

Phyto-Sociological Studies in Chhumbi Surla Wildlife Sanctuary, Chakwal, Pakistan II. Phytoecology

A. ALEEM CHAUDHRY, MANSOOR HAMEED, RIAZ AHAMD AND ANWAR HUSSAIN
Punjab Wildlife Research Institute, Faisalabad-Pakistan

ABSTRACT

Phyto-ecological studies were conducted in the Chhumbi Surla Wildlife Sanctuary, Chakwal during August 1995. Plant species numbered 116 belonged to 35 families; Poaceae was the largest family with 41 grass species. Core area, the mountainous region with sand stones and patches of red sandy clay, comprised of five distinct plant communities, whereas two plant communities were recorded in the peripheral area. *Chrysopogon serrulatus* dominated all the plant communities, either inside the core area or in the periphery. Other major plant species were *Dactyloctenium scindicum*, *Cymbopogon jwarancusa*, *Sporobolus ioclados*, *Digitaria sanguinalis* and *Dichanthium foveolatum* among grasses; *Acacia modesta*, *Dodonaea viscosa* and *Justicia adhatoda* among trees/large shrubs, and *Lespedeza floribunda*, *Pupalia lappacea* and *Diclyptera bupleuroides* among under-shrubs/herbs. Data for relative density, frequency and cover for all the plant species were recorded to determine their importance value. Punjab urial (*Ovis vignei punjabiensis*) habitat was extremely rich with regard to the palatable grass and dicot species ensuring ample food supply but there is a need to improve the status of useful trees and large shrubs like *Olea ferruginea*, *Dodonaea viscosa*, *Maytenus royleanus* and *Ziziphus nummularia* with regard to shelter, nesting and food variety for many wildlife species, especially Punjab urial, francolins and other partridges. Illegal practices like grazing and human influence inside the wildlife sanctuary should be checked to save wildlife population from complete elimination.

Key Words: Wildlife; Phytoecology; Pakistan

INTRODUCTION

The Chhumbi Surla Wildlife Sanctuary, Chakwal is one of the last strongholds of the Punjab urial (*Ovis vignei punjabiensis*). Black and grey francolins (*Francolinus francolinus* and *Francolinus pondicerianus*, respectively) are the other important game species. The area is mountainous, rock base consisting predominantly of sand stone and patches of red sandy clay. The sanctuary is spread over an area of 138,840 acres including 15,000 acres of state forest. The core area consists of natural subtropical thorn scrub forests Surla and Bhukhshi Wala Reserved Forests. Ram Halawan and Dharam Terath Reserved Forests are other forest patches. The peripheral areas, the shamlat, are jointly owned by local inhabitants and used as grazing land. Their utilization is much beyond the grazing capacity levels, thus affecting the vegetation and wildlife in the area. Some important villages of the area are Bhaun, Khokar Bala, Dhariale Kahoon, Dulumial, Dhok Ban Amir Khatoon, Therpal, Bhalla, Kariala, Wariamal, Khokharzir and Khai. Vegetation of forest and peripheral areas is contrasting, as the grazing pressure is very high in peripheral areas. Forests are still rich in biodiversity of both plants and animals but the number of plant species in the periphery is considerably low as compared to forest species.

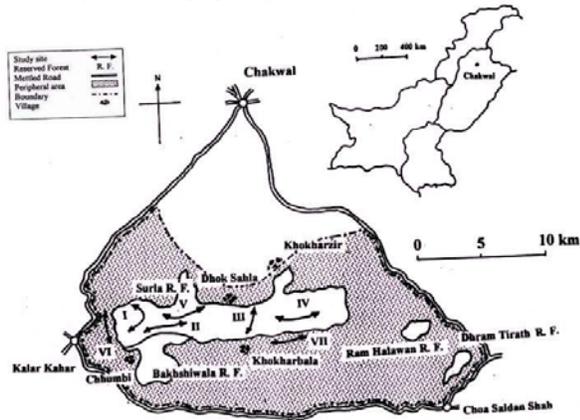
Peripheral area is highly undulating and cultivation is possible only in about 30% of the area. Kahoon valley on the southern side of the forest is most extensively cultivated. Some areas around Dhok Ban Amir Khatoon, Therpal, Bhalla, Kariala, Khokharzir and Khai are also under cultivation. Major crops of the area are wheat,

