

Plant species diversity in the Central Zagros Region of Iran

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Abstract. The Central Zagros Region of Iran located in West Iran comprises delightful oak forests of the Mediterranean type. In this study, plant species diversity of this region is investigated by using data of species in 25 sites (local floras), including Sefidkouh mountain area in the center of the region. With its area of 110 000 hectares and 1000–2060 m elevation a.s.l., the latter is introduced as the richest site comprising 180 previously unreported species occurring in the Central Zagros Region. Multivariate analysis of the species occurrence data has grouped the local floras into five main clusters revealing the floristic structure of this region. Our results showed that multivariate analysis of the species occurrence is a useful tool for floristic regionalization.

Key words: Central Zagros, distribution, endemics, flora, life forms, Sefidkouh

Introduction

During the last glaciation period in the Northern Hemisphere, the Zagros Region of Iran was a mountain steppe in which *Cousinia* spp. and *Tulipa* spp. were abundant (Djamali & al. 2009; Djamali & al. 2011). Postglacial rebound then increased the species richness in that region by altering the species ranges. Species richness increased during the postglacial rebound through range alteration. The climate of Central Zagros is cold, semi-humid, with winter rainfalls in early December to late April, and the dry period coincides with the summer months. Despite overgrazing and excessive exploitation of vegetation, floristic richness in this region was increased by variations in microclimate, altitude, topography, and soil type. Current knowledge about the flora of that region (Fig. 1, Table 1) has been mainly obtained from local studies carried out with emphasis on the managed areas (Unpublished ID176; Asri & Mehrnia 2002, ID156; Safikhani & al. 2003, ID139; Abrari-Vajari & Veiskarami 2005, ID144; Zaji & al. 2005, ID19; Safikhani & al.

2006, ID197; Sohrabi & al. 2007, ID17; Safikhani & al. 2007, ID153; Hamzeh'ee & al. 2008, ID117; Yarahmadi & al. 2009, ID53; Mousavi & al. 2010, ID103; Pilehvar & al. 2010, ID188; Yavari & Shahgolzari 2010, ID55; Veiskarami & al. 2012, ID257; Darvishnia & al. 2012, ID150; Ghahremaninejad & al. 2012, ID184; Heydari & al. 2013, ID242; Abrari-Vajari & al. 2014, ID263; Jalilian & al. 2014, ID166; Kolahi & al. 2014, ID244). However, diversity of plants in the Central Zagros Region of Iran in the Eastern Mediterranean is not yet completely elucidated, and more floristic studies are still to be conducted. Flora of the Sefidkouh Mountain Area (central) was investigated by Asri (2002) and a list of 148 plant species was provided. The closest local flora to Sefidkouh, that of Kian (Nahavand, Hamedan Province), was studied in 2007 by Safikhani and coworkers, and 405 plant species were published (Safikhani & al. 2007). Other adjacent local floras published to date include 23 studies listed in Table 1.

Our fieldwork in 1997–1998 showed that the Sefidkouh Mountain Area is even more species-rich than

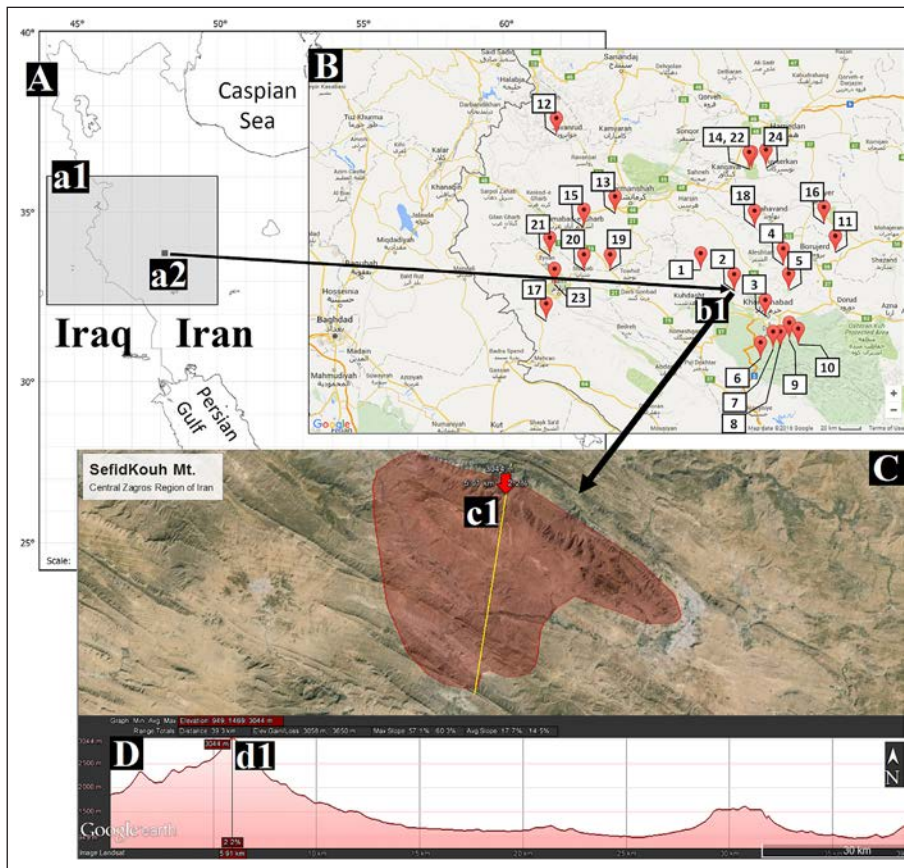


Fig. 1. Map of the study region. **A:** Location of Mt. Sefidkouh on the map of Iran, **a1:** the square encompassing the Central Zagros Region, **a2:** location of the study area. **B:** distribution of the 24 related local floras in the Central Zagros Region adjacent to the study area. Numbers of the 24 local floras follow Table 1. **b1:** location of the study area (Sefidkouh). **C:** satellite view of Mt. Sefidkouh, **c1:** the summit (3060 m). **D:** the elevation profile of Mt. Sefidkouh, **d1:** point of the summit. Map of the region and elevation profile are retrieved from GoogleEarth software package.

Table 1. Twenty-four adjacent local floras to Mt. Sefidkouh. The numbers are matching those on Fig.1, B. Asterisks denote non-outlayers; local floras used in the multivariate analysis.

Flora	ID	Area (ha)	Alt.	Temp.	Prec.	Coordinates	Spec.	Year publ.
*1 Central Sefidkouh Mts	156	69500	1500-2854	-5.9, 35.1	650	N 33.816, E 47.717	148	2002
*2 Endemics of Zagros (unpubl)	176	3000	1000-2900	n/a	400	N 33.654, E 48.027	86	2013
*3 Fruit gardens	103	n/a	n/a	n/a	n/a	N 33.46, E 48.31	90	2010
*4 Mt Mishparvar, Broujerd	224	n/a	2200-3700	14.4	422.22	N 33.854, E 48.479	180	2015
*5 Beyranshahr	251	20000	1101-2489	n/a	n/a	N 33.662, E 48.529	608	2016
*6 C Zagros Forests	188	8072	1400-2900	n/a	n/a	N 33.133, E 48.266	211	2010
7 Endemics of Zagros (Vajari)	263	3000	1000-2900	n/a	450	N 33.217, E 48.383	83	2014
8 Hashtadpahoo	144	3000	1200-2900	n/a	450	N 33.216, E 48.45	182	2005
*9 Nozhian	190	34000	770-3012	-20, 32	896.2	N 33.283, E 48.533	421	2014
*10 Perk Forest	257	2920	1695-2460	-7, 43.2	509.9	N 33.239, E 48.614	145	2012
*11 Zalian Broujerd	53	25	1695-2460	-7, 43.2	509.9	N 33.949, E 48.955	265	2009
*12 Dehsorkh Javanrood	17	45	1300- 1534	13.1	590.5	N 34.842, E 46.396	29	2007
*13 Einolkosh	19	2500	1733	n/a	n/a	N 34.25, E 46.933	105	2005
14 Khangormaz	55	5000	1580- 2853	9	400	N 34.584, E 48.186	213	2010
*15 Chaharzebr	117	3000	1400-1800	23	489	N 34.15, E 46.65	489	2008
*16 Lashkardar Malayer	139	16000	1750- 2928	13.4	288.8	N 34.167, E 48.85	237	2003
17 Manesht and Gholarang	150	33000	1105- 2650	6, 18.4	632	N 33.433, E 46.3	231	2012
*18 Kian	153	n/a	1615- 2080	11.7	534.09	N 34.139, E 48.215	405	2007
*19 Baharaab	166	171	1200-1700	9.13	442	N 33.047, E 46.657	128	2013
*20 Shelem	184	4467	1105- 2650	17.43	536.2	N 33.809, E 46.646	221	2012
21 Qalajeh	196	42607	1160-2200	13.94	414.72	N 33.933, E 46.333	245	2014
22 Khangormaz-2	197	3000	up to 2853	12.7	377.2	N 34.583, E 48.166	206	2006
*23 Dalab Ilam	242	4335	320- 2650	6.3, 22	560.75	N 33.695, E 46.38	224	2013
*24 Alvand Hamedan	244	n/a	up to 3428	1.9, 23.45	313.4	N 34.603, E 48.321	290	2014

already reported. Mt Sefidkouh and the surrounding hillsides (1000–3060 m), with an area of 110 000 ha (Fig. 1), is located 70 km westwards of Khorramabad city (E47 50 – E48 20, N33 30 – N33 45). According to meteorological data (1958–1993), the drought period in this region spans from April to September (Fig. 2), and most rainfalls (401.4 mm; 77%) occur from December to May. The average temperature reaches its maximum (30°C) in August and its minimum (6°C) in February.

This study was aimed at providing a checklist of plant species in this protected area, and at elucidating the structure of the overall flora in the region through multivariate analysis of occurrence (presence/absence of plant species) data in the neighboring local floras in the Central Zagros Region. The results of this study are novel and many new records for this extensive region encompassing 25 local floras are provided. Many rare species collected earlier just once from Iran were now collected again and reported here. The relative floristic similarities of the local floras are described in the important region of Central Zagros (Eastern Mediterranean).

Material and methods

The study area was measured using the GoogleEarth software package (Google 2013). Plant specimens were collected from April 1999 to June 2000 by means of several field collections, then identified and deposited in the Herbarium at the University of Tehran (TUH). Determination of specimens was performed by using the identification keys in *Flora Iranica* (Rechinger 1963–2012), *Flora of Iran* (Assadi 1989–2016), *Flora of Turkey* (Davis 1965–1985), and *Flora Europea* (Tutin & al. 1964). Distributions, endemism and conservation status of species

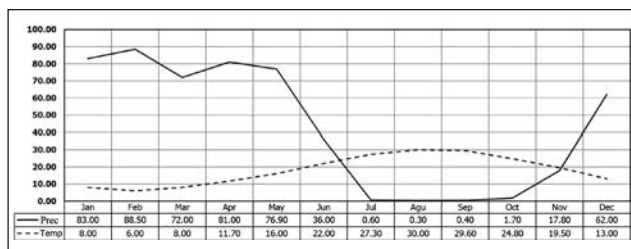


Fig. 2. Ombrothermic graph for the Khorramabad Station. Meteorological data of 35 years (1958–1993) retrieved from Khorramabad Station. Vertical axis corresponds to precipitation, and temperature values are shown in the table beneath.

were checked with the *Red Data Book of Iran* (Jalili & Jamzad 1999). Resultant inventory of the species names and authorities was checked for spelling by the CheckName program (Sharifi-Tehrani 2014). Inventories of twenty-four adjacent local floras (Table 1) were extracted and checked for spelling and authorities, then cumulated into a new dataset and compared with the checklist of Sefidkouh (Table 2). Comparisons were performed in a floristic database entitled ‘iHerbs’ (Sharifi-Tehrani & Rahiminejad-Ranjbar 2013). New records for this region (so far not reported in the 24 local floras published since 2002) are marked by letter ‘R’ in Table 2. A data matrix comprising the species occurrence data (1772 spp × 19 local floras marked by an asterisk in Table 1) is constructed and used for multivariate analyses. Data matrix was analyzed by Dice ($S_{Dice} = 2a / (2a + b + c)$) and SMC ($SM = m/n$) coefficients for qualitative data, in which a = co-occurrence of species, b = species present in one flora, c = species present in another flora, m = number of matches, and n = number of non-matches. PCO and clustering analyses were conducted with NTSYSpc (Rohlf 2000) and SplitTree (Hudson & Bryant 2006) software packages. Exploratory data analysis was performed using CLUTO software package (Karypis 2003) by maximizing internal similarity inside each group, and minimizing similarities between the groups (Table 3).

