



RESEARCH ARTICLE

Open Access

The flora of Dereiçi village (Yusufeli, Artvin, Turkey) and its surroundings

Dereiçi köyü (Yusufeli, Artvin, Türkiye) ve çevresinin florası

Emrah YÜKSEL^{a,*} , Hayal AKYILDIRIM BEĞEN^b 

^aDepartment of Forest Engineering, Faculty of Forestry, Artvin Coruh University, 08000 Artvin, Turkey

^bHealth Services Vocational School, Artvin Coruh University, Artvin, Turkey

Article Info

©2018 Ali Nihat Gökyiğit Botanical Garden Application and Research Center of Artvin Coruh University.

*Corresponding author:

e-mail: emrahysel@artvin.edu.tr

ORCID: 0000-0002-8171-0383

Article history

Received: December 27, 2018

Received in revised form: December 29, 2018

Accepted: December 30, 2018

Available online: December 30, 2018

Citation

To cite this article: Yüksel E, Akyıldırım Beğen H. (2018). The flora of Dereiçi village (Yusufeli, Artvin, Turkey) and its surroundings. *Turk J Biod* 1(1): 34-40.



This is an Open Access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

Keywords:

Artvin, Dereiçi, endemism, flora, Yusufeli.

Anahtar kelimeler:

Artvin, Dereiçi, endemizm, flora, Yusufeli.

ABSTRACT

The vascular flora of the Dereiçi Village and its environs (Yusufeli, Artvin, Turkey) was assessed between March and September 2017. It is located in the north-east of the Eastern Black Sea Region and is taken place in Colchic province of Euro-Siberian floristic area of Holarctic Region and lies between 650 and 2900 m. In this study, 312 genera and 552 plant taxa were found in 87 families. Of these, 11 taxa belong to Pteridophyta, the remaining 541 taxa belong to Magnoliophyta. Magnoliophyta includes Pinidae with 6 taxa and Magnoliidae with 535 taxa. The biggest families identified were as follows: Asteraceae 58 taxa, Poaceae 49 taxa, Rosaceae 37 taxa, Lamiaceae 30 taxa, Fabaceae 25 taxa, Brassicaceae 24 taxa, Apiaceae 18 taxa, Boraginaceae 16 taxa, Caryophyllaceae 15 taxa and Ranunculaceae 14 taxa. The ratio of the phytogeographical regions of 266 taxa was determined as follows: Euro-Siberian with 216 taxa (%39.1), Irano-Turanian with 42 taxa (%7.6), Mediterranean with 8 taxa (%1.5) and unidentified phytogeographic region with 286 taxa (%51.8). The ratio of endemism is % 5.4 with endemic taxa. Threat categories were proposed for 83 taxa (endemic and non-endemic rare plants) according to International Union for Conservation of Nature and Natural Resources (IUCN) Red List Categories.

Öz

Dereiçi köyü ve çevresinin (Yusufeli, Artvin, Türkiye) damarlı bitkiler florası, 2017 yılı Mart ve Eylül ayları arasında tespit edilmiştir. Alan, Doğu Karadeniz Bölgesi'nin Kuzeydoğu kısmında ve Holarctik bölgenin, Avrupa-Sibirya flora alanının Öksin kesiminin Kolşik altkesiminde bulunmakta olup 650 ile 2900 m yükseltiler arasında yer almaktadır. Bu çalışmada 87 familya, 312 cinse ait, 552 bitki taksonu saptanmıştır. Bunlardan 11'i Pteridophyta, kalan 541 taksonu Magnoliophyta bölümüne ilişkindir. Magnoliophyta bölümüne ilişkin taksonlardan 6 tanesi Pinidae ve 535 tanesi ise Magnoliidae alt sınıfında bulunmaktadır. Alandaki en fazla takson içeren familyalar şöyledir: Asteraceae 58 takson, Poaceae 49 takson, Rosaceae 37 takson, Lamiaceae 30 takson, Fabaceae 25 takson, Brassicaceae 24 takson, Apiaceae 18 takson, Boraginaceae 16 takson, Caryophyllaceae 15 takson ve Ranunculaceae 14 taksondur. Araştırmada, 266 taksonun fitocoğrafik bölgeleri saptanmış olup; 216 adet (%39,1) Avrupa-Sibirya, 42 adet (%7,6) İran-Turan, 8 adet (%1,5) Akdeniz elementi ve 286 adet (%51,8) fitocoğrafi bölgesi bilinmeyen takson bulunmaktadır. 30 adet takson endemik olup endemizm oranı % 5,4'tür. IUCN tehlike kategorilerine göre 83 adet endemik ve endemik olmayan nadir bitki taksonunun tehlike kategorileri değerlendirilmiştir.

1. INTRODUCTION

Artvin is the richest city in terms of plant diversity and Yusufeli (Artvin, Turkey) province reflects this diversity with its geographic and geomorphological features. Naturally growing plants are distributed in this area and

diversity of this plants related to climate, habitat and vegetation ([Eminağaoğlu, 2015](#)).

Dereiçi (Yusufeli) is located in the Caucasus Anatolian-Hyrcanian Temperate Forests classified as one of the 200 Global Ecoregions and in the North-eastern Anatolia

Centre of Plant Diversity “SWA No.19” (WWF & IUCN, 1994; Zazanashvili et al., 1999).

