Floristic study of the Dupaza Mountain, Sardasht County, West Azarbaijan Province, NW Iran

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Abstract. Dupaza Mountain is located in the southwest of the West Azarbaijan Province, between 36°10'N and 45°24' E, at an altitude of 2379 m. Life forms of the plant species were determined by the Raunckier's method, and chorotypes of the plant species were determined by essentail references. In this research, 27 families, 70 genera and 97 species were identified. The largest plant family is *Asteraceae*, with 20 species. The main biological forms are respectively hemicryptophytes and therophytes. The most extended chorotype is Irano-Turanian, accounting for 64.94 %.

Key words: Floristic list, Iran, life form, plant geography, plant species

Introduction

In terms of topography, climate, vegetation and geographical features, Iran is one of the most important and unique countries in the Middle East. According to a recent study (Mozaffarian 2007), the flora of Iran comprises 8000 species belonging to 1450 genera and 150 families. These families include 124 dicotyledons, 22 monocotyledons and four gymnosperms. Here are some sources related to the vegetation of Iran: *Flora Orientalis* (Boissier 1936), *Flora Keredjensis* (Bornmuller & Gauba 1935–1941), *Flore de l'Iran* (Parsa 1948–1952), *Flora Iranica* (Rechinger 1963–2010) *Flora of Iran, Tracheophyta* (Mobayen 1975–1995), *Colored Flora of Iran* (Ghahreman 1977–2007), and *Flora of Iran* (Assadi & al. 1988–2011).

The country is situated among three main phytochoria, including Euro-Siberian (boreal), Irano-Turanian and Saharo-Sindian (White & Léonard, 1991), or Saharo-Arabian (Zohary 1973; Akhani 2007), and is influenced by introgression of the Somalia-Masaei and Mediterranean species (Zohary 1973; Takhtajan 1986; Léonard 1989).

Iran has one of the highest number of endemic species across the world, with special mention of the Irano-Turanian region. This indicates that Iran, as a formation center for the Irano-Turanian region, has a rich and unusual flora (Zohary 1963). To the northwest and southwest of the West Azarbaijan Province, with 320 thousand hectares of forests located in the western part of the country, lies one of the major habitats of oak, almond and other species of the Zagros Forests (Tabatabaei & Ghaserbani 1992).

Studies of the flora of each region facilitate maintenance of such ecological issues as biological protection and natural resources management, determining the potential and growth capacity of the region, identification of the resistant and medicinal species and, finally, identification of the plant species of the country (Esmailzade & al. 2004; Amiri & al. 2008; Kazemian & al. 2004)

Knowledge of the floristic composition of an area is a prerequisite for ecological and phytogeograph-

ical studies and conservation management activities. According to Raunkiaer's system, plant species can be classified into five main groups: phanerophytes, chamaephytes, hemicryptophytes, cryptophytes, and therophytes. This system has been widely used in many regions to classify the plant species in life forms, such as the tundra (Raunkiaer 1934), temperate forests (Buell & al. 1948; Gao & Chen 1998), tropical rain forests (Cain & al. 1956), and thorn woodlands (Carvalho & al. 2007). Every plant species has a unique biological scope and endures a specific amount of environmental changes. To have a better understanding the transmittal areas, some scientists like (Takhtajan 1986; Zohary 1963) Geographically, Iranian forests are classified as follows: northern forests, western and southwestern forests, central flat forests, and southern forests (Khalig-Omani sub region). The western and southwestern forests (Zagros Forests) belong to the Irano-Touranian vegetation zone (Sabeti 2002). That region has semiarid climate with a cold winter. Rainfalls are mostly in winter, within the range of 400–900 mm (Mosadegh 2005). In most areas of that zone the soil is calcareous (Marvi Mohadjer 2005). Altitude of the most parts of the area is 1000 m a.s.l. (Majnounian 1999). There are few investigations into the plant life forms and geographical distribution in the Zagros Forests (Abrari & Karami 2004; Pourrezaei & al. 2010; Taghipour & al. 2011).

