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Original research

Diversity and taxonomic structure of Asteraceae in semiarid regions of eastern Algeria

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Abstract

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Asteraceae are a major component of Mediterranean semiarid floras, but recent field-based inventories of the family are scarce for eastern Algeria. A checklist of the Asteraceae family was compiled from itinerant surveys conducted across four habitat strata in the provinces of Batna, Sétif and Oum El Bouaghi between 2022 and 2025. The study aimed to reveal which taxa occur, their biogeographical origin, how species are distributed among genera and tribes, and their distribution among provinces and habitat types. The surveys recorded 132 species belonging to 71 genera and nine tribes. Forty genera (56.3%) were monospecific, and only *Centaurea* (11 species) and *Carthamus* (7 species) contained more than four species. The Shannon index calculated from species distribution among genera was 4.04, and Pielou's evenness was 0.95; these values describe the checklist's taxonomic structure, not community abundance structure. Cardueae (46 species) and Cichorieae (42 species) together accounted for two-thirds of the species. Mediterranean taxa formed the largest chorological group (47.7%). Twenty-one taxa (15.9%) are endemic to Algeria or North Africa, and four are alien or cultivated. Batna held 109 species, Sétif 51 and Oum El Bouaghi 33, and only 10 species were recorded in all three provinces. Endemic taxa were concentrated on rocky slopes, steppes and mountain grasslands, and none were recorded in crops or ruderal sites, whereas 54% of non-endemic species occurred there (Fisher's exact test, $p < 0.001$). The checklist provides a dated baseline for Asteraceae in semiarid eastern Algeria and identifies seminatural habitats in Batna and Sétif as priorities for conserving endemic taxa.

Keywords: chorology, Compositae, endemic species, floristic checklist, habitat, Mediterranean flora, steppe.

INTRODUCTION

The family Asteraceae (synonym: Compositae) is one of the largest and most diverse angiosperm families, comprising more than 1600 genera and over 32000 species distributed across a wide range of ecological habitats (Devkota, 2022). Its diversity is especially pronounced in Mediterranean and semiarid regions (Waheed & Arshad, 2024). The family is also of practical importance. It includes many medicinal and aromatic plants rich in bioactive compounds such as flavonoids, sesquiterpene lactones and essential oils (Adnan et al., 2023). Several species are eaten as leafy vegetables or grown as oilseed crops (Liava et al., 2024; Bhatt et al., 2026). In arid and semiarid rangelands, Asteraceae also contributes to livestock forage (Basbag & Sayar, 2023; Mansouri et al., 2026).

North Africa, especially Algeria, is recognised as an important centre of plant diversity within the Mediterranean Basin, characterised by high levels of endemism and marked floristic heterogeneity (Médail & Quézel, 1997; Meddour et al., 2023). In eastern Algeria, including Batna, Sétif, and Oum El Bouaghi, environmental conditions vary considerably due to differences in altitude, climate, and soil characteristics, creating a mosaic of habitats that support diverse plant assemblages (Le Houérou, 2001). These semiarid areas are also affected by overgrazing, land-use change and climatic variability, which can alter species composition and distribution (Semara et al., 2025).

Within these environments, Asteraceae species show a wide range of adaptive traits, including spinescence, flexible phenology, and tolerance to drought and disturbance (Palazzesi et al., 2022). Tribes such as Cardueae and Cichorieae are particularly well represented in arid and semiarid conditions (Waheed & Arshad, 2024). Several genera within these groups, including *Centaurea* L., *Carthamus* L., and *Lactuca* L., are commonly associated with disturbed habitats and are often considered good indicators of environmental change (Roché & Roché, 2021; Abou Auda, 2023).

Despite the ecological importance of this family, floristic information for much of Algeria remains incomplete or outdated. Earlier works have provided valuable baseline data, but regular updates are needed to track changes in species composition over time, especially in regions exposed to strong environmental and anthropogenic pressures (Quézel & Santa, 1962, 1963; Dobignard & Chatelain, 2010, 2011a, b, 2012, 2013). In eastern Algeria, recent field-based syntheses of Asteraceae diversity are still limited. Without an updated checklist, it is not possible to state which taxa are present today, how many are endemic or alien, how the flora is distributed among genera and tribes, or which provinces and habitats hold the endemic taxa.

This study provides an updated checklist of Asteraceae in the semiarid areas of Batna, Sétif, and Oum El Bouaghi, based on field surveys conducted between 2022 and 2025. It addresses four questions: (1) Which Asteraceae taxa occur in the study area, and what is their chorological composition, including the share of endemic and alien taxa? (2) Is species richness concentrated in a few species-rich genera or spread across many species-poor genera? (3) Which tribes contribute most to the regional Asteraceae flora? (4) How are species, and endemic taxa in particular, distributed among the three provinces and among habitat types? The answers establish a dated baseline against which future floristic change can be measured, and they identify the provinces and habitats where endemic Asteraceae should be prioritised for conservation and monitoring.

MATERIALS AND METHODS

Study area

The study was conducted in three provinces of northeastern Algeria (Batna, Sétif and Oum El Bouaghi) between 2022 and 2025 (Fig. 1). These regions exhibit pronounced spatial and altitudinal climatic variability, driven by the combined effects of latitude, elevation, and topographic heterogeneity. Topography plays a dominant role in shaping local climatic patterns. Mountainous massifs such as the Belezma and the Babors induce cooler and more humid conditions through altitudinal gradients and orographic precipitation. In contrast, the high plains, situated between approximately 800 and 1200 m a.s.l., are characterised by a temperate continental regime with marked thermal contrasts. Further south, depressions and steppe landscapes have a warmer,

