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RESEARCH ARTICLE

NATURAL PLANT SPECIES INVENTORY OF THE IMPORTANT PLANT AREAS IN ARABIAN PENINSULA: BANI OMAR, TAIZ GOVERNORATE, REPUBLIC OF YEMEN

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Abstract

The study area is located on the South western mountains of Republic of Yemen, It is characterized by arid and semi-arid climate with high temperatures and low average annual rainfall. The aims of this study are to explore the natural plant species of one of the Important Plant areas of Arabian Peninsula and to evaluate the chance to be a protected area. 61 sample sites covering the whole ecological zones haven been conducted. 135 plant species are found, in which 3 plant species were endemic, 7 near endemic, 29 regional endemic. The study revealed also three vegetation communities with 7 vegetation associations (vegetation types). Vegetation dominated by *Ficus cordata, F. sycomorus, Salvadora persica Tamarix aphylla* and *Ziziphus spina-christi* were found on main wadis. Vegetation communities dominated by *Acacia asak, Anisotes trisulcus, Jatropha variegate* and *Zygocarpum yemenense* were found on rocky slopes and stony plateau.

Keywords: Bani Omar, Endemism, Important Plant Areas, Taiz, Yemen, Vegetation.

1. Introduction

The protection and the conservation of species in their natural habitats what is called in-situ conservation has long been the proper conservation method for biodiversity in their habitats [1] and it is a conservation method for preserving of natural biodiversity and unique places with endemic, endangered and rare flora and fauna [2]. The conservation of biodiversity in their habitats includes the process of protection and conservation of ecosystems and then the preservation and rescue of the plant species and animals in their habitat [3]. Significant and trustable criteria and priorities that attract national environmental funds are crucial for preserving natural habitat [4]. The preservation of ecosystems is the main aim of the conservation of species in their natural habitats through developing a complete and suitable system of protected areas [5 & 6].

Natural protected areas prevent degradation of natural biodiversity and provide protection for all the plant and animal species from overuse by humans and animals and they can be suitable place for research studies on and natural resources and offer suitable sites for monitoring and evaluating changes in environment and natural resources, therefore, an additional aim of this study is to suggest clearly defined areas which justify protected status. The objective of this study is to investigate the natural plant biodiversity of one of the hotspots of the Arabian Peninsula and to assess the possibility to be a protected site.

The Study Area

The study area is Bani Omar which belongs to Taiz Governorate, Yemen, and located between latitude 13º 10` and 13º 18` and between longitude 43º 50` and 44º 00`, the study area covers about 750 Km^2. and also located within Key Biodiversity Areas in the Eastern Afromontane Hotspot [7], (Figs. 1 & 2).

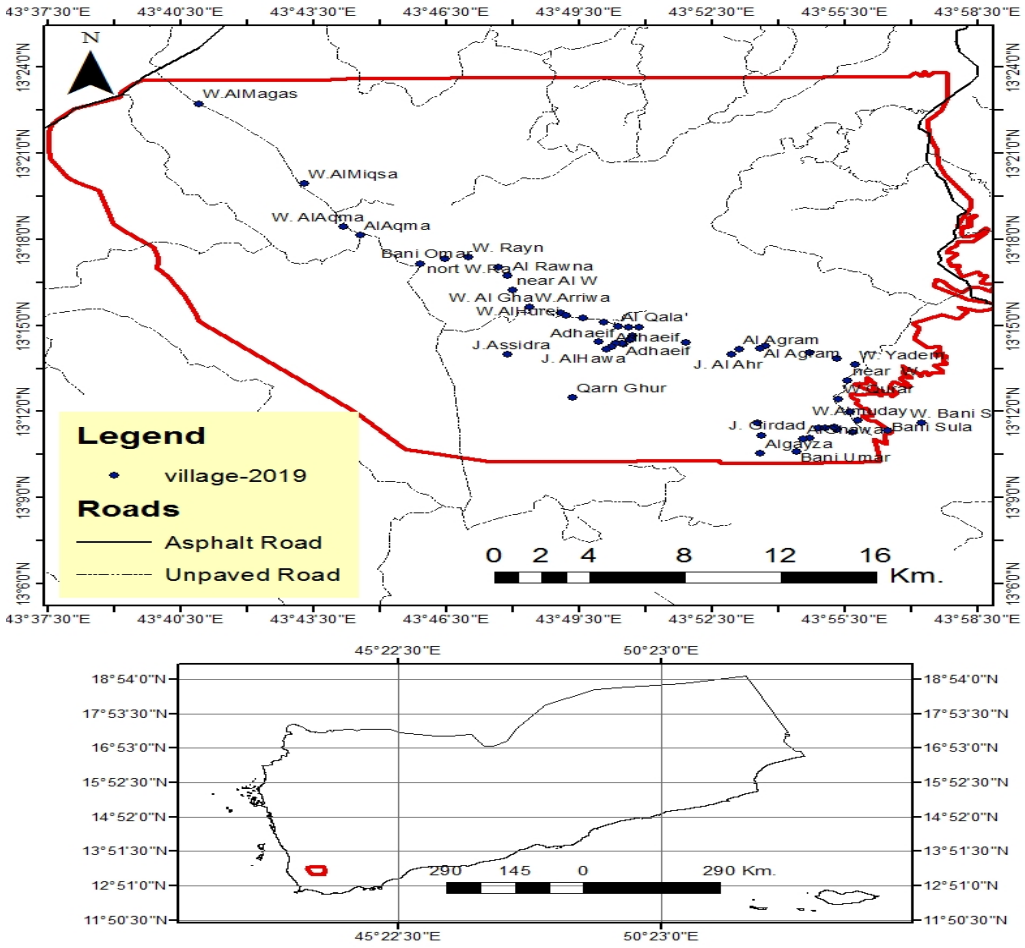

Figure 1. Location of the study area

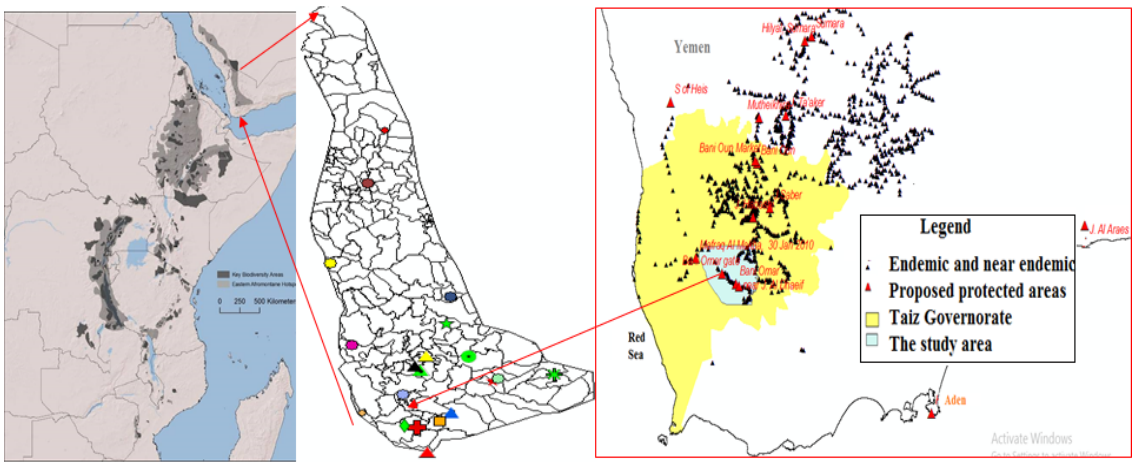

Figure 2. Map of Key Biodiversity Areas (KBA) in the Eastern Afromontane Hotspot and Yemen (CEPF, 2012). The study area in blue right is located within KBA.

Mountain rocky slopes, wadis, plateaus and rocky plains are the characteristic topographical features of the study area. Wadi Qurar and W. Al Agram are the main wadis in the area, the main mountains are Jabal Girdad and J. Adhaif. The altitude ranges between 4**0**0 and 1**800** m above sea level (Figs 3 & 4).

