ISSN: 2538-2152; ECOPERSIA 2022;10(2):133-151.

A Survey of Floristic, Life Forms, and Chorology of Plants in the Akhardaghe Watershed (North Khorasan Province, Iran)

ARTICLEINFO

Article Type
Original Research

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How to cite this article
Asaadi A.M. A Survey of Floristic, Life Forms, and Chorology of Plants in the Akhardaghe Watershed (North Khorasan Province, Iran). ECOPERSIA 2022;10(2): 133-151

DOR:
20.1001.1.23222700.2022.10.2.4.9

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Article History
Received: December 13, 2021
Accepted: February 4, 2022
Published: March 15, 2022

ABSTRACT

Aims: Floristic surveys are essential methods for discovering new herb species and protecting natural ecosystems. Because there has been no report on floristic surveys in the Akhardaghe region, the goals of this study were to determine the floristic list, life forms, chronological analysis, protected status, and endemic status of plant species in the Akhardaghe Watershed in Bojnourd.
Materials & Methods: Plant specimens from the study area were collected from 2016 to 2020 during active growth periods. The life form was determined using the Raunchier category, the endemic, rare, and endangered species of Iran were determined using the Red Data Book of Iran, and the chorology of species is based on the vegetative regions classified by Zohary and Takhtajan.
Findings: A total of 346 plant species were identified in the floristic survey, belonging to 234 genera and 63 families. The Asteraceae, which had 54 species, and the Lamiaceae, 36 species, were the most influential families. In terms of life forms, hemicritophytes and therophytes had the highest percentage (61 percent). According to chorology, there was a high proportion of Iran-Turanian elements (55 percent). Furthermore, 37 endemic species were identified. There are 53 threatened plant species in this area, according to the IUCN.
Conclusion: The finding of the current floristic research revealed that the vascular plant flora in the area is rich in species and contains numerous endemic, rare, and medicinal plants species. However, most plants' species are severely threatened by human overutilization. Therefore, conservation and protection management policies must be applied to the Akhardaghe Watershed vegetation.

Keywords: Akhardaghe; Floristic; Chorotype; IUCN Categories; Iran.

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Introduction

Because of the extent of climatic diversity and topography, Iran is one of the most important countries in terms of herb species diversity. As a result, many naturalists, particularly botanists, traveled to this area to gather and survey herbs [1]. The recognition and presentation of native herbs in an area are significant because it can indicate: specific plant species of the local region and their incidence, growing season, species hardness, different species, detection of new species, and the effect of climatic status such as drought on vegetation [2]. The plants of a region benefit from interactions between biological communities and environmental conditions, and they are also directly related to the evolution of plant species and geographical conditions over time [3].

The diversity of plant life is an essential component of most terrestrial biological communities. Human and animal lives are almost entirely dependent on herbs, either directly or indirectly. Another essential function of plant life is the provision of ecosystem services such as the production of foods, water, fuels, fibers, and genetic resources, slope consolidation, watershed conservation, medicinal plants, soil improvement, climate moderation, and the preparation of habitat for much of the wild fauna. Plant vegetation reflects geographical areas' biological responses to current environmental and historical plant evolution. Flora evaluation, including floristic, biological spectrum, and geographical distribution, is

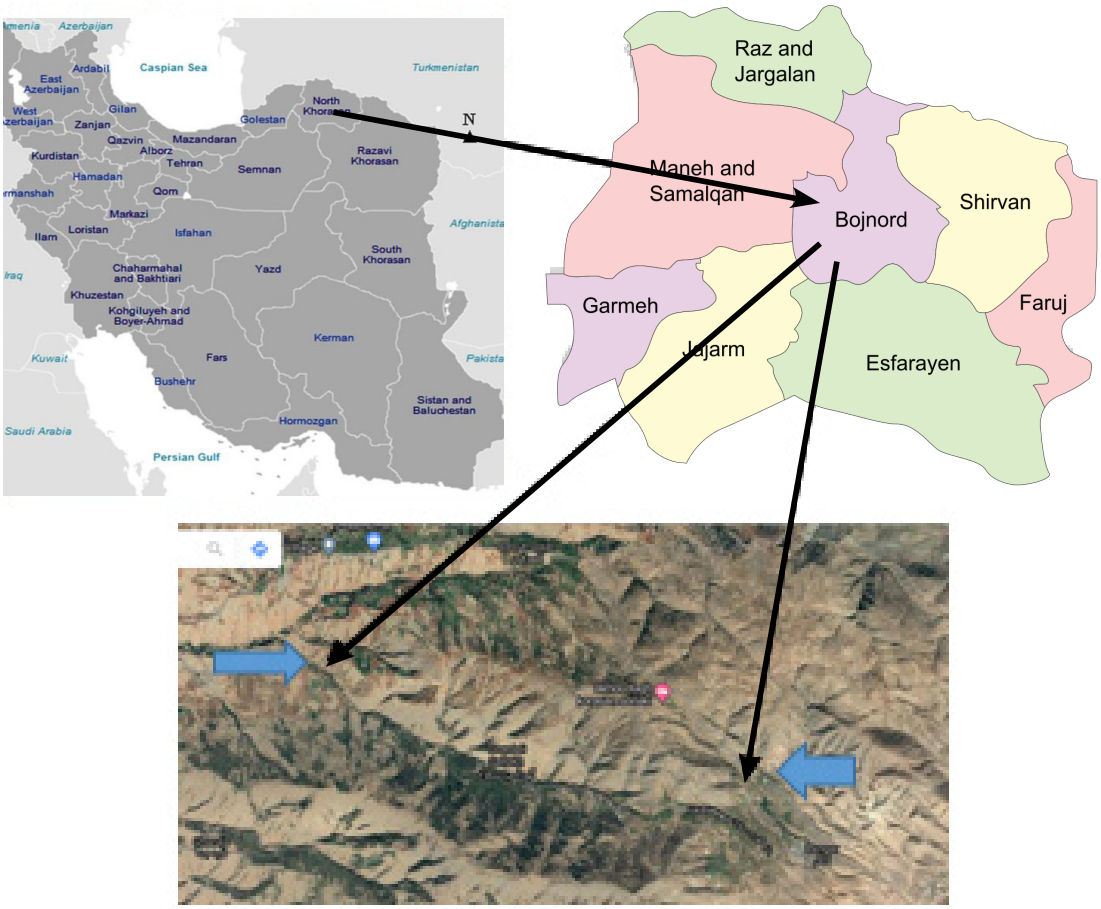

Figure 1) Location map of the study region in Iran and North Khorasan Province.

