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Floristic composition in Baraki Barak district, Logar Province, Afghanistan

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ABSTRACT

Floristic studies are the first step towards understanding ecological conditions, plant geography, identification of new plant species, destructive factors in natural habitats and conservation of genetic resources. The present study provides an analysis of the floristic composition, life form and chorology of the plant species of Baraki Barak district, located southeast Kabul in Logar province. All plant specimens were collected in summer 2020 and spring 2021. The plant specimens were dried, transferred to the herbarium of the University of Guilan, Rasht, Iran and identified using Identification keys. The results led to the identification of 120 species of angiosperms belonging to 97 genera and 31 families. Asteraceae (23 species), Brassicaceae and Fabaceae (10 species each) were the largest families in the region. The results showed that therophytes with 54 species (45.37%) and hemicryptophytes with 42 species (35.29%) were the most abundant life forms in the region. In terms of geographical distribution, most species belong to pluriregional (27.50 %) and Irano-Turanian elements (18.33 %). In addition, the current results led to the identification of three and 15 new species for Afghanistan and Logar Province, respectively

Keywords: Chorology, Floristic, Life form, Genera, Species.
Article type: Research Article.

INTRODUCTION

Afghanistan is located in the Asian continent between 29°30'-38°30' north latitude and 60°30'-74°50' east longitude (Djoghlaf 2010; Breckle *et al.* 2013). With an area of 652089 km^2 (Shank 2006), Afghanistan is covered by up to 7000 m high snow-capped peaks of the Hindu Kush and other high mountains, deeply eroded valleys, high plateaus, intermountain basins, and vast sediments. It is also a very dry land with sparse rainfall (Volk 1954; Flohn 1969; Breckle 1983; Weiers 1995 1998). However, the south-eastern slopes of the Hindu Kush benefit from the seasonal activities of periodic summer rains. Although, due to its location on the border between different biogeographical regions, Afghanistan has very different ecological conditions. Therefore, a remarkable diversity of vegetation types can be observed in this country (Breckle & Rafiqpoor 2010). Floristic studies are the first step in understanding ecological conditions, plant geography, identification of new plant species, destructive factors in natural habitats and conservation of genetic resources (e.g., Feizi *et al.* 2014; Mirhashemi *et al.* 2021; Abolhasani *et al.* 2021; Moghanloo *et al.* 2023; Aghajani *et al.* 2023; Muratovna *et al.* 2024; Ajamian *et al*. 2024). It is also an essential tool for identifying endemic, resistant and endangered species (Malek-Mohammdi *et al.* 2007; Nadaf *et al.* 2011; Heydari *et al.* 2013). In addition, the floristic composition of each region reflects the response of plant communities to biotic and abiotic parameters, indicating the evolution of plant elements and geographical location in previous periods (Tavakoli & Mozaffarian 2004; Hasanzadeh *et al.* 2017). The history of floristic studies in Afghanistan dates back to the 19th century (Griffith 1847; Honigberger 1852). Since then, especially in the years after second World War, Rechinger and his colleagues published the most comprehensive plant resources of Afghanistan in Flora Iranica (1963-2015). Subsequently, other scientists such as Kitamura (1960), Anders (1970 -1972), Breckle (1967, 1976, 1983, 2007), Breckle & Rafiqpoor (2010), Breckle *et al.*

(1975, 2013, 2022), Freitag (1971 a, b, 1972), Neubauer (1954a, b), Podlech & Andres (1977), Lamond (1966), Grey-Wilson (1974), and Ghahremaninejad *et al.* (2017) are among the most important researchers who have actively studied and collected the flora of Afghanistan. So far, however, no floristic studies have been carried out in the study area. Therefore, it is necessary to conduct such a study in the region in order to provide a floristic list of the area. The main objectives of this study were to determine the floristic composition, the life forms and chorology of the individual taxa and provide a preliminary floristic checklist of the plant species in the entire area.

MATERIALS AND METHODS

Study Area

Logar Province, with an area of about 3,880 km^2, is located in the southeast of Afghanistan, centered at 33° 56′ 21″ N and 68°55′ 24″ E, at an altitude of 1953 m.a.s.l. It borders Kabul to the north, Paktia to the south, Nangarhar to the east and Maidan Wardak and Ghazni provinces to the west (Fig. 1). The surveyed area is located in Barki Barak district, 86 km from Kabul, in an area 8 km long, including five sites: Pol Deh Sheikh River basin, Barki Rajan village (high school), Ghazi castle and Pande Dard desert and Chihal Tan mountain (Fig. 2). There are seasonal variations and monthly rainfall in this area, but most rainfall usually occurs in the spring months (50 mm in March in particular). Summers in this region are hot and sunny, and the hottest month is July with the highest average temperature of 50 °C. Winters are dry, very cold and often cloudless, with the lowest rainfall.

Fig. 1. Map of Baraki Barak district in Logar province, showing its position in Afghanistan.

An average total of 7.65 mm falls in December. The ombrothermal diagram of the Barki Barak area is presented on the basis of the statistical period (https://weatherspark.com/) from 2010-2011 (Fig. 3).

