

FLORISTIC STUDIES AND ECOLOGY OF CYPRESS COMMUNITIES (CUPRESSUS SEMPERVIRENS L.) IN HYRCANIAN CHORION, NORTH OF IRAN

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Cupressus sempervirens L. is the only native *Cupressus* in Iran. Basically, the placement of real Mediterranean Forests in the Euro-Siberian vegetation is not expected although its presence in Hyrcanian areas is valuable. In this study; floristic composition, life forms, and chorological spectrum in habitats were analyzed. A total of 700 species belonging to 386 genera from 87 families were recorded. Fabaceae (75), Asteraceae (72), Poaceae (71), and Lamiaceae (46), comprise the largest number of species. 81 species of trees and shrubs grow along with cypress in these areas. Among the recorded life forms, therophytes with 273 species, and hemicryptophytes with 224 species were dominant. More than 85% of the species have at least one Mediterranean or western Iran-Turanian chorotype, which shows a close relationship between cypress growing areas in Iran and the main Mediterranean areas. A total number of 59 species were endemic to Iran. Of these, 31 species (52%) are common with the Irano-Turanian region, 26 species (44%) with the Hyrcanian province, and 2 species (4%) with the Mediterranean region. The results were compared to other studies in the other areas where the cypress does not grow and the cypress grows but outside the Hyrcanian range (Firoozabad, Fars). Our goal is to do a complete floristic and vegetation study in common cypress habitats in Hyrcanian chorion that had imperfections of data. Although these habitats are located within the Hyrcanian chorion, results revealed the floristic composition is not similar to that of the typical Hyrcanian habitats.

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Keywords: Common cypress; *Cupressus sempervirens*; Hyrcanian subprovince; life form, chorology; northern Iran

مطالعات فلورستیک و اکولوژی جوامع زربین (*Cupressus sempervirens* L.) در منطقه هیرکانی، شمال ایران.

طیبه امینی: دانش‌آموخته دکتری اکولوژی گیاهی، آزمایشگاه تحقیقاتی اکولوژی آماری و تنوع زیستی گیاهی، گروه زیست‌شناسی، دانشکده علوم، دانشگاه فردوسی مشهد

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حبیب زارع: باغ گیاه‌شناسی نوشهر، بخش گیاه‌شناسی موسسه تحقیقات جنگلها و مراتع، سازمان تحقیقات و آموزش کشاورزی، ایران

زربین (*Cupressus sempervirens* L.) تنها سرو بومی ایران و عنصری مدیترانه‌ای است. اگر چه وجود آن در رویشگاه هیرکانی ارزشمند است ولی حضور جنگل‌های مدیترانه‌ای در منطقه یورو- سیبری دور از انتظار است. برای اولین بار، ترکیب فلورستیکی، شکل‌های زیستی و پراکنش گونه‌ها در رویشگاه‌های هیرکانی زربین مورد تجزیه و تحلیل قرار گرفت. ۷۰۰ گونه گیاهی متعلق به ۳۸۶ جنس از ۸۷ تیره شناسایی گردید. نیامداران با ۷۵، آفتابگردان با ۷۲، گندمیان با ۷۱ و نعنائیان با ۴۶ گونه بزرگترین تیره‌های موجود هستند. تعداد ۸۱ گونه درخت و درختچه، همراه با زربین رشد می‌کنند. تروفیت‌ها با ۲۷۳ و همی کریپتوفیت‌ها با ۲۲۴ گونه بیشترین تعداد را داشتند. بیش از ۸۵٪ گونه‌ها دارای کروتیپ مدیترانه‌ای یا غرب ایران و توران هستند که ارتباط نزدیکی را بین منطقه مدیترانه اصلی و مناطق رویشی سرو در ایران، نشان می‌دهد. در این رویشگاه‌ها ۵۹ گونه انحصاری وجود دارد که ۳۱ گونه با ۵۲٪ انحصاری ناحیه ایران- تورانی، ۲۶ گونه با ۴۴٪ انحصاری پروونس هیرکانی و ۲ گونه حدود ۴٪ انحصاری مدیترانه هستند. نتایج این تحقیق با نتایج مطالعات در سایر مناطق هیرکانی که زربین در آنها رشد نمی‌کند و با رویشگاه زربین در فیروزآباد فارس که خارج از مناطق هیرکانی است، مقایسه شد. نتایج نشان داد که اگر چه مناطق مورد مطالعه کاملاً درون مناطق هیرکانی قرار گرفته‌اند ولی مشابه رویش‌های هیرکانی نبوده و شباهت بیشتری به مناطق رویشی مدیترانه‌ای و ایران و تورانی دارند.

INTRODUCTION

The Hyrcanian chorion is a unique forested massif that extends from southeastern Azerbaijan eastwards to the Golestan Province in Iran. This chorion is a World Heritage for Iran (IUCN 2019). Due to the historical isolation, the region hosts many relicts, endangered, and regionally and locally endemic species with high ecological values (Ghorbanalizadeh & Akhaneh 2022). Apart from the Hyrcanian mixed broad-leaved forests, there are other vegetation types in the Hyrcanian chorion. The common cypress (*Cupressus sempervirens* L.) woodlands are among the extraordinary vegetation types that grow in this area.