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critical for identifying biodiversity [4, 5]. Life forms induce equivalence between herb species and their environment, resulting in herb adaptation. Life forms from various climates and habitats, in particular, exhibit different environments, which influence plant species distribution [6]. Chronological surveys are necessary for determining species distribution, variation, and identifying endemic species [7].

Many studies in this field are currently being conducted by researchers, including Diversity, Life Forms, and Chorology of Plant Species in Galehdar Watershed [8], Floristic studies, life forms, and chorology of plants in Kouh-payeh area, Isfahan Province [7], and Floristic study of Saldaran Protected Region of Shahr-e Kord City [9]. There is still a significant lack of primary knowledge about the plants themselves. No report on floristic research in the Akhardaghe Region is required for future conservation management plans. The goals of this study were to determine the floristic list, life forms, chronological analysis, protected status, and endemic status of plant species in the Akhardaghe Watershed in North Khorasan Province based on an understanding of the natural ecosystems vegetation composition. For the first time, all data from the study region are reported.

Materials & Methods

The Akhardaghe Watershed was chosen as the research site for this study. This region is located 20 kilometers northwest of Bojnourd County in Iran's northeast (North Khorasan Province) (Figure1). It is situated between the longitudes of 57° 7' and 57° 15' East and the latitudes of 37° 32' and 37° 36' North. The study area is approximately 5300 ha, with elevations ranging from 1000 m to 1900 m. The average annual rainfall is 295mm, with the highest and lowest amounts falling in April and July. The annual mean temperature is 11.28°C. The average maximum temperature in the warmest month (July) is 26°C, and the average minimum temperature in the coldest month (January) is -6.8°C. As determined by the Emberger method, this area's climate is cold and semi-arid. According to the Embrothermic diagram, the wet season lasts seven months, and the drought season begins in June and lasts until October (Figure 2).

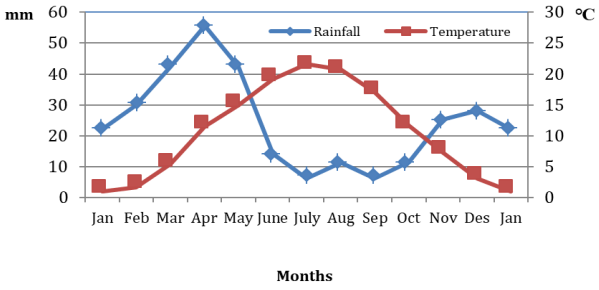

Figure 2) Embrothermic climatic diagram of the study area.

In order to introduce the flora of Akhardaghe, at first related data such as topographic maps and meteorological statistics were gathered. Then, the land survey method was used. It is one of the appointment plant taxonomy studies of the region [10]. In this method, with a direct presence in the study region, vegetation samples from 1000 to 1900 meters above sea level were collected. The plant specimens of the study region were collected during active growth periods from 2016 to 2020. The collected samples were then identified and named on classification and terminology applied to different Flora, such as Flora Iranica Rechinger [11], Flora of Iran Assadi [12], Flora of Iran Parsa [13], Colored Flora of Iran Ghahreman [14], Astragalus communities of Iran Maasoumi [15], Trees and Shrubs of

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Figure 3) The pictures of some species are presented in the Akhardaghe Watershed. A: *Galium verum*, B: *Saponaria bodeana*, C: *Melisa officinalis*, D: *Agrimonia eupatoria*, E: *Tripleurospermum disciforme*, F: *Perovskia abrotanoides.*

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Figure 3) (continued). A: *Artemisia absinthium,* B: *Lychnis coronaria*, C: *Acer campestre,* D: *Digitalis Nervosa,* E: *Dracocephalum Lindberg*, F: *Coronilla varia*, G: *Echinophora platycarpos*, H: *Tussilago farfara*, I: *Ceterach officinarum.*

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Iran Mozaffarian [16] the Illustrated Flora of Golestan National park Akhani [17]. In this manner, geographical plant distribution is also determined according to these Flora. The life forms were determined due to Raunkier's classification [18]. The endemic, rare, and endangered species were recognized based on the Red data book of Iran [19]. The chorology of plant species was determined according to vegetative regions classified by Zohary [20] and Takhtajan [21].

Findings

According to the study's findings, approximately 346 species belonging to 234 Genera and 63 Families have been identified. The Dicotyledonous flora was the most diverse, with 285 species, followed by Monocotyledons (56 species), Gymnosperms (3 species), and Pteridophytes (2 species) (Table 1). Figure 3 depicts images of various plant species. Asteraceae is the most abundant family in the region, with 36 genera and 54 species, followed by Lamiaceae, Poaceae, Papilionaceae, Rosaceae, and Apiaceae, which have 35, 32, 25, 19, and 17 species, respectively. These six families account for approximately 52.60 percent of the flora in the region. In addition to these families, seven other families are represented in three different species. There were fourteen families with two species and 23 families by one plant species in the Akhardaghe Watershed (Figure 4). The genera Astragalus (with six species) and Centaurea (with five species) are the richest, followed by Salvia, Alyssum, Galium, Bromus, Euphorbia, Acantholimon, and Onobrychis with four species, respectively.

The life form of each plant species was also identified. Life forms investigated by Raunkier categories indicated that the most important group is hemicryptophyte. Hemicryptophytes include 35.55% of total species, Therophytes 25.43%, Geophytes 13.87%, Chamaephytes 12.72%, and Phanerophytes 12.43%, respectively. Asteraceae (22%), Lamiaceae (12%), and Poaceae (11.4%) represented the highest percent of hemicryptophytes, followed by Asteraceae (17.04%), Poaceae (13.64%), and Brassicaceae (9.09%) with the highest proportion of therophytes. The spectrum of life forms for plant species is indicated in Figure 5.

The Chorotype distributions of species are as follow: Iran-Turanian 55.13%, Iran-Turanian, and Mediterranean 11.73%, Iran-Turanian, Mediterranean and Euro-Siberian 9.68%, Iran-Turanian and Euro-Siberian 8.8%, Cosmopolitan 7.04%, Iran-Turanian and Sahara-Sindian 3.81%, respectively. Less than 3.81% of total plant species belonged to the other Chorotype elements of the area (Figure 6). The highest amounts of Iran-Turanian elements were found to be Asteraceae (18%), Lamiaceae (11%), Papilionaceae (8%), and Poaceae (6%).

