

Research Article

Post monsoon floristic inventory of Nagarparkar, District Tharparkar, Sindh, Pakistan

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Abstract

The monsoon rain brings a green carpet of landscape to Thar Desert including Karoonjhar mountains range. We explored Nagarparkar, District Tharparkar, Sindh to record post monsoon botanical inventory of the region. The study confirmed 89 plant species of 26 plant families. The vegetation was dominated by Poaceae (18 spp.) and Fabaceae (15 spp.) families. About two third of the families were represented by single species. The vegetation was rich with grasses and herbs making about 60% of the species while the rest includes trees shrubs and subshrubs. The lifespan analysis revealed the dominance of perennials. The life form spectrum shows the abundance of Phanerophytes (30%), Chamaephyte (28%) and Therophyte (25%) across the region. The present study demonstrates vegetation variations triggered by monsoon down pours and indicates the presence of various microhabitats in the study area. The current inventory would be useful for further ecological studies and conservation of species and habitats. These records would help to detect invasive species, their distribution and other environmental impacts on plant species in future.

Keywords: Floristic inventory; Life form; Life-span, Nagarparkar; Plant habits; Thar Desert

Introduction

The flora is an assembled checklist of plant species which provides information about plant biodiversity of any specific geographic zone [1, 2]. A floristic inventory not only reveals the identification and description of local and regional species but also offer the evidence of plant phenology, invasion of new species and vegetation stress [1]. The information may also be useful to understand the impact of climate

change on regional vegetation and the distribution of species [3, 4]. The valuable data records compiled through floras could be utilized for future reference [2]. The flora may range from a local to regional level causing varied habitats [1, 5-9]. Pakistan is rich in floristic diversity and consists around 5,700, both indigenous and alien, plant species of vascular plants [10]. Numerous studies demonstrated the inventories of floras and their importance in

Pakistan [1, 10]. Additionally, several forest, desert and wetland floristic inventories have been conducted in different parts of Sindh Province [2, 11-13]. District Tharparkar, a part of the Thar Desert, is situated at the south-eastern part of Pakistan, at about 433 km from the capital city of Sindh, Karachi. Thar is not only a fertile desert with a unique flora and fauna but also attributed to stunning landscapes and cultural diversity, thus often referred as open air museum [14]. Nagarparkar is one of the Talukas of Tharparkar District stretched over 3,862 km². It is located between Thar Desert and Rann of Kutch and contains the dramatic Karunjar Hills covered by enormous plant species [14]. However, the study area is tropical desert climate in nature, it is cooler than the rest of the Tharparkar. During monsoon it receives considerable quantity of rainfall in the month of July to September. April, May and June are the hottest months (max: temperatures 39°C and min: 20°C) and January and February are the coldest (max: temperatures 26°C and min: 6°C). After the rains in August it becomes extremely green and pleasant and temperatures become bearable (max: temperature 34°C and min: 13°C) [15]. This study was conducted to record the post monsoon floristic inventory of the area to observe plant biodiversity of Nagarparkar which is the part of Thar Desert, Sindh, Pakistan. The study provides information of flora of study area after it receives the monsoon rain and demonstrated the checklist of flora, their life-spans, life forms and habits.

Materials and methods

The study area was visited in post monsoon season 2017 and 2018. The plant species were collected from varied habitats e.g. sand dunes and rocky area of Nagarparkar. All collected specimens were processed for making herbarium and determination of their life-span and life form categories as suggested [2]. The identification of species was carried out with keys published in literature, i.e. Flora of Pakistan [16-18],

Flora of Karachi [19] and floral studies at Nara Desert [20]. The species were deposited in the Herbarium of Centre for Biodiversity and Conservation (CBC), Shah Abdul Latif University (SALU), Khairpur, Sindh for record. To get vernacular names of taxa, the local people of study area were interviewed. Raunkiaer's system [21] of classification was used to determine the life forms of the species. This system uses the position of perennating buds to determine the life form of a species.