Table 2. Floristic inventory of Mt. Sefidkouh, with classification: chorotype (CT), life form (LF). Note: “endemic to the region” or “new record for the study area”.

	Species name	CT	LF	Note
Magnoliophyta				
Liliopsida				
	<i>Alismataceae</i> <i>Alisma lanceolatum</i> With.	Plur	Cr	R
	<i>Amaryllidaceae</i> <i>Ixiolirion tataricum</i> (Pall.) Herb. & Traub	ES, Med, IT	Th	
	<i>Araceae</i> <i>Arum conophalloides</i> Kotschy ex Schott	IT	Cr	
	<i>Cyperaceae</i> <i>Bolboschoenus maritimus</i> (L.) Palla	Plur	Cr	R
	<i>Carex diluta</i> M.Bieb.	IT	Cr	
	<i>Carex otrubae</i> Podp.	ES, IT	Cr	
	<i>Carex pachystylis</i> J.Gay	IT	Cr	
	<i>Cyperus difformis</i> L.	Med, IT, SS	Cr	
	<i>Cyperus distachyos</i>	Med, IT, SS	Ch	R
	<i>Cyperus fuscus</i> L.	Med, IT, SS	He	R
	<i>Cyperus glaber</i> L.	ES, Med, IT	Cr	
	<i>Cyperus longus</i> L.	ES, IT	Cr	
	<i>Cyperus rotundus</i> Kunth	IT	Cr	
	<i>Eleocharis palustris</i> (L.) Roem. & Schult.	Plur	He	

Table 2. Continuation.

	Species name	CT	LF	Note
	<i>Fimbristylis bisumbellata</i> Bubani	Plur	Cr	R
	<i>Pycreus flavidus</i> (Retz.) T.Koyama	ES, Med	Cr	R
	<i>Schoenoplectus bucharicus</i> (Roshev.) Grossh.	IT	Cr	E, N, R
	<i>Schoenoplectus lacustris</i> (L.) Palla	Plur	Th	R
	<i>Schoenoplectus lupulinus</i> (Nees) V.I.Krecz.	IT	Cr	R
	<i>Schoenus nigricans</i> L.	Plur	He	
	<i>Scirpoides holoschoenus</i> (L.) Sojak	IT	Cr	
<i>Iridaceae</i>	<i>Gladiolus kotschyanus</i> Boiss.	IT	Cr	
	<i>Gladiolus segetum</i> Ker Gawl.	Med, IT	Cr	
	<i>Gynandriris sisyrinchium</i> (L.) Parl.	Med, IT, SS	Cr	
	<i>Iris hymenospata</i> B.Mathew & Wendelbo	IT	Cr	
<i>Juncaceae</i>	<i>Juncus articulatus</i> L.	IT, SS	Cr	
	<i>Juncus fontanesii</i> J.Gay ex Laharpe	IT	Cr	R
	<i>Juncus maritimus</i> Lam.	Med, IT	Cr	
	<i>Juncus minutulus</i> (Albert & Jahand.) Prain	Plur	Th	
	<i>Juncus sphaerocarpus</i> Nees	Plur	Th	R
	<i>Juncus turkestanicus</i> V.I.Krecz. & Gontsch.	ES, IT	Th	R
<i>Lemnaceae</i>	<i>Lemna minor</i> L.	Cosm	Cr	R
<i>Liliaceae</i>	<i>Allium convallarioides</i> Grossh.	IT	Cr	R
	<i>Allium eriophyllum</i> Boiss.	IT	Cr	
	<i>Allium haemanthoides</i> Boiss. & Reut. ex Regel	IT	Cr	E*
	<i>Allium laeve</i> Wendelbo & Bothmer	IT	Cr	E*
	<i>Allium paniculatum</i> L.	IT	Cr	
	<i>Allium phaneranthrum</i> Boiss. & Hausskn.	IT	Cr	R
	<i>Allium rotundum</i> L.	IT	Cr	R
	<i>Allium stamineum</i> Boiss.	Med	Cr	
	<i>Bellevalia glauca</i> Kunth	IT	Cr	
	<i>Colchicum persicum</i> Baker	IT	Cr	
	<i>Colchicum robustum</i> Stef.	IT	Th	
	<i>Gagea gageoides</i> (Zucc.) Vved.	Med, IT	Th	
	<i>Gagea tenuifolia</i> (Boiss.) Fomin	ES, Med, IT	Cr	
	<i>Muscari comosum</i> (L.) Mill.	ES, Med, IT	Cr	
	<i>Muscari neglectum</i> Guss. ex Ten.	ES, Med, IT	Th	
	<i>Nectaroscordum koelzii</i> Wendelbo	IT	Cr	E
	<i>Ornithogalum brachystachys</i> C. Koch	Med, IT	Cr	
	<i>Ornithogalum cuspidatum</i> Bertol.	Med, IT	Cr	
	<i>Ornithogalum persicum</i> Hausskn. ex Bornm.	Med, IT	Cr	

Table 2. Continuation.

	Species name	CT	LF	Note
	<i>Tulipa systola</i> Stapf	IT	Cr	
<i>Najadaceae</i>	<i>Najas minor</i> All.	Plur	Cr	R
<i>Orchidaceae</i>	<i>Ophrys reinholdii</i> Spruner ex Fleischm.	Med	Cr	R
	<i>Orchis collina</i> Banks & Sol.	IT	He	
<i>Poaceae</i> (<i>Gramineae</i>)	<i>Aegilops crassa</i> Boiss.	Med, IT	Th	
	<i>Aegilops umbellulata</i> Zhuk.	IT	Th	
	<i>Agropyron leptourum</i> (Nevski) Grossh.	ES, Med, IT	He	R
	<i>Agropyron podperae</i> Nabelek	IT	He	
	<i>Agropyron repens</i> (L.) P.Beauv.	ES, Med, IT	Cr	
	<i>Alopecurus myosuroides</i> Huds.	ES, Med, IT	Th	R
	<i>Arrhenatherum kotschyi</i> Boiss.	IT	He	
	<i>Avena clauda</i> Durieu	Med, IT	Th	R
	<i>Avena fatua</i> L.	ES, IT	Th	
	<i>Boissiera squarrosa</i> (Banks & Sol.) Eig	IT	Th	
	<i>Bothriochloa ischaemum</i> (L.) Keng	Plur	He	
	<i>Brachypodium sylvaticum</i> (L.) P. Beauv.	ES	Cr	
	<i>Bromus danthoniae</i> Trin. ex C.A.Mey.	IT	Th	
	<i>Bromus japonicus</i> Thunb.	Plur	Th	
	<i>Bromus rubens</i> L.	Med, IT, SS	Th	R
	<i>Bromus scoparius</i> L.	Plur	Th	
	<i>Bromus sericeus</i> Drobow	IT	Th	
	<i>Bromus sterilis</i> L.	ES, Med, IT	Th	
	<i>Calamagrostis</i> <i>pseudophragmites</i> (Haller f.) Koeler	ES, Med, IT	Cr	
	<i>Catabrosa aquatica</i> (L.) P.Beauv.	Plur	Cr	
	<i>Catapodium rigidum</i> (L.) C.E.Hubb.	IT	Th	R
	<i>Cenchrus pennisetiformis</i> Steud.	Med, SS	He	R
	<i>Crypsis alopecuroides</i> Guss. ex Schult.	ES, Med, IT	Th	
	<i>Crypsis schoenoides</i> (L.) Lam.	ES, Med, IT	Th	
	<i>Cynodon dactylon</i> (L.) Pers.	Plur	He	
	<i>Cynosurus elegans</i> Desf.	Med	Th	
	<i>Digitaria sanguinalis</i> (L.) Scop.	Plur	Th	
	<i>Echinaria capitata</i> (L.) Desf.	Med, IT	Th	
	<i>Echinochloa colonum</i>	IT	Th	
	<i>Echinochloa crus-galli</i> (L.) P.Beauv.	Cosm	Th	
	<i>Eleusine indica</i> (L.) Gaertn.	Med	Th	R
	<i>Eragrostis pilosa</i> (L.) P.Beauv.	ES, Med, IT	Th	
	<i>Eragrostis poaeoides</i> P. Beauv. ex Roem. & Schult.	ES, Med, IT	Th	
	<i>Eremopoa persica</i> (Trin.) Roshev.	Med, IT	Th	
	<i>Glyceria plicata</i> (Fr.) Fr.	ES, IT	Cr	
	<i>Heterantherium piliferum</i> Hochst. ex Jaub. & Spach	Med, IT	Th	
	<i>Hordeum bulbosum</i> L.	Med, IT	Cr	

Table 2. Continuation.

	Species name	CT	LF	Note
	<i>Hordeum glaucum</i> Steud.	Med, IT	Th	
	<i>Hordeum spontaneum</i> K.Koch	IT	Th	
	<i>Imperata cylindrica</i> (L.) Raeusch.	ES, Med, IT, SS	Cr	R
	<i>Lolium persicum</i> Boiss. & Hohen.	ES, IT	Th	
	<i>Lolium rigidum</i> Gaudin	IT	He	
	<i>Lophochloa berythea</i> (Boiss. & C.I.Blanche) Bor	Med, IT	Th	R
	<i>Lophochloa phleoides</i> Rchb.	Med, IT	Th	
	<i>Melica persica</i> Kunth	IT	He	
	<i>Milium pedicellare</i> (Bornm.) Roshev. ex Melderis	Med, IT	Th	
	<i>Oryzopsis holciformis</i> Hack.	IT	He	
	<i>Parapholis incurva</i> (L.) C.E.Hubb.	ES, Med, IT	Th	R
	<i>Paspalum paspaloides</i> Scribn.	Plur	Cr	R
	<i>Phalaris minor</i> Retz.	Med, IT	Th	
	<i>Phalaris paradoxa</i> L.	Plur	Th	R
	<i>Phleum boissieri</i> Bornm.	IT	Th	
	<i>Phleum montanum</i> K.Koch	ES, Med, IT	Cr	R
	<i>Phragmites australis</i> (Cav.) Steud.	Cosm	Cr	
	<i>Poa annua</i> L.	ES, Med, IT	Cr	
	<i>Poa timoleontis</i> Heldr. ex Boiss.	ES, Med, IT	Cr	
	<i>Polypogon monspeliensis</i> (L.) Desf.	Med, IT, SS	Th	
	<i>Polypogon semiverticillatus</i> (Forssk.) Hyl.	Med, IT	Th	
	<i>Psilurus incurvus</i> Schinz & Thell.	IT	Th	R
	<i>Saccharum ravennae</i> (L.) L.	Med, IT, SS	Cr	R
	<i>Sclerochloa dura</i> (L.) P.Beauv.	ES, Med, IT	Th	R
	<i>Setaria glauca</i> auct.	Plur	Th	R
	<i>Setaria verticillata</i> (L.) P.Beauv.	ES, Med, IT	Th	R
	<i>Sorghum bicolor</i> (L.) Moench	Cosm	Cr	R
	<i>Sorghum halepense</i> Pers.	Cosm	Cr	
	<i>Stipa barbata</i> Desf.	ES, IT	He	
	<i>Stipa kurdistanica</i> Bor	IT	Cr	R
	<i>Stipagrostis plumosa</i> (L.) Munro ex T. Anderson	IT	He	R
	<i>Taeniatherum crinitum</i> (Schreb.) Nevski	ES, Med, IT	Th	
	<i>Trachynia distachya</i> (L.) Link	Med, IT, SS	Th	
	<i>Triticum aestivum</i> L.	IT	Th	R
	<i>Vulpia ciliata</i> Dumort.	ES, Med, IT	Th	
	<i>Vulpia hirtiglumis</i> Boiss. & Hausskn.	IT	Th	R
	<i>Zea mays</i> L.	Cult	Th	R
Potamo- getonaceae	<i>Potamogeton amblyophyllus</i> C.A.Mey.	Plur	Cr	R
	<i>Potamogeton nodosus</i> Poir.	Plur	Cr	R
Typhaceae	<i>Typha australis</i> Schumach. & Thonn.	Plur	Cr	R
Zannichelliaceae	<i>Zannichellia palustris</i> L.	Cosm	Cr	R

Table 2. Continuation.