37 of the 346 plant species found in the studied area are endemic to Iran. The Asteraceae and Lamiaceae have the most endemic species (16%), followed by the Plumbaginaceae (11%). (Table 1). Furthermore, the IUCN classifies plant species into four categories: endangered, vulnerable, low risk, and data deficient. According to Iran's Red Data Book, 53 threatened plant species are in this area. One taxon is listed as endangered. 8, 10, and 34 taxa are classified as vulnerable, data deficient, and low risk, respectively (Table 1).

[DOR: 20.1001.1.23222700.2022.10.2.4.9]

Table 1) List of species, life forms, chorotypes, and IUCN status in the Akhardaghe Watershed.

Scientific name	Life form	Chorotype	IUCN status
Aceraceae			
Acer campestre L.	ph	ES	-
Acer monspessulannum L. *Subsp. ibericum(M.B.)* Yaltirik	ph	(End)IT, ES	DD
Alliaceae			
Allium caspium (Pall.) M.B.	Ge	IT	-
Allium leave Wendelbo & Von Bothmer	Ge	IT	-
Allium monophyllum Vved.	Ge	IT	DD
Amaranthaceae			
Amaranthus retroflexus L.	Th	Cosm	-
Amaryllidaceae			
Ixiolirion tataricum (Pall.) Herb.	Ge	IT,ES,SS	-
Apiaceae			
Actinolema macrolema Boiss.	He	IT	-
Albovia tripartite (Kaleniczenko) Schischk.	He	IT,ES	-
Bunium cylindricum (Boiss. Et Hoh) Drule.	He	IT	-
Bunium persicum L.	He	IT	-
Caucalis platycarpos L.	Th	IT,M	-
Echinophora platyloba DC.	He	IT(End)	LR
Eryngium Bungi Boiss	Ch	IT	-
Falcaria vulgaris Bernh	He	IT,M,ES	LR
Ferula stenocarpa Boiss	He	IT(End)	-
Ferula ovina Boiss	He	IT	-
Lisaea heterocarpa (DC.) Boiss.	Th	IT,M.ES	-
Kelussia odoratissima Mozaff	He	IT	LR
Malabaila porphyrodiscus Staph et Wettstein	Ge	IT(End)	-
Pimpinella eriocarpa Banks et Soland.	He	IT	-
Scandix Iberica M.B	Th	IT	-
Turgenia latifolia (L.) Hoffm.	He	IT,M,ES	-
Zozimia absinthifolia (Vent.) Link	He	IT	-
Araceae			
Arum orientale M.B	Ge	IT	VU
Eminium alberti (Rgl.) Engl	Ge	IT	-
Asclepiadaceae			
Vincetuxicum pumilum Decne.	Ch	IT(End)	LR
Asparagaceae			
Polygonatum sewerzowii Regel.	Ge	IT	-
Aspidiaceae			
Dryopteris filix-mas (L.) Schott	Ge	ES	-
Aspleniaceae			
Ceterach officinarum DC.	Ge	IT,ES	-
Berberidaceae			
Berberis integerrima Bunge.	Ph	IT	-
Berberis khorasanica Browicz & Zielinski	Ph	IT	VU
Boraginaceae			
Anchusa italica Retz.	Ch	Cosm	-
Cynoglossum creticum Miller	He	IT,M,ES	-
Echium italicum L.	Ch	IT,M	-
Lappula microcarpa (Ledeb.) Gurke in Eegler et parntl.	Th	IT	-
Nonea lutea (Desri) Reichenb.	Th	IT,ES	-
Onosma bulbotrichum DC.	Th	IT	-
Onosma koschyi Boiss.	He	IT(End)	LR
Paracaryum intermedium (Fresen) Lipsky	He	IT	-

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Table 1) (Continued). List of species, life forms, chorotypes, and IUCN status in the Akhardaghe Watershed.

Scientific name	Life form	Chorotype	IUCN status
Brassicaceae			
Aethionema arabicum (L.) Andrz. et DC.	Th	IT	-
Alyssum bracteatum Boiss. et Buhse	He	IT(End)	LR
Alyssum desertorum Stapf.	Th	Cosm	-
Alyssum linifolium Steph et Willd.	Th	IT,M.ES(End)	-
Alyssum longistylum (Sommier& Levier) Grossh. & Schischk	He	IT	-
Brassica elongata Ehrh.	He	IT,M	-
Draba nemorosa L.	Th	IT,ES	-
Descurainia Sophia (L.) Webb ex Prantl.	Th	IT,M,ES	-
Capsella bursa-pastoris (L.) Medicus	Th	Cosm	-
Isatis kotschyana Boiss. et Hohen..	He	IT	-
Lepidium draba L.	He	IT	-
Scientific name	Life form	Chorotype	IUCN status
Malcolmia Africana L.	Th	IT,SS	-
Thlaspi perfoliatum L.	Th	IT	-
Campanulaceae			
Campanula latifolia L.	He	IT,M,ES	-
Capparidaceae			
Buhsea coluteoides Boiss.	He	IT	-
Buhsea trinervia (DC.) Stapf.	He	IT	-
Capparis spinosa L.	Ch	IT,M,SS	-
Caprifoliaceae			
Lonicera floribunda Boiss. et Buhse	Ph	IT,M	-
Lonicera iberica M.B.	Ph	IT,M	-
Caryophyllaceae			
Acanthophyllum crassifolium Boiss.	Ch	IT(End)	LR
Acanthophyllum glandulosum Bunge.	Ch	IT	-
Acanthophyllum chloroleucum Rech. F. & All.	Ch	IT(End)	DD
Dianthus crinitus SM.	Ch	IT	-
Dianthus orietalis Adams	Ch	IT(End)	-
Lychnis coronaria Lam.	He	IT-M	-
Melandrium persicum (Boiss.)	He	IT,ES	-
Saponaria bodeana Boiss.	He	IT,ES	LR
Saponaria viscosa C.A.Mey.	Th	IT	-
Silene consider L.	He	IT.ES	-
Silene swertiifolio Boiss.	He	IT	-
Vaccaria oxyodonta Boiss.	Th	IT,M,ES	-
Celastraceae			
Evonymus europaeus L.	Ph	ES	-

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Table 1) (Continued). List of species, life forms, chorotypes, and IUCN status in the Akhardaghe Watershed.

