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Research article/Araştırma makalesi

Flora of alpine grasslands of the Eğribel pass in the Giresun mountains (Turkey)

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Abstract

In this study it was aimed to determine floristic composition of alpine grasslands of Eğribel Pass in the Giresun Mountains in North-Eastern part of Turkey. The study area belongs to the Colchic Province of the Euro-Siberian phytogeographical region. The vascular flora of Eğribel Pass was studied between 2014 and 2016. According to the results, in the study area 230 taxa belonging to 138 genera and 44 families were identified. The richest 3 families are Asteraceae with 39 taxa (17%), Poaceae with 28 taxa (12.2%) and Fabaceae with 18 taxa (7.9%). The richest genera are *Trifolium* L. and *Ranunculus* L. (6 taxa), followed by *Poa* L. (5 taxa). With 32.6% of the plants belonging to the Euro-Siberian Region, 18.3% are of the Irano-Turanian, 3.5% are of the Mediterranean and with 45.6% of the pluriregional or unknown. The life-form ratio of the taxa was as follows: hemicryptophytes 54.4%, cryptophytes 21.3%, chamaephytes 13.5%, therophytes 10.4% and phanerophytes 0.4%. The endemism ratio is 12.2% (28 taxa).

Key words: alpine grasslands, Eğribel pass, flora, Giresun mountains, Turkey

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Giresun dağları Eğribel geçidi alpin çayırlarının florası (Türkiye)

Özet

Bu çalışmada Türkiye'nin kuzey-doğu bölgesinde yer alan Giresun Dağları Eğribel Geçidi alpin çayırların florasının tespit edilmesi amaçlanmıştır. Araştırma alanı Avrupa-Sibirya fitocoğrafik bölgesinin Kolşik kısmında yer almaktadır. Sonuçlara göre araştırma alanında; 44 familya ve 138 cinse ait toplam 230 takson tespit edilmiştir. Araştırma alanında en fazla takson sayısına sahip üç familya sırasıyla Asteraceae 39 takson (% 17), Poaceae 28 takson (%12.2) ve Fabaceae 18 takson (%7.9)'dir. En zengin cinsler *Trifolium* L. ve *Ranunculus* L. (6 takson), üçüncüsü ise *Poa* L. (5 takson)' dır. Fitocoğrafik bölgelere göre dağılımlara bakılırsa, taksonların %32.6' sı Avrupa-Sibirya, %18.3'ü İran-Turan, %3.5'i Akdeniz bölgelerine ait olup, %45.6 'sı ise coğrafi bölgesi bilinmeyen veya birden fazla bölgede yayılış gösterenlerdir. Taksonların hayat formlarına göre oranları sırasıyla şöyledir: hemikriptofit %54.4, kriptofit %21.3, kamefit %13.5, terofit %10.4 ve fanerofit %0.4. Endemizm oranı %12.2 (28 takson)'dur.

Anahtar kelimeler: alpin çayırlar, Eğribel geçidi, flora, Giresun dağları, Türkiye

1. Introduction

Biodiversity contains the differences in genes, species and ecosystems and is the most important natural richness of a country (Deveci, 2012). By reason of great diversity in geology, geomorphology, topography and climate Turkey has the reachest flora in the temperate zone. It has nearly 10,000 vascular plants and is especially well known for endemic plants. Besides with its rich flora, Turkey is very rich in habitat and landscape diversity (Kandemir, 2009; Kılınç et al. 2010).

Alpine grasslands is one of the areas that have unique and valuable habitats and high endemism ratio due to presence of microhabitats, climate changes, long-term changes in floristic composition, geographical isolation, and speciation of new ones in these areas. Almost all of the floristic and vegetation studies in Turkey especially focused on

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the forest and steppic vegetation whereas there are only a few studies about the alpine and subalpine graasland vegetation which have a broad geographical distribution (Tatlı, 1987; Karakaya and Kılınç, 1996; Vural, 1996; Uysal et al. 2011).

The main objective of this study is to identify the flora of alpine grasslands in Giresun Mountains in North-Eastern part of Turkey. In this context, this study could be helpful for further studies on supporting of alpine landscapes and protection efforts of alpine plant species in Turkey.

2. Materials and methods

2.1 Study area

This study was performed in the alpine belt of the Giresun Mountains of Giresun Province, in the North-Eastern part of Turkey. Giresun Mountains are a system of mountains that extend up to the peaks on Karadağ mountain at 3391 m in the East and on the Karagöl plateauat 3095 m in the West.

The study area is surrounded by high mountains where subalpine *Abies nordmanniana* subsp. *nordmanniana* (Steven) Spach forests do not develop because of climatic limitations. Geographyical map of the study area is illustrated in Fig.1. In the study area the alpine belt extends from 1800 m (timberline) to 2600 m upwards on south-facing slopes. These altitudinal boundaries run about 100 m lower in the northern part because of being subject to a more maritime climate.

The nearest province to the study area (Şebinkarahisar) has a Mediterranean type climate with 525 mm mean annual precipitation (P) and a drought period that is observed in July with 0.5 mm precipitation. Mean annual temperature is 11.3 ºC. Summer rainfall (PE) is 37 mm. Mean maximum for the hottest month (M) and mean minimum for the coldest month (m) are 30.3 and -16.1 ºC, respectively. Index of xericity (S=PE/ME) is 1.8. Pluviometric quotient (Q= 2000P/M + m + 546.4[M-m]) is 40.7 and the precipitation regime is SubMediterranean (Spring, Autumn, Winter, Summer; Sp, Au, Wi, Su).

Alpine grasslands in the study area were characterized by *Festuca pinifolia* (Hackel ex Boiss.), Bornm. var. *pinifolia, Festuca amethystina* L. subsp. *orientalis* Krajina var. *turcica* Markgr.-Dann., *Sibbaldia parviflora* Willd. var. *parviflora, Minuartia umbellulifera* (Boiss.) McNeill subsp. *umbellulifera* var. *umbellulifera, Thymus sipyleus* Boiss., *Vaccinium myrtillus* L., *Potentilla crantzii* (Crantz) Beck & Fritsch and many other species. Plant species in the study area are fragile with its species and populations being directly and indirectly influenced by changes in land-use practice, especially abandonment of small-scale agriculture, and fragmentation of habitats.

