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Floristic composition, life forms and geographical distribution of semi steppe pastures of Western Zagros (case study: Perdanan, West Azerbaijan, Iran)

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Abstract

Western forests in Iran cover more than 5 million hectares which compromised 45% of total forest of Iran. Floristic composition of this forest is poorly described while they are under sever threat of degradation. Species compositions were studied through 797 ha of Perdanan pastures in 30 km far from Piranshahr. The average rainfall is 670 mm per year, the altitude is 1455 m and the climate is semi-arid and cold. In total 108 species belong to 29 family within 84 genes were identified. The most spacious family were Poaceae (16 species, 18.39%) followed by Asteraceae (15 species, 13.9%), Fabaceae (14 species, 12.96%) and Apiaceae (8 species, 7.4%). Therophytes were the dominant life forms, accounted for 33.3%, followed by hemicryptophytes (28%), phanerophytes (21.3%), chamaeophytes (10.2%) and cryptophytes (6.4%). Irano-Turanian was the most dominant 34.5% (30 species) chorotypes and 28.17% (25 species) belong to Irano-Turanian-Mediterranean-Euro-Siberian in which showed this area not only located in Irano-Turanian but is on the belt between these two areas.

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Introduction

Conservation of biodiversity in forests is a vital issue and a major challenge because of its key role in human welfare (Hopper, 2004; Stephens and Wagner, 2007). However, rising pressures on biodiversity are resulting from local and regional development pathways and direct extractive resource use (Scholes and Biggs, 2004) and changes in species composition will, in turn, have important consequences for ecosystem-level (Elley *et al.*, 2011; Swaine and Liebsch, 2011; Wright, 2005; Bradshaw *et al.*, 2008 and Peres *et al.*, 2010). Zagros Mountains is from south-west to northwest of Iran and the altitude is 4000 m (Noroozi *et al.*, 2007). These mountains receive humidity from Mediterranean and act as barrier to clouds. This area with more than 5500 years old is home to an appreciable portion of Iran biodiversity and some of its ecosystems retain relatively intact species. Oak trees (*Quercus infectia*) and *Pistacia atlantica* (Ebrahimi *et al.*, 2003; Ghazanfari *et al.*, 2004; El-Moslimany, 1986) commonly dominate forests of the Zagros Mountains (Pourreza *et al.*, 2008). After northern forest (Hyrcanian forest), this is the most important and valuable forest include evergreen or drought-deciduous fine-leaved and broad-leaved forms. However its destruction is still continuing at high rates (Ghazanfari *et al.*, 2004), this process, especially threatens Iran biodiversity because this area consider as one of hotspots regarding many endemic vascular plant species.

It is now increasingly appreciated that anthropogenic climate changes whose impacts are predicted to be most prominent in mountains, population increase which puts a yet higher pressure on natural resources in order to agriculture, grazing and fire are likely to progressively cause changes on this area and its biodiversity and that these will generally be negative from both ecological and economic perspectives (IPCC, 2007). Pourreza *et al.*, (2008) investigated on *Pistacia atlantica* as a valuable species in Zagros. Results showed trees exceeding 50 cm were rare in most areas and in some areas trees are harvested by the time they reach 30 cm. It may require more than 200 years for trees to reach 1 m diameter. In recent years, a lack of smaller size classes has been observed in Qalajeh forest, which is located in the Zagros Mountain region of western Iran. Gazanfari *et al.*, (2004) established a series of plots in an area typical of Qalajeh forest to characterize the diameter distribution of the wild pistachio component. They confirmed a deficit of stems <30 cm dbh. Pourreza *et al.*, (2012) revealed the spatial pattern of tree species in Zagros area. They showed the pattern was aggregated and it implied the unsuccessful establishment of regeneration, missing trees with DBH<16 cm and the quality of seedbed resulted in the existing of this spatial structure. In addition, an experiment was conducted by Arzani *et al.*, (2006) to compare forage quality of 22 native species belong to 11 families of Zagros Mountain. The results indicated adequate nutrients were available in vegetation communities including the evaluated species. According to Ghazanfari *et al.*, (2004) and Pourhashemi *et al.*, (2004) Most areas of Zagros forests have been over utilized and degraded, owing to a wide variety of factors. Management practices vary locally and have been found to be unsustainable (Ghazanfari *et al.*, 2004) in many locations. Noroozi *et al.*, (2007) prepared biogeographical patterns of the alpine flora of Iran and they found 682 species belong to 193 genera and 39 families. The alpine zone is commonly characterized by many species of hemicryptophytes and thorny cushions.