Data Collection

Data collection was carried out in two seasons, summer and spring 2020 and 2021, using a systematic randomized method. The sample collector walked around in random directions and collected each new plant sample. The specimens were then dried and deposited in the herbarium of the University of Guilan. The identification of specimens was based on some references such as Flora of Iran (Assadi *et al.* 1988-2022), Vascular Plants of Afghanistan (Breckle *et al.* 2013), Flora Iranica (Rechinger 1963-2015), Flora of Pakistan (Nasir & Ali 1972-

1994) and Flora of Turkey (Davis 1965-1985). The classification of flowering plants was based on the APGIV (2016) and the name of taxon authors was coordinated with IPNI (2020) and online pages of the Plant List. The conservation category for plant species was also determined based on the International Union for Conservation of Nature (IUCN 2020). The life forms of species were determined depending on the location of the regeneration buds (Raunkiaer 1934). The terminology and delimitation of the main phytogeographical area was according to the Zohary (1973), Takhtajan (1986) and Léonard (1981-1987). To determine the endemic species of Afghanistan, the list of plants studied was compared with the information in Flora Iranica (Rechinger 1963-2015), Vascular Plants of Afghanistan (Breckle *et al.* 2013) as well as Flora and vegetation of Afghanistan (Breckle 2007).

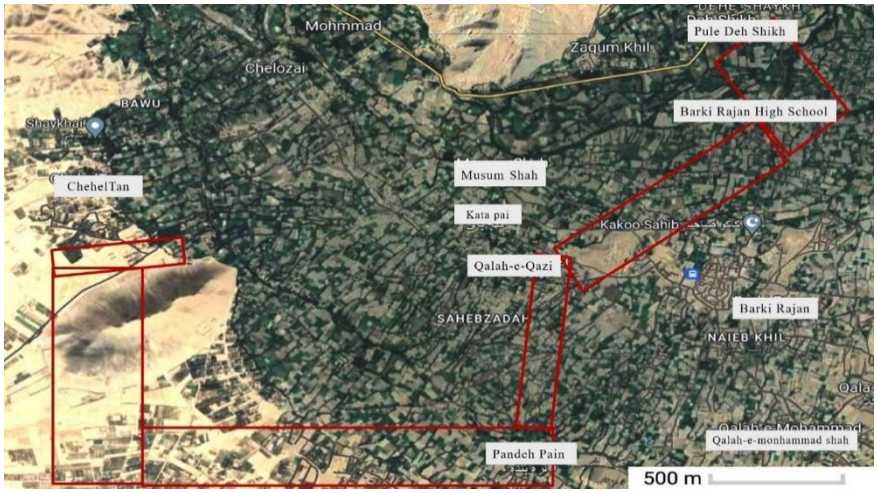

Fig. 2 Map of the study area and the sampling route in the Berki Berk area (includes the area of the river Pule Deh Shikh, the village Barki Rajan, Qalah-e-Qazi, the desert Pandeh Pain and the mountain slope of Chehel Tan. The arrow indicates the collection area. https://earth.google.com/web/).

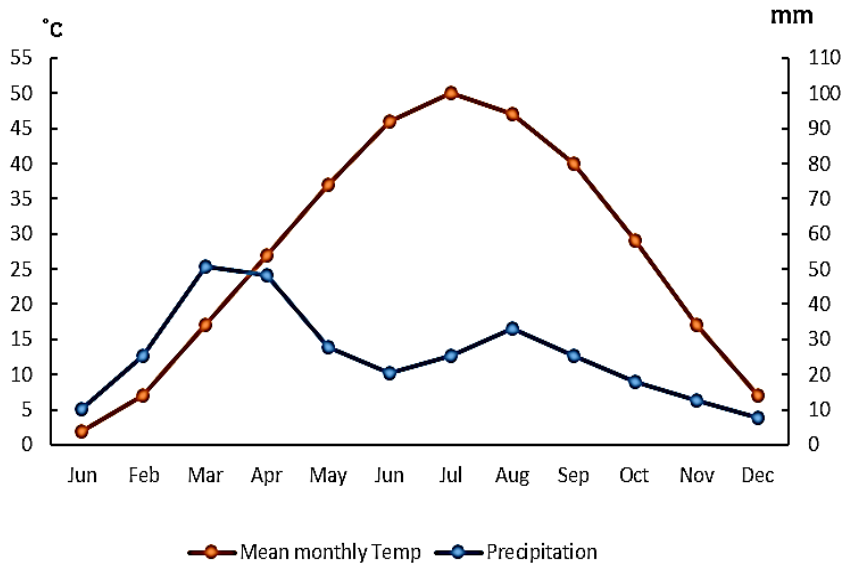

Fig. 3. Climatological diagram in the study area.

RESULTS

Floristic diversity

In the present floristic study, a total of 120 species belonging to 97 genera and 31 families were recorded (Table 1). Angiosperms include the eudicots with 107 species, 87 genera, and 26 families, followed by monocots with 12 species, 10 genera, and five families. The most species-rich families were the Asteraceae (23 taxa), Brassicaceae and Fabaceae (10 each), Boraginaceae (nine taxa), Poaceae and Malvaceae (seven taxa each), Ranunculaceae (five taxa). Three families were represented by four taxa, two families by three taxa, six families

by two taxa and 11 families have only one taxon (Table 2). Seven families, including Asteraceae (20), Brassicaceae (nine), Fabaceae and Boraginaceae (seven), Poaceae (six), Malvaceae (five) and Amaranthaceae (four) contained more than four genera and were the most genera-rich. Five families had three and two genera and the rest (14 families) were unigeneric (Fig. 4). The genera with the highest species richness were *Astragalus*, *Veronica* and *Ranunculus* with three taxa each, *Rosa*, *Euphorbia*, *Allium*, *Malva*, *Lepidium*, *Polygonum*, *Solanum*, *Carthamus*, *Cirsium*, *Conculvulus*, *Achillea* and *Cynoglossum* with two taxa each.

Table 1. Number of species, genera and families identified in Baraki Barak district region arranged based on APG IV (2016).