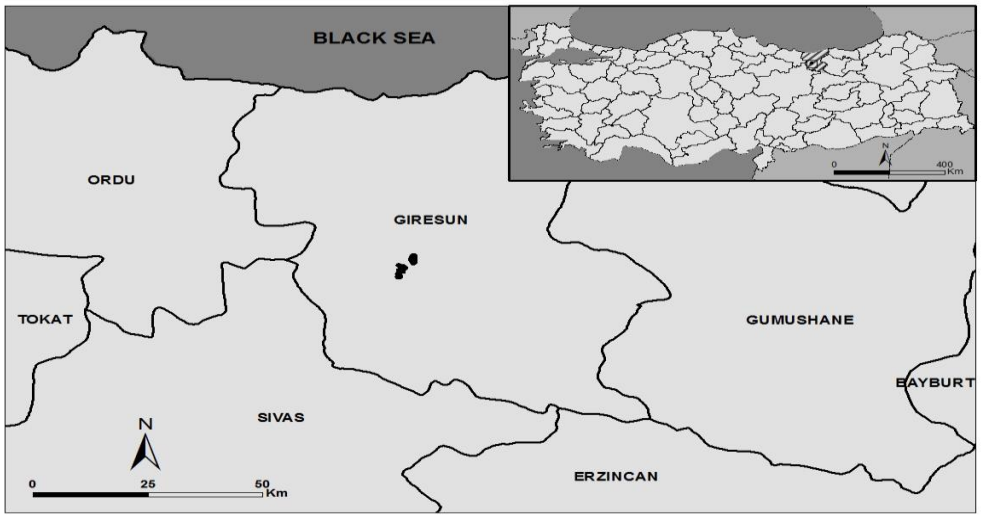

Figure 1. The geographical map of the study area

Generally, the study site is exposed to low but frequent disturbance factors. As an important disturbance factr, grazing reduces the dominance of competitive species and by trampling creates germination niches in the bare soil. It therefore has a direct effect on the structure and organization of grasslands. Today, many of the pastures in the study area are still in use (i.e. mowing, grazing or both); fallow farmland of pastures can be found in different successional stages. The numbers of grazing cows and sheep reach 50.000 individuals during the year.

2.2 Vegetation sampling and identification

The materials of this study includes some vascular plant specimens collected between August 2014 to June 2016. Nonvascular plant specimens were generally omitted. At least 1 sample for each taxon was prepared by

herbarium techniques (Erik et al. 1996) and kept at Herbarium of the Faculty of the Arts and Sciences of the Ondokuz Mayıs University (OMUB). Plant specimens were mainly identified and listed according to the "Flora of Turkey and East Aegean Islands" (Davis, 1965-1988; Davis et al. 1988; Güner et al. 2000; Güner et al. 2012) and the other related literatures (Tutin et al. 1964-1980). The floristic elements are listed in the Results. All taxa in the floristic list are given according to the order in the Flora of Turkey (Davis, 1965-1985). In the Results, each species is represented with the following details: family and taxon name, authors of the species, altitudes, collection dates, and collectors' names and numbers. Author abbrevations of the species names are given according to Brummit and Powell (1992). Additionally, endemism, IUCN threat categories, their phytogeographical regions, and the life-forms (Raunkiaer, 1934) are given. Threatened categories are proposed for the endemic and some nonendemic taxa according to IUCN risk categories (Ekim et al. 2000; IUCN, 2010 Version 8.1). The phytogeographical regions of the taxa were determined according to Davis (1965-85, 1988). The abbreviations used in the floristic list are as follows: Cosm: Cosmopolitan; Euro-Sib: Euro-Siberian element; Eux: Euxine element; Hyrc-Eux: Hyrcano-Euxine element; Ir-Tur: Irano-Turanian element; Medit: Mediterranean element; E: East; mt: mountain; EN: Endangered; DD: Data Deficient; LR: Lower Risk; cd: Conservation Dependent; lc: Least Concern; nt: Near Threatened; VU: Vulnerable; RH: Rena Hüseyinoğlu; EY: Erkan Yalçın; Hcrp: Hemicryptophytes; Crp: Cryptophytes; Chp: Chamaephytes; Thp: Therophytes; Php: Phanerophytes. Hyrc-Eux, Hyrc-Eux (mt), Eux and Eux (mt) species were evaluated as subcategories of Euro-Sib, whereas E. Medit species were evaluated as subcategories of the Mediterranean phytogeographical region..

3. Results

The Floristic List

PTERIDOPHYTA

Polypodiaceae
Polypodium vulgare L. subsp. *vulgare* L.
2450 m, 23.07.2015, EY 270
Crp.

SPERMATOPHYTA

GYMNOSPERMAE (CONIFEROPHYTA)
Cupressaceae
Juniperus communis L. var. *saxatilis* Pall.
2308 m, 14.08.2014, RH 11
Php.

ANGIOSPERMAE (MAGNOLIOPHYTA)

DICOTYLEDONAE (MAGNOLIOPSIDA)
Ranunculaceae
Anemone narcissiflora L. subsp. *willdenowii* (Boiss.) Greuter & Burdet
2500 m, 13.06.2015, EY 100
Hcrp.
Pulsatilla albana (Stev.) Bercht. & J.Presl. subsp. *albana*
2500m, 13.06.2015, EY 101
Ir-Tur., Hcrp.
Ranunculus sericeus Banks & Sol.
2005 m, 11.05.2015, RH 163
Ir-Tur., Hcrp.
R. cappadocicus Willd.
2263 m, 14.08.2014, RH 79
Eux., Crp.
R. repens L.
2450 m, 13.06.2015, EY 103
Hcrp.
R. polyanthemos L.
2500 m, 13.06.2015, EY 102
Chp.
R. grandiflorus L.
2200 m, 14.06.2015, EY 145
Hcrp.
R. ficaria L. subsp. *ficariiformis* Rouy & Foucaud
2005 m, 11.05.2015, RH 158
Crp.
Papaveraceae
Corydalis conorhiza Ledeb.
2260 m, 11.05.2015, RH 162
Eux.-Crp.
Brassicaceae (Cruciferae)
Crambe orientalis L. subsp. *orientalis* var. *orientalis*
2080 m, 14.06.2015, EY 113
Ir-Tur., Hcrp.
Aethionema iberideum (Boiss.) Boiss.
2100 m, 14.06.2015, EY 114
Chp.
Thlaspi huetii Boiss.
2250 m, 05.06.2016, RH 279
Thp.
Noccaea ochroleuca (Boiss. & Heldr.) F.K.Mey.
2500 m, 13.06.2015, EY 88
Chp.
Capsella bursa-pastoris (L.) Medik.
2005 m, 17.08.2014, RH 32
Cosm., Thp.
Alyssum minutum Schlecht.
2250 m, 05.06.2016, RH 280
Widespread, Thp.
A. pseudo-mouradicum Hausskn. & Bornm.
2260 m, 05.06.2016, EY 276
Endemic, LR (lc), Hcrp.
A. armenum Boiss.
2080 m, 14.06.2015, EY 116
Thp.
Draba bruniifolia Stev. subsp. *bruniifolia*
2500 m, 13.06.2015, EY 89
Chp.
D. siliquosa M.Bieb.
2500 m, 13.06.2015, EY 90
Hyrc-Eux. (mt), Chp.
Arabis alpina L. subsp. *alpina*
2550 m, 13.06.2015, EY 91
Widespread, Hcrp.
Cardamine impatiens L. subsp. *impatiens*
2300 m, 14.06.2015, RH 115
Euro-Sib., Crp.
Erysimum pulchellum (Willd.) J. Gay subsp. *pulchellum*
2280 m, 05.06.2016, RH 277
Hcrp.