A number of species were already listed and mapped in the Western foothills of Zagros by Norrozi *et al.*, (2007). This study aimed at describing the main vegetation types in the poorly known area of Perdanan, in terms of species composition and growth form distribution. Despite the ecological uniqueness on the one hand and the extensive destruction on the other, the study of this forest vegetation has been neglected and it is necessary to describe more precisely the different existing vegetation types for future monitoring and conservational purposes.

Methods and materials

Study area

This study was performed in Perdanan pastures (Figure 1) 30 km far from Piranshahr (Western Azerbaijan) between 45° 8' E altitude and 36° 42' N longitude and comprised 797 ha. The climate is typically semi-arid and cold, mean annual temperature is 12 °c and the elevation is 1455 m above the sea level. The summer is arid, hot and sunny with intensive radiation most of the time. Both annual and diurnal amplitudes of temperature can be very high, on the soil surface in particular. Water supply during the arid summer is derived mainly from melting snow. The time of snowmelt is the most characteristic factor which determines vegetation patterns and the distribution of plant communities in these mountains. The mean humidity is 51% and the texture is deep soil with alkaline pH.

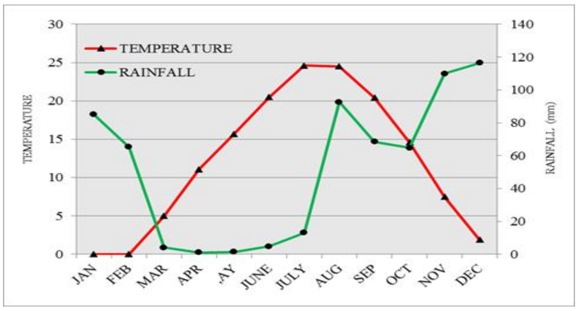

Fig. 1. Emberothermic curve of study area.

Plot censuses

All plant species were recorded and enumerated in 2012 and 2013. The time of sampling always corresponded with the peak of vegetation season, which lasts from April to July. 200 plots (100 m² each) were sampled to cover the physiognomically different vegetation types across the area. Species identification took place at the herbarium of Faculty of Agriculture by means of taxonomic keys and reference books (Akhani, 2005; Assadi *et al.*, 1988-2010) flora. Plant phenotypes were determined according to the Raunkiaer's life form specifications (Asri, 2000).

Resuls

A total of 108 species (non-tree), 84 genus belong to 29 families were encountered within 797 ha (Table 1). The most spacious rich families were Poaceae (16 species, 18.4%), followed by Asteraceae (15 species, 13.9%) and Fabaceae (14 species, 12.96%) (Figures. 2 and 3). Figure 4 shows the percentage of species according to life-form. Therophytes with 33.3% (36 species) showed the highest life-form followed by hemicryptophytes 28% (30 species), phanerophytes 21.3% (23 species), chamaephytes 10.2% (11 species), cryptophytes 6.4% (7 species). Geographical distribution of species revealed more than 34% of species (30 species) belong to Irano-Turanian and 28.7% (25 species) were found in Irano-Turanian, Euro-Siberian and Mediteranean (Figure 5). As many as 20 families (38%) were represented by only one species, 9.5%by two species and 52% by more than two species. Families with high numbers of species are Poaceae and Asteraceae. The ratio of monocots to dicots in the area is 21 to 87 species.

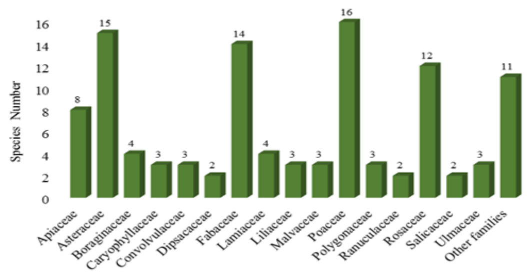

Fig. 2. Frequency graph of plants families in the study area.

