Caspian J. Env. Sci. 2014, Vol. 12 No.2 pp. 169~183

[Research]

CJES

Caspian Journal of Environmental Sciences

Floristic characteristics of the Hyrcanian submountain forests (case study: Ata-Kuh forest)

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(Received: Sept. 10. 2013, Accepted: Feb. 05. 2014)

ABSTRACT

Ata-Kuh forest, a preserved area within Hyrcanian relict forests, with an area of 700 ha is located in north of Iran. Based on floristic studies from 2011 through 2012, 194 vascular plant species were identified belonging to 143 genera and 66 families. Among our samples, 24 taxa were endemic to Hyrcanian area. The largest families in the area were Rosaceae (10.3 %), Poaceae (9.7 %), Asteraceae (6.7 %), Fabaceae (5.6 %) and Lamiaceae (5.1 %). The genera represented by the greatest number of species were *Rubus* (8 species), *Carex* (7 species), *Viola* and *Euphorbia* (each with four species). Classification based on life form indicated that geophytes comprise the largest proportion of the plants in the studied area. From the chorological point of view, the largest proportion of the flora belonged to the Euro-Siberian elements (60 taxa, 31.1%). In this study, a comparison was performed between our results and other studies on the northern Iranian forests with respect to life forms and phytochoria. *Psilotum nodum* is reported here again from a new locality in North Iran, indicating the old Tertiary history of this forest.

Keywords: Ata-Kuh, Chorology, Floristic richness, Lahijan, Life form, North of Iran

INTRODUCTION

The knowledge of the floristic composition of an area is perquisite for any ecological and phytogeographical studies and conservation management activities. The Hyrcanian area, unlike the arid and semiarid landscape throughout most of central and southern Iran, is one of the remnants of natural deciduous forests (Naqinezhad *et al*., 2008), which form a vegetation belt in the southern shores of the Caspian Sea. It is located in the northern slopes of Alborz Mountains in North Iran and covers Guilan, Mazandaran and Golestan provinces. The Hyrcanian forests are the most important relicts of the so called Arcto-Tertiary forests and many tree genera like *Pterocarya*, *Albizia*, *Parrotia* or *Gleditsia* survived the last ice age only in this area (Scharnweber *et al*., 2007). The northern slopes of Alborz Mountains are climatically very different from the southern slopes by having a high annual precipitation and high air humidity. These features make this area suitable for temperate forest and provide divers habitats for plant.

There have been a number of floristic and vegetation researches on Hyrcanian forests in the past (e.g. Djazirei, 1965; Mobayen & Tregubov 1970; Zohary,1973; Dorostkar & Noirfalise 1976; Mossadegh, 1981; Assadi, 1988; Hamzeh'ee, 1994; Akhani, 1998; Ghahreman et al., 2006; Hamzeh'ee *et al*., 2008; Naqinezhad *et al*., 2008; Akhani *et al*., 2010; Naqinezhad *et al*., 2010; Siadati *et al*., 2010; Abedi & Pourbabaei, 2011; Asadi *et al*., 2011; Ghahremaninejad *et al*., 2011). There is no previous floristic information about the flora of Ata-Kuh forest. The main objectives of this paper were: 1) providing a first floristic checklist of the vascular plants of the study area 2) Determining the life forms and chorology of each taxon. This not only provides a current view of plant species diversity in the studied area, but also creates

the foundation for biodiversity conservation and future management on Ata-Kuh forest.

MATERIALS AND METHODS

Study Area

Ata-Kuh forest is located on the northern slope of Alborz Mountains, 10 km to the southeastern of Lahijan (Guilan Province), between 37° 09′ 28.4" -37° 09′ 23.4" N and

50° 05′ 06.9" -50° 06′ 04.1" E, with an altitude ranging from 240 to 684 m a.s.l. (Fig. 1). The northern section of Alborz is a geologically young area which was subsiding and under the Paratethys Ocean until the middle Miocene about 10-15 Ma (Berberian & King 1981). Moreover, in these areas, Mid-Jurassic to Upper Cretaceous limestone formations had already become much more important and form some very high rock cliffs along the East-West directed thrust fault zones (Stöcklin, 1974).

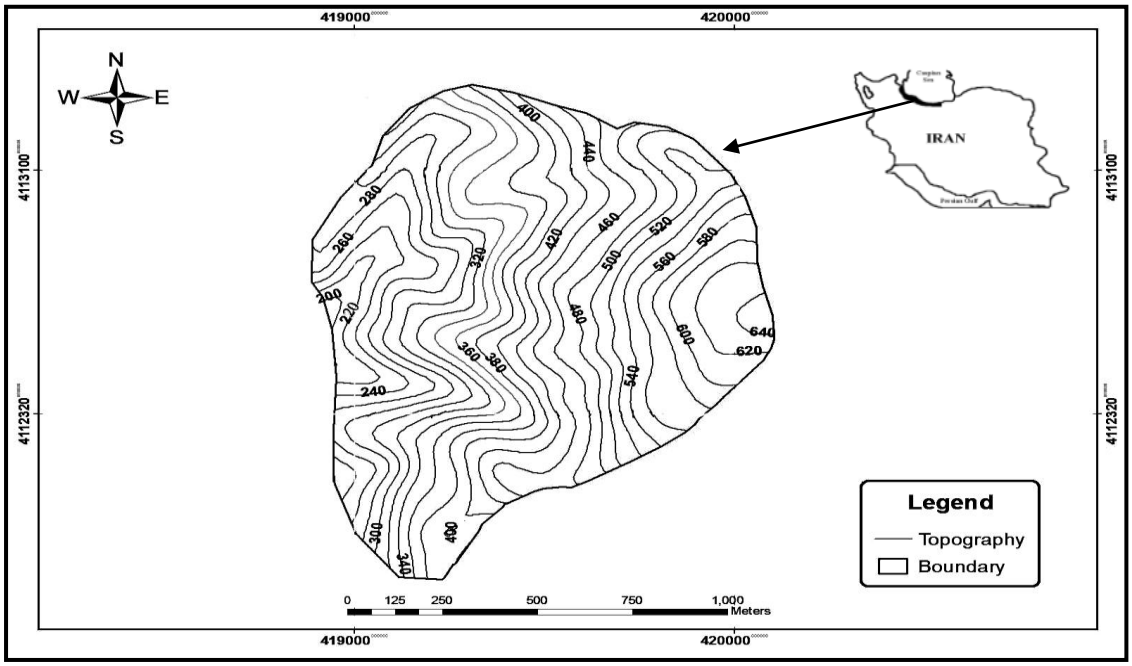

Fig 1. Location of Ata-Kuh forest in Guilan province (North Iran).