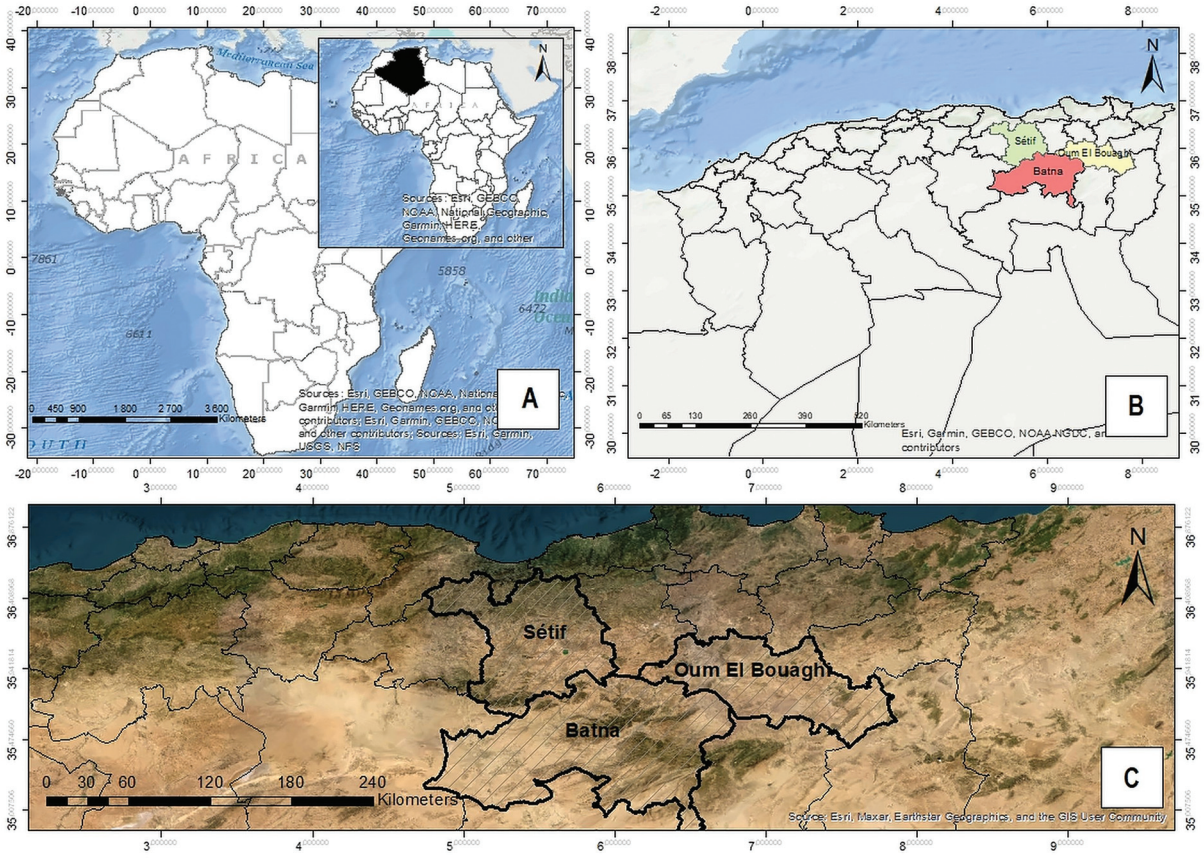


Fig. 1. Location of the study area in northeastern Algeria. A – geographic position of Algeria within Africa; B – administrative map showing the study region, including Batna, Sétif, and Oum El Bouaghi; C – detailed map of the study area overlaid on satellite imagery; green areas represent vegetation cover, and lines show administrative boundaries. Maps were produced in ArcGIS 10.8 and QGIS using the World Geodetic System 1984 (WGS 84).

more arid climate, with high evapotranspiration rates and sparse vegetation cover.

From a bioclimatic perspective, classical classifications by Henri Gaussen and the pluviothermal index of Louis Emberger place the study regions into distinct zones. Batna represents a cold semiarid bioclimate, Sétif corresponds to a transitional subhumid-semiarid zone, and Oum El Bouaghi is characterised by a continental semiarid climate. These areas show a wide annual thermal amplitude, with summer temperatures frequently exceeding 30°C and winter temperatures approaching 0°C, occasionally dropping below freezing in mountainous and high plain environments. Precipitation remains low to moderate and highly irregular in both temporal and spatial distribution. Rainfall is concentrated mainly in spring and autumn, while pronounced drought conditions mark summer. Annual precipitation exceeds 700 mm in the northern mountainous areas of Sétif (Babors range), decreases to approximately 400 mm across the high plains, and falls below 300 mm in the steppe regions of Batna and Oum El Bouaghi, where rainfall events are often short and occasionally torrential.

Floristic survey and sampling

Field surveys were carried out between 2022 and 2025, mainly between March and November, to account for seasonal variation in species occurrence and detectability. Fifteen field visits were made each year, five in each province, so survey effort was equal among Batna, Sétif and Oum El Bouaghi.

The survey was stratified by habitat. Four strata were recognised in each province: rangelands, natural vegetation patches, agricultural margins, and disturbed sites. Floristic data were collected through itinerant surveys within each stratum. Sites were selected to represent the main habitat types and envi-

ronmental conditions of each province. During each visit, all Asteraceae taxa encountered were recorded, along with the habitat in which they grew. Presence was recorded; abundance and cover were not measured.

Species were recorded through direct field observation and specimen collection. At least one voucher specimen for each taxon was collected and processed according to standard herbarium procedures (Bridson & Forman, 1998). Voucher specimens are deposited at the Herbarium of the Department of Ecology and Environment, University of Batna 2, Batna, Algeria. Species identification was based on the regional flora and keys of Quézel & Santa (1962, 1963). Nomenclature follows Dobignard & Chatelain (2010, 2011a, b, 2012, 2013). Strict Algerian endemics were identified following Meddour et al. (2023), whose checklist includes only taxa restricted to Algeria. Taxa shared only with Morocco, Tunisia or other North African countries (Algerian–Moroccan, Algerian–Tunisian, and North African endemics) were identified from Quézel & Santa (1962, 1963) and Dobignard & Chatelain (2010, 2011a, b, 2012, 2013) and were also treated as endemic. Alien status and chorological types were assigned following Quézel & Santa (1962, 1963) and Dobignard & Chatelain (2010, 2011a, b, 2012, 2013).

