FLORISTIC SURVEY, PLANT LIFE CHOROLOGY, AND LIFE FORMS IN THE SHAQRA REGION, SAUDI ARABIA

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Abstract. This study presents the first comprehensive assessment of floral composition, geographic distribution, ecological forms, and plant diversity in three specific regions of the Shaqra area in Saudi Arabia: Rawdah Ghislah, Al-Garaa Protectorate, and Rawdah Al-Qsour. The study identified 80 taxa from 66 genera and 24 families within Angiospermae. Asteraceae was the dominant family with 13 species, followed by Brassicaceae (11 species), Amaranthaceae (8 species), Fabaceae and Poaceae (6 species each), Zygophyllaceae (5 species), and Plantaginaceae, Caryophyllaceae, and Aizoaceae (3 species each). Chamaephytes had the greatest percentage of species (43%), followed by Therophytes (40%), Hemicryptophytes (11%), Geophytes (4%), with Phanerophytes being the least common life form type (3%). Chorological analysis revealed the dominance of the Bi-regional chorotype (45%), with Mono-regional, Pluri-regional, and Worldwide categories contributing 36.3%, 15%, and 3.8%, respectively. The majority of the recorded taxa, specifically 43 species, are annuals, whilst 37 species were identified as perennials. The study found 29 species with a low occurrence rate, seven of which are classified as Least Concern (LC) by the IUCN. This study provides insights to guide the management and conservation of the examined geographical areas.
Keywords: *floristic composition, flora, chorology, Rawdah Ghislah, Al-Garaa Protectorate, Rawdah Al-Qsour, Saudi Arabia*

Introduction

Understanding the plant range in a given area is essential for economic purposes, and floristic studies play a key role in this endeavor. Shehata and Galal (2015) noted that the local flora provides a variety of services, including housing, food, and medicine, to the local population. Floristic composition reflects the diversity of plant species in a given area. It offers essential botanical data and forms the basis for detailed site-specific studies (Keith, 1988; Rafay et al., 2013).

Saudi Arabia boasts a highly diverse floral ecology in the Arabian Peninsula, which includes valuable genetic resources of crop and medicinal plants (Collenette, 1999). Approximately 80% of the Arabian Peninsula's area, Saudi Arabia spans latitude 16º 83` N - 32º 43` N and longitude 34º 36` E - 56º E. With an estimated size of 2.2 million km^2 (Almazroui et al., 2012), and is a major source of biodiversity with about 2220 species, 816 genera and 129 families (Collenette, 1999; Chaudhary, 2001).

The most comprehensive treatments of the country's flora are found in Chaudhary and Al-Jowaid (1999) and Chaudhary (1999). In addition to the illustrations of flowers of Saudi Arabia that were published by Collenette (1999), several studies have been carried out on the native plant species that can be found in particular regions of the country. For instance, Al-Sobeai (2024) carried out a carried out a comprehensive floristic survey of the Al-Fawzan Reserve, located in central Saudi Arabia. Al-Eisawi and Al-Ruzayza (2015) focused their research on the Mecca district, while El-Ghanim et al. (2010) studied the floristic composition of the Hail region. Al-Harbi (2023) investigated the plant diversity of Al-Qassim region, and Aljedaani and Fakhry (2023) examined the Jeddah

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region. Collectively, these studies provide a broad understanding of the ecological and botanical diversity across various regions of Saudi Arabia.

Given the large area of Saudi Arabia and the recent changes in climate, particularly the increased rainfall in the previous three years, a comprehensive survey of its plant life has not been conducted. Consequently, further research is necessary to gather complete information on the country's flora and address any missing data. The main aim of this study was to evaluate, for the first time, the geographical distribution, composition of plant species, and diversity of wild plants in three specific locations (Rawdah Ghislah, Al-Garaa Protectorate, and Rawdah Al-Qsour) in the Shaqra region of Saudi Arabia.

Materials and methods

The current study was conducted at three locations in the Alqaraen region: Rawdah Ghislah, Rawdah Al-Qsour, and Al-Garaa Protectorate. These locations were found to the east of the Saudi Arabian governorate of Shaqra. Shaqra is situated approximately 190 kilometers to the north-west of Riyadh, the capital. Strategically situated at the intersection of longitude 15 and 45 east and latitude 15 and 25 north, it occupies an intermediate position within the Kingdom of Saudi Arabia, whose territory extends from latitude 32 to the north and from latitude 16 to the south. Rawdah Ghislah lies at 25° 15' 40.356 N, 45° 20' 6.863 E, Al-Garaa Protectorate lies at 25° 12' 38.196 N, 45° 16' 47.928 E, and Rawdah Al-Qsour lies at 25° 15' 57.456 N, 45° 19' 39.539 E (*Fig. 1*).

The climate of the Shaqra region is characterized by summers that are hot and dry followed by winters that are pleasant to chilly. The statistics from the climate change knowledge portal (CCKP, 2024) indicates that the mean monthly maximum and minimum temperatures, which vary across the research region, range from 22 degrees Celsius for the month of March to 35 degrees Celsius for the month of July (*Table 1*). Furthermore, the highest temperature ever recorded was 43 degrees Celsius in the months of July and August for the period of 2013-2022. Temperatures of 8.51 degrees Celsius and 10.4 degrees Celsius were recorded as the lowest monthly averages during the colder months of January and December, respectively. The month of March had the highest mean monthly rainfall of 29.77 millimeters for a period of ten years (2013–2022), while the month of September had the lowest mean monthly rainfall of 0.38 millimeters.

A quantitative survey of vegetation distribution was conducted in the Shaqra region from early March 2021 to mid-May 2022. This period encompasses the region's various growing and flowering seasons. The study involved a random selection of fifteen distinct locations, with survey visits carried out monthly throughout the entire period.

The researchers used a stratified random sample technique (Ludwig and Reynolds, 1988). Each site was investigated using three randomly selected 15 × 15 m^2 quadrates. During the vegetation sample process, all plant species were documented at the sampling sites, along with the relevant field data that was observed.

