Original Article
DOI: https://doi.org/10.70749/ijbr.v4i3.3004

INDUS JOURNAL OF BIOSCIENCE RESEARCH
https://ijbr.com.pk
ISSN: 2960-2793/ 2960-2807

Crossref
OPEN ACCESS

Vegetation Distribution Patterns of Anthropogenically Impacted Habitats of Cholistan Desert, Pakistan

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ARTICLE INFO

Keywords: Cholistan, Vegetation, Habitate and Pakistan.

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Declarations
Authors' Contribution
All authors equally contributed to the study and approved the final manuscript

Conflict of Interest: No conflict of interest.

Funding: No funding received by the authors.

Article History
Received: 03-01-2026 Revised: 12-03-2026
Accepted: 17-03-2026 Published: 30-03-2026

ABSTRACT

The current study was conducted to analyze vegetation distribution patterns of Anthropogenically impacted habitats of Cholistan desert, Pakistan. Derawar Fort, Mauj Garh Fort, and Lal Suhanra National Park (RD-50) are among the notable locations. Thirty-three 10 × 10 m2 quadrats were randomly distributed throughout each site; for example, eleven quadrats were placed at each subsite (sand dune, inter dune and clayey land). Density, relative density, relative frequency, cover, relative cover, importance value index, and diversity index are the parameters that we covered during the study. Following the study's conclusion, reports from all three sites include information on 16 families and 33 species. In general, the relative density, frequency, cover, and importance values of Calotropis procera and Suaeda fruticosa were extremely high. Ochthochloa compressa and Haloxylon recurvum have very low values of phytosociology parameters, but Aerva javanica and Calotropis procera have moderate levels. The average Diversity index of all species found at all three sites was (0.82274666). Overall selected three sites Derawar Fort, Mauj Garh Fort and Lal Suhanra National Park (RD-50) have many native species of desert that are facing multiple abiotic and anthropogenic factors.

INTRODUCTION

The Cholistan desert covers 26,000 square kilo meters in Pakistan's southern Punjab province. From an agricultural perspective, it is a very intriguing wilderness with great potential as rangeland if it is managed and utilized skillfully (Akbar *et al*., 1996). The Lesser Cholistan is characterized by large, salty, compacted expanses of alluvial clay (interdunal flats or Daher's) between low, sandy ridges and dunes that are often stable to semi-stabilized or less frequently moving dunes (Arshad *et al*., 2008).

There has been extensive study on the structure and make-up of plant communities. An illustration *Haloxylon stocksii, Prosopis cineraria, Ochthochloa compressa, Tribulus terrestris* (more accurately T. *longipetalus*), *Dipterygium glaucum,* and *Calligonum polygonoides* were identified as six important plant communities in the Cholistan desert (Baig *et al*., 1980). The most palatable species, which include grasses like *Cenchrus ciliaris, Cymbopogon jwarancusa,* and *barrelieri, Lasiurus scindicus*, are the first to suffer. Selective animals like camels prefer the plant species *Haloxylon* and *Salsola*, which are some of the plants that are grazed (Hameed *et al*., 2011).

Based on their capacity for adaptation to severe aridity, ranked *Cenchrus ciliaris* and *Panicum turgidum* as highly adapted grasses, *Calligonum polygonoides, Ziziphus nummularia,* and *Haloxylon stocksii* as highly adapted shrubs, and *Prosopis cineraria* and *Acacia jacquemontii* as highly adapted trees. Four different kinds of soil, each with its own dominant plant community, were classified by Arshad and Rao (1995). Sand dunes, sandy plains, compacted soils, and saline environments were all dominated by *Calligonum polygonoides* communities, *Calligonum polygonoides-Prosopis cineraria-Capparis decidua* communities, and *Haloxylon stocksii-Suaeda fruticosa-Tamarix dioica* communities (Hameed *et al*., 2011).

The Cholistan rangelands' vegetation is extremely important for the local population and as feed for cattle. However, because of constant stress, the browse species in these rangelands are in grave jeopardy and require detailed assessment for prompt remedial action (Abdullah *et al*., 2017). Although the browsing vegetation of the

Cholistan rangelands is under pressure, nothing has been done to evaluate these rangelands' ecology and ethnobotany. In order to determine the best course of action for conservation of the browsing vegetation of the Cholistan rangelands, this study was designed to gather baseline information regarding its ecology, ethnobotany, and state of conservation (Abdullah *et al*., 2021).

It is possible to guarantee the survival of several species and ecosystems that are under danger owing to human activity by conserving biodiversity. In addition to managing and preserving the biotic wealth, it is vital to repair the damaged ecosystems (Arshad *et al*., 2008).

In the view of above facts the study was designed to assess the natural flora of selected areas of Cholistan desert; To calculate the abundance, density and relative abundance of relative frequency and relative cover; to analyses the anthropogenic factors affecting the biodiversity of Cholistan desert; to propose the conservation strategies for conservation of phytodiversity of selected site of Cholistan desert

MATERIALS AND METHODS

Study Site Selection

Our study sites are divided into three study sites i.e., Derawar Fort, Mauj Garh Fort and Lal Suhanra National Park (RD-50). Where the study has been carried out for the 2022 the date of data collection was from February-March. At every site 33 quadrats were placed. Which every sub site we place 11 quadrats. during the study the parameters which we covered cover, relative cover, importance value index, abundance, relative frequency, density, relative density, and abundance and diversity index the three sites mentioned are shown in the map of desert of Cholistan Pakistan.

Survey, sampling, identification and data analysis

Study areas consisted of three major sites i.e., Derawar Fort, Mauj Garh Fort and Lal Suhanra National Park (RD-50). Data of vegetation was recorded in spring season February to March 2022. Quadrats method was used for the quantitative study of vegetation at each locality. We placed 33 quadrats of 10 × 10 m quadrats were placed at random throughout each site. In each site is sub divided into three sub sites (sand dune, inter dune and clayey land) as to check the vegetation distribution pattern of anthropogenically impacted habitats of Cholistan desert, Pakistan

Phytosociological Attributes

It is believed that phytosociological characteristics are required for a thorough analysis of vegetation (Hussain, 1989). The following variables were determined.

A. Frequency

The frequency of a species is the proportion of quadrats in which it was observed. It was computed using the formula.

$$\text{Frequency} = \frac{\text{Number of quadrats in which species occurs}}{\text{Total number of quadrats}} \times 100$$

B. Density

The quantity of each kind of plant in a given area is referred to as density by formula.

$$\text{Density} = \frac{\text{Number of plants of a certain species}}{\text{Total area sampled}} \times 100$$

C. Cover

The percentage of the entire area that a species occupies is known as its cover. The formula used to calculate it is as follows:

$$\text{Cover} = \frac{\text{Total area covered by a species}}{\text{Total area sampled}} \times 100$$

A. Relative density

Relative density is the study of numerical strength of individual species in relation to the total number of individuals of all the species and can be calculated as

$$\text{Relative density} = \frac{\text{Number of individual of the species}}{\text{Number of individual of all the species}} \times 100$$

B. Relative frequency

The degree of species dispersion in a region in relation to the total number of species that existed Mahajan *et al*, (2017).

$$\text{Relative frequency} = \frac{\text{Number of occurrence of the species}}{\text{Number of occurrence of all the species}} \times 100$$

C. Relative cover

Relative cover is the coverage value of a species with respect to the sum of coverage of the rest of the species in the area

$$\text{Relative cover} = \frac{\text{Total basal area of the species}}{\text{Total basal area of all the species}} \times 100$$

The importance value of particular species was calculated.

