PLANT COMMUNITIES OF AL TA'AKR MOUNTAIN AND EL SOHOL AREAS,IBB GOVERNORATE, REPUBLIC OF YEMEN

MAREI , A . HAMED

AL AZHAR UNIVERSITY, FACULTY OF SCIENCE, BOTANY AND MICROBIOLOGY DEPARTMENT

ABSTRACT

El Sohol area is lie north of Ibb city and Al Ta'akr mountain of Ibb with altitude 3000 m above sea level and lie south of Ibb city. This study is a phytosociological comparison between two areas which differ from each other in topography: A total of 111 species belonging to 51 families of were recorded in 29 sites of the studied area.Family Asteraceae was the most abundant family, comprising12 species. The families Acanthaceae and Euphorbiaceae represented by 6 species, each Lamiaceae represented by 5 species and Mimosaceae. Moraceae and Poaceae were represented by 4 species.

The plant life form of the studied area showed that the highest recorded life form was for Phanerophytes constituted species representing 37 % of the total species followed by the chaemophytes with 28 species representing 25 %. Therophytes with 26 species representing 23 % . Cryptophytes with 13 species representing 11 % and Hemicryptophytes with only 2 species representing 1.8 % of total species of the work . From AlTa'akrmountain we can summarize the following: Community in plateau dominated by Pennisetum setaceum,near plateau was dominated by Rosa abyssinica in medium and high slopes, also very steep slopes were dominated by Hypericum revolutum, Wadi El Ganat communityArundo donaxwas dominated by in wadi bed, Ziziphus spina-christi dominated in the terraces , Acacia melifera and Acacia etbaica dominated in slopes.In Najed El El Bard,Ziziphus spina-christi dominated in wadi bed , Acacia asak dominated in the terraces of wadi,Acacia etbaica dominated in low slopes of wadi, and Acacia melifera dominated in medium slope of wadi.In El Gabal El Akhader .Ormocarpum dhofarense dominated the low slopes Euphorbia inarticulate dominated in medium slope and plateau of mountain,whileCynodon dactylon high slopes. DECORANA was used to clarify relations among environmental factors and plant distribution. ANOVA was used to detect the most significant factors affecting species distribution. Moisture soilcontent andcalcium content were the most significant factors in determining different ecological groups with P value = 000, followed by chlorides with P value = 0.003 and organic carbon with P value = 0.014 .

INTRODUCTION

It is to be mentioned that Ibb governorate is the greenest region of the Republic of Yemen and is known for its heavy rainfall, water springs and basins. It is also famous for growing coffee, incense trees, sugar cane and many important crops. Beside the most famous Wadies in Ibb e.g(Wadi Bana and Wadi Al-Door) there are also high mountains e.g (Sumarah and AlTa'akr) which makes it such an interesting research point. Ibb governorate has an area of 5253 km2 with 20 districts. Aqlan (2008). Several authors write on the flora of Ibb and described species according to elevation but they not give any information about vegetation cover and communities(Forsskål, 1775). (Lavranos, 1971a, b, c).(Wood, 1997).(Miller and Cope, 1996).Al-Khulaidi & Pole (1989). AndAl-Hubaishi and Mueller (1984) . Aqlan, (2008) surveyed the flora of Ibb governorate by visiting different localities representing various topographical features of the governorate and collected 416 species belong to 294 genera and 95 plant families . Ibb governorate lacks plant communities studies . Recently, Marei , et al. (2016) studied plant communities of Badan mountain of Ibb governorate using modern programs for analysis and described the plant communities in Badan mountain.

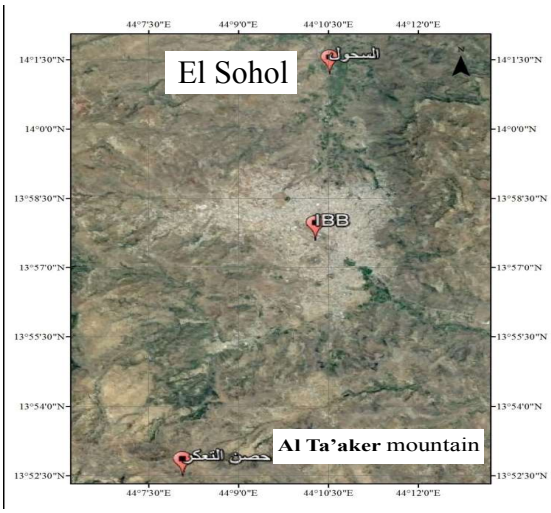
The present the work is comparative study of the plant communities of AlTa'akrmountain and El Sohol area of Ibb governorate according to their ecology and vegetation analysis and interrelated edaphic factors.

THE STUDY AREA

Ibb governorate is called the green province and it belongs to fourtopographical units of the Republic of Yemen. These units are westernmountains, medium altitude of western mountains, high altitude mountainsand highland plains. Ibb governorate consists of twenty districts. These districts extend between (long. 43 o . (Map 1)the study area of the present work including El Sohol area which lie at north from Ibb city and AlTa'akr mountain (3000 m above

sea level.) at south of Ibb city (Map 2). Climatic data of Ibb governorate were obtained as (Statistical year book, 2001-2004). Temperature of Ibb averages between 27.9 ºC in January and 33 ºC in June which represents a limited variability and a moderate temperature along the year. High vegetation density of the area is due to the high precipitation rate. No precipitation was recorded in January, while from October to February precipitation have been recorded. The maximum precipitation rate was recorded in June with 287.5 mm.Records of wind speed showed the highest speed in December with 5.2 knot/s and the lowest in January with 3.4 knot/s. The highest relative humidity records were in August with 69.75%, while the lowest was in March with 47.25%.

Map 1. Administrative map of Yemen showing different governorates of Yemen Republic.



Map 2. Showing El Sohol area (north Ibb city) and Al Ta'aker mountain (south Ibb city).

