



Red list of vascular flora of the Pyrenees

2019

*Mobilize to preserve
mountain plant heritage*



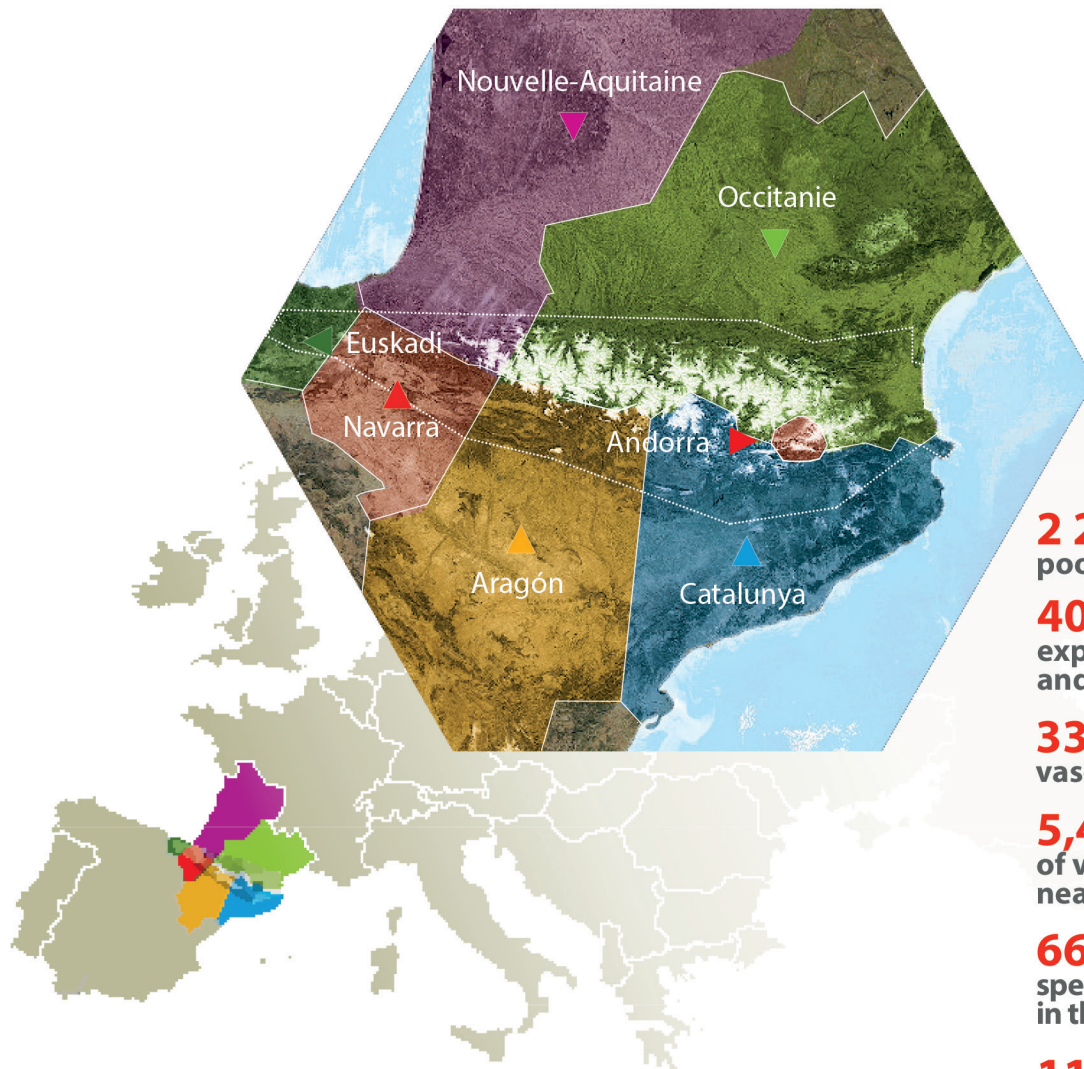
HERBIER P. LE BRUN
FLORE FRANCO-HELVETIQUE

Soldanella villosa Darracq

*Itxassou : vallon de Laxia, rochers mouillés des
cascades du Jardin d'Enfer (Yferroukhotalatin
(Basses-Pyrénées) 3 avril 1919 legi ipse*

Altitude : 4000 m.


FLORAPYR
OPCC



2 216 740
pooled data

40
experts from France, Spain
and Andorra mobilized

3300
vascular plants species assessed

5,4 %
of vascular flora threatened or
near-threatened in the Pyrenees

66
species threatened with extinction
in the Pyrenean mountains

11
Pyrenean species critically
endangered

27
endemic species threatened or
near-threatened on a Pyrenean
scale

Project partners

POCTEFA FLORAPYR EFA 100/15 (act 2) :

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Conservatoire botanique national méditerranéen de Porquerolles (CBNMed),
Instituto Botánico de Barcelona (IBB-CSIC) et Consorci del Museu de Ciències
Naturals de Barcelona (CMCNB), Instituto Pirenaico de Ecología (IPE-CSIC),
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Citation :

CBNPMP (coord.), Aranzadi, CBNMED, CMCNB, IBB-CSIC, IEA-CENMA, IPE-CSIC & UB, 2019.
Liste rouge de la flore vasculaire des Pyrénées. Bagnères-de-Bigorre (France), 32 p.

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FLORAPYR PROJECT EFA 100/15 (2016-19) : RED LIST PARTNERS



Updated version 2022

A PRESERVED TERRITORY A MULTIFACTORIAL RISK

WHY A PYRENEAN FLORA RED LIST ?

Original work by its cross-border and biogeographic dimensions, the red list of threatened flora in the Pyrenees assess for the very first time the extinction risk of Pyrenean flora, beyond the administrative boundaries of regions, provinces and states.

Fruit from a very close partnership between Spain, Andorra and France, the present assessment highlights the relatively well preserved state of Pyrenees mountains toward biodiversity erosion.

Despite everything, results shows that 5.4% of Pyrenean flora is threatened or near-threatened by more or less short term extinction. Near 180 plant species or subspecies are concerned.

Any change in conditions may represent a risk and climate changes comes in addition to anthropogenic pressure factors. Rarest and ecologically demanding populations

- which are potentially the most sensitive ones - deserve special attention and monitoring of their habitats and driving factors : natural dynamics, human intervention, agricultural decline, climate...



WHAT'S A PYRENEAN FLORA RED LIST FOR ?

TO KNOW

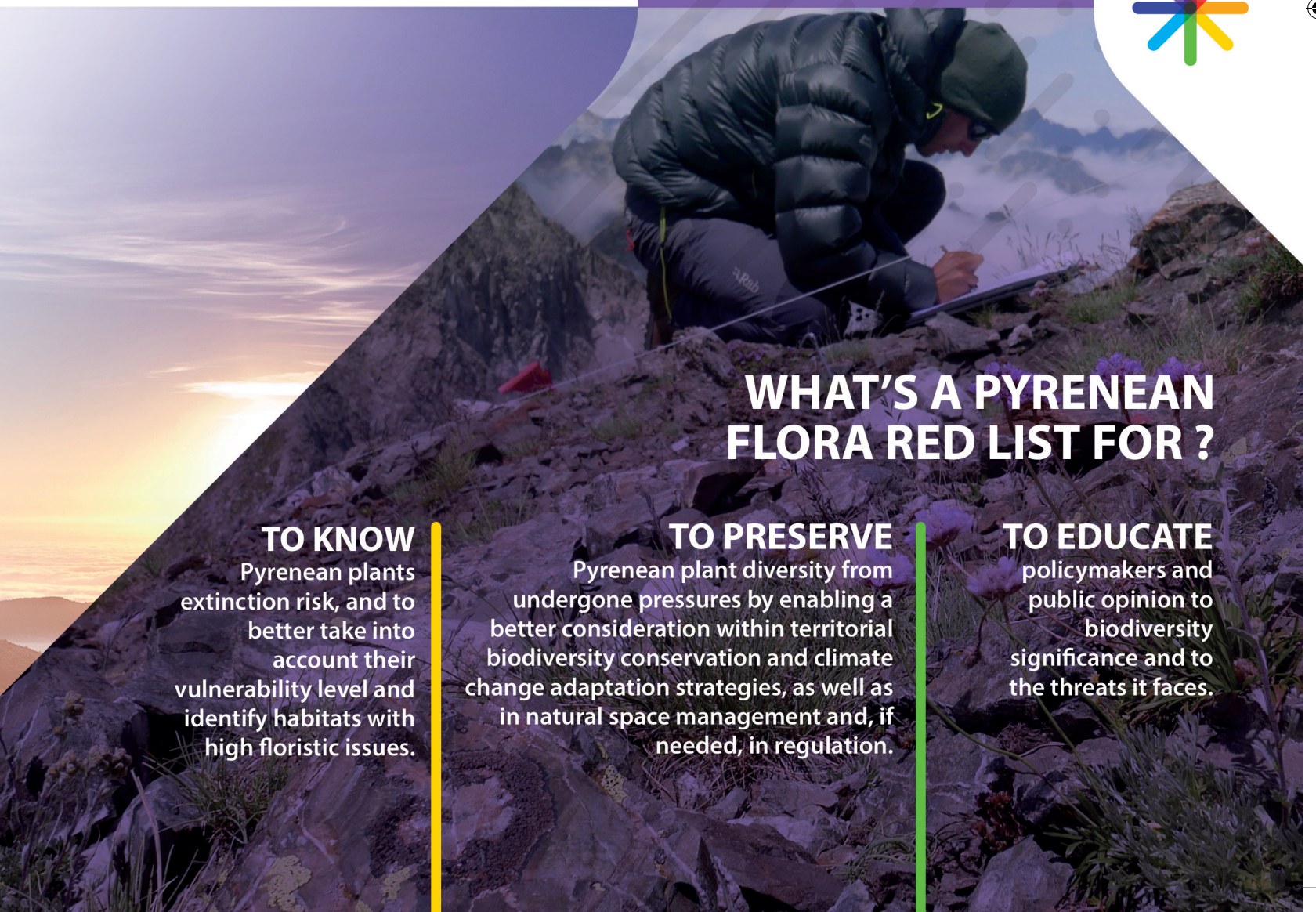
Pyrenean plants extinction risk, and to better take into account their vulnerability level and identify habitats with high floristic issues.

TO PRESERVE

Pyrenean plant diversity from undergone pressures by enabling a better consideration within territorial biodiversity conservation and climate change adaptation strategies, as well as in natural space management and, if needed, in regulation.

