FLORISTIC INVENTORY AND BIODIVERSITY ASSESSMENT OF ANGIOSPERMS ALONG THE WESTERN COAST OF DJELFA PROVINCE, ALGERIA

MEKHLOUFI, M. B.[1*] – KHADER, M.[2]

[1]*Department of Agronomy, Institute of Natural and Life Sciences, Nour Bachir University Center, El-Bayadh, Algeria*

[2]*Faculty of Natural and Life Sciences, Ziane Achour University of Djelfa, Djelfa, Algeria (e-mail: khadermo@gmail.com ORCID: 0009-0006-6229-8588)*

**Corresponding author*
e-mail: m.mekhloufi@cu-elbayadh.dz; phone: +213-77-294-1068; ORCID: 0000-0003-3865-9903

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Abstract. A comprehensive floristic survey conducted along the western coastal zone of the Djelfa Province (Algeria) recorded 406 plant species distributed across 43 botanical families. Asteraceae was the most represented family, followed by Fabaceae, Caryophyllaceae, and Poaceae, all playing significant ecological roles within semi-arid ecosystems. The primary objective of this study was to assess floristic biodiversity and ecological organization across the Djelfa steppe ecosystems through an integrated approach combining species inventory, biological form analysis, flowering phenology, and physico-chemical soil characterization. This approach aimed to identify key indicator species linked to specific edaphic conditions, analyze the environmental gradients structuring vegetation patterns using Principal Component Analysis (PCA) and Hierarchical Ascendant Classification (HAC), and to provide a scientific basis for the conservation and sustainable management of steppe biodiversity. Ten dominant species, including *Stipa tenacissima*, *Centaurea pomeliana*, *Artemisia herba-alba*, *Atriplex halimus*, *Lygeum spartum*, *Salsola vermiculata*, *Noaea mucronata*, *Hammada scoparia*, *Haloxylon scoparium*, and *Zygophyllum album*, were identified as ecological indicators of semi-arid habitats. Additionally, the most frequently recorded species, such as *Bromus rubens*, *Sideritis montana*, *Gladiolus byzantinus*, *Schismus barbatus*, *Salvia verbenaca* ssp. *clandestina*, *Biscutella didyma*, *Malva sylvestris*, *Malva aegyptiaca*, *Gagea mauritanica*, and *Plantago albicans*, reflect the ecological diversity and adaptive responses to anthropogenic pressures. PCA highlighted major edaphic gradients, particularly salinity, active calcium carbonate, and pH, as key drivers structuring the distribution of botanical families. HAC further distinguished distinct floristic assemblages associated with specific soil types and degrees of human disturbance. The biological spectrum was dominated by perennial chamaephytes and hemicryptophytes exhibiting a spring flowering peak, emphasizing the prevalence of adaptive resilience strategies within these semi-arid ecosystems. These findings provide a critical foundation for understanding floristic composition, ecological function, and conservation priorities in the Algerian steppe environment.
Keywords: *floristic inventory, angiosperm biodiversity, biological forms, flowering phenology, plant ecology, hierarchical clustering*

Introduction

The Algerian High Plateau region is one of the major centers of plant biodiversity in steppe zones, hosting flora remarkable for its richness, originality, and endemism (Tavşanoğlu and Pausas, 2018). This ecological mosaic, shaped by climatic, geological, and topographical contrasts, forms a fragile ecosystem, whose balance is increasingly threatened by multiple anthropogenic factors. The combined effects of climate change, unplanned urbanization, overexploitation of natural resources, and agricultural expansion have profoundly altered natural habitats (Tavşanoğlu and Pausas, 2018; Peñuelas et al., 2018).

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In this context, functional trait databases and forest inventories have emerged as fundamental tools for documenting plant diversity and understanding the mechanisms that assemble communities (Ferretti et al., 2024). These resources are essential for assessing conservation status and providing the necessary evidence to guide environmental and forestry management policies in the face of climate change and shifting fire regimes (Peñuelas et al., 2018; Mahmoudi et al., 2025).

Several studies emphasize the urgent need to multiply such initiatives, particularly because certain ecologically sensitive regions such as the southern rim of the Mediterranean remain poorly represented in existing datasets due to a historical lack of available research (Pausas, 2018). Furthermore, advancing regional studies in data-scarce biodiversity hotspots is considered crucial for improving predictive models and managing ecosystems effectively under increasing environmental stress (Peñuelas et al., 2018).

Within this perspective, the present study aims to establish a floristic inventory of the western coast of Djelfa Province, a semi-arid region characterized by habitat diversity, which remains largely under-studied. Based on rigorous phytosociological methodology and 52 surveys conducted across various plant formations, 406 species belonging to 43 botanical families were recorded in this study.

The most diversified families are Asteraceae, followed by Fabaceae, Caryophyllaceae, and Poaceae, which are all recognized for their crucial roles in the functioning of arid ecosystems. In these environments, certain species have developed specialized structures like the lignotuber (a belowground woody burl) to survive recurrent fires, an evolutionary adaptation that is estimated to have originated approximately 6.23 million years ago during major aridification events (Gutiérrez-Larruscain et al., 2025).

Overall, this study fills a scientific gap regarding the angiosperm flora of Djelfa and provides a valuable reference tool for the sustainable management of biodiversity in the northern Algerian steppes.

Materials and methods

Study area selection

Geographical context of the study area

The study area is situated approximately 270 km south of Algiers, in the vicinity of Djelfa city, the administrative capital of Djelfa Province, Algeria. Geographically, it extends between 35°08′ and 34°27′ N latitude and between 3°28′ and 3°54′ E longitude (*Fig. 1*). The region is characterized by heterogeneous topography, with elevations ranging from approximately 910 m in the lower plains to 1362 m in the mountainous areas, based on Shuttle Radar Topography Mission (SRTM) digital elevation data (Farr et al., 2007).

The environment is characterized by steppe vegetation interspersed with the Séhari Guebli state forest massif, which is one of the most significant forested areas in Djelfa. This massif forms part of the Ouled-Naïls Mountains within the Saharan Atlas and represents the last major forested barrier before the encroachment of the Sahara Desert (Khader et al., 2022).

Climatically, the region exhibits a semi-arid bioclimatic stage with cold winters: the minimum temperature recorded in January averages around 0.7°C, the mean annual

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temperature is approximately 6.7°C, while the maximum temperature reaches 31.2°C, with an annual average of 23.6°C. The precipitation was approximately 280 mm. These climatic conditions significantly influenced vegetation patterns and ecological dynamics throughout the study area.

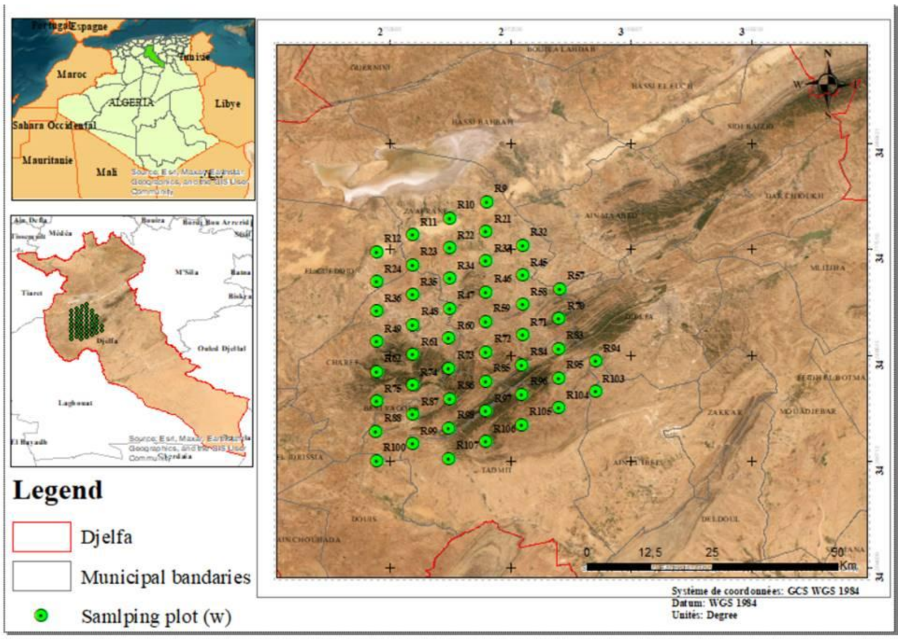

Figure 1. *Floristic sampling design in the western region of Djelfa (Algeria), showing the boundaries of the study area and the distribution of floristic inventory plots based on a systematic sampling grid*

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,*

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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.

Soil sampling and physicochemical analysis

Soil samples were collected at a 0–30 cm depth in each floristic plot. Physicochemical analyses focused on 19 edaphic parameters, measured on samples collected from nine randomly selected plots, with three analytical replicates per plot, in order to ensure data reliability and reproducibility. The resulting values were subsequently projected onto the full set of 52 floristic plots, based on the ecological homogeneity of vegetation units and the identified edaphic gradients. Analyses were performed in accordance with international standards (ISO 10390 for pH and ISO 11261 for total nitrogen). The analyzed parameters included electrical conductivity (EC) for salinity assessment, pH (measured in KCl), organic matter (OM) determined using the Walkley–Black method, total nitrogen (TN) by Kjeldahl digestion, calcium carbonate ($CaCO_3$) by volumetric analysis, and sodium (Na^+) content measured by flame photometry. These data provided a robust basis for characterizing environmental gradients and interpreting their influence on plant distribution and vegetation structure.

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

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 were generated using the R software (R Core Team, 2023) and the associated packages used for multivariate analyses, as well as IBM SPSS Statistics (version 26). 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

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

Results and discussion

Ecological characterization of the study area

The landscape of the western part of Djelfa is marked by pronounced spatial heterogeneity in land cover, which is typical for the northern Algerian High Plateau. Extensive formations dominated by *Artemisia herba-alba*, a heliophilous and xerophilous species emblematic of arid regions, cover large portions of the area (light-green zones). This species is well known for its high drought tolerance and resilience to intensive grazing, as its functional growth strategy allows it to effectively compensate for aboveground biomass loss following significant environmental disturbances (Martínková et al., 2020).

Mixed vegetation assemblages incorporating species such as *Noaea mucronata* occupy areas characterized by stony or gypseous substrates, indicating specialized plant communities whose growth forms and survival strategies are highly associated with extreme aridity gradients and environmental stress (Mahmoudi et al., 2025). Furthermore, the structure of these communities is fundamentally shaped by the soil type; nutrient-poor or specialized substrates often act as a habitat filter that increases flammability and the propensity for recurrent fires, thereby favoring specific phenotypic and phylogenetic clustering among the surviving flora (Cadotte and Tucker, 2017).

The southern and central parts of the region are predominantly covered by steppes dominated by *Stipa tenacissima* and *Lygeum spartum* (yellow and light brown, respectively), which are two perennial species traditionally exploited for artisanal fiber production. Their distribution reflects a strong adaptation to drought conditions, as their specific functional traits determine their ecological role and resilience in water-limited environments. Furthermore, these plant formations are essential for soil stabilization and vegetation dynamics in regions where water availability is a limiting factor.

Areas shown in red represent advanced land degradation, mainly caused by overgrazing and land-use changes, which can exceed the capacity of Mediterranean plants to cope with aridity and lead to increased erosion (*Fig. 2*).

Reforested zones (dark green) indicate localized but ongoing ecological restoration efforts. Advancing forest inventorying and monitoring systems is now considered crucial for providing the evidence base needed to guide such sustainable management and reforestation policies (Ferretti et al., 2024).

Mekhloufi et al. (2022) emphasized that pedoclimatic risks significantly influence the evolution of plant cover and soil properties in both protected and unprotected zones. The systematic placement of sampling plots (green dots) ensured adequate ecological representativeness for floristic diversity analysis.