Scientific name	Life form	Chorotype	IUCN status
Cistaceae			
Fumana procumbens (Dunal) Gren. et God.	Ch	ES	-
Chenopodiaceae			
Chenopodium vulvaria L.	Th	IT,M	-
Asteraceae			
Achillea micrantha Willd	Th	IT	-
Achillea tenuifolia Lam.	He	IT	-
Achillea wilhelmsii C.Koch	He	IT,ES	-
Acroptilon repens (L.) DC.	He	IT	-
Anthemis altissima L.	Th	IT	DD
Arctium minus (Hild) Bernh.	He	IT	-
Arctium lappa L.	He	IT,ES	-
Artemisia absinthium L.	Ch	IT,M	-
Artemisia aucheri Boiss.	Ch	IT	-
Artemisia sieberi Boiss	Ch	IT,SS	-
Carthamus lanatus L. subsp. turkestanicus (M.Pop.) Hanelt	Th	IT	-
Centaurea aucheri (DC.) Wagenitz.	Ge	IT(End)	LR
Centaurea carduiformis DC.	He	IT	VU
Centaurea depressa M.B.	Th	IT,M,ES	LR
Centaurea gaubae (Bornm.) Wagenitz	He	IT	-
Centaurea virgata Lam.	He	IT,ES	-
Chardinia orientalis (L.) O Kuntze	Th	IT	-
Cichorium intybus L.	He	Cosm	-
Cirsium arvense (L.) Ledeb.	Ge	Cosm	-
Cnicus benedictus L.	Th	IT	-
Cousins ironica C. Winkl. & Strauss	He	IT(End)	-
Cousinia linczewskii Juz.	He	IT	-
Cousinia smirnowii Trautv.	He	IT	-
Echinops polygamous Bunge	He	IT(End)	LR
Echinops ritro L.	He	IT	-
Echinops ritrodes Bunge.	He	IT(End)	-
Garhadiolus angulosus Jaub. et Spach	Th	IT,SS	-
Gundelia tournefortii L.	He	IT,M	-
Heteroderis pusilla Boiss.	Th	IT	-
Heteropappus altaicus (Willd.) Novopokv	He	IT	-
Jurina stenocalathia Rech.f.	Ch	IT(End)	LR
Inula oculus- Christi L.	He	IT	-
Inula salicina L.	He	IT-ES	-
Koelpinia linearis Pall.	Th	IT,SS	-
Lactuca glaucifolia Boiss.	Th	IT	-
Scientific name	Life form	Chorotype	IUCN status

[DOR: 20.1001.1.23222700.2022.10.2.4.9]

Table 1) (Continued). List of species, life forms, chorotypes, and IUCN status in the Akhardaghe Watershed.

Scientific name	Life form	Chorotype	IUCN status
Leontodon asperrimus (Willd.) Boiss. ex Ball.	Ge	IT	-
Nikitinia leptoclada (Born. & Sint.) Login	Ch	IT	DD
Onopordon heteracanthum C.A.Mey.	He	IT	-
Scariola orientalis (Boiss.) Sojak	Ch	IT	-
Scorzonera calyculata Boiss.	Ge	IT	-
Siebert nana (DC.) Born.	Th	IT,M	-
Silybum marianum L.	He	IT,M,ES	-
Steptorrhamphus tuberosus (Sacp.) Gross.	Ge	IT	-
Tanacetum balsamita L.	He	IT	-
Taraxacum montanum (C.A. Mey.) DC.	He	IT	-
Taraxacum vulgare Hand. Mt.	Th	IT	-
Tripleurospermum disciforme L. (C.A.Mey.) Schultz-Bip.	He	IT,ES	-
Tripleurospermum maritimum L.	Th	ES	-
Tragopogon caricifolius Boiss.	He	IT(End)	LR
Tragopogon marginatus Boiss. et Buhse	He	IT	-
Tussilago farfara L.	He	ES,M	-
Varthemia persica DC.	Ch	IT	-
Xanthium spinosum L	Th	Cosm	-
Xanthium strumarium L.	Th	IT,M,ES	-
Convolvulaceaes			
Convolvulus arvensis L.	Th	Cosm	-
Convolvulus pilosellaefolius Desr.	He	IT,SS	-
Cornaceae			
Cornus australis C.A.Mey.	Ph	IT,M,ES	-
Cuscutaceae			
Cuscuta approximate Bebington	Th	IT	-
Cyperaceae			
Carex stenophylla Wahlenb.	Ge	Cosm	-
Carex sylvatica Huds.	Ge	Cosm	-
Dipsaceae			
Cephalaria procera Fisch. et Lallem	He	IT	-
Cephalaria transsylvanica (L.) Schrad.	Th	IT,M	VU
Scabiosa micrantha Desf.	Th	IT	-
Scabiosa olivieri Coult	Th	IT	-
*Scabiosa rotat*e M.B.	Th	IT	-
Elaeagnaceae			
Elaeagnus angustifolia L.	Ph	IT	-
Ephedraceae			
Ephedra intermedia Stand	Ph	IT	-
Ephedra major Host.	Ph	IT,ES	-
Ephedra procera Fisch. & Mey.	Ph	IT,SS	-
Euphorbiaceae			
Euphorbia cheiradenia Boiss. et Hohen.	He	IT	-
Euphorbia helioscopia L.	Th	IT,M	-
Euphorbia humilis C.A. Mey. et Ledeb.	He	IT	-
Euphorbia myrsinites L.	He	IT	-
Fumariaceae			
Fumaria parviflora Lam.	Th	IT,ES,M	-

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Table 1) (Continued). List of species, life forms, chorotypes, and IUCN status in the Akhardaghe Watershed.