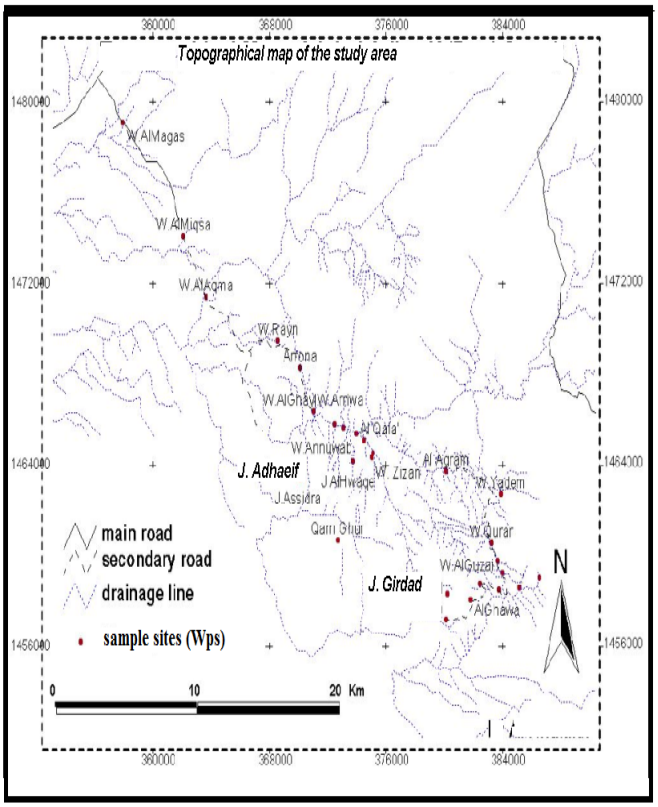

Figure 3. The topographical units of the study area.

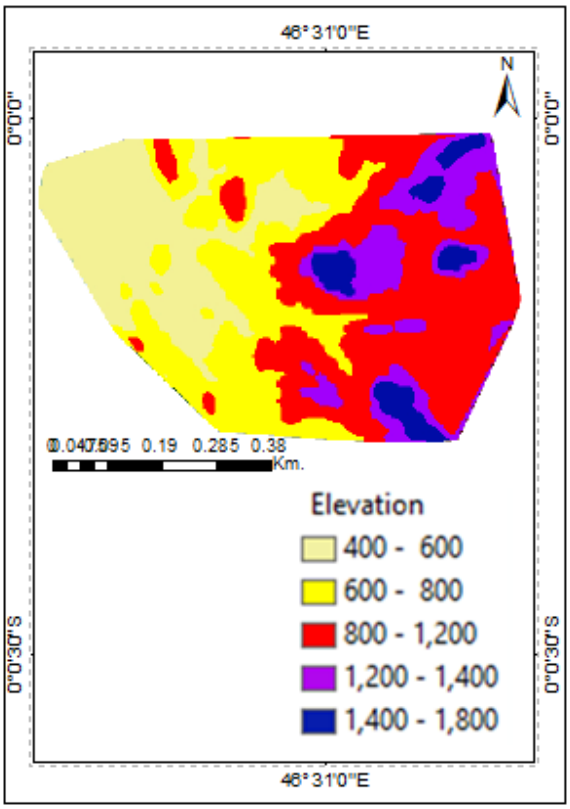

Figure 4. The altitude (m.) of the survey are

2. Materials and Methods

A large number of methods have been used to evaluate and describe the vegetation communities of an area and to understand plant diversity. The Braun-Blanquet approach for classification and data collection of vegetation has been used in Yemen by [2 & 8]. Many vegetation studies in the world have been conducted using this approach and have been accepted as being suitable for illustrating vegetation communities and vegetation types [9-11]. The Braun-Blanquet approach includes information on topography such as slope, aspect, soil and climate and was and is still very useful for natural vegetation survey and classification of vegetation and can be used to estimate abundance and species composition [12 & 13].

The species records from the study area were classified using Braun-Blanquet into: (1) groups that show a similar distribution across the sample plots, these were named as sociological species groups and (2) into groups of sample plots with a large similarity named as vegetation associations or as vegetation types (Table 3).

2.1. Correspondence analysis

Correspondence Analysis (MCA) using Jolliffe's rule to group the plant species to communities using the statistical software of the Multi-Variate Statistical Package (MVSP) version. 4.2. (Fig. 8).

2.2. Frequency

Frequency is defined as the number of times a plant species is present within a given number of sample sites located constantly across a selected habitat and vegetation [14 & 15]. Plant frequency is considered as a useful tool for monitoring plant species changes over time at the same habitats or comparisons of different habitats. The frequency was calculated by dividing the number of plots in which a plant species occurs into the total number of sample sites.

2.3. Regional endemic

The regional endemic is the plant that occurs only in Arabian Peninsula and East Africa (Somalia, Ethiopia, Djibouti, Sudan, Kenya, Uganda, Tanzania) (Fig. 5), this region is part of the Somali-Masai regional centre of endemism and the Sudanian region [16], the Afromontane archipelago-like regional centre of endemism [17] and of the Eastern Afromontane Hotspot [18]. The distribution of regional endemic plants was based on the information gathered from Plants of the world [19-25].

Figure 5. Eastern Africa, 1 Somalia, 2 Ethiopia, 3 Djibouti, 4 Sudan (North & South), 5 Kenya, 6 Uganda, 7 Tanzania

3. Results & Discussion

About 135 plant species are recorded from the study area, in which three are endemic to Yemen namely *Euphorbia qarad*, *Jatropha variegate* and *Zygocarpum yemenense* (Fig. 6 & Plate 1), 7 species are endemic to Arabian Peninsula found only in Yemen and Saudi Arabia (near-endemic), (Table 1; Fig. 7 & Plate 2) 29 species are regional endemic only found in Arabian Peninsula and East Africa (Somalia, Ethiopia, Djibouti, Sudan, Kenya, Uganda, and Tanzania) (Plate 3). These regions are called also The Eastern Afromontane Hotspot [7]. Few species (e.g. *Cadaba rotundifolia*, *Ficus palmata*, *Indigofera spinosa*) extend to Egypt, other species like *Grewia schweinfurthii* is only recorded from Yemen and East Africa [23]. The main wadis of the study area consist of woodland dominated by big trees such as e.g. *Ficus cordata*, *F. sycomorus*, *Phoenix dactylifera*, *Trichilia emetic*, and *Ziziphus spina-christi*, with the association of woody herbs and shrubs such as *Indigofera oblongifolia*, *the endemic Jatropha variegate*, and *Salvadora persica*. The rocky plateau covers mainly by communities dominated by *Acacia etbaica* and *Searsia flexicaulis* with *Cadia purpurea*, *Grewia schweinfurthii*, *Ficus vasta*, and *Zygocarpum yemenense*. The plants *Acacia tortilis* and *Anisotes trisulcus* cover the mountain slopes forming Acacia woodland associate species here are *Acacia asak*, *A. hamulosa*, *A. laeta*, *A. mellifera*, *Commiphora spp.*, *Grewia spp.*, and *Jatropha spinosa*.

