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BIODIVERSITY AND ECOLOGICAL CHARACTERIZATION OF THE FLORA OF GADOON RANGELAND, DISTRICT SWABI, KHYBER PUKHTUNKHWA, PAKISTAN

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This study was conducted to examine plant diversity and its ecological characteristics in Gadoon Hills, District Swabi, Pakistan during 2009 and 2010. The area is under heavy biotic pressure due to deforestation and over grazing. The vegetation presents a wide physiognomic range, from grasses to tall trees. There were 260 plant species belonging to 211 genera and 90 families. Of them 77 families were Dicots, 7 Monocots, 4 Pteridophytes and 2 Gymnosperms. Asteraceae was the dominant family followed by Poaceae. Forty five tree species associated with 30 taxa of shrubs and 185 herb species were recorded during the study. *Viscum album* and *Korthalsella opuntia* were the mistletoes and *Cuscuta reflexa* was the only parasite. Only twenty eight species were spiny. The biological spectrum showed that therophytes and megaphanerophytes were the most abundant life forms, followed by nanophanerophytes. Microphylls dominated the investigated area which was followed by leptophylls.

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Key words: Plant diversity; leaf spectra; life forms; deforestation; over grazing; Gadoon Hills; Swabi-Pakistan

تعيين تنوع زيستي و اكولوژيكي فلور مرتع گادون از منطقه سوابي، استان خيبرپختونخوا، پاكستان

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اين مطالعه براى بررسى تنوع زيستى و مشخصات اكولوژيكى تپه‌هاى گادون در منطقه سوابى پاكستان در طى سالهاى ۲۰۰۹ تا ۲۰۱۰ انجام شده است. اين منطقه تحت تأثير فشارهاى زيستى بدليل از بين رفتن جنگلها و چراى بيش از حد مى‌باشد. پوشش گياهى منطقه دامنه وسيعى از اشكال زيستى از انواع چمن‌ها تا درخت بلند را در بر مى‌گيرد. ٢٦٠ گونه گياهى متعلق به ٢١١ جنس و ٩٠ خانواده شناسايى گرديدند. هفتاد و هفت خانواده از دو لپه‌اى‌ها، ٧ خانواده از تک لپه‌اى‌ها، ٤ خانواده از سرخس‌ها و دو خانواده از بازدانگان شناسايى شدند. خانواده‌هاى آفتابگردان و گندميان داراى بيشترين گونه مى‌باشند. چهل و پنج گونه درختى همراه با ٣٠ گونه درختچه‌اى و ١٨٥ گونه علفى در طى دوره مطالعه ثبت گرديدند. گونه‌هاى *Viscum album* و *Korthalesella opunitia*، از انواع دار رست و *Cuscuta reflexa* تنها گياه انگل در اين منطقه حضور دارند و گياهان يكساله ودرختان بلند فراوان‌ترين فرم رويشى را تشكل مى‌دهند. و بعد از اينها گونه هاى درختچه‌اى كوتاه قرار مى‌گيرند. گياهان برگ ريز داراى اكثريت بودند و بعد از آنها گياهان با برگهاى باريک و بلند قرار دارند.

INTRODUCTION

Gadoon Hills belongs to the District Swabi in northwestern region of Pakistan, lying between the latitude 34-0’ and 34-25’ N and longitude 72-9’ and 72-40’ E. The area is bounded by District Buner on the North-West and Utman merged area on east and Panjmand-Pabenai-Topi area of the District Swabi (Fig 1). The altitude of the area varies from 410 m on the

eastern boundary to 2250 m at Shah Kot Sar (Mahaban Forest). The climate is sub-tropical and semi-arid in the lower reaches and temperate in the upper parts. It experiences heavy rainfall and humidity because of its location between monsoon and western disturbances. Hot summers are characteristic with June and July as the hottest months having mean maximum temperatures of 40-42 ^{0}C. There is a drop in temperature with rising altitude. Winters are cold and mean monthly temperatures are 4 to 10 ^{0}C. January is the coldest month. The annual rainfall varies from 60cm to 145cm, increasing as one goes upwards north and as the altitude increases. Bulk of the rain is received during the monsoon. Snow fall in the winters is characteristic feature at high altitudes. The hilly nature of topography of the tract has resulted in enormous increase in its surface area. The area was once famous for poppy cultivation (Said, 1978).

Deteriorating environmental conditions such as aridity, soil salinity, soil erosion and acid rain are potential threats to biodiversity (Hussain 2003). On the other hand, the floristic composition is a reflection of physiognomy, plant diversity, environmental and biotic influences. Therefore, studies on the regional flora always save time and provide precise information. The life form and leaf size spectra are important physiognomic attributes which are widely used in vegetation studies. The life form spectra are said to be the indicators of micro and macroclimate (Shimwell 1971). Frequent therophytes and chamaephytes in many studies have been reported as indicators of specific desert type climate (Sher & Khan 2007). Hussain & Perveen (2009) determined the life form of each species from Tiko Baran, Khirthar range depending on the position of perennating buds. Mark *et al.* (2001) reported that Chamaephytes and hemicryptophytes dominated alpine zone at meso- and microscales in southern Tierra del Fuego, where the full zone is expressed. Batalha and Martins (2002) compiled Raunkiaer's life-form spectra from cerrado sites and concluded that the site distinguished itself from the savanna by its under-representation of therophytes. Costa *et al.* (2007) organized Raunkier's life form and flora of thorn wood land and reported high percentage of therophytes followed by phanerophytes, chamaephytes, hemicryptophytes and