Based on Global Bioclimatic Classification System (Rivas-Martinez et al., 1997, 1999) the area is characterized as temperate oceanic bioclimate (submediterranean variant) or Tocsm (Djamali *et al*., 2011). In the studied area, most of the precipitation occurs from early autumn to early spring. The autumn months (October to December) are the most humid months of the year. There are two general peaks of precipitation, first one in October and the second in February Siberian anticyclone, formed over North Eurasia and occasionally extending into Central Asia, blocks the eastward penetration of Westerly disturbances during the autumn and winter months but results in high rainfall during the summer and especially autumn in the Caspian coastal area (Khalili, 1973; Alijani & Harman 1985). The mean monthly temperature is the lowest in January and February and the highest in July and August. The maximum and minimum mean temperatures are 22°C, and 10.2°C, respectively. The average total annual precipitation and average annual temperature are 1459.4 mm and 16.47 ˚C, respectively (Fig. 2). Climatically, the Caspian lowland may be regarded, on the whole, as a region of rainy summers and mild winters which are reminiscent of a typical oceanic climate, not unlike that of the Atlantic coast of Europe (Zohary, 1973).

Data Collection

Data collection was performed during four seasons from March 2011 through March 2012. The voucher specimens were deposited in the Herbarium of University of Guilan (GUH). The identification of specimens was performed by Rechinger, 1963-2010; Assadi et al., 1988-2011; Davis, 1965-1988; Tutin *et al*., 1964-1980; Komarov, 1934-1954 and Townsend *et al*., 1966-1985. The classification of flowering plants was based on the APGIII

(2009) and the name of taxon authors was coordinated using IPNI (2012). Some references (Frey et al., 2006; Smith et al., 2006; Khoshravesh et al., 2009) were used for determination of Monilophytes species. Some seedlings of forest plants were determined based on Aghabeigi (1997). In addition, plant formations were recognized using a physiognomical approach and field observations.This method was used in other studied ecosystems (e.g. Naqinezhad et al., 2006; Khodadadi et al., 2009).

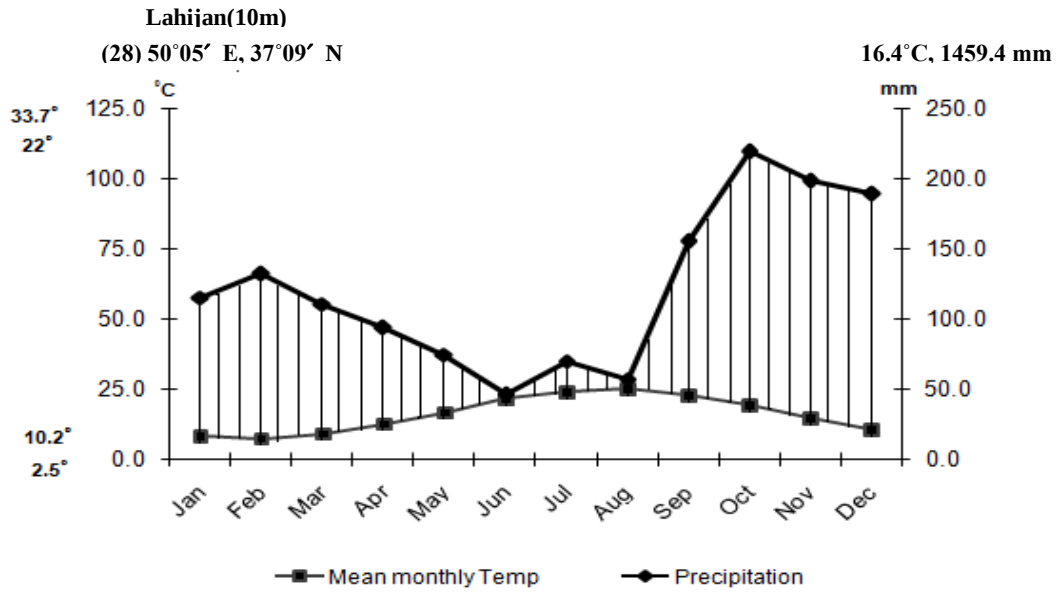

Fig. 2. Climatological diagram from Lahijan station (1982-2010).

Life-form categories were identified according to Raunkiaer's system of classification (Raunkiaer, 1934). Detailed information about phanerophytes was based on Pears (1985), (megaphanerophytes = more than 30 m high, mesophanerophyte = 8–30 m high, microphanerophyte = 2-8 m, nanophanerophyte= less than 2 m height, liana = no height restriction).

The species distribution was based on the reviews, monographs and floras, particularly the Flora Iranica (Rechinger, 1963-2010), Flora of Turkey (Davis, 1965-1988) and Flora of Europaea (Tutin et al., 1964-1980). The terminology and delimitation of the main phytogeographical area was according to the standard reference works, particularly those of Zohary (1973) and Takhtajan (1986). Based on author's assessments, IT (plants distributed in the Irano-Turanian region), M (plants distributed in the Mediterranean region), ES (plants distributed in the Euro-siberian region), PL (Pluriregional elements, referring to plants that are ranging over three phytogeographical regions), PON (plants distributed in the Pontic region), COS (cosmopolitan elements, refering to plants that have a broad worldwide distribution) and SCOS (subcosmopolitan elements, refering to plants ranging in distribution over most continents, but not all of them).

RESULTS AND DISCUSSION

As a result of our fieldwork, the vascular flora of Ata-Kuh forest contains a total of 194 taxa from 66 families and 143 genera (Appendix 1). Eleven families of Monilophytes (Pteridophytes) and 55 families of Angiosperms constitute the studied flora. Eudicots with 45 families, 98 genera and 135 species are the richest group, while monocots have 10 families, 31 genera and 39 species in the studied flora (Table 1). Rosaceae, Poaceae, Asteraceae, Fabaceae, Lamiaceae, all exceed 10 taxa and show the highest species richness, respectively (Table 2). The families Cyperaceae (8), Brassicaceae, Dryopteridaceae and Polygonaceae (each 6 taxa), Euphorbiaceae (5 taxa) are the next species-rich families. Four families are represented in four taxa, six families with three taxa, 10 families with two taxa and 36 families have only a single taxon. Five families, including Poaceae (17), Asteraceae

(12), Rosaceae (9), Fabaceae and Lamiaceae (8), contain more than eight genera and are the most genera-rich. Four families have four genera, one family has three genera, 14 families have two genera and the rest (42 families) are unigeneric. The genera with the highest species richness are *Rubus* with eight taxa, *Carex* with seven taxa, *Viola* and *Euphorbia* each with four taxa, *Dryopteris, Polystichum, Geranium, Hypericum, Polygonum, Rumex* and *Poa* all with three taxa. There are 18 genera with two taxa and 114 genera with only one taxon.

Table 1. Number of families, genera and species in main plant groups of Ata-Kuh forest.

Plant Groups	Families	Genera	Species	Endemic species
Eudicots	45	98	135	22
Monocots	10	31	39	4
Monilophytes	11	14	20	0
Total	66	143	194	26

Table 2. Number of species and genera of the richest plant families of Ata-Kuh forest.