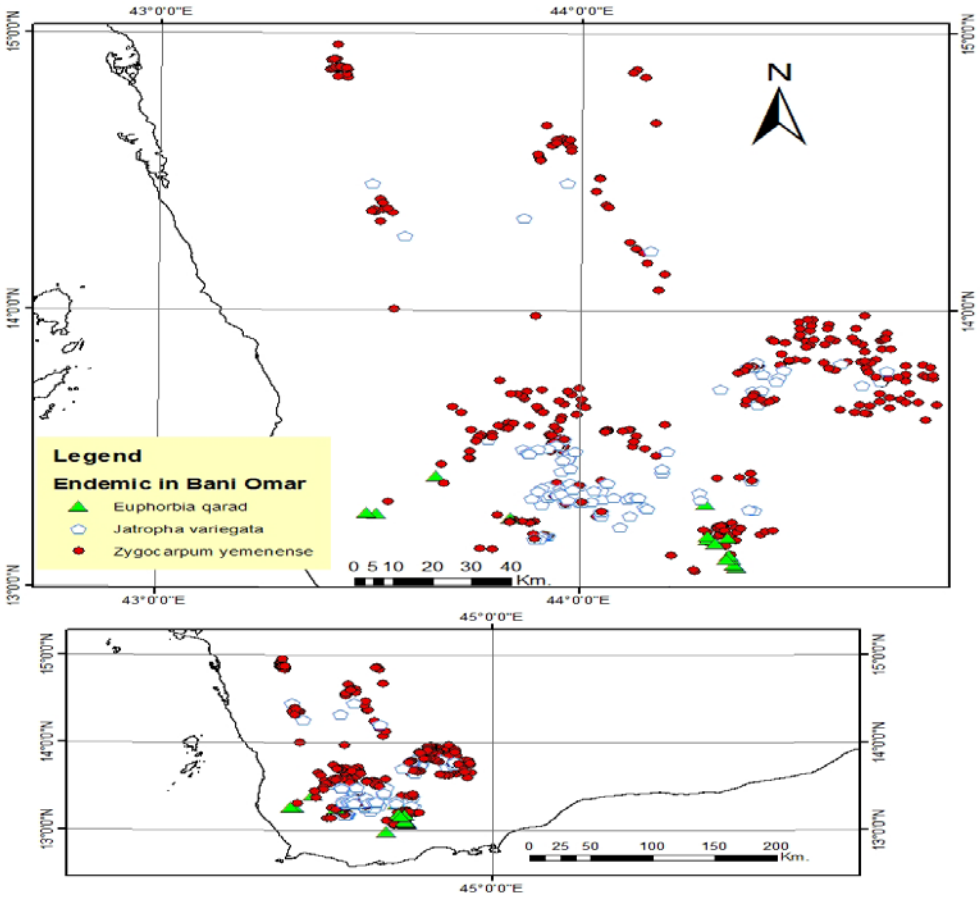

Figure 6. The distribution of 3 endemic plant species within Yemen that are found in the study area (*Euphorbia qarad*, *Jatropha variegate* and *Zygocarpum yemenense*). Almost all with very limited geographical zones on the Important Plant Areas of Yemen.

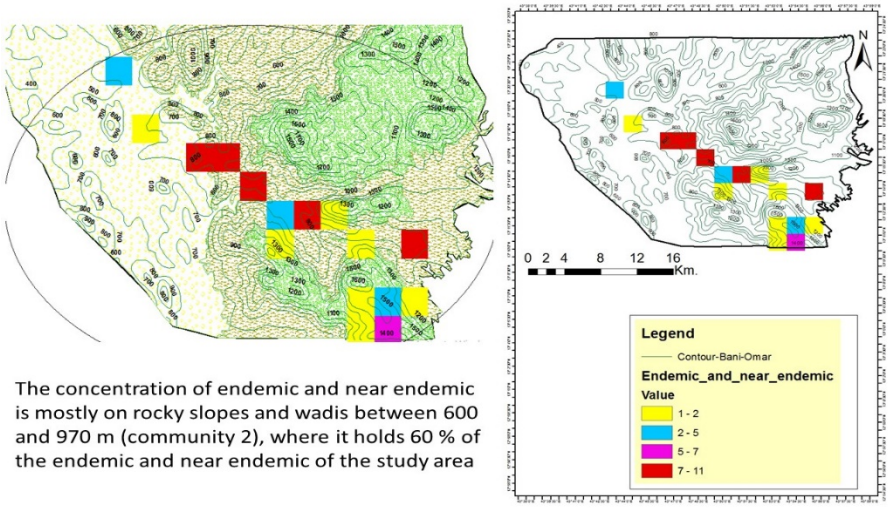

Figure 7. The distribution of endemic and near endemic plants with their numbers per 4 square kilometres.

Table 1. The frequency percentage of each plant species.

Plant name	Endemism	plateau	wadi	slope	Plant name	Endemism	plateau	wadi	slope
Abrus bottae	**	0	0	4.3	*Ficus ingens*		0	11.1	0
Abutilon fruticosum		0	0	2.1	*Ficus palmata*	***	0	5.6	0
Acacia asak	***	60	5.6	34	*Ficus populifolia*		0	22.2	0
Acacia ehrenbergiana		0	11.1	2.1	*Ficus sycomorus*		0	66.7	0
Acacia etbaica	***	100	0	4.3	*Ficus vasta*	***	40	0	0
Acacia hamulosa	***	20	11.1	14.9	*Flueggea virosa*		20	5.6	12.8
Acacia laeta		20	5.6	31.9	*Grewia erythraea*		40	0	8.5
Acacia mellifera		20	11.1	31.9	*Grewia schweinfurthii*	***	60	0	21.3
Acacia nilotica		0	0	2.1	*Grewia tembensis*	***	0	0	10.6
Acacia tortilis		40	5.6	53.2	*Grewia tenax*		0	0	2.1
Acalypha fruticosa		40	22.2	17	*Grewia trichocarpa*	***	20	11.1	8.5
Acokanthera schimperi		0	5.6	2.1	*Indigofera arabica*		0	0	2.1
Adenium obesum		40	0	14.9	*Indigofera articulata*		0	0	10.6
Aerva javanica		20	16.7	34	*Indigofera oblongifolia*		0	27.8	4.3
Aerva lanata		0	5.6	6.4	*Indigofera sp.*		0	0	2.1
Agave sisalana		0	0	2.1	*Indigofera spinosa*	***	40	0	19.1
Aloe sp.		20	0	2.1	*Jatropha curcas*		0	27.8	0
Andropogon sp.		0	0	4.3	*Jatropha glauca*	***	0	0	2.1
Anisotes trisulcus	***	20	16.7	53.2	*Jatropha spinosa*	***	0	5.6	23.4
Annona squamosa		0	5.6	0	*Jatropha variegate*	*	80	0	10.6
Aristida sp.		0	0	6.4	*Justicia odora*		0	0	4.3
Arundo donax		0	22.2	0	*Kanahia laniflora*		0	5.6	0
Bacopa monnieria		0	5.6	0	*Kleinia odora*	***	40	0	2.1
Barleria acanthoides		60	0	6.4	*Leptadenia pyrotechnica*		0	6	2.1
Barleria bispinosa	**	20	0	0	*Maytenus parvifolia*		20	0	0
Barleria proxima	***	0	0	8.5	*Mimusops laurifolia*	***	0	5.6	0
Barleria trispinosa		20	0	0	*Ocimum filamentosum*		*0*	*0*	*2.1*
Berchemia discolor		0	5.6	0	*Pandanus odorifer*		*0*	*5.6*	*0*
Blepharis edulis		40	0	8.5	*Pavetta longiflora*	**	20	0	0
Boscia arabica	**	0	5.6	12.8	*Phoenix caespitosa*	***	0	27.8	0
Cadaba farinosa		0	0	2.1	*Phoenix dactylifera*		0	77.8	0
Cadaba longifolia	***	0	0	2.1	*Pithecellobium dulce*		0	38.9	0
Cadaba rotundifolia	***	0	0	2.1	*Premna resinosa*		0	0	6.4
Cadia purpurea	***	60	0	4.3	*Prosopis juliflora*		0	16.7	2.1
Calotropis procera		0	22.2	6.4	*Pulicaria jaubertii*	***	0	0	2.1
Caralluma sp.		0	0	2.1	*Pulicaria somalensis*	***	20	0	8.5
Chloris sp.		0	0	2.1	*Pupalia lappacea*		0	0	2.1
Cissus quadrangularis		40	5.6	17	*Ricinus communis*		0	5.6	0
Cissus rotundifolia		80	27.8	31.9	*Ruellia forsskolii*	**	20	5.6	4.3
Combretum molle		40	11.1	4.3	*Ruellia patula*		20	0	2.1
Commicarpus helenae		0	0	4.3	*Sageretia thea*		20	0	0
Commicarpus plumbagineus		20	5.6	2.1	*Salsola spec*		0	0	2.1
Commiphora gileadensis	***	0	5.6	2.1	*Saltia papposa*	**	0	5.6	17
Commiphora kataf	***	20	5.6	10.6	*Salvadora persica*		0	22.2	10.6
Commiphora kua		20	0	4	*Sansevieria ehrenbergii*	***	20	0	27.7
Commiphora myrrha	***	20	0	34	*Sansevieria forskaliana*		20	0	2.1
Commiphora schimperi		0	0	6.4	*Sarcostemma viminale*		40	0	25.5
Commiphora sp.		0	0	2.1	*Searsia flexicaulis*	***	*80*	*0*	*4.3*
Commiphora sp.A		0	0	2.1	*Seddera arabica*	***	20	0	14.9
Commipora sp2		0	0	2.1	*Seddera latifolia*		20	0	0
Conyza pyrrhopappa		0	11.1	0	*Selaginella imbricata*		20	0	6.4
Coptosperma graveolens		0	0	6.4	*Senna alexandrina*		*0*	*0*	*2.1*
Corchorus tridens		0	0	2.1	*Senna italica*		20	0	0
Cymbopogon schoenanthus		0	0	6.4	*Senna obtusifolia*		0	5.6	0
Cyphostemma digitatum	***	40	0	2.1	*Senna occidentalis*		0	11.1	0
Dactyloctenium scindicum		0	0	2.1	*Solanum incanum*		40	0	8.5
Delonix elata		0	5.6	0	*Stipagrostis hirtigluma*		0	0	2.1
Dobera glabra		20	0	17	*Tamarix aphylla*		0	38.9	0
Dodonaea viscosa		20	0	0	*Tamarix nilotica*		0	55.6	2.1
Echolium viride		20	5.6	*0*	*Tetrapogon villosus*		0	0	2.1
Euphorbia cuneata		20	0	29.8	*Trichilia emetica*		0	27.8	0
Euphorbia inarticulata	**	40	5.6	10.6	*Turraea parvifolia*	***	20	0	14.9
Euphorbia qarad	*	0	0	2.1	*Typha domingensis*		0	11.1	0
Fagonia indica		20	0	6.4	*Ziziphus spina-christi*		40	62	4.3
Ficus cordata		20	50	0	*Zygocarpum yemenense*	*	80	0	27.7
Ficus glumosa		20	11.1	8.5					