Results and discussion

A total of 89 plant species belonging to 68 genera and 26 families were identified from study area (Table 1) Plant family Poaceae (14 gen., 18 spp.) was found predominant with high species richness, followed by the families Fabaceae (9 gen., 15 spp.), Malvaceae (3 gen., 6 spp.) and Asteraceae (3 gen., 5 spp.) (Figure 1). About 50% of the identified families contained two to four species each, while another 35% were represented by single species (Table 1). Of 26 identified families, Poaceae and Cyperaceae, making less than 20% of species, represented Monocot clad while a high proportion of the species characterized Dicot clad (Figure 2a).

Previous studies had unveiled the floristic inventories including deserts and mountain regions of Sindh province [11-13, 20-24]. The first ever report of floristic inventory of Thar Desert was conducted by Chaudhri [22] that revealed 122 plant species. This study confirmed 72% of those species in a part of that desert. This can be attributed to the varied microhabitats in the Nagarparkar District. Moreover, Thar Desert had been found to be dominated by plant families Amaranthaceae, Cucurbitaceae and Euphorbiaceae [25]. In contrast, this study confirmed the higher species richness of families Poaceae and Fabaceae (Figure 1). One reason for this contrast may be the recent changes in positions of genera in plant families. This study follows the recent classification suggested in the online Flora of Pakistan [26].

This study recorded *Acacia senegal* (Fabaceae); interestingly the same plant species is absent in Nara Desert, Khairpur [20]. Moreover, *Aerva javanica* (Fabaceae family), *Leptadenia pyrotechnica*. (Apocynaceae family), *Calotropis procera* (Apocynaceae family) and *Prosopis cineraria* (Fabaceae family) were found the most frequent species at sand dunes. Whereas the *Prosopis glandulosa* and *Prosopis multiflora* (Fabaceae family) were found abundant at rocky areas of Karoonjhar mountain. These species provide ecosystem services and play a role in human wellbeing [23, 27].

Moreover, the flora was rich with a high proportion of herbs and grasses making about 60% of the total species (Figure 3). This may explain the upshot of monsoon resulting in a growth of annual herbs. This is in consensus with Yaseen *et al.* [25] as they reported the 74% herbs, 18% shrubs and 8% trees, in ethnobotanical survey of Thar, desert of Sindh. The flora of the study area had only two, annual (37%) and perennial (63%), life spans (Figure 2b). However, *Convolvulus glomeratus* (Convolvulaceae) and *Corchorus olitorius* (Malvaceae) are contained within perennial and annual life span in this study, respectively, both species sometimes show biennial behaviour. The plant species belonging to four families, Cyperaceae, Limeaceae, Neuradaceae and Zygophyllaceae, had only annual life-span. On contrast, nine families (of 26) revealed perennial nature while the rest (46%) of families had both, annual and perennial, natured species. The dominance of herbs is

evident after monsoon downpours (Figure 3). Similar results have been reported from other parts of Pakistan [2, 12].

According to Raunkiaer's life form spectrum [21], the vegetation was dominated by Phanerophytes (30%), Chamaephyte (28%) and Therophyte (25%), while Hemicryptophyte and Xeropsammophyte were poorly represented (Figure 4). Though the percentage of various life form in neighboring desert areas varied, a high representation of Therophytes and Phanerophytes have been recorded in the Jaisalmer, Ajmer, Sariska and other parts of Rajasthan, India [28]. A high representation of Phanerophytes in the study may indicate the humid bioclimate of the area [29]. On the other hand, Therophytes, having a short life cycle, are mostly annuals and often grow in rainy season especially monsoon [29].

The monsoon rain provides enough water for the annual herbs and grasses to flourish in the study area (Figure 2). The herbs abundantly grow around Karoonjhar hills of the Nagarparkar [14]. This type of vegetation may raise on the water temporarily adsorbed in the top soil layer, synchronic to precipitation. Further, this is supported with the added layer of moisture present in the subsurface soil and the sandstone laying beneath the soil. However, the dominance of perennial may indicate the resistance of species towards the harsh climate or access to plentiful moisture for long periods after monsoon rains.