Material and methods

This study was conducted in the Dupaza Mountain, Sardasht County, during the 2012–2014 vegetation season. The mountain is situated between 36°10'N and 45°24'E, at 2379 m a.s.l. (Fig. 1). The mean annual rainfall is 700 mm. The average maximum temperature is 14 °C in August and the minimum temperature is –5 °C in February. Plant specimens were collected during different seasons. The samples were transferred to the laboratory, where they were pressed and identified according to Assadi (1988–2011), Takhtajan (1986), Rechinger (1963–2010), Davis (1965–1988), Ghahreman (1977–2007); Massoumi (1995), and Ghahreman (1977–2007), and deposited in the Herbarium of Alzahra University. Identification of life forms followed Raunkier's classification (Raunkier 1934). The endemic species were determined according to Jalili & Jamzad (1999).

Fig. 1. Map of Northwestern Iran, Dupaza Mountain near Sardasht (the West Azerbaijan Province is marked by a black arrow).

Results

The results of the study have shown about 97 identified species, belonging to 70 genera and 27 families. The main families with a large number of elements in the studied region are: *Asteraceae* with 20 species, *Poaceae* (10), *Lamiaceae* (10), and *Fabaceae* (9). Respectively, there are 52 monotypic genera among the existing genera, 13 genera with two species, four genera with three species, and one genus with seven species (Table 1).

The life form spectrum of the plant species indicates: phanerophytes 10.30 %, chamaephytes 13.40 %, hemicryptophytes 36.08 %, therophytes 30.92 %, and cryptophytes 9.27 % (Fig. 2). The phytochorya of the species are distributed as follows: Irano-Turanian 64.94 %, Euro-Siberian 7.21 %, Mediterranean 1.03 %, endemic 6.18 %, Irano-Turanian-Euro-Siberian 17.52 %, Irano-Turanian-Mediterranean 3 % (Fig. 3).

Discussion

Generally, the frequency of hemichryptophytes and therophytes among the plants in the area shows the effect of two types of climate: Mediterranean and cold temperate. Hemicryptophytes adapted to the conditions of the area. Their modes of adaptation and development were quite different: reserving water, using ground water, reducing their water need by shedding their leaves and reducing their vegetative growth. Therophytes adapted to the dryness of the region and shortage of rainfalls, because of spending their vegetative period in the form of seeds (Asri 2003)

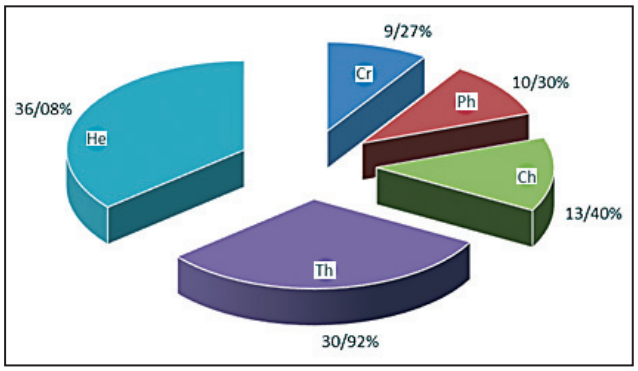

Fig. 2. Pie chart of life-form percentage of the species in Dupaza Mountain. **He**: hemicryptophyte, **Th**: therophyte, **Ph**: phanerophyte, **Ch**: chamaephytes, and **Cr**: cryptophytes.

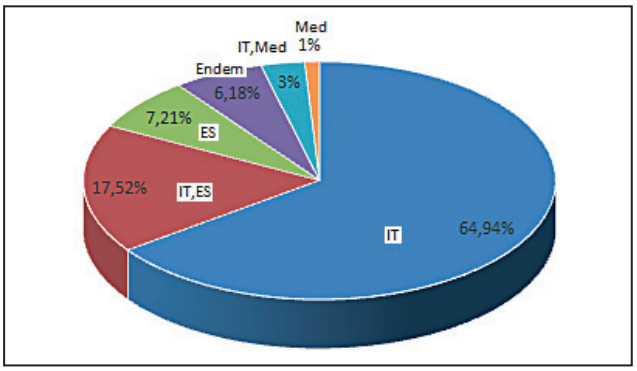

Fig. 3. Pie chart of phytochorya percentage of the species in Dupaza Mountain. **IT**: Irano-Turanian, **Es**: Euro-Siberian, **Med**: Mediterranean, **Endem**: endemic.

