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Research Article

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Diversity, Life Forms, and Distribution Patterns of Vascular Plants in Some Areas East of Al-Wuday'ah District, Abyan Governorate, Yemen

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Abstract

This study investigates the floristic composition and ecological patterns of plant diversity within the semi-arid habitats of southern Yemen. Surveys conducted across 50 sites from 2020 to 2024 recorded 291 vascular plant species, encompassing 175 genera and 61 families. This reflects a notable richness in this understudied region. The flora was dominated by perennials (64.07%), with chamaephytes (39.66%) and therophytes (26.80%) being the most frequent life-forms. This distribution suggests a chamaephyte-therophytic phytoclimate that is well-adapted to arid conditions. Phytogeographical analysis revealed the prevalence of Sudano-Zambezian and Saharo-Sindian elements, which highlights the transitional nature and high ecological value of the area. These findings emphasize the crucial need for conservation and continuous ecological monitoring to protect Yemen's unique arid biodiversity.

Keywords: Floristic diversity, life-form spectrum, phytogeography, Yemen, arid environment, biodiversity conservation**.**

INTRODUCTION

The Republic of Yemen is located in the southwestern corner of the Arabian Peninsula, extending between latitudes 12°40′ and 19°00′ N and longitudes 42°30′ and 53°05′ E (Al-Hawshabi, 2015). It is bordered by the Kingdom of Saudi Arabia to the north, the Arabian Sea and the Gulf of Aden to the south, the Sultanate of Oman to the east, and the Red Sea to the west. The flora of Yemen is distinguished by its remarkable diversity and density, particularly in the southern and western regions (AlHood et al., 2020). Floristic composition and vegetation analysis have become increasingly important, as they provide essential data for understanding biodiversity and ecosystem functioning in these areas (Hamad et al., 2024). The analysis of life-form spectra, in particular, offers valuable insights into plant responses to environmental variations, as highlighted in floristic studies (Alsobeai, 2024). Floristic studies involve the taxonomic examination of a region's flora or a significant portion of it, encompassing the identification, nomen-

clature, and documentation of plant species (Keith, 1988; Ilyas et al.). Moreover, life-form distribution is strongly influenced by topography and landforms (Kassas & Girgis, 1965; Orshan, 1986).

Regional floristic surveys are essential, serving as a “biological identity certificate” that reflects the presence and status of plant species. Investigating the geographical origin of species and conducting floristic analyses are therefore among the most effective approaches for biodiversity management and conservation. Furthermore, the richness of higher plant diversity is increasingly recognized as fundamental to sustaining healthy and resilient ecosystems. In this context, the need for the present study has emerged, since this region has not previously been investigated with respect to life forms and the geographical distribution of plant species (Zamila et al., 2023). This study aims to document and analyze the floristic composition of the study area, with a particular focus on identifying life forms and the phytogeographical distribution of plant species. The findings are intended to provide a scientific baseline that contributes to understanding local biodiversity and supports sustainable management and conservation strategies for plant resources.

This study is significant as it provides the first systematic inventory and documentation of life forms and distribution patterns of vascular plants in the eastern parts of Al-Wade'a district, Abyan Governorate, a region that is ecologically under-explored and data-poor, The findings contribute to enriching the taxonomic base of Yemeni flora, offering crucial insights into the biogeographical and adaptive patterns of vegetation in arid and semi-arid environments, which is vital for biodiversity conservation efforts in the area, The paper establishes a reliable baseline for future studies aimed at assessing and monitoring the impacts of climate change and anthropogenic activities on the plant resources of southern Yemen.

MATERIALS AND METHODS

Study Area

This study was conducted in a semi-arid region of southern Yemen, specifically in areas east of Al-Wuday‘ah District, Abyan Governorate. The study sites include Yabraq Valley, Al-Mahwery Villages, ‘Anan Valley, and Bajrashah Valley, located between latitudes 13.517228° and 13.920573° N, and longitudes 46.047728° and 46.684208° E. The elevation ranges from 700 to 1,250 meters above sea level. The region includes diverse habitats such as alluvial plains, gravel plains, and wadis, and forms part of the southern mountain ranges that overlook the Gulf of Aden (Fig. 1).

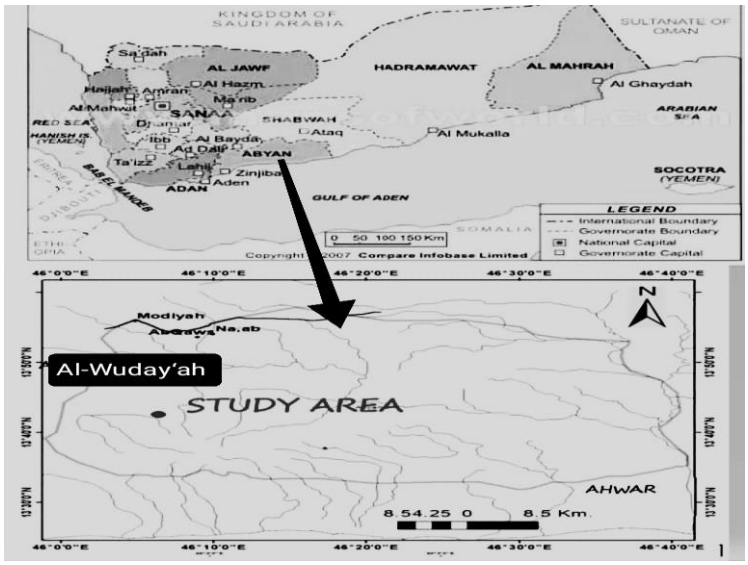

Figure: (1).The study area

Field Surveys and Data Collection

Fieldwork was carried out over four years, from 2020 to 2024. Plant specimens were collected during multiple field visits between 2020 and 2022. In each of the 50 selected sites, representative vegetation was surveyed using a stratified approach that accounted for habitat variation and topographic diversity. Plant identification was conducted with the assistance of regional floras and taxonomic experts, including references such as Al-Khulaidi ,2013), Al-Gifri and Hussein ,1993:, Al-Hawshabi et al. ,2017, Al-Hawshabi et al 2025), Beier ,2005), Chaudhary ,1989), Boulos (1988, 1994):wood,1997), and the online database Plants of the World Online (POWO, 2025). Additionally, expert verification was provided by Prof. Norbert Kilian and other botanists familiar with the region's flora Information

RESULTS

A total of 291 plant species were recorded in the study area, belonging to 175 genera and 61 families. This richness reflects a remarkable level of plant diversity in a relatively harsh and semi-arid environment. The most species-rich families were Asteraceae (28 species), followed by Poaceae (23 species), and Apocynaceae (19 species), highlighting their ecological dominance in arid regions (Fig. 2).