Table 1. Information of plant species distributed in Nagarparkar, Sindh. The position of various genera has been updated after the publication of flora of Pakistan. The legitimate name and plant families are updated with the new online version of flora of Pakistan [26]

No.	Plant Species	Local name	Family	Habit	Life-span	Life form
1	<i>Abutilon indicum</i> (L.) Sweet	Pat-teer	Malvaceae	Shrub	Perennial	Phanerophyte
2	<i>Acacia jacquemontii</i> Benth.	Banwar	Fabaceae	Shrub	Perennial	Phanerophyte
3	<i>Acacia nilotica</i> (L.) Delile	Sindhi ba-bur	Fabaceae	Tree	Perennial	Phanerophyte
4	<i>Acacia senegal</i> (L.) willd (Benth.) Brenan	Kumbat	Fabaceae	Tree	Perennial	Phanerophyte

5	<i>Aerva javanica</i> var. <i>javanica</i> (Burm.f.) Juss. ex.	Booh	Amaranthaceae	Herb	Perennial	Xeropsammyphyte
6	<i>Albizia lebeck</i> (L.) Beth.	Sarenh	Fabaceae	Tree	Perennial	Phanerophyte
7	<i>Alhagi maurorum</i> Medic.	Kandero	Fabaceae	Herb	Perennial	Chamaephyte
8	<i>Amaranthus graecizans</i> L.	Marero	Amaranthaceae	Herb	Annual	Therophyte
9	<i>Amaranthus viridis</i> L.	Lulur	Amaranthaceae	Herb	Annual	Therophyte
10	<i>Aristida adscensionis</i> L.	Lumb Gaah	Poaceae	Grass	Annual	Therophyte
11	<i>Azadirachta indica</i> A. Juss.	Nim	Meliaceae	Tree	Perennial	Phanerophyte
12	<i>Barleria prionitis</i> L.	Khussaro	Acanthaceae	Shrub	Perennial	Chamaephyte
13	<i>Boerhavia procumbens</i> Banks ex Rxb.	Dakhri	Nyctaginaceae	Herb	Perennial	Chamaephyte
14	<i>Brachiaria ramosa</i> (L.) Stapf	Sawri	Poaceae	Grass	Annual	Therophyte
15	<i>Brachiaria reptans</i> (L.) Gardner & Hubbard	Sawri	Poaceae	Grass	Annual	Therophyte
16	<i>Calotropis procera</i> (Aiton) W. T. Aiton	Ak	Apocynaceae	Shrub	Perennial	Phanerophyte
17	<i>Capparis decidua</i> (Forssk.) Edgew.	Kirar	Capparidaceae	Shrub	Perennial	Phanerophyte
18	<i>Cassia italica</i> (Mill.) Spreng.	Ghora wal	Fabaceae	Herb	Annual	Therophyte
19	<i>Cenchrus biflorus</i> Roxb.	Bhorut	Poaceae	Grass	Annual	Therophyte
20	<i>Citrullus colocynthis</i> (Linn.) Schrad.	Trooh	Cucurbitaceae	Herb	Perennial	Hemicryptophyte
21	<i>Cleome scaposa</i> DC.	Kano gah	Cleomaceae	Herb	Annual	Therophyte
22	<i>Coccinia grandis</i> (L.) Voigt.	Kanduri	Cucurbitaceae	Herb	Perennial	Chamaephyte
23	<i>Commicarpus boissieri</i> Cufod.	Ruper	Nyctaginaceae	Herb	Perennial	Xeropsammyphyte
24	<i>Commiphora stocksiana</i> (Engl.) Engl.	Gugur	Burseraceae	Large Shrub	Perennial	Phanerophyte
25	<i>Commiphora wightii</i> (Arn.) Bhandari	Gugur	Burseraceae	Large Shrub	Perennial	Phanerophyte
26	<i>Convolvulus arvensis</i> L.	Narro	Convolvulaceae	Herb	Annual	Chamaephyte
27	<i>Convolvulus glomeratus</i> Choisy	Sankavli	Convolvulaceae	Herb	Perennial	Chamaephyte
28	<i>Convolvulus rhyniospermus</i> Choisy	Phesura wal	Convolvulaceae	Herb	Annual	Therophyte
29	<i>Corchorus depressus</i> Stocks.	Mundheri	Malvaceae	Herb	Perennial	Chamaephyte
30	<i>Corchorus olitorius</i> L.	Datehri	Malvaceae	Herb	Annual	Therophyte
31	<i>Cordia gharaf</i> (Forssk.) Ehrenb. Ex Asch.	Leyar	Boraginaceae	Small tree	Perennial	Phanerophyte
32	<i>Crotalaria burhia</i> Buch.-Ham. ex Benth.	Chag	Fabaceae	sub-Shrub	Semi perennial	Chamaephyte
33	<i>Cymbopogon commutatus</i> (Steud.) stapf	Katan	Poaceae	Grass	Perennial	Hemicryptophyte
34	<i>Cymbopogon jwarancusa</i> (Jones) Schult.	Katan	Poaceae	Grass	Perennial	Xeropsammyphyte
35	<i>Cynodon dactylon</i> (L.) Pers.	Chhabar	Poaceae	Grass	Perennial	Chamaephyte
36	<i>Cyperus rotundus</i> L.	Kabah	Cyperaceae	Sedge	Annual	Chamaephyte
37	<i>Dactyloctenium aegyptium</i> (L.) Wild	Gandheer Gaah	Poaceae	Grass	Annual	Chamaephyte
38	<i>Desmostachya bipinnata</i> (L.) Stapf.	Drabh	Poaceae	Grass	Perennial	Chamaephyte
39	<i>Dichanthium annulatum</i> (Forssk.) Stapf	Palwan	Poaceae	Grass	Perennial	Chamaephyte