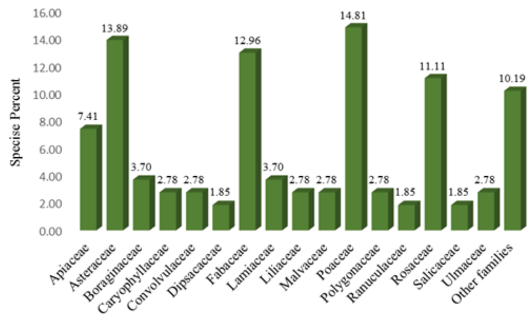

Fig. 3. Percent graph of plants families in the study area.

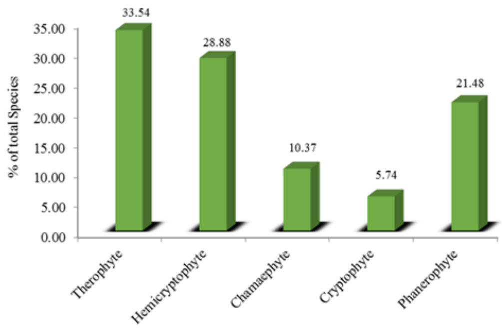

Fig. 4. Life form spectrum of plants in the study area.

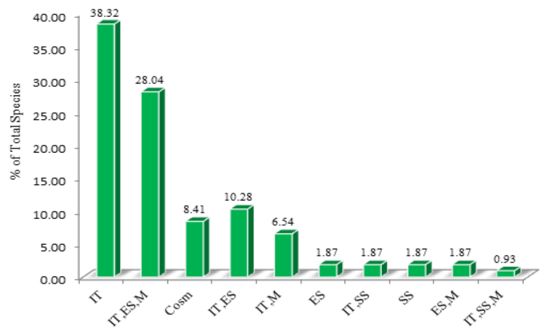

Fig. 5. Chorological types spectrum in the study area.

Table 1. List of family, species, life form and chorotypes in the study area. chorotypes (IT, Irano-Turanian; ES, European-Siberian; M, Mediterranean; Cosm, Cosmopolite; SS, Sahara-Sindian), Life forms (Th, Therophyte; He, Hemicryptophyte; Ch, Chamaephyte; Ge, Geophte; Cr, Cryptophyte; Ph, Phanerophyte).

FAMILY	SPECIES	Chorotypes	Life forms	Endemic
Anacardiaceae	*Pistacia mutica* Desf	IT,ES	Ph	
Apiaceae	*Caucalis platycarpos* L.	IT,ES	Th	*
	Chaerophyllum aureum L.	IT,ES	He	*
	Torilis arvensis (Huds.) Link	IT,ES,M	Th	
	Eryngium billardieri F. delaroche	IT	He	
	Actinolema macrolema Boiss	IT	Ch	
	Eryngium thyrsoideum Boiss.	IT	Ch	
	Falcaria vulgaris Brenh.	IT,ES,M	He	
	Chaerophyllum macrospermum (Spreng.) Fisch et C. A. Mey.	IT,ES,M	Ch	
Aristolochiaceae	*Aristolochia olivieri* Collegno.	IT,ES,M	He	
Asteraceae	*Achillea millefolium* L.	IT	He	
	Anthemis sp.	IT	Th	
	Centaurea albonitens Turrill	IT,ES	Th	
	Centaurea sp.	IT,ES	Th	
	Centaurea solstitialis L. subsp. Solstitialis	IT,M	Th	
	Centaurea sp.	IT	Th	
	Centaurea virgata Lam. subsp. squarrosa (Willd.) Gugler	IT	Th	
	Gundelia tournefortii L.	IT	He	
	Taraxacum bessarabicum (Hornem.) Hand.-Mzt.	IT,ES	Ph	

