



Flora of Akyamaç Waterfall natural park and environs (Rize/Turkey)

Hüseyin BAYKAL *¹

¹ Department of Plant and Animal Breeding, Pazar Vocational School, Recep Tayyip Erdogan University, 53100, Rize, Turkey

Abstract

The purpose of the study is to determine the vascular flora of Akyamaç Waterfall Natural Park, a protected area in Rize, Turkey. During the years 2016-2017, 970 plant materials were collected through comprehensive surveys. 229 taxa belonging to 170 genera and 58 families were determined. Among these, 13 *Pteridophytes*, one *Gymnosperm*, 177 *Dicotyledones*, and 38 *Monocotyledones* were identified. *Poaceae* (20 taxa), *Asteraceae* (17 taxa), *Fabaceae* (14 taxa), *Rosaceae* (13 taxa) and *Lamiaceae* (12 taxa) are the richest families of the Natural Park. The phytogeographic spectrum of the taxa are as follows; Euro-Siberian 100 (43.7%), Mediterranean 7 (3.1%), Irano-Turanian 1 (0.4%), and multiregional or of unknown phytogeographic origin 121 (52.8%), respectively. The life form of the taxa is as follows: hemicryptophytes 97 (42.4%), cryptophytes 53 (23.1%), therophytes 41 (17.9%), phanerophytes 28 (12.2%), chamaephytes 10 (4.4%). The endemism ratio is 0.4%.

Key words: flora, protected area, natural park, Akyamaç Waterfall, Turkey

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Akyamaç Şelalesi tabiat parkı ve çevresinin florası (Rize/Türkiye)

Özet

Çalışmanın amacı, Türkiye'nin Rize ilinde koruma altındaki Akyamaç Şelalesi Tabiat Parkı'nın damarlı bitki florasını tespit etmektir. 2016-2017 yılları boyunca gerçekleştirilen detaylı arazi çalışmaları sonucu 970 bitki materyali toplanmıştır. 170 cins ve 58 familyaya ait 229 bitki taksonu belirlenmiştir. Tespit edilen taksonlardan 13 tanesinin *Pteridophyte*, 1 tanesinin *Gymnosperm*, 177 tanesinin *Dicotyledon* ve 38 tanesinin *Monocotyledon* olduğu tespit edilmiştir. *Poaceae* (20 takson), *Asteraceae* (17 takson), *Fabaceae* (14 takson), *Rosaceae* (13 takson) ve *Lamiaceae* (12 takson) Tabiat Parkının en zengin familyalardır. Araştırma alanındaki taksonların fitocoğrafik spektrumları sırası ile Avrupa-Sibirya 100 (%43.7), Akdeniz 7 (%3.1), İran-Turan 1 (%0.4), ve çok ya da bilinmeyen bölgesi 121 (%52.8) şeklindedir. Taksonların hayat formlarına göre dağılımı şu şekildedir: hemikriptofitler 97 (%42.4), kriptofitler 53 (%23.1), terofitler 41 (%17.9), fanorofitler 28 (12.2%), kamefitler 10 (4.4%). Endemizm oranı %0.4'tür.

Anahtar kelimeler: flora, korunan alan, tabiat parkı, Akyamaç Şelalesi, Türkiye

1. Introduction

1.1. Geographical Features of the Study Area

Akyamaç Waterfall Natural Park is in Hemşin district of Rize, 56 km away from city centre and 18 km away from the Blacksea coast, Turkey (Figure 1). It lies between the latitudes 41° 05' 321 and 41° 04' 169 and the longitudes 40° 90' 136 and 40° 91' 088. Akyamaç Waterfall Natural Park is at A8 square [1] in Colchic floristic sector of Euro-Siberian phytogeographical region.

* Corresponding author / Haberleşmeden sorumlu yazar: Tel.: +904646127317; Fax.: +904646127316; E-mail: huseyin.baykal@erdogan.edu.tr
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1.2. Geology and Edaphic Features

There are 6 geological formations (Hemşindere, Rize, Kaplıca, Melyat, Pazar and Hamidiye) within the generalized columnar section of Rize. Akyamaç and environs, totally composed of Hemşindere formation of upper Cretaceous age, which comprise basic and acid volcanic such as basaltic andesite, dacite, rhyolite and rarely some andesitic intermediate volcanoes [2].

Even though 5 main soil types, called alluvial, colluvial, red-yellow podzol, grey-brown podzol, non-calcareous forest and high mountain meadow soils, are in Rize only two of them, alluvial and red-yellow podzol, are present within Akyamaç and environs [3].

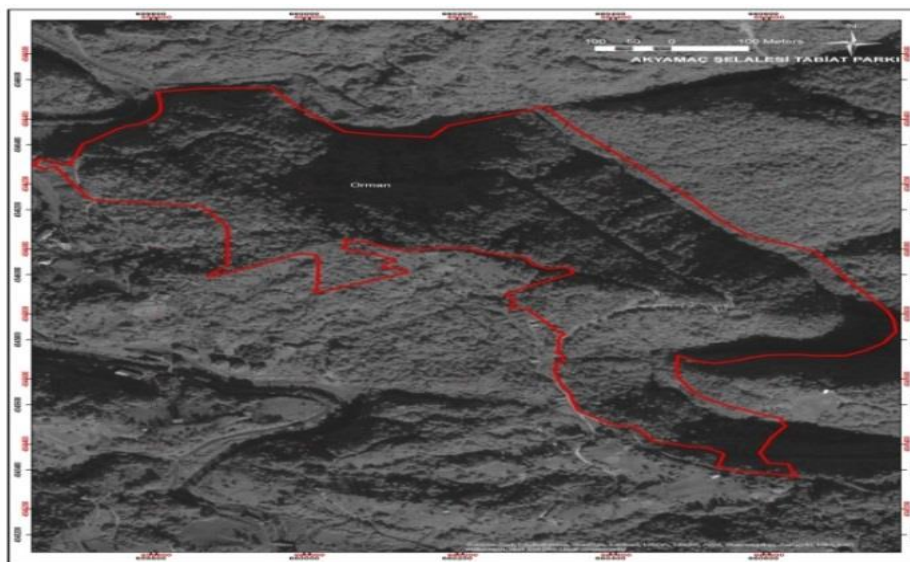


Figure 1. Akyamaç Waterfall Natural Park

1.3. Climatological Features

The climatic data of Pazar station [4] were interpolated for the altitude of 540 m. and Walter climate diagram was drawn for the research area. The climate within Akyamaç and environs is very-humid, mesothermal without any dry season. The precipitation regime is as autumn, winter, spring and summer (Au.Wi.Su.Si.). There is not any frosty or probable frosty month in the study area (Figure 2).

