

Floristic study of AqDagh sanctuary in Marakan protected area: west Azarbaijan province, Iran

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Abstract

AqDagh sanctuary with the area 5184.7 hectares area is one of the three sanctuaries in the Marakan protected area, in west Azarbaijan province. It is located in the semi-dry to cold semi-dry climates. In this research, 227 taxa (species, subspecies and varieties) belonging to 47 families and 166 genera were identified during 2008 through 2009. Among the studied plants, 205 dicots and 21 monocots and one gymnosperm were recognized. Asteraceae (with 30 species) and Lamiaceae (with 26 species) were the largest families; followed by Brassicaceae, Caryophyllaceae and Fabaceae. *Astragalus* (with 9 species) and *Gallium* (with 5 species) were the most diverse genera. Twenty one endemic and 6 rare taxa plus 2 monotypic genera were identified in the studied area. In addition, 11 taxa from northwest of Iran and 29 from west Azarbaijan were reported for the first time. Therophytes (with 36.57%) comprised the most dominant life form, followed by hemicryptophytes (with 27.75%) in this area. From the chorological point of the view, most of the flora has been influenced by the IT (31.53%) and IT-ES (27.49%) elements. The highest proportion of vegetation in this area belonged to bi-tri or pluriregional elements (with 59.01%).

Key words: West Azarbaijan, Aras, Flora, Chorology, Iran

Introduction

Determination of the flora of each region is a very important way to distinguish the aspects of the vital potential and varieties in the area in the specific period of time. For example the native, resistant, immigrant, invaded, medicinal plants and also new species to be determined and distinguished (Malekmohammadi *et al.*, 2007). Moreover, with respect to the effects of many factors on the survival and elimination of some species the necessity of floristic studies to prevent from the destruction of habitats is justified. The knowledge of floristic composition is a prerequisite for other studies such as ecology, phytogeography, conservation management (Siadati *et al.*, 2010), environment, forestry and agriculture (Malekmohammadi *et al.*, 2007). Furthermore, by this way we can control the biodiversity, and implement ecosystem management for a long-term viability.

Iran has a total surface area of 1.65×10^6 km² (Jafari and Akhani, 2008). It is rich in plant diversity except of the interior deserts and the lowlands along the Caspian Sea, Persian Gulf

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and Gulf of Oman. Nearly half of Iran is composed of arid and semi-arid high mountains (Noroozi *et al.*, 2007). The alpine areas of Iran have been poorly investigated ecologically and botanically. AqDagh in Marakan protected area in northwest of Iran is a mountainous area. So, the floristic study of this area and other studies in the east and west Azarbaijan provinces were necessary.

In this research, the floristic study of AqDagh sanctuary was carried out. The most important former floristic studies includes: Ghasemloo (Shohada) Valley Forest Reservoir (Malekmohammadi *et al.*, 2006), Mirabad (Hassanzadeh Gorttapeh and Panahy, 2007), Arasbaran protected area (Assadi, 1987, 1988; Hamzeh'ee *et al.*, 2010), Mishu-Dagh (Manafi and Bahreiny, 1997) and Marakan (Hassanzadeh Gorttapeh *et al.*, 2008) in east and west Azarbaijan provinces. The aim of this study was to achieve the following results: 1- to produce a new list of plants; 2- to compare the previous plant list of Marakan protected area with that of this study and other previous studies.

Materials and Methods

Study area

Marakan protected area with 103983 hectares is located in the east and west Azarbaijan provinces. It is limited to, Qotur River plateau in the south, agricultural fields of Qaraziadin in the west, Jolfa-Khoy road in the east and Aras boundary River from north (from this point, is very close to Republic of Azerbaijan). The altitude range of the area is 720-2100 m. The Aq Chay river in the middle of area is also the approximate boundary line of east and west Azarbaijan provinces (Department of Environment, 2004). In Marakan, there are three sanctuaries consisting of Zarvin in the north slope, Munjughlu in the east and AqDagh in the west of the Aq Chay river (Figure 1).

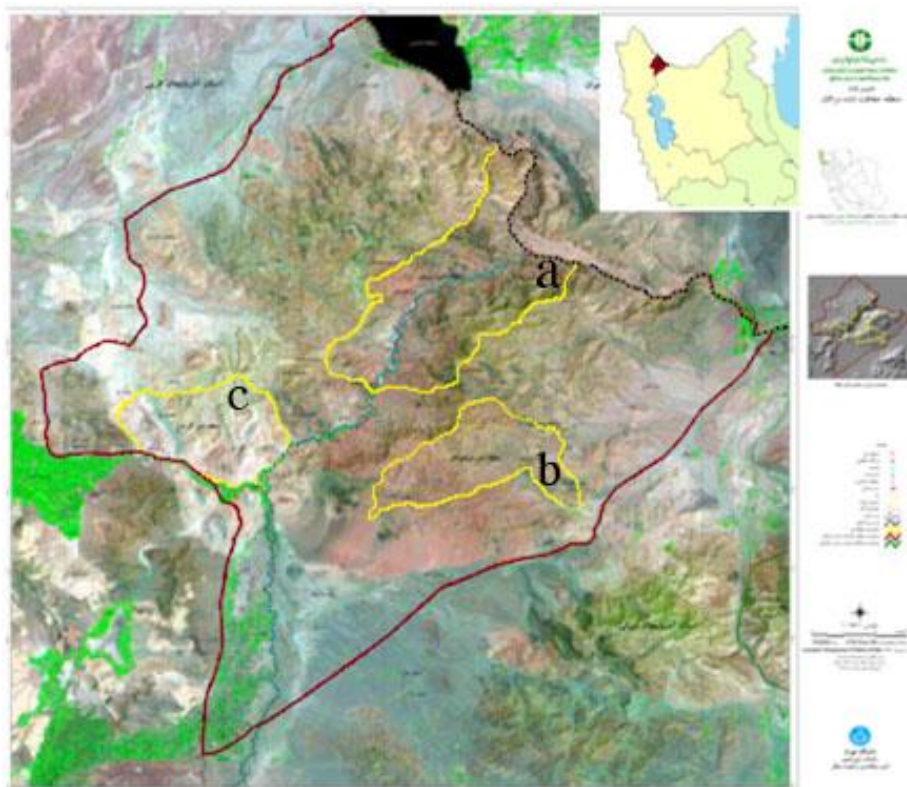


Figure 1. Marakan protected area in Iran plane and satellite picture of sanctuaries. A. Zarvin; B. Munjughlu; C. AqDagh (1:75000)

AqDagh sanctuary is located in west Azarbaijan , northwest Iran ($45^{\circ} 09'$ to $45^{\circ} 16'E$ and $38^{\circ} 51'$ to $38^{\circ} 56'N$). This zone with 5184.7 hectares and altitude ranges between 984-1840 m, is situated in Gochash habitat (Department of Environment, 2004). Most of this sanctuary is mountainous and the rest is low alluvial lands. The average precipitation is 360/9 mm/year and the annual average temperature is $12.76^{\circ}C$.

