Flora of the Natural Park Cadi–Moixeró and neighbouring Pre–Pyrenean areas (Eastern Iberian Pyrenees)

The Serra de Cadi and neighbouring mountains are of great botanical interest given the great diversity and uniqueness of their vascular flora as well as the vast extent of calcareous habitats they harbour, the greatest in the Catalan Pyrenees.

The study area stretches over 884.6 square kilometres (projected surface) belonging to the Berguedà, Cerdanya, Alt Urgell and Solsonès districts and Lleida, Girona and Barcelona provinces. In addition to the Natural Park Cadi–Moixeró, other areas have been declared Natural Interest Sites or Natural Reserves.

Altitudes range from 700 m a.s.l. in the Segre and Llobregat valleys to 2648 m a.s.l. at the Vulturó peak, the top of the Serra de Cadi. The Cadi–Moixeró–Tosa d’Alp–Puigllançada range, in the Northern part, has several summits beyond 2500 m a.s.l. and the roughest relief. Cadinell, Pedraforca and Port del Comte massifs, and the Ensija and El Verd ranges, all of them exceeding 2000 m, are located in the central and southern part. The heads of the valleys of Llobregat, Cardener, Segre, La Vansa and their tributaries separate all these mountains.

Limestone and dolomite are the most common substrates of the highest mountain ranges (fig. 3). The valleys are settled on marls and clay, outcropping in wide badlands in the Llobregat valley. In the SW lie several areas of gypsum and calcareous conglomerates. Siliceous substrata are restricted to tight bands and isolated outcrops between limestone, mainly in the Moixeró–Tosa d’Alp range and in the NW part of Serra de Cadi. Slates, quartz conglomerates and sandstone are frequent, while volcanic rocks and granites are more localised. Detritus are deposited in Cerdanya and in the lower parts of the main valleys.

Lower and mid-altitudes have axeromeric sub–Mediterranean bioclimates on the Gaussen scale, which turn into axeromeric cold–wet, sub–alpine and alpine cold–axeric climates upwards (see ombrothermic diagrams in fig. 4). Aridity and thermal continentality increase SE to NW (Llobregat–Segre valleys), mainly at low altitudes, owing to the weakening of the oceanic influence through the mountains.

Vegetation and landscapes, notably rich and diverse, are arranged according to climate–related gradients. The increase in the aridity–continentality factor favours Mediterranean and sub–Mediterranean xerophytic communities to the detriment of Euro–Siberian mesophiles, rather frequent and extensive in the Eastern half. Concerning the altitude, four vegetation belts according to the alpine zonation can be distinguished, each characterised by specific vegetation domains (see fig. 5):

- **Sub–Montane belt.** Sub–Mediterranean, from 700 to 1000–1500 m a.s.l. Vegetation domains: Calcicolous oak or Scots pine woodlands (*Buxo–Quercetum pubescentis*), Acidophilous oak woodland (*Pteridio–Quercetum pubescentis*), Salzmann pine woodland (*Lonicero–Pinetum salzmannii*, only in Western valleys), Holm oak mountain woodlands (*Quercetum rotundifolieae buxetosum and asplenietosum adianti–nigri*, from Mediterranean spots in the S of Cadi–Moixeró range)


Alpine belt. Boreo–alpine (and oro–Mediterranean), above 2200–2300 m a.s.l. Acidophilous and calcilocal boreo–alpine pastures (Hieracio–Festucetum supinae, Oxytropido–Elynetum myosuroidis) and oro–Mediterranean pastures (Festucion scopariae), in mosaic with rocky and scree areas.

Several types of azonal vegetation also cover quite broad areas and hold a special floristic pattern: riverside woodlands (Alnion incanae, Salicion triandro–neotrichae), rocky areas and scree (Potentilletalia caulescentis, Thlaspietalia rotundifolii), hygrophilous and water–edge (Molinio–Arrhenatheretea, Scheuchzerio–Caricetea fuscae, Phragmitetalia, Montio–Cardaminetea), tall herb (Muldgeo–Aconitetea), ruderal and weed communities (Artemisietalia, Stellarietea, Chenopodietalia and Polygono–Poetalia annuae).

