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RESEARCH ARTICLE

Flora, Life Forms and Chorotypes of Forest Floor Plants in the Asalem Forests, Western Hyrcanian, Iran

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ABSTRACT

The aim of this research was to introduce the forest floor plants species, their life-forms, and describe their geographic distribution in the Asalem Watershed basin (no.7), Western Guilan province (part of Western Hyrcanian) in northern forests of Iran. The Asalem forest is one of the most important and valuable areas of Caspian forest in Iran. The study was conducted on 91 plots of 400 m^2 (20 × 20 m) along 19 transects in the basis of a random- systematic sampling design. Inside each main plot, three quadrates (5 × 5 m) on the diagonal line and internal quadrates (1 × 1 m) were chosen, and all of the floor plants collected. The results revealed that there were 306 species, 181 genera and 54 families. The main family was Poaceae with 36 species and 25 genera (12%). Then, the highest number of species belonged to the Asteraceae with 28 species, Fabaceae with 26 species, Lamiaceae with 20 species, Rosaceae with 14 species, Apiaceae and Cyperaceae each including 13 species, Caryophyllaceae with 12 species, Rubiaceae and Orchidaceae each including 11 species. Regarding to the life forms, Hemicryptophytes with 45% (137 species) were the largest group. The chorological analysis indicated that species belonging to the regions of Euro-Siberian were the most significant ecological groups.

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Introduction

Iran is one of the centres of global biodiversity (Farashi & Shariati, 2017). The number of vascular plants in north provinces in Iran and Talesh of Azarbaijan republic is approximately 3234 species, belonging to 856 genera and 148 families (Akhani et al., 2010). Floristic study of an area is one of the most effective methods in managing and protecting the genetic resources of that area (Park et al., 2018). The vegetation of an area results from the environmental conditions, interactions among species, reflects its geographical conditions (Huang et al., 2022). The distribution of vegetation patterns is not accidental, but a plant community includes a collection of species with similar entities and ecological needs which selects a particular site affected by environmental conditions such as soil properties and topographic conditions. Identifying the vegetation of each region and understanding their ecological interactions are necessary for each study and these are the basis of the vegetation map of that area. Floor plants species in a forest area show the potential and the capability of vegetative area, increase the number of species in terms of density, and identify the resistant and invasive species, medicinal plants, and their proper use.

The life form of any plant is fixed to development based on morphological adaptation of plants to environmental conditions (Doležal et al., 2021). According to Raunkiaer's classification system, plant species can be grouped into five main classes:

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Phanerophytes, Chamaephytes, Hemicryptophytes, Cryptophytes, and Therophytes. Ecological range of each plant species has a unique variation that will tolerate an environmental gradient and distribution of each plant species may be limited or widespread (Dew et al., 2017).

Iran consists of four important phytogeographical zones, including: Irano-Turanian, Euro-Siberian, Sahara-Saudi Arabian, and Sudan like a bridge (Naqinezhad et al., 2009). Several studies on the flora and their life forms have been carried out in Iran (Asri & Eftekharti, 2003; Atashgahi et al., 2008; Azimi Motem et al., 2011; Basiri et al., 2011; Nadaf et al., 2011; Ghahremaninejad et al., 2012; Khajedin & Yeganeh, 2012; Heydari et al., 2013; Moradi et al., 2013; Pourmoghaddam et al., 2013; Ravanbakhsh et al., 2013; Adel et al., 2014; Mataji et al., 2014; Eslami Farouji & Khodayari, 2015; Gahanbakhsh Ganje & Ebadi, 2015; Soleymanipour & Esmailzadeh, 2015; Akhondnejad et al., 2016; Bakhshandeh Navroud et al., 2017; Negahdarsaber et al., 2016; Dehshiri et al., 2017; Salahi et al., 2018), but few studies have been conducted on the structure and flora of the floor layer in the plant communities in the western part of Caspian forest in Iran. In fact, the western part of Caspian forest in Iran is one of the most important and most valuable parts of Caspian forest and comprises commercial forest with unique vegetation. Vegetation of this area shows a high similarity to vegetation of central European forests (Pourbabaei et al., 2019). Then, it is necessary to do more research to achieve more reliable results concerning flora, geographical distribution, and life forms of this area. The aim of this research was to identify the forest floor plants of Asalem watershed basin where it is one of the largest, the most commercial and unique watersheds in the western part of Caspian forest in north of Iran.

Materials and Methods

Study Area

This study was conducted in the Asalem Watershed basin (no. 7), western Guilan province (part of Western Hyrcanian) in northern forests of Iran. Hyrcanian forests form a unique forested massif that stretches 850 km along the southern coast of the Caspian Sea. The studied area is situated in latitude from 37°36′31″ to 37°44′40″ N and longitude from 48°35′17″ to 48°56′26″ E (Figure 1). The minimum and maximum altitudes were 200 and 1800 m a.s.l., respectively. This region has northern and southern aspects and the slope is from moderate (5%) to high (95%). This area covers approximately 22,000 ha of forests. The average annual precipitation and temperature are about 945 mm and 12.4 ℃, respectively. The climate is temperate and humid (Pourbabaei et al., 2020). The common forest soil orders are Alfisols and Inceptisols according to USDA soil classification (Pourbabaei et al., 2019).