Key: Endemism: (*) endemic to Yemen, (**) endemic to Arabian Peninsula found only in Yemen and Saudi Arabia, (***) regional endemic only found in Arabian Peninsula and East Africa (Somalia, Ethiopia, Djibouti, Sudan, Kenya, Uganda, Tanzania).

3.1. The vegetation communities of the study areas

The plant species of the study area were classified using Braun-Blanquet and Correspondence Analysis into tree vegetation communities and 7 vegetation types (Figs 8 & 9 and Table 2).

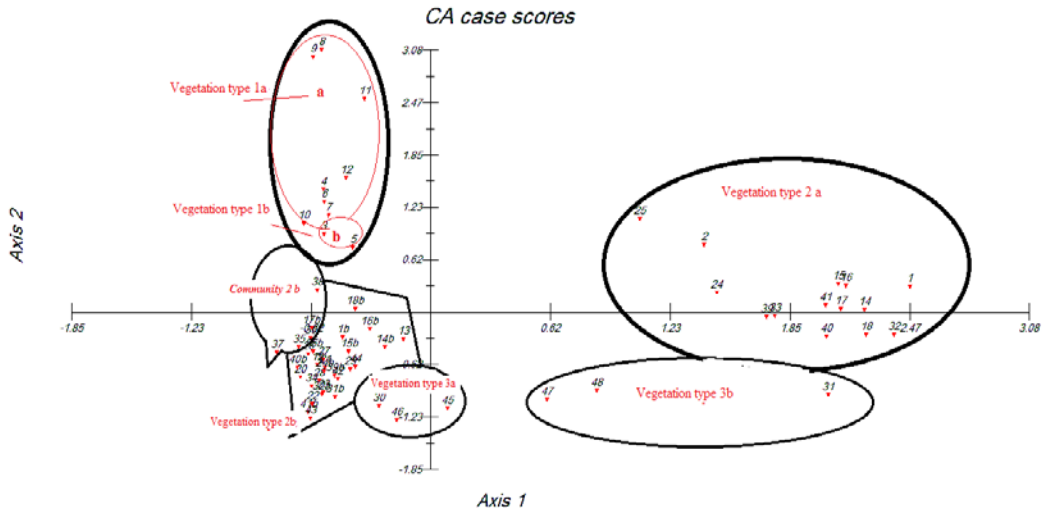

Figure 8. Correspondence Analysis (MCA) by means of Jolliffe's rule. The plant species were grouped to 6 vegetation types belong to the 3 main communities

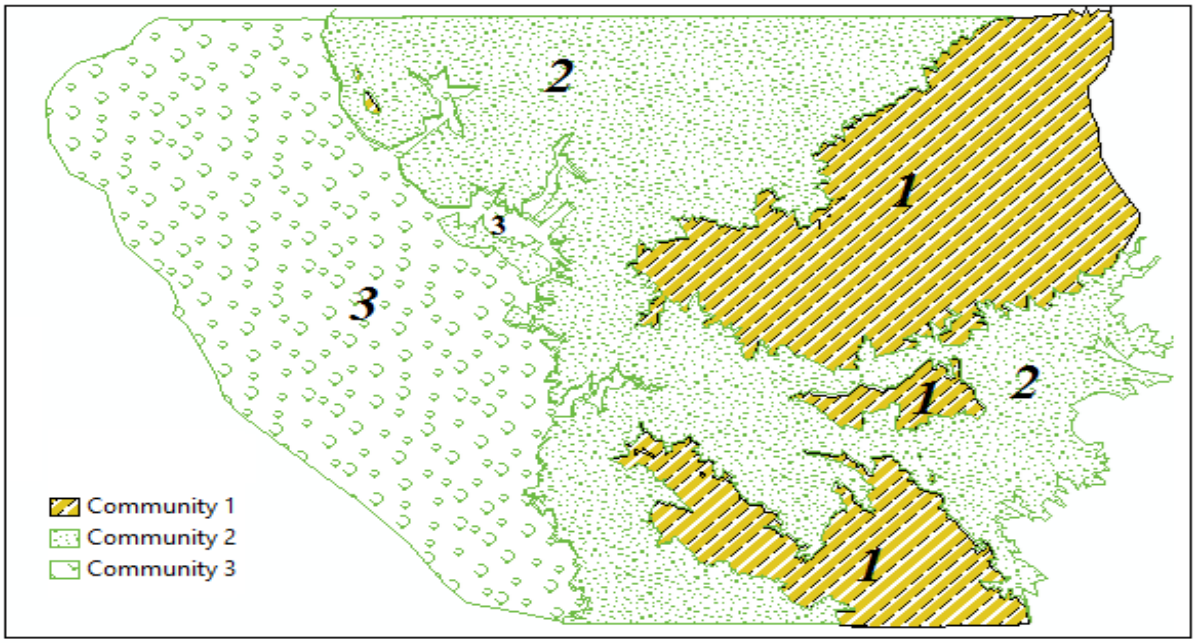

Figure 9. Main vvegetation communities of the study area. **1**- *Jatropha variegata - Zygocarpum yemenense –Acacia asak*, **2**- *Salvadora persica – Cissus rotundifolia - Acacia laeta*, **3**- *Prosopis juliflora - Anisotes trisulcus – Acacia tortilis.* (Table 2 is a legend of thmap showing a detail of each community).

