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Effect of National Parks on Plant Diversity Case Study: Sied National Park

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Abstract

Sied National Park is one of seven National Parks established in Saudi Arabia. The study evaluates the species diversity of the vegetation inside the park comparing with the vegetation outside the park. The vegetation data set was based on the importance value of species from 18 stands represent the sections of the park and 8 stands represents the habitat around the park. TWINSPAN, diversity indeces, and ANOVA were used to analyze the obtained data**.** This study indicated that 21families are recorded in Sied Park, while 17 families are recorded outside the park. The families inside the park comprise 49 species including 32 perennials and 17 annuals, while 27 species are recorded outside the park including 20 perennials and 7 annuals. The vegetation inside the park is divided to five plant groups dominated by *Heliotropium crispum*, *Fagonia bruguieri*, *Penisitum divisum*, *Lasiurus scindicus*, *Cynodon dactylon*, and *Cymbopogon commutatus*, while outside the park the vegetation was divided to three plant groups dominated by *Rhanterium epaposum* and *Rhizyaa stricta.* These results are discussed with the effects of edaphic characteristics variables, also, regard to the type and the absolute density of the cultivated trees in the park.

Keywords: national park, vegetation, afforestation, flora, plant species diversity

Introduction

Biodiversity means the variability among living organisms from all sources and ecological ecosystems of which they are a part; this includes diversity within species, between species and of ecosystems (Heywood & Watson, 1995). Flora of Saudi Arabia comprises of 120 families includes about 3000 species, out of them 246 species are endemic, and many of these species are rare, vulnerable, or threatened (NCWCD, 2005). National Park system plays an important role in the preservation of biodiversity through the protection of endangered species and ecosystems, also serve as reservoirs of plants and animals that can repopulate lands where species have been extirpated. Kingdom of Saudi Arabia established seven National Parks covers most of the habitat and regions of the country. Sied National Park is one of these parks located at 110 km east of Riyadh adjacent of Dahnaa desert, established in 1984 to serve a recreation for the local people of Riyadh region. The area of this park about 300 hec cultivated by about 5000 tree of different species and completely fenced. The artificial forests, which are distributed in the Kingdom of Suadi Arabia especially in the sites of sand creeping, could be suitable enclosures for the

protection and conservation of the wild biota. Afforestation , the planting of trees on land that had not previously been forested, is currently being promoted as a way to sequester carbon produced by the burning of fossil fuel (Cathcart,2000), also has been a common practice for preserve and restore the flora and fauna (Naddra & Nyber, 2001). In arid and semi-arid regions, afforestation was considered as a method for ecological revival in terms of vegetation enrichment, soil amelioration as well as social benefits (Pal and Sharma, 2001). Inventory and monitoring of National Park resources is important to acquire information's needed by park managers to maintain ecosystem integrity in the park that contains significant natural resources. The evaluation of the impacts of several native and exotic forest trees on the natural native flora would help in selecting the most suitable species that would enhance biodiversity and not cause great threat the nature flora, if they escaped and naturalized outside the forests.

This study aims to: 1) describe the vegetation diversity and the flora inside the park; 2) determine the effect of edaphic factors and afforestation on the vegetation diversity; and 3) estimates the effect of the protection on species diversity inside the park comparing with outside the park.

Study Area

Sied National park is situated between 25 06 57.4 N and 47 35 48.5 E in the habitat of sand plain discovered by depressions and water runnels scattered in the sand plains. Data of the Climatic Normals of Saudi Arabia (Zoghet and Akabawi, 1986) show that in Sied Park, the average annual temperature is 20 Cº and the average rainfall is 80 mm/year. The park divided into 18 sections, each section cultivated by four to nine different tree species (Table 1). The cultivated trees irrigated each three to five days from three artesian wells, the salinity of water irrigation reaches to over than 3700 ppm. Four sections irrigated by using flood system, these were 14, 15, 16, and 18 and the other sections irrigated by using dripping system. The cultivated species *Eucolyptus camaldulensis* had the highest presence (100 %) in the park followed by *Prosopis julliflora* (94,4 %) and *Acacia legulata* (72,2 %). *Prosopis julliflora* and *E. camaldulensis* each had the highest absolute density in five sections in the park, while the two species had the highest absolute density in section (13). Each of *Acacia saligna* and *A. legulata* had the highest absolute density in two sections, while each of *Ziziphus spina-christi* and *Albizza lebbek* had the highest absolute density only in one section in the park. Section (16) characterized by equal value of absolute density for all cultivated species (Table 1).