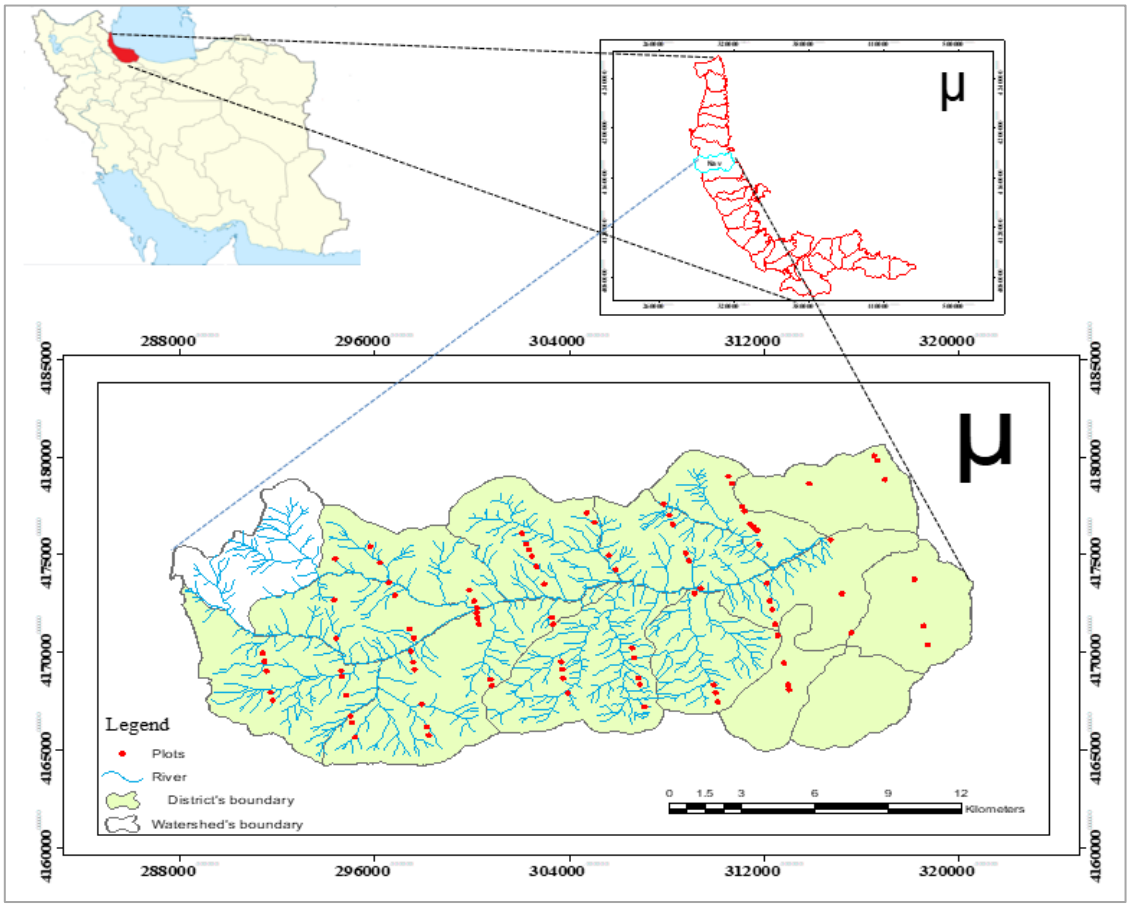

Figure 1. The location of study area, Asalem Watershed basin, north forest of Iran

Field Sampling

The floristic data were collected during the growing season since 2021. Nineteen altitudinal transects were established with 3 km from each other. 46 and 45 sampling plots were located on the southern and northern slopes, respectively between 200 and 1800 m a.s.l. with 200 m intervals. In total, data were collected from 91 plots of 400 m^2 (20 × 20 m) area along transects in the basis of a random-systematic sampling design. To study the floor plants, inside of each sampling plot, three quadrats (5 × 5 m) on the diagonal line and internal (1 × 1 m) quadrates were chosen (Fu et al., 2004).

Identification of Flora

Collected species were dried and pressed, and then they were identified using Flora Iranica (Rechinger, 2015), Flora of Iran (Asadi, 2016), and the Color flora of Iran (Ghahreman, 2006). The life form of plant species was determined using Raunkiaer's method. Chorotype of each species was determined based on Zohary (1973) and Léonard (1992).

Results

In the study area, 306 species belonging to 181 genera and 54 families were found. The highest number of species belonged to the Poaceae family with 36 species and 25 genera (12%). In addition, the other families were Asteraceae with 28 species, Fabaceae with 26 species, Lamiaceae with 20 species, Rosaceae with 14 species, Apiaceae and Cyperaceae each including 13 species, Caryophyllaceae with 12 species, Rubiaceae and Orchidaceae each including 11 species. In total, more than 60% of all species in study area belonged to these 10 families (Figure 2). The list of identified species is presented in Table 1.

