



## The Flora of Melik and Kaldırım Mountains and Surrounding Area (Manavgat-İbradı/Antalya)

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### Research Article

#### Keywords:

Antalya  
 Chorotypes  
 Flora  
 İbradı  
 Life Forms  
 Manavgat

Received: 03.11.2022

Accepted: 14.12.2022

Published: 31.12.2022

DOI: 10.55848/jbst.2022.17

### ABSTRACT

The present study concerns the flora of the Melik and Kaldırım Mountains as well as of their surrounding area. As a result of the evaluation of the plant samples which were collected from the research area between 2008 and 2011, some 944 taxa were identified as taxonomically belonging to 87 different families and 388 genera. Among them, 331 (35.0%) of the total taxa in the field represent Mediterranean elements, 98 (10.4%) Irano-Turanian elements, 50 (5.3%) European-Siberian elements, and 465 (49.3%) constitute multi-regional taxa or taxa whose phytogeographical regions are unknown. The largest family in the research area is that of Asteraceae (117 taxa) and the largest genus is *Trifolium* (20 taxa) in terms of the number of taxa. Nine new taxa were recorded for the Flora of Turkey grid C3. In addition, 154 (16.3%) endemic taxa were found in the research area. Depending on ecological conditions, the number of hemicryptophytes is the highest among life forms in the study area.

## 1. Introduction

It is estimated that there are 400,000 vascular plant species on earth and Türkiye ranks 24<sup>th</sup> with 10001 species in terms of the number of plant species in the world [1, 2]. There are 11707 taxa naturally distributed in Türkiye and 3649 (31.82%) of them are endemic to this country [3]. Türkiye has wild relatives of many cultivated plants and it is one of the eight largest gene centers in the world [4]. Türkiye is a very special country in terms of its temperate zone and is also long-famed for its rich flora with a high proportion of endemics. However, this wealth is under great pressure, especially in terms of natural habitats and rare/endemic species, which is due to various activities such as agriculture, forestry, urbanization, industrialization and the use of water resources [5]. Various parts of the country, such as Amanos Mountains, Ilgaz Mountains, Central Taurus and Taşeli Plateau, Bolkar Mountains-Aladağlar, Antitaurus Mountains, Kaz Mountain, Uludağ, mountains around Gümüşhane-Erzincan, high mountains between Artvin and Rize, Munzur Mountains, Van-Hakkâri-Bitlis surroundings, gypsum lands near Sivas-Çankırı, salty steppes around Tuz Gölü and Southwest Anatolian Section (Muğla, Antalya, Burdur) and some other mountain ranges, are very rich in terms of endemic plants [5, 6]. The most endemic plants in Türkiye are distributed in the Mediterranean Region. Besides, the province Antalya where the studied area is located has the highest number of endemic taxa as well as endemism rate [7-27]. The present paper comprises a floristic catalogue of 944 taxa with an analysis of this inventory by taxonomic categories, chorotypes and life forms.

The study area (Fig. 1) is located between Manavgat and İbradı districts of Antalya and between 31°15' – 31°26' eastern longitudes and 37°08' – 37°17' northern latitudes in the Mediterranean Region. This area is geographically located in the C3 square according to the grid system in the Flora of Türkiye [20, 28, 29]. The study area is surrounded by Burmahan and Çay neighborhoods of Manavgat and Başlar neighbourhood of İbradı. The altitude of the study field varies between 600 and 2273 meters (Fig. 1). The area covers plant communities in the Eu-Mediterranean vegetation belt (500-1000 m), the Supra-Mediterranean vegetation belt (1000-1500 m), the Mediterranean mountain vegetation belt (1500-2000 m) and the Mediterranean high mountain vegetation belt (higher than 2000 m). Based on the elevation the research area displays different vegetation types (e.g. forest, thorny-cushion and dwarf-shrub hygrophytic, snow-patches, moist meadows (meltwater) and dolines, wind-exposed sloping hills, rocks and screes).