Materials and Methods

The absolute density (No. of trees/100 m²) of the cultivated trees in the park was measured in four randomly quadrates per each section. The presence value (%) of the cultivated species in the park was calculated according the following equation:

Presence (P %) = No of sections in which the species occurred × 100 / Total number of sections studied

The vegetation inside Sied Park studied in 18 stands represents the eighteen sections of the park. Outside the park, the vegetation studied in eight stands represents the four directions around the park. In each stand inside and outside the park, a list of species was

recorded and their presence value (%) was calculated according the equation that was mentioned above. Four randomly quadrates (10 × 10 m) were made in each stand. According Muller- Dombois and Ellenberg (1974), species density was calculated per unit area, frequency and the plant cover as percentage of ground surface were measured. Plant cover was determined by the line intercept method. Three line intercept transects (40 m length) were randomly placed within every stand. The importance value (IV) for different species were calculated according to Ludwig & Reynolds (1988). The life forms of the species present were distinguished in the studied stands according Raunkiaer (1937). Taxonomic nomenclature followed Collenette (1999), updated by Chaudhary (2001).

Three soil samples (0-20 cm depth) were collected from each stand and were mixed together to form one composite sample. All samples were air dried and sieved through a 2 mm sieve to get rid of debris and coarse gravel. These samples were analyzed for determination of soil texture, electrical conductivity (EC), potassium, phosphorus, sodium and $CaCo_3$ according to (Jackson, 1967; Piper, 1950).

Data analysis

Two-Ways Indicator Species Analysis (TWINSPAN) was applied to the classification to the eighteen stands inside the park and eight stands outside the park, using the importance value (IV) according Hill (1979). The diversity measures applied here are according to Ludwig & Reynolds (1988) and Magurran (1988). The one-way analysis of variance (ANOVA) test was used to compare the means of all edaphic factors, absolute densities and the number of the cultivated species, and diversity indices for the identified groups. Differences in means of edaphic characteristics and diversity indices inside and outside the park were compared by Duncan′s Multiple range Test (1955). All statistical treatments followed Zar (1984) using student SYSTAT 7.0

Results

Classification

The phytosociological features and the Environmental characteristics of the identified vegetation groups inside and outside the park are given in tables (2; 3; 4; 5). These results are presented by TWINSPAN in Fig.1 and 3.

Classification inside the park

Group A. This group is represented by one stand located in section 13 of the park. This section irrigated by using dripping system, where the highest mean number of cultivated trees types was occurred in this stand (8 trees types/stand). Vegetation is dominated by *Heliotropium crispum* (IV= 137.6). Low number of annuals (7 species) was recorded in this vegetation type. Soil in this stand has the highest value of EC, K and P. There is no of *Casuarina equistifolia* is cultivated in this stand.

Group B. This group comprises four stands mainly located in sections were irrigated by using flood system. Vegetation is dominated by *H. crispum* (IV= 159.8). In these stands, the soil is characterized by the highest content of clay and the lowest amount of sand. The lowest mean number of cultivated trees types were recorded in these stands (5 tree types/stand). The indicator species is *Lasiurus scindicus* in this vegetation type.

Group C. Vegetation of this group is characterized by two co-dominated species *Fagonia. bruguieri* (IV= 93.2) and *H. crispum* (IV= 91.8). The most common species is *L. scindicus*. Plant communities occupy the sections are cultivated by moderate number of trees types, which had moderate absolute density. The soil had moderate values of clay and EC. The highest number of annuals (11 species) was recorded in this vegetation type.

Group D. Fagonia. Bruguieri is the dominant species in this group (IV= 114.6). This group includes 4 stands one of them (stand 18) was irrigated by using flood system. The soil of these stands had the highest amount of sand and lowest values of EC, K and P. The highest absolute density of *Casuarina equistifolia* was recorded in these stands. The lowest number of annuals (5 species) was recorded in this vegetation type.

Group E. Vegetation of this group dominated by *F. bruguieri* (IV= 84.4). The common species in this vegetation were *Cynodon dactylon* and *Cymbopogon commutatus*. This group occupies the sections are not cultivated by *Casuarina equistifolia,* while had the highest density of *Eucolyptus microtheca*. Soil was characterized by the lowest value of clay and EC. High number of annuals (10 species) was recorded in this vegetation type.

Classification outside the park

Group I. This group comprises four stands located in the depressions scattered in the sand plains habitats. Vegetation is dominated by *R. Epaposum* (IV= 62.3). In these stands, the soil is characterized by the highest content of clay and EC and the lowest value of pH. The highest number of annuals (5 species) was recorded in this vegetation type.

Group II. *Rhyza stricta* is the dominated species in this group (IV= 100.0). This group includes 2 stands located in sand formation habitat. The soil of these stands had the highest amount of sand and P and the lowest values of clay and K. The lowest number of annuals was recorded in this vegetation type.

