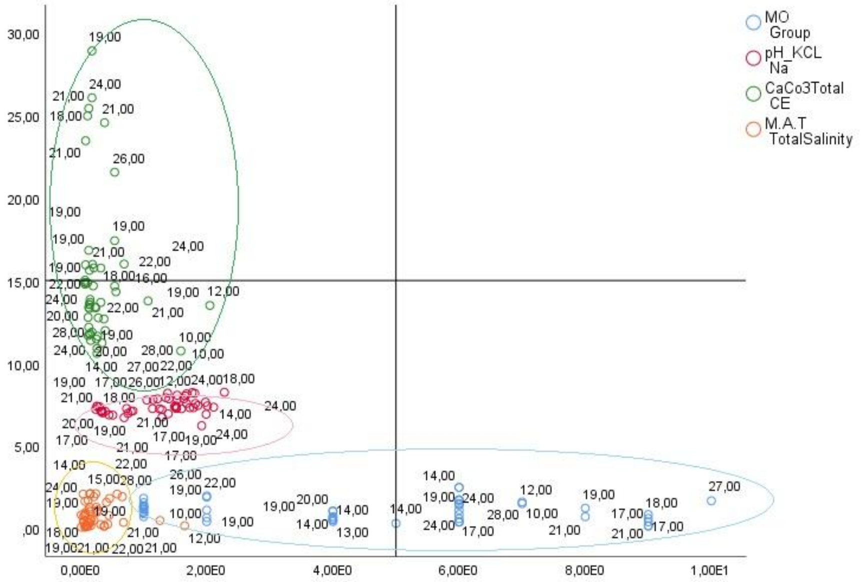

Figure 7. *Multivariate patterns of plant distribution: ecological affinities of functional types under edaphic stress (EC: ElectricalConductivity, OM: Organic Matter, TN: Total Nitrogen, $CaCO_3$: Calcium Carbonate, Na: Sodium PCA / ACP: Principal Component Analysis, KMO: Kaiser–Meyer–Olkin Index)*

Plant diversity indices

Diversity indices were calculated to quantify the richness and evenness of plant communities. The Shannon–Wiener diversity index (H′) for the entire vegetation dataset was computed as follows:

$$H' = -\sum_{i=1}^{S} p_i \cdot \ln(p_i) \quad \text{(Eq.1)}$$

where:
S: total number of species,
p_i: proportion of individuals belonging to species iii,
ln: natural logarithm.

Higher H′ values reflect greater species diversity and a more balanced community structure.

This index integrates species richness and evenness of individual distributions across species. An H′ value of 2.640 suggests moderate to high diversity, indicating a relatively balanced plant community, in which no single species predominates. Recent ecological studies have reported that H′ values between 2 and 3 are typically associated with communities that exhibit good species distribution and low dominance (Moreno et al., 2018). This interpretation is further supported by Zhao et al. (2021), who linked moderate_to_high H′ values to plant systems that maintain functional stability and resilience to environmental pressures. Consequently, the diversity value obtained reflects a certain degree of ecological maturity and structural stability in the community under study.

Analysis of plant life-form types in relation to life cycles and seasonal occurrence revealed a clear dominance of therophytes. These annual species represented the largest group, spanning 24 families and comprising 120 “perennial” and 83 “annual” taxa in the dataset though by strict definition, therophytes are annuals (*Table 1*), this discrepancy likely reflects a classification nuance or recording artifact. Therophytes exhibited a marked seasonal preference for spring and summer, with 194 occurrences recorded during these periods, confirming their adaptive significance in arid steppe ecosystems characterized by abrupt seasonal contrasts (Le Roux et al., 2019; Abd El-Ghani et al., 2020). Hemicryptophytes, covering 19 families (44 perennial and 34 annual species), also showed notable presence. Their survival is ensured by protected basal buds, allowing them to persist through dry seasons and exploit favorable spring, summer conditions (Díaz et al., 2016). Chamaephytes, which are commonly linked to heavily grazed habitats, display intermediate diversity (13 families and 52 perennial species) and are active across multiple seasons, reflecting their structural resilience and ecological plasticity (de Bello et al., 2021). In contrast, life forms such as geophytes, hemiparasites, phanerophytes, and nanophanerophytes are poorly represented, likely because of their specialized ecological requirements and limited adaptability to the prevailing arid conditions (Kumar et al., 2023).This seasonal and functional stratification reflects divergent survival strategies under semi-arid stressors, where temperature extremes and limited water availability exert strong selective pressure on vegetation structure and composition.

Table 1. *Distribution of biological life forms by life cycle and seasonal occurrence in the Djelfa steppe*

Family	Perennial	Annual	Biennial	Spring–Summer	Spring	Summer	Autumn-Winter	Spring-Autumn
24	120	83	3	194	9	3	0	1
19	44	34	0	74	3	2	0	0
13	52	16	1	59	5	3	1	1
5	23	3	0	25	1	0	0	0
12	13	8	0	0	1	19	0	1
1	1	0	0	1	0	0	0	0

Pielou’s evenness index (J′) was also calculated using the formula:

$$J\prime = \frac{H\prime}{\ln(S)} \quad \text{(Eq.2)}$$

where:
H′: Shannon-Wiener Index
S: species richness
J′: ranges from 0 to 1, with values close to 1 indicating high evenness (equal distribution among species), and lower values indicating dominance by a few species.

Where H′ is the Shannon-Wiener diversity index and H′max is the theoretical maximum diversity for a community with *S* species, assuming equal abundance among all species. An evenness value (J′) close to 1 indicates a nearly perfect distribution of individuals among species, indicating that all species have an almost equal abundance.

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This condition is exceptionally rare in natural ecosystems, particularly in semi-arid environments, where the community structure is typically shaped by dominant and stress-tolerant species (Zhao et al., 2021). In applied ecological studies, J′ values ranging between 0.6 and 0.9 are generally interpreted as reflecting a well-balanced but realistic species distribution (Chao et al., 2019). Thus, the value of approximately 1 obtained in our analysis may suggest an unusually homogeneous community, possibly due to recent disturbances or restoration, or point to potential methodological inconsistencies in estimating species richness (S) or computing H′max. Because J′ is mathematically bounded between 0 and 1, a value slightly above 1 warrants cautious interpretation and possible verification of the input data and assumptions.

Shannon index (H′ = 2.640) and species diversity

The Shannon index, *H′* is a key indicator of ecological diversity, accounting for both the total number of species (species richness) and the evenness of their distribution (how individuals are spread among species). An *H′* of 2.640 is relatively high for a natural plant community, suggesting a community with good species diversity; in other words, many species are present, and individuals are distributed fairly evenly among those species. Recent studies have shown that Shannon index values can vary considerably depending on the ecosystem. For example, Wang et al. (2021) found *H′* values ranging from 1.5 to 3.2 for plant communities in China, depending on habitat diversity, indicating that species-rich communities tend to have higher *H′* values (as is the case in our study area). In comparison, Berg et al. (2022) observed Shannon indices of 2.0 to 2.5 in temperate forest ecosystems, which implies a relatively high diversity but not as even as observed in our example. The *H′* value of 2.640 in our study is among the highest values reported, especially in systems where ecological conditions are variable but overall community evenness is maintained.

Theoretical maximum Shannon value (H′ ≈ 2.604)

The theoretical maximum diversity, H′max, represents an ideal scenario, in which each species is equally abundant. In our data, if we consider the presence of 402 species, H′max=ln (402), which is much larger, than 2.604 (note: a value of 2.604 corresponds to a community of approximately 13–14 equally common species when using a natural log). When calculating evenness, a smaller effective species count (approximately 40) may have been considered. In any case, reaching the theoretical maximum *H′* in nature is very difficult, because some variation in individual distributions among species is inevitable. Smith et al. (2020) found that communities with approximately 40 species in a savanna ecosystem tended to approach a high diversity value, although not an absolute maximum. The fact that our observed *H′* was very close to the theoretical maximum for the considered species count suggests an exceptionally balanced distribution of individuals among species, which is rare under natural conditions.

Evenness (J′ = 1.01)

Evenness, measured by *J′*, indicates how evenly individuals are distributed across species. A *J′* value of 1 (100%) denotes perfect evenness. By definition, *J′* can cannot exceed 1. Our calculated *J′* of ~1.01 is an anomalously high result, essentially indicating an extremely uniform distribution of individuals, with almost no single species dominating. In practice, such a value suggests that the community is extraordinarily

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balanced or that there may be an issue with the estimation (e.g., overestimation of species richness or underestimation of the dominant species count). Nonetheless, an extremely high evenness has been observed in some managed ecosystems. For example, López et al. (2021) reported that in sustainable agricultural communities, evenness is often high owing to deliberate management of species and diversity, which is somewhat analogous to what is observed in our case. In contrast, Rao et al. (2022) found a *J′* of 0.85 in high mountain forest communities, indicating a less even distribution with some species dominating. Therefore, the near-perfect evenness in our study area is remarkable and suggests that the ecosystem under study is extremely balanced, potentially because of the particular environmental conditions or the scale of observation.