	Species name	CT	LF	Note
Magnoliopsida				
Aceraceae	<i>Acer monspessulanum</i> L.	IT	Ph	
Amaranthaceae	<i>Amaranthus albus</i> L.	Cosm	Th	
	<i>Amaranthus caudatus</i> L.	Cosm	Th	R
	<i>Amaranthus retroflexus</i> L.	Plur	Th	
Anacardiaceae	<i>Pistacia khinjuk</i> Stocks	IT	Ph	
Apiaceae (Umbelliferae)	<i>Actinolema eryngioides</i> Fenzl	IT	Th	R
	<i>Ammi majus</i> L.	IT	Th	
	<i>Anisosciadium orientale</i> DC.	IT	Th	R
	<i>Apium nodiflorum</i> (L.) Lag.	Plur	Cr	R
	<i>Bifora testiculata</i> (L.) Roth	ES, IT	Th	R
	<i>Bunium luristanicum</i> Rech.f.	IT	Cr	E
	<i>Bunium rectangulum</i> H.Wolff	IT	Cr	E
	<i>Bupleurum gerardii</i> All.	IT	Th	
	<i>Bupleurum haussknechtii</i> Boiss.	IT	Th	E
	<i>Bupleurum lancifolium</i> Hornem.	IT, SS	Th	
	<i>Chaerophyllum macropodium</i> Boiss.	IT	He	
	<i>Daucus carota</i> L.	ES, IT	Cr	
	<i>Eryngium billardierei</i> Heldr. ex Boiss.	ES, Med, IT	He	
	<i>Eryngium creticum</i> Lam.	IT	He	
	<i>Eryngium thyrsoideum</i> Boiss.	IT	He	
	<i>Falcaria vulgaris</i> Bernh.	ES, Med, IT	He	
	<i>Ferula macrocolea</i> Boiss.	IT	He	E
	<i>Ferulago angulata</i> (Schltdl.) Boiss.	IT	He	
	<i>Ferulago macrocarpa</i> Boiss.	IT	He	
	<i>Ferulago stellata</i> Boiss.	IT	He	R
	<i>Lagoecia cuminoides</i> L.	Med, IT	Th	
	<i>Malabaila sekakul</i> Boiss.	IT	He	
	<i>Ormosciadium aucheri</i> Boiss.	IT	Th	R
	<i>Physocaulis nodosus</i> W.D.J.Koch	Med, IT	Th	
	<i>Pimpinella affinis</i> Ledeb.	IT	He	
	<i>Pimpinella barbata</i> Boiss.	IT, SS	Th	
	<i>Pimpinella eriocarpa</i> Banks & Sol.	IT	Th	
	<i>Prangos pabularia</i> Lindl.	IT	He	
	<i>Scandix pecten-veneris</i> L.	ES, Med, IT	Th	
	<i>Scandix stellata</i> Banks & Sol.	ES, IT, SS	Th	
	<i>Semenovia tragioides</i> (Boiss.) Pimenov & V.N. Tikhom.	IT	He	E, R
	<i>Smyrniopsis aucheri</i> Boiss.	IT	He	
	<i>Smyrniium cordifolium</i> Boiss.	IT	He	
	<i>Torilis leptophylla</i> Rchb.f.	ES, Med, IT	Th	
	<i>Torilis radiata</i> Moench	ES, Med, IT	Th	
	<i>Turgenia latifolia</i> Hoffm.	ES, Med, IT	Th	
	<i>Turgenia lisaeoides</i> C.C.Towns.	IT	Th	R
Aristolochiaceae	<i>Aristolochia olivieri</i> Colleg. ex Boiss.	IT	Cr	E
Asteraceae (Compositae)	<i>Achillea wilhelmsii</i> K.Koch	IT	He	
	<i>Anthemis cretica</i> L.	IT	Cr	E

Table 2. Continuation.

Species name	CT	LF	Note
<i>Anthemis hyalina</i> DC.	IT	Th	
<i>Anthemis pseudocotula</i> Boiss.	Med, IT, SS	Th	
<i>Artemisia haussknechtii</i> Boiss.	IT	He	
<i>Atractylis cancellata</i> L.	Med	Th	
<i>Bellis perennis</i> L.	ES, IT	He	
<i>Bidens tripartita</i> L.	Plur	Th	R
<i>Calendula persica</i> C. A. Mey.	IT, SS	Th	
<i>Carduus arabicus</i> Jacq.	Med, IT	Th	
<i>Carlina kurdica</i> Meusel & Kästner	IT	He	E, N, R
<i>Carthamus dentatus</i> Vahl	Med, IT	Th	R
<i>Carthamus lanatus</i> L.	IT	Th	
<i>Carthamus oxyacantha</i> M.Bieb.	IT	Th	
<i>Centaurea behen</i> L.	IT	He	
<i>Centaurea bruguierana</i> (DC.) Hand.-Mazz.	IT, SS	Th	
<i>Centaurea geluensis</i> Boiss. & Hausskn. ex Boiss.	IT	He	E
<i>Centaurea iberica</i> Trevir. ex Spreng.	ES, IT	He	
<i>Centaurea koeieana</i> Bornm.	IT	He	E
<i>Centaurea solstitialis</i> L.	Med, IT	Th	
<i>Centaurea sosnovskyi</i> Grossh.	IT	Th	
<i>Centaurea virgata</i> Lam.	ES, Med, IT	He	
<i>Cephalorrhynchus rechingianus</i>	IT	Cr	E
<i>Chondrilla juncea</i> L.	ES, Med, IT	He	
<i>Cichorium pumilum</i> Jacq.	Med, IT	Th	
<i>Cirsium congestum</i> Fisch. & C.A.Mey. ex DC.	Med, IT	He	
<i>Cirsium spectabile</i> DC.	IT	He	E
<i>Cirsium vulgare</i> (Savi) Ten.	Plur	He	
<i>Cnicus benedictus</i> L.	Med, IT	Th	
<i>Conyza bonariensis</i> (L.) Cronquist	IT	Th	R
<i>Conyza canadensis</i> (L.) Cronquist	IT	Th	
<i>Cousinia disfulensis</i> Bornm.	IT	He	E
<i>Cousinia haussknechtii</i> C.Winkl.	IT	Ch	E
<i>Crepis kotschyana</i> (Boiss.) Boiss.	IT	Th	
<i>Crepis pulchra</i> L.	IT	Th	R
<i>Crepis sancta</i> (L.) Bab.	Med, IT, SS	Th	
<i>Crupina crupinastrum</i> Vis.	Med, IT	Th	
<i>Cymbolaena griffithii</i> (A.Gray) Wagenitz	Med, IT	Th	
<i>Echinops chardini</i> Boiss. & Buhse	IT	He	R
<i>Echinops endotrichus</i> Rech.f.	IT	He	E
<i>Filago eriocephala</i> Guss.	Med, IT	Th	R
<i>Filago pyramidata</i> L.	ES, Med, IT	Th	
<i>Garhadiolus angulosus</i> Jaub. & Spach	Med, IT	Th	
<i>Geropogon hybridus</i> Sch.Bip.	Med, IT	Th	
<i>Gundelia tournefortii</i> L.	Med, IT	He	

Table 2. Continuation.

Species name	CT	LF	Note
<i>Hedypnois rhagadioloides</i> (L.) F.W.Schmidt	Med, IT	Th	R
<i>Helichrysum oligocephalum</i> DC.	IT	He	E
<i>Helichrysum pseudoplicatum</i> Nabelek	IT	He	R
<i>Koelpinia chrysoglochis</i> Rech.f.	IT	Th	R
<i>Lactuca scarioloides</i> Boiss.	IT	He	
<i>Notobasis syriaca</i> (L.) Cass.	Med, IT	Th	
<i>Onopordum carduchorum</i> Bornm. & Beauverd	IT	He	
<i>Outreya carduiiformis</i> Jaub. & Spach	IT	He	
<i>Phagnalon nitidum</i> Fresen.	IT	He	
<i>Phagnalon persicum</i> Boiss.	IT	He	E
<i>Picnomon acarna</i> (L.) Cass.	Med, IT	He	
<i>Picris strigosa</i> M.Bieb.	IT	He	
<i>Postia puberula</i> Boiss. & Hausskn.	IT	Ph	E
<i>Pulicaria dysenterica</i> (L.) Bernh.	Med, IT	Ch	
<i>Rhagadiolus edulis</i> Gaertn.	Med	Th	R
<i>Rhagadiolus stellatus</i> (L.) Gaertn.	Med	Th	
<i>Scariola orientalis</i> (Boiss.) Soják	Med, IT	Ch	
<i>Scorzonera calyculata</i> Boiss.	IT	He	E
<i>Scorzonera papposa</i> DC.	IT	Cr	
<i>Senecio gallicus</i> Vill.	IT	Th	R
<i>Senecio vernalis</i> Waldst. & Kit.	ES, Med, IT	Th	
<i>Serratula cerinthifolia</i> (Sm.) Boiss.	Med, IT	Cr	
<i>Siebera nana</i> (DC.) Bornm.	IT	Th	
<i>Silybum marianum</i> (L.) Gaertn.	Cosm	He	
<i>Sonchus oleraceus</i> L.	Cosm	Th	
<i>Steptorhamphus tuberosus</i> (L.) Grossh.	IT	Cr	
<i>Tanacetum polycephalum</i> Sch. Bip.	IT	He	
<i>Taraxacum wallichii</i> DC.	IT	He	
<i>Tragopogon vaginatus</i> Ownbey & Rech.f.	IT	Th	
<i>Urospermum picroides</i> (L.) Scop. ex F.W.Schmidt	Med, IT	Th	R
<i>Varthemia persica</i> DC.	IT	He	
<i>Xanthium brasiliacum</i> Vell.	Cosm	Th	
<i>Xanthium spinosum</i> L.	Cosm	Th	
<i>Xeranthemum squarrosum</i> Boiss.	IT	Th	R
<i>Zoegea leptaura</i> L.	IT	Th	
<i>Boraginaceae</i> <i>Anchusa italica</i> Retz.	ES, IT	He	
<i>Asperugo procumbens</i> L.	Plur	Th	
<i>Cynoglossum creticum</i> Mill.	ES, Med, IT	He	R
<i>Echium italicum</i> L.	ES, Med, IT	He	
<i>Heliotropium europaeum</i> L.	ES, Med, IT	Th	
<i>Heliotropium supinum</i> L.	Cosm	Th	

Table 2. Continuation.