According to the statistical data of Qaraziadin station, the closest meteorological station to AqDagh, and Domarton and Emberger coefficient this zone possesses respectively semi-dry and semi-dry cold climate. It is resulted from Ombrotermic curve that five months in a year is dry and the humid season continues from November to May. The maximum average precipitation occurs in May (66.3 mm) and Maximum average temperature occurs in August ($27.33^{\circ}C$) (Figure 2).

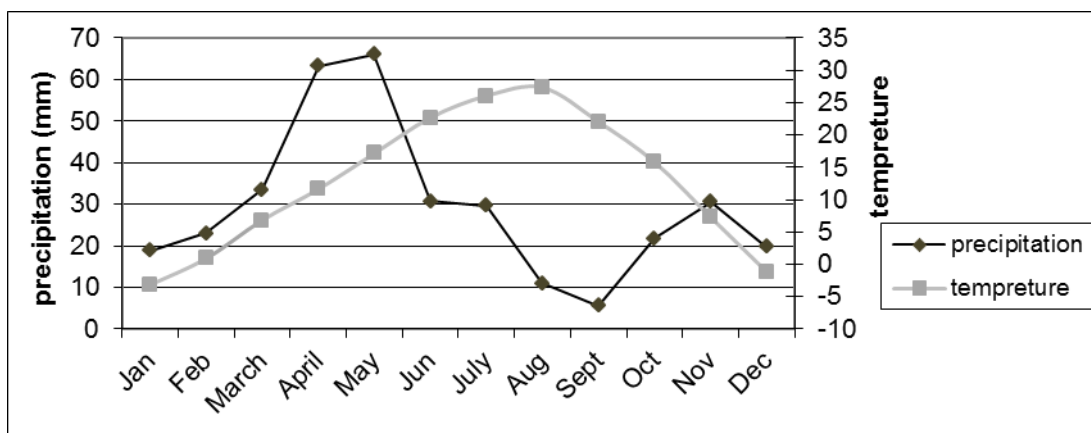


Figure 2. Ombrotermic curve of Qaraziadin meteorological station

Data collection

In this investigation, the plant specimens were collected every 15 days in moist months and every 20 days in dry months, during 2008-2009. For each specimen, digital photographs were taken and the longitude, latitude and altitude of plants habitats were recorded with GPS set.

Collected specimens were pressed and transferred to the Farabi Herbarium of Kharazmi University (FAR). Some references used in plant recognition included: Komarov (1963-2001), Rechinger (1963-2010), Davis (1965-1988), and Assadi *et al.* (1988-2011). According to these Flora, plant geographical distributions were determined, and then their chorotypes were determined based on Zohary (1973) and Leonard (1988). The life forms of specimens were recognized by Raunkier's classification (Archibald, 1995). Monotypic genera and rare species were identified using "Biodiversity of plant species in Iran" (Gahreman and Attar, 1999). Based on "Red data book of Iran" (Jalili and Jamzad, 1999) and Biodiversity of plant species in Iran, endemic taxa and red list of category (IUCN 2001) were determined (Table 1). Author names and scientific name of taxa were checked with IPNI (Macklin and Morris, 2007).

Table 1. List of taxa in Red List of IUCN. Lower risk (LR); Data deficient (DD); Vulnerable (VU)

Taxa	Rank	Taxa	Rank
<i>Scorzonera mucida</i> Rech.f., Aellen & Esfand.	LR	<i>Astragalus latifolius</i> Lam.	VU
<i>Heliotropium dissitiflorum</i> Boiss.	LR	<i>Astragalus crispocarpus</i> Nábělek	LR
<i>Aethionema trinervium</i> (DC.) Boiss.	LR	<i>Astragalus glochidiatus</i> Maassoumi	VU
<i>Paronychia caespitosa</i> Stapf	LR	<i>Astragalus ebenoides</i> Boiss. subsp. <i>ebenoides</i>	LR
<i>Ajuga chamaecistus</i> Ging. subsp. <i>tomentella</i> (Boiss.) Rech.f.	LR	<i>Astragalus iranicus</i> Bunge	DD
<i>Gaillonia szovitsii</i> DC.	DD	<i>Medicago rigidula</i> (L.) All.	LR
<i>Stachys laxa</i> Boiss. & Buhse	LR	<i>Onobrychis subacaulis</i> Boiss.	LR
<i>Alcea glabrata</i> Alef.	LR	<i>Acantholimon bracteatum</i> Boiss.	LR

Result and Discussion

Flora

In this survey from AqDagh sanctuary, 227 taxa of vascular plants consisting of 27 subspecies and 18 varieties and belonging to 47 families and 166 genera were recognized. Among these taxa, 21 taxa, 17 genera and 6 families belonged to monocotyledons, 205 taxa, 149 genera and 40 families belonged to dicotyledons and one taxon dedicated to gymnosperms. The biggest family of the region was Asteraceae with 30 taxa and 23 genera followed by Lamiaceae with 26 taxa and 18 genera, Brassicaceae with 16 taxa and 13 genera, Caryophyllaceae and Fabaceae. *Artemisia-Acantholimon* was the phytosociological dominant type of Gochash habitat (Department of Environment, 2004).

In addition to the above families, there were 19 families with 1 taxa, 8 families with 2 taxa, 3 families with 3 taxa, 4 families with 4 taxa, and 13 families with more than 4 taxa (Table 2). Therefore, most of the families (72.34%) had less than 5 species frequency. Also, 25 families with 1 genus (53.19%), 6 families with 2 genera, 11 families with 3-9 genera and 5 families have 10-30 genera (Table 2); *Astragalus* with 9 species and *Gallium* with 5 species were the richest genera followed by *Centaurea*, *Silene*, *Valerianella*, *Verbascum* and *Alyssum* each with 4 species. High proportion of *Astragalus* in this area showed its adaptation to this mountainous area. *Astragalus* and *Silene* were the typical genera of IT phytogeographical region. 132 genera (79 %) with 1 species were also collected from the studied area. Based on Flora Iranica (Rechinger, 1963-2010), Flora of Iran (Assadi *et al.*, 1988-2011) and floristic studies of east and west Azarbaijan provinces, 11 taxa from the northwest and 29 taxa from west Azarbaijan province were identified for the first time (Appendix 1). *Sedum subulatum* Boiss., *Eryngium glomeratum* Lam., *Arabis gerardii* Besser, *Astragalus wagneri* Bartle. ex Bunge, *Astragalus glochidiatus* Maassoumi, *Galium spurium* L. subsp. *spurium* were identified as rare species. *Cymbolaena griffithii* (A.Gray) Wagenitz, *Drabopsis verna* K.Koch belonged to monotypic genera, were identified in the studied area.

