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A Quantitative Ecological Study on the Vegetation Cover of Burma Valley, Western Area, Saudi Arabia

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Abstract: A total number of 45 plant species belonging to 21 families and 38 genera were identified. The dominant plant species in the study area were: *Dipterygiacum gluacum, Tephrosia purpurea, Zygophyllum simplex, Fagonia indica, Senna alexandrina ,Fagonia crista, Panicum turgidum , Rhaza stricta* and *Acacia ehrenbergiana.* The density of the vegetation cover in the study area differs from site to another according to the topography and rain fall rates. The densities of *Dipterygiacum gluacum ,Tephrosia purpurea ,Zygophyllum simplex* and *Fagonia indica* were associated with high frequency and high abundance. The density of Stiparagrostis *hirtiglum* was associated with low frequency and high abundance. Whereas the density of *Senna alexandrina* was associated with high frequency and low abundance. This reveals that these species are evenly distributed in the area. The densities of *Fagonia crista, Panicum turgidum , Rhaza stricta* and *Acacia ehrenbergiana* were associated with low frequency and low abundance. This explains that these species are not regularly distributed. Statistical analysis showed a positive association between two of the following species: *Dipterygiacum gluacum* and *Zygophyllum simplex*, *Dipterygiacum gluacum* and *Fagonia indica*, *Tephrosia purpurea* and *Zygophyllum simplex*, *Tephrosia purpurea* and *Acacia ehrenbergiana*. *Tephrosia purpurea* and *Panicum turgidum*, *Zygophyllum simplex* and *Fagonia indica*, *Zygophyllum simplex* and *Rhaza stricta*, *Panicum turgidum* and *Rhaza stricta*, *Acacia ehrenbergiana* and *Panicum turgidum*. However, negative associations were observed between each of the following: *Dipterygiacum gluacum* and *Senna alexandrina*, *Dipterygiacum gluacum* and *Zygophyllum simplex*, *Tephrosia purpurea* and *Rhaza stricta*, *Zygophyllum simplex* and *Panicum turgidum*. *Fagonia indica* and Panicum *turgidum*. The dominant species were found across the study area. These species are more suitable for rehabilitation of the study area, due to their adaptability to the environmental conditions. The present study reported the felling of woody species, heavy grazing and browsing. Particularly around water points in the study area. There is need for reseeding of woody species. The management of these plant species should conform to the ecological factors prevailing in the study area.

Keywods: Vegetation, Density, Association, Abundance, Frequency and Dominance, Burma Wadi K.S.A.

Introduction:

Saudi Arabia a part of the Arabian Peninsula, covers more than 2 million square kilometers and comprises several distinct physiographical regions, such as mountains, valleys (Wadis), sandy and rocky deserts, salt pans and lava areas (Harrats). The overall climate of the country, except for Asir Province is classified as an arid province within Thornthwaites global climatic classification (Al-Nafie, 2008). In semi-arid ecosystems, vegetation is heterogeneously distributed, with plant species often association in patches. These associations between species are not constant, but dependent on particular response of each species to environmental factors. The flora of Saudi Arabian consider the richest in biodiversity in the Arabian peninsula and comprises important genetic resources of crop and medicinal plants and xerophytic vegetation makes up the prominent features of the plant life in the kingdom. According to Collenette (1998), the greatest species diversity in Saudi Arabia has occurred in Asir and Hijaz, the western mountainous area of the Kingdom, which borders the Red Sea which can be attributed to a greater rainfall and range of altitude from sea level up to 9,300m.

The flora and vegetation cover of Saudi Arabia were extensively studied represented in the work of Collenette (1998), Chaudhary *et al* (1999),Mogahid (1988), Al-Khamis ,*et al* (2012). Contribution to the flora of Western district was done by Elsafori (2018). The vegetation of the western part of country is diverse and dense. These areas mainly divided coastal Tihama, foothills and escarpment. Wadis and foothills are sparsely vegetated, scattered populations of *Acacia tortilis, Maerua crassifolia, Ficus palmate,*

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Moringa peregrine and *Ocharadenus baccatus* can be seen in areas. Alsherif *et al* (2012) reported a check list of wild plants with economic importance in western region, K.S.A. According to Milad (2006) Literature dealing with the flora and plant ecology of the study area is very little. The numerical data focus on the species which are dominant in the communities. To know their dominance, certain analytical character such as frequency, densities, abundance of species in a community are expressed in quantity, Sumia etal (2017). The study was explained the vital need for reseeding and replanting of the plant species in the study area.

The main objective of the present study is to assess the ecological parameters of the vegetation cover in the study area.