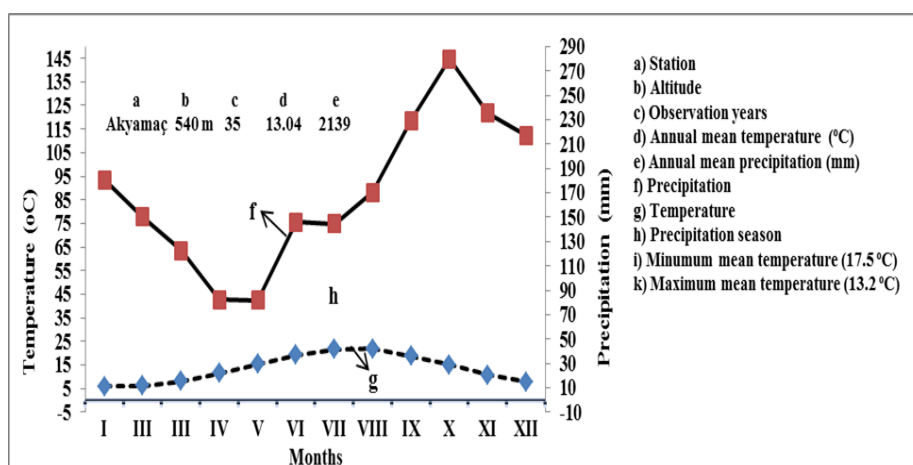


Figure 2. Climate diagram of Akyamaç Waterfall Natural Park

2. Materials and methods

The materials of the study are consisting of the vascular plant taxa collected from Akyamaç Waterfall Natural Park and environs during the vegetation seasons of 2016-2017. The samples for each taxon were dried and stuck according to herbarium rules and preserved in the herbarium of Biology Department, Faculty of Arts and Sciences, Recep Tayyip Erdoğan University. The taxa were identified using The Flora of Turkey and the Aegean Islands [1], [5], and [6]. The

family name, taxon name, author [7] and locations are given correspondingly. The endemism status [7], threatened categories [8], phytogeographical regions [1], [5] and life forms were also given. The study was compared with the studies in adjoining areas [9-15].

Abbreviations

m.: meter
 Euro-Sib: Euro-Siberian element
 Medit: Mediterranean element
 Ir-Tur: Irano-Turanian element
 Eux: Euxine element
 Hyrc-Eux: Hyrcano-Euxine element
 EN: Endangered
 NE: Not evaluated
 NT: Near threatened
 LC: Least concern
 VU: Vulnerable
 HB: Hüseyin Baykal
 VH: Vagif ATAMOV
 Crp: Cryptophytes
 Hcrp: Hemicryptophytes
 Chp: Chamaephytes
 Php: Phanerophytes
 Thp: Therophytes
 Vp: Vascular parasite
 CS.: Current study.

3. Results

The Floristic List

PTERIDOPHYTA

LYCOPODIACEAE

Lycopodium clavatum L., among *Rhododendron* shrub communities, 350 m, 20.06.2016, HB 1256, Hcrp.

POLYPODIACEAE

Polypodium australe Fee, shady and rocky surfaces, 350 m, 27.06.2017, HB 1799, Crp.

EQUISETACEAE

Equisetum palustre L., streamsides, 550 m, 20.06.2016, HB 1251, Crp.

E. telmateia Ehrh., damp shady places, 20.06.2016, HB 1263, Crp.

ASPLENIACEAE

Asplenium adiantum-nigrum L., on rocky surfaces, 370 m, 06.07.2016, HB 1442, Crp.

A. ceterach L., on rocks, 500 m, 15.06.2017, VH 4438, Crp.

A. scolopendrium L., shady rocky surfaces, 340 m, 06.07.2016, HB 1404, Crp.

A. trichomanes L., on rocky surfaces, 450 m, 20.06.2016, HB 1275, Crp.

ASPIDIACEAE

Dryopteris affinis (Lowe) Fraser-Jenkins subsp. *affinis*, close to streamsides, 370 m, 06.07.2016, HB 1399, Crp.

D. carthusiana (Vill.) H. P. Fuchs, among rocks, 550 m, 20.07.2016, HB 1501, Crp.

HYPOLEPIDACEAE

Pteridium aquilinum (L.) Kuhn in Decken, under forest, 450 m, 20.06.2016, HB 1262, Crp.

ATHYRIACEAE

Athyrium filix-foemina (L.) Roth., among shrubs, 470 m, 20.07.2016, HB 1495, Crp.

OSMUNDACEAE

Osmunda regalis L., damp streamsides, 540 m, 06.07.2016, HB 1429, Crp.

SPERMATOPHYTA

GYMNOSPERMAE

PINOPSIDA

PINACEAE

Picea orientalis L., mixed forest, 560 m, 20.06.2016, HB 1259, Eux, Php.