Sisymbrium elatum K.Koch
2200 m, 14.06.2015, EY 112
Hcrp.

Cistaceae
Helianthemum tomentosum Gray
2260 m, 21.07.2015, EY 211
Hcrp.
Violaceae
Viola altaica Ker.-Gawl. subsp. *oreades* (M.Bieb.) Becker
2250 m, 05.06.2016, EY, 289
Hcrp.
Polygalaceae
Polygala pruinosa Boiss. subsp. *pruinosa*
2260 m, 21.07.2015, EY 269
Hcrp.
Caryophyllaceae
Minuartia hirsuta (M.Bieb.) Hand.-Mazz. subsp. *falcata*
2260 m, 21.07.2015, RH 222
Hcrp.
M. recurva (All.) Schinz. &Thell. subsp. *carica* McNeill
2300 m, 21.07.2015 EY, 290
Endemic, VU, Medit., Hcrp.
M. juniperina (L.) Maire & Petitm.
2200 m, 21.07.2015 EY, 291
Chp.
M. umbellulifera (Boiss.) McNeill subsp. *umbellulifera* var. *umbellulifera*
2100 m, 14.06.2015, RH 124
Endemic, LR (lc), Chp.
Stellaria media (L.) Vill.
2005 m,17.08.2014, RH 30
Thp.
S. holostea L.
2250 m, 15.06.2015, EY 146
Euro-Sib., Hcrp.
S. persica Boiss.
2200 m, 14.06.2015, RH 126
Thp.
Spergularia rubra (L.) J.Presl & C.Presl
2411 m, 16.08.2014, RH 67
Thp.
Dianthus zederbaueri Vierh.
2100 m, 21.07.2015, RH 196
Endemic, LR (cd), Ir-Tur., Hcrp.
Petrorhagia alpina (Habl.) P.W.Ball. & Heywood subsp. *alpina*
2100 m, 21.07.2015, RH 195
Thp.
Silene italica (L.) Pers. subsp. *italica*
2005 m, 17.08.2014, RH 33
Medit., Hcrp.
S. spergulifolia (Desf.) M.Bieb.
2200 m, 14.06.2015, RH 125
Ir-Tur., Hcrp.
Polygonaceae
Polygonum alpinum All.
2450 m, 13.06.2015, EY 111
Euro-Sib., Hcrp.
P. bistorta L. subsp. *bistorta*
2550 m, 16.08.2014, RH 27
Eux. (mt), Hcrp.
P. setosum Jacq. subsp. *setosum*
2550 m, 16.08.2014, RH 62
Ir-Tur., Hcrp.
P. arenastrum Boreau
2410 m, 16.08.2014, RH 61
Thp.
Rumex acetosella L.
2005 m, 17.08.2014, RH 63
Cosm., Hcrp.
R. scutatus L.
2005 m, 17.08.2014, RH 31
Chp.
R. alpinus L.
2100 m, 21.07.2015, EY 205
Crp.
Amaranthaceae
Chenopodium foliosum Asch.
2400 m, 16.08.2014, RH 57
Widespread, Thp.
Hypericaceae (Guttiferae)
Hypericum elongatum Ledeb ex Rchb. var. *elongatum*
2411 m, 14.08.2014, RH 68
Ir-Tur., Hcrp.
H. scabrum L.
2100 m, 14.06.2015, EY 130
Ir-Tur., Hcrp.
H. orientale L.
2306 m, 14.08.2014, RH 69
Hcrp.
Geraniaceae
Geranium ibericum Cav. subsp. *jubatum* (Hand.-Mazz.) P.H.Davis
2550 m, 16.08. 2014, RH 28
Endemic, LR (lc), Eux.(mt), Hcrp.
Celastraceae
Parnassia palustris L.
2440 m, 16.08.2014, RH 51
Hcrp.
Fabaceae (Leguminosae)
Cytisus pygmaeus Willd.
2100 m, 14.06.2015, RH 135
Euro-Sib., Chp.
Genista januensis Viv. subsp. *lydia* (Boiss.) Kit Tan & Ziel.
2450 m, 23.07.2015, EY 267
Medit., Chp.
Astragalus barba-jovis DC.
2070 m, 14.06.2015, EY 147
Ir-Tur., Chp.
A. anthylloides Lam.
2350 m, 22.07.2015, EY 247
Ir-Tur., Hcrp.
A.alyssoides Lam.
2100 m, 14.06.2015, RH 136
Ir-Tur., Hcrp.
A. angustifolius Lam. subsp. *angustifolius*
2070 m, 14.06.2015, EY 288
Chp.
Oxytropis lazica Boiss.
2550 m, 13.06.2015, EY 94
Euro-Sib. (mt), Chp.
Trifolium repens L.var. *repens*
2265 m, 23.07.2015, EY 250
Hcrp.
T. hybridum L. var. *anatolicum* (Boiss.) Boiss.
2380 m, 22.07.2015, RH 232
Hcrp.
T. sintenisii Freyn
2282 m, 15.08.2014, RH 53
Euro-Sib., Thp.
T. badium Schreb. subsp. *rytidosemium* (Boiss & Hohen.) Hossain var. *rytidosemium*
2282 m, 14.08.2014, RH 52

