



Floristic Diversity of Handüzü Natural Park and Environs, Turkey

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ABSTRACT

The floristic diversity of Handüzü Natural Park and Environs as a protected area within Kaçkar Mountains chain, situated in Güneysu and İkizdere counties of Rize (Turkey) was studied. Overall, 517 taxa belong to 352 genera and 104 families were determined. Twenty-three of these taxa are represented in division *Pteridophyta* while 494 of them are in division *Spermatophyta*. Ten of *Spermatophytes* are in subdivision *Gymnospermae* and 484 of them are in subdivision *Angiospermae*. 89 of *Angiosperms* are in class Liliopsida while 395 of them in class *Magnoliopsida*. The endemism ratio in the study area is 4.25% (22 taxa). Phytogeographic elements are listed in order as: multiregional-unknown phytogeography root 47.4% (245), Euro-Siberian 47.2% (244), Irano-Turanian 2.1% (11), and Mediterranean 3.3% (17). The life spectrum of taxa is as follows: Hemicryptophytes 48.7% (252), phanerophytes 16.1% (83), therophytes 15.7% (81), chamaephytes 10.4% (54), and cryophytes 9.1% (47). The richest families in taxa are *Asteraceae* (52), *Poaceae* (35), *Rosaceae* (31), *Fabaceae* (25), and *Lamiaceae* (24). In the study area 22 taxa were found as threatened taxa at different threatened levels. The results of the study was compared with the results of 10 studies carried out in Rize and neighboring cities.

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ÖZET

Kaçkar Dağları silsilesinde korunan bir alan olarak, Rize (Türkiye)'nin, Güneysu ve İkizdere ilçelerinde bulunan Handüzü Tabiat Parkı ve çevresinin floristik çeşitliliği çalışılmıştır. 104 familyaya ait 352 cins ve 517 takson belirlenmiştir. Taksonlardan 23 tanesi *Pteridophyta*, 494 tanesi ise *Spermatophyta* bölümünde temsil edilmektedir. *Spermatophyta* bölümüne ait taksonlardan 10'u *Gymnospermae*, 484'ü ise *Angiospermae* alt bölümünde bulunur. *Angiospermlerin* 89'u *Liliopsida* sınıfındayken 395'i *Magnoliopsida* sınıfındadır. Taksonların endemizm oranı %4.25 (22 takson) olarak belirlenmiştir. Çalışma alanındaki taksonların fitocoğrafya bölgelerine göre dağılımı; fitocoğrafik bölgesi bilinmeyenler %47.4 (245), Avrupa-Sibirya %47.2 (244), İran-Turan %2.1 (11) ve Akdeniz %3.31 (17)'dir. Taksonların hayat formları şu şekildedir: Hemikriptofitler %48.7 (252), fanerofitler % 16.1 (83), terofitler %15.7 (81), kamefitler %10.4 (54), and kriptofitler %9.1 (47). Çalışma alanındaki en zengin taksonlu familyalar *Asterceae* (52), *Poaceae* (35), *Rosaceae* (31), *Fabaceae* (25) ve *Lamiaceae* (24)'dir. Çalışma alanındaki 22 takson, farklı tehlike kategorilerinde, tehlike altında bulunmuştur.

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INTRODUCTION

The total number of plant species in the world is increasing day by day. According to Payne (2016) more

than 250.000 plant species have been identified after binominal nomenclature concept of Linnaeus (1973). Maarten *et al.* (2016) reported that the total plant species of the world is ca 374.000, of which 308.312 are

in *Spermatophyta* division. Nowadays, the number of the new species, published per year, is ca 2.0000 (Lindon *et al.*, 2015).