In summary, the diversity indices in our study depicted an exceptionally diverse and well balanced plant community. The *H′* and *J′* values were among the highest recorded in the natural ecosystems. Such high diversity and evenness are typically observed only in well-managed ecosystems or areas where ecological conditions strongly favor biodiversity. Comparisons with other studies highlight that Shannon index values approaching their theoretical maximum and very high evenness values are generally associated with optimal diversity and conservation. The results for $H' = 2.640$ and $J' \approx 1.0$ in our example underscore the importance of ecological management and conservation efforts in maintaining healthy, balanced ecosystems. They suggested that; relative to many other systems, the plant community in this part of Djelfa is very well balanced, with minimal dominance by particular species.

The PCA plot illustrates the distribution of observed life-form modalities (numbered points) across two principal components, with component 1 explaining 63.64% of the variance and component 2 accounting for 20.42%, supporting the robustness of the ordination model (*Fig. 8*). Three distinct clusters emerge from the analysis:

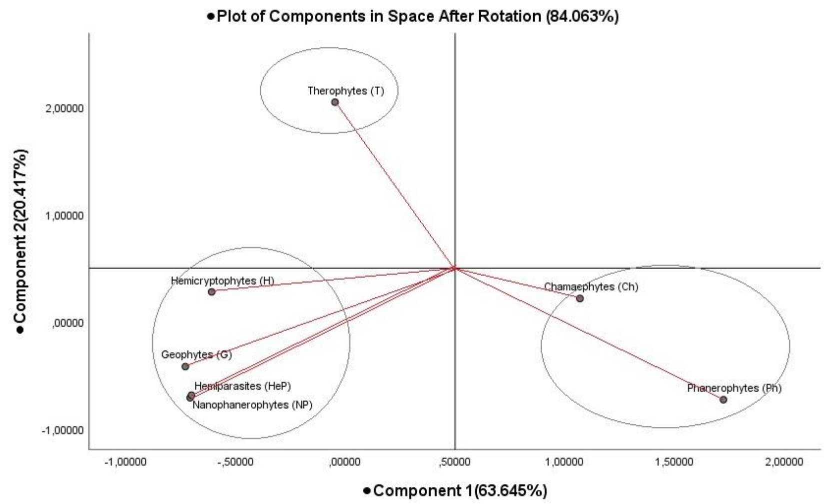

Figure 8. *Principal component analysis (PCA) of plant life-form types along two principal axes (84.06% of total variance explained)*

The first cluster (modalities 2, 5, and 19), located in the lower-left quadrant, suggests strong similarity among these entities, typically representing stress-tolerant life forms such as geophytes or hemicryptophytes, which are adapted to climatic variability and seasonal extremes (Díaz et al., 2016; Pierce et al., 2017).

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The second cluster (modalities 12 and 13), positioned at the far right of the first axis, exhibited a high contribution to component 1 and was likely associated with opportunistic strategies, such as those observed in the dominant therophytes of arid and semi-arid ecosystems (Le Roux et al., 2019).

Point 24, isolated near the top of the plot (along component 2), stands out as an ecologically distinct modality, possibly corresponding to a less common woody life form, such as nanophanerophytes or hemiparasites, which are often under-represented in harsh steppe systems (Kumar et al., 2023).

This multivariate ordination clearly reflects the ecological differentiation among life-form types and reinforces the usefulness of PCA in detecting major environmental and functional gradients in semi-arid floristic assemblages (de Bello et al., 2021).

The map highlights the pronounced spatial heterogeneity of land cover in the steppe region of Djelfa, characterized by the dominance of *Artemisia herba-alba* formations an iconic species of the Algerian arid steppes known for its high drought tolerance and resistance to grazing pressure (Abd El-Ghani et al., 2020; Zerrouki et al., 2022). Light green areas indicate more complex plant associations involving species such as *Noaea mucronata*, typically found on stony or gypseous substrates (Boulahbal et al., 2019; Medail et al., 2021). Extensive stands of *Stipa tenacissima* and *Lygeum spartum* (shown in yellow and light brown) dominate the southern and central zones, reflecting perennial vegetation adapted to deep soils and sloped terrains. These species are traditionally valued for their role in artisanal fiber production and soil stabilization (Zemmouri et al., 2021).

Degraded zones (in red) and cleared areas (in pink) indicate an ongoing process of land degradation, largely driven by overgrazing, agricultural expansion (orange zones), and the growth of urban settlements. Reforested units (dark green) are more localized but illustrate current restoration and anti-desertification efforts (*Fig. 9*), often implemented within national and international environmental frameworks (FAO, 2020; Achour et al., 2022).

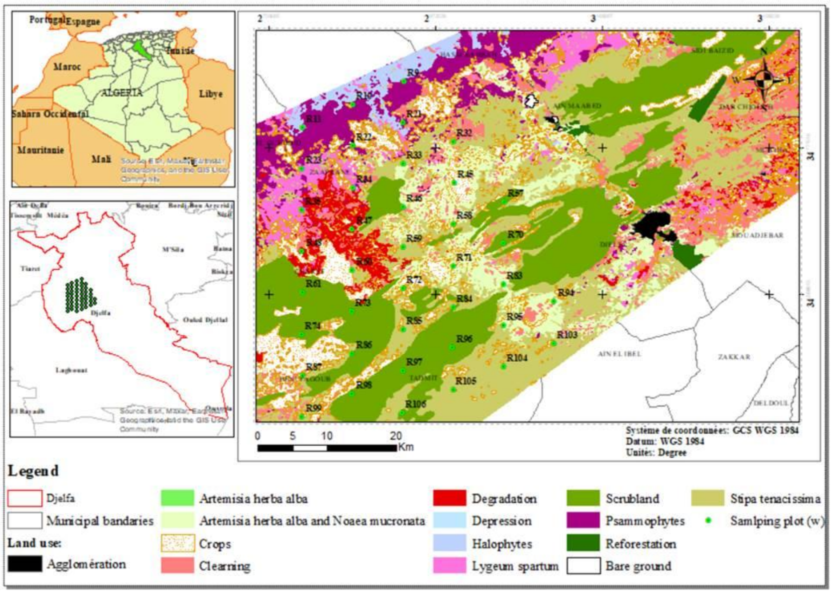

Figure 9. *Ordination of plant life-form types by principal components according to their ecological affinities in the Djelfa steppe*

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The map also displays systematically distributed sampling plots (green dots), ensuring adequate ecological representativeness for analyzing regional plant diversity. Altogether, the figure reflects the complex mosaic of steppe landscapes in Algeria's semi-arid zones, shaped by interacting ecological, topographical, and anthropogenic gradients.

The PCA of plant life-form types reveals a clear ecological structuring within the Djelfa steppe. Therophytes (T) and hemicryptophytes (H), both strongly correlated with the first principal component (explaining 60.21% of total variance) (*Fig. 10*), indicate the prevalence of short-lived, stress-tolerant species well-adapted to unstable semi-arid environments that favor rapid life cycles and regeneration strategies (Le Roux et al., 2019; Kumar et al., 2023). Chamaephytes (Ch), located near the center of the ordination plot, represent intermediate adaptive strategies, often associated with steppe ecosystems exposed to recurrent grazing and moderate soil disturbance. Their central position suggests ecological plasticity and resilience to anthropogenic pressure (de Bello et al., 2021; Bencherif et al., 2022). Nanophanerophytes (NP), showing a strong correlation with the second component (39.78%), appear to be more influenced by microhabitat variables, such as soil depth or local humidity, possibly linked to protected ecological niches. In contrast, geophytes (G), hemiparasites (HeP), and phanerophytes (Ph) display weak correlations with both components and are more sporadically represented in the dataset. Their distribution likely reflects sensitivity to aridity and the specificity of their ecological requirements (Kattge et al., 2020; Zhao et al., 2021). Overall, this multivariate ordination highlights divergent adaptive strategies across life-form categories, shaped by the intense selective pressures of the steppe environment.