	Clade	Clade	Clade	Clade	Order	Family	Genus	Species
Clade Angiosperms	**Monocots**	Commelinids			Poales	3	8	9
					Asparagales	2	2	3
	Eudicots				Ranunculales	2	5	7
		Superrosids	Rosids	Fibids	Fabales	1	7	10
					Rosales	3	5	6
					Malpighiales	2	3	4
					Zygophyllales	1	1	1
					Myrtales	1	1	2
				Malvids	Malvales	2	6	8
					Brassicales	1	9	10
					Sapindales	1	1	1
					Caryophyllales	4	9	10
				Campanulids	Asterales	1	20	23
		Superasterids	Asterids		Solanales	2	6	8
				Lamiids	Lamiales	4	7	9
					Boraginales	1	7	9
Total					16	31	97	120

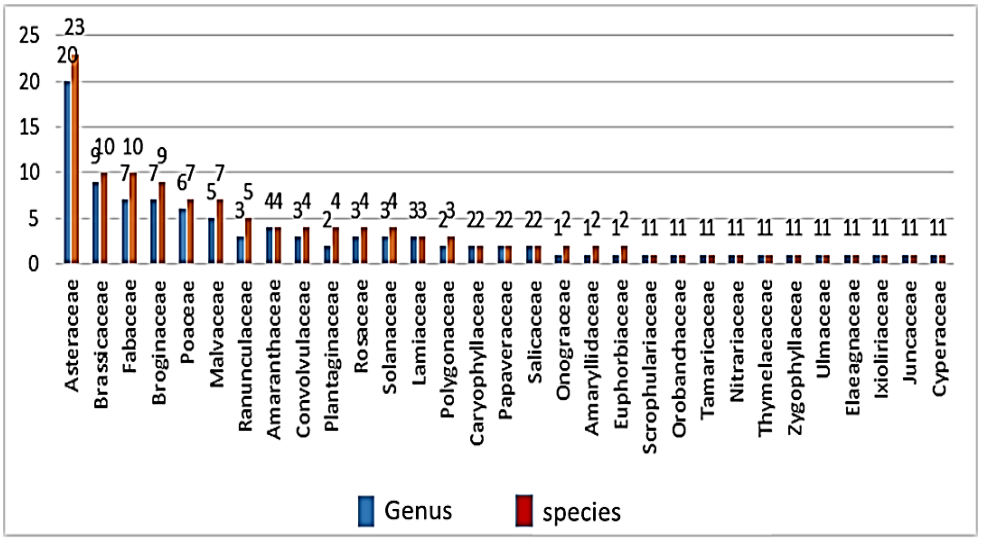

Fig. 4. Families, genera and species in the study area (Horizonal axis, name of families; Vertical axis, the number of genera and species per each family).

Table 2. Checklist of identified plant species in the study area. Asterisk (*) indicates medicinal plants.

No.	Orders/Families/ Species	Life form	Chorology	Habitat	Species common between Flora of Afghanistan and Iran (according to Rechinger 1963-2015)	Species presence in Afghanistan /Logar (according to Rechinger 1963-2015)	Species presence in the Flora of Afghanistan/ Loger (according to Breckle *et al.* 2013)	Accession No
	Poales							
	Cyperaceae							
1	*Carex* sp.	Ge	-	C				8565
	Juncaceae							
2	*Juncus inflexus* L.	Ge	PL	F	+	+/-	+/+	8566
	Poaceae							
3	*Bromus* sp.	Th	-	C				8567
4	*Echinochloa crus- galli* (L.) P. Beauv.	Th	COSM	C	+	+/-	+/+	8568
5	*Eremopyrum bonaepartis* (Spreng.) Nevski	Th	IT-M-SA	D	+	+/-	+/+	8569
6	*Phleum* sp.*	He	-	A				8570
7	*Poa* sp.	Ge	-	C				8571
8	*Poa bulbosa* L.	Ge	PL	C	+	+/-	+/+	8572
9	*Setaria viridis* (L.) P. Beauv.	Th	PL	C	+	+/-	+/+	8573
	Asparagales							
	Amaryllidaceae							
10	*Allium* sp. *	Ge	-	C				8574
11	*Allium* sp. *	Ge	-	C				8575
	Ixioliriaceae			C				
12	*Ixiolirion tataricum* (Pall.) Schult. & Schult.f. *	Ge	IT-SA	C	+	+/-	+/+	8576
	Ranunculales							
	Papaveraceae							
13	*Fumaria vaillantii* Loisel. *	Th	PL	A	+	+/+	+/+	8577

14	*Roemeria sicula* (Guss.) Galasso, Banfi, L.Sáez & Bartolucci	Th	IT-M-SA	A	+	+/-	+/+	8578
	Ranunculaceae							
15	*Adonis aestivalis* L.	Th	IT-ES-M	C	+	+/-	+/+	8579
16	*Ranunculus falcatus* L.	Th	IT-ES-M	D	+	+/+	+/+	8580
17	*Ranunculus* sp.	Th	-	A				8581
18	*Ranunculus* sp.	Th	-	C				8582
19	*Ranunculus arvensis* L.	Th	PL	C	+	+/-	+/+	8583
	Fabales							
	Fabaceae							
20	*Astragalus* sp.	He	-	D				8584
21	*Astragalus* sp.	He	-	D				8585
22	*Astragalus* sp.	He	-	D				8586
23	*Glycyrrhiza aspera* Pall. *	He	IT-EA	D	+	+/+	+/+	8587
24	*Medicago lupulina* L. *	He	PL	A	+	+/-	+/+	8588
25	*Onobrychis* sp.	He	-	D				8589
26	*Sophora alopecuroides* L. *	He	IT-EA	B	+	+/-	+/+	8590
27	*Trifolium fragiferum* L.	He	PL	A	+	+/-	+/+	8591
28	*Trifolium pratense* L.	He	PL	A	+	+/-	+/+	8592
29	*Vicia villosa* Roth.	Th	IT-ES-M	C	+	+/-	+/+	8593
	Rosales							
	Elaeagnaceae							
30	*Elaeagnus angustifolia* L. *	Ph	IT-ES-EA	A	+	+/-	+/+	8594
	Rosaceae							
31	*Prunus spinosissima* (Bge.) Franch.	Ph	IT	G	+	+/-	+/+	8595
32	*Rosa beggeriana* Schrenk ex Fisch. & C. A. Mey. *	Ph	IT-EA	A	+	+/-	+/+	8596
33	*Rosa foetida* Herrm.	He	IT	B	+	+/-	+/+	8597
34	*Sanguisorba minor* subsp. *minor* Scop. *	He	IT-ES-M	A	#	-/-	-/-	8598
	Ulmaceae							
35	*Ulmus minor* Mill.	Ph	IT-ES-M	A	-	-/-	+/-	8599
	Malpighiales							