The classification scheme suggested by Raunkiaer (1934) was applied to the life form spectra of the examined species. The chorotypes of the phytogeographical categories were analyzed in accordance with the methods described by White and Léonard (1991), Al-Nafie (2008), and Zohary (1973). The identification of plant species was conducted based on the works of Chaudhary (1999, 2000), Collenette (1999), Migahid (1988), and Boulos (1999). The nomenclature of the recognized taxa was revised and updated using resources such as the Global Biodiversity Information Facility (GBIF, 2023) and the Plants of the World Online (POWO, 2023). Additionally, the Taxonomic Name Resolution Service

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(TNRS) was utilized in order to check for any spelling errors that may have occurred (Boyle et al., 2023). The assessment of species rarity and the likelihood of extinction were updated using data from the International Union for Conservation of Nature (IUCN) in 2023.

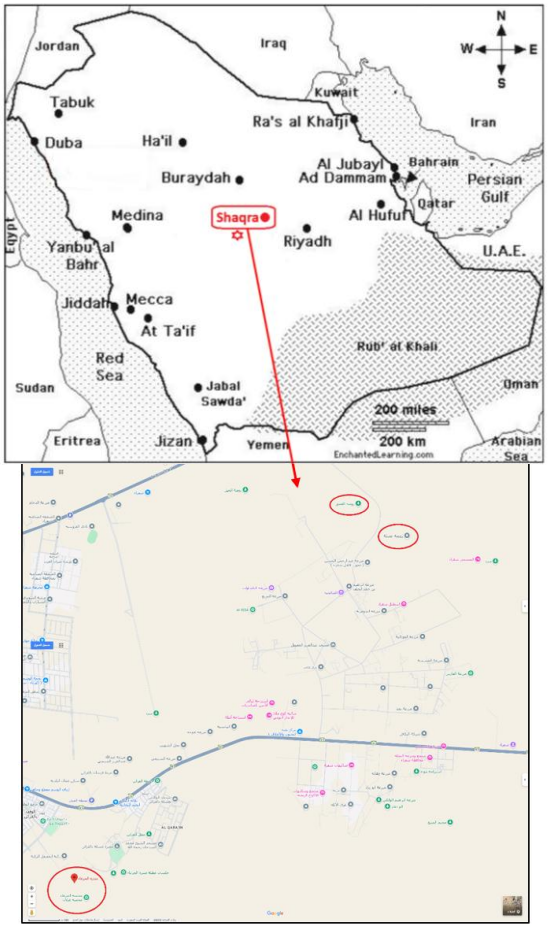

Figure 1. *Map of Saudi Arabia kingdom showing the study area's location. The red star refers to Shaqra region, the red circles refer to the study areas*

Table 1. *Monthly mean, minimum and maximum temperature, and participation (average for 10 years, 2013 - 2022)*

Month	Maximum temperature	Minimum temperature	Average temperature	Average rainfall (mm)
January	21.8	8.51	15.12	17.31
February	25.3	11.11	18.5	7.37
March	29.19	15.17	22.16	29.77
April	34.35	20.2	27.16	27.49
May	39.91	24.78	32.32	13.18
June	42.47	26.41	34.41	0.58
July	43.53	27.92	35.71	0.69
August	43.37	27.84	35.58	1.24
September	40.59	24.36	32.45	0.38
October	35.5	18.94	26.97	2.5
November	28.57	14.4	21.28	8.8
December	23.45	10.4	16.72	10.51

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A list that was offered by the International Union for Conservation of Nature and Natural Resources (IUCN, 2023) was utilized in order to verify the plants that were recognized in the current study. For the purpose of identifying taxa that are in grave danger of extinction on a global basis, the IUCN has developed a method that is simple to comprehend and is known as the Red List. In the IUCN Red List, species are classified into nine categories according to the growing risk of extinction. These categories are as follows: (NE) not evaluated, (DD) data deficient, (LC) least concerned, (NT) near threatened, (VU) vulnerable, (EN) endangered, (CR) critically endangered, (EW) extinct in the wild, and (EX) extinct.

Results

Eighty plant species in all were recorded from the research areas; these were categorized by our fieldwork into 66 genera and 24 families (*Table 2, Fig. 2*). About 95.8% (23 families) of the families were dicotyledonous, and as *Fig. 3* illustrates, 4.2% (one family) were monocotyledonous. Six species are members of the Monocotyledonous family, Poaceae (*Fig. 4*).

Based on the findings of the current study, it can be observed in *Table 3* that the Shaqra region possesses a somewhat higher degree of plant variety than other regions. There was a total of 24 plant families that were found in the research region. This represented approximately 18.60% of the total number of plant families that were reported in the flora of Saudi Arabia, which was 129 families. The current inquiry identified a total of 66 genera, which accounted for approximately 8.09% of the total number of genera that were documented in the Flora of Saudi Arabia, which totaled 816 genera. The recognized plant species, which included 80 different species, accounted for around 6.60 percent of the total number of plant species that were documented across the entire nation, which totaled 2223 different animals and plants. According to the findings of the current study, the ratio of species to genera is 1.21, whereas the general ratio of species to genus across the entire nation is 2.72 (*Table 3*).

The Asteraceae family had the most significant representation, with a total of thirteen species, which accounted for 16.3 percent of the total number of species that were recognized. Second in line were the Brassicaceae family, which had 11 species (13.8%), the Amaranthaceae family, which had 8 species (10%), the Poaceae and Fabaceae families, which each had 6 species (6%), and the Zygophyllaceae family, which had 5 species (6.3%). Furthermore, three families each represented three species, which accounted for 3.8% of the total, and seven families each represented two species, which accounted for 2.5% of the total. By contrast, only one species contributed to each of the other eight families, which accounted for 1.3% of the total (*Fig. 4*).

