

A contribution to flora, life form and chorology of plants in Noor and Sisangan lowland forests

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Abstract

Lowland Hyrcanian (Caspian) areas possess a number of important remnant patches of deciduous Euro-Siberian forests distributed sparsely in the three Iranian provinces, Guilan, Mazandaran and Golestan. Noor and Sisangan are two large patches of such lowland forests classified as “natural forest parks” in the context of “Iranian Natural Resources”. In spite of a few local studies, broad knowledge upon the flora and vegetation of these areas are lacking. A total of 225 species belonging to 175 genera and 77 plant families were collected from the studied areas. The largest families in terms of species richness, were Poaceae (28 spp.), Asteraceae (18 spp.) and Rosaceae (9 spp.), respectively. The genera with the largest number of species were *Carex* (6 spp.), *Veronica* (5 spp.) and *Euphorbia*, *Polygonum*, *Solanum* (each with 4 spp.), respectively. In the assessment of life form spectrum, the dominant life forms were therophytes (30.2%), followed by the geophytes (27.1%), hemicryptophytes (20.9%) and phanerophytes (18.2%). The flora was mostly composed of pluriregional elements with 60 taxa (27.3%), followed by Euro-Siberian/Irano-Turanian/Mediterranean elements with 43 taxa (19.5%). Life form spectra and chorotype percentages were discussed for each study area separately. According to Sørensen's (1948) similarity index, there was a remarkable similarity between two forest areas. Noor and Sisangan forests were highly threatened ecosystems in case of species loss and changing natural communities due to occurrence of anthropogenic and over-grazing effects.

Key words: Flora, Lowland Hyrcanian forest, Life form, Noor and Sisangan

Introduction

Hyrcanian (Caspian) forests extend from Talish area of Azerbaijan Republic in the west to Golestan National Park of Golestan in the east and constitute a green cover across the northern slopes of the Alborz Mountains. These forests are related to an unique climate with high annual precipitation (ranging from 600 to 2000 mm) and considered to be largely compatible with the Euro-Siberian forest structure (Frey and Probst, 1986). The forests of the south Caspian area have been severely degraded and deforested; particularly, in the alluvial and lowlands where only small remnants of the forests exist now. Due to this land conversion, many plant species were restricted to isolated remnants of a formerly more widespread lowland habitats (Ghahreman *et al.*, 2006). A considerable number of

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vegetation and floristic investigations have been conducted especially in the mountain and sub-mountain forests of Hyrcanian area (e.g. Djazirei, 1965; Mobayen and Tregubov, 1970; Dorostkar and Noirfalise, 1976; Assadollahi, 1980; Mossadegh, 1981; Hamzeh'ee, 1994; Akhiani, 1998; Klein, 2001; Akbarinia *et al.*, 2004; Esmailzadeh *et al.*, 2007; Atashgahi *et al.*, 2009; Naqinezhad *et al.*, 2010). However, necessity of an extensive floristic and vegetation studies in the remained lowland patches is felt more than ever. There are some specific investigations particularly on the lowland areas (Rastin, 1983; Tabari *et al.*, 2002; Ghahreman *et al.*, 2006; Hamzeh'ee *et al.*, 2008; Naqinezhad *et al.*, 2008; Ghahremaninejad *et al.*, 2011; Asadi *et al.*, 2011). For instance, Tabari *et al.* (2002) provided some information on the distribution and vegetation structure of *Fraxinus excelsior* in the lowland Hyrcanian forests. Likewise, a detailed vegetation and floristic survey was done particularly on the *Alnus glutinosa* subsp. *barbata* patches in northern Iran (Ghahreman, *et al.*, 2006; Hamzeh'ee *et al.*, 2008).

Noor and Sisangan are two large patches of such lowland forests classified as "natural forest parks" in the context of "Iranian Natural Resources" (Mazandaran Natural Resources Office, 2012). It may be proclaimed that these forests are the only remnants of Caspian lowland forests, due to the destruction and severe damage by animals and humans in recent years (Barzehkar, 1994; Hamzeh'ee *et al.*, 2008). Sisangan is known by the occurrence of pure stands of *Buxus hyrcana*, an endemic Hyrcanian woody species which has been largely destroyed from the other parts of the Hyrcanian forest. Likewise, one of the main habitats of *Populus caspica*, a rare tree in the area, is located in Noor forest. Detailed floristic and vegetation studies should be conducted to provide a basic framework for further ecological and conservational studies on these highly threatened ecosystems. By now, no comprehensive study has been accomplished in these two areas particularly on all parts of the forests and forest margins. The aims of the current investigation are (1) representing a complete and updated checklist of all plant species of these two areas; (2) assessing some species-related characters such as life form and chorology in the areas; and (3) comparing the flora of the two forest areas with each other and with other forest areas studied in the Hyrcanian area.

Materials and Methods

Study sites

Noor forest is located between 52° 00' to 52° 06' E and 36° 32' to 36° 34' N with a 3600 hectare surface area. The forest is surrounded by main transitional Noor-Nowshahr road in the north, Noor-Chamestan road in the west, Afraseyabkola village in the south and Hashemrud river and Izdeh forests in the east. The area is generally flat. Sisangan forest is located between 51° 47' to 51° 49' E and 36° 33' to 36° 34' N, in 27 km east of Nowshahr, Mazandaran. The total area of the forest is approximately 602 hectare and is generally flat. The forest faces Caspian Sea and main transitional road in the north, Tooskatook village in the west, Salahedinkala in the east and south (Figure 1).