Group **III.** Vegetation of this group dominated by *R. Epaposum* (IV= 86.7). The stands of this group are located in the water runnels scattered in the sand plains habitats. The indicator species of this group is F. indica. Soil was characterized by the highest amount of clay, pH, K and CaCo3 and the lowest values of sand and P.

Species Diversity

Inside the park: From the results in Table 3 and Figure 3 one may report that group C which occupies the sections are cultivated by moderate number of trees types, that had moderate absolute density is floristically more diverse (richness = 15 and H' = 1.88) than the other groups, followed by group B. The lowest species richness and Shannon values were found in group E. The highest evenness of species abundance exhibited also by group E (0.83).

Outside the park: Table (5) and Figure 5 showed that group I is more diverse (richness= 11 and H'= 1.72) than the other groups. The lowest species richness and Shannon values were found in group II. The highest evenness of species abundance exhibited also by group II (0.89).

Table (7) shows that, the species diversity inside the park was significantly more than outside the park, while the evenness of species abundance outside the park was more than inside the park. Also, the values of clay, EC, Na and K in the soil of the park were significantly more than that outside the park, while the values of P and CaCo3 in the soil outside the park were significantly more than that inside the park.

Floristic Composition

Twenty one families of the Angiospermae are recorded inside Sied Park. These families comprise 44 genera including 49 species, 32 perennials and 17 annuals (Fig.5). Only one of these families – family Gramineae contributes about one fourth (22.4%) of the total number of the recorded species (Fig. 6). Three perennial species had presence over than 50%, these species were *Fagonia bruguieri*, *Heliotropium crispum* and *Atractylus carduus*, while 13 species had presence less than 10% (Annex.1). The most common annuals belong to the families Gramineae and Astraceae. *Senecio desfontiani* is the most common species inside the park (P% = 94.4%). On the other hand, 17 families were recorded outside the park comprise 25 genera including 27 species, 20 perennials and 7 annuals (Fig.5). Families Gramineae and Asteracea contributes one third (33.3%) of the total number of the recorded species in the habitat outside the park (Fig.6). Two perennial species in this habitat had presence 100%, *Rhanterium epaposum* and *Rhizyaa stricta*, while nine species had presence 25% (Annex.2). *Schimus barbatus* is the most common annual species in this habitat (P%= 75%).

Figure (7) showed that the Chaemephytes plants are the dominated life form in the vegetation inside and outside the park. The percentages of Chaemephytes, Geophytes and Therophytes inside the park were more than outside the park, while the percentages of Phanerophytes and Hemicryptophytes were higher outside the park than inside the park.

Table 1. Mean of absolute density (tree/100m²) and presence (P %) of the trees are cultivated in Sied National Park.

Species	Sites																		P %
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Acacia arabica	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.5	-	11.1
Acacia legulata	0.5	0.5	-	0.5	0.5	-	-	1.0	-	-	3.0	3.0	0.5	0.5	0.5	0.5	0.5	0.5	72.2
Acacia saligna	-	-	-	-	0.5	-	-	-	-	-	-	-	0.5	4.5	3.0	-	0.5	5.5	33.3
Albizzia lebbek	-	-	2.0	-	-	-	-	-	-	-	0.5	0.5	0.5	-	-	0.5		0.5	38.9
Casuarina equistifolia	-	0.5	0.5	0.5	-	-	-	-	0.5	-	-	-	-	-	-	-	-	0.5	27.8
Conocarpus erectus	-	-	1.0	0.5	-	-	-	-	2.0	1.5	0.5	-	0.5	-	2.0	0.5	-	2.0	50.0
Eucolyptus camaldulensis	1.0	0.5	0.5	0.5	3.0	1.5	1.5	1.0	3.0	0.5	0.5	0.5	1.0	1.0	1.0	0.5	1.5	1.0	100
Eucolyptus microtheca	-	0.5	-	-	-	0.5	1.0	0.5	-	-	1.0	1.0	0.5	0.5	-	-	0.5	1.0	55.6
Prosopis juliflora	3.5	5.0	1.5	4.0	1.5	1.0	1.0	4.0	0.5	0.5	0.5	0.5	1.0	-	4.5	0.5	1.0	1.0	94.4
Tamarix aphylla	0.5	-	-	-	-	0.5	-	-	-	-	-	-	-	-	-	-	-	0.5	16.7
Ziziphus spina-christi	-	-	-	-	-	1.5	0.5	0.5	0.5	3.5	-	-	0.5	-	-	0.5	0.5	-	44.4
Total Number of Species	5	5	5	5	4	5	4	5	5	4	6	5	8	4	5	6	8	9	

Table 2. Mean importance value (IV) of the plant species in the of different vegetation groups inside Sied National Park. The indicator species are shown in bold. The annual species are recorded visually as common (++), less common (+), or absent (-).