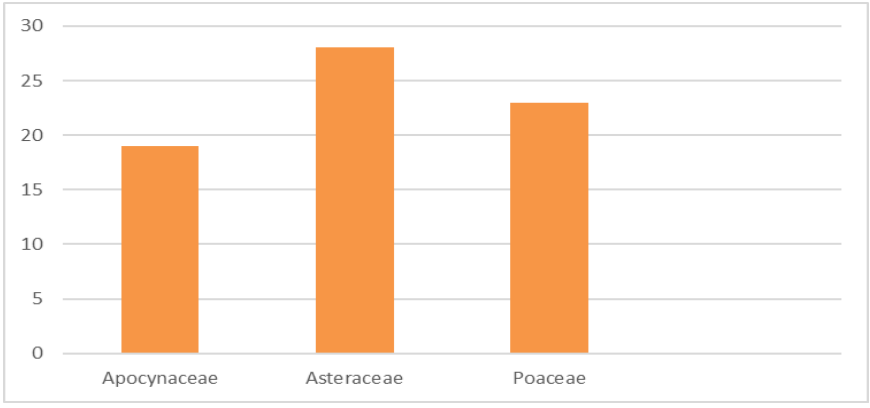

Figure: (2).The largest families according the number of genera and species in the study area.

The flora includes a mixture of annuals and perennials, with perennials representing 189 species (64.07%) and annuals 106 species (35.93%) (Fig. 3). The predominance of perennial species suggests long-term adaptation to drought and seasonal variability, as is typical in arid and semi-arid ecosystems.

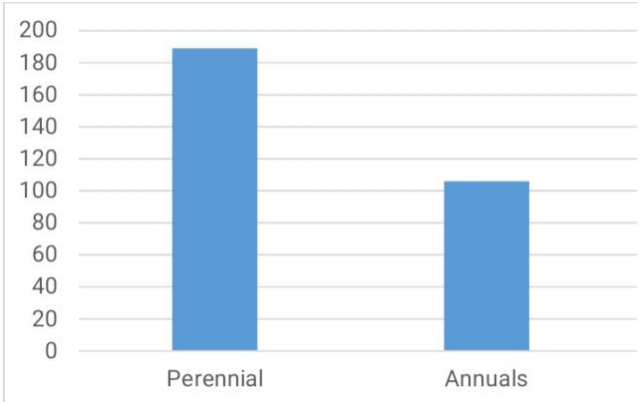

Figure: (3) . The number of the studied species by life – span

Table: (1) . List of plant species recorded in the studied area with their families, life-forms and lifespan

Family Name	Taxon Name	Life form	Lifespan	Choro types
Acanthaceae	*Anisotes trisulcus* (Forssk.) Nees	Ph	Per	SU-ZA
	Barleria prionitis subsp. *appress* (Forssk.) Brummitt & J.R.I.Wood	Ch	Per	N ENDMIC
	Barleria proxima Lindau.	Ch	Ann	SU-ZA
	Barleria trispinosa (Forssk.) Vahl	Ch	Ann	SA_SI+SU_ZA
	Blepharis edulis (Forssk.) Pers.	He	Per	SA-SI+IT
	Ecbolilum viride (Forssk.) Alston	Ch	Per	IT
	Justicia flava (Forssk.) Vahl	Th	Per	SU-ZA
	Justicia odora (Forssk.) Lam.	Ch	Per	SU-ZA
	Ruellia discifolia Oliv.	Ch	Per	SU-ZA
	*Ruellia patula*Jacq.	Ch	Per	ME + SA-SI + SU-ZA
Aizoaceae	*Aizoon canariense* L.	Th (s)	Ann.	SU-ZA
	Trianthema crystallina (Forssk.) Vahl	Th (s)	Ann.	SU-ZA+SA-SI
	Trianthema portulacastrum L.	Th (s)	Ann.	PAL.
Amaranthaceae	*Achyranthes aspera* L.	Ch	Per	COSM
	Aerva javanica Juss.	Ch	Per	IT
	Aerva lanata (L.) Juss.	Ch (s)	Ann	SA-SI
	Amaranthus graecizan L.	Ch	Per	SA-SI+SU-ZA
	Amaranthus spinosus L.	Ch	Per	SA-SI
	Amaranthus viridis L.	Ch	Per.	IT
	Caroxylon spinescens (Moq.) Akhani & Roalson	Ch	Per.	IT
	Digera muricata (L.) Mart.	Ch	Per	TR
	Halothamnus bottae Jaub. & Spach	Th	Ann	COSM
	Suaeda aegyptiaca (Hasselq.) Zohary	Th	Ann	COSM
	Suaeda monoica Forssk. ex J.F.Gmel.	Th	Ann	COSM
	Suaeda vermiculata Forssk. ex J.F.Gmel.	Th	Ann	IT
Apiaceae	*Conium maculatum* L.	Ch	Ann	ME + SA-SI + SU-ZA+ IR.-TU
Apocynaceae	*Adenium obesum*(Forssk.) Roem. & Schult.	Ph (s)	Per	SU-ZA+SA-SI
	Calotropis procera(Aiton) W.T.Aiton	Ph (s)	Per	SA -SI+ IR-TUR
	Caralluma edulis (Edgew.) Meve & Liede	He	Per	SA-SI+SU-ZA
	Ceropegia subaphylla K.Schum.	Ch	Per	SA-SI