Table 1: Floristic list of the Dupaza Mountain.

Number	Family	Species	Life form	Chorotype	Voucher number, Collection
1	*Anacardiaceae*	*Rhus coriaria* L.	Ch	IT	93h175, azizi
2	*Apiaceae*	*Eryngium caeruleum* M. Bieb.	He	IT	93h176, azizi
3	*Apiaceae*	*Ferula orientalis* L.	He	IT	93h177, azizi
4	*Asteraceae*	*Achilea tenuifolia* Lam.	Cr	IT,ES	93h178, azizi
5	*Asteraceae*	*Achilea millefolium* L.	Cr	IT,ES	93h179, azizi
6	*Asteraceae*	*Achillea vermicularis* Trin.	Cr	IT,ES	93h180, azizi
7	*Asteraceae*	*Antemis tinctoria* L.	He	IT	93h181, azizi
8	*Asteraceae*	*Artimisia Vulgaris* L.	Ch	IT,ES	93h182, azizi
9	*Asteraceae*	*Artimisia scoparia* Waldst & Kit	Ch	IT,ES	93h183, azizi
10	*Asteraceae*	*Centurea virgata* Lam.	Th	IT	93h184, azizi
11	*Asteraceae*	*Centurea solstitialis* L.	Th	IT	93h185, azizi
12	*Asteraceae*	*Circium arvense*(L.) Scop.	He	ES	93h186, azizi
13	*Asteraceae*	*Cousinia sardashtensis* Rech.f.	He	Endem	93h187, azizi
14	*Asteraceae*	*Cousinia urumiensis* Bornm.	He	IT	93h188, azizi
15	*Asteraceae*	*Cousinia tenuifolia* C.A. Mey ex DC	He	Endem	93h189, azizi
16	*Asteraceae*	*Echinops orientalis* Trautv.	He	IT	93h190, azizi
17	*Asteraceae*	*Echinops pungens* Trautv.	He	IT,ES	93h191, azizi
18	*Asteraceae*	*Gundelia tournefortii* L.	He	IT	93h192, azizi
19	*Asteraceae*	*Helichrysum oligocephalum* DC	Ch	IT	93h193, azizi
20	*Asteraceae*	*Lactuca scarioloides* Boiss.	Th	IT,ES	93h194, azizi
21	*Asteraceae*	*Sonchus asper* (L.) Hill.	Th	IT	93h195, azizi
22	*Asteraceae*	*Senecio vernalis* Waldst. & Kit.	Th	IT	93h196, azizi
23	*Asteraceae*	*Senecio molis* Willd.	He	IT	93h197, azizi
24	*Boraginaceae*	*Anchusa italica* Reiz.	Th	IT,ES	93h198, azizi
25	*Boraginaceae*	*Echium italicum* L.	Th	IT	93h199, azizi
26	*Boraginaceae*	*Lappula spinocarpos* (Forssk) Aschers. ex Kuntze	Th	IT	93h200, azizi
27	*Boraginaceae*	*Myosotis sylvatica* Ehrh. ex Hoffmann	Th	IT	93h201, azizi
28	*Boraginaceae*	*Nonea persica Boiss.*	Th	Endem	93h202.azizi
29	*Boraginaceae*	*Onosma bulbotrichum* DC	He	IT	93h203, azizi
30	*Boraginaceae*	*Onosma elwendicum* Wettst.	He	IT	93h204, azizi
31	*Boraginaceae*	*Onosma sericeum* Willd.	He	IT	93h205, azizi
32	*Brassicaceae*	*Alyssum bracteatum* Boiss. & Bushe	He	Endem	93h206, azizi
33	*Brassicaceae*	*Capsella bursa-pastoris* (L.) Medik.	Th	IT	93h207, azizi
34	*Brassicaceae*	*Cardaria draba* (L.) Desv.	He	Med	93h208, azizi
35	*Brassicaceae*	*Descurainia Sophia* (L.) Schur	Th	IT	93h209, azizi

Table 1: Continuation.

