

Analysis of the páramo vascular flora in the Cajas National Park (Central Andes, Ecuador)

Raffaella Ansaloni¹, Jesús Izco², Javier Amigo² & Danilo Minga¹

Received: 8 June 2021 / Accepted: 31 January 2022 / Published online: 21 February 2022

Abstract. The Cajas National Park (CNP) is located 30 km from the city of Cuenca (Ecuador), in the western Andean chain and occupies an area of almost 30,000 ha, between 3300–4450 m of altitude, and includes various ecosystems: subpáramo, herbaceous paramo and super-páramo, which include grasslands (dominant in CNP), wetlands, *Polylepis* *sp. pl.* and scrubs; above 4200 m asl, bush communities adapted to extreme edaphoclimatic conditions dominate. For the elaboration of the catalogue of the vascular flora of the CNP, we compiled, refined and analysed the information available in the herbaria of the University of Azuay (Cuenca, Ecuador) (HA), Missouri Botanical Garden (MO), Pontificia Universidad Católica de Ecuador (QCA) and Tropicos® database, with records of altitudes above 3300 m asl and our collections in the years 2012–2019. 666 species are documented, belonging to 264 genera and 89 botanical families; we describe their biological form (biotype), habitat, distribution –with special attention to endemic and non-native species– and degree of threat. Finally, the data for each of these criteria are jointly analysed and compared with other Andean mountain ranges. *Dichondra macrocalyx* Meisn. and *Piptochaetium tovarii* Sánchez Vega are reported for the first time in Ecuador.

Keywords: Andean cushions, Andean floristic richness, Bunchgrasses (*pajonales*), *Cuatrecasiella*, Páramo, Plant conservation, Plant growth forms, *Polylepis*, Subpáramo, Super-páramo, Wetlands.

How to cite: Ansaloni, R., Izco, J., Amigo, J. & Minga, D. 2022. Analysis of the páramo vascular flora in the Cajas National Park (Central Andes, Ecuador). *Mediterr. Bot.* 43, e76491. <https://doi.org/10.5209/mbot.76491>

1. Introduction

The term ‘páramo’ in the context of the Andes has its origins in the transposition by Cuatrecasas (1958) of a common Spanish term for the desolate high-mountain landscapes of the Andes. South American páramos are located between latitudes 11°N and 8°S, from Costa Rica to northern Peru (Luteyn & Balslev, 1992; Luteyn, 1999; Sklenář & Jørgensen, 1999; Hofstede, 2003; Sklenář *et al.*, 2005; Llambí *et al.*, 2014), although in other cases the northern limit is located in Venezuela; however other authors reject this more restricted definition and extend the concept of páramo to the whole of the tropical alpine belt (*tropicalpine*) (Smith & Young, 1987; Hofstede, 2003; Pulgar *et al.*, 2010), where there are numerous morphological and structural convergences. The definition of páramo and its limits according to different criteria have been widely analysed by Hofstede (2014a). Andean páramos extend throughout broad areas in the highest altitudes of this mountain range and constitute a natural region determined by its special geographic, soil, climate and biotic conditions, in addition to man-made impacts. The Andean páramo is located above the cloud forest or *ceja andina*, at an altitude of over approximately 3000/3300 m asl; the upper limit of the vegetation is approximately 4700–5000 m asl, above which extends the desert

páramo. The lower limit of the páramo has no fixed altitude and its location depends on climate factors, continental slopes, orientation of the valleys and the human activities that have taken place over time (Beltrán *et al.*, 2009; White, 2013); the upper limit is also subject to local conditions. Notwithstanding these explanations, the term is polysemic for a variety of reasons, including the difficulty in defining it (Hofstede, 2003).

The páramo in Ecuador occupies an area of 1,250,000 ha, and accounts for approximately 6% of the total area of the country (Mena & Medina, 2001; Mena & Hofstede, 2006). The Cajas National Park (CNP) is located to the west of the city of Cuenca (Ecuador) between the coordinates 2°42’ to 2°58’ South and 79°05’ to 79°25’ West, at altitudes of between 3160 m asl and 4450 m asl, covering an area of approximately 28,544 hectares; it constitutes the main part of the Cajas Massif Biosphere Reserve. Its summits mark the dividing ridge between the Pacific Ocean to the west and the Atlantic Ocean to the east and represent the nearest watershed to the Pacific coastline in the whole of South America (Minga *et al.*, 2016). The northern part of the Atlantic slope is drained by small rivers (Quinuas, Llaviucu and Mazan) that converge in the Tomebamba River; the southern part is drained by the Yanuncay River. There are also two river basins on the Pacific slope that are fed by numerous small tributaries: the Migüir River

¹ Azuay Herbarium (HA), University of Azuay. Cuenca, Ecuador.

² Botany Department, University of Santiago de Compostela. E-15782 Santiago de Compostela, España. Email: jesusm.izco@gmail.com

tributary in the north and the Angas River tributary in the south (Figure 1). The rocky substrate is Mesozoic and was physically shaped during the Pleistocene glaciations 1–2 million years ago (Mosquera *et al.*,

2017). It has U-shaped valleys and depressions that were subsequently flooded, giving rise to 767 permanent bodies of water, of which 165 occupy an area of over 1 ha (Buytaert *et al.*, 2006a).

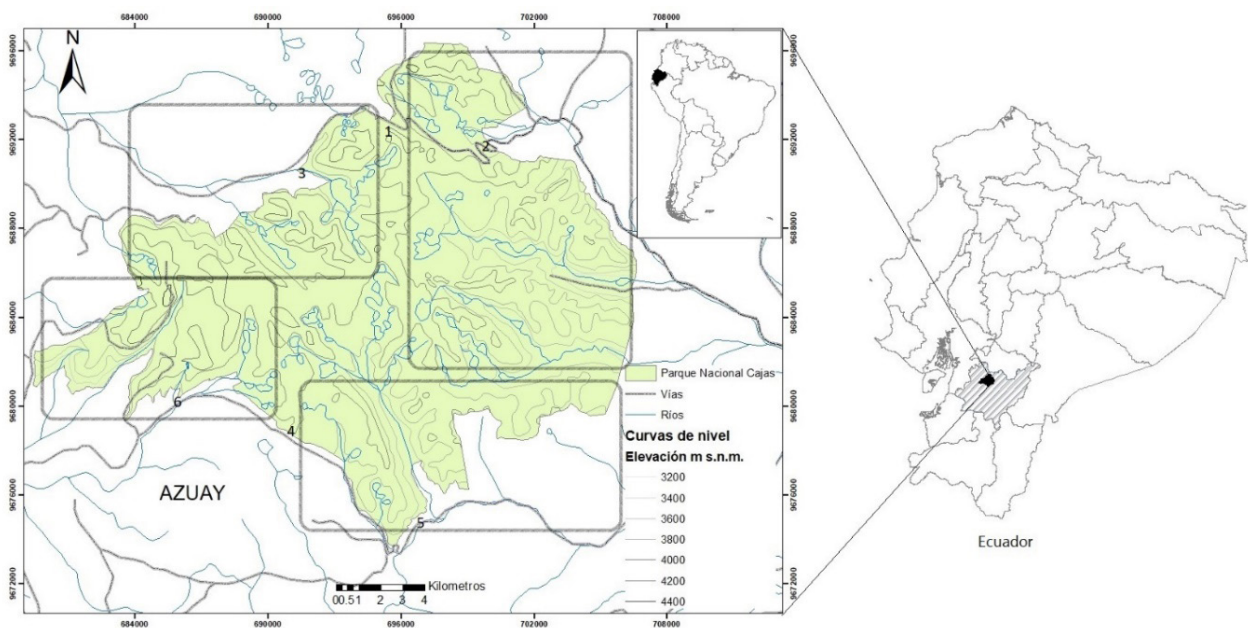


Figure 1. Location of the CNP. 1: Tres Cruces Pass (4270 m asl). 2: Quinuas River. 3: Migüir River. 4: Ruta de Soldados Pass (4080 m asl). 5: Yanuncay River. 6: Angas River.

According to Buytaert *et al.* (2005), the soils in this area have a high organic matter content—in some cases over 20%—, an acid or very acid pH, little available phosphorus and potassium, and low resistance to tread and tilling (Buytaert *et al.*, 2006a; Chacón *et al.*, 2009). From a systematic point of view they correspond to the type nonalophanic Andosols, and are therefore differentiated from the soils present in the páramos of northern and central Ecuador, which have varying quantities of ancient volcanic ash (Buytaert *et al.*, 2005; Chacón *et al.*, 2009) (Figure 1).

The climate has the typical features of the Andean páramos close to the equator, with slight fluctuations in the average monthly temperature (Buytaert, 2004); the temperature drops 0.6–0.7 °C for every 100 m of altitude (Buytaert *et al.*, 2006b; Fick & Hijmans, 2017). Minimum temperatures below 0°C are recorded only a few days a year at altitudes of over 4100 m. Generally speaking, the eastern mountain range receives rains from the Amazon basin, whereas the western part is subject to the *föhn* effect and is significantly drier (Luteyn, 1999; Morocho & Romero, 2003; Buytaert *et al.*, 2006b; Pulgar *et al.*, 2010). The CNP is wetter than the western páramos in the center and south of the country, including the páramos in the nearby Jubones River basin (Galeas & Guevara, 2013). Annual precipitation is 1200 mm, although the rainfall regime is not constant or uniform: the northern part of the Cajas National Park has an average rainfall of approximately 1300 mm/year, which decreases progressively towards the south, with the lowest

amounts – approximately 800 mm/year – registered in the southern part of the Park (Sarmiento, 1986; ETAPA-EP, 2016, INAMHI, 2016). Maximum rainfall is in April and minimum in August. There are frequent mists, so real evapotranspiration is low (Buytaert *et al.*, 2006b). However, the topography can condition the determining climate variations.

The altitudinal zonation of the vegetation is a classic area of botanical geography. Also classic is the zonation of the Andean high mountain based on the first classifications of Cuatrecasas (1958), which were subsequently followed by numerous authors (Harling, 1979; Cleef, 1981; Acosta-Solís, 1984; Ramsay, 1992; Jørgensen & Ulloa, 1994), who recognise three bands of páramo with slightly different limits and denominations. The three classic types of páramo are all represented in the CNP: subpáramo, páramo (middle páramo) and super-páramo. From a biogeographical point of view the páramo in the CNP is part of the Neotropical-Austroamerican kingdom, Neotropical subkingdom, Caribbean-Novogranatense super region, Novogranatense region, Guayaquilean-Ecuadorean province, according to the classification of Rivas-Martínez *et al.* (2011).

This study includes the subpáramo with bunchgrasses (*pajonal*) and a greater or lesser participation of shrubby plants, the herbaceous páramo dominated by bunchgrasses and *Plantago rigida* carpets on wet valley floors, plant communities linked to glacial lakes, the páramo formations of *Polylepis* spp. and *Polylepis lanuginosa* on the western slope, plus the super-páramo. The high Andean forests in Mazán and Llaviucu (slope of

the Tomebamba River), and the area of forest formations in Jerez-Yacutubiana (slope of the Angas River) that fall within the administrative boundaries of the Park are not included in the study. The distribution of the main plant formations in the CNP has been outlined by Minga *et al.* (2016).

Our aims are to catalogue and analyse the richness of the vascular flora in the CNP from materials deposited in various herbaria and from our own collections, and determine their distribution within the Park, their environmental adaptations as expressed in their growth forms, their tendencies to participate in different vegetation types, and to estimate the northern or southern influence of the existing flora and establish the endemic flora (Ecuador, Azuay, CNP), non-native flora and the degree of threat to the species present.

2. Materials and methods

The catalogue is based primarily on the herbaria of the University of Azuay (HA) and the Missouri Botanical Garden (MO), and in a secondary manner, on other Ecuadorian herbaria, including the herbarium of the Pontificia Universidad Católica de Ecuador (QCA), plus the Tropicos® database (2020). Species recorded exclusively below an altitude of 3300 m are not included.

The catalogue is arranged into the main systematic groups: lycopods (Lycopodiopsida), ferns (Polypodiopsida), gymnosperms and angiosperms (Appendix 1). Within these groups the catalogue is ordered alphabetically by families, and within the families by genera, and within these genera by species. Ranks below species level are not indicated. The classification of the Pteridophyte Phylogenic Group is used for lycopods and ferns (Smith *et al.*, 2006; PPG I, 2016; Hassler, 2017). The APG IV system (Angiosperm Phylogeny Group IV, 2016) is used for angiosperms and the classification of Christenhusz *et al.* (2011) for gymnosperms. The authorship in Tropicos® from the Missouri Botanical Garden is followed for all the groups. The number of genera and species present is reported for each family, with a note as to the number of endemics; and the number of species and endemic species is also given for each genus mentioned. The following information is specified for each species: altitudinal range (m asl), distribution, growth form, habitat, and degree of threat.

The classification of growth forms or biological forms follows the main types of Rivas-Martínez (2004) and Rivas-Martínez & Rivas-Sáenz (2009), based on Raunkiaer (1934), Braun-Blanquet (1979) and Elleberg & Mueller-Dombois (1967). One of the most significant modifications in this system is that tussock grasses, which have their growth bud clearly above ground level, are included in the chamaephyte type, a concept that has habitually been applied for woody types, but with the renewal bud more than 25 cm above ground level. The traditional group of hemicryptophytes is complex and heterogeneous and, from our point of view, the height of the shoot

bud of tall-grasses of páramo is better suited as a chamaephyte. Many ferns have been considered to belong to the rhizomatous geophyte type, although their rhizome may not always be clearly underground; however, it may be under organic matter or mosses. The biological form indicated corresponds to the individuals in the CNP. It was decided to highlight the species that are not completely autotrophic and indicate their condition of hemiparasite beside their biotype, although this is not contemplated in the classification of Rivas Martínez (2004). The spatial distribution of the species is occasionally described at the scale of the CNP: eastern or western slope, north/south areas, specific hydrographic basin(s)

In the section on distribution we specify whether the species is autochthonous or non-native in Ecuador; the distribution of autochthonous species is indicated by region, or in the case of Andean species, by country. It is reported whether a plant is cultivated. The species distribution is based on Tropicos® (<http://www.tropicos.org>), Catalogue of Life in www.catalogueoflife.org/annual-checklist/ (Roskov *et al.*, 2019), Catalogue of Vascular Plant of Ecuador (Jørgensen & León-Yáñez 1999), the pertinent volumes of Flora of Ecuador (Persson, Eriksson, Sthl, Romoleroux Eds.) and Flora Neotropica (Zanoni, Ed.), monographs and articles on the Andean flora of Ecuador or neighbouring countries (Cleef, 1978; 1979, 1981; Jørgensen & Ulloa, 1994; Jørgensen & León-Yáñez, 1999; Luteyn, 1999; Sklenář & Baslev, 2005; Sklenář *et al.*, 2005, 2011; Bernal *et al.*, 2015; Hassler, 2016). The degree of endemism of the endemic species is indicated on three levels (Ecuador, province of Azuay, and Cajas National Park) based on the information in the Red Book of Endemic Plants (León-Yáñez, 2011) plus Tropicos® (2020). In certain cases, it is indicated whether the species is rare in the CNP. The whole Cajas National Park is located in Azuay province, so species endemics of CNP are also endemic both of Azuay and Ecuador.

The most significant types of vegetation or habitats are described, partially guided by the vegetation types described by Minga *et al.* (2016). The species were ascribed to the habitats based on their greater frequency in the study area, although this does not imply that they are exclusive to this area and cannot be found in other environments inside or outside the Park; the habitat in which the species is most frequently found has been exclusively considered for the analysis, because we observed that even the species that share habitats, always are more frequent in one, as mentioned by Minga *et al.* (2016). The habitats studied are: grassland, wetland and *Plantago rigida* cushions, *Polylepis* formations, *P. lanuginosa* forest (this plant formation is distinguished from the *Polylepis* stands present in the páramo as it is a marginal forest located in a single part of the western slope of the CNP), water bodies and wetlands, paths, ecotone, forest scrub, *Loricaria ilinissae* scrubland, rocks. The term ecotone refers to the transition between the woody vegetation of the

high Andean forests and the tussock grassland, and is a band with small trees, shrubs and grasses and a varying composition and structure. For species that live preferentially in scrublands we have specified the type; however, as certain species share several habitats we preferred to analyse the data together and indicate a generic “scrubland”. One exception is the scrubland dominated by *Loricaria ilinissae*, as it is very different from the others. The species in this plant formation, together with rock-dwelling species, are common in areas above 4200 m asl, and are mentioned jointly in the text as “scrublands of the super-páramo”, although some are also present at lower levels.

The degree of threat is reported according to the most recent evaluation, based on the IUCN red list (IUCN, 2021) and the two editions of the red list of endemic plants of Ecuador (Valencia, 2000; León-Yáñez *et al.*, 2011). The year of the evaluation is given in parentheses

only if it does not refer to León-Yáñez *et al.* evaluation (2011). The six species with a restricted distribution that are not included in any threat category by any of the above-cited works have been here classified as “DD, deficient data”

3. Results

3.1. Floristic richness

666 species were documented, belonging to 264 genera and 89 families, recorded between the boundaries of the CNP indicated. Angiosperms are the most represented group with 583 species, followed by ferns and similar (*Polypodiopsida*) with 24 genera and 59 species, lycopods and similar (*Lycopodiopsida*) with 4 genera and 22 species, whereas only two species belong to the gymnosperm group (Appendix 1, see also ZENODO, <https://doi.org/10.5209/mbot.76491>).

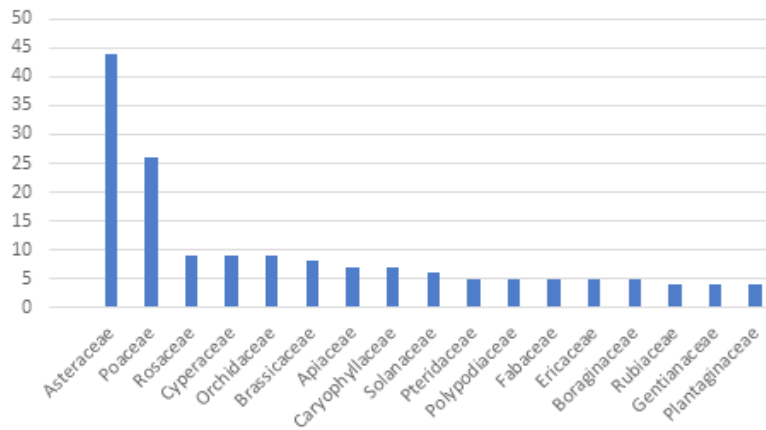


Figure 2. Number of genera per family (≥ 4 genera).

In regard to generic richness, 17 families are represented by ≥ 4 genera, of which the most numerous are Asteraceae (44, almost 17% of the total), followed by Poaceae (26), Rosaceae, Cyperaceae and Orchidaceae (9 each), Brassicaceae (8), Caryophyllaceae and Apiaceae (7 each), Solanaceae (6), Pteridaceae, Polypodiaceae, Fabaceae, Ericaceae and Boraginaceae (5 each), Plantaginaceae, Gentianaceae, Rubiaceae (4 each); the rest are below this limit. The richest families (≥ 4

genera) account for 61% of the generic richness in the CNP (Figure 2).

Five families are represented by ≥ 20 species: Asteraceae (111, almost 17% of the total), Poaceae (70), Rosaceae (31), Cyperaceae (29) and Brassicaceae (20), which jointly represent 39% of the total. Of the group of ferns and lycopods, the four richest families (*Lycopodiaceae*, *Dryopteridaceae*, *Pteridaceae* and *Polypodiaceae*) account for 55 species, 8.3% of the total flora (Figure 3)

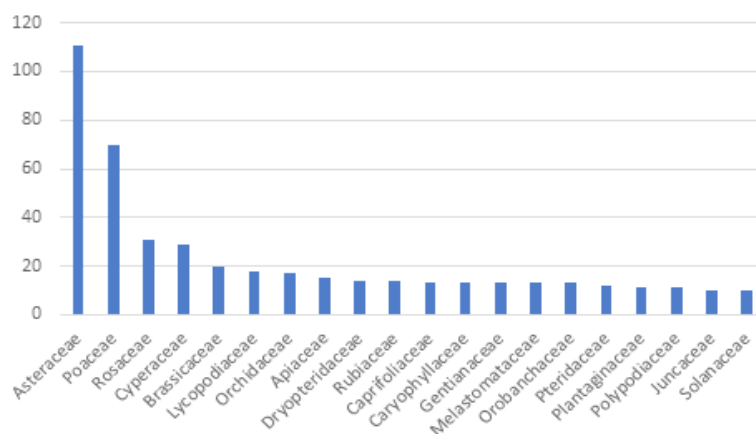


Figure 3. Number of species per family (≥ 10 species).

In terms of richness, the following 7 genera occupy the first positions, with ≥ 10 species: *Lachemilla* (17), *Baccharis*, *Calamagrostis* and *Phlegmariurus* (14 each), *Valeriana* (13), *Elaphoglossum* (12), *Carex* (10). Other well diversified genera are: *Agrostis*, *Draba* and *Hypericum* with 9 species each, *Asplenium*,

Diplostegium, *Geranium* and *Jamesonia* with 8 species, *Arcytophyllum*, *Bartsia*, *Gentianella*, *Gynoxys*, *Miconia* and *Monticalia* with 7. Among the lycopods and ferns, 4 genera have ≥ 7 species (*Phlegmariurus* 14, *Elaphoglossum* 12, *Asplenium* y *Jamesonia* 8) (Figure 4).

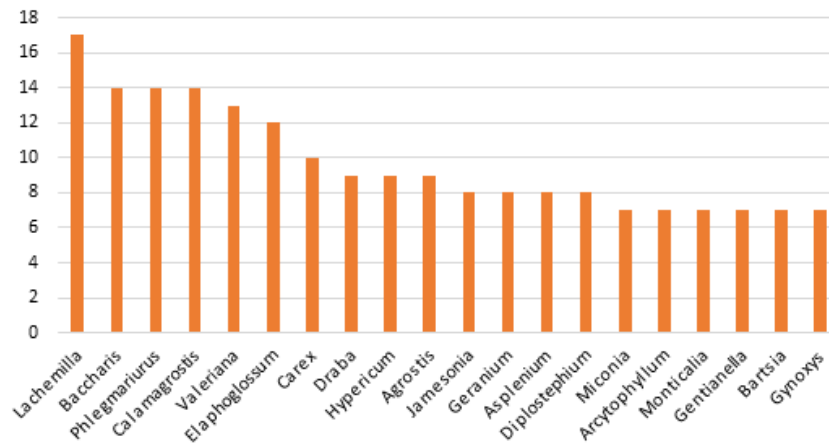


Figure 4. Genera with the greatest number of species (≥ 7 species).

3.2. Richness of growth forms

This is the first classification of the biological forms in the páramo of the CNP, in this case defined according to the proposal of Rivas-Martínez (2004). 32 of the total forms in this classification are present, corresponding to 54% of the total.

Ten main categories can be recognised among the 630 terrestrial and 36 aquatic species: hemicryptophyte, chamaephyte, phanerophyte, geophyte, epiphyte, hydrophyte,

helophyte, therophyte and liana. There are four predominant types: hemicryptophyte (31%), chamaephyte (22%) – including 96 non-grasses and 52 grasses–, phanerophyte (18.7%) and geophyte (15%). Most of the phanerophytes belong to the nanophanerophyte and microphanerophyte subtypes. The aquatic flora is represented by 18 hydrophytes and the same number of other helophyte species, jointly accounting for 5.4% of the total species in the CNP. The rest of the types (epiphyte, therophyte and liana) are represented by 58 species (7.6%) (Figure 5).

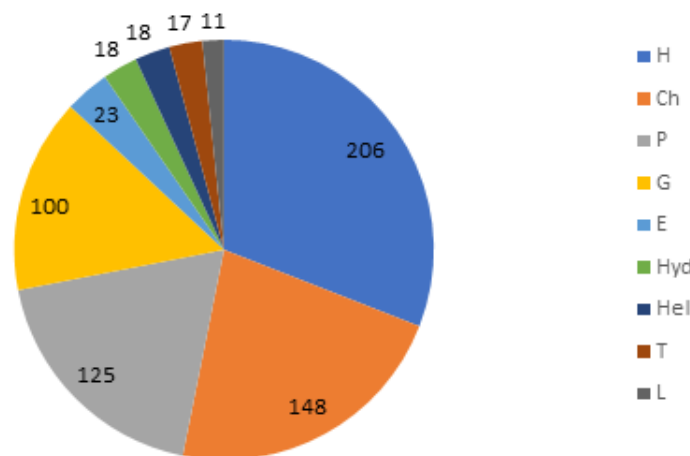


Figure 5. Number of species according to their biological form (principal ranks), according to the classification of Rivas-Martínez (2004). H: Hemicryptophyte, Ch: Chamaephyte, P: Phanerophyte, G: Geophyte, E: Epiphyte, Hyd: Hydrophyte, Hel: Helophyte, T: Therophyte, L: Liana.

The most represented subtypes are rhizomatous geophytes and scapiform hemicryptophytes, followed by nanophanerophytes, microphanerophytes and graminoid chamaephytes. Other life forms present in numerous species are creeping, rosulate, caespitose and scapiform hemicryptophytes, suffruticose, cushion-forming and fruticose chamaephytes, and rooted epiphytes.

3.3. Habitats

An analysis was conducted on the vegetation types. In a very preliminary way, and based essentially on their ecology, structure and the flora, nine vegetation types are recognised: bunchgrasses, *Polylepis* forests (excluding *P. lanuginosa*), wetlands, montane-páramo

forest ecotone, shrubland, *Loricaria ilinissae* scrubland, lakeside vegetation, roadside vegetation and *Polylepis lanuginosa* community, plus summit boulder fields. The

floristic richness of each of these habitats is shown in Figure 6.

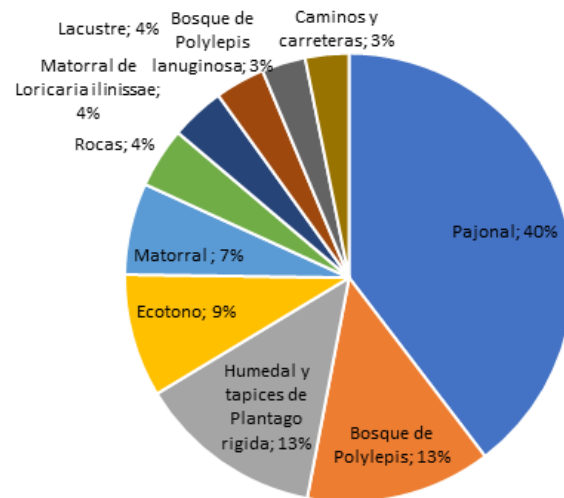


Figure 6. Number of species by preferred habitat.

The most extensive habitat is tussock grassland, which occupies almost three quarters of the area of the Park and covers over 21,000 ha (Vasco-Tapia *et al.*, 2012; ETAPA-EP, 2016) between altitudes of 3500 and 4200 m. This is also the habitat with the greatest number of recorded species, almost 40% of the flora of the páramo. The following species are especially abundant: *Calamagrostis intermedia* and *Festuca subulifolia*, *Xenophyllum humile*; and particularly worth mentioning among the exclusive species are: *Poa paramoensis*, *Gentianella hirculus* and *G. hysoppifolia*. In any case, a preliminary approach to this vegetation type reveals the existence of different tussock grassland communities.

Polylepis formations (also known as *quinuales* or paper tree forests) are notable for their high plant biodiversity, with 110 species that live preferentially in this ecosystem, 13% of the total: 89 of them are characteristic of páramo *Polylepis* stands, small or medium-sized woody remnants that are relegated to crags, steep slopes and areas sheltered from strong winds, frequently on rocky substrates. Four species and two natural hybrids have been recorded in this genus: *P. reticulata* is the most common species in the Park, and is found between 3300 and 3800 m asl; *P. incana*, whose groves are in the northern part of the CNP, near the watercourses; while *P. weberbaueri* is present only in the south-eastern part of the CNP. There are numerous woody species in these groves such as *Gynoxis buxifolia* and *Berberis rigida*; also numerous epiphyte species, especially ferns, such as the endemic *Polypodium mindense*, and herbs, including *Geranium diffusum* and *G. pseudodiffusum*. *Polylepis lanuginosa* is an endemic species that dominates the vegetation band between the forest and the herbaceous páramo on the western slope in the areas of Angas, Yacutubiana and Río Blanco.

The third habitat in number of species, and second in area occupied, is complex as it contains the wetlands associated with the flooded edges of lakes and carpets dominated by *Plantago rigida*, also known as *pillow* or *cushion páramo*. It contains 89 low-growing species

adapted to wet or waterlogged but not marshy soils, which are present as small patches on deep soils with more moisture than the tussock grassland, in the whole of the area of the páramo.

8.3% of the species are typical of the scrubland of the super-páramo, which covers a total area of approximately 18 km² (6% of the area of the CNP) (Sklenář & Balslev, 2005); of these, 29 species are rock-dwelling, such as *Draba steyenmarkii*, *Valeriana henrici*, *Eudema nubigena* and *Lysipomia vitreola*; and 26 taxa (including shrubs such as *Hypericum decandrum* and *Miconia chionophila* and herbaceous species such as *Bartsia stricta* and *Castilleja ecuadorensis* prefer the scrublands of the super-páramo, which are dominated by *Loricaria ilinissae*.

The scrublands present between 3700 and 4000 m are located on shallow soils and rocks, and contain numerous shrubs such as *Arcytophyllum vernicosum*, a dominant species in the scrublands in the central zone of the CNP, *Chuquiraga jussieui* and *Hypericum quitense*, an endemic species in the southern Andes of Ecuador. The numerous herbaceous species include particularly the endemic species *Senecio josei* and *Werneria pumila* and the ferns *Melpomene moniliformis* and *Pleopeltis macrocarpa* (Minga *et al.*, 2016).