Species	IV	Species	IV	Species	IV	Species	IV	Species	IV
Group A		Group B		Group C		Group D		Group E	
H. crispum	137.6	H. crispum	159.8	F. bruguieri	93.2	F. bruguieri	114.6	F. bruguieri	84.4
P. divisum	64.4	P. divisum	29.4	H. crispum	91.8	H. crispum	47.4	C. dactylon	76.7
F. indica	22.5	F. indica	28.5	L. scindicus	34.9	P. divisum	27.7	C. commutatus	68.9
A. carduus	20.2	A. carduus	14.4	A. carduus	20.2	C. commutatus	21.2	A. carduus	35.1
Brassica sp	7.5	C. monocantha	13.7	P. divisum	18.8	C. dactylon	19.3	F. indica	12.5
C. procera	6.9	P. desertorum	13.4	C. monocantha	7.7	P. setaceum	14.3	H. digynum	12.2
C. monocantha	6.9	C. lanatus	10.6	R. epaposum	6.1	P. turgidum	12.9	H. crispum	9.1
H. tuberculatum	6.9	F. bruguieri	9.0	B. ciliaris	5.3	R. stricta	6.2	L. scindicus	5.2
P. setaceum	6.9	A. bombycinus	6.6	F. indica	3.5	P. juliflora	6.1	Annuals	
P. dactylifera	6.9	H. tuberculatum	5.1	S. villosa	3.0	L. shawii	5.5	C. memphitica	++
R. epaposum	6.9	C. colocynthis	5.0	P. crispa	2.7	Annuals		S. desfontiani	++
S. villosa	6.9	L. scindicus	4.0	P. setaceum	2.7	S. desfontiani	++	L. capitata	+
Annuals		R. epaposum	3.0	C. ciliaris	2.5	C. memphitica	++	P. ovata	+
S. desfontiani	++	F. aegyptiaca	2.3	S. lanata	2.4	P. ciliata	+	S. aegyptiaca	+
C. memphitica	++	R. stricta	2.3	C. rupicula	2.2	R. vesicarius	+	T. terrestris	+
P. minor	++	Annuals		Annuals		E. persica	+	B. muricata	+
P. ciliate	++	P. ciliate	++	S. desfontiani	++			S. barbatus	+
C. ambrosioides	+	R. vesicarius	++	T. terrestris	++			A. tenuifolius	+
T. terrestris	+	S. barbatus	++	B. muricata	++			S. barbatus	+
S. aegyptiaca	+	S. desfontiani	++	P. ciliate	++				
		T. terrestris	++	R. vesicarius	++				
		C. memphitica	+	C. ambrosioides	+				
		A. lanatum	+	P. minor	+				
		I. spicata	+	A. tribuloidus	+				
				I. spicata	+				
				C. memphitica	+				
				E. persica	+				

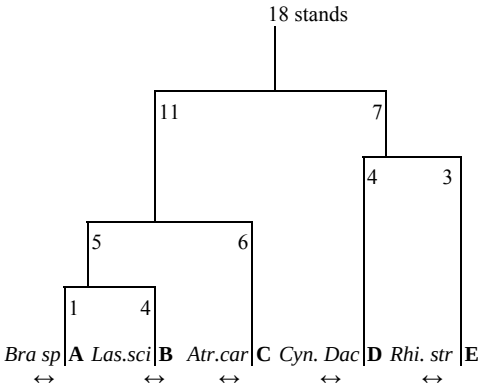


Figure 1. TWINSPAN dendogram of 18 stands based on the importance values of plant species inside Sied National Park. The indicator species of each group is abbreviated to the first letter of the genus and the first three letters of the species name.

Table 3. Means of edaphic characteristics, number of trees types/group and absolute density of common cultivated trees inside the park, and the analysis of variances (ANOVA) between groups (A-G). The diversity indices of the studied groups are shown. (a=vegetation groups, b=number of stands per groups). * Significant at p<0.05, ** Significant at p<0.01, *** Significant at p<0.001, ns= not significant.