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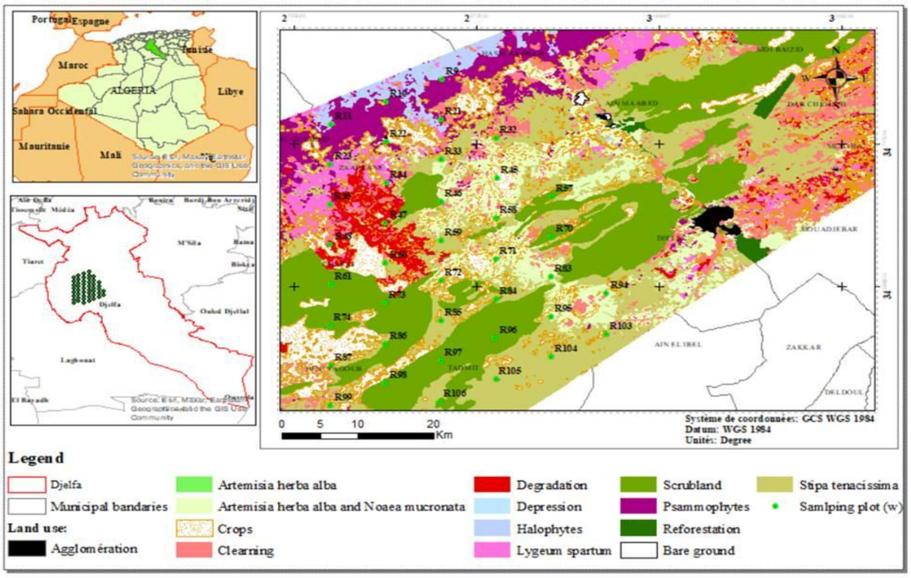

***Figure 2.** Ordination of plant biological types according to their ecological affinities in the western steppe of Djelfa*

Land cover analysis

The land cover map of the western part of Djelfa Province (2022) illustrates the spatial distribution of different land-use units representative of the semi-arid steppe ecosystems in northern Algeria (*Fig. 3*).

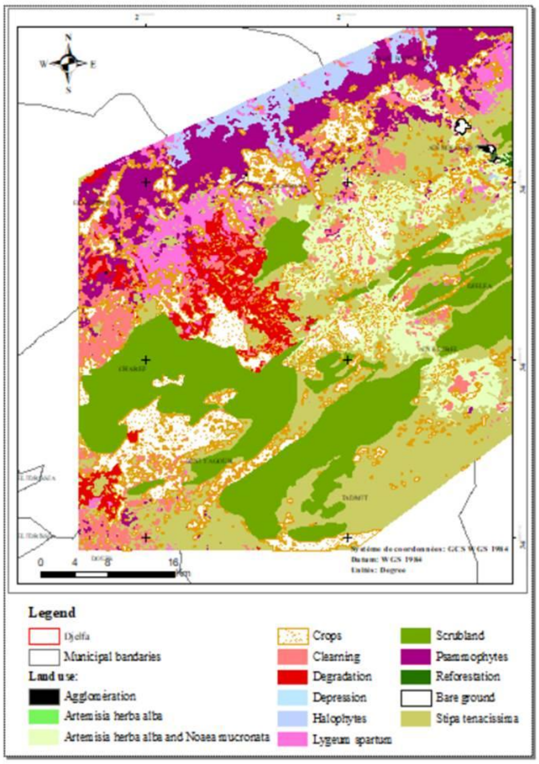

***Figure 3.** Land use map of the western region of Djelfa (2022)*

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The landscape is largely dominated by steppe formations *of Artemisia herba-alba*, a xerophytic species whose prevalence is a biological indicator of the historical transition toward Mediterranean climate seasonality and the intensification of fire regimes (Gutiérrez-Larruscain et al., 2025). Steppes dominated by *Lygeum spartum* and *Stipa tenacissima* were also prominent; these perennial species possess evolutionary mechanisms for persistence under recurrent disturbances, allowing populations to survive and recover despite severe environmental stress (Pausas and Keeley, 2014). Their adaptation to specialized sandy and gypseous substrates reflects the importance of phenotypic evolution in constructing favorable niche spaces within harsh and degraded arid environments (Verdú et al., 2021).

In addition to their ecological role in soil stabilization and vegetation dynamics in arid environments, these species are embedded in local socio-ecological systems that influence land-use patterns and resource exploitation (Boussaïd and Schmitz, 2022). The forested areas (green) in the southern and central regions reflect sustained reforestation programs, particularly within the framework of large-scale national initiatives such as the Green Dam project, aimed at mitigating desertification and stabilizing vulnerable pre-Saharan landscapes. Agricultural zones (blue hatching) remain spatially restricted and are generally concentrated in relatively favorable microenvironments, where improved infrastructure, irrigation development, and economic policy orientations support localized productivity (World Bank, 2024).

Furthermore, areas characterized by degradation, bare soils, and vegetation regression indicate the cumulative impacts of overgrazing, sedentarization processes, and increasing socio-economic pressures on pastoral systems (Boussaïd and Schmitz, 2022). These stressors, combined with recurrent drought episodes and broader macroeconomic transitions, contribute to declining biomass production and reduced ecosystem resilience (World Bank, 2024). This spatial assessment highlights the structural fragility of Algerian steppe ecosystems and underscores the urgent need for integrated, evidence-based land management strategies to ensure long-term ecological sustainability and prevent irreversible land degradation.

Assessment of plant biodiversity

Assessment of plant biodiversity represents a fundamental step toward understanding the structure and functioning of natural ecosystems, particularly in semi-arid environments that are highly exposed to anthropogenic and climatic pressures (Maestre et al., 2015; IPBES, 2019). In this study,406 vascular plant species belonging to 43 botanical families were identified (*Appendix 5*). This floristic richness was subjected to both quantitative and qualitative analyses aimed at characterizing the species composition, functional structure, and seasonal dynamics of local flora. Specific richness indices were used to assess alpha diversity within the plots, where the analysis of biological spectra based on Raunkiaer's classification revealed a predominance of chamaephytes and hemicryptophytes, illustrating a strong adaptation to steppe ecological conditions (Pausas and Bond, 2020).

Morpho-biomorphological analysis highlighted a diversity of adaptive strategies to edaphic and climatic constraints, with results comparable to observations from the North Saharan region (Belhadj et al., 2023a; Belhadj et al., 2023b) (*Appendix 4*). Specifically, recent research in the arid steppes of southeast Algeria confirms that vegetation health is strictly linked to climate, with degradation primarily driven by the recurrence and severity of drought events. The morpho-biomorphological distribution

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revealed a balanced functional structure dominated by branched forms (96 species), rosette forms (90 species), and caespitose forms (77 species), reflecting resistance strategies against grazing and drought typical of Mediterranean steppe ecosystems. These functional traits reflect essential morphological properties that determine the ecological role each plant species plays within its ecosystem.

Regarding reproductive modes, the majority of species reproduce sexually (160 species), followed by vegetative reproduction (129 species), and mixed strategies (122 species), indicating strong clonal resilience capacities, consistent with observations from Mediterranean and arid steppe systems. Clonal reproduction is considered particularly advantageous in such stressful environments; for instance, belowground organs like rhizomes provide critical adaptive benefits by storing resources and enabling persistence during extended droughts.

The persistent organs are dominated by bulbs, seeds, and rhizomes, which are essential for survival in environments with severe water stress. In terms of vertical stratification, the flora was distributed among herbaceous (139 species), shrub (134 species), and tree (138 species) life forms, indicating a relatively balanced vertical structure. The Shannon diversity index (H′ = 2.31) calculated for life forms confirmed high functional richness, reflecting a significant ecological heterogeneity conducive to agroecosystem stability and resilience (Díaz et al., 2016; Violle et al., 2007).

These results emphasize the importance of integrating functional analysis with traditional floristic approaches to better understand the dynamics and resilience of semi-arid ecosystems.

Additionally, a seasonal analysis of floral phenology highlighted the evolution of families and species according to flowering periods, with a marked peak during spring and early summer coinciding with maximum soil water availability a pattern widely documented in Mediterranean ecosystems where precipitation pulses regulate flowering dynamics and seasonal growth cycles (Gordo and Sanz, 2010). The integration of taxonomic and functional data has enabled the development of a robust floristic typology that provides a strong scientific basis for biodiversity management and conservation planning in arid regions.

Multivariate analyses of ecological patterns

Principal Component Analysis (PCA) of ecological traits revealed two major functional gradients structuring the plant species distribution. The first axis, PC1 (40.7% of the variance), reflects an ecological dominance gradient and is positively correlated with species abundance (Alfa), vegetation cover (Forest), and pastoral value (*Artemisia herba-alba*). This axis distinguishes frequent and competitive species, primarily therophytes, which are characteristic of open or disturbed semi-arid environments (*Fig. 4*).

The second axis, PC2 (12.2%), highlights ecological specialization to stress, isolating halophyte species thriving in degraded and saline ecosystems. This functional structuring is consistent with contemporary trait-based analyses showing that halophytes act as key indicators of resilience to salinity and environmental filtering in arid and semi-arid ecosystems (Flowers and Colmer, 2015).

These results are also aligned with modern CSR-based ecological frameworks that distinguish competitive, stress-tolerant, and ruderal strategies in plant communities under disturbance gradients (Pierce et al., 2017). The integration of stress-related traits (Degradation, Clearing) and ecological specialization indicators (Halophytes,

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Psammophytes) enhances the ability of PCA to differentiate functional groups, making it a valuable tool for rangeland monitoring, ecological zoning, and biodiversity conservation in fragile dryland environments (*Appendix 3*).

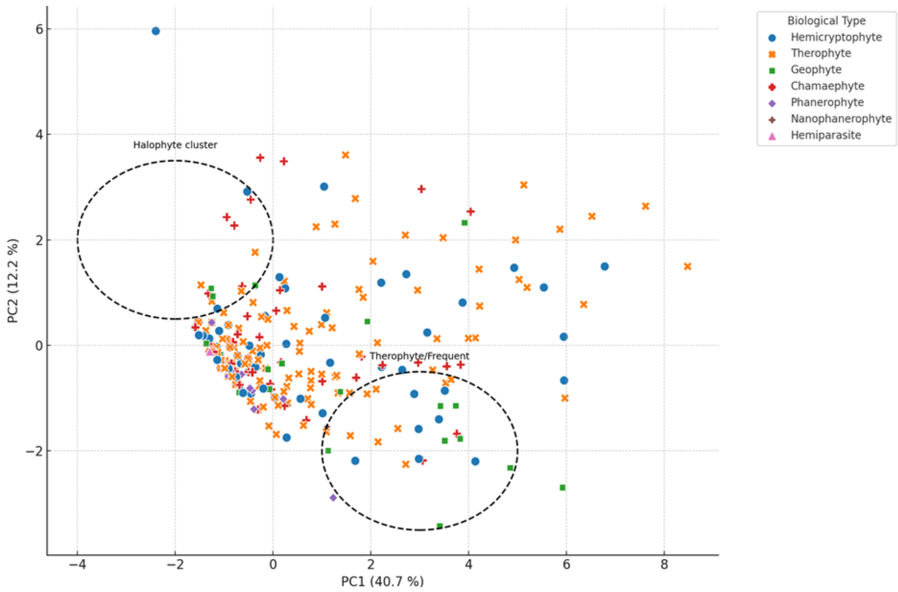

Figure 4. *PCA projection of plant species according to ecological traits and biological types PCA: species clustering according to biological types*

The PCA correlation circle further highlights the contribution of ecological variables to the functional structuring of biological types in semi-arid systems. The first principal component (PC1 = 46.2%) represents an ecological dominance gradient, strongly correlated with variables such as the Alfa index, forest cover, *Artemisia herba-alba* dominance, and the number of surveys, emphasizing the prevalence of frequent and ecologically influential species within pastoral and semi-natural habitats (*Fig. 5*). These variables reflect pastoral value, species abundance, and adaptive capacity within relatively stable steppe ecosystems (*Appendix 2*).

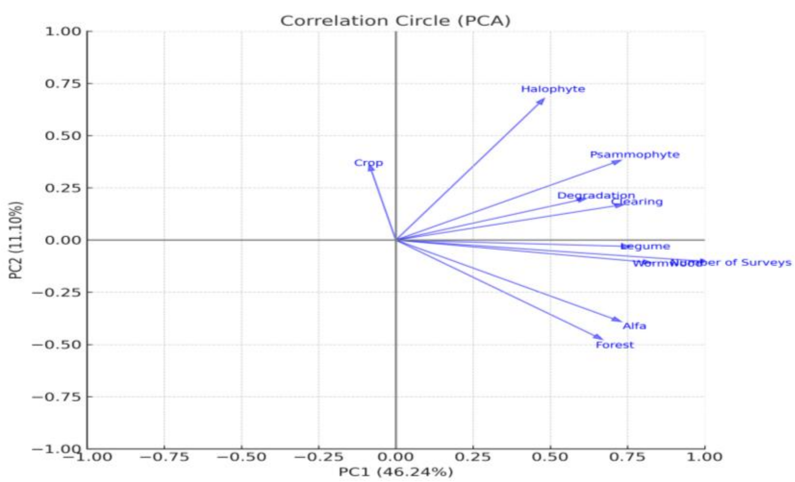

Figure 5. *Correlation circle from PCA: ecological drivers of functional differentiation in semi-arid plant communities*

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Conversely, the second principal component (PC2 = 11.1%) differentiated species specializing in extreme or disturbed ecological conditions, particularly halophytes, with notable contributions from psammophytes, cultivated areas, and cleared land. These variables reflect adaptations to salinity, sandy substrates, and anthropogenic disturbance. This functional organization is consistent with contemporary trait-based ecological frameworks describing stress-tolerant and ruderal strategies under environmental filtering in drylands (Pierce et al., 2017). Moreover, multivariate approaches such as PCA are widely recognized as effective tools for describing vegetation structure along environmental stress and land-use gradients in Mediterranean and semi-arid ecosystems (Borcard et al., 2018).