Material and Methods:
The study area lies between (21^0 $48^/$ $3^{//}$N, 39^0 $43^/$ $25^{//}$ E), Western district, Saudi Arabia. This area has an arid climate and rainfall apart from its scantiness, is irregular and variable. The mean annual rainfall (2018-2019) varies from 4.2mm to 70.9mm/annum in the study area.

The Climate of the area understudy is characterized by high temperature in summer and warm in winter.

Many field trips were carried out to the study area for collecting specimens and measuring the ecological parameters such as Association, Density, Abundance and Frequency. Quadrats were randomly chosen within the study area and a total of 14 quadrats (50x50m) were surveyed. The results were recorded and analyzed for each of foregoing parameters:-

Association: The degree of association between any two species (**X** and **Y**) in a set of samples can be quantified. One of the most widely used method of measuring association is that of **Chi-square (X^2)** using contingency tables as follows:

Species X

	+	-	
+	**a**	**c**	**a +c**
-	**b**	**d**	**b+d**
	a+b	**C+d**	**N**

Species Y

Where:
a = both species X and Y are reported.
b = species X is present but species Y is absent.
C = species Y is present but species X is absent.
d = both species X and Y are absent.
N = a+b+c+d = total number of quadrats.
$\mathbf{X^2}$ can be calculated by the following formula:

$$\mathbf{X^2 = \frac{(|ad - bc| - 0.5\ N)^2\ N}{(a+b)(c+d)\ (a+c)\ (b+d)}}$$

Joint occurrence (J.O.) of the two species was calculated as follows:

$$\mathbf{J.O. = \frac{(a+b)\ x\ (a+c)}{N}}$$

Density (D):
Density is the number of individuals per unit area and is determined as follows:

$$\mathbf{D} = \frac{\text{Total number of individuals}}{\text{Total number of quadrats}}$$

Abundance (A):
This was determined as follows:

$$\mathbf{A} = \frac{\text{Total number of individuals}}{\text{Number of occupied sample plots}}$$

Frequency (F):
This was calculated as follows:

$$\mathbf{F} = \frac{\text{Number of occupied quadrats}}{\text{Total number of quadrats}} \times 100$$

Results
A total number of 45 plant species belonging to 21 families and 38 genera were identified at the study area. The results are given in (Table 1).

The dominant plant species in the study area were: *Dipterygiacum gluacum, Tephrosia purpurea, Zygophyllum simplex, Fagonia indica, Senna alexandrina ,Fagonia crista, Panicum turgidum , Rhaza stricta* and *Acacia ehrenbergiana*. The density, abundance and Frequency were calculated as shown in (Table 2).

The densities of *Dipterygium glaucum , Tephrosia purpureu* , Zygophyllum *simplex* and *Fagonia indica* were associated with high frequency and high abundance while that *Stipagrostis hirtigluma* associated with low frequency and high abundance. The density of Senna *alexandrina* was associated with high frequency and low abundance. The densities of *Acacia ehrenbergiana, Fagonia crista, Rhaza stricta* and *Panicum turgidum* were associated with low frequency and abundance.

Association between the dominant plant species at the study area is given in (Table 3).

Table No. (1): A Check List of identified plant species at Burma Valley, Western Area, Saudi Arabia. The study area (2018 /2019):