Data sets and analysis

All analyses used one data set: the checklist of 132 species (Table 1). For each species, the table gives its tribe, status (alien or cultivated), the provinces in which it was recorded, the habitat types in which it was recorded, and its chorological type, which also indicates endemism and the endemic range. Habitats were coded in nine categories (Table 1). Because the survey produced only presence records, the analyses describe the composition of the regional flora and the distribution of species among provinces and habitats. They do not describe species abundance or plant community structure.

Taxonomic structure was described by species richness, genus richness, the species-to-genus ratio, the number of monospecific genera, and the number of species and genera per tribe. The Shannon index (H′, natural logarithm) and Pielou's evenness (J′ = H′/ln G) on the distribution of species among genera were calculated. In this application, p_i is the proportion of the 132 species that belong to genus i, and G is the number of genera (71). H′ and J′ therefore measure how evenly species are spread across genera. These values do not estimate community diversity and cannot be compared with abundance-based Shannon values from plot studies. The genus level was chosen because it is the only level above species at which the checklist provides enough units for a frequency distribution (71 genera, compared with nine tribes).

Chorological types were grouped into seven categories: endemic; North African taxa of uncertain endemic status; Mediterranean (including western, southern and circum-Mediterranean, sub-Mediterranean and Ibero-Mauritanian types); Mediterranean-Irano-Turanian and Saharo-Sindian; Euro-Mediterranean and Eurasian; widespread (cosmopolitan, circumboreal and palaeotemperate); and alien or cultivated. The chorological spectrum was calculated for the whole checklist and for each province.

Floristic similarity between provinces was measured with the Sørensen index. The association between endemism and anthropogenic habitats was tested with a two-sided Fisher's exact test, using species as units. Each species was classified as endemic or not, and as recorded or not recorded in crops and fallows or ruderal sites. Habitat types were grouped by Asteraceae composition using a habitat × species presence matrix, Jaccard dissimilarity and UPGMA clustering; the fit of the dendrogram was assessed with the cophenetic correlation coefficient. All indices and tests were computed in Python 3 (NumPy and SciPy).

RESULTS

Floristic composition

The surveys recorded 132 species belonging to 71 genera and nine tribes (Table 1). The species-to-genus ratio was 1.86.

Twenty-one taxa (15.9%) are endemic (Table 1). Two are endemic to Algeria (*Centaurea tougourensis* Boiss. & Reut. and *Hieracium faurelianum* Maire), five are shared with Morocco, five with Tunisia, and nine are North African endemics. The endemic status of five of these taxa is uncertain (Table 1).

Table 1. Checklist of Asteraceae species recorded in the semiarid areas of Batna, Sétif and Oum El Bouaghi (eastern Algeria), 2022–2025. Species are listed alphabetically. Nomenclature follows Dobignard & Chatelain (2010, 2011a, b, 2012, 2013). **Status**: A – alien (neophyte); C – cultivated, occasionally subspontaneous; N – native. **Provinces**: B, Batna; S, Sétif; O, Oum El Bouaghi. **Habitats**: F, forest and pre-forest stands; M, matorral and garrigue; St, steppe and rangeland; G, mountain grassland; R, rocky slopes and cliffs; C, crops and fallows; Ru, ruderal sites (roadsides, waste ground, overgrazed areas); W, wet places and wadi banks; Sa, sandy soils. **Chorotypes** (after Quézel & Santa, 1962, 1963, updated with Dobignard & Chatelain, 2010, 2011a, b, 2012, 2013): Med, Mediterranean; W Med, western Mediterranean; S Med, southern Mediterranean; Circummed, circum-Mediterranean; Sub-Med, sub-Mediterranean; Eur, European; Eur-Med, Euro-Mediterranean; Euras, Eurasian; Euras-Med, Eurasian-Mediterranean; Med-Irano-Tour, Mediterranean-Irano-Turanian; Ibero-Maur, Ibero-Mauritanian; Paleotemp, Palaeotemperate; Circumbor, circumboreal; Cosmop, cosmopolitan; Sah, Saharan; Sah-Sind, Saharo-Sindian; End, endemic, followed by the endemic range: Alg, Algeria; Alg-Mor, Algeria and Morocco; Alg-Tun, Algeria and Tunisia; N Afr, North Africa; End … (?), endemic taxon whose endemic status is uncertain (five taxa, counted as endemic but excluded in the sensitivity test; see Results); N Afr (?), North African taxon whose endemic status is uncertain (three taxa, not counted as endemic)

