



RESEARCH PAPER

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Floristic analysis of Badro Mountain (Khirthar range), District Dadu, Sindh, Pakistan

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Abstract

The Badro Mountain is a part of Kirthar Mountain range, which is important for its ecological value and conservation of species and habitats. The area is becoming popular among the tourists and nature lovers for its wide variety of ecological features which support the range of biological diversity. We surveyed the Badro Mountain and its base area for floristic inventory. The entire collected plant specimens were processed through recommended methods for drying and preparing herbarium sheets and preserved, for future reference, at Centre for Biodiversity and Conservation (CBC), Shah Abdul Latif University (SALU), Khairpur, Sindh. The study recorded 64 floral species of 25 plant families. The species of family Poaceae (21%), Fabaceae (14%), and Apocynaceae (6%) were found to be more frequent in the study area. More than 75% of the identified species were perennial. The vegetation was dominated by a higher number of shrub species (40%) followed by herbs (38%). The analysis revealed the Phanerophyte (36%) and Chamaephyte (27%) as common life forms of the species. The study also recorded a critically endangered species, *Convolvulus scindicus* (Convolvulaceae). Conservative measures are required to protect the declining population of threatened species. The study demonstrates vegetation variations and plant biodiversity conservation in arid mountainous region of Kirthar ranges of Sindh.

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Introduction

The species and their interactions in an ecosystem provide a wide range of ecosystem services for the sustainable life on earth and human wellbeing (Sodhi and Ehrlich, 2010). Ecosystems are constantly changing in response to the external impetuses such as climate change, habitat loss, invasive species and other anthropogenic activities (Isbell *et al.*, 2014; Hautier *et al.*, 2015; Barlow *et al.*, 2016). An instantaneous decline in biological diversity around the world has increased the need of documentation and conservation of species. This needs identification of biological components of ecosystems. Since, numerous studies have documented the floristic inventories and vegetation pattern in the country and around the world (Wariss *et al.*, 2013; Charan and Sharma, 2016; Al-Hawshabi, 2017). Documentation of the floral inventory of a geographic area is vital to understand the ecological interactions in the ecosystems. It further serves as a future reference to assess the changes in habitats and plant responses to changing environment (de Boer *et al.*, 2011; Lammertsma *et al.*, 2011).

Kirthar Mountain range is located at the south west part of Sindh. A part of this mountain range is designated as National Park under protected Category II by IUCN, due to its unique ecological features and species for their conservation status. Since, a few studies have documented the plant diversity of National Park (Enright *et al.*, 2005) and individuals mountains, within National park and surrounding, at Kirthar Mountain range (Müller, 2002; Perveen and Hussain, 2007; Hussain and Perveen, 2015). Anthropogenic activities of the increasing human inhabitants are the important concerns for the biological diversity of the region (Enright *et al.*, 2005).

Badro Mountain (Bado Jabal) is situated in the Kirthar Mountain range (26°04'58.4"N 67°40'09.2"E). It has become the popular tourist destination for the nature lovers due to its unique ecological and landscape features. The study area has been recoded with a warm temperature ranges up to

32 °C in summer. The phytological characteristics of the area (to our knowledge) are seldom documented. This study recorded the floristic inventory of this naturally important site. The study would serve as a base line study for the conservation and sustainable management of the plant resources of the area.

Material and methods

The plants were collected from Badro Mountain and its surroundings in year 2018. The specimens were transported and processed for preparing herbarium specimens as per standard protocol at the Herbarium, CBC Shah Abdul Latif University Khairpur. The taxonomic identification of plants was carried out with the help of available literature, Flora of Karachi and Pakistan (Jafri, 1966; Ali & Nasir, 1989-92; Ali & Qaiser, 1993-2007). The flora of Pakistan were written long ago. Ever since, Nomenclature (species names and taxonomic position) has improved significantly. Therefore this study used the recent legitimate names and taxonomic positions of species, according to International Code of Nomenclature for algae, fungi, and plants, recorded in online flora of Pakistan by Missouri Botanical Garden (Missouri Botanical Garden, 2018). The specimens were further analyzed for determining life forms, habit and life span of recorded plant species. The Raunkiaer's classification used to distinguish the life forms of the species (Raunkiaer, 1934). The specimens were deposited at Herbarium, Centre for Biodiversity and Conservation, Shah Abdul Latif University, Khairpur, for future reference.

Results and discussion

A total of 64 floral species belonging to 55 genera and 25 plant families were recorded at Badro Mountain and its surroundings (Table 1). Species were dominated by family Poaceae (21%), followed Fabaceae (14%), Apocynaceae (6%), Euphorbiaceae (4), Solanaceae (4%), Tamaricaceae (4%) and Zygophyllaceae (4%). About 44% of the recorded families were represented by single species. Of the observed families, only two, Arecaceae and Poaceae having 14 species, belonged to Monocotyledon clad (Fig. 1a).