The hydrophilous vegetation of lakes, ponds and streams is home to 24 aquatic species plus others that are semi-aquatic, among which the most common are *Carex toreadora* and *Isoetes andina*. 21 species of roadside and anthropic vegetation were recorded, typical of roadways and inhabited sites; they tend to be non-native and adapted to environments that have been disturbed by humans. The vegetation band containing the limit between the high Andean forest and the grassland is defined as the “forest-páramo ecotone”, and has 59 typical species common to both the high Andean forest and the herbaceous habitat. We chose to assign them to this environment as it is neither uniform nor perfectly defined, but allows us to spatially locate the taxa that inhabit both the forest edges and among the tussock grass; these include

particularly species of micro- and nanophanerophytes in the genera *Gynoxis*, *Chuquiraga*, *Baccharis*, *Berberis*, *Arcytophyllum* (Figure 6).

3.4. Biogeography

According to Rivas-Martínez *et al.*, (2011), the study area is part of the Guayaquilean-Ecuadorian province in the Novogranatense Region. It was impossible to perform a detailed chorological analysis of the flora in the CNP as there is no classification of this type for the Ecuadorian or páramo flora as a whole; we therefore chose to establish general relations based on their distribution by country in order to observe their general phytogeographical tendencies.

The phytogeographical trends of the flora in the CNP can be observed by applying the phytogeographical approach for the genera (Cleef, 1979; Van der Hammen & Cleef, 1983; Jørgensen & Ulloa, 1994; Luteyn, 1999; Sklenář & Balslev, 2007; Sklenář *et al.*, 2011). Cosmopolitan genera represent 17% of the total, and genera with a tropical and temperate origin are proportionally equivalent (41% and

43% respectively); the number of genera from temperate zones with a northern origin is slightly higher than those with a southern origin.

According to previous sources on the distribution of the flora, there are 135 species present exclusively in the páramo region or northern Andes (Colombia, Ecuador, northern Peru and Venezuela), and 180 species in the central and southern Andes (Ecuador, Peru, Bolivia, Chile, Argentina), in addition to other species with a broader distribution. Almost 50 species, both autochthonous and non-native, are cosmopolitan.

New citations for Ecuador are *Dichondra macrocalyx* Meisn., the sole representative of the Convolvulaceae family in the CNP, and *Piptochaetium tovarii* Sánchez Vega, from the Poaceae family.

Of the total of the catalogue, 640 species (96%) are autochthonous, and of that total 93 species (14%) are endemic to Ecuador, 4 (0.6%) to Azuay and 9 (1.4%) to the CNP (Table 1). The following are particularly notable in terms of numbers of endemic species: the *Brassicaceae* and *Gentianaceae* families and the genera *Diplostephium*, *Lysipomia* and *Valeriana* (Table 1).

Table 1. Endemic species to Azuay and to the CNP in the catalogue (Appendix 1).

Endemic species of the province of Azuay	Endemic species of the CNP
<i>Oritrophium tergoalbum</i> (Cuatrec.) Cuatrec.	<i>Carex azuayae</i> Steyerem.
<i>Lithospermum azuayensis</i> Weigend & Nürk	<i>Draba steyermarkii</i> Al-Shehbaz
<i>Lysipomia rhizomata</i> McVaugh	<i>Gentianella hirculus</i> (Griseb.) Fabris
<i>Lepechinia rufocampii</i> Epling & Mathias	<i>Gentianella longibarbata</i> (Gilg) Fabris
	<i>Halenia serpyllifolia</i> J.S. Pringle
	<i>Loricaria azuayensis</i> Cuatrec.
	<i>Loricaria cinerea</i> D.J.N. Hind
	<i>Lysipomia vitreola</i> McVaugh
	<i>Xenophyllum roseum</i> (Hieron.) V.A. Funk

There are 26 (4%) non-native species, some cultivated or associated with cultivation environments, others introduced accidentally, whose presence occurs predominantly on roadsides; a third group is linked to wetlands and *Plantago rigida* carpets where grazing is frequent (Table 2). To judge by these data, urbanisation in all its different aspects and roadways are the most likely sources that provide the greatest number of entries of non-native species.

3.5. Threat levels of the flora in the CNP

According to the IUCN threat categories, there are five critically endangered species (CR) in the bunchgrasses and associated formations in the CNP: *Puya compacta*, whose distribution is restricted to the provinces of Azuay and Loja; *P. maculata* and *P. pygmaea*, endemic species to Ecuador and rare in the CNP; *Nasa profundilobata* (Loasaceae), endemic to the provinces of Azuay and Cañar; and *Lysipomia rizophomata* (Campanulaceae), endemic to Azuay. There are 14 endangered species (EN), of which four are endemic to the CNP (*Loricaria azuayensis*, *Lysipomia vitreola*, *Carex azuayae*, *Halenia serpyllifolia*) and one to Azuay (*Oritrophium tergoalbum*). 52 species are categorised as vulnerable (VU) and among these, *Xenophyllum roseum* and *Draba steyermarkii*

are endemic to the CNP, while *Lepechinia rufocampii* is endemic to Azuay and *Dendrophorbium pericaule* is endemic to the provinces of Azuay and Loja; 22 species are in the *near threatened* (NT) class, of which 19 are endemic to Ecuador; six endemic species have not been evaluated (DD); these include *Loricaria cinerea* which is endemic to the CNP, *Lithospermum azuayensis*, endemic to Azuay, and *Senecio josei*, endemic to Azuay and Loja; 23 species belong to the least concern (LC) class, and of these, *Gentianella hirculus* and *G. longibarbata* are endemic to the CNP. Two species of threatened orchids have been registered in the Cajas, and 14 species that are not in any IUCN category but appear in Appendix II of the CITES convention on species trading and have therefore been included in this analysis. A total of 528 species are not in any IUCN threat category (79% of the vascular flora in the CNP) (Table 2).

4. Discussion

4.1. Floristic richness

In their entirety, the páramos that extend from Costa Rica to northern Peru cover a total area of 33,978 km²,

of which Ecuador (12,603 km²) occupies the second position after Colombia (Hofstede, 2003). The Andean páramos are home to the most abundant floristic richness among the tropical mountains due to their special historic, geological, geographical – including the phenomenon of insularity –, climatic and anthropic characteristics (Simpson, 1974; Vuilleumier & Monasterio, 1986; Smith & Cleff, 1988; Luteyn, 1992; Jørgensen & Ulloa, 1994; Hofstede & Rossenaar, 1995; Ramsay & Oxley, 1997; Richter & Moreira-Muñoz, 2005; Weigend *et al.*, 2005; Coblenz & Keating, 2008; Josse *et al.*, 2008; Richter *et al.*, 2009; Madriñán *et al.*, 2013; Sklenář *et al.*, 2014; Vázquez *et al.*, 2015). In regard to the flora of the páramo, Luteyn (1999) indicated a total of 447 genera and 3045 species from Costa Rica to Peru; and Sklenář *et al.* (2011) subsequently reported 509 genera and 3564 species, while Rangel-Churío (2000) calculated a total of 566 genera and 3173 species. These data vary widely, probably due to the different concepts of páramo, the geographic scope considered or the taxonomic criteria

applied. The floristic richness of the páramos in Ecuador was initially calculated to be approximately 1500 species (León-Yáñez, 1993); while Ortiz (2003), based on the flora of Sklenář & Jørgensen (1999), indicated a richness of plants with flowers of up to 447 genera and 3045 species, plus five genera of ferns and lycophytes, with 77 species. Sklenář *et al.* (2005) indicated a richness of 404 genera and 1524 species, and Rangel-Churío (2015) reported 388 genera and 1678 species. These results are surprising for their discrepancy, which probably originates from the different areas considered in each case or the taxonomic criteria used in the reference works. In this regard, it is also worth noting the increase in species described for the flora of Ecuador, which in the period 1999–2010 was over 100 a year, and similar in the period 2010–2020. Recent estimations (Ulloa *et al.*, 2017) found 17,548 species for Ecuador, which is still likely to be an underestimate, particularly due to the increase in the number of orchid species, which currently comprise 4250 species.

Table 2. Non-native species in the catalogue and their distribution according to the habitats where they occur.

Non-native species	Crops	Urban and roadside environments	Wetlands	Disturbed grasslands
<i>Agrostis capillaris</i> L.		+		+
<i>Agrostis gigantea</i> Roth		+		+
<i>Aira caryophylla</i> L.		+		
<i>Anthoxanthum odoratum</i> L.		+		+
<i>Calamagrostis coarctata</i> Eaton		+		
<i>Carex microglochis</i> Wahlenb.		+		+
<i>Centaurium erythraea</i> Rafin	+	+		+
<i>Cotula australis</i> (Sieber ex Spreng.) Hook. f.			+	
<i>Cynoglossum amabile</i> Stapf & J.R. Drumm.		+ and <i>Polylepis</i> grove		
<i>Dactylis glomerata</i> L.	+	+		
<i>Diplotaxis tenuifolia</i> (L.) DC.		+		+
<i>Eragrostis tenuifolia</i> (A. Rich.) Hochst. ex Steud.		+		+
<i>Fragaria vesca</i> L.	+	+		+
<i>Holcus lanatus</i> L.		+		+
<i>Leucanthemum maximum</i> (Ramond) DC.	+	+		
<i>Lysimachia arvensis</i> (L.) U. Manns & Anderb.		+		
<i>Plantago major</i> L.	+	+		+
<i>Poa annua</i> L.		+		
<i>Polylepis racemosa</i> Ruiz & Pav.	+	+		
<i>Raphanus sativus</i> L.	+			
<i>Rorippa nasturtium-aquaticum</i> (L.) Hayek			+	
<i>Rumex acetosella</i> L.	+			+
<i>Trifolium repens</i> L.	+		+	
<i>Trisetum spicatum</i> (L.) K. Richt.		+		+
<i>Urtica urens</i> L.		+		+
<i>Vulpia myuros</i> (L.) C.C. Gmel.		+		

In any case, in relation to these data from the Ecuadorian moors, the 264 genera and 666 species in our study represent a high genera richness, around 60–

65%, and around 20% of species richness, according to Ortiz data (2003) and 40–45% according to the data of Sklenář *et al.* (2005) (Table 3).

Table 3. Percentage of flora in the catalogue (264 gener and 666 species) compared to the data on genera and species in the Ecuadorian páramos according to different authors.

Author (year)	% genera	% species
Ortiz (2003)	58	21
Sklenář <i>et al.</i> (2005)	65	44
Rangel (2015)	68	40

There are two prior publications on the flora of the CNP (Ulloa *et al.*, 2004; Minga *et al.*, 2016), but neither offers a generalised catalogue of the flora; the portal of the Missouri Botanical Garden provides a page on the flora of the CNP which lists 544 taxa of vascular plants (Jørgensen, 2021). The catalogue we present of the CNP comprises 264 genera and 666 species in an area of 1.6% of the páramos in Ecuador, representing 60% of the genera and 40% of the species in the Ecuadorian páramo listed in the catalogue of Sklenář *et al.* (2005). In any case, the total floristic richness of the CNP is greater if we take into account the band below 3300 m – not analysed here – and the very weak prospection in certain areas that are difficult to access (Lagartococha, upper basin of the Mazan River, the area around the lakes of Osohuayco and Taitachugo), given that a territory's taxonomic richness, particularly in mountain areas, largely depends on the number of collections (Sklenář & Jørgensen, 1999).

The ordination of the richest families in the CNP disagrees the sequence of Ecuadorian páramo vegetation according to the data of Rangel-Churío (2002): Asteraceae (141 genera/1165 species), Orchidaceae (60/161) and Poaceae (56/292).

The landscape in the CNP is essentially grassland due to the abundance of Gramineae, a family with a wide diversification. The Poaceae family occupies fourth place in the world in richness of genera and fifth in the number of species (Clayton & Renvoize, 1986); based on data from various authors (Jørgensen & León-Yáñez, 1999; Luteyn, 1999; Rangel-Churío, 2002; Sklenář *et al.*, 2005; Giraldo-Cañas, 2011; Jørgensen *et al.*, 2011), in Ecuador the family lags somewhat behind the other countries in South America in terms of both number of genera and species. However, it climbs to second place in both categories in the CNP, which is to be expected in view of the predominance of the herbaceous páramo or tussock grassland.

Within the Gramineae, the data on *Calamagrostis* in the CNP are particularly significant. This genus is present in the páramos from Costa Rica to Peru, and is diversified in 54 species (Sylvester *et al.*, 2019); 27-35 species are recognised in Ecuador (Jørgensen & León-Yáñez, 1999; Luteyn, 1999), 21 of which are present in the páramos (Jørgensen & León-Yáñez, 1999). This implies that 34–44% of the species in Ecuador and 71% of the species of the páramos in the country are present in the CNP. The genus *Neurolepis* is also relatively diversified in Ecuador (12 species) (Jørgensen & León-Yáñez, 1999) and is an important base for the bunchgrasses in the eastern Andean range; however only *Neurolepis aristata*

and *N. villosa* are present in the CNP, representing merely 16.5% of the total Ecuadorian species in the genus, in both cases with very scarce and reduced populations. This lack of symmetry in the richness of *Calamagrostis* compared to *Neurolepis* probably reveals a functional substitution in the páramos in the two Andean ranges, with a predominance of *Calamagrostis* species in the drier western range, compared to the richness of bamboos in the genus *Neurolepis*, which are indicators of high environmental humidity (Hofstede *et al.*, 2014a), and are predominant in the páramos of the eastern range with a more humid climate (Buytaert *et al.*, 2006b; Pulgar *et al.*, 2010). In this regard, in the eastern Colombian range, Cleef (1978) establishes an inverse relation between *Calamagrostis efussa* cover and annual rainfall, compared to the direct relation of various species of *Swallenochloa*, a genus considered a section of *Chusquea*.

Due to their species richness, there is another important change of position in the Cyperaceae family compared to its position in other floras. It is in the last place among the ten richest families in Bolivia, but less abundant in Colombia (328 species), Peru (234) and Ecuador (222) (Jørgensen *et al.*, 2011), and is not among the richest families in genera and species in the Ecuadorian flora (Jørgensen *et al.*, 2006). However, it is fourth in species richness in the list of the richest families in our catalogue of the CNP, with nine genera (*Carex*, *Eleocharis*, *Isolepis*, *Oreobolopsis*, *Oreobolus*, *Rhynchospora*, *Schoenoplectus*, *Trichophorum*, *Uncinia*) and 29 species (13%), of which ten belong to the genus *Carex*. This local distortion, with a high relative position compared to the general position of the country as a whole, is probably due to the environmental conditions of the herbaceous páramo and the presence of numerous glacial lakes that form a mosaic of hygrophilous ecosystems that develop around them; here, Cyperaceae find favourable life conditions, which is evidence of the importance of local factors in the distribution and richness of flora.

Pteridophytes are represented by 59 species of *Polypodiopsida* and 22 species of *Lycopodiopsida*, jointly accounting for 12% of the flora in the CNP. This richness may be based on a certain environmental humidity, possibly related with the high humidity of the CNP in the context of the western Ecuadorian Andes, as indicated by Buytaert *et al.* (2006b); however, the number are lower than the 23% indicated for pteridophyte flora in the páramos of Colombia (Murillo, 2000). The list of the 20 richest genera in species in the CNP includes four ferns: *Phlegmariurus* (14), *Elaphoglossum* (12), *Jamesonia* (8) and *Asplenium* (8) (Figure 4); these numbers are also lower than for Colombian páramos, where *Elaphoglossum*, with 44 species, and *Huperzia* + *Phlegmariurus* (39) occupy the two first places (Murillo, 2000)

In regard to the Orchidaceae family, which is very rich in the northern Andean countries and in the *ceja* forests and shrub páramos (Luteyn, 1999; Rangel-Churío, 2000), it is worth noting the poverty of this family in the bunchgrasses and associated vegetation in the CNP, where

Orchidaceae are represented by only nine genera (1.3%) (*Aa*, *Altensteinia*, *Elleanthus*, *Epidendrum*, *Gomphichis*, *Oncidium*, *Pleurothallis*, *Pterichis*, *Stelis*) and 17 species (2.1%). This relative poverty is associated with the absence of environmental conditions for epiphyte species and the low temperatures prevailing above 3300 m asl, which may limit the existence of their pollinator species; these figures contrast with the 36% of genera and the 11% of species of Ecuadorian páramo flora supplied by Ortiz (2003).

4.2. Growth (biological) forms

The analysis of the different biological forms, growth forms or biotypes is European in origin and mainly covers holarctic flora (temperate and Mediterranean). Given that intertropical flora is not subject to the same seasonal rhythms, other types rather than the traditional types have been proposed for the Andean “afroalpine” flora (Hedberg, 1964; Hedberg & Hedberg, 1979; Ramsay & Oxley, 1997). We have followed the classification of Rivas-Martínez (2004, 2007).

The vegetation of the CNP has a high diversity of biological types; of the ten main categories proposed by Rivas-Martínez (2004, 2007) only the pleustophytes are missing. This richness of adaptive types was reported by Zomer & Ramsay (2020), with significant differences between localities (Ramsay & Oxley, 1997).

The hemicryptophyte type contains species from very different genera: notable among this group is the genus *Lachemilla* (17 species), in addition to different Gentianaceae from the genera *Gentiana*, *Gentianella* and *Halenia* (12 species in total) and representatives from other families such as *Valeriana* (8 species), *Bartsia* (7 species), *Peperomia* (6 species), *Geranium* (6 species), *Poa* (5 species) and *Senecio* (4 species). For the same reason, hemicryptophytes are dominant in all altitudinal belts except the highest, which is part of the super-páramo, where the climate conditions and the shallowness of the soil are more favourable to chamaephytes such as *Arcytophyllum capitatum*, *A. filiforme* and *A. vernicosum*, plus diverse species of *Loricaria*, among others.

Chamaephytes include very diverse forms, from graminoid herbaceous plants with renewal buds over 20 cm above ground level in cold climates through to woody types. This consideration of Gramineae with renewal buds above ground level as chamaephytes positively affects the percentage of this biological type and negatively the figures for hemicryptophytes reported by other authors. The tussock forms of many Gramineae (graminoid chamaephyte) represent the best response to the páramo conditions (Ramsay & Oxley, 1997), and particularly to the herbaceous páramos. Among this type of Gramineae it is particularly worth noting the genera *Calamagrostis* (14 species) and *Agrostis* (5 species); notable among the fruticose chamaephytes are the Lycopodiaceae, *Phlegmariurus* (14 species) and *Lycopodium* (4 species), plus other species from different families: *Draba* (9 species), *Hypericum* (9 species), *Azorella* (6 species), *Lysipomia* (6 species), *Arcytophyllum* (5 species out of a total of 7). Chamaephytes in the rosulate-forming subtype

belonging to the genus *Puya* (6 species) are particularly significant for their spectacular appearance and their function in the ecosystem.

The phanerophyte biotype is represented in the lower belt (up to 3600 m asl) by various species belonging to the genera *Solanum*, *Saracha*, *Aristeguietia*, *Weinmannia*, *Tournefortia*, etc. This flora comes essentially from the forests of the Andean *ceja* located at lower altitudes.

Quínuas or paper trees – to give the popular name for *Polylepis* species in the CNP – belong to the type of microphanerophytes or mesophanerophytes. However, they cannot be strictly classified as trees since they do not fulfil the main character that is specific to these woody perennial plants: the existence of an undivided trunk up to a variable height in its lower part.

There is a frequent presence of large shrubs (nanophanerophytes and microphanerophytes) in the CNP, among which the following genera are notable for their richness: *Baccharis* (11 species out of a total of 14), *Diplostephium* (8 species), *Gynoxis*, *Miconia*, *Monticalia*, (7 species each), *Brachyotum*, *Castilleja*, *Ribes* (5 species each) present throughout the altitudinal gradient of the páramo as highlighted by Ramsay & Oxley (1997), although they are more frequent in the belts below 3600 m asl. At altitudes over 4000 m asl the most representative phanerophytes are *Arcytophyllum vernicosum*, *Chuquiraga jussieui*, *Diplostephium glandulosum*, *Baccharis buxifolia*, and *Valeriana microphylla*.

Geophytes generally belong to the rhizomatous subtype, which contains many ferns from the genera *Elaphoglossum* (8 species out of a total of 12), *Jamesonia* (8 species) and *Asplenium* (3 species out of a total of 8), in addition to various Boraginaceae (5 species). Humid environments also provide a large proportion of rhizomatous geophytes, with the genus *Carex* in first place (8 species out of a total of 10).

The least frequent group of biological forms are hydrophytes and helophytes, with a total of 36 species, of which 24 live in lakes and rivers, while 12 are typical of wetlands, where there is also a presence of cushion-forming chamaephytes, grasses and some suffruticose species, in addition to hemicryptophytes and rhizomatous geophytes.

Only 11 species of liana have been recorded, a number linked to the rarity of the ecosystems where they flourish. Most of these species are associated to *Polylepis* formations in the lower belts. The genus *Passiflora* (4 species) is particularly worth noting for its richness in this aspect.

As expected in an environment with a stable year-round climate with no pronounced temperature and rainfall variations, there is a scarcity of therophytes, with barely 17 species, of which six are non-native; their absence above 4000 m asl could be due to meteorological instability, which hinders all their developmental processes.

4.3. Habitat

The apparent homogeneity of the páramo vegetation conceals a wide diversity of plant communities in each

of the aforementioned types, even within the same formation. The number of formations or vegetation types in the páramos according to different authors varies enormously depending on the scale and focus of the approach: Rangel-Churío (2002) recognises 134 scrubland types and 45 tussock grassland types in the Colombian páramos, in addition to other vegetation groups; with other criteria, Peyre (2015) distinguishes 17 vegetation groups in the northern and central Andes (Venezuela-Ecuador and northern Peru): 2 in the subpáramo, 9 in the páramo and 4 in the super-páramo, plus one type of azonal vegetation and another of disturbed vegetation with a broad variation within the groups. For Ecuador, Hofstede (2003) indicate 12 different páramo vegetation types.

Tussock grassland is unquestionably the richest vegetation type in terms of genera and species, including herbaceous and woody species (woody chamaephytes and phanerophytes), although the common physiognomy is determined by large clusters of different grass species with growth buds protected by a large mass of leaves, whereas other plants find adequate conditions among the tussocks, with an absolute richness of 264 species. In their study on the herbaceous páramo (2900–4200 m asl) throughout the Ecuadorian Andes, Fiallos *et al.* (2015) indicated the existence of 37 genera and 90 species, whereas Izco *et al.* (2007) reported a total of 216 species in the bunchgrasses of Loja.

The zonal or local condition of formations of several species of *Polylepis* has been the subject of debate for decades (Simpson, 1979). Some authors regard these as being remnants of more widespread presences as a response to climate changes (Van Der Hammen & Cleef, 1983), others have related their current presence with the so-called *paramization* process, whereby woody vegetation types are substituted by páramo-type open formations due to human actions (Lægård, 1992; Ramsay, 1992; Verweij, 1995; Fjeldsá & Kessler, 1996; Luteyn, 1999; Rangel-Churío, 2000; Josse *et al.*, 2008; Cleef, 2008; Moscol-Olivera & Cleef, 2009); and it has even been suggested that this is a “climactic woody formation” that has taken refuge in sites that are at less risk of disturbance or are safe from fire (Sarmiento, 2002). The patchy distribution of the formations of *Polylepis sp. pl.* has also been justified as being due to local environmental reasons (Bader *et al.*, 2007). In our opinion, it is time to set aside the generalisations about the condition of *Polylepis sp. pl.* forests and specify the particular condition of each species in each territory. We consider the absence of isolated or juvenile individuals in the heart of the herbaceous páramo in the CNP and the repeated presence of these formations on steeply sloping rocky beds to be evidence of azonal formations, as highlighted by Pulgar *et al.* (2010). In this regard, the field cultivation of *P. sericea* in the Venezuelan Andes carried out by A.P. Smith (1978) showed that the plantlets only survived on gravel, whereas in the bare soils of the páramo the mortality was 100%.

The species *Polylepis lanuginosa* is rare in absolute terms; barely eight sites are known, one of which is located in the sub-basins of the western slope of the CNP

(Romoleroux & Pitman, 2004) at altitudes of 3200–3700 m asl. The most significant and abundant among the rest of the *Polylepis* species is *P. reticulata*, very frequent in the sub-basins of the Tomebamba and Taitachugo rivers, on the eastern slope at altitudes of 3300–4200 asl. The companion flora of both species is very different; the flora linked to *P. lanuginosa* is insignificant, whereas the flora associated to *P. reticulata* is more abundant (25 species), and includes two species of *Elaphoglossum* and one of *Campyloneurum*. These differences may be related with the altitude of the *Polylepis* formations, since half the flora associated to *P. reticulata* are located above altitudes of 3700 m asl. In absolute terms, the species richness of the *Polylepis* formations studied in the CNP is equivalent to those of the Peruvian formations of *Polylepis incana* and *P. subsericans* (Mendoza & Roque, 2007).

The communities of the phytosociological class *Plantagini rigidae-Distichietea muscoidis*, which contains the formations of *Plantago rigida*, *P. tubulosa*, and *Distichia muscoides*, plus different species of *Werneria*, *Puccinellia*, *Calamagrostis*, etc., are located from Colombia to Chile-Argentina, generally at an average altitude over 4000 m asl – the limit indicated by Ramsay & Oxley (1997) – above the bunchgrasses, and even above the high-mountain scrublands, often with spherical or cushion forms. The *Plantago rigida* formations in the CNP are interspersed at the level of the bunchgrasses, in the bottom of depressions or in moist soils in lake environments, in all cases below altitudes of 4000 m; they generally form flat or slightly undulating carpets. The existence of two types of vegetation within this group has been highlighted by numerous authors (Cleef, 1978, 1981; Gutte, 1980; Sánchez & Rangel-Churío, 1990; Josse *et al.*, 2008), who distinguish between the lower carpets of *Plantago rigida* “High Andean and high-mountain wetlands in the northern Andes”, and those located above 4200 m and belonging to the “Subnival vegetation of the northern Andes”.

These are clearly azonal formations, as indicated by numerous authors (Cleef, 1981; Sturm & Rangel-Churío, 1985; Sánchez & Rangel-Churío, 1990; Rangel-Churío & Arellano, 2001). This set of typical Andean formations (Colombia-Chile) is floristically poor, in the order of 80-90 species. The area occupied by *Plantago rigida* carpets covers 10% of the CNP (Mora & Cisneros, 2009) with 45 associated species, representing 6.7% of the species in the catalogue and 50-55% of the species present in the relevés for the páramos as a whole (authors' own data).

We assign the rock formations and formations characterised by *Loricaria ilinissae* located above the bunchgrasses (> 4000 m asl), growing on superficial or rocky soils subjected to intense winds, low temperatures and an irregular rainfall regime (Smith & Young, 1987) to the scrublands in the super-páramos. Although these characteristics are common to the high Andean summits, the floristic composition is typical of the CNP. The list of species in the scrublands of the super-páramo is not very extensive but has a wide diversity of taxa per unit of area (Minga *et al.*, 2016). Of the 55 species in the super-

páramo, 14 are endemic to Ecuador, and two of these are exclusive to the CNP and one to Azuay, indicating a high specificity.

Aquatic flora is scarce despite the presence of numerous lakes. In total, 36 hydrophilous or helophytic species were counted, which we associate to lakes and marshy habitats; they represent 44% of the 82 vascular species recorded in the lakes in the Ecuadorian páramos (Terneus, 2020).

The vegetation concept we call ecotone is ambiguous and contains vegetation types with a predominantly woody consistency and others with a predominance of herbs, forming a mosaic in which the successional stage and the level of degradation of the soil determine the dominance of one or another, or their coexistence. According to Bader *et al.* (2007), cited by Ramírez *et al.* (2009), the ecotone in the case of the Tropical Andes is a complex transitional zone between the tropical high-mountain forests and the páramos, and includes forests interspersed with typical páramo vegetation.

4.4. Biogeography

According to numerous authors, the Andean range has a significant frontier at the height of Huancabamba (northern Peru) dividing the northern and central Andes (Josse *et al.*, 2008), which in the biogeographical systematisation of Rivas-Martínez *et al.* (2011) is translated into two super-regions: Caribbean-Novogranatense, to the north, and Tropical South Andean to the south. The independence of the páramos in southern Ecuador has been justified based on their flora (Peyre, 2015).

The Andean flora has its origin in three major phytogeographical units: tropical, holarctic and antarctic, as initially noted by Cleef (1978, 1979). This idea was subsequently expanded and documented by other authors (Simpson, 1983; van der Hammen & Cleef, 1983, 1986; Smith & Cleef, 1988; Luteyn, 1999; Izco *et al.*, 2007; Sklenář & Balslev, 2007; Sklenář *et al.*, 2011). The proportion of the different biogeographical elements is not constant either above or below the equator, or latitudinally in each of the two hemispheres, or altitudinally in each territory; these issues highlight the need to explore this aspect in greater depth with precise evidence.

The Andes act as corridors for holarctic flora towards the south, and for antarctic flora towards the north, and each massif has a different proportion of each phytogeographical element. According to the data of Ramsay (1992) on the phytogeographical adscription of the genera of the páramo flora based on other authors' data, the austral-antarctic element decreases proportionally in the direction Ecuador>Colombian eastern range>Colombia, whereas other biogeographical elements have a less clear behaviour. As a whole, for the flora of the páramos in Ecuador Mena & Medina (2001), based on Ramsay (1992), note a different proportion between flora with a holarctic phytogeographical origin (14%) and an austral-antarctic origin (10%), although these proportions vary depending on the type of

vegetation. For example, there is a high proportion of antarctic elements in *Plantago rigida* wetlands (Cleef, 1978).

The páramo is home to two endemic genera (*Neurolepis* and *Chrysactinium*) (Sklenář *et al.*, 2011) and a high proportion of endemic species, with a 60% endemicity rate in the tropical Andes as a whole (León-Yáñez *et al.*, 2011) as a result of the processes of adaptive radiation and subsequent geographic isolation (von Hagen & Kaderheit, 2003; Bell & Donoghue, 2005; Hughes & Eastwood, 2006; Scherson *et al.*, 2008). 659 endemic species were counted in the Ecuadorian páramos, of which 273 grow exclusively in the páramo, while the rest are also present in the Andean forests and even in other ecosystems. The species that are exclusive to the Ecuadorian páramos belong to 40 families, in unequal proportions: Asteraceae (16.1%), Orchidaceae (16.1%), Gentianaceae (9.1%), Poaceae (6.6%) are in the four first positions (León-Yáñez *et al.*, 2011).