	Euphorbiaceae							
36	*Euphorbia* sp. *	Th	-	A				8600
37	*Euphorbia* sp. *	Th	-	D				8601
	Salicaceae							
38	*Populus macrocarpa* (Schrenk) Pavlov & Lipsch.	Ph	IT	A	-	+/-	+/+	8602
39	*Salix excelsa* S. G. Gmel. *	Ph	IT	A	+	+/-	+/+	8603
	Zygophyllales							
	Zygophyllaceae							
40	*Zygophyllum fabago* L. *	He	IT	B	+	+/-	+/+	8604
	Myrtales							
	Onograceae							
41	*Epilobium minutiflorum* Hausskn.	Ge	IT	A	+	+/-	+/+	8605
42	*Epilobium parviflorum* Schreb.	He	PL	A	+	+/-	+/-	8606
	Malvales							
	Malvaceae							
43	*Abutilon theophrasti* Medik.	Ge	IT-EA	C	+	+/-	+/+	8607
44	*Alcea rhyticarpa* (Trautv.) Iljin*	He	IT	C	+	+/-	+/+	8608
45	*Alcea* sp. *	He	-	C				8609
46	*Althaea armeniaca* Ten. *	He	IT	C	+	+/-	+/+	8610
47	*Hibiscus trionum* L. *	Th	IT-ES-M	C	+	+/-	+/+	8611
48	*Malva neglecta* Wallr. *	He	PL	C	+	+/-	+/+	8612
49	*Malva sylvestris* L. *	Th	IT-ES-M	C	+	+/-	+/+	8613
	Thymelaeaceae,							
50	*Diarthron vesiculosum* (Fischer & C. A. Mey.) C. A. Mey.	Th	IT	C	+	+/+	+/+	8614
	Brassicales							
	Brassicaceae							
51	*Brassica juncea* (L.) Czern.	Th	IT	C	-	+/-	+/+	8615
52	*Capsella bursa-pastoris* (L.) Medik. *	Th	COSM	C	+	+/-	+/+	8616
53	*Descurainia sophia* (L.) Webb & Prantl*	Th	COSM	A	+	+/-	+/+	8617
54	*Euclidium syriacum* (L.) R. Br.	Th	IT-SS	C	+	+/-	+/+	8618
55	*Goldbachia laevigata* (M. Bieb.) DC.	Th	IT-ES	C	+	+/+	+/+	8619

56	*Lepidium draba* L. *	He	PL	B	+	+/-	+/+	8620
57	*Lepidium latifolium* L.	He	PL	B	+	+/+	+/+	8621
58	*Litwinowia tenuissima* (Pall.) Woronow ex Pavlov	Th	IT	C	+	+/-	+/+	8622
59	*Streptoloma desertorum* Bunge	Th	IT	D	+	+/-	+/-	8624
60	*Strigosella africana* (L.) Botsch. *	Th	PL	B	+	+/-	+/+	8623
	Sapindales							
	Nitrariaceae							
61	*Peganum harmala* L. *	He	PL	D	+	+/+	+/+	7625
	Caryophyllales							
	Amaranthaceae							
62	*Amaranthus retroflexus* L. *	Th	COSM	C	+	+/-	+/-	8626
63	*Bassia scoparia* (L.) A.J.Scott	Th	COSM	C	+	+/-	+/+	8627
64	*Ceratocarpus arenarius* L.	Th	IT-ES	C	+	+/+	+/+	8628
65	*Chenopodium album* L.	Th	COSM	C	+	+/+	+/+	8629
	Caryophyllaceae							
66	*Herniaria hirsuta* L.	Th	PL	D	+	+/-	+/-	8630
67	*Lepyrodiclis holosteoides* (C. A. Mey.) Fenzl. ex Fisch. & C. A. Mey.	Ge	IT-EA	C	+	+/-	+/+	8631
	Polygonaceae						+/+	
68	*Persicaria hydropiper* (L.) Delarbre	Th	PL	A	+	+/-	+/+	8632
69	*Polygonum arenastrum* Boreau	He	PL	E	+	+/-	+/+	8633
70	*Polygonum* sp.	He	-	D				8634
	Tamaricaceae							
71	*Tamarix ramosissima* Ledeb.	Ph	IT-SS-EA	F	+	+/-	+/+	8635
	Asterales							
	Asteraceae							
72	*Achillea millefolium* L. *	He	COSM	B	+	+/-	+/-	8636
73	*Achillea wilhelmsii* K. Koch *	He	IT-SS	B	+	+/-	+/+	8637
74	*Bidens tripartita* L.	Th	PL	A	+	+/-	+/+	8638
75	*Carthamus tinctorius* L. var. *inermis* Schweinf*	Th	IT	C	+	+/-	+/+	8639
76	*Carthamus tinctorius* var. *tinctorius* L. *	Th	IT	C	+	+/-	+/+	8640