Edaphic variables characteristics	Vegetation Groups					F-ratio	p-value
	A[a] 1 b	B 4	C 6	D 4	E 3		
Sand %	92.0	89.5	90.7	94.2	92.0	3.549*	0.024
Silt %	4.0	4.4	5.3	2.7	6.0	3.065*	0.040
Clay %	4.0	4.7	4.0	3.0	2.0	3.579*	0.023
pH	7.85	7.81	7.82	8.04	8.07	2.745ns	0.057
EC (ml mohs/cm)	1.01	0.76	0.78	0.25	0.25	5.234**	0.005
Na+ (ppm)	64.7	216.1	204.8	153.0	148.1	1.378 ns	0.277
K+ (ppm)	213	111.8	149.3	96.5	149.3	9.393***	0.000
P+ (ppm)	9.0	4.5	5.2	2.8	6.7	12.201***	0.000
CaCo3 %	5.53	6.84	5.46	5.53	6.47	1.493 ns	0.242
Cultivated trees							
Number of trees types/group	8.0	5.0	5.2	5.8	5.3	5.313**	0.004
Absolute density:							
Acacia legulata	0.5	0.5	0.75	0.25	1.33	2.080 ns	0.122
Acacia saligna	0.5	1.48	0.17	1.32	0.0	1.999 ns	0.133
Albizzia lebbek	0.5	0.13	0.42	0.13	0.17	0.928 ns	0.468
Casuarina equistifolia	0.0	0.13	0.08	0.37	0.0	5.366**	0.004
Conocarpus erectus	0.5	0.75	0.42	1.2	0.12	2.408ns	0.083
Eucolyptus camaldulensis	1.0	0.8	1.2	1.7	0.9	1.681 ns	0.192
Eucolyptus microtheca	0.5	0.25	0.25	0.25	0.67	2.177 ns	0.109
Prosopis juliflora	1.0	2.5	1.4	1.6	1.8	0.973 ns	0.444
Ziziphus spina-christi	0.5	0.13	0.67	0.25	0.67	0.536 ns	0.711
Diversity Indices							
Richness	12.0	15.0	15.0	10.0	8.0	9.5*	0.015
Shannon index (H`)	1.76	1.82	1.88	1.83	1.72	374804.8 ***	7.11E-14
Evenness	0.71	0.67	0.69	0.79	0.83	663585.5 ***	1.7E-14

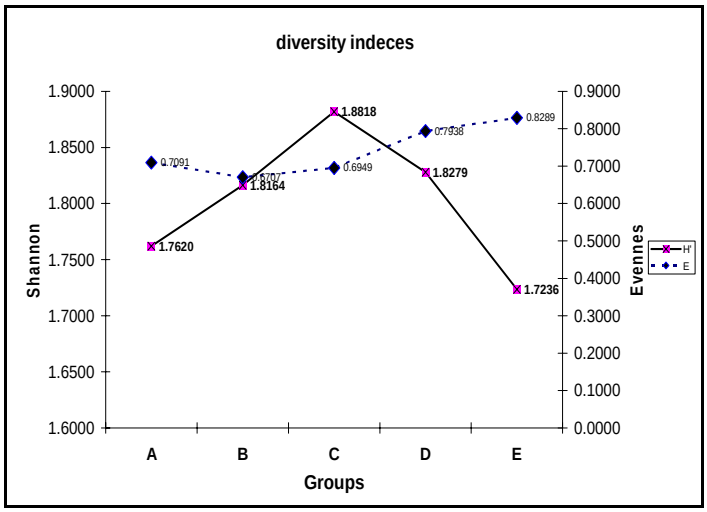
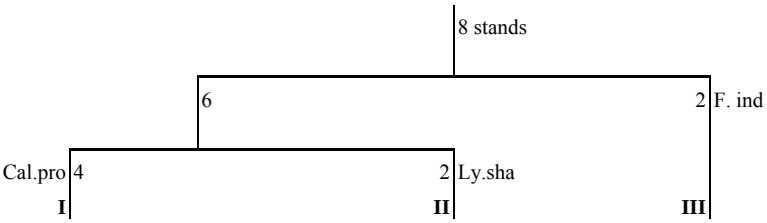


Figure 2. The diversity indices of the studied groups inside Sied Park.

Table 4. Mean importance value (IV) of the plant species in the of different vegetation groups outside Sied National Park. The indicator species are shown in bold. The annual species are recorded visually as common (++), less common (+), or absent (-).

Species	IV	Species	IV	Species	IV
Group I		Group II		Group III	
R. epaposum	62.3	R. stricta	100.0	R. epaposum	86.7
C. colocynthis	25.8	F. bruguieri	57.2	A. carduus	28.9
Z. spinosa	28.1	R. epaposum	49.6	F. indica	28.9
H. crispum	25.8	A. carduus	26.8	R. stricta	16.3
R. stricta	18.9	L. shawii	14.6	T. nilotica	8.8
F. bruguieri	15.1	Annuals		A. ehrenbegiana	8.4
H. hemistemon	13.2	P. minor	+++	P. divisum	8.4
C. procera	11.7	S.barbatus	++	Annuals	
P. crispa	11.6			S.barbatus	++
S. cilliatae	3.9			P. ciliate	+
L. scindicus	3.4				
Annuals					
P. ciliate	+++				
P. ovata	++				
S. desfontiani	++				
A. lanatum	+				
A. hierochuntica	+				



Figuer 3. . TWINSPAN dendogram of 8 stands based on the importance values of plant species outside Sied National Park. The indicator species of each group is abbreviated to the first letter of the genus and the first three letters of the species name.