Hyrc. (mt), Hcrp.
T. pratense L. var. *pratense*
2411 m, 16.08.2014, RH 25
Hcrp.
T. ochroleucum Huds.
2411 m, 16.08.2014, RH 223
Hcrp.
Melilotus officinalis (L.) Desr.
2400 m, 16.08.2014, RH 70
Hcrp.
Medicago papillosa Boiss. subsp. *macrocarpa* (Boiss.) Urb.
2450 m, 22.07.2015, EY 228
Hcrp.
Lotus corniculatus L. var. *alpinus* Ser.
2300 m, 14.08.2014, RH 71
Hcrp.
L. corniculatus L. var. *corniculatus*
2450 m, 22.07.2015, EY 229
Hcrp.
Onobrychis montana DC. subsp. *cadmea* (Boiss.) P.W.Ball.
2470 m, 22.07. 2015, EY 227
Hcrp.
Rosaceae
Rubus idaeus L. subsp. *idaeus*
2300 m, 14.08.2014, RH 72
Euro-Sib., Chp.
Potentilla inclinata Vill.
2410 m, 16.08.2014, RH 60
Hcrp.
P. crantzii (Crantz) Fritsch
2400 m, 16.08.2014, RH 59
Euro-Sib., Chp.
P.cappadocica Boiss.
2450 m, 13.06.2015, EY 87
Endemic, LR (nt), Euro-Sib. (mt), Hcrp.
P. erecta (L.) Räusch.
2270 m, 14.08.2014, RH 64
Crp.
Sibbaldia parviflora Willd. var. *parviflora*
2207 m, 14.08.2014, RH 22
Chp.
Alchemilla caucasica Buser
2308 m, 14.08.2014, RH 76
Eux. (mt), Crp.
A. erythropoda Juz.
2450 m, 22.07.2015, RH 238
Euro-Sib., Crp.
A. orthotricha Rothm.
2411 m, 16.08.2014, RH 75
DD, Eux., Crp.
A. orduensis B.Pawl.
2050 m, 11.05.2015, EY 168
Endemic, EN, Euro-Sib., Hcrp.
Onagraceae
Epilobium angustifolium L.
2300 m, 14.08.2014, RH 65
Crp.
E. gemmascens C.A.Mey.
2300 m, 14.08.2014, RH 56
Eux. (mt), Crp.
Crassulaceae
Phedimus spurius (M.Bieb.)'t Hart
2308 m, 14.08.2014, RH 49
Hyrc-Eux., Hcrp.
Sedum pallidum M.Bieb.
2550 m, 16.08.2014, RH 50
Eux., Crp.
Sempervivum armenum Boiss. & A.Huet subsp. *insigne* (Muirhead) Karaer
2250 m, 05.06.2016, RH 286
Endemic, LR (cd), Hcrp.
Apiaceae (Umbelliferae)
Bunium microcarpum (Boiss.) Freyn & Bornm. ex Freyn subsp. *bourgaei* (Boiss.) Hedge & Lamond.
2100 m, 14.06.2015, RH 118
Ir-Tur., Crp.
Carum meifolium (M.Bieb). Boiss.
2350 m, 22.07.2015, RH 245
Chp.
Geocaryum cynapioides (Guss.) Engstrand subsp. *macrocarpum* (Boiss. & Spruner)Menemen
2100 m, 14.06.2015, EY 292
Crp.
Asteraceae (Compositae)
Helichrysum graveolens (M.Bieb.) Sweet
2550 m, 16.08.2014, RH 42
Hcrp.
H. arenarium (L.) Moench subsp. *aucheri* (Boiss.) P.H.Davis & Kupicha
2500 m, 23.07.2015, EY 254
Endemic, LR (lc), Ir-Tur., Hcrp.
Filago arvensis L.
2450 m, 22.07.2015, RH 187
Cosm.,Thp.
Solidago virgaurea L. subsp. *virgaurea*
2450 m, 23.07.2015, EY 265
Euro-Sib., Hcrp.
Aster alpinus L.
2400 m, 23.07.2015, RH 268
Crp.
Bellis perennis L.
2308 m, 14.08.2014, RH 12
Euro-Sib., Hcrp.
Turanecio taraxacifolius (M.Bieb.) Hamzaoğlu var. *taraxacifolius*
2310 m, 14.08.2014, RH 34
Hcrp.
Senecio recemosus (M. Bieb.)DC.
2500 m, 23.07. 2015, EY 253
Ir-Tur., Hcrp.
S. pseudo-orientalis Schischk.
2100 m, 21.07.2015, EY 201
Ir-Tur., Hcrp.
S. viscosus L.
2150 m, 21.07.2015, RH 202
Thp.
Tussilago farfara L.
2005 m, 11.05.2015, RH 157
Euro-Sib., Crp.
Archanthemis marschalliana (Willd.) Lo Presti & Oberpr. subsp. *pectinata* (Boiss.) Lo Presti & Oberpr.
2050 m, 21.07.2015, EY 206
Eux., Hcrp.
Cota tinctoria (L.) J.Gay ex Guss. var. *tinctoria*
2411 m, 17.08.2014, RH 40
Hcrp.
C. melanoloma (Trautv.) Holub subsp. *melanoloma*
2500 m, 23.07.2015, RH 257
Endemic, LR (lc), Hcrp.
Achillea millefolium L. subsp. *millefolium* var. *millefolium*
2410 m, 17.08.2014, RH 37
Euro-Sib., Hcrp.
Tanacetum parthenium (L.) Sch.Bip.
2300 m, 14.06.2015, EY 293