Table 1. Floristic inventory recorded at Badro Mountain, Sindh.

S. No.	Plant species	Family	Local name	Life span	Life form
1	<i>Abutilon indicum</i> (L.) Sweet	Malvaceae	Pat-teer	Perennial	Phanerophyte
2	<i>Acacia nilotica</i> (L) Delile	Fabaceae	Sindhi babur	Perennial	Phanerophyte
3	<i>Acacia senegal</i> (L.) willd (Benth.) Brenan	Fabaceae	Kumbat	Perennial	Phanerophyte
4	<i>Albizia lebbek</i> (L) Beth.	Fabaceae	Sarenh	Perennial	Phanerophyte
5	<i>Aristida adscensionis</i> L.	Poaceae	Lumb Gaah	Annual	Therophyte
6	<i>Aristida funiculata</i> Trin. & Pupr.	Poaceae	Lamb gaah	Annual	Therophyte
7	<i>Arthrocnemum indicum</i> (Willd.) Moq.	Amaranthaceae	Lano	Perennial	Xeropsammophyte
8	<i>Azadirachta indica</i> A. Juss.	Meliaceae	Nim	Perennial	Phanerophyte
9	<i>Boerhavia procumbens</i> Banks ex Rxb.	Nyctaginaceae	Dakhri	Perennial	Chamaephyte
10	<i>Calotropis procera</i> (Aiton)W.T., Aiton	Apocynaceae	Ak	Perennial	Phanerophyte
11	<i>Capparis decidua</i> (Forssk.) Edgew.	Capparidaceae	Kirar	Perennial	Phanerophyte
12	<i>Cassia holosericea</i> Fresen.	Fabaceae	Ghorawal	Perennial	Chamaephyte
13	<i>Cassia italica</i> (Mill.) Spreng.	Fabaceae	Ghora wal	Annual	Therophyte
14	<i>Cenchrus ciliaris</i> L.	Poaceae	Dhaman	Perennial	Xeropsammophyte
15	<i>Citrullus colocynthis</i> (L.) Schrad.	Cucurbitaceae	Trooh	Perennial	Hemicryptophyte
16	<i>Cleome scaposa</i> DC.	Cleomaceae	Kano gah	Annual	Therophyte
17	<i>Cocculus pendulus</i> (J.R. & G. forst.) Deils	Menispermaceae	Zahmur	Perennial	Chamaephyte
18	<i>Commiphora wightii</i> (Arn.) Bhandari	Burseraceae	Gugur	Perennial	Phanerophyte
19	<i>Convolvulus scindicus</i> Stocks	Convolvulaceae		Annual or Perennial	Chamaephyte
20	<i>Convolvulus spinosus</i> Burm.f.	Convolvulaceae	Sussai	Perennial	Chamaephyte
21	<i>Crotalaria burhia</i> Buch.-Ham. ex Benth.	Fabaceae	Chag	Perennial	Chamaephyte
22	<i>Cymbopogon jwarancusa</i> (Jones) Schult.	Poaceae	Katan	Perennial	Xeropsammophyte
23	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	Chhabar	Perennial	Chamaephyte
24	<i>Dactyloctenium aegyptium</i> (L.) Wild.	Poaceae	Gandheer Gaah	Annual	Chamaephyte
25	<i>Desmostachya bipinnata</i> (L.) Stapf.	Poaceae	Drabh	Perennial	Chamaephyte
26	<i>Eragrostis minor</i> Host.	Poaceae	Makhni gah	Annual	Therophyte
27	<i>Euphorbia caducifolia</i> Haines	Euphorbiaceae	Thohar	Perennial	Chamaephyte
28	<i>Euphorbia granulata</i> Forssk.	Euphorbiaceae	Kheer wal	Annual to Perennial	Hemicryptophyte
29	<i>Euphorbia inderiensis</i> Less. ex Kar. & Kir.	Euphorbiaceae	Mar maro	Annual	Hemicryptophyte
30	<i>Fagonia indica</i> Burm f.	Zygophyllaceae	Dhamaaho	Annual to Perennial	Xeropsammophyte
31	<i>Ficus johannis</i> Boiss.	Moraceae	Hanjir	Perennial	Phanerophyte