Species	Tribe	Status	Provinces	Habitats	Chorotypes
Anacyclus clavatus (Desf.) Pers.	Anthemideae	N	B, O	C, Ru	Eur-Med
Anacyclus pyrethrum (L.) Link	Anthemideae	N	B	St, G	Ibero-Maur
Andryala integrifolia L.	Cichorieae	N	B, S	M, Ru	W Med
Anthemis pedunculata Desf.	Anthemideae	N	B, S	St, R	Ibero-Maur
Arctium atlanticum (Pomel) H. Lindb.	Cardueae	N	B	F, W	N Afr (?)
Artemisia atlantica Coss.	Anthemideae	N	B	G, R	End N Afr
Artemisia campestris L.	Anthemideae	N	B, O	St, Sa	Circumbor
Artemisia herba-alba Asso s.l.	Anthemideae	N	B	St	Med-Irano-Tour
Asteriscus aquaticus (L.) Less.	Inuleae	N	B	C, Ru	Med
Atractylis caespitosa Desf.	Cardueae	N	B	St, G	End N Afr (?)
Atractylis cancellata L.	Cardueae	N	B, S	St, C	Circummed
Bellis sylvestris Cirillo	Astereae	N	B, S, O	F, G	Circummed
Bombycilaena discolor (Pers.) M. Laínz	Gnaphalieae	N	B, S	St, G	Med
Calendula arvensis (Vaill.) L.	Calenduleae	N	B, S, O	C, Ru	Sub-Med
Calendula suffruticosa Vahl	Calenduleae	N	B	M, R	W Med
Calendula tripterocarpa Rupr.	Calenduleae	N	B	St, Sa	Med-Irano-Tour
Carduus macrocephalus Desf.	Cardueae	N	B, S	Ru, C	Med
Carduus pycnocephalus L.	Cardueae	N	B, S	Ru	Euras
Carduus tenuiflorus Curtis	Cardueae	N	B, S	Ru	Eur-Med
Carlina gummifera (L.) Less.	Cardueae	N	B, S	M, G	Med
Carlina hispanica Lam.	Cardueae	N	S	M, St	W Med
Carlina lanata L.	Cardueae	N	B, O	M, C	Circummed
Carthamus caeruleus L.	Cardueae	N	B	M, C	Med
Carthamus creticus L.	Cardueae	N	B	C, Ru	Med
Carthamus lanatus L.	Cardueae	N	B	C, Ru	Eur-Med
Carthamus pectinatus Desf.	Cardueae	N	S	St, G	End N Afr
Carthamus pinnatus Desf.	Cardueae	N	B, O	St, G	S Med
Carthamus plumosus (Pomel) Greuter	Cardueae	N	O	St	End Alg-Tun (?)
Carthamus tinctorius L.	Cardueae	C	B	C	Cultivated (Irano-Tour)
Catananche caerulea L.	Cichorieae	N	B, O	M, G	W Med
Catananche caespitosa Desf.	Cichorieae	N	B	G, R	End Alg-Mor
Catananche lutea L.	Cichorieae	N	B	St, C	Med
Catananche montana Coss. & Durieu	Cichorieae	N	B	G, R	End Alg-Mor
Centaurea acaulis L.	Cardueae	N	B	G, St	End Alg-Tun
Centaurea benedicta (L.) L.	Cardueae	N	B	C, Ru	Med-Irano-Tour
Centaurea calcitrapa L.	Cardueae	N	B	Ru	Eur-Med

Species	Tribe	Status	Provinces	Habitats	Chorotypes
Centaurea melitensis L.	Cardueae	N	B, O	C, Ru	Med
Centaurea parviflora Desf.	Cardueae	N	B, S	M, St	End Alg-Tun
Centaurea pubescens Willd.	Cardueae	N	B, S, O	St, G	Ibero-Maur
Centaurea pullata L.	Cardueae	N	B	C, G	Med
Centaurea resupinata Coss.	Cardueae	N	B	G, R	Ibero-Maur
Centaurea sicula L.	Cardueae	N	B, O	C, Ru	S Med
Centaurea solstitialis L.	Cardueae	N	B	C, Ru	Med-Irano-Tour
Centaurea tougourensis Boiss. & Reut.	Cardueae	N	B	St, R	End Alg
Chondrilla juncea L.	Cichorieae	N	S, O	C, Ru	Euras
Cichorium intybus L.	Cichorieae	N	B, S, O	Ru, W	Cosmop
Cirsium vulgare (Savi) Ten.	Cardueae	N	B	Ru, W	Paleotemp
Coleostephus myconis (L.) Rchb. f.	Anthemideae	N	S, O	C, Ru	Med
Crepis bursifolia L.	Cichorieae	N	O	Ru	Med
Crepis vesicaria L.	Cichorieae	N	B, S	G, Ru	Eur-Med
Crupina crupinastrum (Moris) Vis.	Cardueae	N	S	M, G	Med
Crupina vulgaris Cass.	Cardueae	N	B	M, G	Euras-Med
Cynara cardunculus L.	Cardueae	N	B, S	Ru, C	Med
Dittrichia graveolens (L.) Greuter	Inuleae	N	B	Ru, W	Med-Irano-Tour
Dittrichia viscosa (L.) Greuter	Inuleae	N	B, S	Ru, W	Circummed
Echinops bovei Boiss.	Cardueae	N	B, S	St, R	S Med-Sah
Erigeron bonariensis L.	Astereae	A	B	Ru	Cosmop (Neotrop)
Filago asterisciflora (Lam.) Sweet	Gnaphalieae	N	B	St, G	Circummed
Filago pyramidata L.	Gnaphalieae	N	B	St, C	Med
Galactites tomentosus Moench	Cardueae	N	S	C, Ru	Circummed
Geropogon hybridus (L.) Sch.Bip.	Cichorieae	N	B	C, G	Med
Glebionis segetum (L.) Fourr.	Anthemideae	N	B	C	Med
Hedypnois rhagadioloides (L.) F.W. Schmidt	Cichorieae	N	B	C, G	Med
Helichrysum lacteum Coss. & Durieu	Gnaphalieae	N	B, S	R, G	End N Afr
Helichrysum pendulum (C.Presl) C.Presl	Gnaphalieae	N	S	M, R	W Med
Helichrysum pomelianum Greuter	Gnaphalieae	N	B, S	R, M	End N Afr (?)
Helichrysum stoechas (L.) Moench	Gnaphalieae	N	O	M, Sa	W Med
Helminthotheca echioides (L.) Holub	Cichorieae	N	B, O	C, Ru	Euras-Med
Hertia cheirifolia (L.) Kuntze	Senecioneae	N	B, S, O	St, R	End Alg-Tun
Hieracium faurelianum Maire	Cichorieae	N	B	F, R	End Alg
Hyoseris radiata L.	Cichorieae	N	B, S, O	G, Ru	Eur-Med
Hyoseris scabra L.	Cichorieae	N	B, O	C, G	Circummed
Jacobaea gigantea (Desf.) Pelser	Senecioneae	N	B	F, W	End N Afr
Jurinea humilis (Desf.) DC.	Cardueae	N	B	G, R	W Med
Klasea flavescens (L.) Holub	Cardueae	N	B	M, G	W Med
Klasea pinnatifida (Cav.) Talavera	Cardueae	N	O	M, G	Ibero-Maur
Lactuca muralis (L.) Gaertn.	Cichorieae	N	B, S	F	Eur
Lactuca saligna L.	Cichorieae	N	O	Ru, W	Euras-Med
Lactuca viminea (L.) J.Presl & C.Presl	Cichorieae	N	B	R, Ru	Med
Lactuca virosa L.	Cichorieae	N	S, O	Ru, M	Eur-Med
Lapsana communis L.	Cichorieae	N	B	F, Ru	Euras
Launaea fragilis (Asso) Pau	Cichorieae	N	B	St, Sa	Med-Sah-Sind
Launaea lanifera Pau	Cichorieae	N	B	St	End Alg-Mor (?)
Launaea nudicaulis (L.) Hook.f.	Cichorieae	N	B	St, Sa	Sah-Sind