This study was carried out to contribute to the knowledge on the flora of Artvin. This region reflects the eastern part of the rich plant composition of the Black Sea region. So it was focused to the new floristic taxa, the endemic and rare plants, and to enrich the Herbarium of Artvin Coruh University (ARTH) with the new data obtained from this study.

Some flora studies in nearby areas were published by Anşin (1979, 1983), Güner (1983), Güner et al. (1987), Vural (1996), Anşin et al. (2000), Eminağaoğlu and Anşin (2002, 2003, 2004, 2005), Eminağaoğlu et al. (2007, 2012, 2018), Eminağaoğlu (2009, 2015) and Yüksel and Eminağaoğlu (2017).

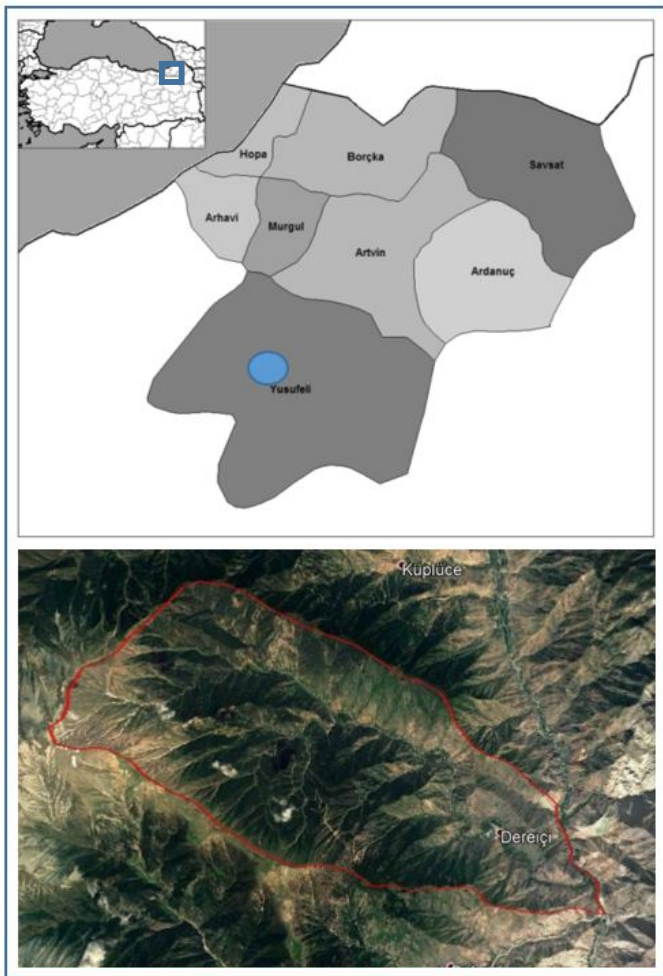


Figure 1. Map of the research area.

According to the Davis’s grid system, the research area is in the A9 square, and within the Colchic province of the Euro-Siberian floristic area in the Holarctic region (Davis et al., 1971; Eminağaoğlu, 2015). The research area is located between long 41°32’26”-41°24’45”E and lat 40°51’17”-40°53’45”N, and its elevation ranges between 650 and 2900 m (Figure 1).

Climatological data were provided from Yusufeli Meteorological station. The average rainfall is 275,4 mm (annual) and the average temperature is 14.13 °C in the research area (DMİ, 2018) (Table 1). The climatic diagram was prepared using Walter’s method (Walter, 1956). Most rainy season in winter, the driest of seasons in summer (Figure 2).

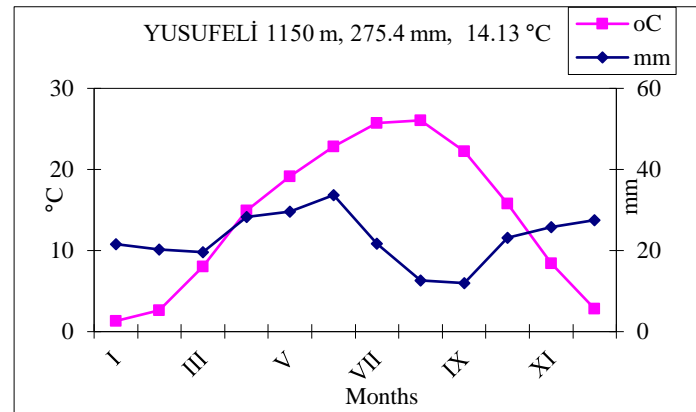


Figure 2. Climatic diagram of Yusufeli.

2. MATERIAL AND METHOD

A total of 1781 plant specimens were collected from Dereçi Village of Yusufeli District (Artvin) during March–September 2017. Three plant samples collected were placed in the Artvin Coruh University Herbarium (ARTH). They were photographed, and their GPS coordinates were recorded. The plant specimens were identified by using identification keys given in Flora of Turkey (Davis, 1965 - 1985; Davis et al., 1988; Güner et al., 2000), Flora of USSR (Komarov, 1934-1978) and other floras (Ketzkhoveli & Gagnidze, 1971-2001). At least 1 sample for each taxon was prepared by herbarium techniques and kept at the Herbarium of Artvin Coruh University (ARTH), Artvin, Turkey. All rare plants are listed in the Appendix. According to IUCN risk categories, threatened

Table 1. The average climatic values in Yusufeli (DMİ, 2018).