The Cajas páramo is known to have been connected to other páramos in the north and south during the last glaciation (Hofstede *et al.*, 2014b). Many species are therefore shared with the central páramos in Ecuador, and a large number of the species recorded on the western slope of the CNP are shared with the páramos in the province of Loja and the northern range in Peru (Herbario Azuay, 2021), very probably because their common characteristic is their climatic condition. The relation with the northern páramos of Peru has been favoured by the possibility of connecting corridors between neighbouring massifs and by the high proportion of anemochoric species (Sklenář & Jørgensen, 1999).

In spite of the historic connections with other paramo areas, there are 106 endemic to Ecuador species in the study area in the CNP, representing 16.5% of the total of the vascular flora catalogued, a similar proportion to that indicated by Sklenář & Jørgensen (1999) for the páramos of Ecuador (16–18%). The endemic species of the CNP are unevenly distributed between the different families, with the four first positions occupied by Asteraceae (31%), Brassicaceae (8.5%), Gentianaceae (7.5%) and Poaceae (5.6%); these results differ from those of León-Yáñez *et al.* (2011), particularly in regard to the Orchidaceae and Brassicaceae (2.9%) endemics in ninth position. There is no apparent reason to justify these differences, particularly in regard to the Brassicaceae; the difference in the Orchidaceae is probably due to the absence of forests, which are suitable habitats for the species in this family.

The genera richest in endemic species in the páramos in the CNP *Draba* (6), *Brachyotum* (5), *Gentianella* (5), *Phlegmariurus* (4) have very little overlap with those indicated by León-Yáñez *et al.* (2011); the only genera in the first four positions that coincide are *Gentianella* (20) and *Draba* (11). It is worth noting the absence of the genus *Espeletia*, with 140 species that are endemic to the northern Andes (Sklenář, 2010), outside its distribution area.

The anthropic influence in the páramos has been analysed by (Moscol-Olivera & Cleef, 2009; Valencia *et*

al., 2013; Vázquez *et al.*, 2015) in relation to grazing and farming activities, both of which are currently prohibited in the CNP. However, other activities that favour the introduction of exotic species continue: road traffic and the information area at the entrance to the CNP from the city of Cuenca. Additionally, the deliberate introduction of non-native forage species and the cultivation of tree species on the outer limits of the CNP are possible sources of new incorporations of non-native flora

Of the exotic species found in the CNP, *Rumex acetosella* is the most frequently cited among the exotic flora present in the páramos, and to a lesser degree, *Pennisetum clandestinum*, *Poa annua*, *Trifolium repens*, *Anthoxanthum odoratum*, *Holcus lanatus*, *Dactylis glomerata*, *Achillea millefolium*, *Lolium multiflorum*, *Urtica urens*, *Taraxacum officinalis* (Luteyn, 1999; Jaimes & Sarmiento, 2002; Moscol-Olivera & Cleef, 2009; Llambí *et al.*, 2014). Some authors consider *Gamochaeta americana* and *Geranium multipartitum* to be non-native, whereas others (Jørgensen & León-Yáñez, 1999; Bernal *et al.*, 2015; POWO, 2019) maintain that the first is native to tropical and subtropical America, and these same authors plus Aedo (2012) regard *G. multipartitum* as being native to the tropical Andes, the criterion we have followed for the two species.

The data on the CNP indicate a substantial anthropic influence, greater than indicated in other protected spaces, to judge from the number of exotic species present. This is particularly true in the category of species with urban and roadside appetites, which is certainly related to the uses and activities of the past, many of which continue to the present day: tourism, fishing, photography, transit along the Cuenca-Guayaquil highway, visitor information center, etc.

4.5. Threat categories

In spite of the altitudinal location of the páramos, far removed from intense human activity, there is a large proportion of threatened flora but only half (48%) of the endemic species in the páramos have been recorded within the National System of Protected Areas of Ecuador (Rangel-Churío, 2000; León-Yáñez *et al.*, 2011).

León-Yáñez (2011) lists 273 endemic taxa, of which 78% are included in some threatened category: VU (40.7%), EN (27.8%), CR (9.5%). In our catalogue the figures are lower for all threat categories; however, it should be noted that six endemic taxa have not been evaluated, three of which have a very restricted distribution: *Loricaria cinerea*, endemic to the CNP, *Lithospermum azuayensis*, endemic to Azuay, and *Senecio josei*, endemic to Azuay and Loja, whose evaluation would probably increase the list of threatened flora. Additionally, the species in critical danger (CR), *Lysipomia rhizomata*, is very rare, at least in the parts of the CNP that have been exhaustively explored, and it is confirmed that its survival is at risk.

Much has been written on the health and future of *Polylepis sp.pl.* forests, particularly in regard to

the anthropic actions that pose a risk of damage to its populations (Hofstede *et al.*, 2002; Gareca *et al.*, 2010; Cuycken & Renison, 2018; Renison *et al.*, 2018), and the inexorable disappearance of the forests from the wet páramos if the current climate trends are maintained (Rangel-Churío & Arellano, 2010). In the list of threatened flora of Ecuador (León-Yáñez *et al.*, 2011), *Polylepis lanuginosa* and *P. reticulata* are considered as VU.

Acknowledgements

Our sincerest thanks go to Carmen Ulloa-Ulloa who provided the data on the collections in the study area recorded in the Tropicos® database and allowed the stay of one of the authors at the Missouri Botanical Garden in February and March 2016. We would also like to thank Ruth Arias, Nubia Guzmán and Mayra Jiménez for their tireless work in the field and the herbarium. The University of Azuay mainly funded the studies. We want to thank its authorities, particularly Jacinto Guillén, vice-rector of research. We are also grateful for the help of the Spanish Agency for International Cooperation (AECI)- CPI-Iberoamérica.

References

- Acosta Solís, M. 1984. Los páramos andinos del Ecuador. Publicaciones científicas MAS.
- Aedo, C. 2012. Revision of *Geranium* (Geraniaceae) in the New World. *Syst. Bot. Monogr.* 95: 1–550.
- APG IV. 2016. An update of the Angiosperm Phylogeny. Group classification for the orders and families of flowering plants: APG IV. The Linnean Society of London. *Bot. J. Linn. Soc.* 181: 1–20.
- Bader, M.Y., Rietkerk, M. & Bregt, A.K. 2007. Vegetation structure and temperature regimes of tropical alpine treelines. *Arct. Antarct. Alp. Res.* 39: 353–364.
- Bell, C.D. & Donoghue, M.J. 2005. Phylogeny and biogeography of Valerianaceae (Dipsacales) with special reference to the South American valerians. *Org. Divers. Evol.* 5(2): 147–159. doi: 10.1016/j.ode.2004.10.014
- Beltrán, K., Salgado, S., Cuesta, F., León-Yáñez, S., Romoleroux, K., Ortiz, E., Cárdenas, A. & Velástegui, A. 2009. Distribución espacial, sistemas ecológicos y caracterización florística de los páramos en el Ecuador. EcoCiencia, Proyecto Páramo Andino Y Herbario QCA. Quito, Ecuador.
- Bernal, R., Gradstein, S.R. & Celis, M. (Eds.). 2015. Catálogo de plantas y líquenes de Colombia. Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá. <http://catalogueoplantasdecolombia.unal.edu.co/es/>
- Braun-Blanquet, J. 1979. Fitosociología. Bases para el estudio de las comunidades vegetales. Blume Ediciones, Madrid.
- Buytaert, W. 2004. The properties of the soils of the south Ecuadorian paramo and the impact of land use changes on their hydrology. PhD thesis. Faculty of Agricultural and Applied Biological Sciences, Katholieke Universiteit Leuven.

- Buytaert, W., Sevink, J., De Leeuw, B. & Deckers, J. 2005. Clay mineralogy of the soils in the south Ecuadorian paramo region. *Geoderma* 127(1): 114–129.
- Buytaert, W., Deckers, J. & Wyseure, G. 2006a. Description and classification of nonallophanic Andosols in south Ecuadorian alpine grasslands (páramo). *Geomorphology* 73(3): 207–221.
- Buytaert, W., Céleri R., Willems, P., De Bièvre, B. & Wyseure, G. 2006b. Spatial and temporal rainfall variability in mountainous areas: A case of study from the south Ecuadorian Andes. *J. Hydrol.* 329(3): 413–421.
- Chacón, G., Gagnon, D. & Paré, D. 2009. Comparison of soil properties of native forests, *Pinus patula* plantations and adjacent pastures in the Andean highlands of southern Ecuador: land use history or recent vegetation effects? *Soil Use Manage.* 25(4): 427–433.
- Christenhusz, M.J.M., Reveal, J.L., Farjon, A., Gardner, M.F., Mill, R.R. & Chase, M.W. 2011. A new classification and linear sequence of extant gymnosperms. *Phytotaxa* 19: 55–70.
- Clayton, W.D. & Renvoize, S.A. 1986. *Genera Graminum: Grasses of the World*. HMSO, London.
- Cleef, A. 1978. Characteristics of neotropical páramo and its subantarctic relations. In: Troll, C. & Lauer, W. (Eds.). *Geological relations between the Southern Temperate zone and the tropical mountains*. *Erdwissenschaftliche Forschung* 11: 365–390.
- Cleef, A.M. 1979. The phytogeographical position of the neotropical vascular paramo flora with special reference to the Colombian Cordillera Oriental. In: Larsen, K. & Holm-Nielsen, H.B. (Eds.). *Tropical Botany*. Pp. 175–184. Academic Press, New York.
- Cleef, A.M. 1981. The vegetation of the páramos of the Colombian Cordillera Oriental. *Dissertationes Botanicae* 61: 321 pp. J. Cramer, Vaduz. [Published In: *El Cuaternario de Colombia* 9. Van der Hammen, T. (Ed.). Amsterdam.]
- Cleef, A.M. 2008. Influencia humana en los páramos. In: Castañeda, J.P. (Ed.). *Panorama y perspectivas sobre la gestión ambiental de los ecosistemas de páramo: memorias*. Pp. 26–33. Procuraduría Delegada para Asunto Ambientales y Agrarios, Bogotá. <https://hdl.handle.net/11245/1.297709>
- Coblentz, D. & Keating, P. L. 2008. Topographic controls on the distribution of tree islands in the high Andes of south-western Ecuador. *J. Biogeogr.* 35(11): 2026–2038.
- Cuatrecasas, J. 1958. Aspectos de la vegetación natural de Colombia. *Rev. Acad. Colombiana Ci.* 10: 40.
- Cuyckens, G.A.E. & Renison, D. 2018. Ecología y conservación de los bosques montanos de *Polylepis*. Una introducción al número especial. *Ecología Austral* 28:157–162.
- Elleberg, H. & Muller-Dombois, D. 1967. A key to Raunkiaer plant life forms with revised subdivisions. *Ver. Geobot. Inst. ETH, Zurich*.
- Fiallos, R. Herrera, R.S. & Velázquez, R. 2015. Flora diversity in the Ecuadorian Páramo grassland ecosystem. *Cuban. J. Agric. Sci.* 49 (3): 299–405.
- Fick, S. & Hijmans, R. 2017. WorldClim 2: New 1–km spatial resolution climate surfaces for global land areas. *Int. J. Climatol.* Royal Meteorological Society. DOI: 10.1002/joc.5086
- Fjeldsá, J. & Kessler, M. 1996. Conserving the biological diversity of *Polylepis* woodlands of the highland of Peru and Bolivia. A contribution to Sustainable Natural Resource Management in the Andes. NORDECO, Copenhagen.
- Galeas, R., Guevara, J.E. (Eds.). 2013. *Sistema de clasificación de los ecosistemas del Ecuador continental*. Ministerio del Ambiente del Ecuador, Subsecretaría de Patrimonio Natural, Quito.
- Gareca, E.E., Hermy, M., Fjeldsa, J., Honnay, O. 2010. *Polylepis* woodland remnants as biodiversity islands in the Bolivian high Andes. *Biodivers Conserv* 19:3327–3346. doi: 10.1007/s10531–010–9895–9
- Giraldo-Cañas, D. 2011. Catálogo de la familia Poaceae en Colombia. *Darwiniana* 49(2): 139–247.
- Gutte, P. 1980. Beitrag zur Kenntnis zentralperuanischer Pflanzengesellschaften II. Die hochandinen Moore und ihre Kontakgesellschaften. *Feddes Repert.* 91(5–6): 327–336.
- Harling, G. 1979. The vegetation types of Ecuador - A brief survey. In: Larsen, K. & Holm-Neilsen, H.B. (Eds.). *Tropical botany*. Academic Press, New York.
- Hassler, M. 2016. Retrieved from World Plants: Synonymic Checklists of the Vascular Plants of the World (version Nov 2016). In: Roskov, Y., Abucay, L., Orrell, T., Nicolson, D., Bailly, N., Kirk, P., Bourgoin, T., DeWalt, R.E., Decock, W., De Wever, A. & Nieukerken, E. van (Eds.). *Species 2000 ITIS Catalogue of Life*, 23rd December 2016. Digital resource at www.catalogueoflife.org/col. Species 2000: Naturalis, Leiden. ISSN 2405–8858.
- Hassler, M. 2017. Retrieved from World Ferns: Checklist of Ferns and Lycophytes of the World (version May 2017). In: Roskov, Y., Abucay, L., Orrell, T., Nicolson, D., Bailly, N., Kirk, P.M., Bourgoin, T., DeWalt, R.E., Decock, W., De Wever, A., Nieukerken, E. van, Zarucchi, J. & Penev, L. (Eds.). *Species 2000 & ITIS Catalogue of Life*, 29th May 2017. Digital resource at www.catalogueoflife.org/col. Species 2000: Naturalis, Leiden. ISSN 2405–8858.
- Hedberg, O. 1964. Features of Afroalpine Plant Ecology. *Acta Phytogeogr. Suecica* 49.
- Hedberg, I. & Hedberg, O. 1979. Tropical-alpine life-forms of vascular plants. *Oikos*: 297–307.
- Hofstede R., Coppus, R., Mena Vásconez, P., Segarra, P., Wolf, J. & Sevink, J. 2002. El estado de conservación de los páramos de pajonal en el Ecuador. *Ecotropicos* 15(1): 3–18.
- Hofstede, R.G.M. 2003. Los páramos en el mundo: su diversidad y sus habitantes. In: Hofstede, R.G.M., Segarra, P. & Mena, P. (Eds.). *Los páramos del mundo: 15–38*. Proyecto Atlas mundial de los páramos. Global Peatland Initiative/NC–IUNC/Ecociencia, Quito.

- Hofstede, R.G.M., Calles, J., López, V., Polanco, R., Torres, F., Ulloa, J., Vásquez, A. & Cerra, M. 2014a. Los Páramos Andinos ¿Qué sabemos? Estado de conocimiento sobre el impacto del cambio climático en el ecosistema páramo. UICN, Quito, Ecuador.
- Hofstede, R.G.M., Dickinson, K.J.M., Mark, A.E., Alan, F. & Narváez, E. 2014b. A broad transition from cloud forests to páramo characterizes an undisturbed treeline in Parque Nacional Llanganates, Ecuador. *Arct. Antarct. Alp. Res.* 46(4): 975–986.
- Hofstede, R. & Rossenaar A. 1995. Biomass of Grazed, Burned and Undisturbed Páramo Grassland, Colombia. II. Root Mass and Aboveground: Belowground Ratio. *Arct. Alp. Res.* 27(1): 13–18.
- Hughes, C. & Eastwood, R. 2006. Island radiation on a continental scale: Exceptional rates of plant diversification after uplift of the Andes. *PNAS* 103(27): 10334–10339. doi: 10.1073/pnas.0601928103
- Izco, J., Pulgar, Í., Aguirre, Z. & Santin, F. 2007. Estudio florístico de los páramos de pajonal meridionales de Ecuador. *Revista Peruana de Biología* 14(2): 237–246.
- Jaimés, V. & Sarmiento, L. 2002. Regeneración de la vegetación del páramo después de un disturbio agrícola en la Cordillera Oriental de Colombia. *Ecotrópicos* 15(1): 61–74.
- Jørgensen, P. M. & Ulloa-Ulloa, C. 1994. Seed plants of the high Andes of Ecuador: A checklist.
- Jørgensen, P.M. & León-Yáñez, S. (Eds.). 1999. Catalogue of the vascular plants of Ecuador. *Monogr. Syst. Bot. Missouri Bot. Gard.* 75: i–viii, 1–1182.
- Jørgensen, P.M., Ulloa, C., Maldonado, C. 2006. Riqueza de plantas vasculares. In: Moraes, M., Øllgaard, R., B., Kvist, L. P., Borchsenius, F. & Balslev, H. (Eds.). *Botánica Económica de los Andes Centrales*. Pp. 37–50. Universidad Mayor de San Andrés, La Paz,
- Jørgensen, P.M.; Ulloa-Ulloa, C., León, B., León-Yáñez, S., Beck, S.G., Nee, M., Zarucchi, J.L., Celis, M., Bernal, R. & Gradstein, R. 2011. Regional patterns of vascular plant diversity and endemism. In: Herzog, S.K., Martínez, R., Jørgensen, P.M. & Tiessen, H. (Eds.). *Climate change and biodiversity in the Tropical Andes*. Pp. 192–203. São José dos Campos: Inter-American Institute for Global Change Research (IAI) and Scientific Committee on Problems of the Environment (SCOPE).
- Jørgensen, P.M. 2021. Checklist of the Flora of the Páramo of Cajas, Ecuador. <http://legacy.tropicos.org/NameSearch.aspx?projectid=2&listid=7370> [Accessed 15 may, 2021].
- Josse, C., Cuesta, F., Navarro, G., Barrena, V., Cabrera, E., Chacón-Moreno, E., Ferreira, W., Peralvo, M., Saito, J. & Tovar, A. 2008. Ecosistemas de los Andes del Norte y Centrales. Bolivia, Colombia, Ecuador, Peru y Venezuela. Secretaría General de la Comunidad Andina, Programa Regional ECOBONA-Intercooperation, CONDESAN-Proyecto Páramo Andino, Programa BioAndes, EcoCiencia, NatureServe, IAvH, LTA-UNALM, ICAE-ULA, CDC-UNALM, RUMBOL SRL, Lima.
- Lægaard, S. 1992. Influence of fire in the grass paramo vegetation of Ecuador. In: Balslev, H. & Luteyn, J.L. (Eds.). *Páramo andean ecosystem under human influence*. Pp. 151–170. Academic Press, London.
- León-Yáñez, S. 1993. Estudio ecológico y fitogeográfico de la vegetación del páramo de Guamaní, Pichincha-Napo, Ecuador. PUCE, Quito, Ecuador.
- León-Yáñez S. 2011. Endemismos en los páramos. In: León-Yáñez, S., Valencia, R., Pitman, N., Endara, L., Ulloa-Ulloa, C. & Navarrete, H. (Eds.). *Libro rojo de las plantas endmicas de Ecuador*, 2ª ed. Publicaciones del Herbario QCA, Pontificia Universidad Católica del Ecuador, Quito. https://bioweb.bio/floraweb/librorojo_páramos/ (Accessed 8 March 2020).
- León-Yáñez, S., Valencia, R., Pitman, N., Endara, L., Ulloa-Ulloa, C. & Navarrete, H. (Eds.). 2011. *Libro rojo de las plantas endémicas del Ecuador*, 2ª ed. Publicaciones del Herbario QCA, Pontificia Universidad Católica del Ecuador, Quito.
- Llambí, L., Soto-W, A., Celleri, R., De-Biere, B., Ochoa, B. & Borja, P. 2012. Ecología, hidrología y suelos de páramos. Proyecto páramo andino.
- Llambí, L., Fariñas, M., Smith, J.K., Castañeda, S.M. & Briceño, B. 2014. Diversidad de la vegetación en dos páramos de Venezuela: un enfoque multiescala con fines de conservación. In: Cuesta, F., Sevink, J., Llambí, L.D., De Bièvre, B. & Posner, J. (Eds.). *Avances en investigación para la conservación de los páramos andinos*. Pp 40–68. Consorcio para el Desarrollo Sostenible de la Ecorregión Andina/CONDESAN, Lima, Quito.
- Luteyn, J.L. 1992. Paramos: why study them? In: Balslev, H. & Luteyn, J.L. (Eds.). *Páramo andean ecosystem under human influence*. Pp.1–14. Academic Press. London.
- Luteyn, J.L. 1999. Páramos, a checklist of plant diversity, geographical distribution, and botanical literature. *Mem. New York Botan. G.* 84: viii–xv, 1–278.
- Luteyn, J.L. & Balslev, H. 1992. *Páramo: an Andean ecosystem under human influence*. Academic Press, London.
- Madriñán, S., Cortés, A.J. & Richardson, J.E. 2013. Páramo is the world's fastest evolving and coolest biodiversity hotspot. *Front. Gen.* 4: 1–7.
- Mena, P. & Medina, G. 2001. La biodiversidad de los páramos del Ecuador. In: Mena, P., Medina, G. & Hofstede, R.G.M. (Eds.). *Los páramos del Ecuador*. Proyecto Páramo y Abya Yala, Quito.
- Mena, P. & Hofstede, R. 2006. Los páramos ecuatorianos. In: Moraes, M., Øllgaard, B., Kvist, L., Borchsenius, F. & Balslev, H. (Eds.). *Botánica económica de los Andes Centrales*. Pp. 91–109. La Paz.
- Mendoza, W. & Roque, E. 2007. Diversidad de la flora vascular asociada a los bosques de *Polylepis* (Rosaceae) en los Andes Meridionales del Peru (Ayacucho): Implicancias para su conservación. Serie de publicaciones de flora y fauna silvestre. Instituto Nacional de Recursos Naturales, Lima.

- Minga, D., Ansaloni, R., Verdugo, A. & Ulloa-Ulloa, C. 2016. Flora del Páramo de Cajas, Ecuador. Universidad del Azuay. Imprenta Don Bosco-Centro Gráfico Salesiano. Cuenca.
- Mora, D. & Cisneros, F. 2009. Identificación de las áreas de influencia de los humedales en el Parque Nacional Cajas en base al análisis de imágenes satelitales. Memorias del II Congreso mundial de páramos, Loja.
- Morocho, D. & Romero, J.C. (Eds.). 2003. Bosques del Sur. El estado de 12 remanentes de bosques andinos en la provincia de Loja. Fundación Arcoiris/PROBANA/DICA, Loja.
- Moscol-Olivera, M. & Cleef, A. 2009. A phytosociological study páramo along two altitudinal transects in El Carchi Province, northern Ecuador. *Phytocoenologia* 39(1): 79–107.
- Mosquera, P. V., Hampel, H., Vazquez, R. F., Alonso, M. & Catalán, J. 2017. Abundance and morphometry changes across the high–mountain lake–size gradient in the tropical Andes of Southern Ecuador. *Water Resour. Res.* 53: 7269–7280. doi:10.1002/2017WR020902
- Murillo, M.T. 2000. Flora: Helechos. In: Rangel-Churío (Ed.) Colombia, diversidad biótica, III. La región de vida paramuna en Colombia. Pp. 528–562. Universidad Nacional de Colombia.
- Ortiz, D. 2003. Los páramos del mundo: Ecuador. In Hofstede, R.G.M., Segarra, P. & Mena, P. (Eds.). Los páramos del mundo. Pp. 91–158. Proyecto Atlas mundial de los páramos. Global Peatland Initiative/NC–IUNC/ Ecociencia, Quito.
- Peyre, G. 2015. Plant diversity and vegetation of the Andean Páramo. PhD Thesis. University of Barcelona, Spain. <http://hdl.handle.net/10803/296441>
- PPG I. 2016. A community–derived classification for extant lycophytes and ferns. *J. Syst. Evol.* 54 (6): 563–603. doi: 10.1111/jse.12229
- Pulgar, I., Izco, J. & Jadán, O. 2010. Flora selecta de los pajonales de Loja. Ediciones Abya Yala, Universidad Santiago de Compostela/Universidad de Loja/ Ecociencia, Quito.
- Ramírez, L., Llambí, L.D., Schwarzkopf, T., Gámez, L.E. & Márquez, N.J. 2009. Vegetation structure along the forest–páramo transition belt in the Sierra Nevada de Mérida: implications for understanding treeline dynamics. *Ecotropicos* 22(2): 83–98.
- Ramsay, P. 1992. The páramo vegetation of Ecuador: the community ecology, dynamics and productivity of tropical grasslands in the Andes. PhD Thesis. School of Biological Science, University of Wales, Bangor.
- Ramsay, P. & Oxley, E. 1997. The growth form composition of plant communities in the Ecuadorian páramos. *Plant Ecol.* 131(2): 173–192.
- Rangel-Churío, J.O. 2000. Flora y vegetación amenazada. In: Rangel-Churío, J.O. (Ed.). Colombia. Diversidad biótica III: La región de vida paramuna colombiana. Pp. 785–813. Universidad Nacional de Colombia/Instituto Alexander von Humboldt, Santa Fe de Bogotá.
- Rangel-Churío, J.O. 2002. Biodiversidad en la región del páramo: con especial referencia a Colombia. In: Jaramillo, C.A. (Ed.). Congreso mundial de páramos. Memorias, I: 168–200.
- Rangel-Churío, J.O. & Arellano, H. 2010. Bosques de Polylepis: un tipo de vegetación condenado a la extinción. In: Rangel-Churío, J.O. (Ed.). Colombia, Diversidad Biótica X. Cambio global (natural) y climático (antrópico) en el páramo colombiano. Pp. 443–478. Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá D.C.
- Rangel-Churío, J.O. 2015. La biodiversidad de Colombia: significado y distribución regional. *Revista Acad. Colomb. Ci. Exactas Físicas Nat.* 39(151): 176–200.
- Ranison, D., Morales, L., Cuyckens, G.A.E., Sevillano, C.S. & Cabrera, D.M. 2018. Ecología y conservación de los bosques y arbustales de Polylepis: ¿qué sabemos y qué ignoramos? *Ecología Austral* 28: 163–174.
- Raunkiaer, C. 1934. The life form of plants and statistical plant geography. Oxford University Press, Oxford.
- Richter, M. & Moreira-Muñoz, A. 2005. Heterogeneidad climática y diversidad de la vegetación en el sur de Ecuador: un método de fitoindicación. *Rev. Peruana Biol.* 12(2): 217–238.
- Richter, M., Diertl, K.-H., Emck, P., Peters, T. & Beck, E. 2009. Reasons for an outstanding plant diversity in the tropical Andes of Southern Ecuador. *Landscape Online*: 1–35.
- Rivas-Martínez, S. 2004. Global Bioclimatics (Clasificación Bioclimática de la Tierra) (Versión 27/08/2004). Cap. 4: Nociones sobre geobotánica y biogeografía. http://www.globalbioclimatics.org/book/bioc/global_bioclimatics_4.htm#4aa [Accessed 27 Aug. 2018].
- Rivas-Martínez, S. 2007. Mapa de series, geoseries y geopermaseries de vegetación en España. Memoria del mapa de vegetación potencial de España. I. Itinera geobotánica 17: 5–435.
- Rivas-Martínez, S., Navarro, G., Penas, A. & Costa, M. 2011. Biogeographic map of South America. A preliminary survey. *International Journal of Geobotanical Research* 1(1): 21–40.
- Rivas-Martínez, S. & Rivas-Sáenz, S. 1996–2017. Worldwide Bioclimatic Classification System. Phytosociological Research Center, Spain. <http://www.globalbioclimatics.org>
- Romoleroux, K. & Pitman, N. 2004. Polylepis lanuginosa. The IUCN Red List of Threatened Species 2004: e.T38119A10099269. doi: 10.2305/IUCN.UK.2004.RLTS.T38119A10099269
- Roskov, Y., Ower, G., Orrell, T., Nicolson, D., Bailly, N., Kirk, P.M., Bourgoin, T., DeWalt, R.E., Decock, W., Nieukerken, E. van, Zarucchi, J. & Penev L. (Eds.). 2019. Species 2000 & ITIS Catalogue of Life, 2019 Annual Checklist. Digital resource at www.catalogueoflife.org/annual-checklist/2019. Species 2000: Naturalis, Leiden,
- Sánchez, M.R. & Rangel-Churío J.O. 1990. Estudios ecológicos en la Cordillera Oriental colombiana V. Análisis fitosociológico de la vegetación de los depósitos turbosos paramunos de los alrededores de Bogotá. *Caldasia* 16(77): 155–191.
- Sarmiento, G. 1986. Ecological features of climate in high tropical mountains. In: Vuilleumier, F. & Monasterio, M. (Eds.). High Altitude Tropical Biogeography. Pp. 11–45. Oxford University Press, Oxford.