### 1.1. Climate

The meteorological data were obtained from Turkish State Meteorological Service and Antalya Regional Directorate of Meteorology. The climatic diagrams of the stations were prepared using Walter's method [30], (Fig. 2). The nearest stations are in Beşkonak, İbradı, Manavgat and Akseki. According to the values from these stations (precipitation data of İbradı station are lacking), the research area has a Mediterranean climate characterised by half dry summers and

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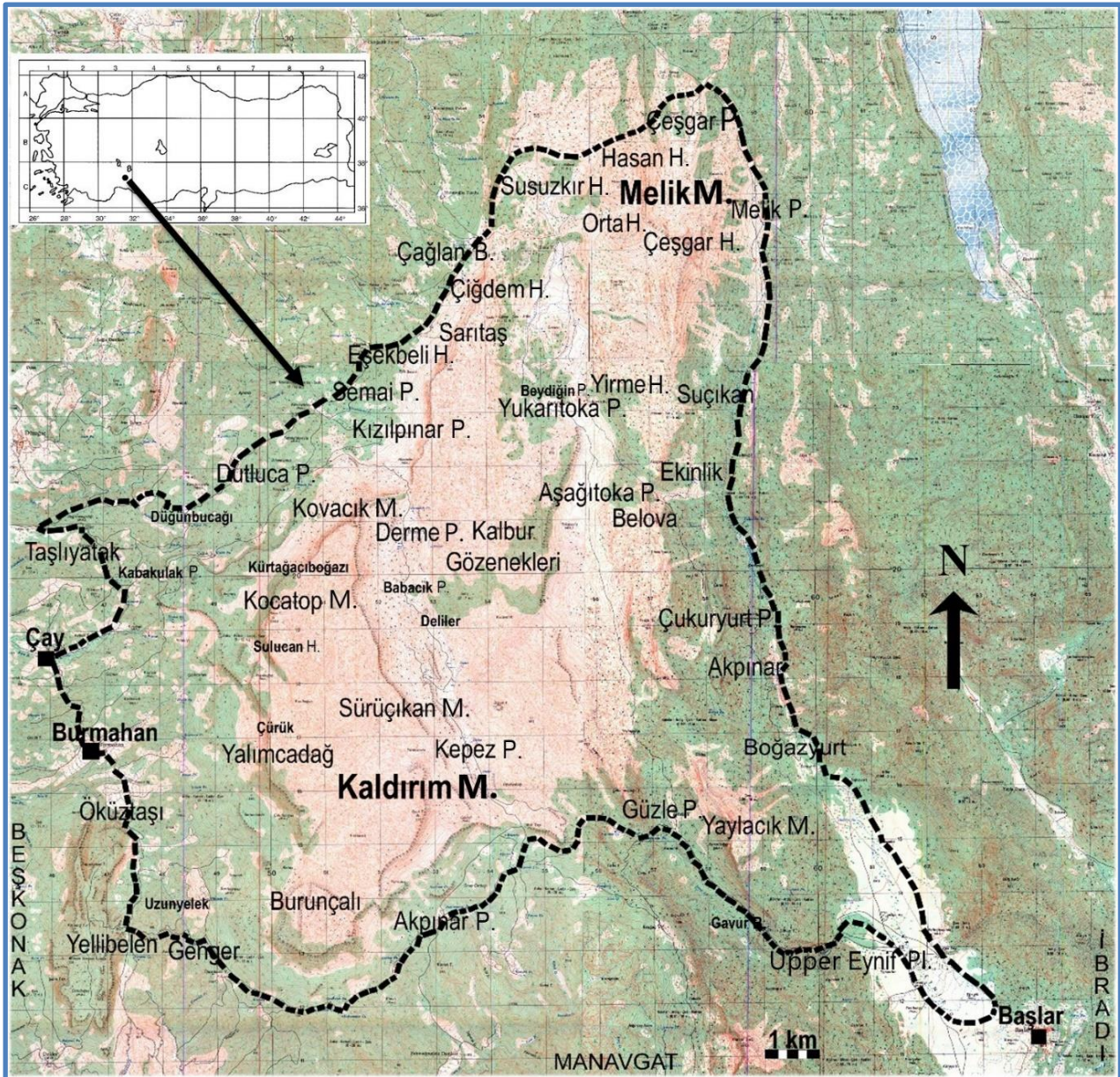


Fig. 1 Geographic map of the research area.