Meteorological Data	Months												Average Annual
	1	2	3	4	5	6	7	8	9	10	11	12	
Mean Temperature (°C)	1,3	2,6	8	14,9	19,1	22,8	25,7	26	22,2	15,8	8,4	2,8	14,13
Total rainfall (mm)	21,6	20,2	19,6	28,2	29,6	33,6	21,7	12,6	12,0	23,1	25,8	27,4	275,4

categories were given (Ekim et al., 2000, 2014; IUCN, 2018). The phytogeographical regions of the taxa were evaluated according to Davis (1965 - 85) and Davis et al., (1988). The plant names were given the accepted names using Türkiye Bitkileri Listesi, Damarlı Bitkiler (Güner et al., 2012), The International Plant Names Index (IPNI, 2012) and The Plant List (2013). The abbreviations used in the appendix and in the text are as follows: LC: Least concern; CR: Critically endangered; VU: Vulnerable; NT: Near threatened; .NE: Not evaluated; EN: Endangered.

3. RESULTS AND DISCUSSION

A total of 552 taxa from 87 families were identified. 11 of them belong to Pteridophyta and the remaining 541 taxa were Magnoliophyta, which included 6 taxa from the Pinidae and 535 taxa from the Magnoliidae (Table 2).

Table 2. The dispersion of taxa into large taxonomical groups.

	Number of Families	Number of Taxa
Pteridophyta	5	11
Magnoliophyta	82	541
Pinidae	2	6
Magnoliidae	80	535
Total	87	552

The ratio of endemism is 5.4%, with 30 taxa. According to IUCN risk categories (Ekim et al., 2000; IUCN, 2018), totally 83 rare taxa (30 endemic taxa and 53 nonendemic) were evaluated. The distribution of the threat categories is as follows: 4 endemic taxa in CR [*Campanula troegerae* Damboldt, *Helichrysum artvinense* P.H.Davis & Kupicha, *Saxifraga artvinensis* V.A.Matthews, *Stachys choruhensis*

Kit Tan & Sorger], 9 endemic [*Acer cappadocicum* Gled. subsp. *divergens* (K.Koch ex Paxton) A.E.Murray, *Alyssum artvinense* N.Busch., *Bupleurum schistosum* Woronow, *Chesneya elegans* Fomine, *Gypsophila simulatrix* Bornm. & Woronow, *Eminium koenianum* Lobin & P.C.Boyce, *Salvia huberi* Hedge, *Sempervivum staintonii* Muirhead, *Sorbus caucasica* Zinserl. var. *yaltirikii* Gökşin] and 1 nonendemic [*Knautia montana* DC.] taxa in EN, 5 endemic [*Bupleurum brachiatum* K.Koch ex Boiss., *Cirsium pseudopersonata* Boiss. & Balansa ex Boiss. subsp. *pseudopersonata*, *Papaver lateritium* K.Koch subsp. *lateritium*, *Primula longipes* Freyn & Sint., *Psephellus taochius* Sosn.] and 6 nonendemic [*Crocus scharojanii* Rupr., *Cyanus cheiranthifolius* (Willd.) Soják var. *purpurascens* (DC.) Wagenitz, *Cynoglossum holosericeum* Steven, *Gypsophila tenuifolia* M.Bieb., *Lilium kesselringianum* Misch., *Primula elatior* (L.) Hill subsp. *pseudoelatior* (Kusn.) W.W.Sm & Forrest] taxa in VU, 1 endemic [*Ballota rotundifolia* K.Koch] and 1 nonendemic [*Astrantia maxima* Pall. subsp. *maxima*] taxa in NT, 11 endemic [*Alcea calvertii* (Boiss.) Boiss., *Allium djimilense* Boiss. ex Regel, *Campanula betulifolia* K.Koch, *Cerastium armeniacum* Gren., *Elymus lazicus* (Boiss.) Melderis, *Euonymus latifolius* (L.) Mill. subsp. *caucanis* Coode & Cullen, *Galium margaceum* Ehrend. & Schönb.-Tem., *Linaria genistifolia* (L.) Mill. subsp. *confertiflora* (Boiss.) P.H.Davis, *Salvia rosifolia* Sm., *Taraxacum turcicum* Soest, *Tragopogon aureus* Boiss.] and 20 nonendemic [*Abies nordmanniana* (Steven) Spach subsp. *nordmanniana*, *Alnus glutinosa* (L.) Gaertn. subsp. *barbata* (C.A.Mey) Yalt., *Betula pendula* Roth, *Carpinus betulus* L., *C. orientalis* Mill., *Daphne glomerata* Lam, *Heracleum cyclocarpum* C. Koch, *Juniperus oxycedrus* L. subsp. *oxycedrus*, *J. excelsa* M.Bieb., *J. foetidissima* Willd., *Ostrya carpinifolia* Scop., *Picea orientalis* (L.) Peterm., *Populus tremula* L., *Salix alba* L., *S. caprea* L., *S. excelsa* S.G.Gmel.,