MATERIALS AND METHODS

Twenty nine sites were selected to represent the vegetation of AlTa'akrmountain and El Sohol area, sites from 1 to8 were located from 2400 to 3100 m above sea level.Elevation of AlTa'akrrmountain, El Sohol area (elevation from 1800 to 2100m above sea level) included the following A: Wadi El Ganat slopes , terraces and wadi bed sites from 9 to to 14 , B: Najed El Bard sites from 15 to 24 and C: El Gabal El Akhdar sites from 25 to 29. These sites were subjectively chosen at locations where either dense vegetation or change in species composition was encountered. For each stand, three soil samples were collected at a depth of 5-30 cm. These samples were then pooled together to form one composite sample. Part of the soil sample was used to determine the soil moisture content after Piper (1950). The rest of the soil sample was air-dried, sieved through 2mm mesh and stored at room temperature for further analyses. Electrical conductivity (EC) and pH were determined in the filtrate of 1:5 soil / distilled water (w/v) extract. Organic carbon (O.C.) was measured according to the method of Piper (1950). Carbonates and chlorides were determined using the method described by Jackson (1967). Calcium and magnesium were determined according to the procedure of Richards (1954). Vegetation of ten quadrates (10×10 m) in each stand was investigated. Floristic composition of the 29 sites were recorded. All plant species existing in each stand were listed after complete identification according to Täckholm (1974), Wood (1997) and Boulos (1999-2009). Voucher herbarium specimens were prepared and kept in the herbarium of the Department of Biology, Faculty of Science, Ibb University. According to Shukla and Chandel (1989) Density (D), percentage of frequency (F), abundance (A), cover (C), relative density (RD), relative frequency (RF), relative abundance (RA), relative cover (RC) and importance value (IV) were calculated for each species in each stand. Data management was performed using PC-ORD ver. 5 (McCune and Mefford, 1999) to run TWINSPAN and DECORANA. (ter Braak, 1988). Analysis of variance (ANOVA) using SPSS ver. 22 (Santoso, 2014) was used to test the most significant soil factors affecting the classification of samples.

RESULTS

A total of 111 species belonging to 51 families were recorded in 29 site of the studied area Family Asteraceae was the most abundant family comprising 12species. The families of Acanthaceae and Euphorbiaceae were represented by 6 species Lamiaceae and Mimosaceae representing by 5 species. Moraceae and Poaceae was represent by4species.The plant life form of the studied area showed that the highest life form recorded was Phanerophytes comprising 37 % of the total species followed by the Chaemophytes with 28 species (representing 25 %of total species). Therophytes with 26 species representing 23%, Cryptophytes with 13 species representing 11 % and Hemicryptophytes with only 2 species representing 1.8 % of total species of the work (Table 1).

Table 1:Plant species recorded in Ibb (Al Ta'akr mountain and El Sohol) P = Present. m= meter elevation above sea level.

Family	Species	Life form	Ibb		Abbreviation in TWINSPAN
			Al Ta'akr mountain 3000 m	AlSohol 1900 m	
Acanthaceae	*Barleria trispinosa* (Forssk.) Vahl.	Phanerophyte.		P	*Bartri*
	Blepharis ciliaris (L.) B.L. Burtt.	Hemicryptophyte.		P	*Blecil*
	Hypoestes forskalii (Vahl.) R. Br.	Chamaephyte.		P	*Hypfor*
	Justicia flava (Vahl.) Vahl.	Chamaephyte.		P	*Jusfla*
	Ruellia patula Jacq.	Hemicryptophyte	P	P	*Ruepat*
	Acanthus arboreus Forssk.	Phanerophyte.	P	P	*Acaarb*
Actinopteridaceae	*Adiantum capillus-veneris* L.	Cryptophyte	P		*Adicap*
Agavaceae	*Agave sisalana* Perr.	Phanerophyte.		P	*Agasis*
Aloeaceae	*Aloe inermis* Forssk.	Cryptophyte		P	*Aloine*
.Amaranthaceae	*Aerva javanica* (Burm. F.) Juss. ex Schult.	Chamaephyte.		P	*Aerjav*
	Amaranthus lividus L *Alternanthera pungens* Kunth.	Therophyte. Therophyte.	P	P P	*Amaliv*
Apiaceae	*Ferula communis* L.	Chamaephyte.	P		*Fer com*
Apocynaceae	*Adenium obesum* (Forssk.) Roem. & Schult.	Phanerophyte	P P	P	*Adeobe*
Asclepiadaceae	*Caralluma cicatricosa* (Deflers) N. E. Br.	Chamaephyte.		P	*Carcic*
	Ceropegia rupicola Defl.	Chamaephyte.		P	*Cerrup*
	Kanahia laniflora (Forssk.) R. Br.	Phanerophyte.		P	*Kanlan*
Asparagaceae	*Asparagus falcatus* L.	Phanerophyte.	P	P	*Aspfal*
Asphodelaceae	*Kniphofia sumarae* Deflers	Cryptophyte.	P		*Kni sum*
Asteraceace	*Echinops spinosissimus* Turra	Chamaephyte.	P		*Echspi*
	Kleinia anteuphorbium (L.) DC	Chamaephyte.		P	*Kleant*
	Osteospermum vaillantii (Decne.) T. Norlindh	Therophyte	P	P	*Ost vai*
	Senecio hadiensis	Phanerophyte.	P	P	*Senhad*