The flora of this region shared maximum number of common taxa (with 91 taxa) with Arasbaran protected area, but regarding number of dissimilar taxa, AqDagh showed maximum SØRENSEN index comparing with Munjughlu, Marakan and Mishu-Dagh, respectively. According to this study, AqDagh sanctuary had 51 common species (22.46%), 83 genera (50%) and 34 families (72.34%) with Marakan (Hassanzadeh Gortapeh *et al.*, 2008). So based on this result some species and genera were added to Marakan flora. Considering AqDagh as a subset of Marakan, covering 5% of its area, more species diversity of Marakan flora was expected. Ratios of taxa/genus and genus/family of the studied areas are given (Table 3). Indeed a complete list for the Marakan protected area has not been reported by the previous researchers (Hassanzadeh *et al.*, 2008).

Table 2. List of rich families with more than 4 taxa in AqDagh sanctuary zone

Families	Genera	Taxa
Asteraceae	23	30
Lamiaceae	18	26
Brassicaceae	13	16
Caryophyllaceae	8	14
Fabaceae	6	14
Poaceae	10	12
Amaranthaceae	10	11
Scrophulariaceae	5	9
Rubiaceae	4	9
Boraginaceae	6	8
Apiaceae	6	7
Rosaceae	6	6
Papaveraceae	4	5

Table 3. Comparing floristic richness, taxonomic diversity and geographic characteristics of AqDagh and its adjacent studied areas

Studied area	Province	Area (hectar)	Precipitation mm.year	Taxa	Genera
Marakan (Hasanzadeh <i>et al.</i> , 2008)	east & west Azarbaijan	103986	281.1	282	167
Munjughlu (Ghahremaninejad and Nafisi, 2011)	east Azarbaijan	5270	242.88	236	166
Mishu-Dagh (Manafi and Bahreiny, 1997)	east Azarbaijan	-	736	390	232
Arasbaran (Assadi, 1987-1988; Hamzeh'ee <i>et al.</i> , 2010)	east Azarbaijan	80654	316-686	1067	442
Ghasemloo Valley (Malekmohammadi <i>et al.</i> , 2006)	west Azarbaijan	577	459.6	204	165
Mirabad (Hassanzadeh Gorttpeh and Panahy, 2007)	west Azarbaijan	11435	600	192	126
AqDagh (The present study)	west Azarbaijan	5184.7	360.9	227	166

Studied area	Province	Families	Taxa/Genera	Genera/Families
Marakan (Hasanzadeh <i>et al.</i> , 2008)	east & west Azarbaijan	47	1.69	3.55
Munjughlu (Ghahremaninejad and Nafisi, 2011)	east Azarbaijan	38	1.42	4.36
Mishu-Dagh (Manafi and Bahreiny, 1997)	east Azarbaijan	60	1.68	3.86
Arasbaran (Assadi, 1987-1988; Hamzeh'ee <i>et al.</i> , 2010)	east Azarbaijan	83	2.41	5.32
Ghasemloo Valley (Malekmohammadi <i>et al.</i> , 2006)	west Azarbaijan	50	1.23	3.3
Mirabad (Hassanzadeh Gorttpeh and Panahy, 2007)	west Azarbaijan	41	1.52	3
AqDagh (The present study)	west Azarbaijan	47	1.37	3.53

The AqDagh sanctuary had 84 species (37%), 101 genera (60.47%) and 32 families (68%) in common with Munjughlu flora. Violaceae, Verbenaceae, Ulmaceae, Thymelaeaceae, Salicaceae, Rosaceae, Rhamnaceae, Lythraceae, Hypericaceae Ephedraceae, Convolvulaceae,

Crassulaceae, Cistaceae and Capparidaceae families are present in AqDagh sanctuary but were absent in Munjughlu. In contrast, Cleomaceae, Juncaceae, Orobanchaceae, Solanaceae, Tamarixaceae, Xanthorrhoeaceae were present in Munjughlu and were absent in AqDagh region.

The Flora of AqDagh and Munjughlu had a total of 80 species, 110 genera and 36 families in common with Marakan flora. Based on this study, 59 genera and 12 families included: Violaceae, Verbenaceae, Santalaceae, Rhamnaceae, Primulaceae, Polygalaceae, Lythraceae, Ixioliriaceae, Dipsacaceae, Cistaceae and Capparidaceae, Asparagaceae are not found in study of Marakan by Hasanzadeh *et al.* (2008).

Life form

In the assessment of life form spectrum therophytes with 36.57% of flora were the most dominant, followed by hemicytopytes (with 27.75%), chamaephytes (with 19.38%), cryptophytes (with 11.01%) and phanerophytes (with 5.29%) (Figure 3). The high presence of annual plants is the characteristic feature of this region, but with the increase in the altitude in mountainous parts hemicytopytes became more abundant.