TO EDUCATE

policymakers and public opinion to biodiversity significance and to the threats it faces.



THE PYRENEES A CROSS-BORDER BIOGÉOGRAPHIC AREA



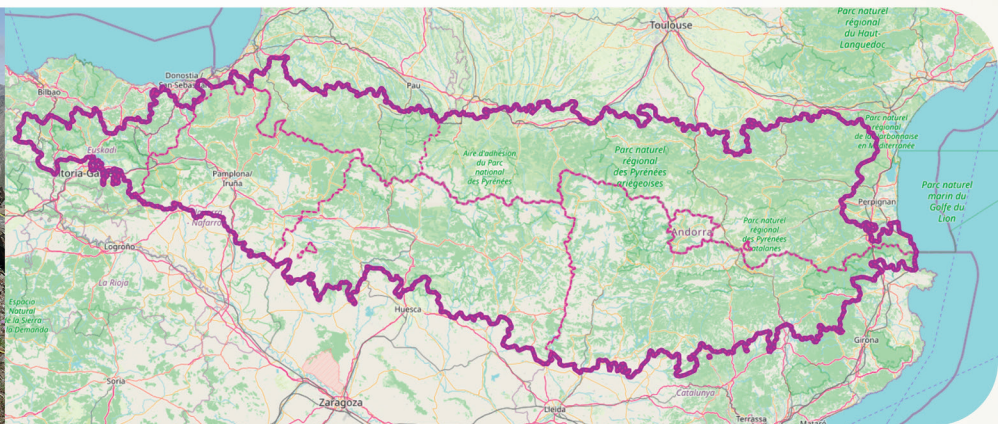
From basque meadows to catalan coasts, from farmlands and urban areas in Occitanie and Nouvelle-Aquitaine piedmonts to Andorran summits, from north face forests and navarrese valleys to the great Aragon lakes, the Pyrenean massif is home to an abundant wild flora and its territories share a common natural and human history. Thus, studying Pyrenean flora within administrative borders would only have offered a fragmented vision of conservation issues at stake.

At the crossroad of highly contrasted climatic influences, mediterranean, oceanic and mountainous, with a great variety of ecological situations due to geology, topography, altitude and exposure, the Pyrénées are home to an outstanding biodiversity, a fascinating object of study for botanists.

The massif's southern location, with a relatively wide alpine level and high calcareous massifs, adds up to highly favorable conditions for a great richness in terms of flora and vegetation.

Beyond its inherent interest in terms of biodiversity, **this wild flora is in permanent interaction with many socio-economic activities** : pastoralism, forestry, tourism, outdoor activities or even gathering practices... Some of these practices, such as grazing and logging, have played – sometimes for centuries - a major role in plant formations spatial organization, and continue to have a major impact on their evolution.

Gathering these observations, the study perimeter for assessing the conservation status and the extinction risks of the Pyrenean vascular flora concerns a coherent biogeographical set, where three countries meet (Spain, France, Andorra), and moreover in a territory where many species have a unique distribution area or a clearly distinct one from the rest of their continental or worldwide range.



VASCULAR PLANTS

also known as « Tracheophytes », have roots and sap-conducting vessels which allow water and nutrients circulation. They include all seed plants (Angiosperms and Gymnosperms), including deciduous and coniferous trees, as well as ferns and related plants (formerly pteridophytes).

NATIVE SPECIES,

or indigenous species, are plants that are naturally present on a territory, without any human intervention contributing to their introduction.

HABITAT

refers to the biotope, whose geographical, physical and ecological characteristics are favorable to the vital development of a species or group of plants.

ENDEMIC,

describes a species whose range is limited to a specific geographical area, whatever its size. The presence of endemic plants implies strong conservation responsibilities, since they exist nowhere else.

VEGETATION

refers to plant communities, i.e. all plants living together and interacting in a given habitat.



63 320 km²
explored by the
Florapyr project in
the Pyrenees

4 403
vascular plant
species registered in
the Pyrenees

7%
of Pyrenean
vascular flora
is endemic



THE PYRENEAN FLORA VEGETAL MOSAIC

As Europe's second most diverse mountain range in terms of plant life after the Alps, the Pyrenees are home to some 3,300 indigenous vascular plants, which underpin the originality of this remarkable natural heritage.

Straddling the border between the flora of the Iberian Peninsula and the rest of Europe, the Pyrenean mountain range is also the meeting point between the vegetation of the Cantabrian mountains and that of the Alpine and Mediterranean massifs. To its unique geographical situation, as well as its complex geological and bioclimatic background is added the impact of human activity. This has resulted in the expression of a wide variety of plants in a multitude of natural habitats: forests and clearings, meadows and grasslands, rocky areas and screes, wetlands and aquatic environments, agricultural lands and inhabited areas...

The data collected by the partners come from recent surveys, bibliography and herbariums, and were compiled in the Pyrenean Flora Atlas. They show the south center and all the east of the Pyrenees as the areas with the greatest floristic diversity. Various types of grassland are found here; slightly colonized by trees, they are among the richest ecosystems on the scale of the massif, since botanical inventories register here one third of Pyrenean plant diversity.

Wetlands are home to one Pyrenean species in six.

Eurasian and Mediterranean plant communities are the backbone of the Pyrenean flora, each accounting for almost one third of the species inventoried. At the same time, alpine and boreo-alpine orophyte plants, characteristic of the great European mountain ranges and very northern latitudes, only account for 10% of the Pyrenean flora.

Finally, nearly 300* vascular plants observed are considered as endemic to the Pyrenees, a relatively small but significant number compared to other European mountains, and represent an inestimable heritage value since these plants exist nowhere else...

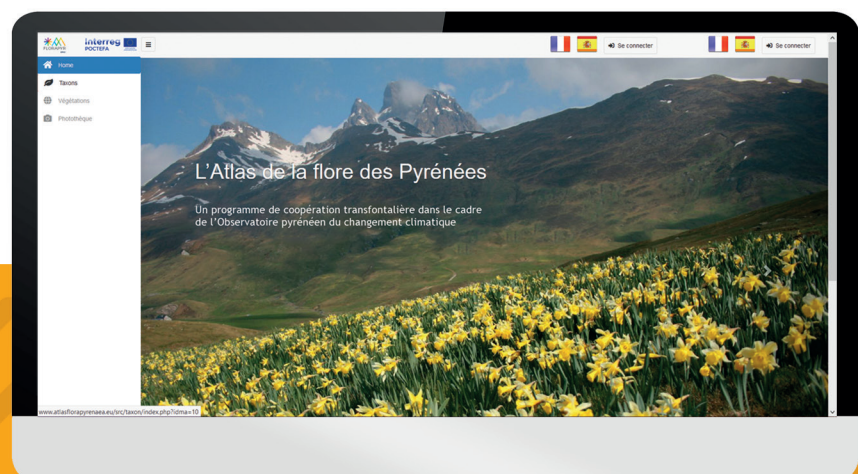
Source of wonder for locals and visitors, place of knowledge for naturalists, the Pyrenean mountain range, natural barrier cut by deep valleys, is undoubtedly home to very unique plant world.

Some call the Pyrenees a European biodiversity hot spot.

* Endemic species and subspecies, according to the Pyrenean Flora Atlas, including apomictic groups.

To go further :

Descriptions, pictures of Pyrenean species and vegetations, summary distribution maps and short diagnosis... To find out more, please consult the dedicated website :



www.atlasflorapyrenaea.eu

A CROSS-BORDER PARTNERSHIP APPROACH AN ORIGINAL ASSESSMENT OF THE THREAT LEVEL

As producers of botanical data and collectors of all available knowledge about Pyrenean flora, the six institutions involved in drawing up this red list have shared their floristic observations to create an unprecedented dataset, enabling an objective assessment of the threats to the massif's plant heritage.

As a result of a dynamic partnership beyond administrative boundaries, this overview allowed to measure the degree of threat to the vascular flora of the Pyrenees, based on the methodology developed by the International Union for Conservation of Nature (IUCN) applied at regional and national* levels, i.e. continents and especially countries and regions. The present scale of work, on a cross-border perimeter, is somewhat original in that it is not based on administrative boundaries but on a biogeographical zone.

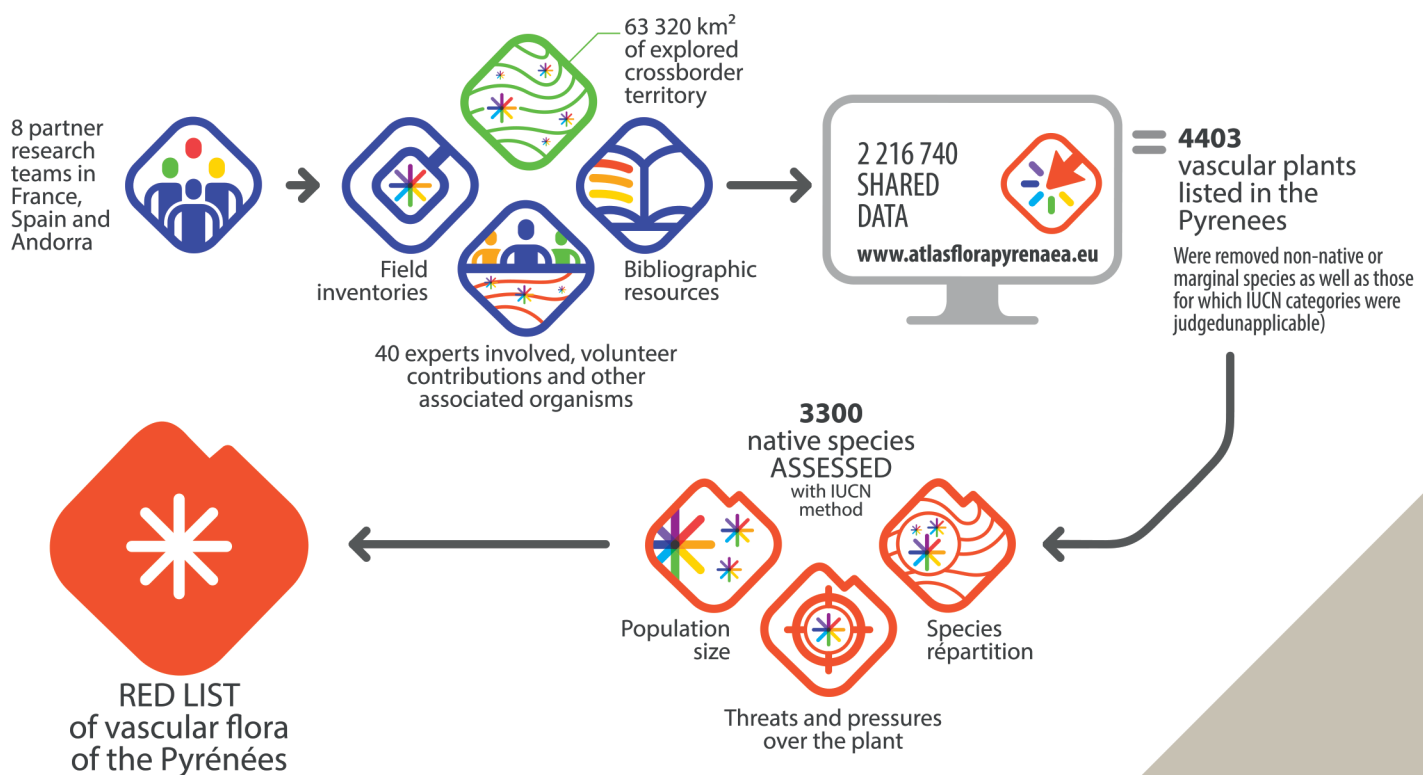
This method is based on several evaluation criteria (see diagram) and on the best available knowledge. Due to the types of data shared within the Pyrenean Atlas, the assessment essentially considered the criteria of geographical distribution, population size and dynamics to measure the extinction risk for each species. The different types of threat likely to affect the plant in the near future have been taken into account, including climate change, impact of human activities and ecological competition, when their effects have been proven...