Figure 1. Locations of the Noor and Sisangan forests in the Hyrcanian lowland area

Data collection

Data was collected during March to November of 2011. Floristic data were collected by using 62 relevés with the area of 400 m² surface in Noor and 20 relevés with the area of 100 m² in Sisangan forests. Different sizes of relevés were allocated to different vegetation physiognomy and plant density and richness. Sisangan forest was covered mainly by mono-dominant *Buxus hyrcana* trees or shrubs with low herbaceous ground vegetation. Other species found beyond the relevés were also considered for our floristic survey. Plant determination was carried out using Rechinger (1963-2010), Assadi *et al.*, (1988-2011), Davis (1965-1988), Komarov (1968-1980), Townsend *et al.*, (1966-1985), Ghahreman (1979-2003). Moreover, the ferns were identified using Khoshravesh *et al.*, (2009). All plant names and their authors were checked by IPNI website (www.ipni.org). The classification system of The angiosperm phylogeny group (2009) was used for family names. The life form of each species followed Raunkiaer's classification system (Raunkiaer, 1934). The terminology and delimitation of the main phytocoria was based on the concepts applied by Zohary (1973), Léonard (1988) and Takhtajan (1986). In this article, PL (Pluri-regional elements) are plants ranging in distribution over three phytogeographical regions, SCOS (sub-cosmopolitan elements) are plants ranging in distribution over most continents but not all of them and COS (cosmopolitan elements) referring to plants that have a broad worldwide distribution. Floristic similarity between two forests was evaluated using Sørensen's (1948) similarity index.

Results

Floristic study in Noor forest showed the occurrence of 185 plant species belonging to 149 genera and 68 families while the number of determined plants in the Sisangan forest was 137 species belonging to 111 genera and 57 families. Totally, 225 plant species from 176 genera and 77 families were collected from these two forests. Among the 77 plant families, nine families were Pteridophytes and 68 were Angiosperms (Table 1). Eudicots with 56 families, 123 genera and 160 species were the richest group, while monocots had 12 families, 40 genera and 50 species in the studied flora (Table 2).

Table 1. Checklist of identified plant species in Noor and Sisangan lowland forests

Symbols and abbreviation used in Table 1:

Life forms: Chamaephyte (Ch), Bulbose geophyte (GB), Geophyte with corm (GC), Rhizomatose geophyte (GR), Stoloniferous geophyte (GS), Tuber geophyte (GT), Hemicryptophyte (Hem), Helophyte (Hel), Hydrophyte (Hyd), Phanerophyte (Ph), Therophyte (Th).

Chorotypes: Caucasian (Cau), Cosmopolitan (COS), Endemic (En), Euro-Siberian (ES), Euxino-Hyrcanian (Euxino-Hyr), Hyrcanian (Hyr), Irano-Turanian (IT), Mediterranean (M), Pluriregional (PL), Subcosmopolitan (SCOS), Saharo-Sindian (SS), North (N), South (S), East (E), West (W), Afghanistan (Afgh), Azerbaijan (Azer), Himalaya (Him), Khorasan (Khor), Mountains (Mts), Pakistan (Pak), Temperate (Temp), Transcaucasus (Transcau), Turkmenistan (Turk).

Habitats: Inside of Noor forest (NI), Margin of Noor forest (NM), Inside of Sisangan forest (SI), Margin of Sisangan forest (SM).

Taxon	Life form	Chorotype	Habitat
Pteridophytes			
Aspleniaceae			
<i>Asplenium adiantum-nigrum</i> (L.)	GR	PL	NI-SI
<i>Phyllitis scolopendrium</i> (L.) Newman	GR	PL (N Temp.)	NI-SI
Dennstaedtiaceae			
<i>Pteridium aquilinum</i> (L.) Kuhn	GR	COS	NI
Dryopteridaceae			
<i>Dryopteris pallida</i> (Bory) Fomin	GR	M [Hyr]	NI
<i>Polystichum aculeatum</i> (L.) Roth	GR	PL	NI
<i>Polystichum woronowii</i> Fomin	GR	Euxino-Hyr	NI
Equisetaceae			
<i>Equisetum telmateia</i> Ehrh.	GR	PL (N Temp.)	NI-NM
Onocleaceae			
<i>Matteuccia struthiopteris</i> (L.) Tod.	GR	PL	NI
Ophioglossaceae			
<i>Ophioglossum vulgatum</i> L.	GR	PL (N Temp.)	NI-SI
Polypodiaceae			
<i>Polypodium vulgare</i> L.	GR	PL	NI-SI
Pteridaceae			
<i>Adiantum capillus-veneris</i> L.	GR	PL	NI
<i>Pteris cretica</i> L.	GR	PL	NI-SI
<i>Pteris dentata</i> Forssk.	GR	PL	NI
Woodsiaceae			
<i>Athyrium filix-femina</i> (L.) Roth.	GR	PL (N Temp.)	NI
Angiosperms			
Dicotyledones			
Adoxaceae			
<i>Sambucus ebulus</i> L.	GR	ES, IT 2, M, N Africa	NI-NM-SM
Amarantaceae			
<i>Alternanthera sessilis</i> (L.) DC.	Th	PL (Neophyte)	NM
<i>Amaranthus hybridus</i> L.	Th	PL (Neophyte)	SM
<i>Amaranthus blitum</i> L.	Th	PL	SM
Apiaceae			
<i>Bupleurum marschallianum</i> C.A.Mey.	GR	Cau, Hyr [Azer]	NM-SM
<i>Eryngium caucasicum</i> Trattv.	Hem	IT 2, 3, 4, Cau	NM-SM
<i>Pimpinella affinis</i> Ledeb.	Hem	IT 2, Cau, Euxino-Hyr	NI-SM
<i>Sanicula europaea</i> L.	Hem	ES [M]	NI
<i>Torilis arvensis</i> Link	Th	PL	NI-SI
Apocynaceae			
<i>Periploca graeca</i> L.	Ph	M(E), ES(Euxino-Hyr+S)	NI-NM
Araliaceae			
<i>Hedera pastuchovii</i> Woronow	Ph	Cau (Transcau), Hyr	NI-SI
Asteraceae			
<i>Artemisia annua</i> L.	Th	M, IT 2, 3, Cau	NM-SM
<i>Bidens tripartita</i> Bigelow	Th	PL	NM
<i>Carduus arabicus</i> Jacq.	Th	M, IT 1, 2	NM-SM
<i>Carpesium abrotanoides</i> L.	Hem	PL	SM
<i>Carpesium cernuum</i> L.	Hem	PL	NI-NM-SM
<i>Cichorium inybus</i> L.	Hem	PL	NM-SM
<i>Cirsium arvense</i> (L.) Scop.	Hem	PL	NI
<i>Conyza bonariensis</i> (L.) Cronquist	Th	COS	NI-NM-SM
<i>Conyza canadensis</i> (L.) Cronquist	Th	SCOS (Neophyte)	SM