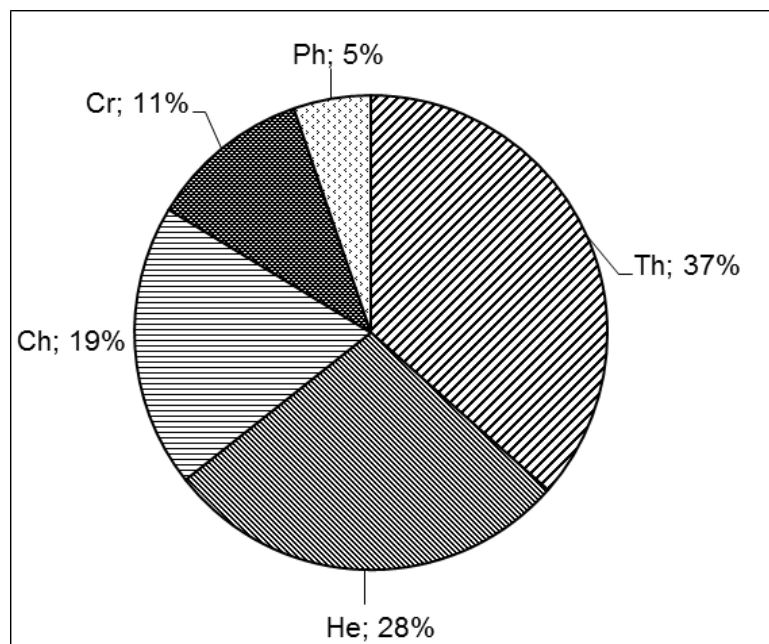


Figure 3. The pie chart of life form of AqDagh species

Life forms of plants indicated the possibility of its adaptation to environmental factors especially climatic condition. According to Mobayen (1980-1996), the frequency of therophytes was due to Mediterranean climate and the frequency of hemicytopytes was due to cold and temperate climate. High percentage of therophyte indicated the fact that this area had low rainfall. Dominance of therophyte and hemicytopyte indicated the adaptation of these plants to arid and cold area. The low percentage of Cryptophyte and Phanerophyte showed that they were not adapted to existing climate and edaphical situations. In addition, based on our statistic data, this rank of frequency fitted in semi-dry and semi-dry cold condition. Therophytes adapted to drought and shortage of rainfall, because they spend their vegetative period in the form of seed and hemicytopyte use different ways such as: reserving water, using ground water, reducing their water need by losing their leaves and

reduction of vegetative growth to overcome difficult environmental conditions (Asri, 2003).

Comparing life forms of the studied area with other regions Assadi (1987, 1988), Manafi and Bahreiny (1997), Malekmohammadi *et al.* (2006), Hassanzadeh Gorttapeh and Panahy (2007), Hasanzadeh *et al.* (2008), and Ghahremaninejad and Nafisi (2011), maximum resemblance between AqDagh and Munjughlu followed by Marakan and Ghasemloo valley (Table 4) is revealed. In this table, Arasbaran data are from (Hamzeh'ee *et al.*, 2010).

Table 4. plant life form spectrums in studied area in east and west Azarbaijan provinces

Marakan	Th: 31.91%	He: 26.95%	Ch: 16.31%	Ph: 15.06%	Cr: 9.26%
Munjughlu	Th: 40%	He: 31.92%	Ch: 15.32%	Cr: 10.21%	Ph: 1.7%
AqDagh	Th: 36.72%	He: 27.87%	Ch: 19.02%	Cr: 11.06%	Ph: 5.30%
Mishu-Dagh	He: 42.1%	Cr: 19.55%	Th: 19.24%	Ch: 14.24%	Ph: 5.3%
Arasbaran	He: 42.5%	Th: 25.8%	Cr: 18.8%	Ph: 8.1%	Ch: 4.8%
Ghasemloo valley	Th: 30.9%	He: 29.9%	Ph: 16.7%	Ch: 12.25%	Cr: 10.3%
Mirabad	He: 30.2%	Th: 28.1%	Cr: 22%	Ph: 17.7%	Ch: 12.5%

Chorology

This area is situated at junction of 2 important phytogeographic regions namely Irano-Turanian and Euro-Siberian. The vegetation of the area has been influenced by the elements of four phytogeographical regions, including Irano-Turanian, Euro-Siberian, Mediterranean, Saharo-Sindian, therefore as it is supposed rather high proportions of bi-tri or pluriregional elements occur in the area. The results showed that 59.01 % of the flora in this area belonged to bi-tri or pluriregional elements. This showed overlap of some phytogeographic areas in this region. Irano-Turanian elements (31.53%), Irano-Turanian and Euro-Siberian (27.49%), Pluriregional (13.06%), Irano-Turanian, Mediterranean and Euro-Siberian (7.66%), Irano-Turanian and Mediterranean (4.95%), Irano-Turanian, Mediterranean and Saharo-Sindian (2.25%), Irano-Turanian and Saharo-Sindian (1.8%), Irano-Turanian, Euro-Siberian and Saharo-Sindian (0.9%), Cosmopolitan (0.9%) and endemic (9.46%) were the most important Phytogeographic elements of the studied area (Figure 4). The phytochoria of the studied area that are compared with other regions (Table 5), showed the presence of similar Phytogeographical elements in AqDagh and Munjughlu and Arasbaran area. In addition, IT and IT-ES were the dominant chorotypes in all areas except in Arasbaran region.

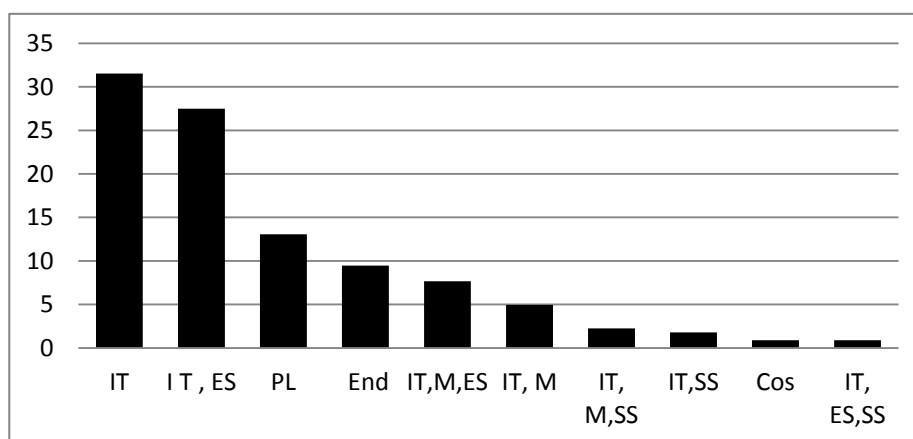


Figure 4. The column chart of percentage of phytocorya in AqDagh

Table 5. Comparison of chorotypes in studied area in east and west Azarbaijan provinces

Marakan	IT: 65.25%	Bi- tri- or plural: 24.13%	ES: 5.31%	End: 4.25%	M: 1.06%
Munjughlu	Bi- tri- or plural: 58.51%	IT: 34.06%	End: 6.12%	ES: 1.31%	
AqDagh	Bi- tri- or plural: 59.01%	IT: 31.53%	End: 9.46%		
Arasbaran	Bi- tri- or plural: 45.6%	ES: 26.6%	IT: 23.2%	M: 4.6%	
Ghasemloo valley	IT: 61.28%	Bi- tri- or plural: 22.55%	ES: 8.33%	End: 6.86%	M: 0.98%
Mirabad	IT: 62.5%	Bi- tri- or plural: 25.52%	ES: 6.78%	End: 4.68%	M: 0.52%