	Species name	CT	LF	Note
	<i>Lappula barbata</i> (M.Bieb.) Gürke	IT	Th	
	<i>Lappula sinaica</i> (A.DC.) Asch. & Schweinf.	IT, SS	Th	
	<i>Lappula spinocarpos</i> (Forssk.) Asch. ex Kuntze	IT, SS	Th	
	<i>Mattiastrum cristatum</i> Brand	IT	He	R
	<i>Myosotis Koelzii</i> Riedl	IT	Th	E
	<i>Nonea caspica</i> G.Don	ES, IT	Th	
	<i>Nonea suchtelenioides</i> Riedl	IT	He	E
	<i>Onosma kotschy</i> Boiss.	IT	He	E
	<i>Onosma platyphylla</i> Riedl	IT	He	E
	<i>Onosma sericea</i> Willd.	IT	He	
	<i>Onosma straussii</i> (Riedl) Khat.	Med, IT	He	R
	<i>Rochelia disperma</i> (L.) Wettst.	IT	Th	
	<i>Rochelia persica</i> Bunge ex Boiss.	ES, IT	Th	
Brassicaceae (Cruciferae)	<i>Aethionema carneum</i> B.Fedtsch.	IT	Th	
	<i>Alyssum desertorum</i> Stapf	Cosm	Th	
	<i>Alyssum menioides</i> Boiss.	IT	Th	
	<i>Alyssum stapfii</i> Vierh.	IT	Th	
	<i>Alyssum strigosum</i> Banks & Sol.	IT	Th	
	<i>Alyssum szovitsianum</i> Fisch. & C.A.Mey.	IT	Th	
	<i>Arabis caucasica</i> Willd.	ES, Med, IT	He	
	<i>Arabis nova</i> Vill.	ES, Med, IT	Th	
	<i>Aubrieta parviflora</i> Boiss.	IT	Ch	
	<i>Barbarea plantaginea</i> DC.	Med, IT	He	
	<i>Biscutella didyma</i> L.	ES, Med, IT	Th	
	<i>Brassica nigra</i> (L.) K.Koch	Med	Th	
	<i>Calepina irregularis</i> (Asso) Thell.	IT	Th	R
	<i>Capsella bursa-pastoris</i> (L.) Medik.	Cosm	Th	
	<i>Cardamine hirsuta</i> L.	ES	Th	R
	<i>Cardaria draba</i> (L.) Desv.	Cosm	Th	
	<i>Clypeola aspera</i> Turrill	IT	Th	
	<i>Clypeola jonthlaspi</i> L.	ES, Med, IT, SS	Th	
	<i>Conringia orientalis</i> (L.) C.Presl	IT	Th	
	<i>Conringia perfoliata</i> (C.A.Mey.) N.Busch	IT	Th	
<i>Descurainia sophia</i> (L.) Webb ex Prantl	ES, Med, IT	Th		
<i>Drabopsis verna</i> K.Koch	Med, IT, SS	Th		
<i>Eruca sativa</i> Mill.	ES, Med, IT	Th		
<i>Erucaria hispanica</i> (L.) Druce	Med	Th	R	
<i>Erysimum repandum</i> L.	IT	He		
<i>Erysimum sisymbrioides</i> C.A.Mey.	IT	Th	R	
<i>Euclidium syriacum</i> (L.) W.T.Aiton	ES, IT	Th	R	
<i>Fibigia macrocarpa</i> Boiss.	ES, IT	He		
<i>Graellsia saxifragifolia</i> Boiss.	IT	Ch	E	

Table 2. Continuation.

	Species name	CT	LF	Note
	<i>Hesperis kurdica</i> F.Dvořák & Hadač	IT	He	E
	<i>Hesperis odorata</i> F.Dvorak	IT	Ch	E
	<i>Hirschfeldia incana</i> (L.) Lagr.- Foss.	IT	Th	
	<i>Isatis cappadocica</i> Desv.	IT	He	
	<i>Isatis lusitanica</i> L.	ES, Med, IT	Th	
	<i>Lepidium latifolium</i> L.	ES, Med, IT	Cr	
	<i>Lepidium perfoliatum</i> L.	IT	Th	R
	<i>Lepidium sativum</i> L.	Cosm	Th	R
	<i>Malcolmia africana</i> (L.) W.T.Aiton	Med, IT, SS	Th	
	<i>Matthiola longipetala</i> DC.	Med, IT	Th	
	<i>Moriera spinosa</i> Boiss.	IT	Ch	
	<i>Myagrum perfoliatum</i> L.	ES, IT	Th	R
	<i>Nasturtium officinale</i> R.Br.	IT	Cr	
	<i>Neslia apiculata</i> Fisch., C.A.Mey. & Avé-Lall.	ES, Med, IT	Th	
	<i>Parlatoria cakiloides</i> Boiss.	IT	Th	
	<i>Sameraria stylophora</i> Boiss.	IT	Th	E
	<i>Sinapis arvensis</i> L.	ES, Med, IT	Th	
	<i>Sisymbrium altissimum</i> L.	ES, Med, IT	Th	R
	<i>Sisymbrium irio</i> L.	ES, Med, IT, SS	Th	
	<i>Sisymbrium loeselii</i> L.	IT	He	R
	<i>Sisymbrium officinale</i> (L.) Scop.	IT	Th	
	<i>Sisymbrium orientale</i> L.	ES, Med, IT	Th	
	<i>Thlaspi perfoliatum</i> L.	ES, Med, IT	Th	
Caesalpiniaceae	<i>Cercis siliquastrum</i> L.	ES, IT	Ph	R
Campanulaceae	<i>Asyneuma multicaule</i> (Boiss.) Rech.f. & Schiman-Czeika	IT	He	E
	<i>Asyneuma pulchellum</i> (Fisch. & C.A.Mey.) Bornm.	IT	He	
	<i>Campanula cecilii</i> Chitt.	IT	Th	
	<i>Campanula flaccidula</i> Vatke	IT	Th	
	<i>Legousia falcata</i> Fritsch	ES, Med, IT	Th	
	<i>Mindium laevigatum</i> (Vent.) Rech.f. & Schiman-Czeika	IT	He	
Capparaceae	<i>Capparis spinosa</i> L.	Med, IT	Ch	
	<i>Cleome iberica</i> DC.	Med, IT	Th	
Caprifoliaceae	<i>Lonicera nummulariifolia</i> Jaub. & Spach	Med, IT	Ph	
	<i>Sambucus ebulus</i> L.	ES, Med, IT	He	R
Caryophyllaceae	<i>Acanthophyllum kurdicum</i> Boiss. & Hausskn. ex Boiss.	IT	Ch	
	<i>Arenaria leptoclados</i> Boiss.	ES, IT	He	
	<i>Bufonia oliveriana</i> Ser.	IT	He	
	<i>Cerastium dichotomum</i> L.	ES, Med, IT, SS	Th	
	<i>Cerastium glomeratum</i> Thuill.	Med, IT	Th	
	<i>Dianthus orientalis</i> Adams	IT	He	E
	<i>Gypsophila persica</i> Barkoudak	IT	He	E
	<i>Gypsophila pilosa</i> Huds.	IT	Th	R
	<i>Herniaria hirsuta</i> L.	ES, Med, IT	Th	R
	<i>Holostium umbellatum</i> L.	Med, IT	Th	

Table 2. Continuation.

	Species name	CT	LF	Note
	<i>Mesostemma kotschyana</i> (Fenzl ex Boiss.) Vved.	IT	He	
	<i>Minuartia hamata</i> (Hausskn.) Mattf.	Es, Med, IT	Th	
	<i>Minuartia hybrida</i> (Vill.) Schischk.	ES, Med, IT	Th	
	<i>Minuartia montana</i> L.	ES, IT	Th	R
	<i>Minuartia picta</i> (Sm.) Bornm.	ES, Med, IT	Th	
	<i>Minuartia recurva</i> (All.) Schinz & Thell.	Med, IT	He	
	<i>Petrorhagia cretica</i> (L.) P.W.Ball & Heywood	ES, Med, IT	Th	
	<i>Silene austroiranica</i> Rech.f., Aellen & Esfand.	IT, SS	Th	R
	<i>Silene chlorifolia</i> Sm.	Med, IT	He	
	<i>Silene conoidea</i> L.	Med, IT	Th	
	<i>Silene odontopetala</i> Fenzl	IT	Ch	
	<i>Silene pseudaueriana</i> Melzh.	IT	Ch	E
	<i>Stellaria pallida</i> (Dumort.) Crép.	ES, IT	Th	
	<i>Telephium imperati</i> L.	IT	He	R
	<i>Vaccaria grandiflora</i> Jaub. & Spach	IT	Th	
	<i>Velezia rigida</i> L.	ES, Med, IT	Th	
Chenopodiaceae	<i>Atriplex tatarica</i> L.	ES, Med, IT	Th	
	<i>Chenopodium album</i> L.	Plur	Th	
	<i>Chenopodium botrys</i> L.	Med, IT	Th	
	<i>Chenopodium foliosum</i> Asch.	IT	Th	
	<i>Chenopodium vulvaria</i> L.	Med, IT	Th	R
	<i>Kochia scoparia</i> (L.) Schrad.	Plur	Th	R
	<i>Noaea mucronata</i> Asch. & Schweinf.	Med, IT, SS	Ch	
	<i>Spinacia oleracea</i> L.	Cult	Th	R
Cistaceae	<i>Helianthemum ledifolium</i> (L.) Mill.	IT	Th	E, N
Convolvulaceae	<i>Calystegia sepium</i> (L.) R. Br.	Cosm	Cr	
	<i>Convolvulus arvensis</i> L.	Cosm	Th	
	<i>Convolvulus betonicifolius</i> Mill.	Med, IT	Cr	R
	<i>Convolvulus chondrilloides</i> Boiss.	IT	He	E
	<i>Convolvulus reticulatus</i> Choisy	IT	He	R
	<i>Convolvulus stachydifolius</i>	IT	He	R
Crassulaceae	<i>Crassula alata</i> (Viv.) A. Berger	IT, SS	Th	
	<i>Rosularia elymaitica</i> A. Berger	IT	He	E
	<i>Rosularia globulariifolia</i> (Fenzl) A. Berger	Med, IT	He	R
	<i>Rosularia sempervivoides</i> (Fisch. ex M. Bieb.) Boriss.	Med, IT	He	
	<i>Sedum callichroum</i> Boiss.	Med, IT	Th	R
	<i>Umbilicus intermedius</i> Boiss.	Med, IT	Cr	
	<i>Umbilicus tropaeolifolius</i> Boiss.	IT	Cr	E
Cucurbitaceae	<i>Bryonia multiflora</i> Boiss. & Heldr.	IT	He	
	<i>Cuscuta babylonica</i> Aucher ex Choisy	IT	Th	R
	<i>Cuscuta campestris</i> Yunck.	IT	Th	

Table 2. Continuation.

	Species name	CT	LF	Note
	<i>Cuscuta kotschyana</i> Boiss.	IT	Th	E
	<i>Cuscuta monogyna</i> Vahl	Cosm	Th	
Dipsacaceae	<i>Cephalaria dicaetophora</i> Boiss.	IT	Th	
	<i>Cephalaria setosa</i> Boiss. & Hohen.	Med, IT	Th	
	<i>Cephalaria syriaca</i> Schrad.	Med, IT	Th	
	<i>Pterocephalus brevis</i> Coult.	Med, IT	Th	R
	<i>Pterocephalus canus</i> Coult. ex DC.	IT	He	
	<i>Pterocephalus plumosus</i> Coult.	IT	Th	
	<i>Pterocephalus szovitsii</i> Boiss.	Med, IT	Ch	
	<i>Scabiosa leucactis</i> Patzak	ES, Med, IT	Th	
	<i>Scabiosa olivieri</i> Coult.	IT	Th	
Elatinaceae	<i>Bergia aquatica</i> Roxb.	Cosm	Cr	N, R
Euphorbiaceae	<i>Chrozophora hierosolymitana</i> Spreng.	Med, IT	Th	
	<i>Euphorbia craspedia</i> Boiss.	IT	Th	E
	<i>Euphorbia densa</i> Schrenk	IT	Th	
	<i>Euphorbia denticulata</i> Lam.	IT	Ch	
	<i>Euphorbia eriophora</i> Boiss.	IT	Th	R
	<i>Euphorbia helioscopia</i> L.	IT	Th	
	<i>Euphorbia orientalis</i> L.	IT	Cr	
	<i>Euphorbia petiolata</i> Banks & Sol.	IT	Th	
	<i>Euphorbia phymatosperma</i> Boiss.	IT	Th	
	<i>Euphorbia sororia</i> Schrenk	IT	Th	
	<i>Euphorbia turcomanica</i> Boiss.	IT	Th	R
Fabaceae (Leguminosae)	<i>Alhagi persarum</i> Boiss. & Buhse	IT	He	
	<i>Astragalus anacardius</i> Bunge	IT	Ch	E, R
	<i>Astragalus baba-alliar</i> Parsa	IT	Ph	E
	<i>Astragalus babakhanloui</i> Maassoumi & Podlech	IT	Ch	E
	<i>Astragalus bodeanus</i> Fisch.	IT	Ch	E
	<i>Astragalus campylorhynchus</i> Fisch. & C.A. Mey.	IT	Th	
	<i>Astragalus ebenoides</i> BOISS.	IT	Ch	E
	<i>Astragalus ecbatanus</i> Bunge	IT	He	E
	<i>Astragalus galbineus</i> Maassoumi	IT	Ch	E
	<i>Astragalus gaubae</i> Bornm.	IT	Ch	E
	<i>Astragalus gossypinus</i> Fisch.	IT	Ch	
	<i>Astragalus hamosus</i> L.	Plur	Th	
	<i>Astragalus ibicinus</i> Boiss. & Hausskn.	IT	Ch	E
	<i>Astragalus leonardii</i> Maassoumi	IT	Ch	E
	<i>Astragalus ophiocarpus</i> Boiss.	ES, Med, IT	Th	
	<i>Astragalus ovinus</i> Boiss.	IT	Ch	
	<i>Astragalus ptychophyllus</i> Boiss.	IT	Ch	E
	<i>Astragalus rhodosemius</i> Boiss. & Hausskn.	ES, IT	Ch	
	<i>Astragalus veiskaramii</i> Zarre, Podlech & Sabaii	IT	Ch	E, N
	<i>Coronilla scorpioides</i> (L.) Koch	Med, IT	Th	

Table 2. Continuation.

