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Systematic composition, species diversity and plant chorology at Wadi Tashar, Jazan, Saudi Arabia

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Abstract
Wadi Tashar the border regions Near Yemen frontier, it is more favorable for plant growth The present studies concerned with analysis of floristic composition in addition to the vegetation analysis. A total of 89 species belonging to 68 genera and 27 families were recorded from various sample plots and attached areas. Biological spectrum showedthe most highly represented families were Poaceae, Euphorbiaceae and Amaranthaceae. where therophytes constituted 42% 31 species (35%) of the total species. Phanerophytes in this area represented by 11 species (12%), Only 10 species (11%) constituted cryptophytes. The highest species richness values are recorded in the wadi bed. The lowest species richness value are recorded in the wadi plateau. Chronological analysis revealed bi regional elements of Saharo-Arabian together Sudano-Zambezian have the highest share of species, representing 29 species followed by the Saharo-Arabian region elements at 21 taxa (23%), flowed tropical plants only by 9 species (10%), 8 cosmopolitan species (7%) present in the study. Irano-Turanian and Mediterranean are represented by five species representing 4%. Pluriregional elements that belong to the Saharo-Arabian and Mediterranean and Sudano-Zambezian representing 2% has only one species.

Keywords: Systematic composition, species diversity, life forms, chorology, Wadi Tashar

Introduction
Saudi Arabia is a huge arid desert with an area of about 2,250,000 km2 and covers the majority of the Arabian Peninsula It is approximately located between latitude 15˚45'N and 34˚35'N and between longitudes 34˚40'E and 55˚45'E. The flora of Saudi Arabia consider the richest biodiversity areas in the Arabian Peninsula and comprises important genetic resources of crop and medicinal plants and xerophytic vegetation which make up the prominent features of the plant life in the kingdom (Zahran, *et al*., 1985) [21]. South-western region of Saudi Arabia is unique with regard to its nature, landform, climate and water availability (Abulfatih, 1981) [1]. Several studies on plant communities and floristic of Saudi Arabia were done (Vessey 1955, Baierle *et al.* 1985, Younes *et al.* 1983; Batanouny 1979, Batanouny & Baeshin, 1983 and Kasem and Marei (2017) [19, 7, 21, 8, 9, 20]. Also, A1-Sherif, *et al*. (2013) recognized Jazan region geomorphologically, into three main sectors Mountains; E1-Sarwat mountains, Plains: Tihamah coastal plains and Islands: including those between Jazan city and Farsan Islands. Recently, Al-Farhan *et al*., 2005 [3] and Masrahi (2012) [15] described the vegetation characteristics of wild plant of jazan Wadis represent one of the most prominent desert landforms, exhibiting physiographic irregularities that lead to parallel variation in species distribution (Kassas & Batanouny, 1984) [12]. The distribution Life-form is closely related to topography and landform (Zohary, 1973; Orshan, 1986; Fakhireh *et al*., 2012) [23, 16, 11]. Life-form composition is typical of desert flora; the majority of species are therophytes and chamaephytes. Wadi vegetation in general is not constant. It varies from year to year depending upon moisture levels (Siddiqui & Al-Harbi, 1995) [18]. Wadi Tashar the border regions (about 40 km) near Yemen frontier, are more favorable for plant growth as most of the silty regions of the wadi are wet due to stagnant water. Aims of the work is to analyses the vegetation of the Wadi Tashar, Jazan, Saudi Arabia in terms of species floristic composition, life-form, chorotype which in turn help us to assess the plant wealth and its potentiality of any given area and understanding the basic aspects of biology such as speciation, isolation, endemism and evolution.

Study Area

Wadi Tashar is also located in the western part of Saudi Arabia, between the Al-Sirgah coastal plain in the east and the Al-Tuwal coast in the west, and it extends between 16^0 32` N latitude $43^0$ 05`E longitude (Figure 1). Wadi Tashar is situated between 100 k m above sea level, the border regions near Yemen frontier, are more favorable for plant growth as most of the salty regions of the wadi are wet due to stagnant water. The average annual temperature is 28.3 °C; January is the coldest month with the lowest average temperature (26^0C), and the hottest month is August with the highest average temperature (40°C). The maximum rainfall (15.0 mm) was estimated during August, while the minimum of about 5.0 mm was attained during January (Fig. 2).