	Genera	Species
Rosaceae	9	20
Poaceae	17	19
Asteraceae	12	13
Fabaceae	8	11
Lamiaceae	8	10

Life Form Spectrum

The floristic analysis of the vegetation from life form point of view is widely used as a criterion for describing it (Raunkiaer, 1934). According to Box (1981), the study of plant life forms is important, because it provides the basic structural components of vegetation stands and explains vegetation structure. In the assessment of life form spectrum, geophytes with 73 taxa, rhizomatous geophytes (60 taxa, 31%), stoloniferous geophytes (6 taxa, 3.1%), bulbiferous geophytes (4 taxa, 2.1%), tuberous geophytes (2 taxa, 1%) and geophytes with corm (1 taxa, 0.5%) are the dominant life form, which constitute 37.7% of studied flora, followed by the therophytes (44 taxa, 22.7%), hemicryptophytes (41 taxa, 21.1%), phanerophytes (34 taxa, 17.5%), chamaephyte and parasitic (each with one taxa, 0.5%, see Fig. 3). Detailed classification of phanerophytes shows that they consist of nanophanerophytes (with 12 taxa, 6.2%), microphanerophytes (with 11 taxa, 5.7%), megaphanerophytes (with 7 taxa, 3.6%), lianas and mesophanerophytes (each 2 taxa and 1%). The high proportion of geophytes in the studied area primarily reflects the long period of wetness during the growing season and relatively high annual precipitation (Danin & Orshan 1990). However, geophytes can occur in many habitats (Esler et al., 1999; Proches et al., 2006). Therophytes and hemicryptophytes are the most prominent life form after geophytes. Since life form classification is based essentially on plant reaction to extremes of climate, the individual spectrum or the variation when two or more spectra are compared should tell us much about macroclimatic patterns at the field sites (Pears, 1985). Also, a comparison between the life forms in Ata-Kuh forest and those in the other forests in northern Iran are shown in Fig. 4 (Naqinezhad *et al*., 2010; Siadati *et al*., 2010Asadi *et al.,* 2011;; Ghahremaninejad *et al*., 2011;). The highest concentration of geophytes is found in Ata-Kuh and Kheyrud. Moreover, these results are consistent with those found in the other forest areas of the Hyrcanian area (e.g. Akbarinia *et al*., 2004; Ghahreman *et al.,* 2006;

Razavi, 2008). It seems that these concentrations exhibit the best correspondence with a normal structure and flora of lowland Hyrcanian forests (Zohary, 1973; Rastin, 1983). Hemicryptophytes show peak of presence in Ramsar. The occurrence of a high proportion of Hemicryptophytes in Ramsar is typical of a temperate climate (Naqinezhad *et al*., 2010). Although, therophytes occur abundantly in desert area (Archibald, 1995), a high proportion of this life form is present in Semeskandeh and Dasht-e Naz (Ghahremaninejad *et al*., 2011). This is due to the more affected faces of this site caused by human activities and extensive grazing. Likewise, these results are in agreement with Grime's studies (2001).

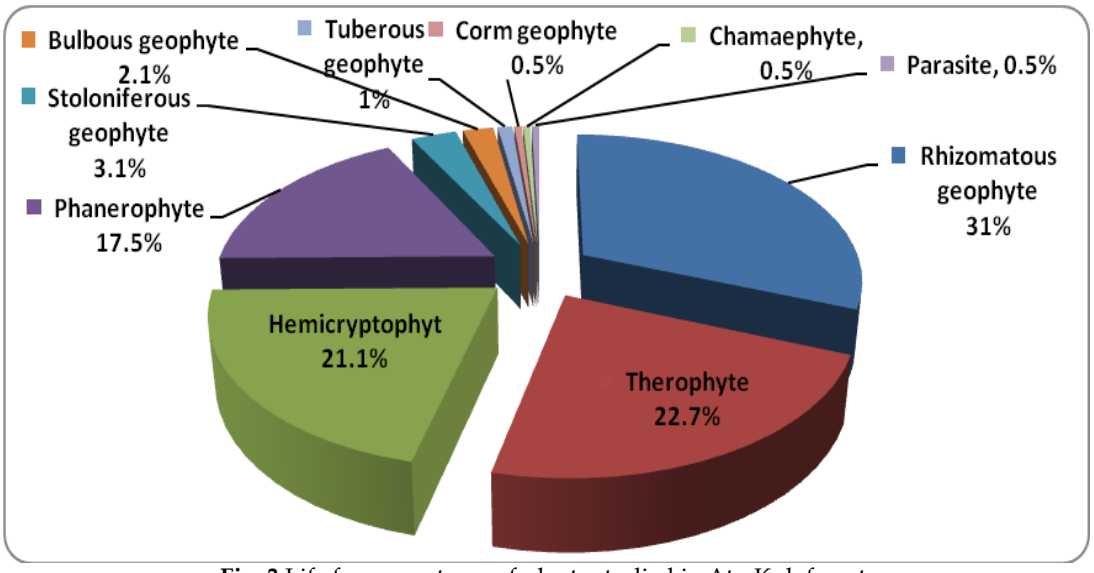

Fig. 3. Life form spectrum of plants studied in Ata-Kuh forest.

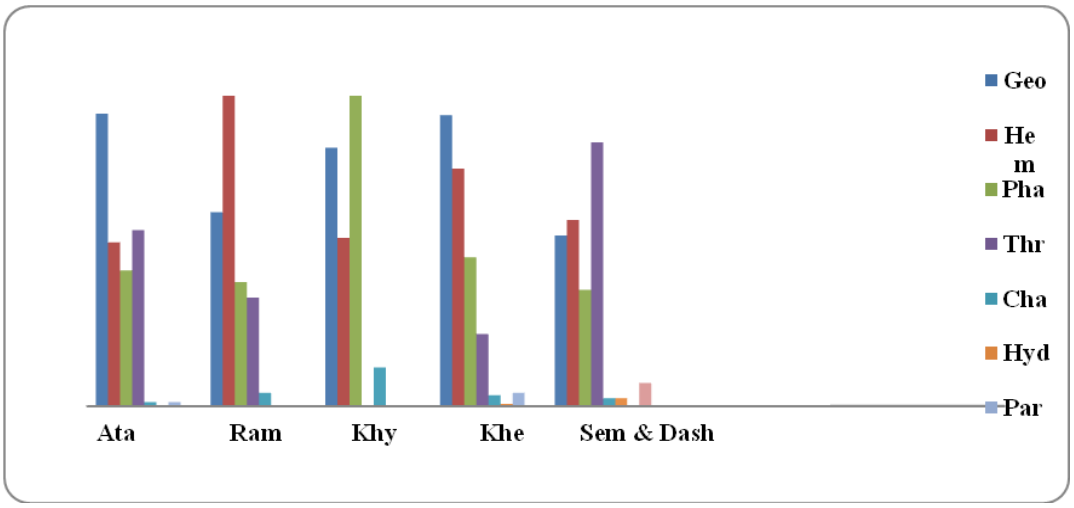

Fig. 4. Variation of each life form over the sites Ramsar forest (Naqinezhad *et al*. 2010); Khybus forest (Asadi *et al*. 2011); Kheyrud forest (Siadati *et al*. 2010); Semeskandeh and Dasht-e Naz forests (Ghahremaninejad *et al*. 2011). Abbreviations: Cha= Chamaephyte, Geo= Geophyte, Hel= Helophyte, Hem= Hemicryptophyte, Hyd= Hydrophyte, Pha= Phanerophyte, Par= Parasite, Thr= therophyte

Chorotype Spectrum

In terms of geographical distribution, the flora of the studied area is composed mostly of ES elements (60 taxa, 31.1%), followed by PL elements (57 taxa, 29.5%), ES- M- IT (21 taxa, 10.9%), ES-IT(17 taxa, 8.8%), ES-M (14 taxa, 7.3 %), SCOS (12 taxa, 6.2 %), COS (5

taxa, 2.6 %), M-IT (3 taxa, 1.6 %), IT (2 taxa, 1%), IT-M-PON and M (each 1 taxon, 0.5%, see Fig. 5). The occurrence of a high proportion of Euro-Siberian elements indicates a phytogeographical floristic link between Ata-Kuh forest and Euro-Siberian forest.

