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Phytosociology and distribution of dominant plant community types along the road from fukum khors omerah: A costal area east of Aden, Yemen

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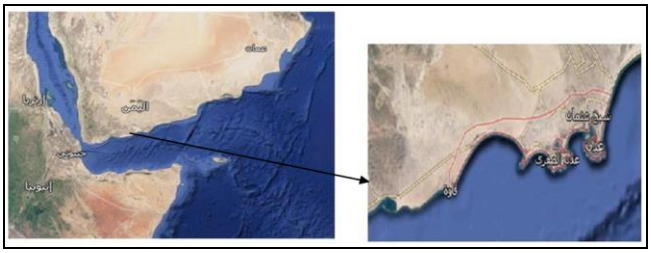
Abstract
This paper is a survey of the plant communities along the road from Fukum, Aden to Khor Omerah, and Lahej on the coast of the Gulf of Aden. The area consists mainly of sandy, sand dunes and salt marshes with few flood flowing paths. The plant vegetation of the area is rather very poor, but the rain helps number of annuals and perennials herbs to grow forming good range for camels and bees, 30 sites with number of stands, were chosen and nine plant communities are found. *Diptergium glaucum* with *Zygophyllum simplex*, play very important role in reproduction of Bees.
Therophytes were the prevailed life forms, indicating a typical desert life-form spectrum (chameo-therophytic) type, followed by Hemicryptophyte. The chorological analysis revealed a total of 14 species representing 46.6 % fell under monoregional, 16 species (53.3%) as biregional area. Somali-Masai (MS) element was the most common.

Keywords: dominant plant community type, life form, phytogeography, chorology

Introduction
Vegetation is an indication of considerable reliability of the environmental gradient, where the number of population and community composition are related to the complex environmental patterns [42, 23, 9]. Most species grown naturally in a range of habits are sufficiently distinctive for the plants to be regarded as separate ecological forms. As plant communities represent ecosystems, the knowledge of these communities and the understanding of the potentials of the associated ecosystems allow for the successful management of those areas [10] especially as different ecosystems react differently to varying management practices [13, 16, 28].
The identification of the plant communities from an area and their description and analysis from ecological, chorological, syntaxonomical, and sindynamical perspectives has a great importance from the scientific and practical point of view. [28]. A good knowledge of plant communities is essential for the conservation of the natural heritage and for developing sustainable landscape management strategies [28]. Plant communities change gradually along environmental gradients [37, 1, 2]. The species distribution reflects the effects of several factors at different scales. Climate, topography and soil are thought to exert influences on the plant distribution at region and landscape [29, 31]. Many authors have found that landscape or physiographic factors play an important role in community organization [11, 27]. Others have demonstrated that soil characteristics are the most important factors in community organization [37, 14, 21, 28].
In the arid regions of many Arab countries, there are considerable studies focused on the effects of environmental factors on plant communities [22, 10, 8, 17, 26, 43, 2]. However, detailed ecological and floristic accounts remain very scarce particularly for the arid land in general and Arabia in specification.
The current levels of understanding of the vegetation of southern part of Yemen are limited to regional classifications conducted on a broad scale such as those undertaken by [5, 4, 6, 3, 15, 24, 18, 32, 33, 35, 36, 39, 40].
The present study aimed to investigate the Dominant plant communities, floristic composition, life-form and chorotype; to classify, document and assess the species diversity between the different community types of the study area.

Study Area
The study area started at Fukum coast up to Khor Omerah village for about 70 km and lies on the east of Aden along the coast of Gulf of Aden and Arabian Sea. The area consists mainly of sand dunes and salt marshes. It extends between 12°46 616'- 12°38 568' N latitude and 44° 43 678'- 44° 07 260' E longitude (Fig. 1). It stretch along the road for around 70 km; altitude ranges from 1-150 m above sea level (asl.). According to Al-Gifri and Hussein (1993) [4] the study area lies within the arid zone and has very hot summers and mild winters; the topography is mostly sandy with some Salt marches (sabakhates) and small dry water running paths (Wadis).
December and January are the coldest months (22˚C) while the hottest month is, July (39˚C). The maximum precipitation (20.0 mm) falls during June, while the minimum precipitation of about 6.0 mm falls during November.
The plant vegetation of the area is rather very poor, but the rain helps number of annuals and perennials herbs to grow forming good range for Camels, Sheep's and Bees. Diptergium glaucum with Zygophyllum simplex, play very important role

in reproduction of Bees and alone used by fisher men to keep the eggs of fishes and Lobster save while using the iron tent box for fishing. (Personal communication with Bee keepers and fisher men at the study area.)