The common cypress is one of the important species in the genus *Cupressus* (Farjon & Filer 2013). The natural geographic distribution of *C. sempervirens* is characterized by uneven and often relict populations that grow in Iran, Syria, Jordan, Lebanon, Palestine, Libya, Turkey, Cyprus, Morocco, Algeria, and Tunisia. This species is also cultivated in many Mediterranean countries (Caudullo & De Rigo 2016; Farahmand 2020). It was also recorded from different parts of southwestern and southeastern Iran (Behbahan in Khuzestan, Firozabad in Fars, and the slopes of Mount Taftan in Sistan & Baluchestan, in a scattered form or in a mixed form with columnar cypress). Considering the ancient inscription near the tree stands, they might be the remnants of ancient common cypress cultivation in these areas (Assadi 1988).

Within the Hyrcanian chorion, the common cypress woodlands are formed in areas with different soil and microclimatic conditions, making them distinguishable from adjacent forests (Zare 2001; Zohary 1973). Its deep and strong roots allow this tree to grow on steep slopes, cliffs, and stone beds where the common broad-

leaved trees of the Hyrcanian chorion cannot survive. However, this species is not a good competitor (Caudullo & De Rigo 2016), and broad-leaved species do not allow this plant to grow in suitable soil conditions. In the western and central parts of the Hyrcanian chorion (i.e., the Gilan and Mazandaran provinces), these woodlands have been limited to rocky and steep beds with unfavorable soil conditions for broad-leaf trees. In the eastern parts of the Hyrcanian chorion, the common cypress woodlands remnants can be observed in the valleys on steep slopes and rocks. extensive agriculture destroyed the other habitats in this part of the Hyrcanian chorion (Amini & al. 2020).

There is no complete data on the floristic composition of the common cypress woodlands in the Hyrcanian chorion. A floristic study in the southwestern habitat of this species in Iran reported 238 species (Bahrani Fard & al. 2018). During the recent decades, several disturbance factors such as heavy grazing, uncontrolled tree logging, and land usage changes affected the common cypress woodlands in the Hyrcanian chorion. The current study aims to evaluate floristic diversity, life forms, and phytogeographical affinities of the vascular plants growing in the common cypress habitats of the Hyrcanian chorion. We hypothesized that floristic composition of these woodlands is not similar to other habitats within the Hyrcanian chorion. Our data will make a basic knowledge for management strategies for these unique ecosystems.

MATERIALS AND METHODS

Study area

Data collection was conducted in 2017-2020 growing seasons. The studied habitats were

mountainous woodlands with an elevation range of 350-1100 m a.s.l. They were geographically situated between 36°44' and 37°35' northern latitudes and 49°25' and 55°49' eastern longitudes (Fig. 1). There was approximately a 700 km distance between the two farthest habitats. Overall, these habitats had an area of ca. 15000 ha. These habitats were isolated discrete mountains with particular geology, mainly composed of marls, marlstones, limestones, and shales. The Hassan Abad Reserve is the only common cypress habitat in the central Hyrcanian chorion, and it is also the largest habitat among the studied areas. The average annual rainfall in these areas is significantly lower than the rest of the Hyrcanian zone and northern slopes of Alborz (Ambrothermic diagrams of the nearest meteorological stations to cypress habitats in the Hyrcanian chorion as shown in Fig. 2). The Mediterranean was the dominant bioclimatic condition in the common cypress woodlands. A complete list of

the studied habitats is presented in Table 1. The bioclimatic classification was extracted from Djamali & al. (2011). More than 2000 vascular plants were collected from the studied habitats. The collected specimens were identified according to published Floras and literature (Assadi & al., 1988-2020; Komarova 1963; Rechinger 1963-2008; Zare 2001). A voucher number was assigned to each specimen. The identified samples were deposited in the Herbarium of the Nowshahr Botanical Garden (HNBG). The life form of each species was identified based on the Raunkiaer system (Kent 2012). Life form spectrums were drawn using the same method as Erfanian & al. (2021). The graphs were produced by using the ggplot2 (Wickham 2009) R package (R Core Team 2020). Chorology and species distribution data were identified using the published literature (i.e. Zohary 1973; Takhtajan 1986-7; White & Leonard 1991).

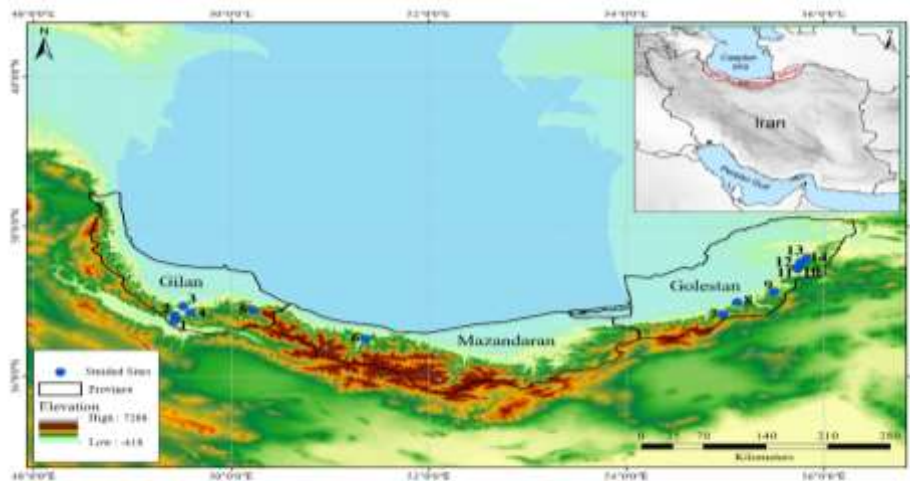


Fig. 1. Location of the common cypress habitats in the Hyrcanian chorion, Iran.