40	<i>Digera muricata</i> (L.) Mart.	Lulur	Amaranthaceae	Herb	Annual	Therophyte
41	<i>Digitaria ciliaris</i> (Retz.) Koel.	Pachar Gaah	Poaceae	Grass	Annual	Therophyte
42	<i>Dipterygium glaucum</i> Decne.	Phair	Cleomaceae	sub-shrub	Perennial	Phanerophyte
43	<i>Eclipta prostrata</i> (L.) L.	Daryai buti	Asteraceae	Herb	Annual	Hemicryptophyte
44	<i>Euphorbia caducifolia</i> Haines	Thohar	Euphorbiaceae	Shrub	Perennial	Chamaephyte
45	<i>Euphorbia hirta</i> L.	Kheer Wal	Euphorbiaceae	Herb	Annual	Therophyte
46	<i>Euphorbia prostrata</i> Aiton	Kheera Wal	Euphorbiaceae	Herb	Annual	Therophyte
47	<i>Fagonia indica</i> var. <i>schweinfurthii</i> Hadidi	Dramaaho	Zygophyllaceae	Sub-shrub	Annual	Xeropsammophyte
48	<i>Grangea maderaspatana</i> (L.) Poir.	Mundi	Asteraceae	Herb	Annual	Therophyte
49	<i>Grewia erythraea</i> Schweinf.	Gangi	Malvaceae	Shrub	Perennial	Phanerophyte
50	<i>Grewia tenax</i> (Forssk.) fiori.	Gangi	Malvaceae	Shrub	Perennial	Phanerophyte
51	<i>Grewia villosa</i> Willd.	Gangi	Malvaceae	Shrub	Perennial	Phanerophyte
52	<i>Heliotropium crispum</i> Desf.	Kharsan	Boraginaceae	Herb	Annual	Xeropsammophyte
53	<i>Indigofera argentea</i> Burm.f.	Lathio	Fabaceae	Under-shrub	Perennial	Therophyte
54	<i>Indigofera cordifolia</i> Heyne ex Roth	Lathio	Fabaceae	Herb	Annual	Therophyte
55	<i>Launaea procumbens</i> (Roxb) Ramayya & Rajagopal.	Bhattar	Asteraceae	Herb	Perennial	Hemicryptophyte
56	<i>Leptadenia pyrotechnica</i> (Forsk.) Decne.	Khip	Apocynaceae	Shrub	Perennial	Phanerophyte
57	<i>Limeum indicum</i> Stocks.ex T. Anderson	Khir wal	Limeaceae	Herb	Annual	Therophyte
58	<i>Merremia aegyptia</i> (L.) Urb.	Naaro	Convolvulaceae	Herb	Perennial	Therophyte
59	<i>Moringa oleifera</i> Lam.	Moa	Moringaceae	Small tree	Perennial	Phanerophyte
60	<i>Mukia maderaspatana</i> (L.) M. Roem.	-----	Cucurbitaceae	Herb	Annual	Hemicryptophyte
61	<i>Neurada procumbens</i> L.	Chhapri/Chhipri	Neuradaceae	Herb	Annual	Therophyte
62	<i>Ochthochloa compressa</i> (Forssk.) Hilu.	Ghander	Poaceae	Grass	Perennial	Hemicryptophyte
63	<i>Oxystelma esculentum</i> (L.f.) R. Br.	Phuli	Apocynaceae	Herb	Perennial	Chamaephyte
64	<i>Pennisetum orientale</i> Rich.	Bhurut	Poaceae	Grass	Perennial	Hemicryptophyte
65	<i>Phragmites karka</i> (Retz.) Trin. ex Steud.	Nar/Naro	Poaceae	Grass	Perennial	Chamaephyte
66	<i>Pluchea lanceolata</i> (DC.) C. B. Clarke	Phaar Buti	Asteraceae	Under-shrub	Perennial	Chamaephyte
67	<i>Prosopis cineraria</i> (L) Druce	Kandi	Fabaceae	Tree	Perennial	Phanerophyte
68	<i>Prosopis glandulosa</i> Torr.	Devi	Fabaceae	Tree	Perennial	Phanerophyte
69	<i>Prosopis juliflora</i> (Sw.) DC.	Devi	Fabaceae	Shrub	Perennial	Phanerophyte
70	<i>Rhynchosia minima</i> (L.) DC.	Wanverhi	Fabaceae	Herb	Perennial	Chamaephyte
71	<i>Ricinus communis</i> L.	Heran	Euphorbiaceae	Shrub	Perennial	Phanerophyte
72	<i>Saccharum bengalense</i> Retz.	Booro	Poaceae	Grass	Perennial	Chamaephyte
73	<i>Saccharum griffithii</i> Munro ex	Kanh	Poaceae	Grass	Perennial	Phanerophyte