The study area displayed the existence of five unique categories of life forms, which are recorded in *Table 2* and visually represented in *Figure 5*. The examination of the observed species revealed that the plant life in the Shaqra region consisted primarily of chamaephytes, which accounted for 34 species or 43 percent of the total species gathered. The therophytes were the second most abundant category, following the chamaephytes, with a total of 32 species, which accounts for 40 percent of the remaining species. The total number of species that were found to be hemicryptophytes was nine, which represents around 11% of the entire population of species.

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Table 2. *List of plant species recorded in Shaqra region with their families, chorotypes, life forms, life span, and economic uses*

Family	No.	Species name	Chorotype	Life Spans	Life form	Economic uses
Acanthaceae	1	*Blepharis ciliaris* (L.) B.L.Burtt	IT+SA	Perennial	Ch	M, G
Aizoaceae	2	*Aizoanthemum hispanicum* (L.) H.E.K Hartmann	SA	Annual	He	G, O
	3	*Aizoon canariense* L.	IT+SA	Annual	He	G, O
	4	*Mesembryanthemum nodiflorum* L.	ES+ME+SA	Annual	Th	G
Amaranthaceae	5	*Anabasis articulata* (Forssk.) Moq.	SA	Perennial	Ch	M, G, O
	6	*Atriplex leucoclada* Boiss.	IT+SA	Perennial	Ch	M, G
	7	*Haloxylon persicum* Bunge	IT+SZ	Perennial	Ch	M, G, F, O
	8	*Haloxylon salicornicum* (Moq.) Bunge ex Boiss.	IT+SZ	Perennial	Ch	M, G, E, F, O
	9	*Salsola imbricata* Forssk.	SA+SZ	Perennial	Ch	G, F, O
	10	*Salsola jordanicola* Eig.	SA	Annual	Ch	M, G, O
	11	*Salsola tetrandra* Forssk.	SA	Perennial	Ch	G, F, O
	12	*Salsola* volkensii Schweinf. & Asch.	IT+ME+SA	Annual	Ch	G, F
Apiaceae	13	*Anisosciadium lanatum* Boiss.	IT+SA	Annual	Ch	M, G, E
	14	*Deverra tortuosa* (Desf.) DC.	SA	Perennial	Ch	M, G, F
Apocynaceae	15	*Calotropis procera* (Aiton) W. T. Aiton	SA+SU	Perennial	Ph	G, O
	16	*Rhazya stricta* Decne.	SA+SU	Perennial	Ch	G
Asteraceae	17	*Aaronsohnia factorovskyi* Warb. & Eig	SA	Annual	Ch	M, G
	18	*Achillea fragrantissima* (Forssk.) Sch. Bip.	IT+SA	Perennial	Ch	M, G, F
	19	*Anthemis melampodina* Delile	ME+SZ	Annual	Th	O
	20	*Artemisia judaica* L.	SA	Perennial	Ch	M, G, O
	21	*Artemisia monosperma* Del.	SA	Perennial	Ch	M, G, O
	22	*Carduus pycnocephalus* subsp. *marmoratus* (Boiss. & Heldr.) P. H. Davis	ES+IT+ME+SA	Annual	Ch	O
	23	*Echinops spinosissimus* Turra	ES+IT+ME+SA	Perennial	Ch	M, G, E, F
	24	*Launaea capitata* (Spreng.) Dandy	IT+ME+SZ	Annual	Th	G
	25	*Launaea nudicaulis* (L.) Hook.f.	IT+SA	Annual	Ch	M, G, E, F, O
	26	*Pallenis hierochuntica* (Michon) Greuter	IT+SA	Annual	Ch	M, G, O
	27	*Picris cyanocarpa* Boiss.	SA	Annual	Th	G
	28	*Pulicaria undulata* (L.) C. A. Mey.	SA+SU	Perennial	He	M, G, E, O
	29	*Senecio glaucus* L.	IT+SA	Annual	Th	G, E
Boraginaceae	30	*Echium plantagineum* L.	COSM	Annual	Th	G
	31	*Heliotropium crispum* Desf.	IT+SA	Perennial	Ch	M, F
Brassicaceae	32	*Anastatica hierochuntica* L.	SA	Annual	Th	M
	33	*Brassica rapa* L.	COSM	Annual	Th	F, E, O
	34	*Brassica tournefortii* Gouan	ME+SA	Annual	Th	G, E, O
	35	*Diplotaxis harra* (Forssk.) Boiss.	IT+SA	Perennial	Ch	G, E, O
	36	*Erucaria hispanica* (L.) Druce	ME	Annual	Th	G
	37	*Farsetia aegyptia* Turra	SU	Perennial	Ch	M, G
	38	*Horwoodia dicksoniae* Turrill	IT	Annual	He	G
	39	*Matthiola longipetala* (Vent.) DC.	IT+ME	Annual	Th	G
	40	*Savignya parviflora* (Del.) Webb	SA	Annual	Th	G
	41	*Sisymbrium irio* L.	IT+ME	Annual	Th	M, G, E
	42	*Zilla spinosa* (L.) Prantl	SA	Perennial	Ch	M, G, F
Caryophyllaceae	43	*Gypsophila capillaris* (Forssk.) C. Chr.	IT	Annual	Th	M, O
	44	*Herniaria hirsuta* L.	ES+IT+ME	Annual	Th	G
	45	*Silene villosa* Forssk.	SA	Annual	Th	M, O
Cistaceae	46	*Helianthemum ledifolium* (L.) Mill.	IT+ME	Annual	Th	G
	47	*Helianthemum salicifolium* (L.) Mill.	ES+IT+ME	Annual	Th	G
Convolvulaceae	48	*Convolvulus spicatus* Peter ex Hallier f.	SA	Perennial	Ch	G, F
Cucurbitaceae	49	*Citrullus colocynthis* (L.) Schrad.	SA	Perennial	He	M, G, F
	50	*Cucumis prophetarum* subsp. dissectus (Naudin) C.Jeffrey	SA+SZ	Perennial	He	G