Taxon	Life form	Chorotype	Habitat
<i>Conyzanthus squamatus</i> (Spreng.) Tamamsch.	Hem	PL (Neophyte)	NM-SM
<i>Eclipta prostrata</i> (L.) L.	Th	PL	NM-SM
<i>Senecio vernalis</i> Waldst. & Kit.	Hem	ES, IT2	SM
<i>Siegesbeckia orientalis</i> L.	Th	PL	NI-SM
<i>Sonchus asper</i> (L.) Hill	Th	IT, M	NM
<i>Sonchus oleraceus</i> L.	Th	PL	NI-SM
<i>Tagetes minuta</i> L.	Th	PL (Neophyte)	SM
<i>Willemetia tuberosa</i> Fisch. & C.A.Mey. ex DC.	GT	Cau, Hyr, IT2	NI
<i>Xanthium brasiliacum</i> Vell.	Th	M, IT2	NM
Betulaceae			
<i>Alnus glutinosa</i> (L.) Gaertn.	Ph	Cau, Euxino-Hyr	NI-SI
<i>Alnus subcordata</i> C.A.Mey.	Ph	Endem (Hyr)	NI
<i>Carpinus betulus</i> L.	Ph	ES [Alborz]	NI-SI
Boraginaceae			
<i>Cynoglossum officinale</i> L.	Hem	ES, M, Euxino-Hyr [IT2,3,4]	NI
<i>Lindelofia kandavanensis</i> Bomm. & Gauba	Hem	Endem (Iran-Hyr)	NI-NM-SM
<i>Buglossoides purpurocaenlea</i> (L.) I.M. Johnst.	Hem	ES [M]	SM
<i>Lithospermum officinale</i> L.	GR	ES, M, IT2,3,4	SM
<i>Nonea lutea</i> (Desr.) A.DC.	Th	ES (Cau) [IT2]	NI-NM
Brassicaceae			
<i>Brassica toumefortii</i> Gouan	Th	M, SS, IT2,3, N Africa	NM
<i>Cardamine hirsuta</i> L.	Th	SCOS	NI
<i>Cardamine tenera</i> Boiss.	GR	Cau (Hyr)	NI
<i>Lepidium nudemale</i> L.	Hem	IT2	NM-SM
<i>Nasturtium officinale</i> R.Br.	Hem	ES, IT, M	NM
Buxaceae			
<i>Buxus hyrcana</i> Pojark.	Ph	Endem (Hyr)	SI-SM
Campanulaceae			
<i>Campanula rapunculoides</i> L.	Hem	ES [IT, M]	SM
Cannabaceae			
<i>Celtis australis</i> L.	Ph	M, N Africa	SI-SM
Caryophyllaceae			
<i>Cerastium glomeratum</i> Thuill.	Th	PL	NI-NM-SM
<i>Minuartia hybrida</i> (Vill.) Schischk.	Th	M, ES (European Russia), IT1,2	SM
<i>Polycarpon tetraphyllum</i> (L.) L.	Th	M, IT2 [SS]	SM
<i>Stellaria media</i> Cirillo	Th	COS	NI-SI-NM-SM
Amaranthaceae			
<i>Chenopodium album</i> subsp. <i>album</i> L.	Th	SCOS	SM
Convolvulaceae			
<i>Calystegia sepium</i> (L.) R. Br.	GR	PL	NI-NM-SM
<i>Calystegia silvatica</i> (Kit.) Griseb.	GR	ES [IT-Azer]	SM
Cornaceae			
<i>Cornus australis</i> C.A.Mey.	Ph	ES, IT1,2	NI-SM
Crassulaceae			
<i>Sedum stoloniferum</i> S.G.Gmel.	Hem	Cau, Euxino-Hyr	NM
Dipsacaceae			
<i>Dipsacus pilosus</i> L.	Hem	ES	NM
Ebenaceae			
<i>Diospyros lotus</i> L.	Ph	Cau (Transcau), Euxino-Hyr [Himalaya]	NI-SI
Euphorbiaceae			
<i>Acypha australis</i> L.	Th	PL (Neophyte)	NM
<i>Euphorbia amygdaloides</i> L.	GR	ES, M, N Africa	NI-SM
<i>Euphorbia pepus</i> L.	Th	PL	NI-SM
<i>Euphorbia</i> sp.	Th		NM
<i>Euphorbia turcomanica</i> Boiss.	Th	IT2,3,4, Cau	NM-SM
<i>Mercurialis perennis</i> L.	GR	ES [N Africa]	NI
Fabaceae			
<i>Albizia julibrissin</i> Durazz.	Ph	Euxino-Hyr [China+Japan]	SI
<i>Coronilla varia</i> L. subsp. <i>varia</i>	Hem	ES, M, IT2	NM-SM
<i>Gleditsia caspica</i> Desf.	Ph	Endem (Hyr) [Turk]	NI
<i>Lotus corniculatus</i> L.	Hem	PL	SM
<i>Medicago lupulina</i> L.	Hem	PL	NM
<i>Trifolium campestre</i> Schreb.	Th	ES, M, IT1,2, N Africa [SS]	NM-SM
<i>Trifolium resupinatum</i> L. var. <i>resupinatum</i>	Th	ES, M, IT2,3,4, N Africa	NM-SM
<i>Vicia tetrasperma</i> (L.) Schreb.	Hem	PL	NM
Fagaceae			
<i>Quercus castaneifolia</i> C.A.Mey.	Ph	Endem (Hyr) [Khor]	NI-SI
Gentianaceae			