Importance Value Index (IVI)

For tree, shrubs and herb species and some researchers have used **(**Relative cover**)**. Calculating the basal area of the herb species even in 1*1m plot is time consuming and questionable.

$$\text{IVI} = \frac{RD + RF + RC}{3}$$

Simpson's Diversity Index

Simpson's Diversity Index is a measure of diversity which takes into account the number of species present, as well as the relative abundance of each species. As species richness and evenness increase, so diversity increases. n = the total number of organisms of a particular species.

$$D = 1 - \frac{\varepsilon n(n-1)}{N(N-1)}$$

Where:

- n = number of individuals of each species
- N = total number of individuals of all species

Soil and climate

The Cholistan desert's soil can be considered poor since it has very little organic matter in it. Large Between low sand ridges and dunes, there are alluvial clay areas (interdunal flats or Dahars) that are frequently stable to semi-stabilized or less frequently shifting. are what give the Lesser Cholistan its name. With pHs ranging from 8.2 to 9.6, the soil of interdunal flats has a variety of textures, structures, and levels of salt and sodicity (Arshad et al., 2008). Less than 100 meters lower than those found in the Greater portion are sand dunes. The Greater Cholistan is made up of vast, wind-driven sand dunes and hills, separated by drastically diminished interdunal lowlands (Arshad *et al.,* 2006).

Anthropogenic Factors.

Anthropogenic disruptions have a significant impact on the community's structural traits and biodiversity. Studies on how human activity affects the vegetation and floristic mix. attributed three primary factors soil chemistry, anthropogenic disturbance, and physical environmental variables impacting water availability to the spatial distribution patterns of plant communities and species diversity in arid situations (Hunter *et al*.,1996).

RESULTS

Families and species of quadrats of study recorded at all three sites during spring saeson 2022

In the season 02 we have studied three sites for collection data i.e., site 01 Derawar Fort,site 02 Lal Suhanra National Park (RD-50) and site 03 Mauj Garh Fort which have sub sites as given Sand dune,Inter dune and Clayey land. After the study completion of study 14 families covers the 29 plant species during in spring season 2022.

Table 1

All the families and species of quadrats of study recorded at all three sites Derawar Fort Lal Suhanra National Park RD-50 and Mauj Garh Fort. And sub sites during spring saeson 2022

S.NO.	Family	Scientific name
1	Fabaceae	*Acacia nilotica* *Prosopis cineraria* *Prosopis juliflora*
2	Amaranthanceae	*Aerva javanica* *Haloxylon recurvum* *Haloxylon salicarnicum* *Salsola bryosma* *Suaeda fruticosa* *Salsola imbricate* *Salsola imbricate*
3	Poaceae	*Cenchrus biflorus* *Cenchrus ciliaris* *Cymbopogon jwarancusa* *Cynodon dactylon* *Lasiurus scindicus* *Ochthochloa compressa*
4	Brassicaceae	*Brassica campestris*
5	Polygonaceae	*Calligonum polygonoides*
6	Apocynaceae	*Calotropis procera*
7	Caparaceae	*Capparis decidua*
8	Capparidaceae	*Diptrigium gluacum*
9	Zygophyllaceae	*Tribulus terrestris*
10	Asteraceae	*Launaea nudicaulis* *Launaea residifolia* *Silybum marianum*
11	Apocynaceae	*Leptadenia pyrotechnica*
12	Tamaricaceae	*Tamarix aphylla*
13	Solanaceae	*Withania coagulans*
14	Rhamnaceae	*Ziziphus mauritiana*

Study site 01 Derawar Fort.

The Derawar Fort have three sub sites Sand dune,Inter dune and Clayey land.

Derawar Fort sand dune.

Calligonum polygonoides has very high relative density, *Cenchrus ciliaris* has moderate while *Ochthochloa compressa* has very low relative density (figure. 1). *Calligonum polygonoides* has very high relative frequency, *Salsola bryosma* has moderate while *Ochthochloa compressa* has very low relative frequency (figure. 2)

Capparis decidua has very high relative cover, *Cenchrus ciliaris* has moderate while *Ochthochloa compressa* has very low relative cover (figure. 3). *Lasiurus scindicus* and *Calligonum polygonoide* have very high IVI, *Salsola imbricata* has moderate while *Ochthochloa compressa* has very low IVI (figure. 4). Diversity index of the species found Derawar Fort sand dune i.e. (0.76971021).

Figure 1

Relative density of sand dune (SD) in Derawar Fort during Spring season 2022.

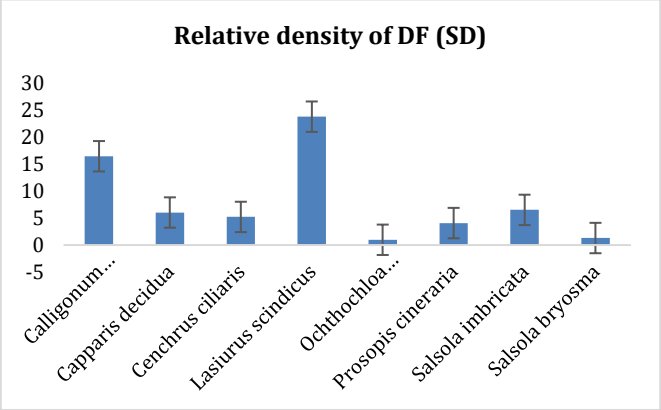


Figure 21

Relative frequency of sand dune (SD) in Derawar Fort during Spring season 2022.

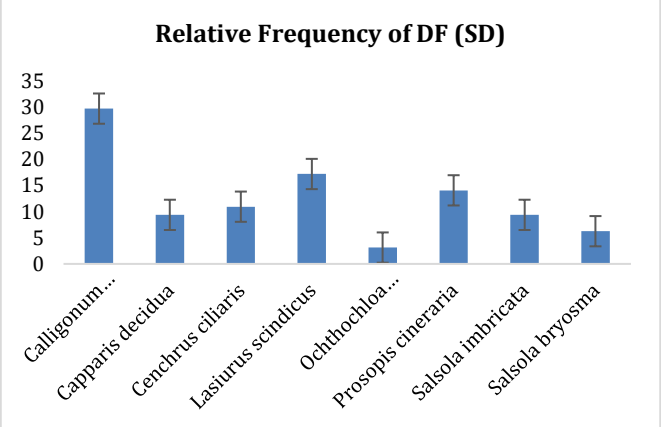


Figure 3

Relative cover of sand dune (SD) in Derawar Fort during Spring season 2022.

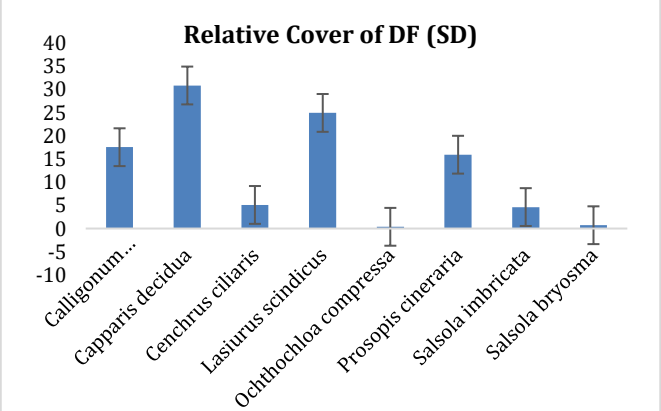
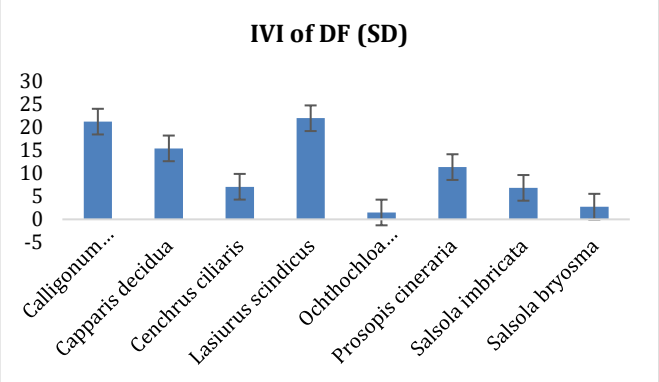


Figure 4
Relative IVI of sand dune (SD) in Derawar fort during Spring season 2022.