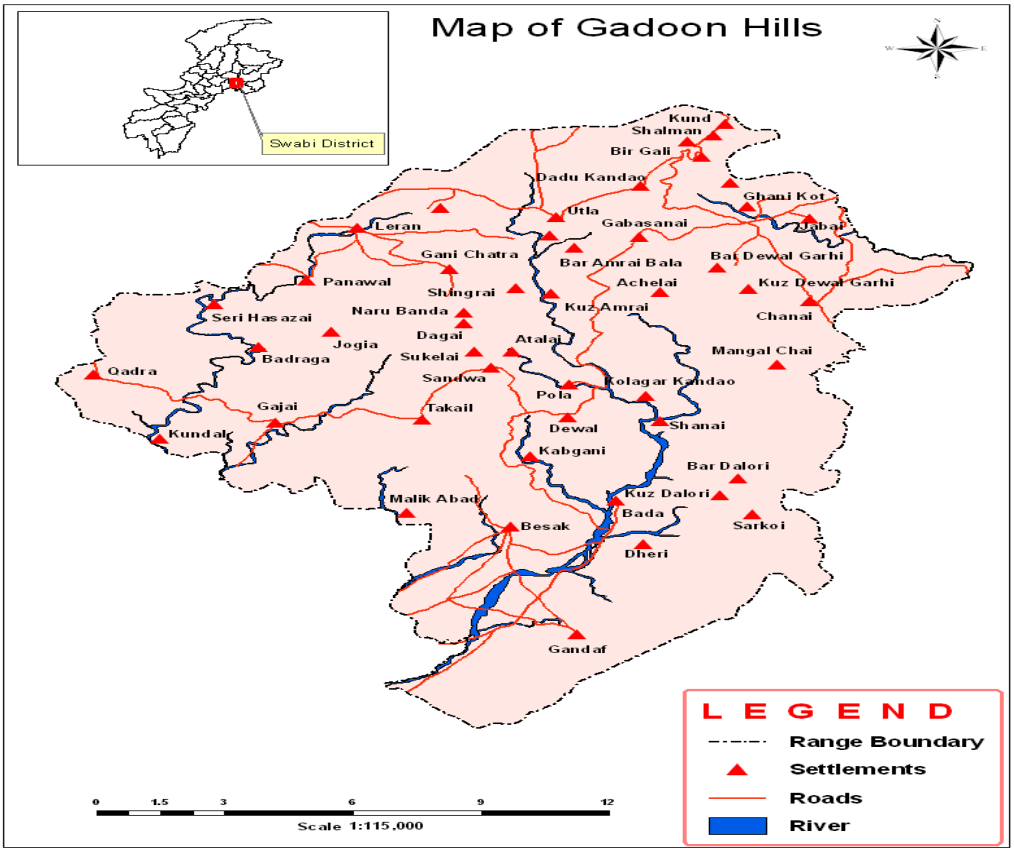

Fig. 1. Map of Gadoon Hills showing the research area.

cryptophytes. Yemeni and Sher (2010) concluded that leaf size spectra analysis reveal the dominance of microphylls followed by nanophylls, leptophylls, mesophylls, macrophylls and megaphylls from Asir Mountain of the Kingdom of Saudi Arabia. Greater percentage of microphylls and mesophylls followed by nanophylls, leptophylls and megaphylls indicates that the investigated ecosystem is under heavy biotic pressure due to deforestation and over grazing (Sher & Khan 2007). All these studies show that no reference is available on the flora and ecological characterization of study area. The present study was therefore undertaken to report the floristic diversity of Gadoon Hills, District Swabi together with its ecological characteristics. The findings might be of help to ecologists, ethnobotanists and conservationists.

MATERIALS AND METHODS

This study was conducted for two consecutive years (2009 & 2010). Plant specimens were collected, dried and preserved. They were identified through available literature (Nasir & Ali, 1971-1995; Ali & Qaisar, 1971-2010). Plant specimens were submitted to the Herbarium, department of Botany, University of Peshawar, Pakistan. Leaf size and life forms were determined after Raunkier (1934) and Hussain (1989).

RESULTS AND DISCUSSION

The flora of Gadoon Hills, District Swabi consisted of 260 plant species belonging to 211 genera and 90 families (Table 1). Out of these 77 families were Dicots, 7 Monocots, 4 Pteridophytes and 2 Gymnosperms (Table 1). Our findings are in line with Hussain *et al.*, (2004) who reported 256 species belonging to 90 families from the various parts of District Swat. They also reported bryophytes, pteridophytes, gymnosperms, monocots and dicots in their areas. The present list had 67 percent similarity in species composition with Chagharzai Valley, District Buner enlisted by Sher & Khan (2007). Similar floristic list was presented by Sher *et al.* (2011) and present results are in agreement on the basis of species. This can be explained due to similar environmental conditions as the area is adjacent to Buner. Forty five tree species associated with 30 taxa of shrubs and 185 herb species have also been observed. Two species of mistletoe (*Viscum album, Korthalsella opuntia*) and one parasite (*Cuscuta reflexa*) were recorded in the area (Table 1). Most of the species were growing wild (235 species), sixteen species were cultivated, nine species were growing wild as well as cultivated. Of the 75 trees and shrubs, 28 were evergreen and 48 were deciduous species. Annuals shared 129 species while 49 species were perennials. Only twenty eight species were spiny.

Asteraceae had 23 species which was followed by Poaceae (18 spp.), Lamiaceae (13 spp.), Rosaceae & Papilionaceae (each with 11 spp.) and Brasicaceae (10 spp.). Euphorbiaceae, Moraceae and Polygonaceae had 7 spp. each. Caryophyllaceae had 6 spp. Each of the Amaranthaceae, Apiaceae, Mimosaceae, Ranunculaceae and Scrophulariaceae had 5 species. Alliaceae, Cyperaceae, Malvaceae and Solanaceae families were represented by 4 species, while the remaining 71 families had 3 or less than 3 species. Thus, our results support their findings. Durrani *et al.* (2005) reported 202 species of 45 plant families from Harboi rangeland (Kalat, Pakistan). Asteraceae, Papilionaceae, Poaceae, Brassicaceae and Lamiaceae were also the leading families in their investigations. While studying the flora of Mastuj, District Chitral, Hussain *et al.* (2007) recorded that Asteraceae (11 spp.), Papilionaceae (10 spp.), Rosaceae (9 spp.), Brassicaceae and Polygonaceae (5 spp. each) were the leading families in terms of number of species. Our results agree with these. The results published and reported by other workers which coincide with our findings are listed as follows. Sher & Khan (2007) recorded Asteraceae as the leading family with 21 taxa followed by Papilionaceae (12 spp.), Lamiaceae (10 spp.), Poaceae and Rosaceae (each with 9 spp.) from Chagharzai Valley, District Buner. Mood (2008) also reported Asteraceae (22 species), Chenopodiaceae (16 species), Brassicaceae (11 species), Lamiaceae (10 species), Caryophyllaceae (9 species), Poaceae (8 species), Fabaceae (8 species) and Boraginaceae (8 species) as the dominant families. Perveen *et al.* (2008) recorded Poaceae (12 sp.) as the largest family followed by Papilionaceae (7 sp.) and Asteraceae (6 sp.) from Dureji game reserve. Similarly, Qureshi (2008) identified Poaceae (18.38%), Fabaceae (8.82%), and Amaranthaceae (5.15%) as the leading plant families from Sawan Wari of Nara Desert. Asteraceae was the dominating family in their study area. Durrani *et al.* (2010) enlisted Asteraceae, Fabaceae, Poaceae, Brassicaceae, Lamiaceae and Boraginaceae as important families in the protected area of Aghberg rangelands of Quetta Pakistan.