Number	Family	Species	Life form	Chorotype	Voucher number, Collection
36	*Brassicaceae*	*Sisymbrium loeselii* L.	Th	IT	93h210, azizi
37	*Caryophyllaceae*	*Acanthophyllum microcephalum* Boiss.	Ch	IT	93h211, azizi
38	*Caryophyllaceae*	*Silene spergulifolia* (Willd.) M. Bieb.	Th	IT	93h212, azizi
39	*Caryophyllaceae*	*Stellaria persica* Boiss.	Th	IT	93h213, azizi
40	*Caryophyllaceae*	*Vaccaria grandiflora* Fisch. ex DC	Th	IT	93h214, azizi
41	*Convolvolaceae*	*Convolvulus arvensis* L.	Cr	IT	93h215, azizi
42	*Cypraceae*	*Scirpus lacustris* L.	He	IT	93h216, azizi
43	*Dipsacaceae*	*Dipsacus pilosus* L.	Th	IT	93h217, azizi
44	*Dipsacaceae*	*Scabiosa rotate* M. B.	Th	IT,ES	93h218, azizi
45	*Eleagnaceae*	*Elaeagnus angustifolia* L.	Ph	ES	93h219, azizi
46	*Euphorbiaceae*	*Euphorbia falcata* L.	Th	IT,Med	93h220, azizi
47	*Euphorbiaceae*	*Euphorbia stricta* L.	Th	Es	93h221, azizi
48	*Fabaceae*	*Astragalus Campylosema*	Ch	IT	93h222, azizi
49	*Fabaceae*	*Astragalus chartaceus* Ledeb.	He	IT	93h223, azizi
50	*Fabaceae*	*Astragalus chrysostachys* Boiss.	Ch	IT	93h224, azizi
51	*Fabaceae*	*Astragalus comosus* Chamb.	Ch	IT	93h225, azizi
52	*Fabaceae*	*Astragalus ovinus* Boiss.	He	IT	93h 226, azizi
53	*Fabaceae*	*Astragalus oxyglittis*	Th	IT	93h 227, azizi
54	*Fabaceae*	*Astragalus tribuloides* DC	Th	IT	93h228, azizi
55	*Fabaceae*	*Medicago sativa* L.	He	IT	93h 229, azizi
56	*Fabaceae*	*Meliolotus officinalis* (L.) Desr.	Th	IT	93h230, azizi
57	*Hypericaceae*	*Hypericum scabrum* L.	He	IT	93h231, azizi
58	*Juglandaceae*	*Juglans regia* L.	Ph	IT,ES	93h232, azizi
59	*Lamiaceae*	*Phlomis tuberosa* L.	He	IT,ES	93h233, azizi
60	*Lamiaceae*	*Phlomis olivieri* Benth.	He	IT,ES	93h234, azizi
61	*Lamiaceae*	*Marrubium astracanicum* Jacq.	He	IT.Med	93h235, azizi
62	*Lamiaceae*	*Mentha longifolia* (L.) Handson	Cr	Endem	93h236, azizi
63	*Lamiaceae*	*Mentha spicata* L.	He	ES	93h237, azizi
64	*Lamiaceae*	*Salvia multicaulis* Vahl.	Ch	IT	93h238, azizi
65	*Lamiaceae*	*Salvia nemorosa* L.	He	ES	93h239, azizi
66	*Lamiaceae*	*Stachys kurdica* Boiss. & Hohen	Ch	IT	93h240, azizi
67	*Lamiaceae*	*Stachys lavandulifolia* Vahl.	Ch	IT	93h241, azizi
68	*Lamiaceae*	*Ziziphora clinopodioides* Lam.	Ch	IT	93h242, azizi
69	*Liliaceae*	*Allium sativum* L.	Cr	IT	93h243, azizi
70	*Malvaceae*	*Alcea hyrcana* L.	He	Endem	93h244, azizi
71	*Papaveraceae*	*Papaver persicum* Lindl.	He	IT	93h245, azizi
72	*Plantaginaceae*	*Plantago lanceolata* L.	He	ES	93h246, azizi
73	*Plumbaginaceae*	*Acantholimon venustum* Boiss.	Ph	IT	93h247, azizi
74	*Poaceae*	*Aegilops cylindrica* Host.	Th	IT	93h248, azizi
75	*Poaceae*	*Bromus sterilis* L.	Th	IT	93h249, azizi
76	*Poaceae*	*Bromus tectorum* L.	Th	ES	93h250, azizi
77	*Poaceae*	*Bromus tomentellus* Boiss.	He	IT	93h251, azizi
78	*Poaceae*	*Festuca rubra* L.	He	IT	93h252, azizi
79	*Poaceae*	*Leucopoma sclerophylla*(Boiss. et Hohen)	He	IT	93h253, azizi
80	*Poaceae*	*Melica jacquemontii* Decne ex Jacquem	Cr	IT	93h254, azizi
81	*Poaceae*	*Melica persica* Kunth.	Cr	IT	93h255, azizi
82	*Poaceae*	*Paspalum dilatatum* Poir.	Th	IT	93h256, azizi
83	*Poaceae*	*Poa bulbosa* L.	Cr	IT,Med	93h257, azizi
84	*Polygonaceae*	*Polygonum avicuLare* L.	Th	IT	93h258, azizi
85	*Polygonaceae*	*Rheum ribes* L.	Ch	IT	93h259, azizi
86	*Ranunculaceae*	*Ranunculus arvensis* L.	Th	IT	93h260, azizi