S. triandra L., *Sempervivum transcaucasicum* Muirhead, *Sorbus subfusca* (Ledeb. Ex Nordm.) Boiss., *Swertia iberica* Fisch. ex C.A.Mey.] taxa in LC, 25 nonendemic [*Androsace intermedia* Ledeb., *Campanula alliariifolia* Willd., *C. lactiflora* M.Bieb., *Cirsium caucasicum* Petr., *C. obvallatum* (M.Bieb.) M.Bieb., *Crocus vallicola* Herb., *Delphinium flexuosum* M.Bieb., *Draba hispida* Willd., *D. siliquosa* M.Bieb., *Epilobium colchicum* Albov, *Fritillaria latifolia* Willd., *Geranium ibericum* Cav. subsp. *ibericum*, *G. psilostemon* Ledeb., *Origanum rotundifolium* Boiss., *Pedicularis wilhelmsiana* Fisch. Ex M.Bieb., *Potentilla elatior* Willd. ex Schldl., *Primula meyeri* Rupr., *Rhamnus pallasii* Fisch. & C.A.Mey., *Rhododendron caucasicum* Pall., *Rhynchosorys stricta* Albov, *Ribes petraeum* Wulfen, *Sedum spurium* M.Bieb., *Sorbus caucasica* Zinserl. var. *caucasica*, *Scutellaria pontica* K.Koch, *Thymus praecox* Opiz subsp. *grossheimii* (Ronniger) Jalas var. *grossheimii*] taxa in NE.

The study area is included in the Colchic sub-section of Euxine section of the Euro-Siberian phytogeographic area of the Holarctic region in terms of plant geography. The reason of this plant diversity is that the area is located close to one of the 144 Important Plant Areas of Turkey "Important Plant Areas Yalnızçam mountains" and "Coruh Valley Important Plant Areas" (Özhatay et al., 2005).

The endemic elements and phytogeographical percentages are given in Table 3. Endemism ratio is similar with other floristic studies (Güner, 1983; Güner et al., 1987; Eminağaoğlu & Anşin, 2003; Eminağaoğlu et al., 2007, 2018; Eminağaoğlu, 2009; Yüksel & Eminağaoğlu, 2017).

The research area is located in a transitional zone among this three phytogeographic region. The Euro-Siberian elements (39.1%) seem to be dominant in all areas studied, the Irano-Turanian elements (7.6%) come second. When the distribution of taxa determined by phytogeographic regions is examined, it is seen that the European -Siberian elements are more in the all works. Mediterranean taxa were determined in some regions like other studies with low number of taxa (Table 3).

The largest families in terms of number of genera were, Poaceae (28), Asteraceae (26), Lamiaceae (22), Rosaceae (18), Brassicaceae (17), Boraginaceae (17), Fabaceae (16), Apiaceae (14), Caryophyllaceae (11), Ranunculaceae (10). The richest families in terms of number of species were Asteraceae (58), Poaceae (49), Rosaceae (37), Lamiaceae (30), Fabaceae (25), Brassicaceae (24), Apiaceae (18), Boraginaceae (16), Caryophyllaceae (15), Ranunculaceae (14). The total ratio of the 10 major families is 51.8%, with the remaining families comprising 48.2% (Table 4). The major family order in our study is concordant with the Flora of Turkey (Güner et al., 2000).

A comparison of families in terms of the largest number of species found in this study and in previous studies carried out in nearby regions is given in Table 4. The data of this research are similar with those of other similar studies. As a result of climatic and habitat changes, plant families might differ and show diversity. In this study, *Campanula* (10), *Geranium* (9), *Poa* (9) are the richest genera with their taxon number.

Table 3. The phytogeographical spectra of the taxa (%) in this study and other studies.

	Study Area	Eminağaoğlu et al. (2018)	Yüksel and Eminağaoğlu (2017)	Eminağaoğlu (2009)	Eminağaoğlu et al. (2007)	Eminağaoğlu & Anşin (2003)	Güner et al. (1987)	Güner (1983)
Taxa	552	566	651	459	963	769	1430	1024
Euro-Siberian	39.1	22.90	50.08	17.2	48.90	35.60	48.25	40.82
Irano-Turanian	7.6	14	2.92	17.6	2.00	6.90	5.73	4.00
Mediterranean	1.5	2.40	0.77	2.6	2.00	2.20	3.01	1.46
Endemism	5.4	3.20	2.92	7.6	1.10	7.40	18.46	20.02

Table 4. Comparison of the ten families containing the most species in studies conducted in nearby regions (%).

