Taxonomy and Biosystematics, 4th Year, No. 13, Winter 2012, Page: 31-44
Received: 23 December 2011 Accepted: 24 June 2012

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

Alireza Naqinezhad * and Somayeh Zarezadeh

Department of Biology, Faculty of Basic Sciences, University of Mazandaran, Babolsar, Iran

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

* Corresponding Author: a.naqinezhad@umz.ac.ir

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; Akhani, 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 aimes 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).

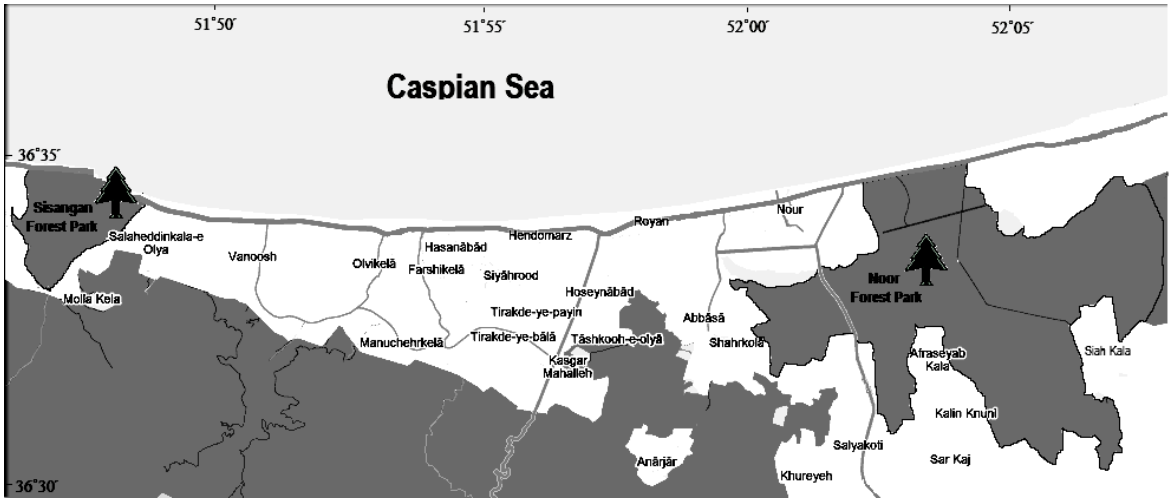

Figure 1. Locations of the Noor and Sisangan forests in the Hyrcanian lowland area

Data collection

Data was collected during March to November of 2011. Floristic data were collected by using 62 relevés with the area of 400 m^2 surface in Noor and 20 relevés with the area of 100 m^2 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 phytochoria was based on the concepts applied by Zohary (1973), Léonard (1988) and Takhtajan (1986). In this article, PL (Pluriregional 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-Sibirian (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			
Asplenium adiantum-nigrum (L.)	GR	PL	NI-SI
Phyllitis scolopendrium (L.) Newman	GR	PL (N Temp.)	NI-SI
Dennstaedtiaceae			
Pteridium aquilinum (L.) Kuhn	GR	COS	NI
Dryopteridaceae			
Dryopteris pallida (Bory) Fomin	GR	M [Hyr]	NI
Polystichum aculeatum (L.) Roth	GR	PL	NI
Polystichum woronowii Fomin	GR	Euxino-Hyr	NI
Equisetaceae			
Equisetum telmateia Ehrh.	GR	PL (N Temp.)	NI-NM
Onocleaceae			
Matteuccia struthiopteris (L.) Tod.	GR	PL	NI
Ophioglossaceae			
Ophioglossum vulgatum L.	GR	PL (N Temp.)	NI-SI
Polypodiaceae			
Polypodium vulgare L.	GR	PL	NI-SI
Pteridaceae			
Adiantum capillus-veneris L.	GR	PL	NI
Pteris creica L.	GR	PL	NI-SI
Pteris dentata Forssk.	GR	PL	NI
Woodsiaceae			
Athyrium filix-femina (L.) Roth.	GR	PL (N Temp.)	NI
Angiosperms			
Dicotyledones			
Adoxaceae			
Sambucus ebulus L.	GR	ES,IT2,M, N Africa	NI-NM-SM
Amarantaceae			
Alternanthera sessilis (L.) DC.	Th	PL (Neophyte)	NM
Amaranthus hybridus L.	Th	PL (Neophyte)	SM
Amaranthus blitum L.	Th	PL	SM
Apiaceae			
Bupleurum marschallianum C.A.Mey.	GR	Cau, Hyr [Azer]	NM-SM
Eryngium caucasicum Trautv.	Hem	IT2,3,4, Cau	NM-SM
Pimpinella affinis Ledeb.	Hem	IT2,Cau,Euxino-Hyr	NI-SM
Sanicula europaea L.	Hem	ES [M]	NI
Torilis arvensis Link	Th	PL	NI-SI
Apocynaceae			
Periploca graeca L.	Ph	M(E), ES(Euxino-Hyr+S)	NI-NM
Araliaceae			
Hedera pastuchovii Woronow	Ph	Cau (Transcau), Hyr	NI-SI
Asteraceae			
Artemisia annua L.	Th	M, IT2,3, Cau	NM-SM
Bidens tripartita Bigelow	Th	PL	NM
Carduus arabicus Jacq.	Th	M, IT1,2	NM-SM
Carpesium abrotanoides L.	Hem	PL	SM
Carpesium cernuum L.	Hem	PL	NI-NM-SM
Cichorium intybus L.	Hem	PL	NM-SM
Cirsium arvense (L.) Scop.	Hem	PL	NI
Conyza bonariensis (L.) Cronquist	Th	COS	NI-NM-SM
Conyza canadensis (L.) Cronquist	Th	SCOS (Neophyte)	SM