77	*Centaurea iberica* Trevir. ex Spreng.	He	IT-ES-M	C	+	+/+	+/+	8641
78	*Cirsium arvense* var. *incanum* (S. G. Gmel.) Ledeb.	Ge	PL	C	+	+/-	+/+	8642
79	*Cirsium vulgare* (Savi) Ten.	He	PL	A	+	+/-	+/+	8643
80	*Cousinia* sp.	He	-				+/+	8644
81	*Centaurea depressa* M.Bieb.	Th	IT	C	+	+/+	+/+	8645
82	*Erigeron bonariensis* L.	Th	Introduced	C	+	+/-	+/+	8646
83	*Hertia intermedia* (Boiss.) Kuntze	Th	IT-SS	G	+	+/+	+/+	8647
84	*Aster altaicus* Willd.	He	PL	C	+	+/+	+/+	8648
85	*Koelpinia linearis* Pall.	Th	IT-SS-M	D	+	+/+	+/+	8649
86	*Lactuca glauciifolia* Boiss.	He	IT-SS	C	+	+/-	+/+	8650
87	*Rhaponticum repens* (L.) Hidalgo	He	IT	B	+	+/+	+/+	8651
88	*Scorzonera laciniata* Jacq.	Ge	IT-ES-M	C	+	+/-	+/+	8652
89	*Senecio vulgaris* L.	Th	PL	C	+	+/-	+/+	8653
90	*Tanacetum parthenium* (L.) Sch.Bip.	He	IT-ES-M	F	+	+/-	+/+	8654
91	*Taraxacum* sp.	He	-	C	-	-/-	+/+	8655
92	*Tragopogon porrifolius* L.	He	ES-M	C	#	-/-	-/-	8656
93	*Tripleurospermum disciforme* (C.A.Mey.) Sch.Bip. *	He	IT	C	+	+/-	+/+	8657
94	*Xanthium strumarium* L.	Th	PL	C	+	+/-	+/+	8658
	Solanales							
	Convolvulaceae							
95	*Convolvulus arvensis* L. *	He	PL	B	+	+/-	+/+	8659
96	*Convolvulus lineatus* L.	He	IT-M	B	+	+/-	+/+	660
97	*Cuscuta campestris* Yunck.	P	COSM	C	-	+/-	+/+	8661
98	*Ipomoea eriocarpa* R. Br.	Th	PL	E	#	-/-	+/+	8662
	Solanaceae							
99	*Datura stramonium* L. *	Th	COSM	C	+	+/+	+/+	8663
100	*Hyoscyamus squarrosus* Griff.	Ge	IT	B	+	+/-	+/+	8664
101	*Solanum nigrum* var. *villosum* L. *	Th	COSM	C	+	+/-	+/-	8665
102	*Solanum dulcamara* L.	He	PL	E	+	+/-	+/-	8666
	Lamiales							

	Lamiaceae							
103	*Lycopus europaeus* L.	Ge	PL	A	+	+/-	+/+	8667
104	*Mentha longifolia* var. *petiolata* Boiss. *	Ge	IT	A	-	-/-	-/-	8668
105	*Nepeta cataria* L.	Th	PL	A	+	+/-	+/+	8669
	Orobanchaceae							
106	*Orobanche aegyptiaca* Pers.	P	PL	C	+	+/-	-/-	8670
	Plantaginaceae			C				
107	*Plantago lanceolata* L. *	He	COSM	C	+	+/+	+/+	8671
108	*Veronica anagallis-aquatica* L.	Th	PL	A	+	+/-	+/+	8672
109	*Veronica campylopoda* Boiss.	Th	IT-ES	C	+	+/+	+/+	8673
110	*Veronica polita* Fr.	Th	PL	C	+	+/+	+/-	8674
	Scrophulariaceae							
111	*Verbascum blattaria* L.	He	IT-ES-M	A	+	+/-	+/+	8675
	Boraginales							
	Broginaceae							
112	*Anchusa arvensis* (L.)M. Bieb.	Th	PL	C	#	-/-	-/-	8676
113	*Arnebia guttata* subsp. *griffithii* (Boiss.) Sadat*	He	IT		-	+/-	+/+	8677
114	*Asperugo procumbens* L.	Th	PL	B	+	+/-	+/+	8678
115	*Cynoglossum microglochin* Benth.	He	IT	B	-	+/-	+/-	8679
116	*Cynoglossum zeylanicum* Sw. ex Lehm.) Thunb. ex Brand	Th	IT-EA	A	-	+/-	+/+	8680
117	*Lappula barbata* (M.Bieb.) Gurke	Th	IT-M	C	+	+/-	+/+	8681
118	*Lappula marginata (*M.Bieb.) Gurke	Th	IT	C	+	+/-	+/-	8682
119	*Nonea caspica* (Willd.) G. Don	Th	IT-ES	B	+	+/-	+/+	8683
120	*Paracaryum* sp.	He	-	A				8684

Abbreviations and symbols used: -: Absent; +: present; #, absent in Iran and Afghanistan; Habitat types: A. Near water canal; B. Ruderal; C. Near farms; D. Desert; E. Road side; F. Riverside; G. Mountain slope; IT= Irano-Turanian; ES= Euro-Siberian; COSM= Cosmopolitan; PL= Pluriregional; M= Mediterranean; SS= Sahara –Sindian; SA= Sahara-Arabian; EA= East Asian; He= Hemicryptophyte; Ph= Phanerophyte; Th= Therophytes; Ge= Geophyte; P= Parasite.