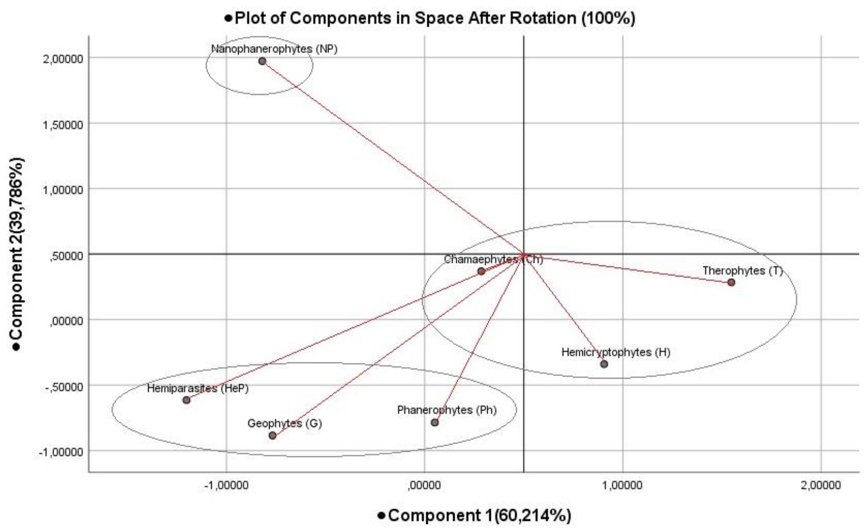

Figure 10. *Principal component analysis reveals functional divergence and adaptive strategies of plant life-forms in the Djelfa steppe ecosystem*

The analysis of life-form types based on taxonomic classification reveals a clear dominance of therophytes, with 201 species distributed across only two families. This pattern suggests a strong adaptation to unstable or disturbed environments, which are typical of arid and semi-arid climates. Similar findings were reported by Kumar et al. (2023) in the Ratle H.E. Project watershed in India, where therophytes accounted for

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33.85% of the flora (*Table 2*). Hemicryptophytes, represented by 81 species across 13 families, also show a significant presence, characteristic of steppe and temperate regions (Pignatti et al., 2005). In contrast, chamaephytes, with 66 species belonging to 24 families, reflect adaptation to drought conditions and grazing pressure, as noted by Quézel (2000) in Mediterranean environments.

Table 2. *Lists of biological types classified by taxonomy and species*

Biological Cycle	Chamaephyte	Geophyte	Hemicryptophyte	Hemiparasite	Nanophanerophyte	Phanerophyte	Therophyte
A taxonomic family	24	19	13	5	12	1	2
species	66	27	81	1	2	23	201

Geophytes (27 species from 19 families) demonstrate their survival strategy under strong seasonal variation through their underground storage organs, as originally described by Raunkiaer (1934). Conversely, phanerophytes (23 species, all from a single family) and nanophanerophytes (2 species across 12 families) are poorly represented, likely due to climatic constraints limiting woody plant development. Hemiparasites, with only one species across five families, remain marginal, reflecting their specific ecological interactions.

This distribution clearly illustrates a flora strongly shaped by local ecological conditions, as confirmed by several studies on the biogeography of North African steppe regions (Benhouhou et al., 2016).

Hierarchical cluster analysis (using the UPGMA method) visualizes similarity structures among the studied floristic entities (*Fig. 11*). A clear hierarchical organization emerged, with two main clusters forming at an average dissimilarity distance of approximately 15, indicating a marked differentiation between the two sets of floristic/ecological groups.

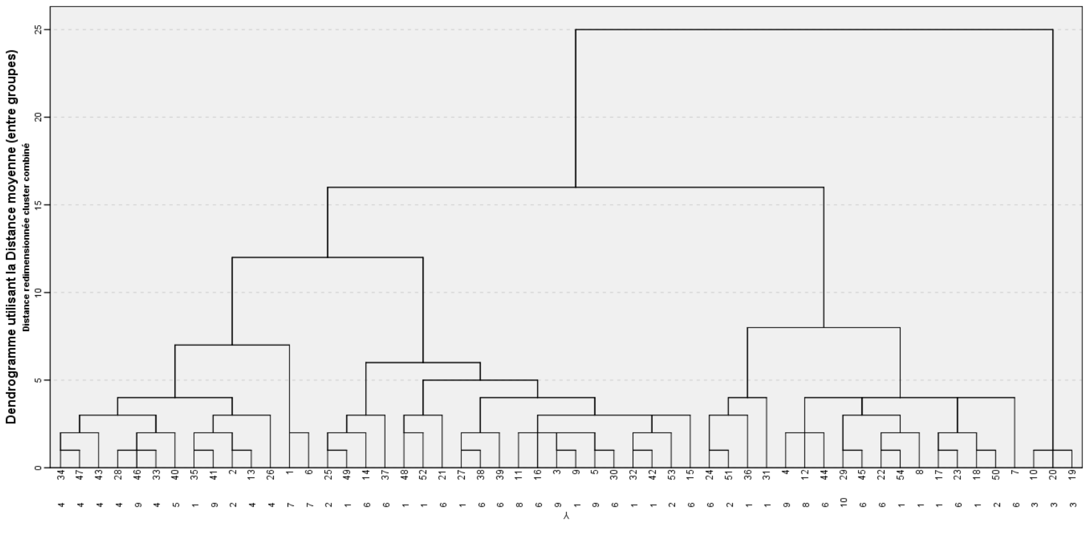

Figure 11. *Dendrogram of plant life-form types based on their ecological affinities*

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Each main cluster was further subdivided into homogeneous sub-groups, suggesting ecological, functional, or biogeographical proximity among the species or life-form types within each subgroup. This type of structure is typical of semi-arid ecosystems, where environmental constraints (periods of drought, poor soils, and overgrazing) favor groupings of species with convergent adaptive strategies (Benhouhou et al., 2016; Quézel, 2000). The existence of well-defined clusters reinforces the value of multivariate analysis in understanding local vegetation dynamics, especially in the context of biodiversity management or conservation (Kumar et al., 2023).

Conclusion

This floristic assessment of the eastern part of Djelfa Province revealed an exceptional diversity of angiosperms, with 427 species belonging to 44 families. The Asteraceae (20.1%) and Fabaceae (13.8%) families were the most dominant. The biological spectrum was largely dominated by therophytes (53.3%), followed by hemicryptophytes (20.1%), indicating strong adaptation to harsh climatic conditions and anthropogenic disturbances. The highest species richness was observed in the spring season (337 species), while the lowest was recorded in winter (79 species), highlighting significant seasonal variability.

Among the recorded species, 31 were identified as exotic, and more than 90 species are traditionally used for medicinal purposes, reflecting the region's strong ethnobotanical heritage. Several rare and narrowly distributed taxa were observed, including Ziziphus lotus, Retama raetam, and Salsola vermiculata, underlining the conservation value of the study area. The floristic composition varied significantly between stations, with Principal Component Analysis showing strong correlations between plant diversity and edaphic variables such as salinity, sodium content, and organic matter.

Land use mapping revealed considerable habitat fragmentation and degradation, particularly in zones affected by overgrazing and agricultural expansion. The detection of bare soil, forest clearings, and reduced vegetation cover further indicates cumulative human pressures on native plant communities.

These results underline the need to establish long-term floristic monitoring programs, implement conservation strategies for vulnerable habitats, and promote sustainable land use practices. Encouraging community awareness and integrating biodiversity data into regional planning are essential steps toward preserving the floristic richness and ecological stability of Algeria's steppe ecosystems.

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APPENDIX

Appendix A. *List of species and their flowering phenology (type and biological cycle)*

Species	Family	Biological Type	Flowering Period	Biological Cycle
Centaurea pomeliana (Batt.)	Asteraceae	Chamophyte	Spring-Summer	Biennial
Myosotis versicolor (Pers.) Smith = M. discolor	Boraginaceae	Thérophyte	Spring-Summer	Annual
Nardurus maritimus (L.) Janchen	Poaceae	Thérophyte	Spring-Summer	Annual
Silene tridentata (Desf.)	Caryophyllaceae	Thérophyte	Spring-Summer	Perennial
Adonis aestivalis (L.)	Renonculaceae	Thérophyte	Spring-Summer	Annual
Adonis dentata Del.	Renonculaceae	Thérophyte	Spring-Summer	Annual
Aegilops triuncialis (L.)	Poaceae	Thérophyte	Spring-Summer	Annual
Aeluropus littoralis (Gouan.) Parl	Poaceae	Hémicryptophyte	Spring-Summer	Perennial
Ajuga chamaepitys (Schreber.)	Lamiaceae	Chamophyte	Spring-Summer	Annual
Ajuga iva (L.) Schreb	Lamiaceae	Chamophyte	Spring-Summer	Perennial
Allium chamaemoly (L.)	Liliaceae	Géophyte	Spring	Perennial
Allium paniculatum (L.) ssp. typicum	Liliaceae	Géophyte	Spring-Summer	Perennial
Allium roseum (L.)	Liliaceae	Géophyte	Spring-Summer	Perennial
Alyssum alpestre (L.)	Brassicaceae	Thérophyte	Spring-Summer	Perennial
Alyssum granatense Bois et Reut.	Brassicaceae	Thérophyte	Spring-Summer	Perennial
Alyssum macrocalyx Coss et Dur.	Brassicaceae	Thérophyte	Spring-Summer	Perennial
Alyssum parviflora Fisch.	Brassicaceae	Thérophyte	Spring-Summer	Annual
Alyssum scutigerum Dur.	Brassicaceae	Thérophyte	Spring-Summer	Perennial
Ammodaucus leucotrichus Coss. et Dur.	Apiaceae	Thérophyte	Spring-Summer	Annual
Ammoides atlantica (Coss. et Dur.) Wolf	Apiaceae	Hémicryptophyte	Spring-Summer	Annual
Ampelodesma mauritanica (Poir.) Dur. et Schinz	Poaceae	Géophyte	Spring-Summer	Perennial