ANGIOSPERMAE
MAGNOLIOPSIDA

RANUNCULACEAE

- Adonis aestivalis* L. subsp. *aestivalis*, rocky slopes, 560 m, 06.07.2016, HB 1410, Thp.
Consolida orientalis (Gay.) Schrod., roadsides, 480 m, 20.07.2016, HB 1503, Ir-Tur, Thp.
Ranunculus arvensis L., under forest, 560 m, 20.06.2016, HB 1269, Thp.
R. cappadocicus Willd., under forest, 470 m, 12.07.2017, VH 4462, Hcrp.
R. constantinopolitanus (DC.) Da'Urv., damp meadows, 420 m, 06.07.2016, HB 1397, Hcrp.
R. marginatus Da'Urv., damp places, 380 m, 07.08.2016, HB 1686, Thp.
R. repens L., damp places, 540 m, 20.07.2016, HB 1498, Hcrp.
Thalictrum minus L. var. *majus* (Crantz) Crepin, damp meadows, 540 m, 21.08.2016, HB 1725, Euro-Sib, Hcrp.

PAPAVERACEAE

- Chelidonium majus* L., under forest, 380 m, 20.06.2016, HB 1257, Euro-Sib, Hcrp.
Roemeria refracta DC., close to streamsides, 330 m, 20.06.2016, HB 1265, Thp.
Papaver dubium L. subsp. *dubium*, roadsides, 500 m, 06.07.2016, HB 1393, Thp.
P. rhoeas L., roadsides, 410 m, 07.08.2016, HB 1677, Hcrp.

BRASSICACEAE

- Alliaria petiolata* (Bieb.) Cavara et Grande, under shrubs, 370 m, 20.06.2016, HB 1283, Hcrp.
Alyssum murale Waldst et Kit. var. *murale*, roadsides, 480 m, 06.07.2016, HB 1412, Hcrp.
Aethionema arabicum (L.) Andr. ex DC., stony slopes, 550 m, 20.06.2016, HB 1278, Cosmopolite, Thp.
Capsella bursa-pastoris (L.) Medik., roadsides, 320 m, 07.08.2016, HB 1682, Cosmopolite, Thp.
Cardamine bulbifera (L.) Crantz, streamsides, 410 m, 20.06.2016, HB 1253, Crp.
C. impatiens L. var. *pectinata* (Pallas) Trautv., damp spaces, 560 m, 07.08.2016, HB 1678, Euro-Sib, Crp.
Nasturtium officinale R.Br., streamsides, 470 m, 05.06.2016, HB 1193, Crp.
Rapistrum rugosum (L.) All., roadsides, 340 m, 20.06.2016, HB 1247, Hcrp.
Rorippa sylvestre (L.) Bess., damp places, 380 m, 21.08.2016, HB 1721, Hcrp.
Thlaspi arvense L., ridgeways, 450 m, 05.06.2016, HB 1175, Cosmopolite, Thp.

POLYGALACEAE

- Polygala major* Jacq., close to streamsides, 430 m, 06.07.2016, HB 1394, Euro-Sib, Hcrp.

VIOLACEAE

- Viola alba* Besser subsp. *dehnhardtii* (Ten.) Becker, under shrubs, 430 m, 08.05.2016, HB 1116, Hcrp.
V. sieheana W. Becker, under shrubs, 470 m, 05.06.2016, HB 1183, Hcrp.
V. tricolor L., streamsides, 380 m, 20.06.2016, HB 1255, Thp.

CARYOPHYLLACEAE

- Agrostemma githago* L., roadside, 380 m, 06.07.2016, HB 1420, Thp.
Cerastium glomeratum Thuill., under shrubs, 520 m, 05.06.2016, HB 1182, Thp.
Dianthus calocephalus Boiss., close to forests, 430 m, 07.08.2016, HB 1688, Hcrp.
Moenchia mantica (L.) Bartl., roadsides, 410 m, 05.06.2016, HB 1173, Thp.
Silene alba (Miller) Krause subsp. *divaricata* (Reichb.) Walters, under shrubs, 480 m, 06.07.2016, HB 1435, Thp.
S. italica (L.) Pers., streamsides, 320 m, 12.07.2017, VH 4457, Hcrp.
S. vulgaris (Moench) Garcke var. *vulgaris*, under shrubs, 470 m, 07.08.2016, HB 1683, Hcrp.
Stellaria holostea L., under shrubs, 350 m, 05.06.2016, HB 1191, Euro-Sib, Thp.
S. media subsp. *media*, meadows, 470 m, 05.06.2016, HB 1176, Thp.

OXALIDACEAE

- Oxalis acetosella* L., under forest, 450 m, 08.05.2016, HB 1117, Hcrp.

POLYGONACEAE

- Polygonum arenastrum* Bor., grainy soils, 430 m, 09.10.2016, HB 1775, Thp.
P. hydropiper L., under forest, 380 m, 07.08.2016, HB 1675, Thp.
P. perfoliatum L., streamsides, 340 m, 21.08.2016, HB 1727, Hcrp.
Rumex acetosella L., edge of shrubs, 430 m, 14.08.2017, VH 4483, Cosmopolite, Hcrp.
R. pulcher L., roadsides, 340 m, 06.07.2016, HB 1400, Hcrp.
R. scutatus L., edge of shrub communities, 380 m, 06.07.2016, HB 1395, Chp.

HYPERICACEAE

- Hypericum calycinum* L., damp forests, 380 m, 06.07.2016, HB 1433, Eux, Php.
H. bithynicum Boiss., under forest, 370 m, 06.09.2016, HB 1762, Eux, Hcrp.
H. xylosteifolium (Spach) Robson, under forest, 430 m, 06.07.2016, HB 1440, Eux, Php.

GERANIACEAE

- Geranium pyrenaicum* Burm. Fil., under forest, 370 m, 20.06.2016, HB 1282, Crp.