Widespread, Hcrp.
T. albipannosum Hub.-Mor. & Grierson
2050 m, 21.07.2015, EY 191
Endemic, LR (cd), Ir-Tur., Hcrp.
T. armenum (DC.) Sch.Bip.
2150 m, 21.07.2015, RH 132
Hcrp.
Tripleurospermum sevanense (Manden.) Pobed.
2411 m, 17.08.2014, RH 36
Hcrp.
Cirsium tomentosum C.A. Mey.
2212 m, 15.08.2014, RH 43
Ir-Tur., Hcrp.
C. rhizocephalum C.A.Mey. subsp. *sinuatum* (Boiss.) P.H.Davis & Parris
2411 m, 17.08.2014, RH 35
Hcrp.
Carduus lanuginosus Willd.
2350 m, 14.08.2014, RH 44
Endemic, LR (lc), Hcrp.
Jurinella moschus (Hablitz) Bobrov subsp. *pinnatisecta*
2300 m, 14.06.2015, RH 48
Ir-Tur., Hcrp.
Centaurea salicifolia M.Bieb. ex Willd. subsp. *abbreviata* K.Koch
2500 m, 23.07.2015, RH 252
Eux., Hcrp.
C. armena Boiss.
2500 m, 23.07.2015, EY 263
Endemic, LR (lc), Ir-Tur., Hcrp.
Psephellus mucronifer (DC.) Wagenitz
2100 m, 14.06.2015, EY 139
Endemic, LR (lc), Ir-Tur., Hcrp.
Cyanus reuterianus (Boiss.) Holub var. *reuterianus*
2050 m, 21.07.2015, RH 189
Endemic, LR (lc), E. Medit., Hcrp.
Scorzonera cana (C.A. Mey.) Griseb. var. *jacquiniana* (W.Koch.) D.F.Chamb.
2350 m, 22.07.2015, EY 244
Hcrp.
S. cana (C.A.Mey.) Griseb. var. *radicosa* (Boiss.) D.F.Chamb.
2150 m, 22.07.2015, RH 248
Hcrp.
Leontodon hispidus L. subsp. *hispidus*
2450 m, 23.07.2015, EY 192
Euro-Sib., Crp.
L. crispus Vill. subsp. *asper* (Waldst. & Kit.) Röhl. var. *asper*
2550 m, 16.08.2014, RH 46
Widespread, Hcrp.
Hieracium pollichiae Sch. Bip.
2411 m, 16.08.2014, RH 47
Euro-Sib., Hcrp.
H. cyaneum Arvet-Touvet
2411 m, 17.08.2014, RH 38
Euro-Sib., Hcrp.
H. giresunense Hub.-Mor.2050 m, 21.07.2015, EY 193
Endemic, EN, Euro-Sib**.**, Hcrp.
Pilosella hoppeana (Schultz) F.W.Schultz & Sch. Bip. subsp. *testimonialis* (Naegli ex Peter) P.D.Sell & C.West
2410 m, 16.08.2014, RH 41
Euro-Sib., Hcrp.
Lapsana communis L. subsp. *intermedia* (M.Bieb.)Hayek var. *intermedia*
2411 m, 17.08.2014 RH, 39
Hcrp.
Taraxacum microcephaloides van Soest
2490 m, 16.08.2014, RH 45
Hcrp.
T. bithynicum DC.
2005 m, 11.05.2015, RH 164
Hcrp.
T. stevenii DC.
2550 m, 13.06.2015, EY 106
Ir-Tur., Hcrp.

Campanulaceae

Campanula tridentata Schreb.
2450 m, 22.07.2015, EY 241
Eux. (mt), Crp.
C. stevenii M.Bieb. subsp. *beauverdiana* (Fomin) Rech.f. & Schiman-Czeika
2100 m, 14.06.2015, EY 138
Ir-Tur., Hcrp.
Asyneuma amplexicaule (Willd.) Hand.-Mazz. subsp. *amplexicaule* var. *amplexicaule*
2550 m, 16.08.2014, RH 78
Widespread, Hcrp.
Jasione supina Sieber ex Spreng. subsp. *pontica* (Boiss.) Damboldt
2270 m, 14.08.2014, RH 77
Endemic, LR (lc), Euro-Sib., Hcrp.

Ericaceae

Vaccinium myrtillus L.
2308 m, 14.08.2014, RH 21
Euro-Sib., Chp.

Primulaceae

Primula longipes Freyn & Sint.
2300 m, 13.06.2015, EY 294
Endemic, NT, Eux., Hcrp.
P. auriculata Lam.
2300 m, 13.06.2015, RH 84
Ir-Tur., Hcrp.
P.algida Adams
2550 m, 13.06.2015, EY 295
Hcrp.
P. acaulis (L.) L. subsp. *rubra* (Sm.) Greuter & Burdet
2000 m, 11.05.2015, RH 148
Eux., Hcrp.
Androsace albana Steven
2550 m, 13.06.2015, RH 93
Eux. (mt), Thp.
Cyclamen parviflorum Pobed.
2300 m, 14.06.2015, EY 296
Endemic, LR (lc), Eux. (mt), Crp.

Gentianaceae

Gentianella ciliata (L.) Borkh. subsp. *blepharophora* (Bordz.) N.M.Pritch
2500 m, 16.08.2014, RH 1
Hyrc-Eux.(mt), Hcrp.

Boraginaceae

Myosotis sylvatica Hoffm. subsp. *cyanea* (Hayek)Vestergren
2400 m, 16.08.2014, RH 58
Hcrp.
M. alpestris F.W.Schmidt subsp. *alpestris*
2500 m, 13.06.2015, RH 85
Crp.
M. olympica Boiss.
2005 m, 11.05.2015, RH 160
Eux. (mt), Crp.
M. lithospermifolia Hornem.
2300 m, 14.06.2015, EY 131
Hcrp.
M. propinqua Fisch. & C.A.Mey.
2240 m, 05.06.2016, RH 283