Scientific name	Life form	Chorotype	IUCN status
Geraniaceae			
Biebersteinia multifida DC.	Ge	IT	-
Erodium cicutarium (L.) L'Hér. ex Aiton	Th	IT,M,ES	-
Geranium lucidum L.	Th	Cosm	-
Geranium persicum Sehonbeck- Temesy	Ge	IT,ES	-
Geranium robertianum L.	Ge	IT,M,ES	-
Hypericaceae			
Hypericum perforatum L.	He	IT,ES	-
Hypericum scabrum L.	He	IT	-
Iridaceae			
Iris acutiloba C.A.Mey.	Ge	IT	-
Iris songarica Schrenk.	Ge	IT	-
Iris kopetdaghensis (Vved) Mathew & Wendelbo	Ge	IT	-
Juglandaceae			
Juglans regia L.	Ph	IT,M,ES	-
Scientific name	Life form	Chorotype	IUCN status
Lamiaceae			
Clinodium vulgare L.	He	IT,M	-
Dracocephalum Lindbergii Rech.f.	He	IT(End)	EN
Eremostachys labiosa Bunge	He	IT,M	-
Eremostachys laevigata Bge.	He	IT	-
Hymenocrater calycinus (Boiss). Benth.	Ph	IT	-
Lamium album L.	He	IT,M	-
Marrubium parviflorum Fisch. & C.A.Mey.	He	IT,M	-
Marrubium vulgare L.	Ge	IT,M	-
Melissa Officinalis L.	He	IT,M	-
Mentha longifolia L.	He	Cosm(End)	LR
Nepeta pungens (Bunge) Benth.	Th	IT	-
Nepeta racemosa Lam.	Ch	IT	-
Nepeta sintenisii Bornm.	He	IT	-
Origanum vulgare L.	Ch	IT,ES	-
Perovskia abrotanoides Karel.	Ph	IT(End)	-
Phlomis anisodonta Boiss.	He	IT	-
Phlomis cancellata Bunge	He	IT	-
Phlomis persica Boiss.	Ch	IT(End)	LR
Salvia chloroleuca Rech. F. et. All.	He	IT	-
Salvia nemorosa L.	Ge	IT	-
Salvia reuterana Boiss.	He	IT(End)	-
Salvia sclarea L.	He	IT	-
Satureja spicigera (C.Koch) Boiss.	Ch	ES,M	VU
Scutellaria orientalis L.	He	IT	-
Stachys inflata Bth.	Ch	IT	-
Stachys lavandulifolia Vahl.	Ch	IT	-
Stachys turcomanica Trautv.	Ge	IT	-
Sideritis Montana L.	Th	IT,M	-
Teucrium polium L.	Ch	Cosm	-
Thymus kotschyanus Boiss. et Hohen.	Ch	IT	LR
Thymus transcaspicus Klokov.	Ch	IT	-
Thymus trautvetteri Klokov	Ch	IT	-
Zataria multiflora Boiss.	Ch	IT,SS	LR
Ziziphora clinopodioides Lam.	Ch	IT(End)	VU
Ziziphora tenuior L.	Th	IT,ES	-

[DOR: 20.1001.1.23222700.2022.10.2.4.9]

Table 1) (Continued). List of species, life forms, chorotypes, and IUCN status in the Akhardaghe Watershed.

Scientific name	Life form	Chorotype	IUCN status
Liliaceae			
Bellevalia tristis Bornm.	Ge	IT	LR
Eremurus olgae Regel	Ge	IT	-
Eremurus spectabilis M.B.	Ge	IT	LR
Gagea reticulata (Pull.) Roem et Schult.	Ge	IT,ES	-
Ornithogalum sintenisii Freyn.	Ge	IT	LR
Tulipa micheliana Hoog.	Ge	IT	-
Tulipa montana Lindl.	Ge	IT(End)	-
Linaceae			
Linum usitatissimum L.	Th	IT(End)	DD
Linum nodiflorum L.	Th	IT,M	-
Malvaceae			
Alcea aucheri (Boiss.) Alef.	He	IT	-
Althaea cannabina L.	He	IT,M	-
Malva neglecta Wallr.	He	IT,M,ES	-
Moraceae			
Ficus carica L.	Ph	IT,M,ES	-
Morus alba L.	Ph	IT	-
Oleaceae			
Jasminum fruticans L.	Ph	IT,M,ES	-
Orchidaceae			
Cephalanthera longifolia (L.) Fritsch	Ge	ES	-
Orobanchaceae			
Orobanche alba Stephan	Ge	IT,ES	-
Papaveraceae			
Glaucium elegans F. et M.	Th	IT	-
Papaver dubium L.	Th	IT(End)	-
Rosemarie refracta DC	Th	IT,ES	-
Scientific name	Life form	Chorotype	IUCN status
Papilionaceae			
Alhagi camelorum Fisch.	Ch	IT,M,SS	-
Astragalus brachycalyx Syn.	Ph	IT	LR
Astragalus gossypinus Fisch.	Ch	IT	LR
Astragalus grammocalyx Boiss. et Hoh.	He	IT	-
Astragalus microcephalus Maass & Mozaff.	Ph	IT	-
Astragalus mollis M.B.	He	IT	-
Astragalus vanilla Boiss.	Ch	IT	-
Colutea buhsei (Boiss.) Shap.	Ph	IT,ES	-
Colutea persica Boiss.	Ph	IT(End)	LR
Coronilla varia L.	He	IT,M,ES(End)	-
Glycyrrhiza glabra L.	Ch	IT,M,ES	LR
Hedysarum kopetdaghi Boriss.	Ch	IT	-
Lathyrus inconspicuous L.	Th	IT	-
Lathyrus sativus L.	Th	IT,M	-
Medicago sativa L.	He	Cosm	-
Medicago Radiata L.	Th	IT,SS	-
Medicago polymorpha L.	Th	IT,SS	-
Melilotus officinalis (L.) Lam.	He	Cosm	-
Meristotropis xanthioides Vassilcz.	Ch	IT	-
Onobrychis aucheri Boiss.	He	IT	DD
Onobrychis cornuta (L.) Desv. *Subsp.cornuta*	Ch	IT	-
Onobrychis gaubae Bornm.	He	IT(End)	DD
Onobrychis transcaspica V.Nikitn	He	IT	-
Trigonella monantha C.A.Mey.	Th	IT	-
Vicia monantha Retz.	Th	IT,M	-

[DOR: 20.1001.1.23222700.2022.10.2.4.9]

Table 1) (Continued). List of species, life forms, chorotypes, and IUCN status in the Akhardaghe Watershed.