S.N	Family	Species
1	Amarnthaceae	*Aerva javanica* (Burm.f.)Schultes
2		*Amaranthus lividus L.*
3	Apocynaceae	*Rhaza stricta* Decene
4	Asclepiadaceae	*Calatropis procera* (Ait.)Ait.f..
5		*Leptadenia pyrotecnica* (Forssk.)Dence.
6	Asteraceae	*Pulicarpa crispa* (Forssk.)Oliver.
7		*Rhanterium epapposum* Oliv.
8		*Sonchus tenerrimus* L.
9	Boraginaceae	*Heliotropium arbainense* Fresen.
10	Caesalpiniaceae(Caesalpinoideae)	*Senna alexandrina* Mill.
11	Capparaceae	*Dipterygium glaucum* Decene.
12	Caryophyllaceae	*Polycarpa repens* (Forssk.) Aschers& Schweif.
13	Celasteraceae	*Haloxylon persicum*
14	Chenopodiaceae	*Salsola spinescens* Moq.
15	Cruciferae	*Farsetia aegyptiaca* Turra
16		*Farsetia ramosissima* Hochst.ex.Boiss
17		*Horwoodia dicksoniae Turril.*
18	Cucurbitaceae	*Citrullus colocynethus (L.)Shrad.*
19	Euphorbiaceae	*Chrozophora plicata* (Vahl.) A.Juss.
20		*Euphorbia granulate Forssk.*
21		*Euphorbia hirta L.*
22		*Phylanthus rotundifolius Willd..*
23	Fabaceae	*Acacia ehrenbergiana (Forssk.)Hayne.*
24		*Acacia tortilis (Forssk.) subsp.raddiana*
25		*Acacia tortilis (Forssk.) Hayne.*
26		*Prosopis juliflora (Sw.)Dc.*
27		*Indigofera spinosa Forssk.*
28		*Tephrosia nubica ((Bioss.)Baker.*
29		*Tephrosia purpureu (L.)Pers.*
30	Malvaceae	*Abutilon muticum .*
31	Nyctaginaceae	*Boehervia errecta L.*
32	Papaveraceae	*Agremone Mexicana L.*
33	Poaceae	*Cenchrus ciliaris L.*
34		*Chloris gyanana Kunth.*
35		*Dactylectonium aegyptium (L.)Willd.*
36		*Eragrostis diplachnoides Steud.*
37		*Panicum turgidum Forssk.*
38		*Stipagrostis hirtigluma (Steud.ex.Trin)Dewinter.*
39	Solanaceae	*Withonia somifera (L.)Dunal.*
40	Tiliaceae	*Corchorus dpresses Stocks.*
41	Urticaceae	*Forskaolea tenacissima L*
42	Zygophyllaceae	*Fagonia crista L.*
43		*Fagonia indica L.*
44		*Tribullus terristris L.*
45		*Zygophyllum simplex L.*

Table (2): Density, abundance and Frequency of the dominant plant species at the study area:

Species	**Density /ha.**	**Abundance/ha.**	**Frequency%**
Stipagrostis hirtigluma (Steud.ex.Trin)Dewinter	537	1505	35.7
Dipterygium glaucum Decene.	231	248	92.8
Tephrosia purpureu (L.)Pers.	227	265	85.7
Zygophyllum simplex L.	154	216	71.4
Fagonia indica L.	91	128	71.4
Fagonia crista L.	88	176	50
Acacia ehrenbergiana (Forssk.)Hayne.	69	108	64.2
Senna alexandrina Mill.	57	62	92.8
Panicum turgidum Forssk.	48	70	64.2
Rhaza stricta Decene	37	65	57.1

Table (3): Summary of the degree of association between the dominant plant species at the study area, as determined by observed cell (a) values and expected joint occurrence:

Species	**Obs.(a) values**	**Exp. J. O.**	**Sig.**

Dipterygium glaucum Decene. *Senna alexandrina* Mill.	-	13	n.s
Dipterygium glaucum Decene. *Zygophyllum simplex* L.	0.24	9.3	n.s
Dipterygium glaucum Decene. *Tephrosia purpureu* (L.)Pers.	4.3	6.5	*
Dipterygium glaucum Decene. *Fagonia indica* L.	3.6	0.93	*
Dipterygium glaucum Decene. *Rhaza stricta* Decene	0.31	6.5	n.s
Dipterygium glaucum Decene. *Acacia ehrenbergiana* (Forssk.)Hayne	0.2	9.3	n.s
Dipterygium glaucum Decene. *Panicum turgidum* Forssk.	0.09	8.4	n.s
Tephrosia purpureu (L.)Pers. *Zygophyllum simplex* L.	1.7	5.5	*
Tephrosia purpureu (L.)Pers. *Fagonia indica* L.	3.1	6	*
Tephrosia purpureu (L.)Pers. *Acacia ehrenbergiana* (Forssk.)Hayne	3.2	5	*
Tephrosia purpureu (L.)Pers. *Panicum turgidum* Forssk.	1.2	4.5	*
Tephrosia purpureu (L.)Pers. *Rhaza stricta Decene*	-	3.5	n.s
Zygophyllum simplex L. *Fagonia indica* L.	2.5	8.5	*
Zygophyllum simplex L. *Acacia ehrenbergiana* (Forssk.)Hayne	0.21	7.1	n.s
Zygophyllum simplex L. *Panicum turgidum* Forssk.	0.01	6.4	n.s
Zygophyllum simplex L. *Rhaza stricta* Dence	1.3	6.4	*
Fagonia indica L. *Acacia ehrenbergiana* (Forssk.)Hayne	0.03	8.6	n.s
Fagonia indica L. *Panicum turgidum* Forssk.	0.1	7.7	n.s
Fagonia indica L. *Rhaza stricta* Decene	0.58	6	n.s
Acacia ehrenbergiana (Forssk.)Hayne *Panicum turgidum* Forssk.	1.8	6.4	*
Acacia ehrenbergiana (Forssk.)Hayne *Rhaza stricta Denece*	0.4	5	n.s
Panicum turgidum Forssk. *Rhaza stricta* Denece	1.2	4.5	*