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

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

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

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

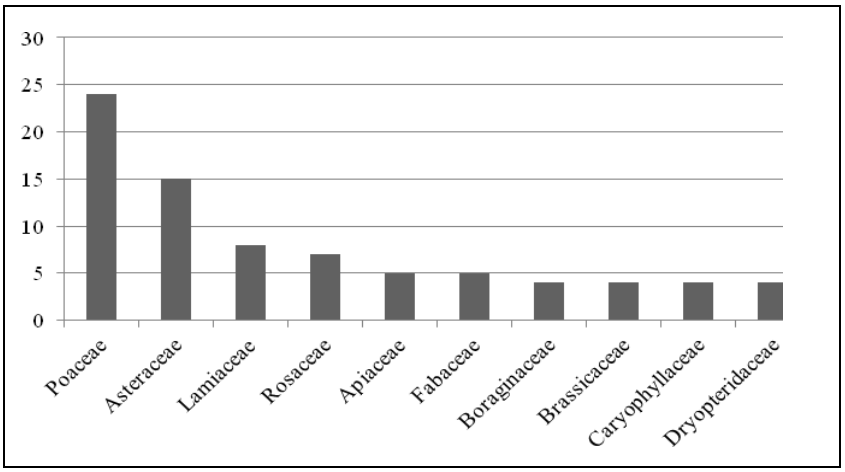

Figure 2. The richest families in terms of number of genera

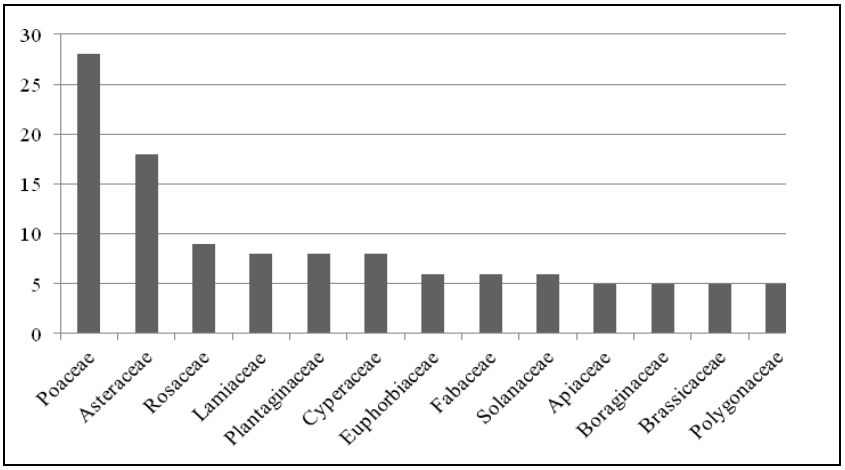

Figure 3. The richest families in terms of number of taxa

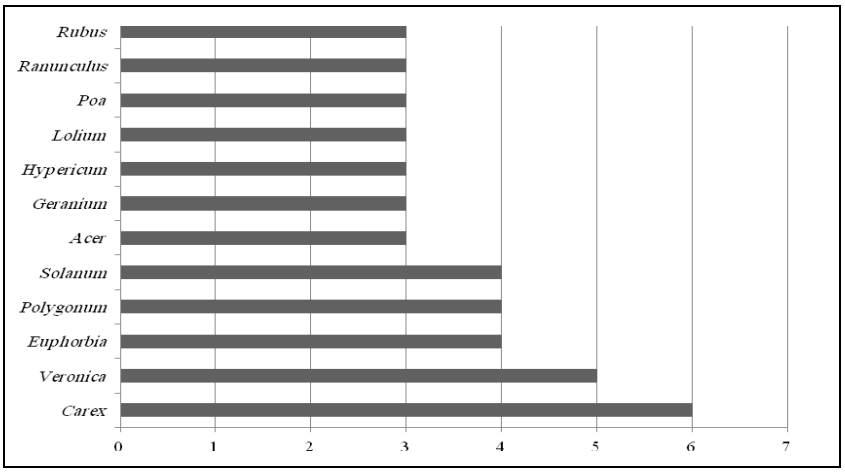

Figure 4. The genera with the largest number of species

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.

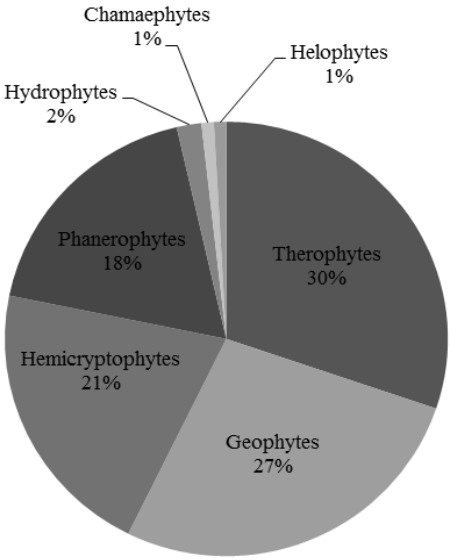

Figure 5. Life form spectrum of studied flora of Noor and Sisangan forests

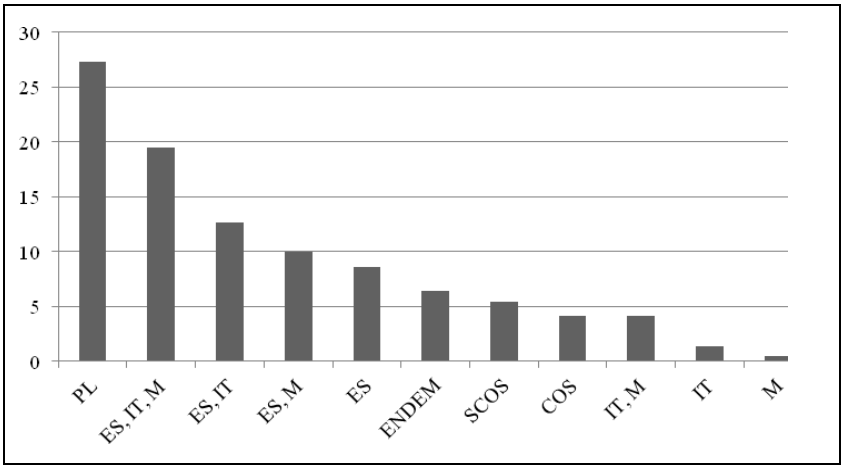

Figure 6. Percentage of main chorotypes of plants studied in Noor and Sisangan forests

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; Akhani *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 exteriminated from other areas of the Hyrcanian forests. Conservation policies upon the areas should be applied seriously in order to decrease further damaging effects.

Acknowledgement

We are indebted to Dr. H. Zare, Botanical Garden, Nowshahr for his helps during the study. Mr. A. Dehghani and Mr. H. Gholizadeh, University of Mazandaran are thanked for their helps during the field studies.

References

Akbarinia, M., Zare, H., Hoseini, S. M. and Ejtehadi, H. (2004) Study on vegetation structure, floristic composition and chorology of silver birch communities at Sangdeh, forest of Hyrcanian region. Pajouhesh va Sazandegi 64: 84-96.

Akhani, H. (1998) Plant biodiversity of Golestan National Park, Iran. Stapfia 53: 1-411.

Akhani, H., Djamali, M., Ghorbanalizadeh, A. and Ramezani, E. (2010) Plant biodiversity of Hyrcanian relict forests, N Iran: an overview of the flora, vegetation, palaeoecology and conservation. Pakistan Journal of Botany 42: 231-258.