Scientific name	Life form	Chorotype	IUCN status
Plantaginaceae			
Plantago Lagopus L.	He	IT,M	-
Plantago lanceolata L.	He	Cosm	-
Plantago media L.	He	Cosm	VU
Plumbaginaceae			
Acantholimon acmostegium Boiss. et Buhse	Ch	IT(End)	LR
Acantholimon aspadanum Buge.	Ch	IT(End)	DD
Acantholimon oliganthum Boiss.	Ch	IT(End)	DD
Acantholimon scorpius (Jaub. et Sp.) Boiss.	Ch	IT(End)	LR
Poaceae			
Aegilops crassa Boiss.	Th	IT	-
Aegilops cylindrica Host.	Th	IT	-
Aegilops ovata L.	Th	IT	-
Agropyron intermedium (Host) P. Beauv.	He	IT,ES	-
Agropyron trichophorum (Link) Richter.	He	IT,M	-
Arrhenatherum elatius (L.) P.Beauv. ex J &C.Presl	Ge	IT,M	-
Avena wiestii Steud.	Th	IT	-
Boissiera squarrosa (Banks et soland) Nevski	Th	IT	-
Bromus briziformis Fisch. et C.A.Mey.	Th	IT,M	-
Bromus danthoniae Trin.	Th	Cosm	-
Bromus tectorum L.	Th	Cosm	-
Bromus tomentellus Boiss.	He	IT	-
Cynodon dactylon (L.) Pers.	Ge	Cosm	-
Dactylis glomerata L.	He	IT,M	-
Dichanthium annulatum (Forssk) Taff.	Ge	IT,SS	-
Eremopyrum confusum Melderis var. confusum	Th	IT	-
Festuca arundinacea Schreb.	He	IT,ES	-
Festuca ovina L.	He	IT	-
Heteranthelium piliferum (Banks et Soland.) Hochst.	Th	IT	-
Hordeum bulbosum L.	Ge	IT,M	-
Hordeum glaucum Stand.	Th	IT,M	-
Melica persica Kunth subsp. Persica	He	IT	-
Pennisetum orientale L.C.Rich.	He	IT,SS	-
Phleum pratense Commoni	He	IT,M	LR
Phragmites australis (Car.) Trin	Ge	IT,M,SS	-
Poa bulbosa L.	Ge	IT,M,ES	-
Poa trivialis L.	He	IT,M,ES	-
Stipa barbata Desf.	He	IT,M,SS	-
Stipa hohenacheriana Trin & Rupr.	He	IT	-
Stipa parviflora Desf.	He	IT,M	-
Scientific name	Life form	Chorotype	IUCN status
Trisetum flavescens (L.) P.Beauv.	He	IT	-
Vulpia myuros (L.) C.C.Gmelin	Th	IT,M	-
Podophyllaceae			
Bongardia chrysogonum (L.) Boiss.	Ge	IT,M	-
Leontine leontopetalum L.	Ge	IT,M	-
Polygonaceae			
Atraphaxis Spinosa L.	Ph	IT	-
Polygonum aviculare L.	Th	Cosm	-
Polygonum rottboellioides Jaub. & Spach	Th	IT	-
Rumex acetosella L.	He	Cosm	-
Primulaceae			
Anagallis arvensis L.	Th	Cosm	-
Androsace maxima L.	Th	IT,M,ES	-

[DOR: 20.1001.1.23222700.2022.10.2.4.9]

Table 1) (Continued). List of species, life forms, chorotypes, and IUCN status in the Akhardaghe Watershed.

Scientific name	Life form	Chorotype	IUCN status
Ranunculaceae			
Adonis flammea Jacq.	Th	IT,M,ES	-
Anemone biflora DC.	Ge	IT	-
Ceratocephallus falcatus (L.) Pers	Th	IT,M,ES	-
Consolida regalis S.F.Gray	Th	IT	-
Delphinium cyphoplectrum Boiss.	He	IT	-
Ranunculus arvensis L.	Th	IT	-
Thalictrum foetidum L.	Ge	IT,M,ES	-
Thalictrum isopyroides C.A.Mey.	Ge	IT,M	-
Thalictrum minus L.	Ge	IT	-
Resedaceae			
Reseda aucheri Boiss.	He	IT,SS	-
Reseda lutea L.	Th	IT,M,ES	-
Rhamnaceae			
Paliurus spina-christi Mill.	Ph	IT,M	LR
Rhamnus pallasii Fisch. & C.A. Mey.	Ph	IT(End)	LR
Rhamnus persica Boiss.	Ph	IT(End)	LR
Zizyphus jujuba Mill.	Ph	IT,ES	-
Rosaceae			
Agrimonia eupatoria L.	He	ES,IT,M	-
Cerasus incana (Pall.) Spachr	Ph	IT	-
Cerasus microcarpa (C.A. mey) Boiss.	Ph	IT	-
Cerasus pseudoprostrata Pojark.	Ph	IT	-
Cotoneaster multiflora Bge.	Ph	IT	-
Cotoneaster nummularias Fisch. C.A Mey.	Ph	IT,M	-
Crataegus elbursensis Rech.F.	Ph	IT,ES	-
Crataegus orientalis M.Bieb	Ph	IT,ES	-
Crataegus turkestanica A.Pojark	Ph	IT,ES	-
Hulthemia persica mich.	Ch	IT	-
Geum kokanicum Regel et Schmalh.	He	IT	-
Mespilus germanica L.	Ph	IT,M,ES	-
Potentilla recta L.	Ge	IT	-
Pyrus boissieriana Buhse	Ph	IT,ES	-
Rosa beggeriana Schrenk	Ph	IT	-
Rosa canina L.	Ph	IT,M,ES	-
Rosa foetida Herrm.	Ph	IT	-
Rubus caesius L.	Ph	IT,ES	-
Sanguisorba minor Boiss. et Hausskn.	He	IT,M,ES	-
Rubiaceae			
Asperula arvensis L.	Th	IT	-
Asperula setosa Jaub. et Spah	Th	IT	-
Crucianella sintenisii Bornm. in Mittheil	Ch	IT	-
Galium humifusum Bieb.	He	IT	-
Galium setaceum Lam.	Th	IT,M	-
Galium spurium L.	Th	IT,M,ES	-
Galium verum L.	Ch	IT,ES	-
Phuopsis styloso (Trin) Hook.F.	He	IT,M	-
Rubia Florida Boiss.	Ph	IT(End)	LR
Rubia tinctorum L.	Th	IT,M	LR
Vaillant hispida L.	Th	IT,M	-
Scientific name	Life form	Chorotype	IUCN status

[DOR: 20.1001.1.23222700.2022.10.2.4.9]

Table 1) (Continued). List of species, life forms, chorotypes, and IUCN status in the Akhardaghe Watershed.