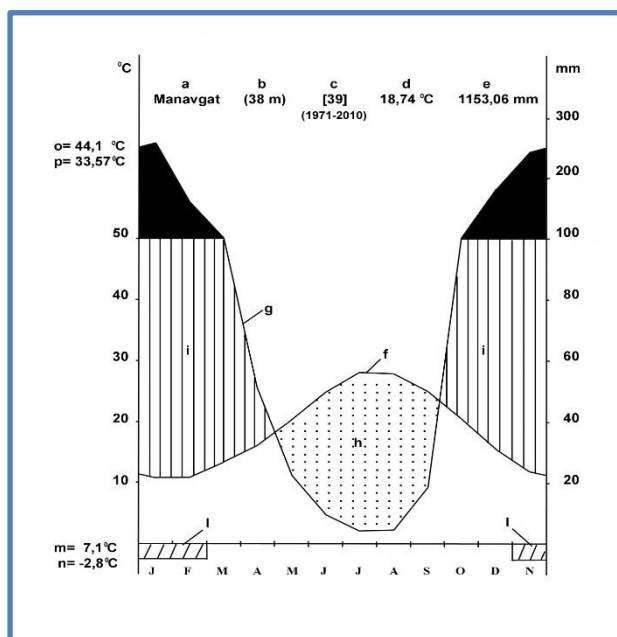
variable temperatures during the winter months. In all stations, the seasonal precipitation regime during the year is as follows: WASS; winter (W) > autumn (A) > spring (S) > summer (S). One of the general characteristics of the Mediterranean climate, the climate is indicated the degree of general drought that is performed with the use of rainfall and temperature data. According to this, bioclimatic type of the research area is determined with the help of Emberger's formula and drought index. The Emberger precipitation-temperature coefficient (Q) was calculated as 161.5 for Beşkonak station, 148.2 for Manavgat station, 159.3 for Akseki station. Average annual temperature is 14.36 °C in İbradı, 17.48 °C in Beşkonak, 18.74 °C in Manavgat and 13.08 °C in Akseki. Average annual rainfall is 1556.08 mm in Beşkonak, 1153.06 mm in Manavgat and 1433.98 mm in Akseki. According to climatic data, İbradı is located the Mediterranean bioclimatic layer with cool winters. Beşkonak is located the Mediterranean bioclimatic layer with half dry summers and warm winters. Manavgat is located the Mediterranean bioclimatic layer with half dry summers and hot winters. Akseki is located the Mediterranean bioclimatic layer

with half dry summers and cold winters. Beşkonak, Manavgat and Akseki stations are in the very rainy and rainy Mediterranean bioclimatic layer according to precipitation-temperature coefficient (Q) values. Besides, they are in the rainy bioclimatic type according to annual rainfalls.

## 1.2. Geology, Soil and Geomorphology

The study area is located within the Anamas-Akseki autochthon (Geyik Mountain Unit) with generally platform feature. This unit, which is called "para-autochthon", is an important part of the Taurus Carbonate Platform [31].

In the area, Middle - Upper Triassic old Kasımlar formation (TRk), Menteşe dolomite - Leylek limestone units (TRml) and Jurassic - Cretaceous old Üzümdere formation (TRJü), Kurucaova formation (JKk), Alıçbeleni formation (Jal), Dumanlı formation (Kd), alluvia (Qal), hillside debris - accumulation colony (Qym) and Düzağaç conglomerate (Qdü) units are determined on based Şenel [32] (Fig. 3).



**Fig. 2** The climatic diagrams of the stations a) meteorological station, b) altitude, c) observation (years), d) average annual temperature (°C), e) average annual precipitation (mm), f) temperature, g) precipitation, h) dry season, i) precipitation season, l) probable frost months, m) average minimum temperature of the coldest month (°C), n) annual absolute minimum temperature (°C), o) absolute maximum temperature (°C), p) average maximum temperature (°C).