Endemism

Among 227 taxa distributed in the studied area, 14 species, 4 variety and 3 subspecies were endemic. The endemic taxa in this area were: *Aethionema trinervium* Boiss. var. *apterocarpum* (Rech.f. & Aellen) Hedge, *Alyssum inflatum* Nyár., *Dianthus orientalis* Donn var. *obtusisquameus* (Boiss.) Rech.f., *Minuartia lineata* (Boiss.) Bornm., *Paronychia caespitosa* Stapf, *Astragalus ebenoides* Boiss. subsp. *ebenoides*, *Astragalus glochidiatus* Maassoumi, *Astragalus rhodosemius* Boiss. & Hausskn., *Astragalus vegetus* Bunge, *Astragalus wagneri* Bartle. ex Bunge, *Ajuga chamaecistus* Ging ex Benth. subsp. *tomentella* (Boiss.) Rech.f., *Phlomis olivieri* Benth., *Stachys laxa* Boiss. & Buhse, *Allium subakaka* Razyfard & Zarre, *Alcea flavovirens* (Boiss. & Buhse) Iljin var. *flavovirens*, *Alcea glabrata* Alef. var. *glabrata*, *Acantholimon bracteatum* Boiss., *Rhamnus pallasii* Fisch. & C.A.Mey., *Crucianella gilanic* Trin. subsp. *glauca* (A.Rich. ex DC.) Ehrend., *Scorzonera mucida* Rech.f., Aellen & Esfand., *Heliotropium dissitiflorum* Boiss. Endemic taxa comprised 8.84% of total taxa in this area. About 6916 plant species were present in Iran out of which 1810 were endemic species (26%) (Ghahreman and Attar, 1999), this area consisted of 1.1% of Iran endemic species. Endemism frequency in families is in (Figure 5). The reason for reduction of endemism and biodiversity in this sanctuary could be due to maximum grazing that would lead to biodiversity losses and distribution of rural species. *Astragalus brachyodontus* Boiss., *Astragalus ebenoides* Boiss. subsp. *ebenoides*, *Astragalus vegetus* Bunge., *Astragalus wagneri* Bartle. ex Bunge., *Artemisia spicigera* K.Koch., *Echinops haussknechtii* Boiss., *Tragopogon caricifolius* Boiss., *Dianthus orientalis* Donn var. *obtusisquameus* (Boiss.) Rech.f., *Paronychia caespitosa* Stapf, *Phlomis olivieri* Benth., *Sameraria nummularia* Bornm., *Heliotropium esfandiarrii* Akhani & H.Riedl, *Alcea flavovirens* (Boiss. & Buhse) Iljin var. *flavovirens*, *Acantholimon gilliatii* Turril., *Malabaila kotschyi* Boiss. were the endemic taxa in Munjughlu sanctuary that among these seven endemic taxa were common.

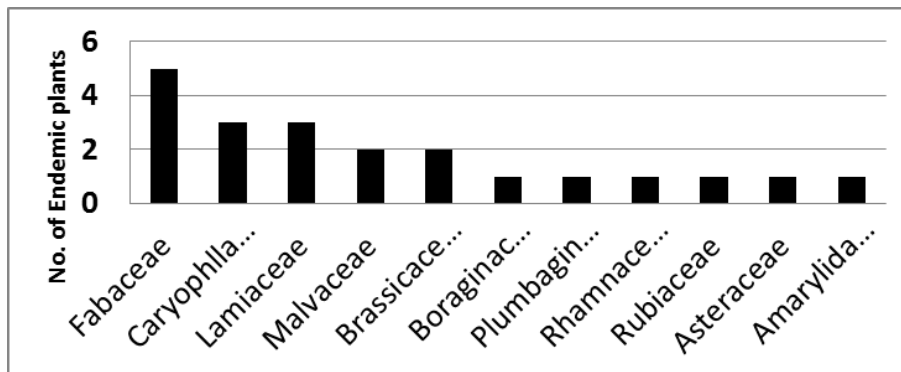


Figure 5. The column chart of endemic taxon number in families

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References

- Archibold, O. W. (1995) Ecology of world vegetation. Chapman and Hall, London.
- 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).
- Assadi, M. (1987) Plants of Arasbaran Protected Area, NW Iran (part I). Iranian Journal of Botany 3(2): 129-175.
- Assadi, M. (1988) Plants of Arasbaran Protected Area, NW Iran (part II). Iranian Journal of Botany 4(1): 1-59.
- Asri, Y. (2003) Plant diversity in Touran biosphere reservoir. Research Institute of Forests and Rangelands, Tehran (in Persian).
- Davis, P. H. (ed.). (1965-1988) Flora of Turkey and the East Aegean Islands. Edinburgh University Press, Edinburgh.
- Department of Environment (2004) Marakan Protected Area General Managment Project. Negin Gostar Andisheh Engineering Counselor (in Persian).
- Ghahreman, A. and Attar, F. (1999) Biodiversity of plant species in Iran. Tehran University publications, Tehran (in Persian).
- Ghahremaninejad, F. and Nafisi, H. (2011) Floristic study of Munjughlu sanctuary zone in Marakan protected area (east Azarbaijan province, NW Iran). Rostaniha 12(1): 73-82. (in Persian)
- Hamzeh'ee, B., Safavi, S. R., Asri, Y. and Jalili, A. (2010) Floristic analysis and a preliminary vegetation description of Arasbaran Biosphere Reserve, NW Iran. Rostaniha 11: 1-16. (in Persian)
- Hassanzade Gorttapeh, A. and Panahy, J. (2007) Floristic study of Mirabad region. Pakistan Journal of Biological Sciences 10(20): 3698-3702.
- Hassanzadeh Gorttapeh, A., Panahy, J. and Talet, F. (2008) Floristic study of Marakan Protected Region (west Azarbaijan province). Research Journal of Biological Sciences 3(6): 581-588.
- IUCN (2001). IUCN red list categories and criteria, ver. 3.1. IUCN Species Survival Commission.
- Jafari, S. M. and Akhiani, H. (2008) Plants of Jahan Nama protected area, Golestan province, N. Iran. Pakistan Journal of Botany 40(4): 1533-1554.
- Jalili, A. and Jamzad, Z. (1999) Red Data Book of Iran, A preliminary survey of endemic, rare and endangered plant species in Iran. Research Institute of forests and Rangelands, Tehran.
- Komarov, V. L. (ed.). (1963-2001) Flora USSR. Publishing House of the Academy of Sciences of the USSR, Moscow and Leningrad (in Russian).
- Leonard, J. (1988) Contribution à l'étude de la flore et de la végétation des desert d'Iran, Fascicule 8: Etude des aires de distribution-Les phytochories-Les chorotypes. Bulletin of the Jardin Botanique National de Belgique, Meise.
- Macklin, A. J. and Morris, J. P. (2007) Scaling up to the international plant names index. Retrieved from <http://www.ipni.org>. On: 24 December 2011.