- Sarmiento, F.O., 2002. Human drivers of landscape change: treeline dynamics in neotropical montology. *Ecotropicos* 15: 129–146.
- Scherson, R.A., Vidal, R. & Sanderson, M. 2008. Phylogeny, biogeography, and rates of diversification of New World *Astragalus* (Leguminosae) with an emphasis of South American radiations. *Am. J. Bot.* 95(8): 1030–1039.
- Simpson, B.B. 1974. Glacial migrations of plants: Island biogeographical evidence. *Science* 185(4152): 698–700.
- Simpson, B.B. 1979. A revision of the genus *Polylepis* (Rosaceae: Sanguisorbeae). *Smithsonian Contributions to Botany* 43.
- Simpson, B.B. 1983. An Historical Phytogeography of the High Andean Flora. *Rev. Chil. Hist. Nat.* 56: 109–122.
- Sklenář, P. & Jørgensen, P. M. 1999. Distribution Patterns of Páramo Plants in Ecuador. *J. Biogeogr.* 26(4): 681–691.
- Sklenář, P., Luteyn, J.L., Ulloa-Ulloa, C., Jørgensen, P.M. & Dillon, M.O. 2005. Flora genérica de los páramos: Guía ilustrada de las plantas vasculares. *Mem. New York Botan. G.* 92.
- Sklenář, P. & Balslev, H. 2005. Superpáramo plant species diversity and phytogeography in Ecuador. *Flora* 200(5): 416–433. doi: 10.1016/j.flora.2004.12.00
- Sklenář, P. & Balslev, H. 2007. Geographic flora elements in the Ecuadorian superpáramo. *Flora* 202(1): 50–61.
- Sklenář, P., Dušková, E., & Balslev, H. 2011. Tropical and temperate: evolutionary history of páramo flora. *Bot. Rev.* 77(2): 71–108.
- Sklenář, P., Hedberg, I. & Cleef, A.M. 2014. Island biogeography of tropical alpine floras. *J. Biogeogr.* 41: 287–297. doi: 10.1111/jbi.12212
- Smith, A.P. 1978. Establishment of seedlings of *Polylepis sericea* in the Páramo (Alpine) zone of the Venezuelan Andes. *Bartonia* 45: 11–14.
- Smith, A. R., Pryer, K. M., Schuettpelz, E., Korall, P., Schneider, H. & Wolf, P. G. 2006. A classification for extant ferns. *Taxon* 55(3): 705–731.
- Smith, A.R. & Young, T.R. 1987. Tropical alpine plant ecology. *Ann. Rev. Ecol. Syst.* 18(1): 137–158.
- Smith, J.M.B. & Cleef, A.M. 1988. Composition and origins of the world's tropical alpine floras. *J. Biogeogr.* 15: 631–645.
- Sturm, H., Rangel-Churío, O. 1985. *Ecología de los páramos andinos: una visión preliminar integrada.* Universidad Nacional de Colombia. 292 p.
- Sylvester, S.P., Soreng, R.J., Bravo-Pedraza, W.J., Cuta-Alarcón, L.E., Giraldo-Cañas, D., Aguilar-Cano, J. & Peterson, P. 2019. Páramos of NW South America and southern Central America including two new species, one new variety and five new records for Colombia. *PhytoKeys* 122: 29–78.
- Terneus, E. 2002. Comunidades de plantas acuáticas en lagunas de los páramos del Norte y Sur del Ecuador. *Caldasia* 24(2): 379–391.
- Ulloa-Ulloa, C., Álvarez, S., Jørgensen, P., Minga, D. 2004. *Guía de 100 Plantas Silvestres del Páramo del Parque Nacional Cajas.* Etapa, Cuenca.
- Ulloa-Ulloa, C., Acevedo-Rodríguez, P., Beck, S., Belgrano, M., Bernal, R., Berry, P., Brako, L., Celis, M., Davidse, G., Forzza, R., Gradstein, R., Hokche, O., León, B., León-Yáñez, S., Magill, R., Neill, D., Nee, M., Raven, P., Stimmel, H., Strong, M., Villaseñor, J., Zarucchi, J., Zuloaga, F. & Jørgensen, P. 2017. An integrated assessment of the vascular plant species of the Americas. *Science* 358: 1614–1617.
- Valencia, R. 2000. *Libro rojo de las plantas endémicas del Ecuador.* Herbario QCA, Pontificia Universidad Católica del Ecuador.
- Valencia, J., Lassaletta, L., Velázquez, E., Nicolau, J.M., Gómez-Sal. C. 2013. Factors controlling compositional changes in a northern Andean páramo (La Rusia, Colombia). *Biotropica* 45:18–26.
- Van Der Hammen, T. & Cleef, A. 1983. Datos para la Historia de la Flora Andina. *Rev. Chil. Hist. Nat.* 56: 97–101.
- Vasco-Tapia, S., Rodríguez, S., Rodas, F., Pesántez, M., Cabrera, S., Romero, M. & Vallejo, S. 2012. Propuesta para la declaratoria de reserva de biosfera dirigida a la UNESCO denominada: Área de la Biosfera Macizo del Cajas. Comité promotor para la nominación ante UNESCO, Cuenca.
- Vázquez, D.L.A., Balslev, H. & Sklenář, P. 2015. Human impact on tropical–alpine plant diversity in the northern Andes. *Biodiv. Conserv.* doi: 10.1007/s10531–015–0954–0
- Von Hagen, K. B. & Kaderheit, J. W. 2003. The diversification of *Halenia* (Gentianaceae): Ecological opportunity versus key innovation. *Evolution* 57(11): 2507–2518.
- Weigend, M., Rodríguez-Rodríguez, E. & Arana, C. 2005. Bosques relictos del NO de Peru y SO de Ecuador. *Rev. Peru. biol.* 12(2): 185–194.
- Verweij, P.A. 1995. Spatial and temporal modelling of vegetation patterns. Burning and grazing in the paramo of Los Nevados National Park, Colombia. PhD Thesis, University of Amsterdam, Enschede.
- White, S. 2013. Grass páramo as hunter-gatherer landscape. *The Holocene* 23(6): 898–915.
- Vuilleumier, F. & Monasterio, M. 1986. *High altitude tropical biogeography.* Oxford University Press, Oxford.
- Zanoni, T. (Ed.). 1967–2014. *Flora Neotropica*, vol. 1–114. Institute of Systematic Botany, The New York Botanical Garden, New York.
- Zomer, M.A. & Ramsay, P.M. 2020. Post-fire changes in plant growth form composition in andean páramo grassland. *Appl. Veg. Sci.* 24, e12554. doi: 10.1111/avsc.12554

Websites

- ETAPA–EP. 2016. Datos termo-pluviométricos de las estaciones meteorológicas ubicadas en el Macizo del Cajas. Cuenca, Azuay, Ecuador. ETAPA–EP. 2016. Datos termo-pluviométricos de las estaciones meteorológicas ubicadas en el Macizo del Cajas. Cuenca, Azuay, Ecuador. <https://geo.etapa.net.ec/>
- Herbario Azuay (HA). 2010–onward. <https://herbario.uazuay.edu.ec/> [Accessed 15 may 2021].
- INAMHI 2016. Datos termo-pluviométricos de las estaciones meteorológicas ubicadas cerca del Macizo del Cajas, entre 1960 y 2015, Quito. <http://www.inamhi.gob.ec/>
- POWO. 2019. Plants of the World Online. The Royal Botanic Gardens, Kew. <http://www.plantsoftheworldonline.org/> [Retrieved 23 March 2021].
- Tropicos®. Missouri Botanical Garden. <http://www.tropicos.org> [Accessed 10 January 2021].

Appendix 1. Catalogue of the Vascular Flora of Cajas National Park, Ecuador

The following information is accounted for in the current list for every species: Altitudinal range (m asl), Distribution, Growth form, Habitat and Threat category by the IUCN 2011, except when other year indicated. Access in ZENODO (<https://doi.org/10.5209/mbot.76491>).

LYCOPODIOPSIDA: 3 families, 4 genera, 22 species (4 endemic species of Ecuador).

Isoetaceae: 1 genus, 3 species.

Isoetes andina Spruce ex Hook.

3700–4200 m asl. Native (Colombia, Ecuador, Peru, Venezuela). Hemicryptophyte. Lagoon banks, swamps.

Isoetes killipii C.V. Morton

3200–3500 m asl. Native (Colombia, Ecuador, Guiana, Venezuela). Hemicryptophyte. Lagoon banks.

Isoetes novo-granadensis H.P. Fuchs

3700–4000 m asl. Native (Colombia, Ecuador, Peru). Hemicryptophyte. Flooded soils.

Lycopodiaceae: 2 genera, 18 species (4 endemic species of Ecuador).

Lycopodium clavatum L.

3200–3850 m asl. Native (Cosmopolitan). Rhizomatous geophyte. Bunchgrasses.

Lycopodium jussiaei Desv. ex Poir.

3200–4000 m asl. Native (Central America, South America). Rhizomatous geophyte. Bunchgrasses.

Lycopodium magellanicum (P. Beauv.) Sw.

3500–4300 m asl. Native (Caribbean, Costa Rica, South America). Rhizomatous geophyte. Disturbed bunchgrasses, roadsides.

Lycopodium vestitum Desv. ex Poir.

3200–3500 m asl. Native (Ecuador, Peru, Venezuela). Rhizomatous geophyte. Bunchgrasses.

Phlegmariurus capellae (Herter) B. Øllg.

3200–4000 m asl. Native (Colombia, Ecuador, Peru). Rhizomatous geophyte. Bunchgrasses.

Phlegmariurus columnaris (B. Øllg.) B. Øllg.

3200–4000 m asl. Native (Endemic to Ecuador). Rhizomatous geophyte. Bunchgrasses. VU B1ab(iii).

Phlegmariurus compactus (Hook.) B. Øllg.

3300–4100 m asl. Native (Endemic to Ecuador). Rhizomatous geophyte. Bunchgrasses. VU B1ab(iii).

Phlegmariurus crassus (Humb. & Bonpl. ex Willd.) B. Øllg.

3500–4200 m asl. Native (Bolivia, Colombia, Costa Rica, Ecuador, Guatemala, Panama, Peru, Venezuela). Rhizomatous geophyte. Wetlands.

Phlegmariurus eversus (Poir.) B. Øllg.

3200–3900 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Rhizomatous geophyte. Forests of *Polylepis*.

Phlegmariurus hippurideus (H. Christ) B. Øllg.

3800–4000 m asl. Native (Bolivia, Central America, Colombia, Ecuador, Peru, Venezuela). Rhizomatous geophyte. Forests of *Polylepis*.

Phlegmariurus hypogaeus (B. Øllg.) B. Øllg.

3700–4300 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Rhizomatous geophyte. Forests of *Polylepis*.

Phlegmariurus hystrix (Herter) B. Øllg.

3700–4200 m asl. Native (Colombia, Ecuador). Rhizomatous geophyte. Forests of *Polylepis*.

Phlegmariurus lindenii (Spring) B. Øllg.

3500–4300 m asl. Native (Colombia, Ecuador). Rhizomatous geophyte. Bunchgrasses.

Phlegmariurus polydactylus (B. Øllg.) B. Øllg.

3500–4000 m asl. Native (Endemic to Ecuador). Rhizomatous geophyte. Forests of *Polylepis*.

Phlegmariurus polylepidetorum (B. Øllg.) B. Øllg.

3500–4000 m asl. Native (Ecuador, Peru). Rhizomatous geophyte. Forests of *Polylepis*.

Phlegmariurus rufescens (Hook.) B. Øllg.

3500–4300 m asl. Native (Colombia, Ecuador, Venezuela). Rhizomatous geophyte. Bunchgrasses.

Phlegmariurus scabridus (B. Øllg.) B. Øllg.

3400–4000 m asl. Native (Endemic to Ecuador). Rhizomatous geophyte. Bunchgrasses. VU B1ab(iii).

Phlegmariurus talpiphilus (B. Øllg.) B. Øllg.

3400–3700 m asl. Native (Bolivia, Ecuador). Rhizomatous geophyte. Bunchgrasses. VU D2.

Selaginellaceae: 1 genus, 1 species.

Selaginella novae-hollandiae (Sw.) Spring

3500–3600 m asl. Native (South America). Rhizomatous geophyte. Bunchgrasses, wetlands.

POLYPODIOPSIDA: 13 families, 24 genera, 59 species (4 endemic species to Ecuador).

Aspleniaceae: 1 genus, 8 species.

Asplenium: 8 species.

Asplenium alatum Humb. & Bonpl. ex Willd.

3200–3800 m asl. Native (Central America, South America, Caribbean). Rhizomatous geophyte. Bunchgrasses.

Asplenium castaneum Schldt. & Cham.

3200–4300 m asl. Native (Central America, South America). Rhizomatous geophyte. Bunchgrasses, rocky places.

Asplenium heterochroum Kunze.

3100–3400 m asl. Native (America). Rhizomatous geophyte. Rocky places.

Asplenium monanthes L.

3100–3800 m asl. Native (Cosmopolitan). Rooted epiphyte. Forest–bunchgrass ecotone.

Asplenium peruvianum Desv.

3100–3800 m asl. Native (Argentina, Bolivia, Chile, Ecuador, Colombia, Peru, Venezuela). Rhizomatous geophyte. Rocky places.

Asplenium polyphyllum Bertol.

3200–3800 m asl. Native (Central America, Bolivia, Colombia, Ecuador, Venezuela). Rhizomatous geophyte. Bunchgrasses.

Asplenium sessilifolium Desv.

3100–3500 m asl. Native (America). Rooted epiphyte. Forest–bunchgrass ecotone.

Asplenium triphyllum C. Presl

3100–4000 m asl. Rhizomatous geophyte. Forests of *Polylepis*. Native (South America).

Blechnaceae: 1 genus, 2 species.*Blechnum loxense* (Kunth) Hook. ex Salomon

3400–3900 m asl. Native (Bolivia, Colombia, Costa Rica, Ecuador, Panama, Peru, Venezuela). Rhizomatous geophyte. Forests of *Polylepis*, bunchgrasses.

Blechnum schomburgkii (Klotzch) C. Chr.

3300–3500 m asl. Native (Bolivia, Colombia, Costa Rica, Ecuador, Guiana, Panama, Paraguay, Peru, Venezuela). Rhizomatous geophyte. Bunchgrasses edges.

Cystopteridaceae: 1 genus, 1 species.*Cystopteris fragilis* (L.) Bernh.

3800–3900 m asl. Native (Cosmopolitan). Rhizomatous hemicryptophyte. Bunchgrasses.

Dennstaedtiaceae: 1 genus, 1 species, endemic to Ecuador.*Hypolepis crassa* Maxon

3800–4000 m asl. Native (Endemic to Ecuador). Rhizomatous geophyte. Forests of *Polylepis*. DD

Dicksoniaceae: 2 genera, 2 species.*Dicksonia sellowiana* Hook.

3300–3500 m asl. Native (Central America, South America). Rhizomatous geophyte. Forest–bunchgrass ecotone.

Lophosoria quadripinnata (J.F. Gmel.) C. Chr.

3100–3600 m asl. Native (Caribbean, Central America, South America, Mexico). Rhizomatous geophyte. Forest–bunchgrass ecotone.

Dryopteridaceae: 3 genera, 14 species (2 endemic species to Ecuador).*Dryopteris wallichiana* (Spreng.) Hyl.

3300–3600 m asl. Native (Cosmopolitan). Rhizomatous geophyte. Forest–bunchgrass ecotone.

Elaphoglossum cardiophyllum (Hook.) Moore

3750–4000 m asl. Native (Endemic to Ecuador). Rhizomatous geophyte. Forests of *Polylepis*. DD

Elaphoglossum engelii (H. Karst.) Christ

3600–3900 m asl. Native (Bolivia, Dominican Republic, Colombia, Ecuador, Guatemala, Mexico, Panama, Peru, Costa Rica, Venezuela). Rhizomatous geophyte. Bunchgrasses.

Elaphoglossum hartwegii (Fée) T. Moore

3500–3800 m asl. Native (Bolivia, Colombia, Ecuador, Chile, Mexico, Costa Rica, Guatemala). Rhizomatous geophyte. Bunchgrasses.

Elaphoglossum lasioglottis Mickel

3700–3800 m asl. Native (Bolivia, Ecuador, Peru, Colombia). Rhizomatous geophyte. Bunchgrasses.

Elaphoglossum lindenii (Bory ex Fée) T. Moore

3300–3500 m asl. Native (Bolivia, Colombia, Costa Rica, Cuba, Ecuador, Guatemala, Mexico, Panama, Peru, Venezuela). Rhizomatous geophyte. Forests of *Polylepis lanuginosa*.

Elaphoglossum minutum (Pohl ex Fée) T. Moore

3600–4000 m asl. Native (Central America y South America). Rhizomatous geophyte. Bunchgrasses.

Elaphoglossum oreophilum A. Vasco

3700–4000 m asl. Native (Colombia, Ecuador). Rhizomatous geophyte. Forests of *Polylepis*.

Elaphoglossum ovatum (Hook. & Grev.) T. Moore

3700–3900 m asl. Native (Colombia, Ecuador, Venezuela). Rooted epiphyte. Forests of *Polylepis*.

Elaphoglossum paleaceum (Hook. & Grev.) Sledge
3100–3400 m asl. Native (Central America, Dominican Republic, Jamaica, Mexico, South America). Rooted epiphyte. Forests of *Polylepis lanuginosa*.

Elaphoglossum petiolosum (Desv.) T. Moore

3600–3800 m asl. Native (Bolivia, Colombia, Costa Rica, Ecuador, Peru). Rooted epiphyte. Forests of *Polylepis*.

Elaphoglossum rimbachii (Sodiolo) Christ

3700–3900 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Rooted epiphyte. Forests of *Polylepis*.

Elaphoglossum yatesii (Sodiolo) Christ

3700–4000 m asl. Native (Colombia, Ecuador, Peru). Rhizomatous geophyte. Forests of *Polylepis*. VU B1ab(iii).

Polystichum orbiculatum (Desv.) J. Rémy & Fée

3400–3800 m asl. Native (Bolivia, Costa Rica, Ecuador, Guatemala, Mexico, Peru, Venezuela). Rhizomatous geophyte. Bunchgrasses.

Equisetaceae: 1 genus, 1 species.*Equisetum bogotense* Kunth

3100–4000 m asl. Native (Costa Rica, Panama, South America). Rhizomatous geophyte/ Helogeophyte. Wetlands.

Hymenophyllaceae: 1 genus, 1 species.*Hymenophyllum undulatum* (Sw.) Sw.

3800–4000 m asl. Native (Bolivia, Caribbean, Central America, Colombia, Ecuador, Venezuela). Rhizomatous geophyte. Forests of *Polylepis*.

Ophioglossaceae: 1 genus, 1 species.*Ophioglossum crotalophoroides* Walter

3800–4000 m asl. Native (America). Rhizomatous geophyte. Well-preserved bunchgrasses, forests of *Polylepis*.

Plagiogyriaceae: 1 genus, 1 species.

Plagiogyria pectinata (Liebm.) Lellinger
3600–3750 m asl. Native (Central America, Bolivia, Colombia, Ecuador, Peru, Venezuela). Rhizomatous geophyte. Forests of *Polylepis*.

Polypodiaceae: 5 genera, 11 species (1 endemic species to Ecuador).

Campyloneurum amphostenon (Kunze ex Klotzsch) Fée
3100–4000 m asl. Native (Caribbean, Central America, South America). Rooted epiphyte. Forests of *Polylepis*.

Campyloneurum angustifolium (Sw.) Fée
3100–4300 m asl. Native (America). Rooted epiphyte. Forests of *Polylepis*.

Campyloneurum asplundii (C. Chr.) Ching
3300–3800 m asl. Native (Bolivia, Ecuador, Peru, Venezuela). Rooted epiphyte. Forests of *Polylepis lanuginosa*, bunchgrasses.

Campyloneurum solutum (Klotzsch) Fée
3300–4000 m asl. Native (South America). Rooted epiphyte. Forests of *Polylepis*.

Melpomene moniliformis (Lag. ex Sw.) A.R. Sm. & R.C. Moran

3400–4100 m asl. Native (Bolivia, Brazil, Caribbean, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru, Venezuela). Rhizomatous geophyte. Scrub of *Arcytophyllum vernicosum*.

Melpomene pseudonutans (Christ & Rosenst.) A.R. Sm. & R.C. Moran

3600–4000 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Rhizomatous geophyte. Bunchgrasses.

Peculuma curvans (Mett.) M.G. Price
3100–3700 m asl. Native (Bolivia, Ecuador, Peru, Colombia). Rhizomatous geophyte/ Rooted epiphyte. Roadsides, embankments, forests of *Polylepis*.

Pleopeltis macrocarpa (Bory ex Willd.) Kaulf.
3100–3500 m asl. Native (Cosmopolitan). Rhizomatous geophyte. Scrub of *Chusqueira* and *Diplostegium*.

Polypodium buchtienii Christ & Rosenst.
3300–4000 m asl. Native (Caribbean, Colombia, Costa Rica, Ecuador, Peru, Venezuela). Rhizomatous geophyte. Forests of *Polylepis*.

Polypodium mindense Sodiro
3400–3900 m asl. Endemic of Ecuador. Rooted epiphyte. Forests of *Polylepis*. LC.

Polypodium murorum Hook.
3300–4000 m asl. Native (Caribbean, Colombia, Costa Rica, Ecuador, Peru, Venezuela). Rhizomatous geophyte/Rooted epiphyte. Forests of *Polylepis*.

Pteridaceae: 5 genera, 12 species.

Adiantum poiretii Wikstr.
3300–3500 m asl. Native (Cosmopolitan). Rhizomatous geophyte. Bunchgrasses.

Cheilanthes bonariensis (Willd.) Proctor
3300–3500 m asl. Native (America). Rhizomatous geophyte. Bunchgrasses.

Jamesonia alstonii A.F. Tryon
3800–3900 m asl. Native (Bolivia, Colombia, Central America, Ecuador, Panama, Peru, Venezuela). Rhizomatous geophyte. Bunchgrasses.

Jamesonia boliviensis A.F. Tryon
3600–4400 m asl. Native (Bolivia, Ecuador). Rhizomatous geophyte. Scrub of *Loricaria ilinissae*, rocks.

Jamesonia cinnamomea Kunze
3700–3900 m asl. Native (Colombia, Ecuador). Rhizomatous geophyte. wetlands, bunchgrasses.

Jamesonia cheilanthoides (Sw.) Christenh.
3200–4000 m asl. Native (Bolivia, Brazil, Colombia, Ecuador, Peru). Rhizomatous geophyte. Bunchgrasses.

Jamesonia flexuosa (Kunth) Christenh.
3300–3500 m asl. Native (Bolivia, Central America, Colombia, Ecuador, Guiana, Peru, Venezuela). Rhizomatous geophyte. Bunchgrasses.

Jamesonia goudotii (Hieron.) C. Chr.
3700–4400 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Rhizomatous geophyte. Scrub of *Loricaria ilinissae*, rocky places.

Jamesonia hirta (Kunth) Christenh.
3200–4000 m asl. Native (Bolivia, Central America, Colombia, Ecuador, Peru, Venezuela). Rhizomatous geophyte. Bunchgrasses.

Jamesonia scammaniae A. Tryon
3800–3900 m asl. Native (Bolivia, Colombia, Costa Rica, Ecuador, Panama, Paraguay, Peru, Venezuela). Rhizomatous geophyte. Forests of *Polylepis*.

Pteris muricata Hook.
3200–3800 m asl. Native (Bolivia, Central America, Colombia, Ecuador, Panama). Rhizomatous geophyte. Bunchgrasses.

Vittaria moritziana Mett.
3300–3500 m asl. Native (Bolivia, Colombia, Costa Rica, Ecuador, Guiana, Panama, Venezuela, Peru). Cup-shaped epiphyte. Bunchgrasses.

Thelypteridaceae: 1 genus, 4 species.

Thelypteris caucaensis (Hieron.) Alston
3200–3600 m asl. Native (Bolivia, Colombia, Costa Rica, Ecuador, Guatemala, Peru). Rhizomatous geophyte. Bunchgrasses.

Thelypteris cheilanthoides (Kunze) Proctor
3800–3900 m asl. Native (Bolivia, Brazil, Central America, Colombia, Ecuador, Peru, Venezuela). Rhizomatous geophyte. Bunchgrasses, wetlands.

Thelypteris pilosula (Klotzsch & H. Karst. ex Mett.) R.M. Tryon
3200–4000 m asl. Native (Bolivia, Caribbean, Central America, Colombia, Ecuador, Panama, Peru, Venezuela). Rhizomatous geophyte. Bunchgrasses.

Thelypteris rosenstockii (C. Chr.) R.M. Tryon
3700–3800 m asl. Native (Colombia, Ecuador, Peru). Rhizomatous geophyte. Bunchgrasses, wetlands. VU B2.

GYMNOSPERMAE. GNETIDAE: 1 family, 1 genus, 2 species

Ephedraceae: 1 genus, 2 species.

Ephedra americana Humb. & Bonpl. ex Willd.
3300–3800 m asl. Native (Argentina, Bolivia, Ecuador, Peru, Venezuela). Fruticose chamaephyte. Bunchgrasses.

Ephedra rupestris Benth.
3700–4400 m asl. Native (Bolivia, Chile, Ecuador, Peru). Fruticose chamaephyte. Rocky super-páramo.

ANGIOSPERMAE: 72 families, 235 genera, 583 species (93 endemic species to Ecuador, 4 endemic species to Azuay, 9 endemic species to CNP).

Adoxaceae: 1genus, 1 species.

Viburnum triphyllum Benth.
3100–3700 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Forests–bunchgrasses ecotone.

Alstroemeriaceae: 1genus, 5 species.

Bomarea chimborazensis Baker
3150–4100 m asl. Native (Endemic to Ecuador). Climbing geophyte. Bunchgrasses, rocks. VU D2.

Bomarea glaucescens (Kunth) Baker
3100–4200 m asl. (Tomebamba, Taitachugo y Migüir). Native (Bolivia, Ecuador, Peru). Climbing geophyte. Scrub Páramo, bunchgrasses, forests of *Polylepsis*.

Bomarea multiflora (L. f.) Mirb.
3400–3800 m asl. Native (Bolivia, Colombia, Costa Rica, Ecuador, Peru, Venezuela). Climbing geophyte. Scrub páramo, forests of *Polylepsis*.

Bomarea setacea (Ruiz & Pav.) Herb.
3500–4000 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Rhizomatous geophyte. Bunchgrasses, rare inside the CNP.

Bomarea unciifolia Herb.
3500–3800 m asl. Native (Endemic to Ecuador). Climbing geophyte. Montane forest, forests of *Polylepsis*. NT.

Amaryllidaceae: 1genus, 1 species.

Stenomesson aurantiacum (Kunth) Herb.
3100–3900 m asl. (Pacific slope). Native (Ecuador, Peru). Bulbous geophyte. Forests of *Polylepsis*.

Apiaceae: 7 genera, 15 species.

Arracacia elata H. Wolff
3300–3800 m asl. Native (Colombia, Ecuador, Peru, Venezuela). Rhizomatous geophyte. Forests of *Polylepsis*, Bunchgrasses, montane forests.

Arracacia moschata (Kunth) DC.
3300–3800 m asl. Native (Colombia y Ecuador). Rhizomatous geophyte. Scrub páramo, forests of *Polylepsis*.

Azorella aretioides DC.

3700–4300 m asl. Native (Colombia, Ecuador). Pulviniform chamaephyte. *Plantago rigida* cushions.

Azorella biloba (Schltdl.) Wedd.

3300–4400 m asl. (Atlantic slope y cumbre). Native (Argentina, Bolivia, Colombia, Costa Rica, Ecuador, Peru). Pulviniform chamaephyte. Rocks, bunchgrasses.

Azorella corymbosa (Ruiz & Pav.) Pers.

4000–4400 m asl. Native (Colombia, Ecuador, Peru). Pulviniform chamaephyte. Rocky places. Rare in CNP.

Azorella crenata (Ruiz & Pav.) Pers.

3700 m asl. Native (Colombia, Ecuador, Peru, Venezuela). Pulviniform chamaephyte. Bunchgrasses, wetlands.

Azorella multifida (Ruiz & Pav.) Pers.

3200–4400 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Pulviniform chamaephyte. Bunchgrasses, rocks.

Azorella pedunculata (Spreng.) Mathias & Constance

3100–4400 m asl. Native (Colombia, Ecuador). Pulviniform chamaephyte. Bunchgrasses, wetlands.

Daucus montanus Humb. & Bonpl. ex Spreng.

3300–3800 m asl. Native (Central America, South America). Scapiform therophyte. Roadsides, bunchgrasses.

Eryngium humile Cav.

3100–4200 m asl. Native (Colombia, Costa Rica, Ecuador, Panama, Peru, Venezuela). Rosulate hemicryptophyte. Bunchgrasses, *Plantago rigida* cushions.

Lilaeopsis schaffneriana (Schltdl.) J.M. Coult. & Rose
3100–4200 m asl. Native (Bolivia, Colombia, Ecuador, Mexico, USA). Hydrogeophyte. Lagoons, ponds and streams.

Niphogeton azorelloides Mathias & Constance

3700–4100 m asl. Native (Ecuador, Peru). Scapiform hemicryptophyte. *Plantago rigida* cushions. Nomenclatural type: Ecuador: Azuay: páramo, near Toreadora, between Molleturo and Quinoas, alt. 3810–3930 m asl, 15 Jun 1943, J.A. Steyermark 53226, HT: F–1250146, Ecuador

Niphogeton dissecta (Benth.) J.F. Macbr.

3300–4000 masl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Scapiform hemicryptophyte. Scrub of *Loricaria ilinissae*, shallow places.

Niphogeton ternata (Willd. ex Schltr.) Mathias & Constance

3300–4100 m asl. (Atlantic slope). Native (Colombia, Ecuador, Venezuela). Scapiform hemicryptophyte. Scrub of *Loricaria ilinissae*, shallow places.

Oreomyrrhis andicola (Kunth) Endl. ex Hook f.

3600–4200 masl. Native (Argentina, Bolivia, Colombia, Costa Rica, Ecuador, Peru). Rosulate hemicryptophyte. *Plantago rigida* cushions, wet places.

Araliaceae: 1genus, 3 species.

Hydrocotyle bonplandii A. Rich.

3100–3700 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Creeping hemicryptophyte. Forests of *Polylepsis*.