Table 5. Means of edaphic characteristics, and the analysis of variances (ANOVA) between groups (I - III) outside the park. The diversity indices of the studied groups are shown. (a=vegetation groups, b=number of stands per groups). Significant at p<0.05, ** Significant at p<0.01, *** Significant at p<0.001, ns= not significant.

Edaphic characteristics variables	Vegetation Groups			F-ratio	p-value
	I [a] 4 b	II 2	III 2		
Sand %	94.7	96	92	7*	0.027
Silt %	4	4	4	0 ns	1
Clay %	1.3	0.0	4	7*	0.027
pH	7.95	8.00	8.05	25*	0.013
EC (ml mohs/cm)	0.31	0.22	0.23	1.52 ns	0.293
Na+ (ppm)	25.37	24.5	25.7	0.27 ns	0.773
K+ (ppm)	84	60.3	105	36.63***	0.000
P+ (ppm)	7.67	8.0	6.0	7.75*	0.022
CaCo3 %	7.77	7.5	9.48	8.03*	0.020
Diversity Indices					
Richness	11.0	5.0	7.0	9.333*	0.052
Shannon index (H`)	1.72	1.43	1.57	210.33***	0.000
Evenness	0.83	0.89	0.81	17.33*	0.022

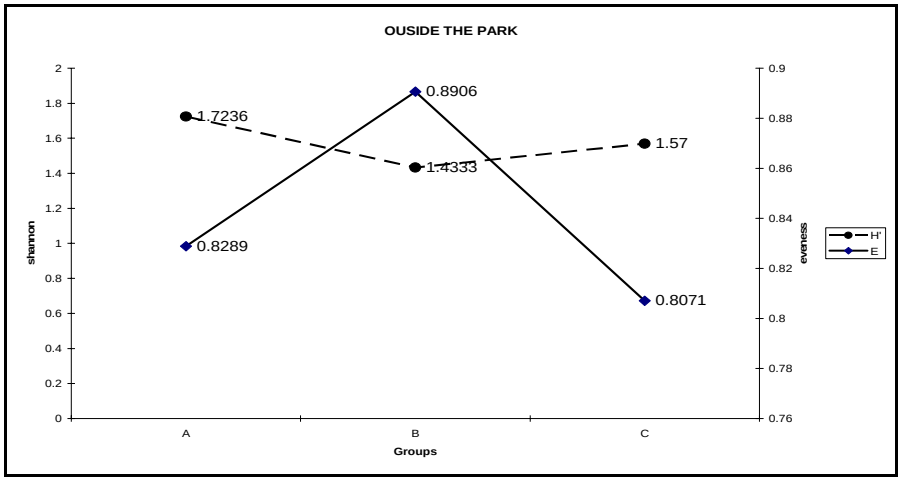


Figure 4. The diversity indices of the studied groups inside Sied Park.

Table 6. Comparison between the means of edaphic characteristics and diversity indices inside and outside the park. Significant at p<0.05, ** Significant at p<0.01, ns= not significant.

Variables	Inside the park	Outside the park
Edaphic characteristics		
Sand %	91.7	94.2ns
Silt %	4.5	4.0 ns
Clay %	3.7	1.8*
pH	7.92	8.0 ns
EC (ml mohs/cm)	0.61	0.25*
Na+ (ppm)	157.3	25.2**
K+ (ppm)	143.9	83.1*
P+ (ppm)	5.6	7.2*
CaCo3 %	6.0	8.7*
Diversity Indices		
Richness	12.0	7.7*
Shannon index (H`)	1.80	1.57*
Evenness	0.74	0.84 ns

Discussion

Any vegetation in particular place is influenced by the prevailing environmental factors including: climate, topography, soil, human activities and other biotic factors (Zahran, 1982). Analysis (TWINSPAN) technique is used in the present study classified the stands inside Sied Park to five groups. Heliotropium crispum and F. bruguieri each dominate two groups, while one group co-dominated by the two species. Analysis of the relationship between variations in vegetation composition and edaphic variables indicate that the distribution of vegetation in Sied Park is mainly controlled by soil salinity (EC), K, P, sand and clay. Chapman (1966) stated that salinity plays an important role in controlling the distribution of vegetation in arid region. Jafari et al.(2003) found that, soil salinity and soil texture are the main factors that cause the separation of the vegetation types. This result