sorghum, maize, barley, millets, guara, peanut and some oil seeds like mustard and raya. The condition of forests and shamlat is quite contrasting with regard to vegetation status. Vegetation within the core area is very dense with greatly overlapping stratification. A variety of tree, shrub, herb and grass species can be seen in the core area; whereas, there are hardly any large trees in the peripheral area. The present studies were conducted with a view to conducting detailed survey of Punjab urial habitat and to promoting efforts in the protection of the habitat and population of the endangered wildlife of the area.

MATERIALS AND METHODS

An exploratory trip was conducted to survey the fauna and flora of the Chhumbi Surla Wildlife Sanctuary, Chakwal during August 1995 (Fig. 1). Vegetation was studied at five relatively homogenous sites within the core forest areas and at two sites in the peripheral area. For the nomenclature and identification of plant species Flora of Pakistan (Nasir & Ali, 1970-90) was followed. Seven sites were selected on the basis of slope, aspect, soil texture and habitat type for the study of vegetation type/ structure and the number of plant species. Ten quadrats, each of 25 m² for shrubs/trees and 10 each of 1 m² for undershrubs/herbs/ grasses, were laid at each study site along a transect line, separated by 20 m from each other. Each one m² quadrat was laid in the fixed corner of 25 m² quadrat. Data on density, frequency and cover were recorded following Hussain (1983) and used to compute relative density (RD) relative frequency (RF) and relative cover (RC).

Fig. 1. Map of Chhumbi Suria Wildlife Sanctuary showing sites of phyto-social studies



RESULTS AND DISCUSSION

During the survey of Chhumbi Suria Wildlife Sanctuary, 116 plant species were recorded belonging to 35 families. The largest family was Poaceae with 41 grass species, while other major families were Cyperaceae (10 species) and Papilionaceae (seven species). Many grasses predominantly occupied the area; dominant species were *Chrysopogon (C.) serrulatus*, *Dactyloctenium (D.) scindicum*, *Cymbopogon (Cy.) jwarancusa*, *Sporobolus (S.) ioclados*, *Digitaria (D.) sanguinalis* and *Dichanthium (Di.) foveolatum*. Dominant species among dicots were *Acacia (A.) modesta*, *Dodonaea (Do.) viscosa*, *Justicia (J.) adhatoda*, *Lespedeza (L.) floribunda* and *Diclyptera (Dic.) bupleuroides*. In the peripheral area, *Cynodon dactylon*, *Imperata cylindrica*, *Saccharum spontaneum* and *Cyperus niveus* were dominant species along with *C. serrulatus*.

Plant communities at western side of the sanctuary.

Three vegetation study sites were established on the western side of the sanctuary supporting three distinct plant communities. Site I was selected on the flat top hill region, having a slope up to 15° on western aspect. Soil sandy clayey with sand stones. Vegetation mainly grasses with few large shrubs, comprised of *C. serrulatus* community. Site II was chosen within the narrow valley with steep slopes up to 60° on northern aspect where vegetation community was *C. serrulatus-Do. viscosa*. Site V composed of *C. serrulatus-J. adhatoda* community and established within the broad valley, vegetation was the mixture of grasses and shrubs.

C. serrulatus, a grass species, dominated the western top hills (Site I), which was more or less flattened, where 43 plant species were recorded (Table I). Some other grasses like *Cy. jwarancusa*, *Di. foveolatum*, *D. sanguinalis*, *Hordeum murinum* and *S. ioclados* quite frequently recorded but their relative density and cover were much less than that of *C. serrulatus*. *A. modesta* was the solitary tree

species with relatively high cover. Herbaceous and shrubby species were very occasionally recorded, however, *Maytenus (M.) royleanus* and *Opuntia monacantha* were more frequent amount them.