Life Form spectrum

Therophytes (53 species, 44.17%) were the predominant life form, followed by hemicryptophytes (43 species, 35.83%), geophytes (15 species, 12.5%), phanerophytes (seven species, 5.83%) and parasitic (two species, 1.7%) (Fig. 5). Most of the identified therophytes belong to the Asteraceae (nine species), followed by Brassicaceae (eight species), Boraginaceae (six species), Ranunculaceae (five species), Amaranthaceae and Poaceae (four species each), Plantaginaceae (three species), Papaveraceae and Solanaceae (two species each), Thymelaeaceae, Polygonaceae and Fabaceae (one species each).

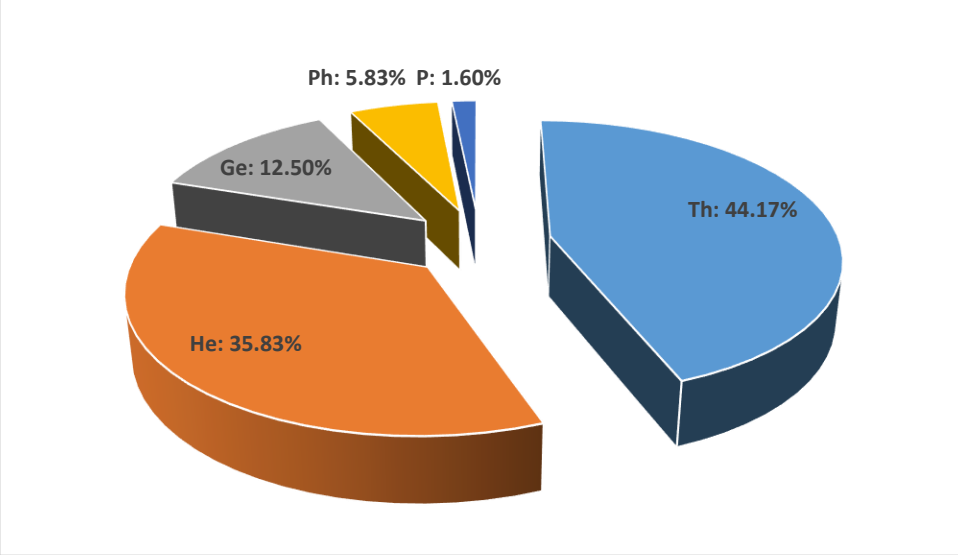

Fig. 5. Life form spectrum of plants studied in the study area; Abbreviations used: He= Hemicryptophyte, Ph= Phanerophytes, Th= Therophytes, Ge: = Geophyte, P = Parasite.

ChorologyIn terms of geographical distribution, the flora of the studied area consists mainly of pluriregional (PL, 33 taxa) and Irano-Turanian (IT, 22 taxa) elements. In addition, 19 taxa (15.38%) were categorized as unknown since it was not possible to determine their name at species level. Details of the phytochorions are shown in Fig. 6.

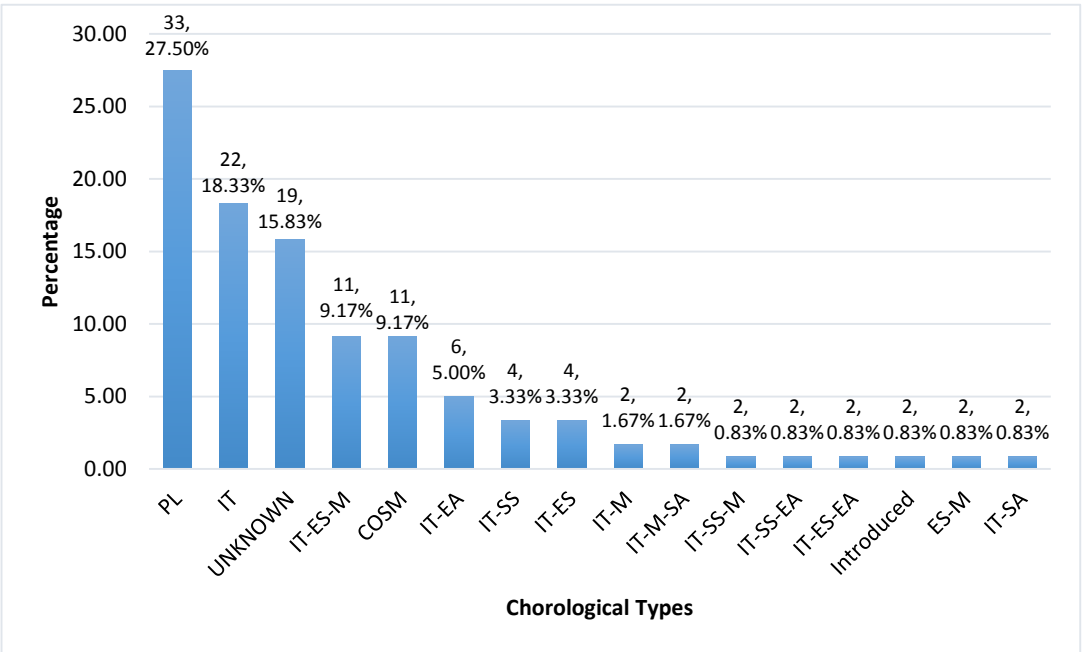

Fig. 6. Proportion of the different chorotypic elements of the plants in the study area. Abbreviations: IT=Irano-Turanian; ES=, European-Siberian; COSM= Cosmopolitan; PL=Pluriregional; M= Mediterranean; SS=, Sahara-Sindian; SA=, Sahara-Arabian; EA= East Asian.