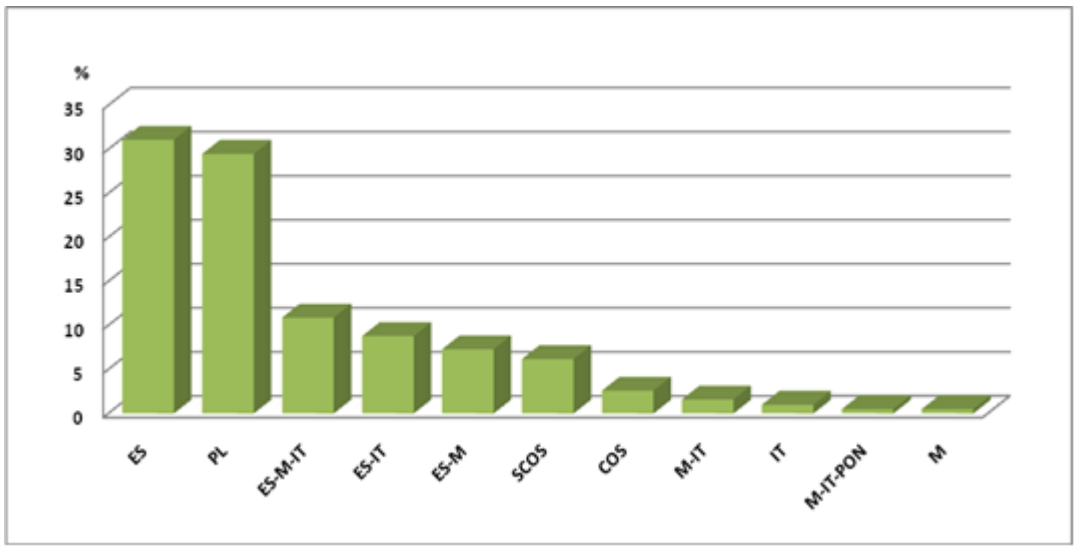

Fig. 5. Proportion of different phytochoria elements of plants in Ata-Kuh forest. Abbreviations:ES= Euro-Siberian, PL= Pluriregional, M= Mediterranean, IT= Irano-Turanian, COS= Cosmopolitan, SCOS= Subcosmopolitan

Iranian endemics. The detailed assessment of phytogeographical element demonstrates that some of these genera contain a relatively high proportion (26 species or 13.4% of all species) of Iranian endemics, of which 24 taxa (12.4%) are endemic or nearly endemic to the Hyrcanian area. The Hyrcanian forests are known as a refuge for many Arcto-Tertiary relict elements (Zohary, 1973; Leestmans, 2005). These species are grouped into Hyrcanian and Euxino-Hyrcanian elements (Akhani et al., 2010). Some species are endemic or nearly endemic to the Hyrcanian area, such as *Ilex spinigera, Hedera pastuchovii, Epimedium pinnatum, Campanula rapunculus* subsp. *lambertiana, Gleditsia caspica, Quercus castaneifolia* subsp. *castaneifolia, Parrotia persica, Scutellaria tournefortii, Teucrium hyrcanicum, Primula heterochroma, Rubus esfandiarii, Rubus grantii, Rubus lahidjanensis, Rubus persicus, Rhynchocorys maxima, Ornithogalum sintenisi, Scilla hohenackeri, Ruscus hyrcanus.* The presence of these endemic taxa reveals the special ecologic and biogeographic importance of the area.

Phytogeographical comparison of Ata-Kuh forest and the other forests in North Iran are demonstrated in Fig. 6. Two peaks in phytochoria curves are identified, one in Euro - Siberian and the other one in the Pluriregional elements.

Some phytogeographical elements such as ES-M-IT, ES-IT, ES-M, SCOS, COS, M-IT, IT, M-IT-PON, M do not demonstrate high variations among the sites, while ES and PL elements show more variation between the sites. The highest proportion of Euro-Siberian elements present in Khybus, while the lowest one is seen in Semeskandeh and Dasht-e Naz forests. Also, the Semeskandeh and Dasht-e Naz demonstrate the highest amount of Pluriregional elements. Our results indicate that due to the high Euro-Siberian elements, the Khybus forest has the highest correspondence with a common Euro-Siberian forest.

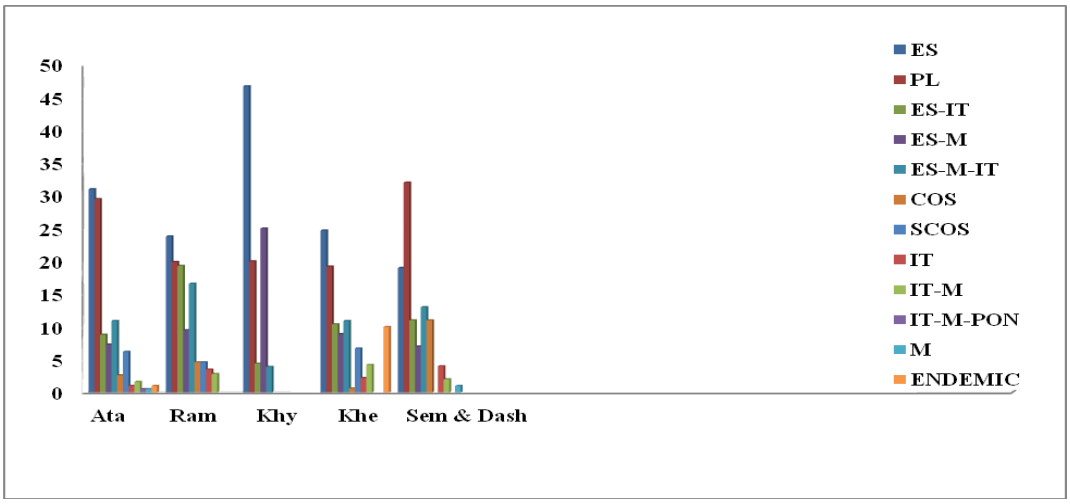

Fig. 6. Variation of each phytochoria over the sites. Abbreviations:Ata= Ata-Kuh, Ram= Ramsar, Khy= Khybus, Khe= Kheyrud, Sem & Dash= Semeskandeh and Dasht-e Naz, ES= Euro-Sibirian, PL= Pluriregional, M= Mediterranean, IT= Irano-Turanian, COS= Cosmopolitan, SCOS= Subcosmopolitan

Plant Formations

In this study four distinct plant formations are recognized by the physiognomical method for this region. For each plant formations we give the description of characteristic species.