Slopes at site II were the steepest (60°) forming narrow valleys where 37 plant species were noted (Table I). Major grass species was *C. serrulatus* covering about 50% of the total vegetation while the other dominant grasses were *Desmostachya bipinnata*, *S. ioclados*, *D. scindicum*, *Cynodon dactylon*, *Heteropogon contortus* and *Di. foveolatum*. *Do. viscosa* dominated the broad-leaved vegetation with high density and cover, whereas *A. modesta*, *Opuntia monacantha* and *L. floribunda* were the other frequently recorded species. Size and cover of larger species like *A. modesta* and *Prosopis glandulosa* was relatively reduced as compared to that recorded at site I.

Site V was selected in the broader valley on the eastern side of the wildlife sanctuary where soils were typically reddish sandy clay. Slopes at this study site were about 15° where plant diversity was the minimum and only 23 species were recorded. Twenty-three species were recorded at this site (Table I). Vegetation predominantly comprised of grasses like *C. serrulatus*, *Heteropogon contortus*, *Di. foveolatum*, *Cy. jwarancusa*, *S. ioclados*, *Cenchrus pennisetiformis*, *Ochthochloa compressa*, *Saccharum bengalense* and *Aristida mutabilis* and dicots like *J. adhatoda*, *L. floribunda* and *A. modesta*.

Plant communities at eastern side of the sanctuary.

Vegetation was studied at two distinct sites on the eastern side of the sanctuary. Site III composed of *C. serrulatus-S. ioclados* community with dominant grasses and small shrubs. *C. serrulatus-Cy. jwarancusa* community was noted at site IV, which was established within a narrow valley with 60° slope on northern aspect and 42 plant species were recorded.

Slopes were about 45% on the southwestern side where 34 plant species were collected (Table II). Vegetation mainly comprised of two grass species, *C. serrulatus* and *S. ioclados*, with some frequent excellent fodder grasses like *Di. foveolatum*, *D. scindicum* and *Cenchrus pennisetiformis* (Cope, 1982; Chaudhary, 1989). Relative density of *A. modesta* was the maximum but plants were very small and covered a small portion of land. *L. floribunda* frequently occurred with few plants of *Capparis decidua*. Herbaceous species were rarely recorded.

Site IV was quite similar to site II with regard to topography, but it was selected on the southern side of the sanctuary. Vegetation of site IV was also somewhat different and 42 plant species were noted (Table II). *C. serrulatus* possessed the maximum relative density, however, its frequency and cover is much lower than that recorded from other study sites. Other frequent grasses were *S. ioclados*, *Cenchrus pennisetiformis*, *D. scindicum*, *D. sanguinalis*, *Heteropogon contortus* and *Saccharum spontaneum*.

Plant communities at peripheral area of the sanctuary.

Two study sites were selected at the peripheral region of the sanctuary within 'shamlats'. Site VI was established on the western side, the soil was more or less flattened. Vegetation mainly comprised of a mixture of creeping and erect grasses with few shrubs. Site VII was selected on southern side of the sanctuary where soil was highly uneven. Vegetation predominantly consisted of grasses with few sedges and small shrubs.

Grazing pressure and human interference were enormous in the western periphery of the wildlife sanctuary

(site VI) where 33 species were recorded (Table III). Two grass species; *Cynodon dactylon* and *C. serrulatus* dominated the area with only a few other species like *Heterospogon contortus*, *D. scindicum* and *D. sanguinalis*. The only dominant dicot species was *A. modesta* having medium-sized plants. This habitat can be regarded as good pastureland as the most dominant species *Cynodon dactylon* is considered a first class fodder grass (Cope, 1982). High grazing pressure of livestock eliminated all the dicot species and most of the grasses from the area but *Cynodon dactylon* survived because it is a high yielding palatable species and