Archibold, O. W. (1995) Ecology of world vegetation. Chapman and Hall, London.

Asadi, H., Hosseini, S. M., Esmailzadeh, O. and Ahmadi, A. (2011) Flora, life form and chorological study of Box tree (*Buxus hyrcana* Pojark.) sites in Khybus protected forest, Mazandaran. Journalof Plant Biology 3: 27-40

Assadi, M., Massoumi, A. A., Khatamsaz, M. and Mozaffarian, V. (1988-2011) Flora of Iran. Research Institute of Forests and Rangelands Publication, Tehran (in Persian).

Assadollahi, F. (1980) Etude phytosociologique et biogéographique des forêts Hyrcanienne. Essai synthétique et application à la region d'Assalem (Iran). Tèse 127 p. Marseille.

Atashgahi, Z., Ejtehadi, H. and Zare, H. (2009) Study of floristics, life form and chorology of plants in the east of Dodangeh forests, Mazandaran province, Iran. Iranian Journal of Biology 22 (2): 193-203.

Barzehkar, G. (1994) The identification of species and plant society of Noor forest park and their distribution, concern to Ecological need (with to supply the plant mapping). MSc.Thesis, Tarbiat Modarres University, Noor, Iran.Davis, P. H. (1965-1988) Flora of Turkey and East Aegean Islands 1-10. Edinburg University Press, Edinburgh.

Djazirei, M. H. (1965) Contribution à l'étude des forêts primaries de la Caspienne. Bulletin des Institut Agronomiques de Gembloux 33(1): 36-71.

Dorostkar, H. and Noirfalise, A. (1976) Contribution à l'étude des forêts caspiennes orientales (chaine du Gorgan. Bulletin des Institut Agronomiques de Gembloux 11(1-2): 42-57.

Esmailzadeh, O., Hosseini, S. M. and Tabari, M. (2007) A phytosociological study of English yew (*Taxus baccata* L.) in Afratakhteh reserve. Pajouhesh va Sazandegi 74: 17-24.

Frey, W. and Probst, W. (1986) A synopsis of the vegetation of Iran. In: Contributions to the vegetation of Southwest Asia. (ed. Kürschner, H.) 1-43. Dr. Ludwig Reichert, Wiesbaden.

Ghahreman, A. (1979-2003) Color flora of Iran. Research Institute of Forests and Rangelands, Tehran.

Ghahreman, A., Naqinezhad, A. R., Hamzeh'ee, B., Attar, F. and Assadi, M. (2006) The flora of threatened black alder forests in the Caspian lowlands, Northern Iran. Rostaniha 7: 5-30.

Ghahremaninejad, F., Naqinezhad, A. R., Bahari, S. H. and Esmaeili, R. (2011) A contribution to flora, life form and distribution of plants in two protected lowland forests, Semeskandeh and Dasht-e Naz, Mazandaran, N. Iran. Taxonomy and Biosystematics 3(7): 53-70.

Grime, J. P. (2001) Plant strategies, vegetation processes and ecosystem properties. John Wiley and

Sons Inc., New York.

Hamzeh'ee, B. (1994) A survey of the plant associations of the Lesakuti Forests, 3th series, SE Tonekabon, Research Institute of Forests and Rangelands, Tehran.

Hamzeh'ee, B., Naqinezhad, A. R., Attar, F. Ghahreman, A., Assadi, M. and Prieditis, N. (2008) Phytosociological survey of remnant *Alnus glutinosa* ssp. *barbata* communities in the lowland Caspian forests of northern Iran. Phytocoenologia 38: 117-132.

Hegazy, A. K., El-Demerdash, M. A. and Hosni, H. A. (1998) Vegetation, species diversity and floristic relations along an altitudinal gradient in south-west Saudi Arabia. Journal of Arid Environments 38: 3-13.

Khoshravesh, R., Akhani, H., Eskandari, M. and Greuter, W. (2009) Ferns and fern allies of Iran. Rostaniha 10 (supplementary 1): 1-132.

Klein, J. C. (2001) La végétation altitudinale de l'Alborz central (Iran). Institut Français de Recherche en Iran, Tehran, Iran.

Komarov, V. L. (1968-1980) Flora of the URRS. vol. 1-24. Israel program for scientific translation, Jurnalism. (Translated From Russian).