PCA revealed marked structuring of botanical families according to soil physicochemical parameters, with the first two axes (PC1 = 45.5%, PC2 = 28.6%) accounting for over 74% of the total variance, providing a robust visualization of ecological affinities (*Fig. 6*). The most contributive vectors electrical conductivity, total salinity, clay percentage, and total $CaCO_3$ illustrate the major structuring edaphic gradients (Mekhloufi and Lakel, 2025).

Floristic distribution analysis highlighted strong edaphic specialization among the main botanical families. Chenopodiaceae dominated highly saline and high-conductivity zones characteristic of halomorphic ecosystems, reflecting their well-documented tolerance to salt-affected soils in arid environments (Flowers and Colmer, 2015). Poaceae prevailed in open and sandy environments, demonstrating notable ecological plasticity and adaptation to edaphic and climatic variability typical of semi-arid systems. Lamiaceae and Fabaceae showed a marked preference for substrates rich in active limestone and alkaline pH, consistent with functional differentiation observed along soil gradients in Mediterranean drylands (Maestre et al., 2015).

The observed edaphic gradient, opposing fine sand and electrical conductivity to clay and $CaCO_3$, reflects erosion and deposition dynamics characteristic of steppe ecosystems. This structuring illustrates adaptive strategies such as halophytism and calciphily, as well as functional responses to anthropogenic disturbances including overgrazing and land clearing, which are widely recognized as key drivers of vegetation differentiation in dryland ecosystems (Khader et al., 2025).

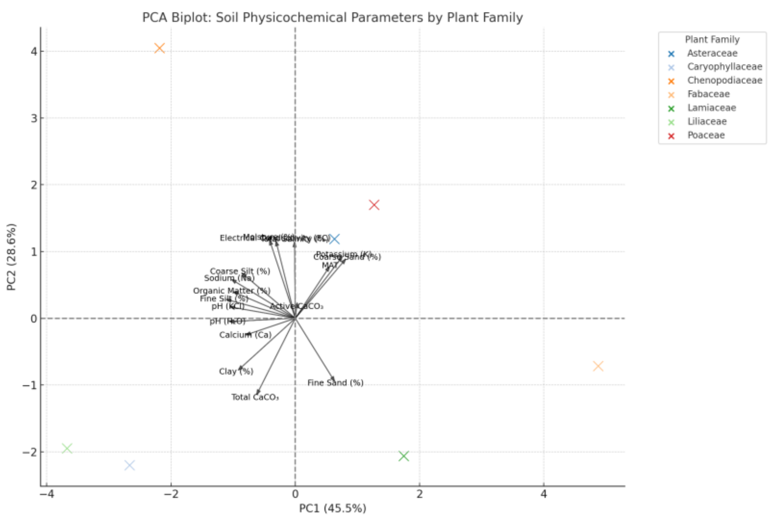

***Figure 6.** Ecological structure of botanical families based on edaphic gradients (PCA)*

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The robustness of this PCA is reinforced by its coherence with recent trait-based and multivariate models of floristic distribution in semi-arid ecosystems, where environmental gradients strongly structure community composition and functional organization (Laughlin, 2014; Shipley et al., 2016). Thus, multivariate approaches have emerged as powerful tools for bioindicating soil conditions and strategically managing Mediterranean agroecosystems. *Figure 7* illustrates the variation in the four major ecological indices calculated from floristic data collected across 107 steppe survey plots in a semi-arid environment. Species richness (S) represents the total number of species per plot. The Shannon Index (H′) accounted for both richness and evenness (*Fig. 7*). Pielou's evenness (J′) measures the regularity of species abundance distribution, whereas Simpson's index (1–D) reflects the probability that two randomly selected individuals belong to different species.

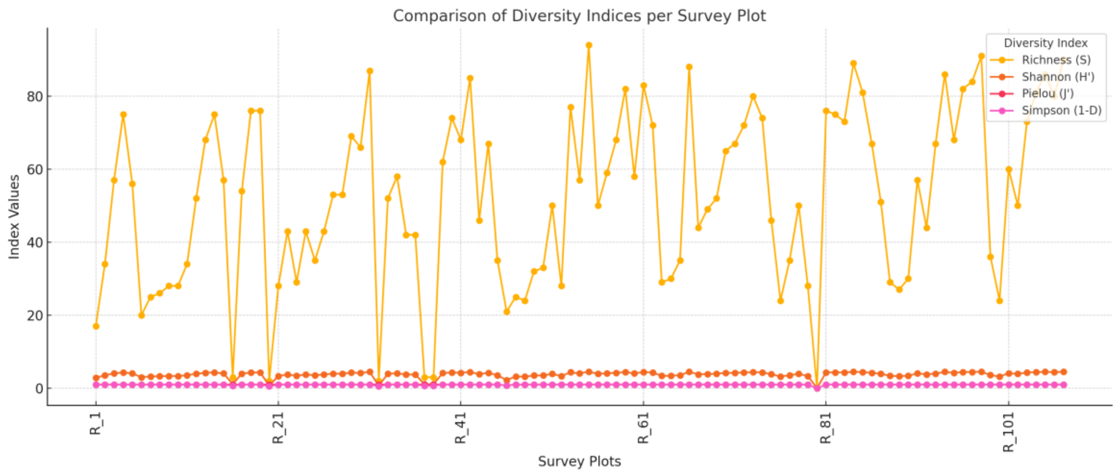

Figure 7. *Variation in floristic diversity indices across the107 semi-arid steppe survey plots*

The results revealed high and homogeneous values for most indices, indicating an ecologically stable and balanced floristic structure. Species richness varied from 17 to over 75 species per plot, reflecting considerable spatial heterogeneity associated with edaphic micro-variations (saline, gypsiferous, sandy soils) and anthropogenic pressures such as extensive grazing and land clearing. Shannon Index values exceeded 4.0 in several plots, indicating a high level of diversity and a non-dominant distribution pattern, suggesting the presence of functionally stable communities even under constrained conditions. Pielou's evenness (J′) was particularly high and consistent, approaching 1.0, reflecting an even distribution of individuals among species an important feature of resilient ecological systems (Jost, 2010). Simpson's index (1–D) also showed very high values (>0.97), confirming low species dominance and marked functional diversity (*Table 1*).

These trends reflect strong ecological stability despite harsh climatic conditions and support trait-based interpretations in which community responses to disturbance can be detected through diversity structure and functional organization (Mouillot et al., 2013). Structured diversity often reflects extensive sustainable management practices compatible with floristic biodiversity conservation.

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Table 1. *Floristic diversity indices across 107 steppe survey plots. Summary of Biodiversity*

Index	Formula	Global Value
Species Richness (S)	S = Number of species per plot	S = 50.44
Shannon Index (H')	$H' = -\sum(p_i * \ln(p_i))$	H' = 4.029
Pielou's Evenness (J')	$J' = H' / \ln(S)$	J' = 4.029 / ln(50.44) = 0.980
Simpson's Index (1 - D)	$1 - D = 1 - \sum(p_i^2)$	1 - D = 0.981

Parameters: Synthesis of Ecological Diversity Indices (Species Richness [S], Shannon Index [H′], Pielou's evenness [J′], Simpson's index [1–D])

Figure 8 illustrates the variation in mean ecological scores among groups defined by Hierarchical Ascendant Classification (HAC) applied to the phytosociological surveys. Cluster 2 is characterized by a strong representation of *Stipa tenacissima* (Alfa) and a high number of plots, reflecting well-preserved habitats dominated by typical steppe vegetation. Such community structuring and co-occurrence patterns in *Stipa tenacissima* steppes are consistent with the documented role of patch dynamics and vegetation composition in Mediterranean semi-arid steppes (Tormo et al., 2020). Cluster 3 showed a higher frequency of halophytes and degradation indicators, indicating pronounced salinity influence and anthropogenic disturbances, notably secondary salinization and overgrazing. The strong association of halophytes with salinity-driven ecological gradients is consistent with vegetation–environment analyses in salt-affected habitats, where salinity and related soil properties are key drivers of community differentiation (Lubińska-Mielińska et al., 2023).

Cluster 4 presented intermediate values, suggesting ecotonal areas or transitional zones between different habitat types (*Fig. 8*). Cluster 1, which has a weak structure, appears to reflect impoverished or heavily degraded habitats due to human activities, and specific variables such as psammophytes, secondary forest species, and taxa associated with cultivated environments allow for finer ecological discrimination between groups, emphasizing the bioindicator role of halophytes, Poaceae, and psammophytes in assessing disturbance gradients in semi-arid steppe landscapes. Thus, HAC combined with ecological trait analysis has emerged as a powerful diagnostic tool for evaluating conservation status and degradation dynamics in arid pastoral ecosystems.

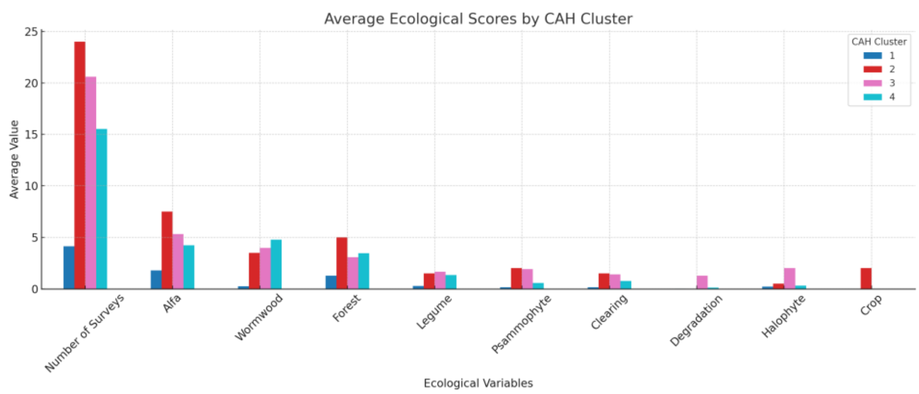

Figure 8. *Comparison of mean ecological scores among groups from hierarchical ascendant classification (HAC)*

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PCA projection of botanical families against ecological parameters revealed a clear structuring of environmental affinities along the main axes (PC1 = 54.1%, PC2 = 14.1%). PC1 expresses a land-use intensity and habitat naturalness gradient, evidenced by strong positive correlations with Alfa (species abundance), forest (forest cover), crop (cultivated areas), and Degradation. PC2 contrasts families associated with extreme edaphic conditions (salinity, sandy substrates), linked to vectors such as Halophyte, Psammophyte, Legume (Fabaceae), and Wormwood (*Artemisia* spp.) (*Fig. 9*). Poaceae and Fabaceae, positioned in transitional quadrants, illustrate pronounced ecological plasticity across disturbance and resource gradients. Conversely, Apiaceae, Asteraceae, and Chenopodiaceae showed marked affinity for open, degraded, and saline environments. Overall, these ordination patterns align with trait–environment frameworks showing how functional differences and environmental filtering structure plant assemblages along gradients (Kandlikar et al., 2022). Thus, this PCA confirms the relevance of using average ecological traits at the family level as bioindicators to assess conservation status and habitat degradation dynamics in Algerian semi-arid steppes.