Gleditsia-Pterocarya forests: These forests are dominated by temperate broad-leaved deciduous trees, *Gleditsia caspica* and *Pterocarya fraxinifolia*, with associated hardwood species including *Albizia julibrissin* and *Alnus glotinosa*. The primary *Pterocarya fraxinifolia*, is common along the lower zone of the northern slopes of the Alborz Mts (Hamzeh'ee *et al.*, 2008) where it constitutes *Pterocaryo fraxinifoliae-Alnetum glutinosae* Rastin (1983) and it can penetrates into the submountain communities of the Hyrcanian forest such as, *Pterocaryo fraxinifoliae-Alnetum subcordatae* Djazirei (1965). The shrub species in this vegetation type are composed mainly of *Punica granatum*, *Mespilus germanica* and *Danae racemosa*. Also several lianas are occurred on many of the trees and shrubs species such as *Hedera pastuchovii, Dioscorea communis* and *smilax excelsa.*

Carpinus betulus forests: These forests type are dominated in this region by *Carpinus betulus*, also in different places of this forest sparsely *Diospyros lotus* appears with it. The understory vegetation is composed of ferns (*Dryopteris affinis, Athyrium filix-femina*), *Primula heterochroma* and shrubs such as *Ilex spinigera, Ruscus hyrcanus, Crataegus microphylla*. *Carpinus betulus* occurs in some communities of the Hyrcanian forests, such *as Querco-Carpinetum* (Djazirei, 1964, 1965; Mossadegh, 1981), *Parrotio-Carpinetum* (Hejazi & Sabeti 1961; Djazirei, 1964, 1965; Dorostkar & Noirfalise 1976; Mossadegh, 1981).

Carpinus-Fagus forests. These forests type are distinguished by the co-occurrence of *Carpinus betulus* and *Fagus orientalis*. As *Carpinus betulus* gradually is replaced by *Fagus orientalis* at high altitudes. In the studied area, the ground layer vegetation of *Carpinus-Fagus* Forest mainly composed of species such as *Potentilla reptans*, *Viola odorata, Athyrium filix-femina, Geranium molle.* The most important diagnostic species of this association is *Fagus orientalis*. *Fagus orientalis,* may also occur in many phytosociological orders and suborders in the Hyrcanian area, such as *Rhododendro-Fagetalia orientalis* (Quezel et al., 1980), *Ilico-Fagenetalia orientalis* and *Rubo-Fagion orientalis* (Assadollahi, 1980). Also, *Carpineto-Fagetum* is prevailed at altitudes between 700-2000 ma.s.l. beech forests (Sefidi & Mohadjer 2010). This vegetation type is similar to those found in the forest areas of the Hyrcanian area (e.g. Sefidi & Mohadjer, 2010; Taheri Abkenar *et al.*, 2012).

These results indicate that the above mentioned forest formation has relatively wide distribution in Hyrcanian area. It is concluded that in the studied area *Gleditsia-Pterocarya* forest has a relatively similar structure to lowland forests as shown by occurrence of some common species e.g. *Albizia julibrissin, Danae racemosa, Hedera*

pastuchovii, Dioscorea communis and *Carpinusbetulus. Carpinus-Fagus* forests are somewhat similar to submontane and montane deciduous forest for two reasons. First, occurrence of rather dense understory vegetation including grasses (*Poa nemoralis*), ferns (*Dryopteris affinis, Athyrium filix-femina*) and *Ilex spinigera* and cold resistance tree such as *Carpinus betulus* (Akhani, 1998). Second, *Fagus orientalis* and *Carpinus betulus* are dominant in the montane and submontane and transition zones of Caspian forests, respectively (Mobayen & Tregubov 1970; Asli & Nedialkov 1973).

Ruderal Communities

Ruderal plant communities are the first plant communities on destroyed areas and this species are useful in restoration of destroyed areas, due to high organic matter production (Güleryüz et al., 2006). In the studied area, development of this community begins during the month May and continues until the mid- summer. In general, this community includes a relatively large number of species, such as *Eryngium caucasicum, Sambucus ebulus, Urtica dioica, Phytolacca americana, Centaurea iberica, Rhynchocorys maxima, Capsella bursa-pastoris, Oxalis corniculata, Eleusine indica, Spiranthes spiralis, Pteridium aquilinum, Conyza canadensis, Artemisia annua.*

Threats and Conservation Notes

This research clearly shows that forest zones have high value in terms of floristic biodiversity, to which serious attention must be paid. In recent years, increase in exploitation of natural resources following increase in population has led to the destruction of forests. Therefore important threats have emerged to all ecosystems, especially to our studied forest zone. These threats are due to six reasons: 1) Road building, which not only has resulted in destruction of natural landscapes and forests but also ease access to the high altitudes both for mass climber and grazing animals. 2) The woody plant species provide some of the country's timber. 3) Tea plantations have claimed land from the forest zone. 4) The pleasant climate, fascinating landscape among deep inaccessible valley, forest ecosystems, Alisrod stream attract many people during holiday times, resulting in much destruction and litter. 5) Livestock grazing causes a remarkable disturbance to the forest. 6) Exploitation of medicinal plants which were abundant until a few decades ago, but are now endangered in their natural habitats.

As a result of destruction, *Gleditsia-Pterocarya* forests composed of *Alnus glotinosa*, *Pterocarya fraxinifolia, Albizia julibrissin, Gleditsia caspica* has mostly destroyed in the lower areas due to agricultural activities especially tea gardens in the study area. These forests are regarded to as habitats for some of the most endangered endemic plants such as *Gleditsia caspica*. Among the major threats to this tree species are habitat loss, fragmentation, and even hybridization with introduced species (*G. triacanthos*) (Schnabel & Krutovskii 2004). Also *Gleditsia caspica* and *Parrotia persica* play important role on stability of soil (Bibalani et al., 2006). Therefore the removal of the natural forest cover specially cutting trees to create tea plantations lead to landslides which cause significant damage to forest vegetation, agricultural land and road.

Psilotum nudum has been considered as an extremely rare plant (Khoshravesh *et al*., 2009) and information about the distribution of *P. nudum* in Iran demonstrates positions for this species in lowland forests of Ramsar and Chalus, Mazandaran province (Rezaei, 2003, Nazarian *et al*., 2010) which grows as an epiphyte on the trunks of old tree of *Parrotia persica* and *Alnus glutinosa*, respectively. In this research, we found other samples of this species which grows in crevices among rocks of Ata-Kuh forest, Guilan province. These habitats are under the threat of damage and destruction by road building and human activites, therefore we should be considered the threat category for this species according to IUCN categories and criteria.