Life form and leaf size spectra indicate climatic and human disturbance of a particular area (Sher & Khan, 2007; Durrani *et al.* 2010). Keeping this in view, the ecological characteristics of the flora such as life form and leaf spectra were studied in order to evaluate the biotic and anthropogenic interferences responsible for the present vegetation structure and physiognomy. Life form and leaf spectra are important because they show the ecological amplitude and tolerance of the species (Cain & Castro, 1959). The biological spectrum showed that therophytes (129 spp., 49.62%) and

Table 1. Floristic list, Life form and Leaf size classification of some plants of Gadoon Hills, District Swabi, Pakistan.

S.No.	Families and Species	W/C	Flower Period	LF	LS	Smr.	Wnt.
A.	**Pteridophytes**						
1	**Adiantaceae**						
	1. Adiantum incisum Forsk.	W	Summer	G	Na	+	+
	2. Adiantum venustum D.Done	W	Summer	G	Na	+	+
2	**Aspleniaceae**						
	3. Asplenium adiantum nigrum L.	W	Summer	G	Mic	+	+
	4. Ceterach dalhousiae (Hk.) C. Chr.	W	Summer	G	Mic	+	+
3	**Equisetaceae**						
	5. Equisetum arvense L.	W	Summer	G	Lp	+	+
4	**Pteridaceae**						
	6. Cheilanthes marantae (L.) Domin.	W	Summer	G	Mic	+	+
B.	**Gymnosperms**						
5	**Pinaceae**						
	7. Pinus roxburghii Sergent	W	Spring	Mp	Lp	+	+
	8. Pinus wallichiana A.B.Jackson.	W	Spring	Mp	Lp	+	+
6	**Taxaceae**						
	9. Taxus wallichiana Zucc.	W	Spring	Mp	Lp	+	+
C.	**Monocotyledons**						
7	**Alliaceae**						
	10. Allium cepa L.	C	Summer	G	Mic	+	-
	11. Allium griffithianum Boiss.	W	Spring	G	Lp	+	-
	12. Allium jacquemontii Kunth	W	Spring	G	Lp	+	-
	13. Allium sativum L.	C	Summer	G	Mic	+	-
8	**Amaryllidaceae**						
	14. Narcissus tazzeta L.	W	Summer	G	Mic	-	+
9	**Asparagaceae**						
	15. Asparagus adscendens Roxb.	W	Winter	Ch	Lp	+	+
10	**Araceae**						
	16. Acorus calamus Linn.	W	Summer	G	Mic	+	-
11	**Cyperaceae**						
	17. Cyperus niveus Retz.	W	Spring	G	Lp	+	+
	18. Cyperus rotundus Linn.	W	Summer	G	Lp	+	+
	19. Fimbristylis dichotoma (L.) Vahl.	W	Summer	G	Mic	+	+
	20.Schoenoplectus litoralis Schrad.	W	Summer	G	Mic	+	+
12	**Liliaceae**						
	21. Tulipa stellata Hk.f.	W	Spring	G	Lp	+	-
13	**Poaceae**						
	22. Apluda mutica L.	W	Winter	Hc	Lp	+	+
	23. Aristida adscensionis L.	W	Spring	Hc	Lp	+	+
	24. Arthraxon prionodes (Steud.) Dandy.	W	Summer	Hc	Lp	+	+
	25. Avena sativa L.	W	Winter	Th	Lp	+	+
	26. Chrysopogon aucheri (Boiss.) Stapf	W	Winter	Hc	Lp	+	+
	27. Cynodon dactylon (L.) Pers.	W	Throughout year	Hc	Lp	+	+
	28. Dichanthium annulatum (Forssk.) Stapf.	W	Summer	Hc	Mic	+	-
	29. Digitaria sanguinalis (L.) Scop.	W	Summer	Hc	Lp	+	+
	30. Heteropogon contortus (L.) P. Beauv.	W	Summer	Hc	Lp	+	+
	31. Imperata cylindrica (L.) P. Beauv.	W	Summer	Hc	Lp	+	-
	32. Miscanthus nepalensis (Trin.) Hack.	W	Summer	Hc	Lp	+	+
	33. Pennisetum orientale L. C. Rich.	W	Summer	Hc	Mic	+	-
	34. Phalaris minor Retz.	W	Spring	Th	Mic	-	+
	35. Poa annua L.	W	Through out year	Th	Lp	-	+
	36. Saccharum bengalense Ritz.	W	Autumn	Hc	Mic	+	-