G. purpureum Vill., damp places, 460 m, 22.05.2016, HB 1151, Thp.

G. robertianum L., under forest, 350 m, 26.08.2017, VH 4494, Thp.

G. sanguineum L., under forest, 380 m, 06.07.2016, HB 1418, Hcrp.

ACERACEAE

Acer cappadocicum Gleditsch. var. *cappadocicum*, mixed forest, 570 m, 08.05.2016, HB 1120, Hyrc-Eux, Php.

A. platanoides L., mixed forest, 530 m, 08.05.2016, HB 1123, Euro-Sib, Php.

RHAMNACEAE

Frangula alnus Miller. subsp. *alnus*, mixed forest, 530 m, 22.05.2016, HB 1146, Euro-Sib, Php.

AQUIFOLIACEAE

Ilex colchica Pojark, forest, 440 m, 20.06.2016, HB 1260, Eux. Php.

FABACEAE

Lathyrus aureus (Stev.) Brandza, under shrubs, 390 m, 06.07.2016, HB 1431, Eux, Hcrp.

L. hirsutus L., damp shrubs, 420 m, 15.06.2017, VH 4435, Thp.

Lotus corniculatus L. var. *corniculatus* (Bieb.) Arc., meadows, 390 m, 06.07.2016, HB 1423, Hcrp.

Medicago lupulina L., under shrubs, 480 m, 06.07.2016, HB 1427, Crp.

M. sativa L. subsp. *sativa*, under forest, 520m, 21.08.2016, HB 1722, Hcrp.

Psoralea bituminosa L., under forest, 450 m, 12.07.2017, VH 4466, Medit, Hcrp.

Securigera varia (L.) Lassen subsp. *varia*, under forest, 510 m, 21.08.2016, HB 1726, Medit, Hcrp.

Trifolium arvense L., meadows, 340 m, 22.05.2016, HB 1154, Thp.

T. aureum Poll., rocky slopes, 530 m, 12.07.2017, VH 4453, Euro-Sib, Thp.

T. canescens Willd., treasides, 370 m, 06.07.2016, HB 1406, Hyrc-Eux, Hcrp.

T. repens L. var. *repens*, meadows, 450 m, 06.07.2016, HB 1396, Hcrp.

Vicia cracca L. subsp. *cracca* L., among shrub communities, 470 m, 06.07.2016, HB 1401, Euro-Sib, Hcrp.

V. cracca L. subsp. *stenophylla* Vel., under shrub communities, 380 m, 28.07.2017, HB 1859, Hcrp.

V. villosa Roth subsp. *villosa*, damp places, 530 m, 27.06.2017, HB 1800, Thp.

ROSACEAE

Aruncus vulgaris Rafin., streamsides, 450 m, 06.07.2016, HB 1416, Euro-Sib, Hcrp.

Crataegus microphylla C. Koch, forest, 420 m, 20.06.2016, HB 1246, Php.

Fragaria vesca L., damp places, 340 m, 20.06.2016, HB 1279, Euro-Sib, Hcrp.

Filipendula vulgaris Moench, roadsides, 350 m, 06.07.2016, HB 1414, Euro-Sib, Hcrp.

Geum urbanum L., streamsides, 550 m, 06.07.2016, HB 1430, Euro-Sib, Crp.

Laurocerasus officinalis Roemer., forest, 400 m, 05.06.2016, HB 1179, Php.

Potentilla recta (L.) Rauschel., damp meadows, 450 m, 26.08.2017, VH 4485, Eux, Crp.

Rosa canina L., edge of forest, 475 m, 12.07.2017, VH 4464, Php.

Rubus discolor Weihe et Nees., forest, 430 m, 06.07.2016, HB 1398, Chp.

R. sanctus Scheber, among shrub communities, 400 m, 06.07.2016, HB 1424, Euro-Sib, Chp.

R. hirtus Waldst. et Kit., mixed forest, 370 m, 20.06.2016, HB 1261, Euro-Sib, Chp.

Sanguisorba minor Scop. subsp. *muricata* (Spach) Briq., forest, 375 m, 20.06.2016, HB 1248, Hcrp.

Sorbus umbellata (Desf.) Fritsch var. *umbellate*, forest, 440 m, 20.06.2016, HB 1281, Php.

ONAGRACEAE

Circaea lutetiana L., under forest, 510 m, 20.07.2016, HB 1493, Hcrp.

APIACEAE

Conium maculatum L., streamsides, 470 m, 20.07.2016, HB 1506, Thp.

Heracleum platytaenium Boiss., streamsides, 380 m, 20.07.2016, HB 1510, LR (Ic), Eux, Hcrp.

H. sphondylium L. subsp. *cyclocarpum* (C.Koch.) Davis., streamsides, 530 m, 20.07.2016, HB 1496, Eux, Hcrp.

Scaligeria lazica Boiss., under forest, 520 m, 12.07.2017, VH 4452, Hcrp.

Sanicula europaea L., forest, 470 m, 06.07.2016, HB 1438, Euro-Sib, Hcrp.

Torilis arvensis (Huds.) Link, rocky surfaces, 530, 07.08.2016, HB 1681, Hcrp.

ARALIACEAE

Hedera helix L., on trees and rocky surfaces, 330 m, 05.06.2016, HB 1181, Php.

CAPRIFOLIACEAE

Lonicera caucasica Pallas. subsp. *orientalis*, shrub communities, 550 m, 12.07.2017, VH 4459, Endemic, LR (Ic), Chp.

Scabiosa columbaria L. subsp. var. *intermedia* (Post) Matthews, among shrubs, 450 m, 06.07.2016, HB 1447, Hcrp.

ADOXACEAE

Sambucus ebulus L., forest, 500 m, 20.07.2016, HB 1500, Euro-Sib, Chp.

Viburnum orientale Pallas, shrub communities, 510 m, 06.07.2016, HB 1444, Eux, Php.

RUBIACEAE

Asperula involucrata Wahlenb., under forest, 420 m, 07.08.2016, HB 1685, Eux, Crp.