The first study on the Flora of Turkey, documented in 6 volumes, is Flora Orientalis (Boissier, 1865-1888). The second and the most detailed research on the Flora of Turkey, documented as 11 volumes, in which 8988 species were described, is Flora of Turkey and the East Aegean Islands (Davis, 1965-1985; Davis *et al.*, 1988; Güner *et al.*, 2000). Güner *et al.* (2012) published the Plant List of Turkey, Vascular Plants (Güner *et al.* 2012), in which 9996 species were described. After check list series of Özhatay *et al.* (2013), the total number of plant species in Turkey increased to 10169 while the total taxa number (with addition of subspecies, varieties and hybrids) increased to 11935. Currently, the total number of Turkish vascular plant taxa is over 12.000 and it continues to increase.

There have been some floristic studies in Rize (Güner 1987; Çobanoğlu 2012; Demir 2013; Baykal and Atamov 2016; Baykal and Atamov 2017; Baykal and Atamov 2018; Baykal *et al.* 2018) and in neighboring cities (Terzioğlu 1998; Palabaş-Uzun 2009; Uzun 2009; Eminağaoğlu 2003; Eminağaoğlu and Anşın 2004).

The study area covers Handüzü Natural Park and its environs. There is not any floristical study which is focused on only its flora that reflects all seasonal variations. The objective of this research was to

determine the floristic diversity of this Natural Park and its environs.

MATERIAL and METHODS

Handüzü Natural Park is 16 km away from Rize city center in Turkey. The study area, Handüzü Natural Park and environs, lies between the latitudes 40°58'11"- 40°47'54" and longitudes 40°37'39"- 40°42'55", contains two highlands. The first highland Handüzü is in the Güneysu district and the second one Çağrankaya is in the İkizdere district. According to Davis (1965-1985), the study area is at A8 square, in Colchic sector of Euro-Siberian floristic region. The study area is very mountainous and is deeply divided by the streams Taşlıdere, Paşacur, and Sel in the west and Kale and Güneysu in the east. The lowest part of the study area was 150 m just over Güneysu district and the highest part was 2700 m at Çağrankaya highland (Fig. 1).

The lower part of Handüzü Natural Park is geologically composed of Paleozoic and Cretaceous aged granodiorite, andesite and basalt and the higher parts, especially Çağrankaya highland, composed of upper Cretaceous aged lava, dasite, andesite (Gedik *et al.*, 1992; Anonymous, 2000). The mountainous zones in the study area consist of scars and rifts while the rest parts contain 3 main soil types, namely red-yellow podzolic, calcareous brown forest and high mountain meadow soils (Anonymous, 2005).



Fig. 1. The study area.

There are elevational differences (150-2700 m) in the study area and as a result of these differences the climate from 150 m to 2000 m is very-humid, mesothermal, oceanic climate while from 2000 m to 2700 m very-humid, microthermal which reminiscent of continental climate. Both in Rize and study area, there is not any dry season and the precipitation regime is as autumn, winter, spring and summer (Au.Wi.Su.Si.). The annual mean precipitation in Rize,

for last 20 years, is 2441 mm while the annual mean temperature is 14.9 °C . (Anonymous, 2016). The climatic data of Rize station were interpolated for the altitude 2000 m and according to these values, in the study area, January, February, March, November and December are the frosty months while April is the probable frosty month (Fig. 2).