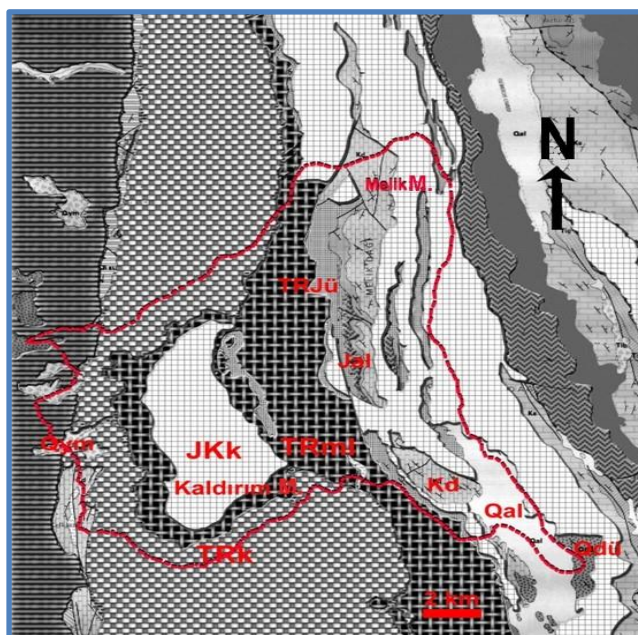
The soil groups in the study area are determined according to Antalya Province Lands Being [33]. These are Red Mediterranean Soils “Terra Rosa Soils” (T), Red Mediterranean Forest Soils (T – F), Red - Brown Mediterranean Forest Soils (R – B), Alluvial Soils (A), Colluvial Soils (C), Bare Rock and Debris (RD) (Fig. 4).

In terms of geomorphological structure of the research area, typical karst shapes are seen such as karren, doline, uvala, sinkhole and katavothre that has been formed on plains and mountainous areas. Especially, rocky debris in near Kızılpınar Plateau (Fig. 5) and Aşağıtoka Plateau are nice examples to slope debris.

Besides, periodic lakes are formed at the base of plains because of Akpınar Stream source, rainfall and melting snow waters and water can't be evicted by sinkholes (Fig. 6).

## 2. Materials and Methods

In the studied area, 5325 plant samples were collected and observed between 2008 and 2011. All specimens were dried according to the standard herbarium methods and kept in Akdeniz University Manavgat Tourism Faculty, Ecotourism Practice Laboratory. The major taxonomic references [34-46] and some other areal specific ones were used to identify the plant specimens [7-20, 22-27, 47-54]. Diagnosed specimens are listed in alphabetical order in Appendix 1. Besides, location, habitat, voucher number, life forms of the specimens are given. Their chorotypes and endemism status are given according to the related literatures [29, 42-44, 55-57]. Meteorological data were obtained from Turkish State Meteorological Service and



**Fig. 3** Geologic map of the research area it's modified from Şenel (1997) [32].

Antalya Regional Directorate of Meteorology [58, 59]. All meteorological data were evaluated according to previously reported methods in Akman (1999) as Emberger formulas and Walter's method [30]. Geological map (Isparta Plot K-12) and information [32] of the area were obtained from Department of Scientific Documentation and Publicity of the General Directorate of Mineral Research and Exploration (MTA). Furthermore, 1/25 000 topographic maps of the research area (N26 - b3, b4, c1, c2), were obtained from Akdeniz University Biological Diversity Research Development and Application Centre (AK-BİYOM). A new topographic map was provided by combining the maps.