RESULTS

Floristic diversity

We recorded 700 species from the common cypress woodlands of the Hyrcanian chorion. Some plant species including rare species that were in their natural habitats within the common cypress woodlands are depicted in Fig. 3. These 700 plant species belong to 386 genera from 87 families. Pteridophytes with 8 families 13 genera and 17 species, Gymnosperms with 2 families 3 genera and 5 species, of Angiosperms, Monocots with 11 families, 63 genera and 112 species comprise 16% and the Eudicots with 66 families, 307 genera and 568 species comprise 81% of the total flora). Five families, namely Fabaceae (75), Asteraceae (74), Poaceae (71), Lamiaceae (46), and Brassicaceae (36), comprise the largest number of species in this list.

Astragalus, with 14 species, was the most species-rich genus in the studied area (Table 2). A number of 223 genera (59% of identified species) were represented by one species. The life form spectrum of the studied areas contained therophytes with 275 species (40%), hemicryptophytes with 225 (32%), phanerophytes with 81 (12%), cryptophytes with 87 (12%), and chamaephytes with 34 species (5%) and is presented in Fig. 4. Within these habitats, the common cypress had the highest canopy, and the other phanerophyte species were mainly dwarf trees, shrubs, and bushes. A list of all phanerophyte species that were recorded in this study is presented in Table 3. A number of species, such as *Fagus orientalis*, *Parrotia persica* and *Quercus castaneifolia*, have dispersed into the cypress habitat from neighboring forest areas and have grown in these forests.

Table 1. Fourteen studied common cypress habitats. The studied woodlands were located within the Hyrcanian chorion, Iran.

No	Location	Name	Area (ha.)	Coordinates	Climate	Altitude (m)
1	West	Harzevil	680	36° 44' 41" N - 49° 25' 38" E	Mediterranean xeric-oceanic	350-900
2		Nesfii-Rudbar	2260	36° 48' 52" N - 49° 25' 39" E	Mediterranean xeric-oceanic	300-600
3		Seydan & Poshtahan	2047	36° 50' 50.85" N - 49° 35' 21" E	Mediterranean xeric-oceanic	300-900
4		Aminabad & Aghapirdar	400	36° 56' 13.27" N - 49° 30' 42.73" E	Mediterranean xeric-oceanic	350-450
5		Eshkevar	1000	36° 52' 50.85" N - 50° 13' 31" E	Temperate oceanic	400-700
6	Central	Hassanabad	7397	36° 29' 56.27" N - 51° 21' 21" E	Mediterranean pluviseasonal-oceanic	300-1100
7	East	Zarren Gol	115	36° 50' 01.9" N - 54° 58' 41.3" E	Mediterranean pluviseasonal-continental	400-530
8		Ramiyan	520	36° 59' 11" N - 55° 07' 24" E	Mediterranean pluviseasonal-continental	300-400
9		Hosseyna	80	37° 07' 43" N - 55° 29' 40" E	Mediterranean pluviseasonal-continental	500-680
10		Golestan National Park	28	37° 27' 4.3" N - 55° 43' 26" E	Mediterranean pluviseasonal-continental	850-900
11		Ghorche-Cheshmeh Paean	190	37° 26' 16.3" N - 55° 44' 7" E	Mediterranean pluviseasonal-continental	650-800
12		Savare-Bala	76	37° 27' 01.2"N - 55° 43' 27.7" E	Mediterranean pluviseasonal-continental	650-900
13		Zav-Koh	300	37° 31' 35.6"N - 55° 45' 49" E	Mediterranean pluviseasonal-oceanic	500-700
14		Qezel otagh	140	37° 35' 4.7"N - 55° 49' 41.2" E	Mediterranean pluviseasonal-oceanic	700-850

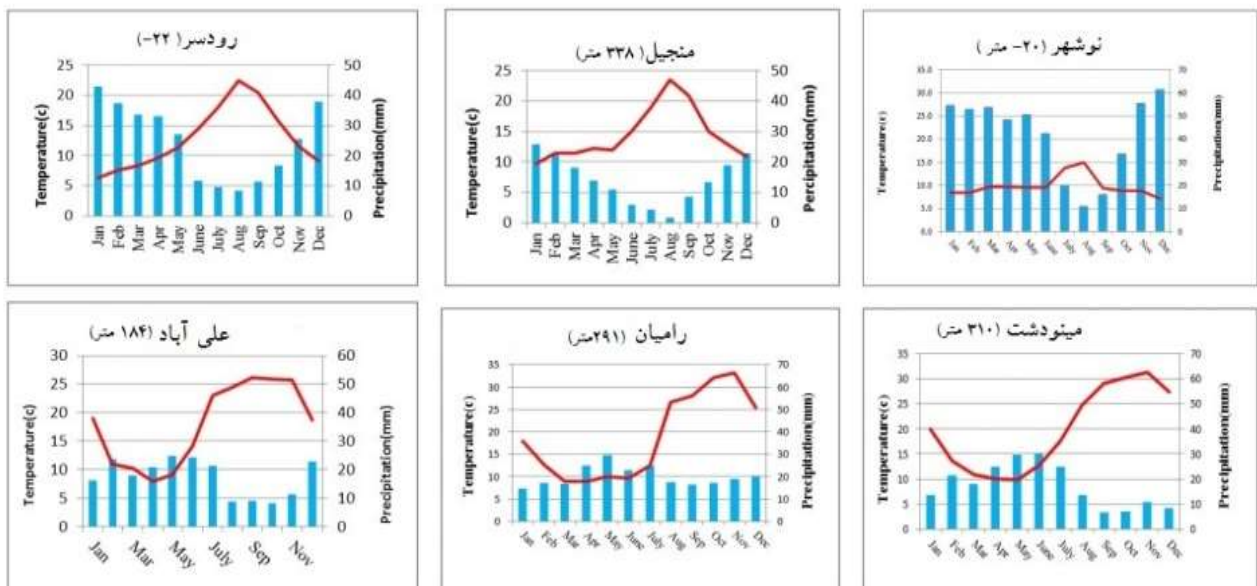


Fig. 2. Ambrothermic diagrams of the nearest meteorological stations to cypress habitats in the Hyrcanian chorion.