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Species	Family	Biological Type	Flowering Period	Biological Cycle
Anacyclus clavatus (Desf.)	Asteraceae	Thérophyte	Spring-Summer	Annual
Anacyclus cyrtolepidioides (Pomel.)	Asteraceae	Thérophyte	Spring-Summer	Annual
Anacyclus radiatus (Lois.)	Asteraceae	Thérophyte	Spring-Summer	Annual
Anacyclus valentinus (L.)	Asteraceae	Thérophyte	Spring-Summer	Annual
Anarrhinum fruticosum (Desf.)	Scrophulariaceae	Thérophyte	Spring-Summer	Perennial
Androsace maxima (L.)	Primulaceae	Thérophyte	Spring-Summer	Annual
Anthemis pedunculata Desf.	Asteraceae	Hémicryptophyte	Spring-Summer	Annual
Anthyllis sericea (L.) ssp. sericea (Lag.)	Fabaceae	Chaméphyte	Spring-Summer	Perennial
Arabis auriculata Lam.	Brassicaceae	Thérophyte	Spring-Summer	Annual
Arabis verna (L.) W.T. Aiton	Brassicaceae	Thérophyte	Spring-Summer	Annual
Arceuthobium oxycedri (DC.) M. Bieb.	Viscaceae	Hémiparasite	Spring-Summer	Perennial
Arenaria serpyllifolia (Rchb.) Guss	Caryophyllaceae	Thérophyte	Spring-Summer	Annual
Aristida pungens (Desf.)	Poaceae	Hémicryptophyte	Spring-Summer	Perennial
Aristida ciliata Desf.	Grammineae	Hémicryptophyte	Spring-Summer	Annual
Artemisia campestris (L.)	Asteraceae	Chamophyte	Spring-Summer	Perennial
Artemisia herba-alba (Asso)	Asteraceae	Chamophyte	Spring-Summer	Perennial
Asparagus acutifolius L.	Liliaceae	Phanérophyte	Spring-Summer	Perennial
Astragalus armatus Willd.	Fabaceae	Chamophyte	Spring-Summer	Perennial
Astragalus caprinus (L.)	Fabaceae	Chamophyte	Spring-Summer	Perennial
Astragalus caprinus ssp. lanigerus (Desf.) Maire	Fabaceae	Chamophyte	Spring-Summer	Perennial
Astragalus crucialus (Link)	Fabaceae	Chamophyte	Spring-Summer	Perennial
Astragalus gombo (Coss.) et Dur.	Fabaceae	Chamophyte	Spring-Summer	Perennial
Astragalus incanus (L.)	Fabaceae	Chamophyte	Spring-Summer	Perennial
Astragalus monspessulanus (L.)	Fabaceae	Chamophyte	Spring-Summer	Perennial
Astragalus scorioides (Pourret)	Fabaceae	Chamophyte	Spring-Summer	Perennial
Astragalus senaicus (Senicus)	Fabaceae	Chamophyte	Spring-Summer	Perennial
Astragalus sesameus (L.)	Fabaceae	Chamophyte	Spring-Summer	Perennial
Atractylis echinata (Pomel.)	Asteraceae	Thérophyte	Spring-Summer	Perennial
Atractylis caerulea (Batt.)	Asteraceae	Thérophyte	Spring-Summer	Perennial
Atractylis cancellata (L.) Steeppe	Asteraceae	Thérophyte	Spring-Summer	Perennial

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Species	Family	Biological Type	Flowering Period	Biological Cycle
Atractylis carduus (Forsk.) Christ.	Asteraceae	Thérophyte	Spring-Summer	Perennial
Atractylis humilis (L.)	Asteraceae	Thérophyte	Spring-Summer	Perennial
Atractylis humilis ssp. caespitosa (Desf.) M.	Asteraceae	Thérophyte	Spring-Summer	Perennial
Atractylis phaeolepis (Pomel.)	Asteraceae	Thérophyte	Spring-Summer	Perennial
Atractylis polycephala (Coss.)	Asteraceae	Thérophyte	Spring-Summer	Perennial
Atractylis serratuloides (Sieb.)	Asteraceae	Thérophyte	Spring-Summer	Annual
Atriplex halimus (L.)	Chenopodiaceae	Nanophanérophyte	Spring-Summer	Annual
Avena breviaristata (Barratte ex Trab.) Holub	Poaceae	Hémicryptophyte	Spring-Summer	Annual
Avena bromoides (Gouan.)	Poaceae	Hémicryptophyte	Spring-Summer	Annual
Bascurtella didyma	Crucifereae	Chamophyte	Spring-Summer	Perennial
Bassia muricata (L.) Asch.	Chenopodiaceae	Thérophyte	Spring-Summer	Biennial
Bellis silvestris Cyrillo	Asteraceae	Hémicryptophyte	Spring-Summer	Annual
Beta vulgaris (L.)	Chenopodiaceae	Thérophyte	Spring-Summer	Annual
Biscutella didyma (L.)	Crucifereae	Thérophyte	Spring-Summer	Annual
Boreava aptera Bois	Crucifereae	Thérophyte	Spring-Summer	Annual
Brachyapium dichotomum (L.) Maire (Stoibrax dichotomum (L.) Raf.)	Apiaceae	Thérophyte	Spring-Summer	Annual
Bromus hordaceus (L.)	Poaceae	Thérophyte	Spring-Summer	Annual
Bromus madritensis (L.)	Poaceae	Thérophyte	Spring-Summer	Annual
Bromus ramasum (L.) R. et S.	Poaceae	Thérophyte	Spring-Summer	Annual
Bromus rubens (L.)	Poaceae	Thérophyte	Spring-Summer	Annual
Bromus squarrosus (L.)	Poaceae	Thérophyte	Spring-Summer	Perennial
Bromus tectorum (L.)	Poaceae	Thérophyte	Spring-Summer	Perennial
Buffonia perennis Pourr.	Caryophyllaceae/Alsinoideae	Chamophyte	Spring-Summer	Perennial
Buffonia tenuifolia Griseb.	Caryophyllaceae/Alsinoideae	Chamophyte	Spring-Summer	Perennial
Bunium macuca Boiss.	Apiaceae	Géophyte	Spring-Summer	Perennial
Bupleurum atlanticum Murb.	Apiaceae	Hémicryptophyte	Spring-Summer	Annual
Bupleurum balansae Boiss. et Reut.	Apiaceae	Hémicryptophyte	Spring-Summer	Annual
Calendula aegyptiaca Desf.	Asteraceae	Thérophyte	Spring-Summer	Perennial
Calendula arvensis ssp. communis (Emb. et M.)	Asteraceae	Thérophyte	Spring-Summer	Perennial
Callitris articulata (Vahl.) Link (Thuya)	Cupressaceae	Phanérophyte	Spring-Summer	Perennial