ACKNOWLEDGMENTS

This research was supported by the project of University of Guilan. The authors would like to express special thanks to Dr. V. Mozaffarian and Dr. M. Assadi (Research Institute of Forest and Rangelands, Tehran), for determination and confirmation of many species of Asteraceae and Caryophyllaceae families, respectively. We also thank H. Vahdati and SH. Khodadadi for generous help during field studies.

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Appendix 1

Checklist of Identified Plant Species in The Ata-Kuh Research Forest. Symbols and abbreviation used: 1. Life forms (Cha= Chamaephyte, Geo= Geophyte [G.b (bulbose geophytes), G.c (corm geophytes), G.r (rhizomatose geophytes), G.s (stoloniferum geophytes), G.t (tuber geophytes)], Hem= Hemicryptophyte, Pha= Phanerophyte [(PH-M= megaphanerophyte, PH-m= mesophanerophyte, PH-mi= microphanerophyte, PH-n= nanophanero-phyte, PH-cli= Liana], Par= Parasite, Thr= therophyte), 2. Chorotype (COS= Cosmopolitan, ES= Euro-Sibirian (HYR= Hyrcanian, E-Hyr= Euxino-Hyrcanian, Endemic), IT= Irano-Turanian, M= Mediterranean, PL= Pluriregional, PON= Pontic area SCOS= Subcosmopolitan). Numbers in parenthesis refers to voucher specimen(s), *= Ruderal plants

Monilophytes

Aspleniaceae: *Asplenium scolopendrium* L. (G.r, PL, 4026), *Asplenium trichomanes* L. (G.r, COS, 4027).

Dennstaedtiaceae: **Pteridium aquilinum* (L.) Kuhn (G.r, COS, 4028).

Dryopteridaceae:*Dryopteris affinis* Newman (G.r, ES, 4029), *Dryopteris filix-mas* (L.) Schott.(G.r, ES, 4030), *Dryopteris pallida* Fomin (G.r, ES-M, 4031), *Polystichum braunii.*(Spenn.)Fee (G.r, ES, 4032), *Polystichum lonchitis* (L.)Roth (G.r, ES, 4033), *Polystichum woronowii* Fomin (G.r, ES, 4034).

Equisetaceae: *Equisetum telmateia* Ehrh. (G.r, PL, 4035).

Onocleaceae: *Matteuccia struthiopteris* (L.) Tod. (G.r, PL, 4036).

Ophioglossaceae:*Ophioglossum vulgatum* L. (G.r, PL, 4037).

Polypodiaceae:*Polypodium vulgare* L. (G.r, PL, 4038).

Psilotaceae: *Psilotum nudum* (L.) P.Beauv. (G.r, PL, 4039).

Pteridaceae:*Adiantum capillus-veneris* L. (G.r, SCOS, 4040), *Pteris cretica* L. (G.r, PL, 4041).

Thelypteridaceae:*Thelypteris limbosperma* (All.) H.P.Fuchs (G.r, PL, 4042), *Thelypteris palustris* Schott (G.r, PL, 4043).

Woodsiaceae: *Athyrium filix-femina* (L.) Roth (G.r, PL, 4044), *Cystopteris fragilis* var. *fragilis* Bernh. (G.r, SCOS, 4045).

Angiosperms

Eudicots

Adoxaceae: **Sambucus ebulus* L. (G.r, ES-M-IT, 4046).

Amaranthaceae: **Amaranthus chlorostachys* Willd.(Thr, PL, 4047).

Apiaceae: **Eryngium caucasicum* Fisch. ex Steud. (Hem, ES-M-IT, 4048), *Froriepia subpinnata.*Baill.(Hem, ES, 4049), *Pimpinella affinis* Ledeb.(Hem, PL, 4050), *Torilis leptophylla* Rchb.f. (Thr, PL, 4051).

Aquifoliaceae:*Ilex spinigera* Loes. (PH-mi, EN-(ES)(HYR), 4052).

Araliaceae:*Hedera pastuchovii* Woronow ex Grossh. (PH-cli, EN-(ES)(HYR), 4053).

Asteraceae:*Amblyocarpum inuloides* Fisch. &C.A.Mey. (Thr, ES(HYR), 4054), **Artemisia annua* L. (Thr, ES-M-IT, 4055), *Artemisia vulgaris* L.(Hem, PL, 4056), **Centaurea iberica* Trevir. ex Spreng. (Hem, M-IT, 4057), *Cirsium vulgare* (Savi) Ten.(Hem, PL, 4058), **Conyza canadensis* (L.)Cronquist(Thr, COS, 4059), **Conyzanthus squamatus* (Spreng.)Tamamsch. (Hem, SCOS, 4060), *Dichrocephala integrifolia* Kuntze (Thr, PL, 4061), *Lapsana communis* L. (Hem, ES(HYR)-IT, 4062), *Launaea procumbens.*(Roxb.)Amin (Hem, PL, 4063), *Sonchus asper* Garsault (Hem, PL, 4064), *Taraxacum* sp. (Hem, -, 4065), *Willemetia tuberosa* Fisch.& C.A.Mey.ex DC. (Hem, ES(HYR), 4066).

Berberidaceae:*Epimedium pinnatum* Fisch. **(**G.r, EN-(ES)(HYR), 4067).

Betulaceae: *Alnus glutinosa* (L.) Gaertn.subsp. *barbata* (C.A.Mey.) Yalt. (PH-M, ES(E-Hyr), 4068). *Carpinus betulus* L. **(**PH-M, ES, 4069).

Boraginaceae: *Nonea lutea* DC. (Hem, ES(HYR), 4070).

Brassicaceae: **Capsella bursa-pastoris* (L.) Medik.(Hem, PL, 4071), *Cardamine hirsuta* L. (Thr, COS, 4072), *Cardamine impetiense* L. var. *pectinata* (Pall.)Trautv.(Thr, PL, 4073), *Lepidium draba* L. (Hem, ES-IT, 4074), *Thlaspi hastulatum* Steven ex DC.(Thr, Endemic,4075), *Thlaspi umbellatum* Steven ex DC. (Thr, ES(HYR), 4076).

Campanulaceae: *Campanula latifolia* L. (Hem, ES-M, 4077), *Campanula rapunculus* L. subsp. *lambertiana* (DC.) Rech.(Hem, EN-(ES)(HYR) [Transcaucasia], 4078).

Caryophylaceae: *Cerastium glomeratum* Thuill. (Thr, SCOS, 4079), **Polycarpon tetraphyllum* (L.)L. (Thr, PL, 4080), *Silene apetala* Willd.(Thr, PL, 4081), **Stellaria media* Cirillo (Thr, SCOS, 4082).

Convolvulaceae: *Calystegia sylvestris* Roem. & Schult.(G.r, ES-M, 4083).

Crassulaceae: *Sedum stoloniferum* S.G.Gmel. (Hem, ES(HYR), 4084).