Table 1. List of species, family, life form and chorotypes in the study area

Family	Species	Life-form[1]	Chorotype[2]
Amaryllidaceae	*Allium ursinum* L.	Ge	ES, IT, M
	Galanthus caucasicus (Baker) Grossh.	Ge	ES
	Galanthus transcaucasicus Fomin.	Ge	ES
Apiaceae	*Albovia tripartita* (Kalen.) Schischk.	He	ES
	Anthriscus cerefolium (L.) Hoffm.	He	IT, ES
	Bupleurum falcatum L.	He	IT, M
	Bupleurum marschallianum C. A. Mey	Ge	Pl
	Cervaria cervariifolia (C. A. Mey.) Pimenov.	He	IT, ES
	Chaerophyllum meyeri Boiss. & Buhse	He	IT
	Eryngium caeruleum M. Bieb.	He	ES, IT
	Laser trilobum (L.) Borkh.	He	ES, M
	Libanotis transcaucasica Schischk.	He	ES
	Pimpinella affinis Ledeb.	He	Pl
	Sanicula europaea L.	He	Pl
	Torilis arvensis (Huds.) Link	Th	ES, IT, M
	Torilis nodosa (L.) Gaertn.	He	IT, ES
Apocynaceae	*Vincetoxicum funebre* Boiss. & Kotschy.	Ch	IT, ES
	Vincetoxicum scandens Sommier & Levier.	He	ES, IT
Araceae	*Arum maculatum* L.	Ge	ES
Asparagaceae	*Danae racemosa* (L.) Moench	Ge	ES
	Muscari neglectum Guss. ex Ten.	Ge	Pl
	Ornithogalum sintenisii Freyn	Ge	IT
	Polygonatum multiflorum (L.) All.	Ge	ES
	Polygonatum orientale Desf.	Ge	ES, IT, M
	Ruscus hyrcanus Woronow	Ph	IT
	Scilla persica Hausskn.	Ge	IT
	Scilla siberica subsp. *caucasica* (Miscz.)	Ge	ES
Aspidiaceae	*Dryopteris affinis* Fraser- Jenk.	Ge	ES
	Dryopteris radeana (Fomin) Fomin.	Ge	Pl

Table 1. (continued)

Family	Species	Life-form[1]	Chorotype[2]
Aspleniaceae	*Asplenium adiantum-nigrum* L.	Ge	Pl
	Asplenium ceterach L.	Ge	IT, ES
	Asplenium scolopendrium L.	Ge	Pl
	Asplenium trichomanes L.	Ge	Pl
	Asplenium onopteris L.	Ge	Pl
	Athyrium filix-femina (L.) Roth.	Ge	Pl
	Matteuccia struthiopteris (L.) Tod.	Ge	Pl
Asteraceae	*Artemisia annua* L.	Th	ES, IT, M
	Bidens tripartita L.	Th	Pl
	Carpesium abrotanoides L.	He	ES
	Carpesium cernuum L.	Th	ES
	Centaurea hyrcanica Bornm.	He	ES
	Crepis sancta (L.) Bornm.	Th	IT, ES
	Erigeron canadensis L.	He	Pl
	Eupatorium cannabinum L.	He	ES
	Filago vulgaris Lam.	Th	ES
	Hieracium prenanthoides Vill.	He	ES
	Hieracium procerum Fr.	He	IT, ES
	Klasea quinquefolia (Willd.) Greuter & Wagenitz	He	ES
	Klasea radiata (Waldst. & Kit.) Á. Löve & D. Löve	He	ES
	Lactuca garganica Rech. F. & Esfand.	Th	ES
	Lactuca macrophylla (Willd.) A. Gray	Th	ES, M
	Lactuca sativa L.	He	ES
	Lactuca serriola L.	He	ES, IT, M
	Lapsana communis L.	He	ES, IT
	Leontodon asperrimus (Willd.) Endi.	He	ES, IT
	Myriactis wallichii Less.	He	ES, IT
	Petasites albus (L.) Gaertn.	Ge	ES
	Pilosella procera (Fr.) F. W. Schultz & Sch. Bip.	He	ES, IT
	Psephellus zuvandicus Sosn	He	ES, IT
	Sigesbeckia orientalis L.	Th	COSM
	Solidago virgaurea L.	He	ES
	Tanacetum parthenium (L.) Sch. Bip	He	IT, ES, M
	Taraxacum syriacum Boiss.	He	IT
	Willemetia tuberosa Fisch. & C. A. Mey. ex DC	Ge	IT
Berberidaceae	*Epimedium pinnatum* Fisch. ex DC.	Ge	ES
Boraginaceae	*Myosotis anomala* Riedi	Th	ES
	Symphytum asperrimum Donn ex Sims.	He	ES
Brassicaceae	*Alliaria petiolata* (M. Bieb.) Cavara & Grande.	He	ES, IT, M
	Cardamine bulbifera (L.) Crantz.	He	ES
	Cardamine impatiens L.	Th	ES, IT
	Cardamine parviflora L.	Th	ES
	Erophila verna (L.) DC.	Th	Pl
	Hesperis hyrcana Bornm. & Gauba	He	ES
	Thlaspi hastulatum (Stev. Ex) DC.	Th	ES, IT
	Thlaspi perfoliatum L.	Th	IT
Campanulaceae	*Campanula odontosepala* Boiss.	He	ES, IT
	Campanula rapunculoides L.	He	ES
Caprifoliaceae	*Dipsacus strigosus* Willd. ex Roem. & Schult.	Th	ES
	Valeriana alliariifolia Vahl.	He	IT

Table 1. (continued)