Table 2. Legend to the main vegetation communities of the study area

Vegetation community	Vegetation type	Topography	Vegetation structure y	Dominant species	Associated species	Note
1. *Jatropha variegata - Zygocarpum yemenense - Acacia asak*	a) *Searsia flexicaulis - Acacia asak*	drainage lines, rocky slopes, and plateaus between 1000 and 1435 m.	woodland and shrub land	*Searsia flexicaulis*, and *Acacia asak*	*Grewia schweinfurthii, Zygocarpum yemenense, Acacia etbaica, Cadia purpurea, Cyphostemma digitatum, Ficus vasta, Commiphora kua, Kleinia odora, Barleria bispinosa* and *Dodonaea viscosa.*	High quantity of endemic and near-endemic plant species as well as economic plants.
		mountain slopes and plateaus between 1180 and 1435 m		*Acacia asak*	*A. etbaica, Grewia schweinfurthii, Zygocarpum yemenense, Jatropha variegate. Searsia flexicaulis, Cyphostemma digitatum, Ficus vasta* and *Kleinia odora,*	*Barleria bispinosa, Dodonaea viscosa, Maytenus parvifolia, Pavetta longiflora* and *Segeretia thea,* are only confined to this type
	b) Pulicaria somalensis – Acacia asak	mountain slopes and rocky plain between 1000 and 1145 m		*Acacia asak*	*Jatropha variegate, Euphorbia inarticulata, Cissus quadrangularis, Zygocarpum yemenense, Anisotes trisulcus* and *Cynanchum viminale*	*Aloe niebuhriana, Barleria trispinosa, Pulicaria somalensis, Seddera latifolia* are only confined to this type.
2. *Salvadora persica – Cissus rotundifolia - Acacia laeta*	*a) Ficus sycomorus – Ziziphus spina-christi – Ficus cordata*	wadis and rocky slopes between 600 and 970 m	woodland and shrubland	*Cissus rotundifolia,* and *Acacia laeta*	*Acacia tortilis, Dobera glabra, Ficus cordata, Jatropha spinosa, Saltia papposa, Sansevieria ehrenbergiana,* and *many others*	Has 6 endemic and near-endemic plant species and important economic plant species. The type covers a large
		rich wadis between 590 and 965 m		*Ficus cordata* and *Ziziphus spina-christi*	*Arundo donax, Jatropha curcus, Ficus sycomorus, Phoenix dactylifera, Tamarix aphylla, T. arabica* and *Trichelia emetica,*	*Annona squamosa, Berchemia disclor, Ficus palmata, Mimusops laurifolia, and Pandanus odoriferus* are only confined to this type.
	b. *Indigofera articulata – Barleria proxima – Seddera arabica*	moderate steep slope mountain of J. Adhaif, the altitude ranges between 640 and 895 m		*Euphorbia cuneata*	*Acacia laeta, A. tortilis, Adenium obesum, Aerva javanica, Grewia schweinfurthii, Indigofera spinosa, Saltia papposa, Sansevieria ehrenbergiana, Zygocarpum yemenense* and others	Very rare species such as *Eleocharis geniculata, Fimbristylis cymosa and Ceratophyllum demersum* were only found in this type.
	c. *Boscia arabica- Acacia tortilis – Acacia laeta*	steep rocky slopes of moderate altitude (between 660 and 970 m)		*Acacia tortilis* and *Anisotes trisulcus*	*Acacia asak, A. laeta, A. mellifera, Acalypha fruticosa, Aerva javanica, Cissus rotundifolia, Cynanchum viminale, Dobera glabra, Fleuggia virosa, Jatropha spinosa* and many others.	The species *Cadaba farinosa, C. longifolia, Cassia senna, Euphorbia qarad* and *Grewia tenax* are only found in this type
3. *Prosopis juliflora - Anisotes trisulcus – Acacia tortilis*	a. *Acacia tortilis – Anisotes trisulcus*	Wadis, mountain slopes, rocky plains at low altitude areas (between 440 and 600 m)	Woodland	*Acacia tortilis*	*Acacia ehrenbergiana, A. mellifera, Aerva javanica* and *Anisotes trisulcus.*	
		plains and rocky slopes (between 525 and 600 m)		*Acacia tortilis*	*Acacia mellifera, A. ehrenbergiana, Anisotes trisulcus, Prosopis juliflora,* and others.	*Senna alexandrina and Cadaba rotundifolia* are only found in this type
	b) Prosopis juliflora – Tamarix aphylla	wadis and adjacent rocky slope, (between 445 and 600 m)		*Prosopis juliflora* and *Phoenix dactylifera*	*Acacia ehrenbergiana, Anisotes trisulcus, Aerva javanica, Indigofera oblongifolia, Tamarix aphylla, T. arabica,* and others.	

Table 3. A matrix of sample sites in the columns (vegetation types) and plant species in the rows (sociological species groups).

Sociological species group

Communities	1											2																																											3							
Veg. types	a							b				a														b						c																						a					b		
Land form	p	p	s	d	s	pl	s	s	s	pl	s	w	w	w	w	w	w	w	w	w	w	w	w	w	w	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	w	w	w
Altitud (m)	1434	1430	1372	1140	1182	1425	1392	1102	1144	1107	1025	867	890	852	840	827	638	617	679	599	965	983	710	603	590	895	808	746	708	749	643	970	890	827	852	828	818	883	812	840	867	743	715	710	700	710	680	679	661	638	617	603	662	571	563	599	555	525	555	495	442
Releve	10	9	8	6	7	**11**	**12**	**3**	**4**	**5**	13	15	14	16	17	18	39	40	24	32	1	2	25	41	33	38	**37**	26	**35**	**36**	**34**	1b	14b	18b	16b	19	22	20	21	17b	15b	23	42	25b	27	29	30	24b	28	39b	40b	41b	43	44	45	32b	31b	46	31	47	48
Jatr vari		1	1	1	1	1	1	1	1	1																																																			
Acac etba	1	1	1	1	1	1				1																																																				
Cadi purp		1	1	1		1			1																																																				
Sear flex	1	1	1	1	1	1																																																							
Cyph digi		1	1			1																																																							
Klei odor	1						1			1																																																			
Ficu vast		1				1																																																						
Comm habe						1		1																		1																																			
Aloe nieb								1		1																																																		
Puli soma								1	1	1	1																						1																												
Ciss rotu	1			1		1		1		1								1					1	1	1				1	1		1	1		1	1			1			1	1			1	1	1	1	1				1							
Acal frut						1	1			1	1						1		1				1										1	1	1					1			1											1							1
Acac asak	1	1	1	1	1		1	1	1		1											1							1	1		1		1	1		1			1				1		1		1													
Grew schw	1	1	1	1	1		1	1																		1	1		1	1					1					1																					
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Table 3. Continued

	Communities	1											2																																											3							
	Veg. types	a							b				a														b						c																						a					b		
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	Altitud (m)	1434	1430	1372	1140	1182	1425	1392	1102	1144	1107	1025	867	890	852	840	827	638	617	679	599	965	983	710	603	590	895	808	746	708	749	643	970	890	827	852	828	818	883	812	840	867	743	715	710	700	710	680	679	661	638	617	603	662	571	563	599	555	525	555	495	442
	Releve	10	9	8	6	7	**11**	**12**	**3**	**4**	**5**	13	15	14	16	17	18	39	40	24	32	1	2	25	41	33	38	**37**	26	**35**	**36**	**34**	1b	14b	18b	16b	19	22	20	21	17b	15b	23	42	25b	27	29	30	24b	28	39b	40b	41b	43	44	45	32b	31b	46	31	47	48
Sociological species group	Acac laet										1																	1		1	1	1						1	1	1			1			1		1	1	1	1	1	1	1								
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Key: Land form: w= wadi, p= plateau, s= mountain slope, pl= plain

3.2. Plant frequency

The most abundant plant species in the study area with a frequency of more than 19% were the followings: *Acacia asak. A. laeta, A. mellifera, A. tortilis, Acalypha fruticosa, Aerva javanica, Anisotes trisulcus, Cissus rotundifolia,, Commiphora myrrha, Cynanchum viminale, Euphorbia cuneata, Ficus sycomorus, Grewia schweinfurthii, Jatropha spinosa, Phoenix dactylifera, Sansevieria ehrenbergii, Ziziphus spina-christi* and *Zygocarpum yemenense* (Fig. 10).

Wadis are characterized by the abundant of *Ficus sycomorus, F. cordata, Phoenix dactylifera, Tamarix arabica Ziziphus spin-christi*, while rocky plateau was abundant by *Acacia etbaica, Cissus rotundifolia, Jatropha variegate, Searsia flexicaulis*, and *Zygocarpum yemenense*. The mountain rocky slopes were abundant by *Acacia tortilis, A. asak, Anisotes trisulcus, Aerva javanica*, and *Commiphora myrrha* (Table 1, Fig. 11).