Taxon	Life form	Chorotype	Habitat
<i>Centaurium pulchellum</i> (Sw.) Druce	Th	ES, IT, N Africa	SM
Geraniaceae			
<i>Geranium columbinum</i> L.	Hem	ES, M, N Africa [Azer]	NM-SM
<i>Geranium molle</i> L.	Th	ES, IT, M, N Africa	NI-SM
<i>Geranium robertianum</i> L.	Hem	PL	SI-SM
Hamamelidaceae			
<i>Parrotia persica</i> C.A.Mey	Ph	Hyr [Azer]	NI-SI
Hypericaceae			
<i>Hypericum androsaemum</i> L.	Ch	ES, M, N Africa [IT-Azer+Turk]	NI
<i>Hypericum hirsutum</i> L.	Hem	ES (Cau+E+Euxino-Hyr), NW Africa	NI
<i>Hypericum perforatum</i> L.	Hem	PL	NM-SM
Juglandaceae			
<i>Pterocarya fraxinifolia</i> (Poir.) Spach	Ph	Cau, Euxino-Hyr	NI-SI
Lamiaceae			
<i>Ajuga reptans</i> L.	GS	ES [M+N Africa]	NI
<i>Clinopodium umbrosum</i> (M. Bieb.) K. Koch	GR	Cau, Euxino-Hyr [Afgh+Him+N India]	NI-SM
<i>Lamium album</i> L. subsp. <i>album</i>	GR	ES, IT	NI-SI
<i>Lycopus europaeus</i> L.	GS	PL	NI-NM
<i>Mentha aquatica</i> L.	GS	PL	NI-SM
<i>Prunella vulgaris</i> L.	GR	PL	NI-SM
<i>Scutellaria tournefortii</i> Benth.	GR	Hyr [Azer+Afgh]	NI-SM
<i>Teucrium hyrcanicum</i> L.	GR	Cau (Transcau), Euxino-Hyr	NM-SM
Linaceae			
<i>Linum bienne</i> Mill.	Hem	ES, IT2, M, N Africa	SM
Lythraceae			
<i>Lythnum salicaria</i> L.	Hem	SCOS	NM
<i>Punica granatum</i> L.	Ph	PL	NI-NM
Malvaceae			
<i>Malva</i> sp.	Th		NM
<i>Sida rhombifolia</i> L.	Hem	PL (Neophyte)	NM-SM
<i>Tilia dasystyla</i> Steven	Ph	ES	SI-SM
<i>Tilia</i> sp.	Ph		SM
Moraceae			
<i>Ficus carica</i> L.	Ph	M, IT2, Cau	NI-SI
<i>Morus alba</i> L.	Ph	IT	NI-SI
Oleaceae			
<i>Fraxinus excelsior</i> L. subsp. <i>coriariifolia</i> (Scheele) E. Murray.	Ph	Cau Euxino-Hyr [IT2]	NI
<i>Jasminum fruticans</i> L.	Ph	M, Cau, N Africa [IT2+S Europe]	NM
Onagraceae			
<i>Circaea lutetiana</i> L.	GR	ES, IT, M, N Africa	NI-SI
<i>Epilobium hirsutum</i> L.	GR	PL	NI-NM
Orobanchaceae			
<i>Orobanche cernua</i> Loefl.	Hem	PL	NI
Oxalidaceae			
<i>Oxalis comiculata</i> L.	Th	COS	NI-SM
Papaveraceae			
<i>Chelidonium majus</i> L.	Hem	ES, M, IT3, N Africa	SM
Phytolaccaceae			
<i>Phytolacca americana</i> L.	Hem	PL (Neophyte)	SM
Plantaginaceae			
<i>Kickxia elatine</i> (L.) Dumort. subsp. <i>crinite</i> (Mabille.) Greuter.	Th	IT, M	NM
<i>Plantago lanceolata</i> L.	Hem	ES, IT, M, SS, N Africa	NM-SM
<i>Plantago major</i> L.	Hem	SCOS	NM-SM
<i>Veronica anagallis-aquatica</i> L. subsp. <i>michauxii</i> (Lam.) A. Jelen.	Hem	IT	NM
<i>Veronica arvensis</i> L.	Th	ES, IT, M	NI
<i>Veronica crista-galli</i> Steven	Th	Cau, Hyr	NI-SI
<i>Veronica francispetae</i> M.A.Fisch.	Th	Endem (Iran-Hyr)	NI-SI
<i>Veronica persica</i> Poir.	Th	SCOS	NI
Polygonaceae			
<i>Polygonum hydropiper</i> L.	Th	ES, IT, M	NM
<i>Polygonum hyrcanicum</i> Rech.f.	Hem	Endem (Iran-Hyr) [Alborz]	NM-SM
<i>Polygonum lapathifolium</i> L.	Th	ES, IT, M	NI-NM-SM
<i>Polygonum patulum</i> M.Bieb.	Hem	M, IT2,3, Cau	NM
<i>Rumex sanguineus</i> L.	Hem	ES [M]	NI-SM
Portulacaceae			
<i>Portulaca oleracea</i> L.	Th	COS	NM
Primulaceae			
<i>Anagallis arvensis</i> L.	Th	ES, IT	SM