Eux-Hyrc. (mt), Thp.
Echium italicum L.
2148 m, 17.08.2014, RH 29
Medit., Hcrp.
Solanaceae
Hyoscyamus niger L.
2050 m, 16.06.2015, RH 287
Hcrp.
Scrophulariaceae
Verbascum armenum Boiss. & Kotschy ex Boiss. var. *tempskyanum* (Freyn & Sint.)Murb.
2050 m, 21.07.2015, RH 180
Endemic, LR (lc), Ir-Tur., Hcrp.
V. froedinii Murb.
2300 m, 14.06.2015, EY 121
Ir-Tur., Hcrp.
Orobanchaceae
Pedicularis caucasica M.Bieb.
2500 m, 13.06.2015, EY 99
Hyrc-Eux. (mt), Hcrp.
Euphrasia pectinata Ten.
2550 m, 14.08.2014, RH 297
Euro-Sib., Widespread, Thp.
Lamiaceae (Labiatae)
Ajuga orientalis L.
2550 m, 13.06.2015, RH 92
Crp.
Teucrium chamaedrys L. subsp. *chamaedrys*
2050 m, 21.07.2015, EY 194
Euro-Sib., Chp.
Lamium macrodon Boiss. & Huet
2105 m, 14.06.2015, EY 128
Ir-Tur., Thp.
L. album L. subsp. *album*
2411 m, 16.08.2014, RH 26
Euro-Sib., Hcrp.
L. tomentosum Willd.
2450 m, 23.07.2015, RH 266
Ir-Tur., Hcrp.
L. galactophyllum Boiss. & Reuter
2020 m, 14.06.2015, EY 127
Endemic, LR (lc), Ir-Tur., Thp.
Marrubium astracanicum Jacq. subsp. *astracanicum*
2050 m, 21.07.2015, RH 185
Hcrp.
Nepeta italica L.
2450 m, 23.07.2015, RH 271
Medit., Chp.
N.nuda L. subsp. *nuda*
2080 m, 14.06.2015, EY 129
Euro-Sib., Hcrp.
Thymus sipyleus Boiss.
2300 m, 14.08.2014, RH 81
Chp.
Mentha longifolia (L.) L. subsp. *longifolia*
2005 m, 17.08.2014, RH 55
Eux., Crp.
Plumbaginaceae
Acantholimon bracteatum (Girard) Boiss.
2050 m, 21.07.2015, EY182
Ir-Tur**.,** Chp.
Plantaginaceae
Plantago lanceolata L.
2411 m, 16.08.2014, RH 24
Hcrp.
P. argentea Chaix.
2450 m, 13.06.2015, EY 105
DD, Euro-Sib., Hcrp.
Linaria genistifolia (L.) Mill. subsp. *linifolia* (Boiss.) P.H.Davis
2050 m, 21.07.2015, EY 181
Hcrp.
Digitalis lamarckii Ivanina
2050 m, 21.07.2015, EY 170
Endemic, LR (lc), Ir-Tur., Hcrp.
Veronica gentianoides Vahl. subsp. *gentionoides* var. *alpina*
2080 m, 11.05.2015, RH 149
Endemic, EN, Crp.
V. hispidula Boiss. & A.Huet subsp. *hispidula*
2050 m, 11.05.2015, RH 166
Ir-Tur., Thp.
V. anagallis-aquatica L.
2005 m, 17.08.2014, RH 73
Widespread, Hcrp.
V. peduncularis M.Bieb.
2300 m, 14.06.2015, EY 122
Eux., Crp.
Euphorbiaceae
Euphorbia herniariifolia Willd. var. *glaberrima* Halácsy
2400 m, 13.06.2015, EY 120
Hcrp.
E. rigida M.Bieb.
2100 m, 14.06.2015, EY 137
Medit., Hcrp.
Urticaceae
Urtica dioica L. subsp. *dioica*
2306 m, 14.08.2014, RH 23
Euro-Sib., Hcrp.
Rubiaceae
Crucianella gilanica Trin. subsp. *pontica* (Ehrend.) Ehrend.
2260 m, 21.07.2015, RH 221
Eux., Chp.
Asperula prostrata (Adams) K.Koch
2200 m, 14.06.2015, RH 134
Eux. (mt), Chp.
A. nitida Sm. subsp. *subcapitellata* Ehrend.
2260 m, 21.07.2015, EY 210
Endemic, LR (nt), Ir-Tur., Chp.
A.suavis Fisch. & Mey.
2080 m, 21.07.2015, RH 197
Endemic, LR (lc), Ir-Tur., Chp.
Galium humifusum M.Bieb.
2050 m, 14.06.2015, EY 133
Thp.
G. verum L. subsp. *verum*
2005 m, 17.08.2014, RH 80
Euro-Sib., Hcrp.
G.incanum Sm. subsp. *elatius* (Boiss.) Ehrend.
2450 m, 13.06.2015, EY 104
Ir-Tur., Hcrp.
Cruciata taurica (Pall. ex Willd.) Ehrend.
2250 m, 05.06.2016, RH 284
Widespread, Ir-Tur., Hcrp.

MONOCOTYLEDONAE (LILIOPSIDA)

Asparagaceae
Scilla siberica Haw. subsp. *armena* (Grossh.) Mordak
2270 m, 11.05.2015, RH 155
Ir-Tur., Crp.
Ornithogalum oligophyllum E.D.Clarke
2270 m, 11.05.2015, RH 96
Crp.
Muscari aucheri (Boiss.) Baker

2500 m, 13.06.2015, RH 97
Endemic, LR (lc), Crp.
M. armeniacum Leichtlin ex Baker
2260 m, 11.05.2015, RH 156
Widespread, Crp.
Colchicaceae
Colchicum szovitsii Fisch.& C.A.Mey. subsp. *szovitsii*
2500 m, 13.06.2015, RH 98
Ir-Tur., Crp.
Liliaceae
Fritillaria latifolia Willd.
2550 m, 13.06.2015, EY 95
Eux. (mt), Crp.
Gagea glacialis K.Koch
2080 m, 11.05.2015, RH 150
Ir-Tur., Crp.
Melanthiaceae
Veratrum album L.
2100 m, 14.06.2015, RH 298
Euro-Sib., Crp.
Amaryllidaceae
Allium aucheri Boiss.
2080 m, 21.07.2015, RH 198
Ir-Tur., Crp.
Iridaceae
Crocus kotschyanus K.Koch subsp. *suworowianus* (K.Koch) B.Mathew
2500 m, 16.08.2014, RH 2
Crp.
C. speciosus M.Bieb. subsp. *speciosus*
2350 m, 21.09.2014, RH 9
Crp.
Orchidaceae
Gymnadenia conopsea (L.) R.Br.
2470 m, 22.07.2015, EY 226
Euro-Sib., Crp.
Juncaceae
Juncus effusus L. subsp. *effusus*
2280 m, 14.09.2014, RH 82
Cosm., Hcrp.
Luzula spicata (L.) DC. subsp. *italica* (Parl.) Areang.
2400 m, 22.07.2015, RH 299
Hcrp.
L. stenophylla Steud.
2450 m, 22.07.2015, RH 236
Eux. (mt), Crp.
L. campestris (L.) DC.
2050 m, 11.05.2015, RH 167
Euro-Sib., Hcrp.
Cyperaceae
Kobresia simpliciuscula (Wahlenb.) Mackenzie subsp. *simpliciuscula*
2306 m, 14.08.2014, RH 14
Hcrp.
Carex oreophila C.A.Mey.
2450 m, 22.07. 2015, EY 233
Ir-Tur., Crp.
C. davalliana Sm.
2306 m, 14.08.2014, RH 16
Euro-Sib., Crp.
C. nigra (L.) Reichard subsp. *dacica* (Heuffel) Soó
2500 m, 13.06.2015, EY 110
Eux., Crp.
Poaceae (Gramineae)
Elymus repens (L.) Gould
2400 m, 17.08.2014, RH 6
Crp.
Bromus commutatus Schrad.
2050 m, 21.07.2015, RH 207
Thp.
B. lanceolatus Roth.
2100 m, 14.06.2015, EY 142
Thp.
B. danthoniae Trin. subsp. *danthoniae*
2100 m, 14.06.2015, EY 141
Thp.
B. tectorum L.
2270 m, 14.08.2014, RH 18
Widespread, Thp.
Helictotrichon argaeum (Boiss.) Parsa
2450 m, 13.06.2015, EY 300
Endemic, LR (lc), Ir-Tur., Chp.
H. pubescens (Huds.) Schult. & Schult. subsp. *pubescens*
2450 m, 13.06.2015, RH 107
Euro-Sib., Hcrp.
Trisetum flavescens (L.) P.Beauv.
2306 m, 14.08.2014, RH 4
Euro-Sib., Hcrp.
Koeleria eriostachya Pančič
2400 m, 23.07.2015, RH 144
Hcrp.
Calamagrostis arundinacea (L).Roth.
2308 m, 14.08.2014, RH 13
Euro-Sib., Crp.
Agrostis canina L.
2263 m, 14.08.2014, RH 17
Euro-Sib., Hcrp.
A. capillaris L. var. *capillaris*
2450 m, 13.06.2015, EY 199
Euro-Sib., Crp.
A. capillaris L. var. *aristata* (Parnell) Druce
2450 m, 13.06.2015, EY 108
Euro-Sib., Hcrp.
A. stolonifera L.
2282 m, 15.08.2014, RH 20
Euro-Sib., Hcrp.
Alopecurus pratensis L.
2400 m, 17.08.2014, RH 7
Euro-Sib., Hcrp.
Phleum alpinum L.
2200 m, 14.06.2015, EY 234
Euro-Sib., Crp.
P. pratense L.
2050 m, 21.07.2015, RH 143
Euro-Sib., Widespread, Chp.
Rhizocephalus cristata (L.) Tzvelev var. *cristata*
2300 m, 14.06.2015, EY 301
Hcrp.
Festuca amethystina L. subsp. *orientalis* Krajina var. *turcica* Markgr.-Dann.
2350 m, 22.07.2015, EY 235
Endemic, LR (cd), Eux. (mt), Hcrp.
F. pinifolia (Hackel ex Boiss.) Bornm. var. *pinifolia*
2600 m, 16.08.2014, RH 3
E. Medit., Hcrp.
Poa pratensis L.
2400 m, 23.07.2015, RH 274
Widespread, Crp.
P. longifolia Trin.
2400 m, 23.07.2015, RH 272
Eux., Crp.
P. chaixii Vill.
2100 m, 14.06.2015, EY 140
Euro-Sib., Hcrp.