Families	Study Area	Eminağaoğlu et al. (2018)	Yüksel and Eminağaoğlu (2017)	Eminağaoğlu (2009)	Eminağaoğlu et al. (2007)	Eminağaoğlu & Anşın (2003)	Güner et al. (1987)	Güner (1983)
Asteraceae	10.5	6.3	12.0	8.1	11.5	9.5	12.5	13.2
Poaceae	8.9	6.7	6.8	8.7	7.0	4.9	10.7	6.5
Rosaceae	6.7	6.7	5.9	3.0	6.1	6.5	5.0	5.9
Lamiaceae	5.4	6.7	4.3	4.5	4.5	5.5	4.3	4.3
Fabaceae	4.5	5.6	4.6	8.1	6.0	8.7	4.8	5.8
Brassicaceae	4.4	4.5	4.3	5.0	4.6	6.4	4.4	4.2
Apiaceae	3.3	2.8	2.6	4.1	2.5	1.7	3.3	3.2
Boraginaceae	2.9	3.8	2.8	3.4	3.6	3.3	-	2.7
Caryophyllaceae	2.7	3.8	3.2	5.0	3.0	3.7	3.9	4.0
Ranunculaceae	2.5	3.5	3.1	1.3	3.2	4.2	-	2.7

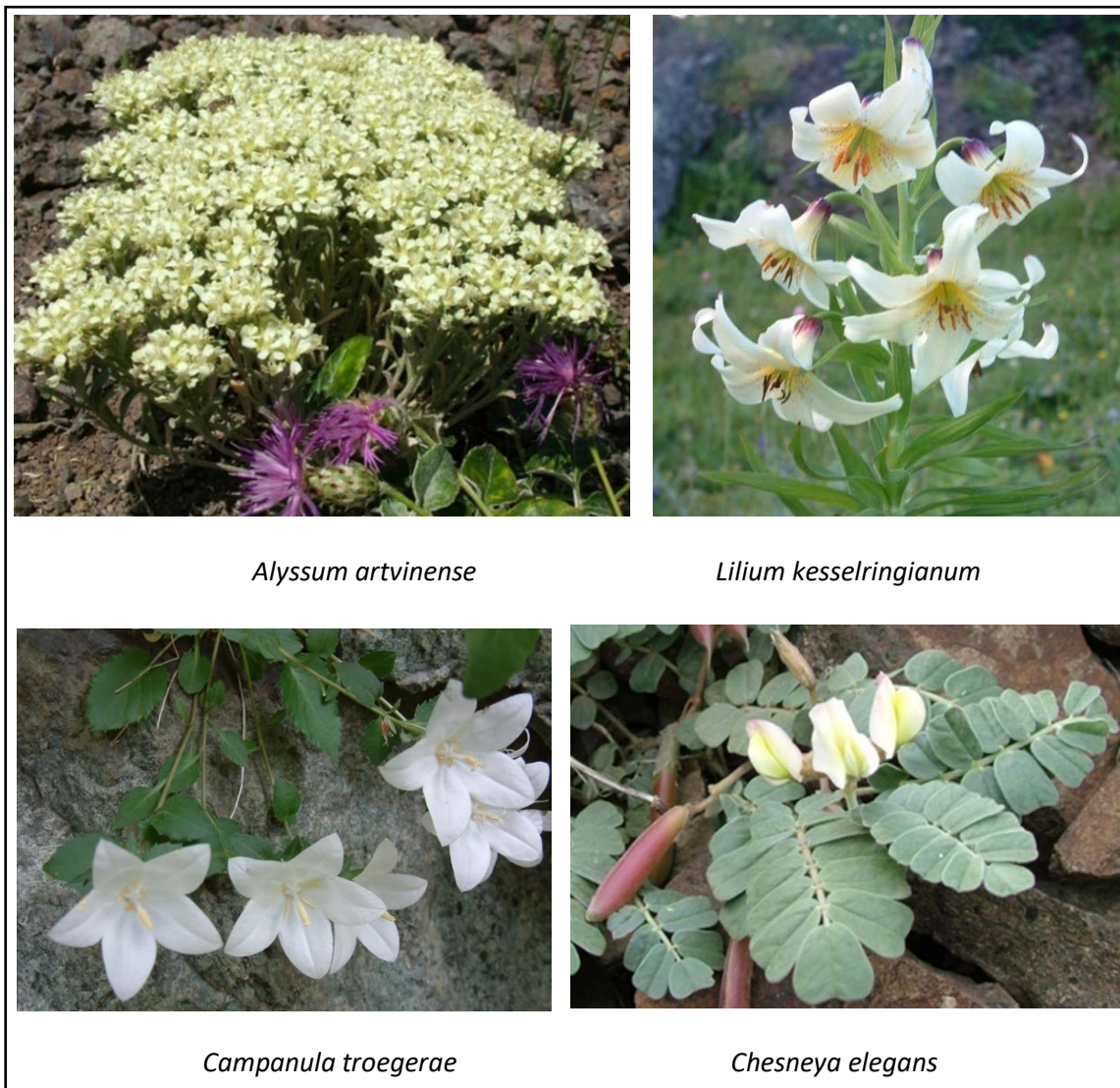


Figure 3. Some important endemic and non endemic taxa (Photo: Ö.Eminağaoğlu)

Campanula troegerae, *Helichrysum artvinense*, *Acer cappadocicum* subsp. *divergens*, *Saxifraga artvinensis*, *Stachys choruhensis*, *Sorbus caucasica* var. *yaltirikii* which have limited distribution area in this region. Considering this biological richness, the research area should be protected (Figure 3).