	Boiss.					
74	<i>Saccharum spontaneum</i> L.	Booro/Munian	Poaceae	Grass	Perennial	Chamaephyte
75	<i>Salvadora oleoides</i> Decne.	Jar/Peroon	Solvdoraceae	Shrub	Perennial	Phanerophyte
76	<i>Sesuvium sesuvioides</i> Verdc.	Kori lonak	Aizoaceae	Herb	Annual	Therophyte
77	<i>Solanum surattense</i> Burm.f.	Kanderi Wal	Solanaceae	hrub	Annual	Chamaephyte
78	<i>Stipagrostis plumosa</i> (L.) Munro ex T. Anderson.	Lumb Gaah	Poaceae	Grass	Annual	Therophyte
79	<i>Tamarix aphylla</i> (L.) Karst.	Lawo	Tamaricaceae	Tree	Perennial	Phanerophyte
80	<i>Tamarix dioica</i> Roxb. Ex Roth.	Lawo	Tamaricaceae	Shrub	Perennial	Phanerophyte
81	<i>Tamarix indica</i> willd.	Lai	Tamaricaceae	Shrub	Perennial	Phanerophyte
82	<i>Tephrosia falciformis</i> Ramasw.	----- -	Fabaceae	Shrub	Perennial	Phanerophyte
83	<i>Tephrosia uniflora</i> Pers.	Andhari	Fabaceae	Herb	Annual	Chamaephyte
84	<i>Trianthema portulacastrum</i> L.	Waho	Aizoaceae	Herb	Annual	Therophyte
85	<i>Tribulus longipetalus</i> Viv.	Bakhro/Bhurt	Zygophyllaceae	Herb	Annual	Hemicryptophyte
86	<i>Vernonia cinerascens</i> Sch. Bip	Lanski	Asteraceae	Shrub	Perennial	Chamaephyte
87	<i>Withania somnifera</i> (L.) Dunal	Akri	Solanaceae	Shrub	Perennial	Chamaephyte
88	<i>Zaleya pentandra</i> (L.) Jeffrey.	Waho	Aizoaceae	Herb	Perennial	Chamaephyte
89	<i>Ziziphus nummularia</i> (Burm.f.) Wt. & A.	Ber	Phamnaceae	Shrub	Perennial	Xeropsamphyte