Taxon	Life form	Chorotype	Habitat
<i>Cyclamen coum</i> Mill. subsp. <i>caucasicum</i> (K.Koch.) Meikle	GT	Cau, Euxino-Hyr	NI-SI
<i>Primula heterochroma</i> Stapf	Hem	Endem (Hyr) [Semnan]	NI
Ranunculaceae			
<i>Batrachium trichophyllum</i> (Chaix) Bosch	Hyd	SCOS	NM
<i>Ranunculus dolosus</i> Fisch. & C.A.Mey.	Th	Endem (Hyr)	NI
<i>Ranunculus muricatus</i> L.	Th	IT, M, Cau, N Africa	NI-SM
<i>Ranunculus ophioglossifolius</i> Vill.	Th	ES, M, Euxino-Hyr, N Africa [IT2]	NM
Rhamnaceae			
<i>Paliurus spina-christi</i> Mill. var. <i>spina-christi</i>	Ph	M, IT2,3	NM-SM
Rosaceae			
<i>Crataegus microphylla</i> K.Koch	Ph	Cau, Euxino-Hyr [Krym, E Bulgaria]	NI-SI
<i>Geum urbanum</i> L.	GR	ES, IT2,3, N Africa	NI-NM-SM
<i>Mespilus germanica</i> L.	Ph	M (E), IT2, ES (Cau+Euxino-Hyr+S Europe)	NI-SM-NM
<i>Potentilla reptans</i> L.	Hem	ES, IT, M, N Africa [SS]	NI
<i>Prunus divaricata</i> Ledeb. subsp. <i>caspiaca</i> (Kov. & Ekim.) Browicz	Ph	Cau, Hyr [IT]	NI-SI
<i>Rubus caesius</i> L.	Ph	ES, IT	NI-SM
<i>Rubus persicus</i> Boiss.	Ph	Endem (Hyr)	NI-SM
<i>Rubus sanctus</i> Kuntze	Ph	IT, M, Cau	NM-SM
<i>Sanguisorba minor</i> Scop.	Hem	ES, M, IT2,3, N Africa	NI-NM
Rubiaceae			
<i>Galium ghilanicum</i> Stapf	Th	IT, Cau	NI-SM
Salicaceae			
<i>Populus caspica</i> (Bornm.) Bomm.	Ph	IT2,3, Cau	NI
<i>Salix alba</i> L.	Ph	ES, IT, M, N Africa	NM
<i>Salix</i> sp.	Ph		SI-SM
Sapindaceae			
<i>Acer cappadocicum</i> Gled.	Ph	Euxino-Hyr, Cau [Pak]	SI
<i>Acer velutinum</i> Boiss. var. <i>glabrescens</i>	Ph	Endem (Hyr)	NI-SI
<i>Acer velutinum</i> Boiss. var. <i>velutinum</i>	Ph	Endem (Hyr)	NI
Scrophulariaceae			
<i>Scrophularia vernalis</i> L. subsp. <i>clausii</i> (Boiss. & Buhse) Grau.	Hem	Hyr [IT-Azer+Semnan]	NI
<i>Verbascum</i> sp.	Hem		SM
Solanaceae			
<i>Atropa belladonna</i> L.	GR	ES, M	SM
<i>Physalis alkekengi</i> L.	GR	ES, IT2,3,4	SM
<i>Solanum dulcamara</i> L.	Ph	IT2, ES (Cau, S Russia)	NI-NM
<i>Solanum kieseritzkii</i> C.A.Mey.	GR	Endem (Hyr)	NM
<i>Solanum nigrum</i> L.	Th	COS	NI-SI-SM
<i>Solanum sisymbriifolium</i> Lam.	Ph	PL	SM
Tamaricaceae			
<i>Tamarix ramosissima</i> Ledeb.	Ph	ES, IT	NM
Ulmaceae			
<i>Ulmus glabra</i> Huds.	Ph	ES, [IT, M]	SI
<i>Ulmus minor</i> Mill.	Ph	ES, M, N Africa	NI-SI-NM
<i>Zelkova carpinifolia</i> Dippel	Ph	Cau, Euxino-Hyr [IT2-Iran]	NI-SI-NM
Urticaceae			
<i>Parietaria officinalis</i> L.	GR	ES [IT, M]	NI
<i>Urtica dioica</i> L.	GR	PL	NI-SI
Verbenaceae			
<i>Verbena officinalis</i> L.	Hem	SCOS	NM-SM
Violaceae			
<i>Viola alba</i> Besser	GR	ES, M, N Africa	NI-SI
<i>Viola odorata</i> L.	GR	ES, IT, M, N Africa	NI-SI
Zygophyllaceae			
<i>Tribulus terrestris</i> L. var. <i>orientalis</i>	Th	PL	NM
Monocotyledones			
Alismataceae			
<i>Alisma plantago-aquatica</i> L.	Hyd	PL	NM
Araceae			
<i>Arum maculatum</i> L.	GR	ES	NI
<i>Lemna minor</i> L.	Hyd	COS	NM
Cyperaceae			
<i>Carex divulsa</i> Gooden. subsp. <i>divulsa</i>	GR	ES, IT, M, N Africa	NI-SI
<i>Carex grioletii</i> Roem. ex Schkuhr	GR	M, Cau, Euxino-Hyr	NI
<i>Carex remota</i> L.	GR	ES, M, N Africa	NI-SI
<i>Carex songorica</i> Kar. & Kir.	GR	IT2,3,4, ES (Cau+Russia) [East Asia]	NM
<i>Carex strigosa</i> Huds.	GS	ES	NI-SI
<i>Carex sylvatica</i> Huds.	GR	ES, N Africa [Altai Mts]	NI-SI