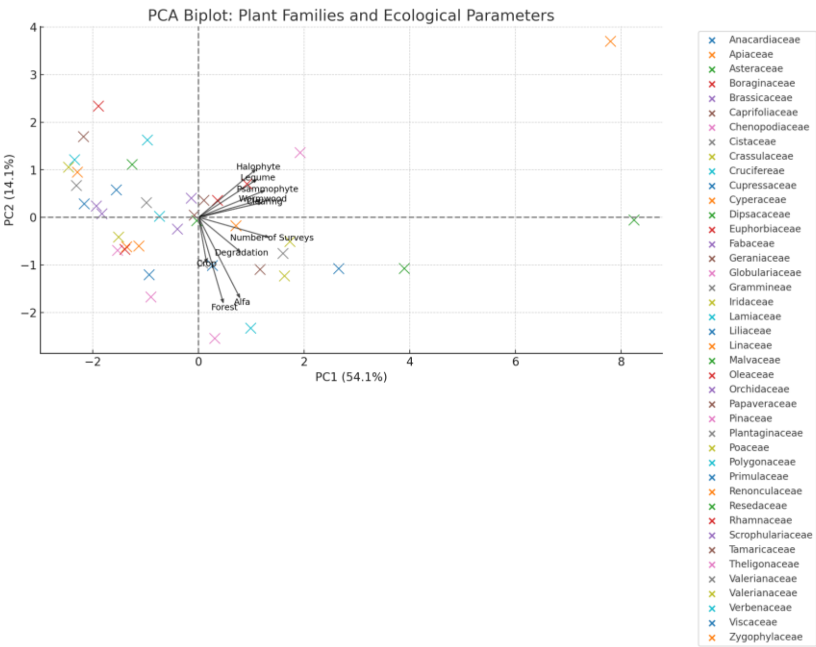

***Figure 9.** Principal component analysis (PCA) of botanical families in relation to ecological parameters*

The graph in *Figure 10* highlights the numerical predominance of certain botanical families across the floristic surveys conducted in the study area. Asteraceae and Poaceae dominate, with more than 300 and 250 records respectively, confirming their structural importance in steppe and semi-arid plant communities of Mediterranean drylands (Médail, 2017) (*Fig. 10*). Fabaceae, well known for its forage value and nitrogen-fixing capacity, also represents a major component of the vegetation. Its strong morphophysiological adaptability to nutrient-poor soils and climatic variability explains its high representation under arid conditions. Other families, including Liliaceae, Lamiaceae, Chenopodiaceae, and Caprifoliaceae, stand out for their ecological specialization, occupying halophilic, nitrophilic, or calcicolous niches, thereby

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reflecting the edaphic and topographic heterogeneity of the region. These results underline both the floristic richness of the Djelfa region and the functional complexity of its plant assemblages, structured along gradients of aridity, salinity, and anthropogenic land use.

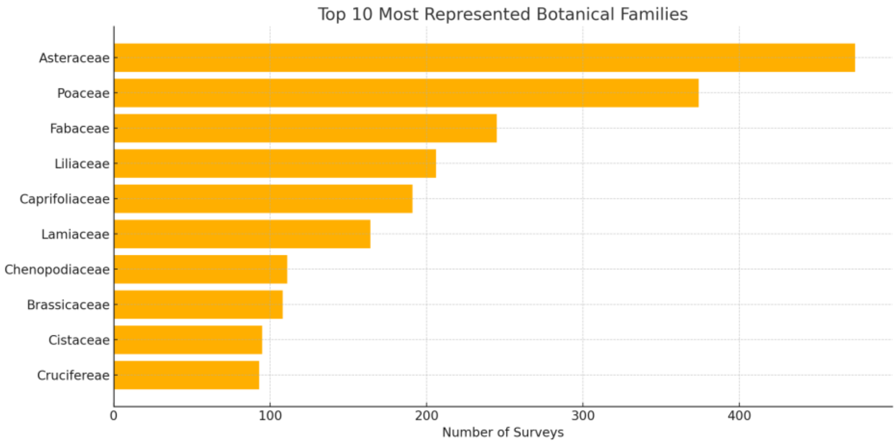

Figure 10. *Distribution of the 10 most represented botanical families by total number of surveys*

In the study area. *Bromus rubens* (Poaceae), a typical annual species occurring in disturbed habitats and dry substrates, is widely recognized as indicative of grazing pressure and land-use disturbance in semi-arid ecosystems (Noy-Meir, 1973). It is followed by *Sideritis montana*, *Gladiolus byzantinus*, and *Schismus barbatus*, all characterized by short life cycles and adaptive strategies suited to xeric conditions (*Fig. 11*). The occurrence of ruderal or nitrophilous taxa such as *Malva sylvestris*, *Malva aegyptiaca*, and *Plantago albicans* suggests anthropogenic disturbance, particularly linked to agricultural activities and overgrazing. Additional species such as *Gagea mauritanica* and *Biscutella didyma* reflect microhabitat heterogeneity, commonly observed at the interface between steppe vegetation and cultivated lands. These assemblages are consistent with vegetation dynamics typically reported in Mediterranean-type drylands, where opportunistic annuals coexist with stress-tolerant species under recurrent disturbance regimes (Rundel et al., 2016).

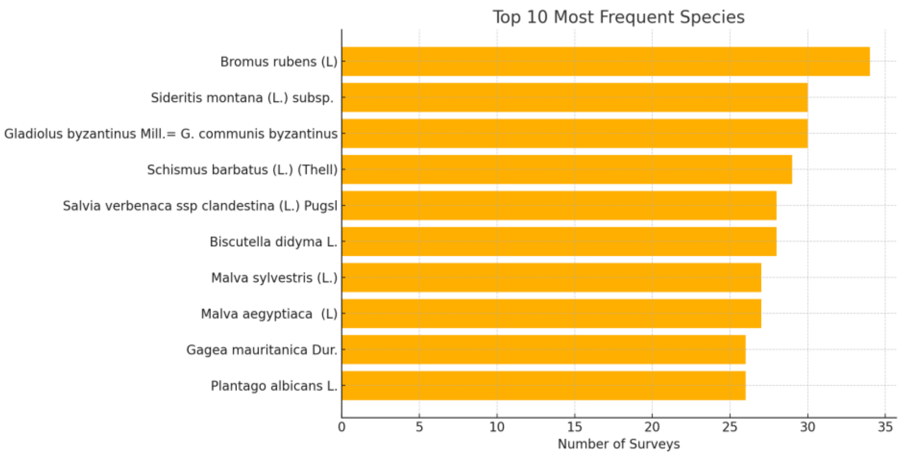

Figure 11. *Top 10 most frequently recorded plant species in the study area*

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The dendrogram generated by hierarchical cluster analysis (HAC) revealed a clear functional structuring of plant species according to their ecological affinities and co-occurrence patterns across the surveyed sites. Several distinct clusters emerged, suggesting the presence of relatively homogeneous floristic assemblages shaped by similar edaphic and climatic constraints. Species belonging to Poaceae, Asteraceae, Fabaceae, and Chenopodiaceae formed well-defined groups, reflecting convergent adaptive strategies in open steppe and halomorphic environments typical of arid and semi-arid ecosystems (Lavorel and Garnier, 2002) (*Fig. 12*).

Specialized subgroups, notably those containing halophilic or ruderal pioneer species, illustrate the gradients of disturbance or salinity. This type of classification aligns with Le Houérou's (1995) observations, emphasizing the bioindicative value of floristic assemblages for assessing the conservation status of North African steppes. Thus, combining HAC dendrograms with PCA-type analyses provides a powerful functional interpretation of vegetation and enables a fine habitat typology.

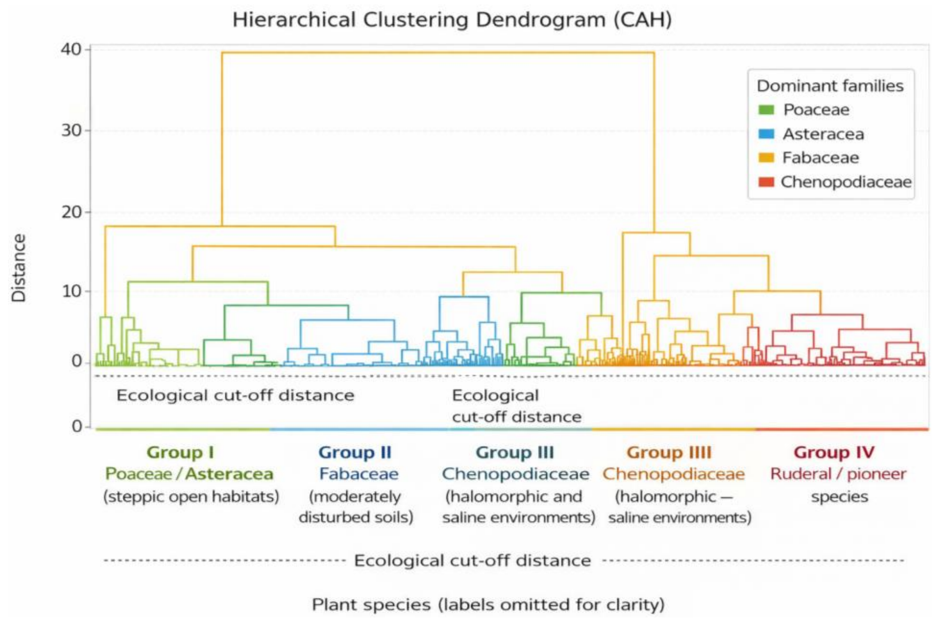

Figure 12. *Dendrogram of hierarchical ascendant classification (HAC) for plant species in the study area*

Conclusion

The floristic and ecological assessment conducted in the western region of Djelfa reveals pronounced spatial heterogeneity and a complex functional organization of semi-arid steppe ecosystems. Vegetation dominated by *Artemisia herba-alba* occupies approximately 40% of the area, followed by steppes dominated by *Stipa tenacissima* and *Lygeum spartum* (30%), while agricultural and degraded zones represent around 20%, and reforested areas about 10%. The floristic inventory identified 406 vascular plant species distributed among 43 botanical families, with clear dominance of Asteraceae (27%), Poaceae (23%), and Fabaceae (18%). The flora is characterized by a predominance of chamaephytes and hemicryptophytes (≈60%), reflecting strong adaptation to xeric conditions, and by morphological diversity including branched (24%), rosette (22%), and caespitose (19%) forms, indicative of resistance strategies to

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grazing and drought. Vertical stratification is balanced among herbaceous (34%), shrub (33%), and tree (33%) layers, confirming ecological stability and functional equilibrium. Diversity indices demonstrate high stability and resilience, with a mean species richness of 50 species per plot, Shannon index (H′) = 4.03, Pielou's evenness (J′) = 0.98, and Simpson's index (1–D) = 0.98, reflecting both species diversity and even abundance distribution. Multivariate analyses (PCA and HAC) revealed two major ecological gradients: (1) an ecological dominance and land-use gradient (PC1 = 40–54% of variance) linked to vegetation cover, species abundance, and pastoral value; and (2) a stress and specialization gradient (PC2 = 11–14%) opposing competitive and pastoral species to halophytic and psammophytic taxa adapted to saline, sandy, or disturbed habitats. PCA based on soil parameters explained 74% of total variance, highlighting the structuring role of electrical conductivity, total salinity, clay content, and $CaCO_3$, which govern the spatial distribution of botanical families Poaceae and Fabaceae exhibiting high ecological plasticity, and Chenopodiaceae prevailing in saline soils. Overall, the Djelfa steppe flora represents a dynamic equilibrium between competitive, stress-tolerant, and ruderal species, demonstrating remarkable ecological stability, structural balance, and high functional resilience under harsh climatic and anthropogenic pressures. These findings underscore the ecological significance of the Djelfa steppe as a representative model of North African semi-arid ecosystems and highlight the urgent need for integrated conservation and sustainable management strategies to preserve its floristic diversity and pastoral resources.