Crucianella gilanica Trin. subsp. *pontica* (Ehrend.) Ehrend., on rocky surfaces, 450 m, 27.06.2017, HB 1796, Eux, Crp.

Cruciata laevipes Opiz, under shrubs, 370 m, 06.07.2016, HB 1407, Euro-Sib, Hcrp.

Galium palustre L., damp places, 380 m, 15.06.2017, VH 4440, Euro-Sib, Hcrp.
G. rotundifolium L., under forest, 480 m, 12.07.2017, VH 4461, Euro-Sib, Hcrp.
G. verum L. subsp. *verum*, streamsides, 330 m, 07.08.2016, HB 1679, Euro-Sib, Hcrp.

ASTERACEAE

A. millefolium L. subsp. *millefolium*, meadows, 480 m, 20.06.2016, HB 1264, Euro-Sib, Hcrp.
Bellis perennis L., under forest, 330 m, 06.07.2016, HB 1417, Euro-Sib, Hcrp.
Bidens tripartita L., streamsides, 450 m, 07.08.2016, HB 1674, Thp.
Cirsium arvense (L.) Scop. subsp. *vestitum* (Wimmer et Grab.) Petrak, roadsides, 430 m, 20.07.2016, HB 1492, Hcrp.
Crepis foetida L. subsp. *foetida*, forest, 520 m, 06.07.2016, HB 1437, Crp.
Inula salicina L., among shrubs, 470 m, 06.07.2016, HB 1421, Euro-Sib, Hcrp.
Lactuca serriola L., roadsides, 380 m, 12.07.2017, VH 4467, Euro-Sib, Hcrp.
Leontodon hispidus L. var. *hispidus*, under shrubs, 400 m, 20.07.2016, HB 1499, Euro-Sib, Crp.
Petasites albus L., damp places, 380 m, 08.05.2016, HB 1119, Euro-Sib, Crp.
P. hybridus (L.) Gaertner Mey. et Scherb., streamsides, 450 m, 05.06.2016, HB 1187, Euro-Sib, Crp.
Senecio vulgaris L., grainy soils, 470 m, 06.07.2016, HB 1403, Thp.
Sigesbeckia orientalis L., edge of forest, 430 m, 06.07.2016, HB 1402, Hcrp.
Tanacetum macrophyllum (Waldst. et Kit.) Schultz Bip., streamsides, 540 m, 20.07.2016, HB 1508, Euro-Sib, Hcrp.
Telekia speciosa (Schreber.) Baumg., stony meadows, 360 m, 06.07.2016, HB 1443, Euro-Sib, Hcrp.
Tripleurospermum oreades Boiss. var. *tchihatchewii* (Boiss.) E. Hossain, streamsides, 320 m, 06.07.2016, HB 1432, Crp.
Tragopogon reticulatus Boiss., damp places, 480 m, 06.07.2016, HB 1411, Hcrp.
Tussilago farfara L., damp slopes, 410 m, 08.05.2016, HB 1122, Euro-Sib, Crp.

CAMPANULACEAE

Campanula collina Sims., rocky surfaces, 530 m, 06.07.2016, HB 1434, Eux, Crp.
C. lactiflora Bieb., forest, 400 m, 20.07.2016, HB 1494, Eux, Hcrp.
C. latifolia L., forest, 540 m, 12.07.2017, VH 4463, Euro-Sib, Hcrp.
C. rapunculus L. var. *rapunculus*, forest, 480 m, 20.06.2016, HB 1285, Hcrp.

ERICACEAE

Rhododendron luteum Sweet, under forest, 480 m, 05.06.2016, HB 1194, Eux, Php.
R. ponticum L. subsp. *ponticum*, under forest, 410 m, 05.06.2016, HB 1177, Eux, Php.
Vaccinium arctostaphylos L., among shrubs, 500 m, 20.07.2016, HB 1505, Eux, Php.

PRIMULACEAE

Cyclamen coum Miller var. *coum*, under forest, 370 m, 22.05.2016, HB 1149, Crp.
Lysimachia verticillaris Sprengel, wet places under forest, 470 m, 22.05.2016, HB 1144, Eux, Hcrp.
Primula vulgaris Huds. subsp. *vulgaris*, damp slopes, 490 m, 15.06.2017, VH 4434, Eux, Hcrp.

OLEACEAE

Osmanthus decorus (Boiss. Et Bal.) Kasapligil, mixed forest, 450 m, 20.06.2016, HB 1266, Eux, Php.

GENTIANACEAE

Gentiana asclepiadea L., under forest, 360 m, 20.06.2016, HB 1258, Euro-Sib, Hcrp.

CONVOLVULACEAE

Calystegia silvatica (Kit.) Griseb., edge of forest, 400 m, 05.06.2016, HB 1185, Hcrp.
Convolvulus arvensis L., roadsides, 350 m, 12.07.2017, VH 4465, Cosmopolite, Hcrp.

BORAGINACEAE

Asperugo procumbens L., roadsides, 380 m, 15.06.2017, VH 4439, Euro-Sib, Thp.
Echium vulgare L., roadsides, 420 m, 20.07.2016, HB 1509, Euro-Sib, Crp.
Lithospermum officinale L., shady places, 390 m, 20.06.2016, HB 1249, Hcrp.
Heliotropium supinum L., roadsides, 370 m, 06.07.2016, HB 1405, Thp.
Myosotis laxa Lehm. subsp. *caespitosa* (Schutz) Hyl. ex Nordh., shady places, 360 m, 06.07.2016, HB 1419, LR (lc), Thp.
Omphalodes cappadocica DC., stony slopes, 390 m, 05.06.2016, HB 1196, Eux, Hcrp.
Symphytum ibericum Steven., shady meadows, 490 m, 06.07.2016, HB 1422, Eux, Hcrp.
Trachystemon orientalis (L.) G. Don., forest, 370 m, 05.06.2016, HB 1192, Eux, Hcrp.