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Calycotome spinosa (L.) Lamk.	Fabaceae	Phanérophyte	Spring-Autumn	Annual
Calycotome villosa (Poiret.) Link.	Fabaceae	Phanérophyte	Spring-Summer	Perennial
Capsella bursa-pastoris (L.)	Cruciferae	Thérophyte	Spring-Summer	Perennial
Carduncellus duvauxii Batt.	Asteraceae	Hémicryptophyte	Spring-Summer	Perennial
Carduncellus pinnatus (Desf.) DC.	Asteraceae	Hémicryptophyte	Spring-Summer	Perennial
Carduncellus plumosus (Pomel.)	Asteraceae	Chamophyte	Spring-Summer	Perennial
Carduncellus pomelianus Batt.	Asteraceae	Hémicryptophyte	Spring-Summer	Perennial
Carduus getulus Pomel.	Asteraceae	Hémicryptophyte	Spring-Summer	Perennial
Carex divisa Huds.	Cyperaceae	Hémicryptophye	Spring-Summer	Perennial
Carex halleriana Asso.	Cyperaceae	Hémicryptophye	Spring-Summer	Annual
Carlina involucrata ssp. corymbosa (Q. et S.)	Asteraceae	Chaméphyte	Spring-Summer	Perennial
Catapodium loliaceum (Huds.) Link.	Poaceae	Thérophyte	Spring-Summer	Annual
Centaurea alba L.	Asteraceae	Chamophyte	Spring-Summer	Perennial
Centaurea melitensis (L.)	Asteraceae	Chamophyte	Spring-Summer	Perennial
Centaurea parviflora (Desf.)	Asteraceae	Chamophyte	Spring	Annual
Centaurea pengens (Pomel)	Asteraceae	Chamophyte	Spring-Autumn	Annual
Ceratocephalus falcatus (L.) Pers. ssp. incurvus Stev.	Renonculaceae	Thérophyte	Spring-Autumn	Annual
Chenopodium album (L.)	Chenopodiaceae	Hémicryptophyte	Spring-Summer	Annual
Chenopodium murale (L.)	Chenopodiaceae	Hémicryptophyte	Spring-Summer	Annual
Chrysanthemum fuscatum Desf.	Asteraceae	Thérophyte	Spring-Summer	Annual
Cistus villosus L. var. creticus	Cistaceae	Phanérophyte	Spring-Summer	Annual
Cistus villosus L. var. mauritanicus Grosser.	Cistaceae	Phanérophyte	Spring-Summer	Annual
Coronilla scorpioides Koch.	Fabaceae	Thérophyte	Spring-Summer	Annual
Ctenopsis pectinella (Del.) De Not.	Poaceae	Thérophyte	Spring-Summer	Biennial
Cutandia dichotoma var. memphitica (Roth.) M. et W.	Poaceae	Thérophyte	Spring-Summer	Biennial
Cutandia divaricata (Desf.) Benth.	Poaceae	Thérophyte	Spring-Summer	Perennial
Cutandia vallessina (Honck.) Gaud.	Poaceae	Thérophyte	Spring-Summer	Perennial
Cynoglossum cheirifolium L.	Boraginaceae	Hémicryptophyte	Spring-Summer	Perennial
Cynoglossum clandestinum Desf.	Boraginaceae	Hémicryptophyte	Spring-Summer	Annual
Cytisus fontanesii Spach.	Fabaceae	Chaméphyte	Spring-Summer	Annual
Dactylis glomerata (L.)	Poaceae	Hémicryptop	Spring-	Annual

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		hyte	Summer	
Delphinium pubescens DC.	Renonculaceae	Thérophyte	Spring-Summer	Annual
Diplotaxis erucoides (L.)	Crucifereae	Thérophyte	Spring-Summer	Perennial
Diplotaxis harra (Forsk.) Boiss.	Crucifereae	Thérophyte	Spring-Summer	Annual
Diplotaxis pitardiana (Maire)	Crucifereae	Thérophyte	Spring-Summer	Perennial
Diplotaxis virgata DC.	Crucifereae	Thérophyte	Spring-Summer	Perennial
Ebenus pinnata L.	Fabaceae	Chaméphyte	Spring-Summer	Perennial
Echinaria capitata (L.) Desf.	Poaceae	Thérophyte	Summer	Perennial
Echinops spinosus L.	Asteraceae	Chamophyte	Autumn-Winter	Perennial
Echium pycnanthum (Pomel) ssp. humile (Desf.) Jah. et M.	Boraginaceae	Hémicryptophyte	Spring-Summer	Annual
Echium trygorrhizum (Pomel.)	Boraginaceae	Hémicryptophyte	Spring-Summer	Annual
Epipactis helleborine (L.) Crantz.	Orchidaceae	Géophyte	Spring-Summer	Annual
Erica multiflora (L.)	Crucifereae	Thérophyte	Spring-Summer	Annual
Erodium bipinnatum (Willd.)	Geraniaceae	Thérophyte	Spring-Summer	Annual
Erodium botrys (Cav.) Betel	Geraniaceae	Thérophyte	Spring-Summer	Annual
Erodium cicutarium (L'Her.)	Geraniaceae	Thérophyte	Spring-Summer	Annual
Erodium glaucophyllum (L'Her.)	Geraniaceae	Thérophyte	Spring-Summer	Annual
Erodium hirtum (Desf.)	Geraniaceae	Thérophyte	Spring-Summer	Annual
Erodium hymenodes (L'Her.)	Geraniaceae	Thérophyte	Spring-Summer	Annual
Erodium malachoides (L.) Willd.	Geraniaceae	Thérophyte	Spring-Summer	Annual
Erodium meynieri Maire.	Geraniaceae	Thérophyte	Spring-Summer	Annual
Erodium polyanthemum (Desf.) Pers.	Geraniaceae	Thérophyte	Spring-Summer	Perennial
Erodium triangulare ssp. lacialum (Cav.) Muschler	Geraniaceae	Thérophyte	Spring-Summer	Perennial
Eruca vesicaria (L.) Cav. ssp. vesicaria (L.) Briq.	Brassicaceae	Thérophyte	Spring-Summer	Perennial
Eruca vesicaria ssp. pannatifida (Desf.) Emb. et Maire	Brassicaceae	Thérophyte	Spring-Summer	Annual
Eryngium ilicifolium Lam.	Apiaceae	Thérophyte	Spring-Summer	Annual
Erysimum bocconei (All.) Pers.	Brassicaceae	Thérophyte	Spring-Summer	Annual
Erysimum incanum Kunze	Brassicaceae	Thérophyte	Spring-Summer	Annual
Euphorbia falcata (L.)	Euphorbiaceae	Thérophyte	Spring-Summer	Annual
Euphorbia chamaesyce (L.)	Euphorbiaceae	Thérophyte	Spring-Summer	Annual
Euphorbia exigua (L.)	Euphorbiaceae	Thérophyte	Spring-Summer	Annual

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Euphorbia granulata Forsk.	Euphorbiaceae	Thérophyte	Spring-Summer	Annual
Euphorbia helioscopia ssp. helioscopiodes (Losc. et Pardo.) Rouy	Euphorbiaceae	Thérophyte	Spring-Summer	Annual
Euphorbia sulcata de Lens.	Euphorbiaceae	Thérophyte	Spring-Summer	Perennial
Evax argentea Pomel.	Asteraceae	Thérophyte	Spring	Perennial
Filago heterantha (Guss.)	Asteraceae	Thérophyte	Spring	Perennial
Filago spathulata (Pers.)	Asteraceae	Thérophyte	Spring	Perennial
Fumana thymifolia (L.) Verlot.	Cistaceae	Chaméphyte	Spring	Perennial
Gagea arvensis (Pers.) Dumort.	Liliaceae	Géophyte	Spring-Summer	Perennial
Gagea granatilli (Parl.) ssp. eu-granatilli (Terracc.)	Liliaceae	Géophyte	Spring-Summer	Perennial
Gagea mauritanica Dur.	Liliaceae	Géophyte	Spring-Summer	Perennial
Gagea reticulata Pall.	Liliaceae	Géophyte	Spring-Summer	Perennial
Galium palustre L.	Scrophulariaceae	Chaméphyte	Spring-Summer	Annual
Genista erioclada ssp. erioclada (Emb.) et Maire.	Fabaceae	Chaméphyte	Spring-Summer	Annual
Genista microcephala (Coss.) et Dur.	Fabaceae	Chaméphyte	Spring	Perennial
Genista quadriflora Munby.	Fabaceae	Chaméphyte	Spring	Perennial
Geranium dissectum L.	Geraniaceae	Thérophyte	Spring	Perennial
Geranium pyrenaicum Burm.f.	Geraniaceae	Hémicryptophyte	Spring-Summer	Perennial
Gladiolus byzantinus Mill.	Iridaceae	Géophyte	Spring-Summer	Perennial
Gladiolus byzantinus Mill. (G. communis byzantinus)	Iridaceae	Géophyte	Spring-Summer	Perennial
Gladiolus segetum (Ker.) Gawl.	Iridaceae	Géophyte	Spring-Summer	Perennial
Globularia alypum L.	Globulariaceae	Chamaephyte	Spring-Summer	Perennial
Helianthemum ledifolium (L.) Mill.	Cistaceae	Chamophyte	Spring-Summer	Perennial
Helianthemum cinereum (Cav.) Pers. (= Malcomia torulosa)	Cistaceae	Chamophyte	Spring-Summer	Perennial
Helianthemum hirtum (Spreng.) ssp. reficomum	Cistaceae	Chamophyte	Spring-Summer	Perennial
Helianthemum hirtum ssp. ruficomum (Viv.) M.	Cistaceae	Chamophyte	Spring-Summer	Perennial
Helianthemum kahiricum	Cistaceae	Chamophyte	Spring-Summer	Perennial
Helianthemum lipii (L.) Pers.	Cistaceae	Chamophyte	Spring-Summer	Perennial
Helianthemum papillare (Boiss.)	Cistaceae	Chamophyte	Spring-Summer	Perennial
Helianthemum pilosum (L.) Pers.	Cistaceae	Chamophyte	Spring-Summer	Perennial
Helianthemum virgatum	Cistaceae	Chamophyte	Spring-Summer	Perennial
Helianthemum apertum (Pomel.)	Cistaceae	Chamophyte	Spring-Summer	Annual
Helichrysum stoechas (L.) DC.	Asteraceae	Chaméphyte	Spring-Summer	Annual
Helosciadium nodiflorum Lag.	Apiaceae	Hémicryptop	Spring-	Annual