	Cirsium alatum (S.G. Gmelin) Bobrov	IT	Ch	
	Cirsium haussknechtii Boiss.	ES,M	Ch	
	Echinops ritrodes Bunge.	IT	He	
	Echinops macrophyllus Boiss. & Hausskn.	IT	He	*
	Scorzonera sp.	IT	He	
Astercaeae	*Onopordon leptolepis* DC.	IT	He	
Biebersteiniaceae	*Bieberstinia multifida* DC.	IT,ES,M	Ch	
Boraginaceae	*Anchusa barrellieri* (All.) Vitman	IT,ES,M	Th	
	Anchusa sp.	IT,ES,M	Th	
	Anchusa azurea Mill.	IT,ES,M	Th	
Brassicaceae	*Cardaria draba* (L.) Desv.	Cosm	He	
Caryophyllaceae	*Silen latifolia* poir.	IT,ES	He	
	Cerastium sp.	Cosm	Th	
	Dianthus orientalis subsp. Gorganicus Rech.F.	IT	Ch	
Cannaceae	*Cannabis sativa L.*	IT,ES	Ch	
Convolvulaceae	*Convolvulus* arvensis L.	Cosm	He	
	Convolvolus sp.	Cosm	Th	
	Cuscuta campestris Yunck.	SS	Th	
Cyperaceae	*Carex hirta* L.	IT	He	
Dipsacaceae	Cephalaria sp.	IT	Th	
	Scabisa olivieri Coult.	IT,SS	Th	
Fabaceae	*Astragalus (Cystium) kurdaicus* Saposhn. ex Summ.	IT,ES	He	
	Astragalus pinetorum Boiss.	IT	He	
	Astragalus remotijugus Boiss.	IT	He	
	Astragalus tragacantha ssp. vicentinus	IT	He	
	Glycyrrhiza glabra L.	IT,ES,M	He	*
	Medicago sativa L.	Cosm	Th	*
	Melilotus sp.	IT,ES,M	Th	
	Robinia pseudoacacia L.	IT,ES,M	Ph	
	Trifolium pratense L.	IT,ES,M	He	
	Trifolium prosumbens L.	IT,ES,M	Th	

	Trifolium purpureum Loisel.	IT,ES,M	Th	
	Vicia sp.	IT	Th	
	Vicia sativa L.	IT,ES,M	Th	
	Vicia variabilis Freyn & Sint.	IT	Th	
Fagaceae	*Querqus infectia* Oliv.	IT	Ph	
Juglandaceae	*Juglans regia* L.	IT,ES,M	Ph	
Juncaceae	*Juncus articulatus* L.	Cosm	Cr	*
Lamiaceae	Prunella sp.	IT,ES,M	Ch	
	Salvia sp.	IT,ES,M	Ch	
	Salvia vividis L.	IT,ES,M	Ch	
	Ziziphora tenuior L.	IT	Th	
Liliaceae	*Muscaria caucasicum* Griseb	IT,M	Cr	
	Allium vavilovii M.Pop. & Vved.	IT	Cr	*
	Lilium sp.	ES	Cr	
Malvaceae	*Alcea crassicaulis* I.Riedl.	IT	He	
	Alcea kurdica (Schlecht.) Aleff.	IT	He	
	Malva neglecta Wallr.	IT,ES,M	He	
Plantaginaceae	*Plantago lanceolata* L.	IT,M	He	
Poaceae	*Aegilops triuncialis* L.	IT	Th	
	Avena sterilis L.	IT,M	Th	
	Boissiera squarrosa Hochst. Ex Steud	IT,M	Th	
	Bromus danthoniae Trinius	IT	Th	
	Bromus scoparius L.	IT,M	Th	
	Dactylis glomerata L.	IT,ES,M	He	
	Festuca arundinaceae schreb.	IT	He	
	Hordeum bulbosum L.	IT	Cr	
	Hordeum marinum Hudson	IT,ES,M	Th	
	Phalaris paradoxa L.	ES	Ch	
	Poa sp	IT	He	
	Poa trivialis L.	IT,ES,M	Th	
	Secal montanum Guss.	IT,ES,M	Th	
	Taeniatherum crinitum (Schreb) Nevski.	M,SS,IT	Th	
	Cynodon dactylon (L.)Pers.	Cosm	Cr	