	Tagetes minuta L.	Therophyte		P	*Tagmin*
	Xanthium strumarium L.	Therophyte	P	P	*Xanstr*
	Sonchus oleraceus L.	Therophyte	P		*Sonole*
	Pluchea dioscoridis (L.) DC.	Phanerophyte.		P	*Pludio*
	Centaurea pseudosinaica Czerep.	Chamaephyte.		P	*Cenpse*
	Centaurothamnus maximus (Forssk.) Wagenitz & Dittrich	Phanerophyte.	P		*Cenmax*
	Psiadia punctulata (DC.) Vatk *Flaveria trinervia* (Spreng.) Mohr.	Phanerophyte. Therophyte	P P	P	*Psipun* Fla tri
Boraginaceae	*Heliotropium europaeum* L.	Therophyte		P	*Heleur*
	Trichodesma ehrenbergii Schweinf. ex Boiss.	Therophyte	P		*Triehr*
Burseraceae	*Commiphora habessinica* (Berg.) Engl.	Phanerophyte.		P	*Com hab*
Cactaceae	*Opuntia ficus-indica* (L.) Miller	Phanerophyte.		P	*Opu fic*
Caeslpinaceae	*Ceratonia siliqua* L.	Phanerophyte.		P	*Cersil*
	Senna italica Miller	Chamaephyte.		P	*Sen ita*
	Senna occidentalis (L.) Link	Therophyte			*Sen occ*
Campanulaceae	*Campanula edulis* Forssk.	Chamaephyte.		P	*Cam edu*
Capparaceae	*Cadaba farinose* Forssk.	Phanerophyte.		P	*Cad far*
Chenopodiaceae	*Chenopodium murale* L.	Therophyte.		P	*Che mur*
Convolvulaceae	*Convolvulus arvensis* L.	Chamaephyte.		P	*Conarv*
	Seddera arabica (Forssk.) Choisy.	Phanerophyte	P		*Sed ara*
	Ipomoea purpurea (L.) Roth.	Therophyte		P	*Ipo pur*
Caryophyllaceae	*Spergularia rubra* (L.) J&C. Prosl.	Therophyte	P		*Spe rub*
Cyperaceae	*Cyperus rotundus* L.	Cryptophye		P	*Cyprot*
Dipsacaceae	*Scabiosa columbaria* L.	Chamaephyte.	P		*Scacol*
Dracaenaceae	*Sansevieria ehrenbergii* Schweinf. ex Baker.	Cryptophyte.	P	P	*San ehr*

Euphorbiaceae	*Euphorbia ammak* Schweinf.	Phanerophyte		P	*Eup amm*
	Euphorbia cactus Ehrenb. ex Boiss.	Phanerophyte		P	*Eupcac*
	Euphorbia hirta L.	Therophyte.	P		*Euphir*
	Euphorbia peplus L.	Therophyte		P	*Euppep*
	Euphorbia inarticulate Schweinf	Phanerophyte		P	*Eupina*
	Jatropha curcas L.	Phanerophyte		P	*Jatcur*
Fabaceae	*Indigofera spinosa* Forssk.	Chanerophyte.		P	*Indspi*
	Indigofera hochstetteri Bak.	Therophyte.		P	*Indhoc*
	Ormocarpum dhofarense Hillcoat & Gillett	Phanerophyte	P	P	*Ormdho*
	Cadia purpurea (Picc.) Ait.	Phanerophyte		P	*Cadpur*
Geraniaceae	*Geranium arabicum* Forssk.	Chamaephyte.	P	P	*Gerara*
	Geranium biuncinatim Kokwaro	Therophyte.	P		*Gerbiu*
Hypericaceae	*Hypericum revolutum* Vahl.	Phanerophyte	P		*Hyp rev*
Lamiaceae	*Thymus laevigatus* Vahl.	Chamaephyte.	P	P	*Thy lae*
	Plectranthus barbatus Andr.	Chamaephyte.	P	P	*Plebar*
	Mentha longifolia (L.) L.	Chamaephyte.	P	P	*Menlon*
	Mentha Piperia L.	Chamaephyte.	P		Men pip
	Morrubium vulgare L .	Chamaephyte.	P		Mor vul
Malvaceae	*Abutilon fruticosum* Guill. & Perr.	Phanerophyte.		P	*Abu fru*
	Hibiscus deflersii Schweinf. ex Cufod.	Phanerophyte		P	*Hibdef*
	Hibiscus trionum L.	Therophyte	P		*Hibtri*
	Malva parviflora L.	Therophyte.		P	*Malpar*
Mimosaceae	*Acacia asak* (Forssk.) Willd.	Phanerophyte Phanerophyte		P	*Aca asa*
	Acacia etbaica Schweinf.	Phanerophyte		P	*Acaetb*
	Acacia mellifera (Vahl.) Benth	Phanerophyte		P	*Acamel*
	Acacia origena Asfaw	Phanerophyte		P	*Aca ori*
Moraceae	*Dorstenia foetida* (Forssk.) Schweinf.	Chamaephyte.		P	*Dor foe*
	Ficus populifolia Vahl.	Phanerophyte		P	*Ficfoe*
	Ficus cordata Thunb.	Phanerophyte		P	*Fic car*
Nyctaginaceae	*Mirabilis jalapa* L.	Chamaephyte	P	P	*Mirjal*
	Commicarpus	Chamaephyte.		P	*Com gra*

	grandiflorus (A. Rich.) Standl.				
Oleaceae	*Jasminum grandiflorum* L.	Phanerophyte.		P	*Jas gra*
Orchidaceae	*Holothrix arachnoidea* (A. Rich.) Reichb. f.	Cryptophyte.	P		*Hol ara*
Orobanchaceae	*Cistanche phelypaea* (L.) Cout.	Cryptophyte.		P	*Cisphe*
	Orobanche ramose L.	Cryptophyte.	P		*Oro ram*
Oxalidaceae	*Oxalis corniculata* L.	Chamaephyte.	P	P	*Oxacor*
Papaveraceae	*Argemone mexicana* L.	Chamaephyte.		P	*Arg mex*
Poaceae	*Arundo donax* L.	Cryptophyte		P	Aru don
	Cynodon dactylon (L.) Pers	Cryptophyte	P	P	*Cyndac*
	Pennisetum setaceum (Forssk .) Chiov .	Cryptophyte	P	P	*Penvil*
	*Hopochne vulgare*L .	Cryptophyte	P		Hop vul
Polygonaceae	*Emex spinosa* (L.) Campd.	Therophyte.	P		Eme spi
	Rumex nervosus Vahl.	Phanerophyte	P	P	*Rum ner*
	Persicaria salicifolia (Willd.) S. F. Gray	Chamaephyte.	P		*Per sal*
Portulacaceae	*Portulaca oleracea* L.	Therophyte.		P	*Porole*
Primulaceae	*Anagallis arvensis* L.	Therophyte.	P		*Ana arv*
Resedaceae	*Caylusea hexagyna* (Forssk.) M. L. Green	Chamaephyte.	P		*Cayhex*
	Ochradenus baccata Del.	Phanerophyte		P	*Ochbac*
Rhamnaceae	*Ziziphus spina-christi* (L.) Willd.	Phanerophyte		P	*Zizspi*
Rosaceae	*Rosa abyssinica* Lindley	Phanerophyte	P		*Ros aby*
Sapindaceae	*Dodonaea viscosa* (L.) Jacq.	Phanerophyte		P	*Dod vis*
Scrophulariaceae	*Kickxia elatine* (L.) Dum.	Therophyte.	P		*Kicela*
Selaginellaceae	*Selaginella yemensis* (Swartz) Spring	Cryptophyte	P		*Sel yem*
Solanaceae	*Solanum glabratum* Dunal.	Phanerophyte	P	P	*Solgla*
	Solanum incanum L. var. *incanum*	Phanerophyte	P	P	*Solinc*
	Solanum nigrum L.	Therophyte.	P	P	*Solnig*
	Withania somnifera (L.) Duna	Chamaephyte.		P	*Wit som*
	Datura innoxia Mill	Therophyte		P	Dat inn
Verbenaceae	*Lantana camara* L.	Phanerophyte	P	P	*Lancam*
Vitaceae	*Cissus quadrangularis* L.	Phanerophyte.		P	*Cisqua*
	Cissus rotundifolia (Forssk.) Vahl.	Phanerophyte.		P	*Cisrot*
Zygophyllaceae	*Tribulus terrestris* L.	Therophyte.		P	*Tri ter*