4. CONCLUSION

Biodiversity in Yusufeli is under the threat of various factors; investment projects, dam construction, illegal cutting, road construction. The study area has been exposed to these factors. For this reason, similar activities to be carried out in Dereiçi and its surroundings may cause detrimental impact on habitat changes and result in the destruction of rare species in the area.

These areas should be conservation status. The construction of the dam in the vicinity of the site threatens the existing vegetation diversity directly and indirectly. Populations that will be damaged by dam water or dam construction should be transported to the areas determined by ex situ conservation. *Bupleurum schistosum* and *Chesneya elegans* which are distributed at lower altitudes and the majority of their populations will remain under the dam water mirror, may be damaged by road and dam construction activities. For this reason, especially the rare and endemic areas of this plant species should be protected and their generations should be protected (Figure 3).

Acknowledgements

We would like to thank the Ministry of Agriculture and Forestry for its financial support.

REFERENCES

- Anşin R (1979). Trabzon-Meryemana Araştırma Ormanı Florası ve Saf Ladin Meşcerelerinde Floristik Araştırmalar. Trabzon: Karadeniz Gazetecilik ve Matbaacılık Press, 234p. (in Turkish)
- Anşin R (1983). Türkiye'nin Flora Bölgeleri ve Bu Bölgelerde Yayılan Asal Vegetasyon Tipleri (The Floristic Regions and the Major Vegetation Types of Turkey). *KTÜ Orman Fakültesi Dergisi* 6(2): 318-339. (in Turkish)
- Anşin R, Özkan ZC, Abay G, Eminağaoğlu Ö (2000). New Floristic Records From A8 Artvin. *Ot Sistematik Botanik Dergisi* 4(1): 95-98.

- Davis PH (ed) (1965-1985). Flora of Turkey and the East Aegean Islands. Vols. 1-9. Edinburgh: Edinburgh University Press.
- Davis PH, Harper PC, Hedge IC (1971). Plant Life of South West Asia. Edinburgh: The Botanical Society of Edinburgh. 335p.
- Davis PH, Mill RR, Tan K, (eds) (1988). Flora of Turkey and the East Aegean Islands. Vol. 10. Edinburgh: Edinburgh University Press.
- DMİ (2018). Artvin Meteoroloji Müdürlüğü 1970-2018 Yılları Arası Yusufeli İlçesi İklim Verileri. Ankara.
- Ekim T, Koyuncu M, Vural M, Duman H, Aytaç Z, Adıgüzel N (2000). Türkiye Bitkileri Kırmızı Kitabı, Eğrelti ve Tohumlu Bitkiler (Red Data Book of Turkish Plants, Pteridophyta and Spermatophyta). Ankara: Barışcan Ofset, 246p.
- Ekim T, Terzioğlu S, Eminağaoğlu Ö, Coşkunçelebi K (2014). Turkey. In: Solomon J, Schulkina T, Schatz GE (eds), Red List of the Endemic Plants of Caucasus: Armenia, Azerbaijan, Georgia, Iran, Russia, and Turkey. Monographs in Systematic Botany from the Missouri Botanical Garden (MSB) Saint Louis: 125. Missouri Botanical Garden Press, pp: 209-242.
- Eminağaoğlu Ö (2009). The Plant Diversity Of Tekkale Çevreli And Cemketen Villages (Yusufeli, Artvin). *Batumi Botanical Garden Bulletin* 33: 152-159.
- Eminağaoğlu Ö (ed) (2015). Artvin'in Doğal Bitkileri. İstanbul: Promat, 456p. (in Turkish).
- Eminağaoğlu Ö, Anşin R (2002). A9 (Artvin) Karesi İçin Yeni Floristik Kayıtlar. *Kafkas Üniversitesi Artvin Orman Fakültesi Dergisi* 3(1): 96-108. (in Turkish).
- Eminağaoğlu Ö, Anşin R (2003). The Flora of Hatila Valley National Park and its close Environs (Artvin). *Turkish Journal of Botany* 27(1): 1-27.
- Eminağaoğlu Ö, Anşin R (2004). Flora of the Karagöl-Sahara National Park (Artvin) and its Environs. *Turkish Journal of Botany* 28(6): 557-590.
- Eminağaoğlu Ö, Anşin R (2005). The Flora of Cerattepe Meydanlar Demirci Gavur Creek and Near Environment in Artvin. *İstanbul Üniversitesi Orman Fakültesi Dergisi* 55(2): 31-46.
- Eminağaoğlu Ö, Anşin R, Kutbay HG (2007). Forest Vegetation of Karagöl Sahara National Park (Artvin, Turkey). *Turkish Journal of Botany* 31(5): 421-449.
- Eminağaoğlu Ö, Özkaya M S, Akpulat HA (2012). A New Record for the Flora of Turkey: *Sorbus caucasica* var. *caucasica* (Rosaceae). *Turkish Journal of Botany* 36(4): 426-426.
- Eminağaoğlu Ö, Yüksel E, Akyıldırım Beğen H (2018). Flora of the Hod Valley (Artvin, Turkey). *International Journal of Ecosystems and Ecology Science-IJEES* 8 (2): 273-282.
- Güner A (1983). Kaçkar Dağlarının Kuzey Yamacının Florası. TÜBİTAK, TBAG-463, Ankara. (in Turkish).
- Güner A, Aslan S, Ekim T, Vural M, Babaç MT (eds) (2012). Türkiye Bitkileri Listesi (Damarlı Bitkiler). İstanbul: Nezahat Gökyiğit Botanik Bahçesi ve Flora Araştırmaları Derneği Yayını. (in Turkish).
- Güner A, Özhatay N, Ekim T, Başer KHC (2000). Flora of Turkey and the East Aegean Islands. Vol. XI, (Supplement II), Edinburgh: Edinburgh University Press.
- Güner A, Vural M & Sorkun K (1987). Rize Florası, Vegetasyonu ve Yöre Ballarının Polen Analizi. TÜBİTAK, TBAG-650, Ankara. (in Turkish).
- IPNI (2015). International Plant Name Index. Published on the Internet. <http://www.ipni.org>. Downloaded on 13 September 2018.
- IUCN (2018). The IUCN Red List of Threatened Species. Version 2018-2. <http://www.iucnredlist.org>. Downloaded on 13 August 2018.
- Ketzkhoveli NN & Gagnidze RI (eds.) (1971-2001). Georgian Flora (Flora of Georgia). Vols. 1-13. Metsniereba, Tbilisi, Georgia.