32	<i>Forsskaolea tenacissima</i> L.	Urticaceae	Luchkano	Annual	Hemicryptophyte
33	<i>Grewia tenax</i> (Forssk.) fiori.	Malvaceae	Gangi	Perennial	Phanerophyte
34	<i>Heliotropium crispum</i> Desf.	Boraginaceae	Kharsan	Annual	Xeropsammophyte
35	<i>Heliotropium europaeum</i> L.	Boraginaceae	Kharsan	Annual	Xeropsammophyte
36	<i>Indigofera oblongifolia</i> Forssk.	Fabaceae	Jhill	Perennial	Therophyte
37	<i>Iphiona grantioides</i> (Boiss.) Anderb.	Asteraceae	Gandraf	annual	Chamaephyte
38	<i>Lasturus scindicus</i> Henr.	Poaceae	Sain	Perennial	Hemicryptophyte
39	<i>Launaea procumbens</i> (Roxb) Ramayya & Rajagopal.	Asteraceae	Bhattar	Perennial	Hemicryptophyte
40	<i>Leptadenia pyrotechnica</i> (Forsk.) Decne.	Apocynaceae	Khip	Perennial	Phanerophyte
41	<i>Lycium ruthenicum</i> Murray	Solanaceae	Garathi	Perennial	Phanerophyte
42	<i>Nannorrhops ritchiana</i> (Griff.) Aitch.	Arecaceae	Pesh	Perennial	Phanerophyte
43	<i>Ochthochloa compressa</i> (Forssk.) Hilu.	Poaceae	Ghander	Perennial	Hemicryptophyte
44	<i>Panicum turgidum</i> Forssk.	Poaceae	Dhaman	Perennial	Hemicryptophyte
45	<i>Periploca aphylla</i> Decne.	Apocynaceae	Nar khip	Perennial	Phanerophyte
46	<i>Prosopis cineraria</i> (L) Druce	Fabaceae	Kandi	Perennial	Phanerophyte
47	<i>Pteropryum aucheri</i> Jaub. & Spach.	Polygonaceae	Wekho	Perennial	Phanerophyte
48	<i>Pteropryum olivieri</i> Jaub & Spach	Polygonaceae	Wekho	Perennial	Phanerophyte
49	<i>Rhazya stricta</i> Decne.	Apocynaceae	Sahaer	Perennial	Chamaephyte
50	<i>Saccharum bengalense</i> Retz.	Poaceae	Booro	Perennial	Chamaephyte
51	<i>Saccharum spontaneum</i> L.	Poaceae	Sar	Perennial	Chamaephyte
52	<i>Salvadora oleoides</i> Decne.	Solvdoraceae	Jar/Peroon	Perennial	Phanerophyte
53	<i>Solanum surattense</i> Burm.f.	Solanaceae	Kanderi Wal	Annual	Chamaephyte
54	<i>Stipagrostis plumosa</i> (L.) Munro ex T. Anderson	Poaceae	Lamb gaah	Perennial	Therophyte
55	<i>Suaeda fruticosa</i> Forssk. ex J.F. Gmel.	Amaranthaceae	Lano	Perennial	Chamaephyte
56	<i>Tamarix aphylla</i> (L.) Karst.	Tamaricaceae	Lawo	Perennial	Phanerophyte
57	<i>Tamarix dioica</i> Roxb. Ex Roth.	Tamaricaceae	Lawo	Perennial	Phanerophyte
58	<i>Tamarix indica</i> willd.	Tamaricaceae	Lai	Perennial	Phanerophyte
59	<i>Tephrosia uniflora</i> Pers.	Fabaceae	Andhari	Annual	Chamaephyte
60	<i>Tribulus longipetalus</i> Viv.	Zygophyllaceae	Bakhro/Bhurt	Annual	Hemicryptophyte
61	<i>Tribulus terrestris</i> L.	Zygophyllaceae	Bakhro	Annual or Biennial	Hemicryptophyte
62	<i>Withania coagulans</i> (Stocks) Dunal	Solanaceae	Paneer	Perennial	Phanerophyte
63	<i>Ziziphus mauritiana</i> Lam.	Rhamnaceae	Ber	Perennial	Phanerophyte
64	<i>Ziziphus nummularia</i> (Burm.f.) Wt. & A.	Rhamnaceae	Ber	Perennial	Xeropsammophyte