- Hydrocotyle humboldtii* A. Rich.
3300–3800 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Creeping hemicryptophyte. Forests of *Polylepis*.
- Hydrocotyle leucocephala* Cham. & Schldl.
3300–3800 m asl. (Atlantic slope). Native (Central and South America). Hemicryptophyte. Flooded places.
- Asteraceae:** 44 genera, 111 species (29 endemic species to Ecuador, 1 endemic to Azuay, 2 endemics to CNP).
- Achyrocline alata* (Kunth) DC.
3500–4200 m asl. (Atlantic slope). Native (Bolivia, Brazil, Colombia, Ecuador, Peru). Scapiform hemicryptophyte. Roadsides, bunchgrasses.
- Achyrocline hallii* Hieron.
3300–3700 m asl. Native (Endemic to Ecuador). Scapiform hemicryptophyte. Roadsides, forests–scrub ecotone, bunchgrasses. VU D2.
- Aetheolaena rosana* (Cuatrec.) B. Nord.
3300–3650 m asl. Native (Endemic to Ecuador). Suffruticose chamaephyte. Forests of *P. lanuginosa*, scrubs. VU B1.
- Ageratina glandulifera* (Hieron.) R.M. King & H. Rob.
3300–3600 m asl. (Pacific slope, Migüir river basin). Native (Ecuador) Suffruticose chamaephyte. Scrub–bunchgrass ecotone.
- Ageratina rhyodes* (B.L. Rob.) R.M. King & H. Rob.
3400–4100 m asl. Native (Endemic to Ecuador). Suffruticose chamaephyte. Dense bunchgrasses, Angas and Taitachugo river bassins.
- Ageratina pichinchensis* (Kunth) R.M. King & H. Rob.
3100–3500 m asl. (Pacific slope, Angas river basin). Native (Colombia, Ecuador, Guatemala, Honduras, Mexico, Panama, Peru, Venezuela). Suffruticose chamaephyte. High Andean forest, scrub, bunchgrasses.
- Aphelandra soniana* Wedd.
3600–4200 m asl. Native (Colombia, Ecuador). Creeping hemicryptophyte. Bunchgrasses. LC.
- Aphanactis villosa* S.F. Blake
3600–4200 m asl. (Atlantic slope). Native (Ecuador, Peru). Scapiform hemicryptophyte. Disturbed bunchgrasses.
- Aristeguietia glutinosa* (Lam.) R.M. King & H. Rob.
3100–3600 m asl. Native (Endemic to Ecuador). Microphanerophyte. Scrub. LC.
- Baccharis alaternoides* Kunth
3300–4000 m asl. Native (Ecuador, Peru). Microphanerophyte. Forests of *Polylepis*, bunchgrasses.
- Baccharis alpina* Kunth
3300–4400 m asl. Native (Argentina, Bolivia, Colombia, Chile, Ecuador, Peru). Creeping hemicryptophyte. Disturbed bunchgrasses, *Plantago rigida* cushions, rocky places.
- Baccharis arbutifolia* Vahl.
3300–3900 m asl. Native (Endemic to Ecuador). Microphanerophyte. Wet bunchgrasses.
- Baccharis buxifolia* (Lam.) Pers.
3100–4300 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Microphanerophyte. Bunchgrasses, Montane forest.
- Baccharis caespitosa* (Ruiz & Pav.) Pers.
3200–4400 m asl. frequent over 3800 m asl. Native (Bolivia, Colombia, Chile, Ecuador, Peru). Creeping hemicryptophyte. Open bunchgrasses, *Plantago rigida* cushions, rocky places.
- Baccharis genistelloides* (Lam.) Pers.
3100–3900 m asl. Native (South America). Microphanerophyte. Bunchgrasses, forests of *Polylepis*.
- Baccharis hieronymi* Heering
3100–3500 m asl. Native (Endemic to Azuay, Cañar). Microphanerophyte. High Andean forest, rare inside páramo. VU D2.
- Baccharis huairacajensis* Hieron.
3300–3600 m asl. Native (Endemic to Ecuador). Nanophanerophyte. High Andean forest–scrub ecotone, bunchgrasses. VU D2.
- Baccharis latifolia* (Ruiz & Pav.) Pers.
3100–4000 m asl. (Atlantic slope). Native (Argentina, Bolivia, Colombia, Ecuador, Peru, Venezuela). Microphanerophyte. Forests–bunchgrass ecotone.
- Baccharis macrantha* Kunth
3100–4200 m asl. Native (Colombia, Ecuador). Microphanerophyte. Bunchgrasses.
- Baccharis paramicola* Cuatrec.
3300–3600 m asl. Native (Colombia y Ecuador). Fruticose chamaephyte. Wet bunchgrasses, wetlands.
- Baccharis prunifolia* Kunth
3300–3700 m asl. Native (Colombia, Ecuador, Peru, Venezuela). Microphanerophyte. Scrub páramo, bunchgrasses.
- Baccharis teindalensis* Kunth
3300–4000 m asl. Native (Colombia, Ecuador). Microphanerophyte. Scrub páramo, bunchgrasses.
- Baccharis tricuneata* (L. f.) Pers.
3400–4000 m asl. Native (Argentina, Bolivia, Colombia, Ecuador, Peru, Venezuela). Microphanerophyte. Disturbed bunchgrasses, scrub of *Arcytophyllum vernicosum*.
- Badilloa salicina* (Lam.) R.M. King & H. Rob.
3200–3800 m asl. (only one collection at Toreadora 3700). Native (Colombia, Ecuador, Venezuela). Microphanerophyte. Forests of *Polylepis*.
- Barnadesia aculeata* (Benth.) I.C. Chung
3300–3600 m asl. (Pacific slope). Native (Endemic to Ecuador). Microphanerophyte. Scrub. VU B2.
- Belloa longifolia* (Cuatrec. & Aristeg.) Sagást. & M.O. Dillon
3400–4000 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Rosulate hemicryptophyte. Scrub of *Arcytophyllum vernicosum*. Rocky places.
- Bidens andicola* Kunth
3200–4000 m asl. Native (Argentina, Bolivia, Colombia, Ecuador, Peru, Venezuela). Suffruticose chamaephyte. Scrub of *Arcytophyllum vernicosum*, rocky places, bunchgrasses, disturbed places.
- Bidens triplinervia* Kunth
3200–4000 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Scapiform hemicryptophyte. Scrub of *Arcytophyllum vernicosum*, disturbed bunchgrasses.

- Cacosmia hieronymi* H. Rob.
3100–3500 m asl. Native (Endemic to Azuay, Cañar, Loja). Nanophanerophyte. Lower edge of páramo. VU B1ab(iii).
- Chaptalia cordata* Hieron.
3300–3900 m asl. Native (Colombia, Ecuador, Peru). Rosulate hemicryptophyte. Bunchgrasses.
- Chaptalia stuebelii* Hieron.
3100–3400 m asl. Native (Colombia, Ecuador). Rosulate hemicryptophyte. High Andean forest–bunchgrass ecotone.
- Chevreulia acuminata* Less.
3400–3750 m asl. Native (South America). Scapiform hemicryptophyte. Bunchgrasses.
- Chrysactinium acaule* (Kunth) Wedd.
3400–4000 m asl. (both slopes and summit). Native (Ecuador, Peru). Rosulate hemicryptophyte. Bunchgrasses.
- Chrysactinium hieracioides* (Kunth) H. Rob. & Brettell
3400–4000 m asl. (Atlantic slope). Native (Ecuador, Peru). Scapiform hemicryptophyte. Forests of *Polylepis*–bunchgrass ecotone.
- Chuquiraga jussieui* J.F. Gmel.
3300–4300 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Nanophanerophyte. Scrub of *Arcytophyllum vernicosum*, bunchgrasses.
- Cotula australis* (Sieber ex Spreng.) Hook. f.
3200–4200 m asl. Alien (Cosmopolitan). Scapiform therophyte/Scapiform hemicryptophyte. Wetlands, wet bunchgrasses.
- Cotula mexicana* (DC.) Cabrera
3200–4000 m asl. Native (Argentina, Bolivia, Chile, Colombia, Costa Rica, Ecuador, Mexico, Panama, Peru, Venezuela). Scapiform hemicryptophyte. Bunchgrasses.
- Cuatrecasasiella isernii* (Cuatrec.) H. Rob.
3200–4200 m asl. Native (Ecuador, Peru). Creeping hemicryptophyte. Wetlands.
- Dendrophorbium pericaule* (Greenm.) B. Nord.
3300–3900 m asl. Native (Endemic to Azuay, Loja). Fruticose chamaephyte. Forests of *Polylepis*. VU D2.
- Diplostephium ericoides* (Lam.) Cabrera
3500–4100 m asl. Native (Ecuador, Peru). Nanophanerophyte. Rocky places, scrub. LC.
- Diplostephium espinosae* Cuatrec.
3800–4100 m asl. Native (Ecuador, Peru). Nanophanerophyte. Forests of *Polylepis*–bunchgrass ecotone. Rare in CNP.
- Diplostephium glandulosum* Hieron.
3800–4100 m asl. Native (Colombia, Ecuador). Nanophanerophyte. Bunchgrasses, summit areas.
- Diplostephium hartwegii* Hieron.
3600–4000 m asl. Native (Colombia, Ecuador). Nanophanerophyte. Bunchgrasses.
- Diplostephium macrocephalum* S.F. Blake
3800–4000 m asl. Native (Endemic to Ecuador). Nanophanerophyte. Bunchgrasses, forests of *Polylepis*.
- Diplostephium oblanceolatum* S.F. Blake.
3500–4000 m asl. Native (Endemic to Ecuador). Nanophanerophyte. Bunchgrasses, scrubs.
- Diplostephium rupestre* (Kunth) Wedd.
3800–4200 m asl. Native (Colombia, Ecuador). Nanophanerophyte. Rocky places, scrub.
- Diplostephium sagasteguii* Cuatrec.
3700–4000 m asl. (Summit area near Soldados). Native (Ecuador, Peru). Nanophanerophyte. *Plantago rigida* cushions, scrub. NT.
- Dorobaea laciniata* B. Nord. & Pruski
3300–4000 m asl. Native (Ecuador, Peru). Rosulate hemicryptophyte. Wet bunchgrasses, scrubs, rocky places.
- Dorobaea pimpinellifolia* (Kunth) B. Nord.
3300–3800 m asl. Native (Colombia, Ecuador, Peru). Rosulate hemicryptophyte. Wet bunchgrasses, scrubs, rocky places.
- Erigeron ecuadoriensis* Hieron.
3400–3800 m asl. (Atlantic slope). Native (Colombia, Ecuador, Peru). Rosulate hemicryptophyte. Burned bunchgrasses.
- Gamochaeta americana* (Mill.) Wedd.
3600–4000 m asl. Native (Cosmopolitan). Scapiform hemicryptophyte/Scapiform therophyte. Bunchgrasses, disturbed wetlands.
- Gerbera hieracioides* (Kunth) Zardini
3300–3450 m asl. Native (Ecuador, Peru). Rosulate hemicryptophyte. Scrubs.
- Gnaphalium chimborazense* Hieron.
3800–4200 m asl. (Pacific slope). Native (Endemic to Ecuador). Scapiform hemicryptophyte. Bunchgrasses, rocky places. Vu D2.
- Gnaphalium dombeyanum* DC.
3300–3900 m asl. (Pacific slope). Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Scapiform hemicryptophyte/Scapiform therophyte. Bunchgrasses.
- Gnaphalium tenue* Kunth
3400–3600 m (Atlantic slope). Native (Cosmopolitan). Scapiform hemicryptophyte/Scapiform therophyte. Bunchgrasses.
- Grosvenoria hypargyra* (B.L. Rob.) R.M. King & H. Rob.
3500–3800 m asl. Native (Endemic to Ecuador). Microphanerophyte. High Andean forests–bunchgrass ecotone, disturbed places. VU B1ab(iii).
- Guevaria sodiroi* R.M. King & H. Rob.
3500–3600 m asl. Native (Ecuador, Peru). Rhizomatous hemicryptophyte. Well–preserved bunchgrasses.
- Gynoxys baccharoides* (Kunth) Cass.
3300–4000 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Microphanerophyte. *Polylepis*–scrub ecotone, bunchgrasses. VU D2.
- Gynoxys buxifolia* (Kunth) Cass.
3300–4100 m asl. Native (Colombia, Ecuador, Peru). Microphanerophyte. Forests of *Polylepis*, scrub of *Chuquiraga*.
- Gynoxys cuicochensis* Cuatrec.
3300–4000 m asl. Native (Endemic to Ecuador). Microphanerophyte. Bunchgrasses, shallow soils.
- Gynoxys ferreyrae* B. Herrera
3300–3800 m asl. Native (Ecuador, Peru). Microphanerophyte. Forests of *Polylepis* (Rare in CNP).

- Gynoxys hallii* Hieron.
3400–3800 m asl. Native (Endemic to Ecuador).
Microphanerophyte. Bunchgrasses, forests of
Polylepis. LC.
- Gynoxys miniphylla* Cuatrec.
3400–4100 m, registrada en todas las subcuencas.
Native (Endemic to Ecuador). Nanophanerophyte.
Thick bunchgrasses, *Polylepis* forests edges.
- Gynoxys parvifolia* Cuatrec.
3600–3800 m asl. Native (Colombia, Ecuador).
Nanophanerophyte. Forests of *Polylepis*.
- Hieracium erianthum* Kunth
3600 m asl. Native (Colombia, Ecuador, Venezuela).
Climbing hemicryptophyte. Bunchgrasses. Rare.
- Hieracium frigidum* Wedd.
3700–4000 m asl. Native (Argentina, Bolivia,
Colombia, Ecuador, Peru, Venezuela). Climbing
hemicryptophyte. Rocky places, bunchgrasses.
- Hieracium sodiroanum* Zahn
3700–4100 m asl. (Burines river basin). Native
(Endemic to Ecuador). Climbing hemicryptophyte.
Bunchgrasses.
- Hypochoeris sessiliflora* Kunth
3200–4100 m asl. Native (Bolivia, Colombia, Ecuador,
Peru, Venezuela). Rosulate hemicryptophyte.
Disturbed places, bunchgrasses, wetlands.
- Kaunia pachanoi* (B.L. Rob.) R.M. King & H. Rob.
3300–3500 m asl. Native (Endemic to Ecuador).
Microphanerophyte. High Andean forest–bunchgrass
ecotone. EN B1ab(iii).
- Lasiocephalus involucratus* (Kunth) Cuatrec.
3600–4000 m asl. Native (Colombia, Ecuador,
Peru). Scapiform hemicryptophyte. Bunchgrasses.
Syn.: *Aetheolaena involucrata* (Kunth) B. Nord.
(Jørgensen, P. m asl. & S. León-Yáñez 1999)
- Lasiocephalus lingulatus* Schltldl.
4000–4300 m asl. Native (Endemic to Ecuador).
Suffruticose chamaephyte. Bunchgrasses. Syn.:
Aetheolaena lingulata (Schltldl.) B. Nord (Jørgensen,
P. m asl. & S. León-Yáñez 1999)
- Lasiocephalus otophorus* (Wedd.) Cuatrec.
3300–3600 m asl. Native (Colombia, Ecuador,
Peru). Nanophanerophyte. Bunchgrasses. Syn.:
Aetheolaena otophora (Wedd.) B. Nord. (Jørgensen,
P. m asl. & S. León-Yáñez 1999)
- Lasiocephalus ovatus* Schltldl.
3300–3600 m asl. Native (Colombia, Ecuador).
Nanophanerophyte. Bunchgrasses.
- Leucanthemum maximum* (Ramond) DC.
3300–3400 m asl. Alien and cultivated. Suffruticose
chamaephyte. Roads and trails.
- Llerasia assuensis* (Kunth) Cuatrec.
3400–3500 m asl. Native (Endemic to Ecuador).
Microphanerophyte. Bunchgrasses, close to trails.
VU B1ab(iii).
- Llerasia hypoleuca* (Turcz.) Cuatrec.
3400–4000 m asl. Native (Colombia, Ecuador).
Microphanerophyte. Forests of *Polylepis*.
- Llerasia lindenii* Triana
3400–4000 m asl. (western slope). Native
(Colombia, Ecuador). Microphanerophyte.
Bunchgrasses.
- Loricaria azuayensis* Cuatrec.
3700–4100 m asl. Native (Endemic to Cajas).
Nanophanerophyte. Wetlands, *Plantago rigida*
cushions. EN B1ab(iii). Nomenclatural type:
Ecuador: Azuay: paramos in vicinity of Toreador,
between Molleturo and Quinoas, 3810–3930 m asl,
collect. June 15, 1943, Steyermark, J.A. 53210, HT:
F, Endemic.
- Loricaria cinerea* D.J.N. Hind
3800 m asl. (Luspa). Native (Endemic to Cajas).
Nanophanerophyte. Bunchgrasses. DD.
Nomenclatural type: Ecuador. Azuay: Occidental
Range, 20 km W of Cuenca, L. Luspa, El Cajas
National Recreation Area, 3800 m, 19 Aug 1985,
Ramsay & Merrow–Smith 122, HT: K; IT: QCNE
- Loricaria ferruginea* (Ruiz & Pav.) Wedd.
3700–4100 m asl. Native (Ecuador, Peru).
Nanophanerophyte. Bunchgrasses, wet places.
- Loricaria ilinissae* (Benth.) Cuatrec.
4000–4400 m asl. (Burines, Osohuayco, Patul, Tres
Cruces). Native (Endemic to Ecuador).
Nanophanerophyte. Super-páramo, on non-rock
soils. Dominant species in this habitat. DD
- Loricaria leptothamna* (Matf.) Cuatrec.
3800 m asl (Soldados). Native (Ecuador, Peru).
Nanophanerophyte. Forests of *Polylepis*, wetlands.
- Loricaria thuyoides* (Lam.) Sch. Bip.
3700–4100 m asl. Native (Bolivia, Colombia,
Ecuador, Peru). Nanophanerophyte. Disturbed
bunchgrasses.
- Luciliocline lopezmirandae* (Cabrera) Anderb. & S.E.
Freire
3400–3700 m asl. Native (Argentina, Bolivia, Ecuador,
Peru). Scapiform hemicryptophyte. Bunchgrasses.
- Monticalia andicola* (Turcz.) C. Jeffrey
3900–4300 m asl. Native (Colombia, Costa
Rica, Ecuador, Panama, Peru, Venezuela).
Nanophanerophyte. Scrub of *Loricaria*, rocky places.
- Monticalia arbutifolia* (Kunth) C. Jeffrey
3700–4100 m asl. Native (Colombia, Ecuador).
Microphanerophyte. Bunchgrasses, forest of
Polylepis. Syn.: *Pentacalia arbutifolia* (Kunth)
Cuatrec.
- Monticalia empetroides* (Cuatrec.) C. Jeffrey
3200–3900 m asl. Native (Ecuador, Peru).
Microphanerophyte. Bunchgrasses, forests of
Polylepis. Syn.: *Pentacalia empetroides* (Cuatrec.)
Cuatrec
- Monticalia myrsinites* (Turcz.) C. Jeffrey
3600–4100 m asl. Native (Endemic to Ecuador).
Nanophanerophyte. Bunchgrasses, scrub, wet places.
LC.
- Monticalia nitida* (Kunth) C. Jeffrey
3700 m asl. (Pacific slope). Native (Colombia,
Ecuador). Nanophanerophyte. Bunchgrasses, forests
of *Polylepis*.
- Monticalia peruviana* (Pers.) C. Jeffrey
3600–4000 m asl. (Atlantic slope). Native (Ecuador,
Peru). Nanophanerophyte. More or less disturbed
bunchgrasses. Syn.: *Pentacalia peruviana* (Pers.)
Cuatrec.

- Monticalia vaccinioides* (Kunth) C. Jeffrey
3400–4200 m asl. Native (Colombia, Ecuador, Venezuela). Nanophanerophyte. Bunchgrasses, rocky places.
- Mutisia alata* Hieron.
3100–3700 m asl. Native (Ecuador, Peru). Climbing liana. High Andean forest–bunchgrass ecotone, forests of *Polylepis*.
- Mutisia lehmannii* Hieron.
3100–3700 m asl. Native (Endemic to Ecuador). Climbing liana. High Andean forest–bunchgrass ecotone, forests of *Polylepis*. EN B1ab(iii).
- Oritrophium crocifolium* (Kunth) Cuatrec.
3400–4200 m asl. Native (Ecuador, Peru). Scapiform hemicryptophyte. Wet bunchgrasses pools.
- Oritrophium limnophilum* (Sch. Bip.) Cuatrec.
3600–4100 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Scapiform hemicryptophyte. *Plantago rigida* cushions. pools, lagoon banks.
- Oritrophium peruvianum* (Lam.) Cuatrec.
3500–4100 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Scapiform hemicryptophyte. Swamps, flooded places, pools, lagoon banks.
- Oritrophium tergoalbum* (Cuatrec.) Cuatrec.
3800–4000 m asl (Osohuayco). Native (Endemic to Azuay. Two populations: Oña and CNP). Scapiform hemicryptophyte. Wetlands, *Plantago rigida* cushions. EN B1ab(iii).
- Perezia multiflora* (Bonpl.) Less.
3200–3800 m asl (Pacific slope). Native (Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Peru). Scapiform hemicryptophyte. Bunchgrasses.
- Perezia pungens* (Bonpl.) Less.
3600–4300 m asl. Native (Argentina, Bolivia, Chile, Colombia, Ecuador, Peru). Scapiform hemicryptophyte. Bunchgrasses, scrub, rocky places.
- Plagiocheilus frigidus* Poepp.
3800–3900 m asl. Native (Ecuador, Peru). Rhizomatous hemicryptophyte. Bunchgrasses, rare inside CNP.
- Plagiocheilus soliviformis* DC.
3800–4000 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Scapiform hemicryptophyte. Bunchgrasses, rare inside CNP.
- Senecio chionogeton* Wedd.
3600–4200 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Scapiform hemicryptophyte. Bunchgrasses, scrub of *Gynoxys*.
- Senecio culcitioides* Sch. Bip.
4000–4300 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Scapiform hemicryptophyte. Rocky places.
- Senecio josei* Sklenář
3700–3900 m asl. Native (Endemic of Ecuador). Scapiform hemicryptophyte. Scrub of *Arcytophyllum vernicosum*, *Gynoxys*, rocky places. DD
- Senecio tephrosioides* Turcz.
3600–4000 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Scapiform hemicryptophyte. Bunchgrasses.
- Smallanthus fruticosus* (Benth.) H. Rob.
3500–3600 m (Angas). Native (Colombia, Ecuador, Peru). Fruticose chamaephyte. Forests of *Polylepis lanuginosa*.
- Werneria nubigena* Kunth
3600–4000 m asl. Native (Bolivia, Central America, Colombia, Ecuador, Peru). Rosulate hemicryptophyte. Disturbed bunchgrasses.
- Werneria pumila* Kunth
3800–4200 m asl. Native (Endemic to Ecuador). Rosulate hemicryptophyte. Scrub of *Arcytophyllum vernicosum*, rocky places, edges of bunchgrasses. LC.
- Werneria pygmaea* Gillies ex Hook. & Arn.
3800–4100 m asl. Native (Argentina, Bolivia, Chile, Colombia, Ecuador, Peru, Venezuela). Rosulate hemicryptophyte. Wetlands, flooded soils, *Plantago rigida* cushions.
- Xenophyllum humile* (Kunth) V.A. Funk
3500–4400 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Pulviniform chamaephyte. Wet bunchgrasses, wet places.
- Xenophyllum roseum* (Hieron.) V.A. Funk
3700–4300 m asl. Native (Endemic to Cajas). Pulviniform chamaephyte. Wetlands, *Plantago rigida* cushions. VU D2. Nomenclatural type: Ecuador, Lehmann, F.C. 5687, B destr.; LT: K; ILT: US, MA; photo: F, GH, NY, US (all of B).
- Basellaceae:** 1genus, 1 species.
- Tournonia hookeriana* Moq.
3300–3600 m asl. Native (Colombia, Ecuador). Supported liana. Scrub, bunchgrasses.
- Berberidaceae:** 1genus, 4 species (1 endemic species to Ecuador).
- Berberis lutea* Ruiz & Pav.
3200–4100 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Microphanerophyte. Forests of *Polylepis*, bunchgrasses.
- Berberis pichinchensis* Turcz.
3200–3800 m asl. Native (Colombia, Ecuador). Microphanerophyte. Forests of *Polylepis*, bunchgrass.
- Berberis pindilicensis* Hieron.
3100–3500 m asl. Native (Endemic to Ecuador). Microphanerophyte. High Andean forest–bunchgrass ecotone. VU D2.
- Berberis rigida* Hieron.
3300–4100 m (Atlantic slope). Native (Colombia, Ecuador). Microphanerophyte. Forests of *Polylepis*, bunchgrasses, *Plantago rigida* cushions.
- Boraginaceae:** 5 genera, 7 species (1 endemic species to Azuay).
- Cynoglossum amabile* Stapf & J.R. Drumm.
3800–3900 m asl. Alien. Rhizomatous geophyte. Forests of *Polylepis* near Toreadora.
- Hackelia mexicana* (Schltdl. & Cham.) I.M. Johnst.
3300–4000 m asl. (Atlantic slope). Native (Central America, Bolivia, Colombia, Ecuador, Peru,

Venezuela). Rhizomatous geophyte. Forest, Bunchgrasses.

Lithospermum azuayensis Weigend & Nürk
3300–3700 m asl. Native (Endemic to Azuay).
Rhizomatous geophyte. Bunchgrasses. DD

Lithospermum cinerascens (A. DC.) I.M. Johnst.
3500 m asl. Native (Ecuador, Peru). Rhizomatous
geophyte. Bunchgrasses (only one record from the CNP).

Plagiobothrys linifolius (Willd. ex Lehm.) I.M. Johnst.
3700–3800 m asl. (Pacific slope). Native
(Colombia, Ecuador). Rhizomatous geophyte.
Bunchgrasses, rare inside CNP.

Tournefortia fuliginosa Kunth
3300–3600 m asl. (Migüir). Native (Bolivia,
Colombia, Ecuador, Peru, Venezuela). Microphaner-
ophyte. High Andean forest bunchgrass ecotone.

Tournefortia polystachya Ruiz & Pav.
3300–3500 m asl. (Angas). Native (Bolivia, Colombia,
Ecuador, Peru, Venezuela). Microphanerophyte.
Disturbed forests of *Polylepis lanuginosa* (Rare in
CNP).

Brassicaceae: 8 genera, 20 species (8 endemic species
to Ecuador, 1 endemic to CNP).

Brayopsis colombiana Al-Shehbaz
4100–4400 m asl. Native (Colombia, Ecuador).
Pulviniform chamaephyte. *Plantago rigida* cushions,
rocky places.

Cardamine bonariensis Pers.
3300–3950 m asl. Native (Central and South
America). Helohemicryptophyte. Wetlands, *Plantago*
rigida cushions, flooded places

Cardamine jamesonii Hook.
3400–3900 m asl. Native (Colombia, Ecuador,
Venezuela). Scapiform hemicryptophyte. Forests of
Polylepis.

Diplotaxis tenuifolia (L.) DC.
3300–3900 m asl. Alien (Cosmopolitan). Scapiform
hemicryptophyte. Disturbed bunchgrasses, close to
trails.

Draba alyssoides Humb. & Bonpl.
3800–4200 m asl. (Pacific slope and summit of the
range). Native (Colombia, Ecuador, Peru, Venezuela).
Suffruticose chamaephyte/Pulviniform chamaephyte.
Bunchgrasses.

Draba aretioides Kunth
4000–4200 m asl. Native (Endemic to Ecuador).
Suffruticose chamaephyte/Pulviniform chamaephyte.
Rocky places, rare in CNP.

Draba ecuadoriana Al-Shehbaz
3800–4200 m asl. Native (Endemic to Ecuador).
Pulviniform chamaephyte. Bunchgrasses, rocky
places. EN B2ab(iii).

Draba hallii Hook. f.
4000–4300 m asl. Native (Colombia, Ecuador).
Suffruticose chamaephyte. Bunchgrasses.

Draba schusteri O.E. Schulz
3900–4000 m asl. (Soldados). Native (Ecuador,
Peru). Pulviniform chamaephyte. Rocky places, wet
bunchgrasses.

Draba splendens Gilg
3950–4300 m asl. Native (Endemic to Ecuador).
Suffruticose chamaephyte. Rocky places. VU B1ab(iii).

Draba steyermarkii Al-Shehbaz
3700–4300 m asl. Native (Endemic to CNP).
Suffruticose chamaephyte. Rocky places, scrubs of
Loricaria, forest of *Polylepis*, bunchgrasses. VU
D2. Nomenclatural type: Ecuador: Azuay: paramos,
in vicinity of Toreador, between Molleturo and
Quinoas, 3,810–3,930 m, 15 June 1942, Steyermark
53077, HT: F; IT: GH, MO, NY, S, Ecuador

Draba stylosa Turcz.
3700–4300 m asl. (Pacific slope). Native (Endemic
to Ecuador). Suffruticose chamaephyte. Rocky
places. VU B2ab(iii).

Draba violacea Humb. & Bonpl.
3900–4000 m als. (northern side of CNP). Native
(Endemic to Ecuador). Suffruticose chamaephyte.
Wet bunchgrasses, *Plantago rigida* cushions. VU
B2ab(iii).

Eudema nubigena Bonpl.
4000–4400 m asl. Native (Endemic to Ecuador).
Pulviniform chamaephyte. Rocky places. VU B2ab (iii).

Eudema rupestris Bonpl.
3800–4100 m (Soldados). Native (Endemic to Ecuador).
Pulviniform chamaephyte. Wet bunchgrasses, *Plantago*
rigida cushions, EN B1ab(iii).

Lepidium abrotanifolium Turcz.
3500–4100 m asl. Native (Bolivia, Ecuador, Peru).
Scapiform hemicryptophyte. Forests of *Polylepis*,
rocky places.

Lepidium bipinnatifidum Desv.
3100–3800 m asl. Native (Bolivia, Chile,
Colombia, Ecuador, Peru, Venezuela). Scapiform
hemicryptophyte. Forests of *Polylepis*, High Andean
forest.

Lepidium ecuadoriense Thell.
4100–4400 m asl. Native (Endemic to Ecuador).
Scapiform hemicryptophyte. Scrub of *Loricaria*
ilinissae, rocky places. VU B2ab(iii).

Raphanus sativus L.
3300–3900 m asl. Alien, cultivated. Scapiform
therophyte/Scapiform hemicryptophyte. Trails on
bunchgrasses.

Rorippa nasturtium-aquaticum (L.) Hayek
3300–3900 m asl. Alien (Cosmopolitan).
Hydrogeophyte/Rhizomatous geophyte. Streams,
flooded places. Syn.: *Nasturtium officinale* W.T. Aiton

Bromeliaceae: 3 genera, 8 species (3 endemic species
to Ecuador).

Greigia mulfordii L.B. Sm.
3900–4100 m asl. Native (Colombia, Ecuador).
Rosulate chamaephyte. Wet bunchgrasses. VU (2001).