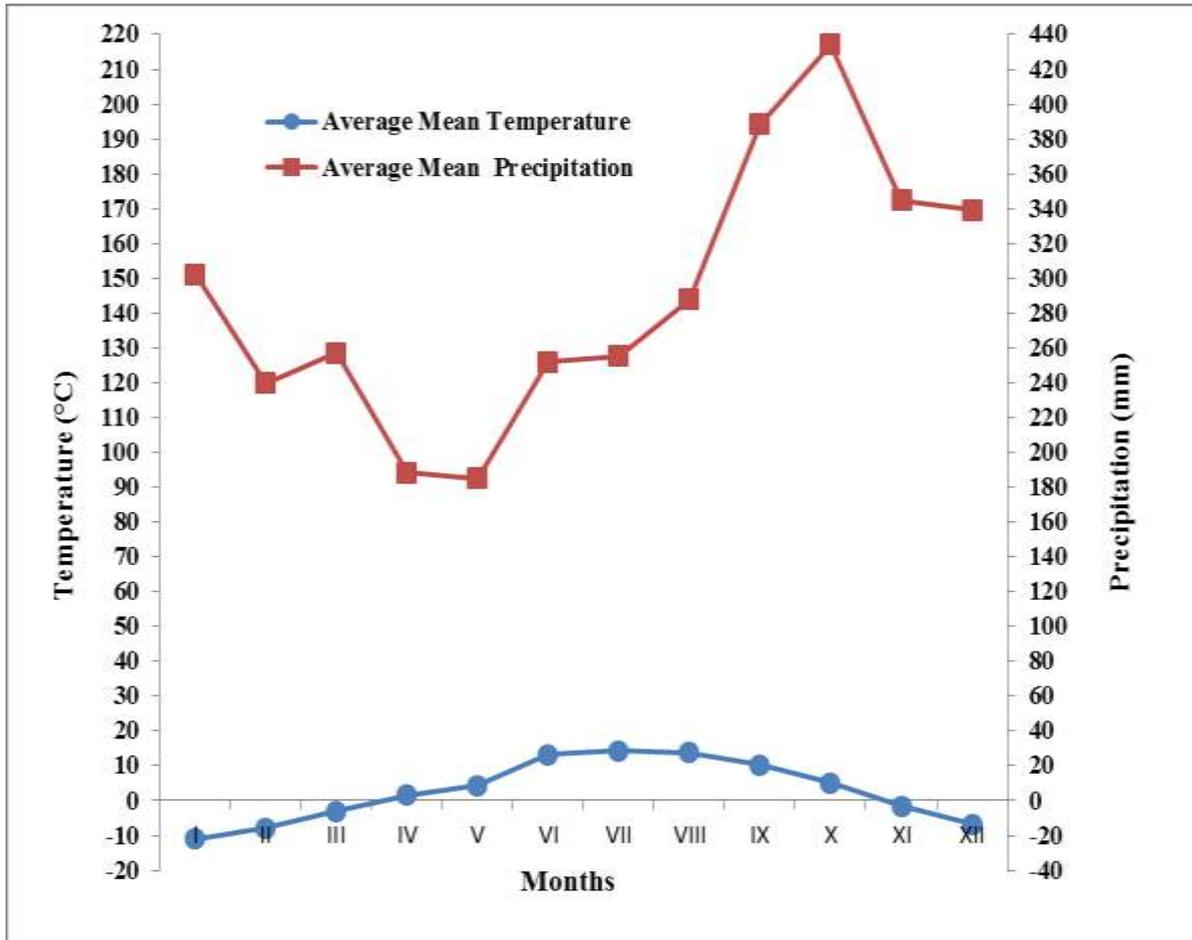


Figure 2. Interpolated climate diagram for Handüzü Natural Park and environs (for 2000 m)

The materials of the study were consist of 2000 vascular plant samples, which were collected from the study area during the vegetation periods of the years 2010-2011 and 2016. The plant materials were collected ensuring that they possess all vegetative and generative organs. The collected plant samples were dried out and stuck on cartons with modern herbarium rules (Seçmen et al., 2008). The herbarium materials of each taxon have been preserved at the herbarium of Biology Department, Faculty of Science and Arts, Recep Tayyip Erdoğan University. The Flora of Turkey and the East Aegean Islands, documented in 11 volumes (Davis, 1965-1985; Davis et al., 1988; Güner et al., 2000), was used to describe all taxa. The European (Tutin et al., 1964-1980) and Russian flora (Komarov and Shishkin, 1933-1964; Ketzkhoveli and

Gagnidze, 1971-2001) were also used in identification of taxa. Some more studies (Güner et al., 1987; Terzioğlu, 1998; Eminağaoğlu and Anşın, 2003, 2004; Uzun, 2009; Palabaş Uzun, 2009; Güner et al., 2012; Khan et al., 2011; Demir, 2013; Shaheen, 2014; Baykal, 2015) were followed, to checked the described taxa and to compare the results of the study. All described taxa were controlled with the herbarium samples of Karadeniz Technical and Hacettepe Universities. The family, taxa and author (Brummitt et al., 1992) name and localities of each taxon are given correspondingly. The endemism and phytogeography element status (Davis, 1965-1985; 1988; Güner et al., 2012), life spectrum (Raunkiaer, 1934; Ellenberg Mueller-Dombois, 1967) and threatened categories (Ekim et al., 2000), were also given.