The study area is located next to the Kirthar National park and contains a similar ecological features. The results of this study are comparable with the other studies which recorded the inventory at the adjoining mountain regions, as Gorkh Hill, Tiko Baran and Rani Kot (Perveen and Hussain, 2007; Hussain and Perveen, 2009, 2015) . However the study conducted in Kirthar National park found a comparatively

higher number of species over a larger area, the frequency of plant families were remarkably similar except Asteraceae, Convolvulaceae which were poorly represented in our study (Enright *et al.*, 2005). Badro Mountain is sparsely populated and contains lower diversity of plant species as compared to the mountains in Northern areas of Pakistan (Mehmood *et al.*, 2015).

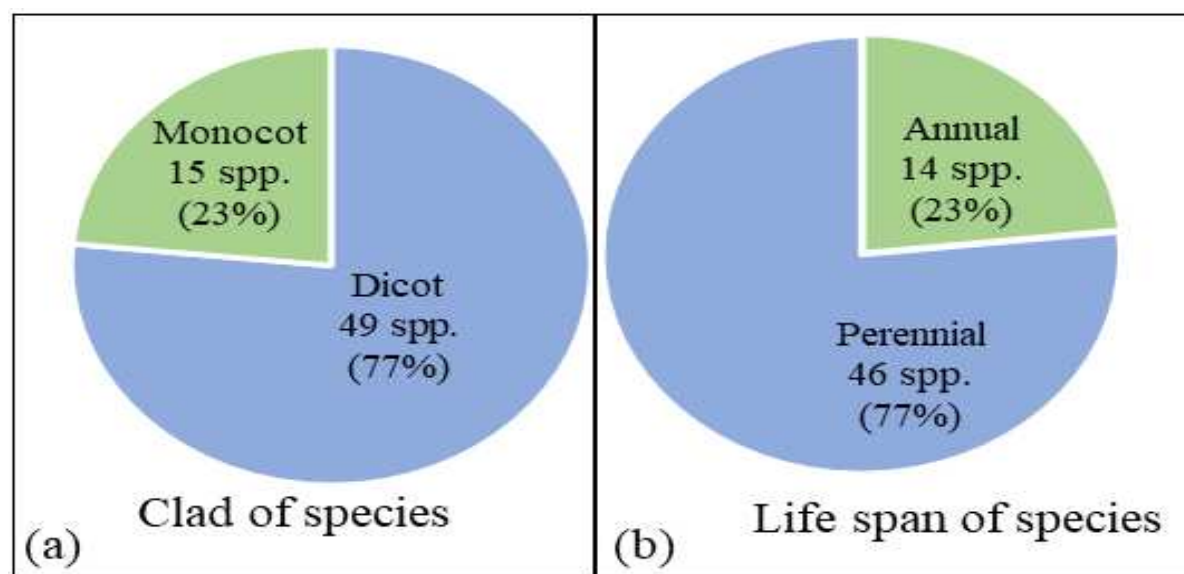


Fig. 1. Vegetation characteristics of Flora of Badro Mountain, (a) Clad of Plant species, (b) Life span of species. Four species, *T. terrestris*, *C. scindicus*, *F. indica*, and *E. granulate*, are excluded from life span analysis due to their varied life span duration.

The plant life span analysis revealed that more than 75% of the plant community comprised of perennial populations (Fig.1b). This included the perennial herbs and grasses. Annual species belonged to families Asteraceae, Boraginaceae, Cleomaceae, Convolvulaceae, Euphorbiaceae, Fabaceae, Poaceae, Solanaceae, Urticaceae, and Zygophyllaceae. A few species recorded in the study show a varied life span, for example *Tribulus terrestris* (Zygophyllaceae) has annual to biennial life span whereas *Convolvulus scindicus* (Convolvulaceae), *Fagonia indica* (Zygophyllaceae) and *Euphorbia granulata* (Euphorbiaceae) exhibit annual to perennial life span.

However, the vegetation was dominated by shrubs containing about 40% of the recorded species. The herbs and grasses also contributed a significant share of species (Fig. 2). In contrast a higher number of

herbs (38%) were recorded in adjoining mountains of Kirthar National park (Enright *et al.*, 2005).

This difference of species may lie in the various microhabitats within the study areas, for example Enright *et al.* (2005) recorded a distinctive species in small wetlands which are not found elsewhere in the park.

The Phanerophyte (36%) was found to be a common life form of species followed by Chamaephyte (27%) and Hemicryptophyte in the vegetation (Fig. 3). The higher number of Phanerophytes represent shrubs and trees. These life forms with least protected and unprotected buds are common in warmer part of the world and decrease towards the North (Smith, 1913). A similar dominance of Phanerophyte and Chamaephyte had been recorded in other mountains

of Kirthar Mountain range (Hussain and Perveen, 2015). This study also confirmed the population of *Convolvulus scindicus* (Convolvulaceae); an endemic species to Pakistan which has been assessed as critically endangered species (Abbas and Qaiser, 2011). The species is recorded from only two regions

of Pakistan and part of Thar Desert in India (Roy and Pandey, 1971; Abbas and Qaiser, 2011). Other rare species were also reported from the adjoining mountains of Kirthar range (Perveen and Hussain, 2007).