We found the most intact common cypress trees inside the religious sites and shrines in the studied habitats during our study. The results of studies on the life form in Hyrcanian cypress habitats were compared with the results of other studies in different Hyrcanian chorion (Fig. 4). Therophytes mostly grow in places that are ecologically unsuitable and where other plants are not given enough opportunity to grow. As shown in the Fig. 4, in cypress vegetation of Firoozabad, around Sefidrud dam in the westernmost part of Hyrcanian chorion and Miyankaleh peninsula in the east of Caspian Sea, therophytes have the highest life forms among species. In contrast, in Dodangeh, Ghorkhod, and in Fazelabad habitats, where the growing

conditions are more favorable, hemicryptophyte species have the highest amount.

Phytogeography

Phytogeographical analysis showed that 35.57 % (249 species) of the total recorded species were mono-regional, 31.7 % (222 species) bi-regional, 20% (141 species) three-regional, and 12.57 % (88 species) were widespread. These results are presented in Table 4. Our results showed that 153 Out of 700 species had IT chorotype, i.e., 21.8 % of all species. A total number of 301 species with at least one Mediterranean chorotype (including one, two, three, and pluri-regional species) were recorded in this study.



Fig. 3. Images of some plant species within the common cypress woodlands, including rare species in their natural habitats. 1, *Iris reticulata*; 2, *Matthiola farinosa*; 3, *Smilax excelsa*; 4, *Veronica chamaedrys*; 5, *Linum mucronatum* var. *assyriacum*; 6, *Campanula glomerata*; 7, *Anchusa italica*; 8, *Aethionema arabicum*; 9, *Prunus microcarpa*; 10, *Humulus lupulus*; 11, *Orchis simia*; 12, *Plumbago europaea*; 13, *Aristolochia hyrcana*; 14, *Limodorum abortivum*, 15, *Clematis orientalis*.

Table 2. (A) Families with the highest species number in the studied habitats. Families with genera >10 are shown. These nine families contain 56 % of the genera in the study area. (B) Most abundant genera in the common cypress habitats of the Hyrcanian chorion.

(A)		
Family	No. of Genera	No. of Species
Asteraceae	45	72
Poaceae	42	71
Brassicaceae	26	36
Fabaceae	21	75
Lamiaceae	21	46
Apiaceae	17	22
Rosaceae	16	30
Boraginaceae	14	22
Caryophyllaceae	14	26

Endemism

Among the 700 collected and recorded vascular plant taxa, 59 species (8/4%) are endemic to Iran. Asteraceae has the highest number of endemic species (12 species), and Lamiaceae (8 species) is the second family with high endemic species. Poaceae, which is the third high species family in the Hyrcanian cypress habitats (71 species) has no endemic species. Among the total number of 59 endemic species, 31 species (52%) are common with the Irano-Turanian region, 26 species (44%) with the Hyrcanian province and 2 species (4%) with the Mediterranean region (Table 5).

DISCUSSION

Here, we provide an annotated checklist, phytogeographical analysis, and life form spectrum of plant species growing in the natural habitats of the common cypress in the Hyrcanian chorion. Although these habitats are located within the Hyrcanian chorion our results revealed that the floristic composition of the common cypress woodlands are not similar to the typical Hyrcanian habitats. For example, the common evergreen broadleaf species in the Hyrcanian chorion are *Prunus laurocerasus* L., *Buxus sempervirens* L., *Ruscus hyrcanus* Woronow, and *Ilex spinigera* (Loes.) Loes. However, within the common cypress habitats, we recorded *Pistacia atlantica* Desf. subsp. *mutica* (Fish. & C.A. Mey.) Rech. f., *Rhus coriaria* L., *Myrtus communis* L., *Ruta graveolens* L. and *Humulus lupulus* L. Considering these species, there was also a heterogeneity among the studied habitats. The species mentioned above were found only in western habitats. In the central Hyrcanian habitats (e.g., of the

(B)			
Genus	No. of Species	Genus	No. of Species
<i>Astragalus</i>	14	<i>Salvia</i>	5
<i>Carex</i>	10	<i>Stachys</i>	
<i>Trifolium</i>		<i>Trigonella</i>	
<i>Geranium</i>	8	<i>Aegilops</i>	4
<i>Vicia</i>		<i>Amaranthus</i>	
<i>Lathyrus</i>	7	<i>Asplenium</i>	
<i>Medicago</i>		<i>Avena</i>	
<i>Viola</i>		<i>Campanula</i>	
<i>Alyssum</i>	6	<i>Convolvulus</i>	
<i>Artemisia</i>		<i>Crataegus</i>	
<i>Bromus</i>		<i>Crepis</i>	
<i>Papaver</i>		<i>Erodium</i>	
<i>Poa</i>		<i>Helianthemum</i>	
<i>Sedum</i>		<i>Lappula</i>	
<i>Silene</i>	5	<i>Malva</i>	
<i>Veronica</i>		<i>Plantago</i>	
<i>Euphorbia</i>		<i>Potentilla</i>	
<i>Galium</i>		<i>Rubus</i>	
<i>Linum</i>		<i>Salsola</i>	
<i>Nepeta</i>	5	<i>Scabiosa</i>	
<i>Phlomis</i>		<i>Stipa</i>	