Derawar Fort Inter dune.

Calotropis procera has very high relative density, *Salsola imbricata* has moderate while *Salvadora oleoides* and *Tamarix dioica* have very low relative density (fig. 5). *Calotropis procera* has very high relative frequency, *Salvadora oleoides* has moderate while *Salsola bryosma* and *Tamarix dioica* have very low relative frequency (fig. 6).

Prosopis juliflora has very high relative cover, *Capparis decidua* has moderate while *Salsola imbricata* and *Salsola bryosma* have very low relative cover (fig. 7). *Leptadenia pyrotechnica* has very high IVI, *Lasiurus scindicus* and *Salsola imbricata* have moderate while *Salsola bryosma* has very low IVI (fig. 8). Diversity index of the species found Derawar Fort of inter dune i.e. (0.847001054).

Figure 2
Relative density of inter dune (ID) in Derawar fort during Spring season 2022.

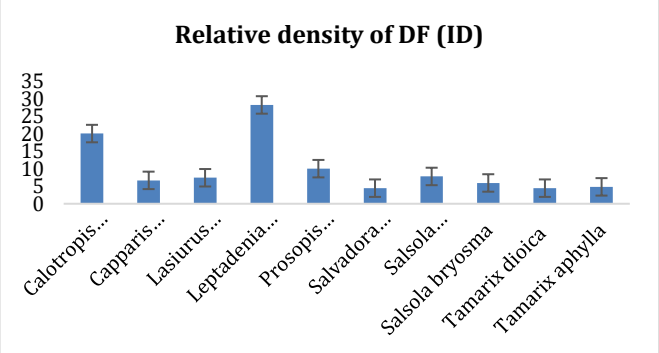


Figure 6
Relative frequency of inter dune (ID) in Derawar Fort during Spring season 2022.

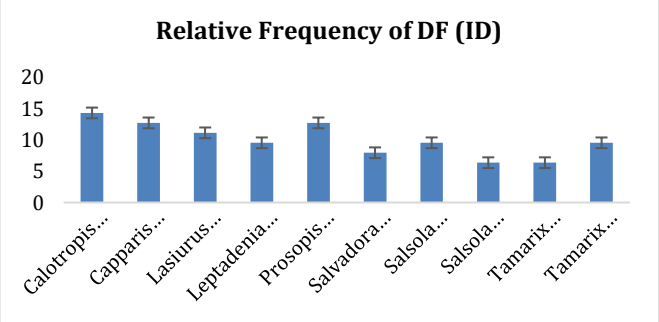


Figure 7
Relative cover of inter dune (ID) in Derawar Fort during Spring season 2022.

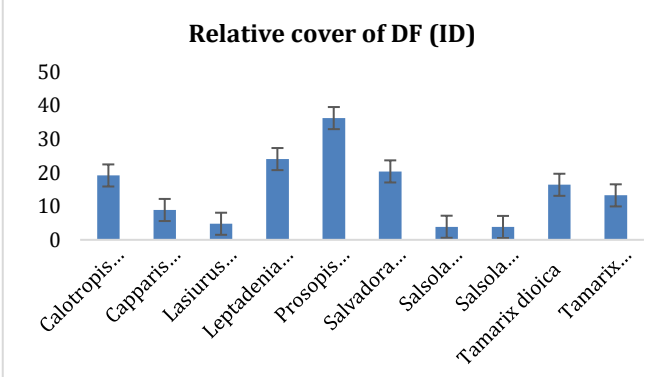
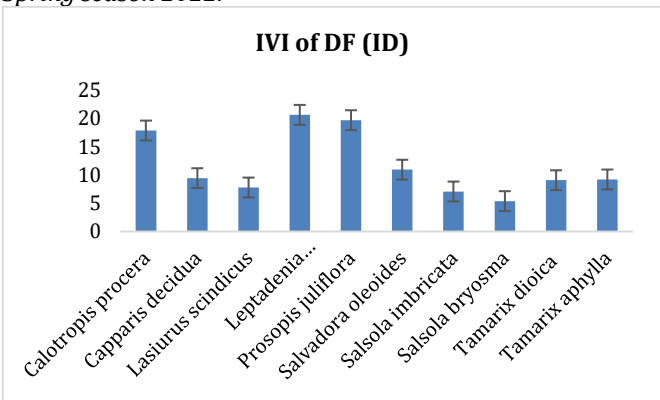


Figure 83
Relative IVI of inter dune (ID) in Derawar Fort during Spring season 2022.



Derawar Fort clayey land 2.

Diptrigium gluacum has very high relative density, *Calotropis procera* has moderate while *Carotalaria bhuria* has very low relative density (fig. 9). *Calotropis procera* has very high relative frequency, *Lasiurus scindicus* has moderate while *Suaeda fruticosa* has very low relative frequency (fig. 10).

Calotropis procera has very high relative cover, *Lasiurus scindicus* has moderate while *Carotalaria bhuria* and *Suaeda fruticosa* have very low relative cover (fig. 11). *Calotropis procera* has very high IVI, *Lasiurus scindicus* has moderate while *Carotalaria bhuria* and *Suaeda fruticosa* have very low IVI (fig. 12). Diversity index of the species found Derawar Fort of clayey land i.e. (0.794427324).

Figure 09
Relative density of clayey land (CL) in Derawar Fort during Spring season 2022.

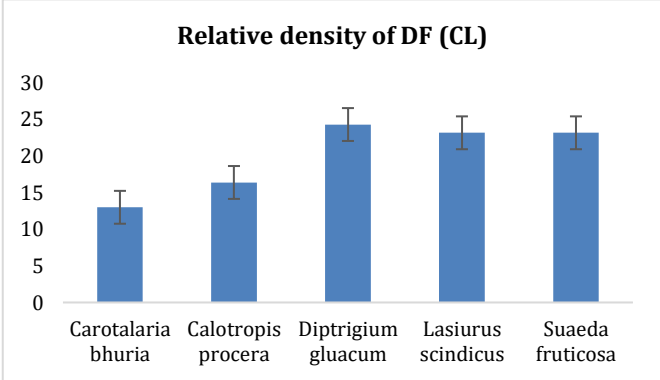


Figure 10
Relative frequency of clayey land (CL) in Derawar Fort during Spring season 2022.

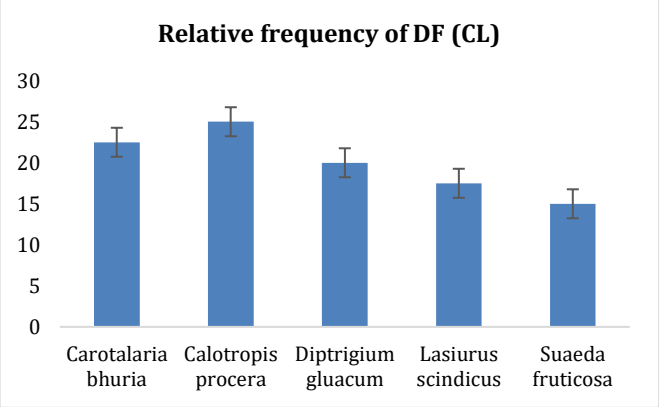


Figure 114
Relative cover of clayey land (CL) in Derawar Fort during Spring season 2022.