Map 1: Location of the study area, along the east coast of Aden.

Materials and methods

A total of 30 sites with variable number of stands depends on the site size, start from one stand to number of stands up to 7 stands, depending on how large of each site. (Table 1), along the road from coast of Fukum, Aden governorate up to Khor Omerah, Lahej governorate, were randomly selected within the available vegetation cover areas, for surveying the plant vegetation and diversity. The study was conducted during February 2015 that period just one month after good rain at the area. Represents the optimum growing and flowering seasons for almost plant species in the area. The vegetation investigation follow the Broun Blanque Quadrate system of 10X10 m, were the covering percentage of each plant was calculated and figures 5,4,3,2,1 and + (Plus) are used following Broun Blanque (1964) [12] for each stand.

The vegetation analysis follow Whittaker (1978) [42]. The Dominant Community Type (DCT) was used by follow the presence of high covering percentage of each species in each stand.

Life-forms were determined according to Raunkier (1937) [30].

A chorological analysis of the recoded species was made to assign to world geographical groups, according to White & Leonard (1991) [41].

The collected specimens were identified and deposited at Aden University Herbarium.

Altitude and geographical coordinates were measured using GPS (Geographical Position System) for each site see (Table 1).

Table 1: GPS coordinates and soil type for each sites.

Site No.	N. longitude	E. latitude	Soil type
1	12 46 616	044 43 678	Salt marshes
2	12 15 975	044 45 289	Saline soil
3	12 47 566	044 42 562	Sandy soil
4	12 47 009	044 43 304	Sandy with gravels
5	12 46 616	044 43 678	Sandy plain
6	12 48 435	044 40 173	Sandy with water running coarse
7	12 48 335	044 48 635	Sandy with water running coarse
8	12 48 678	044 39 296	Sandy with water running coarse
9	12 48 435	044 40 173	Sandy area
10	12 49 038	044 39 719	Sandy area
11	12 48 835	044 48 635	Sandy area
12	12 48 795	044 32 393	Small Sand dune
13	12 48 610	044 43 059	Small Sand dune
14	12 49 038	044 37 719	Small Sand dune
15	12 46 530	044 28 711	Small Sand dune
16	12 46 902	044 29 454	Sandy area
17	12 48 795	044 32 393	Salt marshes
18	12 45 831	044 25 782	Salt marshes
19	12 45 965	044 26 402	Stable sand dune
20	12 46 166	044 27 243	Stable sand dune
21	12 46 301	044 27 837	Stable sand dune
22	12 46 530	044 28 711	Sandy with clay
23	12 41 540	044 17 121	Sandy with clay
24	12 41 660	044 17 400	Sand dune
25	12 45 831	044 25 787	Sand dune
26	12 39 215	044 10 243	sandy and gravel
27	12 37 229	044 11 945	sandy and gravel
28	12 40 471	044 14 945	sandy and gravel
29	12 41 540	044 17 121	sandy and gravel
30	12 38 568	044 07 260	sandy and gravel

Results

Our finding are summarized in (Tables 2 and 3) as follows:

Dominant Community Types (DCT)

The Distribution of the plant community types among their altitudinal ranges, location, the mean cover abundance values and the description of the nine plant community types as follows:

I- *Halopeplis perfoliata***,** this community type was represented in pure stand in 2stands, at sabakha area between Fukum and

Emran and its abundance cover is about 40 %. See Fig.2.