The analysis of the vegetation was carried out using 29 sites distributed in the two studied areas as the follows Al-Ta'akrmountain (sites from 1 to 8) from the top to bottom of the slope , El Sohol area included the following : A - Wadi ElGanat slopes , terraces and wadi bed sites from 9 to to 14 , B- Najed ElBard sites from 15 to 24 and C- ElGabal ElAkhdar sites from 25 to 29.

AlTa'akr Mountain

From Al-Ta'akrmountain data can summarize the following:

Community of the plateauwas dominated by*Pennisetum setaceum ,* Communities of the near plateau was dominated by*Rosa abyssinica.* Communitiesof medium and high slopes also steep slopes were dominated by *Hypericum revolutum.*

El Sohol area(sites from 9 to 29) included the following:

A - Wadi El Ganat

From wadi El Ganat survey the following could be found

Communities dominated in wadi bed were dominated by*Arundo donax.*Communities dominated in the terraces were dominated by*Ziziphus spina-christi.*Communities of slopes of wadi were dominated by *Acacia melifera* and *Acacia etbaica*

B- Najed El Bard

From Najed El El Bard data one can summarize the following:

Communities of the wadi bed were dominated by*Ziziphus spina-ch*risti .Communities of the terraces of wadi were dominated by*Acacia asak.* Communities of the low slopes of wadi were dominated by*Acacia etbaica.*

Communities of modrate slope of wadi were dominated by *Acacia melifera*. Communites of high and steep slopes were dominated by *Euphorbia cactus* and *Commiphora habessinica.*, while communities of plateau of mountain were dominated by *Ormocarpum dhofarense* and Kleinia odora .

El Gabal El Akhader El Gabal El Akhader

From El Gabal El Akhader data one summarize the following:

Communities presentin low slopes were dominated by *Ormocarpum dhofarense.*Communities at modrate slopes and plateau of mountain were dominated with *Euphorbia inarticulate.* Communites in high slopes *were dominated by Cynodon dactylon.*And communities of plateau of mountain dominated dominated by *Ormocarpum dhofarense* and *Kleinia odora*(Table 2 and plates 1,2 and 3).

Table (2) Communities types of the study area (Al Ta'akr mountain sites from 1 to 8 , Wadi El Ganat site from 9 to 14 , Najed El Bard sites from 15 to 24 and El Gabal El Akhader sites from 25 to 29) .

Site No.	Habitat	Dominant	Co Dominant
1	Moderate slope	*Rosa abyssinica*	*Acanthus arboreus*
2	Moderate steep slope	*Rosa abyssinica*	*Acanthus arboreus*
3	high steep slope	*Hypericum revolutum*	*Rosa abyssinica*
4	High danger slope	*Hypericum revolutum*	*Pennisetum villosum*
5	Very high slope	*Hypericum revolutum*	*Pennisetum villosum*
6	Very high slope	*Hypericum revolutum*	*Rosa abyssinica*
7	Near plateau of mountain	*Rosa abyssinica*	*Emex spinosa*
8	Plateau of mountain	*Pennisetum villosum*	*Rosa abyssinica*
9	Wadi terrace	*Ziziphus spina-christi*	*Acacia melifera*
10	Terrace and low slope of mountain	*Acacia melifera*	*Hibiscus deflersii*
11	Moderate slope	*Acacia etbaica*	*Cissus rotundifolia*
12	Steep slope and terrace	*Acacia etbaica*	*Pennisetum villosum*
13	Wadi bed	*Arundo donax*	*Ceratonia siliqua*

14	slope	*Acacia melifera*	*Acanthus arboreus*
15	Terrace	*Acacia asak*	*Commiphora habessinica*
16	High slope	*Acacia etbaica*	*Kleinia odora*
17	Plateau of mountain	*Ormocarpum dhofarense*	*Kleinia odora*
18	Very danger high slope	*Euphorbia cactus*	*Acacia asak*
19	High slope	*Commiphora habessinica*	*Senna etalica*
20	High slope	*Commiphora habessinica*	*Acacia etbaica*
21	Wadi bed	*Ziziphus spina-christi*	*Jatropha curcas*
22	Low slope	*Acacia origana*	*Euphorbia inarticulate*
23	Moderate slope of mountain	*Acacia melifera*	*Euphorbia inarticulate*
24	Plateau of mountain	*Kleinia odora*	*Acacia melifera*
25	Plateau of mountain	*Euphorbia inarticulate*	*Cadia purpurea*
26	High slope	*Cynodon dactylon*	*Euphorbia inarticulate*
27	Moderate slope	*Euphorbia inarticulate*	*Commiphora habessinica*
28	Moderate slope	*Euphorbia inarticulate*	*Acacia melifera*
29	mild slope	*Ormocarpum dhofarense*	*Commiphora habessinica*