Materials and Methods

Sample sites

Several field trips carried out in the study area for collecting plants specimens between September 2016 to March 2017. Locations and sample plots were selected to represent a wide range of physiographic and environmental variation in each tributary. In each location, sample plots were selected randomly Map of the study area is given in Fig. 1. The vegetation sampling involved listing all plant species at the sample plots. The plant cover of each species was estimated according to the Zurich-Montpellier technique (Braun-Blanquet, 1965) [10]. The collected plant specimens were identified and named according to Chaudhary (2001), Al-Farhan (2005) [3], Migahid (1996) [13], Plant specimens were deposited in Jazan University Herbarium, KSA (JAZUH), Biology Department, Faculty of Science. life-forms were determined according to the location of regenerative buds and the parts shed during the unfavorable season (Raunkiaer, 1934). A chronological analysis of the floristic categories of species was made to assign the recorded species to world geographical groups, according to Wickens (1978) [25] and Zohary (1973) [23].

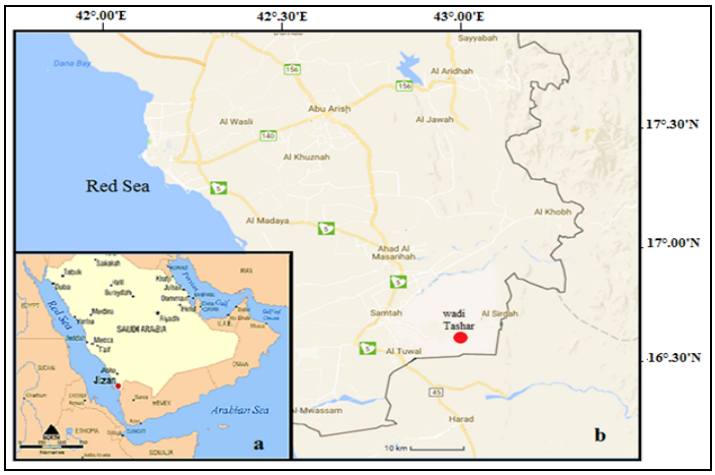
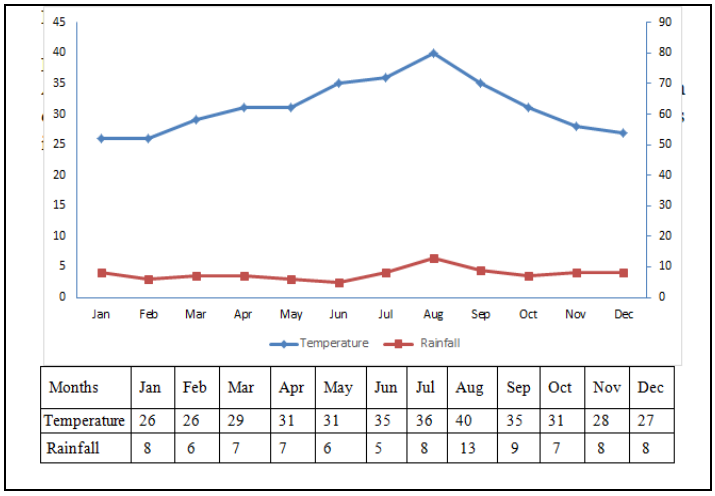


Fig 1: a. Location of jazan Region in Saudi Arabia, b. Location map of the studied area showing wadi Tashar

Results and Discussion

Floristic Diversity

A total of 89 species belonging to 68 genera and 27 families were recorded from different sample plots and attached areas. the Poaceae was the most abundant family comprising 20% of the total taxa (Table 2 and Fig. 3), with 18 species. These floristic findings were in accordance with those of Kasem and Marei (2017) [20], followed by Euphorbiaceae in which 12 species related to 6 genera. Another four families named of Amaranthaceae, Apocynaceae, Aizoaceae, Malvaceae and Zygophyllaceae are contributed nearly the majority of the total flora in the wadi. Asteraceae, Cyperaceae, Cucurbitaceae, Mimosaceae, Tiliaceae, Nyctaginaceae and Portulacaceae represented by two species.Heliotropiaceae and Moraceae have only one species.



Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature	26	26	29	31	31	35	36	40	35	31	28	27
Rainfall	8	6	7	7	6	5	8	13	9	7	8	8

Fig 2: Monthly average temperature and rainfall in the study area

Table 1: List of plant species recorded in the studied area with their families, life forms and chorotypes. Ph= Phanerophytes; Ch= Chamaephytes; Cr= Cryptopyte, and Th=Therophytes. COSM = Cosmopolitan, TR = Tropical, PAN = Pantropical, SA = Saharo-Arabian, SZ = Sudano-Zambezian, Me = Mediterranean, and IT = Irano-Turanian

Taxa	Family	Life form	Life span	Chorotype
Achyranthes aspera L	Amaranthaceae	Ch	Per	Me + SA
Aerva javanica (Burm.f.) Juss		Ch	Ann	SA + SZ
Aerva lanata (L.) Juss.		Th	Per	TR
Amaranthus graecizans L.		Th	Ann	SA + SZ
Amaranthus viridis L.		Th	Ann	COSM
Digera muricata (L.) Mast.		Th	Ann	TR
Eclipta prostrata (L.) L.	Astracaee	Th	Per	Me + SA
Pluchea dioscoridis (L.) DC.		Ch	Per	SA+SZ
Asphodelus tenuifolius Cav	Asphodelaceae	Cr	Ann	SA+SZ
Calotropis procera L	Apocynaceae	Ph	Per	SA + SZ
Desmidorchis retrospiciens (Forssk.) Plowes		Ch	Per	SA + SZ
Leptadenia pyrotechnica (Forssk.) Decne		Ph	Per	SA + SZ
Pentatropis nivalis (Gmel.) Field & Wood		Ch	Per	SA +SZ
Glinus lotoides L.	Aizoaceae	Th	Ann	SZ
Sesuvium sesuvioidus (Fenzl) Verdc		Ch	Per	TR
Trianthema portulacastrum L.		Th	Ann	SA
Trianthema sheilae A.G. Miller		Th	Ann	SA
Zaleya pentandra (L.) Jeffrey		Th	Ann	SZ
Cleome gynandra L.	Cleomaceae	Ch	Ann	SA + SZ
Dipterygium glaucum Decne		Ch	Ann	SZ
Cyperus alopecuroides Rottb. Descr	Cyperaceae	Cr	Ann	PAN
Cyperus conglomeratus Rottb.		Cr	Ann	SA
Cyperus laevigatus L.		Cr	Ann	SA
Citrullus colocynthis (L.) Schrad	Cucurbitaceae	Ch	Ann	SA + SZ
Momordica balsamina L.		Ph	Ann	TR
Chamaecrista nigricans (Vahl) Greene	Caesalpiniaceae	Ph	Ann	SA + SZ
Prosopis juliflora (Sw.) DC		Ph	Per	SA
Senna italica Mill		Ch	Per	SZ
Senna alexandrina Mill.	Euphorbiaceae	Ch	Per	SA + SZ
Acalypha fruticosa Forssk.		Th	Ann	SA
Acalypha indica L.		Th	Ann	SA
Chrozophora brocchiana Vis.		Ch	Per	SA
Euphorbia arabica T. Anderson		Th	Ann	SA
Euphorbia chamaepeplus Boiss. & Gaill		Th	Ann	ME+IT
Euphorbia hirta L.		Th	Ann	COSM
Euphorbia inaequilatera Sond.		Th	Ann	SA
Euphorbia granulata Forssk		Th	Ann	SA+ SZ
Euphorbia peplus L.		Th	Ann	ME+IT
Jatropha pelargoniifolia Courb.		Ch	Per	SA+SZ
Ricinus communis L.		Ph	Per	TR
Heliotropium pterocarpum (DC.) Steud. & Hochst	Heliotropiaceae	Ch	Ann	SA + SZ
Abutilon pannosum (G. Forst.) Schlecht.	Malvaceae	Ch	Per	TR
Abutilon fruticosum Guill. & Perr.		Ch	Per	SA + SZ
Malva parviflora L.		Th	Ann	ME+IT
Senra incana Cav		Ch	Per	SA + SZ
Acacia ehrenbergiana Hayne	Mimosaceae	Ph	Per	SA + SZ
Acacia tortilis (Forssk.) Hayne		Ph	Per	SA + SZ
Boerhavia diffusa L.	Nyctaginaceae	Ch	Ann	SA+TR
Boerhavia repens L.,		Ch	Ann	TR
Ficus populifolia Vahl,	Moraceae	Ph	Per	SA + SZ
Indigofera argentea Burm	Papilionaceae	Ch	Ann	SZ
Indigofera oblongifolia L.		Ch	Per	SZ
Tephrosia purpurea (L.) Pers.		Ch	Ann	SA
Aristida mutabilis Trin. & Rupr	Poaceae	Th	Ann	SA
Cenchrus pennisetiformis Hochst. & Steudel		Th	Ann	SA + SZ
Cynodon dactylon (L.) Pers.		Th	Ann	COSM
Dactyloctenium aegyptium (L.) Willd		Th	Ann	COSM
Dactyloctenium aristatum Link, Hort		Th	Ann	SA
Dactyloctenium scindicum Boiss.		Th	Ann	SA + SZ
Dichanthium annulatum (Forssk.) Stapf		Cr	Per	SA
Dichanthium foveolatum (Delile) Roberty		Cr	Per	SA+ TR
Desmostachya bipinnata L. Stapf		Cr	Per	SA + SZ
Digitaria ciliaris (Retz.) Koel		Th	Ann	ME+IT
Echinochloa colona (L.) Link		Th	Per	TR
Eragrostis ciliaris (L.) R. Br		Cr	Per	SA+ IT