After working together on the Pyrenean taxonomic reference system, the data was processed to automatically pre-assess the geographical distribution criteria.

The data processing was adapted according to the precision of the information available. The Atlas of the Flora of the Pyrenees compiles current data with levels of geographical precision ranging from geolocated points to 100 km² grid cells; in this case, the area of occupation was estimated in terms of 4 km² grid cells on the basis of results obtained elsewhere in the massif using precise data.

These estimates were then reviewed by experts during the assessment.

A shared web interface was then used to complete the criteria and collaborate on the assessments. Finally, the evaluation committee met several times to deal with contentious cases and validate the categories collectively. It took eight months of collaboration to deliver this red list, from building the collaborative tool to consolidating the results.



(*) Reference : IUCN., 2012. Guidelines for application of IUCN Red List criteria at regional and national levels : version 4.0. Gland, Switzerland: IUCN. iii + 41pp.

PYRENEAN FLORA IS PRESERVED BUT UNDER PRESSURE

Pursuing one of the objectives of the FLORAPYR project launched in 2016, this reference document provides an objective assessment of the level of threat to vascular plants in the Pyrenees. Although this wild flora has been relatively spared, botanists must remain vigilant, as the results clearly show that it is not completely safe...

This Red List is an original scientific basis, based on the synthesis and methodical analysis of over 2 million items of data collected by a network of some forty experts, botanists and researchers, specialists and volunteers.

A tool for raising awareness among the general public and political leaders, the red list have not regulatory status, but it is nonetheless a valuable decision-making tool in that it allows species to be ranked according to their risk of extinction, based on the following categories :



TO GO FURTHER :

Check-ist of species on the Red List of threatened vascular flora in the Pyrenees, available online

https://doctech.cbnpmp.fr/RedList_VascularPlants_Pyrenees.xlsx

RE

4 species extinct in the study area

EN

17 of which 1 endemic endangered species, facing an extremely high risk of extinction in the wild

NT

113 of which 18 endemic near-threatened species, close to the threshold of threatened species and likely to become threatened in the short or medium term if no specific conservation measures are implemented

CR

11 of which 2 endemic critically endangered species facing an extremely high risk of extinction in the wild

VU

38 of which 6 endemic vulnerable species, facing an extremely high risk of extinction in the wild

DD

552 of which 134 endemic species with data deficient, for which knowledge of the populations and their distribution is not sufficient to carry out a relevant assessment of its conservation status on a local scale

LC

2 565 of which 143 endemic species with a low risk of extinction


By the end of the study, 3,300 species and subspecies had been assessed, revealing 66 plants considered threatened (VU, EN, CR) and 113 near-threatened (NT).

Among the most important data, 4 native plants have become definitively extinct (RE), while 9 species endemic to the Pyrenees are threatened, a situation already recorded on the global red list...

Finally, despite the naturalist inventories and scientific surveys undertaken over many years, the vulnerability of almost 17% of the Pyrenean plants inventoried has not been assessed due to data deficiency, poor knowledge of the species concerned or insufficient resources to carry out the necessary investigations... It is imperative that we continue to improve our knowledge of the state of plant diversity in the Pyrenees.

Number of threatened or near-threatened species, extinct or with data deficient, for 7 major natural habitat types	CONTINENTAL ROCK, SCREE AND SAND	MOORS, FRUTICÉES, GRASSLANDS AND MEADOWS	FORESTS	PEATLANDS AND MARSHES	FARMLAND AND ARTIFICIAL LANDSCAPES	NON-MARINE AQUATIC ENVIRONMENTS	LITTORAL AND HALOPHILOUS HABITATS
RE		1				3	
CR	4	1	1			4	1
EN	3	5	2	3	2	1	
VU	6	14	4	7	1	4	2
NT	22	34	17	18	6	6	5
DD	97	238	69	19	50	19	20
LC	336	1286	331	135	331	61	36
% threatened or near-threatened species	7,5	3,4	5,7	15,4	2,3	15,3	12,5

95 species and subspecies assessed as part of this Red list are not included in this table because it do not thrive in the environments mentioned here.



Forest in the Aure valley © C. Bergès - CBNPMP

MOUNTAIN FOREST HABITAT

PRESERVING EXPLOITED ECOSYSTEMS

Forests are the most common type of vegetation in the Pyrenees, except at the highest altitudes and in rocky areas, without soil. The forest ecosystems of the massif are of high ecological quality, with high levels of biodiversity...

Pyrenean forests are diverse, with a preponderance of deciduous species, and their tree composition varies according to altitude, exposure, climatic influences and soil type.

For example, the montane zone on the northern slopes of the range - at an altitude of between 500 and 1,500 m - is covered by beech-fir forests, while on the southern slopes and in sheltered valleys, a Scots Pine (*Pinus sylvestris* L.) forest takes its place.

Higher up, the subalpine zone and its steep slopes are home to the very resistant Mountain Pine (*Pinus uncinata* Ramond ex DC.), a survivor of Ice Age, sometimes reaching record altitudes - over 2,400 metres - as in Néouvielle Nature Reserve.

At the foot of inhabited and exploited mountains, the hilly zone is home to beech-oak stands, downy oak stands and holm oak stands, depending on the climate.

Smaller areas of original forests occupy unique substrata: lime and elm woods and maple groves on steep slopes with unstable or scree soils, pedunculate oak-ash groves on alluvial terraces at bottom of valleys and alder-willow groves on marshy soils.

Vast areas of the lower slopes of valleys are populated by pioneer forests resulting from recolonisation of abandoned former agro-pastoral areas ; the Common Ash (*Fraxinus excelsior* L.) is of great importance here, with a frequent understorey of Common Hazel (*Corylus avellana* L.).

Home to exceptional biodiversity, these hardwood and softwood stands, not forgetting dead wood, are involved in the life cycle of a large number of organisms, including lichens, mosses, fungi, molluscs, amphibians, insects, birds and mammals...



Carpet of *Tractema lilio-hyacinthus* in a beech forest in the Iheris mountain. © A. Reteau - CBNPMP



5,7 % of vascular species
threatened or
near-threatened

IN RED LIST

A significant number of hyperatlantic ferns are present among the forest plants assessed as threatened or near-threatened in the Pyrenees.

The species *Hymenophyllum tunbridgense* (L.) Sm., *Vandenboschia speciosa* (Willd.) Kunkel and *Woodwardia radicans* (L.) Sm. are designated vulnerable [VU] in view of a number of mature individuals of less than 1,000 and/or a population reduction, measured over 10 years or 3 generations, of greater than 30%.

Cystopteris diaphana (Bory) Blasdell [VU] and *Dryopteris aemula* (Aiton) Kuntze [VU] are also under pressure, with populations that are also small and very localised.

These species share the same ecological requirements - sensitivity to drought, thermal contrasts and frost - which in part underlies their fragility, and are sensitive to the slightest change in the conditions of their habitats.

Under forest cover, in favourable topographical situations, in the hollows of valleys or ravines close to the ocean coast, they find the stable hygrometric and thermal conditions they need to survive.

Deforestation or forest felling that abruptly alters microclimatic conditions within forest may be detrimental to them.

Hydric disturbance or drying out of seepage areas that are favourable to maintenance of most vulnerable species - with translucent, single-celled leaf blades - should also be taken into account as a potential threat factor.

SYLVICULTURE AND SPACE FRAGMENTATION

Management and harvesting practices are the main threats to these habitats, as they simplify forest ecosystems and reduce diversity of microhabitats, which depends in particular on variety of natural species present, as well as quantity and quality of dead wood.

Development of river basins and creation of access roads also have a significant influence, as they disrupt the functionality of specific forest habitats such as alluvial forests, forests on peat bogs and ravine forests.

Among the other threats with specific effects, eutrophication of forest soils, through fragmentation and ruderalisation, soil amendments, introduction of nitrifying exotic species or atmospheric deposits, greatly modifies composition of soil fungi communities, many of which interact with vascular flora.

The threats to forest habitats therefore go far beyond the issue of conserving vascular flora, which ultimately represents only a small part of biodiversity of these environments.

Indeed, apart from special cases of highly hygrosiophilous species - such as Braun's Hollyfern (*Polystichum braunii* (Spenn.) Fée) [NT] - or those with symbiotic links such as certain non-chlorophyllous orchids, for example Ghost Orchid (*Epipogium aphyllum* Swartz) [NT], or any geophytes with a slow establishment time such as Lily of the Valley (*Convallaria majalis* L.), for which concern remains minor, other organisms, namely invertebrates, fungi and bryophytes, are the most threatened in forest.

Cystopteris diaphana [VU] © C.Bergès - CBNPMP



Hymenophyllum tunbridgense © F.Prud'Homme - CBNPMP

Epipogium aphyllum © C.Bergès - CBNPMP



Polystichum braunii [NT] © Collection Herbar Le Brun - CBNPMP




ROCK OUTCROPS

THE RESILIENCE OF EXPOSED ENVIRONMENTS

The ecology of these exposed rock surfaces is strongly determined by their geology and the climatic hazards to which they are exposed... Walls, cliffs, slabs and natural scree, as well as quarries, tunnels and trenches resulting from development, are home to specific species that are particularly well adapted.