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Family	No.	Species name	Chorotype	Life Spans	Life form	Economic uses
Euophorbiaceae	51	*Chrozophora tinctoria* (L.) A.Juss.	IT+ME	Perennial	Ge	M, G, F
	52	*Euphorbia retusa* Forssk.	ES+ME+SZ	Perennial	Th	M
Fabaceae	53	*Alhagi graecorum* Boiss.	IT+ME	Perennial	Ch	M, G, E, F, O
	54	*Astragalus arpilobus* subsp. *hauarensis* (Boiss.) Podlech	SA	Annual	He	G, F, O
	55	*Astragalus spinosus* (Forssk.) Muschl.	IT	Perennial	Ch	G
	56	*Medicago laciniata* (L.) Mill.	SA	Annual	Th	G, F, O
	57	*Melilotus indicus* (L.) All.	ME+SA+SZ	Annual	Th	G, F, O
	58	*Trigonella hamosa* L.	ME+SA	Annual	Th	G
Geraniaceae	59	*Erodium laciniatum* (Cav.) Willd.	ME	Annual	Th	G
Lamiaceae	60	*Salvia spinosa* L.	IT	Perennial	Ch	M, G, E, F, O
Malvaceae	61	*Malva parviflora* L.	IT+ME	Annual	Th	M, G, E
Plantaginaceae	62	*Plantago ciliata* Desf.	IT+SA	Annual	Ch	G
	63	*Plantago coronopus* L.	IT+SA	Annual	He	M, G, E, O
	64	*Plantago ovata* Forssk.	IT+SA	Annual	Th	M, G
Poaceae	65	*Bromus alopecuros* Poir.	ME	Perennial	Th	G
	66	*Cenchrus ciliaris* L.	COSM	Perennial	Ge	M, G
	67	*Chloris barbata* Sw.	SZ	Perennial	He	G
	68	*Schismus barbatus* (L.) Thell.	IT+SA	Annual	Th	G
	69	*Stipa capensis* Thunb.	IT+SZ	Annual	Ge	M
	70	*Stipagrostis drarii* (Tackh.) De Wint.	SA	Perennial	Ch	G
Polygonaceae	71	*Emex spinosa* (L.) Campd.	IT+ME+SA	Annual	Th	M, G, E
	72	*Rumex vesicarius* L.	ME+SA	Annual	Th	M, G, E, O
Resedaceae	73	*Reseda muricata* C. Presl	SA+SZ	Perennial	Th	G
Solanaceae	74	*Lycium shawii* Roem. & Schult.	SA+SU	Perennial	Ch	M, G, E, F, O
Tamaricaceae	75	*Tamarix aphylla* (L.) H.Karst.	SZ	Perennial	Ph	M, G, F, O
Zygophyllaceae	76	*Fagonia bruguieri* DC.	IT+SA	Perennial	Ch	M
	77	*Fagonia glutinosa* Del.	SA	Perennial	Ch	M
	78	*Tetraena hamiensis* (Schweinf.) Beier & Thulin	SA+SZ	Perennial	Ch	M, G
	79	*Tetraena simplex* (L.) Beier & Thulin	SA+SZ	Annual	Th	M
	80	*Tribulus terrestris* L.	ES+IT+ME	Annual	Th	M, G

COSM: Cosmopolitan, ES: Euro-Siberian, IT: Irano-Turanian, ME: Mediterranean, SA: Saharo-Arabian, SZ: Sudano-Zambesian, SU: Sudanian, Ch: chamaephytes, He: hemicryptophytes, Ge: geophytes, Ph: phanerophytes, Th: therophytes, M: medical, G: grazing, E: edible, F: fuel and O: other uses

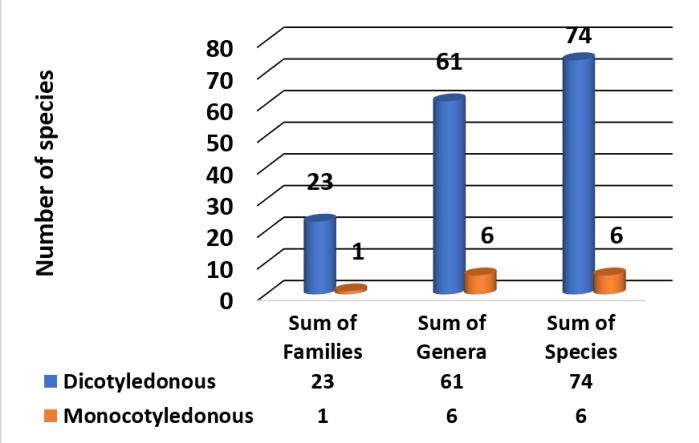

Figure 2. *Histogram of the numbers of families, genera and species based on Dicotyledonous and Monocotyledonous categories Shaqra region*

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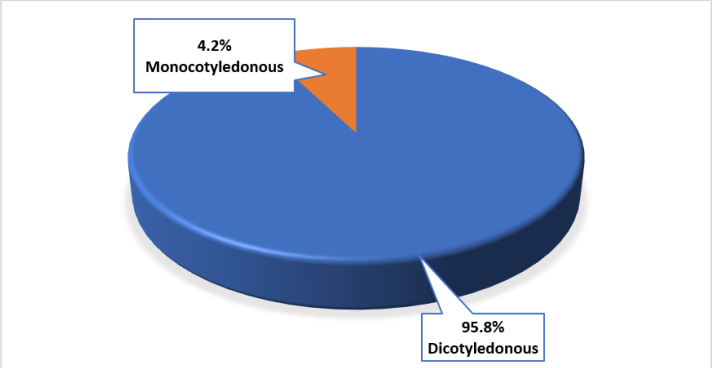