Table 1: Continuation.

Number	Family	Species	Life form	Chorotype	Voucher number, Collection
87	*Rosaceae*	*Amygdalus communis* L.	Ph	IT	93h261, azizi
88	*Rosaceae*	*Amygdalus scoparia* L.	Ph	IT	93h262, azizi
89	*Rosaceae*	*Cerasus avium* L.	Ph	IT	93h263, azizi
90	*Rosaceae*	*Cratagus monogyna* Jacq	Ph	IT	93h264, azizi
91	*Rosaceae*	*Crataegus pontica* C. Koch	Ph	IT,ES	93h265, azizi
92	*Rosaceae*	*Sanguisorba minor* Scop.	He	IT,ES	93h266, azizi
93	*Salicaceae*	*Salix alba* L.	Ph	IT,ES	93h267, azizi
94	*Salicaceae*	*Salix wilhimsiana* M. B.	Ph	IT	93h268, azizi
95	*Scrophulariaceae*	*Scrophularia siriata* Boiss.	He	IT.ES	93h269, azizi
96	*Scrophulariaceae*	*Verbascum* sp.	He	IT-ES	93h270, azizi
97	*Solanaceae*	*Hyoscyamus muticus* Born.	Th	IT	93h271, azizi

The abbreviations used: **He** = hemicrytophyte; **Ch** = chamaephyte; **Cr** = cryptophyte **Th** = therophyte; **Ph** =phanarophyte; **ES** = Euro-Siberian; **IT** = Irano-Turanian; **M** = Mediterranean; **Endem** = endemic.

The low percentage of cryptophytes, chamophytes and phanerophytes shows that they are not well adapted to the climate and edaphic situations. Each plant species has its special ecological area with a known tolerance of the living conditions there. Therefore, geographical distribution of the plant species depends on the living conditions in the area and adaptation of plants to them (Asri 2003).

Frequency of the plant species of *Asteracae* may be related to destruction of the plant cover in this region under the climatic effects and occurrence of severe droughts across the years. so that the Destruction of plant covering is quite clear, or because of being young and growth of this kind of Plant, they are not allowed to be scattered so much. The presence of endemic species is among the fundamental criteria for characterization of biodiversity of a territory (Giuseppe 2013).

On the other hand, there is no obvious correlation between modern climate and endemism (Linder 2001). Iran is one of the main centers of endemism in the world (Saberamoli 2001). A total of 2000 endemic species grow in Iran, while Irano-Turanian region contains 85 % of the endemic plant species of the country (Dehshiri 2005). The results of the study have shown that about 6.18 % of the species are endemic. Fig. 3 shows that most species were Irano-Turanian elements. The remaining plants were common elements between the Irano-Turanian and other regions.

Thus the flora of Dupaza Mountain consists of plants that have adapted to the climatic and edaphic conditions of the region in life forms, morphology or life cycle. There are also many invasive plants. They are distributed in this area due to natural erosion and degradation resulting from human activities.

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