Puya cajasensis Manzan. & W. Till
3800–4100 m asl. (Atlantic slope). Native (Ecuador,
Peru). Rosulate chamaephyte. Wet bunchgrasses.
Nomenclatural type: Ecuador. Azuay: Parque
Nacional Cajas, 4010 m., J.M. Manzanares 7719,
HT: QCNE; IT: WU, Ecuador

Puya clava-herculis Mez & Sodiro
3600–3800 m asl (Atlantic slope). Native (Colombia, Ecuador). Rosulate chamaephyte. Wet bunchgrasses.

Puya compacta L.B. Sm.
3400–3950 m asl. Native (Endemic to Azuay, Loja). Rosulate chamaephyte. Scrub of *Arcytophyllum vernicosum*, disturbed forests of *Polylepis*. CR A4c. Nomenclatural type: Ecuador. Prov. Azuay: common on paramos and on flat open ground at lower elevations, Quinoas to Sayausí, 2740–3290 m asl. 16 Jun 1943., Steyermark 53256, HT: GH; IT: F.

Puya hamata L.B. Sm.
3300–3900 m (Mazán, Quinoas). Native (Colombia, Ecuador, Peru). Rosulate chamaephyte. Scrub, bunchgrasses.

Puya maculata L.B. Sm.
3900–3950 m (Rare in CNP). Native (Endemic to Ecuador). Rosulate chamaephyte. Scrub of *Arcytophyllum vernicosum*, forests edges of *Polylepis*. CR A4c.

Puya pygmaea L.B. Sm.
3200–3500 m (Rare in CNP). Native (Endemic to Ecuador). Rosulate chamaephyte. Bunchgrasses. CR A4c.

Tillandsia complanata Benth.
3100–3500 m asl. Native (Bolivia, Brazil, Caribbean, Colombia, Costa Rica, Ecuador, Guiana, Panama, Peru, Venezuela). Rooted epiphyte. Scrub. LC (2006).

Calceolariaceae: 1 genus, 5 species (1 endemic species to Ecuador).

Calceolaria ericoides Vahl
3100–3700 m (Pacific slope). Native (Ecuador, Peru). Nanophanerophyte. Forest and bunchgrasses.

Calceolaria helianthemoides Kunth
3100–3500 m (Pacific slope). Native (Endemic to Ecuador). Fruticose chamaephyte. High Andean forest–bunchgrass ecotone. NT (2004)

Calceolaria mexicana Benth.
3100–3800 m (Atlantic slope). Native (Central America, Bolivia, Colombia, Ecuador, Peru, Venezuela). Fruticose chamaephyte. Forest and Bunchgrasses.

Calceolaria nivalis Kunth
3100–3600 m asl. Native (Ecuador, Peru). Nanophanerophyte. High Andean forest–bunchgrass ecotone.

Calceolaria rosmarinifolia Lam.
3100–3850 m asl. Native (Ecuador, Peru). Fruticose chamaephyte. High Andean forest–bunchgrass ecotone, forests of *Polylepis*.

Campanulaceae: 2 genera, 7 species (1 endemic species to Ecuador, 1 endemic to Azuay, 1 endemic to CNP).

Lobelia tenera Kunth
3300–3750 m asl. Native (Colombia, Ecuador, Peru, Venezuela). Climbing hemicryptophyte. Bunchgrasses.

Lysipomia montioides Kunth
4000–4200 m asl. Native (Colombia, Ecuador, Peru). Pulviniform chamaephyte. *Plantago rigida* cushions.

Lysipomia multiflora McVaugh
4000–4400 m asl. Native (Ecuador, Peru). Pulviniform chamaephyte. Open bunchgrasses, rocky places.

Lysipomia oellgaardii Jeppesen
3800–4200 m asl. Native (Endemic to Ecuador). Pulviniform chamaephyte. *Plantago rigida* cushions (Osohuayco). EN B1ab(iii).

Lysipomia rhizomata McVaugh
3800–4200 m asl. Native (Endemic to Azuay, Loja). Pulviniform chamaephyte. Rocky places, shallow soils. CR B1ab(iii).

Lysipomia sphagnophila Griseb. ex Wedd.
3900–4400 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Pulviniform chamaephyte. Open bunchgrasses, rocky places, wetlands.

Lysipomia vitreola McVaugh
3800–4400 m asl. Native (Endemic to Cajas). Pulviniform chamaephyte. Rocky places, shallow soils. EN B1ab(iii).

Caprifoliaceae: 1 genus, 13 species (3 endemic species to Ecuador).

Valeriana asterothrix Killip
3900–4000 m (Taitachugo river basin). Native (Endemic to Ecuador). Rhizomatous geophyte. Forests of *Polylepis*.

Valeriana bracteata Benth.
3100–4400 m asl. Native (Colombia, Ecuador, Peru). Rosulate hemicryptophyte. *Plantago rigida* cushions, wet and open bunchgrasses.

Valeriana cernua B. Eriksen
3700–4100 m (Tomebamba). Native (Endemic to Ecuador). Rhizomatous geophyte. Forests of *Polylepis*, bunchgrasses. Nomenclatural type: Ecuador: Azuay: around Laguna Toreador in Paramo de Las Cajas, 3950 m, 14 June 1979, Lojtnant, Molau & Molau 14791, HT: AAU; IT: GB.

Valeriana henrici (Graebn.) B. Eriksen
4100–4400 m asl. Native (Ecuador, Peru). Rosulate hemicryptophyte. Rocky places. Rare in CNP.

Valeriana hirtella Kunth
3100–3800 m asl. Native (Ecuador, Peru). Microphanerophyte. High Andean forest–bunchgrass ecotone, forests of *Polylepis*, bunchgrasses.

Valeriana microphylla Kunth
3200–4200 m asl. Native (Colombia, Ecuador, Peru). Nanophanerophyte. Bunchgrasses, High Andean forest–bunchgrass ecotone.

Valeriana niphobia Briq.
3700–4300 m asl. Native (Colombia, Ecuador, Peru, Venezuela). Rosulate hemicryptophyte. Wet bunchgrasses.

Valeriana plantaginea Kunth
3800–4200 m asl. Native (Bolivia, Ecuador, Peru). Rosulate hemicryptophyte. Open bunchgrasses, forests of *Polylepis*.

Valeriana pyramidalis Kunth
3100–4000 m asl. Native (Bolivia, Ecuador, Peru).
Rhizomatous geophyte. Forests of *Polylepis*,
bunchgrasses.

Valeriana quadrangularis Kunth
3200–3400 m asl. Native (Ecuador, Peru). Climbing
hemicryptophyte. Scrub, High Andean forest–
bunchgrass ecotone.

Valeriana rigida Ruiz & Pav.
3500–4100 m asl. Native (Colombia, Ecuador, Peru).
Rosulate hemicryptophyte. Bunchgrasses.

Valeriana secunda B. Eriksen
3800–4400 m asl. Native (Endemic to Ecuador).
Rosulate hemicryptophyte. Rocky places. EN
B1ab(iii). Nomenclatural type: Ecuador: Azuay:
Páramo de Las Cajas, above Lagunas Suerocochoa,
35 km on Cuenca–Molleturo road, 4200–4400 m, 30
January 1988., Molau & Eriksen 2768, HT: GB; IT:
AAU.

Valeriana tomentosa Kunth
3300–3450 m asl. Native (Ecuador, Peru). Climbing
hemicryptophyte. Scrub páramo, disturbed areas,
limit with montane forest.

Caryophyllaceae: 7 genera, 13 species.

Arenaria digyna Willd. ex D.F.K. Schltld.
3800–4300 m asl. Native (Bolivia, Chile, Ecuador,
Peru). Suffruticose chamaephyte. Wet bunchgrasses,
wetlands, rocky places.

Arenaria parvifolia Benth.
3700–3800 m asl. Native (Bolivia, Chile, Ecuador,
Peru). Creeping hemicryptophyte. Bunchgrasses,
forests of *Polylepis*.

Cerastium danguyi J.F. Macbr.
3300–4400 m asl. Native (Bolivia, Colombia,
Ecuador, Peru). Scapiform hemicryptophyte.
Bunchgrasses, scrub of *Loricaria*, rocky places.
Syn.: *Cerastium trianae* Briq.

Cerastium floccosum Benth.
4100–4300 m asl. Native (Colombia, Ecuador, Peru).
Scapiform hemicryptophyte. Scrub of *Loricaria*,
rocky places.

Cerastium kunthii Briq.
3400–3700 m (Pacific slope). Native (Colombia,
Ecuador). Scapiform hemicryptophyte. Bunchgrasses.

Colobanthus quitensis (Kunth) Bartl.
3800–3900 m asl. Native (Mexico, South America).
Pulviniform chamaephyte. Bunchgrasses.

Drymaria villosa Schltld. & Cham.
3600–3700 m asl. Native (Cosmopolitan). Climbing
hemicryptophyte. Roadsides, bunchgrasses.

Paronychia chilensis DC.
3400–3700 m (Pacific slope). Native (Argentina,
Bolivia, Chile, Ecuador, Paraguay, Peru). Creeping
hemicryptophyte. Bunchgrasses.

Silene thysanodes Fenzl
3400–4000 m (Pacific slope). Native (Ecuador,
Peru). Scapiform therophyte. Bunchgrasses.

Stellaria cuspidata Willd. ex D.F.K. Schltld.
3400–3500m(Mazán).Native(America).Scapiform
therophyte. High Andean forest–bunchgrass
ecotone.

Stellaria ovata Willd. ex D.F.K. Schltld.
3200–4000 m asl. Native (Caribbean, Central America,
South America). Scapiform hemicryptophyte.
Bunchgrasses, forests of *Polylepis*.

Stellaria recurvata Willd. ex D.F.K. Schltld.
3200–3900 m asl. Native (Colombia, Ecuador, Peru).
Climbing hemicryptophyte. Wetlands, bunchgrasses,
forests of *Poylepis*. LC (2001).

Stellaria serpyllifolia Willd. ex D.F.K. Schltld.
3100–3900 m asl. Native (Colombia, Ecuador, Peru,
Venezuela). Climbing hemicryptophyte. Bunchgrasses,
wetlands.

Clethraceae: 1 genus, 1 species.

Clethra fimbriata Kunth
3300–3600 m asl. Native (Bolivia, Colombia,
Ecuador, Peru). Nanophanerophyte. High Andean
forests, forests of *Polylepis*.

Convolvulaceae: 1 genus, 1 species.

Dichondra macrocalyx Meisn.
3300–3600 m (Rare in CNP). Native (Argentina,
Bolivia, Brazil, Peru). New record to Ecuador.
Creeping hemicryptophyte. Bunchgrasses.

Crassulaceae: 1 genus, 2 species.

Crassula aquatica (L.) Schönland
3800–3900 m asl. Native (Cosmopolitan).
Hemicryptophyte. Lagoon banks.

Crassula venezuelensis (Steierm.) m asl. Bywater &
Wickens
3800–4300masl. Native (Argentina, Bolivia, Colombia,
Ecuador, Peru, Venezuela). Hemicryptophyte. Ponds
and temporally flooded soils

Cunoniaceae: 1 genus, 1 species.

Weinmannia fagaroides Kunth
3100–3600 m asl. Native (Bolivia, Colombia, Costa
Rica, Ecuador, Guiana, Honduras, Panama, Peru,
Venezuela). Microphanerophyte. High Andean
forest-bunchgrass ecotone.

Cyperaceae: 9 genera, 29 species (1 endemic species to
Ecuador, 1 endemic species to CNP).

Carex azuayae Steierm.
3700–4000 m asl (East). Native (Endemic to
CNP). Helogeophyte. shallow lagoons. EN
B1ab(iii). Nomenclatural type: Ecuador: Prov.
Azuay: páramos in vicinity of Toreador, between
Molleturo and Quinoas, alt. 3785–3900 m, June
15, 1943, J. A. Steiermark 53105, HT: F; IT: US.

- Carex crinalis* Boott
3700–4100 m asl. Native (Colombia, Ecuador, Peru). Rhizomatous geophyte. Wetlands, *Plantago rigida* cushions, scrub of *Arctophyllum vernicosum*.
- Carex jamesonii* Boott
3200–3900 m asl. Native (Belice, Bolivia, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru, Venezuela). Rhizomatous geophyte. Bunchgrasses, swamp places.
- Carex lemanniana* Boott
3700–4100 m (Atlantic slope). Native (Argentina, Bolivia, Colombia, Costa Rica, Ecuador, Panama, Peru). Helogeophyte. Lagoon banks, wet bunchgrasses.
- Carex mandoniana* Boeckeler
3700–3900 m asl. Native (Bolivia, Ecuador, Peru). Rhizomatous geophyte. *Plantago rigida* cushions, swamp soils.
- Carex microglochis* Wahlenb.
3700–3900 m asl. Alien. Rhizomatous geophyte. Trails, disturbed bunchgrasses.
- Carex pichinchensis* Kunth
3600–4200 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Rhizomatous geophyte. Bunchgrasses.
- Carex pygmaea* Boeckeler
3700–4100 m asl. Native (Bolivia, Colombia, Costa Rica, Ecuador, Panama, Peru). Rhizomatous geophyte. *Plantago rigida* cushions, wet bunchgrasses. Syn.: *Carex tristicha* Boeckeler.
- Carex tamana* Steyerl.
3600–4100 m (Pacific slope and Mazán). Native (Colombia, Costa Rica, Ecuador, Venezuela). Rhizomatous geophyte. Well-preserved bunchgrasses of *Calamagrostis intermedia* and *Festuca subulifolia*.
- Carex toreadora* Steyerl.
3700–4300 m asl. Native (Endemic to Ecuador). Helogeophyte. shallow lagoons, *Plantago rigida* cushions. VU Blab(iii). Nomenclatural type: Ecuador: Prov. Azuay: páramos in vicinity of Toreador, between Molleturo and Quinoas, in moist mossy boggy places bordering alpine lake, alt. 3785–3900 m, June 15, 1943, J. A. Steyerl. HT: F.
- Eleocharis acicularis* (L.) Roem. & Schult.
3700–3900 m asl. Native (Cosmopolitan). Helogeophyte. Wetlands, *Plantago rigida* cushions.
- Isolepis cernua* (Vahl) Roem. & Schult.
3700–4000 m asl. Native (Cosmopolitan). Caespitose therophyte. Wetlands, flooded places.
- Isolepis inundata* R. Br.
3700–4000 m (Atlantic slope). Native (Cosmopolitan). Helogeophyte. Wetlands, flooded places
- Oreobolopsis inversa* Dhooge & Goetgh
3600–4200 m asl. Native (Ecuador, Peru). Graminoid chamaephyte. Bunchgrasses, rocky places, wetlands.
- Oreobolopsis tepalifera* T. Koyama & Guagl.
3900–4100 m (Soldados). Native (Bolivia, Ecuador, Peru). Graminoid chamaephyte/
- Caespitose hemicryptophyte. *Plantago rigida* cushions.
- Oreobolus ecuadorensis* T. Koyama
3200–3900 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Caespitose hemicryptophyte. *Plantago rigida* cushions, wetlands.
- Oreobolus goeppingeri* Suss.
3700–4200 m asl. Native (South America). Caespitose hemicryptophyte. *Plantago rigida* cushions, bunchgrasses, wetlands.
- Oreobolus obtusangulus* Gaudich.
3700–4200 m asl. Native (South America). Caespitose hemicryptophyte. *Plantago rigida* cushions, bunchgrasses, wetlands.
- Rhynchospora macrochaeta* Steud. ex Boeckeler
3200–3900 m (Atlantic slope). Native (Bolivia, Central America, Colombia, Ecuador, Peru, Venezuela). Graminoid chamaephyte. Bunchgrasses, wetlands.
- Rhynchospora oreoboloidea* Gómez-Laur.
3700–3900 m (Soldados). Native (Colombia, Costa Rica, Ecuador, Panama). Graminoid chamaephyte. Bunchgrasses.
- Rhynchospora ruiziana* Boeckeler
3500–3700 m asl. Native (Bolivia, Central America, Colombia, Ecuador, Peru, Venezuela.). Graminoid chamaephyte. Bunchgrasses.
- Rhynchospora vulcani* Boeckeler
3600–4100 m asl. Native (Bolivia, Central America, Colombia, Ecuador, Peru, Venezuela). Graminoid chamaephyte. Well-preserved bunchgrasses.
- Schoenoplectus californicus* (C.A. Mey.) Soják
3100–3900 m asl. Native (Cosmopolitan). Helogeophyte. Lagoons and swamps.
- Trichophorum rigidum* (Boeckeler) Goetgh.
3100–3900 m asl. Native (Argentina, Bolivia, Ecuador, Peru). Helogeophyte. Lagoons and swamps.
- Uncinia hamata* (Sw.) Urb.
3200–4200 m asl. Native (Caribbean, Central America, South America). Graminoid chamaephyte/Rhizomatous geophyte. Wet bunchgrasses, *Plantago rigida* cushions.
- Uncinia macrolepis* Decne.
3100–3800 m asl. Native (Argentina, Bolivia, Chile, Colombia, Ecuador, Peru, Venezuela). Graminoid chamaephyte/Rhizomatous geophyte. Wetlands, *Plantago rigida* cushions.
- Uncinia paludosa* G.A. Wheeler & Goetgh.
3700–3800 m asl. Native (Colombia, Ecuador, Peru). Helogeophyte. Wetlands, *Plantago rigida* cushions.
- Uncinia phleoides* (Cav.) Pers.
3600–3900 m asl. Native (Argentina, Bolivia, Central America, Chile, Colombia, Ecuador, Peru, Venezuela). Graminoid chamaephyte/Rhizomatous geophyte. Wet bunchgrasses.
- Uncinia tenuis* Poepp. ex Kunth
3200–4000 m asl. Native (Argentina, Bolivia, Brazil, Caribbean, Central America, Chile, Colombia, Ecuador, Peru, Venezuela). Graminoid chamaephyte/Rhizomatous geophyte. *Plantago rigida* cushions, wet bunchgrasses.

Elaeocarpaceae: 1 genus, 1 species.

Vallea stipularis L. f.

3300–3600 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Microphanerophyte. High Andean forest–bunchgrass ecotone, forests of *Polylepis*.

Elatinaceae: 1 genus, 1 species.

Elatine ecuadoriensis Molau

3200–4000 m asl. Native (Colombia, Ecuador, Peru). Hydrotherophyte. Lagoons, swamp places, wetlands.

Ericaceae: 4 genera, 7 species.

Disterigma empetrifolium (Kunth) Drude

3300–4300 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Creeping chamaephyte. *Plantago rigida* cushions, scrub of *Loricaria* and *Chuquiraga*.

Gaultheria amoena A.C. Sm.

3600–4300 m asl. Native (Colombia, Ecuador). Creeping chamaephyte. Scrub of *Loricaria*, bunchgrasses.

Gaultheria glomerata (Cav.) Sleumer

3200–3700 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Nanophanerophyte. Bunchgrasses.

Gaultheria myrsinoides Kunth

3200–3950 m asl. Native (Central and South America). Fruticose chamaephyte. Bunchgrasses, scrub, rocky places.

Gaultheria reticulata Kunth

3700–3750 m asl. Native (Bolivia, Ecuador, Peru). Nanophanerophyte. Bunchgrasses.

Gaultheria tomentosa Kunth

3300–3600 m asl. Native (Bolivia, Ecuador, Peru). Nanophanerophyte. Forests of *Polylepis lanuginosa*, High Andean forest–bunchgrass ecotone.

Macleania rupestris (Kunth) A.C. Sm.

3200–3700 m asl. Native (Bolivia, Colombia, Costa Rica, Ecuador, Nicaragua, Panama, Peru, Venezuela). Nanophanerophyte. Scrubs.

Vaccinium floribundum Kunth

3200–4100 m asl. Native (Argentina, Bolivia, Colombia, Costa Rica, Ecuador, Panama, Peru, Venezuela). Fruticose chamaephyte. Bunchgrasses, scrub of *Loricaria ilinissae*.

Eriocaulaceae: 1 genus, 1 species.

Paepalanthus pilosus (Kunth) Kunth

3600–3900 m (Osohuayco). Native (Bolivia, Colombia, Costa Rica, Ecuador, Panama, Peru, Venezuela). Pulviniform chamaephyte. Wet and open bunchgrasses, *Plantago rigida* cushions. Syn.: *Paepalanthus espinosianus* Moldenke (Jørgensen, P. m. & S. León-Yáñez 1999).

Escalloniaceae: 1 genus, 1 species.

Escallonia myrtilloides L. f.

3200–4100 m asl. Native (Argentina, Bolivia, Colombia, Costa Rica, Ecuador, Panama, Peru, Venezuela). Microphanerophyte. Forests of *Polylepis* and scrubs of *Chuquiraga jussieui* or *Arcytophyllum vernicosum*.

Euphorbiaceae: 1 genus, 1 species.

Dysopsis glechomoides (A. Rich.) Müll. Arg.

3300–3700 m asl. Native (Argentina, Bolivia, Chile, Colombia, Costa Rica, Ecuador, Panama, Peru). Creeping hemicryptophyte. Forests of *Polylepis*.

Fabaceae: 5 genera, 9 species.

Astragalus weberbaueri Ulbr.

3200–4100 m asl. Native (Argentina, Bolivia, Colombia, Costa Rica, Ecuador, Panama, Peru, Venezuela). Nanophanerophyte. Forests of *Polylepis*, scrubs of *Chuquiraga jussieui* or *Arcytophyllum vernicosum*.

Lupinus eramosus C.P. Sm.

3800–3900 m (Atlantic slope). Native (Colombia, Ecuador). Suffruticose/fruticose chamaephyte. Bunchgrasses.

Lupinus microphyllus Desr.

3700–4300 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Suffruticose chamaephyte. Bunchgrasses, rocky places.

Lupinus revolutus C.P. Sm.

3100–3900 m asl. Native (Colombia, Ecuador). Suffruticose chamaephyte. Bunchgrasses.

Lupinus tauris Benth.

3200–4200 m asl. Native (Colombia, Ecuador). Suffruticose chamaephyte. Bunchgrasses.

Otholobium brachystachyum (Spruce ex Diels) J.W. Grimes

3300–3600 m (Pacific slope). Native (Colombia, Ecuador). Nanophanerophyte. Forests of *Polylepis lanuginosa*.

Trifolium repens L.

3300–4000 m asl. Alien (Cosmopolitan). Creeping hemicryptophyte. Disturbed wetlands.

Vicia andicola Kunth

3400–3900 m asl. Native (Argentina, Bolivia, Chile, Colombia, Ecuador, Peru, Venezuela). Climbing hemicryptophyte. Wet bunchgrasses, disturbed wetlands.

Vicia setifolia Kunth

3500–3800 m (Pacific slope). Native (Argentina, Bolivia, Chile, Colombia, Ecuador, Mexico). Climbing hemicryptophyte. Forests of *Polylepis*.

Gentianaceae: 4 genera, 13 species (5 endemic species to Ecuador, 3 endemic species to CNP).

Centaurium erythraea Rafn

3300–3500 m asl. Alien (Cosmopolitan). Creeping hemicryptophyte. Roadsides, wet places.

Gentiana sedifolia Kunth

3300–4000 m asl. Native (Argentina, Bolivia, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Panama, Peru, Venezuela). Creeping hemicryptophyte. *Plantago rigida* cushions, wet bunchgrasses, scrub.

Gentianella cerastioides (Kunth) Fabris

3200–4300 m asl. Native (Colombia, Ecuador, Peru). Scapiform hemicryptophyte. *Plantago rigida* cushions, wetlands.

Gentianella foliosa (Kunth) Fabris

3700–3800 m asl. Native (Endemic to Ecuador). Scapiform hemicryptophyte. Bunchgrasses. LC.

Gentianella hirculus (Griseb.) Fabris

3700–4300 m asl. Native (Endemic to CNP). Scapiform hemicryptophyte. Wet bunchgrasses, rocky places. LC.

Gentianella hyssopifolia (Kunth) Fabris

3400–4100 m asl. Native (Endemic to Ecuador). Scapiform hemicryptophyte. Dense bunchgrasses. VU B1ab(iii).

Gentianella limoselloides (Kunth) Fabris

3300–4000 m asl. Native (Endemic to Ecuador). Scapiform hemicryptophyte. Disturbed wetlands, flooded places LC

Gentianella longibarbata (Gilg) Fabris

3500–4300. Native (Endemic to CNP. Scapiform hemicryptophyte. Scrubs, forests of *Polylepis*. LC. Nomenclatural type: Ecuador: Azuay: Paramo of Cajas. 3300–3800 m asl. 1876–1881, F.C. Lehmann 4877.

Gentianella rapunculoides (Willd. ex Schult.) J.S. Pringle

3100–4000 m asl. Native (Colombia, Ecuador). Scapiform hemicryptophyte. Scrubs, bunchgrasses, wetlands.

Halenia minima C.K. Allen

3200–4000 m asl. Native (Endemic to Ecuador). Scapiform hemicryptophyte. Open bunchgrasses, grazed pastures. LC.

Halenia serpyllifolia J.S. Pringle

3300–4200 m asl. Native (Endemic to CNP). Scapiform hemicryptophyte. *Plantago rigida* cushions, wetlands. EN B1ab(iii). Nomenclatural type: Ecuador. Azuay: Río Machángara, NW of Cuenca, 3000–3100 m asl, B. Sparre 18621, HT: S, Endemic to Ecuador.

Halenia taruga-gasso Gilg

3300–4200 m asl. Native (Endemic to Ecuador). Scapiform hemicryptophyte. Well-preserved bunchgrasses.

Halenia weddelliana Gilg

3500–4100 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Scapiform hemicryptophyte. Wet bunchgrasses, wetlands.

Geraniaceae: 1 genus, 8 species.*Geranium chilloense* Willd.ex Kunth

3300–3400 m asl. Native (Colombia, Ecuador, Peru). Scapiform hemicryptophyte. High Andean forest–scrub ecotone.

Geranium diffusum Kunth

3200–3900 masl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Scapiform hemicryptophyte. Forest edges, bunchgrasses, disturbed wetlands.

Geranium maniculatum H.E. Moore

3700–4300 m asl. Native (Colombia, Ecuador, Peru). Rosulate hemicryptophyte. Wetlands, *Plantago rigida* cushions.

Geranium multipartitum Benth.

3700–4300 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Rosulate hemicryptophyte. Scrub of *Loricaria*, rocky places.

Geranium pseudodiffusum Aedo

3400–3900 m (Atlantic slope). Native (Ecuador, Peru). Rosulate hemicryptophyte. Scrubs, forests of *Polylepis*, wet soils. Nomenclatural type: Ecuador: Azuay, Páramo de Cajas, Chuspiuña, scrub of *Gynoxys*, 3440 m, 02.48.09S 79.13.06W, Aedo & Ulloa 13101, HA, JE, MA, MO, QCNE, Ecuador, Peru.

Geranium reptans R. Knuth

3400–4100 m asl. Native (Colombia, Ecuador, Peru). Creeping hemicryptophyte. Bunchgrasses, forests of *Polylepis*.

Geranium sibbaldioides Benth.

3700–4300 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Suffruticose chamaephyte. Bunchgrasses, *Plantago rigida* cushions.

Geranium stramineum Triana & Planch.

4300–4400 m asl. Native (Colombia, Ecuador, Peru). Rosulate hemicryptophyte. *Plantago rigida* cushions, wet soils.

Grossulariaceae: 1 genus, 5 species (1 endemic species to Ecuador).*Ribes andicola* Jancz.

3200–3850 m asl. Native (Colombia, Ecuador, Peru, Venezuela). Nanophanerophyte. Forests of *Polylepis*, bunchgrasses.

Ribes ecuadorensis Jancz.

3200–3550 m asl. Native (Colombia, Ecuador). Nanophanerophyte. High Andean forest–bunchgrasses ecotone.

Ribes erectum Freire-Fierro

3400–3700 m asl. Native (Colombia, Ecuador). Nanophanerophyte. Forests of *Polylepis*, Bunchgrasses.

Ribes hirtum Willd.ex Roem. & Schult.

3200–3700 m asl. Native (Colombia, Ecuador). Nanophanerophyte. Bunchgrasses, forests of *Polylepis*.

Ribes lehmannii Jancz.

3700–4300 m asl. Native (Endemic to Ecuador). Nanophanerophyte. Forests of *Polylepis*, rocky places. EN B1ab(iii). Nomenclatural type: Ecuador: Azuay: Cuenca, 4000 m, Lehmann, F.C. 7713, T: B, K!, US; photo A, F, MO, Ecuador.

Gunneraceae: 1 genus, 1 species.*Gunnera magellanica* Lam.

3600–3800 m (Atlantic slope). Native (Argentina, Bolivia, Chile, Colombia, Ecuador, Peru). Creeping hemicryptophyte. Wetlands.

Haloragaceae: 1 genus, 1 species.

Myriophyllum quitense Kunth

3100–4000 m asl. Native (Argentina, Bolivia, Chile, Colombia, Ecuador, Mexico, Peru, Uruguay, USA, Venezuela). Hydrogeophyte. Lagoons.

Hypericaceae: 1 genus, 9 species (1 endemic species to Ecuador).

Hypericum aciculare Kunth

3250–4350 m asl. Native (Ecuador, Peru). Suffruticose chamaephyte. Forests of *Polylepis*, scrubs of *Loricaria* and *Chuquiraga*.

Hypericum brevistylum Choisy

3400–3800 m asl. Native (Argentina, Bolivia, Chile, Colombia, Ecuador, Peru). Suffruticose chamaephyte. Bunchgrasses.

Hypericum decandrum Turcz.

3200–4350 m asl. Native (Ecuador, Peru). Suffruticose chamaephyte. Bunchgrasses, scrub of *Loricaria*.

Hypericum lancioides Cuatrec.

3300–4300 m asl. Native (Colombia, Ecuador, Venezuela). Fruticose chamaephyte. Bunchgrasses, scrub of *Loricaria*.

Hypericum laricifolium Juss.

3100–3600 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Fruticose chamaephyte. Bunchgrasses.

Hypericum loxense Benth.

3100–3600 m asl. Native (Ecuador, Peru). Fruticose chamaephyte. Lower edge of bunchgrasses.