Plate 1. Shows *Hypericum revolutum* **community aslo** *Rosa abyssinica* **appear here as a co dominate speciesin the high slope of Al Ta'akr mountain.**

Plate 2. Shows *Jatropha curcas* **and** *Argemone mexicana* **inWadi terrace of Najed El Bard.**

Plate 3.Shows Al Gabal El Akhader with high slope covered with *Cynodon dactylon***.**

Out of the TWINSPAN classification, the 29 stands were classified into four groups after three levels of classification. Negative groupincluding sites from 9 - 28this is large group which classified in second classification into two group negative group (group A) icluding sites of wadi El Ganat sites 16 , 17 19, 20 22, 24 some exception here this group contain site 21 of Najed El Bard and Negative group (14 sites) which also classified in third level into Negative group (Group B) including 7 sites 16 . 17 , 19 , 20 24 and site 29 of El Gabal Al Akhader Positive group (Group C) 7 sites this is mixed group which containing some sites of Najed El Bard (15 , 18 and 23) as well as some sites of El Gabal Al Akhdr (25 , 26 , 27 and 28). Positive group (Group D) with eight stands (1 to 8) at the mountain of AlTa'akr where *Rosa abyssinica* . *Hypericum revolutum* and *Pennisetum setaceum*are the dominant species table 3.

Table 3. TWINSPAN classification of 29 sites showing different groups of the study area

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                    11111211122221122222
                    90123416790249583567812345678