II-*Zygophullum-Diptergium-Odyssea*, this community type widespread, along the study area it found in seven stands. Associated with *Panicum turgidum, Heliotropium bacciferum* and *Cyperus conglomeratus;* the abundance plant cover is about 60 %.

III-*Zygophyllum simplex*, this community type found in 5 stands and associated with *Diptergium glaucum and Odyssea mucronata*; its vegetation cover is about 45 %. See Fig. 3.

IV-*Heliotropium bacciferum* the dominant community, found at 9 stands and associated with *Diptergium glaucum, Cenchrus ciliaris, Eragrostis papposa, Zygophyllum simplex, Panicum turgidum, Cyprus conglomeratus, polycarpea repens* and *Indegofera argentea.* Its vegetation cover is about 30 %. See Fig. 5.

V- *Diptergium glaucum* community type, found at fine sandy soils, it consisted of eight stands and associated with *Cenchrus ciliaris, Chenopodium murale, Chloris barbata, Cyperus conglomeratus, Zygophyllum simplex* and *Heliotropium bacciferum*, the plant cover abundance about 20%. See Fig.8.

VI-*Calligonum comosum* community type, occupies a large parts of the wadi, located on slopes on sandy soils. It consisted of seven plots, associated with *Zygophyllum simplex, Aerva javanica, Polycarpea repens, Indegofera argentea Chloris barbata,* and *Fagonia indica;* their cover abundance is 50%. See Fig.4.

VII-*Salvadora persica* community type, located at sandy soils, and stable sand dunes represents a large amount in the study area. It consisted of 10 stands and associated with *Chloris barbata, Aristida adscensionis, Cleome viscosa, Cyperus conglomerates, Calotropis procera, Euphorbia granulata* and *Senna italica;* cover abundance about 40%.

VIII-*Pulicaria –Salsola* community type inhabits the wadi bed; consisted of three stands and associated with *Salvadora persica, Calotropis procera, Aristida adscensionis, Cyperus conglomeratus, Leptadenia pyrotechnica, Fagonia paulayana* and *Tephrosia purporea;* cover abundance about 20 %.

IX-*Acacia tortilis* community type, widespread on gravel sandy soils just near of Khor Omerah, it consisted of five stands and associated with *Salvadora persica, Aerva javanica, Anticharis glandlosa, Calotropis procera, Senna italica, Panicum turgidum, Cleome brachycarpea* and *Euphorbia granulate;* their cover abundance about 40%.

Fig 2: The *Halopeplis perfoliata* community type at the salt marshes (sabakhaes)

Fig 3: Sandy area with vegetation cover of *Zygophyllum simplex.*

Table 2: to show the plant species in each site with its covering value and the dominant community type between the bold lines

	Study Sites																												
species names	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Halopeplis perfata	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Odyssea mucronata	-	1	2	1	3	1	+	1	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-
Diptergium glaucum	-	3	2	3	3	+	1	1	3	3	-	-	-	-	1	+	1	+	3	3	2	2	3	+	2	+	1	+	1	+
Zygophyllum simplex	-	3	3	2	1	1	1	1	3	3	3	2	2	2	+	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1
Panicum turgidum	-	-	-	-	1	+	+	1	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	-	-	-	-	-	-	-
Heliotropium bacciferum	-	-	-	-	+	-	-	+	-	-	-	-	-	-	3	3	3	3	4	4	3	4	3	-	-	-	+	+	-	-
Cyperus conglomeratus	-	-	-	-	+	+	+	+	-	-	-	-	-	-	-	+	-	-	+	-	-	+	+	-	-	-	-	-	-	-
Cenchrus ciliaris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	+	-	+	+	-	-	-	-	-	-	-	-
Eragrostis papposa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Polycarpea repens	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-	1	1	1	+
Fagonia indica	-	-	-	-	+	-	+	+	+	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-	-	+	-	-	+
Indegofera argentea	-	-	-	-	-	+	+	+	-	-	-	-	-	-	+	-	+	-	-	-	-	+	+	-	-	-	+	+	+	-
Calligonum comosum	-	-	-	-	-	4	3	4	1	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Salvadora persica	-	-	-	-	-	-	-	-	-	-	2	3	3	3	2	2	3	2	-	-	-	-	-	+	+	+	-	-	-	4
Calotropis procera	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-
Chloris barbata																														
Aristida adscensionis																														
Euphorbia granulata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-	+	+	+	+
Pulicaria glutinosa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2	2	-	-	-	-
Tephrosia purporea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	--	-	-	-		-	-	+	+	+	+	+	+	-	-
Leptadenia pyrotechnica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	+	-	-	-	-	-
Salsola spinescens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	3	+	+	+	+
Fagonia paulayana	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-
Acacia tortilis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	3
Senna italica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	--	-	-	-	-	-	+	-	+	+
Anticharis glandlosa	-	-	-	-	-	-	-	--	-	-	-	-	-	-	--	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1
Cleome brachycarpea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+