OROBANCHACEAE

Euphrasia rostkoviana Hayne subsp. *rostkoviana*, forest, 380 m, 05.06.2016, HB 1178, Euro-Sib, Thp.
Melampyrum arvense L. var. *elatius* Boiss., among shrubs, 420 m, 20.06.2016, HB 1276, Euro-Sib, Thp.
Rhynchosorys elephas (L.) Griseb. subsp. *elephas* Under forest, 440 m, 12.07.2017, VH 4460, Euro-Sib, Hcrp.

PHYTOLACCACEAE

Phytolacca americana L., roadsides, 430 m, 21.08.2016, HB 1723, Hcrp.

SOLANACEAE

Atropa belladonna L., shady paces, 490 m, 05.06.2016, HB 1195, Euro-Sib, Hcrp.

Solanum luteum Miller, edge of forest, 330 m, 20.06.2016, HB1268, Thp.

S. nigrum L. subsp. *schultesii* (Opiz) Wessely, roadsides, 450 m, 20.06.2016, HB 1274, Cosmopolite, Thp.

SCROPHULARIACEAE

Scrophularia kotschyana Benth., roadsides, 540 m, 06.07.2016, HB 1413, Hcrp.

S. capillaris Boiss et Ball., stony slopes, 530 m, 27.06.2017, HB 1797, Eux, Hcrp.

S. scopoli Hoppe ex Pers. var. *scopoli* (Hoppe Ex) Pers., streamsides, 320 m, 12.07.2017, VH 4454, Hcrp.

LAMIACEAE

Ajuga reptans L., forests, 350 m, 20.06.2016, HB 1271, Euro-Sib, Crp.

Ballota nigra L. subsp. *nigra*, among shrubs, 510 m, 20.07.2016, HB 1497, Euro-Sib, Hcrp.

Calamintha grandiflora (L.) Moench, damp stony surfaces, 320 m, 06.07.2016, HB 1446, Euro-Sib, Hcrp.

Clinopodium umbrosum (Bieb.) C. Koch, damp places, 400 m, 06.07.2016, HB 1425, Hcrp.

Lamium garganicum L. subsp. *reniforme* (Montbret et Aucher ex Benth.) R. Mill, damp places, 410 m, 07.08.2016, HB 1676, Hcrp.

L. purpureum L. var. *purpureum*, streamsides, 500 m, 05.06.2016, HB 1188, Euro-Sib, Thp.

Mentha longifolia (L.) L. subsp. *longifolia*, streamsides, 520 m, 06.07.2016, HB 1415, Eux, LR (lc), Crp.

M. aquatica L., streamsides, 330 m, 26.08.2017, VH 4486, Hcrp.

Origanum vulgare L. subsp. *viridulum* (Martin Donos) Nyman, roadsides, 430 m, 06.07.2016, HB 1441, Hcrp.

Prunella vulgaris L., streamsides, 480 m, 06.07.2016, HB 1428, Euro-Sib, Hcrp.

Stachys sylvatica L., forest, 440 m, 26.08.2017, VH 4484, Eux, Hcrp.

Teucrium chamaedrys L. subsp. *trapezunticum* Rech. Fil., streamsides, 440 m, 20.06.2016, HB 1250, Euro-Sib, Chp.

PLANTAGINACEAE

Plantago major L. subsp. *major*, streamsides, 340 m, 20.06.2016, HB 1270, Hcrp.

Veronica anagallis-aquatica L., streamsides, 330 m, 20.06.2016, HB 1280, LR (lc), Hcrp.

V. peduncularis M. Bieb., forest, 470 m, 05.06.2016, HB 1174, Eux, Crp.

V. serpyllifolia L., shady forest, 490 m, 20.06.2016, HB 1267, Crp.

THYMELAEACEAE

Daphne pontica L., forest, 540 m, 20.06.2016, HB 1254, Eux, Php.

EUPHORBIACEAE

Euphorbia squamosa Willd., among shrubs, 360 m, 15.06.2017, VH 4436, Hyrc-Eux, Hcrp.

Mercurialis annua L., forest, 460 m, 20.07.2016, HB 1502, Thp.

ULMACEAE

Ulmus minor Miller. subsp. *minor* Miller, streamsides, 340 m, 20.06.2016, HB 1252, Medit, Php.

U. glabra Huds., mixed forest, 510 m, 22.05.2016, HB 1147, Euro-Sib, Php.

FAGACEAE

Castanea sativa Miller., mixed forests, 450 m, 20.06.2016, HB 1277, Euro-Sib, Php.

Fagus orientalis Lipsky., mixed forests, 500 m, 22.05.2016, HB 1152, Euro-Sib, Php.

BETULACEAE

Alnus glutinosa L. subsp. *barbata* (C.A. Meyer.) Yaltırık, mixed forest, 350 m, 22.05.2016, HB 1150, Euro-Sib, Php.

CORYLACEAE

Carpinus betulus L., mixed forest, 650 m, 22.05.2016, HB 1153, Euro-Sib, Php.

Corylus avellana L. var. *avellana* L., mixed forest, 500 m, 22.05.2016, HB 1148, Euro-Sib, Php.

SALICACEAE

Salix caprea L., streamsides, 350 m, 15.05.2017, VH 4417, Euro-Sib, Php.

Populus tremula L., mixed forests, 370 m, 22.05.2016, HB 1155, Euro-Sib, Php.

URTICACEAE

Parietaria judaica L., on rocky surfaces, 540 m, 07.08.2016, HB 1684, Hcrp.

Urtica dioica L. subsp. *dioica*, forest, 330 m, 21.09.2016, HB 1772, Euro-Sib, Hcrp.

LILIOPSIDA

ASPARAGACEAE

Scilla autumnalis L., damp places, 400 m, 05.06.2016, HB 1180, Medit, Crp.