Ochthochloa compressa (Forssk.) Hilu		Ch	Per	SA
Panicum turgidum Forssk		Cr	Per	SA+ SZ
Poa annua L.		Th	Ann	COSM
Rhynchelytrum repens (Willd.) Hubbard		Th	Per	SA
Saccharum spontaneum L.		Th	Per	SA + SZ
Sporobolus helvolus (Trin.) Dur. & Schinz		Th	Per	SA + SZ
Portulaca oleracea L.	Portulacaceae	Th	Ann	COSM
Portulaca quadrifida L.		Th	Ann	COSM
Ziziphus spina-christi (L.) Willd.	Rhamnaceae	Ph	Per	SA + SZ+ME
Salvadora persica L .	Salvadoraceae	Ph	Per	SA + SZ
Schweinfurthia pterosperma (A. Rich.) A. Br	Scrophulariaceae	Th	Ann	SA
Scoparia dulcis L.		Ch	Per	SA
Datura innoxia Mill.	Solanaceae	Th	Per	COSM
Solanum incanum L.		Th	Per	SA +SZ
Withania somnifera (L). Dunal.		Ch	Per	SA+ TR
Tamarix nilotica L.	Tamaricaceae	Ph	Per	SA
Corchorus depressus (L.) Stocks	Tiliaceae	Th	Ann	SA+ TR
Corchorus olitorius L.		Th	Ann	TR
Typha domingensis (Pers.) Poir	Typhaceae	Cr	Per	SA
Phyla nodiflora (L.) Greene	Verbenaceae	Ch	Per	SA+SZ
Fagonia indica Burm. f.	Zygophyllaceae	Ch	Per	SA
Fagonia schweinfurthii (Hadidi) Hadidi		Ch	Per	SA+IT
Zygophyllum *simplex* L.		Ch	Ann	SA
Tribulus terrestris L.		Th	Ann	ME+SZ

Life form

From the vegetation analysis, life form varied between the studied taxa where therophytes constituted 38 species (42.69%) of the total species. Phanerophytes in this area represented by 12 species (13.48%), Only 10 species representing cryptophytes constituted 11.23% (Table 1; Fig. 3). the dominance of therophytes, chaemophytes and phanerophytes over other life forms are seen to be a response to the hot dry climate (Abd El-Ghani and Abd El-Khalik, 2006) [2]. Therophytes have the highest contribution followed by chameophytes indicating the adjustment of the flora to water balance.