Species	Tribe	Status	Provinces	Habitats	Chorotypes
Mantisalca salmantica (L.) Briq. & Cavill.	Cardueae	N	B, S	C, Ru	Eur-Med
Micropus supinus L.	Gnaphalieae	N	B	St, G	Med-Irano-Tour
Onopordum arenarium (Desf.) Pomel	Cardueae	N	B	St, Sa	End N Afr (?)
Onopordum macracanthum Schousb.	Cardueae	N	B, S, O	Ru, St	Ibero-Maur
Pallenis spinosa (L.) Cass.	Inuleae	N	B, S	M, Ru	Eur-Med
Petasites pyrenaicus (L.) G.López	Senecioneae	N	B, S	F, W	W Med
Phagnalon rupestre (L.) DC.	Gnaphalieae	N	B, S	R	Circummed
Phagnalon saxatile (L.) Cass.	Gnaphalieae	N	B, S, O	R, M	W Med
Phagnalon sordidum (L.) Rchb.	Gnaphalieae	N	B, S	R	W Med
Picnomon acarna (L.) Cass.	Cardueae	N	B, S	Ru, St	Med
Picris hispanica (Willd.) P.D.Sell	Cichorieae	N	B	M, G	Ibero-Maur
Pilosella pseudopilosella (Ten.) Soják	Cichorieae	N	B	G, F	Eur-Med
Plagius maghrebinus Vogt & Greuter	Anthemideae	N	S	R, W	End Alg-Tun
Podospermum laciniatum (L.) DC.	Cichorieae	N	B	C, St	Eur-Med
Ptilostemon rhiphaeus (Pau & Font Quer) Greuter	Cardueae	N	S	M, R	End Alg-Mor
Pulicaria dysenterica (L.) Bernh.	Inuleae	N	S	W	Eur-Med
Pulicaria inuloides (Poir.) DC.	Inuleae	N	O	St, R	N Afr-Sah (?)
Pulicaria odora (L.) Rchb.	Inuleae	N	B	F, M	Circummed
Reichardia picroides (L.) Roth	Cichorieae	N	B	R, M	Med
Reichardia tingitana (L.) Roth	Cichorieae	N	O	St, Sa	Med-Sah-Sind
Rhagadiolus stellatus (L.) Gaertn.	Cichorieae	N	B	C, G	Euras-Med
Rhaponticum acaule (L.) DC.	Cardueae	N	B	St, G	End N Afr
Rhaponticum coniferum (L.) Greuter	Cardueae	N	B, O	M, G	W Med
Santolina africana Jord. & Fourr.	Anthemideae	N	B, S	St, R	End N Afr
Santolina pectinata Lag.	Anthemideae	N	B, S	M, R	Ibero-Maur
Scolymus grandiflorus Desf.	Cichorieae	N	B, S, O	C, Ru	S Med
Scolymus hispanicus L.	Cichorieae	N	B	Ru, C	Med
Scolymus maculatus L.	Cichorieae	N	B	C, Ru	Circummed
Senecio perralderianus Coss. & Durieu	Senecioneae	N	S	F, R	End Alg-Mor
Senecio squalidus L.	Senecioneae	N	B	R, Ru	Eur-Med
Silybum eburneum Coss. & Durieu	Cardueae	N	B, O	Ru	Ibero-Maur
Silybum marianum (L.) Gaertn.	Cardueae	N	B	Ru	Cosmop
Solidago virgaurea L.	Astereae	N	B	F	Circumbor
Sonchus maritimus L.	Cichorieae	N	B	W	Med
Sonchus oleraceus L.	Cichorieae	N	B	C, Ru	Cosmop
Sonchus tenerrimus L.	Cichorieae	N	B, O	R, Ru	Med
Tanacetum corymbosum (L.) Sch.Bip.	Anthemideae	N	S	F, G	Euras
Taraxacum erythrospermum Andrz. ex Besser	Cichorieae	N	B	G, St	Euras
Taraxacum inaequilobum Pomel	Cichorieae	N	S	G, W	N Afr (?)
Taraxacum obovatum (Willd.) DC.	Cichorieae	N	B	G	W Med
Tolpis barbata (L.) Gaertn.	Cichorieae	N	S	M, Sa	Med
Tolpis virgata (Desf.) Bertol.	Cichorieae	N	S	M, G	Med
Tragopogon porrifolius L.	Cichorieae	N	B	G, Ru	Circummed
Tussilago farfara L.	Senecioneae	N	B, S	W	Paleotemp
Urospermum dalechampii (L.) F.W.Schmidt	Cichorieae	N	B, S, O	G, Ru	Med
Xanthium spinosum L.	Heliantheae	A	B, O	Ru, W	Cosmop (S Amer)
Xanthium strumarium L.	Heliantheae	A	B	Ru, W	Cosmop (Amer)
Xeranthemum inapertum (L.) Mill.	Cardueae	N	B	St, G	Euras-Med

Cardueae contained the most endemic taxa (9), followed by Cichorieae (4). Three taxa are alien (*Erigeron bonariensis* L., *Xanthium spinosum* L. and *Xanthium strumarium* L.), and *Carthamus tinctorius* L. is a cultivated species.