Family Name	Taxon Name	Life form	Lifespan	Choro types
	Ceropegia variegate Decne.	Ch	Per	SA-SI
	Cynanchum forskaolianum (Schult.) Meve & Liede	Ch	Per	N ENDMIC
	Cynanchum registanense Jayanthi	He	Per	SU-ZA
	Cynanchum viminale (L.) L.	Ch	Per	SA-SI
	*Desmidorchis adenensis (*Deflers) Meve & Liede	Ch	Per	N-ENDEMIC
	Desmidorchis awdeliana (Deflers) Meve & Liede	Ch (s)	Per	N-ENDEMIC
	Desmidorchis penicillata (Deflers) Plowes	Ch (s)	Per	SA-SI
	Leptadenia arborea (Forssk.) Schweinf.	Ch	Per	SA-SI+SU-ZU
	Leptadenia pyrotechnica (Forssk.) Decne.	Ph	Per	SA-SI.+ IR.-TUR
	Monolluma hexagona (Lavranos) Meve & Liede	He	Per	N-ENDEMIC
	Monolluma quadrangula (Forssk.) Plowes	Ch (s)	Per	ENDMEC
	Orbea deflersiana (Lavranos) Bruyns	He	Per	N-ENDEMIC
	Pentatropis nivalis (J.F.Gmel.) D.V.Field & J.R.I.Wood	Ch (s)	Per	PAL
	Pergularia tomentosa L.	Ch	Per	SA+S I
	Rhytidocaulon macrolobum Lavranos	Ch	Per	NEAR-ENDEMIC
	Hyphaene thebaica (L.) Mart.	Ph	Per	SA-SI+IT
Arecaceae	*Livistona carinensis* (Chiov.) J.Dransf. & N.W.Uhl	Ph	Per	SU-ZA
	Phoenix dactylifera L.	Ph	Per	SA-SI
Aristolochiaceae	*Aristolochia bracteolata* Lam.	Th	Ann	SA-SI+SU-ZA
	Hydnora abyssinica A.Br.	P	Ann	SA-SI+SU -ZA
Asparagaceae	*Dracaena forskaliana* (Schult. & Schult.f.) Byng & Christenh.	G (s)	Per	SA-SI+SU -ZA
	Dracaena hanningtonii Baker	G (s)	Per	SA-SI+SU -ZA
	Dracaena ombet Kotschy & Peyr.	Ph	Per	SA-SI
Asphodelaceae	*Aloe inermis* Forssk.	Ch (s)	Per	SA-SI+SU -ZA
	*Aloe lanata*T.A.McCoy & Lavranos	Ch (s)	Per	SA-SI+SU -ZA
	Aloe lavranosii Reynolds	Ch (s)	Per	ENDMEC
	Aloe vacillans Forssk.	Ch (s)	Per	N.ENDMIC
Asteraceae	*Cyanthillium cinereum* (L.) H.Rob.	Th	Ann	SU-ZA
	Echinops erinaceous Kit Tan	Ch	Ann	SA-SI+SU -ZA+ME
	Eclipta prostrata (L.) L.	He	Per	COSM
	Flaveria trinervia (Spreng.) C.Mohr	Ch	Ann	COSM
	Helichrysum somalense Baker f.	Ch	Ann	COSM
	Iphiona scabra DC. ex Decne.	Ch	Per	ME+-SA-SI
	Kleinia odora (Forssk.) DC.	Ch (s)	Per	SU+ZA
	Kleinia pendula (Forssk.) DC.	Ch (s)	Per	SU-ZA
	Kleinia semperviva (Forssk.) DC.	Ch	Per	ENDEMIC
	Lactuca serriola L.	Th	Per	COSM
	Launaea hafunensis Chiov.	G	Ann	SA-SI
	Launaea nudicaulis (L.) Hook.f.	Ch	Ann	SA-SI
	Launaea procumbens (Roxb.) Ramayya & Rajagopal	Th	Ann	SA-SI
	Pluchea dioscoridis (L.) DC.	Ch	Per	SA+SI
	Pluchea indica subsp. *indica*	Ph	Per	SA-SI+SU -ZA
	Psiadia punctulata Vatke	Ph	Per	SA-SI+SU-ZA
	Pulicaria arabica (L.) Cass.	Th	Ann	SU-ZA
	Pulicaria jaubertii E.Gamal-Eldin	Th	Ann	SA-SI+SU -ZA
	Pulicaria petiolaris Jaub. & Spach	Ch	Ann	SA-SI+SU -ZA
	Pulicaria schimperi DC.	Ch	Ann	SU-ZA
	Pulicaria somalensis subsp. *schweinfurthii* E.Gamal-Eldin	Ch	Ann	ENDMIC