Fig 4: *Calligonum comosum* community type

Fig 5: *Heliotropium bacciferum* the dominant community.

Life form spectrum

According to the life form classification of Raunkiaer (1937) [30] and as shown in (Table 3 and Fig. 6), the Therophytes were the most dominant life form, constituted by 16 species representing 53.3% of the total recorded species followed by the chamaephytes represented by 7 species (23.3%). On the other hand, 4 species of the Hemicryptophyte estimated 13.3% were conducted. Also

Phanerophytes were occurred by 2 species (6.6%) of the total recorded taxa. Cryptophytes have the lowest contribution by one species of Cyperus conglomeratus, with a percentage of 3.3%.

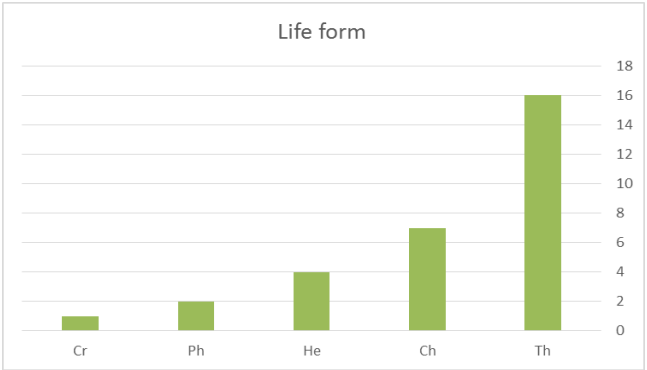


Fig 6: The life form of the study vegetation.

Phytogeographical data

Regarding the global floristic regions, monoregional and biregional are constructed as phytochoria regions (Table 3and Fig 7). A total of 14 species representing 46.6% fell under monoregional region. In this area the highest number of 6 species was recorded in Somali-Masai (20 %), Saharo-

Arabian, Sudano-Zambezian and Pantropic are represented with two species (6.6%) each, whereas the lowest one which estimated by one species of each recoded in Afro-mountain and Iran-Turan regions. Biregional area included the larger number of species (16 species with 53.3%). Also in this region, 8 species (26.6%) shared by Saharo-Arabian and Sudano-Zambezian, Saharo-Arabian and Iran-Turan represented with 4 species (13.3%), Saharo-Arabian and Saharo-Sindian were represented with 2 species (6.6%) whereas the lowest are represented in Saharo-Arabian and tropical as well as Saharo-Arabian and Somali-Masai regions by only one species (3.3%) each.