Taxon	Life form	Chorotype	Habitat
<i>Cyperus difformis</i> L.	Th	PL	NM
<i>Cyperus rotundus</i> L.	GR	COS	NM
Dioscoreaceae			
<i>Tamus communis</i> L.	GC	ES, IT2, M, N Africa	SM
Iridaceae			
<i>Iris pseudacorus</i> L.	GR	ES, M, N Africa	NI-NM
Juncaceae			
<i>Juncus inflexus</i> L.	Hel	PL	NM
Liliaceae			
<i>Ornithogalum kochii</i> Parl.	GB	ES, [IT2-Iran]	NI
<i>Scilla gorganica</i> Speta	GB	Endem (Iran-Hyr)	NI
Orchidaceae			
<i>Limodorum abortivum</i> (L.) Sw.	GR	ES, M [IT2-Iran]	SI
<i>Listera ovata</i> (L.) R.Br.	GR	PL	NI
<i>Ophrys sphegodes</i> Mill. subsp. <i>sphogodes</i>	GT	ES, M	NI-SI
Poaceae			
<i>Aegilops tauschii</i> Coss.	Th	IT2, Cau	SM
<i>Alopecurus myosuroides</i> Huds. var. <i>myosuroides</i>	Th	ES, IT, M	NM
<i>Arthraxon hispidus</i> (Thunb.) Makino	Th	PL	NM
<i>Brachypodium sylvaticum</i> (L.) P.Beauv.	Hem	ES, IT2	NI-SM
<i>Briza minor</i> L.	Th	ES, M, IT1,2, N Africa	SM
<i>Bromus japonicus</i> var. <i>japonicus</i> Thunb.	Th	PL	NM
<i>Catapodium rigidum</i> (L.) C.E.Hubb. ex Dony	Th	ES, M, IT2	SM
<i>Cynodon dactylon</i> (L.) Pers.	Hem	COS	NM-SM
<i>Digitaria sanguinalis</i> (L.) Scop.	Th	PL	NM
<i>Echinochloa crus-galli</i> (L.) P.Beauv. var. <i>crus-galli</i>	Th	SCOS	NM
<i>Eleusine indica</i> (L.) Gaertn.	Th	SCOS	NM-SM
<i>Hordeum glaucum</i> Steud.	Th	IT, M, N Africa [SS]	NM-SM
<i>Lolium multiflorum</i> Lam.	Th	ES, IT2, M, N Africa	SM
<i>Lolium perenne</i> L.	Hem	PL	SM
<i>Lolium rigidum</i> Gaudin	Th	ES, M, IT2	NM
<i>Lophochloa phleoides</i> (Vill.) Rchb.	Th	PL	NM-SM
<i>Microstegium vimineum</i> (Trin.) A.Camus	Th	PL (Neophyte)	NI-SM
<i>Milium vemale</i> M.Bieb.	Th	ES, IT	NI
<i>Oplismenus undulatifolius</i> (Ard.) P.Beauv.	Hem	ES, M	NI-SI-NM-SM
<i>Paspalum dilatatum</i> Poir.	GR	PL (Neophyte)	NM-SM
<i>Phragmites australis</i> (Cav.) Steud.	Hel	PL	NM
<i>Poa annua</i> L.	Th	SCOS	NI-SI-SM
<i>Poa nemoralis</i> L.	GS	PL	NI-SI
<i>Poa trivialis</i> L.	GS	ES, IT, M	NI-SI
<i>Polypogon monspeliensis</i> (L.) Desf.	Th	PL	NM
<i>Setaria glauca</i> (L.) P.Beauv.	Th	SCOS	NM-SM
<i>Sorghum halepense</i> (L.) Pers.	GR	PL	NM
<i>Vulpia myuros</i> (L.) C.C.Gmel.	Th	M, IT2,4	SM
Ruscaceae			
<i>Ruscus hyrcanus</i> Woronow	Ch	IT2, Cau, Hyr	NI-SI
Smilacaceae			
<i>Smilax excelsa</i> L.	Ph	M, Cau, Euxino-Hyr	NI-SI
Typhaceae			
<i>Sparganium erectum</i> L.	Hyd	ES, M, N Africa [IT2]	NM

Table 2. Number of families, genera and species in the main taxonomic groups

Plant Groups	Families	Genera	Species
Eudicots	56	123	161
Monocots	12	40	50
Pteridophytes	9	12	14

The largest families in terms of number of genera were Poaceae (24 genera), Asteraceae (15 genera) and Lamiaceae (8 genera) (Figure 2). Poaceae (28 spp.), Asteraceae (18 spp.) and Rosaceae (9 spp.) showed the highest species richness respectively (Figure 3). The genera with the largest number of species were *Carex* (6 spp.), *Veronica* (5 spp.) and *Euphorbia*, *Polygonum* and *Solanum* (each with 4 spp.) respectively (Figure 4).