Family Name	Taxon Name	Life form	Lifespan	Choro types
	Pulicaria undulata (L.) C.A.Mey.	Th	Ann	SA-SI+SU -ZA
	Sonchus oleraceus L.	Th	Ann	ME+IT
	Vernonia arabica F.G.Davies	Ch	Ann	SU-ZA
	Vernonia spatulata Hochst. ex Sch.Bip.	Ch	Ann	SA-SI
	Xanthium spinosum L.	Th	Per	NEO
	Xanthium strumarium L.	Ch	Per	ME
	Euploca rariflora (Stocks) Diane & Hilger	Ch	Per	SU-ZA
	Heliotropium aegyptiacum Lehm.	Ch	Per	SU-ZA
	Heliotropium bacciferum Forssk.	He	Per	SA-SI+SU-ZA
	Heliotropium curassavicum L.	He	Per	SU-ZA
Boraginaceae	*Heliotropium eurapaeum* L.	Ch	Per	ME
	Heliotropium longiflorum (A.DC.) Jaub. & Spach subsp. *longiflorum*	Ch	Per	ENDMEC
	Heliotropium pterocarpum (DC.) Hochst. & Steud. ex Bunge	Th	Per	SU-ZA
	Eruca sativa Mill.	Th	Ann	ME, IT
	Farsetia linearis Decne. ex Boiss.	Ch	Ann	N.ENDMEC
Brassicaceae	*Farsetia longisiliqua* Decne.	Ch	Ann	SU-ZA
	Farsetia stylosa R.Br.	Ch	Ann	SA-SI+SU -ZA +IT
	Schouwia purpurea (Forssk.) Schweinf.	Th	Ann	ME +SA-SI
	Commiphora africana (A.Rich.) Engl.	Ph	Per	TROP
Burseraceae	*Commiphora kataf* (Forssk.) Engl.	Ph	Per	SA-SI+SU-ZA
	Commiphora myrrha (T.Nees) Engl.	Ph	Per	SA-SI+SU -ZA
	Commiphora schimperi (O.Berg) Engl.	Ph	Per	SU+ZA
Cactaceae	*Opuntia ficus-indica* (L.) Mill	Ph	Per	SU-ZA
	Cadaba glandulosa Forssk.	Ph	Per	TR
	Cadaba linearifolia (J.Graham) M.R.Almeida	Ph	Per	SA-SI+SU-ZA
	Cadaba rotundifolia Forssk.	Ph	Per	SU-ZA
Capparaceae	*Capparis cartilaginea* Decne.	Ph	Per	SU-ZA
	*Capparis spinosa*L.	Ch	Per	ME
	Maerua angolensis DC.	Ph	Per	SU-ZA
	Maerua crassifolia Forssk.	Ph	Per	SA-SI+SU -ZA
Caryophyllaceae	*Cometes abyssinica* R.Br. ex Wall.	Ch	Ann	SU-ZA
	Polycarpaea spicata Wight ex Arn.	He	Per	SA-SI+TR
	Cleome brachycarpa Vahl ex DC.	He	Ann	SA-SI+TR
	Cleome glaucescens DC.	Ch	Ann	SA-SI
Cleomaceae	*Cleome gynandra* L.	Th	Ann	PAN
	Cleome pallida Kotschy	Ch	Ann	SA- SI
	Cleome scaposa DC.	Th	Ann	SU – ZA
	Cleome viscosa L.	He	Ann	COSM
Commelinaceae	*Aneilema forskaolii* Kunth	Th	Per	SU – ZA
	Commelina benghalensis L.	He	Per	SU – ZA
	Convolvulus arvensis L.	G	Per	COSM
Convolvulaceae	*Convolvulus fatmensis* Kunze	Ch	Per	SA-SI
	Convolvulus glomeratus Choisy	Ch	Per	SA-SI
	Ipomoea pes-caprae (L.) R.Br.	He	Per	PAN
Crassulaceae	*Kalanchoe bentii* C.H.Wright ex Hook f.	Ch (s)	Per	ENDMIC
	Citrullus colocynthis (L.) Schrad.	He	Ann	ME,SA-SI
	Coccinia grandis (L.) Voigt	Ch	Ann	SA-SI+SU -ZA
	Corallocarpus glomeruliflorus (Deflers) Cogn.	Ch	Ann	SA-SI
Cucurbitaceae	*Cucumis melo* L.	Th	Ann	SA-SI
	Cucumis prophetarum subsp. *prophetarum*	Th	Ann	SA-SI+SU -ZA
	Luffa acutangula (L.) Roxb.	Th	Ann	SA-SI
	Momordica balsamina L.	Th	Ann	SA-SI+SU -ZA
Cynomoriaceae	*Cynomorium coccineum* L.	P (s)	Ann	ME,SA-SI
Cyperaceae	*Cyperus rotundus* L.	G	Per	COSM