Scientific name	Life form	Chorotype	IUCN status
Rutaceae			
Haplophyllum canaliculatum Boiss.	He	IT,SS(End)	LR
Haplophyllum perforatum (M.B.).Kar. et Kir.	Ch	IT	-
Scrophulariaceae			
Bellardia trixago (L.) All.	Th	IT	-
Digitalis nervosa Steud. et Hochst.	He	IT	-
Linaria simplex (Willd.) DC.	Th	IT,M	-
Verbascum erianthum Benth. in DC.	He	IT	-
Verbascum cheiranthifolium Boiss.	He	IT	-
Veronica biloba Schreb.	Th	IT	-
Solanaceae			
Hyoscyamus reticulates L.	He	IT-M	-
Valerianaceae			
Valerianella vesicaria (L.) Moench	Th	IT	-
Ulmaceae			
Celtis caucasica Willd.	Ph	IT	-
Urticaceae			
Urtica dioica L.	He	IT,ES	-
Violaceae			
Viola odorata L.	He	IT,M,ES	LR
Zygophyllaceae			
Peganum harmala L	He	Cosm	-
Tribulus terrestris L.	He	IT,M	VU

Ph: phanerophyte, Ch: chamaephyte, G: geophyte, H: hemicryptophyte, T: therophyte, IT: Iran-Turanian, ES: Euro-Siberian, M: Mediterranean, SS: Sahara-Sindian, COSM: Cosmopolitan, End: Endemic.

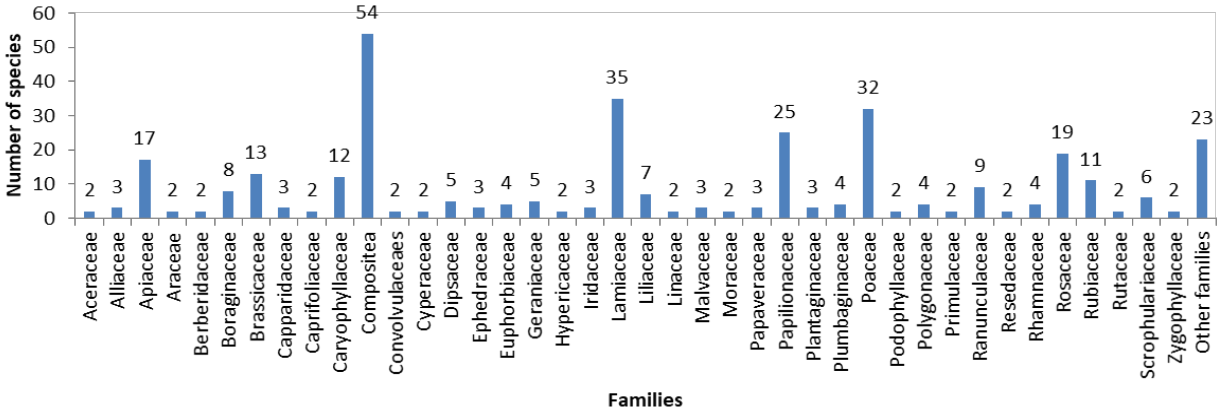

Figure 4) Frequency of various families regarding the number of species in the study region.

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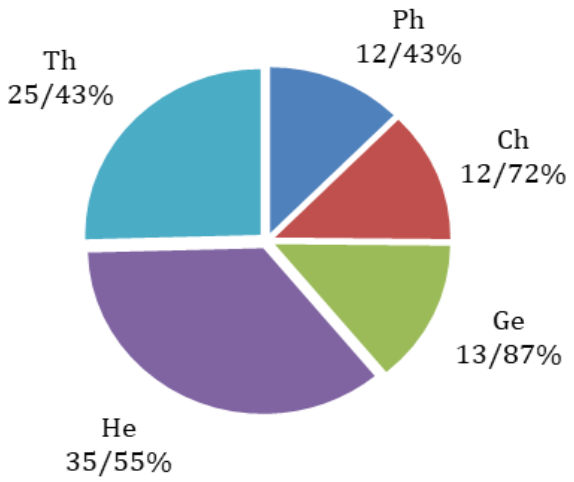

Figure 5) Frequency of life forms of plants in the study region. Ch: chamaephyte, Ge: geophyte, He: hemicryptophyte, Ph: phanerophyte, and Th: therophyte.

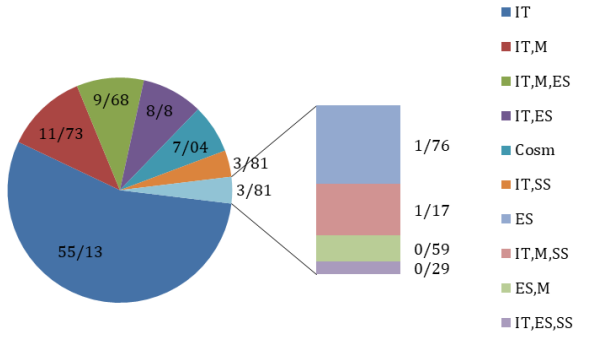

Figure 6) Different Chorotypes of plant species in the study region. IT: Irano-Turanian, ES: Euro-Siberian, M: Mediterranean, SS: Sahara-Sindian, COSM: Cosmopolitan.

Discussion

Plant species in each area are one of the essential ecosystem phenomena and the best advising guide to the biological sciences of that area. According to the current literature, the main factors influencing natural resource vegetation are climatic, topographic, and edaphic conditions [22]. According to our findings, 346 plant species from 63 families and 234 different genera have grown in this region, forming several communities that have adapted to their ecological needs and management over the years. According to our findings, the study region is very diverse in plant diversity. The diversity and richness of species in the area were most likely influenced by the area's wide altitudinal range, climatic, and ecological variations. All data in the current study are presented for the first time in the Akhardagh region. Asteraceae and Lamiaceae had the most species in the studied region, with 54 and 35 species, respectively. The presence of the Asteraceae and Lamiaceae families and a large number of plant species is the result of destruction in this area. Aromatic and poisonous substances, spins, or short life cycles are herb adaptations to livestock grazing [23]. It is known that Asteraceae members possess the high potential to adapt the severe mountainous conditions and scatter the seeds. In addition, the destruction and grazing pastures do not affect this family [9]. Astragalus is a characteristic Irano-Turanian zone element [24]. Astragalus diversity with its six species identified in the survey region, which is mountainous, indicates that Astragalus genera have adapted to mountainous conditions.