12  Mir jal   1----2---------------1-------  000
19  Oxa cor   -----2---------------1-------  000
23  Xan str   2--2--3----------------1-----  001
27  Sol inc   12-3----4------1--1----1-----  001
35  Ziz spi   745-539-----------1----------  001
36  Aca mel   69---95-----7--89-5-7--------  001
37  Aga sis   1---1-2---------------------  001
38  Fla tri   2---2-2-2-------------------  001
40  Cer sil   3--262-----------------------  001
41  Abu fru   2-------------------------  001
42  Arg mex   3-------------------------  001
43  Wit som   1-------------------------  001
44  Hyp for   2-------------------------  001
45  Alt pun   1-------------------------  001
47  Hib def   -7-3---2--2--2--------------  001
48  Bel cil   -955-3----2-2----------------  001
49  Cis qua   --4------2---------2---------  001
50  Cis rot   --73--2-----2-2---3----------  001
51  Aer jav   --2-----1-------------------  001
52  Hib vit   --5--2-------------------1---  001
53  Aca etb   --98---9--9--------6---------  001
54  Ade obe   ---3---12--------------------  001
55  Jat cur   3--55-8-----------------------  001
56  Alo ine   ---2--------1----------------  001
57  Opu fic   ----2-3-------43-------------  001
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58	Lan	cam	----2----------1------------	001
59	Bar	tri	-----5-------3------4--------	001
60	Dod	vis	-----2----------------------	001
61	Fic	sal	-----1----------------------	001
62	Fic	pop	-----2----------------------	001
63	Kan	lan	-----2-------------2---------	001
65	Dat	ino	-----1----------------------	001
80	Com	erc	------4----4-----------------	001
90	Com	gra	------2--------2------------	001
98	Ama	liv	-3-------------------------	001
99	Bar	bi	---2-----------------------	001
101	Aru	don	----9----------------------	001
102	Cad	far	-----5----------------------	001
103	Ind	spi	-----2----------------------	001
110	Men	pip	-----2----------------------	001
11	Eup	hir	----------7---------1-------	010
13	Rue	pat	----2--5-4343-33533-41-1-----	010
39	Sen	ita	22---22--55-2-23------------	010
64	Eup	ina	-----1------223--7-89--------	010
66	Aca	asa	---------5----7--3----------	010
67	Com	hab	----------9-6962-2263--------	010
68	Kle	odo	-------8843-89334-2----------	010
69	Ind	spi	--------33-3--22----2--------	010
70	Eup	cac	-------4------38--7-4--------	010
71	Tag	mim	------2-----1-3-------------	010
72	Tri	ter	-------------2--------------	010
73	Car	cic	-------21--2-31-------------	010
74	Orm	dho	-------59-7-49-4-315-1---2---	010
75	Jus	fla	-------364343--3543----------	010
76	Cyp	rot	--------2---2----------------	010
77	Kle	ant	---------6------------------	010
78	Sed	ara	---------9----------------2	010
79	Com	for	----------2-------1----------	010
81	Eup	amm	----------------9------------	010
82	Cad	pur	-----------------75-8--------	010
83	Che	mur	--2----------3---2-----------	010
84	Jas	gra	-----------------223---------	010
85	Och	bac	------------2---------------	010
100	Aca	ori	----3---4--9-----------------	010
104	Ind	hoc	-------------2--23----------	010
106	Hel	eur	----------------1-----------	010
111	Cer	rup	-------2---------------------	010
18	Sol	gla	--------22--3--1-----1----12-	011
93	Ple	bar	1------3-------3321-3----22-2	011
95	Men	lon	-2---------3--2--2-2-------4-	011
105	San	ehr	----------3--2----3-2-----4-	011
20	Cyn	dac	3---------------567--74----9	100
1	Ros	aby	--------------------98555668	101
2	Aca	arb	-------------2------483---2-	101
3	Hyp	qua	--------------------359999--	101
5	Thy	lae	-----------------2--2456-252	101
6	Res	sph	--------------------221-4--2	101
7	Eme	spi	--------------------2-1--23-	101
8	Ech	spi	--------------------1-1--221	101
9	Tri	aff	--------------------1----2--	101
10	Ana	arv	--------------------1-1-----	101
14	Cen	max	--------------------1-1---3-	101
21	Psi	pun	----------2-------2--3--31--	101
22	Sca	col	----------------------3-2232	101
26	Cen	pse	----------------------1-----	101
28	Hol	arz	----------------------22----	101
29	Tec	gem	----------------------22----	101

```
30   Spo rub   ------------------------2---   101
31   Fer com   ------------------------1131   101
32   Kic sca   -------------------------12-   101
34   Fun sp    -----2---------------2324---2   101
86   Adi cap   --------------------1-------   101
87   Kni sum   --------------------2-1343--   101
88   Cay hfx   ----------------------2-----   101
89   Pie bar   ----------------------2-----   101
91   Sel yem   ------------------------32---   101
92   Per sal   ------------------------2----   101
94   Ger biu   -------------------------22--   101
96   Ger ara   --------------------2-----2-   101
107  D0r foe   --------------------1-------   101
108  Hop sch   --------------------2-1-----   101
109  Mor vul   --------------------1-------   101
4    Rum ner   ---32----------------3-2----3   110
15   Sol neg   1-------------------1-------   110
16   Asp fal   --2---2-------------21-2--2--   110
17   Pen vil   ---62-----------------3--57--   110
24   Ost vai   1---------------------1-----   110
25   Plu dis   22------1---------------1--2-2   110
46   Ama gra   1--1----------------------3-   110
97   Ipo pur   ----3----------------------2-   110
33   Sen had   1-----------1-----------1--   111

                  00000000000000000000011111111
                  00000001111111111111
                        00000001111111
********** TWINSPAN completed **********
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After TWINSPAN classification, data was analyzed by DECORANA (indirect gradient analysis). Results showed thatsites of El Sohol area (the plateau) were positively correlated to axis 2 represented by groups A , B and C .while group D was related to axes 1 including sites from 1 to 8 were located in El Taaker mountain peak were positively correlated to axes I . Ordination results were in accordance with TWINSPAN classification which is quite common in vegetation studies. Axis 1 group Dwas dominated by *Rosa abyssinica* . *Hypericum revolutum* and*Pennisetum setaceum* on the other hand, groups correlated to axis 2 Group A was dominated by *Ziziphus spina-christi, Acacia etbica , Acacia milefera ,* and *Arundo donxia* , Group B was dominated by*Acacia etibca* . *Acacia origana , Ormocarpum dhofarense , Commiphora habessinica , Euphorbia inarticulate and Kleiniaodora* , and Group C was dominated by *Acacia asak , Euphorbia cactus , Cadia purpurea , Acacia melifera , Cynodon dactylon,* and *Euphorbia inarticulate*. Group D was related to axes 1 including sites from 1 to 8 which representing AlTa'akrmountain peak were positively correlated to axes1. Soil parameters correlation to axis 1 and 2 were also examined. Moisture content, Na+, Ca++, and organic carbon were positively correlated to axis 1, while pH, Cl-, Co3--, K+, Mg++ were positively correlated to axis 2. (Fig1) .