Mediterranean taxa formed the largest chorological group (63 species, 47.7%), followed by Euro-Mediterranean and Eurasian taxa (24 species, 18.2%) and endemic taxa (21 species, 15.9%). Mediterranean-Irano-Turanian and Saharo-Sindian taxa (10 species, 7.6%), widespread taxa (7 species, 5.3%), alien and cultivated taxa (4 species, 3.0%) and North African taxa of uncertain status (3 species, 2.3%) made up the remainder.

Taxonomic structure: distribution of species among genera

Species richness was concentrated in two genera, *Centaurea* (11 species) and *Carthamus* (7 species). *Catananche* L., *Helichrysum* Mill. and *Lactuca* each had four species, and 10 genera had three species (Fig. 2). Two genera (2.8% of all genera) held 18 species (13.6%), and *Centaurea* alone contained 8.3% of all species. Species richness per genus decreased abruptly over the five richest genera, and the remaining 66 genera had three species or fewer; the monospecific genera occupied ranks 32 to 71 (Fig. 2).

Shannon and Pielou indices of the distribution of species among genera

The Shannon index calculated on the distribution of species among genera was $H' = 4.04$, and Pielou's evenness was $J' = 0.95$. The high J' value reflects the large number of genera with one or two species (56 of 71 genera). Species are therefore spread across many genera rather than concentrated in a few. These indices describe the checklist composition and do not indicate the relative abundance of species in the field.

Tribal composition

Cardueae and Cichorieae together accounted for two-thirds of the species (Fig. 3), but they differed in structure, endemism and habitat. Species of Cardueae were concentrated in fewer genera (2.3 species per genus) than those of Cichorieae (1.75 species per genus). Cardueae were proportionally richer in endemic taxa (9 taxa, 19.6% of the tribe) than Cichorieae (4 taxa, 9.5%); among the smaller tribes, Senecioneae contained three endemic taxa among six species and Anthemideae three among 12. About half of the species of the two large tribes were recorded in crops, fallows or ruderal sites (Cardueae 50.0%, Cichorieae 57.1%), compared with only one of the 11 species of Gnaphalieae, which occurred mainly on rocky slopes, in matorral, steppes and mountain grasslands.

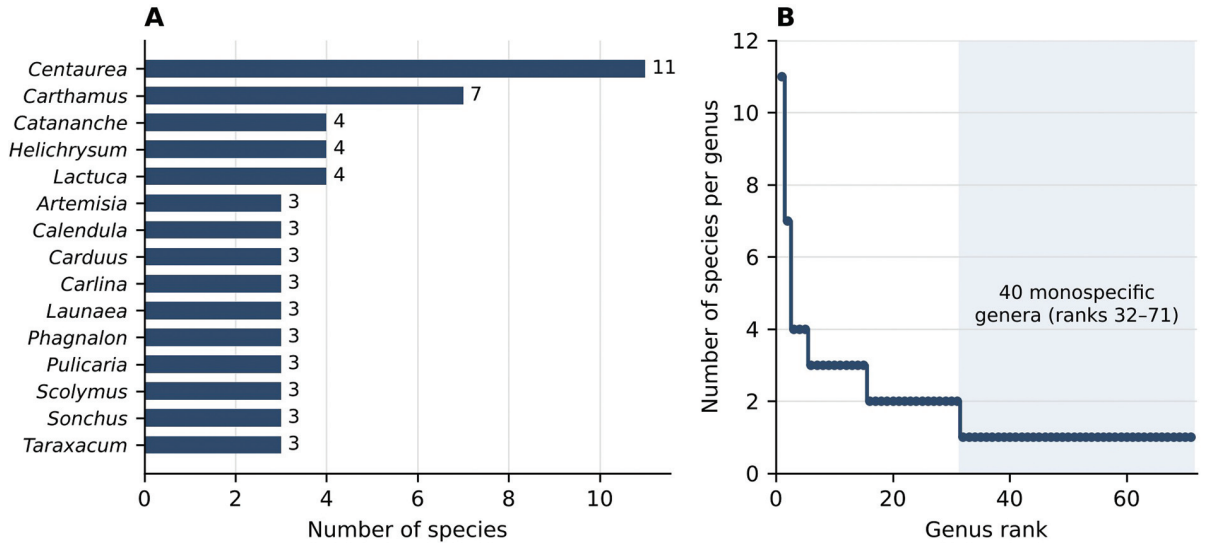


Fig. 2. Distribution of species among genera. A – genera with three or more species; B – number of species per genus plotted against genus rank for all 71 genera; the shaded area marks the 40 monospecific genera.