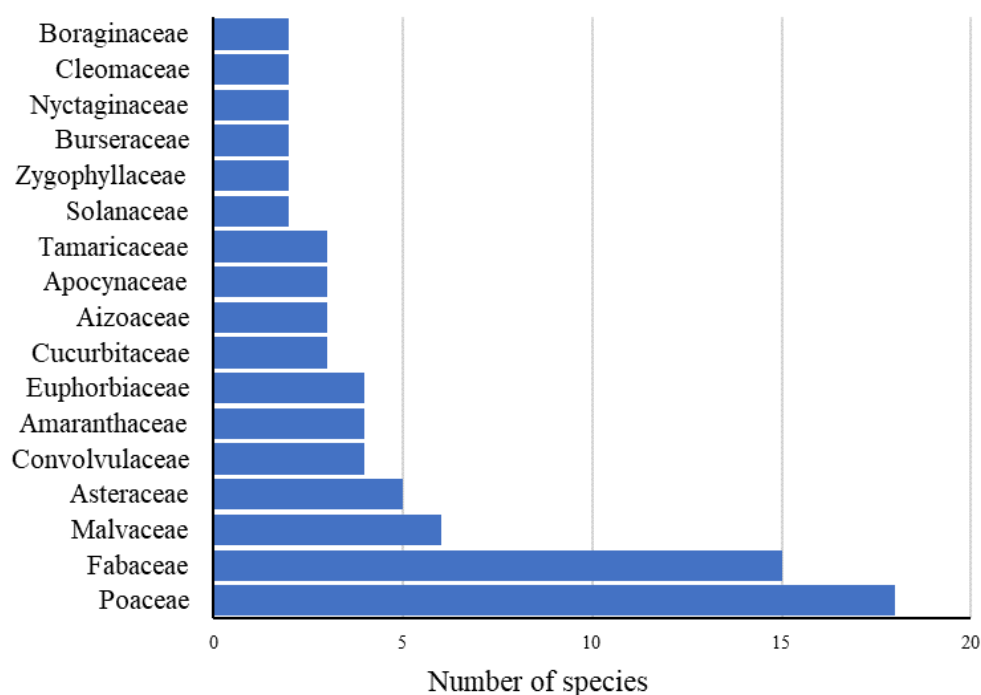


Figure 1. Plant families and species richness of flora of Nagarparker Sindh. Plant families Meliaceae, Cyperaceae, Acanthaceae, Limeaceae, Cappridaceae, Moringaceae, Phamnaceae, Neuradaceae, Solvdoraceae were represented by single species each therefore excluded from the figure.

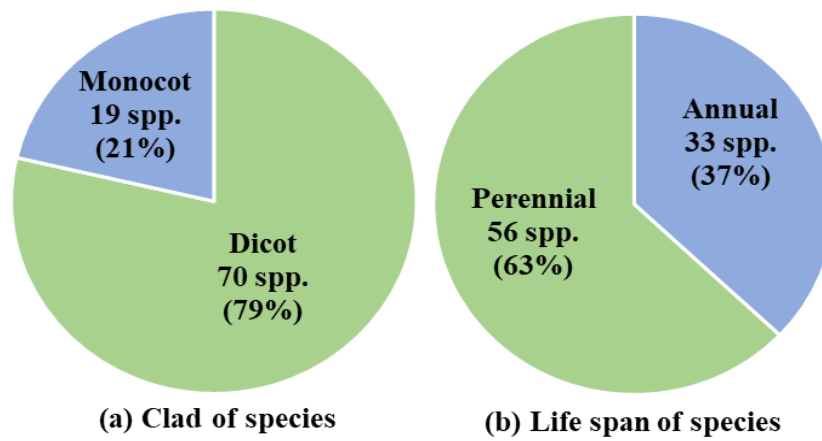


Figure 2. Vegetation characteristics of flora of Nagarparker, Sindh (a) Clad of the species and (b) Life span of the species