Ebenaceae:*Diospyros lotus* L. (PH-mi, ES(HYR)-IT, 4085).

Euphorbiaceae: *Euphorbia amygdaloides* L. (G.r, ES[Algeria], 4086), *Euphorbia macrocarpa* Boiss. & Buhse.(G.r, ES, 4087), *Euphorbia squamosa* Willd. (G.r, ES(E-Hyr)-IT, 4088), *Euphorbia stricta* L. (G.r, ES-M-IT, 4089), *Mercurialis perennis* L. (G.r, ES[M], 4090).

Fabaceae: *Albizia julibrissin* Durazz. (PH-mi, PL, 4091), *Coronilla varia* L. (Hem, ES-M-IT, 4092), *Gleditsia caspica* Desf. (PH-mi, EN-(ES)(HYR), 4093), *Lotus angustissimus* L. (Hem, PL, 4094), *Lotus corniculatus* L. (Hem, ES-M-IT, 4095), *Medicago polymorpha* L. (Thr, IT-M, 4096), **Melilotus indicus* (L.) All.(Thr, PL, 4097), *Trifolium arvense* L. var. *arvense.*(Thr, ES-M, 4098), **Trifolium campestre* Schreb.(Thr, ES-M-IT, 4099), **Vicia sativa* L. (Hem, PL, 4100), **Vicia tetrasperma* (L.)Schreb.(Hem, ES-M-IT, 4101).

Fagaceae:*Fagus orientalis* Lipsky (PH-M, ES(HYR)-M, 4102), *Quercus castaneifolia*

C.A.Mey. subsp.*castaneifolia* (PH-M, EN-(ES)(HYR), 4103), *Quercus macranthera* Fisch. &C.A.Mey. (PH-M, ES(HYR), 4104).

Gentianaceae:*Centaurium erythraea* Rafn (Hem, ES-M-IT, 4105).

Geraniaceae:**Geranium dissectum* L. (Thr, PL, 4106), **Geranium molle* L. (Thr, ES-IT, 4107), **Geranium purpureum* Gilib. **(**Thr, ES-M, 4108).

Hamamelidaceae: *Parrotia persica* C.A.Mey. (PH-M, EN-(ES)(HYR), 4109).

Hypericaceae: *Hypericum androsaemum* L. (Cha, ES[N.Syria,Tur-Ammanus], 4110), *Hypericum perforatum* L. (Hem, SCOS, 4111), *Hypericum triquetrifolium* Turra (Hem, ES-M-IT, 4112).

Juglandaceae: *Pterocarya fraxinifolia* (Poir.) Spach. (PH-m, ES(HYR), 4113).

Lamiaceae: *Clinopodium* cf. *vulgare* L. (G.r, ES-IT, 4114), *Clinopodium vulgare* L. (G.r, ES-IT, 4115), *Lamium album* L. subsp. *album* (G.r, PL, 4116), *Mentha aquatica* L. (G.s, ES, 4117), *Mentha pulegium* L. (Hem, ES, 4118), *Origanum vulgare* L.subsp. *viride* (Boiss.) Hayek. (Hem, PL, 4119), *Prunella vulgaris* L. (G.r, PL, 4120), *Salvia glutinosa* L. (Hem, ES(HYR)-M, 4121), *Scutellaria tournefortii* Benth. (G.r, EN-(ES)(HYR), 4122), *Teucrium hyrcanicum* Steud. (G.r, EN-(ES)(HYR), 4123).

Lythraceae: *Punica granatum* L. (PH-mi, PL, 4124).

Malvaceae: *Sida rhombifolia* L. (PH-n, PL, 4125).

Moraceae: *Ficus carica* L. (PH-mi, ES-M-IT, 4126).

Onagraceae: *Circaea lutetiana* L. (G.r, PL, 4127), *Epilobium minutiflorum* Hausskn. (G.r, PL, 4128).

Orobanchaceae: *Orobanche ramosa* L. (Par, ES(HYR)-IT, 4129).

Oxalidaceae: **Oxalis corniculata* L. (Thr, PL, 4130).

Papaveraceae: *Chelidonium majus* L. (Hem, PL, 4131).

Phytolacaceae: *Phytolacca americana* L. **(**Hem, SCOS[originated from N.America]), 4132).

Plantaginaceae: *Plantago major* L. (G.r, PL, 4133), *Veronica crista-galli* Steven(Thr, ES(E-Hyr), 4134), **Veronica persica* Poir. (Thr, SCOS, 4135).

Polygonaceae: *Polygonum convolvulus* L. (Thr, PL, 4136), **Polygonum lapathifolium* L. subsp. *brittingeri* (Opiz.) Rech.f. (Thr, ES-M-IT, 4137), **Polygonum mite* Pers.(Thr, ES-M, 4138), *Rumex chalepensis* Mill. (Hem, IT-M-PON ,4139), *Rumex pulcher* subsp. *pulcher* L. (Hem, ES-M-IT, 4140), **Rumex sanguineus* L. (Hem, ES, 4141).

Primulaceae:*Anagallis arvensis* L. (Thr, COS, 4142), *Cyclamen coum* Mill.var. *caucasicum* (K.Koch) O.Schwarz (G.t, ES(HYR)-IT, 4143), *Primula heterochroma* Stapf (Hem, EN-(ES)(HYR), 4144).

Ranunculaceae: *Ranunculus arvensis* L. (Thr, ES-M-IT, 4145).

Rosaceae: *Agrimonia eupatoria* L. (Hem, ES-M-IT, 4146), *Crataegus microphylla* K.Koch var. *dolichocarpa* K.Koch. (PH-mi, ES-IT, 4147), *Crataegus pseudomelaocurpa* Popov ex Lincz.(PH-mi, ES-IT, 4148), *Fragaria vesca* L. (G.s, ES-IT, 4149), *Fragaria viridis* Duchesne. (G.s, ES(HYR), 4150), *Geum iranicum* Khat. (G.r, Endemic, 4151), *Geum urbanum* L. (G.r, PL, 4152), *Mespilus germanica* L. (PH-mi, ES(HYR), 4153), *Potentilla adscharica* Sommier& Levier ex R.Keller (PH-n, ES(HYR), 4154), **Potentilla reptans* L. (Hem, ES-IT, 4155), *Prunus divaricata* Ledeb. (PH-mi, ES-IT, 4156), *Pyrus communis* L. (PH-m, IT, 4157), *Rubus caesius* L. (PH-n, PL, 4158), *Rubus discolor* Weihe & Nees (PH-n, ES(HYR), 4159), *Rubus* × *esfandiarii* Gilli (PH-n, EN-(ES)(HYR), 4160), *Rubus* ×*grantii* Gilli(PH-n, EN-(ES)(HYR), 4161), *Rubus hirtus* Waldst. & Kit. (PH-n, ES(HYR), 4162), *Rubus lahidjanensis* Rech.f.(PH-n, EN-(ES)(HYR), 4163), *Rubus persicus* Boiss. (PH-n, EN-(ES)(HYR), 4164), *Rubus saxatilis* L. (PH-n, EN-(ES)(HYR), 4165).