Komarov VL (1934-78). Flora of the U.S.S.R., Vol. 1-30. Israel Program for Scientific Translations, Jerusalem.
 Özhatay N, Byfield A, Atay S (2005). Türkiye'nin 122 Önemli Bitki Alanı. İstanbul: WWF Turkey, pp. 476. (in Turkish)
 PL (2013). The Plant List, Version 1.1. Published on the Internet. <http://www.theplantlist.org>. Downloaded 12 October 2018.
 Vural M (1996). Rize'nin Yüksek Dağ Vegetasyonu. *Turkish Journal of Botany* 20: 83-102.
 Walter H (1956). Kurak Zamanların Tesbitinde Esas Olarak Kullanılacak Klimogram, (Çev. S.Uslu). *İÜ Orman Fakültesi Dergisi* 8(2): 95-104.

WWF & IUCN (1994). Centres of Plant Diversity. A Guide and Strategy for Their Conservation. Vol. 1. Cambridge: IUCN Publications Unit.
 Yüksel E, Eminağaoğlu Ö (2017). Flora Of The Kamilet Valley (Arhavi, Artvin, Turkey). *International Journal of Ecosystems and Ecology Science-IJEES* 7(4): 905-914.
 Zazanashvili N, Sanadiradze G, Bukhnikashvili A (1999). Caucasus. In: Mittermeier RA, Meyers N, Robles Gil P, Mittermeier CG (eds). Hotspots: Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions. Mexico: CEMEX. pp. 268-277.

APPENDIX: IUCN risk categories of endemic and non-endemic rare plants in the research area.

TAXA	ENDEMİSM	IUCN (2018)
<i>Campanula troegerae</i> Damboldt	Endemic	CR
<i>Helichrysum artvinense</i> P.H.Davis & Kupicha	Endemic	CR
<i>Saxifraga artvinensis</i> V.A.Matthews	Endemic	CR
<i>Stachys choruhensis</i> Kit Tan & Sorger	Endemic	CR
<i>Acer cappadocicum</i> Gled. subsp. <i>divergens</i> (K.Koch ex Paxton) A.E.Murray	Endemic	EN
<i>Alyssum artvinense</i> N.Busch.	Endemic	EN
<i>Bupleurum schistosum</i> Woronow	Endemic	EN
<i>Chesneya elegans</i> Fomine	Endemic	EN
<i>Gypsophila simulatrix</i> Bornm. & Woronow	Endemic	EN
<i>Eminium koenianum</i> Lobin & P.C.Boyce	Endemic	EN
<i>Salvia huberi</i> Hedge	Endemic	EN
<i>Sempervivum staintonii</i> Muirhead	Endemic	EN
<i>Sorbus caucasica</i> Zinserl. var. <i>yaltirikii</i> Gökşin	Endemic	EN
<i>Bupleurum brachiatum</i> K.Koch ex Boiss.	Endemic	VU
<i>Cirsium pseudopersonata</i> Boiss. & Balansa ex Boiss. subsp. <i>pseudopersonata</i>	Endemic	VU
<i>Papaver lateritium</i> K.Koch subsp. <i>lateritium</i>	Endemic	VU
<i>Primula longipes</i> Freyn & Sint.	Endemic	VU
<i>Psephellus taochius</i> Sosn.	Endemic	VU
<i>Ballota rotundifolia</i> K.Koch	Endemic	NT
<i>Alcea calvertii</i> (Boiss.) Boiss.	Endemic	LC
<i>Allium djimilense</i> Boiss. ex Regel	Endemic	LC
<i>Campanula betulifolia</i> K.Koch	Endemic	LC
<i>Cerastium armeniacum</i> Gren.	Endemic	LC
<i>Elymus lazicus</i> (Boiss.) Melderis	Endemic	LC
<i>Euonymus latifolius</i> (L.) Mill. subsp. <i>caucasicus</i> Coode & Cullen	Endemic	LC
<i>Galium margaceum</i> Ehrend. & Schönb.-Tem.	Endemic	LC
<i>Linaria genistifolia</i> (L.) Mill. subsp. <i>confertiflora</i> (Boiss.) P.H.Davis	Endemic	LC
<i>Salvia rosifolia</i> Sm.	Endemic	LC
<i>Taraxacum turcicum</i> Soest	Endemic	LC
<i>Tragopogon aureus</i> Boiss.	Endemic	LC
<i>Knautia montana</i> DC.	Non Endemic	EN
<i>Crocus scharojanii</i> Rupr.	Non Endemic	VU
<i>Cyanus cheiranthifolius</i> (Willd.) Soják var. <i>purpurascens</i> (DC.) Wagenitz	Non Endemic	VU
<i>Cynoglossum holosericeum</i> Steven	Non Endemic	VU
<i>Gypsophila tenuifolia</i> M.Bieb.	Non Endemic	VU
<i>Lilium kesselringianum</i> Misch.	Non Endemic	VU
<i>Primula elatior</i> (L.) Hill subsp. <i>pseudoelatior</i> (Kusn.) W.W.Sm & Forrest	Non Endemic	VU
<i>Astrantia maxima</i> Pall. subsp. <i>maxima</i>	Non Endemic	NT