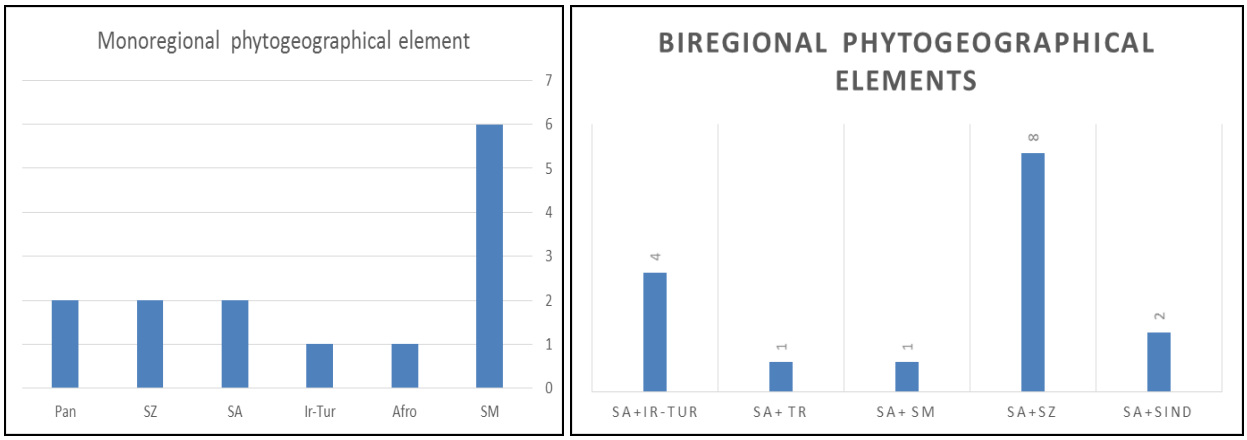


Fig 7: Phytogeographical represents at study area.

Discussion

A total of 30 plant species belonging to 28 genera and 18 families were recorded from study area. The floristic analysis revealed four most families of Poaceae, Chenopidaceae, Zygophyllaceae and Cleomeaceae abundant in the study area. These findings were in accordance with those of Al-Gifri and Hussein. (1993) [4], Saeed and Saleh (2007) [32]. The abundance of the Annual might be due to water availability, including annual precipitation and soil properties, Saeed and Alsubai (2001) [33].

Nine plant dominant community types were identified and described with varying degrees of species richness, evenness and diversity. The ninth plant community (*Acacia tortilis*) exhibited the highest richness (9 species). The increase in the number of samples increased the species encountered (Al-Gifri and Hussein 1993 and Gabali & Al-Gifri 1991) [4, 15]. The community types *Halopeplis perfoliata* (I) and *Zygophyllum simplex* (III) appeared with the lowest species richness, that they represented species from only two and three sample plots respectively. This result could be attributed to variations in their environmental gradients that can limit the ecological distributions of plant species (Lulekal, 2014) [25]. Moreover, the area covered by these plants was large in size and occupied vast area of the quadrates.

On the other hand, *Senna italica,, Odyssea mucronata, Acacia tortilis, Heliotropium bacci, Cleome viscosa, Halopeplis perfoliata, Cyperus conglomeratus* and *Zygophyllum simplex* were recorded from the sample plots of the study area, this result matches that of Al-Gifri and Hussein (1993) [4], as well as, the association of various species in plant communities (I) *Halopeplis perfoliata* and (11I) *Zygophyllum simplex* is in agreement with Kurschner *et al* (1998) [24].

Life forms were diverse and the vegetation is sparse; therophyte were dominant, referring to the ephemeral (or annual) vegetation that can be accompanied by permanent plant growth depending on the amount of precipitation in a given year as indicated with the finding of Al-Gifri (2006) [6]. Moderate cover abundance in the study area may be due to the soil mobility, as indicated by Al-Gifri and Hussein (1993) [4] in their studies along the roadside from Aden to Sheikh Salem (Abyan), Yemen. The intermediate diversity in the study area appears to be due to abiotic factors (temperate rainfall and soil fertility), so the phytoclimate of the study area was classified as thero-chamophytic type.

The dominance of therophytes over other life forms is seen to be an outcome of hot dry climate, topographic variation, human and animal interference (Al-Gifri, 2006 and Saleh 2006) [6, 35]. The high contributions of therophytes lead to adjustment of the flora to water balance. These results are in accordance with several reports proceeded in different regions of Yemen by Alhawshabi *et al*. (2017) Gabali & Al-Gifri (1991) Ibrahim *et al*., (2018) [7, 15, 20].