Table 1. Continued

S.No.	Families and Species	W/C	Flower Period	LF	LS	Smr.	Wnt.
	37. Saccharum spontaneum L.	W	Summer	Hc	Mic	+	-
	38. Sorghum helepense (L.) Bern.	W	Summer	Hc	Mic	+	-
	39.Themeda anathera (Nees) Hack.	W	Summer	Hc	Lp	+	-
D.	**Dicotyledons**						
14	**Acanthaceae**						
	40. Dicliptera roxburghiana Nees	W	Summer	Th	Na	+	-
	41. Justicia adhatoda L.	W	Summer	Np	Mic	+	+
15	**Amaranthaceae**						
	42. Achyranthes aspera L.	W	Spring	Th	Mes	+	-
	43. Aerva javanica (Burm. f.) Juss.	W	Summer	Th	Mic	+	-
	44. Amaranthus spinosus L.	W	Spring	Th	Mic	+	-
	45. Amaranthus viridis L.	W	Spring	Th	Mic	+	-
	46. Celosia cristata L.	W	Spring	Th	Na	+	-
16	**Anacardiaceae**						
	47. Pistacia integrima J.L.Stewart ex Brandis	W	Spring	Mp	Mic	+	+
	48. Rhus cotinus L.	W	Summer	Mp	Mic	+	+
17	**Apiaceae**						
	49. Ammi visnaga (L.) Lamk.	C		Th	Lp	+	-
	50. Bupleurum subuniflorum Boiss. & Heldr.	W	Summer	Th	Mic	+	-
	51. Coriandrum sativum L.	C	Early spring	Th	Lp	+	-
	52. Eryngium biebersteinianum Nevski ex Bobrov.	W	Summer	Th	Mes	+	+
	53. Foeoniculum vulgare Miller.	C	Summer	Th	Lp	+	-
18	**Apocynaceae**						
	54. Carissa spinarum auct. non L.	W	Summer	Np	Mic	+	+
	55. Nerium indicum Mill.	C	Summer	Np	Mic	+	+
	56. Rhazya stricta Dcne.	W	Winter	Np	Mic	+	+
19	**Araliaceae**						
	57. Hedera helix L.	W	Autumn	L	Mic	+	+
20	**Asclepiadaceae**						
	58.Calotropis procera (Wild) R.Br.	W	Throughout year	Np	Mes	+	+
	59. Pergularia daemia (Forssk.) Chiov.	W	Autumn	L	Mic	+	-
	60. Periploca aphylla Dcne.	W	Spring	Np	LL	+	+
21	**Asteraceae**						
	61. Achillea millefolium L.	W	Summer	Th	Na	+	-
	62. Artemisia vulgaris L.	W	Summer	Ch	Mic	+	+
	63. Bidens cernua L.	W	Summer	Th	Mic	+	-
	64. Calendula arvensis L.	W	Spring	Th	Na	-	+
	65. Calendula officinalis L.	W	Spring	Th	Na	-	+
	66. Carthamus oxycantha M.B.	W	Spring	Th	Na	-	+
	67. Cichorium intybus L.	W	Spring	Th	Mes	+	-
	68. Cirsium arvense (L.) Scop.	W	Spring	Th	Mic	+	-
	69. Conyza canadensis (L.) Cronquist	W	Winter	Th	Lp	+	-
	70. Conyza crispus Pourr.	W	Winter	Th	Lp	+	-
	71. Echinops echinatus Roxb.	W	Spring	Th	Mic	+	-
	72. Filago spathulata C. Presl.	W	Spring	Th	Mic	+	-
	73. Inula cappa (Ham.) DC.	W	Winter	Th	Mic	+	-
	74. Inula racemosa Hk. f.	W	Winter	Th	Mic	+	-
	75. Lactuca serriola L.	W	Spring	Th	Mic	+	-
	76. Myriactus wallichii Less.	W	Spring	Th	Mic	+	-
	77. Saussurea heteromalla (D.Don.) Hand-Mazz	W	Spring	Th	Mic	-	+
	78. Sonchus arvensis L.	W	Spring	Th	Mes	-	+
	79. Sonchus asper L.	W	Spring	Th	Mes	-	+
	80. Sonchus auriculata L.	W	Spring	Th	Mes	+	-

Table 1. Continued

S.No.	Families and Species	W/C	Flower Period	LF	LS	Smr.	Wnt.
	81.Tagetus minuta L.	W	Throughout year	Th	Mic	-	+
	82. Taraxacum officinale Weber.	W	Spring	Th	Mic	-	+
	83. Xanthium strumarium L.	W	Summer	Th	Mes	+	-
22	**Berberidaceae**						
	84. Berberis lycium Royle.	W	Summer	Np	Mic	+	+
23	**Bombacaceae**						
	85. Bombax ceiba Linn.	W/C	Winter	Mp	Mes	+	+
24	**Boraginaceae**						
	86. Lithospermum officinale L.	W	Summer	Th	Mic	+	-
	87. Trichodesma indica (L.) R.Br.	W	Summer	Th	Na	+	-
25	**Brasicaceae**						
	88. Arabidopsis wallichii (H.&T.) N. Busch.	W	Summer	Th	Mic	-	+
	89. Brassica compestris L.	C	Winter	Th	Mes	-	+
	90. Capsella bursa-pestoris Medic.	W	Summer	Th	Mic	-	+
	91. Coronopus didymus (L.) Sm.	W	Summer	Th	Lp	-	+
	92. Eruca sativa L.	W	Spring	Th	Mic	+	-
	93. Lepidium apetalum Willd.	W	Summer	Th	Na	+	-
	94. Nasturtium officinale R.Br.	W	Summer	Th	Mes	-	+
	95. Neslia apiculata Fisch., Mey. & Ave Lall.	W	Spring	Th	Mic	+	-
	96. Sisymbrium orientale L.	W	Summer	Th	Mic	+	-
	97. Thlaspi perfoliantum L.	W	Summer	Th	Mic	+	-
26	**Buddlejaceae**						
	98. Buddleja asiatica Lour.	W	Spring	Np	Mic	+	+
27	**Buxaceae**						
	99. Buxus wallichiana Baill.	W	Spring	Mp	Mic	+	+
	100.Sarcococa saligna (Dcne) Duel	W	Autumn	Np	Mic	+	+
28	**Cactaceae**						
	101. Opuntia dilleni Haw.	W	Spring	Np	LL	+	+
29	**Caesalpinaceae**						
	102. Bauhinia variegata L.	W/C	Spring	Mp	Mes	+	+
	103. Cassia fistula Linn.	W	Summer	Mp	Mes	+	+
30	**Canabanaceae**						
	104. Cannabis sativa L.	W	Summer	Th	Mic	+	-
31	**Caprifoliaceae**						
	105. Lonicera hypoleuca Dcne.	W	Summer	Np	Mic	+	+
	106. Lonicera quinquilacularis Hardw.	W	Summer	Mp	Mic	+	+
	107.Vibernum cotinifolium D. Don.	W	Spring	Mp	Mic	+	+
32	**Caryophyllaceae**						
	108. Arenaria serpyllifolia L.	W	Summer	Th	Lp	-	+
	109. Cerastium dichotomum L.	W	Spring	Th	Mic	-	+
	110. Cerastium fontanum Baumg.	W	Summer	Th	Mic	-	+
	111. Silene conoidea L.	W	Spring	Th	Na	-	+
	112. Silene vulgaris (Moench) Carcke	W	Summer	Th	Na	-	+
	113. Stellaria media (L.) Cyr.	W	Summer	Th	Lp	-	+
33	**Celastraceae**						
	114. Gymnosporia royleana Wall ex Lawson	W	Throughout year	Np	Mic	+	+
34	**Chenopodiaceae**						
	115. Chenopodium album L.	W	Spring	Th	Mic	-	+
	116. Chenopodium ambrosioides L.	W	Summer	Th	Mic	-	+
	117. Chenopodium murale L.	W	Summer	Th	Mic	-	+
35	**Convolvulaceae**						
	118. Convolvulus arvensis L.	W	Throughout year	L	Mic	-	+
	119. Convolvulus pluricaulis Choisy	W	Spring	Th	Mic	-	+