Labas peak © A. Reteau - CBNPMP



Almost devoid of organic soil, rocky outcrops occupy very large areas between upper limits of forests and summits, but can also be discontinuous or more localised at lower altitudes. Their stony substrates, mainly limestone or siliceous in the Pyrenees, have a major influence on vegetation of these nutrient-poor terrains, with low water availability and often subject to strong thermal oscillation.

Beneath its desert-like appearance, this environment, where colonisation is difficult - not to say impossible - for many species, unexpectedly harbours vascular plants of great botanical and heritage interest. And despite the often extreme conditions that limit the number of species represented compared with other, more open habitats, a sparse flora, often specialised, manages to develop, nestling in cracks, settled on small rocky ledges or scattered among the more or less fine, shifting chaos...

These environments are conducive to development of rare plants, with a high rate of endemism, among the most remarkable of mountain flora, such as Pyrenean Ramonde (*Ramonda myconi* (L.) Rchb.) can be found from Hautes-Pyrénées and Aragon to Catalan coast, Pyrenean Chickweed (*Cerastium pyrenaicum* J. Gay) in eastern part of the massif and Pyrenean Columbine (*Aquilegia pyrenaica* DC. subsp. *pyrenaica*) scattered from Basque country to Andorra.

From natural or anthropogenic origin, these habitats, which are more or less stable depending on their exposure, altitude and geological type, are home to plant communities that are vulnerable in many cases but, above all, are still poorly understood due to the difficulties of exploring a large part of these areas.



**7.5% of vascular species
threatened or
near-threatened**

**4 critically endangered
species**

IN RED LIST

The botanists' assessment revealed around thirty threatened or near-threatened species in this habitat.

Among these, the endemic *Borderea chouardii* (Gausson) Gausson & Heslot [CR] has been found in Aragón, and nowhere else, in the cracks of vertical, shaded limestone walls at altitudes of between 500 and 1,000 meters. A relic of a tropical flora from the Tertiary era, it is one of the oldest European plants with a single known station.

A herbaceous, dioecious plant measuring up to 25 cm, it is very long-lived. Anchoring its tuber in the rock, it remains discreet with its heart-shaped leaves and flowers that appear in spring. Particularly well adapted to its environment, its capsule-shaped fruits are attached to a pedicel that grows longer as it matures, reaching the fissure where the seeds are deposited.

Its extremely restricted range makes it a very sensitive species to the slightest change in its habitat, especially as observations have shown a decline in the number of mature individuals, justifying its classification as "critically endangered".

In the vulnerable category, Pyrenean Alysson (*Alyssum pyrenaicum* Lapeyr.) [VU], found only in limestone massif of Mont Coronat in the heart of eastern Pyrenees, lives for a long time at altitude, up to 2,000 m, in hollows of cracks and on cliff flats.

Described by Philippe Picot de Lapeyrouse in 1813, this perennial plant can grow up to 50 cm tall, erecting branching, woody stems with rosette-shaped leaves at the tips.

Its very small population means that it requires very special attention, as any disturbance to its environment could jeopardise the survival of this species.

CLIMATIC INFLUENCES

AND LACK OF KNOWLEDGE

Relatively well-preserved, rocky ecosystems are not among the most threatened in the Pyrenees. Natural erosion caused by meteorological events disrupts biodiversity present. Although it is a potential and unavoidable threat, it can also be a source of renewal to a certain extent, providing space for pioneering plant formations when it is sudden...

This environment appears to be stable in terms of biodiversity, but is nonetheless sensitive to local conditions, particularly the climate. These areas are rarely, if ever, used by humans, except for certain outdoor activities, the development of which must be monitored and supported.

However, it must be noted that the habitats concerned and the plants that occupy them are still poorly known. Certain rock species belonging to complex taxonomic groups, particularly in the genus *Hieracium* (Hawkweeds), have yet to be studied in depth. A more detailed investigation of these habitats and species would require the mobilisation of specific material, technical and human resources...

In the absence of a precise estimate of the populations of species found there, it remains difficult to assess their conservation status with any relevance, which does not encourage any preservation, protection or conservation initiatives.

11

Borderea chouardii [CR] © C. Bernal - IPE-CSIC



Alyssum pyrenaicum [VU] © CBNPMP





Mown meadow © F. Laigneau - CBNPMP

GRASSLANDS, MEADOWS AND MOORS, THE BALANCE OF DEPRECIATED WILD ENVIRONMENTS

Occupying considerable areas, these habitats made up of herbaceous vegetation and shrubs can be seen, sparsely, from the montane level, in the intermediate grazing and mowing areas and higher up in the mountain pastures, up to an altitude of more than 2,500 m where the alpine grasslands extend, concentrating a wealth of biodiversity that is quite exceptional...



Pastured terraces around Barèges (65) © G. Couëron - CBNPMP

These open to semi-open environments are among the most diverse ecosystems on the scale of the massif, with a third of the vascular plants represented. They form a mosaic landscape where tall grass meadows with grasses, low woody plants, often in thickets around forest islands, and more or less open grasslands harbour a multitude of species.

Shaped largely by man and pasture, except at the highest altitudes where ecological conditions restrict their dynamics, these habitats occupy all types of soil with exception of peaty substrates, vertical rocks and eternal ice.

As a result, they can be broken down into a large number of ecologically, chorologically and biotically determined sub-types across the different vegetation levels throughout the Pyrenees. A fortiori, species composition of vegetation concerned is also very varied, from lawns dominated by endemic Gispet (*Festuca eskia* Ramond ex DC.), which often form tufts on the acidic soils of the sub-alpine zone, to xerophilous calcic Aragon moors with Hedgehog Broom (*Echinopartum horridum* (Vahl) Rothm.), not forgetting the megaphorbiae in avalanche paths with Red Cirse (*Cirsium carniolicum* subsp. *rufescens* (Ramond ex DC.) P. Fourn.), which is endemic to the western Pyrenees.

Man-made hay meadows, when managed relatively extensively, are a diverse, highly flowering type of vegetation, particularly in the montane zone, where they are penetrated by orophilous species from megaphorbiae. Intensification of management practices tends to impoverish these meadows, while if they are abandoned, they gradually become overgrown and revert to forest.



3.4% of vascular species in this habitat are threatened or near-threatened

238 species whose conservation status cannot be assessed due to a lack of knowledge

IN RED LIST

Depending on the precarious balance between open and wooded environments or subject to overgrowth, the highly diverse flora of the Pyrenean grasslands, meadows and moors is not out of danger, even at the highest altitudes...

Among other examples, Rue-leaved Buttercup (*Callianthemum coriandrifolium* Rchb.) [VU], which is common in the Alps, is only known from one sector of the Pyrenees, with fewer than 10 stations on the northern slopes. Considered very rare here, it is confined to calcareous grasslands with late snow cover, between 2,000 and 2,500 m, and flowers as soon as snow melts.

It was first recorded in the Pyrenees in 1845 by botanist Philippe, who spotted the species on the Arize ridges in Hautes-Pyrénées; it was not until 2009 that it was found again on same site by Jean-Paul Vogin, a keen amateur botanist, who also listed a number of new stations in surrounding area.

A high-altitude plant that is susceptible to the vagaries of climate change, its very limited distribution in the Pyrenees and its isolated stations accentuate its vulnerability to the point of highlighting the high risk of its extinction.

Further west, and only in Pyrénées-Atlantiques, megaphorbiae of the lower collinean level, which evolve into riparian forests with very damp thickets, are home to Monkshood (*Aconitum napellus* L. subsp. *napellus*) [NT], a subspecies of *Aconitum napel* characteristic of this type of habitat.

Named after the shape of its inflorescence, this rare and as yet little-known plant has the particularity of flowering very early in season, from April onwards, contributing to the beauty of undergrowth along River Saison and its tributaries... Retreat of riparian forests works to its disadvantage, and this species, which is virtually threatened on a massif-wide scale given the small areas it occupies, could also be affected in long term by development of invasive exotic plants such as knotweed.

DECLINE, INTENSIFICATION AND DEVELOPMENT

The potential threats to these habitats stem from a variety of anthropogenic issues, due to the influence of human activities, some of which have been going on for centuries, but also from natural causes. These threats vary according to the ecological characteristics of each habitat type.

Overall, at higher altitudes, pressures remain low and localised, even if dynamics linked in particular to phenomena of abandonment or, conversely, excessive grazing and trampling can change the respective distribution of elementary habitats.

Reasoned and appropriate herd management plays an essential role in maintaining the diversity of these environments, while use of these areas by tourists must remain responsible to avoid any further impact...

From montane level upwards and at lower altitudes, abandonment of some areas, leading to the re-colonisation of these habitats by ligneous plants, or the intensification of some practices, such as the over-fertilisation of meadows, results in a loss of biodiversity that is far from negligible. Early mowing can also reduce plant diversity in these sensitive areas, as most plants do not have time to complete their entire life cycle and are replaced by more competitive pioneer species...

Lastly, on more moderate slopes, increasing urbanisation and, locally, penetration of non-native plants can be factors in degradation of these areas in absence of management measures.



Callianthemum coriandrifolium [VU] © G. Corriol - CBNPMP



Aconitum napellus subsp. *napellus* © C. Bergès - CBNPMP





Agricultural land of the Pyrenean foothills © C. Bergès - CBNPMP

FARMLAND AND ARTIFICIAL LANDSCAPES

RECONCILING ANTHROPISED BIOTOPES

Present throughout the Pyrenees mountain range, mainly at altitudes below 1,000 m, agricultural and artificial habitats are spread over plains and gently sloping areas where diversity of wild vegetation has been tamed by hand of man...

Agricultural land of the Pyrenean foothills © C. Bergès - CBNPMP



Covering larger areas on the Spanish side, and mainly planted in sunny locations, these meadows have been farmed for centuries, mainly for livestock, and this has had an impact on biodiversity.

Whether permanent, temporary or artificial, i.e. sown - and fertilised - to produce fodder, these meadows are naturally rich in grasses, harbouring a high density of vascular species. The atlas of Pyrenean flora lists more than 700 plants associated with these habitats, some of which are very rare, such as the Pectinated Chrysanthemum (*Prolongoa hispanica* G. López & C.E. Jarvis) [EN] only found in Aragón and the Dove's-foot Cranesbill (*Geranium divaricatum* Ehrh) [EN] found in the eastern part of the massif, others known as messicolous plants such as the Hare's Ear (*Bupleurum rotundifolium* L.) [NT] or the Ball Mustard (*Neslia paniculata* subsp. *thracica* (Velen.) Bornm.) [NT].