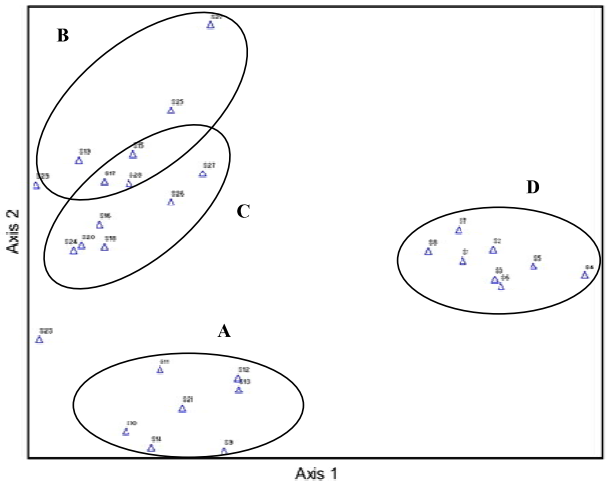

Fig. 1. DCA ordination diagram for the vegetation groups of the 29 stands in El Sohol area and Al Ta'akr mountain on axes 1 and 2.

In order to investigate the most significant factors affecting the grouping of the 29 stands, ANOVA (Analysis of Variance) was used to detect such factors. Soil moisture content andcalcium content were the most significant factors in determining different ecological groups with *P* value = 000, followed by chlorides with *P* value = 0.003 and organic carbon with *P* value = 0.014 . (Table 3) .

Table 3. Standard deviation (S. D.), Mean values and ANOVA P values of the soil variables in the studied sites.

Soil variable	TWINSPAN Group				*P* value
	A	B	C	D	
pH	7.5 ± 0.47	7.12 ± 0.17	7.12 ± 0.25	7.27 ± 0.95	0.594
EC	0.46 ± 0.26	0.26 ± 0.08	0.41 ± 0.31	0.35 ± 0.10	0.369
Cl	0.57 ± 0.49	0.10 ± 0.06	0.11 ± 0.07	0.10 ± 0.03	0.003
Mg	1.85 ± 1.31	1.48 ± 0.62	1.37 ± 0.45	1.51 ± 0.35	0.685
Ca	0.67 ± 0.21	0.42 ± 0.29	0.44 ± 0.14	1.07 ± 0.32	0.000
HCO3	109. ± 45.7	104. ± 33.1	97.6 ± 72.5	136. ± 131.	0.805
Carbonate	2.84 ± 0.51	1.34 ± 0.91	2.71 ± 0.73	3.98 ± 0.50	1.491
Organic Carbon	2.75 ± 0.58	2.76 ± 0.70	3.67 ± 0.69	2.01 ± 1.30	0.014
Moisture Content	16.3 ± 6.57	12.3 ± 4.32	9.80 ± 4.14	4.31 ± 3.32	0.000

DISCUSSION

The governorate of Ibbis named the Governorate of the Green Brigade and the reason for this is the dense vegetation cover on the mountains and the valleys .the climate of Ibb throughout the year , temperature is confined to between 27 to 33ºC conditions suitable for growth as well as the high summer rainfall rate during the month of March to September makes the environmental conditions good for this dense vegetative growth

A total of 111 species belonging to 51 families were recorded in 29 sites of the studied area .Family Asteraceae was the most abundant family comprising 12 species followed by Acanthaceae , Euphorbiaceae , Lamiaceae , Mimosaceae . Moraceae and Poaceae .Marei , (2006) reported that family Asteraceae is dominant family in south Sinai wadies .

The plant life form of the studied area shows that phanerophytes are the most dominant species representing 37 % ,followed by chaemophytes with 28 species representing 25 %. Therophytes with 26 species representing 23 % , cryptophytes with 13 species representing 11 % and hemicryptophytes with only 2 species representing 1.8 % of total species of the work. These result supported by Aqlan, (2008) .

On the other hand , Marei , et al (2016) studied Badan Mountain in Ibb governorate and recorded 71 species representing 38 families . Asteraceae was the prevalent family with 16 species followed by Poaceae (5 species) and Lamiaceae (4 species) . Also the same authors studied life forms of species and mention that , chamaephytes was the most predominant life form with 33.8% of total species, followed by therophytes with 23.9%, Phaneropytes with 21.1%, cryptophytes with 19.7%, and hiemicryptopytes with 1.4%.

Vegetation analysis of the study area showed that the trees and shrubs of the grassy plants support it (in the mountain of Al Ta'akr). seven sites and the herb of *Pennisetum setaceum* was observed only in one site (as dominant species) at plateau of AlTa'akr mountain .

In wadi El Ganat the dominatedtrees (Ziziphus spina-christi and *Acacia etbaica*) and shrubs of *Acacia mellifera* in 5 sites , while one site was dominated by *Arundo donax*represented theherbaceous case in the wadi .

In Najed El Bard the trees and shrubs also were dominated : 5 sites with*Ziziphus spina-christi , Acacia etbaica, Acacia mellifera* and *Acaia asak*

the shrubs were dominated in 3 sites (*Euphorbia cactus* and *Commiphora habessinica*) , one site was dominated by the undershrub*Kleinia odora* and in one site the dominance was shared with both *Acacia etbaica* (tree) and *Commiphora habessinica* (shrub) .InEl Gabal El Akhdr 3 sites were dominated by shrubs (*Euphorbia cactus* and *Commiphora habessinica*) , one site by undershrub *(Kleinia odora*) and one site by the herbaceous plant *Cynodon dactylon* . Also this specieswas present as co dominant in two sites in El Gabal El Akhader so the plateau and high slope of mountain attained ther green color due to the coverage *by Cynodon dactylon* .

Al-Khulaidi & Pole (1989) mentioned that in the western high mountains of Yemen (including Ibb governorate), trees, shrubs and perennial herbs are dominated at the slope of mountain, terraces and even in the wadies. Plant communities of the present work are differ from AlTa'akr mountain than El Sohol area

Community in plateau of AlTa'akrmountain dominated by *Pennisetum setaceum*, this species was recorded by Wood ,(1997)who reported that this species grow well at elevation high as 3000m of sea level in plateau of mountain.

Communities in near plateau weredominated by *Rosa abyssinica* Wood , (1997) reported that *R . abyssinica* is widespread on the escarpment and high plateau from 1500 to 3100 m above sea level.Al Khulidi , (2000) recorded *R . abyssinica* on moderate steep slope mountains and hills, between 1900-2200m. Othman and El Naggar(2015) recorded *R . abyssinica* at High altitude mountains elevations above 1800 m high .

and communities of moderate and high slopes and also steep slopes were dominated by *Hypericum revolutum*. Wood , (1997) recorded this species in AlTa'akrmountain and reported that it grows above 2400 m and reaches 3200 m above sea level .

Communities in wadi bed are dominated by*Arundo donax* . Wood , (1997) mention that this species is abundant along the margin of flowing wadies on the escarpment from 1500 to 1700 m. also may found at 300 m. height .

Communities of the terraces were dominated by*Ziziphus spina-christi* in wadi El Ganat and Najed El Bard , Wood , (1997) reported that *Z . spina-christi* is found under 2500 m height of republic of Yemen and also this result is supported in the present work for all sites regarding the present of this species below 2500 height .

Communities of slopes were dominated by*Acacia melifera* in wadi El Ganat and Najed El Bard Wood , (1997) reported that *A . melifera*was found and abundantly between 300 to 1700 m and not abundant at height more than 1900 m , Al Khulidi , (2013) recorded this species on slopes north and north east Taiz (between 1200-1500m.) here this species forming a community type at height above 2000 m.