Table I. Vegetation studies on the western side of Chhumbi-Surla Wildlife Sanctuary

| Site number | Site I | | | Site II | | | Site V | | |
|-----------------------------------|-------------------------------|--------------------|----------------|--|--------------------|----------------|---|--------------------|----------------|
| | <i>Chrysopogon serrulatus</i> | | | <i>Chrysopogon serrulatus-Dodonaea viscosa</i> | | | <i>Chrysopogon serrulatus-Justicia adhatoda</i> | | |
| Plant community | Relative Density | Relative Frequency | Relative Cover | Relative Density | Relative Frequency | Relative Cover | Relative Density | Relative Frequency | Relative Cover |
| <i>Abutilon fruticosum</i> | 1.01 | 2.73 | 0.94 | | | | | | |
| <i>Acacia modesta</i> | 1.46 | 6.36 | 14.27 | 1.56 | 9.09 | 5.51 | 2.31 | 10.94 | 13.5 |
| <i>Acrachne racemosa</i> | | | | | | | 1.30 | 3.13 | 0.58 |
| <i>Aerva javanica</i> | 0.55 | 1.82 | 0.4 | | | | | | |
| <i>Aristida adscensionis</i> | 0.27 | 0.91 | 0.09 | 1.15 | 2.27 | 0.59 | 6.48 | 4.69 | 3.86 |
| <i>Bidens pilosa</i> | 0.37 | 1.82 | 0.18 | | | | | | |
| <i>Capparis decidua</i> | | | | 0.21 | 2.27 | 0.43 | 0.29 | 1.56 | 1.29 |
| <i>Astragalus psilocentros</i> | 0.18 | 1.82 | 0.27 | | | | | | |
| <i>Cenchrus pennisetiformis</i> | | | | 1.67 | 3.41 | 0.75 | 5.62 | 9.38 | 4.76 |
| <i>Chrysopogon serrulatus</i> | 21.32 | 7.27 | 33.3 | 27.29 | 6.82 | 28.97 | 11.24 | 9.38 | 10.42 |
| <i>Cymbopogon jwarancusa</i> | 3.75 | 6.36 | 1.66 | | | | 4.61 | 3.13 | 7.85 |
| <i>Cynodon dactylon</i> | 0.91 | 0.91 | 0.45 | 7.29 | 2.27 | 3.21 | | | |
| <i>Cynoglossum lanceolatum</i> | 0.82 | 2.73 | 0.36 | | | | | | |
| <i>Cyperus niveus</i> | 1.83 | 0.91 | 0.45 | 0.42 | 1.14 | 0.05 | | | |
| <i>Dactyloctenium aegyptium</i> | | | | 0.52 | 1.14 | 0.11 | 8.21 | 4.69 | 5.79 |
| <i>Dactyloctenium scindicum</i> | 4.21 | 2.73 | 0.94 | 9.48 | 3.41 | 7.54 | 6.48 | 6.25 | 2.83 |
| <i>Desmostachya bipinnata</i> | 2.38 | 1.82 | 1.84 | 3.96 | 4.55 | 3.21 | | | |
| <i>Dichanthium foveolatum</i> | 1.01 | 3.64 | 0.27 | 5.94 | 4.55 | 3.10 | 5.76 | 3.13 | 4.50 |
| <i>Diclyptera bupleuroides</i> | 16.1 | 0.91 | 6.28 | | | | | | |
| <i>Digitaria sanguinalis</i> | 9.15 | 7.27 | 8.08 | 0.63 | 2.27 | 0.27 | 4.18 | 3.13 | 2.57 |
| <i>Dodonaea viscosa</i> | | | | 10.83 | 5.68 | 17.32 | 0.86 | 1.56 | 1.93 |
| <i>Eragrostis pilosa</i> | 0.46 | 1.82 | 0.18 | | | | | | |
| <i>Heteropogon contortus</i> | 6.59 | 7.27 | 10.10 | 3.96 | 2.27 | 5.88 | 6.48 | 4.69 | 8.36 |
| <i>Hordeum murinum</i> | 3.75 | 6.36 | 1.53 | 0.94 | 2.27 | 0.21 | 1.59 | 3.13 | 1.86 |
| <i>Justicia adhatoda</i> | | | | | | | 7.20 | 4.69 | 9.65 |
| <i>Lantana indica</i> | | | | 0.31 | 2.27 | 0.27 | | | |
| <i>Lespedeza floribunda</i> | | | | | | | 9.37 | 6.25 | 3.09 |
| <i>Lespedeza juncea</i> | | | | 4.48 | 5.68 | 2.46 | | | |
| <i>Malvastrum coromandelianum</i> | 0.55 | 1.82 | 0.22 | | | | | | |
| <i>Maytenus royleanus</i> | 0.73 | 4.55 | 1.44 | | | | | | |
| <i>Olea ferruginea</i> | 0.37 | 1.82 | 0.90 | 3.13 | 2.27 | 1.60 | | | |
| <i>Opuntia monacantha</i> | 4.03 | 5.45 | 5.12 | 2.08 | 4.55 | 4.49 | | | |
| <i>Panicum atrosanguineum</i> | 0.09 | 0.91 | 0.72 | | | | | | |
| <i>Periploca aphylla</i> | 0.18 | 1.82 | 0.13 | | | | | | |
| <i>Prosopis glandulosa</i> | | | | 0.42 | 3.41 | 2.57 | | | |
| <i>Pupalia lappacea</i> | 10.34 | 3.64 | 5.83 | | | | | | |
| <i>Rhynchelytrum repens</i> | 1.37 | 0.91 | 0.90 | | | | 1.01 | 1.56 | 1.29 |
| <i>Saccharum bengalense</i> | | | | 0.31 | 2.27 | 0.75 | 3.75 | 6.25 | 7.07 |
| <i>Saccharum spontanium</i> | | | | 1.46 | 3.41 | 2.67 | | | |
| <i>Salicornia brachiata</i> | 0.09 | 0.91 | 0.45 | | | | 2.16 | 4.69 | 0.32 |
| <i>Sporobolus iochaos</i> | 3.39 | 4.55 | 1.62 | 10.21 | 6.82 | 7.06 | 10.66 | 4.69 | 8.36 |
| <i>Vernonia cinerascens</i> | 1.92 | 1.82 | 0.54 | | | | | | |