Biregional area of the Saharo-Arabian, Sudano-Zambezian chorotype were dominated than monoregional area, which is in accordance with Al-Gifri (2006) [5]. It represented less than one third of the total species (26.66%), because this area is mainly deserted and located within the Saharo-Sindian belt. This result was confirmed by the evidence: Saharo-Arabian, Sudano-Zambezian chorotypes percentages reduced due to moving to the north area and are replaced by Mediterranean and Irano-Turanian area (Danin and Plitman, 1987; Abd El-Ghani and Amer, 2003) [12, 2].

Table 3: Collected plant species with their families, life forms and chorotypes. Ph., Phanerophytes; Ch., chamaephytes; Cr, Cryptophytes; H, hemi-cryptophytes and Th, therophytes, per=perennial, Ann=Annual, IT=Irano-Turanian, PAN=Panatropical, SA= Saharo-Arabian, SZ=Sudano-Zambezian and TR=Tropical, SM= Somali- Masai

Family	Species	Life form	Habit	Life Span	Chorotype
Amaranthaceae	*Aerva javanica*	Ch.	Sub-shrub	Per	SA+ Ir-Tr
Asclepdiaceae	*Calotropis procera*	nanoPh	Small Tree	Per	SA+ Ir-Tr
	Leptadenia pyrotechnica	Ch.	shrub	Per	SA+ Ir-Tr
Asteraceae	*Pulicaria glutinosa*	He	herb	Per	SM
Boraginaceae	*Heliotropium bacciferum*	He	Herb	Per	SM
Caesalpiniaceae	*Senna italica*	Ch.	Sub-shrub	Per	SA+SZ
Capparaceae	*Diptergium glaucum*	Th	Herb	Annual	SA+SZ
Caryophyllaceae	*Polycarpeae repens*	Th	Herb	Annual	SM
Cleomaceae	*Cleome brachycarpea*	Th	Herb	Ann	SA+TR
	Cleome viscosa	Th	Herb	Ann	SM
Chenopidaceae	*Chenopodium murale*	Th	Herb	Ann	SA+Ir-Tr
	Halopeplis perfoliata	He	Herb	Per	SA-Sind
	Salsola spinescens	Ch.	Sub-shrub	Per	SM
Cyperaceae	*Cyperus conglomeratus*	Cr	Herb	Per	SA
Euphorbiaceae	*Euphorbia granulata*	Th	Herb	Ann	SA
Mimosaceae	*Acacia tortilis*	Micro Ph.	small Tree	Per	SA+SZ
Papilionaceae	*Indegofera argentea*	Th	Herb	Ann	SA+SZ
	Tephrosia purporea	Th	Herb	Ann	SZ
Poaceae	*Aristida adscensionis*	Th	Herb	Ann	SA+SZ
	Cenchrus ciliaris,	Th	Herb	Ann	Pan
	Chloris barbata	Th	Herb	Ann	SZ
	Eragrostis papposa	Th	Herb	Ann	Pan
	Odyssea mucronata	Ch.	Herb	Per	SA-SM
	Panicum turgidum	He	Herb	Per	SA+ SZ
Polygonaceae	*Calligonum comosum*	Ch.	Sub shrub	Per	Ir-Tr
Salvadoraceae	*Salvadora persica*	Ch.	shrub	Per	SA+SZ
Scrophulariaceae	*Anticharis glandlosa*	Th	Herb	Ann	Afro
Zygophyllaceae	*Fagonia indica*	Th	Herb	Ann	SA+Sind
	Fagonia paulayana	Th	Herb	Ann	SA+SZ
	Zygophyllum simplex	Th	Herb	Ann	SM

Conclusions

The floristic composition and community structure along the study area is mainly determined by climatic condition, but it is strongly influenced by the human and its animal's activities, which disturbed the equilibrium of the ecosystem and implicitly affected the entire vegetation types. The results here obtained reflect the physiognomy, floristic composition, and ecology of this plant community in the area, show how poor and delicate the vegetation of the study area.

Fig 8: Bee Hives in *Diptergium glaucum* community type area.