Family	Species	Life-form[1]	Chorotype[2]
Caryophyllaceae	*Arenaria serpyllifolia* L.	Th	ES, M, IT
	Cerastium cerastioides (L.) Britton.	He	IT, ES, M
	Cerastium dichotomum L.	Th	IT, ES, M
	Melandrium persicum (Boiss & Buhse) bornm.	He	IT
	Moehringia trinervia (L.) clairv.	Th	ES, IT
	Petrorhagia saxifraga (L.) Link.	He	IT, ES
	Polycarpon tetraphyllum (L.) L.	Th	ES, M
	Scleranthus orientalis Rössler	He	IT
	Silene latifolia Poir.	He	ES, IT
	Silene schafta J. G. Gmel. ex Hohen.	He	ES
	Stellaria holostea L.	Ge	ES, IT
	Stellaria media (L.) Vill.	Th	COSM
Convulvulaceae	*Calystegia sylvestris* (Willd.) Roem. & Schult.	Ge	ES, IT, M
	Convolvulus cantabrica L.	He	ES, IT
Crassulaceae	*Rosularia sempervivum* (M. Bieb.) A. Berger.	He	IT
	*Sedum hispanic*um L.	He	ES, IT, M
	Sedum stoloniferum S. G. Gmel.	He	ES
Cyperaceae	*Carex caucasica* Steven.	Ge	IT, ES
	Carex cuprina (Sándor ex Heuff.) Nendtv. ex A. Kern.	*Ge*	ES, IT
	Carex depressa Link.	Ge	ES
	Carex digitata L.	Ge	ES
	Carex divulsa Stokes.	Ge	COSM
	Carex grioleti (Roem. ex Schkuhr) J. Gay.	He	ES, IT, M
	Carex humilis Leyss.	Ge	ES
	Carex melanostachya M. Bieb. ex. Willd.	Ge	ES, IT, M
	Carex pendula Huds.	Ge	ES, M, IT
	Carex phyllostachys C. A. Mey.	He	ES
	Carex remota L.	He	ES, M
	Carex strigosa Huds.	He	ES
	Carex sylvatica Huds.	Ge	ES
Dennstaedtiaceae	*Pteridium aquilinum* (L.) Kuhn	Ge	Pl
Dioscoreaceae	*Tamus communis* L.	Ge	ES, M
Ericaceae	*Pyrola rotundifolia* L.	Ge	ES
Euphorbiaceae	*Acalypha australis* L.	Th	Pl
	Euphorbia amygdaloides L.	Ch	ES, M
	Euphorbia macroceras Fisch. & C. A. Mey.	Ge	ES
	Euphorbia squamosa Willd.	Ge	ES, IT
	Euphorbia stricta L.	Th	ES, IT
	Mercurialis perennis L.	Ge	ES, M
Fabaceae	*Astragalus glycyphyllos* L.	He	ES, IT
	Astragalus jodostachys Boiss & Buhse.	He	ES
	Lathyrus aphaca L.	Th	ES, IT, M
	Lathyrus laxiflorus (Desf.) Kuntze.	He	ES
	Lathyrus nissolia L.	Th	IT, ES, M
	Lathyrus pratensis L.	He	IT, M
	Lathyrus roseus Steven	He	IT, ES
	Lathyrus vernus (L.) Bernh.	He	ES
	Medicago sativa L.	Th	IT
	Medicago lupulina L.	He	ES, IT
	Medicago orbicularis (L.) Bartal.	Th	ES, IT, M, SS
	Medicago polymorpha L.	Th	IT, SS

Table 1. (continued)

Family	Species	Life-form[1]	Chorotype[2]
Fabaceae	*Securigera orientalis* (Mill.) Lassen	He	ES
	Securigera varia (L.) Lassen	He	IT, ES
	Trifolium arvense L.	Th	ES, M
	Trifolium campestre Schreb.	Th	ES, IT, M
	Trifolium caucasicum Tausch	Th	ES
	Trifolium echinatum M. Bieb.	He	IT, ES
	Trifolium pratense L.	He	Pl
	Trifolium repens L.	He	Pl
	Trifolium tumens Steven ex M. Bieb.	Ge	IT, M
	Trigonella spruneriana Boiss.	Th	IT
	Vavilovia formosa (Steven) Fed.	He	ES
	Vicia abbreviata Fisch. ex Spreng.	He	ES
	Vicia crocea (Desf.) B. Fedtsch.	He	ES
	Vicia tetrasperma (L.) Schreb.	Th	ES, IT, M
Gentianaceae	*Centaurium minus* Moench.	Th	ES, IT, M
Geraniaceae	*Geranium dissectum* L.	He	ES, IT
	Geranium gracile Ledeb. ex Nordm.	He	ES
	Geranium molle L.	He	ES, IT
	Geranium robertianum L.	Th	COSM
	Geranium rotundifolium L.	Th	ES, IT, M
Hypericaceae	*Hypericum androsaemum* L.	Ch	ES
	Hypericum hirsutum L.	He	ES
	Hypericum perforatum L.	He	PL
	Hypericum tetrapterum Fr.	He	ES
Iridaceae	*Crocus caspius* Fisch. & C. A. Mey. ex Hohen.	Ge	ES, IT
	Crocus sativus L.	Ge	Pl
	Gladiolus italicus Mill.	Ge	IT, ES, M
Ixioliriaceae	*Ixiolirion tataricum* (Pall.) Schult. & Schult.f.	Ge	IT, ES
Juncaceae	*Juncus effusus* L.	Ge	COSM
	Luzula forsteri (Smith.) DC.	Ge	ES, M
	Luzula multiflora (Ehrh.) Lej.	He	Pl
Lamiaceae	*Prunella vulgaris* L.	He	ES, IT, M
	Calamintha grandiflora (L.) Moench.	He	ES
	Clinopodium nepeta (L.) Kuntze	He	ES
	Clinopodium umbrosum (M. Bieb.) K. Koch	He	PL
	Clinopodium vulgare L.	He	ES, IT, M
	Lamium album L.	He	ES, IT
	Lamium galeobdolon (L.) L.	He	ES
	Lycopus europaeus L.	Ge	Pl
	Mentha aquatica L.	Ge	ES
	Nepeta racemosa Lam.	He	IT, ES
	Origanum vulgare L.	He	Pl
	Prunella laciniata (L.) L.	He	ES
	Prunella vulgaris L.	Ge	Pl
	Salvia glutinosa L.	He	ES, IT, M
	Scutellaria tournefortii Benth.	Ge	ES
	Stachys byzantina K. Koch.	He	ES
	Stachys iberica M. Bieb.	He	IT
	Teucrium chamaedrys L.	He	ES, M, IT
	Teucrium hyrcanicum L.	He	ES
	Teucrium polium L.	Ch	IT, M