very resistant to grazing and trampling (White *et al.*, 1959).

Maximum diversity of the plant species was recorded at site VII, selected on the southern side of the main core area (Table III). Fifty-five species were noted at this site. Dominant grass species were *Imperata cylindrica*, *C. serrulatus*, *Cy. jwarancusa*, *D. scindicum*, *Cyperus niveus*, *Hordeum murinum*, *Heteropogon contortus* and *Saccharum spontaneum*. Not a single dicot species could be strictly regarded as the dominant species but small bushy plants of *A. modesta*, *Prosopis glandulosa* and *Ziziphus (Z.) nummularia* were recorded here and there.

There was a great variability in all the habitats studied with regard to soil texture and form, topography, species structure and composition, making the wildlife sanctuary greatly suitable for many mammal and bird species. Shrubs or trees like *A. modesta*, *J. adhatoda*, *Opuntia monacantha*, *M. royleanus*, *Olea (O.) ferruginea*, *Butea monosperma*, *Z. nummularia*, *Do. viscosa*, *Lantana indica* are useful for nesting and shelter. Grasses like *Acrachne racemosa*,

Aristida adscensionis, *Cenchrus pennisetiformis*, *Cenchrus setigerus*, *Cynodon dactylon*, *D. aegyptium*, *D. scindicum*, *Di. annulatum*, *Echinochloa colona*, *Echinochloa crus-galli*, *Enneapogon persicus*, *Eragrostis cilianensis*, *Eragrostis pilosa*, *Heteropogon contortus*, *Ochthochloa compressa*, *Panicum atrosanguineum*, *Panicum miliaceum*, *Tragus roxburghii* are considered fodder grasses (White *et al.*, 1959; Cope, 1982; Chaudhary, 1989). Tussocks of *Saccharum spontaneum* and *Saccharum bengalense* are useful for francolin nesting and fruits of many species like *Z. nummularia*, *O. ferruginea*, *Periploca aphylla*, *Corralocarpus epigeus*, *Plantago major*, *Solanum incanum* are edible.