LILIACEAE

Paris incompleta Bieb., under forest, 480 m, 26.05.2017, VH 4423, Crp.

Ruscus colchicus P. F. Yeo, mixed forest, 430 m, 08.05.2016, HB 1124, Eux, Hcrp.

Smilax excelsa L., on trees, 460 m, 08.05.2016, HB 1121, Medit, Php.

ORCHIDACEAE

Cephalanthera longifolia (L.) Fritsch., forest, 450 m, 15.05.2017, VH 4418, Euro-Sib, Crp.

Listera ovata (L.) R. Br., under forest, 350 m, 05.06.2016, HB 1184, Euro-Sib, Hcrp.

Orchis tridentata Scop., under shrubs, 540 m, 08.05.2016, HB 1128, Medit, Crp.

JUNCACEAE

Luzula multiflora (Ehrh. Ex Retz.) Lej., under forest, 390 m, 05.06.2016, HB 1190, Hcrp.

L. forsteri (Sm.) DC., under forest, 460 m, 15.06.2017, VH 4441, Euro-Sib, Hcrp.

Juncus inflexus L., damp places, 330 m, 20.07.2016, HB 1507, Hcrp.

J. effusus L. subsp. *effusus*, damp meadows, 480 m, 06.07.2016, HB 1439, Cosmopolite, Hcrp. *J. tenageia* Ehrh., damp places, 420 m, 05.06.2016, HB 1186, Euro-Sib, Hcrp.

CYPERACEAE

Carex echinata Murray subsp. *echinata*, streamsides, 360 m, 28.07.2017, HB 1860, Euro-Sib, Crp.

C. muricata L., edge of forest, 350 m, 06.07.2016, HB 1445, Euro-Sib, Crp.

C. pendula Hudson, streamsides, 320 m, 21.08.2016, HB 1724, Euro-Sib, Crp.

Cyperus longus L., streamsides, 340 m, 21.09.2016, HB 1773, Crp.

Isolopis setacea (L.) R. Br., damp forest, 430 m, 20.06.2016, HB 1284, Crp.

Pycneus flavescens (L.) Reichb., streamsides, 360 m, 06.09.2016, HB 1761, Crp.

POACEAE

Agrostis capillaris L. var. *capillaris*, edge of forest, 450 m, 28.07.2017, HB 1861, Crp.

Alopecurus arundinaceus Poiret., roadsides, 320 m, 07.08.2016, HB 1680, LR (lc), Euro-Sib, Crp.

Brachypodium sylvaticum (Hudson) P.Beauv., forest, 3600 m, 12.07.2017, VH 4455, Euro-Sib, Crp.

Briza maxima L., forest, 360 m, 22.05.2016, HB 1145, Thp.

Bromus japonicus Thunb. subsp. *japonicas*, meadows, 480 m, 20.06.2016, HB 1273, Thp.

B. lanceolatus Roth, edge of forest, 370 m, 20.07.2016, HB 1504, Crp.

Cynosurus cristatus L., forest, 480 m, 09.10.2016, HB 1776, Euro-Sib, Hcrp.

C. echinatus L., forest, 380 m, 06.07.2016, HB 1426, Medit, Thp.

Digitaria sanguinalis (L.) Scop., forest, 380 m, 26.08.2017, VH 4488, Thp.

Elymus repens (L.) Gould subsp. *repens*, roadsides, 460 m, 12.07.2017, VH 4458, Crp.

Festuca gigantea (L.) Vill., forest, 480 m, 27.06.2017, HB 1798, Euro-Sib, Chp.

F. drymeja Mertens et Koch, forest, 320 m, 26.08.2017, VH 4489, Chp.

Glyceria plicata Fries., meadows close to streams, 510 m, 06.07.2016, HB 1436, Hcrp.

Lolium perenne L., roadsides, 700 m, 06.07.2016, HB 1408, Euro-Sib, Hcrp.

Melica uniflora Retz., forest, 380 m, 12.07.2017, VH 4456, Euro-Sib, Crp.

Paspalum paspalodes (Michx.) Scribner, streamsides, 380 m, 09.10.2016, HB 1777, Crp.

Phleum pratense L., forest, 450 m, 07.08.2016, HB 1687, Euro-Sib, Chp.

Poa trivialis L., under forest, 390 m, 20.06.2016, HB 1272, Crp.

P. pratensis L., under forest, 450 m, 06.07.2016, HB 1409, Crp.

Rostraria cristata (L.) Tzvelev, under forest, 360 m, 15.06.2017, VH 4437, Thp...

4. Conclusions and discussion

The results of the vascular flora of Akyamaç Waterfall and environs are summarized below. These results, discussed with some studies carried out in the adjoining areas [9-15].

For each taxon, three or four samples were collected from Akyamaç Waterfall Natural Park and environs, between the years 2016-2017 in vegetation seasons. As a result of identifications and verifications it is determined that the vascular flora of Akyamaç Waterfall consists of 229 taxa belonging to 170 genera and 58 families. 13 *Pteridophytes*, 1 *Gymnosperm*, 177 *Dicotyledones*, and 38 *Monocotyledones* were determined (Table 1). The total number of taxa in Akyamaç Natural Park and environs is fewer than the compared studies (Table 2). The taxa number is related with the geographical size, diversity of habitat, and edaphic factors etc. The study area is totally covered with the forest vegetation, so the vegetation types and habitat diversity is very low. In addition, the extent of the study area is smaller than the other study areas. These factors can explain the reason of low number of taxa in the study area.