Previously much more extensive, at altitudes of over 1,500 m in some regions, cultivated areas were gradually abandoned during the 20th century. Today, they are being reinvested by forests, unless they are covered by Spanish Broom (*Genista hispanica* L.), which is widely present from the Basque country to Navarre, or monogynous Hawthorn (*Crataegus monogyna* Jacq) and elm-leaved Bramble (*Rubus ulmifolius* Schott).

In addition to farmland and surrounding hedgerows, other artificial landscapes have developed around towns, with a wide variety of ruderal-nitrophilous vegetation, although *Compositae* and *Chenopodiaceae* predominate. The development of this peri-urban flora is largely the result of human intervention, such as plantings of Scots pine, poplar and fruit tree orchards, or the introduction of exotic plants during roadside development...



2.3% of vascular species in this habitat are threatened or near-threatened



IN RED LIST

Today, these agricultural and artificially-developed lands are heavily impacted by practices that rely heavily on pesticides and fertilisers, not to mention increasingly mechanised farming methods that restrict the expression of a remarkable flora and fauna.

The Pectinated Chrysanthemum (*Prolongoa hispanica* G. López & C.E. Jarvis) [EN], endemic to center and south of Iberian Peninsula, is one of species facing a very high risk of extinction in the wild in agricultural and artificial lands of the Pyrenees, with less than a dozen recorded sightings.

An annual plant of Asteraceae family, it prefers sandy soils and fields and can be found in certain fallow and cultivated land in generally dry, sunny conditions at low altitude.

Distribution of this species is very limited at the extreme southern limit of eastern Pyrenees, with isolated populations that are all the more vulnerable to slightest change in conditions.

A representative of messicolous flora that accompanies cereal fields, the Hare's Ear (*Bupleurum rotundifolium* L.) [NT] is remarkably attractive, with its perfoliated leaves crossed by the stem and its inflorescence in bright yellow-green umbels. Found at altitudes of between 400 and 1,300 m, mainly on southern slopes of the Pyrenees, most known citations are more than 20 years old.

It is also on Red List of vascular flora in mainland France as a near-threatened species [NT], and conservation measures are urgently needed to halt its extinction.

Little is known about the number of residual populations, and their survival is uncertain given the irrepressible effect of various factors, such as the abandonment of extensive farming methods, overgrowth or, at the other extreme, intensification of farming and widespread use of plant protection products.

ABANDON AND INTENSIVE USE

In the most intensively farmed areas, over-fertilisation of soil and use of herbicides have the direct consequence of reducing diversity of flora in these areas. These disturbances lead to profound and lasting changes in habitats, helping to standardise plant life of these areas towards a relatively banal flora.

Messicolous flora, associated with crops and all too often considered to be "weeds", are particularly affected by these pressures, to the point of becoming residual or endangered for certain sensitive species. Appropriate cultivation practices, as well as controlling overgrowth and the fragmentation of areas, are among the efforts that should be made as a priority to maintain it.

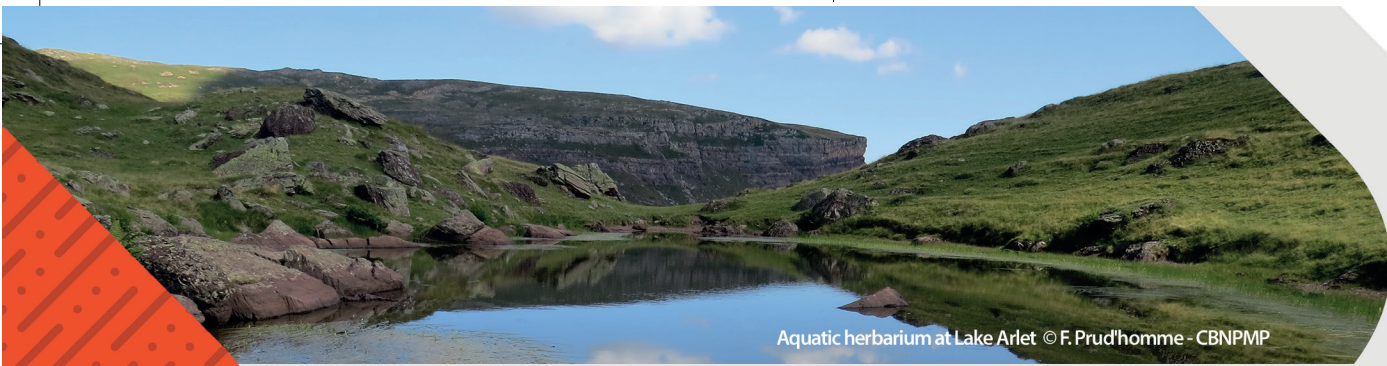
Highly dependent on farming practices, these species are currently threatened or almost threatened with extinction if no specific management measures are implemented, which could be quite feasible in the vicinity of protected natural areas such as national parks or reserves.

Geranium divaricatum [EN] © JVE (dr)



Bupleurum rotundifolium [NT] © J. Garcia - CBNPMP





Aquatic herbarium at Lake Arlet © F. Prud'homme - CBNPMP

MOUNTAIN LAKES AND RIVERS

THE SUSTAINABILITY OF MANAGED NATURAL AREAS

Combined with relief, the abundant rainfall - particularly in western part of the massif - feeds ubiquitous running waters, springs, seeps, streams and rivers, which are juxtaposed with the stagnant waters of the mountain lakes, forming a dense hydrographic network that is an integral part of the identity of the Pyrenees and their biological wealth...

Botanical subaquatic prospecting at Guits lake (65) © F. Prud'homme - CBNPMP



Narrow-leaved cottongrass in a lake environment © C. Bergès - CBNPMP

Giving life to original ecosystems, from vast expanses of water perched high - at over 3,000 m on southern slopes - to calmer river basins downstream, via rapid torrents that have carved out deep valleys, these environments are home to a great diversity of plant life that is still little known.

The countless lakes in the Pyrenees - especially on northern slope - are either natural, sometimes glacial in origin, or more artificial and held back by dams. Their waters are generally poor in nutrients, spending part of year without light - under ice and snow - and are home to a highly specialised flora that is still under-researched. These habitats have particularity of existing in very mineral or peaty contexts surrounded by varied low marshes. Associated aquatic plants (hydrophytes) are characterised by heterogeneous lifestyles, with belts of vegetation that are sometimes submerged and notably composed of Narrowleaf Bur-Reed (*Sparganium angustifolium* Michx.) and Water Awlwort (*Subularia aquatica* L.) [NT], while the deeper waters are home only to Characeae, sometimes to depths of more than 20 m... Between these two zones, lawns of Isoetes and meadows of *Ranunculus*, Potamots and sometimes Water-lilies complete the range of lake vegetation.

Around lakes, terrestrial plants resist and form trembling belts of Bottle Sedge (*Carex rostrata* Stokes) and Water Horsetail (*Equisetum fluviatile* L.) or low marshes of Marsh Cinquefoil (*Potentilla palustris* (L.) Scop.). In fast-flowing waters, only bryophytes can withstand torrential currents, while wide watercourses give way to *Ranunculus penicillatus* (Dumort.) Bab.



15.3% of vascular species in this habitat are threatened or near-threatened

4 critically endangered species and 3 extinct throughout the massif

IN RED LIST

Submerged or floating, aquatic vegetation remains relatively unknown, yet like all wild environments, its biotopes are subject to a number of pressures, many of them linked to human activities.

The Lake Quillwort (*Isoetes lacustris* L.) [NT], a strictly aquatic fern, is regularly observed in sub-alpine lakes of the massif in company of Spiny Quillwort (*Isoetes echinospora* Durieu) [NT], with which it can hybridize. The distribution of this species is centred on eastern part of the range, from Catalonia to upper Garonne valley, and more locally in Hautes-Pyrénées around Néouvielle massif.

The turfs formed by these species - along with Water Awlwort - are sometimes dense and, although rare, can cover the bottom of some lakes. Listed in the Habitats, Fauna and Flora Directive, Isoetes vegetation is highly symbolic of boreo-arctic plant associations in the Pyrenees.

The impact of hydroelectric developments and the introduction of fish is now well documented, making it possible to identify a major conservation issue for this aquatic plant, which is virtually threatened in the Pyrenees.

The Floating Water-plantain (*Luronium natans* (L.) Raf.) [CR], an aquatic alismatacea found in Atlantic regions of temperate Europe, is only found on mountains in the Pyrenees, on southern slope, where it remains extremely rare.

This plant, like the Whitestem Pondweed (*Potamogeton praelongus* Wulfen) [NT] and the Schweinfurth Pondweed (*Potamogeton schweinfurthii* A.Benn.) [CR], recently discovered in central Spanish Pyrenees, likes shallow, acidic, cold water of average depth.

As a heritage species, the floating Water-plantain benefits from protection policies, notably through Habitats, Fauna and Flora Directive, and its Pyrenean populations have been the focus of special attention as part of specific action programmes.

Like most plants native to mountain lakes, it is under threat from an increase in nutrient levels in water, linked to introduction of fish, proximity to cattle resting places or infrastructures, such as refuges, whose effluents are poorly controlled... Global warming and invasive exotic plants, in particular the Canadian Waterweed (*Elodea canadensis* Michx.), are also among the pressures whose effects on *Luronium natans* and mountain aquatic meadows need to be monitored.

FISHING ACTIVITIES

AND DEVELOPMENTS

Although they are a key feature of Pyrenean landscape, aquatic ecosystems have long been ignored, including in terms of biodiversity issues, perhaps because these lacustrine environments give the impression of a certain immutability... Today, a number of threats have been widely documented.

The introduction of fish for fishing, which began in the Middle Ages and has been intensified since the 1950s, has had a major impact. Regular influx of salmonids and minnows into these naturally fish-friendly environments upsets trophic balance, affecting entire sections of food chain, including plants.

Naturally poor in nutrients, lakes can also be locally affected by inputs from tourist or pastoral developments. These enriched waters favour competitive species, often non-native, to detriment of oligotrophic plants, which are sometimes rare and characteristic of nutrient-poor mountain lakes.

In addition, hydroelectric developments and their impact on watercourse regime and quality of the river substrate are contributing to profound changes in stationary conditions of rivers and plants that live there.

Finally, there are also questions about future of lake plant communities in context of climate change... Monitoring programmes have been launched in recent years to characterise lakes and monitor various parameters.