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APPENDIX

Appendix 1. *Illustrated table of the 10 most frequent species in a semi-arid Algerian ecosystem. This table summarizes the top ten most frequent plant species recorded in the arid regions of Algeria. It includes a reference image, its biological form, flowering period, and the biological cycle*

Species	Image	Biological form	Flowering period	Biological cycle	Image source
Centaurea pomeliana		Chamaephyte	March–July	Biennial	https://www.floramaroccana.fr/c.-pomeliana.html
Stipa tenacissima		Hemicryptophyte	April–June	Perennial	https://www.biodiversidadvirtual.org/herbarium/Stipa-tenacissima-L.-img18646.html
Artemisia herba-alba		Chamaephyte	March–July	Perennial	https://www.bioexplorer.net/plants/flowers/white-wormwood/
Atriplex halimus		Chamaephyte	March–July	Perennial	https://www.bethchatto.co.uk/conditions/plants-for-dry-conditions/atriplex-halimus.htm
Lygeum spartum		Hemicryptophyte	April–June	Perennial	https://www.freenatureimages.eu/plants/Flora%20J-N/Lygeum%20spartum/index.html
Salsola vermiculata		Chamaephyte	March–July	Perennial	https://assessment.ifas.ufl.edu/assessments/salsola-vermiculata/

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Species	Image	Biological form	Flowering period	Biological cycle	Image source
Noaea mucronata		Chamaephyte	March–July	Perennial	https://www.alamy.com/stock-photo-noaea-noaea-mucronata-desert-scrubland-plant-from-middle-east-with-95587077.html
Hammada scoparia		Chamaephyte	March–July	Perennial	https://www.wildflowers.co.il/hebrew/picture.asp?ID = 18403
Haloxylon scoparium		Chamaephyte	March–July	Perennial	https://powo.science.kew.org/taxon/urn%3Alsid%3Aipni.org%3Anames%3A165856-1
Zygophyllum album		Chamaephyte	March–July	Perennial	https://powo.science.kew.org/taxon/urn%3Alsid%3Aipni.org%3Anames%3A873500-1

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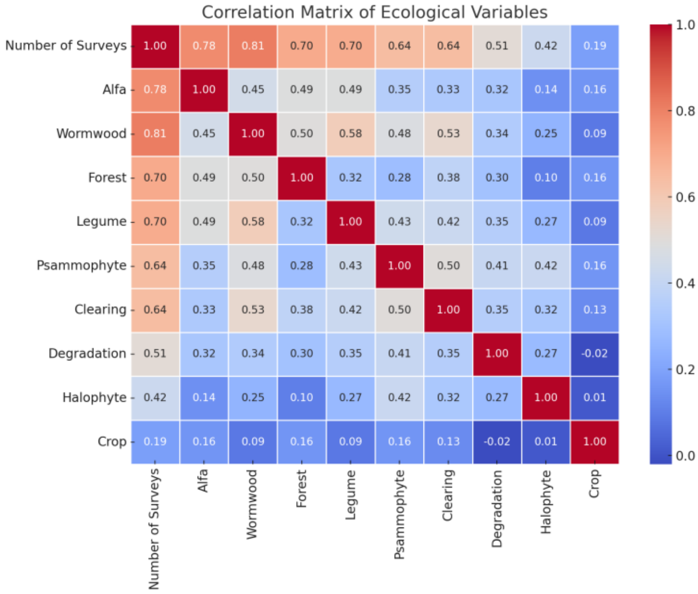

Appendix 2. *Correlation matrix of ecological variables from 107 semi-arid survey plots. The figure presents a Pearson correlation matrix of ten ecological variables across 107 floristic survey plots. The color intensity and numerical values indicate the strength and direction of the linear correlations (1 = strongly positive, 0 = no correlation). Notably, high correlations included the Number of Surveys with Alfa (r = 0.78), wormwood (r = 0.81), and forest (r = 0.70), suggesting co-occurrence patterns among frequently recorded species and pastoral quality indicators. Lower correlations were observed between halophytes and other traits, indicating ecological isolation in extreme environments and highlighting meaningful associations between key ecological descriptors. The strong correlation between the Number of Surveys, Alfa, and Wormwood supports their use as proxies for species abundance and pasture dominance in semi-arid landscapes. Moderate associations between wormwood and clearing (r = 0.53), as well as between psammophytes and degraded areas, indicate adaptive strategies typical of disturbance-tolerant taxa in semi-arid environments. In contrast, halophytes exhibited weak correlations with other vegetation units (e.g., r = 0.10 with Forest, r = 0.14 with Alfa), reflecting their ecological specialization in saline substrates and marginal habitats. Such differentiation between generalist disturbance-adapted species and highly specialized halophytic taxa has been widely documented in dryland vegetation studies (Flowers & Colmer, 2015; Ozenda, 2004). These patterns further highlight the importance of integrating both abundance-based metrics and functional trait descriptors when interpreting vegetation dynamics in arid and semi-arid ecosystems.*

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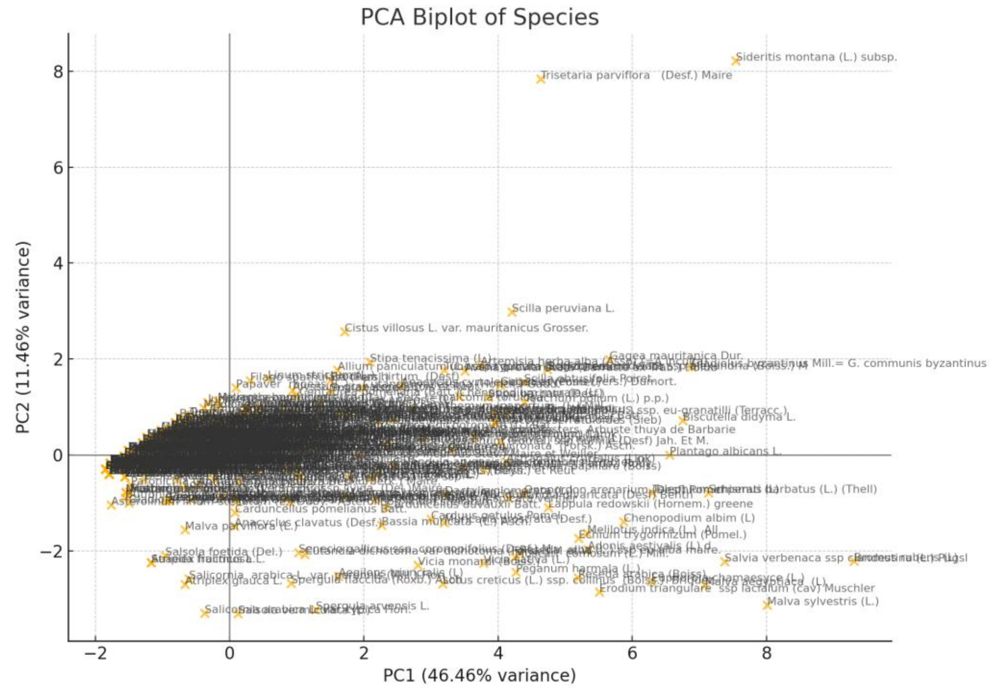

Appendix 3. *PCA Biplot of species based on ecological trait responses across 107 semi-arid floristic surveys. This biplot displays the ordination of plant species in the ecological trait space defined by the first two principal components (PC1, 46.46%; PC2, 11.46%). Each point represents a species positioned according to its association with multivariate ecological gradients. Species names were overlaid, outliers were identified as extreme points along PC1 or PC2. The PCA biplot revealed a clear structure of species based on their responses to ecological variables. PC1 appeared to represent a gradient of floristic abundance and disturbance affinity, separating species frequently in open, disturbed habitats (e.g., Wormwood, Clearing-associated taxa) from those in more stable or stress-adapted environments. PC2 highlights specialization under abiotic stress, such as salinity or substrate specificity, isolating halophytes and rare psammophytes in the upper quadrants. Species such as Scilla peruviana and Trisetaria parviflora appeared to be ecologically distant, suggesting niche differentiation or habitat isolation. The central clustering of most species suggests the predominance of generalist taxa and partially overlapping ecological functions, which is characteristic of structurally heterogeneous steppe communities under semi-arid climatic conditions. Such configurations are commonly observed in multivariate analyses of trait–environment relationships, where gradients of aridity and disturbance shape functional convergence within Mediterranean-type ecosystems (Díaz et al., 2016).*

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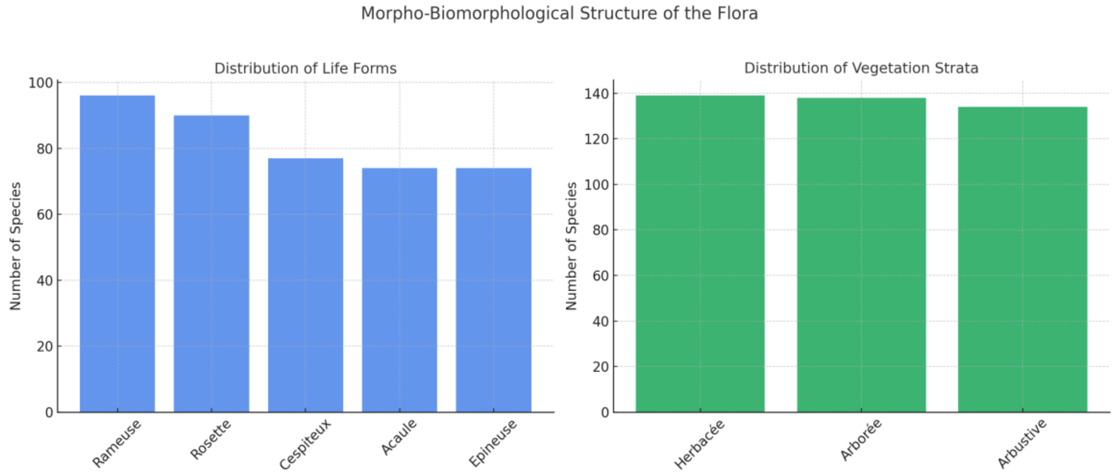

Appendix 4. *Distribution of life forms and vegetation strata based on morpho-biomorphological analyses*

Appendix 5. *List of species and flowering phenology (types and biological cycles)*

Species	Family	Biological type	Flowering period	Biological cycle
Aegilops triuncialis (L)	Poaceae	Thérophyte	March–May	Annual
Atriplex glauca L.	Chenopodiaceae	Hémicryptophyte	April–June	Perennial
Atriplex halimus L.	Chenopodiaceae	Nanophanérophyte	March–June	Perennial
Bassia muricata (L.) Asch.	Chenopodiaceae	Thérophyte	March–May	Annual
Bromus rubens (L)	Poaceae	Thérophyte	March–May	Annual
Carduus getulus Pomel.	Asteraceae	Hémicryptophyte	April–June	Perennial
Chenopodium albim (L)	Chenopodiaceae	Hémicryptophyte	April–June	Perennial
Chenopodium murale (L.)	Chenopodiaceae	Hémicryptophyte	April–June	Perennial
Cutandia dichotoma var dichotoma (Forsk.) M et W	Poaceae	Thérophyte	March–May	Annual
Erodium triangularessp lacialum (cav) Muschler	Geraniaceae	Thérophyte	March–May	Annual
Euphorbia chamaesyce (L.)	Euphorbiaceae	Thérophyte	March–May	Annual
Gladiolus byzantinus Mill. = G. communis byzantinus	Iridaceae	Géophyte	February–April	Perennial
Herniaria glabra L.	Caryophyllaceae	Thérophyte	March–May	Annual
Malva aegyptiaca (L)	Malvaceae	Thérophyte	March–May	Annual
Malva sylvestris (L.)	Malvaceae	Thérophyte	March–May	Annual
Muricaria prostrata (Desf.)	Brassicaceae	Thérophyte	March–May	Annual
Onopordon arenarium (Desf) Pomel	Asteraceae	Hémicryptophyte	April–June	Perennial
Reseda arabica (Boiss)	Resedaceae	Thérophyte	March–May	Annual
Salicorniaarabica L. var. perennis (Mill.) Fiori	Chenopodiaceae	Chaméphyte	March–July	Perennial
Salicornia arabica L. var. typica Fiori.	Chenopodiaceae	Chaméphyte	March–July	Perennial
Salsola foetida (Del.)	Chenopodiaceae	Chamophyte	Spring–Summer	Unknown
Salsola vermiculata (L.)	Chenopodiaceae	Chamophyte	Spring–Summer	Unknown
Salvia verbenaca ssp clandestina (L.) Pugsl	Lamiaceae	Hémicryptophyte	April–June	Perennial
Schismus barbatus (L.) (Thell)	Poaceae	Thérophyte	March–May	Annual
Senecio gallicus ssp. coronopifolius (Desf.) M	Asteraceae	Thérophyte	March–May	Annual
Spergula arvensis L.	Caryophyllaceae	Thérophyte	March–May	Annual
Suaeda fructicosa L.	Chenopodiaceae	Chaméphyte	March–July	Perennial
Alyssum scutigerum Dur.	Brassicaceae	Thérophyte	March–May	Annual
Atractylis serratuloides (Sieb)	Asteraceae	Thérophyte	March–May	Annual