## 3. Results and Discussion

As a result of the evaluation of the collected plant samples, 944 subgeneric taxa were identified as taxonomically belonging to 87 different families and 388 genera. Most of them belong to Spermatophyta (934 taxa) and the remainder belong to Pteridophyta (10 taxa). Nine taxa belong to Gymnospermae, and 925 taxa belong to Angiospermae. From the subdivision of Angiosperm, 776 taxa belong to Magnoliopsida, and 149 taxa belong to Liliopsida classes (Appendix 1, Table 1). According to the phytogeographical analysis, 331 (35.0%) of the total taxa in the area are Mediterranean elements, 98 (10.4%) Irano-Turanian elements, 50 (5.3%) European-Siberian elements and 465 (49.3%) multi-regional or taxa whose phytogeographical regions are unknown (Table 1). These findings show that the study area is important in terms of floristic features according to the floristic studies [7-19, 22-27, 48, 49, 53] in near regions. The research area lies completely within the Mediterranean

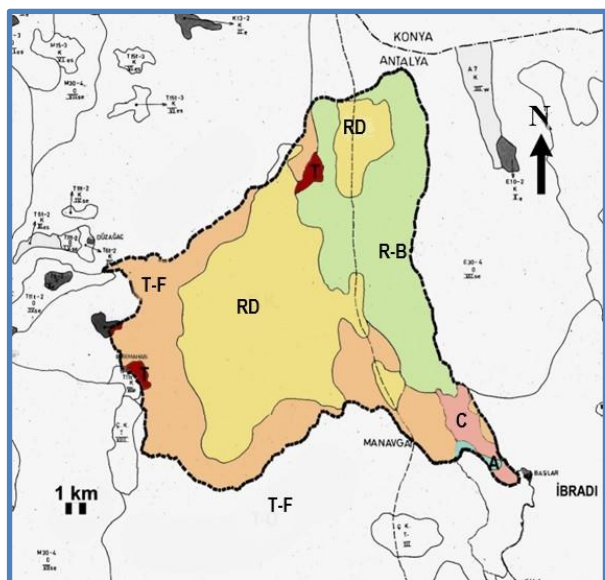


Fig. 4 Soil map of the research area (it's modified from Antalya Province Lands Being [33]).

phytogeographic region [3, 20]. So, Mediterranean elements take the first order, and Irano-Turanian and Euro-Siberian elements follow this.

In terms of the number of taxa, the largest family in the research area is Asteraceae (117 taxa) and the largest genus is Trifolium (20 taxa). The 10 largest families according to the number of taxa in this study are shown in Table 2.

The genera containing the highest number of taxa in the research area are presented in Table 3.

The life forms of the taxa are given according to Raunkiaer [8, 14, 60-66] in Table 4; 410 (43.4%) of the taxa are hemicryptophytes, 262 (27.7%) therophytes, 98 (10.4%) chamaephytes, 86 (9.1%) phanerophytes, 77 (8.2%) geophytes. Furthermore, 11 (1.2%) vascular parasites were collected in the field. Hemicryptophytes were found the most common life forms due to suitable ecological conditions of the research area in terms of climatic and edaphic characteristics. Hemicryptophytes were found the most common life forms due to suitable ecological conditions of the research area in terms of climatic and edaphic characteristics.



Fig. 5 Slope debris (in Kızılpınar Plateau).



Fig. 6 The periodic lake (in Upper Eynif Plain).

Table 1. Floristic properties of the study area.

Properties	Pteridophyta	Gymnospermae	Spermatophyta		Total
			Magnoliopsida	Angiospermae Liliopsida	
Number of Families	5	2	67	13	87
Number of Genera	5	5	313	65	388
Number of Species	10	9	736	146	901
Number of Taxa	10	9	776	149	944
Number of Endemic Taxa	-	1	134	19	154
Mediterranean elements	1	3	273	54	331
Irano-Turanian elements	-	-	79	19	98
Euro-Siberian elements	-	-	38	12	50
Multi-regional or unknown	9	6	388	62	465

**Table 2.** Numbers Genera and taxa of the largest families found in the area.

Families	Number of Genera	Number of Taxa
Asteraceae	46	117
Fabaceae	27	101
Lamiaceae	22	74
Poaceae	36	68
Caryophyllaceae	18	58
Brassicaceae	29	56
Boraginaceae	15	32
Rosaceae	14	29
Apiaceae	18	27
Plantaginaceae	8	25
Other 77 families	158	357