C. serrulatus dominated all the vegetation study sites and its peripheral area among grasses with regard to importance value. Status of *Heteropogon contortus*, *S. ioclados*, *Saccharum spontaneum*, *Saccharum bengalense*, *D. sanguinalis*, *Di. foveolatum*, *Desmostachya bipinnata*, *D. scindicum*, *Cy. jwarancusa* and *Cynodon dactylon* was quite

Table II. Vegetation studies on the eastern side of Chhumbi-Surla Wildlife Sanctuary

| Site number | Site III | | | Site IV | | |
|---------------------------------|--|-----------|----------------|--|-----------|----------------|
| Plant community | <i>Chrysopogon serrulatus</i> – <i>Sporobolus ioclados</i> | | | <i>Chrysopogon serrulatus</i> – <i>Cymbopogon jwarancusa</i> | | |
| Plant species | Relative Density | Relative | | Relative Density | Relative | |
| | | Frequency | Relative Cover | | Frequency | Relative Cover |
| <i>Abutilon fruticosum</i> | 0.22 | 1.23 | 0.44 | | | |
| <i>Acacia modesta</i> | 2.52 | 9.88 | 22.12 | 0.98 | 10.00 | 8.35 |
| <i>Acrachne racemosa</i> | 0.22 | 1.23 | 0.06 | | | |
| <i>Aerva javanica</i> | | | | 0.55 | 1.25 | 1.04 |
| <i>Aristida adscensionis</i> | | | | 0.44 | 1.25 | 1.04 |
| <i>Capparis decidua</i> | 0.88 | 1.23 | 2.88 | | | |
| <i>Cenchrus pennisetiformis</i> | 7.22 | 7.41 | 4.65 | 1.20 | 2.50 | 2.09 |
| <i>Chrysopogon serrulatus</i> | 22.43 | 12.35 | 24.00 | 23.39 | 6.25 | 5.22 |
| <i>Cymbopogon jwarancusa</i> | 3.83 | 2.47 | 2.77 | 20.22 | 5.00 | 4.17 |
| <i>Cynanchum auriculatum</i> | 0.22 | 1.23 | 0.06 | | | |
| <i>Cynodon dactylon</i> | | | | 0.55 | 1.25 | 1.04 |
| <i>Cynoglossum lanceolatum</i> | | | | 0.44 | 1.25 | 1.04 |
| <i>Cyperus niveus</i> | | | | 1.64 | 2.50 | 2.09 |
| <i>Dactyloctenium aegyptium</i> | 3.28 | 2.47 | 1.11 | | | |
| <i>Dactyloctenium scindicum</i> | 5.69 | 3.70 | 3.32 | 8.74 | 3.75 | 3.13 |
| <i>Desmostachya bipinnata</i> | | | | 0.22 | 1.25 | 1.04 |
| <i>Dichanthium annulatum</i> | 4.70 | 6.17 | 2.88 | 0.44 | 1.25 | 1.04 |
| <i>Dichanthium foveolatum</i> | | | | 1.64 | 2.50 | 2.09 |
| <i>Digitaria sanguinalis</i> | 7.88 | 2.47 | 7.74 | 10.93 | 7.50 | 6.26 |
| <i>Dodonaea viscosa</i> | | | | 5.36 | 6.25 | 5.22 |
| <i>Heteropogon contortus</i> | 1.09 | 2.47 | 1.66 | 9.29 | 3.75 | 3.13 |
| <i>Hordeum murinum</i> | 1.75 | 3.70 | 0.72 | 0.22 | 1.25 | 1.04 |
| <i>Lantana indica</i> | | | | 2.30 | 5.00 | 4.17 |
| <i>Lespedeza floribunda</i> | | | | 0.44 | 1.25 | 1.04 |
| <i>Lespedeza juncea</i> | 14.00 | 7.41 | 5.86 | | | |
| <i>Maytenus royleanus</i> | 0.98 | 2.47 | 1.33 | 0.22 | 2.50 | 2.09 |
| <i>Olea ferruginea</i> | 0.11 | 1.23 | 0.55 | 0.33 | 1.25 | 1.04 |
| <i>Otostegia limbata</i> | | | | 0.22 | 2.50 | 2.09 |
| <i>Periploca aphylla</i> | 0.98 | 1.23 | 1.11 | | | |
| <i>Rhynchelytrum repens</i> | 1.75 | 4.94 | 0.83 | | | |
| <i>Saccharum bengalense</i> | | | | 1.09 | 1.25 | 1.04 |
| <i>Saccharum spontaneum</i> | 0.77 | 2.47 | 1.11 | 3.06 | 2.50 | 2.09 |
| <i>Salicornia brachiata</i> | 1.97 | 1.23 | 0.55 | | | |
| <i>Sporobolus ioclados</i> | 16.30 | 7.41 | 13.61 | 4.37 | 5.00 | 4.17 |