Hypericum quitense R. Keller

3200–3900 m asl. Native (Endemic to Ecuador). Fruticose chamaephyte. Bunchgrasses, scrub. LC. Nomenclatural type: Ecuador: Azuay: near Cuenca, Surucucho, Aug 1865 (fl). Jameson 128, HT: W!; IT: K!; photos: F!, GH!, Endemic to Ecuador.

Hypericum silenoides Juss.

3200–3850 m (Atlantic slope). Native (Argentina, Bolivia, Chile, Colombia, Ecuador, Mexico, Peru). Suffruticose chamaephyte. Bunchgrasses.

Hypericum sprucei N. Robson

3200–4100 m asl. Native (Ecuador, Peru). Fruticose chamaephyte. Bunchgrasses, scrubs, forests of *Polylepis*.

Iridaceae: 2 genera, 4 species.

Orthrosanthus chimboracensis (Kunth) Baker

3200–3700 m asl. Native (Bolivia, Colombia, Costa Rica, Ecuador, Honduras, Peru, Venezuela). Rhizomatous geophyte. Disturbed bunchgrasses.

Sisyrinchium chilense Hook.

3500–3600 m asl. Native (Argentina, Bolivia, Chile, Colombia, Ecuador, Peru). Rhizomatous geophyte. Bunchgrasses.

Sisyrinchium jamesonii Baker

4000–4300 m asl. Native (Argentina, Bolivia, Colombia, Ecuador, Peru, Venezuela). Rhizomatous geophyte. Bunchgrasses intervenido.

Sisyrinchium palustre Diels

3700–4200 m asl. Native (Bolivia, Ecuador, Peru). Rhizomatous geophyte. *Plantago rigida* cushions, wetlands, scrub of *Loricaria ilinissae*.

Sisyrinchium tinctorium Kunth

3300–3700 m asl. Native (Argentina, Bolivia, Central America, Colombia, Ecuador, Peru, Venezuela). Rhizomatous geophyte. Disturbed bunchgrasses.

Juncaceae: 4 genera, 10 species (1 endemic species to Ecuador).

Distichia acicularis Balslev & Læggaard

3700–4100 m asl. Native (Endemic to Ecuador). Helohemicryptophyte. Wetlands, flooded pastures. Nomenclatural type: Ecuador: Azuay: Páramo de Soldados, 3700 m, 24 Oct 1984, Laegaard 53236, HT: AAU; IT: GB, K, NY, QCA, Ecuador.

Distichia muscoides Nees & Meyen

3700–4300 m asl. Native (Argentina, Bolivia, Chile, Colombia, Ecuador, Peru). Helohemicryptophyte. Wetlands, *Plantago rigida* cushions.

Juncus arcticus Willd.

3600–3800 m (Atlantic slope). Native (Cosmopolitan). Helogeophyte. Wetlands, flooded places

Juncus ecuadoriensis Balslev

3200–3400 m (Atlantic slope). Native (Colombia, Ecuador, Venezuela). Helogeophyte. Wet disturbed bunchgrasses, flooded places.

Juncus stipulatus Nees & Meyen.

3200–4200 m asl. Native (Argentina, Bolivia, Chile, Colombia, Ecuador, Peru). Helogeophyte. Disturbed bunchgrasses, wetlands.

Luzula ecuadoriensis Balslev

3200–3400 m (Pacific slope). Native (Bolivia, Ecuador, Peru). Graminoid chamaephyte. Bunchgrasses.

Luzula gigantea Desv.

3400–3900 m asl. Native (Argentina, Bolivia, Colombia, Costa Rica, Ecuador, Guatemala, Mexico, Panama, Peru, Venezuela). Graminoid chamaephyte. Forests of *Polylepis*.

Luzula racemosa Desv.

3200–3900 m asl. Native (Argentina, Bolivia, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Mexico, Peru, Venezuela). Graminoid chamaephyte. Wetlands.

Luzula vulcanica Liebm.

3700–4000 m asl. Native (Bolivia, Colombia, Costa Rica, Ecuador, Mexico, Peru). Graminoid chamaephyte. Wetlands.

Rostkovia magellanica (Lam.) Hook. f.

3800–3900 m asl. Native (Argentina, Bolivia, Colombia, Costa Rica, Chile, Ecuador, Falkland Islands, New Zealand, Peru). Graminoid chamaephyte. Wetlands, flooded places

Juncaginaceae: 1 genus, 1 species.

Triglochin scilloides (Poir.) Mering & Kadereit

3800–4100 m asl. Native (Argentina, Brazil, Canadá, Chile, Colombia, Ecuador, Mexico, Peru, USA).

Hydrogeophyte. Lagoons, wetlands. Syn.: *Lilaea scilloides* (Poir.) Hauman.

Lamiaceae: 3 genera, 6 species (1 endemic species to Azuay).

Clinopodium nubigenum (Kunth) Kuntze
3200–4200 m asl. Native (Colombia, Ecuador, Peru, Venezuela). Creeping hemicryptophyte. Bunchgrasses.

Clinopodium tenellum (Epling) Harley
3200–3900 m asl. Native (Colombia, Ecuador, Peru). Creeping hemicryptophyte. Bunchgrasses.

Lepechinia heteromorpha (Briq.) Epling
3700–3800 m (Pacific slope). Native (Bolivia, Colombia, Ecuador, Peru). Nanophanerophyte. Bunchgrasses.

Lepechinia rufocampii Epling & Mathias
3600–3700 m (Pacific slope). Native (Endemic to Azuay). Suffruticose chamaephyte. Bunchgrasses. VU A4c; B1ab(iii).

Stachys elliptica Kunth
3700–3900 m asl. Native (Colombia, Ecuador, Venezuela). Suffruticose chamaephyte. Wetlands, *Plantago rigida* cushions.

Stachys pusilla (Wedd.) Briq.
3700–3800 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Suffruticose chamaephyte. Wetlands, *Plantago rigida* cushions, bunchgrasses (Rare in CNP).

Lentibulariaceae: 1 genus, 1 species.

Pinguicula calyptrata Kunth
3100–3950 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Scapiform hemicryptophyte. Wet bunchgrasses, wet terraces.

Loasaceae: 2 genera, 3 species (1 endemic species to Ecuador)

Caiophora contorta (Desr.) C. Presl
3200–3900 m asl. Native (Bolivia, Chile, Ecuador, Peru). Climbing geophyte. Bunchgrasses, disturbed forest.

Nasa loxensis (Kunth) Weigend
3300–3500 m asl. Native (Ecuador, Peru). Suffruticose chamaephyte. High Andean forest–scrub ecotone, disturbed forest. VU B2ab(iii).

Nasa profundilobata (Werderm.) Weigend
3300–3700 m (Pacific slope). Native (Endemic to Azuay and Cañar) Suffruticose chamaephyte. High Andean forest–bunchgrass ecotone, forests of *Polylepis lanuginosa*. CR B1ab(iii)[2011].

Loranthaceae: 2 genera, 2 species.

Gaiadendron punctatum (Ruiz & Pav.) G. Don
3300–3700 m asl. Native (Bolivia, Brazil, Colombia, Costa Rica, Ecuador, Guiana, Nicaragua, Panama, Peru, Venezuela). Microphanerophyte, hemiparasite.

Scrub páramo of *Chuquiraga jussieu* or *Arcytophyllum vernicosum*.

Tristerix longebracteatus (Desr.) Barlow & Wiens
3300–3900 m asl. Native (Colombia, Ecuador, Peru). Fruticose chamaephyte, hemiparasite. Scrub of *Chuquiraga jussieu*, forests of *Polylepis lanuginosa*.

Malvaceae: 2 genera, 2 species (1 endemic species to Ecuador).

Acaulimalva parnassiifolia (Hook.) Krapov.
3600–3800 m asl. Native (Ecuador, Peru). Rosulate chamaephyte. Roadsides, bunchgrasses.

Nototriche hartwegii A.W. Hill
4100–4450 m asl. Native (Endemic to Ecuador). Pulviniform chamaephyte. Rocky places, sandy soils, open bunchgrasses. EN B1ab(iii). Syn.: *Nototriche jamesonii* A.W. Hill.

Melastomataceae: 3 genera, 13 species (7 endemic species to Ecuador).

Axinaea affinis (Naudin) Cogn.
3100–4100 m asl. Native (Colombia, Ecuador, Venezuela). Microphanerophyte. Forests of *Polylepis*.

Brachyotum alpinum Cogn.
3200–4000 m (Atlantic slope). Native (Endemic to Ecuador). Nanophanerophyte. Forests of *Polylepis*, rocky places. LC.

Brachyotum confertum (Bonpl.) Triana
3100–3600 m asl. Native (Endemic to Ecuador). Nanophanerophyte. Scrub, High Andean forest–scrub ecotone. LC.

Brachyotum fraternum Wurdack
3400 (Atlantic slope)–3700 m asl (Pacific slope). Native (Endemic to Ecuador). Nanophanerophyte. Scrub, High Andean forest–scrub ecotone. VU B1ab(iii).

Brachyotum gleasonii Wurdack
3200–3600 m asl. Native (Endemic to Ecuador). Nanophanerophyte. Disturbed bunchgrass, forest edges of *Polylepis*. VU B1ab(iii).

Brachyotum jamesonii Triana
3200–4000 m asl. Native (Endemic to Ecuador). Nanophanerophyte. Bunchgrasses, scrub of *Arcytophyllum vernicosum*, forest edges of *Polylepis*. VU B1ab(iii).

Miconia bracteolata (Bonpl.) DC.
3100–3800 m asl. Native (Colombia, Ecuador, Peru). Microphanerophyte. Bunchgrasses, scrubs.

Miconia chionophila Naudin
3800–4200 m asl. Native (Bolivia, Colombia, Costa Rica, Ecuador, Panama, Peru, Venezuela). Suffruticose chamaephyte. Well–preserved bunchgrasses, scrubs of *Gynoxys* and *Loricaria*, forests of *Polylepis*.

Miconia crocea (Desr.) Naudin
3300–3700 m asl. Native (Colombia, Ecuador, Peru). Microphanerophyte. High Andean forest–scrub ecotone, forests of *Polylepis lanuginosa*.

Miconia huigrensis Wurdack
3300–3500 m (Pacific slope). Native (Endemic to Ecuador). Nanophanerophyte. High Andean forest–bunchgrasses ecotone, forests of *Polylepis lanuginosa*. VU B1ab(iii).

Miconia pernettifolia Triana
3400–4000 m asl. Native (Endemic to Ecuador). Suffruticose chamaephyte. Bunchgrasses. VU B1ab(iii).

Miconia rotundifolia (D. Don) Naudin
3800–4000 m asl. Native (Ecuador, Peru). Suffruticose chamaephyte. Bunchgrasses, forests of *Polylepis*.

Miconia salicifolia Naudin
3200–4000 m asl. Native (Colombia, Ecuador, Peru, Venezuela). Microphanerophyte. Forests of *Polylepis*, scrubs of *Gynoxys* and *Chuquiraga*.

Montiaceae: 1 genus, 1 species.

Calandrinia acaulis Kunth
4000–4400 m asl. Native (Argentina, Bolivia, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Mexico, Peru, Venezuela). Rosulate hemicryptophyte. Rocky places, sandy soils.

Myricaceae: 1 genus, 2 species.

Morella parvifolia (Benth.) Parra–Os.
3200–3600 m asl. Native (Colombia, Ecuador, Venezuela). Microphanerophyte. Bunchgrasses, scrubs. Syn.: *Myrica parvifolia* Benth.

Morella pubescens (Humb. & Bonpl. ex Willd.) Wilbur
3200–3500 m asl. Native (Colombia, Ecuador, Venezuela). Microphanerophyte. Bunchgrasses, scrubs.

Nyctaginaceae: 1 genus, 1 species.

Colignonia glomerata Griseb.
3200–3500 m (Pacific slope). Native (Argentina, Bolivia, Ecuador, Peru). Supported liana. Bunchgrasses lower edge, forests of *Polylepis lanuginosa*.

Onagraceae: 3 genera, 5 species (1 endemic species to Ecuador).

Epilobium denticulatum Ruiz & Pav.
3700–4200 m (Atlantic slope). Native (Argentina, Bolivia, Chile, Colombia, Costa Rica, Ecuador, Mexico, Peru, Venezuela). Rhizomatous geophyte. Forests of *Polylepis reticulata*, trails.

Fuchsia ayavacensis Kunth
3300–3400 m asl. Native (Ecuador, Peru). Nanophanerophyte. High Andean forest–bunchgrasses ecotone.

Fuchsia loxensis Kunth
3300–3600 m asl. Native (Endemic to Ecuador). Nanophanerophyte. Bunchgrasses lower edge, forest edges of *Polylepis*. LC.

Fuchsia vulcanica André
3300–3600 m asl. Native (Colombia, Ecuador). Nanophanerophyte. Bunchgrasses lower edge, forest edges of *Polylepis*.

Oenothera epilobiifolia Kunth
3700–3900 m (Atlantic slope). Native (Colombia, Costa Rica, Ecuador, Guatemala, Mexico, Panama, Peru, Venezuela). Creeping hemicryptophyte. Scrub of *Chuquiraga*, bunchgrasses.

Orchidaceae: 9 genera, 17 species (3 endemic species to Ecuador).

Aa colombiana Schltr.
4000–4300 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Scapiform hemicryptophyte. Bunchgrasses. CITES Appendix II (2003).

Aa denticulata Schltr.
3800–4000 m asl. Native (Colombia, Ecuador). Scapiform hemicryptophyte. Bunchgrasses. CITES Appendix II (2003).

Aa maderoi Schltr.
3700–4300 m asl. Native (Colombia, Ecuador, Venezuela). Scapiform hemicryptophyte. Bunchgrasses. CITES Appendix II (2003).

Altensteinia fimbriata Kunth
3300–4000 masl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Scapiform hemicryptophyte. Scrub of *Arcytophyllum vernicosum*, open bunchgrasses on rocky places. CITES Appendix II (2003).

Elleanthus ventricosus Schltr.
3200–3500 m asl. Native (Colombia, Ecuador, Peru). Rhizomatous geophyte. High Andean forest–scrub ecotone. CITES Appendix II (2003).

Epidendrum mesogastropodium Hágsater & Dodson
3300–3500 m asl. Native (Endemic to Ecuador). Rooted epiphyte. Bunchgrasses, scrubs. VU D2, CITES Appendix II (2003).

Epidendrum pteroglottis Schltr.
3100–3600 m asl. Native (Endemic to Ecuador). Rooted epiphyte. Bunchgrasses, scrubs. CITES Appendix II (2003).

Epidendrum scabrum Ruiz & Pav.
3200–4000 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Rooted epiphyte. Forests of *Polylepis*. CITES Appendix II (2003).

Epidendrum serpens Lindl.
3200–3800 m asl. Native (Colombia, Ecuador, Peru, Venezuela). Rooted epiphyte. Scrubs. CITES Appendix II (2003).

Epidendrum tenuicaule F. Lehm. & Kraenzl.
3200–3900 m asl. Native (Endemic to Ecuador). Rooted epiphyte. Forests of *Polylepis*, scrub of *Arcytophyllum vernicosum*, rocky places. LC CITES Appendix II (2003).

Gomphichis macbridei C. Schweinf.
3300–3600 masl. Native (Ecuador, Peru). Rhizomatous geophyte. Bunchgrasses. CITES Appendix II (2003).

Gomphichis valida Rchb. f.
3300–3600 m asl. Native (Bolivia, Ecuador, Peru). Rhizomatous geophyte. Forests of *Polylepis*, bunchgrasses. CITES Appendix II (2003).

- Oncidium pentadactylon* Lindl.
3300–3400 m (Angas subbasin). Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Rooted epiphyte. Forests of *Polylepis lanuginosa*. CITES Appendix II (2003).
- Pleurothallis coriacardia* Rehb. f.
3600–3900 m asl. Native (Colombia, Ecuador, Venezuela). Rooted epiphyte. Bunchgrasses. CITES Appendix II (2003).
- Pleurothallis laevigata* Lindl.
3300–3500 m asl. Native (Colombia, Ecuador, Peru). Rooted epiphyte. Scrubs. CITES Appendix II (2003).
- Pterichis parvifolia* (Lindl.) Schltr.
3200–4000 m asl. Native (Colombia, Costa Rica, Ecuador, Peru). Scapiform hemicryptophyte. Wet bunchgrasses. CITES Appendix II (2003).
- Stelis ligulata* (Lindl.) Pridgeon & M.W.
3200–3500 m asl. Native (Bolivia, Ecuador). Rooted epiphyte. Scrub. CITES Appendix II (2003). Syn: *Crocodeilanthe patula* Luer.

Orobanchaceae: 3 genera, 13 species (1 endemic species to Ecuador).

- Bartsia crisafullii* N.H. Holmgren
3300–4100 m asl. Native (Ecuador, Peru). Scapiform hemicryptophyte, hemiparasite. Bunchgrasses.
- Bartsia flava* Molau
3100–3500 m asl. Native (Ecuador, Peru). Scapiform hemicryptophyte, hemiparasite. Bunchgrasses (Rare in CNP).
- Bartsia laticrenata* Benth.
3700–4400 masl. Native (Colombia, Ecuador). Scapiform hemicryptophyte, hemiparasite. Bunchgrasses, rocky places.
- Bartsia melampyroides* (Kunth) Benth.
3700–3900 m (Pacific slope). Native (Bolivia, Ecuador, Peru). Scapiform hemicryptophyte, hemiparasite. Bunchgrasses.
- Bartsia orthocarpiflora* Benth.
3500–4000 m asl. Native (Colombia, Ecuador, Peru). Scapiform hemicryptophyte, hemiparasite. Bunchgrasses, scrub of *Arcytophyllum vernicosum*, rocky places.
- Bartsia pedicularoides* Benth.
3600–4300 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Scapiform hemicryptophyte. *Plantago rigida* cushions.
- Bartsia stricta* (Kunth) Benth.
3800–4400 m asl. Native (Colombia, Ecuador, Venezuela). Scapiform hemicryptophyte, hemiparasite. Scrub of *Loricaria ilinissae*, bunchgrasses, rocky places.
- Castilleja ecuadorensis* N.H. Holmgren
3500–3950 m asl. Native (Endemic to Ecuador). Scapiform hemicryptophyte, hemiparasite. Scrub of *Loricaria ilinissae*, bunchgrasses, rocky places. VU B1ab(iii).
- Castilleja fissifolia* L. f.
3500–4200 m asl. Native (Bolivia, Colombia, Costa Rica, Ecuador, Peru, Venezuela). Hemicryptophyte,

- hemiparasite. Disturbed bunchgrasses, scrub of *Loricaria ilinissae*, rocky places.
- Castilleja nubigena* Kunth
3800–4100 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Scapiform hemicryptophyte, hemiparasite. Wetlands, *Plantago rigida* cushions. LC (2004).
- Castilleja pumila* (Benth.) Wedd.
3800–4100 m asl. Native (Bolivia, Chile, Colombia, Ecuador, Peru). Scapiform hemicryptophyte, hemiparasite. Wetlands, *Plantago rigida* cushions).
- Castilleja virgata* (Wedd.) Edwin
3200–4200 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Scapiform hemicryptophyte, hemiparasite. Wet bunchgrasses, creeks.
- Pedicularis incurva* Benth.
3200–4200 masl. Native (Bolivia, Colombia, Ecuador, Peru). Scapiform hemicryptophyte, hemiparasite. Bunchgrasses, scrub of *Loricaria ilinissae*, wet places.

Oxalidaceae: 1 genus, 2 species.

- Oxalis lotoides* Kunth
3300–3850 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Climbing hemicryptophyte. Forests of *Polylepis*.
- Oxalis phaeotricha* Diels
3500–3800 masl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Creeping hemicryptophyte. Forests of *Polylepis*, Bunchgrasses.

Passifloraceae: 1 genus, 4 species (1 endemic species to Ecuador).

- Passiflora ampullacea* (Mast.) Harms
3100–3500 m asl. Native (Endemic to Ecuador). Climbing liana. High Andean forest–bunchgrass, forests of *Polylepis*. VU B1ab(iii).
- Passiflora cumbalensis* (H. Karst.) Harms
3300–3900 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Climbing liana. High Andean forest–bunchgrass ecotone, forests of *Polylepis*.
- Passiflora mathewsii* (Mast.) Killip
3300–3600 m asl. Native (Ecuador, Peru). Climbing liana. High Andean forest–bunchgrass, forests of *Polylepis*.
- Passiflora tripartita* (Juss.) Poir.
3300–3600 m asl. Native (Bolivia, Colombia, Costa Rica, Ecuador, Mexico, Panama, Peru, Venezuela). Climbing liana. High Andean forest–bunchgrass ecotone, scrubs.

Piperaceae: 1 genus, 6 species (1 endemic species to Ecuador).

- Peperomia galioides* Kunth
3300–3800 m asl. Native (Bolivia, Brazil, Central America, Colombia, Ecuador, Peru, Venezuela). Scapiform hemicryptophyte. Bunchgrasses lower edge, forests of *Polylepis lanuginosa*.

Peperomia guttulata Sodiro
3300–3500 m asl. Native (Endemic to Ecuador).
Climbing hemicryptophyte. Forests of *Polylepis lanuginosa*.

Peperomia hartwegiana Miq.
3300–4000 m asl. Native (Colombia, Ecuador, Peru, Venezuela). Creeping hemicryptophyte/Nesoepiphyte.
Scrubs, forests of *Polylepis*.

Peperomia hispidula (Sw.) A. Dietr.
3300–4000 m asl. Native (Caribbean, Central America, Argentina, Bolivia, Brazil, Colombia, Ecuador, Guiana, Peru, Suriname, Uruguay, Venezuela). Creeping hemicryptophyte. Forests of *Polylepis reticulata*.

Peperomia hispiduliformis Trel.
3300–3700 m asl. Native (Argentina, Bolivia, Ecuador, Mexico, Panama). Creeping hemicryptophyte. Forests of *Polylepis reticulata*.

Peperomia rotundata Kunth
3100–3400 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Creeping hemicryptophyte. High Andean forest–bunchgrass ecotone, forests of *Polylepis lanuginosa*.

Plantaginaceae: 4 genera, 11 species.

Callitriche deflexa A. Braun ex Hegelm.
3700–3800 m asl. Native (America). Hemicryptophyte.
Lagoons.

Callitriche heterophylla Pursh
3500–3700 m asl. Native (America). Hemicryptophyte.
Streams.

Ourisia chamaedrifolia Benth.
3900–4400 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Caespitose hemicryptophyte. Rocky places.

Ourisia muscosa Wedd.
3900–4400 m asl. Native (Bolivia, Chile, Colombia, Ecuador, Peru). Caespitose hemicryptophyte.
Plantago rigida cushions.

Plantago australis Lam.
3500–3900 m asl. Native (Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, USA, Venezuela). Rosulate hemicryptophyte. Bunchgrasses, disturbed places.

Plantago linearis Kunth
3200–3900 m asl. Native (Colombia, Ecuador, Guatemala, Mexico, Peru, Venezuela). Rosulate hemicryptophyte. Bunchgrasses, floded places.

Plantago major L.
3300–3900 m asl. Alien (Cosmopolitan). Rosulate hemicryptophyte. Disturbed and wet bunchgrasses, trails.

Plantago rigida Kunth
3600–4100 masl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Pulviniform chamaephyte. Valley bottoms, flooded soils, wetlands.

Plantago sericea Ruiz & Pav.
3600–4100 m asl. Native (Argentina, Bolivia, Chile, Colombia, Ecuador, Mexico, Peru, Venezuela). Rosulate hemicryptophyte. Bunchgrasses, disturbed wetlands.

Plantago tubulosa Decne.
3700–4000 m asl. Native (Argentina, Bolivia, Chile, Colombia, Ecuador, Mexico, Peru). Rosulate hemicryptophyte. Wetlands, flooded soils.

Sibthorpia repens (L.) Kuntze
3400–4000 m asl. Native (Argentina, Bolivia, Central America, Colombia, Ecuador, Peru, Venezuela). Creeping hemicryptophyte. Forests of *Polylepis*, bunchgrasses.

Poaceae: 26 genera, 70 species (6 endemic species to Ecuador).

Aciachne flagellifera Lægaard
3800–4300 m asl. Native (Colombia, Ecuador). Pulviniform chamaephyte. Bunchgrasses, scrub of *Loricaria ilinissae*.

Aciachne pulvinata Benth.
3700–4300 m asl. Native (Bolivia, Colombia, Costa Rica, Ecuador, Peru, Venezuela). Pulviniform chamaephyte. Bunchgrasses, scrub of *Loricaria ilinissae*, rocky places.

Agrostis breviculmis Hitchc.
3500–4300 m asl. Native and Cosmopolitan (Bolivia, Brazil, Chile, Colombia, Ecuador, Peru, Venezuela). Caespitose hemicryptophyte. *Plantago rigida* cushions, disturbed bunchgrasses.

Agrostis capillaris L.
3400–3500 m asl. Alien (Cosmopolitan). Caespitose hemicryptophyte. Disturbed bunchgrasses.

Agrostis foliata Hook. f.
3900–4300 m asl. Native (Colombia, Ecuador, Peru, Venezuela). Graminoid chamaephyte. Wet bunchgrasses, scrub of *Loricaria ilinissae*.

Agrostis gigantea Roth
3300–3400 m asl. Alien (Cosmopolitan). Rhizomatous hemicryptophyte. Disturbed bunchgrasses, trails.

Agrostis haenkeana Hitchc.
3800–3900 m (Osohuayco). Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Graminoid chamaephyte. Wet bunchgrasses.

Agrostis mertensii Trin.
3700–4200 m asl. Native (North and South America). Graminoid chamaephyte. *Plantago rigida* cushions, bunchgrasses.

Agrostis perennans (Walter) Tuck.
3300–4100 m asl. Native (North, Central and South America). Graminoid chamaephyte. Open bunchgrasses, scrubs.

Agrostis toluensis Kunth
3700–4200 m asl. Native (Argentina, Bolivia, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Mexico, Panama, Peru, Venezuela). Graminoid chamaephyte. Bunchgrasses, scrubs, wetlands.

Agrostis trichodes (Kunth) Roem. & Schult.
4100–4200 m asl. Native (Colombia, Ecuador, Peru, Venezuela). Graminoid chamaephyte. Rocky places.

Aira caryophyllea L.
3400–4100 m asl. Alien (Cosmopolitan). Caespitose therophyte. Roadsides.

- Anthoxanthum odoratum* L.
3900–4000 m asl. Alien (Cosmopolitan). Caespitose hemicryptophyte. Disturbed bunchgrasses.
- Brachypodium mexicanum* (Roem. & Schult.) Link
3400–3500 m asl. Native (Bolivia, Colombia, Costa Rica, Ecuador, Guatemala, Honduras, Mexico, Panama, Peru, Venezuela). Caespitose hemicryptophyte. Bunchgrasses, trails.
- Bromus catharticus* Vahl
3200–4200 m asl. Native (Cosmopolitan). Caespitose therophyte. Bunchgrasses, pastures.
- Bromus lanatus* Kunth
3200–4200 m asl. Native (Argentina, Bolivia, Chile, Colombia, Ecuador, Peru, Uruguay, Venezuela). Caespitose therophyte. Lagoon banks, bunchgrasses, *Plantago rigida* cushions.
- Bromus pitensis* Kunth
3300–3900 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Uruguay, Venezuela). Caespitose therophyte. Disturbed grasslands or pasturelands.
- Calamagrostis aurea* (Munro ex Wedd.) Hack. ex Sodiro
4200–4450 m asl. Native (Ecuador, Peru). Graminoid chamaephyte. Rocky places, sandy soils.
- Calamagrostis bogotensis* (Pilg.) Pilg.
3700–4100 m asl. Native (Colombia, Costa Rica, Ecuador, Panama, Peru, Venezuela). Graminoid chamaephyte. Wet bunchgrasses.
- Calamagrostis coarctata* Eaton
3100–3450 m asl. Alien (North America). Graminoid chamaephyte. Roadsides.
- Calamagrostis ecuadoriensis* Lægaard
3900–4000 m asl. Native (Endemic to Ecuador). Graminoid chamaephyte. Bunchgrasses. LC.
- Calamagrostis fibrovaginata* Lægaard
3700–4300 m asl. Native (Chile, Colombia, Ecuador, Peru, Venezuela). Caespitose hemicryptophyte. *Plantago rigida* cushions, wetlands.
- Calamagrostis intermedia* (J. Presl) Steud.
3600–4300 m asl. Native (Argentina, Bolivia, Central America, Colombia, Ecuador, Peru). Graminoid chamaephyte. Bunchgrasses with *Festuca subulifolia*.
- Calamagrostis jamesonii* Steud.
3700–4200 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Caespitose hemicryptophyte. *Plantago rigida* cushions, wet places.
- Calamagrostis ligulata* (Kunth) Hitchc.
3750–4300 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Graminoid chamaephyte. Rocky places, scrub of *Loricaria*, wetlands.
- Calamagrostis macrophylla* (Pilg.) Pilg.
3300–3800 m asl. Native (Colombia, Ecuador, Peru). Graminoid chamaephyte. Bunchgrasses.
- Calamagrostis nuda* (Pilg.) Pilg.
3750–3900 m asl. Native (Colombia, Costa Rica, Ecuador, Panama). Graminoid chamaephyte. Bunchgrasses.
- Calamagrostis podophora* Pilg.
4300–4400 m asl. Native (Colombia, Ecuador, Peru, Venezuela). Graminoid chamaephyte. Scrub of *Loricaria ilinissae*, rocky places.
- Calamagrostis recta* (Kunth) Trin. ex Steud.
3600–4100 m asl. Native (Argentina, Bolivia, Colombia, Ecuador, Peru, Venezuela). Graminoid chamaephyte. Bunchgrasses.
- Calamagrostis rigida* (Kunth) Trin. ex Steud.
3600–4000 m asl. Native (Argentina, Bolivia, Chile, Ecuador, Peru). Graminoid chamaephyte. Bunchgrasses.
- Calamagrostis steyermarkii* Swallen
3750–4150 m asl. Native (Endemic to Azuay and Cañar). Graminoid chamaephyte. Thick undisturbed bunchgrasses. VU B1ab(iii). Nomenclatural type: Ecuador: Azuay: paramos, in vicinity of Toreador, between Molleturo and Quinoas, 3810–3930 m, 15 Jun 1943, Steyermark 53195, HT: US, Ecuador.
- Calamagrostis teretifolia* Lægaard
4300–4400 m (Rare in CNP). Native (Endemic to Ecuador). Graminoid chamaephyte. Rocky places. TC:VU D2.
- Chascolytrum monandrum* (Hack.) Essi, Longhi-Wagner & Souza-Chies
3400–3900 m asl. Native (Argentina, Bolivia, Colombia, Ecuador, Peru). Caespitose therophyte. Bunchgrasses.
- Cortaderia bifida* Pilg.
3700–4200 m asl. Native (Bolivia, Colombia, Costa Rica, Ecuador, Panama, Peru, Venezuela). Graminoid chamaephyte. Wet bunchgrasses and scrubs, wetlands.
- Cortaderia hapalotricha* (Pilg.) Conert.
3500–4100 m asl. Native (Bolivia, Colombia, Costa Rica, Ecuador, Panama, Peru, Venezuela). Graminoid chamaephyte. Rocky places, scrub of *Arcytophyllum vernicosum*.
- Cortaderia nitida* (Kunth) Pilg.
3700–4100 m asl. Native (Bolivia, Colombia, Costa Rica, Ecuador, Panama, Peru, Venezuela). Graminoid chamaephyte. Wet bunchgrasses.
- Cortaderia sericantha* (Steud.) Hitchc.
3600–4200 m asl. Native (Colombia, Ecuador, Peru). Graminoid chamaephyte. Wetlands, *Plantago rigida* cushions.
- Dactylis glomerata* L.
3300–4000 m asl. Alien (Cosmopolitan). Caespitose hemicryptophyte. Roadsides.
- Elymus cordilleranus* Davidse & R.W. Pohl
3300–3700 m asl. Native (Argentina, Bolivia, Chile, Colombia, Costa Rica, Ecuador, Panama, Peru, Venezuela). Graminoid chamaephyte. Bunchgrasses, disturbed places.
- Eragrostis tenuifolia* (A. Rich.) Hochst. ex Steud.
3500–3600 m asl. Alien (Cosmopolitan). Caespitose hemicryptophyte. Trails, disturbed bunchgrasses.
- Festuca asplundii* E.B. Alexeev
4000–4300 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Graminoid chamaephyte. Wet bunchgrasses.
- Festuca imbaburensis* Stančík
4200–4400 m asl. Native (Colombia, Ecuador). Graminoid chamaephyte. Scrub of *Loricaria ilinissae*, bunchgrasses.