Species name	CT	LF	Note
<i>Glycyrrhiza glabra</i> L.	IT	He	
<i>Hippocrepis bisiliqua</i> Forssk	Med, IT	Th	
<i>Hymenocarpus circinnata</i> Savi	Med	Th	
<i>Lathyrus aphaca</i> L.	ES, IT	Th	
<i>Lathyrus inconspicuus</i> L.	Med, IT	Th	
<i>Lathyrus pseudocicera</i> Pamp.	Med	Th	R
<i>Lathyrus sativus</i> L.	ES, IT	Th	
<i>Lens culinaris</i> Medik.	Cult	Th	
<i>Lens orientalis</i> Popow	Med, IT	Th	
<i>Medicago constricta</i> Durieu	Med	Th	R
<i>Medicago coronata</i> (L.) Bartal.	Med, IT	Th	
<i>Medicago lupulina</i> L.	IT	Th	
<i>Medicago minima</i> (L.) L. ex Bartal.	ES, IT	Th	R
<i>Medicago orbicularis</i> (L.) Bartal.	ES, Med, IT, SS	Th	R
<i>Medicago polymorpha</i> L.	ES, Med, IT	Th	
<i>Medicago radiata</i> L.	Med, IT	Th	
<i>Medicago rigidula</i> (L.) All.	Med, IT	Th	
<i>Melilotus indicus</i> (L.) All.	IT	Th	
<i>Onobrychis caput-galli</i> Lam.	Med	Th	R
<i>Onobrychis crista-galli</i> (L.) Lam.	Med	Th	R
<i>Onobrychis melanotricha</i> Boiss.	IT	He	E
<i>Ononis spinosa</i> L.	ES, Med, IT	Cr	
<i>Ononis viscosa</i> L.	Med, IT	Th	R
<i>Pisum sativum</i> L.	ES, IT	Th	
<i>Sophora alopecuroides</i> L.	IT	Cr	
<i>Trifolium campestre</i> Schreb.	IT	Th	
<i>Trifolium cherleri</i> L.	Med, IT	Th	
<i>Trifolium dasyurum</i> C. Presl	Med, IT	Th	
<i>Trifolium fragiferum</i> L.	ES, Med, IT	Cr	
<i>Trifolium grandiflorum</i> Schreb.	ES, Med, IT	Th	
<i>Trifolium hybridum</i> L.	ES, Med, IT	He	R
<i>Trifolium lappaceum</i> L.	ES, Med, IT	Th	
<i>Trifolium leucanthum</i> M. Bieb.	Med, IT	Th	R
<i>Trifolium pilulare</i> Boiss.	ES, Med, IT	He	
<i>Trifolium purpureum</i> Loisel.	ES, Med, IT	Th	
<i>Trifolium repens</i> L.	ES, Med, IT	He	
<i>Trifolium resupinatum</i> L.	ES, Med, IT	Th	R
<i>Trifolium scabrum</i> L.	ES, Med, IT	Th	
<i>Trifolium spumosum</i> L.	Med, IT	Th	R
<i>Trifolium stellatum</i> L.	Med	Th	
<i>Trifolium tomentosum</i> L.	ES, Med, IT	Th	
<i>Trifolium vavilovii</i> Eig	Med	Th	R
<i>Trigonella crassipes</i> Boiss.	IT	Th	
<i>Trigonella foenum-graecum</i> L.	Med, IT	Th	R
<i>Trigonella macroglochis</i> Durieu	Med, IT	Th	R
<i>Trigonella monspeliaca</i> L.	ES, Med, IT	Th	
<i>Trigonella persica</i> Boiss.	IT	Th	E
<i>Trigonella spruneriana</i> Boiss.	IT	Th	
<i>Trigonella uncinata</i> Banks & Sol.	Med, IT	Th	
<i>Vicia amphicarpa</i> Dorthes	ES, Med, IT	Th	
<i>Vicia ervilia</i> (L.) Willd.	Cult	Th	

Table 2. Continuation.

Species name	CT	LF	Note
<i>Vicia hybrida</i> L.	IT	Th	R
<i>Vicia kotschyana</i> Boiss.	IT	Cr	E
<i>Vicia michauxii</i> Spreng.	IT	Th	
<i>Vicia narbonensis</i> L.	ES, Med, IT	Th	
<i>Vicia variabilis</i> Freyn & Sint. ex Freyn	IT	Cr	
<i>Fagaceae</i>			
<i>Quercus brantii</i> Lindl.	IT	Ph	E
<i>Fumariaceae</i>			
<i>Corydalis rupestris</i> Kotschy	ES, IT	Cr	
<i>Fumaria parviflora</i> Lam.	ES, Med, IT	Th	
<i>Gentianaceae</i>			
<i>Gentiana olivieri</i> Griseb.	IT	Cr	
<i>Geraniaceae</i>			
<i>Biebersteinia multifida</i> DC.	Med, IT	Th	
<i>Erodium cicutarium</i> (L.) L'Hér.	ES, Med, IT	Th	
<i>Erodium deserti</i> (Eig.) Eig.	Med, IT, SS	Th	R
<i>Erodium malacoides</i> (L.) L'Hér.	Med, IT	Th	
<i>Geranium mascatense</i> Boiss.	IT, SS	Th	R
<i>Geranium molle</i> L.	IT	Th	R
<i>Geranium rotundifolium</i> L.	ES, Med, IT	Th	
<i>Geranium tuberosum</i> L.	ES, Med, IT	Cr	
<i>Hypericaceae</i>			
<i>Hypericum helianthemoides</i> (Spach) Boiss.	Cosm	He	
<i>Hypericum hirtellum</i> (Spach) Boiss.	IT	He	
<i>Hypericum scabrum</i> L.	IT	He	
<i>Juglandaceae</i>			
<i>Juglans regia</i> L.	Cult	Ph	
<i>Lamiaceae</i>			
<i>(Labiatae)</i>			
<i>Cyclotrichium leucotrichum</i> (Stapf) Leblebici	IT	Ch	R
<i>Cyclotrichium straussii</i> (Bornm.) Rech.f.	IT	Ch	E
<i>Eremostachys laevigata</i> Bunge	IT	He	
<i>Eremostachys macrophylla</i> Montbret & Aucher	IT	He	
<i>Lallemantia iberica</i> Fisch. & C.A. Mey.	ES, Med, IT	Th	
<i>Lamium amplexicaule</i> L.	Cosm	Th	
<i>Lycopus europaeus</i> L.	ES, Med, IT	Cr	R
<i>Marrubium astracanicum</i> Jacq.	ES, Med	He	
<i>Mentha longifolia</i> (L.) L.	Plur	He	
<i>Micromeria myrtifolia</i> Boiss. & Hohen.	IT	Ph	R
<i>Nepeta fissa</i> C. A. Mey.	IT	Cr	
<i>Nepeta humilis</i> Benth.	IT	Th	E
<i>Nepeta kotschyi</i> Boiss.	IT	Cr	E
<i>Nepeta petraea</i> Benth.	IT	Th	E
<i>Nepeta straussii</i> Hausskn. & Bornm.	IT	Th	E
<i>Phlomis anisodonta</i> Boiss.	IT	He	E
<i>Phlomis bruguieri</i> Desf.	IT	He	
<i>Phlomis caucasica</i> Rech.f.	IT	Cr	
<i>Phlomis kurdica</i> Rech.f.	IT	Ch	
<i>Phlomis lanceolata</i> Boiss. & Hohen.	IT	Cr	
<i>Phlomis olivieri</i> Benth.	IT	He	E
<i>Salvia bracteata</i> Banks & Sol.	IT	He	
<i>Salvia ceratophylla</i> L.	IT	He	
<i>Salvia indica</i> L.	Med, IT	Cr	

Table 2. Continuation.

	Species name	CT	LF	Note
	<i>Salvia macrosiphon</i> Boiss.	IT	He	R
	<i>Salvia palaestina</i> Benth.	IT, SS	He	
	<i>Salvia reuteriana</i> Boiss.	IT	He	E
	<i>Salvia sclareopsis</i> Bornm. ex Hedge	IT	Cr	E
	<i>Salvia syriaca</i> L.	Med, IT	Cr	
	<i>Salvia trichoclada</i> Benth.	Med, IT	Cr	
	<i>Scutellaria nepetifolia</i> Benth.	IT	Ch	E
	<i>Scutellaria velenovskyi</i> Rech.f.	Med, IT	Cr	R
	<i>Sideritis comosa</i> (Rochel ex Benth.) Stankov	ES, Med, IT	Th	R
	<i>Sideritis montana</i> L.	ES, Med, IT	Th	
	<i>Stachys ballotiformis</i> Vatke	IT	Ch	
	<i>Stachys benthamiana</i> Boiss.	IT	Ch	E
	<i>Stachys inflata</i> Benth.	ES, IT	He	
	<i>Stachys lavandulifolia</i> Vahl	IT	Ch	
	<i>Stachys melampyroides</i> Hand.-Mazz.	IT	Th	E, N
	<i>Stachys persepolitana</i> Boiss.	It	Th	E
	<i>Teucrium orientale</i> L.	IT	He	
	<i>Teucrium polium</i> L.	Med, IT	Ch	
	<i>Thymus eriocalyx</i> (Ronniger) Jalas	IT	He	
	<i>Vitex pseudonegundo</i> Hand.-Mazz.	IT	Ph	R
	<i>Ziziphora capitata</i> L.	Med, IT	Th	
	<i>Ziziphora clinopodioides</i> Lam.	IT	Ch	
Linaceae	<i>Linum mucronatum</i> Bertol.	ES, Med, IT	Ch	R
	<i>Linum nodiflorum</i> L.	ES, Med, IT	Th	R
	<i>Linum strictum</i> L.	IT, SS	Th	R
Lythraceae	<i>Ammannia auriculata</i> Willd.	Cosm	Cr	R
	<i>Ammannia baccifera</i> L.	Plur	Cr	R
	<i>Ammannia multiflora</i> Roxb.	IT	Th	R
	<i>Ammannia verticillata</i> Lam.	Plur	Cr	N, R
	<i>Lythrum salicaria</i> L.	IT	Ch	
	<i>Lythrum silenoides</i> Boiss. & Noë	Plur	He	R
Malvaceae	<i>Abutilon theophrasti</i> Medik.	IT, SS	Th	
	<i>Alcea digitata</i> Alef.	IT	He	
	<i>Hibiscus trionum</i> L.	ES, Med, IT	Th	
	<i>Malva rotundifolia</i> auct.	Plur	He	
Ry well cultivated	<i>Malva sylvestris</i> L.	IT	Th	
Mimosaceae	<i>Prosopis farcta</i> (Banks & Sol.) J.F.Macbr.	Med, IT, SS	Ph	R
Moraceae	<i>Ficus carica</i> L.	ES, Med, IT	Ph	
	<i>Morus alba</i> L.	IT	Ph	R
Myrtaceae	<i>Myrtus communis</i> L.	IT	Ph	R
Onagraceae	<i>Epilobium hirsutum</i> L.	Plur	Th	
	<i>Epilobium minutiflorum</i> Hausskn.	IT	Cr	R
Orobanchaceae	<i>Orobanche nana</i> Noë ex Reut.	ES, Med, IT	Par	
Papaveraceae	<i>Hypocoum pendulum</i> L.	ES, IT	Th	
	<i>Papaver argemone</i> L.	ES, Med, IT	Th	
	<i>Papaver glaucum</i> Boiss. & Hausskn.	IT	Th	R

Table 2. Continuation.