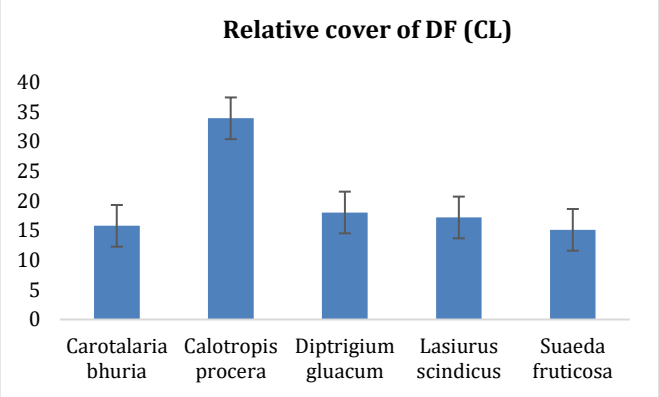
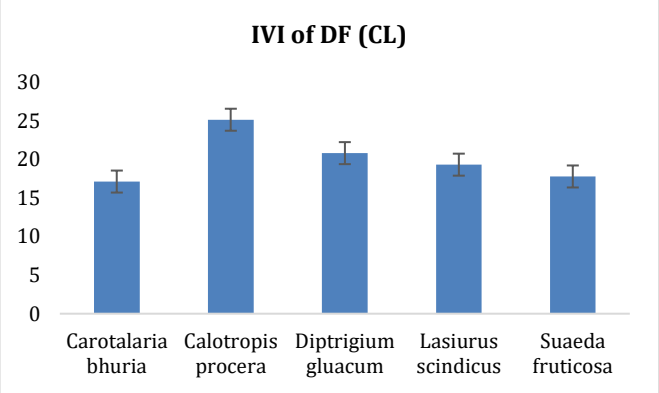


Figure 12
Relative IVI of clayey land (CL) in Derawar Fort during Spring season 2022.



Study site 02 Lal Suhanra National Park (RD-50).
The site 02 Lal Suhanra National Park (RD-50 have three sub sites i.e. Sand dune,Inter dune and Clayey land.

Lal Suhanra National Park (RD-50) Sand dune.
Prosopis cineraria has very high relative density, *Acacia nilotica* has moderate while *Ochthochloa compressa* has very low relative density (fig. 13). *Prosopis cineraria* has very high relative frequency, *Haloxylon recurvum* has moderate while *Ochthochloa compressa* has very low relative frequency (fig. 14).

Prosopis cineraria has very high relative cover, *Haloxylon salicarnicum* has moderate while *Ochthochloa compressa* has very low relative cover (fig. 15). *Prosopis cineraria* has very high IVI, *Haloxylon recurvum* has moderate while *Ochthochloa compressa* has very low IVI (fig. 16). Diversity index of the species found RD-50 of sand dune i.e. (0.818428184).

Figure 13
Relative density of sand dune (SD) in Lal Suhanra National Park (RD-50) during Spring season 2022.

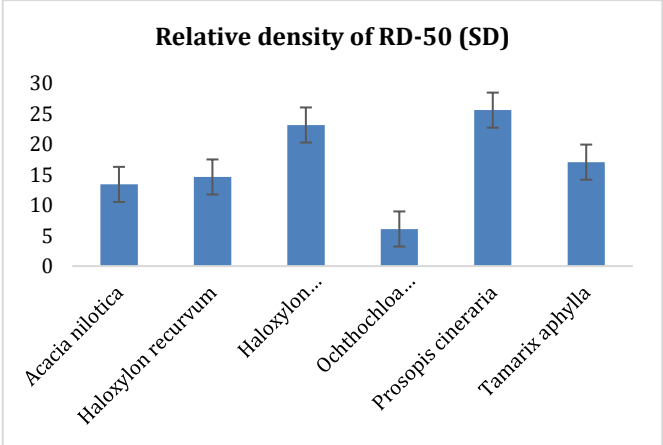


Figure 14
Relative frequency of sand dune (SD) in Lal Suhanra National Park (RD-50) during Spring season 2022.

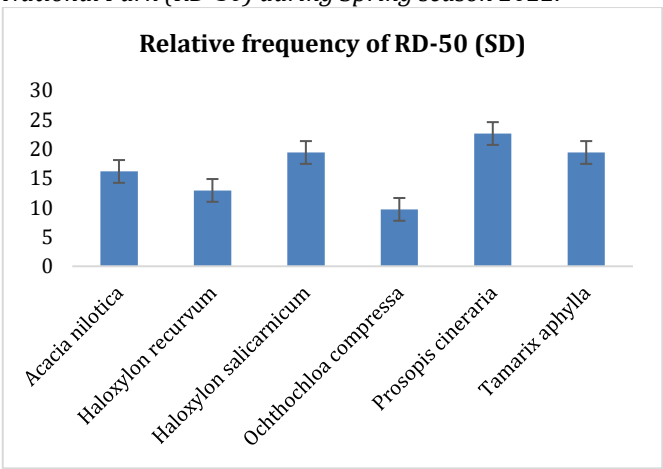


Figure 155
Relative cover of sand dune (SD) in Lal Suhanra National Park (RD-50) during Spring season 2022.

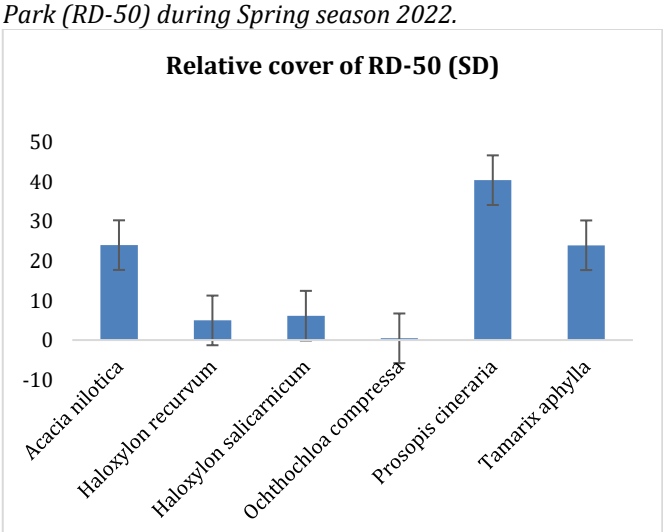
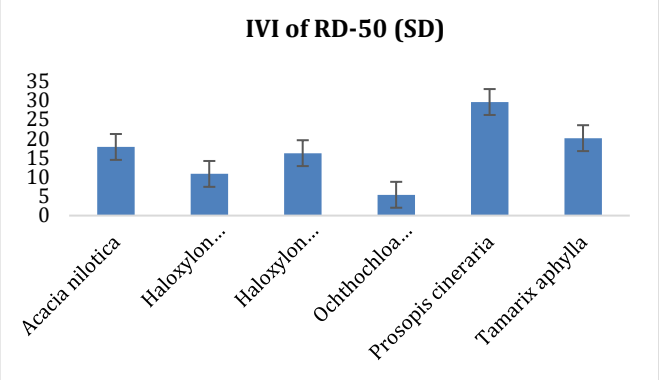


Figure 16
Relative IVI of sand dune (SD) in Lal Suhanra National Park (RD-50) during Spring season 2022.



Lal Suhanra National Park (RD-50) inter dune.

Acacia jacquemontii has very high relative density, *Aerva javanica* has moderate while *Acacia nilotica* has very low relative density (fig. 17). *Capparis decidua* has very high relative frequency, *Acacia nilotica* has moderate while *Aerva javanica* has very low relative frequency (fig. 18).

Acacia jacquemontii has very high relative cover, *Capparis decidua* has moderate while *Aerva javanica* has very low relative cover (fig. 19). *Acacia jacquemontii* has very high IVI, *Acacia nilotica* has moderate while *Aerva javanica* has very low IVI (fig. 20). Diversity index of the species found RD-50 of inter dune i.e. (0.776689977).