Acacia etbaica was recorded in wadi El Ganat and Najed El Bard Wood , (1997) reported that *A . etbaica* is widespread between 1200 to 2300 m . Al Khulidi , (2013) recorded *A . etbaica* on rocky wadi at plateau (1344 m) . These woodlands are found on plains, plateaus, at the bottom of mountains and onmoderate- steep slope mountains (between 1400-1800m.). Abdalluah *et at*.(2016) recorded *A . etbaica* in El Baha at the altitude ranges from 1805 to 2020 m above sea level .

Communities dominated in the terraces in wadi El Ganat *Acacia asak*Wood ,(1997) reported that *A . asak* is abundant on steep well-drained mountain slope between 600 t0 1700 m. Abdalluah *et at*. (2016) recorded *A . asak* in El Baha at the altitude ranges from 1127 to 1756 m above sea level .

Communitiesof high and steep slopes were dominated by*Euphorbia cactus* Wood , (1997) reported that *E . cactus* is widespread between 300 to 2000 m .

Commiphora habessinica Wood ,(1997) reported that *C . habessinica* is widespread between 1400 to 1900 m . And communities of plateau were dominated by Ormocarpum dhofarense , wood , (1997) recorded this species in Udayn (found in Ibb governorate) at 1500 m .

*Kleinia odora*Wood , (1997) reported that *K . odora* is widespread between 600 to 2500 m . Abdalluah *et at*(2016) recorded *K . odora* in El Baha at the altitude ranges from 1805 to 2020 m above sea level

Communities ofmoderate slopeand mountainplateau were dominated by*Euphorbia inarticulate* Wood , (1997) reported that *E . inarticulate* is widespread between 300 to 2000 m .

Communites in high slopes were dominated by*Cynodon dactylon*Wood ,(1997) reported that *C . dactylon* is one of the most widespread and abundant plant in Yemen occurring almost everywhere up to 2800 m. between 300 to 2000 m above sea level .

The application of TWINSPAN on the vegetation data yielded four vegetation groups , 1-Group El Sohol area with height between 1800 to 2100 m including the following groups : Group A which is dominated by *Ziziphus spina-christi Acacia etbica , Acacia milefera ,* and *Arundo donxia* , Group B which is dominated by *Acacia etibca . Acacia origana , Ormocarpum dhofarense , Commiphora habessinica , Euphorbia inarticulate* and *Kleinia odora* and Group C which is dominated by *Acacia asak , Euphorbia cactus , Cadia purpurea , Acacia melifera , Cynodon dactylon,* and *Euphorbia inarticulate*as well as AlTa'akrmountain including one group (group D) with height between 2400 to 3000 m was dominated by *Rosa abyssinica . Hypericum revolutum* and *Pennisetum setaceum* .The results of Decorana and through the drawing sites of the top of AlTa'akrmountainrelated to axes 1 while the other sites are towards the direction of the axes 2 entirely and the results also showed the vast environmental difference between these groups of plants , while the other communities in Wadi El Ganat , El Gabal El Akhader and Najed El Bard to axes 2 .

The results of analysis of variance showed that soil content of carbonate, calcium, moisture content and chlorides gave very high differences between the different groups, while the organic carbon content showed significant differences less than the previous elements, while PH , EC and HCO3 showed no significant differences Fig.2

TheseResults were supported by Abd EL-Ghani & Marie (2006).

Carbonate and organic carbon showed significant differences between groups while supporting these results

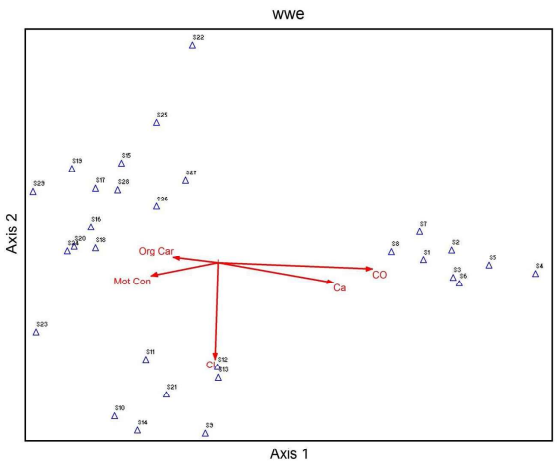

Fig. 2. DCA ordination diagram for the TWINSPAN groups of the 29 sites in in El Sohol area and AlTa'akrmountain on axes 1 and 2 in relation to differentenvironmental factors.

Elevation play an important role in determine vegetation type , vegetation of AlTa'akrmountain (about 3000m above sea level) differ from El Sohol area (1800 to 2100 m above sea level) these area are near to each other being in the same governorate (Ibb governorate) but were different in vegetation characteristics and floristic composition of plants and communities.So , elevation is one of the factors determining phytogeographical regions and its communities in mountains, these results are in accordance with Lorphelin (1986) and Drever & Zobrist (1992).,

RECOMMENDATION

This study, which was conducted on some plant communities in the province of Ibb.

1 - To strengthen the use of modern programs TWINSPAN and DECORANA to facilitate understanding of the relationship between plant species and the environment.

2. In the future, GISGeographic Information Systems (GIS) will be used to make accurate geographical maps and plant communities.

3- To limit and preserve plant species used in folk medicine, especially rare and threatened species.

4- Announcing the governorate of Ibb as anatural concerned area reserve in the future.

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المجتمعات النباتية فى جبل التعكر و منطقة السحول محافظة اب الجمهورية اليمنية

عبدة مرعى حامد مرعى

جامعة الازهر كلية العلوم قسم النبات و الميكروبيولوجي

الملخص

يقع جبل التعكر (3000 م) جنوب مدينه اب و منطقه السحول(1800 الي 2100 م) تقع شمال المدينه و الدراسه هى مقارنه بين تلك المنطقتان و المختلفتان من الناحيه التوبغرافيه تم تسجل 111 نوع نباتى و 51 فصيله نباتيه فى 29 موقع فى منطقه الدراسه و كانت الفصيله المركبه هى الفصيله الشائعه و السائده فى منطقه الدراسه و الفصيله الاكانسيه و اللبنيه بعد ذلك و ضما 6 انواع نباتيه لكل منها ثم الفضائل الشفويه و التوتيه و النجيليه و احتوت كل فصيله منهم على 5 انواع نباتيه.

احتوى شكل الحياه Phanerophytes على 37% من الانواع المسجله ثم شكل الحياه chaemophytes احتوى على 25 % من الانواع اللمسجله ثم شكل الحياه Therophytes احتوى على 23 % من الانواع المسجله ثم شكل الحياه Cryptophytes احتوى على 11 % من الانواع المسجله و اخيرا شكل الحياه Hemicryptophytes احتوى على 1.8 % منالانواع المسجله.

موقع واحد فقط سياده *Rosa abyssinica*و *Hypericum revolutum*فى جبل التعكر وضح سياده الاشجار و الشجيرات فى مصاطب *Ziziphus spina-christi* و ساد نبات *Arundo donax* للاعشاب المعمرة فى وادى الجنات ساد نبات فى بطن الوادى فى منحدر الوادى *Acacia etbaica*و *Acacia melifera* الوادى و نباتى

Acacia وفى مصاطب الوادى ونبات *Acacia asak* فى بطن الوادى و نبات *Ziziphus spina-christi* فى نجد البرد ساد نبات فى المنحدرات العاليه للوادى *Acacia melifera*فى المنحدرات قليله الارتفاع و نبات *etbaica*

Euphorbia inarticulate فى المنحدرات القليله الارتفاع و نبات *Ormocarpum dhofarense* فى الجبل الاخضر ساد نبات فى المنحدرات العاليه للجبل *Cynodon dactylon* فى المنحرات متوسطه الارتفاه و هضبه الجبل و كذلك نبات

تم استخدام برنامجTWINSPAN فى منطقه الدراسه لتقسيم المجموعات طبقا للانواع الدليله و كذلك برنامجDECORANA لتوضيح العلاقه بينتوزيع الانواع و العوامل البيئيه المختلفه و استخدم برنامجANOVA لتوضيح عوامل التربه التى على اساسها تم تقسيم الانواع فى منطقه الدراسه اظهرت عوامل المحتوى الرطوبى و نسبه الكالسيوم فى التربه فروقا معنويه كبيره ثم الكلوريدات و كذلك الكربون العضوى