	Species name	CT	LF	Note
	<i>Papaver hybridum</i> L.	ES, IT	Cr	R
	<i>Papaver rhoeas</i> L.	Plur	Th	
	<i>Roemeria refracta</i> DC.	ES, IT	Th	
Pedaliaceae	<i>Sesamum indicum</i> L.	Cult	Th	R
Plantaginaceae	<i>Plantago bellardii</i> All.	Med, IT	Th	
	<i>Plantago lanceolata</i> L.	Plur	He	
	<i>Plantago major</i> L.	Cosm	He	
	<i>Plantago psyllium</i> L.	ES, IT	Th	R
Plumbaginaceae	<i>Acantholimon brachystachyum</i> Boiss. ex Bunge	IT	Ch	E
	<i>Acantholimon bromifolium</i> Boiss. ex Bunge	IT	Ch	E
	<i>Acantholimon eschkerense</i> Boiss. & Hausskn. ex Boiss.	IT	Ch	E
	<i>Plumbago europaea</i> L.	IT	He	
Podophyllaceae	<i>Bongardia chrysogonum</i> Boiss.	IT	Th	
Polygonaceae	<i>Polygonum aviculare</i> L.	Med, IT	Th	
	<i>Polygonum hydropiper</i> L.	Plur	Cr	R
	<i>Polygonum lapathifolium</i> L.	Plur	Cr	R
	<i>Polygonum persicaria</i> L.	Plur	Th	R
	<i>Polygonum rottboellioides</i> Jaub. & Spach	IT	Th	R
	<i>Polygonum setosum</i> Jacq.	IT	Ph	R
	<i>Pteropyrum noeanum</i> Boiss.	IT	Ph	R
	<i>Rheum ribes</i> L.	IT	Th	
	<i>Rumex chalepensis</i> Mill.	Med, SS	Th	
	<i>Rumex crispus</i> L.	Plur	Th	
	<i>Rumex dentatus</i> L.	IT	Th	
Portulacaceae	<i>Portulaca oleracea</i> L.	IT	Th	
Primulaceae	<i>Anagallis arvensis</i> L.	ES, Med, IT	Th	
	<i>Androsace maxima</i> L.	ES, Med, IT, SS	Th	
	<i>Dionysia haussknechtii</i> Bornm. & Strauss ex Bornm.	IT	Ch	E
	<i>Lysimachia linum-stellatum</i> L.	IT, SS	Th	R
	<i>Primula gaubaeana</i> Bornm.	IT	Cr	E
Ranunculaceae	<i>Adonis flammea</i> Jacq.	Med, IT	Th	R
	<i>Anemone coronaria</i> L.	Med, IT	Cr	
	<i>Ceratocephala falcata</i> (L.) Pers.	ES, Med, IT	Th	
	<i>Consolida ambigua</i> (L.) P.W.Ball & Heywood	Med, IT	Th	R
	<i>Delphinium lanigerum</i> Boiss.	IT	Cr	E
	<i>Delphinium venulosum</i> Boiss.	IT	Th	N, R
	<i>Ficaria kochii</i> (Ledeb.) Iranshahr & Rech.f.	IT	Cr	
	<i>Nigella nigellastrum</i> (L.) Willk.	ES, Med, IT	Th	R
	<i>Nigella oxypetala</i> Boiss.	Med, IT	Th	
	<i>Nigella sativa</i> L.	Med, IT	Th	R
	<i>Nigella segetalis</i> M.Bieb.	Med, IT	Th	R
	<i>Ranunculus arvensis</i> L.	Med, IT	Th	
	<i>Ranunculus asiaticus</i> L.	Med, IT	Cr	
	<i>Ranunculus chiusi</i> DC.	Med, IT	Th	R
	<i>Ranunculus marginatus</i> d'Urv.	IT, SS	Th	
	<i>Ranunculus millefolius</i> Banks & Sol.	Med, IT	Cr	

Table 2. Continuation.

	Species name	CT	LF	Note
	<i>Ranunculus oxyspermus</i> Willd.	Med, IT	Cr	
	<i>Ranunculus pinardi</i> Boiss.	Med, IT	Th	R
	<i>Thalictrum sultanabadense</i> Stapf	IT	He	
Resedaceae	<i>Reseda luteola</i> L.	Med, IT	Cr	
Rhamnaceae	<i>Rhamnus cornifolia</i> Boiss. & Hohen.	IT	Ph	
	<i>Rhamnus pallasii</i> Fisch. & C.A. Mey.	IT	Ph	
Rosaceae	<i>Amygdalus arabica</i> Olivier	IT	Ph	
	<i>Amygdalus haussknechtii</i> C.K.Schneid. ex Bornm.	IT	Ph	E
	<i>Amygdalus lycioides</i> Spach	IT	Ph	E
	<i>Cerasus brachypetala</i> Boiss.	IT	Ph	E
	<i>Cerasus mahaleb</i> (L.) Mill.	IT	Ph	
	<i>Cerasus microcarpa</i> Boiss.	IT	Ph	
	<i>Cotoneaster morulus</i> Pojark.	IT	Ph	
	<i>Crataegus meyeri</i> Pojark.	IT	Ph	
	<i>Potentilla lignosa</i> D.F.K.Schltld.	IT	Ch	R
	<i>Potentilla reptans</i> L.	Plur	Cr	
	<i>Pyrus syriaca</i> Boiss.	IT	Ph	
	<i>Rosa elymaitica</i> Boiss. & Hausskn. ex Boiss.	IT	Ph	
	<i>Rosa villosa</i> L.	ES, IT	Ph	R
	<i>Rubus persicus</i> Boiss.	ES	Ph	R
Rubiaceae	<i>Sanguisorba minor</i> Bertol.	ES, Med, IT	He	
	<i>Asperula arvensis</i> L.	ES, Med, IT	Th	
	<i>Asperula fragillima</i> Boiss. & Hausskn.	IT	Ch	
	<i>Asperula glomerata</i> (M.Bieb.) Griseb.	IT	Ch	
	<i>Callipeltis cucullaris</i> (L.) DC.	IT	Th	
	<i>Cruciata coronata</i> (Sibth. & Sm.) Ehrend.	IT	Ch	R
	<i>Galium ceratocarpon</i> Boiss.	IT	Ch	E
	<i>Galium consanguineum</i> Boiss.	IT	Ch	R
	<i>Galium humifusum</i> M.Bieb.	ES, Med, IT	Cr	
	<i>Galium kurdicum</i> Boiss. & Hohen.	IT	Ch	
	<i>Galium parisiense</i> L.	Med	Th	
	<i>Galium setaceum</i> Lam.	IT	Th	
	<i>Galium tricorntum</i> Dandy	IT	Th	
	<i>Rubia albicaulis</i> Boiss.	IT, SS	Ch	R
	<i>Sherardia arvensis</i> L.	Med	Th	
Rutaceae	<i>Haplophyllum perforatum</i> Kar. & Kir.	IT	He	
Salicaceae	<i>Populus euphratica</i> Oliv.	IT	Ph	
	<i>Salix acmophylla</i> Boiss.	Med, IT	Ph	
	<i>Salix alba</i> L.	ES, Med, IT	Ph	
Scrophulariaceae	<i>Kickxia elatine</i> (L.) Dumort.	Med	Th	
	<i>Linaria chalapensis</i> (L.) Mill.	Med, IT	Th	
	<i>Linaria micrantha</i> (Cav.) Hoffmanns. & Link	Med, IT	Th	R
	<i>Lindernia procumbens</i> (Krock.) Philcox	Plur	Th	R

Table 2. Continuation.

	Species name	CT	LF	Note
	<i>Parentucellia viscosa</i> (L.) Caruel	Med, IT	Th	R
	<i>Scrophularia nervosa</i> Benth.	IT	Cr	E*
	<i>Scrophularia syriaca</i> Benth.	IT	Ch	R
	<i>Scrophularia variegata</i> M.Bieb.	Med, IT	Ch	
	<i>Verbascum agrimoniifolium</i> (K.Koch) Hub.-Mor.	ES, Med, IT	He	
	<i>Verbascum pseudodigitalis</i> Nabelek	IT	He	E*
	<i>Verbascum sinuatum</i> L.	IT	He	
	<i>Veronica anagallis-aquatica</i> L.	Cosm	He	
	<i>Veronica arvensis</i> L.	Cosm	Th	
	<i>Veronica persica</i> Poir.	IT	Th	
	<i>Veronica polita</i> Fr.	Med, IT	Th	
Solanaceae	<i>Datura stramonium</i> L.	IT	Th	
	<i>Hyoscyamus reticulatus</i> L.	IT	He	
	<i>Physalis divaricata</i> D. Don	IT	Th	
	<i>Solanum melongena</i> L.	Cult	Th	R
	<i>Solanum nigrum</i> L.	Cosm	Th	
	<i>Solanum persicum</i> Willd. ex Roem. & Schult.	IT	Ph	R
	<i>Solanum tuberosum</i> L.	Cult	Cr	
Tamaricaceae	<i>Tamarix ramosissima</i> Ledeb.	Plur	Ph	R
Thymelaeaceae	<i>Daphne mucronata</i> Royle	IT	Ph	
	<i>Thymelaea passerina</i> (L.) Coss. & Germ.	ES, IT	Th	R
Ulmaceae	<i>Celtis tournefortii</i> Lam.	Med	Ph	R
	<i>Ulmus carpinifolia</i> Gled.	Med	Ph	R
Urticaceae	<i>Parietaria judaica</i> L.	ES, Med, IT	He	
Valerianaceae	<i>Valeriana sisymbriifolia</i> Vahl	IT	He	
	<i>Valerianella coronata</i> (L.) DC.	ES, IT	Th	R
	<i>Valerianella dactylophylla</i> Boiss. & Hohen.	Med, IT	Th	
	<i>Valerianella pumila</i> DC.	ES, Med, IT	Th	R
	<i>Valerianella vesicaria</i> (L.) Moench	ES, IT	Th	
Verbenaceae	<i>Verbena officinalis</i> L.	Plur	He	
Violaceae	<i>Viola modesta</i> Fenzl	IT	Th	
Vitaceae	<i>Ampelopsis vitifolia</i> (Boiss.) Planch.	IT	Ph	R
Zygophyllaceae	<i>Peganum harmala</i> L.	ES, Med, IT	He	
	<i>Tribulus terrestris</i> L.	ES, Med, IT	Th	
Pteridophyta				
Pteropsida				
Adiantaceae	<i>Adiantum capillus-veneris</i> L.	Cosm	Cr	
Aspleniaceae	<i>Ceterach officinarum</i> DC.	Med, IT, SS	Cr	R
Sinopteridaceae	<i>Cheilanthes persica</i> (Bory) Mett ex Kuhn	Cosm	Cr	R
Sphenopsida				
Equisetaceae	<i>Equisetum ramosissimum</i> Desf.	ES, IT	He	

ES: EuroSiberian, M: Mediterranean, IT: IranoTuranian, SS: SaharoSindian, Ph: phanerophyte, He: hemicriptophyte, Th: therophyte, Ge: geophyte, Ch: chamaephyte, Cr: cryptophyte, E: endemic to flora of Iran, E*: endemic to Iraq and Iran, N: new report from the region (refer to text), R: record for the study region.

Table 3. Statistics of the K – means clustering of species occurrence data. Isim: internal similarity, Esim: external similarity measures of defined groups (k=2 to k=6). Membership of each local flora in each cluster is presented.