<i>Abies nordmanniana</i> (Steven) Spach subsp. <i>nordmanniana</i>	Non Endemic	LC
<i>Alnus glutinosa</i> (L.) Gaertn. subsp. <i>barbata</i> (C.A.Mey) Yalt.	Non Endemic	LC
<i>Betula pendula</i> Roth	Non Endemic	LC
<i>Carpinus betulus</i> L.	Non Endemic	LC
<i>Carpinus orientalis</i> Mill.	Non Endemic	LC
<i>Daphne glomerata</i> Lam	Non Endemic	LC
<i>Heracleum cyclocarpum</i> C. Koch	Non Endemic	LC
<i>Juniperus oxycedrus</i> L. subsp. <i>oxycedrus</i>	Non Endemic	LC
<i>Juniperus excelsa</i> M.Bieb.	Non Endemic	LC
<i>Juniperus foetidissima</i> Willd.	Non Endemic	LC
<i>Ostrya carpinifolia</i> Scop.	Non Endemic	LC
<i>Picea orientalis</i> (L.) Peterm.	Non Endemic	LC
<i>Populus tremula</i> L.	Non Endemic	LC
<i>Salix alba</i> L.	Non Endemic	LC
<i>Salix caprea</i> L.	Non Endemic	LC
<i>Salix excelsa</i> S.G.Gmel.	Non Endemic	LC
<i>Salix triandra</i> L.	Non Endemic	LC
<i>Sempervivum transcaasicum</i> Muirhead	Non Endemic	LC
<i>Sorbus subfusca</i> (Ledeb. Ex Nordm.) Boiss.	Non Endemic	LC
<i>Swertia iberica</i> Fisch. ex C.A.Mey.	Non Endemic	LC
<i>Androsace intermedia</i> Ledeb.	Non Endemic	NE
<i>Campanula alliariifolia</i> Willd.	Non Endemic	NE
<i>Campanula lactiflora</i> M.Bieb.	Non Endemic	NE
<i>Cirsium caucasicum</i> Petr.	Non Endemic	NE
<i>Cirsium obvallatum</i> (M.Bieb.) M.Bieb.	Non Endemic	NE
<i>Crocus vallicola</i> Herb.	Non Endemic	NE
<i>Delphinium flexuosum</i> M.Bieb.	Non Endemic	NE
<i>Draba hispida</i> Willd.	Non Endemic	NE
<i>Draba siliquosa</i> M.Bieb.	Non Endemic	NE
<i>Epilobium colchicum</i> Albov	Non Endemic	NE
<i>Fritillaria latifolia</i> Willd.	Non Endemic	NE
<i>Geranium ibericum</i> Cav. subsp. <i>ibericum</i>	Non Endemic	NE
<i>Geranium psilostemon</i> Ledeb.	Non Endemic	NE
<i>Origanum rotundifolium</i> Boiss.	Non Endemic	NE
<i>Pedicularis wilhelmsiana</i> Fisch. Ex M.Bieb.	Non Endemic	NE
<i>Potentilla elatior</i> Willd. ex Schltdl.	Non Endemic	NE
<i>Primula meyeri</i> Rupr.	Non Endemic	NE
<i>Rhamnus pallasii</i> Fisch. & C.A. Mey.	Non Endemic	NE
<i>Rhododendron caucasicum</i> Pall.	Non Endemic	NE
<i>Rhynchosorys stricta</i> Albov	Non Endemic	NE
<i>Ribes petraeum</i> Wulfen	Non Endemic	NE
<i>Sedum spurium</i> M.Bieb.	Non Endemic	NE
<i>Sorbus caucasica</i> Zinserl. var. <i>caucasica</i>	Non Endemic	NE
<i>Scutellaria pontica</i> K.Koch	Non Endemic	NE
<i>Thymus praecox</i> Opiz subsp. <i>grossheimii</i> (Ronniger) Jalas var. <i>Grossheimii</i>	Non Endemic	NE