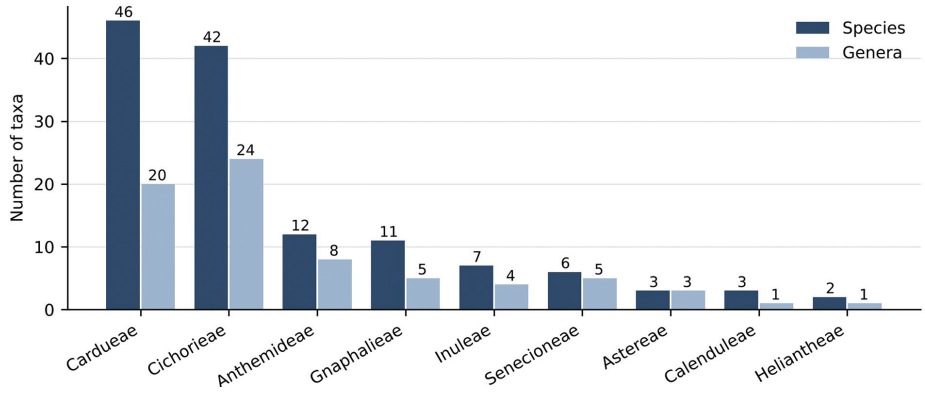


Fig. 3. Number of species and genera in each Asteraceae tribe recorded in the study area (132 species, 71 genera). Cardueae is the richest tribe in species, whereas Cichorieae is the richest in genera.

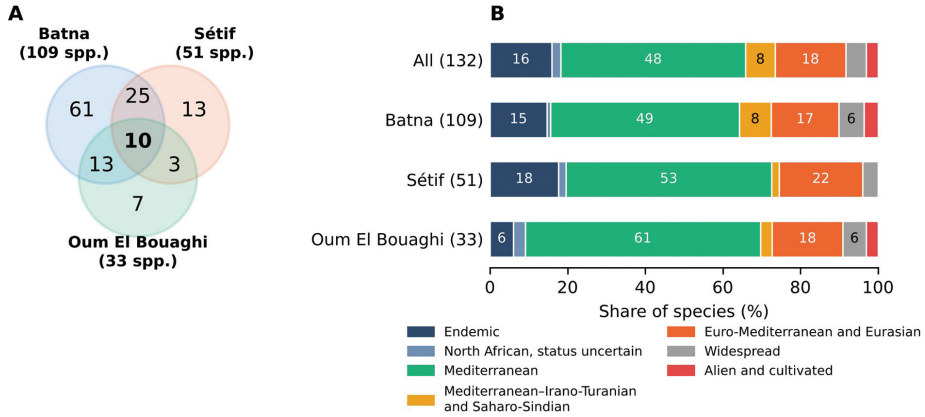


Fig. 4. Distribution of Asteraceae species among the three provinces. A – number of species recorded in one, two or all three provinces; B – chorological spectrum of the whole checklist and of each province; numbers are percentages of species (values below 6% not labelled).

Distribution among provinces

Batna held 109 species (82.6% of the checklist), Sétif 51 and Oum El Bouaghi 33 (Fig. 4). Only 10 species were recorded in all three provinces: *Bellis sylvestris* Cirillo, *Calendula arvensis* (Vaill.) L., *Centaurea pubescens* Willd., *Cichorium intybus* L., *Hertia cheirifolia* (L.) Kuntze, *Hyoseris radiata* L., *Onopordum macracanthum* Schousb., *Phagnalon saxatile* (L.) Cass., *Scolymus grandiflorus* Desf. and *Urospermum dalechampii* (L.) F.W.Schmidt. Most species (81, 61.4%) were recorded in a single province, including 61 species found only in Batna and 13 found only in Sétif.

Floristic similarity was the highest between Batna and Sétif (Sørensen index 0.44; 35 shared species) and lower between Batna and Oum El Bouaghi (0.32) and between Sétif and Oum El Bouaghi (0.31). Batna held 16 endemic taxa (14.7% of its species), 11 of which were recorded in no other province. Sétif held nine (17.6%) and Oum El Bouaghi two (6.1%). Mediterranean taxa dominated the chorological spectrum of the whole checklist and of each province; they made up 61% of the species in Oum El Bouaghi, compared with 49% in Batna and 53% in Sétif (Fig. 4).

Distribution among habitat types

Ruderal sites held the most species (47), followed by mountain grasslands (41), steppes (35) and crops and fallows (33) (Fig. 5). The share of endemic taxa was the highest on rocky slopes (12 of 27 species, 44.4%), in steppes (11 of 35, 31.4%) and forests (3 of 12, 25.0%). No endemic taxon was recorded in crops, fallows, or ruderal sites. In contrast, 60 of the 111 non-endemic species (54.1%) occurred in at

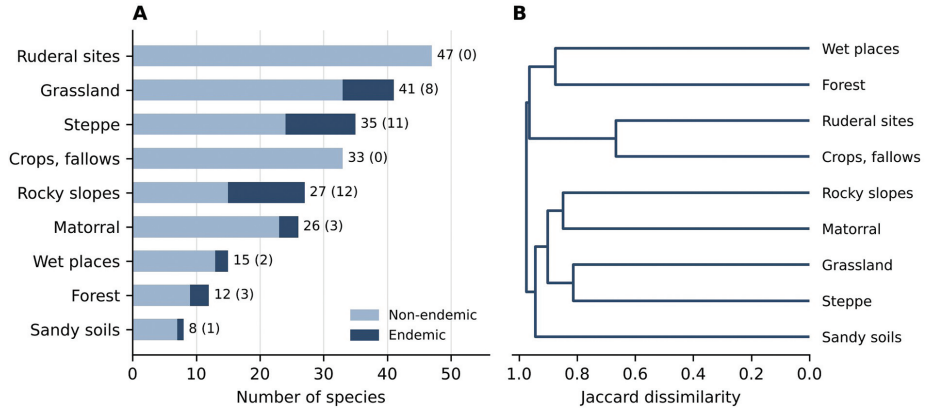


Fig. 5. Distribution of Asteraceae species among habitat types. A – number of species recorded in each habitat; the number of endemic taxa is given in parentheses and shown in dark blue; B – dendrogram of habitat types based on Jaccard dissimilarity applying unweighted pair group method with arithmetic mean of their Asteraceae composition (cophenetic correlation 0.86).

least one of these two habitats (Fisher's exact test, $p < 0.001$). The result was unchanged when the five endemic taxa of uncertain status were excluded (0 of 16 endemic taxa). Twenty-nine species were recorded only in crops, fallows, or ruderal sites, including the three alien taxa.