Concerning endemism, South Anatolia is among of the richest regions in Turkey [5]. In the research area, 154 (16.3%) endemic taxa were found. This ratio is seemed high according to many other floristic studies close to the research area. The main reason is that endemic species are mostly found on high mountains [especially in places (particular mountain range etc.) where the altitude is between 1000 to 2000 m] [5, 49]. Families with the most endemic species are as follows: Asteraceae (24), Lamiaceae (20), Caryophyllaceae (13), Fabaceae (12), Brassicaceae (10), Boraginaceae (9), Apiaceae (7), Plantaginaceae (6), Asparagaceae (6), Scrophulariaceae (5) and Rubiaceae (5). The distribution of the threat categories according to IUCN (2001; 2022) and Ekim et al. (2000) is as follows [47, 50-52, 54-57, 67, 68]: 4 endemic taxa in CR (Critically Endangered), 12 endemic taxa in EN (Endangered), 18 endemic taxa in VU (Vulnerable), 41 endemic taxa in NT (Near threatened), 77 endemic taxa in LC (Least concern). Taxa in category “CR” are *Rhaponticoides gokceoglui*, *Pimpinella ibradiensis*, *Silene caramanica* var. *ilarslanii*, *Eryngium trisectum*. Two of them, *Rhaponticoides gokceoglui* (gökçetülüşah) and *Pimpinella ibradiensis* (ibradianasonu) which were discovered during this study, were brought to the scientific world [67, 68]. New threat categories were suggested for some taxa because of their population distribution in the research area and in Türkiye. There are *Seseli gummiferum* subsp. *corymbosum* (VU), *Cota pestalozzae* (LC), *Rosularia sempervivum* subsp. *glaucophylla* (VU), *Phlomis leucophracta* (LC), *Cyclamen cilicicum* (LC). Among the endemic plants in the research area, *Tordylium ketenoglui*, *Eryngium trisectum*, *Bupleurum davisii*, *Omphalodes ripleyana*, *Aethionema subulatum*, *Ricotia varians*, *Silene caramanica* var. *ilarslanii*, *Crocus asumaniae*, *Origanum bilgeri*, *Salvia adenocaulon*, *Rosa dumalis* subsp. *antalyensis*, *Galium sorgerae*, *Verbascum nudatum* var. *spathulatum*, *Linaria dumanii* are known only from in the area and near regions.

Nine new taxa were recorded for the Flora of Turkey grid C3. These are as follows: *Vicia lunata* var. *lunata*, *Ranunculus polyanthemus*, *Scorzonera incisa*, *Linum boissieri*, *Bornmuellera cappadocica*, *Salvia adenocaulon*, *Silene lycanica*, *Allium enginii*, *Polygonum karacae*.

**Table 3.** Taxa totals of the major genera in the study area.

Genera	Number of Taxa
<i>Trifolium</i>	20
<i>Astragalus</i>	16
<i>Ranunculus</i>	16
<i>Silene</i>	16
<i>Allium</i>	15
<i>Minuartia</i>	12
<i>Centaurea</i>	11
<i>Alyssum</i>	10
<i>Galium</i>	10
<i>Medicago</i>	10
Other genera	808

#### 4. Conclusion

The Melik and Kaldırım Mountains and their surrounding area have been found to display a rich flora diversity as well as high endemism with 944 total and 154 (16.3%) endemic taxa. Data suggest that priority should be given to the conservation of plant diversity in the further research and the study area is important and vulnerable to anthropogenic effects.

#### Declaration

**Author Contribution:** Conceive- İ.Ç., M.G.; Design- İ.Ç., M.G.; Supervision- İ.Ç., M.G.; Experimental Performance, Data Collection and/or Processing İ.Ç.; Analysis and/or Interpretation İ.Ç.; Literature Review- İ.Ç.; Writer- İ.Ç.; Critical Reviews – İ.Ç.

**Conflict of interests:** The authors have declared no conflicts of interest.

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**Table 4.** Life forms and its total number and percentages in the research area.

Life Form	Total Number	Rate
Hemicryptophytes (H)	410	43.4%
Therophytes (Th)	262	27.7%
Chamaephytes (Ch)	98	10.4%
Phanerophytes (Ph)	86	9.1%
Geophytes (G)	77	8.2%
Vascular parasites (Vp)	11	1.2%

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