Table 1. (continued)

Family	Species	Life-form[1]	Chorotype[2]
Liliaceae	*Erythronium caucasicum* Woronow.	Ge	ES
Lythraceae	*Lythrum salicaria* L.	He	COSM
Malvaceae	*Alcea hyrcana* Grossh.	He	ES
Onagraceae	*Circaea lutetiana* L.	Ge	ES, IT, M
Ophioglossaceae	*Ophioglossum lusitanicum* L.	Ge	Pl
	Ophioglossum vulgatum L.	Ge	ES, IT
Orchidaceae	*Cephalanthera caucasica* Kraenzi.	Ge	ES
	Cephalanthera longifolia (L.) Fritsch	Ge	ES
	Cephalanthera rubra (L.) Rich.	Ge	ES, M
	Epipactis helleborine (L.) Crantz.	Ge	Pl
	Epipactis microphylla (Ehrh.) Sw.	Ge	ES‹IT
	Epipactis persica (Soó) Hausskn. ex Nannf.	Ge	ES‹IT
	Listera ovata (L.) R. Br.	Ge	ES
	Neottia nidus-avis (L.) Rich.	Ge	ES, M
	Orchis adenocheila Czerniak.	He	IT
	Platanthera bifolia (L.) Rich.	Ge	M
	Steveniella satyrioides (Spreng.) Schltr.	Ge	ES
Orobanchaceae	*Orobanche cernua* Loefl	He	IT, ES
Oxalidaceae	*Oxalis acetosella* L.	He	Pl
Papaveraceae	*Corydalis cava* subsp. *marschalliana* (willd.) Hayek	He	ES
Phytolaccaceae	*Phytolacca americana* L.	He	Pl
Plantaginaceae	*Plantago lagopus* L.	Th	Pl
	Plantago major L.	He	COSM
	Veronica serpyllifolia L.	He	ES
	Veronica arvensis L.	Th	COSM
	Veronica aucheri Boiss.	He	IT
	Veronica crista-galli Steven	Th	IT
	Veronica officinalis L.	He	ES, M
	Veronica persica Poir.	Th	COSM
Poaceae	*Aegilops cylindrica* Host	Th	IT, SS
	Bothriochloa ischaemum (L.) Keng.	He	Pl
	Brachypodium pinnatum (L.) P. Beauv.	He	ES, M, IT
	Brachypodium sylvaticum (Huds.) P. Beauv.	He	Pl
	Bromus tectorum L.	Th	COSM
	Bromus benekenii (Lange) Trimen.	He	ES, IT, M
	Bromus japonicus Thunb.	Th	IT
	Bromus sericeus Drobow	He	IT
	Bromus sterilis L.	Th	ES, IT, M
	Catapodium rigidum (L.) C. E. Hubb.	Th	ES, IT, M
	Cleistogenes serotina (L.) Keng	He	ES
	Cynodon dactylon (L.) Pers.	He	Pl
	Cynosurus echinatus L.	He	ES, IT
	Dactylis glomerata L.	He	Pl
	Deschampsia caespitosa P. Beauv.	He	ES
	Digitaria sanguinalis (L.) Scop.	Th	Pl
	Festuca drymeia Mert. & Koch	Ge	ES
	Festuca gigantea (L.) Vill	He	ES
	Lolium perenne L.	He	Pl
	Melica uniflora Retz.	Ge	ES, IT
	Microstegium vimineum (Trin.) A. Camus	He	Pl

Table 1. (continued)