The floristic catalogue has been built on the basis of about 20,000 mainly original records, from five sources:

- Phytocoenological releves, original, partly published
- Partial floristic monographs of some of the authors (Vigo, 1983; Font, 1989, 1993; Soriano, 1992, 1994)
- Other floristic data, original
- Bibliographical records from other authors, mainly Vives (1964) and Gruber (1978) (see Bibliography)
- Critical revision of herbaria (mainly BC, BCN and JACA)

The references are arranged in alphabetical order according to the scientific names of plants. For every taxon, the following information is given:

- Scientific name
- Ecology (vegetation belts, altitude range, habitats, communities and syntaxa)
- Frequency degree, on the basis of a six–term scale, from very common, CCC, to very rare, RRR.
- Occurrence in the studied area, in each sector (see fig. 2 and 6) and 10 x 10 km UTM squares, in a small map annex to the text of each spontaneous taxon.
- Taxonomical and/or chorological comments.

Bibliographical references are given only for quotations of plants, sectors and UTM squares that have not been confirmed by us in the field. However, a complete list of bibliographical sources (mentioned or not in the text) is given in the Bibliography.

Our catalogue collects 1744 taxa at a species or subspecies level and 17 hybrids —1634 spontaneous plants (not hybrid), 56 sub–spontaneous or adventitious plants without stable populations (scientific name in italics in the catalogue, no map) and 54 plants belonging to false or doubtful records (name and text in small caps , no map). The percentage contribution to the wide taxonomical groups is Dicots 78.6%, Monocots 18.4%, Pteridophyta 2.3% and Gymnospermae 0.7%. The most diverse families and genera are listed in tables 6 and 7.

About 100 plants in our catalogue are exclusive of the Pyrenees and adjacent areas, 18 of them are Catalan endemic taxa and 20 are Catalan sub–endemics (see 3.6). Non–endemic Daphne alpina, Dracocephalum austriacum, Lappula deflexa and Woodsia pulchella have their unique populations in Pyrenees in our area, like Antirrhinum sempervirens subsp. sempervirens, Cystopteris montana, Carex brevicollis and Leuzea centauroides, among others in Eastern Pyrenees.

The global percentages of biological forms on the Raunkiaer classification reveal the dominance of hemicryptophytes (48.6%), followed by therophytes (20.1%), chamaephytes (12.5%), phanerophytes (8.9%), geophytes (8.6%), hydrophytes (1.1%) and parasitic ephiphytes (0.2%). Hemicryptophytes, chamaephytes and phanerophytes are the main groups in the landscape, and often show a wide distribution on a local scale. In contrast, several therophytes and hydrophytes appear only in a part of the area, mostly at lower altitudes.

Among chorological groups, Euro–Siberian plants sensu lato (35.4%) are the most diverse, followed by Pluriregional (20.2%), non–Mediterranean Orophytes (17.6%), Mediterranean (14.9%), Boreo–alpine (5.3%), Sub–cosmopolite (3.5%), Allochthonous (2.6%) and others (0.5%). Sub–Montane and Montane belts are the optimal environment for Euro–Siberian and Pluriregional plants, often widely distributed, like high mountains are the optimal for Orophytes and Boreo–
allpines. All these groups are particularly diverse in the Northern half of the area. On the other hand, Mediterranean, Sub–cosmopolite and Allochthonous mostly occur in lower and mid altitudes, and reach their maximum in the Southern and/or low altitude sectors.

As a general rule, our spectra agree with those of other Pyrenean sites and, as expected, most of percentages show intermediate values between outer Pre–Pyrenean and axial range floras. Thus, our flora can be considered transitional between those of these orographical systems, markedly Mediterranean and rather Euro–Siberian and Boreo–alpine, respectively. At a local scale, the transition is evidenced by some floristic dissymmetries. The Segre and Llobregat valleys bear large amounts of exclusive Euro–Siberian and Mediterranean plants, like the Northern face of the Cadí–Moixeró range. Moreover, non–Mediterranean Orophytes and Boreo–alpine plants reveal a progressive decline southwards and westwards.

Finally, endangered and protected plants are listed in tables 11 and 12, the first according to IUCN criteria (EN, VU and DD categories). The few coincidences point out the need to periodically update these lists and improve the information on plants of the DD (data deficient) category.

Key words – Vascular flora, Eastern Iberian Pre–Pyrenees, floristic catalogue, floristic analysis.