Fig 9: The vegetation is source of fodder for nomad's cattles

References

1. Abd El-Ghani M, Abd El-Khalik K. Floristic diversity and phytogeography of the Gebel Elba national park, southeast Egypt. Turk. J Bot. 2006; 30:121-136.
2. Abd El-Ghani M, Amer WM. Soil-vegetation relationships in a coastal desert plain of southern Sinai,

Egypt. J of Arid Environments. 2003; 55:607-28.
3. Al Khulaidi AA. Environmental and human determinates of vegetation distribution in the Hadhramaut region, Republic of Yemen. A thesis submitted for the degree of Doctor of Philosophy School of Geo Sciences University of Edinburgh, 2006.
4. Al-Gifri A, Hussein MA. Plant Communities along the road from Aden to Sheikh Salem (Abyan). Feddes. Report. 1993; 104:267-270.
5. Al-Gifri AN. Contribution to the vegetation of Hadhramaut, Yemen. J of Natural & Applied Sciences. 2006; 10(2):291-297.
6. Al-Gifri AN, Wadie A Saeed. Vegetation cover and its role in water equilibrium conservation in Yemen. 1st Yemeni workshop for water, Faculty of oil and Minerals, (Shabwa. 1997; (8-10):12. University of Aden.
7. Al-Hawshabi1 OSS, Al-Meisari MAS, MI El-Naggar. Floristic composition, life-forms and biological spectrum of Toor Al-Baha District, Lahej Governorate, Yemen. Current Life Sciences. 2017; 3(4):72-91.
8. Ayyad MA, El-Ghareeb R. Salt marsh vegetation of the western Mediterranean desert of Egypt. Vegetatio. 1982; 49:3-19.
9. Barbourm G, Burk JH, Pitts WD. Terrestrial Plant Ecology. 2nd ed. Massachusetts: Benjamin/Cummings, 1987.
10. Batanouny KH. Vegetation along Jeddah-Mecca road: pattern and process affected by human impact. Journal of Arid Environments. 1979; 2:21-30.
11. Batanouny KH. Plants in the deserts of the Middle East. Springer-Verlag, Heidelberg, 2001.
12. Braun-Blanquet J. Pflanzensoziologie: Grundzüge der Vegetationskunde. 3. Auflage. Springer, New York, 1964, 865 p.
13. Danin A, Plitman U. Revision of the plant geographical territories of Israel and Sinai. Plant Systematics and Evolution. 1987; 156:43-53.
14. El-Bana MI, Li ZQ, Nijs I. Role of host identity in effects of phytogenic mounds on plant assemblages and species richness on coastal arid dunes. Journal of Vegetation Sciences. 2007; 18:635-644.
15. Gabali SA, AI-Gifri AN. A survey of the vegetation of Hadhramaut, Yemen. Frag. Flor. Geobotanica. 1991; 36:127-134.
16. Evenari M. The desert environment, in M. Evenari, I. Noy-Meir and Goodall DW (eds.) Ecosystems of the World. 1985; 12:1-23.
17. Halwagy R, Moustafa AF, Kamel SM. On the ecology of the desert vegetation in Kuwait. Journal of Arid Environments. 1982; 5:95-107.
18. Hussein MA, Saeed WA, Al-Gifri AN. Vegetative composition of wadi Mararah, Hawf, Almaharah, Yemen. J of Natural & Applied Sciences. 2009; 13(2):309-321.
19. Hussein MA, Wadie AG Saeed, Amirah A Awadh. Vegetative composition of plain and lower plateaus of the Costal Area of Abyan Gov. Yemen. Univ. Aden. J Nat and Appl. Sc. 2006; 10(3):439-446.
20. Ibrahim HM, Al-Quhbi HA, Murshed AA, Al-Gifri AN. Influence of the African paleotropical floristic categories on the flora of high-altitude Mountains in Yemen: case study of Jabal An-Nabi Shuáyb, Sana'a, Yemen. Phytologia Balcanica. 2018; 24(1):75-85.
21. Kassas M, Girgis WA. Habitat and plant communities in the Egyptian desert. V. The limestone plateau. Journal of Ecology. 1964; 52:107-119.