Mazandaran province), only a few natural *Olea europaea* were found inside the habitats, and no *Myrtus communis* L. was recorded. *Olea* and *Myrtus* are also absent in the eastern habitats. *Leptorhabdos parviflora* (Benth.) Benth. (Orobanchaceae) and *Plumbago europaea* L. (Plumbaginaceae) are species that were found only in the common cypress habitats in all three parts of the Hyrcanian chorion and was not recorded outside the habitats. *Paliurus spina-christi* Mill. is the only woody species observed in all three provinces and in all the sampling plots close to the common cypress.

In all habitats, *Brachypodium distachyon* (L.) P. Beauv., *Teucrium polium* L., *Linaria simplex* (Link) DC., *Paliurus spina-christi* Mill., *Catapodium rigidum* (L.) C. E. Hubb., *Crepis sancta* (L.) Bornm., *Pallenis*

spinosa (L.) Cass., *Convolvulus cantabricus* L., *Salvia viridis* L., *Galium setaceum* Lam. were observed. These species were common to the Iran-Turanian(IT) habitats (e.g., Atashgahi & al. (2018, 2022) and Memariani & al. (2016). Climbing species such as *Clematis orientalis* L., *Periploca graeca* L., *Vitis sylvestris* C.C.Gmelin, Although the studied sites were located within the Hyrcanian chorion, the IT was the dominant chorotype among the mono-regional species. Unsurprisingly, ES was the second dominant chorotype among the species. Considering Bi-regional species, M-IT was the dominant chorotype. It is well-known that The Mediterranean macrobioclimate is dominant bioclimatic condition in the IT region (Djamali & al. 2011; Karami & al. 2022). This fact along with our findings that showed 301 species had at least one Mediterranean chorotype, reveals the dominance of the Mediterranean macrobioclimate in the studied sites.

Humulus lupulus L. and *Rubus spp.* are almost found in all habitats, but they often grow on roadsides and other tree species, but they never use the common cypresses a support tree. Our field observation revealed the importance of Sacred lands to maintain the biodiversity (Zannini & al. 2021).

It is quite obvious from a phytogeographical point of view that the habitats of common Cypress in Iran, based on floristic composition, are heterogeneous. These areas are within the limitation of the Hyrcanian province of the Euro-Siberian region. As Hyrcanian province is, in fact, the easternmost part of the Euro-Siberian region and as it is in somehow rather isolated from the mainland of the Euro-Siberian region, elements of other regions, in suitable habitats, well penetrate the area. Therefore, we should consider these sorts of habitats as enclaves of other regions to the main region of the area.