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Species	Family	Biological type	Flowering period	Biological cycle
Biscutella didyma L.	Crucifereae	Thérophyte	March–May	Annual
Carduncellus duvauxii Batt.	Asteraceae	Hémicryptophyte	April–June	Perennial
Cutandia divaricata (Desf) Benth	Poaceae	Thérophyte	March–May	Annual
Euphorbia helioscopia ssp helioscopiodes (Losc et Pardo.) Rouy.	Euphorbiaceae	Thérophyte	March–May	Annual
Gagea arvensis (Pers.) Dumort.	Liliaceae	Géophyte	February–April	Perennial
Gagea granatilli (Parl.) ssp. eu-granatilli (Terracc.)	Liliaceae	Géophyte	February–April	Perennial
Hypecoum pendulum (L.)	Papaveraceae	Thérophyte	March–May	Annual
Lappula redowskii (Hornem.) greene	Boraginaceae	Thérophyte	March–May	Annual
Lolium perene (L)	Poaceae	Thérophyte	March–May	Annual
Lotus pusillus Medik.	Fabaceae	Hémicryptophyte	April–June	Perennial
Noaea mucronate (Forsk.) Asch.	Chenopodiaceae	Chamophyte	Spring–Summer	Unknown
Paronychia arabica (L) Dc ssp cossoniana (Gay)	Caryophyllaceae	Hémicryptophyte	April–June	Perennial
Paronychia argentea (Pourr.) Lamk	Caryophyllaceae	Hémicryptophyte	April–June	Perennial
Peganum harmala (L.)	Zygophylaceae	Chamophyte	Spring–Summer	Unknown
Reseda decursiva (Forsk.)	Resedaceae	Thérophyte	March–May	Annual
Sonchus oleraceus L.	Asteraceae	Thérophyte	March–May	Annual
Telephium imperati (L)	Caryophyllaceae	Hémicryptophyte	April–June	Perennial
Trisetaria parviflora (Desf.) Maire	Poaceae	Hémicryptophyte	April–June	Perennial
Tulipa silvestris (L.) sspAustralis (Link.) Pamp	Liliaceae	Géophyte	February–April	Perennial
Centaurea pomeliana (Batt.)	Asteraceae	Chamophyte	Spring–Summer	Unknown
Ajuga iva (L.) Schreb	Lamiaceae	Chamophyte	Spring–Summer	Unknown
Allium paniculatum (L.) ssp typicum (Regel.) emend Vindt.	Liliaceae	Géophyte	February–April	Perennial
Alyssum granatense Bois et Reut.	Brassicaceae	Thérophyte	March–May	Annual
Ammodaucus leucotrichus Coss. et Dur	Apiaceae	Thérophyte	March–May	Annual
Ampelodesma mauritanica (Poir.) Dur. et Schinz.	Poaceae	Géophyte	February–April	Perennial
Anacyclus cyrtolepidioides (Pomel.)	Asteraceae	Thérophyte	March–May	Annual
Anacyclus valentinus (L.)	Asteraceae	Thérophyte	March–May	Annual
Anarrhinum fruticosum (Desf.)	Scrophulariaceae	Thérophyte	March–May	Annual
Arestida pungens (Desf.)	Poaceae	Hémicryptophyte	April–June	Perennial
Asparagus acutifolius L.	Liliaceae	Phanérophyte	April–August	Perennial
Astragalus incanus (L.)	Fabaceae	Chamophyte	Spring–Summer	Unknown
Avena breviaristata (Barratte ex Trab.) Holub	Poaceae	Hémicryptophyte	April–June	Perennial
Bellis silvestris Cyrillo.	Asteraceae	Hémicryptophyte	April–June	Perennial
Bromus madritensis (L.)	Poaceae	Thérophyte	March–May	Annual
Bromus ramasum (L.) R. et S.	Poaceae	Thérophyte	March–May	Annual
Calycotome spinosa (L.) Lamk.	Fabaceae	Phanérophyte	April–August	Perennial
Capsella bursa pastoris (L.)	Crucifereae	Thérophyte	March–May	Annual
Carlina involucrata ssp. corymbosa (Q et S.)	Asteraceae	Chaméphyte	March–July	Perennial
Centaurea parviflora (Desf.)	Asteraceae	Chamophyte	Spring–Summer	Unknown
Cistus villosus L. var. mauritanicus Grosser.	Cistaceae	Phanérophyte	April–August	Perennial
Cutandia vallessina (Honck.) Gaud.	Poaceae	Thérophyte	March–May	Annual
Erica multiflora (L.)	Crucifereae	Thérophyte	March–May	Annual
Erodium hirtum (Desf)	Geraniaceae	Thérophyte	March–May	Annual
Erodium hymenodes L'HerMontagne djelfa	Geraniaceae	Thérophyte	March–May	Annual
Filago spathulata (Persl.)	Asteraceae	Thérophyte	March–May	Annual
Gagea mauritanica Dur.	Liliaceae	Géophyte	February–April	Perennial
Gagea reticulataPall.	Liliaceae	Géophyte	February–April	Perennial
Globularia alypum L.	Globulariaceae	Ph	Spring–Summer	Unknown
Helianthemum cinereum (Cav.) Pers (=malcomia torulosa	Cistaceae	Chamophyte	Spring–Summer	Unknown

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Species	**Family**	**Biological type**	**Flowering period**	**Biological cycle**
Helianthemum virgatum	Cistaceae	Chamophyte	Spring–Summer	Unknown
Helosciadium nodiflorum Lag.	Apiaceae	Hémicryptophyte	April–June	Perennial
Herniaria fontanesii (J.) = fructicosa (L.) ssp	Caryophyllaceae	Thérophyte	March–May	Annual
Juniperus oxycedrus L.	Cupressaceae	Phanérophyte	April–August	Perennial
Juniperus phoenica L.	Cupressaceae	Phanérophyte	April–August	Perennial
Lepidium subulatum L.	Crucifereae	Chaméphyte	March–July	Perennial
Linumgallicum (L.)	Linaceae	Hémiryptophyte	Spring–Summer	Unknown
Linum strictum (L.)	Linaceae	Hémiryptophyte	Spring–Summer	Unknown
Loeflingia hispanica L.	Caryophyllaceae	Thérophyte	March–May	Annual
Malcolmia aegyptiaca Spr.	Crucifereae	Théro	Spring–Summer	Unknown
Matthiola fructicosa (L.) Maire	Brassicaceae	Thérophyte	March–May	Annual
Mentha pulegium L.	Lamiaceae	Chaméphyte	March–July	Perennial
Muscaricomosum (L.) Mill.	Liliaceae	Géophyte	February–April	Perennial
Papaverrhoeas (L.)	Papaveraceae	Thérophyte	March–May	Annual
Paronychia capitata (L.) Lamk	Caryophyllaceae	Hémicryptophyte	April–June	Perennial
Phillyrea angustifolia L.	Oleaceae	Phanérophyte	April–August	Perennial
Pinus halepensis Mill.	Pinaceae	Phanérophyte	April–August	Perennial
Pistacia terebenthus (L.)	Anacardiaceae	Hémicryptophyte	April–June	Perennial
Plantago albicans L.	Plantaginaceae	Hémicryptophyte	April–June	Perennial
Plantago amplexicaule Cav.	Plantaginaceae	Thérophyte	March–May	Annual
Poa bulbosa (L.)	Poaceae	Hémicryptophyte	April–June	Perennial
Quercus ilex L.	Fagaceae	Phanérophyte	April–August	Perennial
Reseda sp (duriaeana) L.	Resedaceae	Thérophyte	March–May	Annual
Rosmarinus officinalis L.	Lamiaceae	Phanérophyte	April–August	Perennial
Rosmarinus tournifortii De Noé	Lamiaceae	Phanérophyte	April–August	Perennial
Scilla obtusifolia Poiret.	Liliaceae	Géophyte	February–April	Perennial
Scilla peruviana L.	Liliaceae	Géophyte	February–April	Perennial
Scorzonera undelata ssp alexandria (Boiss.) M	Asteraceae	Hémicryptophyte	April–June	Perennial
Sedum sediforme (Jacq.) Pau.	Crassulaceae	Thérophyte	March–May	Annual
Senecio vulgaris ssp. massaicus (Maire.) Q. et S.	Asteraceae	Thérophyte	March–May	Annual
Sideritis montana (L.) subsp.	Lamiaceae	Thérophyte	March–May	Annual
Sphenopus divaricatus (Gouan.) Rchb.	Poaceae	Thérophyte	March–May	Annual
Stipa tenacissima (L.)	Poaceae	Hémicryptophyte	April–June	Perennial
Tuberaria guttata (L.) Foureau.	Cistaceae	Thérophyte	March–May	Annual
Veronica praecox All.	Scrophulariaceae	Thérophyte	March–May	Annual
Xeranthemum inapertum (L.) Mill.	Thérophyte	Thérophyte	March–May	Annual
Ziziphora officinalis (L.)	Lamiaceae	Thérophyte	March–May	Annual
Adonis aestivalis (L) d	Renonculaceae	Thérophyte	March–May	Annual
Allium chamaemoly (L)	Liliaceae	Géophyte	February–April	Perennial
Androsace maxima (L.)	Primulaceae	Thérophyte	March–May	Annual
Artemisia herba alba (Asso) (=A. inculta)	Asteraceae	Chamophyte	Spring–Summer	Unknown
Astragalus caprinus (L)	Fabaceae	Chamophyte	Spring–Summer	Unknown
Astragalus crucialus (Link)	Fabaceae	Chamophyte	Spring–Summer	Unknown
Atractylisechinata (Pomel.)	Asteraceae	Thérophyte	March–May	Annual
Atractylis caerulea (Batt.)	Asteraceae	Thérophyte	March–May	Annual
Atractylis phaeolepis Pomel.	Asteraceae	Thérophyte	March–May	Annual
Calendula arvensis ssp communis (Emb et M)	Asteraceae	Thérophyte	March–May	Annual
Centaurea pengens (Pomel)	Asteraceae	Chamophyte	Spring–Summer	Unknown
Dactylis glomerata (L,)	Poaceae	Hémicryptophyte	April–June	Perennial
Diplotaxis harra (Forsk) Boiss	Crucifereae	Thérophyte	March–May	Annual
Diplotaxis pitardiana (Maire)	Crucifereae	Thérophyte	March–May	Annual

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Echium pycnanthum (Pomel) ssp humile (Desf) Jah. Et M.	Boraginaceae	Hémicryptophyte	April–June	Perennial
Erodium cicutarium (L'Her)	Geraniaceae	Thérophyte	March–May	Annual
Erodium glaucophyllum (L'Her)	Geraniaceae	Thérophyte	March–May	Annual
Helianthemum hirtum ssp ruficomum (Viv.) M.	Cistaceae	Chamophyte	Spring–Summer	Unknown
Helianthemum papillare (Boiss)	Cistaceae	Chamophyte	Spring–Summer	Unknown
Herniaria mauritanica (murb) fontanisii Batt.	Caryophyllaceae	Thérophyte	March–May	Annual
Hordeum murinum (L)	Poaceae	Thérophyte	March–May	Annual
Iris sisyrinchium L.	Iridaceae	Géophyte	February–April	Perennial
Koeleria pubescens (Lank.) PB.	Poaceae	Hémicryptophyte	April–June	Perennial
Koelpinia linearis Pallas.	Asteraceae	Thérophyte	March–May	Annual
Launaea angustifolia (Desf) Muschler	Asteraceae	Thérophyte	March–May	Annual
Launaea resedifolia ssp eu-residifolia (M)	Asteraceae	Thérophyte	March–May	Annual
Lolium rigidum (Gaud.)	Poaceae	Thérophyte	March–May	Annual
Lotus creticus (L.) ssp. eu-creticus (Briquet.)	Fabaceae	Chaméphyte	March–July	Perennial
Lotus ornithopodioides L.	Fabaceae	Thérophyte	March–May	Annual
Mantisalca salmantica (L.) Brq et Cavill	Asteraceae	Thérophyte	March–May	Annual
Medicago laciniata (L) All.	Fabaceae	Thérophyte	March–May	Annual
Medicago turbinata (L.) Wild.	Fabaceae	Thérophyte	March–May	Annual
Melilotus indica (L.) All	Fabaceae	Thérophyte	March–May	Annual
Muscari parviflora Desf.	Liliaceae	Géophyte	February–April	Perennial
Papaver hybridum (L)	Papaveraceae	Thérophyte	March–May	Annual
Papaver malviflorum (Doum.)	Papaveraceae	Thérophyte	March–May	Annual
Paronychia arabica ssp annua (Del) Maire	Caryophyllaceae	Hémicryptophyte	April–June	Perennial
Ranunculus arvensis (L)	Renonculaceae	Hémicryptophyte	April–June	Perennial
Resedaalba (L.) ssp eu-alba maire.	Resedaceae	Thérophyte	March–May	Annual
Senecio flavus (Dec.) Sch. Bip,	Asteraceae	Thérophyte	March–May	Annual
Stipa barbata (Desf.)	Poaceae	Hémicryptophyte	April–June	Perennial
Stipa parviflora (Desf.)	Poaceae	Hémicryptophyte	April–June	Perennial
Teucrium polium (L.) p.p.)	Lamiaceae	Chamophyte	Spring–Summer	Unknown
Thymus algeriensis (Boiss.) et Reut	Lamiaceae	Chamophyte	Spring–Summer	Unknown
Tourneuxia variifolia (Coss,)	Asteraceae	Thérophyte	March–May	Annual
Vicia sativa (L.)	Fabaceae	Thérophyte	March–May	Annual
Nardurus maritimus (L.) Janchen.	Poaceae	Thérophyte	March–May	Annual
Silene tridentata (Desf.)	Caryophyllaceae	Thérophyte	March–May	Annual
Adonis dentata Del.	Renonculaceae	Thérophyte	March–May	Annual
Ammoides atlantica (Coss. Et Dur.) wolf	Apiaceae	Hémicryptophyte	April–June	Perennial
Atractylis humilis ssp caespitosa (Desf.) M.	Asteraceae	Thérophyte	March–May	Annual
Brachyapium dichotomum L. Maire = (Stoibrax dichotomum (L.) Raf.)	Apiaceae	Thérophyte	March–May	Annual
Buffonia perennis Pourr.	Caryophyllaceae/Alsinoideae	Chamophyte	Spring–Summer	Unknown
Buffonia tenuifolia Griseb.	Caryophyllaceae/Alsinoideae	Chamophyte	Spring–Summer	Unknown
Bunium macuca Boiss.	Apiaceae	Géophyte	February–April	Perennial
Ceratocephalus falcatus (L.) Pers ssp incurvus Stev.) Maire et Weiller	Renonculaceae	Thérophyte	March–May	Annual
Echium trygorrhizum (Pomel.)	Boraginaceae	Hémicryptophyte	April–June	Perennial
Eruca vesicaria ssp pannatifida (Desf.) Emb. et Maire	Brassicaceae	Thérophyte	March–May	Annual
Erysimum incanum (Kunze.)	Brassicaceae	Thérophyte	March–May	Annual
Herniaria incana Lamk.	Caryophyllaceae	Hémicryptophyte	April–June	Perennial
Jurinea humilis DC.	Asteraceae	Hémicryptophyte	April–June	Perennial
Koniga lybica (Viv.)	Brassicaceae	Thérophyte	March–May	Annual
Launaea glomerata (Cass.) Hook. f.	Asteraceae	Thérophyte	March–May	Annual