Family Name	Taxon Name	Life form	Lifespan	Choro types
Euphorbiaceae	*Acalypha fruticosa* Forssk.	Ch	Per	SU- SA
	Chrozophora oblongifolia (Delile) A.Juss. ex Spreng.	Ch	Per	SU-SA
	Euphorbia adenensis Deflers	Th	Per	SU-ZA
	Euphorbia balbisii Boiss.	Th	Per	SU-ZA +ME
	Euphorbia cuneata subsp. *cuneata*	Ph (s)	Per	SU-ZA
	Euphorbia granulata Forssk.	Ch (s)	Per	SU-ZA
	Euphorbia greuteri N.Kilian, Kürschner & P.Hein	Ch (s)	Per	ENDEMIC
	Euphorbia hadramautica Baker	Ch (s)	Per	N .ENDEMIC
	Euphorbia hirta L.	Th	Ann	COSM
	Euphorbia inarticulata Schweinf.	Ch (s)	Per	N.ENDMIC
	Euphorbia indica Lam.	Th	Ann	SU-ZA +ME
	Euphorbia larica Boiss.	Ph	Per	TR+ SA-SI
	Euphorbia schimperi C.Presl	Ch (s)	Per	SA+SU
	Jatropha glauca Vahl	Ch	Per	SU-ZA
	Jatropha pelargoniifolia Courbon	Ch	Per	SU-ZA
	Jatropha spinosa Vahl	Ch	Per	SU-ZA
Fabaceae	*Alhagi graecorum* Boiss.	Ch	Per	SA-SI+SU -ZA
	Cadia purpurea (G.Piccioli) Aiton	Ph	Per	SU-ZA
	Crotalaria incana L.	Th	Per	COSM
	Crotalaria persica (Burm.f.) Merr.	Ch	Per	SA-SI+SU -ZA
	Crotalaria saltiana Andrews	Th	Per	SA-SI+SU -ZA
	Delonix elata (L.) Gamble	Ph	Per	ME. IT
	Indigofera arabica Jaub. & Spach	He	Per	SA-SI+SU -ZA
	Indigofera articulata Gouan	Th	Per	SU-ZA
	Indigofera coerulea var. *coerulea*	Ch	Per	SA-SI+SU -ZA
	Indigofera oblongifolia Forssk.	Ch	Per	SA-SI+SU -ZA
	Indigofera spinosa Forssk.	Ch	Ann	ME
	Lotus garcinii DC.	Ch	Per	SA-SU +TR
	Melilotus officinalis (L.) Lam.	Th	Ann	SU-ZA
	Neltuma juliflora (Sw.) Raf.	Ph	Per	SA-SI
	Parkinsonia aculeata L.	Ph	Per	COSM
	Prosopis cineraria (L.) Druce	Ph	Per	SA-SI+SU -ZA
	Rhynchosia minima var. *memnonia* (Delile) T.Cooke	He	Ann	SU-ZA
	Rhynchosia minima var. *prostrata* (Harv.) Meikle	He	Ann	SU-ZA+SA-SU
	Senegalia asak (Forssk.) Kyal. & Boatwr.	Ph	Per	SU – ZA + SA - SI
	Senegalia hamulosa (Benth.) Boatwr.	Ph	Per	SU-ZA
	Senegalia mellifera (Vahl) Seigler & Ebinger	Ph	Per	SU -ZA
	Senna alexandrina Mill	Ch	Per	SA-SI+SU -ZA
	Senna italica Mill.	Ch	Per	SA-SI+SU -ZA
	Senna occidentalis (L.) Link	Ch	Per	PAN
	Sesbania pachycarpa DC.	Ph	Ann	TROPIC
	Tephrosia purpurea subsp. *apollinea* (Delile) Hosni & El-Karemy	He	Per	SU-ZA
	Vachellia etbaica subsp. *uncinata* (Brenan) Kyal. & Boatwr.	Ph	Per	SU-ZA
	Vachellia flava (Forssk.) Kyal. & Boatwr.	Ph	Per	SU-ZA
	Vachellianilotica subsp. *indica* (Benth.) Kyal. & Boatwr.	Ph	Per	SU- ZA
	Vachellia tortilis subsp. *tortilis*	Ph	Per	SU-ZA
	Zygocarpum yemenense (J.B.Gillett) Thulin & Lavin	Ch	Per	ENDEMIC
Geraniaceae	*Geranium ocellatum* Jacquem. ex Cambess.	Th	Ann	SU-SA +TR +ME
	Monsonia heliotropioides (Cav.) Boiss.	Th	Ann	SA-SU+ TR

Family Name	Taxon Name	Life form	Lifespan	Choro types
	Coleus cylindraceus (Hochst. ex Benth.) A.J.Paton	Ch	Per	SA-SI+SU -ZA
	Endostemon tenuiflorus (Benth.) M.R.Ashby	Th	Ann	SA-SI+SU -ZA
	Lavandula pubescens Decne.	Ch	Per	SA-SI+SU -ZA
	Leucas alba (Forssk.) Sebald	Th	Ann	N.ENDMIC
	Leucas urticifolia var. *urticifolia*	Th	Ann	SA-SI+SU -ZA
Lamiaceae	*Marrubium vulgare* L.	He	Ann	SA-SI+SU -ZA
	Micromeria imbricata (Forssk.) C.Chr.	Th	Ann	SA-SI+SU -ZA
	Ocimum basilicum var. *basilicum*	Ch	Ann	SU-ZA
	Ocimum filamentosum Forssk.	Ch	Ann	SU-ZA
	Ocimum forskaolii Benth.	Ch	Ann	SU-ZA
	Otostegia fruticosa (Forssk.) Schweinf. ex Penz.	Ch	Per	SU-ZA
	Teucrium yemense Deflers	Ch	Per	N .ENDEMIC
Loasaceae	*Kissenia arabica* R.Br. ex Chiov.	Th	Ann	SA-SI
Lophiocarpaceae	*Corbichonia decumbens* (Forssk.) Exell	Th	Ann	SU-ZA + IT
Loranthaceae	*Oncocalyx doberae* (Schweinf.) A.G.Mill. & J.Nyberg	Ep	Per	SA-SI+SU -ZA
	Plicosepalus acaciae (Zucc.) Wiens & Polhill	P	Per	SA-SI+SU -ZA
Lythraceae	*Lawsonia inermis* L.	Ph	Per	PAL
	Abutilon fruticosum Guill. & Perr.	Ch	Per	SU-ZA
	Abutilon pannosum (G.Forst.) Schltdl.	Ch	Per	TR
	Corchorus depressus (L.) Peterm.	Ch	Ann	ME+SA-SI
	Corchorus olitorius L.	Ch	Ann	TR
	Corchorus tridens L.	Ch	Ann	TR
	Grewia erythraea Schweinf.	Ph	Per	SA-SI+SU-ZA
Malvaceae	*Grewia tenax* (Forssk.) Fiori	Ph	Per	SA-SI+SU-ZA+IT
	Grewia velutina (Forssk.) Lam.	Ph	Per	SA-SI+SU-ZA
	Hibiscus vitifolius L.	Ch	Per	PAL
	Senra incana Cav.	Ch	Ann	SU – ZA
	Sida alba L.	Ch	Per	PAN
	Sida cordifolia L.	Ch	Per	SU -SA
	Sterculia africana (Lour.) Fiori	Ph	Per	SU-ZA
Meliaceae	*Azadirachta indica* A.Juss.	Ph	Per	COSM
Molluginaceae	*Glinus lotoides* L.	Ch	Per	SA-SI+SU ZA
	Ficus cordata Thunb.	Ph	Per	ME- IT
Moraceae	*Ficus sycomorus* L.	Ph	Per	SA-SI+SU -ZA
	Ficus vasta Forssk.	Ph	Per	TR + SU - ZA
	Boerhavia diffusa L.	Ch	Per	COSM
Nyctaginaceae	*Boerhavia elegans* Choisy	Ch	Per	TR
	Boerhavia erecta L.	Th	Per	NEO
Orobanchaceae	*Cistanche phelypaea* (L.) Cout.	P (s)	Ann	SA-SI+SU-ZA+ME+IT
	Cistanche rosea Baker	P (s)	Ann	N.ENDMIC
Oxalidaceae	*Oxalis corniculata* L.	G	Ann	COSM
Papaveraceae	*Argemone mexicana* L.	Th	Ann	SA
Phyllanthaceae	*Phyllanthus fraternus* G.L.Webster	Th	Ann	TR + SU - ZA + SA -SI
	Campylanthus pungens Schwartz	Ch	Ann	N.ENDEMIC
Plantaginaceae	*Plantago lanceolata* L.	He	Per	SU-ZA
	Plantago major L.	He	Per	SU - ZA + SA - SI
	Aeluropus lagopoides (L.) Thwaites	G	Per	IT+SA-SI
Poaceae	*Aristida adscensionis* L.	Th	Ann	PAN
	Aristida ferrilateris S.M.Phillips	Th	Ann	SU - ZA + SA - SI