- Festuca parciflora* Swallen
3800–4000 m asl. Native (Endemic to Azuay and Loja). Graminoid chamaephyte. Wet bunchgrasses, *Plantago rigida* cushions. VU B1ab(iii).
Nomenclatural type: Ecuador: Azuay: páramos, in vicinity of Toreador, between Molleturo and Quinoas, 3810–3930 m asl, 15 Jun 1943, J. A. Steyermark 53092, HT: US–1911635, Ecuador.
- Festuca sodiroana* Hack. ex E.B. Alexeev
3300–3600 m asl. Native (Colombia, Ecuador). Caespitose hemicryptophyte. Bunchgrasses, scrubs.
- Festuca subulifolia* Benth.
3600–4200 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Graminoid chamaephyte. Bunchgrasses.
- Holcus lanatus* L.
3300–3500 m asl. Alien (Cosmopolitan). Caespitose hemicryptophyte. Bunchgrasses, roadsides.
- Muhlenbergia ligularis* (Hack.) Hitchc.
3600–3800 m asl. Native (Argentina, Bolivia, Colombia, Costa Rica, Ecuador, Guatemala, Peru, Venezuela). Graminoid chamaephyte. Disturbed bunchgrasses.
- Muhlenbergia peruviana* (P. Beauv.) Steud.
3300–3600 m asl. Native (America). Scapiform therophyte. Bunchgrasses.
- Nassella inconspicua* (J. Presl) Barkworth
3300–3800 m asl (Pacific slope). Native (Argentina, Bolivia, Colombia, Ecuador, Peru). Graminoid chamaephyte. Bunchgrasses.
- Nassella pubiflora* (Trin. & Rupr.) E. Desv.
3300–3500 m asl. Native (Argentina, Bolivia, Chile, Colombia, Ecuador, Peru). Graminoid chamaephyte. High Andean forest–bunchgrass ecotone.
- Neurolepis aristata* (Munro) Hitchc.
3800–4100 m asl. Native (Colombia, Ecuador, Peru). Graminoid chamaephyte. Wet bunchgrasses.
- Neurolepis villosa* L.G. Clark
3800–4300 m asl. Native (Endemic to Ecuador). Graminoid chamaephyte. Wet bunchgrasses, scrub of *Loricaria ilinissae*. VU B1ab(iii).
Nomenclatural type: Ecuador: Azuay: Páramo de Las Cajas W of Cuenca, 4000–4150 m asl, 2 Sep 1984, S. Laegaard 52884, HT: QCA; IT: AAU, QCNE, Ecuador.
- Ortachne erectifolia* (Swallen) Clayton
3600–4150 m asl. Native (Colombia, Costa Rica, Ecuador, Peru, Venezuela). Graminoid chamaephyte. Bunchgrasses.
- Paspalum bonplandianum* Flügge
3300–4000 m asl. Native (Colombia, Ecuador, Peru, Venezuela). Creeping hemicryptophyte. Disturbed bunchgrasses.
- Piptochaetium indutum* Parodi
3600–3700 m (Pacific slope). Native (Argentina, Bolivia, Ecuador, Peru). Caespitose hemicryptophyte. Bunchgrasses.
- Piptochaetium panicoides* (Lam.) E. Desv.
3700 m (Pacific slope). Native (Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Peru, Uruguay, Venezuela). Caespitose hemicryptophyte. Bunchgrasses.
- Piptochaetium tovarii* Sánchez Vega
3600–3700 m (Pacific slope). Native (Ecuador, Peru). New record to Ecuador. Caespitose hemicryptophyte. Bunchgrasses.
- Poa aequatoriensis* Hack.
3800–3900 m asl. Native (Colombia, Ecuador, Peru). Caespitose hemicryptophyte. Bunchgrasses.
- Poa annua* L.
3100–4100 m asl. Alien (Cosmopolitan). Caespitose therophyte. Roadsides, bunchgrasses, forests of *Polylepis*.
- Poa cucullata* Hack.
4000–4400 m asl. Native (Colombia, Ecuador, Venezuela). Caespitose hemicryptophyte. Rocky places.
- Poa paramoensis* Lægaard
3700–4300 m asl. Native (Endemic to Ecuador). Caespitose hemicryptophyte. Bunchgrasses. LC.
Nomenclatural type: Ecuador: Prov. Azuay: Páramo de las Cajas W of Cuenca, 79°4'W 02°47'S, 4000–4150 m asl, 2 Sept 1984, Laegaard 52843, HT: QCA; IT: AAU, MO, QCNE, S, US, Ecuador.
- Poa pauciflora* Roem. & Schult.
3700–4200 m asl. Native (Colombia, Costa Rica, Ecuador, Peru, Venezuela). Caespitose hemicryptophyte. Bunchgrasses.
- Poa subspicata* (J. Presl) Kunth
3300–4300 m asl. Native (Bolivia, Colombia, Ecuador, Guatemala, Peru, Venezuela). Caespitose hemicryptophyte. Bunchgrasses, rocky places.
- Puccinellia frigida* (Phil.) I.M. Johnst.
3700–3800 m asl. Native (Argentina, Bolivia, Chile, Ecuador, Peru). Caespitose hemicryptophyte. Wetlands, *Plantago rigida* cushions.
- Sporobolus bogotensis* Swallen & García-Barr.
3300–3500 m asl. Native (Colombia, Ecuador). Graminoid chamaephyte. Bunchgrasses.
- Stipa hans-meyeri* Pilg.
3400–4000 m asl. Native (Bolivia, Costa Rica, Ecuador, Peru). Graminoid chamaephyte. Bunchgrasses.
- Stipa rosea* Hitchc.
3500–4200 m asl. Native (Ecuador, Peru). Graminoid chamaephyte. Bunchgrasses.
- Trisetum irazuense* (Kuntze) Hitchc.
3400–4200 m asl. Native (Central America, Colombia, Ecuador, Venezuela). Caespitose hemicryptophyte. Bunchgrasses.
- Trisetum spicatum* (L.) K. Richt.
3400–3800 m asl. Alien (Cosmopolitan). Caespitose hemicryptophyte. Bunchgrasses.
- Vulpia myuros* (L.) C.C. Gmel.
3800 m asl. Caespitose therophyte. Alien (Cosmopolitan). Roads (only one record in CNP).
- Polygalaceae:** 1 genus, 3 species.
- Monnina crassifolia* (Bonpl.) Kunth
3200–4100 m asl. Native (Colombia, Ecuador). Nanophanerophyte. Bunchgrasses, scrub of *Arcytophyllum vernicosum*. Nomenclatural type: Habitat in montibus frigidis prope Cuencam, Assuay, Quito.

- Monnina ligustrifolia* Kunth
3200–3850 m asl. Native (Ecuador, Peru).
Nanophanerophyte. Bunchgrasses.
- Monnina revoluta* (Bonpl.) Kunth
3500–4100 m asl. Native (Colombia, Ecuador).
Nanophanerophyte. Bunchgrasses.

Polygonaceae: 3 genera, 6 species.

- Muehlenbeckia andina* Brandbyge
3400–3600 m (Rare in CNP). Native (Bolivia,
Ecuador, Peru). Supported liana. Bunchgrasses.
- Muehlenbeckia tamnifolia* (Kunth) Meisn.
3300–3500 m asl. Native (Argentina, Bolivia,
Central America, Colombia, Ecuador, Paraguay,
Peru, Venezuela). Supported liana. High Andean
forest–bunchgrass ecotone.
- Muehlenbeckia volcanica* (Benth.) Endl.
3800–4100 m asl. Native (Bolivia, Brazil, Colombia,
Costa Rica, Ecuador, Guatemala, Mexico,
Peru, Venezuela). Climbing hemicryptophyte.
Bunchgrasses, rocky places.
- Polygonum hydropiperoides* Michx.
3300–3800 m asl. Native (North, Central and South
America). Helohemicryptophyte. Flooded places,
wetlands.
- Rumex acetosella* L.
3300–4000 m asl. Alien: (Cosmopolitan). Rosulate
hemicryptophyte. Disturbed bunchgrasses.
- Rumex tolimensis* Wedd.
3700–4400 m asl. Native (Colombia, Ecuador,
Peru). Rosulate hemicryptophyte. Wet bunchgrasses,
stream banks, rocky places. LC (2016).

Potamogetonaceae: 1 genus, 3 species.

- Potamogeton filiformis* Pers.
3800–3900 m asl. Native (Cosmopolitan).
Hydrogeophyte. Lagoons.
- Potamogeton illinoensis* Morong
3400–3900 m asl. Native (North, Central and South
America). Hydrogeophyte. Lagoons.
- Potamogeton paramoanus* R.R. Haynes & Holm–Niels.
3700–4000 m asl. Native (Bolivia, Colombia,
Ecuador, Peru, Venezuela). Hydrogeophyte.
Lagoons, streams.

Primulaceae: 2 genera, 2 species.

- Lysimachia arvensis* (L.) U. Manns & Anderb.
3820 m asl. Alien (Cosmopolitan). Creeping
hemicryptophyte. Roadsides (only one record in CNP).
- Myrsine dependens* (Ruiz & Pav.) Spreng.
3200–3700 m asl. Native (Bolivia, Colombia, Costa Rica,
Ecuador, Panama, Peru, Venezuela). Nanophanerophyte/
Microphanerophyte. Bunchgrasses lower edge, forests
of *Polyepis lanuginosa* (Pacific slope)

Proteaceae: 2 genera, 2 species.

- Lomatia hirsuta* (Lam.) Diels
3200 (Atlantic slope) 3500 m (Pacific slope). Na-
tive (Argentina, Chile, Ecuador, Peru). Microphan-

erophyte. High Andean forest–bunchgrass ecotone,
scrubs.

- Oreocallis grandiflora* (Lam.) R. Br.
3300–3700 m asl. Native (Ecuador, Peru).
Microphanerophyte. High Andean forest, High Andean
forest–bunchgrass ecotone.

Ranunculaceae: 3 genera, 8 species.

- Oreithales integrifolia* (DC.) Schldtl.
3800–4000 m (Soldados). Native (Bolivia, Ecuador,
Peru). Rosulate hemicryptophyte. Disturbed or
burned bunchgrasses.
- Ranunculus flagelliformis* Sm.
3200–4000 m asl. Helohemicryptophyte. Swamps,
pools, lagoon banks.
- Ranunculus geranioides* Humb., Bonpl. & Kunth ex DC.
3600–3900 m asl. Native (Central and South America).
Rosulate hemicryptophyte. Wet bunchgrasses.
- Ranunculus limoselloides* Turcz.
3600–3900 m asl. Native (Bolivia, Colombia,
Ecuador, Peru, Venezuela). Hemicryptophyte.
Lagoons, pools.
- Ranunculus mandonianus* Wedd.
3500–4200 m (Pacific slope). Native (Bolivia,
Ecuador, Peru). Hemicryptophyte. Streams.
- Ranunculus peruvianus* Pers.
3700–4300 m asl. Native (Colombia, Costa Rica,
Ecuador, Guatemala, Mexico, Panama, Peru).
Scapiform hemicryptophyte. *Plantago rigida* cushions,
flooded places
- Ranunculus praemorsus* Kunth ex DC.
3700–4100 m asl. Native (Argentina, Bolivia, Chile,
Colombia, Costa Rica, Ecuador, Mexico, Panama,
Peru, Venezuela). Scapiform hemicryptophyte. Wet
bunchgrasses, forests of *Polylepis*.
- Thalictrum podocarpum* Kunth ex DC.
3100–3600 masl. Native (Bolivia, Colombia, Ecuador,
Peru, Venezuela). Scapiform hemicryptophyte. High
Andean forest–bunchgrass ecotone.

Rosaceae: 9 genera, 31 species (5 endemic species to
Ecuador).

- Acaena ovalifolia* Ruiz & Pav.
3700–4100 m asl. Native (Argentina, Bolivia, Chile,
Colombia, Costa Rica, Ecuador, Mexico, Panama,
Peru, Venezuela). Suffruticose chamaephyte. Forests
of *Polylepis*.
- Fragaria vesca* L.
3300–3800 m asl. Alien. Creeping hemicryptophyte.
Bunchgrasses, roadsides.
- Geum peruvianum* Focke
3300–4000 m asl. Native (Colombia, Ecuador,
Peru). Scapiform hemicryptophyte. Scrubs, forests
of *Polylepis*–bunchgrass ecotone.
- Hesperomeles obtusifolia* (Pers.) Lindl.
3300–4100 m asl. Native (Bolivia, Colombia, Costa Rica,
Ecuador, Panama, Peru, Venezuela). Nanophanerophyte.
Scrub of *Arcytophyllum vernicosum*, open bunchgrasses,
rocky places.

- Lachemilla andina* (L.M. Perry) Rothm.
3400–4000 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Creeping hemicryptophyte. Bunchgrasses.
- Lachemilla angustata* Romol.
3400–3900 m asl. Native (Endemic to Ecuador). Creeping hemicryptophyte. Bunchgrasses. VU B1ab(iii).
- Lachemilla aphanoides* (Mutis ex L. f.) Rothm.
3200–3600 m asl. Native (Bolivia, Central America, Colombia, Ecuador, Peru). Creeping hemicryptophyte. Bunchgrasses.
- Lachemilla diplophylla* (Diels) Rothm.
3800–4000 m asl. Native (Bolivia, Chile, Ecuador, Peru). Helohemicryptophyte. Wetlands, flooded places.
- Lachemilla galioides* (Benth.) Rothm.
3600–3900 m asl. Native (Colombia, Ecuador, Peru). Creeping hemicryptophyte. Bunchgrasses.
- Lachemilla hirta* (L.M. Perry) Rothm.
3300–4000 m asl. Native (Colombia, Ecuador, Venezuela). Creeping hemicryptophyte. Bunchgrasses.
- Lachemilla hispidula* (L.M. Perry) Rothm.
3700–4200 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Creeping hemicryptophyte. *Plantago rigida* cushions, scrubs of *Loricaria ilinissae* and *Chquiraga jussieui*.
- Lachemilla holosericea* (L.M. Perry) Rothm.
3700–4000 m asl. Native (Colombia, Ecuador). Creeping hemicryptophyte. Scrub of *Arcytophyllum vernicosum*, rocky places.
- Lachemilla jamesonii* (L.M. Perry) Rothm.
3800–4000 m asl. Native (Endemic to Ecuador). Creeping hemicryptophyte. Wetlands, *Plantago rigida* cushions. NT.
- Lachemilla nivalis* (Kunth) Rothm.
4000–4300 m (Osohuayco, Tres Cruces). Native (Colombia, Ecuador, Peru, Venezuela). Creeping hemicryptophyte. Scrub of *Loricaria ilinissae*, rocky places.
- Lachemilla orbiculata* (Ruiz & Pav.) Rydb.
3200–4000 m asl. Native (North, Central and South America). Creeping hemicryptophyte. Bunchgrasses, wet pasturelands.
- Lachemilla paludicola* (Rothm.) Rothm.
3700–3800 m asl. Native (Bolivia, Colombia, Costa Rica, Ecuador, Panama, Peru, Venezuela). Creeping hemicryptophyte / Helohemicryptophyte. Wetlands, flooded places.
- Lachemilla pinnata* (Ruiz & Pav.) Rothm.
3600–4150 m (Pacific slope). Native (Argentina, Bolivia, Colombia, Chile, Costa Rica, Ecuador, Guatemala, Mexico, Peru, Venezuela). Creeping hemicryptophyte. Wetlands, forests of *Polylepis lanuginosa*.
- Lachemilla rivulorum* (Rothm.) Rothm.
3700–4300 m asl. Native (Ecuador, Peru). Creeping hemicryptophyte. Wetlands, wet bunchgrasses.
- Lachemilla rupestris* (Kunth) Rothm.
3900–4300 m asl. Native (Endemic to Ecuador). Creeping hemicryptophyte. Rocky places, wet and open bunchgrasses. VU A4ac; B2ab(iii).
- Lachemilla uniflora* Maguire
3800–4000 m asl. Native (Colombia, Ecuador). Creeping hemicryptophyte. Wetlands, *Plantago rigida* cushions.
- Lachemilla vulcanica* (Schltdl. & Cham.) Rydb.
3700–3950 m asl. Native (Bolivia, Colombia, Ecuador, Guatemala, Mexico, El Salvador, Peru). Creeping hemicryptophyte. Bunchgrasses.
- Margyricarpus pinnatus* (Lam.) Kuntze
3300–3600 m asl. Native (Argentina, Bolivia, Brazil, Colombia, Chile, Ecuador, Peru, Uruguay). Suffruticose chamaephyte. High Andean forest–bunchgrass ecotone. Note: In HA and QCA herbaria there are collections of two natural hybrids (*P. incana* × *lanuginosa* and *P. incana* × *reticulata*).
- Polylepis incana* Kunth
3300–4200 m (North of the CNP). Native (Bolivia, Colombia, Ecuador, Peru). Microphanerophyte/ Mesophanerophyte. Forests of *Polylepis*. TC:VU A1acd (1998).
- Polylepis lanuginosa* Kunth
3200–3700 m (Pacific slope). Native (Endemic to Ecuador). Microphanerophyte. Forest of *P. lanuginosa*, on shallow soils. VU B1ab(iii).
- Polylepis racemosa* Ruiz & Pav.
3500–4000 m (outer limits of CNP). Alien (Bolivia, Peru, cultivated in Ecuador). Microphanerophyte. Fences of houses, roadsides. VU A1c (2006).
- Polylepis reticulata* Hieron.
3300–4200 m asl. Native (Endemic to Ecuador). Microphanerophyte. Groves of *P. reticulata* on rocky substrates. VU A4c.
- Polylepis weberbaueri* Pilg.
3200–3900 m (Soldados, southern part of CNP). Native (Ecuador, Peru). Microphanerophyte. Groves of *P. weberbaueri*, near streams. VU A1acd (1994)
- Potentilla dombeyi* Nestl.
3700–4000 m asl. Native (Ecuador, Peru). Creeping hemicryptophyte. Bunchgrasses, scrub of *Arcytophyllum vernicosum*.
- Rubus coriaceus* Poir.
3300–4000 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Nanophanerophyte. Forests of *Polylepis*, scrubs. EN B1ab(i) (2001).
- Rubus glabratus* Kunth
3400–3700 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Nanophanerophyte. Forests of *Polylepis*, scrubs. VU B1ab(i) (2001).
- Rubus nubigenus* Kunth
3200–3600 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Nanophanerophyte. Scrubs, HighAndean forest, bunchgrasses.
- Rubiaceae:** 4 genera, 14 species.
- Arcytophyllum capitatum* (Benth.) K. Schum.
3200–4000 m asl. Native (Colombia, Ecuador, Peru). Nanophanerophyte. Bunchgrasses.
- Arcytophyllum ciliolatum* Standl.
3300–3800 m asl. Native (Ecuador, Peru). Fruticose chamaephyte. Bunchgrasses.

Arcytophyllum filiforme (Ruiz & Pav.) Standl.
3300–4400 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Fruticose chamaephyte. Bunchgrasses, scrubs, forests of *Polylepis*.

Arcytophyllum rivetii Danguy & Cherm.
3300–3800 m (Pacific slope). Native (Ecuador, Peru). Fruticose chamaephyte. High Andean forest–bunchgrass ecotone, bunchgrasses.

Arcytophyllum setosum (Ruiz & Pav.) Schltld.
3700–4200 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Fruticose chamaephyte. Bunchgrasses.

Arcytophyllum thymifolium (Ruiz & Pav.) Standl.
3300–3600 m asl. Native (Colombia, Ecuador, Peru). Fruticose chamaephyte. Forests of *Polylepis lanuginosa*–bunchgrass ecotone.

Arcytophyllum vernicosum Standl.
3200–4100 m asl. Native (Colombia, Ecuador, Peru). Nanophanerophyte. Scrubs, rocky places, bunchgrasses.

Galium canescens Kunth
3700–3800 m asl. Native. (Bolivia, Colombia, Costa Rica, Ecuador, Peru, Venezuela). Climbing hemicryptophyte. Bunchgrasses.

Galium corymbosum Ruiz & Pav.
3500–3900 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Scapiform hemicryptophyte. Bunchgrasses, rocky soils.

Galium hypocarpium (L.) Endl. ex Griseb.
3200–4000 m asl. Native (Caribbean, Central America, South America). Climbing hemicryptophyte. Forests of *Polylepis*, dense bunchgrasses.

Galium obovatum Kunth
3200–3700 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Climbing hemicryptophyte. Bunchgrasses, High Andean forest.

Galium pseudotriflorum Dempster & Ehrend.
3300–3600 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Climbing hemicryptophyte. Bunchgrasses.

Nertera granadensis (Mutis ex L. f.) Druce
3300–3800 m asl. Native (Cosmopolitan). Fruticose chamaephyte. *Plantago rigida* cushions, swamps, flooded places.

Palicourea psittacorum Standl.
3100–3500 m asl. Native (Colombia, Ecuador, Peru). Microphanerophyte. High Andean forest–bunchgrass ecotone, bunchgrasses.

Santalaceae: 1 genus, 2 species.

Cervantesia bicolor Cav.
3500–4000 m asl. Native (Bolivia, Ecuador, Peru). Microphanerophyte, hemiparasite. Scrubs.

Cervantesia tomentosa Ruiz & Pav.
3100–3600 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Nanophanerophyte, hemiparasite. Scrubs.

Saxifragaceae: 1 genus, 1 species.

Saxifraga magellanica Poir.
4100–4400 m asl. Native (Argentina, Bolivia, Chile, Ecuador, Peru). Suffruticose chamaephyte. Scrub of *Loricaria ilinissae*, wetlands, rocky places.

Scrophulariaceae: 2 genera, 4 species.

Alonsoa linearis (Jacq.) Ruiz & Pav.
3400–3900 m asl. Native (Bolivia, Ecuador, Peru). Scapiform hemicryptophyte. Bunchgrasses.

Alonsoa meridionalis (L. f.) Kuntze
3200–3900 m asl. Native (Bolivia, Central America, Chile, Colombia, Ecuador, Peru, Venezuela). Scapiform hemicryptophyte. Bunchgrasses.

Buddleja americana L.
3300–3600 m asl. Native (Bolivia, Caribbean, Central America, Colombia, Ecuador, Peru, Venezuela). Microphanerophyte. High Andean forest, scrubs.

Buddleja incana Ruiz & Pav.
3300–3700 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Microphanerophyte. High Andean forest, scrubs.

Solanaceae: 6 genera, 10 species.

Deprea orinocensis (Kunth) Raf.
3300–3600 m asl. Native (Colombia, Costa Rica, Ecuador, Panama, Venezuela). Suffruticose chamaephyte. Scrubs.

Nierembergia repens Ruiz & Pav.
3300–3600 m asl. Native (South America). Creeping hemicryptophyte. Bunchgrasses.

Salpichroa diffusa Miers
3200–3500 m asl. Native (Bolivia, Colombia, Ecuador, Peru). Suffruticose chamaephyte. High Andean forest–bunchgrass ecotone, bunchgrasses.

Salpichroa tristis Miers
3300–3800 m asl. Native (Argentina, Bolivia, Colombia, Ecuador, Peru, Venezuela). Supported liana. Forests of *Polylepis*.

Saracha quitensis (Hook.) Miers
3200–3600 m asl. Native (Colombia, Ecuador, Peru, Venezuela). Microphanerophyte. High Andean forest–scrub ecotone.

Sessea crassivenosa Bitter
3200–3700 m asl. Native (Colombia, Ecuador). Microphanerophyte. High Andean forest–scrub ecotone.

Solanum furcatum Dunal
3400 m (only one record, in Angas). Native (Argentina, Bolivia, Chile, Ecuador, Peru, USA). Suffruticose chamaephyte. Forests of *Polylepis lanuginosa*, High Andean forest–bunchgrass ecotone.

Solanum hypaleurotrichum Bitter
3300–3600 m asl. Native (Colombia, Ecuador, Peru). Microphanerophyte. Scrubs.

Solanum nitidum Ruiz & Pav.
3300–4000 m asl. Native (Bolivia, Chile, Ecuador, Peru). Nanophanerophyte. Bunchgrasses.

Solanum tuberosum L.
3300–3700 m asl. Native (Argentina, Bolivia, Chile, Colombia, Ecuador, Peru). Radicotuberiform geophyte. Trails.

Symplocaceae: 1 genus, 2 species.

Symplocos nana Brand
3700–4000 m asl. Native (Bolivia, Ecuador, Peru). Nanophanerophyte. Forests of *Polylepis*.

Symplocos quitensis Brand

3300–3600 m (Pacific slope). Native (Bolivia, Colombia, Ecuador, Peru). Nanophanerophyte. Scrubs.

Tofieldiaceae: 1 genus, 2 species.*Harperocallis falcata* (Ruiz & Pav.) L.M. Campb. & Dorr

3200–3600 m asl. Native (Ecuador, Peru). Bulbous geophyte. Bunchgrasses.

Harperocallis sessiliflora (Hook.) L.M. Campb. & Dorr

3300–3600 m asl. Native (Colombia, Ecuador, Venezuela). Bulbous geophyte. Wetlands, wet bunchgrasses.

Tropaeolaceae: 1 genus, 2 species.*Tropaeolum magnificum* Sparre

3200–3700 m asl. Native (Colombia, Ecuador, Peru). Climbing hemicryptophyte. Scrubs. VU B1ab(iii) (2001).

Tropaeolum smithii DC.

3100–3600 m asl. Native (Bolivia, Colombia, Ecuador, Peru, Venezuela). Climbing hemicryptophyte. Roadsides.

Urticaceae: 2 genera, 3 species (1 endemic species to Ecuador).*Pilea jamesoniana* Wedd.

3200–3500 m asl. Native (Endemic to Ecuador). Rhizomatous hemicryptophyte. Bunchgrasses, forests of *Polylepis lanuginosa*. VU D2.

Pilea microphylla (L.) Liebm.

3200–3500 m asl. Native (Cosmopolitan). Rhizomatous hemicryptophyte. Forests of *Polylepis lanuginosa*.

Urtica echinata Benth.

3700–4000 m asl. Native (Bolivia, Ecuador, Peru). Rhizomatous hemicryptophyte. Forests of *Polylepis*.

Urtica urens L.

3200–3950 m asl. Alien (Cosmopolitan). Scapiform therophyte. Forests of *Polylepis*, bunchgrasses.

Violaceae: 1 genus, 3 species.*Viola bangii* Rusby

4100–4400 m asl. Native (Bolivia, Peru, Ecuador). Rosulate hemicryptophyte. Rocky places, shallow places.

Viola dombeyana DC.

3300–3900 m asl. Native (Colombia, Ecuador, Peru). Rosulate hemicryptophyte. Bunchgrasses.

Viola pygmaea Juss. ex Poir.

3700–4400 m asl. Native (Argentina, Bolivia, Ecuador, Peru). Pulviniform chamaephyte. *Plantago rigida* cushions, wet bunchgrasses.

Viscaceae: 1 genus, 1 species.*Phoradendron inaequidentatum* Rusby

3300–3600 m asl. Native (Bolivia, Brazil, Colombia, Ecuador, Guiana, Panama, Paraguay, Peru, Surinam, Venezuela). Nanophanerophyte, hemiparasite. Scrubs.

Xyridaceae: 1 genus, 1 species.*Xyris subulata* Ruiz & Pav.

3400–3900 m asl. Native (Bolivia, Colombia, Costa Rica, Ecuador, Guiana, Panama, Peru, Venezuela). Caespitose hemicryptophyte. Wetlands, *Plantago rigida* cushions.