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Leontodon hispidulus (Del.) Bpoiss. mulleri (Sch. Bip.) M.	Asteraceae	Thérophyte	March–May	Annual
Lobularia lybica (Viv.) Webb	Crucifereae	Thérophyte	March–May	Annual
Matthiola longipetalassp kralikii (pomel.) Maire	Brassicaceae	Thérophyte	March–May	Annual
Medicago litoralis (Rohde.)	Fabaceae	Thérophyte	March–May	Annual
Micropus bombicinus (Lag.)	Asteraceae	Thérophyte	March–May	Annual
mpelodesma mauritanica	Plantaginaceae	Thérophyte	March–May	Annual
Nonnea micronatha Boiss. et Reut.	Boraginaceae	Thérophyte	March–May	Annual
Phagnalon rupestre (L.) DC.	Asteraceae	Chamophyte	Spring–Summer	Unknown
Scorzonera laciniata (L.)	Asteraceae	Hémicryptophyte	April–June	Perennial
Spitzelia coronopifolia Desf./Une autre espèceLeontodonhispanicus	Asteraceae	Hémicryptophyte	April–June	Perennial
Telephium spaerospermum Boiss.	Caryophyllaceae	Hémicryptophyte	April–June	Perennial
Thymelaea tartonraira All.	Theligonaceae	Chamophyte	Spring–Summer	Unknown
Thymus hirtusWilld.	Lamiaceae	Chamophyte	Spring–Summer	Unknown
Trigonella polycerata L.	Fabaceae	Hémicryptophyte	April–June	Perennial
Tunica illyrica (Ard.) Fisch. et Meg.	Caryophyllaceae	Hémicryptophyte	April–June	Perennial
Vicia ervilia (L.) Willd.	Fabaceae	Thérophyte	March–May	Annual
Zizyphora hispanica L.	Lamiaceae	Thérophyte	March–May	Annual
Alyssum macrocalyx Coss et Dur.	Brassicaceae	Thérophyte	March–May	Annual
Astragalus armatus Willd.	Fabaceae	Chamophyte	Spring–Summer	Unknown
Astragalus caprinus ssp lanigerus (Desf.) Maire.	Fabaceae	Chamophyte	Spring–Summer	Unknown
Astragalus monspessulanus L.	Fabaceae	Chamophyte	Spring–Summer	Unknown
Atractylis humilis (L.)	Asteraceae	Thérophyte	March–May	Annual
Atractylis polycephala Coss.	Asteraceae	Thérophyte	March–May	Annual
Avena bromoides Gouan.	Poaceae	Hémicryptophyte	April–June	Perennial
Beta vulgaris L.	Chenopodiaceae	Thérophyte	March–May	Annual
Calendula aegyptiaca Desf.	Asteraceae	Thérophyte	March–May	Annual
Carduncellus pinnatus (Desf) DC.	Asteraceae	Hémicryptophyte	April–June	Perennial
Carduncellus plumosus Pomel.	Asteraceae	Chamophyte	Spring–Summer	Unknown
Ceratocephalus falcatus (L.) Persssp falcatus (Stev.) Maire et Weiller	Renunculaceae	Thérophyte	March–May	Annual
Echinaria capitata (L.) Desf.	Poaceae	Thérophyte	March–May	Annual
Echinops spinosus L.	Asteraceae	Chamophyte	Spring–Summer	Unknown
Erodium meynieri Maire.	Geraniaceae	Thérophyte	March–May	Annual
Erysimum bocconei (All.) Pers	Brassicaceae	Thérophyte	March–May	Annual
Euphorbia sulcata de Lens.	Euphorbiaceae	Thérophyte	March–May	Annual
Helianthemum pilosum (L.) Pers	Cistaceae	Chamophyte	Spring–Summer	Unknown
Hertia cheirifolia (L.) O.K.	Poaceae	Hémicryptophyte	April–June	Perennial
Hippocrepis multisiliquosa (L.) ciliata (Willd.) Maire.	Fabaceae	Thérophyte	March–May	Annual
Hypochoeris radicata L.	Asteraceae	Hémicryptophyte	April–June	Perennial
Leontodon hispidulus (Del.) ssp Muleri (Sch. Bip.) M	Asteraceae	Thérophyte	March–May	Annual
Linum decumbens Desf.	Linaceae	Hémiryptophyte	Spring–Summer	Unknown
Medicago minima (Gruft.)	Fabaceae	Thérophyte	March–May	Annual
Nardurus cynosuroides (Desf.) B. et T.	Poaceae	Thérophyte	March–May	Annual
Ranunculus gramineus L.	Renonculaceae	Hémicryptophyte	April–June	Perennial
Senecio leucanthemifolius Poiret.	Asteraceae	Thérophyte	March–May	Annual
Sisymbrium runcinatum Lag.	Crucifereae	Thérophyte	March–May	Annual
Smilax aspera L.	Lamiaceae	Nanophanérophyte	March–June	Perennial
Stahelina dubia (L.)	Asteraceae	Chaméphyte	March–July	Perennial
Anacyclus clavatus (Desf.)	Asteraceae	Thérophyte	March–May	Annual

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Carduncellus pomelianus Batt.	Asteraceae	Hémicryptophyte	April–June	Perennial
Lotus creticus (L.) ssp. collinus (Boiss.) Briquet.	Fabaceae	Chaméphyte	March–July	Perennial
Spergula flaccida (Roxb.) Asch	Caryophyllaceae	Hémicryptophyte	April–June	Perennial
Vicia monardi (Boiss.)	Fabaceae	Thérophyte	March–May	Annual
Ajuga chameapitys (Schreber.)	Lamiaceae	Chamophyte	Spring–Summer	Unknown
Artemisia compestrice (L.)	Asteraceae	Chamophyte	Spring–Summer	Unknown
Bupleurum balansae Boiss. et Reut.	Apiaceae	Hémicryptophyte	April–June	Perennial
Delphinium pubescens DC.	Renonculaceae	Thérophyte	March–May	Annual
Ifloga spictata (forsk.) sch. Bip soit spicata verifier	Asteraceae	Thérophyte	March–May	Annual
Lotus jolyi Batt.	Fabaceae	Hémicryptophyte	April–June	Perennial
Lotus parviflorus Desf..	Fabaceae	Thérophyte	March–May	Annual
Malva parviflora (L.)	Malvaceae	Thérophyte	March–May	Annual
Muscari maritimum Desf..	Liliaceae	Géophyte	February–April	Perennial
Saccocalyx satureioides (Coss.) et Dur	Lamiaceae	Chaméphyte	March–July	Perennial
Scabiosa arenarea Forsk.	Dipsacaceae	Thérophyte	March–May	Annual
Silene arenarioides (Desf.)	Caryophyllaceae	Thérophyte	March–May	Annual
Urospermum picroides (L.) Schmidt.	Asteraceae	Thérophyte	March–May	Annual
Anthemis pedunculata Desf.	Asteraceae	Hémicryptophyte	April–June	Perennial
Aristida ciliata Desf.	Grammineae	Hémicryptophyte	April–June	Perennial
Astragalus gombo (Coss.) et Dur.	Fabaceae	Chamophyte	Spring–Summer	Unknown
Astragalus scorioides (pourret.)	Fabaceae	Chamophyte	Spring–Summer	Unknown
Bromus tectorum (L.)	Poaceae	Thérophyte	March–May	Annual
Erodium malachoides (L.) Willd	Geraniaceae	Thérophyte	March–May	Annual
Helianthemum kahiricum	Cistaceae	Chamophyte	Spring–Summer	Unknown
Hippocrepis unisiliquosa (L.)	Fabaceae	Thérophyte	March–May	Annual
Lagurus ovatus L.	Poaceae	Thérophyte	March–May	Annual
Lepturus cylindricus (Willd.) Trin.	Poaceae	Thérophyte	March–May	Annual
Moricandia arvensis (L.) DC.	Brassicaceae	Chamophyte	Spring–Summer	Unknown
Plantago ciliata	Plantaginaceae	Thérophyte	March–May	Annual
Teucrium pseudo-chamaepitys (L.)	Lamiaceae	Chamophyte	Spring–Summer	Unknown
Thlaspsi perfoliatum L.	Brassicaceae	Thérophyte	March–May	Annual
Tunica illyrica (Ard.) fisch et Meg = Dianthella compressa (Claus.)	Caryophyllaceae	Hémicryptophyte	April–June	Perennial
Vulpia membranacea (L.) Link.	Poaceae	Thérophyte	March–May	Annual
Ziziphora hispanica (L)	Lamiaceae	Thérophyte	March–May	Annual
Ziziphus lotus	Rhamnaceae	Phanerophyte	Spring–Summer	Unknown
Tamarix gallica L.	Tamaricaceae	Phanérophyte	April–August	Perennial
Helianthemum hirtum (Spreng.) ssp reficomum	Cistaceae	Chamophyte	Spring–Summer	Unknown
Tulipa silvestris ssp. australis (Link.) Pamp.	Liliaceae	Géophyte	February–April	Perennial
Alyssum parviflora Fisch.	Brassicaceae	Thérophyte	March–May	Annual
Calycotome villosa (Poiret.) Link.	Fabaceae	Phanérophyte	April–August	Perennial
Lobularia maritima (L.) Desv.	Crucifereae	Hémicryptophyte	April–June	Perennial
Lygeum spartum (L.)	Poaceae	Hémicryptophyte	April–June	Perennial
Pistacia lentiscus (L.)	Anacardiaceae	Hémicryptophyte	April–June	Perennial
Tulipa silvestris (L.) sspprimulina (Beker.) M.W	Liliaceae	Géophyte	February–April	Perennial
Bromus hordaceus (L.)	Poaceae	Thérophyte	March–May	Annual
Chrysanthemum fuscatum Desf.	Asteraceae	Thérophyte	March–May	Annual
Cynoglossum cheirifoliumL.	Boraginaceae	Hémicryptophyte	April–June	Perennial
Geranium pyrenaicum Burm. f	Geraniaceae	Hémicryptophyte	April–June	Perennial
Arceuthobium oxycedri (DC.) M. Bieb.	Viscaceae	Hémiparasite	Variable	Variable
Medicago italica (Mill.) steud ssp helix (Willd.)	Fabaceae	Thérophyte	March–May	Annual