Léonard, J. (1988) Contribution à l'etude de la flore et de la vegetation des desert d'Iran, Fascicule 8: Etude des aries de distribution, Les phytochories, Les chorotypes. Bulletin of the Jardin Botanique Nacional de Belgique, Meise.

Mazandaran Natural Resources Office (2012) Retrieved from http://sari.frw.org.ir/. on: 7 March 2012.

Mobayen, S. and Tregubov, V. (1970) Carte de la vegetation naturelle de l'Iran, 1:2,500,000.University of Tehran, Tehran.

Mossadegh, A. (1981) Contribution à l'etude des associations forestières des massifs bordant la mere Caspienne en Iran. Proceeding of 17th the Global Network for Forest Science Cooperation world congress, Kyoto, Japan.

Naqinezhad, A. R., Hosseini, S., Rajamand, M. A. and Saeidi Mehrvarz, Sh. (2010) A floristic study on Mazibon and Sibon protected forests, Ramsar, across the altitudinal gradient (300-2300 m). Taxonomy and Biosystematics 2(5): 93-114.

Naqinezhad, A. R., Hamzeh'ee, B. and Attar, F. (2008) Vegetation-environment relationships in the alderwood communities of Caspian lowlands, N. Iran (toward an ecological classification). Flora 203: 567-577.

Naqinezhad, A. R., Saeidi Mehrvarz, Sh., Noroozi, M. and Faridi, M. (2006) Contribution to the vascular and bryophyte flora as well as habitat diversity of the Boujagh national park, N. Iran. Rostaniha 7(2): 83-105.

Ozen, F. and Kilinch, M. (2002) The flora and vegetation of Kunduz forests (Vezirkopru/Samsun). Turkish Journal of Botany 26: 371-393.

Pears, N. (1985) Basic biogeography. John Wiley and Sons Inc., New York.

Rastin, N. (1983) Vegetationskundliche untersuchungen in hochwaldresten der Kaspischen ebene. Phytocoenologia 11(2): 245-289.

Raunkiaer, C. (1934) The life forms of plants and statistical plant geography. Clarendon Press. Oxford.

Razavi, S. A. (2008) Flora study of life forms and geographical distribution in Kouhmian region (Azadshahr-Golestan province). Journal of Agriculture Science and Natural Resource 15: 98-108.

Rechinger, K. H. (ed.). (1963-2010) Flora Iranica, Vols. 1-178. -Graz: Akademische Druck-und Verlasanstalt (1-174), Wien: Naturhistorisches Museum (175-178).

Severoglu, Z., Altay, V., Ilker Oziygit, I., Keskin, M., Serin, M., Yarci, C., Yashar, U. and Demir, G. (2011) Some ecological characteristics and the flora of Golcuk District and its environs (Kocaeli-Turkey). Scientific Research and Essays 6(4): 847-875.

Siadati, S., Moradi, H., Attar, F., Etemad, V., Hamzeh'ee, B. and Naqinezhad, A. R. (2010) Botanical diversity of Hyrcanian forests; a case study of a transect in the Kheyrud protected lowland mountain forests in northern Iran. Phytotaxa 7: 1-18.

Sørensen, T. A. (1948) Method of establishing groups of equal amplitude in plant sociology based on similarity of species content. Biologiske Skrifter Kongelige Danske Videnskabernes Selskab 5: 1-34.

Tabari, M., Jazireei, M. H., Assadollahi, F. and Haji Mirsadeghi, M. M. A. (2002) An investigation of forest associations and environment requirements of ash (*Fraxinus excelsior* L.) in the north of Iran. Pajouhesh va Sazandegi 55: 94-103.

Takhtajan, A. (1986) Floristic regions of the world. University of California Press, Berkeley.

The angiosperm phylogeny group (2009) An update of the angiosperm phylogeny group classification for the orders and families of flowering plants: APG III. Botanical Journal of the Linnean Society 161: 105-121.

Townsend, C. C., Guest, E. and Al-Rawi, A. (1966-1985) Flora of Iraq. vols: 1-10. Ministry of Agriculture of the Republic of Iraq, Baghdad.

Zohary, M. (1973) Geobotanical foundations of the Middle East. 2 vols. Gustav Fisher Verlag, Stuttgart.

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

علیرضا نقی‌نژاد * و سمیه زارع‌زاده
گروه زیست‌شناسی، دانشکده علوم پایه، دانشگاه مازندران، بابلسر، ایران

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٪)، همی‌کریپتوفیت‌ها (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 فلوریستیکی 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

* a.naqinezhad@umz.ac.ir