Family Name	Taxon Name	Life form	Lifespan	Choro types
	Cenchrus ciliaris L.	He	Per	SA-SI+SU -ZA
	Cenchrus setigerus Vahl	Th	Per	SU - ZA + SA - SI
	Chloris barbata Sw.	Ch	Ann	SU - ZA + SA - SI
	Cymbopogon schoenanthus (L.) Spreng.	G	Per	SU - ZA + SA - SI
	Cynodon dactylon (L.) Pers.	G	Per	COSM
	Dactyloctenium aegyptium (L.) Willd.	Th	Ann	COSM
	Dactyloctenium scindicum Boiss.	Th	Ann	SU - ZA + SA - SI
	Echinochloa colona (L.) Link	Th	Ann	TR
	Eragrostis ciliaris (L.) R.Br.	Th	Ann	SU-ZA
	Eragrostis papposa (Roem. & Schult.) Steud.	Th	Ann	SU-ZA
	Panicum turgidum Forssk.	G	Per	SA-SI
	Phalaris minor Retz.	Th	Ann	ME+IT
	Setaria barbata (Lam.) Kunth	G	Ann	COSM
	Sporobolus spicatus (Vahl) Kunth	He	Per	SU - ZA + SA - SI
	Stipagrostis hirtigluma (Steud. ex Trin. & Rupr.) De Winter	He	Per	IT+SA-SI
	Tetrapogon villosus Desf.	He	Per	SU - ZA + SA - SI
	Tragus berteronianus Schult.	He	Per	TROP
	Tragus racemosus (L.) All.	Th	Ann	SA-SI+SU -ZA
	Urochloa reptans (L.) Stapf	Th	Ann	SU - ZA + SA - SI
	Zaqiqah mucronata (Forssk.) P.M.Peterson & Romasch.	Ch	Per	SA-SI+SU -ZA
Polygonaceae	*Calligonum comosum* L'Hér.	Ph	Per	SUSA
	Rumex vesicarius L.	Ph	Per	SA-SI
Portulacaceae	*Portulaca oleracea* L.	Th (s)	Ann	COSM
	Portulaca quadrifida L.	Th (s)	Ann	COSM
Pteridaceae	*Actiniopteris radiata* (Sw.) Link	G	Ann.	SA-SI + SU-ZA
	*Adiantum incisum*Forssk.	G	Per	SA_SI+SU_ZA
Resedaceae	*Reseda sphenocleoides* Deflers	Ch	Per	N.ENDMIC
Rhamnaceae	*Ziziphus spina-christi* (L.) Desf.	Ph	Per	SA-SI+SU -ZA
Rubiaceae	*Breonadia salicina* (Vahl) Hepper & J.R.I.Wood	Ph	Per	SA-SI+SU -ZA
	Coptosperma graveolens subsp. *arabicum* (Cufod.) Degreef	Ph	Per	TROPIC
	Pavetta longiflora Vahl	Ph	Ann	ENDMEC
Salvadoraceae	*Pentas lanceolata* (Forssk.) Deflers	Ch	Per	SU-ZA
	Dobera glabra (Forssk.) Juss. ex Poir.	Ph	Per	SU-ZA
	Salvadora persica L.	Ph	Per	SU-ZA
Scrophulariaceae	*Aptosimum pumilum* (Hochst.) Benth.	Th	Ann	SA-SI+SU -ZA
	Scrophularia arguta Aiton	Th	Ann	SU+SA
	Striga angustifolia (D.Don) C.J.Saldanha	P	Ann	SA-SI+TR
	Striga asiatica (L.) Kuntze	P	Ann	SA-SI
	Striga hermonthica (Delile) Benth.	P	Ann	TROPIC
Solanaceae	*Datura innoxia* Mill.	Ch	Ann	COSM
	Datura stramonium L.	Ch	Ann	COSM
	Lycium shawii Roem. & Schult.	Ph	Per	SI-SA+SU-ZA+IT
	Physalis angulata L.	Th	Ann	NEO
	Solanum coagulans Forssk.	Th	Ann	SA-SI+SU-ZA
	Solanum cordatum Forssk.	Th	Ann	TROPIC
	Solanum glabratum Dunal	Ch	Ann	SA-SI+SU-ZA