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Species	Family	Biological type	Flowering period	Biological cycle
Emb. et Maire				
Minuartia tenuifolia (L.) Hiern.	Caryophyllaceae	Thérophyte	March–May	Annual
Verbena supina L.	Verbenaceae	Thérophyte	March–May	Annual
Thapsia vilosa L.	Apiaceae	Hémicryptophyte	April–June	Perennial
Anacyclus radiatus (lois.)	Asteraceae	Thérophyte	March–May	Annual
Anthyllis sericea (L.) ssp serecea (Lag.)	Fabaceae	Chaméphyte	March–July	Perennial
Astragalus sesameus (L.)	Fabaceae	Chamophyte	Spring–Summer	Unknown
Bascurtella didyma	Crucifereae	Chamophyte	Spring–Summer	Unknown
Boreava aptera Bois.	Crucifereae	Thérophyte	March–May	Annual
Bromus squarrosus (L.)	Poaceae	Thérophyte	March–May	Annual
Callitris articulata (Vahl.) LinkMasters. Arbuste thuya de Barbarie	Cupressaceae	Phanérophyte	April–August	Perennial
Coronilla scorpioides koch.	Fabaceae	Thérophyte	March–May	Annual
Diplotaxis erucoides (L.)	Crucifereae	Thérophyte	March–May	Annual
Erodium botrys (Cav.) Betel	Geraniaceae	Thérophyte	March–May	Annual
Euphorbia granulata Forsk.	Euphorbiaceae	Thérophyte	March–May	Annual
Gladiolus byzantinus Mill.	Iridaceae	Géophyte	February–April	Perennial
Gladiolus segetum (Ker.) Gawl.	Iridaceae	Géophyte	February–April	Perennial
Helianthemum lipii (L.) pers	Cistaceae	Chamophyte	Spring–Summer	Unknown
Lotus villosus (Forsk.) pusillus (Medik.)	Fabaceae	Hémicryptophyte	April–June	Perennial
Olea sylvestris L.	Oleaceae	Phanérophyte	April–August	Perennial
Onopordan acaule (L.)	Asteraceae	Hémicryptophyte	April–June	Perennial
Plantago pssillium ((L.)	Plantaginaceae	Thérophyte	March–May	Annual
Polygonum aviculareL.	Polygonaceae	Thérophyte	March–May	Annual
Sisymbrium irrio (L.)	Crucifereae	Thérophyte	March–May	Annual
Tetraclinis articulata (Vahl.) Link (=Callitris articulata (Vahl.) Link)	Cupressaceae	Phanérophyte	April–August	Perennial
Tetraclinis articulata (Vahl.) Link Callitris articulata (Vahl.) LinkMasters. Arbuste thuya de Barbarie	Cupressaceae	Phanérophyte	April–August	Perennial
Tragopogon porrifolius L	Asteraceae	Hémicryptophyte	April–June	Perennial
Turgenia latifolia L (Hoffm.)	Apiaceae	Thérophyte	March–May	Annual
Catapodium loliaceum (Huds.) link. (=C. marinum)	Poaceae	Thérophyte	March–May	Annual
Cytisus sp. Fontanesii Spach.	Fabaceae	Chaméphyte	March–July	Perennial
Epipactis helleborine (L.) Crantz.	Orchidaceae	Géophyte	February–April	Perennial
Filago heterantha (Guss.)	Asteraceae	Thérophyte	March–May	Annual
Galium palustre L.	Scrophulariaceae	Chaméphyte	March–July	Perennial
Genista erioclada ssp. erioclada (Emb.) et Maire.	Fabaceae	Chaméphyte	March–July	Perennial
Genista microcephala (Coss.) et Dur.	Fabaceae	Chaméphyte	March–July	Perennial
Genista quadriflora Munby.	Fabaceae	Chaméphyte	March–July	Perennial
Geranium dissectum L.	Geraniaceae	Thérophyte	March–May	Annual
Hippocrepis bicontorta (Lois.)	Fabaceae	Thérophyte	March–May	Annual
Jasminum fruticansL.	Oleaceae	Phanérophyte	April–August	Perennial
Launaea acanthoclada M.	Asteraceae	Thérophyte	March–May	Annual
Launaea arborescens (Batt.) M.	Asteraceae	Thérophyte	March–May	Annual
Leontodon hispanicus (Del.) Boiss.	Asteraceae	Thérophyte	March–May	Annual
Medicago truncatula (Gearn.)	Fabaceae	Thérophyte	March–May	Annual
Onobrychis viciifolia Scop.	Fabaceae	Hémicryptophyte	April–June	Perennial
Ophrys lutea (Cav.) Gouan	Orchidaceae	Géophyte	February–April	Perennial
Rumex aristidis Coss.	Polygonaceae	Hémicryptophyte	April–June	Perennial
Scrofularia laevigata Vahl.	Scrophulariaceae	Hémicryptophyte	April–June	Perennial
Silene cerastioide (L.)	Caryophyllaceae	Thérophyte	March–May	Annual

Species	Family	Biological type	Flowering period	Biological cycle
Silene conica (L.)	Caryophyllaceae	Thérophyte	March–May	Annual
Silene setacea (Viv.)	Caryophyllaceae	Thérophyte	March–May	Annual
Stachys brachycladaNoe ex Coss	Lamiaceae	Thérophyte	March–May	Annual
Stipa retorta (Cav.)	Poaceae	Thérophyte	March–May	Annual
Trigonella monspeliaca (L.)	Fabaceae	Hémicryptophyte	April–June	Perennial
Lolium multiflorum Lam.	Poaceae	Thérophyte	March–May	Annual
Allium roseum (L.)	Liliaceae	Géophyte	February–April	Perennial
Alyssum alpestre L.	Brassicaceae	Thérophyte	March–May	Annual
Centaurea alba L.	Asteraceae	Chamophyte	Spring–Summer	Unknown
Euphorbia exigua (L.)	Euphorbiaceae	Thérophyte	March–May	Annual
Linum suffruticosum (L.)	Linaceae	Hémiryptophyte	Spring–Summer	Unknown
Malcolmia torulosa (Desf.) Boiss.	Crucifereae	Thérophyte	March–May	Annual
Nonnea visicaria (L.) Rsch.	Boraginaceae	Thérophyte	March–May	Annual
Sisymbrium torulosum (Desf.)	Crucifereae	Thérophyte	March–May	Annual
Myosotis versicolor (Pers.) Smith. = M. discolor	Boraginaceae	Thérophyte	March–May	Annual
Arabis verna (L.) W.T. Aiton	Brassicaceae	Thérophyte	March–May	Annual
Arenaria serpyllifolia (Rchb.) Guss	Caryophyllaceae	Thérophyte	March–May	Annual
Bupleurum atlanticum Murb.	Apiaceae	Hémicryptophyte	April–June	Perennial
Centaurea melitensis (L.)	Asteraceae	Chamophyte	Spring–Summer	Unknown
Cistus villosusL. var. creticus = undulatus (Spach.) Gross. Emend	Cistaceae	Phanérophyte	April–August	Perennial
Ctenopsis pectinella (Del.) De Not.	Poaceae	Thérophyte	March–May	Annual
Eruca vesicaria (L.) Car. Ssp vesicaria (L.) Briq.	Brassicaceae	Thérophyte	March–May	Annual
Fumana thymifolia (L.) Verlot.	Cistaceae	Chaméphyte	March–July	Perennial
Helianthum apertum (Pomel.)	Cistaceae	Chamophyte	Spring–Summer	Unknown
Hypochoeris laevigata	Asteraceae	Hémicryptophyte	April–June	Perennial
Iberis odarata L.	Brassicaceae	Thérophyte	March–May	Annual
Knautia arvensis (L.) Coult.	Dipsacaceae	Hémicryptophyte	April–June	Perennial
Leontodon saxatilis (Lamk.)	Asteraceae	Thérophyte	March–May	Annual
Lonicera implexa L.	Caprifoliaceae	Phanérophyte	April–August	Perennial
Matthiola longipetala (Vent.) DC. ssp livida (Del.) Maire	Brassicaceae	Thérophyte	March–May	Annual
Minuartia montana (L.)	Caryophyllaceae	Thérophyte	March–May	Annual
Myosotis scorpioides var. collina Ehrh	Boraginaceae	Thérophyte	March–May	Annual
Polygonum equisitiforme S et Sm.	Polygonaceae	Chaméphyte	March–July	Perennial
Pseudognaphalium luteoalbum (L.) Hilliard & B.L. Burtt	Asteraceae		Spring–Summer	
Pulicaria laciniata (Coss et Gral.) Thel	Asteraceae	Thérophyte	March–May	Annual
Romulea bolbucodium (L.) Seb.	Iridaceae	Géophyte	February–April	Perennial
Silene rouyana (B	Caryophyllaceae	Thérophyte	March–May	Annual
Silene rubella (L.)	Caryophyllaceae	Thérophyte	March–May	Annual
Tamarix aphylla (L.) Karst	Tamaricaceae	Phanérophyte	April–August	Perennial
Valeriana tuberosa L.	Valerianaceae	Hémicryptophyte	April–June	Perennial
Valerianella carinata Lois.	Valerianaceae	Thérophyte	March–May	Annual
Vulpia myuros (L.) Gmel.	Poaceae	Thérophyte	March–May	Annual
Sisymbrium thalianum (L.) Gay. et Mon. (=Arabidopsis thaliana) (L.) Heyn.	Crucifereae	Thérophyte	March–May	Annual
Aeluropus littoralis (Gouan.) parl	Poaceae	Hémicryptophyte	April–June	Perennial
Arabis auriculata Lam.	Brassicaceae	Thérophyte	March–May	Annual
Carex halleriana Asso.	Cyperaceae	Hémicryptophye	Spring–Summer	Unknown
Helichrysum stoechas (L.) DC.	Asteraceae	Chaméphyte	March–July	Perennial
Leuzea conifera (L.) DC.	Asteraceae	Hémicryptophyte	April–June	Perennial
Lithospernum arvense (L.)	Boraginaceae	Thérophyte	March–May	Annual

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Lotus edulis L.	Fabaceae	Thérophyte	March–May	Annual
Minuartia campestris (L.)	Caryophyllaceae	Thérophyte	March–May	Annual
Orchissp. L.	Orchidaceae	Géophyte	February–April	Perennial
Roemeria hybrida (L.) DC.	Papaveraceae	Thérophyte	March–May	Annual
Valerianella coronata (L.) DC.	Valerianaceae	Thérophyte	March–May	Annual
Lithospermum apulum (L.) Vahl.	Boraginaceae	Thérophyte	March–May	Annual
Atractylis carduus (Forsk.) Christ.	Asteraceae	Thérophyte	March–May	Annual
Erodium polyanthemum (Desf.) Pers. pimulum pilosum Tex	Geraniaceae	Thérophyte	March–May	Annual
Euphorbiafalcata (L.)	Euphorbiaceae	Thérophyte	March–May	Annual
Eryngium ilicifolium Lam.	Apiaceae	Thérophyte	March–May	Annual
Leontodon tuberosus (L.)	Asteraceae	Thérophyte	March–May	Annual
Astragalus senaicus ou senicus	Fabaceae	Chamophyte	Spring–Summer	Unknown
Diplotaxis virgata DC.	Crucifereae	Thérophyte	March–May	Annual
Herniaria hirsuta L.	Caryophyllaceae	Thérophyte	March–May	Annual
Silene secundiflora otth.	Caryophyllaceae	Thérophyte	March–May	Annual
Carex divisa Huds.	Cyperaceae	Hémicryptophye	Spring–Summer	Unknown
Cynoglossum clandestinum Desf.	Boraginaceae	Hémicryptophyte	April–June	Perennial
Linaria simplex (DC.)	Scrophulariaceae	Chamophyte	Spring–Summer	Unknown
Scilla lingulata Poiret.	Liliaceae	Géophyte	February–April	Perennial
Stachys circinata l'Her.	Lamiaceae	Hémicryptophyte	April–June	Perennial
Cutandia dichotoma var memphitica (Roth.) M. et W	Poaceae	Thérophyte	March–May	Annual
Paronichia capitata ssp chlorothyrum (Murberk.) Maire.	Caryophyllaceae	Hémicryptophyte	April–June	Perennial
Asterolinum linum-stellatum (L.) Duby. = Asterolinon linum stellatum	Primulaceae	Thérophyte	March–May	Annual
Scabiosa stellata L.	Dipsacaceae	Thérophyte	March–May	Annual
Erodium bipinnatum (Willd.)	Geraniaceae	Thérophyte	March–May	Annual
Rumexgonglomeratus (Murr.)(L'SSAN ELFARD)	Polygonaceae	Thérophyte	March–May	Annual
Scabiosa atrpurpurea L.	Dipsacaceae	Thérophyte	March–May	Annual
Thymus ciliatus desf.) ssp eu-ciliatus (Maire.)	Lamiaceae	Chamophyte	Spring–Summer	Unknown
Helianthemumledifolium (L.) Mill	Cistaceae	Chamophyte	Spring–Summer	Unknown
Carduncellus plumosus (Pomel.) (Asteracces)	Asteraceae	Chamophyte	Spring–Summer	Unknown
Ebenus pinnata L.	Fabaceae	Chaméphyte	March–July	Perennial
Atractylis cancellata (L.) Steeppe	Asteraceae	Thérophyte	March–May	Annual
Evax argentea Pomel.	Asteraceae	Thérophyte	March–May	Annual
Phagnalon saxatile (L.) Cass.	Asteraceae	Chamophyte	Spring–Summer	Unknown

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