has been supported by the works of Kassas (1957); Moghimi (1989) and Caballero et al. (1994). These researchers found that distribution of plants in a given region is a function of soil salinity. El-Khouly and Fakhry (1999) and El-Khouly and Khedr (2000) found that there are a negative significant correlation between the diversity of the communities and soil salinity. On the other hand, Ayyad and Fakhry (1996) found positive significant correlation between plant species diversity and percentage of sand. Our results indicated also, that the number of the cultivated trees types had a significant negative effect on plant species diversity inside the park, while the absolute density of Casuarina equistifolia had a significant positive effect on it. The increase in the shade of the cultivated trees may cause a negative effect on the germination and propagation of the plant species growing naturally inside the park. This result is in agreement with Andrés and Ojeda (2002). Casuarina equistifolia litters may increase the soil fertility in the groups had high species diversity. El-Keblawy (2004) found that, the species diversity and the abundance of the perennial trees increase in the afforestation locality due to the high fertility of the soil and increase of the organic carbon in the artificial forests. The effects of type of forests grown in the forest and size of the forests trees were significant on the number of species, species richness and species diversity (El-Keblawy, 2004; El-Keblawy and Ksiksi, 2005). This may explain the highest species richness and diversity of group C and B and the lowest diversity is attained in group E. Group E had the highest density of Eucolyptus microtheca. Eucolyptus species contain allelopathic compounds had negative effects on the germination and growth of the other plants grown in the same site (Noble and Randall, 1998; El-Keblawy, 2004).

Outside the park, TWINSPAN technique classified the stands to three groups dominated by Rhanterium epaposum and Rhizyaa stricta. The distribution of vegetation outside the Park is mainly controlled by the amount of sand and clay and the values of Na, K and CaCo3. The data presented in this study indicated that, group I was the highest diversity than the other vegetation groups are studied. This group is located in the depression habitat recived the high amount of rainfall and plays a great role in regulating moisture availability to plants (Kassas and Girgis, 1965).

The increase of plant species diversity inside Sied Park more than outside the park related to: 1) the increase of soil water availability as a result of the continues irrigation, which the plants can be utilize this water stored in the different depths of soil in addition with precipitation pluses (Abd El-Ghani et al., 2006), that explain the increases of the grasses inside the park; 2) the protection against the grazing, where most of the species recorded inside the park were palatable; and 3) the increase of fertility in the soil inside the park due to utilization of fertilizers and/or the decomposition of the litters of the cultivated trees. Similar results were obtained by El-Keblawy (2004) and Ksiksi (2006).

The increase of the values of clay, EC, Na and P scientifically inside Sied park more than outside the park may be due to the afforestation processes, irrigation system and water salinity is used in the irrigation inside the park. There is a direct impact of trees on the soil proprieties (Barth & Klemmedson, 1978; Virginia & Jarrell, 1983). These authors have been measured a significant accumulations of organic carbon, N, Ca, P and K in the surface horizons beneath Prosopis canopies. El-Keblawy and Ksiksi (2005) found that, the organic matter content, salinity, total sodium ions, total sulfate, total soluble nitrogen, total chromium and copper attained significantly greater values under the crowns of the trees than both between the crowns and outside the artificial forests.

The families of Gramineae, Asteraceae, Leguminosa and Crucifersae constitute the main bulk of the alien plant species in Saudi Arabia (Abdel Ghani & El-Sawaf, 2004).In this study, the largest percentages of families inside the park were Gramineae (22.4%) followed by Asteraceae (12.2%). The increase of the percentage of family Gramineae return to: 1) the protection against the grazing because most species of this family were palatable; 2) increase of soil moisture availability at the upper soil depth as a result of the irrigation by flood system and the continues irrigation causes increase in the grasses have superficial roots utilize the water was stored in this depth, where most species of this family were rhizomatous plants. The ratio species/genera (44/21) and genera/families (49/44) for Sied National Park indicated high taxonomic diversity (lower ratios).Pielou (1975) and Magurran (1988) pointed out that, in intuitive terms, hierarchical (taxonomic) diversity will be higher in an area in which the species are divided amongst many genera as opposed to one in which most species belong to the same genus, and still higher as these genera are divided amongst many families as opposed to few. The fieldwork results indicated that, the number of species and families inside the park were higher than outside the park as a result of protection against grazing. The grazing leads to decrease in the size of edible plants, and temporary changes in their relative abundance (Danin, 1983). Penisitum divisum, Panicum turgidum and Lasiurus scindicus are reproductive vegetatively by rhizome growth and sexually by tillering, where each tiller may end with a spike. These species fail to reproductive sexually if they subjected to overgrazing of flowering branches or seeds before dispersal (El-Khatib & Hegazy, 2001). These species attained greater presence inside the park, but not recorded or attained lower presence outside the park. Also, the salt tolerant species e. g. Salsola villosa and Cynodon dactylon was recorded only inside the park as a result of increase the soil salinity in some sections of the park. Similar results are obtained by El-Keblawy (2004). Many species are recorded inside the park are agricultural weeds such as Heliotropium crispum and Pennisetum setaceum, which had high presence. The increase of annuals inside the park more than outside the park due to overgrazing outside the park, also, due to the high amount of clay and water availability inside the park. These results are in agreement with El-Khouly (2004).