Family Name	Taxon Name	Life form	Lifespan	Choro types
	Solanum incanum L.	Ch	Per	SU-ZA
	Solanum nigrum L.	Th	Ann	ME+IT
	Solanum villosum Mill.	Th	Ann	SU-ZA+IT+ME
	Withania somnifera (L.) Dunal	Ch	Ann	SA-SI+SU-ZA+IT+ME+TR
Tamaricaceae	*Tamarix aphylla* (L.) H.Karst.	Ph	Per	SU-ZA
Urticaceae	*Forsskaolea tenacissima* L.	Ch	Ann	SA-SI+SU-ZA
Vitaceae	*Cissus quadrangularis* L.	He (s)	Per	SA+SU
	Cissus verticillata subsp. *verticillata*	He (s)	Per	TROPIC
	Balanites aegyptiaca var. *aegyptiaca*	Ph	Per	SA-SI+SU -ZA
	Seetzenia lanata (Willd.) Bullock	Th	Ann	SA-SI
	Tribulus terrestris L.	He	Ann	ME+SU-ZA
	Zygophyllum album L.f.	Ph	Ann	ME+SA-SI
Zygophyllaceae	*Zygophyllum hadramauticum* (Beier & Thulin) Christenh. & Byng	Ch	per	ENDMEC
	Zygophyllum indicum (Burm.f.) Christenh. & Byng	Ch	Per	SA-SI+SU-ZA+IT
	Zygophyllum simplex L.	Th (s)	Ann	SU-ZA+SA-SI

Abbreviations:
Ch = Chamaephytes; Ph = Phanerophytes;Th = Therophytes; He = Hemicryptophytes; G = Geophytes ; P= Parasites; Ep = Epiphytic; Ann. = Annual, , Per. = Perennial.

Life-form Spectrum

Life-form classification using Raunkiaer's method revealed that chamaephytes were the most common life-form group, accounting for 39.66% of the total flora. This was followed by therophytes (26.80%), phanerophytes (20.61%), hemicryptophytes (7.56%), geophytes (4.46%), parasites (2.40%), and epiphytes (0.68%) (Table 2, Fig. 4).

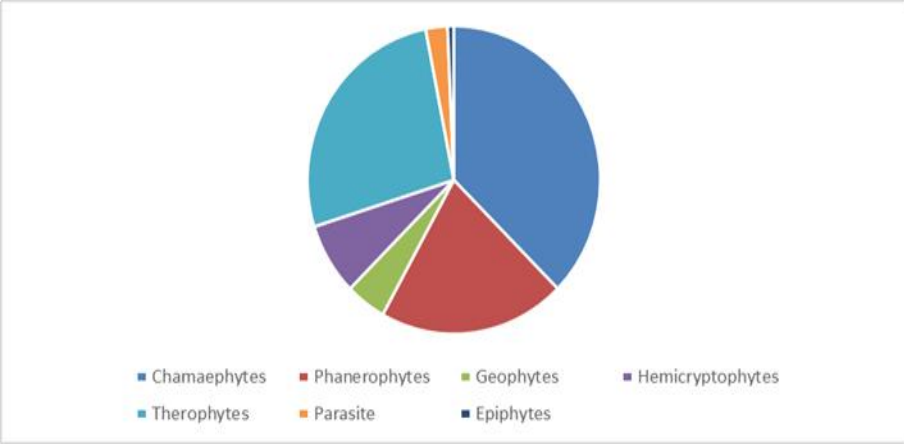

Figure:. (4). Life form spectrum of plants in study area

Table: (2).Life form spectrum of plants in study area

Life form	No. of species	Percentage
Chamaephytes	109	37.45
Phanerophytes	60	20.61
Geophytes	13	4.46
Hemicryptophytes	22	7.56
Therophytes	78	26.80
Parasite	7	2.40
Epiphytes	2	0.68

Total	291	100

.An interesting adaptation was observed in Launaea hafunensis, a geophyte species with tubers that remain dormant underground during dry periods while aerial parts wither, allowing survival in extreme drought conditions (Fig. 5).

Phytogeographical Patterns:

The phytogeographical analysis classified the 291 species into four main categories based on their distribution ranges: mono-regional (51.20%), bi-regional (36.42%), pluri-regional (1.71%), and cosmopolitan (1.65%) (Table 3, Fig. 5). Among the mono-regional elements, Sudano-Zambezian (20.27%) and Saharo-Sindian (17.52%) chorotypes were predominant, reflecting the strong ecological influence of these floristic regions on the local flora. The presence of Arabian endemics (8.59%) further underscores the conservation significance of the study area. Bi-regional species, particularly those exhibiting a combination of Sudano-Zambezian and Saharo-Sindian elements, accounted for a substantial proportion (31.95%), indicating that the study area functions as a transitional zone between two major phytogeographical regions. This convergence contributes to the observed floristic richness and ecological complexity. Pluri-regional and cosmopolitan species were relatively few, highlighting the localized adaptation and ecological specificity of the plant communities in the region.

Table: (3).Chorological types spectrum of Succulent plants in study area

CHOROTYPE	NUMBER OF SPECIES	Percentage (%)
	MONO-REGIONAL	
TR	5	1.71
END- N.END	25	8.59
IT	5	1.71
ME	4	1.37
SA-SI	51	17.52
SU-ZA	59	20.27
SUBTOTAL	149	51.20
	BI-REGIONAL	
ME+IT	1	0.34
TR – SA-SI	1	0.34
ME+SU-ZA	1	0.34
ME+SA,-SI	3	1.030
SU-ZA+SA-SI	93	31.95
TR+SU-ZA	1	0.34
TR+SA-SI	4	1.37
IT+SA-SI	1	0.34
SU-ZA + IT	1	0.34
SUBTOTAL	106	36.42
	PLURI-REGIONAL	
SU-ZA, ME+SA-SI,	1	0.34
IR + TR+ SU - ZA + SA – SI	1	0.34
SA-SI+SU-ZA+IT+ME+TR	1	0.34
SA-SI+SU-ZA+IT	1	0.34
SU-ZA+IT+ME	1	0.34
SUBTOTAL	5	1.71
	WORLDWIDE	
PAL	3	1.030
TROPIC	5	1.71

PAL	4	1.37
NEO	2	0.68
COSM	17	0.058
SUBTOTAL	31	1.65
TOTAL	291	100%

SA-SI = Saharo-Sindian; SU-ZA = Sudano-Zambezian; COSM = Cosmopolitan; ES = Euro-Siberian; IT = Irano-Turanian; ME = Mediterranean; NEO = Neotropical; PAL = Palaeotropical; PAN = Pantropical; TR = Tropical; END = Endemic to Yemen;N/END = Endemic to Arabia.