	Vulpia myuros (L.) C.C. J.F.Gmelin.	Cosm	Th
Polygonaceae	Polygonum sp.	SS	Ph
	Rumex acetosella L.	IT,ES	Cr
	Rumex acetosa L.	Cosm	He
Ranuculaceae	*Ranunculus repens* L.	IT,M	He
	Delphinium sp.	IT,SS	He
Rosaceae	*Sanguisorba minor* Scop.	IT,ES,M	He
	Cerasus incana (pall.) Spach	IT	Ph
	Fragaria vesca L.	IT,ES,M	Ph
	Rosa foetida var. bicolor	IT	Ph
	Amygdalus wendelboi Freitag	IT	Ph
	Pyrus salicifolia pall.	IT	Ph
	Crataegus meyeri A.pojark	IT	Ph
	Crataegus pontica C.koch	IT	Ph
	Cerasus mahaleb (L.) Miller	IT	Ph
	Rubus japonicas L.	IT	Ph
Rubiaceae	*Galium aparine* L.	IT,ES,M	Th
Salicaceae	*Salix acmophylla* Boiss.	IT,ES,M	Ph
	Populus nigra L.	IT,ES	Ph
Simarubaceae	Ailanthus glandulos Desf.	IT	Ph
Ulmaceae	*Ulmus minor* Miller	IT,ES,M	Ph
	Zelkova carpinifolia (Pallas) C. Koch	IT,ES,M	Ph
	Celtis caucasica Willd.	ES,M	Ph
Vitaceae	*Vitis sylverstris* C.C.Gmelin	IT	Ph

Discussion

Zagros Mountains are very important and one of the most representative and emblematic ecosystems and deserve a high priority for conservation. 90 families of total 150, 430 genus of total 1215, 1201 species of 7502 and 50 endemic species (17%) have been recorded from this area. This is because of the geographical isolation of this mountain system (Noroozi *et al*., 2007).

Quercus infectia as an endemic species is the dominant tree while the vascular component of this plant community comprises 182 tree and shrub of total 500 tree and shrub species in Iran (36%) and since this forest has been reduced of its original expanse (more than 20% equal 1200000 ha), the size of remaining fragments may be an important predictor of plant species richness. The high percentage of endemism and rare species in this area and the delicate ecosystems are good reasons for particular attention to stop future loss of biodiversity in high mountain regions Also, during the Pleistocene only valley glaciation (Agakhanjanz and Breckle, 1995) took place in these mountains thus enabling many taxa to withstand and to develop a high degree of endemism, mainly on relict stands. These phenomena could be the most important reasons of the high level of endemism in Iran mountains. During middle Pleistocene, when mountains glaciation seemed to have been at a maximum (Agakhanjanz and Breckle, 1995), vegetation belts migrated down. Refugial stands and other isolated areas opened. In the postglacial movement of the flora to higher mountain areas was possible, by adaptation and by the changing temperature regime (Noroozi *et al.*, 2007).

Zagros Mountains are richer than Alborz in endemic species (Noroozi *et al.*, 2008) and the endemicity 8.3% were recorded in the present study. Among these endemic species, phanerophytes accounted for 0.92%, chamaephytes, Therophytes and cryptophytes 1.85% each and hemicryptophytes 3.7%. Herbs did not have any endemics. This indicates that hemicryptophytes make substantial contribution to the levels of endemism in these forests.

When species richness is compared it can be seen that the ratios of herbaceous (cryptophytes, therophytes and hemicryptophtes) to woody (phanerophytes and camaephytes) species are quite variable (68% against 31.5%).

There are many literature references from recent years that evidence increasing temperature could force plants to migrate upwards until they reach the highest elevations. Therefore many mountain ranges which host a large number of endemic plants are very likely to suffer critical species losses (Theurillat and Guisan, 2001; Pauli *et al.*, 2003, 2007; Noroozi *et al.*, 2007). According to climatic data from meteorological stations we can see increasing temperature in this area during the recent decades. From the data available it can be concluded that in this forest Poaceae, Asteraceae and Fabaceae were the most dominant families, which is typical for the forests of Iran (Fatahi *et al.*, 2009; Ghahramani Nejad and Agheli, 2009; Ghahraman *et al.*, 2006). Poaceae, the most abundant family in terms of species and individuals in our study and one of the richest families in flora of Iran, was well distributed, because the degradation of trees and less crowded overstorey that enabled higher radiation on the soil surface. Therophytes represent the most protection to the renewal tissues (Raunkiaer, 1934; Cain, 1950), the predominance of therophytes reflects an effective strategy for avoiding water losses due to humidity extremes and water deficiencies (Van Rooyen *et al.*, 1990) and their importance increases with decreases of rainfall (Raunkiaer, 1934). Low rainfall levels, high temperature, drought and short growing season are the most important factors in the dominant of therophytes (Raunkiaer, 1934; Cain, 1950). Other factors in introduction and spread of weedy grasses (therophytes) are the destruction factors (over-grazing, cutting trees for fuel and agriculture) and road construction in the region which resulted reducing the diversity of this area most notably Fagaceae. These disturbances may also significantly lower plant species richness and destroy understory plant diversity and paved the way to alien plant invasion. Compaction by cattle reduces the volume and continuity of larger pores in the soil, thus diminishing the movement of water and air through the soil profile (Maass 1995). This process reduce the ability of certain seeds germinate and damages trees and shrubs with shallow root systems (Gillepsi *et al.*, 2000).