- Malekmohammadi, L., Mahmoudzadeh, A. and Hassanzadeh, A. (2007) Floristic Study of Ghasemloo (Shohada) Valley Forest Reserve and adjacent area. *Pakistan Journal of Biological Sciences* 10(10): 1618-1624.
- Manafi, M. and Bahreiny, A. (1997) *An Introduction to Flora of Mishu-Dagh*. Tabriz University Press, Tabriz (in Persian).
- Mobayen, S. (1980-1996) *Flora of Iran*. Tehran University Press, Tehran (in Persian).
- Noroozi, J., Akhiani, H. and Breckle, S. W. (2007) Biodiversity and phytogeography of the alpine flora of Iran. *Biodiversity and Conservation* 17(3): 493-521.
- Rechinger, K. H. (ed.). (1963-2010) *Flora Iranica*, vols. 1-178. Akademische Druck-und Verlagsanstalt, Graz (1-174), Naturhistorisches Museum: Wien (175-178).
- Siadati, S., Moradi, H., Attar, F., Etemad, V., Hamzeh'ee, B., Naqinezhad, A. (2010) Botanical diversity of Hyrcanian forests; a case study of a transect in the Kheyroud protected lowland mountain forests in northern Iran. *Phytotaxa* 7: 1-18.
- Zohary, M. (1973) *Geobotanical foundations of the Middle East*. Stuttgart, G. Fischer.

Appendix 1. Floristic list of AqDagh sanctuary zone in Marakan protected area and herbarium numbers. The first reported taxa from northwest of Iran have been shown with three stars and from west Azarbaijan with one star.

Gymnosperms

Ephedraceae: *Ephedra major* Host. (10672).

Angiosperms

Monocots

Amaryllidaceae: ****Allium subakaka* Razyfard & Zarre (10480), *Allium syntamanthum* K.Koch (10399)

Asparagaceae: *Ornithogalum brachystachys* K.Koch (10449), *Muscari caucasicum* (Griseb.) Baker (10476, 10477), *Muscari neglectum* Guss. ex Ten. (10297).

Iridaceae: *Iris iberica* Hoffm. subsp. *lycotis* (Woron) Takht. (10499, 10301).

Ixioliriaceae: *Ixiolirion tataricum* (Pall.) Herb. subsp. *montana* (10458).

Liliaceae: *Tulipa humilis* Herb. (10241), ****Tulipa lehmanniana* Mercklin (10308).

Poaceae: *Aegilops triuncialis* L. (10412), *Agropyron pectiniforme* Roem. & Schultes (10442), *Boissiera squarrosa* (Sol.) Nevski (10662, 10434), ****Bromus gracilimus* Bunge (10430), ****Bromus madritensis* L. var. *madritensis* (10519, 10661), *Bromus tectorum* L. var. *hirsutus* Regel (10405, 10402), *Eremopoa persica* (Trin.) Roshev. (10438), *Eremopyrum distans* (K.Koch) Nevsk. (10404), *Melica jacquemontii* Decne. subsp. *jacquemontii* (10510, 10441), *Poa bulbosa* L. (10202, 10294), *Stipa barbata* Desf. (10415, 10420), *Taeniatherum crinitum* (Schreb.) Nevski (10408).

Dicots

Amaranthaceae: **Amaranthus albus* L. (10814), *Amaranthus retroflexus* L. (10811), *Atriplex tatarica* L. (10810), *Caroxylon ericoides* (M.Bieb.) Akhani & E.H.Roalson (10788), *Ceratocarpus arenarius* L. (10409), *Halanthium rarifolium* K.Koch (10207), *Krascheninnikovia ceratoides* (L.) Gueldenst. var. *ceratoides* (10669, 10670), *Noaea mucronata* Asch. & Schweinf. subsp. *mucronata* (10820), *Salsola tragus* L. (10214), *Seidlitzia florida* (M.Bieb.) Bunge ex Boiss. (10220, 10212, 10213), *Suaeda altissima* Pall. (10794).

Apiaceae: *Astrodaucus orientalis* Drude (10817, 10437), *Daucus carota* L. subsp. *carota* (10781, 10782, 10783), **Eryngium bungei* Boiss. (10847), *Eryngium glomeratum* Lam. (10846), *Prangos uloptera* DC. (10468), *Scandix aucheri* Boiss. (10413, 10232, 10266), *Zosimia absintifolia* (Vent.) Link (10504).

Asteraceae: *Artemisia scoparia* Waldst. & Kit. (10805), *Carduus pycnocephalus* L. subsp. *pycnocephalus* (10315), *Carthamus lanatus* L. (10801), *Centaurea phaeopappa* (DC.) Sch.Bip. (10703), *Centaurea pseudoscabiosa* Boiss. & Buhse subsp. *pseudoscabiosa* (10691), *Centaurea solstitialis* L. subsp. *solstitialis* (10800), *Centaurea virgata* Lam. subsp. *squarrosa* (Willd.) Gugler (10808, 10463), *Cichorium intybus* L. (10772), *Cirsium congestum* Fisch. & C.A.Mey. (10714), *Cousinia macroptera* C.A.Mey. ex DC. (10417, 10455), *Cymbolaena griffithii* (A.Gray) Wagenitz (10411), *Echinops orientalis* Trautv (10802), *Filago arvensis* L. (10410), *Helichrysum armenium* DC. (10694), *Jurinea pulchella* DC. (10768), *Lactuca serriola* L. (10775), *Onopordum leptolepis* DC. (10813), *Pulicaria dysenterica* (L.) Bernh. (10780), **Scorzonera mucida* Rech.f., Aellen & Esfand. (10265), *Scorzonera ramosissima* DC. (10479), *Senecio vernalis* Waldst. & Kit. (10236, 10290), *Klasea coriacea* (DC.) Holub (10798), *Tanacetum canescens* DC. (10664), *Tanacetum polycephalum* Sch. Bip. (10440), *Tanacetum uniflorum* Sch. Bip. (10459, 10683, 10684), *Taraxacum* sp. (10774, 10803), *Tragopogon coloratus* C.A.Mey. (10506), *Tragopogon graminifolius* DC. (10497), *Xanthium brasiliicum* Vell. (10818), *Xeranthemum squarrosum* Boiss. (10700).

Berberidaceae: *Berberis integerrima* Bunge (10823), *Leontice armeniaca* Boiv. (10488, 10240).