Isoetes lacustris [NT] © F. Prud'homme - CBNPMP

Potamogeton praelongus [NT] © F. Prud'homme - CBNPMP

Luronium natans [CR] © J. Garcia - CBNPMP





Peat bog in Basque mountain © C. Bergès - CBNPMP

PEAT BOGS, MARSHES AND SPRINGS

SAFEGUARDING ENDANGERED BIODIVERSITY RESERVES

In the Pyrenees, low-lying areas at all altitudes encourage water to stagnate, giving rise to marshes connected to the watershed, ponds and fragile peat bogs fed by rainfall... These wetlands are veritable showcases for a specialised biodiversity that is perfectly adapted to harsh conditions that prevail there.

Peat bog in Basque mountain © C. Bergès - CBNPMP



With a wide variety of environments, from peat bogs to lakeside meadows, low marshes and fens, wetlands with waterlogged soils generally occupy only small areas of the massif, but they are remarkable in terms of their wealth of vegetation.

These environments, where water input compensates for or exceeds losses generated by evapotranspiration, absorption by plants or run-off, offer edaphic hydric situations whose dynamics - between flood and drought regimes - determine their ecological and floristic variability. This, superimposed on properties of water that sustains these habitats - principally its mineral content - explains coexistence of different plant communities, often distributed in small-scale mosaics.

In this context, which is asphyxiating for the vast majority of vascular species, two taxonomic groups stand out for their diversity and their structural role: mosses of the genus *Sphagnum* and *Cyperaceae* family, including *Carex bicolor* All. or *Kobresia simpliciuscula* (Wahlenb.) Mack. in alpine zone, and *Carex limosa* L. or *Carex pauciflora* Lightf. in the subalpine zone.

Given restrictions of each type of wetland, with varying levels of oxygen, mineral content and water seasonality, each plant community is generally species-poor, but many of them are ecologically specific.



15.4% of vascular species in this habitat are threatened or near-threatened

IN RED LIST

Despite very difficult conditions for living creatures, flora of wetlands is rich, limited in endemism and singularly fragile.

Woollyfruit Sedge (*Carex lasiocarpa* Ehrh.) [NT], common in boreal zone and the Alps, is only found in a few places in the Pyrenees, scattered in Val d'Aran and Haute-Cerdagne, preferably above 1,500 m altitude. Forming dry lawns, particularly in low marshes, it can locally form abundant populations. Not to be confused with rushes and reeds, this wild plant with its spikes of flowers can sometimes reach over a metre in height and adapts well to a substrate that is poor in nutrients but very rich in organic matter.

Fairly sensitive to aerial erosion, Woollyfruit Sedge is considered to be under threat throughout the massif due to the number of known sites and the fact that its habitat is sensitive to climate change.

Scottish Asphodel (*Tofieldia pusilla* Pers.) [EN] is a herbaceous plant typical of humid, boggy environments on banks of small mountain streams. This boreal species is only known in the Pyrenees from a single Andorran locality, at an altitude of around 2,400 m, where it forms a small population.

Rather rare, it can be recognised above all by its small size and its clusters of very white flowers, which bloom in midsummer.

Considered a glacial relic, the Scottish Asphodel is in danger of disappearing due to the significant decline in its habitat.

LANDFILL

AND SOIL ARTIFICIALISATION

Wetlands are very often ignored or even disregarded because they are considered unhealthy or useless, and are in sharp decline worldwide.

These biotopes, which are particularly sensitive to anthropogenic factors and climate change, are all the more fragile given their limited surface area. As a result, wealth of plant life in these habitats is subject to same pressures, which are amplified by the fact that they are exerted on fragmented populations.

Water abstraction, dams, inter-basin transfers and drainage - particularly for agricultural purposes - have altered the wetlands in many Pyrenean valleys, putting the most vulnerable species at even greater risk. In addition, intensification of grazing in some areas and widespread eutrophication of soils are also generating disturbances that are modifying ecosystem functions and affecting the expression of plant communities present.

These relatively recent imbalances come on top of natural dynamics of closing environments - colonised by shrubby vegetation that benefits from their drying out - and changes in rainfall and temperature patterns. The increasing frequency of hot, dry periods is degrading wetlands, particularly peat bogs, and encouraging their invasion by competitive generalist plants. This combination of threatening factors primarily affects specialised flora characteristic of wetlands, as well as the rarest species, with risk of their disappearance in short to medium term.

Rhynchospora fusca [EN] © C. Bergès - CBNPMP



Carex bicolor [NT] © CBNPMP

Carex lasiocarpa [NT] © NG (dir)



Cap de Creus © B. Durand - CBNPMP

COASTLINE AND SALT WATER

PROTECTING HABITATS UNDER PRESSURE

Original and of major interest for biodiversity, the coastal environments frame the Pyrenean chain from rocks and cliffs where unique vegetation thrives under the decisive influence of the Atlantic and Mediterranean climates...

Carprobrotus edulis at Cap de Creus © J. Dao - CBNPMP



These coastal habitats, characterised by their generally steep relief, are largely exposed to sea breezes laden with saline aerosols, as well as to the more or less intense winds of tramontana, escaping from the foothills of the massif, or the galerne, pounding the Basque coast.

The result is a range of wild plants that are well adapted - depending on whether they are located at eastern or western extremities of the massif - to salinity of the soil brought by both winds and splashing of waves, as well as to rocky substrates present and strong thermal oscillations to which these environments are subjected.

Forming various zones, like vegetation belts, the extension of different types of vegetation - between 150 and 200 m above sea level - varies according to relief and is mainly conditioned by frequency of marine splashes, particularly in highly exposed areas such as northern coast of Cap de Creus or Mount Jaizkibel to the west.

Much of vegetation is made up of small to medium-sized perennial species that are often densely grassed, such as the Sea Plantain (*Plantago maritima* L.).

Close to the coast, sheltered from influence of tides, the most representative plants are Rock Samphire (*Crithmum maritimum* L.) as well as various species of Sea-lavender (*Limonium* spp.) of Lady's Cushion, some of which are endemic, for example (*Armeria euscadiensis* Donad. & Vivant).

In the deepest cracks, where salt water accumulates, halophytic sub-shrubs appear, such as Golden Samphire (*Limbarda crithmoides* (L.) Dumort.) and Sea Purslane (*Atriplex portulacoides* L.), as well as ferns such as Sea Spleenwort (*Asplenium marinum* L.).

On the cliffs, in less exposed environments, characteristic populations can be found, such as the Alene-leaved Plantain (*Plantago subulata* L.) and the Shaggy Sparrow-wort (*Thymelaea hirsuta* (L.) Endl.) on the Mediterranean front. Cornish Heath (*Erica vagans* L.) and Western Broom (*Genista hispanica* subsp. *occidentalis* Rouy) thrive on rocky limestone soils on the coast and elsewhere in the massif.

Finally, other heathers, Bell Heath (*Erica cinerea* L.), Cross-leaved Heath (*Erica tetralix* L.) and Dorset Heath (*Erica ciliaris* Loeff. ex L.) prefer siliceous substrates on the Atlantic coast, marking transition to inland habitats.

IN RED LIST

Trampled, picked or even inadvertently eliminated when paths are laid, for example, the flora associated with coastal habitats is declining under the weight of multiple pressures, including those of more or less natural origin, such as the proliferation of invasive exotic species, fires and climate change.

Seseli farrenyi Molero & J.Pujadas. [CR], a small umbellifer - 6 to 30 cm high - is unique in that it is monocarpic, meaning that it flowers and bears fruit only once during its life cycle, which can last up to 5 years. Critically endangered, this endemic of Cap de Creus peninsula at the eastern end of the Pyrenees lives on schistose rock at low altitude along windy coast.

With only three known populations, very close to each other, this species can be considered as having only one locality, with fewer than 300 individuals over a total area of less than 1 km². This wild plant has undergone a significant reduction - over 90% - in its number of plants over the last decade, before finally stabilising, but well below the minimum viable population size...

Although established in a protected area, in territory of a natural park, this species is threatened by over-frequentation of certain localities, the two smallest populations being located near roads used by bathers, fishermen and walkers... Proliferation of non-native colonising species such as Pigface (*Carpobrotus* spp.) and Prickly Pear (*Opuntia* spp.) are adding to the pressure on native wild flora, particularly *Seseli farrenyi*.

A programme to restore this emblematic species of Catalonia is due to be complete in the near future, involving reinforcement of populations through a reintroduction protocol using seeds and individuals cultivated in botanical gardens...

URBANISATION

ET ACTIVITES SOCIO-ECONOMIQUE

Due to strong demographic pressure, massive urbanisation of Europe's southern coastline and over-frequentation by tourists, the main threat to coastal habitats is essentially anthropogenic.

Developments such as footpaths, housing estates, industries, converting wild land into cultivated areas, fishing and shellfish farming activities, campsites and water sports all contribute to irreversible degradation of these habitats.

While the halophilic flora adapted to substrates of salt marshes and salt meadows is more directly affected by human activities, extreme meteorological phenomena, such as sea storms or thunderstorms liable to cause major flooding, affect coastal habitats to varying degrees by modifying soil salinity.

In addition, deliberate or accidental introduction of invasive exotic species, particularly succulent plants such as Agave (*Agave americana* L.) on the Mediterranean coast or Eastern Baccharis (*Baccharis halimifolia* L.) and American Pokeweed (*Phytolacca americana* L.) on the Atlantic coast, are also among causes of loss of biodiversity in these coastal environments.

Finally, effects of natural or man-made erosion on rocky areas and cliffs also disrupt, to a lesser extent, the plant diversity found there...



12.5% of vascular species in this habitat are threatened or near-threatened

Echinium creticum au Cap de Creus © B. Durand - CBNPMP



Erica vagans and *Daboecia cantabrica* © C. Bergès - CBNPMP

RED LIST OF THREATENED VASCULAR SPECIES IN THE PYRENEES

This red list can be consulted and downloaded in spreadsheet format, from the Conservatoire botanique national des Pyrénées et de Midi-Pyrénées website at the following address:

https://doctech.cbnpmp.fr/RedList_VascularPlants_Pyrenees.xlsx





RE

species extinct in the study area

CR

critically endangered species, facing an extremely high risk of extinction in the wild

EN

endangered species, facing an extremely high risk of extinction in the wild

VU

vulnerable species, facing an extremely high risk of extinction in the wild

NT

near-threatened species, close to the threshold of threatened species and likely to become threatened in the short or medium term if no specific conservation measures are implemented

DD

species with data deficient, for which knowledge of the populations and their distribution is not sufficient to carry out a relevant assessment of its conservation status on a local scale

LC

species with a low risk of extinction

NE

not evaluated (species not yet tested against red list criteria)



Scan of herbarium part *Soldanella villosa* © BBF - Collection Le Brun



HERBIER P. LE BRUN
 FLORE FRANCO-HELVETIQUE

Soldanella villosa Duracq

Itxassou : vallon de Laxia, rochers mouillés des cascades du Jardin d'Enfer (Yfernoukhotalain) (Basses-Pyrénées) 3 avril 1919 legi ipse

Altitude : 450 m.