Table 2: Systematic composition of the studied flora families in the study area

No	Family	Genera	Species	Habit		
				Tree	shrub	Herb
1	Amaranthaceae	4	6			+
2	Asteraceae	2	2			
3	Asphodelaceae	1	1			+
4	Apocynaceae	4	4		+	
5	Aizoaceae	1	5			+
6	Cleomaceae	2	3			+
7	Cyperaceae	1	2			+
8	Cucurbitaceae	2	2			
9	Cesalpaniaceae	3	3			+
10	Euphorbiaceae	6	12	+	+	+
11	Heliotropiaceae	1	1			
12	Malvaceae	3	4			
13	Mimosaceae	1	2			
14	Moraceae	1	1	+		
15	Nactyginaceae	1	2			
16	Papilionaceae	2	3			+
17	Poaceae	14	18			+
18	Portulacaceae	1	2			+
19	Rhammanaceae	1	1			
20	Salvadoraceae	1	1			
21	Scrophulariaceae	2	2			+
22	Solanaceae	3	3			+
23	Tamaricaceae	1	1	+		
24	Tiliaceae	1	1			+
25	Typhaceae	1	1			+
26	Verbenaceae	1	1			+
27	Zygophyllaceae	3	4			+

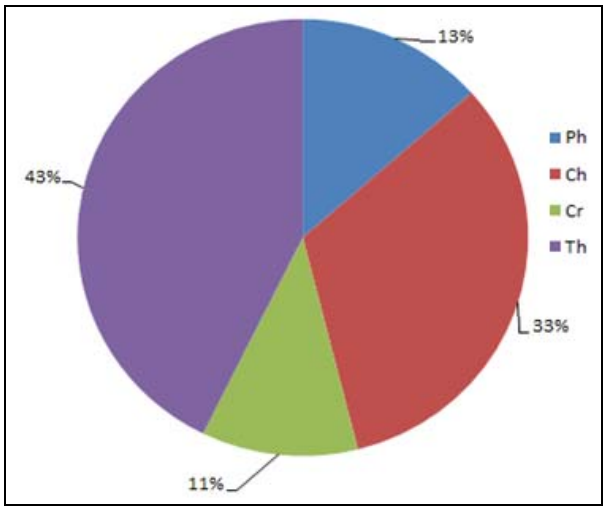


Fig 3: Life-form, relative spectrum of Wadi Tashar. Ph = phanerophyte, Ch = chamaephyte, Th = therophyte, and Hy = hydrophyte

Chorology

Chronological analysis in the study area revealed bi regional elements of Saharo-Arabian shared Sudano-Zambezian have the highest share of species, representing 29 species represented a large sector of the study area (3258%) of the total species, followed by the Saharo-Arabian region elements at 22 taxa (24.71%), flowed tropical plants only by 9 species (10.11%), It is clear that, 8 cosmopolitan species (9%) present in the study. Irano-Turanian shared Mediterranean are represented by four species representing 4.49%. Pluriregional elements that belong to the Saharo-Arabian and Mediterranean and Sudano-Zambezian representing 1.12% has only one species also the systematic composition included one species in panatropical region Saharo-Arabian and Mediterranean. (Table 3; Fig. 4).

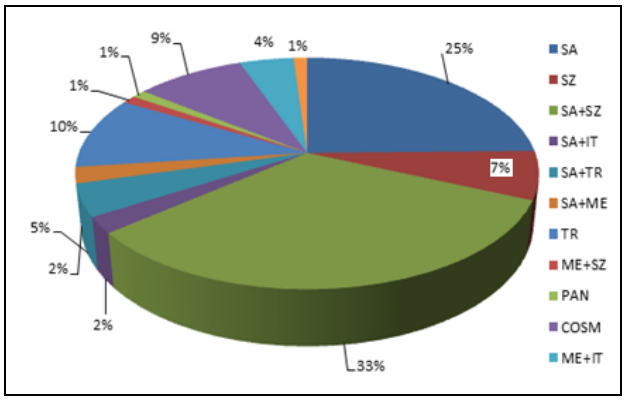


Fig 4: Floristic category spectrum of Tashar. COSM = Cosmopolitan, TR = Tropical, PAN = Pantropical, SA = Saharo-Arabian, SZ = Sudano-Zambezian, Me = Mediterranean, and IT = Irano-Turanian