Figure 3. *Habit of the recorded species in Shaqra region, Saudi Arabia*

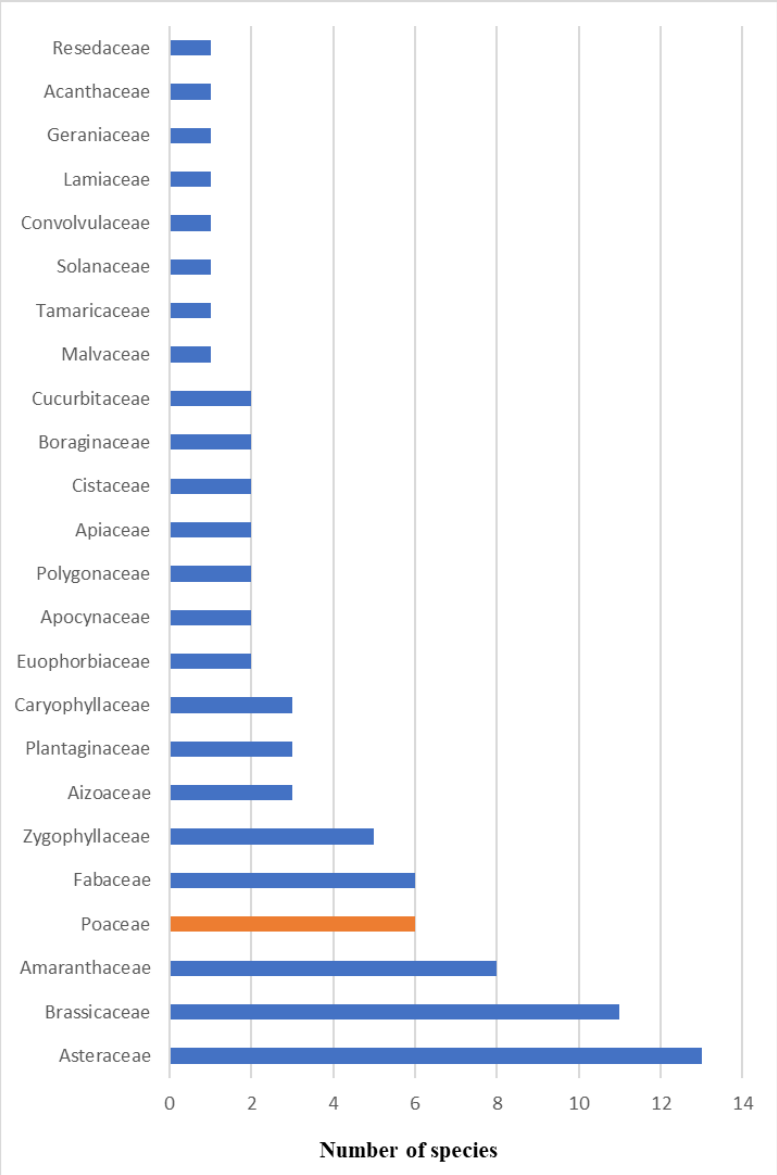

Figure 4. *Plant families of the recorded species in Shaqra region, Saudi Arabia*

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There are a total of three species that belong to the geophytes category, which accounts for around 4% of the total species that have been collected. In conclusion, Phanerophytes are the least common group of life forms, accounting for only 3% of all life forms.

Table 3. *Comparison of floristic diversity in Shaqra region (the present study area) to the floristic diversity in the entire country of Saudi Arabia*

Location	Family	Genera	Species	Generic coefficient
Shaqra region (the present study area)	24	66	80	1.21
Saudi Arabia (Chaudhary, 2001)	129	816	2223	2.72
Percentage (%)	18.60	8.09	3.60	

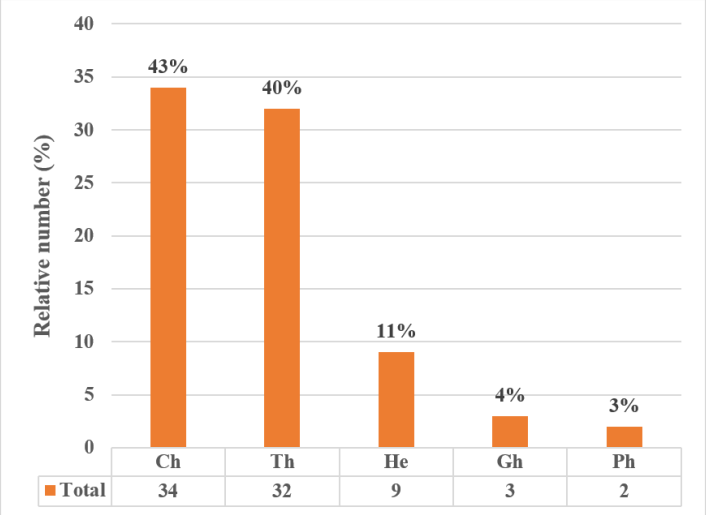

Figure 5. *Life form spectra of the recorded species in Shaqra region, Saudi Arabia. Ch: chamaephytes; Th: therophyte, He: hemicryptophytes; Ge: geophytes, Ph: phanerophytes, Pa: parasites*

The data presented in *Table 4* and *Figure 6* illustrate that the chronological spectrum of phytogeographical distribution of plant taxa within the Shaqra regions was notably diverse. It comprises four primary chorotypes: The mono-regional chorotype, which included a total of 29 species and accounted for 36.3% of the entire distribution, was considered the second category of species coverage that was observed. Five separate chorotypes were included in the dataset. The Saharo-Arabian (SA) chorotype had the highest number of species, which accounted for 19 species, which is equivalent to 23.8% of the total species. Four different species were found within the Irano-Turanian (IT) chorotype, which accounted for 5% of the total species. It was determined that the Mediterranean (ME) chorotypes were present in three different species, accounting for 3.8% of the total. Two different species are responsible for the representation of Saharo-Arabian (SA) chorotypes, which accounts for 2.5% of the total number of species gathered. Out of all the species that were reported, the Sudanian (SU) chorotype had the least amount of representation, with only one species accounting for 1.3% of the total species.