P. alpina L. subsp. *fallax* F.Herm.
2270 m, 21.07.2015, RH 225
Chp.
P. bulbosa L.
2200 m, 14.06.2015, EY 117
Chp.
Dactylis glomerata L. subsp. *hispanica* (Roth) Nyman
2400 m, 17.08.2014, RH 5
Crp.
Nardus stricta L.
2450 m, 22.07.2015, RH 240
Euro-Sib., Hcrp.
Stipa ehrenbergiana Trin. & Rupr.
2100 m, 21.07.2015, EY 200
Ir-Tur., Chp.

4. Conclusions and discussion

The vascular plant flora of Eğribel Pass grasslands is represented by 230 taxa belonging to 138 genera and 44 families. Almost all of them belong to Spermatophyta (229 taxa) and only a taxon belongs to Pteridophyta. Gymnosperms and Angiosperms included 1 and 228 taxa, respectively. Of the Angiosperms, 180 taxa are Dicotyledonae and 48 taxa are Monocotyledonae.

The taxa in the study area, classified with respect to phytogeographical regions may be listed as follows: Euro-Siberian elements 75 (32.6%), Irano-Turanian elements 42 (18.3%), and Mediterranean elements 8 (3.5%). The remaining 105 (45.6%) taxa are pluriregional or unknown phytogeographic region. The high composition rate of Euro-Siberian element is not unexpecting and showed that the study area is a part of this floral element. Similar results were obtained by former studies which have been done in the East Black Sea region of Turkey. Irano-Turanian elements come in the second rank in the study area. The comparison of the distribution of the phytogeographic elements and endemism ratio in the study area and nearby areas is given in Table 1. The results in Table 1 demonstrated that studies by Karakaya and Kılınç (1996), Eminağaoğlu et al. (2008), Deveci (2012) and Şenel et al. (2014) have similar results in respect of three floral elements.

Table 1. Comparison (%) of floristic results between the present study and previous studies performed in nearby areas with respect to number of taxa, the phytogeographical elements, and endemism

Studies	Number of taxa	Euro-Sib.	Ir.-Tur.	Medit.	Endemism
Present study	230	32.60	18.30	3.50	12.2
Karakaya & Kılınç (1996)	323	46.74	4.03	0.93	8.7
Eminağaoğlu et al. (2008)	990	48.20	3.50	1.90	2.30
Deveci (2012)	540	40.56	7.78	2.96	11.50
Şenel et al. (2014)	482	36.93	7.90	3.52	6.4

Twenty-eight of the identified taxa are endemic with total 12.2% endemism rate. Endemic taxa are listed as Euro-Siberian 8 (3.48%), Irano-Turanian 11(4.78%), Mediterranean 2 (0.87%) and unknown or with more than one origin 7 (3.04%). Totally 28 taxa, all endemic, and 2 nonendemic taxa were assessed according to IUCN risk categories (Ekim et al. 2000; IUCN, 2010 Version 8.1). The results are shown in Table 2. The threat categories are as follows: 3 EN, 1 VU, 1 NT, 4 LR (cd), 17 LR (lc), and 2 LR (nt) were determined in endemic taxa, and 2 DD categories were determined in nonendemic taxa. Endemism ratio in the study area was higher compared to former studies performed in nearby areas. Uysal et al. (2011) have pointed out that existence of microhabitats, geographical isolation, climate changes, historical changes in floral composition, and speciation of new ones at higher altitudes give rise to greater endemism ratio in these areas. However, this ratio is low with the mean endemism ratio (34.5%) in the Flora of Turkey (Güner et al. 2000) and the endemism ratio of the Black Sea region (16%) (Ansin et al. 2002).