Figure 17
Relative density of inter dune (ID) in Lal Suhanra National Park (RD-50) during Spring season 2022

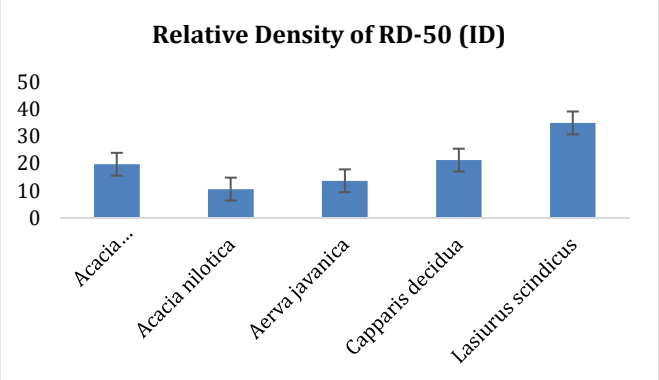


Figure 18
Relative frequency of inter dune (ID) in Lal Suhanra National Park (RD-50) during Spring season 2022.

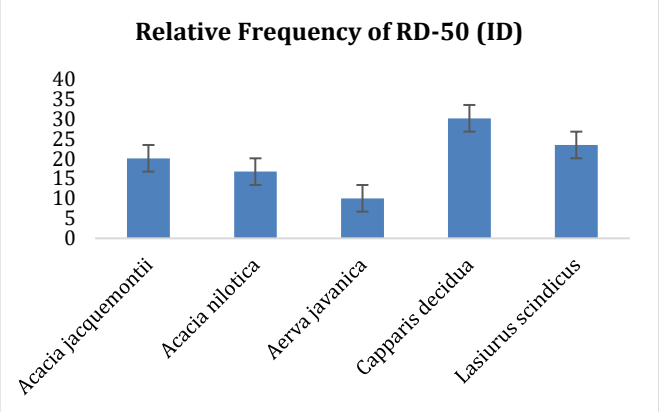


Figure 196
Relative cover of inter dune (ID) in Lal Suhanra National Park (RD-50) during Spring season 2022.

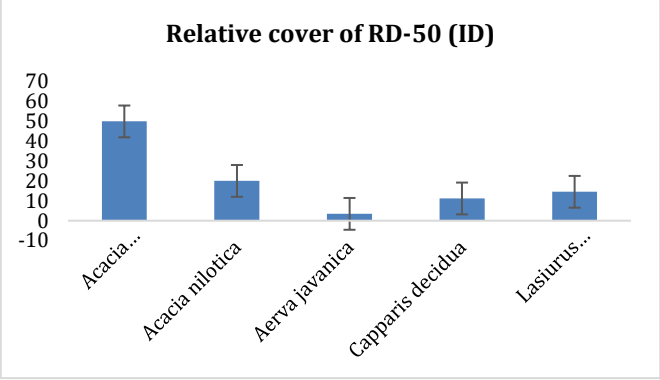
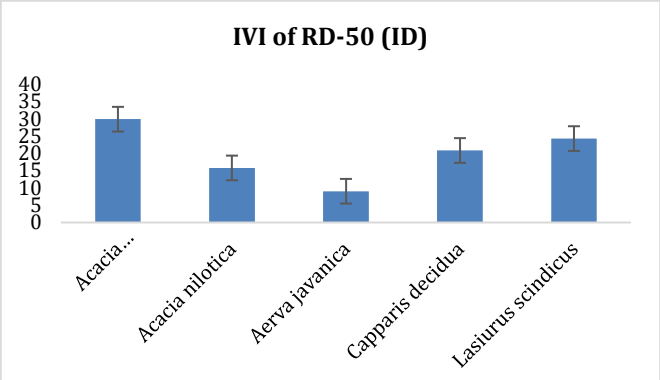


Figure 20
Relative IVI of inter dune (ID) in Lal Suhanra National Park (RD-50) during Spring season 2022



Lal Suhanra National Park (RD-50) Clayey land.

Suaeda fruticosa has very high relative density, *Capparis decidua* has moderate while *Acacia nilotica* has very low relative density (fig. 21). *Suaeda fruticosa* has very high relative frequency, *Calotropis procera* has moderate while *Acacia nilotica* has very low relative frequency (fig. 22).

Acacia nilotica has very high relative cover, *Lasiurus scindicus* has moderate while *Capparis decidua* and *Calotropis procera* very low relative cover (fig. 23). Suaeda fruticosa has very high IVI, Acacia nilotica and Capparis decidua have moderate while *Calotropis procera* has very low IVI (fig. 24). Diversity index of the species found RD-50 of clayey land i.e. (0.729462285).

Figure. 21
Relative density of clayey land (CL) in Lal Suhanra National Park (RD-50) during Spring season 2022.

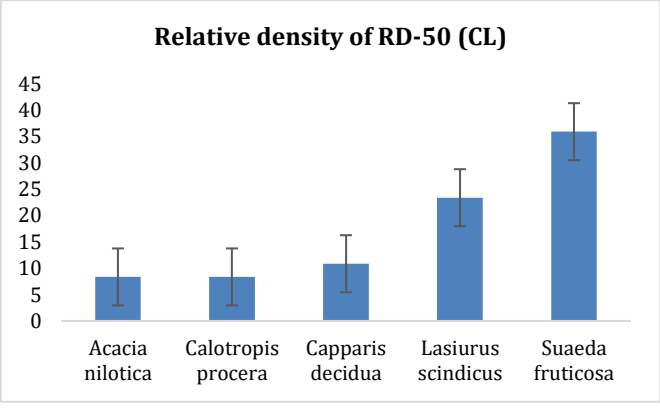


Figure 22
Relative frequency of clayey land (CL) in Lal Suhanra National Park (RD-50) during Spring season 2022.

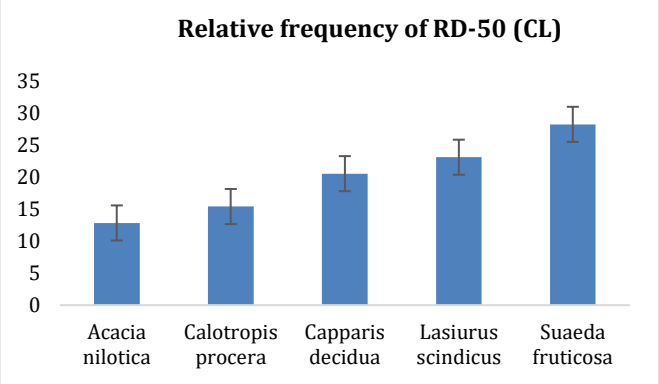


Figure 237
Relative cover of clayey land (CL) in Lal Suhanra National Park (RD-50) during Spring season 2022.

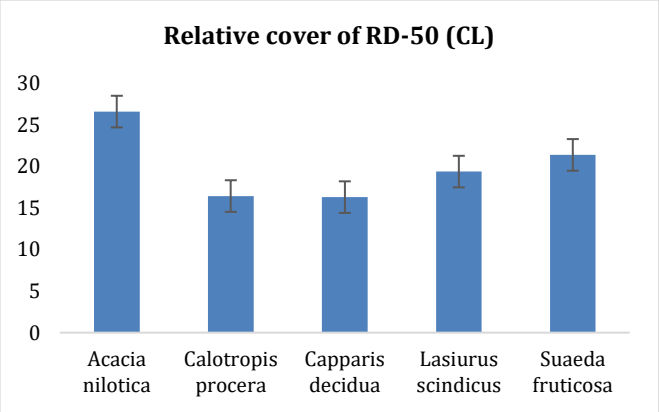
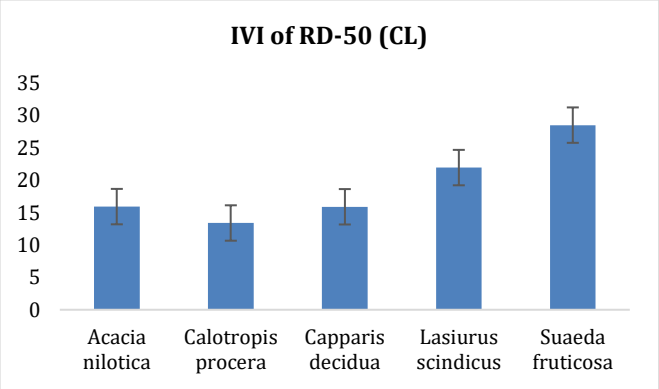


Figure 248
Relative IVI of clayey land (CL) in Lal Suhanra National Park (RD-50) during Spring season 2022.