Approximately 14.5% of the flora consists of chamaephytes, most of them are thorny cushions. In spite of low frequency, cover of these forms is high in most of the habitats. The cushion growth form occurs in various types. This formation is adapted to the intensive radiation, to dry and windswept sites (Ku¨rschner, 1986). Additionally they are rather resistant to grazing. The dominance of thorn-cushion formations is obviously one of the consequences of long-term overgrazing and land use. The severe overgrazing in most parts of high altitudes in recent years resulted in a spread of poisonous species as e.g. Euphorbia as have been seen in Alborz, Binalud and Sahand Mountains as well (Noroozi *et al.*, 2007).
According to Archibold (1995) the frequency of hemicryptophyte is the results of cold climate and altitude. They reserve water, losing their leaves or reduce the size if the leaves and reduction the vegetative growth. The hemicryptophytes fall into three subgroups:

– Rosettes and small stemmed plant forms mostly occur in highest altitudes

– Graminoids which comprises species belonging to Poaceae and Cyperaceae and Juncaceae.

–Tall herbs and Umbellifereae-like herbs: They are tall herbaceous plants belonging to Apiaceae, Polygonaceae.

The geographical distribution of plants reflects the climate condition (Mobayen, 1991). Considering this fact that most species of this region are Irano-Turanianan elements, we can conclude that this region belongs to Irano-Turanianan growth zone. Noroozi *et al.*, (2007) showed the same results. But, plant physiognomi types of this region showed that Euro-Siberian and Mediteranean had more than 28% of species, it revealed there is a close relation and the determination of boundary between Euro-Siberian and Mediteranean growth zone and Irano-Turanianan was difficult (Zohary, 1973). It is concluded that that study area is defined to the Irano-Turanianan growth zone that growth elements of Euro-Siberian and Mediteranean have got into. Also according to results of this study, it can be concluded that the research area is located in Ecoton region, however, Majnonian (2004) believed this area is located in Euro-Siberian region, Pontiac sub region, Euxino-hyrcanian province and Hyrcanian sub province.

Results from this study shared a number of similarities compared to northern forest of Iran. But it has been noted that northern forest contain high levels of species richness (Naginejad and Zarezadeh, 2012; Ramezani *et al.*, 2008; Abdi *et al.*, 2009; Akhani, *et al.*, 2010; Ghahreman *et al.*, 2006; Jafari, and Akhani, 2008; Ramezani *et al.*, 2008; Mousavi *et al.*, 2012) while species as *Quercus infectia*, *Pistacia atlantica* and *Amygdalus* spp were mainly found in western forest.

Conclusion

Floristic studies have important consequences for forest management and conservation. Apart from ecological reasons, maintaining biodiversity in forest ecosystems has economic, spiritual, ethical, scientific and educational importance. This study helps to complete the description of biodiversity and may be used to interpret aspects of mountain forests. Much more research is needed to provide directly relevant and applicable evidence for a better understanding of the Western forest, including factors affecting the trees special *Querqus infecta* as the dominant species which has been reduced increasingly due to agriculture, mining, cutting trees, road and construction of hydro-electric projects. Therefore, the preservation of these forests is crucial not only for conservation of its rich biodiversity, but also for meeting the basic needs of the local population. Most of the endemic species with a narrow distribution in which are potentially endangered and vulnerable species, are severely threatened. Therefore, the protection and management of rangelands in this zone needs to be considered.

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