Table 1. Continued

S.No.	Families and Species	W/C	Flower Period	LF	LS	Smr.	Wnt.
36	**Crassulaceae**						
	120. Sedum ewersii Ledeb.	W	Summer	Th	Lp	-	+
37	**Cucurbitaceae**						
	121. Cucumis prophetarum L.	W	Summer	Th	Mic	+	-
	122. Luffa cylindrica (L.) Roem.	W	Summer	Th	Mac	+	-
	123. Melothria heterophylla Cogn.	W	Spring	Th	Mic	+	-
38	**Cuscutaceae**						
	124. Cuscuta reflexa Roxb.	W	Summer	P	LL	+	+
39	**Ebenaceae**						
	125. Diospyrus kaki L.	C	Summer	Mp	Mes	+	-
	126. Diospyrus lotus L.	W	Summer	Mp	Mic	+	-
40	**Ericaceae**						
	127. Rhododendron arborium Smith.	W	Spring	Np	Mes	+	+
41	**Euphorbiaceae**						
	128. Euphorbia cornigera Boiss.	W	Summer	Th	Na	+	+
	129. Euphorbia helioscopia L.	W	Summer	Th	Na	-	+
	130. Euphorbia hirta L.	W	Summer	Th	Na	-	+
	131. Euphorbia prostrata Ait.	W	Throughout year	Th	Lp	+	+
	132. Mallotus philippensis Muell.	W	Spring	Mp	Mic	+	+
	133. Phyllanthus maderaspatensis L.	W	Summer	Th	Na	+	-
	134. Riccinis communis L.	W	Throughout year	Np	Meg	+	+
42	**Fagaceae**						
	135. Quercus dilatata Lindley	W	Spring	Mp	Mic	+	+
	136. Quercus incana Roxb.	W	Spring	Mp	Mic	+	+
43	**Flacourtiaceae**						
	137. Flacourtia indica (Burm. f.) Merrill	W	Spring	Mp	Mic	+	+
44	**Fumariaceae**						
	138. Fumaria indica (Hsskn) H.N.	W	Summer	Th	Lp	-	+
45	**Gentianaceae**						
	139. Gentiana kurru Royle	W	Throughout year	Th	Lp	+	+
46	**Geraniaceae**						
	140. Geranium nepalensis Sweet	W	Summer	Th	Mic	+	+
	141. Geranium wallichianum D. Don. ex Sweet	W	Summer	Th	Mic	+	+
47	**Hamamelidaceae**						
	142. Parrotiopsis jacquemontiana Dcne.	W	Spring	Mp	Mic	+	-
48	**Hypericaceae/Guttiferae**						
	143. Hypericum perforatum L.	W	Summer	Th	Lp	+	-
49	**Lamiaceae**						
	144. Ajuga bracteosa Wall. Benth.	W	Summer	Th	Mic	+	+
	145. Ajuga parviflora Benth.	W	Summer	Th	Mic	+	+
	146. Colebrookea oppositifolia Sm.	W	Spring	Np	Mic	+	+
	147. Leucas urticifolia (Vahl) R.Br.	W	Summer	Th	Mic	+	-
	148. Mentha longifolia (L.) Huds	W	Summer	G	Mic	+	-
	149. Mentha spicata L.	W	Summer	G	Mic	+	-
	150. Micromeria biflora (Ham.) Bth.	W	Throughout year	Th	Mic	+	+
	151. Origanum vulgare L.	W	Summer	Ch	Mic	+	+
	152. Otostegia limbata Bth.	W	Spring	Np	Mic	+	+
	153. Plectranthus rugosus Wall.ex. Bth.	W	Spring	Th	Mic	+	+
	154. Salvia lanata Roxb.	W	Spring	Th	Mic	+	+
	155. Salvia moocruftiana Wall.	W	Summer	Th	Mes	+	-
	156. Thymus serphyllum L.	W	Spring	Th	Mic	+	-
50	**Lauraceae**						
	157. Litsea deccanensis Gamble	W	Summer	Mp	Mes	+	+