Widespread plant species in the study area were *Acacia asak and A. tortilis, Anisotes trisulcus* and *Cissus rotundifolia* with a significant difference in abundance from landform to another. The frequency percentage of *Acacia asak* and *Cissus rotundifolia remarkably* increase from the wadi to the rocky slopes, and then to the plateaus. Variations in frequency percentages can be seen. Some plant species were at high frequencies in one landform and low frequencies or absent in other landforms (Table 1).

The frequency of endemic, near-endemic and regional endemic plant species varies from topography to other. *Zygocarpum yemenense, Jatropha variegate* and *Searsia flexicaulis* are more abundant on the rocky plateau of high altitude areas (Fig. 12).

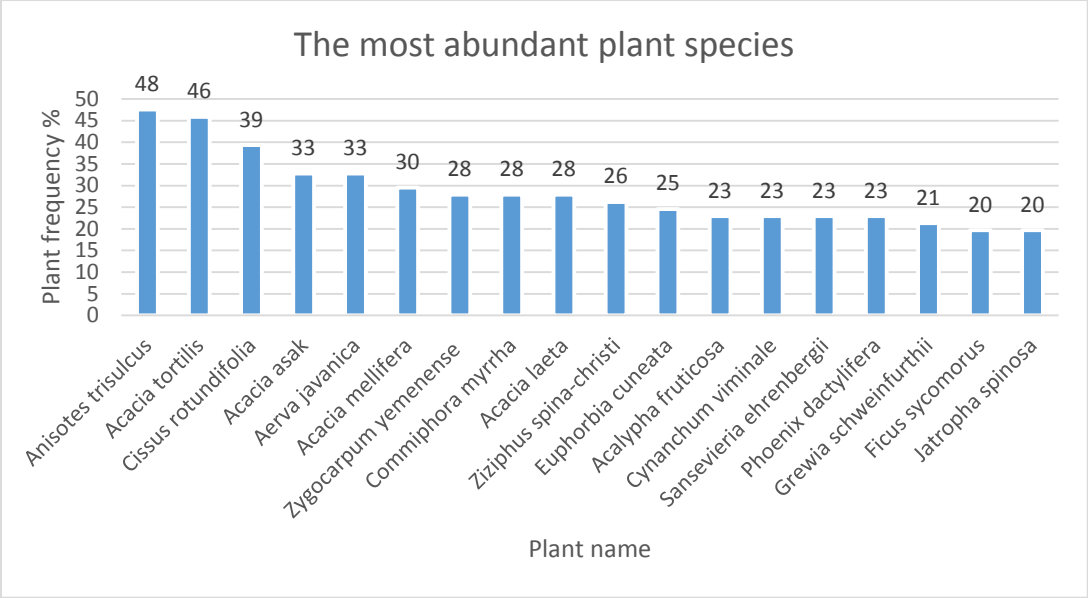

Figure 10. The most abundant plant species in the study area

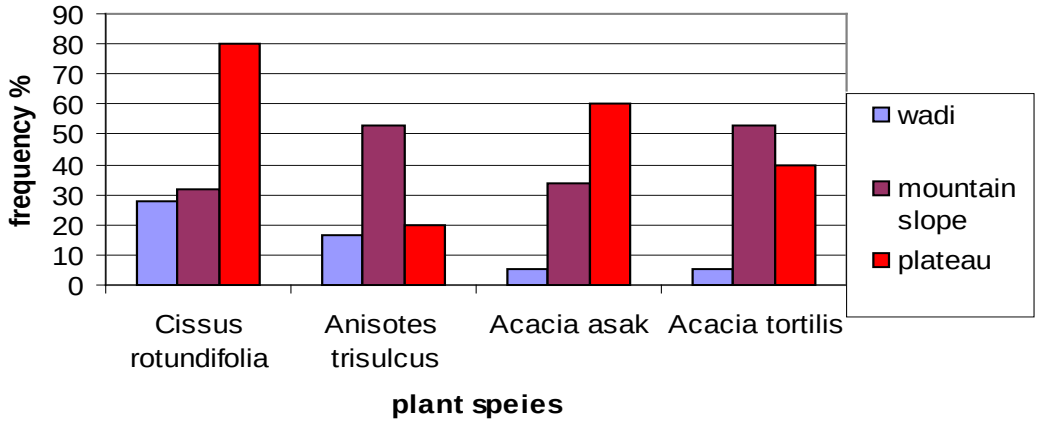

Figure 11. The abundant of focal plant species along the different topographical units.

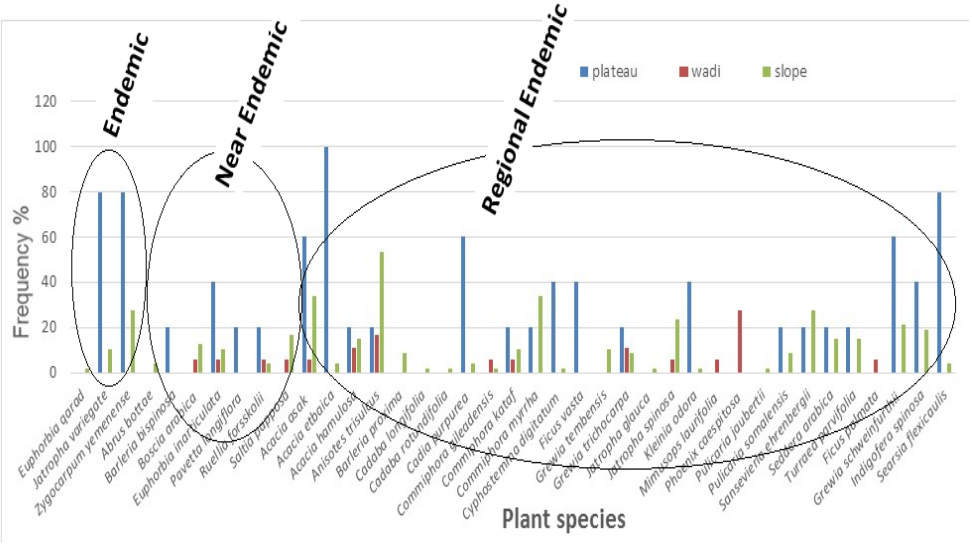

Figure 12. The frequency of endemic, near endemic and regional endemic species in the study area.

3.3. Plant species richness

The richness is a number of species that occur in the sample site, the plant richness is various from landform to other, fig. 13 shows the plant richness in the study area:

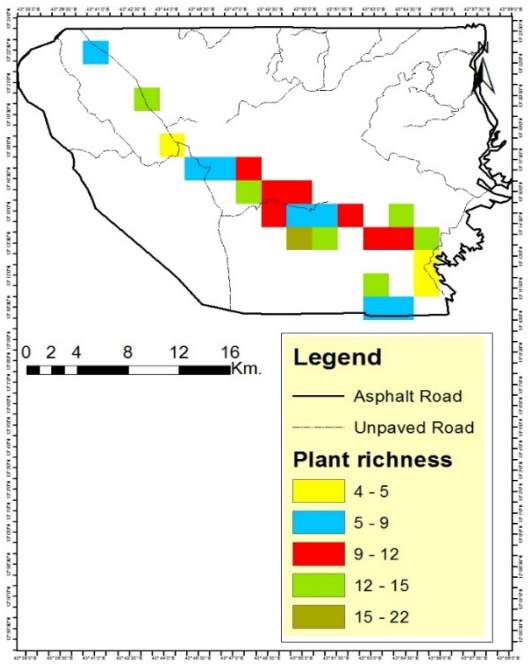

Figure 13. Plant richness per 4 square kilometre.

Few important habitats in Yemen have been already proposed by researchers [26]. Among these habitats the surveyed area, to date, this area has not declared as a protected area.

More than 36 candidate sites have been surveyed and 6 has been declared as nature protected natural habitats in Yemen, these are Utma, Socotra, Huf, J. Bura', north of Kamran and wetland reserves in Aden [27]. These protected areas fall within IUCN Protected Area Category II, under which the area is to be managed and directed mostly for ecosystem protection and entertainment [28 & 29].