The life form patterns of desert plants were reflected by the rainfall, topography and landform types (Kassas and Girgis, 1965; Zohary, 1973). The life form in the arid desert region is characterized by Therophytes (Abd El-Ghani et al., 2006). In the present study, the life form spectrum inside Sied Park is dominated by Therophytes. The increase of the Therophytes due to all the annual species are represented by the same life forms not as perennial species (Ali, 2004). Therophytes, Chamaephytes and Geophytes species inside the park were more than outside the park. Most of these plants are protected from grazing. Also, Geophytes species are able to grow in the water logging and saline habitat (Beeftink, 1977). The main advantage of the drought-evading plant species (Therophytes and Geophytes) is to have a high degree of plasticity in growth rate, size and phenology and to remain dormant in years of climatic extremes (Khedr, 1999). Chamaephytes and Cryptophytes are able to grow in more saline soil (El-Ghareeb & Rezk, 1989).

Although the species diversity and the number of species inside Sied National Park were more than outside the park, the number of species in general is small may be due to the negative effect of the trees types are used in the afforestation, also as a result of elimination the natural vegetation by the workers in the park. Some alien tree species used in afforestation causes major problems as invaders of natural and semi-natural ecosystems.

The magnitude of the problem increased significantly over the past few decades, with rapid increase in afforestation and changes in land use (Richardson, 1997). Eucolyptus and Prosopis juliflora trees had a negative effect on the number of species, species richness, Shannon-Wiener index, and Simpson index of the native species inside the artificial forests in UAE (El-Keblawy, 2004; El-Keblawy and Ksiksi, 2005).

Conclusion

- The species diversity and the total number of species inside Sied National Park were more than outside the park**.**
- The distribution of species inside the park is governed mainly by soil salinity (EC), K, P, sand, clay, the number of the cultivated trees types, and the absolute density of *Casuarina equistifolia*.
- The overgrazing in the stands outside the park has a high effect on the disappearance of many palatable species which are recorded inside the park.
- Afforestation inside the park is an effective tool to promote diversity and improve soil fertility.
- Sied national Park was useful in preservation and development some of the economic species e.g. Penisitum divisum, Panicum turgidum, Lasiurus scindicus, Cymbopogon commutatus, Heliotropium species and Fagoniea species.

Recommendations

- To promote species richness and diversity in Sied Park, the exotic trees e.g. *Eucolyptus* sp. must be replaced gradually with native trees, especially native trees are compatible with the environment of Saudi Arabia and not use much water as exotic trees.
- Afforestation can be used as conservation sites in Sied National park if the elimination of the native flora is stopped.
- Using the proper system in the irrigation of the cultivated trees to decrease soil salinity.

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تأثير المنتزهات الوطنية على التنوع النباتي
دراسة حالة : منتزه سعد الوطني

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يعتبر منتزه سعد الوطني أحد سبع منتزهات وطنية أنشأتها وزارة الزراعة فى المملكة. في هذه الدراسة تم تقييم التنوع فى الكساء الخضري داخل المنتزه بالمقارنة بالمواقع خارج المنتزه. اعتمدت الدراسة على استخدام قيمة درجة الأهمية لأنواع النباتية فى 18 موقع تمثل جميع القطاعات داخل المنتزه بالإضافة إلى 8 مواقع تمثل الموائل المختلفة المحيطة بالمنتزه وباستخدام برامج تحاليل الكساء الخضرى و أدلة التنوع, كما تم تحليل البيانات الناتجة باستخدام التحاليل الإحصائية. أوضحت الدراسة أن الكساء الخضري داخل المنتزه يشمل 21 عائلة نباتية بالمقارنة مع الكساء الخضري خارج المنتزه الذي يشمل عائلة نباتية 17 . وقد احتوت العائلات النباتية داخل المنتزه على 49 نوع منها 32 نوع معمر و17 نوع حولي, بينما احتوت العائلات النباتية خارج المنتزه على 27 نوع منها 20 نوع معمر و 7 أنواع حولية. تبين من الدراسة أن الكساء الخضري داخل المنتزه ينقسم إلى خمس مجموعات نباتية تسودها أنواع الرمرام , الشويكة, ثيموم, ظع, الثيل, صخبر, بينما ينقسم الكساء الخضري خارج المنتزه إلى ثلاث مجموعات تسودها الحرمل والعرفج. وقد تم مناقشة تلك النتائج في ضوء علاقتها بالعوامل الأرضية المختلفة وأيضاً بعلاقتها بأنواع الأشجار المزروعة داخل المنتزه.