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Table 4. *The number of the recognized taxa belonging to the main floristic categories and their relevant percentages (%) in Shaqra region*

Chorotype		Number of Species	Percentage (%)
Mono-regional	SA	19	23.75
	IT	4	5
	ME	3	3.75
	SZ	2	2.5
	SU	1	1.25
	Subtotal	**29**	**36.25**
Bi-regional	IT+SA	15	18.75
	IT+ME	6	7.5
	SA+SZ	5	6.25
	SA+SU	4	5
	ME+SA	3	3.75
	IT+SZ	3	3.75
	Subtotal	**36**	**45**
Pluri-regional	ES+IT+ME	3	3.75
	IT+ME+SA	2	2.5
	ES+IT+ME+SA	2	2.5
	ME+SA+SZ	2	2.5
	ES+ME+SA	1	1.25
	ES+ME+SZ	1	1.25
	IT+ME+SZ	1	1.25
	Subtotal	**12**	**15**
Worldwide	COSM	3	**3.75**
Grand Total		**80**	**100**

COSM: Cosmopolitan, ES: Euro-Siberian, IT: Irano-Turanian, ME: Mediterranean, SA: Saharo-Arabian, SZ: Sudano-Zambesian, SU: Sudanian

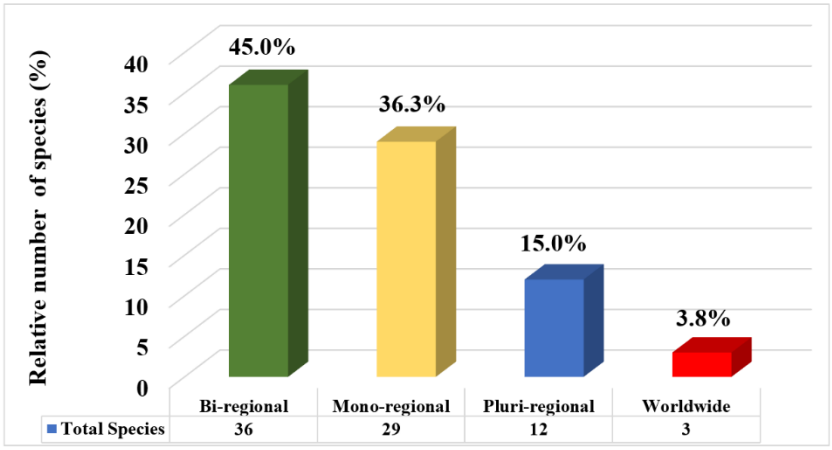

Figure 6. *Global phytogeographical distribution of Shaqra region, Saudi Arabia*

The bi-regional category comprised 36 taxa, or 45% of the total species recorded, representing the greatest number of collected species. Counting 15 species, the Irano-Turanian/Saharo-Arabian (IT+SA) chorotype accounts for 18.8% of the total species recorded. With six species, the Irano-Turanian/Mediterranean (IT+ME) chorotype represented 7.5% of the total species. Five species constituted the Saharo-Arabian/Sudano-Zambesian (SA+SZ) chorotype, which accounted for 6.3% of the

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documented species. Four species comprised the Saharo-Arabian/Sudanian (SA+SU) chorotype, which accounted for 5% of the species that have been documented. Finally, it is worth noting that the Mediterranean/Saharo-Arabian (ME+SA) and Irano-Turanian/Sudano-Zambesian (IT+SZ) chorotypes each consisted of three species, which accounted for 3.8% of the total species recorded.

On the other hand, the Pluri-regional category was distinguished by the existence of twelve species, which accounted for 15 percent of the total recognized taxa. It was comprised of seven primary chorotypes. The Euro-Siberian/Irano-Turanian/Mediterranean (ES+IT+ME) area has the highest level of representation through three species, which accounts for 3.8% of the total taxonomic data that has been recorded. Irano-Turanian/Mediterranean/Saharo-Arabian (IT+ME+SA), Euro-Siberian/Irano-Turanian/Mediterranean/Saharo-Arabian (ES+IT+ME+SA), and Mediterranean/Saharo-Arabian/Sudano-Zambesian (ME+SA+SZ) areas; each of these regions is represented by two species, accounting for a percentage of 2.5%. Additionally, the Euro-Siberian/Mediterranean/Saharo-Arabian (ES+ME+SA), Euro-Siberian/Mediterranean/Sudano-Zambesian (ES+ME+SZ), and Irano-Turanian/Mediterranean/Sudano-Zambesian (IT+ME+SZ) chorotypes exhibit the lowest representation, with each consisting of only one species (1.3% each).

Three species, namely *Echium plantagineum* L., *Cenchrus ciliaris* L., *Brassica rapa* L., were included in the cosmopolitan type, which accounted for 3.8% of the total taxa records.

Regarding the life spans and durations of the taxa being studied, it is observed that the majority of species, accounting for 54% of all reported species, are annuals. There are a total of 43 species in this category. In contrast, perennial plants make up 46% of the documented species, totaling 37 species as shown in *Fig. 7*. The majority of legally recognized taxa primarily comprise herbaceous plants, with 61 species representing 76% of the total collected species. There are a total of 13 species of shrubs, which account for 16% of all the species that were gathered. On the other hand, there are six species of trees, which make up 8% of the total number of species (*Fig. 8*).

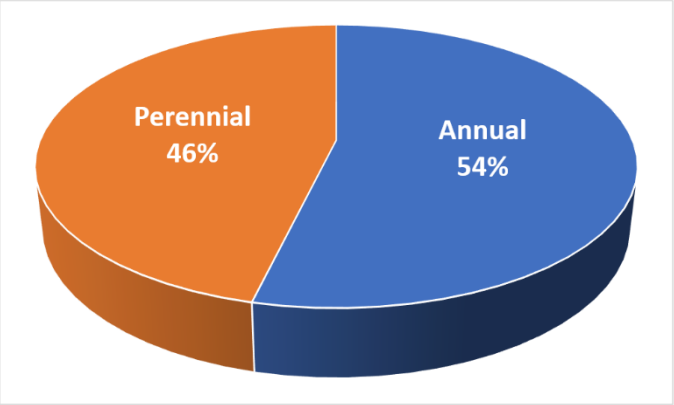

Figure 7. *Life spans of the recorded species in Shaqra region, Saudi Arabia*

In terms of the economic importance and uses of recognized taxa (*Fig. 9*), it is worth mentioning that 85% of the total taxa were used for grazing, and 52.5% of the identified taxa were medicinal plants. In addition, 27.5% of the taxa being studied are utilized as fuel sources, while 18.8% are acknowledged for their edible qualities. In this study, 51

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species were found to be common, making up 64% of the taxa that were recognized. On the other hand, 29 species, representing 36% of the taxa, were identified as having low abundance within the study area (see *Fig. 10*).