K	Cluster	N	Members*	Isim	Isdev	Esim	ESdev
2	0	7	103, 251, 176, 226, 190, 188, 257	0.344	0.077	0.170	0.076
	1	12	139, 153, 244, 53, 224, 184, 242, 156, 166, 117, 19, 17	0.284	0.046	0.170	0.050
3	0	4	166, 117, 19, 17	0.429	0.049	0.160	0.062
	1	7	103, 251, 176, 226, 190, 188, 257	0.344	0.077	0.170	0.076
	2	8	139, 153, 244, 53, 224, 184, 242, 156	0.346	0.033	0.187	0.041
4	0	2	103, 251	0.555	0.000	0.130	0.092
	1	5	176, 226, 190, 188, 257	0.462	0.057	0.185	0.070
	2	4	166, 117, 19, 17	0.429	0.049	0.160	0.062
	3	8	139, 153, 244, 53, 224, 184, 242, 156	0.346	0.033	0.187	0.041
5	0	2	103, 251	0.555	0.000	0.130	0.092
	1	3	184, 242, 156	0.524	0.033	0.207	0.047
	2	5	176, 226, 190, 188, 257	0.462	0.057	0.185	0.070
	3	4	166, 117, 19, 17	0.429	0.049	0.160	0.062
6	0	1	17	1.000	0.000	0.095	0.000
	1	2	103, 251	0.555	0.000	0.130	0.092
	2	3	166, 117, 19, 184, 242, 156	0.524	0.033	0.207	0.047
	3	3	184, 242, 156	0.524	0.033	0.207	0.047
	4	5	176, 226, 190, 188, 257	0.462	0.057	0.185	0.070
	5	5	139, 153, 244, 53, 224	0.426	0.029	0.190	0.041

*members of each cluster are numbered according to IDs in Table 1.

Results and discussion

Flora of Mt. Sefidkouh: the richest flora in the Central Zagros Region

The flora of Mt. Sefidkouh comprises 42 (35 dicots and 7 monocots) families, 389 genera and 698 species. *Asteraceae* (80 species, 11.4%), *Fabaceae* and *Poaceae* (74 species, 10.6% each), *Brassicaceae* (52 species, 7.4%) and *Lamiaceae* (45 species, 6.4%) were the most species-rich families in this area (Fig. 3A, C).

Most generic-rich families are presented in Fig. 3B, E. The largest genera were *Trifolium* (17 spp.), *Astragalus* (16 spp.), *Euphorbia* (10 spp.) and *Salvia* (9 spp.) (Fig. 3D). Determination of Raunkiaer life-forms for each species revealed that 44% of the species (309 spp.) were therophytes, 31% (215 spp.) cryptophytes, 10% (72 spp.) hemicryptophytes, 10% (69 spp.) chamaephytes, and 5% (32 species) phanerophytes (Fig. 5A). Three hundred and eight species (44%) were native to the Irano-Turanian region (monoregional), 205 species (29%) were pluriregional, 160 species (23%) were shared elements between IT and the neighboring floristic regions (Euro-Siberian, Mediterranean, or Saharo-Sindian), and 28 species (4%) were elements of the neighboring regions penetrant into IT region (Fig. 4). Seventy-seven out of 307 IT elements (11% of total species) were endemics (including those species denoted with E* in Table 2 and growing both in Iraq and Iran) (Fig. 5B).

The higher percentage of therophytes and hemicryptophytes among other life forms could be attributed to adaptation of plants to the Mediterranean climate conditions (Zohary, 1973), and also could be related to the intensive grazing in Zagros. Thorny and

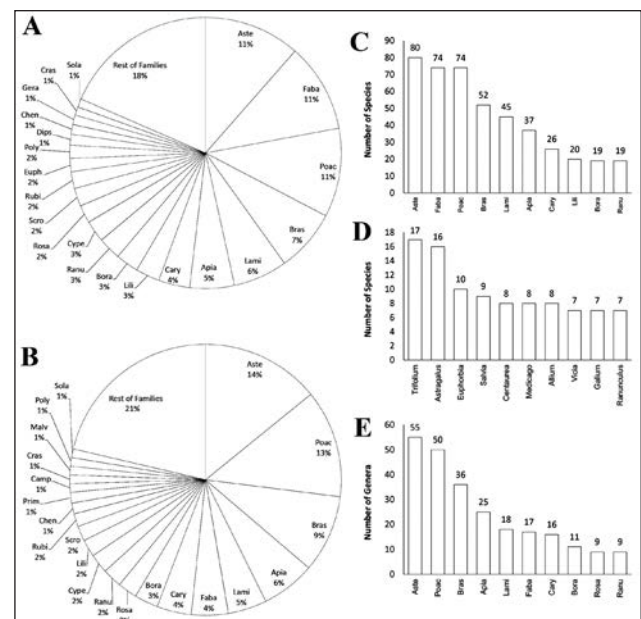


Fig. 3. Important families and genera in the flora of Mt. Sefidkouh. **A:** number and percentage of species in each family. **B:** Number of genera in each family. **C:** Top ten species-rich families. **D:** Top ten species-rich genera. **E:** Top ten genus-rich families. Aste: *Asteraceae*, Faba: *Fabaceae*, Poac: *Poaceae*, Bras: *Brassicaceae*, Lami: *Lamiaceae*, Apia: *Apiaceae*, Cary: *Caryophyllaceae*, Lili: *Liliaceae*, Bora: *Boraginaceae*, Ranu: *Ranunculaceae*, Cype: *Cyperaceae*, Rosa: *Rosaceae*, Scro: *Scrophulariaceae*, Rubi: *Rubiaceae*, Euph: *Euphorbiaceae*.

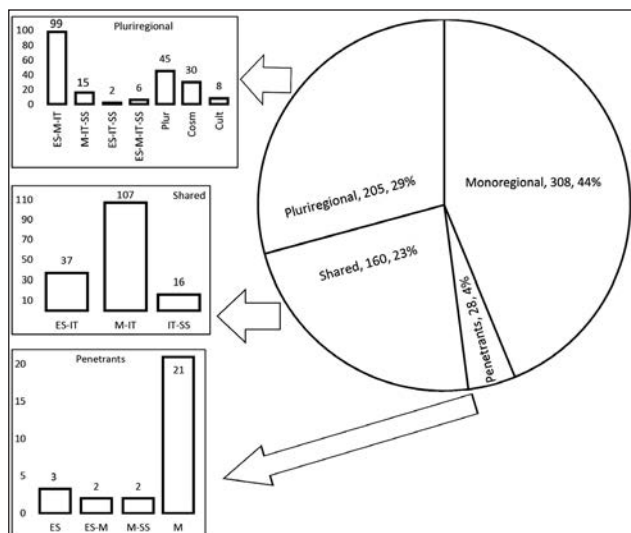


Fig. 4. Chorotypes. ES: EuroSiberian, M: Mediterranean, IT: IranoTuranian, SS: SaharoSindian.

spiny forms like *Astragalus* spp., and poisonous species like *Euphorbia* spp. can better survive grazing and, hence, are among the most abundant and diverse taxa in this region. Non-indigenous plant species constitute up to 33.5% of the flora, indicating floristic affinities between the neighboring regions.

Flora of the region

Twenty-four inventories from adjacent local floras in the Central Zagros Region (Table 1), covering 257 642 ha and circumscribed into a polygon of 3 763 600 ha, with elevation ranging from 1000 m to 3700 m (except for the flora of Dalab, Ilam; ID242, with minimum elevation of 320 m), were cumulated into a single dataset and compared with the floristic inventory of Mt. Sefidkouh (Table 2). Results have revealed that there are 518 shared species between the flora of Sefidkouh and 24 adjacent local floras. In Mt. Sefidkouh, 180 species were new records for the entire region (denoted by letter 'R' in column 'Note' of Table 2). The total number of species present in the overall region consisting of 25 local floras is 1772, with the flora of Mt. Sefidkouh as the most species-rich flora. The floras of Nozhi-an Waterfall (420 spp), Kian (403 spp), Beiranshahr (294 spp), Alvand (286 spp), and Zalian (262 spp) are the next five most species-rich floras (Table 1). The overall region consisting of 25 local floras comprises 96 families and 531 genera. The average species-to-family, species-to-genera and genera-to-family ratios are 18.46, 3.33 and 5.53, respectively, and are comparable to our earlier study in Mt. Jahanbin area in the

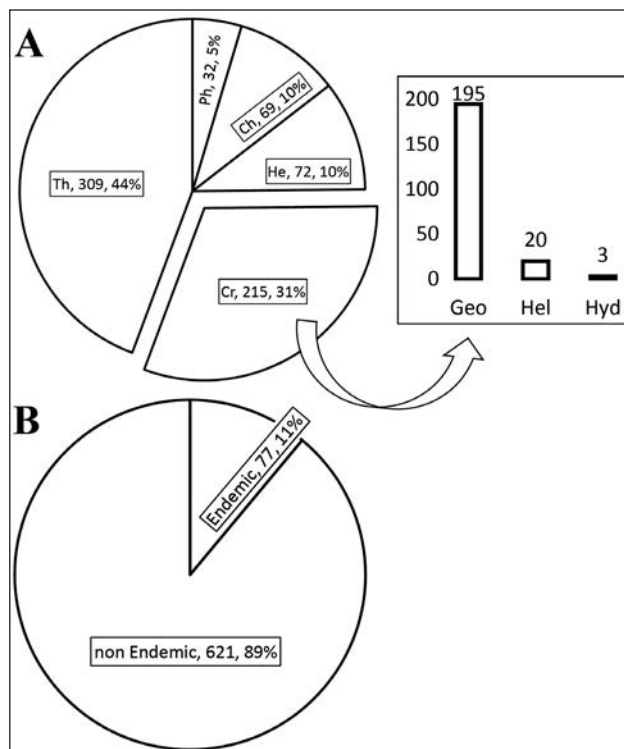


Fig. 5. A: Life forms, Ph: phanerophytes, He: hemicryptophytes, Th: therophytes, Ge: geophytes, Ch: chamaephytes, Cr: cryptophytes. B: endemics.

southern part of the Central Zagros Region. Similar data were obtained in the study of Mt. Jahabin area and the adjacent local floras. A low average species-to-genus ratio in both studies is an indication that Zagros Region had been a refugium during the latest glaciation maximum (Mashkour & al. 2009; Rajaei & al. 2013), in which not all species of many genera and families had survived after colonization to the Central Zagros during the Late Quaternary climatic oscillations. Existence of potential refugial areas in the Southwestern Zagros Mountains (with the center of Dena), and also in the Kope-Dagh and the Southern Caucasus was suggested also on the basis of the genetic study of hind-casting species distribution models of moths and their host plants by Rajaei and coworkers (2013). The species richness of the genera *Astragalus*, *Euphorbia*, *Centaurea*, *Trifolium*, *Allium*, *Cousinia*, and *Silene* is higher than in other genera. This is not specific to this region as we have observed similar high richness values for same genera in our earlier studies (Dehghani 2015; Dehghani & al. 2016; Jalali 2016; Jalali & al. 2016) in the southern parts of Central Zagros. The top ten richest families in terms of the number of species are: *Asteraceae*, *Fabaceae*, *Poaceae*, *Brassicaceae*, *Lamiaceae*, *Apiaceae*, *Caryo-*

phyllaceae, Liliaceae, Boraginaceae and Rosaceae. The top ten richest genera are: *Astragalus* (89 spp), *Euphorbia* (30 spp), *Centaurea* (27 spp), *Trifolium* (26 spp), *Allium* (24 spp), *Cousinia* (22 sp), *Silene* (21 spp), *Onosma* (20 spp), *Salvia* (19 spp), and *Polygonum* (19 spp).

New reports for the region

One hundred and eighty species in the Mt. Sefidkouh flora, marked with letter 'R' in column 'Note' of Table 2, were not previously reported from the overall region comprising 24 local floras, and are reported as new records. Notably, these include *Schoenoplectus bucharicus* (Cyperaceae) – an Iranian endemic and rare helophyte growing along rivers and paddy fields; *Semenovia tragioides* (Apiaceae) – an endemic hemicryptophyte growing in mountainous areas; *Carlina kurdica* (Asteraceae) – an endemic hemicryptophyte growing in mountain steppes and foothills and collected for the first time from Iran after the first record; and *Astragalus anacardius* and *A. veiskaramii* (Fabaceae) – chamaephyte endemics growing in sand hills, the latter being a new species recently described from Iran (Sabaii & al. 2007). Other interesting recorded species (for this region) are *Bergia aquatica* (Elatinaceae) and *Ammannia verticillata* (Lamiaceae) – pluriregional/cosmopolitan helophytes growing as weeds in paddy fields; and *Delphinium venulosum* (Ranunculaceae) – an Irano-Turanian therophyte growing in sandy hills.