Table1. The taxa within upper taxonomical groups

| Systematic categories | Families | Genera | Species | Subsp. | Var. | Taxa | Endemics |
|-----------------------|-----------|------------|------------|-----------|-----------|------------|----------|
| <i>Pteridophyta</i> | 8 | 8 | 12 | 1 | - | 13 | - |
| <i>Spermatophyta</i> | 50 | 162 | 159 | 39 | 18 | 216 | 1 |
| <i>Gymnospermae</i> | 1 | 1 | 1 | - | - | 1 | - |
| <i>Angiospermae</i> | 49 | 161 | 158 | 39 | 18 | 215 | 1 |
| <i>Magnoliopsida</i> | 43 | 131 | 125 | 35 | 17 | 177 | 1 |
| <i>Liliopsida</i> | 6 | 30 | 33 | 4 | 1 | 38 | - |
| Total | 58 | 170 | 171 | 40 | 18 | 229 | 1 |

The endemism ratio of the current study and compared studies are given in table 2. The endemism ratio of [9] and [12] are between 7.7% and 6.3% while [10], [11] and [14] are between 4.9% and 2.3%. In the study area endemism ratio is lower (0.4%) than the other studies (Table 2). The reasons of low endemism are of course related with homogeneity of climate and environment but especially abundance of tree species in the study area.

Table 2. The phytogeographical spectra and endemism ratio of the studies compared

| Studies | Taxa | Endemic | Euro-Sib. | Ir-Tur. | Medit. | Cosmopolite and other |
|---------|------|---------|-----------|---------|--------|-----------------------|
| CS. | 229 | 0.4 | 43.7 | 0.4 | 3.1 | 52.8 |
| [9] | 853 | 6.3 | 39.4 | 10.3 | 1.2 | 49.1 |
| [10] | 990 | 2.3 | 48.2 | 3.5 | 1.9 | 46.9 |
| [11] | 517 | 4.3 | 47.2 | 2.1 | 3.3 | 47.4 |
| [12] | 518 | 7.0 | 43.2 | 4.1 | 2.1 | 50.6 |
| [14] | 408 | 4.9 | 58.1 | 3.4 | 1.2 | 37.3 |

The phytogeographical element status of taxa are Euro-Siberian (including Eux and Hyrc-Eux) 100 (43.7%), Mediterranean 7 (3.1%), Irano-Turanian 1 (0.4%), and multiregional or of unknown phytogeographic origin 121 (52.8%), respectively (Table 2). Akyamaç Waterfall Natural Park is in the borderlines of Euro-Siberian floristical province and it clarifies the dominance of Euro-Siberian elements and it is compatible with the compared studies (Table 3). The presence of Mediterranean and Irano-Turanian elements is due to the microclimates in the study area.

Table 3. Life-form of taxa compared studies

| Studies | Hcrp. | Crp. | Thp. | Php. | Chp. | Hd. | Vp. | NanoPhp. |
|---------|-------|------|------|------|------|-----|-----|----------|
| CS. | 97 | 53 | 41 | 28 | 10 | - | - | - |
| [11] | 252 | 47 | 81 | 83 | 54 | - | - | - |
| [12] | 229 | 145 | 62 | 17 | 57 | 1 | 2 | 3 |
| [14] | 196 | 110 | 46 | 28 | 28 | - | 1 | - |
| [15] | 94 | 34 | 38 | 29 | 6 | - | - | - |

The life spectra of the taxa are given in table 3; Hemicryptophytes 97 (42.4%), cryptophytes 53 (23.1%), therophytes 41 (17.9%), phanerophytes 28 (12.2%), chamaephytes 10 (4.4%). In all studies hemicryptophytes are dominant and there are small differences in the order of the other life categories in the compared studies which can be explained by difference and diversity of habitats and vegetation types.

Table 4. The richest families in terms of number of taxa

| Families | Number of taxa | Ratio(%) |
|------------------------|----------------|-------------|
| <i>Poaceae</i> | 20 | 8.7 |
| <i>Asteraceae</i> | 17 | 7.4 |
| <i>Fabaceae</i> | 14 | 6.1 |
| <i>Rosaceae</i> | 13 | 5.7 |
| <i>Lamiaceae</i> | 12 | 5.2 |
| <i>Brassicaceae</i> | 10 | 4.4 |
| <i>Caryophyllaceae</i> | 9 | 3.9 |
| <i>Boraginaceae</i> | 8 | 3.5 |
| <i>Ranunculaceae</i> | 8 | 3.5 |
| <i>Apiaceae</i> | 6 | 2.6 |
| <i>Cyperaceae</i> | 6 | 2.6 |
| <i>Polygonaceae</i> | 6 | 2.6 |
| Total | 129 | 56.2 |

The richest families regarding the number of taxa are *Poaceae* (20), *Asteraceae* (17), *Fabaceae* (14), *Rosaceae* (23), *Lamiaceae* (12), *Brassicaceae* (10), *Caryophyllaceae* (9), *Boraginaceae* (8), *Ranunculaceae* (8), *Apiaceae* (8), *Cyperaceae* (6), and *Polygonaceae* (6) (Table 4). The richest genera according to total taxa numbers are *Ranunculus*, *Trifolium*, *Geranium*, *Asplenium*, and *Campanula* (Table 5).

Table 5. The richest genera in taxa

| Genera | Number of taxa | Ratio(%) |
|-------------------|----------------|----------|
| <i>Ranunculus</i> | 5 | 2.9 |
| <i>Trifolium</i> | 4 | 2.4 |
| <i>Geranium</i> | 4 | 2.4 |
| <i>Asplenium</i> | 4 | 2.4 |
| <i>Campanula</i> | 4 | 2.4 |
| Total | 21 | 12.5 |

The richest genera in terms of number of taxa are differs in studies. For example in in [10] *Veronica* (15), *Campanula* (15), and *Geranium* (13)), in [11] *Carex* (7), *Allium* (6) and *Campanula* (4), and in [15], *Trifolium* (6), *Ranunculus* (6) and *Poa* (5) are in first 3 rank. In current study the richest 5 genera are also different from the others such as *Ranunculus* (5), *Trifolium*, *Geranium*, *Asplenium* and *Campanula* (4). Thus it is hard to find a correlation between the genera about the total taxa numbers.

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