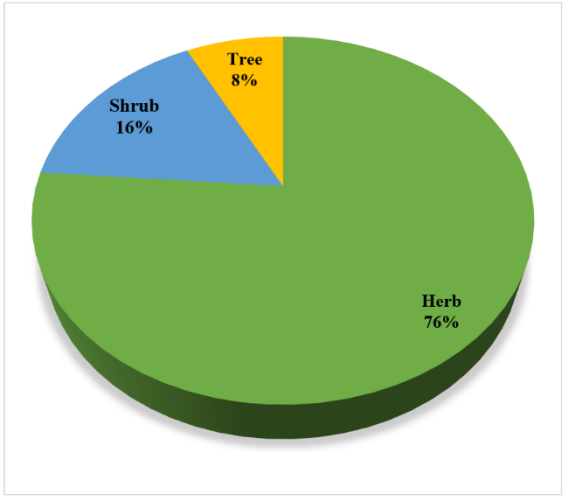

Figure 8. *Habits of the recorded species in Shaqra region, Saudi Arabia*

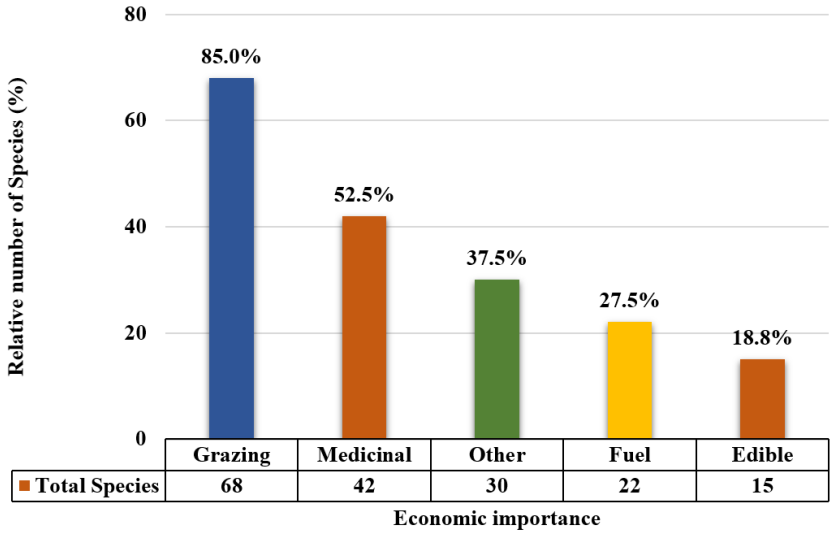

Figure 9. *Potential economic importance of the recorded species in Shaqra region, Saudi Arabia*

The fact that just seven of the eighty species that were recorded in this survey were listed on the Red List of the International Union for Conservation of Nature (*Table 5*) was a noteworthy finding. There is not a single species that has been mentioned that does not fall into the category of least concern (LC). There are four species whose population trends are constant (three of these species are evaluated in Europe, while one species is evaluated globally). The patterns of population distribution across the world for the three species that are still in existence are unknown.

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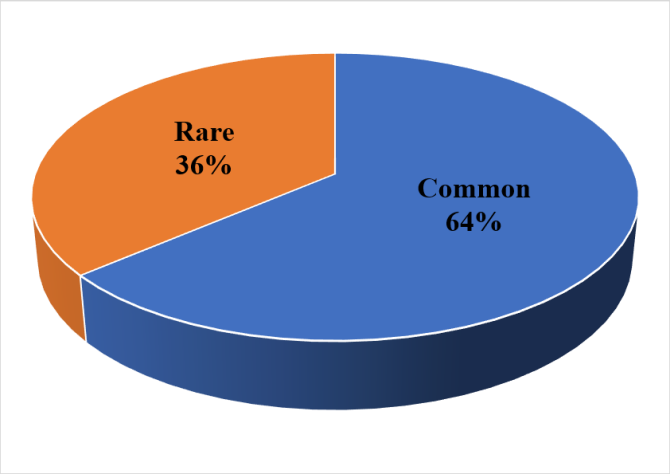

Figure 10. *Abundance of the recorded species Shaqra region, Saudi Arabia*

Table 5. *Status of globally threatened taxa recorded in the study area as checked with the IUCN red list. LC: Least Concern*

Species	Status	Population trend	Scope of assessment	Last assessed
Brassica tournefortii Gouan	LC	Stable	Europe	16 April 2010
Calotropis procera (Aiton) W. T. Aiton	LC	Unknown	Global	14 January 2022
Chrozophora tinctoria (L.) A.Juss.	LC	Unknown	Global	02 May 2012
Haloxylon persicum Bunge	LC	Unknown	Global	12 February 2020
Medicago laciniata (L.) Mill.	LC	Stable	Europe	15 April 2010
Plantago ovata Forssk.	LC	Stable	Europe	26 March 2014
Tribulus terrestris L.	LC	Stable	Global	28 August 2019

It is noteworthy that among the 80 species documented in the present study, only seven species were listed in the IUCN Red List as least concern (LC). It has been determined that the population trends of four species are steady (three species are evaluated in Europe, and one species is evaluated globally). The global population patterns for the remaining three taxa are still unknown on a worldwide scale (*Table 5*).