Search for species distributions in our database containing datasets of more than 200 Iranian local floras published since 1989 (Sharifi-Tehrani & Rahiminejad-Ranjbar 2013) has shown that *Schoenoplectus bucharicus* was reported (after the initial record) just once from Langeroud (Hyrcanian Province, North Iran) collected by Ghahreman and coworkers (Ghahreman & al. 2004). The addition of this endemic and rare species to our collections during 1999–2000 from the Central Zagros Region is an indication of its anthropophilic distribution from the paddy fields in North Iran. *Alisma lanceolatum* (Alismataceae), a helophytic plant with pluriregional distribution is also identified from the paddy fields and shallow waters in the Sefidkouh Mountain Area. This species was reported frequently from the Hyrcanian region of Iran, but was also reported from the flora of Ghadamgah spring-stream in the Fars Province

(Southern Zagros). These occasional reports from different parts of the Zagros Mountain Chain denote the existence of rare species in these regions which should be subjected to more extensive and careful floristic studies. A relatively high number of endemic and rare plant species in Mt. Sefidkouh among the other local floras in this region has shown that the flora of Central Zagros merits more attention, both for identification of all plant species and for its conservation.

Multivariate analysis

Central Zagros of Iran, which comprises delightful oak forests of the Mediterranean type, is very important ecologically, although poorly investigated as compared to the local floras in the Alborz Mountain Chain in North Iran. These forests are adjacent to the Khuzestan Plain through the western foothills of Zagros in Khuzestan Province, SW Iran (Akhani 2004). Dangerous chemical and weapon remains of the war in W Zagros foothills and plains have restricted the efficient floristic investigations in the past decades. In this study, eight local floras from Kermanshah (5 floras) and Ilam (3 floras) provinces (Table 1) are added to the data matrix of 11 floras in Lorestan Province. Relationships and floristic connections between these floras at the western and eastern foothills of the Central Zagros Region have been investigated. The primary data matrix consisted of 25 datasets (Table 1), and by omitting six outlayers (after preliminary clustering analysis), the final matrix comprised 19 local floras (Table 3).

Clustering of these 19 adjacent local floras in the Central Zagros Region (Table 1, 3) into groups of similar entities was performed by k-means clustering of occurrence data (Fig. 6). The results have shown that the 19 local floras could be classified into five groups, since the grouping achieved for k=5 maximized the internal similarity and minimized the external similarity criteria (Table 3). The first division (k=2) separated seven local floras in the center of the region in Lorestan Province; (IDs: 103, 251, 176, 226, 190, 188, 257 in Table 1) from the other 12 local floras. In the second division (k=3), the local floras located in the western part of the region, in Kermanshah Province, (IDs: 166, 117, 19, 17) were separated from the larger group. The best grouping

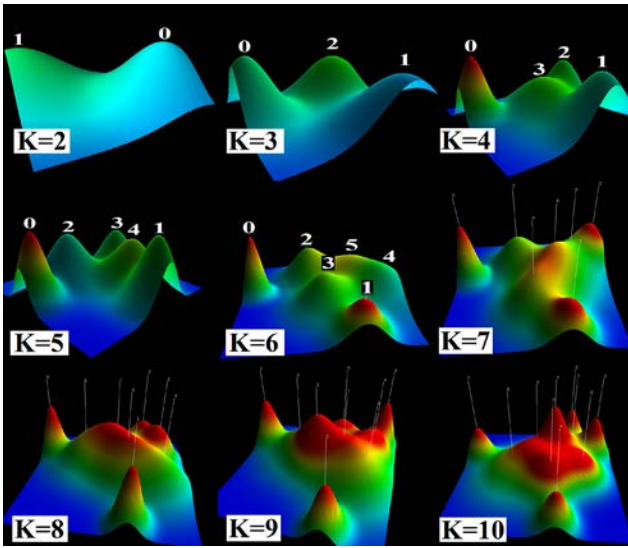


Fig. 6. Mountain visualization of NMDS-K-means clustering of the species occurrence data from Mt. Sefidkouh (this study) and 18 related local floras in the Central Zagros Region of Iran. The best solution was determined as K=5, as the five resulting groups are well separated from each other. For internal and external similarity values and membership of local floras in resultant clusters refer to Table 3.

was finally achieved for k=5. This solution grouped the local floras in southern part of the region, in Kermanshah Provinve, into a single group, while the other groups constituted of the adjacent local floras in Ilam, Hamedan and Lorestan provinces. Two local floras – Beiranshahr (ID 251) and the fruit gardens of Khorramabad (ID 103) – are grouped together, separated from a main group of other local floras in Lorestan Province (Table 3, Fig. 9; right). The results have shown that the analyzed local floras were separated on the basis of their geographical location and their distance in the study region of Cental Zagros. Grouping of the 19 selected local floras in this region was interesting, as different parts of the region were marked according to the floristic contents.

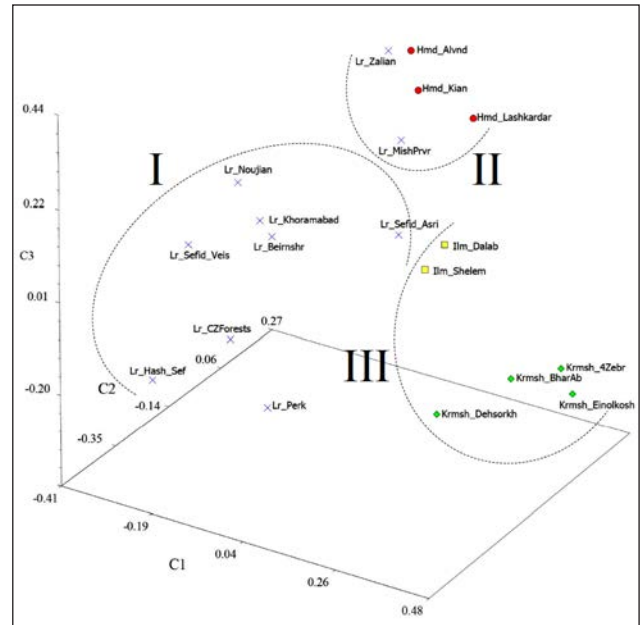


Fig. 7. Multivariate analysis of the presence/absence of species in Mt. Sefidkouh and the adjacent sites (local floras): Cluster analysis by Simple Matching Coefficient in in NTSYS-pc. Abbreviations concordant to Table 1.

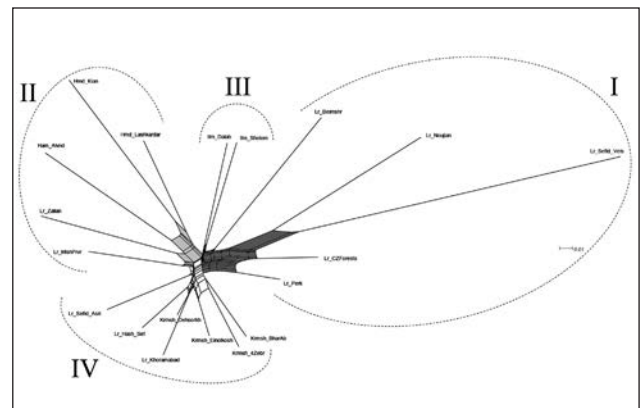


Fig. 8. Multivariate analysis of the presence/absence of species in Mt. Sefidkouh and the adjacent sites (local floras): Analysis of the data matrix by a Neighbor Net Clustering Method. Abbreviations concordant to Table 1.



Fig. 9. Maps circled. Left: three groups based on PCO results. Middle: four groups based on net clustering. Right: five groups based on K – means clustering.

The matrix of species occurrence data was also analyzed by ordination (PCO) and net clustering methods. These methods are agglomerative and contrasting to the divisive methods. Results of these analyses (Figs 7, 8) were consistent with those obtained from the k-clustering method. Ordination analysis (PCO, Fig. 7) separated the local floras (datasets) into three main groups and showed a similar grouping pattern with k-clustering. The resultant 3D plot showed that the local floras within Ilam Province could be either grouped with the local floras in Kermanshah Province, or be separated into a distinct group similar to the resultant plot of the net clustering method (Fig. 8).

A clustering diagram of the net clustering method revealed that the local floras in this region could be arranged into four main clusters, and with a similar pattern of grouping as in k-clustering. Cluster I (Fig. 8) encompasses five local floras in the central part of the region in Lorestan Province. The flora of Mt. Sefidkouh, which is investigated in this study, falls into this cluster. Cluster II is composed of the local floras in Hamedan Province, along with floras of Zalian (ID 53) and Mishparvar (ID 224). Cluster III consists of two local floras in the Ilam Province (Shelem in Manesht-Ghalrang). Local floras located in Kermanshah Province (westwards of the region) and three local floras in Lorestan Province constitute the fourth cluster.

The cumulated checklist of Zalian (ID 53) and Mishparvar (ID 224) floras, which are located in Lorestan Province, consists of 382 species with 185 species in common with the cumulated checklist of the other three local floras in cluster II (with 662 species). The cumulated checklist of these two local floras has 207 species in common with the other local floras from Lorestan Province in cluster I. The number of species observed in these two local floras, which are absent from the other local floras in cluster II, is 196 (174 for cluster I). However, the difference between these two local floras (Zalian and Mishparvar) and the local floras in cluster I is much more prominent (856 species in cluster I are absent from these two local floras) than in cluster II (477 species). Therefore, membership of these two local floras in cluster II, along with the local floras from Hamedan Province is acceptable.

Membership of the local floras in each group was also overallly consistent with the results of the k-clustering method (Table 3) and depicts the geographical

structure of the local floras in this region. The nineteen local floras in this region could be assigned to three main groups on the basis of PCO analysis, or to four groups on the basis of the net clustering method, which is consistent with the results of PCO, or five groups based on the k-clustering method which is consistent with the two former analyses. The number of resulting groups (clusters) could be attributed to the mathematical nature of the analyses, such as agglomerative/divisive nature of the methods.

All kinds of analyses suggested that the local floras of central Mt. Sefidkouh, Zalian and Mishparvar which were studied by Asri & Mehrnia (2002), Yarahmadi & al. (2009) and Moridi (2015), respectively, have affinities to the adjacent groups of local floras, and may help refining the transitional zones between the major floristic sites in this region.

Conclusion

Phytogeographical regionalization into kingdoms, regions, provinces, and other phytochoria is central to phytogeography and evolution, and invaluable for conservation plans. Multivariate analysis of phytogeographic and species occurrence data may have interesting applications for classification purposes and elucidation of the floristic structure of regions. It is an interesting field attracting many researchers (Kreft & Jetz 2010). Application of multivariate analysis for distribution data has contributed a new quantitative aspect to regionalization and floristic structure in the important Central Zagros Region of Iran. Biogeographical borders between the major groups encompassing 19 local floras in the Central Zagros Region are drawn in this study by means of quantitative analyses at the species-level.

Kreft & Jetz (2010) have highlighted the relative usefulness of multivariate methods at different levels of taxonomy. They showed the value of NMDS in identification of transition zones. They also showed that UPGMA had the best performance out of other techniques for analysis of such data. Interestingly, Kreft & Jetz (2010) have observed that quantitative regions obtained through multivariate analyses have both similarities and differences in respect to the classic divisions of the world biota. They have showed that Sahara, North Africa, Arabian Peninsula, and parts of the Middle East may be included in the Afro

Tropics. This approach may be also applied for refining/redefining the borders of lower phytochoria. The flora of Mt. Sefidkouh showed that the species richness in this area is higher than in the neighbouring local floras and merits more attention. The flora of this area may be considered for higher levels of conservation, in order to protect its diversity. Overgrazing in the Zagros Mountain Chain has always had a direct impact on the plant species diversity. Changes in species distributions, which could be regarded as a sign of the gradual climatic change, might be studied consistently, while changes in the borders/transition zones of lower phytochoria might be monitored in the future studies.

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