Scientific name	Red list Pyrenees	Pyrenean endemic	Present in Andorra	Present in Spain	Present in France	Red list Europe
<i>Aconitum burnatii</i> Gáyer	EN				X	NE
<i>Aconitum napellus</i> L. subsp. <i>napellus</i>	NT	X		X	X	NE
<i>Adoxa moschatellina</i> L.	NT				X	NE
<i>Aethionema monospermum</i> R. Br.	NT				X	NE
<i>Alchemilla pentaphyllea</i> L.	VU			X		NE
<i>Allium flavum</i> L.	NT				X	LC
<i>Allium pyrenaicum</i> Costa & Vayr.	NT	X		X	X	NE
<i>Alyssum alpestre</i> L.	NT		X	X	X	NE
<i>Alyssum pyrenaicum</i> Lapeyr.	VU	X			X	VU
<i>Androsace helvetica</i> (L.) All.	EN				X	NE
<i>Apium inundatum</i> (L.) Rchb. F.	RE			X		LC
<i>Aquilegia viscosa</i> Gouan subsp. <i>hirsutissima</i> (Timb.-Lagr.) Breistr.	NT	X		X	X	NE
<i>Arabis nova</i> Vill. subsp. <i>iberica</i> Rivas Mart. ex Talavera	CR			X		NE
<i>Arabis soyeri</i> Reut. & Huet	NT	X		X	X	NE
<i>Arenaria marschlinsii</i> W.D.J. Koch	NT			X	X	NE
<i>Arenaria vitoriana</i> Uribe-Ech. & Alejandro	NT			X		NE
<i>Armeria cantabrica</i> Boiss. & Reut. ex Willk. subsp. <i>vasconica</i> (Sennen) Uribe-Ech.	NT	X		X		NE
<i>Armeria ruscinonensis</i> Girard subsp. <i>ruscinonensis</i>	NT	X		X	X	NE
<i>Asplenium obovatum</i> Viv. subsp. <i>obovatum</i>	VU			X	X	NE
<i>Asplenium seelosii</i> Leyb. subsp. <i>glabrum</i> (Litard. & Maire) Rothm.	NT			X	X	NE
<i>Asplenium trichomanes</i> L. subsp. <i>inexpectans</i> Lovis	CR			X		NE
<i>Astragalus austriacus</i> Jacq.	VU			X		NE
<i>Astragalus penduliflorus</i> Lam.	NT			X	X	NE
<i>Bifora radians</i> M. Bieb.	NT			X	X	NE
<i>Borderea chouardii</i> (Gaussen) Gaussen & Heslot	CR	X		X		CR
<i>Botrychium matricariifolium</i> (A. Braun ex Döll) W.D.J. Koch	VU			X	X	NT
<i>Botrychium simplex</i> E. Hitchc.	EN				X	EN
<i>Brassica repanda</i> (Willd.) DC. subsp. <i>galissieri</i> (Giraudias) Heywood	VU	X			X	NE
<i>Bupleurum rotundifolium</i> L.	NT			X	X	NE
<i>Callianthemum coriandrifolium</i> Rchb.	VU				X	NE
<i>Campanula latifolia</i> L.	NT			X	X	NE
<i>Cardamine parviflora</i> L.	NT			X	X	NE
<i>Carex bicolor</i> All.	NT				X	NE
<i>Carex buxbaumii</i> Wahlenb.	NT				X	NE
<i>Carex cespitosa</i> L.	NT				X	NE
<i>Carex diandra</i> Schrank	EN			X		NE
<i>Carex ferruginea</i> Scop. subsp. <i>tenax</i> (Christ) K. Richt.	EN			X		NE
<i>Carex foetida</i> All.	NT			X	X	NE
<i>Carex grioletii</i> Roem.	NT			X		NE
<i>Carex hispida</i> Willd.	NT			X		NE
<i>Carex lachenalii</i> Schkuhr	VU			X	X	NE
<i>Carex lasiocarpa</i> Ehrh.	NT			X	X	LC
<i>Carex limosa</i> L.	NT			X	X	LC
<i>Carex praecox</i> Schreb.	NT			X	X	NE
<i>Centaurea pinae</i> Pau	NT			X		NE
<i>Ceratophyllum submersum</i> L.	CR			X	X	LC
<i>Chaenorhinum organifolium</i> (L.) Fourr. subsp. <i>cotiellae</i> P. Monts. & G. Monts.	VU	X		X		NE
<i>Chaetonychia cymosa</i> (L.) Sweet	NT				X	NE
<i>Cirsium dissectum</i> (L.) Hill	NT				X	NE

Scientific name	Red list Pyrenees	Pyrenean endemic	Present in Andorra	Present in Spain	Present in France	Red list Europe
<i>Cirsium erisithales</i> (Jacq.) Scop.	NT			X		NE
<i>Cistus psilosepalus</i> Sweet	VU			X		NE
<i>Cochlearia aragonensis</i> Coste & Soulié subsp. <i>aragonensis</i>	NT			X		NE
<i>Cochlearia aragonensis</i> Coste & Soulié subsp. <i>navarrana</i> (P. Monts.) Vogt	NT	X		X		NE
<i>Crassula vaillantii</i> (Willd.) Roth	NT				X	NE
<i>Cyclamen balearicum</i> Willk.	VU				X	NE
<i>Cynoglossum germanicum</i> Jacq. subsp. <i>pellucidum</i> (Lapeyr.) Sutory	NT				X	NE
<i>Cypripedium calceolus</i> L.	NT			X	X	NT
<i>Cystopteris diaphana</i> (Bory) Blasdell	NT			X	X	NE
<i>Cytisus decumbens</i> (Durande) Spach	NT				X	NE
<i>Daphne alpina</i> L.	NT			X	X	NE
<i>Delphinium fissum</i> Waldst. & Kit. subsp. <i>fissum</i>	EN				X	NE
<i>Delphinium fissum</i> Waldst. & Kit. subsp. <i>fontqueri</i> Ascaso & Pedrol	EN	X		X	X	NE
<i>Delphinium montanum</i> DC.	NT	X		X	X	NE
<i>Draba incana</i> L.	VU				X	NE
<i>Dracocephalum austriacum</i> L.	EN				X	DD
<i>Dracocephalum ruyschiana</i> L.	VU				X	LC
<i>Drosera anglica</i> Huds.	NT			X		NT
<i>Dryopteris aemula</i> (Aiton) Kuntze	NT			X	X	LC
<i>Elatine alsinastrum</i> L.	CR			X	X	NT
<i>Elatine brochonii</i> Clavaud	EN			X		NE
<i>Elatine macropoda</i> Guss.	VU			X	X	DD
<i>Eleocharis acicularis</i> (L.) Roem. & Schult.	NT				X	LC
<i>Eleocharis uniglumis</i> (Link) Schult.	NT			X	X	LC
<i>Epipogium aphyllum</i> Swartz	NT			X	X	LC
<i>Erigeron atticus</i> Vill.	NT		X	X	X	NE
<i>Erigeron cabelloi</i> A. Pujadas, R. García-Salmones y E. López	NT	X	X			NE
<i>Eriophorum scheuchzeri</i> Hoppe	NT			X	X	LC
<i>Erucastrum gallicum</i> (Willd.) O.E. Schulz	NT			X	X	NE
<i>Erysimum virgatum</i> Roth	VU		X	X		NE
<i>Euphorbia dendroides</i> L.	NT			X	X	LC
<i>Euphorbia pithyusa</i> L.	NT				X	NE
<i>Festuca prudhommei</i> Kerguélen & Plonka	NT	X			X	NE
<i>Galium boreale</i> L.	NT			X	X	NE
<i>Galium brockmannii</i> Briq.	NT			X		NE
<i>Galium glaucum</i> L.	NT				X	NE
<i>Galium trifidum</i> L.	EN				X	NE
<i>Genista delphinensis</i> Verl., 1872	NT				X	NE
<i>Geranium bohemicum</i> L.	NT			X		NE
<i>Geranium divaricatum</i> Ehrh.	EN			X	X	NE
<i>Geranium endressii</i> J. Gay	NT	X			X	NE
<i>Glandora oleifolia</i> (Lapeyr.) D.C. Thomas	NT	X		X		NE
<i>Gypsophila muralis</i> L.	NT			X	X	NE
<i>Halimium alyssoides</i> (Lam.) DC.	NT			X	X	NE
<i>Halimium umbellatum</i> (L.) Spach subsp. <i>umbellatum</i>	EN				X	NE
<i>Herniaria alpina</i> Chaix	NT			X	X	NE
<i>Hieracium fuxianum</i> Rouy	VU	X			X	NE
<i>Hieracium nobile</i> Gren. & Godr.	NT			X	X	NE
<i>Hippuris vulgaris</i> L.	CR		X	X	X	LC