Family	Species	Life-form[1]	Chorotype[2]
Poaceae	*Milium vernale* M. Bieb.	Th	ES, IT
	Oplismenus undulatifolius (Ard.) P. Beauv.	Ge	ES
	Paspalum dilatatum Poir.	Ge	Pl
	Phleum phleoides (L.) H. Karst.	He	IT, M, ES
	Poa annua L.	Th	Pl
	Poa longifolia Trin.	Th	IT, ES
	Poa nemoralis L.	Th	ES, IT
	Poa masenderana Freyn & Sint.	Ge	Pl
	Poa trivialis L.	He	ES, M, IT
	Polypogon fugax Nees ex Steud.	Th	Pl
	Rostraria cristata (L.) Tzvelev.	Th	ES, IT, M
	Setaria glauca (L.) P. Beauv.	Th	Pl
	Setaria viridis (L.) P. Beauv.	Th	ES
	Trisetum flavescens (L.) P. Beauv.	Th	IT, M
	Vulpia myuros (L.) C. C. Gmel.	Th	IT, M
Polygonaceae	*Persicaria hydropiper* (L.) Delarbre	Th	Pl
	Persicaria hyrcanica Fisch. Et Mey.	Th	Pl
	Polygonum aviculare L.	Th	COSM
	Polygonum convolvulus L.	Th	Pl
	Rumex conglomeratus Murray	He	ES, IT
Polypodiaceae	*Dryopteris caucasica* (A. Braun) Fraser-Jenk. & Corley.	Ge	ES
	Dryopteris dilatate (Hoffm.) A. Gray	Ge	Pl
	Polypodium interjectum Shivas	Ge	ES, M
	Polypodium vulgare L.	Ge	Pl
	Polystichum aculeatum (L.) Roth	Ge	Pl
	Polystichum braunii (Spenn.) Fée	Ge	ES
	Polystichum setiferum (Forssk.) T. Moore ex Woynar	Ge	ES
	Polystichum woronowii Fomin	Ge	ES
Primulaceae	*Cyclamen coum* Mill.	Ge	ES
	Primula heterochroma Stapf	He	ES, IT
	Primula vulgaris Huds.	He	ES, IT
Pteridaceae	*Pteris cretica* L.	Ge	ES
Ranunculaceae	*Ranunculus constantinopolitanus* (DC.) d'Urv.	Ge	ES
	Ranunculus caucasicus M. Bieb.	Th	IT, ES, M
Rosaceae	*Agrimonia eupatoria* L.	He	ES
	Alchemilla plicatissima S. E. Fröhner	Th	ES
	Fragaria vesca L.	Ge	ES, IT
	Fragaria viridis subsp. *viridis*	Ge	ES
	Geum urbanum L.	He	ES
	Potentilla crantzii (Crantz) Beck ex Fritsch	He	ES, IT
	Potentilla micrantha Ramond ex DC.	He	ES, IT, M
	Potentilla reptans L.	He	ES, IT
	Rubus caesius L.	Ph	ES, IT
	Rubus dolichocarpus Juz.	Ph	ES, IT
	Rubus hyrcanus Juz.	Ph	ES
	Rubus hirsutus Thunb.	Ph	ES, M
	Rubus hirtus Waldst & Kit.	Ph	ES
	Sanguisorba minor Scop.	He	ES, M, IT

Table 1. (continued)

Family	Species	Life-form[1]	Chorotype[2]
Rubiaceae	*Asperula glomerata* (M. Bieb.) Griseb.	Ch	IT
	Asperula odorata L.	Ge	ES, M
	Asperula setosa Jaub. & Spach.	Th	IT
	Asperula taurina L.	Ge	ES
	Cruciata laevipes Opiz	He	IT
	Galium caspicum Steven	He	ES, M
	Galium ghilanicum Stapf	Th	ES, IT, M
	Galium rotundifolium L.	Ge	ES, M
	Galium spurium L.	Th	ES, IT
	Galium tenuissimum M. Bieb.	Th	ES
	Phuopsis stylosa (Trin.) G. Nicholson	He	ES
Scrophulariaceae	*Digitalis nervosa* Steud. & Hochst. ex Benth.	He	ES
	Rhynchocorys elephas (L.) Griseb.	He	ES
	Scrophularia vernalis L.	He	IT
Smilacaceae	*Smilax excelsa* L.	Ph	ES, M
Solanaceae	*Atropa belladonna* L.	Ge	ES
	Solanum kieseritzkii C. A. Mey.	Th	ES
	Solanum nigrum L.	Th	COSM
Urticaceae	*Parietaria officinalis* L.	He	M
	Urtica dioica L.	He	COSM
Viburnaceae	*Sambucus ebulus* L.	He	ES, M, IT
Violaceae	*Viola alba* Besser	He	ES
	Viola hirta. L.	He	ES
	Viola ignobilis Rupr.	He	ES
	Viola odorata L.	He	ES, M
	Viola sieheana W. Becker	Ge	ES
	Viola suavis M. Bieb.	He	M, IT

[1]Life forms in the studied area: Phanerophyte (Ph), Chamaephytes (Ch), Hemicryptophytes (He), Therophytes (Th), Geophytes (Ge). [2]Chorotypes in studied area: Cosmopolitan (COSM), Euro-Siberian (ES), Irano-Turanian (IT), Mediterranean (M), Pluri-regional (Pl), Sahara-Sindian (SS).