The life forms of each region are known to reflect the type of climate, rainfall amounts, and range of dry seasons [25]. Life forms have close relationships with environmental factors [26]. Plantlife forms in this area include hemicryptophytes, therophytes, geophytes, chamaephytes, and phanerophytes. Hernicryptophyte dominates all plants with 35.55 percent, followed by Therophyte with 25.43 percent. Plant species' dominant life forms reflect the climate of the study region. Due to the cold semi-arid climate of the region, hemicryptophytes can survive in the cold season by their buds below and near the soil surface or in dried rosette leaves at the soil surface [1]. They adapted and developed themselves to the region by employing various strategies, including using groundwater, reserving water, reducing their water consumption by releasing their leaves, and decreasing vegetative growth. According to

[DOR: 20.1001.1.23222700.2022.10.2.4.9]

Archibold [27], the frequency of hemicryptophytes in an area indicates via adaptation to cold mountainous climate and grazing. Note that the regional climate is cold semi-arid based on Amberger, and hemicryptophytes herbs have been affected by the climate and are plentiful. Low rainfall and short growing seasons are expected to result in a high ratio of therophytes (88 species). The existence of therophytes can be attributed to destructions that have occurred in this area due to overutilization, which has resulted in destruction and a change in the composition of plant species. Drought in recent years has also played a role in this topic. Therophytes exhibit undesirable ecological conditions, demolition of the region, and human pressures [28]. Several other studies in Khorasan Province have reported a higher abundance of Hemicryptophytes and Therophytes. Jankju et al. [29] studied floristic of Rangelands in the Northern Khorasan Province. Naqinezhad et al. [30] investigated flora of Arzaneh rangeland of Taybad in Khorassan-e Razavi Province. Hemicryptophytes and therophytes were the most abundant plant life form. In dry and cold seasons, geophytes survive with resting sprouts on their underground stems. Chamaephytes are adapted to dry, high radiation, and windswept conditions in high altitudes of the region as cushion-like and thorny growth forms. The lowest plant life form is phanerophytes, with 43 species. Woodlands and Shrublands are formed in mesic valleys composed mainly of *Crataegus turkestanica, Mespilus germanica, Rosa beggeriana, Cotoneaster nummularias, Acer campestre, Lonicera Iberica, Ephedra major, and Berberis integerrima*.

The Chorotype distributions of plants reflect the climate condition. The chorotype evaluation findings indicate the study area as typical Iran-Turanian vegetation since more than half of the species (189 species) are Iran-Turanian elements. The presence of several genera, including *Acantholimon, Acanthophyllum, Achillea, Allium, Anthemis, Astragalus, Cousinia, Centaurea, Onobrychis, Phlomis, Salvia,* and *Stachys* are some elements of this vegetation zone [8, 31]. The Iran-Turanian zone is defined by low precipitation and a long dry season. Also, Because of the adjacency of vegetative Mediterranean and European-Syberian to the Akhardaghe region, part of the plants in this region was similar to Iran-Turanian, Mediterranean, and European-Syberian. The similarity of the Iran-Turanian and Mediterranean is more than Iran-Turanian and European- Syberian in the studied area. Hasanzadeh et al. [9] stated that among all the species recognized in their study area, 57% of species belong to the region of Iran-Turanian chorotype. The finding of this survey is similar to their results, and frequently this is due to zonular similarities such as climate condition and topography and micro-relief [32] that affects vegetation. Hassani et al. [33], in a Study of Physiognomy and Origin of Plant Species in the Sarshiv area of Marivan, Iran, reported that most of the identified species were Iran-Turanian. Jankju et al. [29] also mentioned that many plant species of Winter and Rural Range Plants in the Northern Khorasan Province, Iran, belong to the areas of Iran- Turanian and common regions Iran- Turanian and Mediterranean eruption, were the most important ecological groups.

Iran is one of the original centers of indigenousness globally [34]. A total of 2000 endemic species grow in Iran, while Iran, the -Turanian region, contains 85% of the endemic herb species of the country [35]. The study's findings have shown that about 10.69% of the species are endemic. Human activity is the principal reason for risk for endangered herb species. The growing popularity of traditional medicine, the unlimited harvesting of medicinal herbs,

[DOR: 20.1001.1.23222700.2022.10.2.4.9]

and excessive grazing from the natural ecosystem have put many of these species at risk of over-utilization and destruction in the area. The plant species of the Akhardaghe Watershed were checked with the international IUCN list, and of those, 53 taxa situate in the various stages of the IUCN list. Another endangered species is *Dracocephalum lindbergii*, one of Iran's medicinal species. This species is under increasing pressure in North Khorasan Province due to inopportune and severe usage during the growth and flowering season. The same conditions described for *Thymus transcaspicus* could be mentioned for eight vulnerable species in the area. Bad harvesting management and inadequate farming techniques may lead to the extinction of endangered species or the demolition of wild ecosystems. One of the plans for prevailing this universal difficulty could be cultivating precious pharmaceutical herbs in experimental conditions. A wild nursery is established for species-oriented cultivating and domesticating endangered herbs in a protected region, natural ecosystem, or a place only a short interval from where the herbs naturally grow [36].

Conclusion

The goal of this research is to collect essential floristic data to define the herb species that exist in the region and recognize the potential of the region and the feasibility of developing appropriate management programs to preserve it. The current floristic research discovered that the vascular plant flora in the area is diverse, with many endemic, rare, and medicinal plant species. Life forms of herbs in this region are hemicryptophytes, therophytes, geophytes, chamaephytes, and phanerophytes, respectively. Based on a chorology point of view, there was a high Iran-Turanian elements (55%) ratio in the study region. In addition, 37 species are endemic to Iran. Furthermore, according to the IUCN categories, 53 threatened herb species in this region. However, most plants' species are severely threatened by human overutilization. Therefore, conservation and protection management policies have to be applied to the Akhardaghe Watershed vegetation.

Acknowledgments

We thank and appreciate of Mr. Mohammad Reza Joharchi from Ferdowsi University of Mashhad for help in identifying the plant specimens. We also thank the anonymous reviewers for their constructive comments and useful insights.

Conflict of Interest: The author states that there are no conflicts of interest regarding the publication of this manuscript.

Ethical Permissions: Not declared by the authors.

Funding/Support: This study received no specific grant from any funding agency.

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[DOR: 20.1001.1.23222700.2022.10.2.4.9]