Scientific name	Red list Pyrenees	Pyrenean endemic	Present in Andorra	Present in Spain	Present in France	Red list Europe
<i>Hymenophyllum tunbrigense</i> (L.) Sm.	VU			X	X	LC
<i>Hyoseris radiata</i> L.	VU				X	NE
<i>Isoetes echinospora</i> Durieu	NT		X	X	X	LC
<i>Isoetes lacustris</i> L.	NT		X	X	X	LC
<i>Isoetes velata</i> A.Braun	VU			X	X	NT
<i>Juncus heterophyllus</i> Dufour	VU			X		LC
<i>Juniperus thurifera</i> L.	NT			X	X	LC
<i>Lappula deflexa</i> (Wahlenb.) Garcke	EN			X		NE
<i>Lathyrus pannonicus</i> (Jacq.) Garcke subsp. <i>asphodeloides</i> (Gouan) Bässler	NT				X	NE
<i>Limonium geronense</i> Erben	NT	X		X	X	NE
<i>Limonium tremolsii</i> (Rouy) Guinea & Ceballos Jiménez	NT	X		X	X	NE
<i>Lonicera caerulea</i> L.	NT			X	X	NE
<i>Lunaria rediviva</i> L.	NT				X	NE
<i>Luronium natans</i> (L.) Raf.	CR			X	X	LC
<i>Lycopodiella inundata</i> (L.) Holub	NT			X	X	LC
<i>Lycopodium annotinum</i> L.	NT		X		X	LC
<i>Marsilea quadrifolia</i> L.	RE				X	VU
<i>Matthiola fruticulosa</i> (Loefl. ex L.) Maire subsp. <i>valesiaca</i> (Boiss.) P.W. Ball	NT			X	X	NE
<i>Minuartia capillacea</i> (All.) Graebn.	NT				X	NE
<i>Myosotis hervei</i> Sennen	NT			X		NE
<i>Myricaria germanica</i> (L.) Desv.	NT			X	X	NE
<i>Narcissus obsoletus</i> (Haw.) Steud.	NT			X		NE
<i>Neslia paniculata</i> (L.) Desv. subsp. <i>thracica</i> (Velen.) Bornm.	NT			X	X	NE
<i>Nuphar lutea</i> (L.) Sm.	NT				X	NE
<i>Oenanthe aquatica</i> (L.) Poiret	RE			X		LC
<i>Onopordum eriocephalum</i> Rouy, 1897	NT				X	NT
<i>Ophioglossum azoricum</i> C. Presl	NT			X	X	LC
<i>Oplismenus hirtellus</i> (L.) P. Beauv. subsp. <i>undulatifolius</i> (Ard.) U. Scholz	CR			X		NT
<i>Orchis italica</i> (L.) Pers.	VU			X		LC
<i>Orlaya grandiflora</i> (L.) Hoffmanns.	NT			X	X	NE
<i>Orobanche laserpitii-sileris</i> Reut. ex Jord.	VU			X	X	NE
<i>Orobanche pubescens</i> d'Urv.	VU				X	NE
<i>Oxytropis lapponica</i> (Wahlenb.) J. Gay	NT			X		NE
<i>Pedicularis comosa</i> L. subsp. <i>asparagoides</i> (Lapeyr.) P.Fourn.	NT	X			X	NE
<i>Pedicularis rosea</i> Wulfen subsp. <i>allionii</i> (Rchb. f.) Arcang.	NT			X	X	NE
<i>Pellaea calomelanos</i> (Sw.) Link	NT			X		NE
<i>Pentaglottis sempervirens</i> (L.) Tausch	NT			X	X	NE
<i>Petrocoptis pseudoviscosa</i> Fern. Casas	VU	X		X		VU
<i>Peucedanum venetum</i> (Spreng.) W.D.J. Koch	NT			X	X	NE
<i>Phyllodoce caerulea</i> (L.) Bab.	NT			X	X	NE
<i>Plantago cornutii</i> Gouan	CR			X		NE
<i>Polemonium caeruleum</i> L.	NT				X	NE
<i>Polygala vayredae</i> Costa	NT	X		X		NE
<i>Polystichum braunii</i> (Spenn.) Fée	NT			X	X	LC

Scientific name	Red list Pyrenees	Pyrenean endemic	Present in Andorra	Present in Spain	Present in France	Red list Europe
<i>Potamogeton praelongus</i> Wulfen	NT			X	X	LC
<i>Potamogeton schweinfurthii</i> A. Benn.	VU	X		X		DD
<i>Primula subpyrenaica</i> Aymerich, L. Sáez & López-Alvarado	NT	X		X		NT
<i>Prolongoa hispanica</i> G. López & C.E. Jarvis	EN			X		NE
<i>Prunus lusitanica</i> L.	VU		X	X	X	VU
<i>Pulsatilla vulgaris</i> Mill.	VU				X	NT
<i>Ranunculus lingua</i> L.	RE			X	X	LC
<i>Ranunculus omiophyllus</i> Ten.	VU			X		LC
<i>Reseda jacquini</i> Rchb.	VU			X	X	NE
<i>Rhynchospora alba</i> (L.) Valh	NT			X	X	NE
<i>Rhynchospora fusca</i> (L.) W.T. Aiton	EN			X	X	NE
<i>Salix daphnoides</i> Vill.	NT			X	X	LC
<i>Salix hastata</i> L.	NT		X	X	X	NE
<i>Salix myrsinifolia</i> Salisbury	NT		X		X	LC
<i>Salix repens</i> L.	NT			X	X	NE
<i>Saponaria bellidifolia</i> Sm.	NT			X	X	NE
<i>Saxifraga fragosoi</i> Sennen	NT				X	NE
<i>Scheuchzeria palustris</i> L.	VU				X	NE
<i>Sedum maireanum</i> Sennen	VU			X		NE
<i>Senecio carpetanus</i> Boiss. & Reut.	VU			X		NE
<i>Seseli farrenyi</i> Molero & J. Pujadas	CR	X		X		NE
<i>Sideritis bubanii</i> Font Quer	NT			X		NE
<i>Silene conoidea</i> L.	NT			X		NE
<i>Silene viridiflora</i> L.	NT				X	NE
<i>Sisymbrium austriacum</i> Jacq. subsp. <i>contortum</i> (Cav.) Rouy & Foucaud	NT				X	NE
<i>Soldanella villosa</i> Darracq ex Labarrère	VU			X	X	VU
<i>Spiraea crenata</i> L. subsp. <i>parvifolia</i> (Pau) Romo	VU			X		NE
<i>Spiranthes aestivalis</i> (Poir.) L.C.M. Richard	EN			X	X	DD
<i>Stuckenia filiformis</i> (Pers.) Börner	VU			X		LC
<i>Subularia aquatica</i> L.	NT		X	X	X	LC
<i>Thalictrum lucidum</i> L.	VU			X		NE
<i>Tofieldia pusilla</i> Pers.	EN			X	X	NE
<i>Tozzia alpina</i> L.	NT			X	X	NE
<i>Trifolium diffusum</i> Ehrh.	NT			X	X	LC
<i>Trifolium leucanthum</i> M. Bieb.	NT				X	NE
<i>Tyrimnus leucographus</i> (L.) Cass.	NT				X	NE
<i>Utricularia australis</i> R. Br.	NT			X		LC
<i>Vandenboschia speciosa</i> (Willd.) Kunkel	VU			X	X	LC
<i>Vicia argentea</i> Lapeyr.	NT	X		X	X	NE
<i>Woodsia pulchella</i> Bertol.	CR			X		NE
<i>Woodwardia radicans</i> (L.) Sm.	VU			X		VU

CLIMATE CHANGE

AND FLORA OF THE PYRENEES

Particularly sensitive to variations in climatic conditions, biodiversity in the Pyrenees and, more generally, high mountain ecosystems are likely to be affected by changes in climate, with consequences both for maintenance of this exceptional natural heritage and for the development of the resources it represents.

Numerous studies outline general outlook for rising temperatures and falling rainfall, with trends in the latter not yet clear-cut.

Summaries by the French, Catalan and Spanish meteorological services on climate change in the Pyrenees show a rise in average temperatures of 1.6°C between 1959 and 2020, significant in spring and summer, and a fall in rainfall of around 8.8% over the same period, more marked on southern side of the Pyrenees than on northern side. The scenarios envisage a rise in temperatures by 2030, 2050 and 2090, but winter precipitation could increase on northern slopes by 2030 and fall thereafter, with high uncertainties remaining.

Given the diversity of bioclimatic situations and the effect of compensations between pressure factors, it is important to note that general model of organisation of mountain vegetation into altitudinal levels, with fluctuations according to exposure, masks significant variations on a local scale.

In addition, the response of wild organisms and populations will depend on phenotypic plasticity and possibilities for genetic evolution. Rapid adaptations and microevolutions can occur, via epigenetic mechanisms. Knowledge of these processes is still limited, and there are still questions as to how climate change might interact with other parameters of global change... In face of climate change, certain species and ecosystems could have greater resilience capacities than those documented to date, making it imperative to continue efforts to improve our knowledge.

While citing results of scientific studies that identify impacts attributed to climate change and recognising the interest of models proposed, several reports express reservations due to the lack of reliable scenarios or degree of uncertainty associated with the imprecision of scenarios, the often preliminary stage of research and a certain variability depending on local situations. For example, upward movement of forest species, which may have seemed obviously driven by climate, has finally been clarified by research that has shown that other factors of a non-climatic nature were at work in the first place.

It would be risky to generalise too quickly, and it is essential to continue collecting and capitalising on data through field studies and medium- and long-term monitoring.

Ultimately, analysing effects of climate change and vulnerability of ecosystems remains a complex task, due to the interplay of various threat factors, with regard to uses and their changes, effect of extreme events, possibility of compensation between factors, and lack of medium- and long-term studies.

Many thanks to the scientists, technicians and administrative staff involved in compiling this red list, as well as the organisations to which they belong.



In partnership with





According to the OPCC climate change report (2018), "Biodiversity flora chapter".



FLORAPYR A PROJECT ASSOCIATED WITH OPCC



The aim of Pyrenean Climate Change Observatory (OPCC), supported by Pyrenean Working Community (CTP), is to produce data and tools to better monitor effects of climate in the Pyrenees and understand how it is changing, in order to reduce vulnerability of natural and human systems to climate change and help territory adapt to its impacts. It promotes cross-disciplinary collaboration with other projects.

Certain actions underpin cross-disciplinary collaboration with other thematic projects with a view to coordinating and capitalising on results of several studies looking at climate change in the Pyrenees.

From 2016 to 2019, the OPCC was involved in the following projects:



Characterising climate change and providing information on adaptation in the Pyrenees.



Assessment of effects of climate change on high mountain lakes and peat bogs.



Monitoring impact of climate change on Pyrenean forests.



Characterisation of water cycle in the Pyrenees to help regions adapt to challenges of climate change.



Monitoring impact of climate change on flora of the Pyrenees.



A series of horizontal dotted lines for writing, spanning the width of the page.







The Red List of threatened flora in the Pyrenees was produced thanks to a strong cross-border partnership.

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https://doctech.cbnpmp.fr/RedList_VascularPlants_Pyrenees.xlsx



This information and awareness-raising tool is part of FLORAPYR project, 65% of which is co-financed by the European Regional Development Fund (ERDF) as part of the Interreg V-A Spain-France-Andorra Programme (POCTEFA 2014-2020). The aim of the POCTEFA is to strengthen economic and social integration of the Spain-France-Andorra border area. Its aid is focused on development of cross-border economic, social and environmental activities through joint strategies that promote sustainable development of the territory.

The FLORAPYR project has also received support from the French government, Fonds national de développement et d'aménagement du territoire (FNADT) Massif des Pyrénées, and the Occitanie and Nouvelle-Aquitaine regions.

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