From the results of the above table of the association between two plant species, the following it can be observed the: There was a positive association between each of the following two species: *Dipterygium glaucum* and *Tephrosia purpureu*, *Dipterygium glaucum* and *Fagonia indica* , *Tephrosia purpureu* and *Zygophyllum simplex*, *Tephrosia purpureu* and *Fagonia indica*, *Tephrosia purpureu* and *Acacia ehrenbergiana* , *Tephrosia purpureu.*and *Panicum turgidum* , Zygophyllum simplex and *Fagonia indica* , Zygophyllum *simplex* and *Rhaza stricta*, *Acacia ehrenbergiana* and *Panicum turgidum* , *Panicum turgidum* and *Rhaza stricta*. There was a negative association between any two of the other dominant plant species as follows: *Dipterygium glaucum* and *Acacia ehrenbergiana*, *Dipterygium glaucum* and *Panicum turgidum* , *Dipterygium glaucum* and *Rhaza stricta, Dipterygium glaucum* and *Acacia ehrenbergiana, Dipterygium glaucum and Panicum turgidum* , *Tephrosia purpureu and Rhaza stricta* , *Zygophyllum simplex* and *Acacia ehrenbergiana*, *Zygophyllum simplex* and *Panicum turgidum* , *Fagonia indica* and *Panicum turgidum* , *Fagonia indica* and *Acacia ehrenbergiana*, *Fagonia indica* and *Rhaza stricta*, *Acacia ehrenbergiana* and *Rhaza stricta*.

Discussion:

The collection of plant specimens has covered all the habitats at the study area and a total of (45) plant species belonging to 21 families were identified (Table 1). The density of the vegetation cover differs from season to season. The study revealed that the density of vegetation cover in 2019 season is better than 2018 season. This may be attributed to variation in rainfall rates during the seasons.

The relationship between the dominant plant species:

The densities of *Dipterygium glaucum, Zygophyllum simplex, Fagonia indica* and *Tephrosia purpureu* were associated with high frequency and high

abundance, whereas the density of *Senna alexandrina* was associated with high frequency low abundance. This reveals that these species are evenly distributed in the study area. The densities of *Acacia ehrenbergiana Panicum turgidum, Fagonia crista* and *Rhaza stricta* were associated with low frequency and low abundance. This explains that these species are not regularly distributed.

Association between the dominant plant species:
Statistical analysis using Chi- square test (Table 3) showed a significant association between *Dipterygium glaucum and Tephrosia purpureu, Dipterygium glaucum and Fagonia indica , Tephrosia purpureu and Zygophyllum simplex, Tephrosia purpureu and Fagonia indica, Tephrosia purpureu and Acacia ehrenbergiana , Tephrosia purpureu.and Panicum turgidum , Zygophyllum simplex and Fagonia indica , Zygophyllum simplex and Rhaza stricta, Acacia ehrenbergiana and Panicum turgidum , Panicum turgidum and Rhaza stricta.* This indicates that the nature of association was positive and every two positively associated species were found together more frequently than by chance. This confirms that positively associated species have the same environmental requirements.

Negative association were observed between the pairs of the following species:
Dipterygium glaucum and *Acacia ehrenbergiana, Dipterygium glaucum* and *Panicum turgidum , Dipterygium glaucum* and *Rhaza stricta, Dipterygium glaucum* and *Acacia ehrenbergiana, Dipterygium glaucum* and *Panicum turgidum , Tephrosia purpureu* and *Rhaza stricta , Zygophyllum simplex and Acacia ehrenbergiana, Zygophyllum simplex* and *Panicum turgidum , Fagonia indica* and *Panicum turgidum , Fagonia indica* and *Acacia ehrenbergiana, Fagonia indica* and *Rhaza stricta, Acacia ehrenbergiana* and *Rhaza stricta*. This indicates that every two negatively associated species do not appear together and may only do so by mere chance.

Conclusion:
A total number of 45 plant species belonging to 21 families and 38 genera were identified at the study area. Association between different pairs of plant species are shown. The study revealed that the density of vegetation cover in 2019 season is better than 2018 season. From the field observations, clear felling of woody species, heavy grazing and browsing in the study area were reported. Hence, there is vital need for reseeding of threatened plant species that should conform to the ecological factors prevailing in the study area. It is very essential to raise the awareness of the population of the consequences of their utilization of natural resources.

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