Boraginaceae: ****Buglossoides tenuiflora* (L.f.) I.M.Johnst. (10298, 10296), **Heliotropium circinatum* Griseb. (10806, 10807), *Heliotropium dissitiflorum* Boiss. (10699), *Heliotropium szowitsii* Stscheg. (10698), *Lappula microcarpa* Gürke (10491, 10464, 10677, 10452), *Nonea pulla* DC. (10300), *Onosma microcarpa* DC. (10671, 10453), *Paracaryum strictum* Boiss. (10692).

Brassicaceae: **Aethionema trinervium* Boiss. var. *apterocarpum* (Rech.f. & Aellen) Hedge (10469, 10304), *Alyssum inflatum* Nyár. (10288, 10291), *Alyssum linifolium* Steph. ex Willd. var. *linifolium* (10274), *Alyssum minus* (L.) Rothm. (10204), **Alyssum muellerii* Boiss. & Buhse (10709), *Arabidopsis pumila* Busch (10269), **Arabis gerardii* Besser (10281), **Clypeola dichotoma* Boiss. (10419), *Conringia orientalis* (L.) Andr. (10234), **Drabopsis verna* K.Koch (10233, 10203), *Goldbachia laevigata* DC. (10280), *Isatis cappadocica* Desv. subsp. *cappadocica* (10707), *Sameraria stylophora* Boiss. (10505), *Sterigmastemum incanum* M.Bieb. (10299), *Thlaspi perfoliatum* L. (10235), *Torulularia torulosa* O.E.Schulz (10271).

Capparidaceae: *Capparis spinosa* L. (10769, 10770, 10804).

Caryophyllaceae: *Arenaria holostea* M.Bieb. subsp. *macrantha* (Schischk.) McNeill (10494), *Cerastium inflatum* Link ex Sweet (10500), **Dianthus orientalis* Donn var. *obtusisquameus* (Boiss.) Rech.f (10773),

Holosteum glutinosum (M.Bieb.) Fisch. & C.A.Mey. (10278), *Holosteum marginatum* C.A.Mey. (10310), *Minuartia hamata* (Hausskn.) Mattf. (10422), **Minuartia lineata* (Boiss.) Bornm. (10474), *Minuartia meyeri* Bornm. (10706, 10427), **Paronychia caespitosa* Stapf (10418), *Silene chlorifolia* Sm. (10686), *Silene commelinifolia* Boiss. var. *commelinifolia* (10682), *Silene spergulifolia* M.Bieb. (10503), *Silene stenobotrys* Boiss. & Hausskn. (10472), *Velezia rigida* L. (10416).

Cistaceae: *Helianthemum ledifolium* Mill. var. *microcarpum* Willk. (10799).

Crassulaceae: *Rosularia sempervivum* A. Berger var. *sempervivum* (10509), **Sedum subulatum* Boiss. (10679, 10680), *Sedum album* L. (10681).

Convolvulaceae: *Convolvulus lineatus* L. (10667), *Cuscuta brevistyla* A.Braun ex A.Rich. (10668).

Dipsacaceae: *Scabiosa micrantha* Desf. (10502).

Ephorbiaceae: ****Euphorbia denticulata* Lam. (10262, 10263), *Euphorbia* sp. (10400), *Euphorbia* sp. (10701, 10778).

Fabaceae: **Astragalus crispocarpus* Nábělek (10487), *Astragalus ebenoides* Boiss. subsp. *ebenoides* (10483), **Astragalus glochidiatus* Maassoumi (10689), **Astragalus iranicus* Bunge (10279, 10841), *Astragalus latifolius* Lam. (10295), *Astragalus macropelmatus* Bunge subsp. *macropelmatus* (10351, 10305), *Astragalus rhodosemius* Boiss. & Hausskn. (10690), *Astragalus vegetus* Bunge (10314, 10350), *Astragalus wagneri* Bartle. ex Bunge (10277), **Caragana grandiflora* DC. (10303), *Medicago rigidula* (L.) All. var. *rigidula* (10428), *Onobrychis cornuta* (L.) Desv. subsp. *cornuta* (10498, 10293), *Onobrychis subacaulis* Boiss. (10317), *Vicia cappadocica* Boiss. (10287).

Geraniaceae: *Biebersteinia multifida* DC. (10311), **Erodium neuradifolium* Delile ex Godron (10283, 10485), ****Erodium oxyrrhynchum* M.Bieb. subsp. *bryoniifolium* Boiss.) Schön.-Tem. (10423), *Geranium tuberosum* L. (10484, 10312).

Hypericaceae: *Hypericum scabrum* L. (10712, 10478), *Hypericum helianthemoides* (Spach) Boiss. (10771).

Lamiaceae: *Acinos graveolens* Link (10489), **Ajuga chamaecistus* Ging ex Benth. subsp. *tomentella* (Boiss.) Rech.f. (10496), ****Dracocephalum thymiflorum* L. (10456, 10358, 10273), *Eremostachys macrophylla* Montbr. & Auch. (10439), *Eremostachys laciniata* Bunge (10462), *Hymenocrater bituminosus* Fisch. & C.A.Mey. (10481, 10466), *Lallemantia iberica* Fisch. & C.A.Mey. (10363, 10486), *Lamium amplexicaule* L. var. *amplexicaule* (10284), *Marrubium parviflorum* Fisch. & C.A.Mey. (10713, 10676), *Mentha longifolia* L. (10779, 10793), **Nepeta fissa* C.A.Mey. (10695), *Nepeta involucreta* Bornm. (10495, 10508), *Phlomis olivieri* Benth. (10659), **Salvia chloroleuca* Rech.f. & Aellen (10531), *Salvia pachystachya* Trautv. (10454, 10457), *Scutellaria pinnatifida* A.Ham. subsp. *alpina* (Bornm.) Rech.f. (10448), *Scutellaria platystegia* Juz. (10470), *Scutellaria* sp. (10289), *Sideritis montana* L. (10401, 10447), *Stachys inflata* Benth. (10433, 10444), *Stachys schtschegleevii* Sosn. ex Grossh (10264, 10275), ****Stachys laxa* Boiss. & Buhse (10660), *Teucrium polium* L. (10797, 10663, 10432, 10443), *Thymus* sp. (10446, 10461, 10445), *Ziziphora capitata* L. subsp. *orientalis* Samuelsson ex Rech.f. (10460), *Ziziphora tenuior* L. (10403).

Linaceae: **Linum mucrunatum* Betrol. var. *mucrunatum* (10666).

Lythraceae: *Lythrum salicaria* L. (10786).