RESULTS and DISCUSSION

The results of the study, comparison and discussion, with the results of 10 studies (FVP., FEV., FCP., FVU., FVS., FKN., MDB., FHN., FVT and FIN.) close to the research area are given below.

The vascular flora of Handüzü Natural Park and Environs consist of 517 taxa, of which 412 species, 84 subspecies and 21 varieties within 352 genera and 104 families. 494 of these taxa are Spermatophyte while 23 remainders are Pteridophyte. Gymnospermae subdivision is represented by 10 taxa. Overall, 484 of the total taxa are within Angiospermae (Table 1).

Angiosperms divided as 395 Dicotyledones and 89 Monocotyledones. The total taxa number of the study (517) is richer than the total taxa number in the studies FCP. (228), FVT (408) and FVS. (479), while it is nearly equal to FEV. (518) (Table 2). On the other hand, it is smaller than the studies MDB. (656), FHN. (769), FKN. (853), FVU. (1024), and FVP. (1430) (Table 2).

The differences in the total taxa number of the compared studies can be explained with the size of the study areas, habitat diversity, edaphic factors, etc. The Euro-Siberian phytogeography elements are very rich in the study area with 244 (47.2%) taxa (Table 2). The

Mediterranean phytogeography elements follow them with 17 (3.3%) taxa and finally Irano-Turanian elements with 11 (2.1%) taxa. 245 (47.4%) taxa are multi regional or unknown phytogeographic root (Table 2). The study area is under the influence of the Euro-Siberian phytogeography province, which can explain the dominance of the Euro-Siberian phytogeography element. The presence of the Mediterranean and Irano-Turanian phytogeography elements in the study area can be clarify by the microclimates in Handüzü Natural Park and Environs. Also, 13 (2.5%) endemics are Euro-Siberian phytogeography elements, 1 (%0.2) endemic is Mediterranean and 2 (0.4%) endemics are Irano-Turanian phytogeography elements (Table 3). Even though the Euro-Siberian phytogeography region elements are in the first place in all studies (FVP., FEV., FCP., FVU., FVS., FKN., MDB., FHN and FVT.) and Irano-Turanian phytogeography region elements are in the second place, only in this study, with a few majority, Mediterranean phytogeography region elements are in the second place (Table 2). This is an expected result because, all Eastern Black Sea region is in the borderlines of Euro-Siberian phytogeography province.

Table 1. The distribution of taxa in upper taxonomic categories.

	Family	Genus	Species	Subspecies	Variety	Taxa	Endemics
Pteridophyta	10	13	18	5	-	23	-
Spermatophyta	94	339	394	79	21	494	22
Gymnospermae	3	7	5	4	1	10	-
Angiospermae	91	332	389	75	20	484	22
Dicotyledones	78	274	312	64	19	395	19
Monocotyledones	13	58	77	11	1	89	3
Total	104	352	412	84	21	517	22

Table 2. Phytogeography element comparison.

Researches	Euro- Siberian	Mediterranean	Irano Turanian	Cosmopolite and other	Taxa	Endemic
FDH.	47.2	3.3	2.1	47.4	517	4.3
FVP.	48.2	3.0	5.7	43.0	1430	18.5
FEV.	43.2	2.1	4.1	50.6	518	7.0
FCP.	67.5	0	2.2	29.3	228	5.3
FVU.	41.1	2.0	4.6	5.3	1024	7.1
FVS.	49.5	1.3	2.3	46.9	479	4.2
FKN.	39.4	1.2	10.3	49.1	853	6.3
MDB.	43.9	3.4	4.0	48.8	656	5.2
FHN.	35.6	2.2	6.9	55.3	769	7.4
FVT.	58.1	1.2	3.4	37.3	408	4.9