Study site 03 Mauj Garh Fort.
The site 03 Mauj Garh Fort have three sub sites i.e. Sand dune,Inter dune and Clayey land.

Mauj Garh Fort Sand dune.
Calotropis procera has very high relative density, *Prosopis cineraria* and *Acacia nilotica* have moderate while *Withania coagulans* and *Haloxylon recurvum* have very low relative density (fig. 25). *Acacia nilotica* has very high relative frequency, *Calligonum polygonoides* and *Calotropis procera* have moderate while *Haloxylon recurvum* and *Withania coagulans* have very low relative frequency (fig. 26).

Calotropis procera has very high relative cover, *Calligonum polygonoides* has moderate while *Haloxylon salicarnicum* and *Withania coagulans* have very low relative cover (fig. 27). *Calotropis procera* has very high IVI, *Haloxylon salicarnicum* has moderate *Haloxylon salicarnicum* has very low IVI (fig. 28). Diversity index of the species found MG of sand dune i.e. (0.816343189).

Figure 25
Relative density of sand dune (SD) in Mauj Garh Fort during Spring season 2022.

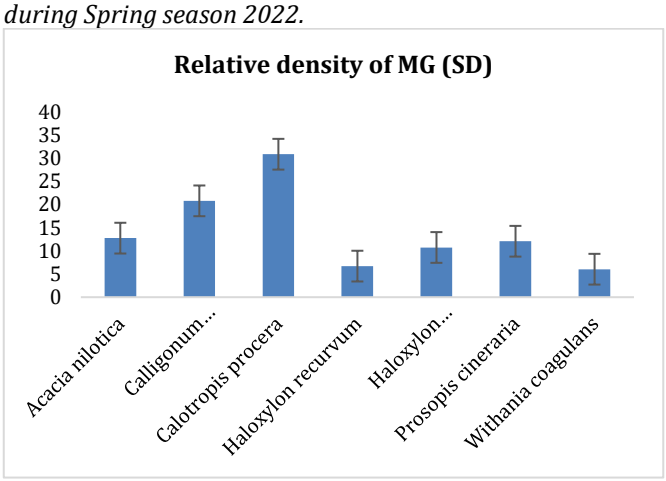


Figure 26
Relative frequency of sand dune (SD) in Mauj Garh Fort during Spring season 2022.

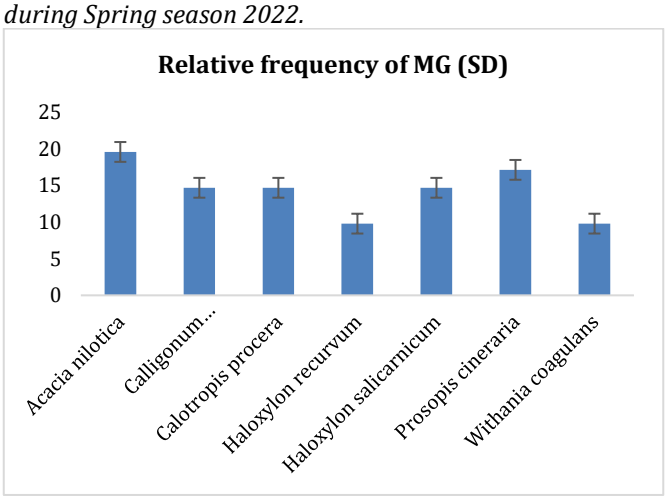


Figure 279
Relative cover of sand dune (SD) in Mauj Garh Fort during Spring season 2022.

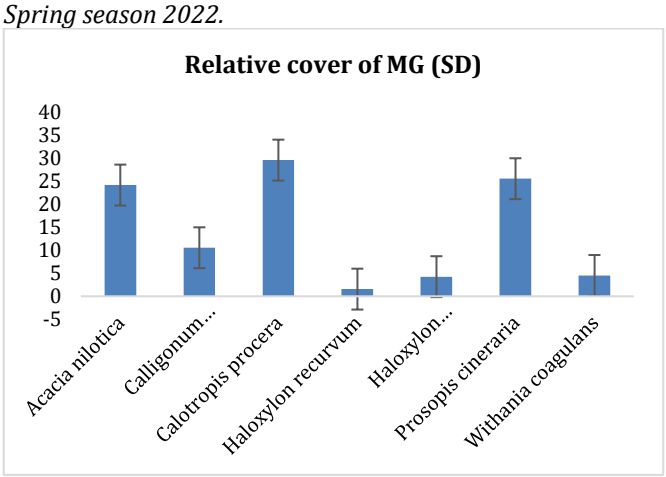
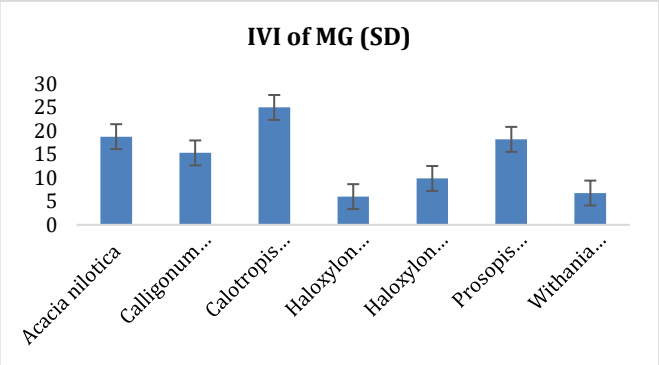


Figure 28

Relative IVI of sand dune (SD) in Mauj Garh Fort during Spring season 2022.



Mauj Garh Fort Inter dune.

Calotropis procera has very high relative density, *Citrullus colocynthis* has moderate while *Cymbopogon jwarancusa* has very low relative density (fig. 29). *Aerva persica* has very high relative frequency, *Citrullus colocynthis* has moderate while *Cymbopogon jwarancusa* and *Ochthochloa compressa* have very low relative frequency (fig. 30).

Calotropis procera has very high relative cover, *Lasiurus scindicus* has moderate while *Cymbopogon jwarancusa* has very low relative cover (fig. 31). *Calotropis procera* has very high IVI, *Lasiurus scindicus* has moderate while *Cymbopogon jwarancusa* has very low IVI (fig. 32). Diversity index of the species found MG of inter dune i.e. (0.817032967).

Figure 29

Relative density of inter dune (ID) in Mauj Garh Fort during Spring season 2022.

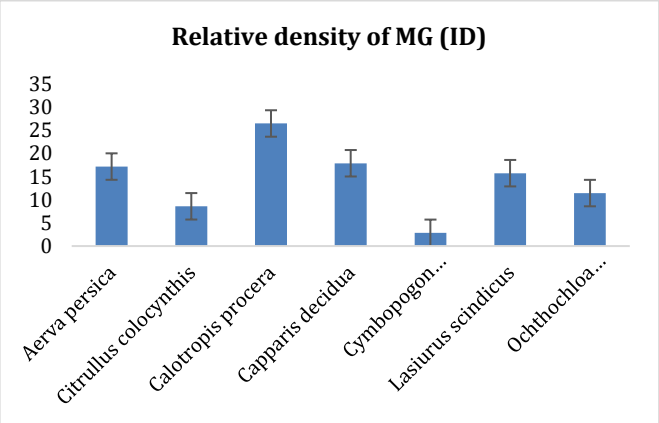


Figure 30

Relative frequency of inter dune (ID) in Mauj Garh Fort during Spring season 2022.