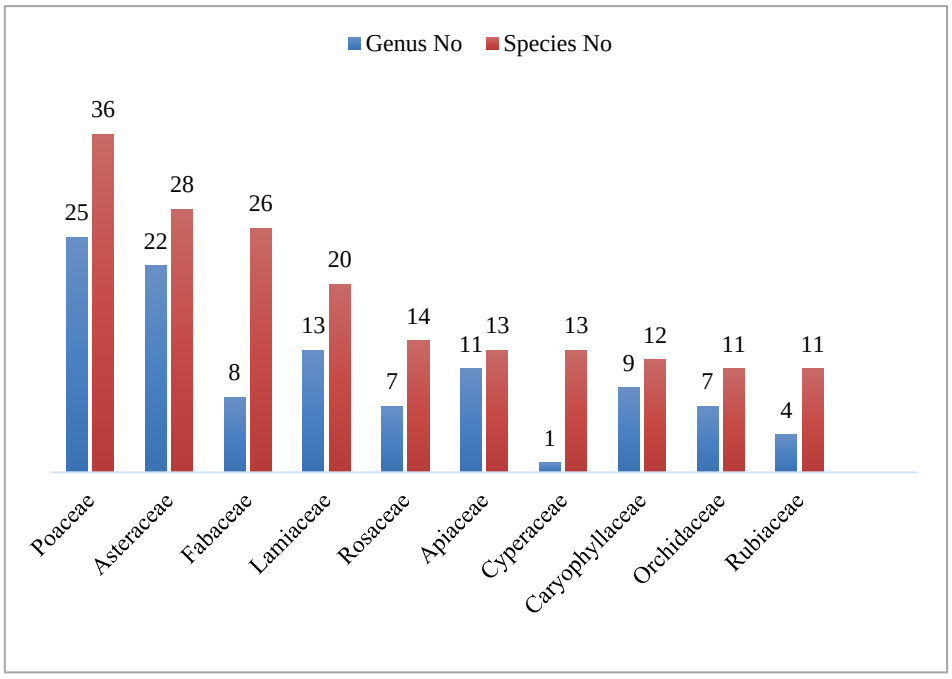

Figure 2. The richest families in terms of number of species and genera

With respect to life forms, hemicryptophytes with 45% (137 species) were the largest group, followed by Geophytes with 29% (89 species), Therophytes with 22% (68 species), Phanerophytes with 2% (7 species), and Chamaephytes with 2% (5 species) (Figure 3).

In terms of geographical distribution, the species with Euro-Siberian elements were the most frequent 32% (97 species). Irano-Turanian/Euro-Siberian 18% (54 species), Pluri-regional 16% (48 species), Irano-Turanian/Euro-Siberian/Mediterranean 13% (39 species), Irano-Turanian 7% (22 species), Euro-Siberian/Mediterranean 7% (20 species), cosmopolitan 4% (13 species), Irano-Turanian/Mediterranean 2% (6 species) were ranked next places in the category ratings. Other chorotypes were in low proportion (1%) (Figure 4).