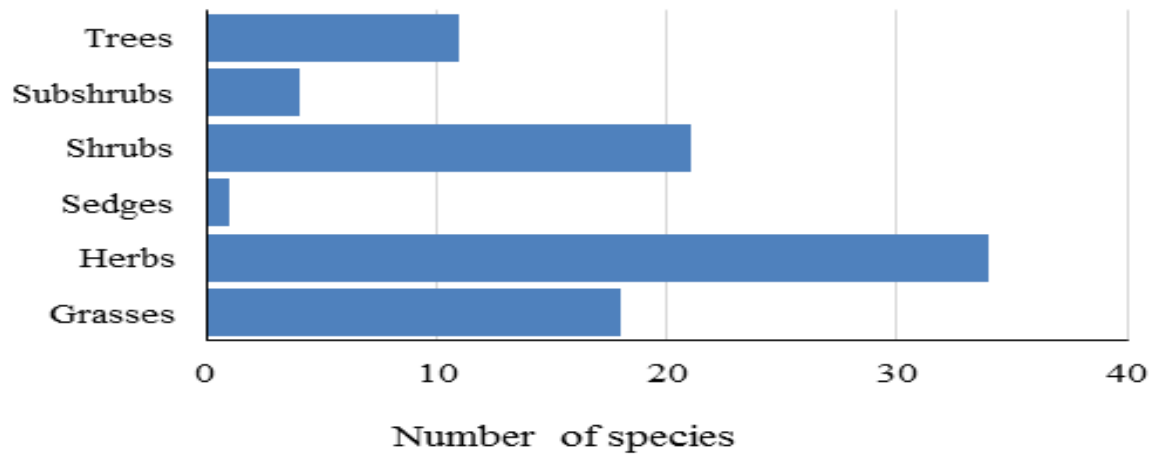


Figure 3. Plant habits of the species of the flora of Nagarparker, Sindh

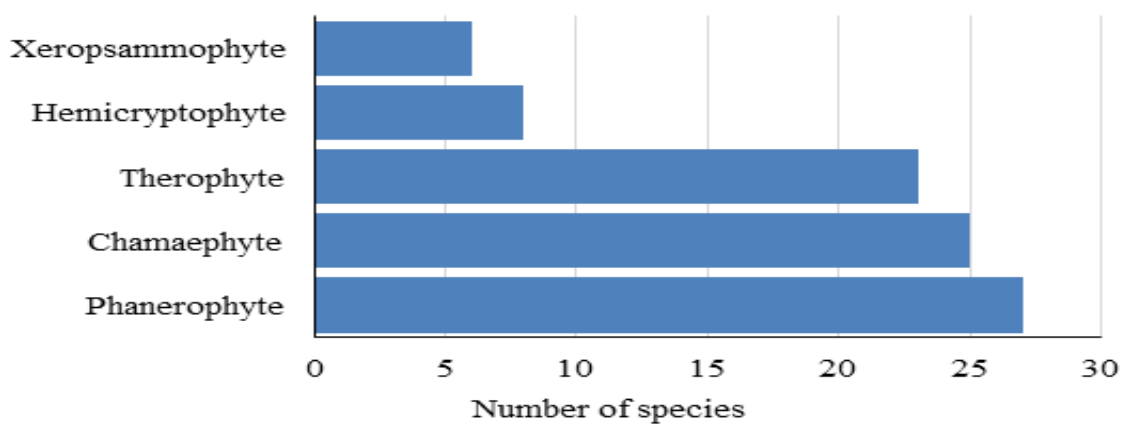


Figure 4. Life form of species identified in the flora of Nagarparker, Sindh

Conclusion

The monsoon season embellishes the Nagarparkar region, District Tharparkar, through addition of plants in its existing vegetation cover. The study recorded an inventory of 89 species of 26 plant families in post monsoon season. The vegetation cover was dominated by the species of family Poaceae and Malvaceae. The diversity in the life forms of the species was supported by a wide range of microhabitats present in the study area. The study will serve as a comprehensive inventory of flowering plant to perceive the potential threats of invasive species and climate change.

Authors' contributions

Conceived and designed the experiments: MA Saand, AA Mirbahar

Performed the experiments: SA Khaskheli & NK Khaskheli, Analyzed the data: KA Ansari & MM Jamro, Contributed materials/ analysis/ tools: SA Khaskheli & AA Mirbahar, Wrote the paper: MH Sirohi & MA Saand.

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