Table 3. Comparison of the statistical data of the species identified in this study with previous references

Number of species	Description
87	Common species between our study from Logar province and other regions of Afghanistan (based on Breckle *et al.* 2013).
86	Common species between Afghanistan and Iran based on Flora Iranica (Rechinger, 1963-2015).
73	Species not reported from Logar Province, based on Flora Iranica (Rechinger, 1963-2015)
20	Species reported from Logar province, based on Flora Iranica (Rechinger, 1963-2015): *Fumaria vaillantii, Ceratocephala falcata, Glycyrrhiza aspera, Diarthron vesiculosum, Goldbachia laevigata, Lepidium latifolium, Peganum harmala, Ceratocarpus arenarius, Chenopodium album, Centaurea iberica, Cyanus depressus, Hertia intermedia, Heteropappus altaicus, Koelpinia linearis, Rhaponticum repens, Datura stramonium, Plantago lanceolata, Veronica campylopoda, V.polita, Nonnea capsica*
8	Species not reported from Afghanistan, based on Flora Iranica (Rechinger, 1963-2015): *Sanguisorba minor* subsp. *minor, Ulmus minor, Taraxacum campylodes, Tragopogon porrifolius, Ipomoea eriocarpa, Solanum dulcamara, Mentha longifolia* var. *petiolata, Anchusa arvensis*
8	Species not common between Afghanistan and Iran, based on Flora Iranica. (Rechinger, 1963-2015): *Ulmus minor, Populus pamirica, Brassica juncea, Cuscuta campestris, Mentha longifolia* var. *petiolata, Arnebia guttata* subsp. *griffithii, Cynoglossum microglochin* var. *nervosum, C . zeylanicum*
6	Species not reported from Afghanistan and Iran, based on Flora Iranica. (Rechinger, 1963-2015): *Sanguisorba minor* subsp. *minor, Taraxacum campylodes, Tragopogon porrifolius Ipomoea eriocarpa, Solanum dulcamara, Anchusa arvensis*
15	New records for flora of Logar province: *Sanguisorba minor* subsp. *minor, Ulmus minor, Epilobium parviflorum, Streptoloma desertorum, Amaranthus retroflexus, Herniaria hirsuta, Achillea millefolium, Solanum dulcamara, S..nigrum* var. *villosum, Mentha longifolia* var. *petiolata, Veronica polita, Cynoglossum microglochin* var. *nervosum, Lappula marginata, Anchusa arvensis, Orobanche aegyptiaca*
3	New records for Afghanistan based on our study: *Anchusa arvensis, Mentha longifolia* var. *petiolata, Tragopogon porrifolius*

DISCUSSION

The largest families in the study area were Asteraceae, Fabaceae, Brassicaceae, Boraginaceae and Poaceae. They are also among the most important families in terms of the number of genera and species in the flora of Afghanistan and Iran (Ghahremaninejad *et al.* 2017; Barkle *et al.* 2022). In Afghanistan, Asteraceae and Fabaceae are the most species-rich families with 730 and 650 species respectively. Fabaceae and Asteraceae are also the richest families in the flora of Iran, with 1400 and 1235 species respectively (Ghahremaninejad *et al.* 2017). *Astragalus*, *Veronica* and *Ranunculus* (with three species each) were also the most species-rich genera in the region. *Astragalus* is the most species-rich genus in both countries, with about 830 and 320 species for Iran and Afghanistan, respectively (Rechinger, 1963-2015). The study of the life form of the plant species in the region shows that therophytes and hemicryptophytes are dominant. A likely explanation is that Baraki Barak has a long warm season (about 7 months, from April to October) followed by cold and dry winters, which means a long dry season and a short growing season, despite the scattered monthly rainfall (Archibold 1995; Naqinezhad *et al.* 2010; Azimi Motem *et al.* 2012). This has led to the proliferation of short-lived and drought-resistant therophytes species, most of which flower in late winter to early spring (Williams 2007), such as *C. arenarius* (Wagnitz, 1975; Dostal 1976; Czerepanov 2001) and *S. desertorum*. Other drought-tolerant species, such as *C. tinctorius* (Wagnitz 1975; Dostal 1976; Czerepanov 2001), and species adapted to saline irrigation e.g. *C. depressus* (Shu 2006) and *B. scoparia* (Salehi *et al.* 2009) have also been recorded in the region. In contrast, some therophytes depends on the seasonal water source and human interventions that promote the growth of annual plants (Archibold 1995: Naqinezhad *et al.* 2010; Azimi Motem *et al*. 2012). Indeed, fluctuations between drought and humidity seem to have large effect