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		hyte	Summer	
Herniaria fontanesii J. (=fruticosa (L.) ssp.)	Caryophyllaceae	Thérophyte	Spring-Summer	Annual
Herniaria glabra L.	Caryophyllaceae	Thérophyte	Spring-Summer	Perennial
Herniaria hirsuta L.	Caryophyllaceae	Thérophyte	Spring-Summer	Perennial
Herniaria incana Lamk.	Caryophyllaceae	Hémicryptophyte	Spring-Summer	Perennial
Herniaria mauritanica (Murb.) Fontanisii Batt.	Caryophyllaceae	Thérophyte	Spring-Summer	Perennial
Hertia cheirifolia (L.) O.K.	Poaceae	Hémicryptophyte	Spring-Summer	Annual
Hippocrepis bicontorta (Loisel.)	Fabaceae	Thérophyte	Spring	Annual
Hippocrepis multisiliquosa (L.) ssp. ciliata (Willd.) Maire	Fabaceae	Thérophyte	Spring-Summer	Perennial
Hippocrepis unisiliquosa (L.)	Fabaceae	Thérophyte	Spring-Summer	Perennial
Hordeum murinum (L.)	Poaceae	Thérophyte	Spring-Summer	Annual
Hypecoum pendulum (L.)	Papaveraceae	Thérophyte	Spring-Summer	Annual
Hypochoeris laevigata	Asteraceae	Hémicryptophyte	Spring	Perennial
Hypochoeris radicata L.	Asteraceae	Hémicryptophyte	Spring-Summer	Perennial
Iberis odorata L.	Brassicaceae	Thérophyte	Spring-Summer	Perennial
Ifloga spicata (Forsk.) Sch. Bip.	Asteraceae	Thérophyte	Spring-Summer	Perennial
Iris sisyrinchium L.	Iridaceae	Géophyte	Spring-Summer	Perennial
Juniperus oxycedrus L.	Cupressaceae	Phanérophyte	Spring-Summer	Perennial
Juniperus phoenica L.	Cupressaceae	Phanérophyte	Spring-Summer	Annual
Jurinea humilis DC.	Asteraceae	Hémicryptophyte	Spring-Summer	Annual
Knautia arvensis (L.) Coult.	Dipsacaceae	Hémicryptophyte	Spring-Summer	Annual
Koeleria pubescens (Lank.) P.B.	Poaceae	Hémicryptophyte	Spring-Summer	Annual
Koelpinia linearis Pallas	Asteraceae	Thérophyte	Spring-Summer	Perennial
Koniga lybica (Viv.)	Brassicaceae	Thérophyte	Spring-Summer	Perennial
Lagurus ovatus L.	Poaceae	Thérophyte	Spring-Summer	Perennial
Lappula redowskii (Hornem.) Greene	Boraginaceae	Thérophyte	Spring-Summer	Perennial
Launaea acanthoclada M.	Asteraceae	Thérophyte	Spring-Summer	Perennial
Launaea angustifolia (Desf.) Muschler	Asteraceae	Thérophyte	Spring-Summer	Perennial
Launaea arborescens (Batt.) M.	Asteraceae	Thérophyte	Spring-Summer	Perennial
Launaea glomerata (Cass.) Hook.f.	Asteraceae	Thérophyte	Spring-Summer	Perennial
Launaea resedifolia ssp. eu-residifolia (M.)	Asteraceae	Thérophyte	Spring-Summer	Perennial

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Leontodon hispanicus (Del.) Boiss.	Asteraceae	Thérophyte	Spring-Summer	Annual
Leontodon hispidulus (Del.) Boiss.	Asteraceae	Thérophyte	Spring-Summer	Annual
Leontodon saxatilis (Lamk.)	Asteraceae	Thérophyte	Spring-Summer	Perennial
Leontodon tuberosus (L.)	Asteraceae	Thérophyte	Spring-Summer	Annual
Lepidium subulatum L.	Asteraceae	Thérophyte	Spring	Perennial
Lepturus cylindricus (Willd.) Trin.	Crucifereae	Chaméphyte	Spring	Perennial
Leuzea conifera (L.) DC.	Poaceae	Thérophyte	Spring	Perennial
Linaria simplex (DC.)	Asteraceae	Hémicryptophyte	Spring-Summer	Perennial
Linum gallicum (L.)	Scrophulariaceae	Chamophyte	Spring-Summer	Perennial
Linum decumbens Desf.	Linaceae	Hémiryptophyte	Spring	Annual
Linum strictum (L.)	Linaceae	Hémiryptophyte	Spring-Summer	Perennial
Linum suffruticosum (L.)	Linaceae	Hémiryptophyte	Spring-Summer	Perennial
Lithospermum apulum (L.) Vahl.	Linaceae	Hémiryptophyte	Spring	Annual
Lithospermum arvense (L.)	Boraginaceae	Thérophyte	Spring-Summer	Annual
Lobularia lybica (Viv.) Webb	Boraginaceae	Thérophyte	Spring-Summer	Perennial
Lobularia maritima (L.) Desv.	Crucifereae	Thérophyte	Spring-Summer	Annual
Loeflingia hispanica L.	Crucifereae	Hémicryptophyte	Spring-Summer	Perennial
Lolium multiflorum Lam.	Caryophyllaceae	Thérophyte	Spring-Summer	Perennial
Lolium perenne (L.)	Poaceae	Thérophyte	Spring-Summer	Perennial
Lolium rigidum (Gaud.)	Poaceae	Thérophyte	Spring-Summer	Perennial
Lonicera implexa L.	Poaceae	Thérophyte	Spring-Summer	Perennial
Lotus creticus (L.) ssp. collinus (Boiss.) Briquet	Caprifoliaceae	Phanérophyte	Spring-Summer	Perennial
Lotus creticus (L.) ssp. eu-creticus (Briquet.)	Fabaceae	Chaméphyte	Spring-Summer	Perennial
Lotus edulis L.	Fabaceae	Chaméphyte	Spring-Summer	Perennial
Lotus jolyi Batt.	Fabaceae	Thérophyte	Spring-Summer	Perennial
Lotus ornithopodioides L.	Fabaceae	Hémicryptophyte	Spring-Summer	Perennial
Lotus parviflorus Desf.	Fabaceae	Thérophyte	Spring-Summer	Annual
Lotus pusillus Medik.	Fabaceae	Thérophyte	Spring-Summer	Annual
Lotus villosus (Forsk.) pusillus (Medik.)	Fabaceae	Hémicryptophyte	Spring-Summer	Annual
Lygeum spartum (L.)	Fabaceae	Hémicryptophyte	Spring-Summer	Annual
Malcolmia aegyptiaca Spr.	Poaceae	Hémicryptophyte	Spring-Summer	Annual