Plant ecology survey such as this study will help the government of Yemen in getting some of the following goals and targets:

Target 1. A comprehensive of identified plant species.

Target 2. An initial evaluation of the preservation status of all recognised flora, at national and international levels.

Target 3. Protection of almost half % of the Most Important Plant Areas (IPAs) for plant biodiversity preservation assured

The out pots of this study will feed directly into the Global Strategy for Plant Conservation (GSPC) process and through the Arabian Plant Specialist Group (APSG).

A significant of endemic and near-endemic of regional and local conservation concern are found in the survey area, these species are:

Abrus botte, Aloe niebuhriana, Barleria bispinosa, Boscia arabica, Euphorbia inarticulate, E. qarad, Jatropha variegate, Pavetta longiflora, Ruellia forsskolii, Saltia papposa, and Zygocarpum yemenense. The frequency percentage of these plants varies from habitat to other, none of these species are abundant in the entire region (Table 2).

A significant of regional endemic and of international conservation concern are found in the survey area, these species are:

Acacia asak A. etbaica, A. hamulosa, Anisotes trisulcus, Barleria proxima, Cadaba longifolia, C. rotundifolia, Cadia purpurea, Commiphora gileadensis, C. kataf, C. myrrha, Cyphostemma digitatum, Ficus palmate, F. vasta, Grewia schweinfurthii, G. tembensis, G. trichocarpa, Indigofera spinosa, Jatropha glauca, J. spinosa, Kleinia odora, Mimusops laurifolia, Phoenix caespitose, Pulicaria jaubertii, P. somalensis, Sansevieria ehrenbergii, Searsia flexicaulis, Seddera arabica, and *Turraea parvifolia.*

The last findings of endemic, near endemic, nationally, regionally and globally threatened species make which fit the adopted criteria for the IPA program in Saudi Arabia, Oman and Yemen [26].

The vegetation of the study area is almost similar to that vegetation and flora of western mountain areas of the Arabian Peninsula and is characterized by woodland and shrubland dominated by Acacia spp. – Commiphora spp. Community [12, 30-32]. Vegetation community 1 that is found on high altitude areas holds an important flora of regional and international conservation concerns, with low plant diversity and vegetation cover, besides that vegetation community 1 is characterized by high inhabitants and settlements. Vegetation communities 2 & 3 which occupied the middle and low altitude of rocky mountain slopes areas are characterized by high plant diversity, dense vegetation cover, rich wadis, and low inhabitants with few settlements. Remarkable endemic and near-endemic plant species such as *Abrus bottae*, *Boscia arabica*, *Euphorbia qarad*, and *Saltia papposa*, are limited to this habitat, but as scattered and as low frequency.

Vegetation communities 2 and 3 are more appropriate to be a protected area than vegetation community 1.

4. Conclusion

- The study area characterized by two different natural ecosystems, both ecosystems are located within the western mountains of the Arabian Peninsula.
One represents the habitat of moderate to relatively high elevation area, with an altitude higher than 1000 m (vegetation community 1) and the second represents the habitat of low elevation areas with an altitude less than 1000 m (vegetation communities 2 and 3).

- The vegetation of the study area is almost similar to that vegetation and flora of western mountain areas of the Arabian Peninsula.

- Vegetation community 1 that is found on high altitude areas holds an important flora of regional and international conservation concerns, with low plant diversity and vegetation cover, besides that vegetation community 1 is characterized by high inhabitants and settlements.

- Vegetation communities 2 & 3 which occupied the middle and low altitude of rocky mountain slopes areas are characterized by high plant diversity, dense vegetation cover, rich wadis, and low inhabitants with few settlements. Remarkable endemic and near-endemic plant species such as Abrus bottae, Boscia arabica, Euphorbia qarad, and Saltia papposa, are limited to this habitat, but as scattered and as low frequency.

- Vegetation communities 2 and 3 are more appropriate to be a protected area than vegetation community 1.

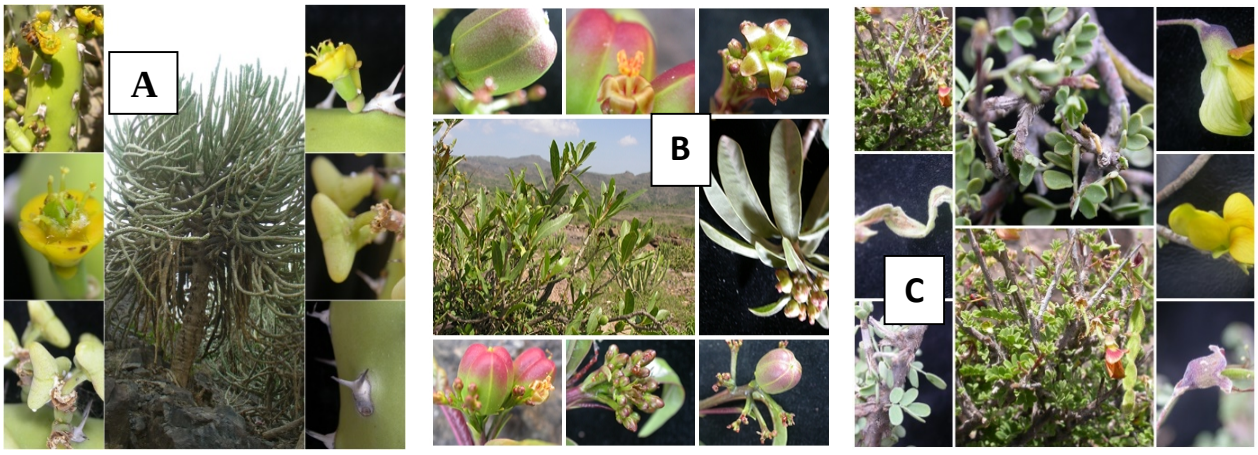

Plate 1. Endemic to Yemen: A. *Euphorbia qarad*; **B.** *Jatropha variegate*; **C.** *Zygocarpum yemenense*