Table III. Vegetation studies on the periphery of Chhumbi-Surla Wildlife Sanctuary

| Site number | Site VI | | | Site VII | | |
|-----------------------------------|--|--------------------|----------------|---|--------------------|----------------|
| Plant community | <i>Cynodon dactylon – Chrysopogon serrulatus</i> | | | <i>Imperata cylindrica – Chrysopogon serrulatus</i> | | |
| Plant species | Relative Density | Relative Frequency | Relative Cover | Relative Density | Relative Frequency | Relative Cover |
| <i>Acacia hydasypica</i> | | | | 0.23 | 3.41 | 2.45 |
| <i>Acacia modesta</i> | 1.24 | 6.45 | 8.33 | 0.34 | 5.68 | 4.13 |
| <i>Aristida adscensionis</i> | 1.33 | 4.30 | 0.51 | 0.11 | 1.14 | 0.05 |
| <i>Cenchrus pennisetiformis</i> | | | | 1.60 | 4.55 | 1.02 |
| <i>Chrysopogon serrulatus</i> | 20.13 | 10.75 | 26.74 | 10.08 | 7.95 | 16.54 |
| <i>Cleome scaposa</i> | 0.99 | 4.30 | 0.26 | | | |
| <i>Cymbopogon jwarancusa</i> | 8.70 | 7.53 | 9.25 | 6.70 | 3.41 | 8.68 |
| <i>Cynodon dactylon</i> | 36.45 | 9.68 | 31.88 | 4.01 | 2.27 | 2.55 |
| <i>Cynoglossum lanceolatum</i> | 0.25 | 2.15 | 0.10 | 0.17 | 2.27 | 0.10 |
| <i>Cyperus niveus</i> | 2.82 | 4.30 | 0.41 | 4.24 | 7.95 | 1.53 |
| <i>Dactyloctenium scindicum</i> | 5.22 | 5.38 | 1.54 | 9.16 | 2.27 | 6.33 |
| <i>Desmostachya bipinnata</i> | | | | 7.04 | 6.82 | 7.66 |
| <i>Dichanthium annulatum</i> | 0.50 | 1.08 | 0.51 | 2.46 | 3.41 | 2.14 |
| <i>Dichanthium foveolatum</i> | 3.89 | 2.15 | 1.54 | 2.06 | 3.41 | 1.74 |
| <i>Diclyptera bupleuroides</i> | 0.66 | 2.15 | 0.21 | 5.73 | 1.14 | 1.53 |
| <i>Digitaria sanguinalis</i> | 3.81 | 4.30 | 3.70 | 0.74 | 1.14 | 0.51 |
| <i>Eragrostis pilosa</i> | 0.50 | 2.15 | 1.03 | | | |
| <i>Hemarthria compressa</i> | | | | 12.03 | 2.27 | 7.15 |
| <i>Heteropogon contortus</i> | 4.23 | 6.45 | 5.66 | 4.24 | 4.55 | 4.39 |
| <i>Hordeum murinum</i> | 0.41 | 2.15 | 0.21 | | | |
| <i>Imperata cylindrica</i> | | | | 18.33 | 2.27 | 17.36 |
| <i>Olea ferruginea</i> | 0.33 | 1.08 | 1.03 | | | |
| <i>Opuntia monacantha</i> | | | | 0.23 | 2.27 | 0.15 |
| <i>Oxalis corniculata</i> | | | | 0.57 | 1.14 | 0.20 |
| <i>Periploca aphylla</i> | 0.08 | 1.08 | 0.21 | 0.34 | 1.14 | 0.20 |
| <i>Pupalia lappacea</i> | 0.17 | 1.08 | 0.51 | | | |
| <i>Saccharum bengalense</i> | | | | 0.34 | 3.41 | 1.74 |
| <i>Saccharum spontanium</i> | | | | 3.04 | 4.55 | 3.78 |
| <i>Scirpus michelianus</i> | | | | 0.69 | 1.14 | 0.20 |
| <i>Sorghum halepense</i> | 0.33 | 1.08 | 0.51 | | | |
| <i>Sporobolus coromandelianus</i> | 3.31 | 2.15 | 2.06 | | | |
| <i>Sporobolus ioclados</i> | 2.65 | 5.38 | 1.03 | 1.66 | 3.41 | 0.71 |
| <i>Trianthema portulacastrum</i> | 0.75 | 2.15 | 0.15 | | | |
| <i>Trichodesma indicum</i> | | | | 0.80 | 1.14 | 0.41 |
| <i>Tribulus terrestris</i> | 0.17 | 1.08 | 0.10 | | | |
| <i>Typha domingensis</i> | | | | 0.57 | 1.14 | 0.51 |
| <i>Ziziphus nummularia</i> | | | | 0.52 | 3.41 | 4.70 |