22. Kassas M. On the ecology of the Red Sea coastal land. Journal of Ecology. 1957; 45:187-203.
23. Kent M, Coker P. Vegetation Description and Analysis: A practical approach. John Wiley and Sons, New York, 1992, 363.
24. Kürschner H, Al-Gifri AN, Al-Subai MY, Rowaishad AK. Vegetation patterns within coastal saline in southern Yemen. – Feddes Rep. 1998; 109:147-159.
25. Lulekal E. Plant Diversity and Ethno botanical Study of Medicinal Plants in Ankober District, North Shewa Zone of Amhara Region, Ethiopia, and Ph.D. Dissertation. Addis Ababa University, Ethiopia, 2014.
26. Maarel E. Transformation of cover-abundance values in phytosociology and its effects on community similarity. Vegetation. 1979; 39:97-114.
27. Mcnaughton S, Wolf L. General Ecology. Holt, Rinehart and Winston, Inc. New York, 1973.
28. Nuta IS, Niculescu M. Phytosociology, Distribution and Ecology of a Willow Community with False Tamarisk from the Lotru Valley (Romanian Carpathians). Not Bot Horti Agrobo. 2019; 47(3):621-628. DOI:10.15835
29. Orshan G. The desert of the Middle East. In: Evenari M, Noy-Meir I & and Goodall DW (eds.) Ecosystems of the World. 1986; 12:1-28.
30. Raunkiaer C. Life forms of plants and statistical plant geography. Oxford: Clarendon Press, 1937.
31. Ricklefs RE. Ecology. Third Edition. W. H. Freeman and Company, New York, 1990.
32. Saeed WA, Hana A, Rahman Saleh Ali. Survey study of plant Vegetation in the low lands and Costal Area of Aden – Gov. Yemen. J of Natural & Applied Sciences, 2007.
33. Saeed WA, Al-Subai MY. The Effect of the different environmental factors the structure on the vegetation cover in the coastal plants in Abyan Governorate, Yemen. J of Natural & Applied Sciences. 2001; 5(1):71-83.
34. Saeed WA, Hussein MA, Al-Subai MY. Vegetation alone g the road Demghout –Sarfit of (Al-Mahara- gove.).The Yemeni Scientific research Association. Science Conference, 2001. Sanna. 11-13 October. 2001-Yemen, 2000.
35. Saleh HA. Plant Vegetation of the Coastal and Low Land Area in Aden Governorate. MSc. Thesis, Biology Dept., Faculty of Science and Education, University of Aden, Yemen, 2006.
36. Saleh HA. Vegetation of Wadi Tuban, Lahej Governorate, Republic of Yemen. Ph.D. Thesis, Dept. of Biology, Faculty of Science, Sana'a University, 2016.
37. Shaltout KH, El-Kady HF, Al-Sodany YM. Vegetation

Analysis of the Mediterranean region of Nile Delta. Vegetatio. 1995; 116:73-83.
38. Wadie AS, Saleh HA. Survey Study of plant Vegetation in The Lowlands and Costal area of Aden governorate. J of Aden University for Natural and applied sciences. 2007; 11(1):35-45.
39. Wadie AS, Hussein MA, Saleh HA. Survey and Ecological study on the flora of Calder escarpment Jabal Shamsan- Aden governorate, Yemen. J of Aden University for Natural and applied sciences. 2007; 11(3):491-500.
40. Wadie A. Saeed and Mohammed Yousef Al-Subai. The Effect of the different environmental factors the structure on the vegetation cover in the coastal plants in Abyan Governorate, Yemen. J of Aden University for Natural and applied sciences. 2001; 5(1):71-83.
41. White F, Léonard J. Phytogeographical links between Africa and Southwest Asia. Fl. Veg. Mundi. 1991; 9:229-46.
42. Whittaker RH. Classification of plant communities. Dr. W. Junk By publisher, the Huge, 1978, 399 page.
43. Zahran M. Ecology of the United Arab Emirates. Metropole. 1997; 8:297-328.