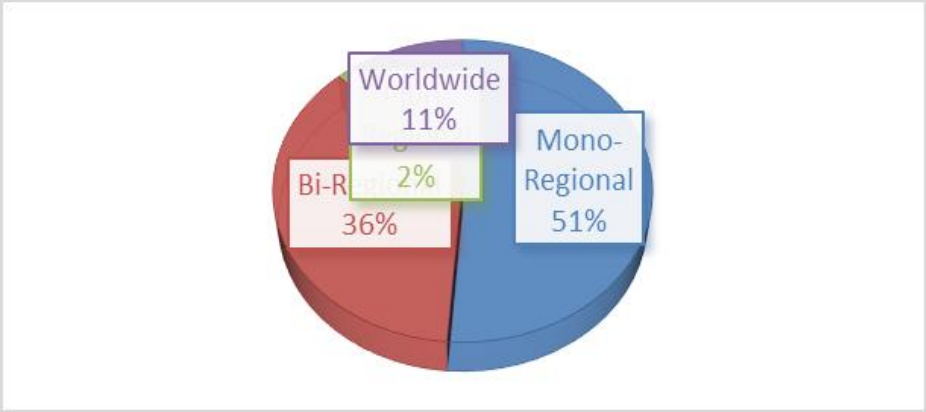

Figure :(5) . Chorological types spectrum of Succulent plants in study area

DISCUSSION

These results are in strong agreement with findings reported from comparable environments across Yemen, Saudi Arabia, Oman, and other parts of the Arabian Peninsula (Al-Sodany *et al*., 2020; Sherwani, 2019; Lamiaa & Yahya, 2019). The dominance of chamaephytes and therophytes in the present study area can be attributed to the combined influence of hot and arid climatic conditions, geological structure, and topographic variability. According to the results of the life-form analysis, chamaephytes were the most abundant group, consistent with the observations of several previous studies (Al-Sodany, 2020; Lamiaa & Yahya, 2019; Sherwani, 2019; Alsherif *et al*., 2013). However, this pattern contrasts with the findings of(El-Kordy *et al*., 2022),(Abbas *et al*., 2020), and(Bahawireth & Bahurmuz , 2018), who reported that phanerophytes were the dominant life forms in their respective study areas.

The prevalence of chamaephytes in the current study region likely reflects the harsh environmental conditions, including high temperatures, low rainfall, and rugged topography, all of which favor species with xerophytic adaptations. Similarly, therophytes are typically associated with arid climates, where they complete their life cycles rapidly during short wet periods and survive as dormant seeds during prolonged drought. The combined effects of high temperature, limited precipitation, topographic variation, and biotic influences contribute to the distinctive structure of vegetation in desert ecosystems. These environmental and microclimatic factors, together with edaphic (soil) conditions, shape the development of desert flora dominated by chamaephytes and therophytes.

A similar therophyte–chamaephyte spectrum has been documented in other desert regions of neighboring countries, including Jabal Al-Ward and the southwestern Tabuk region in Saudi Arabia (Lamiaa & Yahya, 2019), Taif, Saudi Arabia (Al-Sodany *et al*., 2020), and the Muscat Governorate in Oman (Sherwani, 2019). The species Launaea hafunensis exhibits notable morphological adaptation to arid environments. It develops underground tubers that remain dormant

beneath the soil surface while its aerial parts wither during dry periods. This species has been classified as a geophyte and is traditionally used as a local food source by inhabitants of the study area.

Phytogeographically, the study area appears to function as a transitional zone between two major floristic regions. This ecological convergence contributes significantly to the floristic richness and structural complexity observed in the vegetation. In contrast, pluri-regional and cosmopolitan species were relatively scarce, emphasizing the localized adaptation and ecological specificity of the plant communities inhabiting the area. Notably, the predominance of the Sudano-Zambezian chorotype in the present flora aligns closely with previous research conducted in southern Yemen, including the studies of(Obel *et al*., 2025) and (Al-Hawshabi *et al* ., 2025), both of which reported a similar dominance of this floristic element within their respective regions.

CONCLUSION

This study highlights the significant floristic diversity and ecological complexity of a semi-arid region in southern Yemen. The identification of 291 plant species, dominated by perennial life forms and adapted structural types such as chamaephytes and therophytes, reflects the resilience of the local vegetation to harsh environmental conditions including drought, high temperatures, and edaphic variability.

The life-form spectrum suggests a chamaeo-therophytic phytoclimate, while the phytogeographical analysis reveals the study area as a biodiversity-rich transitional zone between the Sudano-Zambezian and Saharo-Sindian floristic regions. The presence of numerous endemic and bi-regional species underlines the unique biogeographical value of the area and its ecological sensitivity.

Given the floristic richness and the dominance of drought-adapted and regionally restricted taxa, it is strongly recommended that this region be recognized as a priority for biodiversity conservation. Conservation efforts should focus particularly on gravel plains and wadis, which harbor high species density and ecological significance. In addition, further ecological and phytosociological studies are needed to:Monitor plant population dynamics under climate variability.Assess threats such as overgrazing and habitat degradation. Inform local conservation policies and protected area designThe results of this study contribute valuable baseline data for the national flora of Yemen and can serve as a reference for future ecological assessments in arid zones of the Arabian Peninsula

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