reasonable in most of the study sites. *Imperata cylindrica* and *Cynodon dactylon* dominated single vegetation study site but in the periphery of the main core area.

A. modesta was the single species among shrubs / trees which was recorded in frequent numbers in all study sites. Useful species like *Do. viscosa*, *Capparis deciduas*, *Z. nummularia*, *J. adhatoda* and *M. royleanus* were frequent at very few areas; therefore, there is a need to improve their vegetation status. Among small shrub or herbs *L. floribunda*, *Pupalia (P.) lappacea*, *Opuntia monacantha* and *Dic. bupleuroides* were recorded as frequent.

CONCLUSION

Relative density and cover of grasses were comparatively less in western study sites than those in eastern side. *C. serrulatus* was the most dominant species at all the three study sites, however, *D. sanguinalis*, *Di. foveolatum*, *Cy. jwarancusa* and *D. scindicum* had patchy distribution. *Dic. bupleuroides* and *P. lappacea* were the dominant herbs, recorded only on the top hills. Large tussock forming grasses, *Saccharum bengalense* and *S. spontanium*, only recorded in the valleys, especially along water channels. *Do. viscosa* occupied the steep hills, more frequently where there was high soil erosion.

Eastern side of the sanctuary was also dominated by *C. serrulatus*, while other grasses like *Cenchrus pennisetiformis*, *Cy. jwarancusa*, *D. scindicum*, *D. sanguinalis*, *Heteropogon contortus* and *S. ioclados* were recorded at scattered places. Trees of *A. modesta* were much larger on eastern side, especially on moderate slopes, nonetheless, other broad-leaved species were rare on this side.

Peripheral region was greatly influenced by human activities and livestock grazing. Thus in the core area tall trees and many palatable grass species were completely eliminated. Species diversity was higher than that within the core area, probably because of more diverse habitat type and partly because of the invasion of weedy species from agricultural lands.

C. serrulatus completely dominated all the sites in the study area within the core area as well as in the periphery. Habitat of Punjab urial is extremely rich in many palatable grass species and some valuable dicots. In spite of such an excellent habitat, urial population constantly remained endangered due to hunting and habitat destruction by wood/forage cutting. Illegal grazing is also one of the major causes of habitat disturbance; hence, indirectly affecting the urial population. One of the major drawbacks for urial is the drought season when water availability is restricted to few areas and this situation provides a great advantage to the

hunters to shoot down thirsty animals around these water points. Another drastic damage to the urial population is the capturing of new born fawns by the local people, particularly by the herdsmen, who often sell them to the people fond of keeping urial as pets, a status symbol in the society. There is a crying need for the protection of urial population and its habitat to minimize the losses, which this valuable and endangered species is facing and ultimately helping in the increase in its population to a considerably.

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