Discussion

According to Al-Eisawi and Al-Ruzayza (2015), Saudi Arabia encompasses a wide range of biogeographic regions, as a result, it displays a wide variety of different categories at the generic and family levels.

For the first time, a floristic inquiry has been carried out in the Shaqra region. This research highlights the relevance of the region in terms of plant variety, as demonstrated by the low ratios that have been observed. The number of species in our study region was equal to or higher than that of various hotspot regions in Saudi Arabia, such as Wadi Al Rummah, Qassim region, which had 59 species (El-Ghazali et al., 2013), Wadi Tashar, in Jazan, which had 89 species (El-Shabasy and Kasem, 2018), Tabuk province, which

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had 96 species (Al-Mutairi et al., 2016), Al-Saoda, in Asir region, which had 103 species (Seraj et al., 2014), and Jeddah, which had 107 species (Aljedaani and Fakhry, 2023).

It is important to note that the scope of this study is restricted to three certain geographical locations inside Saudi Arabia. These places include Rawdah Ghislah, Al-Garaa Protectorate, and Rawdah Al-Qsour. The regions are located in Shaqra governorate, which is situated in the middle of Saudi Arabia. As a result of the analysis of the current research, it was discovered that the locations under investigation include a rather high degree of plant diversity. Within the constraints of these restricted geographical locations, a total of 80 species were discovered, which represents 3.6% of the total number of species that have been reported in the Flora of Saudi Arabia.

It was noted that the families Asteraceae, Brassicaceae, and Amaranthaceae had the highest species richness within the area that was under investigation, these families contained 13, 11, and 8 species, respectively. Within the Shaqra area, the three families that were of concern accounted for about 40% of the floral composition. Other floristic studies conducted in various parts of Saudi Arabia (El-Ghanim et al., 2010; Seraj et al., 2014; Al-Mutairi et al., 2016; Elkordy et al., 2022; Al-Harbi, 2023) have shown similar results about the high frequency of Asteraceae. Jeffrey (2007) attributes the dominance of the Asteraceae family may be attributed to the family's powerful seed dissemination and vast phytogeographical distribution. Furthermore, more than 30% of all families were occupied by a single taxon: Malvaceae, Tamaricaceae, Solanaceae, Convolvulaceae, Lamiaceae, Geraniaceae, Acanthaceae, and Resedaceae. A total of four different species were found within the Salsola genus, which belongs to the Amaranthaceae family. This was quickly followed by the Plantago (Plantaginaceae) genus, which is comprised of two different species altogether. Within the Amaranthaceae family, the genus *Salsola*, which has four different species, had the highest species richness. In close pursuit of this was the genus *Plantago*, which belongs to the family Plantaginaceae and is represented by two species.

With an average of around 2.72 species per genus, the flora of Saudi Arabia displays a notable difference in the number of genera and species. According to Chaudhary (1999, 2000), this number is much lower when compared to the global average of 13.6. A phytogeographical region is considered very diversified when it has a greater number of species from several genera compared to when the same number of species are found in only a few genera Hawksworth (1995). The current study demonstrates that the botanical composition of the Shaqra area is below the average level seen in the plant life of Saudi Arabia, with an average ratio of 1.21 species per genus. This finding indicates that the Shaqra area exhibits a significant proliferation of diverse species within its flora.

According to Di Biase et al. (2021), studying the life form spectrum may provide useful insights on how plants adapt to changes in their environment. Based on the results of the current study on plant life, it was found that the primary vegetation in the research areas is made up of chamaephytes, which comprise the majority of 43 species, making up 43% of the total known species. The next most common group is therophytes, with 32 species, accounting for 40% of the total species collected. In addition, the chamaephytes species' capacity to withstand salinity, drought, and sediment deposition may potentially play a role in their domination (Danin, 2012; Galal and Fahmy, 2012). However, prior research conducted by Al-Sodany et al. (2016) and El-Demerdash et al. (1994) has shown that the prevalence of chamaephytes and therophytes compared to other types of plants indicates a hot and dry climate, changes in the landscape, and the influence of living organisms.

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Mono-regional, bi-regional, pluri-regional, and global are the four primary phytogeographical groupings that are used to classify the species that are found in the area under investigation. The highest part of the population is comprised of mono- and bi-regional groupings, which account for 36.3% and 45% of the total population, respectively. As determined by Zohary (1973), the majority of the vegetation that may be found in Saudi Arabia is classified as belonging to the Saharo-Arabian zone. According to Abd El-Ghani and Amer (2003), the flora that is a part of the Saharo-Arabian chorotype has a remarkable potential to act as trustworthy indicators of the environmental conditions that are prevalent within desert ecosystems. Based on the findings of the analysis, it was determined that the Saharo-Arabian (SA) region had the highest percentage of chorotype distribution within the selected study area. More specifically, this area was found to include 19 species, which accounts for 23.8% of the total number of species that have been recognized. On the other hand, the Irano-Turanian/Saharo-Arabian (IT+SA) area was responsible for 15 species, which is equivalent to 18.8% of the total number of identified taxa. There is a strong correlation between the findings that were published by Al-Nafie (2008) and the results that were achieved in this investigation.

The annual/perennial ratio is affected by abiotic factors such as the aridity of the area and the amount of precipitation (Erfanzadeh et al., 2010). The current research showed that annual taxa dominated over perennial species, with a distribution ratio of 54% to 46%. The examined flora of the current study revealed a predominant occurrence of herbaceous plant species in contrast to other types of habits. Herbs account for approximately 76% of all observed species; this dominance can be due to their very short life cycle, which allows them to resist and adapt to harsh climatic conditions (Gomaa, 2012).

Approximately 29 taxa, representing 36% of the total investigated species, are considered to have a limited distribution or low abundance within the study area. Among them, seven species are categorized as 'Least Concern' according to the IUCN dataset. Despite this classification, conservation efforts should be prioritized for these species due to their restricted occurrence and potential vulnerability to biotic and abiotic threats, which may increase their risk of extinction (Rabei and Elgamal, 2021).

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