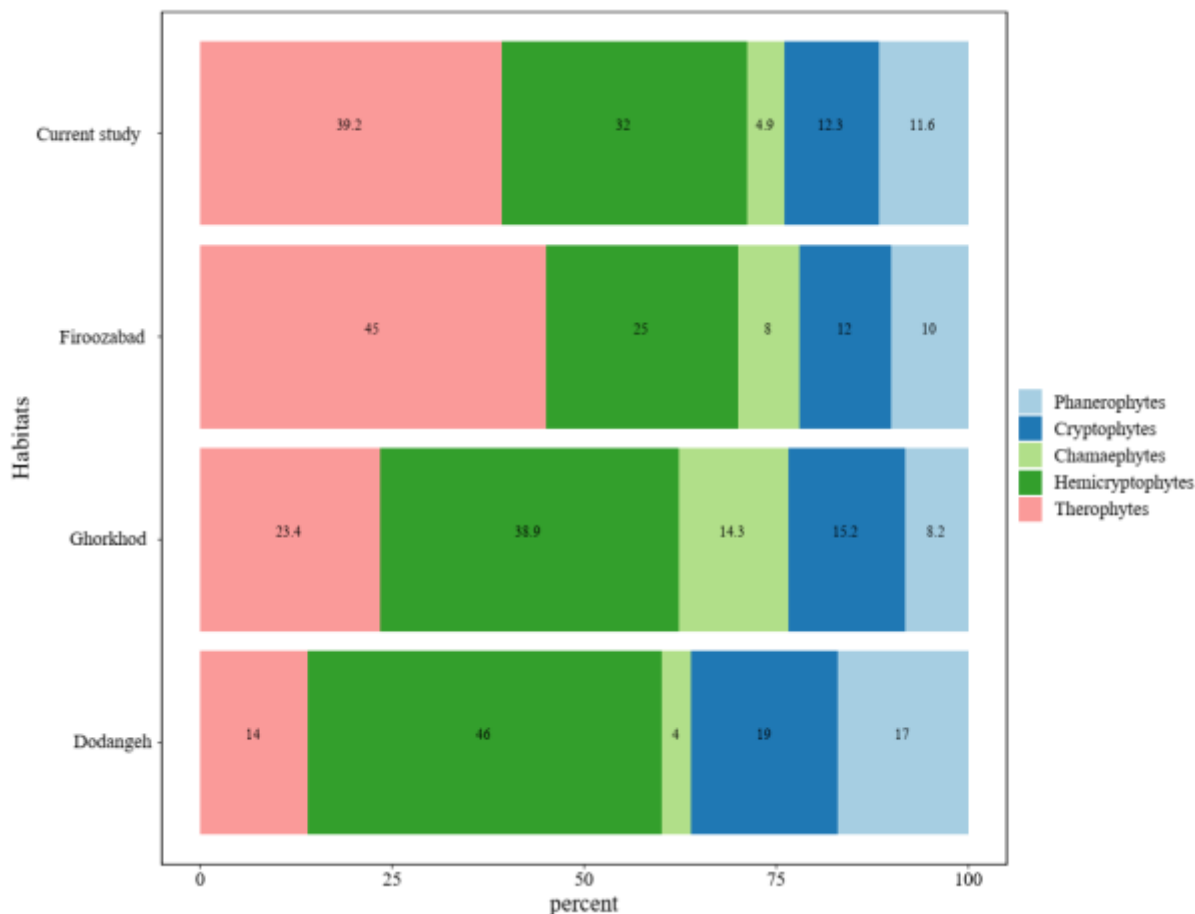


Fig. 4. Life form spectrum of the plants in Hyrcanian Cypress habitats. Life form of the other sites are also presented for the comparison.

Table 3. List of phanerophyte (tree and shrub) species recorded from the Hyrcanian common cypress habitats. A number of species which is marked by *, such as *Fagus orientalis*, *Parrotia persica* and *Quercus castaneifolia*, have dispersed into the cypress habitat from neighboring forest areas and have grown in these forests.

Family	Species	Family	Species
Amaranthaceae	<i>Bassia prostrata</i>	Ranunculaceae	<i>Clematis orientalis</i>
	<i>Camphorosma monspeliaca</i>	Rhamnaceae	<i>Paliurus spina-christi</i>
	<i>Krascheninnikovia ceratoides</i>		<i>Rhamnus cathartica</i>
Anacardiaceae	<i>Pistacia atlantica</i>		<i>Rhamnus pallasii</i>
	<i>Rhus coriaria</i>		<i>Rhamnus spathulifolia</i>
Apocynaceae	<i>Periploca graeca</i>	Rosaceae	<i>Cotoneaster kotschyi</i>
Berberidaceae	<i>Berberis integerrima</i>		<i>Cotoneaster nummularius</i>
	<i>Berberis vulgaris</i>		<i>Crataegus meyeri</i>
Betulaceae	<i>Alnus orientalis</i> *		<i>Crataegus microphylla</i>
	<i>Alnus subcordata</i> *		<i>Crataegus pentagyna</i>
	<i>Carpinus betulus</i>		<i>Crataegus pseudomelanocarpa</i>
	<i>Carpinus orientalis</i>		<i>Crataegus songarica</i>
Cannabaceae	<i>Celtis caucasica</i>		<i>Cydonia oblonga</i> *
	<i>Humulus lupulus</i>		<i>Malus orientalis</i>
Caprifoliaceae	<i>Lonicera floribunda</i>		<i>Mespilus germanica</i>
	<i>Lonicera iberica</i>		<i>Prunus cerasifera</i>
Cornaceae	<i>Cornus sanguinea</i> subsp. <i>australis</i>		<i>Prunus microcarpa</i>
Cupressaceae	<i>Cupressus sempervirens</i>		<i>Prunus spinosa</i>
	<i>Juniperus communis</i>		<i>Pyrus communis</i>
Ephedraceae	<i>Ephedra distachya</i>		<i>Rosa canina</i>
	<i>Ephedra intermedia</i>		<i>Rosa pulverulenta</i>
	<i>Ephedra major</i>		<i>Rubus anatolicus</i>
Fabaceae	<i>Cercis siliquastrum</i> var. <i>hebecarpa</i>		<i>Rubus hyrcanus</i>
	<i>Colutea buhsei</i>		<i>Rubus persicus</i>
	<i>Colutea uniflora</i>		<i>Rubus ulmifolius</i> subsp. <i>sanctus</i>
Fagaceae	<i>Fagus orientalis</i> *	Rutaceae	<i>Spiraea sheikii</i>
	<i>Quercus castaneifolia</i>	Salicaceae	<i>Ruta graveolens</i>
	<i>Quercus petraea</i> subsp. <i>iberica</i>		<i>Populus caspica</i>
Hamamelidaceae	<i>Parrotia persica</i> *		<i>Salix aegyptiaca</i> *
Moraceae	<i>Ficus carica</i>	Santalaceae	<i>Salix alba</i> *
	<i>Morus alba</i> *	Sapindaceae	<i>Viscum album</i>
Myrtaceae	<i>Myrtus communis</i>		<i>Acer campestre</i>
	Oleaceae		<i>Jasminum fruticans</i>
<i>Jasminum officinale</i>			<i>Acer velutinum</i> *
<i>Olea europaea</i>		Smilacaceae	<i>Smilax excelsa</i>
Polygonaceae	<i>Atraphaxis aucheri</i>	Solanaceae	<i>Lycium depressum</i> subsp. <i>depressum</i>
	<i>Fallopia baldschuanica</i>		Tamaricaceae
	<i>Pteropyrum aucheri</i>		
	<i>Pteropyrum olivieri</i>	Ulmaceae	<i>Zelkova carpiniifolia</i>
Punicaceae	<i>Punica granatum</i>	Vitaceae	<i>Vitis sylvestris</i> subsp. <i>anebophylla</i>

In the current study, we observed that the floristic composition of an area is highly influenced by the governing bioclimatic conditions. The number of Mediterranean species decreases from west to east of the Hyrcanian chorion which can be attributed to the greater influence of Hyrcanian and Irano-Turanian

region. Different disturbances affect the studied woodlands, and our results revealed their importance to maintain biodiversity within the Hyrcanian chorion. A proper management and monitoring plan should be considered for these habitats.