FDH.: Floristic Diversity of Handüzü Natural Park and Environs, Turkey, current study; FVP.: Flora, Vegetation and Polen Analysis of Rize, Guner et al., 1987; FEV.: Flora Vegetation and Ethnobotany of Başhemşin (Çamlıhemşin, Rize), Baykal and Atamov, 2016; FCP.: Ayder-Çeymakçur (Çamlıhemşin/Rize) plateau flora and the chemical and polynological properties of local honeys., Demir, 2013; FVU.: Flora and Vegetation of Uzungöl (Çaykara, Trabzon), Terzioglu, 1998; FVS.: Flora, Vegetation and Succession of Sıdadağı (Trabzon), Palabas Uzun, 2009; FKN.: Flora of the Karagol-Sahara National Park (Artvin) and Its Environs, Eminagaoglu and Ansin, 2004; MDB.: Mapping and Determination of plant biodiversity of KTU University Research Forest (Trabzon), Uzun, 2009; FHN.: Flora of Hatıla Valley National Park (Artvin) and its Close Environs, Eminagaoglu and Ansin, 2003; FVT.: Flora of Tunca Valley Natural Park and Environs, Baykal et al., 2018

Table 3. Analogy of phytogeography elements, threatened status, endemic nonendemic.

Phytogeographic regions	Endemic		Nonendemic		Sum	
	Number	Ratio%	Number	Ratio%	Number	Ratio%
Euro-Siberian	13	2.5	231	44.7	244	47.2
Mediterranean	1	0.2	16	3.1	17	3.3
Irano-Turanian	2	0.4	9	1.7	11	2.1
Cosmopolite and others	6	1.2	239	46.2	245	47.4
Total	22	4.3	495	95.7	517	100
Endangered (EN)	4	0.8			4	0.8
Near threatened (NE)	4	0.8			4	0.8
Vulnerable (VU)	4	0.8			4	0.8
Least concern (LC)	10	1.9			10	1.9
Sum	22	4.3			22	4.3

In the study area 22 threatened taxa, all them are endemic, were determined (Table 3). Also, 4 endemic is listed in EN, 4 endemics in NE, 4 endemics in VU and 10 endemics are in LC (Table 3). The number of threatened taxa in compared studies, the threatened taxa data were available, are as follow; MDB. 42, FVS. 30, FKN. 30, FEV. 13 and FCP. 12. 22 endemic taxa were determined in the research area (Table 2). The endemism ratio of the study and compared studies are given in Table 3. The endemism ratio of the studies was generally focus around 7% (FEV., FKN., FVU. and FHN.), and 5% (FCP., FDH., FVT., and MDB). Only RF differs from the others with the endemism ratio of (18.5%). In these studies, the homogeneity of climate and environmental similarities may be the reasons of low endemism ratio.

The richest families of the study area in taxa numbers are Asteraceae (52), Poaceae (35), Rosaceae (31), Fabaceae (25), and Lamiaceae (24) (Table 4).

The family Poaceae is the second richest family about the total taxa numbers in the studies FVG., FEV., FVP., and MDB., which overlaps with large meadow

areas within their boundaries (Table 5). There is a harmony, with small differences, in the series of the other families about the total taxa numbers.

The genera rich families are: Asteraceae (37), Poaceae (25), Rosaceae (21), Fabaceae (17), Lamiaceae (16) (Table 6).

The life-form data of the taxa in the studies FVG., FEV., FCP., and FIN., of which life-form information of the taxa are available, are given in Table 7. The life spectrum of the taxa in the study FVG is: hemicryptophytes 252 (48.7%), phanerophytes 89 (17.2%), therophytes 84 (16.3%), chamaephytes 54 (10.5%), cryptophytes 47 (9.1%). In the studies compared, hemicryptophytes are the richest life-form: FEG. (252), FEV. (229), FVG. (143) and, FIN. (94). This is correlated with large amount of subalpine and alpine vegetation in the study areas. The size of forest vegetation in Handüzü Natural Park is larger than the researches of FEV. and FCP. Hence, the phanerophytes in FVG. (83) are more than the studies FCP. (31), FIN. (29) and FEV. (17) (Table 8).