Rubiaceae: *Galium elongatum* C.Presl (G.r, ES, 4166).

Salicaceae: *Salix aegyptiaca* L. var. *longifrons* Bornm. (PH-mi, PL, 4167).

Sapindaceae: *Acer campestre* L. (PH-M, ES-M, 4168).

Scrophulariaceae: *Rhynchocorys maxima* Richter (Hem, EN-(ES)(HYR), 4169), **Verbascum thapsus* L. (Hem, ES, 4170).

Solanaceae: *Physalis alkekengi* L. (G.r, ES-IT, 4171), *Solanum kieseritzkii* C.A.Mey. (G.r, ES(HYR), 4172), *Solanum nigrum* L. (Thr, SCOS, 4173).

Urticaceae:*Parietaria officinalis* L. (G.r, ES(HYR), 4174), **Urtica dioica* L.(G.r, PL, 4175).

Verbenaceae:*Verbena officinalis* L. (Hem, PL, 4176).

Violaceae: *Viola caspia* subsp. *sylvestroides* Marcussen (G.r, ES(E-Hyr), 4177), *Viola caspia* (Rupr.) Freyn subsp. *caspia* (G.r, ES(E-Hyr), 4178), *Viola odorata* L. (G.r, PL, 4179), *Viola sintenisii* W.Becker (G.r, ES, 4180).

Monocots

Amaryllidaceae: *Galanthus nivalis* L. (G.b, IT, 4181).

Araceae: *Arum maculatum* L. (G.r, ES-IT, 4182).

Asparagaceae: *Danae racemosa* Moench (PH-n, ES(HYR)[Syria], 4183), *Ornithogalum sintenisii* Freyn (G.b, EN-(ES)(HYR), 4184), *Ruscus hyrcanus* Woronow (PH-n, EN-(ES)(HYR), 4185), *Scilla hohenackeri* Fisch. & C.A.Mey. (G.b, EN-(ES)(HYR), 4186).

Cyperaceae: *Carex digitata* L. (G.r, ES, 4187), *Carex diluta* M.Bieb. (G.r, PL, 4188), *Carex divulsa* Stokessubsp. *divulsa* (G.r, ES-IT-M, 4189), *Carex grioletii* Roem.(G.r, ES-M, 4190), *Carex remota* L. subsp. *remota* (G.r, ES-M, 4191), *Carex riparia* (R.Br.)Poir.(G.r, SCOS, 4192),*Carex strigosa* Willd.ex Kunth (G.r, ES,4193), *Cyperus rotundus* L. (G.r, PL, 4194).

Dioscoreaceae: *Dioscorea communis* (L.) Caddick &Wilkin (G.c, ES-M-IT, 4195).

Iridaceae: *Crocus caspius* Fisch. & C.A.Mey. (G.b, ES(E-HYR), 4196).

Juncaceae:*Juncus acutus* L. (G.r, SCOS, 4197), *Luzula forsteri* DC. (Hem, ES-M, 4198).

Orchidaceae: **Spiranthes spiralis* (L.) Chevall.(G.t, ES-M-IT, 4199).

Poaceae: *Agrostis stolonifera* L. (G.s, ES-M-IT, 4200), *Aira elegans* Gaudin. (Thr, M, 4201), *Bromus japonicus* Murray (Thr, PL, 4202), *Cynodon dactylon* (L.)Pers. (G.r, PL. 4203), *Dactylis glomerata* L. subsp. *hispanica* (Roth.)Nyman.(G.r, ES-M-IT, 4204), *Digitaria sanguinalis* (L.)Scop.subsp. *sanguinalis* (Thr, PL, 4205), *Echinochloa crus-galli* (L.) P.Beauv. (Thr, PL, 4206), **Eleusine indica* (L.)Gaertn.(Thr, SCOS, 4207), *Lolium persicum* Boiss.(Thr, PL, 4208), **Lophochloa phleoides* (Vill.)Rchb. (Thr, PL, 4209), *Milium pedicellare* (Bornm.) Roshev.ex Melderis (Thr, M-IT, 4210), *Oplismenus undulatifolius* (Ard.)P. Beauv. (G.r, PL, 4211), *Paspalum dilatatum* Poir. (G.r, PL, 4212), *Phleum paniculatum* Hudson var. *ciliatum* (Boiss.)Bor (Thr, ES, 4213), *Poa annua* L. (Thr, PL, 4214), *Poa nemoralis* L. (G.s, ES-IT, 4215), *Poa trivialis* L. (G.s, PL, 4216), **Setaria glauca* (L.)P.Beauv. (Thr, PL, 4217), *Vulpia myuros* (L.) C.C.Gmel. (Thr, ES(E-Hyr)-M-IT, 4218).

Smilacaceae: *Smilax excelsa* L. (PH-cli, ES(HYR)-M, 4219).

ویژگی‌های فلوریستیک جنگل‌های میان بند شمال ایران (مطالعه موردی: جنگل عطاکوه)

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(تاریخ دریافت:۹۲/۶/۱۹ - تاریخ پذیرش: ۹۲/۱۱/۱۶)

چکیده

جنگل عطاکوه، منطقه‌ای حفاظت شده از باقی مانده‌های جنگل‌های جلگه‌ای خزری است، که با وسعت ۷۰۰ هکتار در شمال ایران قرار دارد. با مطالعه فلوریستیک منطقه در سال‌های ۲۰۱۲-۲۰۱۱، تعداد ۱۹۴ گونه گیاهی متعلق به ۱۴۳ جنس و ۶۶ تیره شناسایی گردید. از میان گونه‌های شناسایی شده، ۲۴ گونه اندمیک ناحیه هیرکانی بودند. تیره های Rosaceae (۱۰/۳ درصد)، Poaceae (۹/۷ درصد)، Asteraceae (۶/۷ درصد)، Fabaceae (۵/۶ درصد) و Lamiaceae (۵/۱ درصد)، بزرگترین تیره‌های گیاهی موجود در منطقه هستند. جنس‌های *Rubus*(۸ گونه)، *Carex* (۷ گونه)، *Viola* و *Euphorbia* (هر کدام با ۴ گونه) بیشترین غنای گونه-ای را دارا هستند. طبقه بندی گیاهان بر اساس شکل زیستی نشان داد که ژئوفیت‌ها بزرگترین گروه گیاهان در ناحیه‌ی مورد مطالعه را تشکیل می‌دهند. از نظر کورولوژی، بیشترین سهم، مربوط به عناصر اروپا-سیبری (۶۰ گونه، ۳۱/۱ درصد) است. در این مطالعه، مقایسه‌ی بین نتایج ما و سایر مطالعات جنگل‌های شمال، با توجه به شکل زیستی و پراکنش جغرافیایی انجام گرفته است. *Psilotum nudum*، دوباره در این جنگل از یک مکان جدید در شمال ایران گزارش شده است و نشاندهنده‌ی این است که قدمت این جنگل به دوران سوم زمین شناسی برمی‌گردد.

*مولف مسئول