on the vegetation development (Aponte *et al*. 2010). This includes *X. strumarium, B. tripartita, A. retroflexus, S. viridis, E. crus-galli, Bromus* sp., *A. aestivalis, F. vaillantii, R. arvensis* and *B. juncea*, in addition to hygroscopic weed that grow in shady, moist places near rivers and temporary ponds e.g. *Veronica anagallis-aquatica* and *P. hydropiper*. Furthermore, *M. africana, D. stramonium* and *C. bursa-pastoris* are among therophytes, often referred as ruderal plants found near fields, wastelands, roadsides, and desert areas. In this study, two parasitic species *O. aegyptiaca* and *C. campestris* were identified in the region. The first species is a parasite of cultivated and wild plants belonging to various families of flowering plants (except monocotyledons), usually growing on roadside and degraded areas. Its centre of distribution includes southern Russia, eastern Caucasus, northern Aral-Caspian and Baltic regions, eastern Mediterranean, Asia Minor, Armenia, Kurdistan, Iran, India and the Himalayas (Nopokrovsky & Tzolov 1958). While the second species, is one of the most destructive parasitic species worldwide for the production of dicot crops. It lacks photosynthetic activity and is an obligate stem parasite of other plants (Córdoba *et al*. 2021). Hemicryptophyte plants are the second most important species in the region with 42 species (Table 2). Most of the hemicryptophyte species (12 species) belong to the Asteraceae. Fabaceae (four species), Malvaceae (three species) and Ranunculaceae (two species) are the next families with a high proportion of hemicryptophilous plants. The frequency of this life form in Asteraceae species (such as *A. millefolium, A. santolinoides* subsp. *wilhelmsii, Cousinia* sp. and *R. repens, T. parthenium*) is due to their high adaptability to arid and semi-arid climatic conditions (Asri 2003). Geophytes are the third largest group in the area studied. In Raunkiaer's system (1934), geophytes, hydrophytes (aquatic plants) and helophytes (marsh plants) are part of a larger group called cryptophytes. However, some prefer the term geophyte ("ground plant") to cryptophyte ("hidden plant"), as not all geophytes can be dormant or "hidden" underground despite their underground regrowing buds. Many of them survive in times of environmental stress, such as summer or winter drought, as underground reserve organs (Galil 1981; Pütz & Sukkau 2002; Procheş *et al.* 2006; Tribble *et al*. 2021), such as bulbs (e.g. *P. bulbosa, I. tataricum*), root and stem tubers (e.g. *S. laciniata*) and rhizomes (e.g. *L. europaeus, M. longifolia*; Raunkiaer 1934). Seven phanerophyte species were identified in the study area. These plants are frequently planted, especially near water sources or along roadsides and in cities (e.g. *E. angustifolia, P. spinosissima, P. pamirica, S. excelsa, U. minor, R. beggeriana*; Juzepczuk 1941; Hall & Heybroek 1997; Caudullo & De Rigo 2016). However, *T. ramosissima* grows in arid and semi-arid habitats (with very low rainfall), with a wide range of soil salinity (Terrones *et al.* 2016), near groundwater or saline water (Akhani 2006). In terms of phytogeography, pluriregional (27.50 %) and Iranian-Turanian (18.33 %) elements had the highest proportion in the region. The high proportion of Iranian-Turanian elements reflects adaptation to the low rainfall and long dry season that prevail in the region (Asri 2003). In the case of the pluriregional elements, this may be related to the presence of different ecological and biological conditions (e.g. access to water reservoirs, diversity of climate, microclimates and habitats) for growth in the study area (Hamzeh *et al*. 2010). Of the 120 species identified, 87 species were described in the Flora of Afghanistan (Breckle *et al.* 2013). In addition, 20 species from Logar Province were listed in the Flora Irainca (Rechinger 1963-2015). Furthermore, 86 species were common between flora of Afghanistan (Breckle *et al.* 2013) and Iran (Rechinger 1963-2015). On the other hand, 73 species from Logar Province were not reported in Flora Iranica and eight species were mentioned in the flora of Afghanistan.

In this study three new records (including *M. longifolia* var. *petiolata*, *A. arvensis* and *T. porrifolius*) were identified for Afghanistan and 15 new records (including *E. parviflorum, U. minor, S. desertorum, Amaranthus retroflexus, H. hirsuta, A. millefolium, V. polita, V. polita, C. microglochin* var. *nervosum, L. marginata*, *S. minor* subsp. *minor, S. dulcamara, M. longifolia* var. *petiolata, A. arvensis* and *T. porrifolius*) were reported for the flora of Logar Province (Table 3). In addition, *P. pamirica* and *R. beggeriana* are among the relict species under protection in Afghanistan, which are sometimes planted as ornamentals in some places (Olonova *et al*. 2020). Based on the previous reports, Logar Province has about 425 species, which is about one third of Kabul Province (1425 species, the highest number of species in Afghanistan; Breckle *et al.* 2022). However, it is expected that further studies in Logar Province will lead to an elevation in the number of species. Despite the small area of this region compared to the entire Logar Province, a considerable number of species (36 % of the total species reported from this province) were identified. Some of the identified species exhibit medicinal properties (Dupree 1990; Amini & Hamdam 2017; Buso *et al.* 2020). No endemic species were reported from this region. On the contrary, a large number of species affected by human activities were found in the study area (57 species near fields, 25 species near irrigation canals and 15 ruderal species). A possible reason for this could be that this area is close to the Pande Dard desert, meaning a long dry period during the growing season and an urgent need for water for the

plants, which is provided by human activities. As a result, these activities lead to a change in vegetation and the decline or extinction of local and indigenous species in the region (Archibold 1995; Vakili Shahrbabki *et al.* 2001; Dolat Choi *et al*. 2012). The second reason could be that land abandonment, overgrazing and destruction of vegetation for firewood, excessive removal and uprooting of some plant species, lead to desertification and a serious threat to Afghanistan's indigenous species (Saba 2001).

CONCLUSION

The current study is one the few works conducted on the flora of Afghanistan and the only floristic study conducted on the flora of Logar Province. Unfortunately, due to the problems caused by decades of war in Afghanistan, there was no suitable opportunity to conduct such studies in the country. Due to the great importance of plant diversity in each region, identifying and assessing the situation of species in each region from an extinction perspective is an important step in implementing appropriate measures to conserve valuable species in each region. The results of the current study reveal that the predominant vegetation in the area ranges from humid to semi-humid and desert habitats. The vegetation of the region is strongly influenced by human activities. Therefore, several ruderal species were found in the study area. It is suggested to plan and conduct further floristic studies in different regions of Afghanistan to get more update information about the genetic treasure of plants in this country. In order to conserve local and endemic species, appropriate measures should be taken to protect natural resources and their management.

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