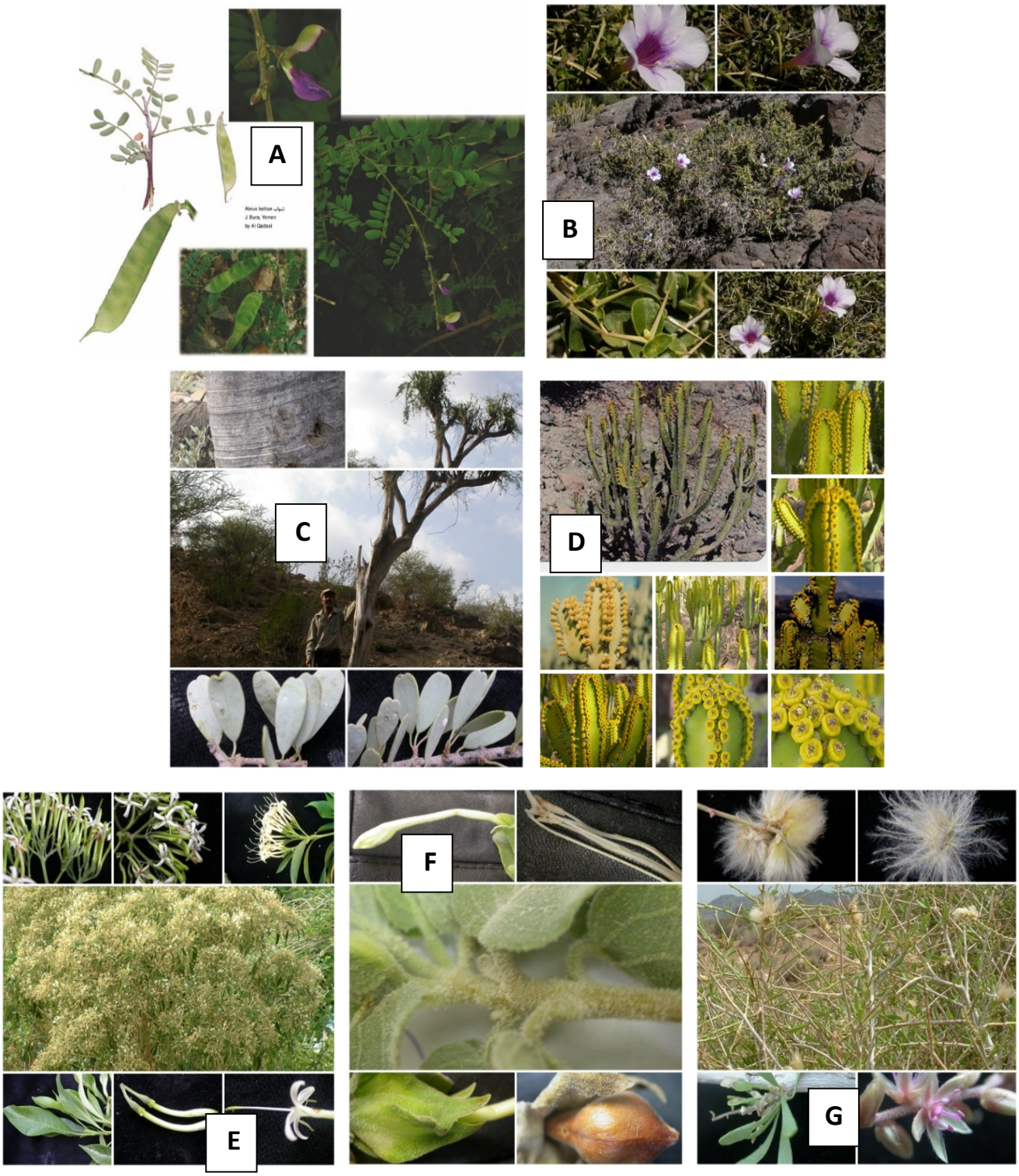

Plate 2. Endemic to Arabian Peninsula: A. *Abrus bottae*; **B.** *Barleria bispinosa; C. Boscia arabica; D. Euphorbia inarticulate*; **E.** *Pavetta longiflora*; **F.** *Ruellia forsskolii*; **G.** *Saltia papposa*

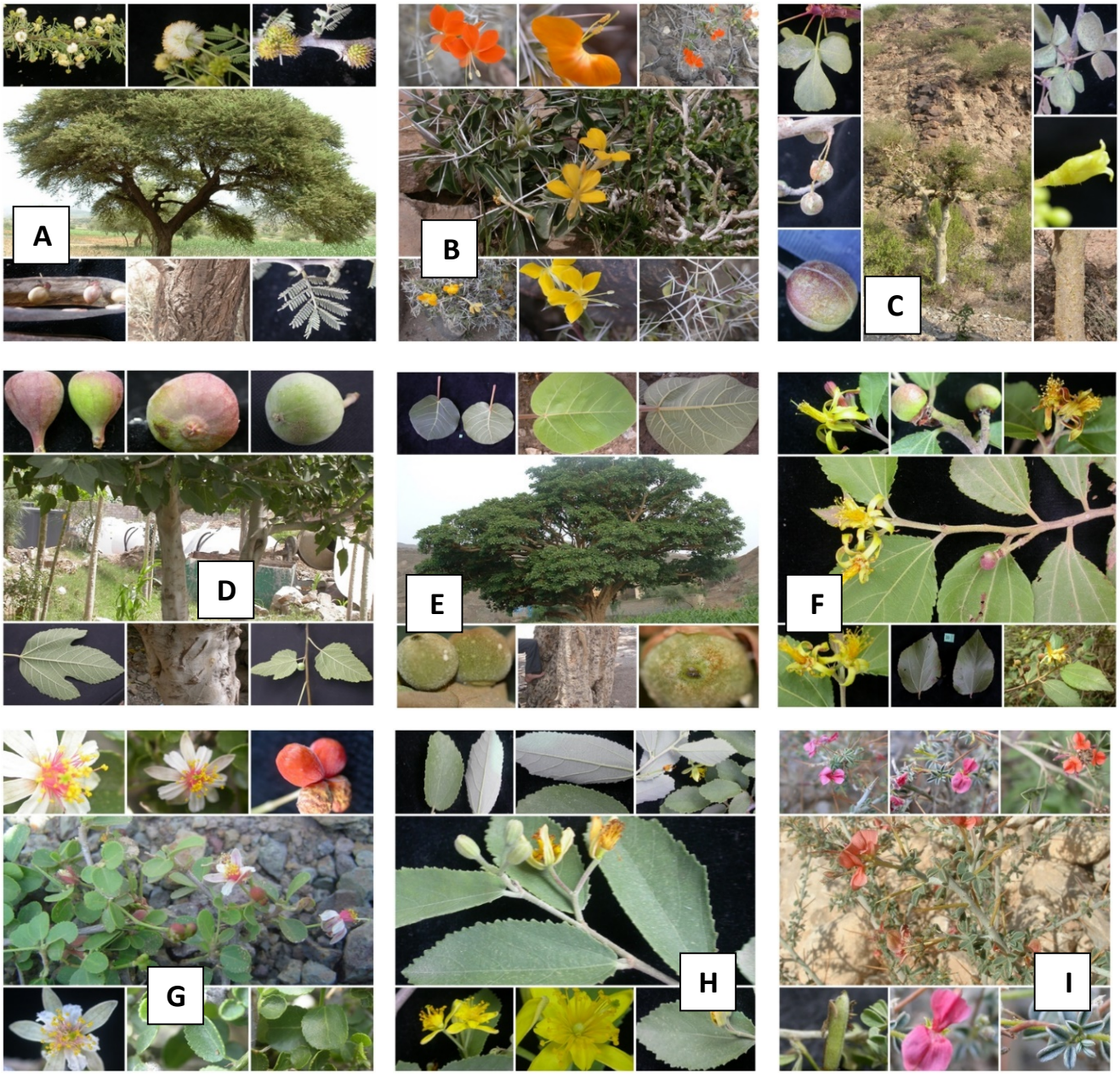

Plate 3. Regional endemic: A. *Acacia etbaica*; **B.** *Barleria proxima*; **C.** *Commiphora kataf*; **D.** *Ficus palmate*; **E.** *Ficus vasta*; **F.** *Grewia schweinfurthii*; **G.** *Grewia tembensis*; **H.** *Grewia trichocarpa*; **I.** *Indigofera spinosa*

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مقالة بحثية

حصر الأنواع النباتية الطبيعية في المناطق النباتية الهامة في شبه الجزيرة العربية: بني عمر، محافظة تعز، الجمهورية اليمنية

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الملخص

تقع منطقة الدراسة على الجبال الجنوبية الغربية للجمهورية اليمنية، وتتميز بمناخ جاف وشبه جاف مع ارتفاع في درجات الحرارة وانخفاض في معدل هطول الأمطار السنوية. تهدف هذه الدراسة إلى استكشاف أنواع النباتات الطبيعية في إحدى المناطق الهامة نباتيا في شبه الجزيرة العربية وتقييم امكانية أن تصبح منطقة محمية. تم إجراء 61 عينة دراسية بحيث تغطي كل المواقع البيئية المختلفة للمنطقة. تم تسجيل 135 نوعًا من النباتات، 3 أنواع نباتية يقتصر تواجدها على اليمن (متوطنة) و 7 شبه مستوطنة يمتد تواجدها الى مناطق اخرى من الجزيرة العربية و 29 متوطنة اقليميا حيث يقتصر تواجدها على الجزيرة العربية وشرق افريقيا. كشفت الدراسة أيضًا ثلاثة مجتمعات نباتية تندرج تحتها 7 انماط نباتية (طرز نباتية). شوهدت النباتات التالية: الأثب *Ficus cordata* والخنس (سقم) *F. sycomorus* و الاراك *Salvadora persica* و الاثل *Tamarix aphylla* والسدر *Ziziphus spina-christi* في الوديان الرئيسية. تم العثور على مجتمعات نباتية تهيمن عليها العسق *Acacia asak* والمض *Anisotes trisulcus* والبكا *Jatropha variegate* والرهض (الحمرور) *Zygocarpum yemenense* على المنحدرات والهضاب الصخرية.

الكلمات الرئيسية: بني عمر، نباتات متوطنة، المناطق النباتية الهامة، تعز، اليمن، غطاء نباتي.