Biological spectrum in the study area revealed the life forms are diverse but the therophyte and chameophytes are the dominant. Six families named of Amaranthaceae, Apocynaceae, Aizoaceae, Euphorbiaceae, Malvaceae, Poaceae, and Zygophyllaceae are contributed nearly the majority of the total flora in the wadi. Table 2 indicated all of the growth types in this study are wild plants. Annual species 45 species (50.56%), while the perennial species are represented by 44 species (49.43%). As well, presence of phanerophytes which represented by 12 species excluded that the flora in wadi bed is tertiary dominated with woody plants (shrub, under shrub and trees). Also displayed the level of woody flora management by the farmers the use of woody species as green fertilizers and assisted natural regeneration. These results coincide with the findings of Al-Turki and Al-Olayan (2003) [6] and Soulé *et al*. (2016) [17].

Table 3: Tubular summary showing the total number of families, genera and species, growth types and life forms of collected plants

Total			Growth type			Life Form		
Families	**Genera**	**Species**	**Type**	**Species No.**	**%**	**Form**	**Species No**	**Percentages %**
27	68	89	Annual	45	50.56	Ph	12	13.48
--	--	--	Perennial	44	49.43	Ch	29	32.58
--	--	--	--	--	--	Cr	10	11.23
--	--	--	--	--	--	Th	38	42.69
--	--	--	Total	70	100	Total	89	100

From the results, annual types were 45 species whereas the perennial types were 44 species (Table 3) which in turn indicates the adjustment of the majority of the studied species to water resources in the wadi. Also, the domination of therophytes and chaemophytes as vegetation spectra in desert and semi-desert vegetation in other parts of the Middle East. Moreover, the dominance of therophytes, chaemophytes and phanerophytes over other life forms are seen to be a response to the hot dry climate, topographic variation and human and animal interference (Abd El-Ghani and Abd El-Khalik, 2006 and Al-Shammari *et al*., 2013) [2, 5].

Table 4: Phytochoric distribution of studied plant Species

Phytochoria Type	Species Number	Percentage (%)
Monoregional		
SA	22	24.71
TR	9	10.11
SZ	6	6.74
Total	37	41.56
Biregional		
SA + SZ	29	32.58
SA +TR	4	4.49
ME + IT	4	4.49
SA +ME	2	2.24
SZ+ME	1	1.12
Total	40	44.92
Pleuriregional		
ME+IT+SA	1	1.12
Total	1	1.12
PAN	1	1.12
COSM	8	8,98
Total	11	12.25

Conclusion

The present survey which recorded 89 taxa and represented over one quarter of the checklist recorded before in Jazan area by Masrahi (2013) [15] who identified and described bout 524 species which belong to these floristic structures. The floristic composition of the wadi is rich in species, genera and botanical families due to rainfall water balance. This high diversity in the wadi was due to the abundance of rainfall sources and soil fertility which considered as a biotic factor. Poaceae is the best represented botanical family followed by five families (Amaranthaceae, Aizoaceae, Euphorbiaceae, Malvaceae and Apocynaceae) constituted the main bulk of the wild plants in the study area. The abundance of the Poaceae might be-due to water availability including annual precipitation and soil properties and might therefore be indicative that the growth types in this study are wild plants. Annual species 45 species (50.56%), while the perennial species are represented by 44 species (49.43%). Poaceae is exceedingly well adapted to this environment. This conclusion in accordance with results of Kasem and Marei (2017) [20] on Wadi Khluab of Saudi Arabia. Their predominance makes the phytoclimate of the wadi thero-chameophytic type. In addition, the areas of Saharo-Arabian and Sudano-Zambezian Saharo-Arabian and are the most dominant chorotypes represented more than third of total species. There are some plant species were left unrecorded hence need long term comprehensive study to document. This high diversity in the wadi was due to the abundance of rainfall sources, soil fertility and the diversity of relief (open shallow valleys, mountains and sand dunes) as mentioned by Al-Shammeri (2013).

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