Table 4. The number and relative proportion of different biogeographical entities to the flora of the common cypress woodlands in the Hyrcanian chorion. Abbreviations: IT (Irano-Turanian region), ES (Euro-Siberian region), M (Mediterranean region), IA (Irano-Anatolia province), H (Hyrcanian province), SS (Saharo-Sindian region), Cos. (Cosmopolitan), Plur. (pluri-regional).

Phytogeographical groups		Taxa No.	Taxa (%)
Widespread (88-12.57 %)	Cos.	20	2.85
	Plur.	68	9.7
Mono-regional (249- 35.57 %)	ES	97 (H, 53)	13.86
	IT	152 (IA, 23)	21.7
Bi-regional (222- 31.7 %)	ES-IT	62 (ES- IA, 5)	8.86
	IT-SS	4	0.57
	M-ES	34	4.85
	M-IT	118 (M-IA , 9)	16.86
	M-SS	4	0.57
Tri-regional (141- 20.14 %)	M-ES-IT	123	17.57
	M-ES-SS	1	0.14
	M-IT-SS	17	2.4



Fig. 5. 1-3, Cypress habitat in Hassanabad (Mazandaran province), the soil is calcareous and very poor in nutrients. In the margins of these areas, where the growth conditions have changed both in terms of soil and slope, broadleaf dominates. 4, cypress habitat in Rudbar; and 5, in valley of Eshkevar in Gilan province. 6, cypress habitat in Savare -Bala (Kalaleh) in Golestan province.

Table 5. Endemic species in phytogeographical groups in the flora of the common cypress woodlands in the Hyrcanian chorion.

Endemic species in phytogeographical groups						
No.	Phytogeo. groups	Species	No.	Phytogeo. groups	Species	
1	Medit. region	<i>Lathyrus cassius</i> Boiss. var. <i>aphaca</i>	31	Ir.-Tur. region	<i>Anthemis hyalina</i> Dc.	
2		<i>Lathyrus cassius</i> Boiss. var. <i>biflorus</i>	32		<i>Artemisia spicigera</i> K. Koch	
3	Hycr. province	<i>Acer monspessulanum</i> subsp <i>ibericum</i> (Pojark.) Rech. f.	33		<i>Bufonia sintenisii</i> Freyn	
4		<i>Aristolochia hyrcana</i> P. H. Davis & M. S. Khan	34		<i>Centaurea aziziana</i> Rech.	
5		<i>Astragalus senilis</i> Bornm.	35		<i>Colutea uniflora</i> Beck	
6		<i>Atraphaxis aucheri</i> Jaub. & Spach	36		<i>Cotoneaster kotschyi</i> (C.K.Schneid.) G.Klotz	
7		<i>Centaurea kandavanensis</i> Wagenitz	37		<i>Crocus gilanicus</i> B.Mathew	
8		<i>Consolida teheranica</i> (Boiss.) Rech.f.	38		<i>Echinops koelzii</i> Rech.f.	
9		<i>Delphinium aquilegifolium</i> (Boiss.) Bornm.	39		<i>Glaucium contortuplicatum</i> Boiss.	
10		<i>Dionysia aretioides</i> (Lehm.) Boiss	40		<i>Halimocnemis mamamensis</i> (Bunge) Assadi	
11		<i>Johrenia ramosissima</i> Mozaff.	41		<i>Hesperis hyrcana</i> Bornm. & Gauba	
12		<i>Leontodon kotschyi</i> Boiss.	42		<i>Hesperis straussii</i> Bornm.	
13		<i>Lindelofia kandavanensis</i> Bornm. & Gauba	43		<i>Nepeta crassifolia</i> Boiss. & Buse.	
14		<i>Onobrychis mazanderanica</i> Rech.f.	44		<i>Oxytropis kotschyana</i> Boiss & Hohen	
15		<i>Ornithogalum sintenisii</i> Freyn	45		<i>Oxytropis szovitsii</i> Boiss. & Buhse	
16		<i>Papaver chelidoniifolium</i> Boiss.&Buhse	46		<i>Paracaryum strictum</i> Brand	
17		<i>Polygala platyptera</i> Bornm. & Gauba	47		<i>Phlomis persica</i> Boiss.	
18		<i>Polygonum hyrcanicum</i> Rech.f.	48		<i>Pimpinella kotschyana</i> Boiss.	
19		<i>Primula heterochroma</i> Stapf	49		<i>Salvia multicaulis</i> Vahl	
20		<i>Rhamnus spathulifolia</i> Fisch. & C.A.Mey.	50		<i>Scabiosa calocephala</i> Boiss.	
21		<i>Scorzonera kandavanica</i> Rech.f.	51		<i>Scorzonera persica</i> Boiss.	
22		<i>Semperivum iranicum</i> Bornm. & Gauba	52		<i>Scrophularia gaubae</i> Bornm.	
23		<i>Spiraea sheikii</i> Zare	53		<i>Scutellaria pinnatifida</i> A. Hamilt	
24		<i>Stachys laxa</i> Boiss. & Buhse	54		<i>Scutellaria tournefortii</i> Benth.	
25		<i>Verbascum sublobatum</i> Murb.	55		<i>Stachys persica</i> S.G.Gmel. ex C.A.Mey.	
26		<i>Veronica aucheri</i> Boiss.	56		<i>Tanacetum hololeucum</i> (Bornm.) Podi.	
27		<i>Veronica francispetae</i> M.A. Fischer	57		<i>Thalaspis hastulatum</i> (Stev.ex) DC.	
28		<i>Viola spathulata</i> Willd. ex Schult.	58		<i>Thymus pubescens</i> Boiss. & Kotschy ex Celak.	
29		Ir.-Tur. region	<i>Alyssum bracteatum</i> Boiss. & Buhse		59	<i>Tragopogon caricifolius</i> Boiss.
30			<i>Anthemis gilanicum</i> Bornm. & Gauba			