Table 1. Continued

S.No.	Families and Species	W/C	Flower Period	LF	LS	Smr.	Wnt.
51	**Linaceae**						
	158. Linum strictum L.	W	Summer	Th	Lp	-	+
52	**Loranthaceae**						
	159. Viscum album L.	W	Spring	M	Lp	+	+
	160. Korthalsella opuntia (Thunb.) Merrill	W	Summer	M	LL	+	+
53	**Lythraceae**						
	161.Woodfordia fruticosa (L.) Kurz	W	Spring	Np	Mes	+	+
54	**Malvaceae**						
	162. Malva neglecta Waller.	W	Summer	Th	Mic	+	-
	163. Malva parviflora L.	W	Summer	Th	Mic	+	-
	164. Malvastrum coromandelianum L.	W	Throughout year	Hc	Mic	+	+
	165. Sida cordata (Burm.f) Borss-Waalkes	W	Spring	Th	Mic	+	-
55	**Meliacea**						
	166. Cedrela serrata Royle.	W	Summer	Mp	Mes	+	+
	167. Melia azedarach L.	C	Spring	Mp	Mic	+	+
56	**Menispernaceae**						
	168. Tinospora cordifolia (DC.) Meirs	C	Summer	L	Mac	+	+
57	**Mimosaceae**						
	169. Acacia catechu (L.f.) Willd.	W	Summer	Mp	Lp	+	+
	170. Acacia modesta Wall.	W	Spring	Mp	Lp	+	+
	171. Acacia nilotica (L.) Delile.	W	Summer	Mp	Lp	+	+
	172. Albizia lebbeck (L.) Bth.	W/C	Spring	Mp	Lp	+	+
	173. Mimosa himalayana Gamble	W	Summer	Np	Lp	+	+
58	**Moraceae**						
	174. Broussonetia papyrifera (L.) L'Herit. ex Vent.	W	Summer	Mp	Mes	+	+
	175. Ficus carica L.	W/C	Spring	Mp	Mes	+	+
	176. Ficus palmata Forssk.	W	Summer	Mp	Mes	+	+
	177. Ficus racemosa L.	W	Spring	Mp	Mac	+	+
	178. Ficus religiosa L.	C	Spring	Mp	Mes	+	+
	179. Morus alba L.	W/C	Spring	Mp	Mes	+	+
	180. Morus indica L.	W/C	Spring	Mp	Mes	+	+
59	**Musaceae**						
	181. Musa sapientum L.	C	Throughout year	G	Meg	+	+
60	**Myrsinaceae**						
	182. Myrsine africana L.	W	Spring	Np	Na	+	+
61	**Nyctaginaceae**						
	183. Boerhaavia diffusa L.	W	Winter	Th	Na	+	+
	184. Boerhavia procumbens Banks ex Roxb.	W	Winter	Th	Na	+	+
	185. Mirabilis jalapa L.	W	Autumn	Th	Mes	+	-
62	**Onagraceae**						
	186. Epilobium brevifolium Don.	W	Summer	Th	Na	+	-
	187. Oenothera rosea Soland.	W	Summer	Th	Mic	+	-
63	**Oxalidaceae**						
	188. Oxalis corniculata L.	W	Winter	Th	Mic		+
64	**Papaveraceae**						
	189. Papaver rhoeas L.	W	Summer	Th	Mic	+	+
65	**Papilionaceae**						
	190. Butea frondosa Roxb.	W	Spring	Mp	Mes	+	+
	191. Crotalaria medicaginea Lam.	W	Summer	TH	Na	-	+
	192. Dalbergia sissoo Roxb.	C	Spring	Mp	Mic	+	+
	193. Indigofera heterantha L.	W	Summer	Np	Lp	+	+
	194. Lathyrus aphaca L.	W	Spring	Th	Na	-	+
	195. Lespedeza juncea (L.f) Persoon	W	Summer	Th	Mic		-

Table 1. Continued

S.No.	Families and Species	W/C	Flower Period	LF	LS	Smr.	Wnt.
	196. Medicago minima (Linn.) Grufb	W	Summer	Th	Na	-	+
	197. Medicago polymorpha L.	W	Spring	Th	Na	-	+
	198. Pueraria tuberosa (Roxb. ex Willd.) DC.	W	Spring	Th	Mic	+	-
	199. Trifolium repens L.	W	Winter	Th	Na	-	+
	200. Vicia saiva L.	W	Winter	Th	Na	-	+
66	**Plantaginaceae**						
	201. Plantago lanceolata L.	W	Summer	Hc	Mic	+	+
	202. Plantago major L.	W	Summer	G	Mes	+	+
67	**Platanaceae**						
	203. Platanus orientalis L.	W	Spring	Mp	Mac	+	+
68	**Polygalaceae**						
	204. Polygala abyssinica R. Br.ex Fresen.	W	Summer	Th	Na	+	-
69	**Polygonaceae**						
	205. Bistorta amplexicaulis (D.Don) Green	W	Winter	Th	Mes	-	+
	206. Polygonum barbatum L.	W	Summer	G	Mic	+	+
	207. Polygonum paronychioides C. A. Mey.ex Hohen	W	Winter	Th	Lp	-	+
	208. Polygonum plebejum R. Br.	W	Summer	Th	Mic	+	+
	209. Rumex dentatus L.	W	Spring	Th	Mes	+	-
	210. Rumex hastatus L.	W	Summer	Ch	Na	+	-
	211. Rumex vesicarius L.	W	Spring	Th	Na	+	-
70	**Portulacaceae**						
	212. Portulaca olearaceae L.	W	Throughout year	Th	Lp	+	-
71	**Primulaceae**						
	213. Anagallis arvensis L.	W	Spring	Th	Lp	-	+
	214. Androsace rotundifolia Hardw.	W	Spring	Th	Mic	+	-
	215. Primula denticulata Sm.	W	Spring	Th	Mic	+	-
72	**Punicaceae**						
	216. Punica granatum L.	C	Summer	Mp	Na	+	+
73	**Ranunculaceae**						
	217. Caltha alba Jacq ex Comb.	W	Summer	G	Mes	+	-
	218. Consolida ambigua (L.) Ball & Heywood	W	Spring	Th	Na	+	-
	219. Delphinium denudatum Wall. ex H, & T.	W/C	Spring	Th	Mic	+	-
	220. Ranunculus muricatus L.	W	Spring	Th	Mic	-	+
	221. Thalictrum foliolosum DC.	W	Spring	Th	Na	+	-
74	**Rhamnaceae**						
	222. Sageretia theezans (L.) Brongn.	W	Summer	Np	Lp	+	+
	223. Zizyphus jujuba Mill.	W/C	Summer	Mp	Mic	+	+
	224. Zizyphus nummularia Buem.f. Weight	W	Summer	Np	Lp	+	+
75	**Rosaceae**						
	225. Cotoneaster bacillaris Wall. ex Lindle.	W	Spring	Mp	Mes	+	+
	226. Duchesnea indica (Andr.) Focke	W	Summer	Th	Mic	+	-
	227. Fragaria indica Andrew	W	Summer	Hc	Mic	+	-
	228. Fragaria vesca Lindle.ex Hk. f.	W	Summer	Hc	Mic	+	-
	229. Potentilla anserina L.	W	Summer	Th	Mic	+	-
	230. Potentilla supina L.	W	Summer	Th	Mic	+	-
	231. Prunus cornuta (Wall ex Royle) Steud.	W	Spring	Mp	Mes	+	+
	232. Pyrus pashia Ham ex. D. Done	W	Spring	Mp	Mes	+	+
	233. Rosa moschata non J. Herrm.	W	Spring	Np	Mic	+	+
	234. Rubus ellipticus Smith	W	Spring	Np	Mic	+	+
	235. Rubus ulmifolius Schott.	W	Spring	Np	Mic	+	+
76	**Rubiaceae**						
	236. Gallium aparine L.	W	Summer	Th	Lp	+	+