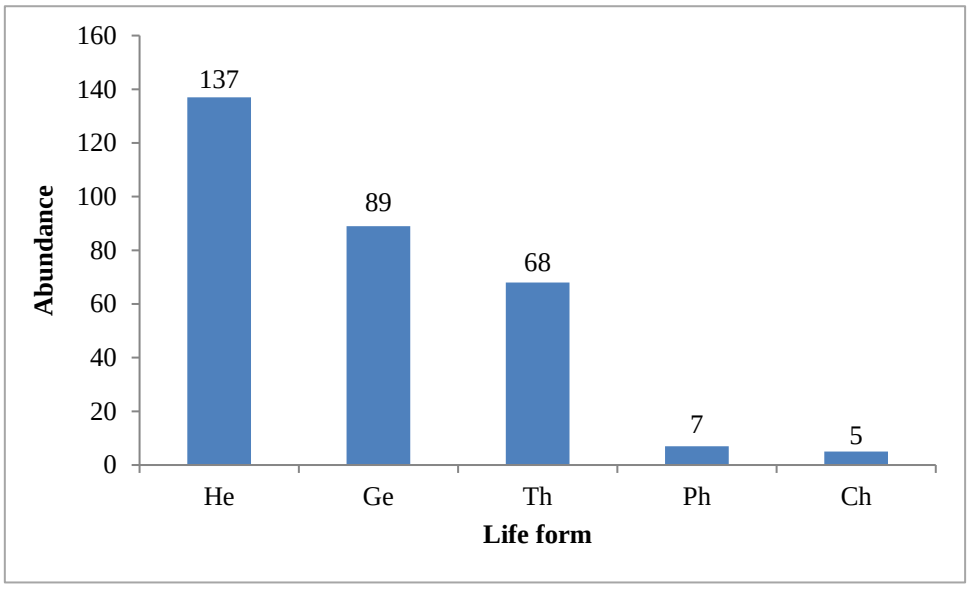

Figure 3. Life forms of floor plants in the study area

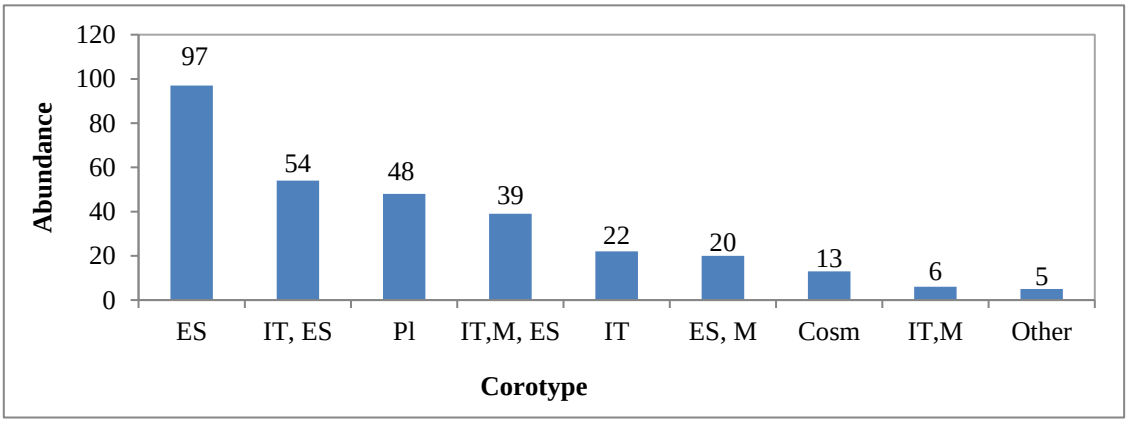

Figure 4. Chorology of floor plants in the study area

Discussion

The study area is in the Asalem Watershed basin (no. 7). This region is in the west of Caspian forests in Iran and it is one of the most important and valuable parts of them. There isn´t much study on the floor plants, life forms and chronology of plant species in the Asalem forest, and this study showed the importance of floor plants in this forest. The results indicated that the mean annual precipitation, temperate and humid climate have caused a high number of species and genera in the study area. This result was supported by the existence of 306 species, 181 genera and 54 families. In the floristic study of herbaceous plants in Hyrcanian beech forests was identified 109 species (Bakhshandeh Navroud et al., 2017). Also, in the Bibi Yanlou's Forest Park, in Astara 92 plant species was identified (Salahi et al., 2018). In another research that conducted in Gisoum forest reserve in Talesh, 76 plant species was determined (Ravanbakhsh et al., 2013). The total of the 10 major families was 60%, the rest families comprising 40%. These families were Poaceae, Asteraceae, Fabaceae, Lamiaceae, Rosaceae, Cyperaceae, Apiaceae, Caryophyllaceae, Rubiaceae, and Orchidaceae. Abundance of species in families namely Poaceae, Lamiaceae, and Orchidaceae were consistent with the result of beech forest, Asalem region, (Bakhshandeh Navroud et al., 2017) and

abundance of species in Asteraceae, Caryophyllaceae, Cyperaceae, and Poaceae were like the result of from Bojag National Park (Naginezhad et al., 2006). After Poaceae family the highest number of species were within the Asteraceae and Fabaceae. It is known that Asteraceae members possess the high potential to adapt the harsh conditions and distribute with the seeds. In addition, this family has easy dispersal ability, and some members of the family have spines for protection against potential grazers (Xu et al., 2020).

The other families such as Fabaceae and Poaceae which belong to 10 major families, are important in terms of soil conservation. (Heydari et al., 2013). It is known that the life forms of each area reflect the type of climate, precipitation values, and extent of dry seasons (Khajedin & Yeganeh, 2012). Regarding to the life forms, hemicryptophytes were dominant. It is common in mountainous climate and shows its adaptability with regional ecological conditions (Soft et al., 2022). Hemicryptophytes resist in unfavorable environmental conditions with lying vegetative buds in the soil surface in winter and this feature causes a high resistance to cold temperature conditions. Moreover, Geophytes are 29% of the plants and indicates mountainous area (Tojibaev et al., 2018).

Therophytes display unfavorable environmental conditions, destruction of the region, and anthropogenic pressures (Haq et al., 2019). A high proportion of therophytes (22%, 68 species) revealed that precipitation is decreasing and growth seasons is declining in the study area. The low percentage of chamaephytes and phanerophytes indicated that they were not adapted to existing climate and edaphically conditions. The geographic distribution of plants reflects the climate condition. Considering this fact that 32% (97 species) of herbaceous species were only Euro-Siberian elements and 38% were Euro-Siberian and other chorotypes, we can conclude that the study region belongs to the Euro-Siberian. The present study showing the importance of Asalem watershed basin in terms of plant diversity which also reflects the favorable climate for plant growth and it will be possible to apply these results for management of Asalem forest.

Conclusion

The results of this study indicated that the study area has a high species diversity. Several factors can be involved in the composition and high diversity of the flora of this region. Ecological features, especially topography such as elevation, slopes with different directions and deep valleys were effective factors in the rich flora and the presence of numerous plant communities in the region. The results showed that this region includes 306 plant species that belong to 54 families and 181 genera. The most important families were Poaceae with 36 species, Asteraceae with 28 species, Fabaceae with 26 species, Lamiaceae with 20 species, Rosaceae with 14 species, Apiaceae and Cyperaceae each including 13 species, Caryophyllaceae with 12 species, Rubiaceae and Orchidaceae each including 11 species. The major life form of the region was hemicryptophyte with 45% and in terms of geographical distribution belongs to Euro-Siberian with 97 species. In this study area topographic factors have a higher impact on the distribution of groups, so that the effect of soil properties diminishes. Identifying how this relates and its effects plays a key role in management programs such as vegetation conservation, soil and water protection, and restoring of plant communities.

Conflict of Interest

The authors declare that they have no conflict of interest.

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