Table 4. The richest 5 families about genera.

Family	Genus	Ratio (%)
Asteraceae	37	10.5
Poaceae	25	7.1
Rosaceae	21	6.0
Fabaceae	17	4.8
Lamiaceae	16	4.5
Total	116	32.9

In Turkey, according to total taxa numbers, Asteraceae is the richest family; thus, all of the studies compared (FVG., FVP., FEV., FCP., FVU., FVS., FKN. and MDB.), except FHN. and FIN., are compatible with Flora of Turkey (Table 5).

Table 5. The analogies of rich families about taxa.

Family	Compared studies (%)									
	FVG.	FVP.	FEV.	FCP.	FVU	FVS.	FKN.	MDB.	FHN.	FIN.
Asteraceae	10.1	12.5	10.9	10.5	13.8	10.9	11.4	11.4	9.8	8.0
Poaceae	6.8	10.7	9.7	3.5	5.5	6.1	7.5	7.3	2.5	10.5
Rosaceae	6.0	5.0	5.2	6.6	6.0	7.9	6.7	6.1	5.9	5.0
Fabaceae	4.8	4.8	5.4	3.9	6.5	6.3	9.4	6.3	10.2	5.5
Lamiaceae	4.6	4.7	4.2	5.3	4.8	5.4	5.8	5.0	5.9	6.0

FIN: Flora of Isırlık Natural Park and Environs

Table 6. The richest 5 families about genera.

Family	Genus	Ratio (%)
Asteraceae	37	10.5
Poaceae	25	7.1
Rosaceae	21	6.0
Fabaceae	17	4.8
Lamiaceae	16	4.5
Total	116	32.9

Table 7. The taxonomic diversity and floristic richness.

	Compared studies								
	FVG.	FVP.	FEV.	FCP.	FVU.	FVS.	FKN.	MDB.	FHN.
Species (T)	517	1430	518	228	1024	479	863	656	769
Genus (G)	352	555	228	131	435	259	364	354	374
Family (F)	104	130	74	48	117	82	91	95	95
T/G	1.8	2.6	2.0	1.7	2.4	1.8	2.4	1.8	2.1
G/F	3.9	4.3	3.5	2.7	3.7	3.1	4.0	3.7	3.9

The taxonomic diversity and floristic richness of Handüzü Natural Park and environs are given in Table 7. Even though there are some little differences there is a concordance in taxonomic diversity and floristic richness in the compared studies. The study (FVG.) has an equal taxonomic diversity and floristic richness (1.8%) with the studies MDB.(1.8%) and FVS. (1.8%).

It has a richer taxonomic diversity and floristic richness than FCP. (1.7%) and lesser than the studies FVP. (2.6), FEV. (2.0), FVU. (2.4), FKN. (2.4) and FHN. (2.1). G/F (3.9%) value of the study is higher than that of FEV. (2.7%), FCP. (2.7%), FVU. (3.7%), FVS. (3.1%) and MDB. (3.7%) equal to FHN. and lower than FVP. (4.3%) and FKN. (4.0%) (Table 7).

Table 8. The comparative life spectrum of compared studies.

Studies	Hcrp.	Php.	Thp.	Chp.	Crp.	NanoPh.	Vp.	Hd.
FVG.	252	83	81	54	47	-	-	-
FEV.	229	17	62	57	145	3	2	1
FCP.	143	31	16	16	31	-	-	-
FIN.	94	29	38	6	34	-	-	-

Hcrp.: Hemicryptophytes; Php.: Phanerophytes; Thp.: Therophytes; Chp.: Chamaephytes; Crp.: Cryptophytes; NanoPh.: Nanophanerophytes; Vp.: Vascular parasite; Hd.: Hydrophytes.

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