Malvaceae: **Abutilon theophrasti* Medik. (10208), *Alcea flavovirens* (Boiss. & Buhse) var. *flavovirens* (10719, 10753), **Alcea glabrata* Alef. var. *glabrata* (10796, 10812, 10205), *Hibiscus trionum* L. (10819).

Papaveraceae: *Glaucium corniculatum* (L.) Rudolph subsp. *corniculatum* (10431), *Hypecoum pendulum* L. (10282), **Papaver argemone* L. (10493), *Papaver macrostomum* Boiss. & A.Huet (10492), *Roemeria hybrida* (L.) DC. subsp. *dodecandra* (Forssk.) Maire (10270).

Plantaginaceae: *Plantago lanceolata* L. (10473).

Plumbaginaceae: *Acantholimon bracteatum* Boiss. (10482), *Plumbago europaea* L. (10815).

Polygalaceae: *Polygala hohenackeriana* Fisch. & C.A.Mey. (10285).

Polygonaceae: *Atraphaxis spinosa* L. (10696).

Primulaceae: *Androsace maxima* L. (10309, 10426).

Ranunculaceae: *Adonis aestivalis* L. (10267), *Ceratocephala falcata* (L.) Pers. (10268), *Consolida regalis* Gray subsp. *divaricata* (Ledeb.) Munz (10704, 10703, 10702), *Thalictrum isopyroides* C.A.Mey. (10313).

Resedaceae: *Reseda lutea* L. (10471, 10688), **Reseda microcarpa* Müll.Arg. (10435).

Rhamnaceae: *Rhamnus pallasii* Fisch. & C.A.Mey. (10407, 10429, 10784, 10490).

Rosaceae: *Amygdalus communis* L. (10276), *Cerasus pseudoprostrata* Pojark. (10705, 10306), *Cotoneaster nummularioides* Pojark. (10824), *Crataegus meyeri* Pojark. (10790, 10825), *Rosa canina* L. (10792, 10795, 10822), *Sanguisorba minor* Scop. subsp. *lasiocarpa* (Boiss. & Hausskn.) Nordborg (10787, 10789).

Rubiaceae: *Callipeltis cucullaria* (L.) DC. (10406), ****Crucianella gilanica* Trin. subsp. *glauca* (A.Rich. ex DC.) Ehrend. (10673), *Crucianella gilanica* Trin. subsp. *trancaspica* (10674), **Gaillonia szowitzii* DC. (10665), *Galium humifusum* M.Bieb. (10675), ****Galium nupercreatum* Popov (10777), *Galium spurium* L.

subsp. *spurium* (10450), *Galium verticillatum* Danthoine ex Lam. (10414), *Galium verum* L. subsp. *verum* f. *verum* (10678, 10451).

Salicaceae: **Salix excelsa* S.G.Gmelin. (10791).

Santalaceae: **Thesium kotschyanum* Boiss. (10710, 10467).

Scrophulariaceae: *Bungea trifida* C.A.Mey. (10711), *Linaria simplex* DC. (10507), *Scrophularia azerbijanica* Grau. (10475), **Verbascum orientale* L.All. (10687), *Verbascum speciosum* Schrad. (10697, 10767), *Verbascum suworowianum* K.Koch var. *suworowianum* (10424), *Verbascum suworowianum* K.Koch var. *acuminatum* (Murb.) Hub.-Mor. (10425), *Veronica microcarpa* Boiss. (10292), *Veronica persica* Poir (10501).

Thymeleaceae: *Diarthron vesiculosum* Endl. (10693).

Ulmaceae: *Celtis glabrata* Steven ex Planch. (10816, 10685).

Valerianaceae: *Valerianella oxyrhyncha* Fisch. & C.A.Mey. (10421), *Valerianella coronata* (L.) DC. (10465), *Valerianella cymbaecarpa* C.A.Mey. (10307), *Valerianella plagiostephana* Fisch. & C.A.Mey. (10708).

Verbenaceae: *Verbena officinalis* L. (10785).

Violaceae: *Viola occulta* Lehm. (10316, 10286).

Zygophyllaceae: *Peganum harmala* L. var. *harmala* (10398), *Zygophyllum atriplicoides* Fisch. & C.A.Mey. var. *atriplicoides* (10436).

مطالعه فلوریستیک منطقه امن آق‌داغ در منطقه حفاظت شده مراکان: استان آذربایجان غربی، ایران

هانیه نفیسی و فرخ قهرمانی نژاد *

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چکیده

منطقه امن آق‌داغ با ۵۱۸۴/۷ هکتار در استان آذربایجان غربی یکی از سه منطقه امن منطقه حفاظت شده مراکان است. بر اساس ضریب آمبرژه آب و هوای این منطقه نیمه‌خشک سرد و بر اساس ضریب دومارتون نیمه‌خشک است. طی سال‌های ۱۳۸۷ تا ۱۳۸۸ از این منطقه ۲۲۷ تاکسون (گونه، زیرگونه، واریته) متعلق به ۴۷ تیره و ۱۶۶ جنس شناسایی شد. از این بین، ۲۰۵ تاکسون دولپه و ۲۱ تاکسون تک‌لپه و یکی بازدانه هستند. تیره‌های Asteraceae (۳۰ گونه)، Lamiaceae (۲۶ گونه) و به دنبال آن تیره‌های Brassicaceae، Caryophyllaceae و Fabaceae غنی‌ترین تیره‌ها هستند و متنوع‌ترین جنس‌ها *Astragalus* با ۹ گونه و *Gallium* با ۵ گونه هستند. این منطقه شامل ۲۱ تاکسون بوم‌زاد ایران و ۶ تاکسون نادر و ۲ جنس مونوتیپیک است. همچنین، در پژوهش حاضر برای نخستین بار، ۱۱ تاکسون از شمال غرب ایران و ۲۹ تاکسون از آذربایجان غربی گزارش می‌شود. شکل زیستی اغلب گیاهان منطقه، تروفیت‌ها با ۳۶/۵۷ و همی کریپتوفیت‌ها با ۲۷/۷۵ درصد هستند. از نظر جغرافیای گیاهی، منطقه تحت تأثیر عناصر ایرانی-تورانی (۳۱/۵۳ درصد) و ایرانی-تورانی/اروپا-سیبری (۲۷/۴۹ درصد) هستند. بالاترین کسر از گیاهان منطقه متعلق به عناصر دو، سه یا چند منطقه‌ای (۵۹/۰۱ درصد) هستند.

واژه‌های کلیدی: آذربایجان غربی، ارس، فلور، کورولوژی، ایران