Table 1. Continued

S.No.	Families and Species	W/C	Flower Period	LF	LS	Smr.	Wnt.
77	**Rutaceae**						
	237. Zanthoxylum aromatum D.C.	W	Spring	Np	Mes	+	+
78	**Salicaceae**						
	238. Populus euphratica Olivier	C	Spring	Mp	Mac	+	+
	239. Salix tetrasperma Roxb.	C	Summer	Mp	Mic	+	+
79	**Sapindaceae**						
	240. Dodonaea viscosa (L.) Jacq.	W	Spring	Np	Mic	+	+
80	**Saxifragaceae**						
	241. Bergenia ciliata (Haw) Sternb.	W	Spring	G	Mes	+	-
81	**Scrophulariaceae**						
	242. Antirrhinum orontium L.	W	Spring	Th	Lp	+	-
	243. Kickxia ramosissima (Wall) Janchen.	W	Spring	Th	Na	+	-
	244. Scrophularia scabiosifolia Bth.	W	Spring	Th	Na	+	-
	245. Verbascum thapsus L.	W	Spring	Th	Mes	+	+
	246. Veronica didyma Tenore	W	Spring	Th	Na	+	-
82	**Simarubaceae**						
	247. Ailanthus altissima (Mill) Swingle	W	Summer	Mp	Mic	+	+
83	**Solanaceae**						
	248. Datura innoxia Mill.	W	Summer	Np	Mes	+	+
	249. Solanum nigrum L.	W	Throughout year	Th	Mic	+	+
	250. Solanum surratense Burm.f.	W	Throughout year	Th	Mic	+	-
	251. Withania somnifera (L.) Dunal.	W	Throughout year	Ch	Mes	+	+
84	**Tiliaceae**						
	252. Grewia optiva Drum. ex. Burret.	W	Summer	Mp	Mic	+	+
85	**Ulmaceae**						
	253. Celtis australis L.	W	Spring	Mp	Mic	+	+
86	**Urticaceae**						
	254. Debregeasia salicifolia (D. Don) Rendle	W	Summer	Np	Mic	+	+
	255. Urtica dioca L.	W	Summer	Th	Mic	+	-
87	**Valerianaceae**						
	256. Valeriana jatamansii Jones.	W	Spring	G	Mic	+	-
88	**Verbenaceae**						
	257. Vitex negundo L.	W	Throughout year	Np	Mic	+	+
89	**Violaceae**						
	258. Viola serpens Wall.	W	Summer	Th	Mic	+	-
	259. Viola stocksii Boiss.	W	Spring	Th	Mic	+	-
90	**Zygophyllaceae**						
	260. Tribulus terrestris L.	W	Throughout year	Th	Na	+	-

Key: **W:** Wild, **C:** Cultivated, **Th:** Therophytes, **Mp:** Megaphanerophytes, **Np:** Nanophanerophytes, **Hc:** Hemicryptophytes, **G:** Geophytes, **Ch:** Chamaephytes, **L:** Lianas, **M:** Mistletoe, **P:** Parasite, **Mic:** Microphylls, **Lp:** Leptophylls, **Mes:** Mesophylls, **Na:** Nanophylls , **Mac:** Macrophylls , **Meg:** Megaphylls, **+:** Grows, **-:** Dormant.

Table 2. Life form and Leaf spectra (%) of the flora of Gadoon Hills District Swabi.

S.No.	Life form	%	Leaf size	%
1	Therophytes	49.62	Microphylls	47.69
2	Megaphanerophytes	17.31	Leptophylls	19.23
3	Nanophanerophytes	11.54	Mesophylls	15
4	Hemicryptophytes	7.31	Nanophylls	13.85
5	Geophytes	9.62	Macrophylls	1.92
6	Chamaephytes	1.92	Megaphylls	0.77
7	Lianas	1.54	Leafless	1.54
8	Mistletoe	0.77	-----	-----
9	Parasite	0.38	-----	-----

megaphanerophytes (45 spp., 17.31%). were the most abundant, followed by nanophanerophytes (30 spp., 11.54%), geophytes (25 spp., 9.62%), hemicryptophytes (19 spp., 7.31%), and chamaephytes (5 spp., 1.92%). Lianas and mistletoe were represented by 4 (1.54%) and 2 (0.77%) species, respectively (Fig. 2), while one species of parasite shared 0.38 % contribution (Table 2). Leaf spectra (Table 3) consisted of microphylls (47.69%), leptophylls (19.23%) mesophylls (15%), nanophylls (13.85%), macrophylls (1.92%), megaphylls (0.77%) and leafless (1.54%) (Fig. 2). The dominance of therophytes and phanerophytes is the characteristic life forms of many areas as reported by a number of studies (Costa *et al.*, 2007; Sher & Khan, 2007; Manhas *et al*., 2010). The dominance of therophytes and microphylls indicated that the investigated area was under heavy biotic pressure due to deforestation and over grazing. Our findings are in line with those of Durrani *et al.* (2010) and Sher & Khan (2007) who also recorded similar results in their areas. The life form is a vegetative form of plant body but it is a hereditary adjustment to environment (Cain & Castro, 1959). In the present attempt it was found that the grasses were dominant in xeric conditions while pteridophytes and other sciophytes were present below forest canopy and on moist conditions.