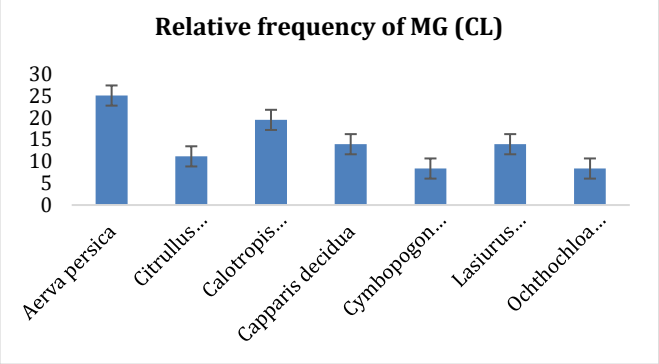


Figure 3110

Relative cover of inter dune (ID) in Mauj Garh Fort during Spring season 2022.

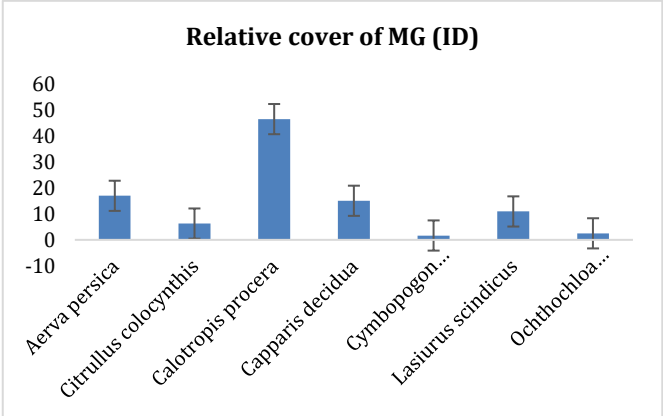
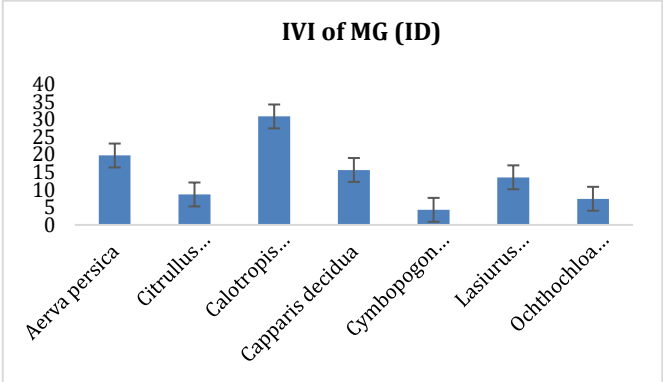


Figure 32

Relative IVI of inter dune (ID) in Mauj Garh Fort during Spring season 2022.



Mauj Garh Fort Clayey land.

Calotropis procera has very relative density, *Fagonia cretica* has moderate while *Prosopis juliflora* has very low relative density (fig. 33). *Suaeda fruticosa* has very high relative frequency, *Lasiurus scindicus* has moderate *Prosopis juliflora* has low relative frequency (fig.34).

Prosopis juliflora has high relative cover, *Suaeda fruticosa* has moderate while *Lasiurus scindicus* has very low relative cover (fig. 35). *Calotropis procera* has very high IVI, *Calotropis procera* has moderate while *Lasiurus scindicus* and *Fagonia cretica* have very low IVI (fig. 36). Diversity index of the species found in MG of clayey land i.e. (0.715434254).

Figure 3311

Relative density of clayey land (CL) in Mauj Garh Fort during Spring season 2022.

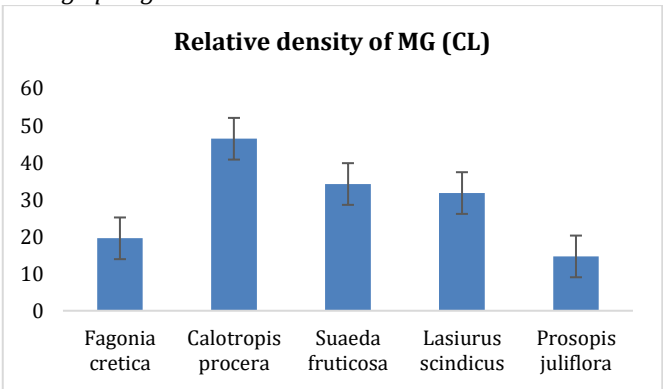


Figure 34

Relative frequency of clayey land (CL) in Mauj Garh Fort during Spring season 2022.

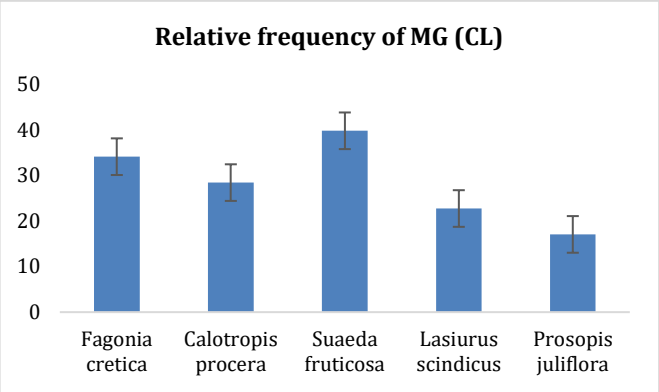


Figure 35

Relative cover of clayey land (CL) in Mauj Garh Fort during Spring season 2022.

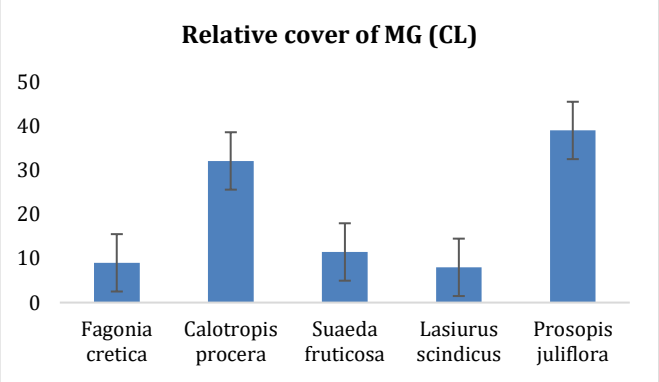
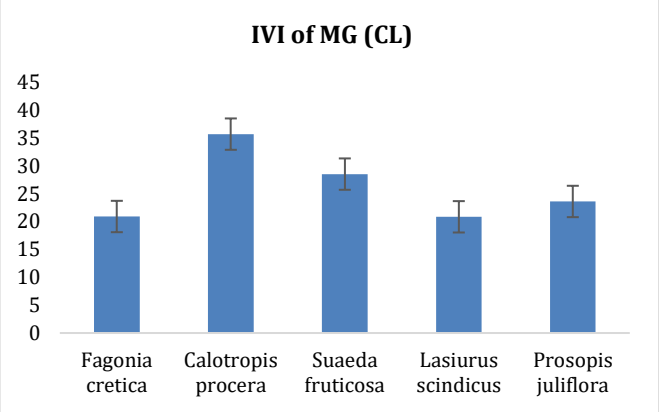


Figure 3612

Relative IVI of clayey land (CL) in Mauj Garh fort during Spring season 2022.



DISCUSSION

In the present study, spring season, *Leptadenia pyrotechnica* has very high relative density, *Prosopis juliflora* moderate, and *Ochthochloa compressa* very low. At Site 02 *Calotropis procera* has very high relative density, *Prosopis cineraria* and *Acacia nilotica* moderate, and *Haloxylon recurvum* very low. At Site 03 in spring season 2, *Suaeda fruticosa* has very high relative density, *Aerva javanica* moderate, and *Ochthochloa compressa* very low. These results are in line with Khan et al. (2009) who studied ethno-veterinary medicinal flora of the greater Cholistan, gathering information on 35 plant species. These results are also at par with Rafay *et al.*, (2015) observed the desert of Cholistan, phyto-sociological research of grasses, twenty recollections were gathered from twenty different locations.