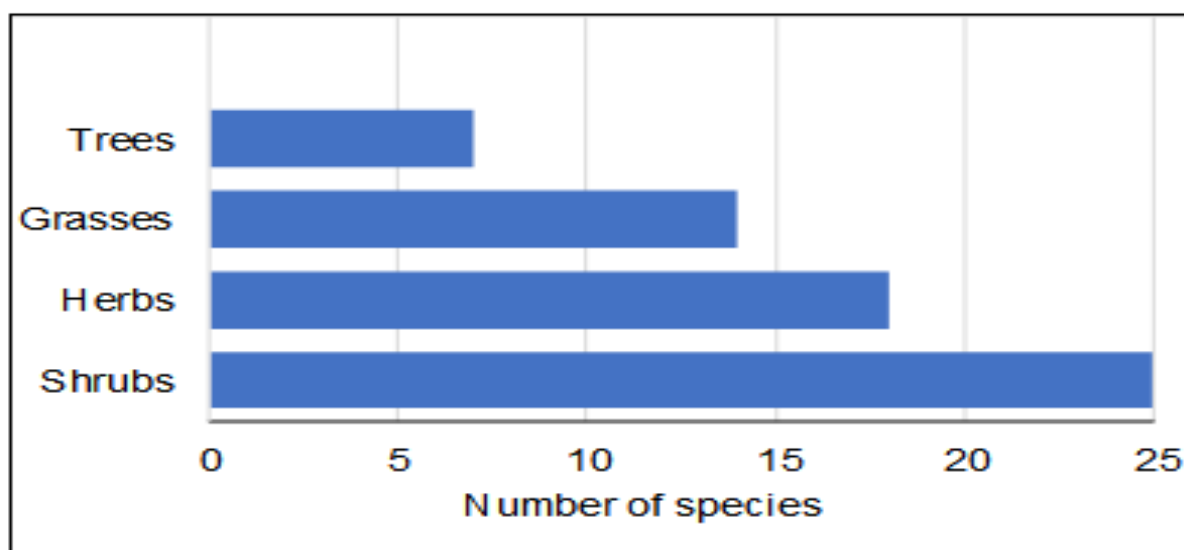


Fig. 2. Plant habits of the flora of Badro Mountain, Sindh.

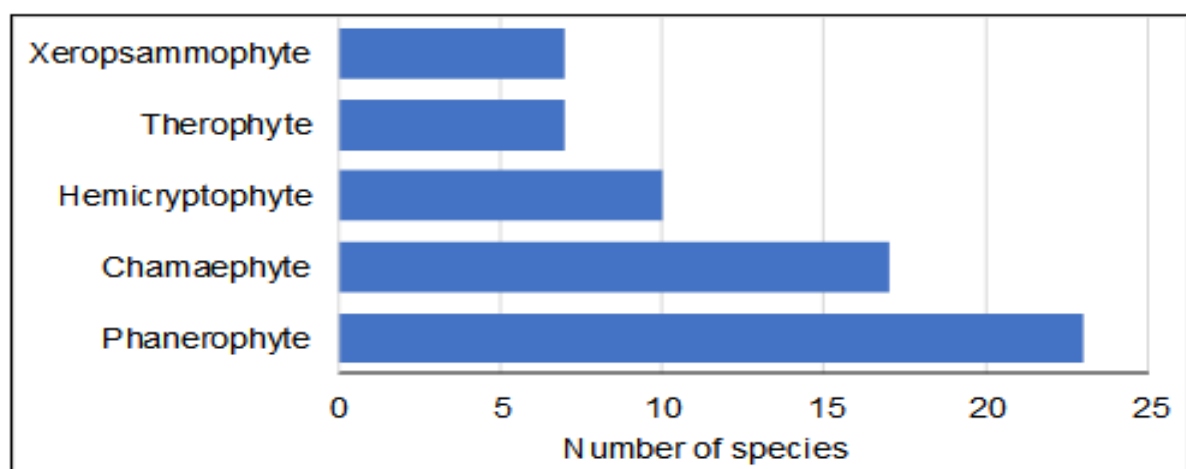


Fig. 3. Life forms of species identified at Badro Mountain Sindh.

This indicates the higher ecological value of the region. The region is under pressure from the growing human population, by direct use of wood as fuel and grazing livestock. This region also receives an increasing number of tourists in recent years.

It necessitates the conservative measures from the community and government to ensure the sustainable use of biological elements and maintain the

ecosystem services in such a valuable ecosystem.

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