Taxing the vegetation of Gadoon Hills in many ways such as cutting and lopping of trees, extraction of fuel wood, clearing of forests for cultivation and grazing land, setting natural vegetation to fire and the increasing population have shaped the present landscape as the high reflection of the human needs and socioeconomic conditions. Agriculture stands on the top and livestock industry ranks second. Forests are gradually dwindling through illicit cutting and insufficient regeneration due to heavy grazing combined with soil degradation and increasing desiccation of the environment due to climatic shift. Many plant species are decreasing in the area. It would be the moral and ethical duty of the local people to protect the plant resources. Most of the medicinal plants are uprooted for burning purposes and some are left for the livestock to graze. There is thus urgent need for appropriate management of the grazing systems. Most of the fuel wood and timber wood are extracted from these forests. Even fruiting trees are grazed by animals and used as fuel wood. The forests in this area is a good refuge for valuable and endangered animals. Steps should be taken to use these more sustainably and

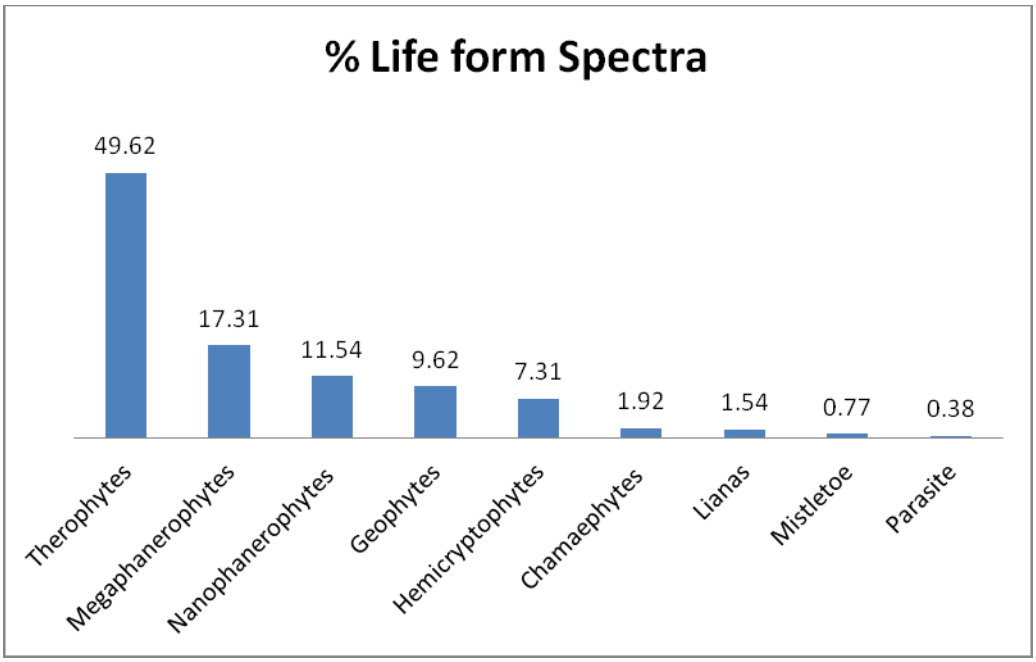

Fig. 2. Life form (%) of the flora of Gadoon Hills.

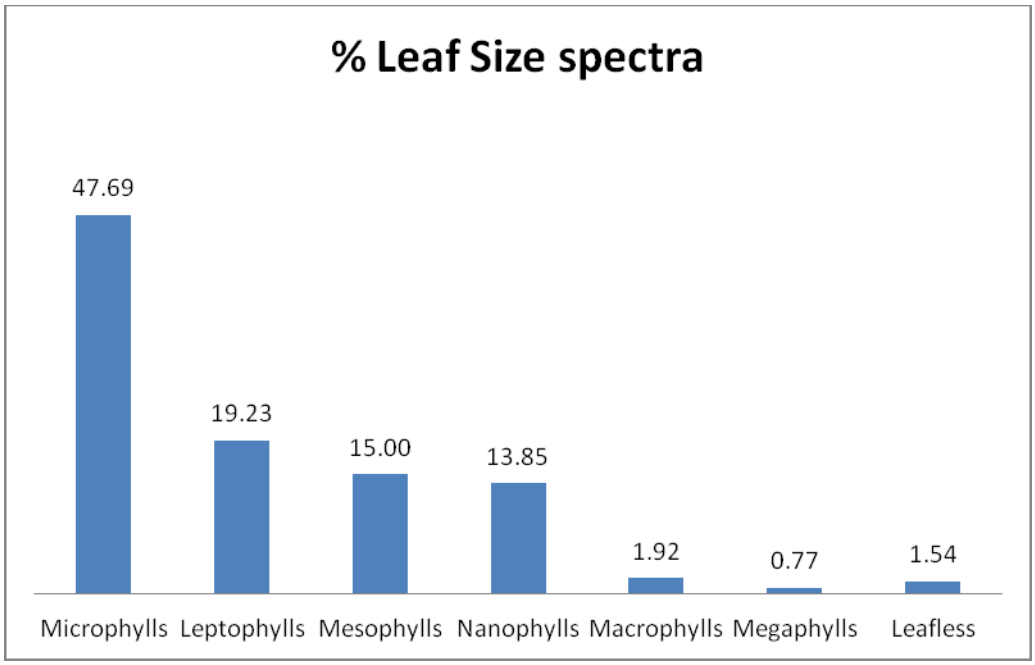

Fig. 3. Leaf size (%) of the flora of Gadoon Hills.

further studies carried out to quantify the data and suggest plans for the conservation of the area.

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