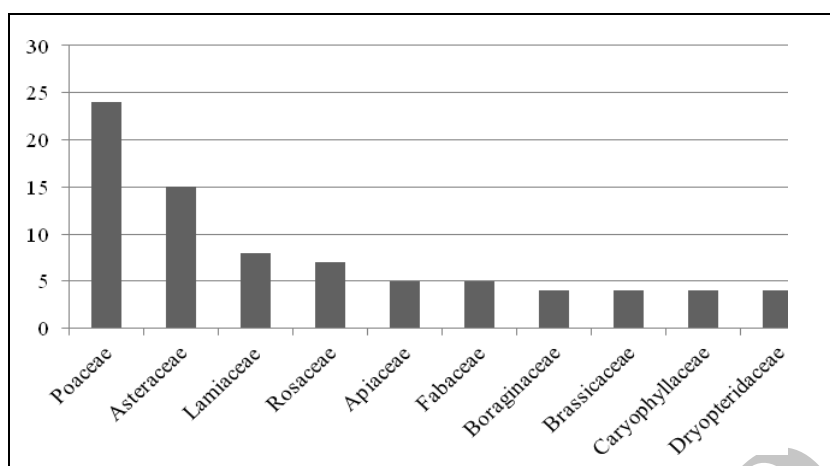


Figure 2. The richest families in terms of number of genera

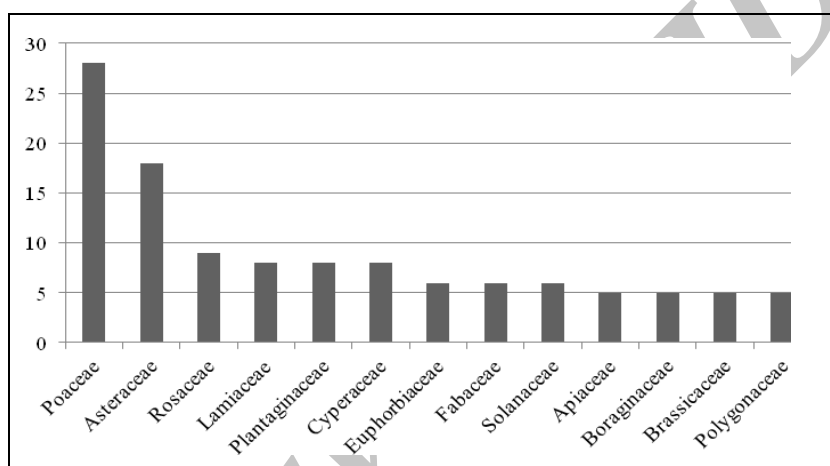


Figure 3. The richest families in terms of number of taxa

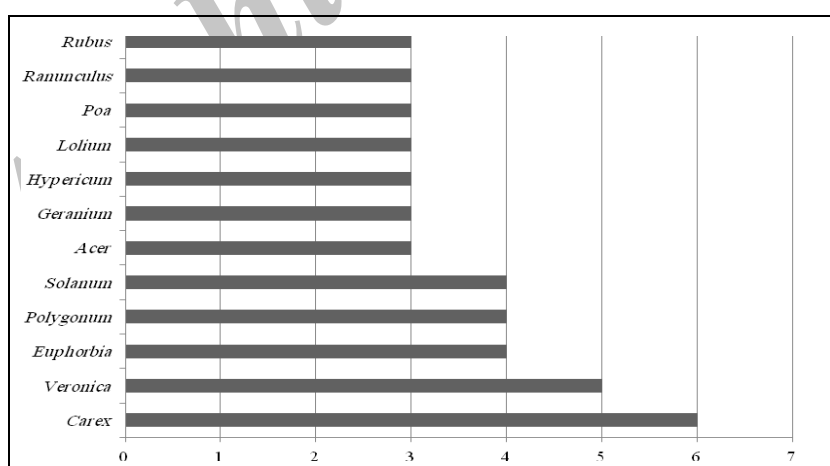


Figure 4. The genera with the largest number of species

Life form and chorotype spectrum

In the assessment of life form spectrum in the two forests, the dominant life forms were therophytes, which constituted 30.2% of the studied flora, followed by the geophytes (27.1%), hemicryptophytes (20.9%) and phanerophytes (18.2%) (Figure 5). Detailed surveys of life form spectrum in the two studied forests showed that the dominant life forms

within the Noor forest were geophytes (29.7%), therophytes (29.2%) and hemicryptophytes (19.5%) followed by phanerophytes (17.3%), hydrophytes (2.1%), chamaephytes and helophytes (1.1%). Nevertheless, the dominant life forms in the Sisangan forest were therophytes (29.9%), geophytes (29.6%) followed by hemicryptophytes, phanerophytes (21.9%) and chamaephytes (0.7%).

The total flora was composed mostly of pluriregional elements with 60 taxa (27.3%), followed by Euro-Siberian/Irano-Turanian/Mediterranean elements with 43 taxa (19.5%) (Figure 6). The ratio of endemism was 6.4% and included 14 taxa in the two studied forests. The flora of both forests was mostly composed of pluriregional elements with 52 taxa (28.1%) in Noor and 33 taxa (24.6%) in Sisangan forest, followed by Euro-Siberian (16.8%), Euro-Siberian/Irano-Turanian/Mediterranean (14%), Euro-Siberian/Mediterranean (9.2%), Euro-Siberian/Irano-Turanian (8.2%), endemics (7%), sub-cosmopolitan (5.4%), cosmopolitan (4.9%), Irano-Turanian/Mediterranean (4.3%), Irano-Turanian (1.6%) and Mediterranean (0.5%) elements in Noor forest and Euro-Siberian/Irano-Turanian/Mediterranean (18.7%), Euro-Siberian (18%), Euro-Siberian/Irano-Turanian (9.7%), ES/M (8.2%), endemics and sub-cosmopolitan (5.2%), Irano-Turanian/Mediterranean (4.5%), cosmopolitan (3.7%), Irano-Turanian (1.5%) and Mediterranean (0.7%) in Sisangan forest.

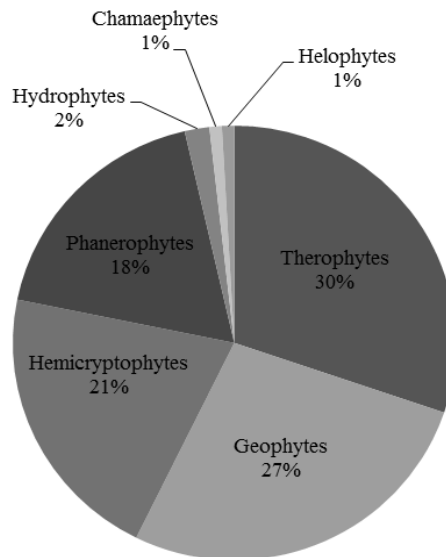


Figure 5. Life form spectrum of studied flora of Noor and Sisangan forests

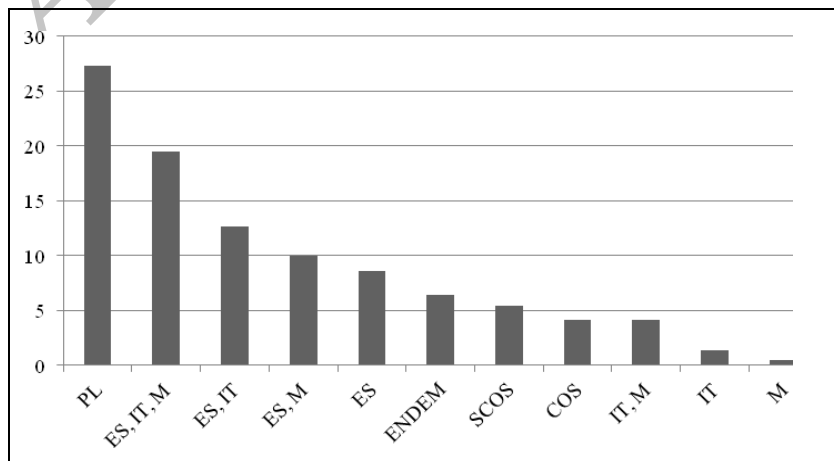


Figure 6. Percentage of main chorotypes of plants studied in Noor and Sisangan forests