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REFERENCES

- Amini, T., Ejtehadi, H., Djamali, M., & Guibal, F. 2020: The world's easternmost natural stands of *Cupressus sempervirens* L. (Cupressaceae) in the Hyrcanian Forest of Iran- *Journal of Mediterranean Ecology* 18(1), 3–8.
- Assadi, M., 1998: Pinaceae, Taxaceae, Cupressaceae and Ephedraceae in Flora of Iran, vol.19-22. In Assadi, Maassoumi, A. A., Khatamsaz, M., & Mozaffarian, V. (eds.). Tehran. Research Institute of Forests and Rangelands Publications.
- Assadi, M., Maassoumi, A. A., Khatamsaz, M., & Mozaffarian, V. (eds.). 1988-2021: Flora of Iran nos. 1-151. Research Institute of Forests and Rangelands Publications, Tehran.
- Atashgahi, Z., Ejtehadi, H., & 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*.
- Bahrani Fard, E., Yousofi, M., & Khosravi, A. R. 2018: Floristic Study of the Cypress (*Cupressus Sempervirens* L.) Habitat in Firoozabad (Fars Province). -*Taxonomy and Biosystematics* 9(32), 21–42.
<https://doi.org/10.22108/tbj.2018.107476.1044>
- Caudullo, G., & De Rigo, D. 2016: *Cupressus sempervirens* in Europe: Distribution, habitat, usage and threats. In *European Atlas of forest tree species* (pp. 88–89)- Publications Office of the European Union Luxembourg.
- Djamali, M., Akhane, H., Khoshravesh, R., Andrieu-Ponel, V., Ponel, P., & Brewer, S. 2011: Application of the global bioclimatic classification to Iran: Implications for understanding the modern vegetation and biogeography- *Ecologia Mediterranea* 37, 91–114.
- Ejtehadi, H., Amini, T., Kianmehr, H., & Assadi, M. 2003: Floristical and chorological studies of vegetation in Myankaleh wildlife refuge, Mazandaran province, Iran- *Iranian International Journal of Science* 4(2), 107–120.
- Erfanian, M. B., Alatalo, J. M., & Ejtehadi, H. 2021: Severe vegetation degradation associated with different disturbance types in a poorly managed urban recreation destination in Iran. *Scientific Reports* 11(1), 19695. <https://doi.org/10.1038/s41598-021-99261-5>
- Farahmand, H. 2020: The genus *Cupressus* L.: Mythology to Biotechnology with Emphasis on Mediterranean Cypress (*Cupressus sempervirens* L.). - In I. Warrington (Ed.), *Horticultural Reviews* (1st ed., pp. 213–287). Wiley. <https://doi.org/10.1002/9781119625407.ch5>
- Ghorbanalizadeh, A., & Akhane, H. 2022: Plant diversity of Hyrcanian relict forests: An annotated checklist, chorology and threat categories of endemic and near endemic vascular plant species. *Plant Diversity* 44(1), 39–69. <https://doi.org/10.1016/j.pld.2021.07.005>
- IUCN. 2019: World Heritage Nomination-IUCN Technical Evaluation for Hyrcanian Forests (Islamic Republic of Iran). <https://whc.unesco.org/en/list/1584/>
- Komarov, V. L., Shishkin, B. K., Bobrov, E. G.(eds.). 1963: Flora of the U.S.S.R. Vols. 1-24. Israel Program for Scientific Translations.
- Memariani, F., Joharchi, M. R., & Akhane, H. 2016: Plant diversity of Ghorkhod protected area, NE Iran. *Phytotaxa* 249(1), 118–158. <https://doi.org/10.11646/phytotaxa.249.1.6>
- Moradi, A., Asri, Y., & Sobh-Zahedi, S. 2013: An introduction of flora, life form, chorotype and habitat of plants around Sepidroud dam, Iran. - *Taxonomy and Biosystematics* 5(15), 95–112.
- Rechinger, K. H. (Ed.). 1963-2008: Flora Iranica: vols. 1–181. Akademische Druck- u. Verlagsanstalt.
- Takhtajan, A. 1986-1987: Floristic Regions of the World, University of California press.
- Wickham, H. 2009: ggplot2: Elegant Graphics for Data Analysis. Springer-Verlag.
- White, F. & Leonard, J. 1991: Phytogeographical links between Africa and Southwest Asia. *Flora et Vegetation Mundi* 9: 229-246/
- Zannini, P., Frascaroli, F., Nascimbene, J., Persico, A., Halley, J. M., Stara, K., Midolo, G., & Chiarucci, A. 2021: Sacred natural sites and biodiversity conservation: A systematic review. *Biodiversity and Conservation* 30(13), 3747–3762. <https://doi.org/10.1007/s10531-021-02296-3>
- Zare, H. 2001: Introduced and native conifers of Iran. Research Institute of Forests and Rangelands of Iran.
- Zohary, M. 1973: Geobotanical Foundations of the Middle East. G. Fischer.