Table 2. Dispersial rates of the phytogeographic elements, endemic, nonendemic, and threat categories in the present study

Phytogeographical region	Endemic		Nonendemic		Total	
	Number	Percent (%)	Number	Percent (%)	Number	Percent (%)
Euro-Sib.	8	3.48	67	29.13	75	32.60
Ir.-Tur.	11	4.78	31	13.48	42	18.30
Medit.	2	0.87	6	2.61	8	3.50
P. Reg. Or Unk.	7	3.04	98	42.61	105	45.60
Total	28	12.2			230	100.00
EN	3	1.30			3	1.30
VU	1	0.43			1	0.43
NT	1	0.43			1	0.43
LR (cd)	4	1.74			4	1.74
LR (lc)	17	7.39			17	7.39
LR (nt)	2	0.87			2	0.87
DD			2	0.87	2	0.87
Total	28		2		30	

The largest families with regard to number of genera were Asteraceae (25), Poaceae (15), Brassicaceae (11), Fabaceae (9), Lamiaceae (7), Caryophyllaceae (6), Rosaceae (4), Plantaginaceae (4), Rubiaceae (4) and Ranunculaceae (3). The major families with regard to number of taxa were Asteraceae (39), Poaceae (28), Fabaceae (18), Brassicaceae (14), Caryophyllaceae (12), Lamiaceae (11), Rosaceae (10), Plantaginaceae (8), Ranunculaceae (8) and Rubiaceae (8) (Table 3). The total rate of the major families is 67.83%, with the remaining families consisting of 32.17%. It has been indicated that the major three families in Turkey are Asteraceae, Fabaceae and Lamiaceae (Davis, 1965-1985, 1988). In this study, Poaceae was determined in the second order because alpine belt in the North-Eastern part of Turkey is commonly represented by plants with a grass form. Some differences in major family ranks might be explained by the dissimilarities in climate and habitats. A comparison of families in terms of the largest number of species found in this study and in previous studies conducted in nearby regions is given in Table 4. In general, the results of this study complied with those of other similar studies (Eminağaoğlu et al. 2008; Korkmaz et al. 2008; Deveci, 2012; Şenel et al. 2014). Asteraceae (the largest family in our list) is the largest family in the Flora of Turkey (Güner et al. 2000).

Table 3. Numerical and dispersial rates of major families including the most taxa identified in the present study

Family	**Number of genera**	**Number of taxa**	**Rates**
Asteraceae	25	39	16.95
Poaceae	15	28	12.20
Fabaceae	9	18	7.82
Brassicaceae	11	14	6.08
Caryophyllaceae	6	12	5.22
Lamiaceae	7	11	4.77
Rosaceae	4	10	4.35
Plantaginaceae	4	8	3.48
Ranunculaceae	3	8	3.48
Rubiaceae	4	8	3.48
Other Families	50	74	32.17
Total	138	230	100.00

Table 4. Comparison (%) of similar studies with respect to the major families

Family	**Present study**	**Eminagaoglu et al. (2008)**	**Korkmaz et al. (2008)**	**Deveci (2012)**	**Şenel et al. (2014)**
Asteraceae	16.9	11.5	9.9	11.9	14.5
Poaceae	12.2	7.0	9.0	8.7	4.9
Fabaceae	7.8	6.0	8.2	10.0	8.1
Brassicaceae	6.1	4.7	2.2	2.6	5.4
Caryophyllaceae	5.2	3.3	3.1	-	4.4
Lamiaceae	4.8	4.3	6.5	6.1	6.6
Rosaceae	4.4	6.0	5.4	4.1	3.9
Plantaginaceae	3.5	-	-	-	2.7
Ranunculaceae	3.5	3.5	-	-	-
Rubiaceae	3.5	-	-	-	-

The largest genera with regard to the number of taxa were *Trifolium* L. (6), *Ranunculus* L. (6), *Poa* L. (5), *Astragalus* L. (4) and *Polygonum* L. (4) (Table 5). *Astragalus* L., *Verbascum* L. and *Centaurea* L. are the major three genera in Turkey (Davis, 1965-1985, 1988). However, *Astragalus* is the fourth major genus in the present study. Also, *Verbascum* and *Centaurea* are not observed in the first five in the floristic list. There are some differences in the ranks of genera between Flora of Turkey and the study area. These differences might be explained by the dissimilarities in climatic, geomorphologic, phytogeographic and edaphic features. Alpine grasslands in the study area were characterized mainly by grass species whereas *Astragalus* and *Verbascum* are distributed in steppic vegetation in the central and eastern parts of Anatolia. In the study area these genera were found only in south-facing slopes, where demonstrate more steppic features and dry climate. On the other hand, Turkey is very rich Mediterranean country for *Trifolium* L. genus with over 100 species in its natural flora (Deveci, 2012). *Trifolium* and *Astragalus* genera are present in all studies conducted in the Eastern Black Sea Region of Turkey (Davis 1965, 1985; Eminağaoğlu and Ansin, 2003, 2004; Uzun and Terzioğlu, 2008; Severoğlu et al. 2011; Deveci, 2012).

Table 5. Numerical and dispersial rates of major genera including the most taxa identified in the present study

Genera	**Number of Taxa**	**Rates**
Trifolium L.	6	2.61
Ranunculus L.	6	2.61
Poa L.	5	2.17
Astragalus L.	4	1.74
Polygonum L.	4	1.74

The biological spectrum of the taxa comprised of hemicryptophytes 125 (54.4%), cryptophytes 49 (21.3%), chamaephytes 31(13.5%), therophytes 24 (10.4%) and phanerophytes 1(0.43%) (Figure 2). Hemicryptophytes were the best observed lfe-form in the study area. High ratio of hemicryptophytes might be thougt of as an adaptation to grazing (Yalçın et al. 2011). Since traditional land management (e.g. grazing by cattle and sheep) prevails at moderate intensity in the study area, hemicryptophyte species with rosette leaves have defensive and effective allocation mechanism againist grazing. This distribution is specific for grassland ecosystems. Cryptophytes were in the second order with renewing buds under soil.

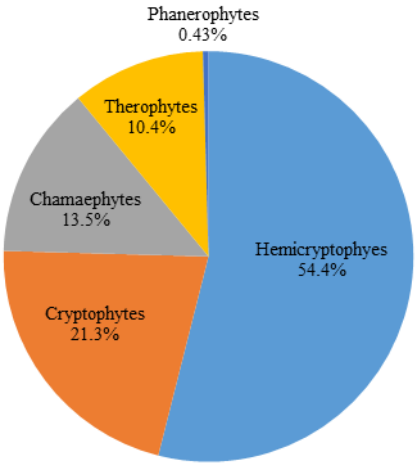

Figure 2. Biological spectrum of the plant species in the present study

Finally, considerable results were found in this study, which was carried out to draw attention to and improve understanding of the plant diversity in the alpine belt of Colchic province in the North-Eastern Black Sea Region. In this context, this study could be helpful for further studies on supporting of alpine landscapes and protection efforts of alpine plant species in Turkey..

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