Discussion

The knowledge of the floristic composition of an area is a prerequisite for any ecological and phytogeographical study and conservation management (Siadati *et al.*, 2010). Noor and Sisangan forests are considered as remnants of Caspian lowland forests. For the first time, Barzehkar (1994) conducted a preliminary study on vegetation of Noor forest, but detail floristic accounts of this area is still lacking. On the other hand, Sisangan forest is characterized as a unique lowland forest due to occurrence of Hyrcanian endemic plant, *Buxus hyrcana*. The latter species constitutes some rare pure stands across Hyrcanian lowland and submountain forests (Zohary, 1973; Rastin, 1983; Hamzeh'ee *et al.*, 2008; Asadi *et al.*, 2011). Likewise, Noor forest is characterized by the occurrence of *Populus caspica*, a rare and endangered tree species in Iran. Sisangan forest has lower plant diversity compared to Noor forest due to high density of box trees and shrubs in the former. According to a subjective observation, soil texture of the two forests is relatively different from each other and it might be considered as the main cause of differences in the floristic composition and vegetation structure between the two areas.

Based on Sørensen's formula, the obtained similarity between the two forests was about 60 % which indicates rather high similarity of floristic compositions between the forests due to their placement within the lowlands and lacking altitudinal gradients. However, the occurrence of *Buxus* as mono-dominant woody species in some parts of Sisangan forest makes its floristic composition slightly different from Noor forest Park.

Since the life form classification is based essentially on plant reaction to climate, the individual spectrum should tell us much about macroclimatic patterns at field sites (Pears, 1985). Although, therophytes occur abundantly in desert areas (Archibold, 1995), more or less high occurrence of this life form indicates some anthropogenic and over-grazing effects in the study areas (Grime, 2001; Naqinezhad *et al.*, 2006). Similar proportion of therophytes has been previously observed in some other studied ecosystems (Ghahreman *et al.*, 2006, Naqinezhad *et al.*, 2006, Ghahremaninejad *et al.*, 2011). The high percentage of therophytes in the life form spectrum were also encountered elsewhere (Ozen and Kilinch, 2002; Severoglu *et al.*, 2011). The occurrence of therophytes in the Sisangan forest is more prominent than in the Noor forest due to more anthropogenic effects in the former. Following therophytes, geophytes are next dominant life forms. The high proportion of geophytes is consistent with the results of some floristic studies in some other forest areas in the Hyrcanian district (e.g. Ghahreman *et al.*, 2006; Akbarinia *et al.*, 2004; Razavi, 2008; Siadati *et al.*, 2010).

Similar to previous investigations (Ghahreman *et al.*, 2006; Naqinezhad *et al.*, 2010; Ghahremaninejad *et al.*, 2011), pluriregional species constitute a remarkable proportion of the studied flora. These elements can be observed in the lower altitudes of some mountainous systems (Hegazy *et al.*, 1998). Euro-Siberian elements constitute the large proportions of both total flora and flora of each studied forest separately. The occurrence of these elements reflects the phytogeographical link of the studied area with the Euro-Siberian region (e.g. Zohary, 1973; Takhtajan, 1986; Akhiani *et al.*, 2010).

Noor and Sisangan forests are the last remnants of the lowland Hyrcanian forests. These highly threatened ecosystems possess two rare and endemic/subendemic species (*Populus caspica* and *Buxus hyrcana*) which have been drastically exterminated from other areas of the Hyrcanian forests. Conservation policies upon the areas should be applied seriously in order to decrease further damaging effects.

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معرفی فلور، شکل زیستی و پراکنش جغرافیایی گیاهان جنگل‌های پست نور و سیسنگان

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چکیده

مناطق پست هیرکانی (خزری) شامل لکه‌های به جامانده از جنگل‌های خزان‌کننده اروپا-سیبری است که در سه استان گیلان، مازندران و گلستان پراکنده است. نور و سیسنگان دو تکه بزرگ از این جنگل‌های پست هستند که با عنوان "پارک جنگلی" در مفهوم "منابع طبیعی ایران" طبقه‌بندی شده‌اند. با وجود برخی مطالعات محلی بر روی این جنگل‌ها، هنوز دانش کافی در مورد فلور و پوشش گیاهی این مناطق وجود ندارد. گونه‌های گیاهی جمع‌آوری شده از این مناطق نشان‌دهنده وجود ۲۲۵ گونه گیاهی متعلق به ۱۷۵ جنس و ۷۷ تیره گیاهی است. Poaceae با ۲۸، Asteraceae با ۱۸ و Rosaceae با ۹ گونه، به ترتیب بیشترین غنای گونه‌ای را نشان می‌دهند. جنس‌های دارای بیشترین تعداد گونه به ترتیب *Carex* (با ۶ گونه)، *Veronica* (با ۵ گونه) و *Euphorbia*، *Polygonum* و *Solanum* (هر کدام با ۴ گونه) هستند. به لحاظ طیف شکل زیستی، تروفیت‌ها با ۳۰/۲٪ اشکال زیستی غالب را تشکیل می‌دهند و به دنبال آن، ژئوفیت‌ها (۲۷/۱٪)، همی کریپتوفیت‌ها (۲۰/۹٪) و فانروفیت‌ها (۱۸/۲٪) قرار دارند. فلور این مناطق، عمدتاً از عناصر چندناحیه‌ای با ۶۰ تاکسون (۲۷/۳٪) و سپس عناصر اروپا-سیبری/ایرانی-تورانی/مدیترانه‌ای با ۴۳ تاکسون (۱۹/۵٪) تشکیل شده است. درصد هر کدام از عناصر جغرافیایی و اشکال زیستی به طور اختصاصی برای هر جنگل ارائه می‌شود. بر اساس شاخص تشابه سورنسن، برخی شباهت‌های فلورستیکی بین دو جنگل وجود دارد. جنگل‌های پست نور و سیسنگان، به علت فشار فعالیت‌های انسانی و چرای دام، در معرض خطر حذف گونه‌های گیاهی و یا تغییر جوامع طبیعی هستند.

واژه‌های کلیدی: فلور، جنگل پست هیرکانی، شکل زیستی، نور و سیسنگان

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