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Malcolmia torulosa (Desf.) Boiss.	Crucifereae	Thérophyte	Spring-Summer	Perennial
Malva aegyptiaca (L.)	Crucifereae	Thérophyte	Spring	Annual
Malva aegyptiaca (L.)	Malvaceae	Thérophyte	Spring-Summer	Perennial
Malva parviflora (L.)	Malvaceae	Thérophyte	Spring-Summer	Perennial
Malva sylvestris (L.)	Malvaceae	Thérophyte	Spring-Summer	Perennial
Mantisalca salmantica (L.) Brq et Cavill	Malvaceae	Thérophyte	Spring-Summer	Perennial
Matthiola fructicosa (L.) Maire	Asteraceae	Thérophyte	Spring-Summer	Perennial
Matthiola longipetala (Vent.) DC. ssp. livida (Del.) Maire	Brassicaceae	Thérophyte	Spring-Summer	Perennial
Matthiola longipetala ssp. kralikii (Pomel.) Maire	Brassicaceae	Thérophyte	Spring-Summer	Perennial
Medicago italica (Mill.) Steud. ssp. helix (Willd.) Emb. et Maire	Brassicaceae	Thérophyte	Spring-Summer	Perennial
Medicago laciniata (L.) All.	Fabaceae	Thérophyte	Spring-Summer	Perennial
Medicago litoralis (Rohde.)	Fabaceae	Thérophyte	Spring-Summer	Annual
Medicago minima (Gruft.)	Fabaceae	Thérophyte	Spring-Summer	Perennial
Medicago truncatula (Gearn.)	Fabaceae	Thérophyte	Spring	Perennial
Medicago turbinata (L.) Wild.	Fabaceae	Thérophyte	Spring-Summer	Perennial
Melilotus indica (L.) All	Fabaceae	Thérophyte	Spring-Summer	Perennial
Mentha pulegium L.	Fabaceae	Thérophyte	Spring-Summer	Annual
Micropus bombicinus (Lag.)	Lamiaceae	Chaméphyte	Spring-Summer	Perennial
Minuartia campestris (L.)	Asteraceae	Thérophyte	Spring-Summer	Perennial
Minuartia tenuifolia (L.) Hiern.	Caryophyllaceae	Thérophyte	Spring-Summer	Perennial
Moricandia arvensis (L.) DC.	Caryophyllaceae	Thérophyte	Spring-Summer	Perennial
Mpelodesma mauritanica	Brassicaceae	Chamophyte	Spring-Summer	Perennial
Muricaria prostrata (Desf.)	Plantaginaceae	Thérophyte	Spring-Summer	Perennial
Muscari comosum (L.) Mill.	Brassicaceae	Thérophyte	Spring-Summer	Perennial
Muscari maritimum Desf.	Liliaceae	Géophyte	Spring-Summer	Perennial
Muscari parviflora Desf.	Liliaceae	Géophyte	Spring-Summer	Perennial
Myosotis scorpioides var. collina Ehrh	Liliaceae	Géophyte	Spring-Summer	Perennial
Myosotis scorpioides var. collina Ehrh	Boraginaceae	Thérophyte	Spring-Summer	Perennial
Nardurus cynosuroides (Desf.) B. et T.	Boraginaceae	Thérophyte	Spring-Summer	Perennial
Noaea mucronata (Forsk.) Asch.	Poaceae	Thérophyte	Spring-Summer	Perennial
Nonnea micronatha Boiss. et Reut.	Chenopodiaceae	Chamophyte	Summer	Perennial

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Nonnea visicaria (L.) Rsch.	Boraginaceae	Thérophyte	Summer	Perennial
Olea sylvestris L.	Boraginaceae	Thérophyte	Spring-Summer	Perennial
Onobrychis viciifolia Scop.	Oleaceae	Phanérophyte	Spring	Perennial
Onopordon acaule (L.)	Fabaceae	Hémicryptophyte	Spring-Summer	Annual
Onopordon arenarium (Desf) Pomel	Asteraceae	Hémicryptophyte	Spring-Summer	Annual
Ophrys lutea (Cav.) Gouan	Asteraceae	Hémicryptophyte	Spring-Summer	Annual
Orchis sp. L.	Orchidaceae	Géophyte	Spring-Summer	Perennial
Papaver rhoeas (L.)	Orchidaceae	Géophyte	Spring-Summer	Perennial
Papaver hybridum (L)	Papaveraceae	Thérophyte	Spring-Summer	Annual
Papaver malviflorum (Doum.)	Papaveraceae	Thérophyte	Spring-Summer	Perennial
Paronichia capitata ssp. chlorothyrum (Murberk.) Maire	Papaveraceae	Thérophyte	Spring-Summer	Perennial
Paronychia arabica (L.) Dc ssp. cossoniana (Gay)	Caryophyllaceae	Hémicryptophyte	Spring-Summer	Perennial
Paronychia arabica ssp. annua (Del) Maire	Caryophyllaceae	Hémicryptophyte	Spring-Summer	Perennial
Paronychia argentea (Pourr.) Lamk	Caryophyllaceae	Hémicryptophyte	Spring-Summer	Perennial
Paronychia capitata (L.) Lamk	Caryophyllaceae	Hémicryptophyte	Spring-Summer	Perennial
Peganum harmala (L.)	Caryophyllaceae	Hémicryptophyte	Spring-Summer	Perennial
Phagnalon rupestre (L.) DC.	Zygophylaceae	Chamophyte	Spring-Summer	Perennial
Phagnalon saxatile (L.) Cass.	Asteraceae	Chamophyte	Spring-Summer	Perennial
Phillyrea angustifolia L.	Asteraceae	Chamophyte	Spring-Summer	Annual
Pinus halepensis Mill.	Oleaceae	Phanérophyte	Spring-Summer	Annual
Pistacia lentiscus (L.)	Pinaceae	Phanérophyte	Spring-Summer	Annual
Pistacia terebenthus (L.)	Anacardiaceae	Hémicryptophyte	Spring-Summer	Annual
Plantago albicans L.	Anacardiaceae	Hémicryptophyte	Spring-Summer	Perennial
Plantago amplexicaule Cav.	Plantaginaceae	Hémicryptophyte	Summer	Annual
Plantago ciliata	Plantaginaceae	Thérophyte	Summer	Annual
Plantago psyllium ((L.))	Plantaginaceae	Thérophyte	Spring-Summer	Perennial
Poa bulbosa (L.)	Plantaginaceae	Thérophyte	Spring-Summer	Perennial
Polygonum aviculare (L.)	Poaceae	Hémicryptophyte	Spring-Summer	Perennial
Polygonum equisitiforme S et Sm.	Polygonaceae	Thérophyte	Spring-Summer	Annual
Pseudognaphalium luteoalbum (L.) Hilliard & B.L.Burtt	Polygonaceae	Chaméphyte	Spring-Summer	Annual
Pulicaria laciniata (Coss et Gral.) Thel	Asteraceae	Thérophyte	Spring-Summer	Perennial

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Species	**Family**	**Biological Type**	**Flowering Period**	**Biological Cycle**
Quercus ilex L.	Asteraceae	Thérophyte	Spring-Summer	Annual
Ranunculus arvensis (L)	Fagaceae	Phanérophyte	Spring-Summer	Annual
Ranunculus gramineus L.	Renonculaceae	Hémicryptophyte	Spring-Summer	Annual
Reseda alba (L.) ssp. eu-alba Maire	Renonculaceae	Hémicryptophyte	Spring-Summer	Annual
Reseda arabica (Boiss)	Resedaceae	Thérophyte	Spring-Summer	Perennial
Reseda decursiva (Forsk.)	Resedaceae	Thérophyte	Spring-Summer	Perennial
Reseda sp. (Duriaeana) L.	Resedaceae	Thérophyte	Spring-Summer	Perennial
Roemeria hybrida (L.) DC.	Resedaceae	Thérophyte	Spring-Summer	Perennial
Romulea bolbucodium (L.) Seb.	Papaveraceae	Thérophyte	Spring-Summer	Perennial
Rosmarinus officinalis L.	Iridaceae	Géophyte	Spring-Summer	Annual
Rosmarinus tournifortii De Noé	Lamiaceae	Phanérophyte	Spring-Summer	Perennial
Rubia peregrina L.	Lamiaceae	Phanérophyte	Spring-Summer	Perennial
Rumex gonglomeratus (Murr.) (L'SSAN ELFARD)	Rubiaceae	Phanérophyte	Spring-Summer	Perennial
Rumex aristidis Coss.	Polygonaceae	Thérophyte	Spring-Summer	Perennial
Saccocalyx satureioides (Coss.) et Dur	Polygonaceae	Hémicryptophyte	Spring-Summer	Perennial
Salicornia arabica L. var. perennis (Mill.) Fiori	Lamiaceae	Chaméphyte	Spring-Summer	Perennial
Salicornia arabica L. var. typica Fiori	Chenopodiaceae	Chaméphyte	Spring-Summer	Perennial
Salsola foetida (Del.)	Chenopodiaceae	Chaméphyte	Summer	Annual
Salsola vermiculata (L.)	Chenopodiaceae	Chamophyte	Summer	Annual
Salvia verbenaca ssp. clandestina (L.) Pugsl	Chenopodiaceae	Chamophyte	Spring-Summer	Annual
Scabiosa arenarea Forsk.	Lamiaceae	Hémicryptophyte	Spring-Summer	Perennial
Scabiosa atropurpurea L.	Dipsacaceae	Thérophyte	Spring-Summer	Perennial
Scabiosa stellata L.	Dipsacaceae	Thérophyte	Spring-Summer	Perennial
Schismus barbatus (L.) (Thell)	Dipsacaceae	Thérophyte	Spring-Summer	Perennial
Scilla lingulata Poiret.	Poaceae	Thérophyte	Spring-Summer	Perennial
Scilla obtusifolia Poiret.	Liliaceae	Géophyte	Spring-Summer	Perennial
Scilla peruviana L.	Liliaceae	Géophyte	Spring-Summer	Perennial
Scorzonera laciniata (L.)	Liliaceae	Géophyte	Spring-Summer	Perennial
Scorzonera undelata ssp. alexandria (Boiss.) M	Asteraceae	Hémicryptophyte	Spring-Summer	Perennial
Scrofularia laevigata Vahl.	Asteraceae	Hémicryptophyte	Spring-Summer	Perennial
Sedum sediforme (Jacq.) Pau.	Scrophulariaceae	Hémicryptophyte	Spring-Summer	Annual