Cluster analysis separated crops and fallows and ruderal sites, which shared the most species (Jaccard dissimilarity 0.67), from the seminatural habitats (Fig. 5). Within the latter, steppes grouped with mountain grasslands and rocky slopes with matorral, while forests grouped with wet places. Dissimilarities among seminatural habitats were high (0.81–0.97), indicating that each habitat held a largely distinct set of species. The cophenetic correlation coefficient was 0.86.

DISCUSSION

The surveys recorded 132 Asteraceae species in 71 genera in the semiarid areas of Batna, Sétif and Oum El Bouaghi. This checklist answers our first question and provides a dated reference for the family in the study area. Comparable plant richness under semiarid conditions has been reported along a watershed in the drylands of North Africa (Souahi et al., 2022). The chorological spectrum is dominated by Mediterranean taxa, with a substantial Euro-Mediterranean and Eurasian component and a smaller contribution of Irano-Turanian and Saharo-Sindian elements. This mix is consistent with the study area's position between the subhumid mountains of the Tell and the steppes of the High Plateaux.

Twenty-one taxa (15.9%) are endemic to Algeria or North Africa. North Africa, and Algeria in particular, has high plant endemism within the Mediterranean Basin (Médail & Quézel, 1997; Médail & Myers, 2004; Meddour et al., 2023). The endemic share of our checklist depends on the definition used: only two taxa, *Centaurea tougourensis* and *Hieracium faurelianum*, are strict Algerian endemics (Meddour et al., 2023), and five of the 21 have an uncertain status. Therefore, the endemic share is reported alongside its endemism levels rather than as a single figure. The checklist also contains widespread ruderal species and four alien or cultivated taxa. The co-occurrence of endemic, widespread and alien taxa is common in Mediterranean landscapes under human pressure (Médail & Quézel, 1997; Elgadi et al., 2024).

Our second question concerned species distribution among genera. Species richness was concentrated in two genera, while more than half of the genera were represented by one species. Low species-to-genus ratios were once interpreted as evidence of competitive exclusion between congeners. They are also expected from sampling alone, because the ratio increases with the number of species in a flora (Järvinen, 1982). The high J′ value (0.95) follows from this spread of species across many genera. It should not be read as evidence of balanced or stable communities, which would require plot-based cover or density data.

The two richest genera, *Centaurea* and *Carthamus*, both belong to Cardueae. Their richness could reflect drought tolerance, seed dormancy and disper-

sal, and tolerance of disturbance, traits reported for these and related Asteraceae (Baskin & Baskin, 2023; Kaur et al., 2024). These traits were not measured in our study, so this explanation remains a hypothesis to be tested with trait data.

Our third question concerned the tribal composition. Cardueae and Cichorieae together contributed two-thirds of the species. Both tribes are also well represented in other semiarid Asteraceae floras (Waheed & Arshad, 2024). Cardueae also contained the most endemic taxa. Spiny defences in many Cardueae and pappus-bearing, wind-dispersed achenes in Cichorieae are often proposed to explain their success under grazing and disturbance (Palazzesi et al., 2022). Our data document the pattern but do not test these mechanisms.

Our fourth question concerned species distribution among provinces and habitats. Batna held twice as many species as Sétif and three times as many as Oum El Bouaghi, although each province received the same number of visits. Batna also held three-quarters of the endemic taxa, most of them recorded nowhere else. A likely explanation is the wider range of altitudes and habitats covered in Batna, from the Belezma and Aurès mountains to the southern steppes. Differences in the area covered by the itinerant surveys cannot be excluded, however, because equal numbers of visits do not guarantee equal spatial coverage. The low richness and the small number of endemic taxa in Oum El Bouaghi are consistent with a province dominated by high plains, where crops and rangelands predominate. Only 10 species were common to the three provinces, and most of them are widespread species of disturbed or open ground. The regional Asteraceae flora is therefore not uniform: each province contributes a distinct set of species.

The clearest pattern concerned endemic taxa. None of them was recorded in crops, fallows or ruderal sites, whereas more than half of the non-endemic species occurred there. Endemic taxa were concentrated on rocky slopes, in steppes and in mountain grasslands. The cluster analysis also separated crops, fallows and ruderal sites from all seminatural habitats. These results show an association between endemism and seminatural habitats, but they do not establish its cause. Endemic taxa may be excluded from cultivated and ruderal ground by disturbance, or they may be restricted to the substrates and altitudes where such ground is rare. In either case, the persistence of endemic Asteraceae in the study area depends on conserving seminatural habitats, especially rocky slopes, steppes and mountain grasslands in Batna and Sétif. Increasing grazing and land-use pressure could favour widespread and alien species at the expense of endemic taxa, as reported for invasive plants in many regions (Gioria et al., 2023).

The study has three main limitations. First, the data are presence records, so they cannot describe abundance, dominance or community structure. Secondly, the disturbance at the survey sites was not quantified, and the habitat type is only a proxy. Third, environmental variables were not measured at the site level, so the roles of climate, altitude and soil remain untested. Repeated plot-based surveys that record cover, disturbance intensity and environmental variables would allow ordination and regression methods to test these effects.

The semiarid areas of Batna, Sétif and Oum El Bouaghi host at least 132 Asteraceae species in 71 genera, including 21 taxa endemic to Algeria or North Africa. Species are spread across many genera, and Cardueae and Cichorieae contain two-thirds of the species. Most species occur in a single province, and endemic taxa are confined to seminatural habitats. These results provide a baseline for monitoring floristic change in the region and identify the seminatural habitats of Batna and Sétif as priorities for conserving endemic Asteraceae.

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LMM and AK wrote the original draft; LMM, AK and CV reviewed and edited the original draft; LMM and AK supervised and administered the project. All authors read and approved the final version of the article.

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