In spring season 2 site 01 the frequency of *Calligonum polygonoides* has very high relative frequency, *Cenchrus ciliaris* has moderate while *Ochthochloa compressa* has very low relative frequency. During spring season, site 02 *Suaeda fruticosa* has very high relative frequency, *Calotropis procera* and *Calligonum polygonoides* have moderate while *Ochthochloa compressa* has very low relative frequency. In spring season site 03 *Lasiurus scindicus* has very high relative frequency, *Ochthochloa compressa* has moderate while *Tribulus terrestris* and *Ochthochloa compressa* has very low relative frequency. These results are in line with Muhammad *et al.*, (2013) who observed the influence of canopy cover on soil chemistry and the Cholistan Desert. These plants species do not develop any kind of interaction with one another, other plant species contribute to the formation of the understory vegetation of tree species, albeit to a lesser. Correspondingly, Ashraf *et al.*, (2013) indicated that *Haloxylon salicornicum's* stem and leaves are abundant in chemical components and may be used as a suitable source of animal feed Alkaloids, tannins, saponins, glycosides, and bound glycosides were discovered during a phytochemical analysis, indicating that the plant may have therapeutic use.

During spring season site 01 *Calotropis procera* has very high relative cover, *Tamarix aphylla* has moderate while Ochthochloa compressa has very low relative cover. spring season site 2 *Calotropis procera* has very high relative cover, *Calligonum polygonoides* has moderate while *Haloxylon recurvum* has very low relative cover. During spring season 2 site 03 *Acacia jacquemontii* has very high relative cover, *Capparis decidua* has moderate while *Ochthochloa compressa* has very low relative cover. These results are similar with those of Ahmad & Afzal, (2021) who results demonstrate a clear link between the availability of water and the alleviation of poverty. The study advises combining indigenous technology with contemporary water collecting methods to reduce rural poverty while simultaneously illuminating its advantages and disadvantages. Similarly, Giulietti *et al.*, (2005) noticed the biodiversity and conservation of plant nearly 19% of the world's plant species are found in Brazil. These activities also highlight the pressing need to increase the quantity and geographic reach of plant systematics and taxonomy studies in Brazil, a move that necessitates proper financing and training for plant specialists.

In spring season, site 01 *Calotropis procera* has very high IVI, *Capparis decidua* and *Tamarix dioica* have moderate while *Ochthochloa compressa* has very low IVI. spring season, site 02 *Calotropis procera* has very high IVI, *Calligonum polygonoides* has moderate while *Cymbopogon jwarancusa* has very low IVI. In site 03 *Acacia jacquemontii* has very high IVI, *Acacia nilotica* has moderate while *Ochthochloa compressa* has very low IVI. These results are in line with Khan *et al.*, (2004) showed that Salt tolerance was higher in accessions with high GSTI, cell membrane integrity (reduced damage), PHSTI, DMSTI, and low RSD than it was in the other accessions, and they appear

potential for achieving good production in salt-affected locations. Also, Karim *et al.* (2009) discovered that organic matter increased from 0.630% in the arid soil to 0.726%, according to measurements of the total nitrogen concentration and organic matter in the soil. nitrogen content of the soil increased from 0.040% in the bare soil to 0.135% under the canopy, according to similar research.

CONCLUSION

Site 01, Derawar Fort

- *Leptadenia pyrotechnica* (very high density), *Prosopis juliflora* (moderate), *Ochthochloa compressa* (very low).
- **Frequency:** *Calligonum polygonoides* (very high), *Cenchrus ciliaris* (moderate), *Ochthochloa compressa* (very low)
- **Cover:** *Calotropis procera* (very high), *Tamarix aphylla* (moderate), *Ochthochloa compressa* (very low)
- **IVI:** *Calotropis procera* (very high), *Capparis decidua* & *Tamarix dioica* (moderate), *Ochthochloa compressa* (very low)

Season 1, Site 02

- Density: *Calotropis procera* (very high), *Prosopis cineraria* & *Acacia nilotica* (moderate), *Haloxylon recurvum* (very low)
- Frequency: *Suaeda fruticosa* (very high), *Calotropis procera* & *Calligonum polygonoides* (moderate), *Ochthochloa compressa* (very low)
- Cover: *Calotropis procera* (very high), *Calligonum polygonoides* (moderate), *Haloxylon recurvum* (very low)
- IVI: *Calotropis procera* (very high), *Calligonum polygonoides* (moderate), *Cymbopogon jwarancusa* (very low)

Season 1, Site 03

- Density: *Calotropis procera* (very high), *Prosopis cineraria* (moderate), *Ochthochloa compressa* (very low)
- Frequency: *Lasiurus scindicus* (very high), *Ochthochloa compressa* (moderate), *Tribulus terrestris* & *Ochthochloa compressa* (very low — typo likely)
- Cover: *Acacia jacquemontii* (very high), *Calligonum polygonoides* (moderate), *Ochthochloa compressa* (very low)
- IVI: *Calotropis procera* (very high), *Aerva javanica* (moderate), *Ochthochloa compressa* (very low)

Site 03

- Density: *Suaeda fruticosa* (very high), *Aerva javanica* (moderate), *Ochthochloa compressa* (very low)
- Frequency: *Capparis decidua* (very high), *Calotropis procera* (moderate), *Ochthochloa compressa* (very low)
- Cover: *Acacia jacquemontii* (very high), *Capparis decidua* (moderate), *Ochthochloa compressa* (very low)
- IVI: *Acacia jacquemontii* (very high), *Acacia nilotica* (moderate), *Ochthochloa compressa* (very low)

Site 01, Derawar Fort

- **Density:** *Launaea nudicaulis* (very high), *Salsola bryosma* (moderate), *Ochthochloa compressa* (very low)
- **Frequency:** *Calligonum polygonoides* (very high), *Cenchrus ciliaris* (moderate), *Ochthochloa compressa* (very low)
- **Cover:** *Calligonum polygonoides* (very high), *Prosopis juliflora* (moderate), *Aerva javanica* (very low)
- **IVI:** *Haloxylon salicarnicum* (very high), *Capparis decidua* & *Lasiurus scindicus* (moderate), *Ochthochloa compressa* (very low)

Site 02, Mauj Garh Fort

- **Density:** *Calotropis procera* (very high), *Prosopis cineraria* & *Acacia nilotica* (moderate), *Haloxylon recurvum* (very low)
- **Frequency:** *Suaeda fruticosa* (very high), *Calotropis procera* & *Calligonum polygonoides* (moderate), *Ochthochloa compressa* (very low)
- **Cover:** *Calotropis procera* (very high), *Calligonum polygonoides* (moderate), *Cenchrus ciliaris* (very low)
- **IVI:** *Calotropis procera* (very high), *Calligonum polygonoides* (moderate), *Cymbopogon jwarancusa* (very low)

Site 03, Lal Suhanra National Park (RD-50)

- **Density:** *Suaeda fruticosa* (very high), *Aerva javanica* (moderate), *Ochthochloa compressa* (very low)
- **Frequency:** *Capparis decidua* (very high), *Calotropis procera* (moderate), *Ochthochloa compressa* (very low)
- **Cover:** *Acacia jacquemontii* (very high), *Capparis decidua* (moderate), *Ochthochloa compressa* (very low)
- **IVI:** *Calotropis procera* (very high), *Aerva javanica* (moderate), *Ochthochloa compressa* (very low)
- **Site 01 (Derawar Fort)** – Diversity indices: 0.845939, 0.877192, 0.746003 → Average: 0.823053
- **Site 02 (Mauj Garh Fort)** – Diversity indices: 0.847043, 0.841992, 0.786555 → Average: 0.825696
- **Site 03 (Lal Suhanra National Park, RD-50)** – Diversity indices: 0.864310, 0.878740, 0.715434 → Average: 0.819491
- **Overall average (all three sites):** 0.822747

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