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Senecio flavus (Dec.) Sch.Bip.	Crassulaceae	Thérophyte	Spring-Summer	Perennial
Senecio gallicus ssp. coronopifolius (Desf.) M	Asteraceae	Thérophyte	Spring-Summer	Perennial
Senecio leucanthemifolius Poiret.	Asteraceae	Thérophyte	Spring-Summer	Annual
Senecio vulgaris ssp. massaicus (Maire.) Q.et S.	Asteraceae	Thérophyte	Spring-Summer	Annual
Sideritis montana (L.) subsp.	Asteraceae	Thérophyte	Spring-Summer	Perennial
Silene arenarioides (Desf.)	Lamiaceae	Thérophyte	Spring-Summer	Annual
Silene cerastioides (L.)	Caryophyllaceae	Thérophyte	Spring-Summer	Perennial
Silene conica (L.)	Caryophyllaceae	Thérophyte	Spring-Summer	Perennial
Silene rouyana (B.)	Caryophyllaceae	Thérophyte	Spring-Summer	Annual
Silene rubella (L.)	Caryophyllaceae	Thérophyte	Spring-Summer	Annual
Silene secundiflora Otth.	Caryophyllaceae	Thérophyte	Spring-Summer	Annual
Silene setacea (Viv.)	Caryophyllaceae	Thérophyte	Spring-Summer	Annual
Sisymbrium irio (L.)	Caryophyllaceae	Thérophyte	Spring-Summer	Perennial
Sisymbrium runcinatum Lag.	Crucifereae	Thérophyte	Spring-Summer	Annual
Sisymbrium thalianum (L.) Gay. et Mon. (= Arabidopsis thaliana (L.) Heyn.)	Crucifereae	Thérophyte	Spring-Summer	Annual
Sisymbrium torulosum (Desf.)	Crucifereae	Thérophyte	Spring-Summer	Annual
Smilax aspera L.	Crucifereae	Thérophyte	Spring-Summer	Perennial
Sonchus oleraceus L.	Lamiaceae	Nanophanérophyte	Spring-Summer	Perennial
Spergula arvensis L.	Asteraceae	Thérophyte	Spring-Summer	Perennial
Spergula flaccida (Roxb.) Asch	Caryophyllaceae	Thérophyte	Spring-Summer	Perennial
Sphenopus divaricatus (Gouan.) Rchb.	Caryophyllaceae	Hémicryptophyte	Spring-Summer	Perennial
Spitzelia coronopifolia Desf.	Poaceae	Thérophyte	Spring-Summer	Perennial
Leontodon hispanicus (Del.) Boiss.	Asteraceae	Hémicryptophyte	Spring-Summer	Perennial
Stachys brachyclada Noé ex Coss	Lamiaceae	Thérophyte	Spring-Summer	Perennial
Stachys circinata L'Her.	Lamiaceae	Hémicryptophyte	Spring-Summer	Perennial
Stahelina dubia (L.)	Asteraceae	Chaméphyte	Spring-Summer	Perennial
Stipa barbata (Desf.)	Poaceae	Hémicryptophyte	Spring-Summer	Perennial
Stipa parviflora (Desf.)	Poaceae	Hémicryptophyte	Spring-Summer	Perennial
Stipa retorta (Cav.)	Poaceae	Thérophyte	Spring-Summer	Perennial
Stipa tenacissima (L.)	Poaceae	Hémicryptophyte	Spring-Summer	Perennial

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Suaeda fructicosa L.	Chenopodiaceae	Chaméphyte	Spring-Summer	Perennial
Tamarix aphylla (L.) Karst	Tamaricaceae	Phanérophyte	Spring-Summer	Perennial
Tamarix gallica L.	Tamaricaceae	Phanérophyte	Spring-Summer	Perennial
Telephium imperati (L.)	Caryophyllaceae	Hémicryptophyte	Spring-Summer	Perennial
Telephium spaerospermum Boiss.	Caryophyllaceae	Hémicryptophyte	Spring-Summer	Perennial
Tetraclinis articulata (Vahl.) Link (= Callitris articulata (Vahl.) Link)	Cupressaceae	Phanérophyte	Spring-Summer	Perennial
Tetraclinis articulata (Vahl.) Link Masters. Thuya de Barbarie	Cupressaceae	Phanérophyte	Spring-Summer	Annual
Teucrium polium (L.) p.p.	Lamiaceae	Chamophyte	Spring-Summer	Perennial
Teucrium pseudo-chamaepitys (L.)	Lamiaceae	Chamophyte	Spring-Summer	Perennial
Thapsia vilosa L.	Apiaceae	Hémicryptophyte	Spring-Summer	Perennial
Thlaspi perfoliatum L.	Brassicaceae	Thérophyte	Spring-Summer	Perennial
Thymelaea tartonraira All.	Theligonaceae	Chamophyte	Spring-Summer	Perennial
Thymus algeriensis (Boiss.) et Reut	Lamiaceae	Chamophyte	Spring-Summer	Annual
Thymus ciliatus (Desf.) ssp. eu-ciliatus (Maire.)	Lamiaceae	Chamophyte	Spring-Summer	Annual
Thymus hirtus Willd.	Lamiaceae	Chamophyte	Spring-Summer	Annual
Tourneuxia variifolia (Coss.)	Asteraceae	Thérophyte	Spring-Summer	Perennial
Tragopogon porrifolius L.	Asteraceae	Hémicryptophyte	Spring-Summer	Perennial
Trigonella monspeliaca (L.)	Fabaceae	Hémicryptophyte	Spring-Summer	Perennial
Trigonella polycerata L.	Fabaceae	Hémicryptophyte	Spring-Summer	Perennial
Trisetaria parviflora (Desf.) Maire	Poaceae	Hémicryptophyte	Spring-Summer	Perennial
Tuberaria guttata (L.) Foureau	Cistaceae	Thérophyte	Spring-Summer	Perennial
Tulipa silvestris (L.) ssp. Australis (Link.) Pamp	Liliaceae	Géophyte	Spring-Summer	Perennial
Tulipa silvestris (L.) ssp. primulina (Beker.) M.W	Liliaceae	Géophyte	Spring-Summer	Perennial
Tulipa silvestris ssp. australis (Link.) Pamp.	Liliaceae	Géophyte	Spring-Summer	Annual
Tunica illyrica (Ard.) Fisch et Meg (= Dianthella compressa (Claus.))	Caryophyllaceae	Hémicryptophyte	Spring-Summer	Perennial
Tunica illyrica (Ard.) Fisch et Meg.	Caryophyllaceae	Hémicryptophyte	Spring-Summer	Annual
Turgenia latifolia L. (Hoffm.)	Apiaceae	Thérophyte	Spring-Summer	Annual
Urospermum picroides (L.) Schmidt	Asteraceae	Thérophyte	Spring-Summer	Annual
Valeriana tuberosa L.	Valerianaceae	Hémicryptophyte	Spring-Summer	Perennial
Valerianella carinata Lois.	Valerianaceae	Thérophyte	Spring-Summer	Annual

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Valerianella coronata (L.) DC.	Valerianaceae	Thérophyte	Spring-Summer	Annual
Verbena supina L.	Verbenaceae	Thérophyte	Spring-Summer	Annual
Veronica praecox All.	Scrophulariaceae	Thérophyte	Spring-Summer	Annual
Vicia ervilia (L.) Willd.	Fabaceae	Thérophyte	Spring-Summer	Annual
Vicia monardi (Boiss.)	Fabaceae	Thérophyte	Spring-Summer	Perennial
Vicia sativa (L.)	Fabaceae	Thérophyte	Spring-Summer	Perennial
Vulpia membranacea (L.) Link	Poaceae	Thérophyte	Spring-Summer	Perennial
Vulpia myuros (L.) Gmel.	Poaceae	Thérophyte	Spring-Summer	Perennial
Xeranthemum inapertum (L.) Mill.	Asteraceae	Thérophyte	Spring-Summer	Perennial
Ziziphora hispanica (L.)	Lamiaceae	Thérophyte	Spring-Summer	Perennial
Ziziphora officinalis (L.)	Lamiaceae	Thérophyte	Spring-Summer	Perennial
Ziziphus lotus	Rhamnaceae	Phanerophyte	Spring-Summer	Perennial
Zizyphora hispanica L.	Lamiaceae	Thérophyte	Spring-Summer	Perennial

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