

IMPACT OF FENCING ON VEGETATION STRUCTURE IN LEHRI AND JINDI SUB-MOUNTAINOUS OPEN SCRUB FOREST

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ABSTRACT

Lehri and Jindi Reserve Forest is about 6 km from Dina on a way to Rawalpindi. Total area of these two forests is about 80 sq km. Their habitat is suitable for many important wildlife species including game birds and mammals. Vegetation assessment survey was conducted in October 2007 to explore the present state of biodiversity at Lehri & Jindi forest area. Vegetation cover is about 60 %. Trees and large shrubs contributes only 20-30 % of the cover. Plant diversity is astonishingly high; over 140 species were recorded during a single season survey belonging to 46 families. There was a significant difference in vegetation structure between fenced and non-fenced areas in the forest.

Keywords: Rawalpindi, Vegetation, wildlife species, Trees, large shrubs

INTRODUCTION

Lehri and Jindi Reserved Forest is about 6 km from Dina on a way to Rawalpindi between 73°27' and 73°38' longitude and 33°00' and 33°13' latitude (Fig. 1). Total area of these two forests is about 80 sq km (Muzaffar, 1997). The vegetation is typically subtropical dry evergreen open scrub, comprising mainly of few shrubs and many annual and perennial grasses. Average annual rainfall is 85 cm. A single main ridge is situated along northwest side of the area with almost all the drainage towards southwest. Main nullahs of Lehri Forest are Pangali Kas, Panyala Kas, and those of Jindi Forest are Darwazawala Kas and Chakwala Kas with many small branches. Most of the water runs off quickly to river Jhelum; allow only a small quantity of it absorbed locally because of scarce grass cover. Therefore, there is a general shortage of water available to mammals and other wildlife species.

The habitat is suitable for many important wildlife species, including potential game species like Punjab urial (*Ovis vigne punjabiensis*), gular (*Panthera pardus*), wolf (*Canus lupius*), hare (*Lepus nigricollis*), black francilin (*Francolinus francolinus*), grey francilin (*Francolinus pondicerianus*), seese (*Amoperdix griseogularis*) and chakor (*Alectoris graeca*). Vegetation is a typical subtropical open scrub type but highly depleted. Provided the present level of human interference continues this will no more be able to sustain in the long term future.

Among the game animals ungulates are the most important, which are facing habitat degradation due to increasing population pressure as well as extremely high illegal hunting and poaching. As a result many valuable species of ungulates like swamp deer, Punjab urial and black are very near to be extinct from their natural habitats (Azam *et al.*, 2008).

Many wildlife species are excellent indicators of forest health and structure (Carey 2000; Steele and Koprowski 2001) due to their dependence on forests for food, nesting sites and shelter (Gurnell 1987; Steele and Koprowski 2001). The presence, demographics, and habitat use of wildlife species can indicate the status of forested ecosystems (Koprowski, 2005).

Wildlife habitat at Lehri / Jindi Reserved Forests has been continuously degrading with the time, mainly due to high population pressure and livestock interference. At the present stage, many plant species are also on a verge of extinction, and this will certainly effect the population of dependent wildlife of the area (Awan, 2004). Serious and immediate steps are, therefore, required to save the remaining biodiversity unless it is too late to recover the native flora. For this purpose the area was thoroughly surveyed for habitat ecology and plant species diversity in relation to the native wildlife.

MATERIALS AND METHODS

Vegetation assessment survey was conducted in October 2005 to explore the present state of biodiversity at Lehri / Jindi Reserved Forest area. Vegetation of the area was sampled by quadrats laid along a transect line in three distinct habitat types viz. Foothill region, Mid region and Top hill region. Each transect was separated from the previous one by 20 km (Fig. 1). Along each transect line 10 quadrats, 5x5 m each were taken perpendicular to the

transact line, with a 5 m distance in between two consecutive quadrats. Frequency, density and per cent cover of all the species were recorded and their importance value was calculated in accordance with Hussain (1983).

Plant species were collected for identification and herbarium record. Plant communities were studied in all habitat types keeping in view their economic importance for the native wildlife.

RESULTS AND DISCUSSION

Plant diversity is astonishingly high; over 140 species were recorded during a single season survey. Year round surveys to cover seasonal variation are likely to add many more species to the checklist (Table 1).

Acacia modesta (Phulai) is the most dominant surpassing all other species found in the region. Other likely trees almost been eliminated from the area, though, *Butea monosperma* (Dhak) and *Ficus palmata* (Phagwara) are found at few scattered places. *Ficus palmata* was seen seldom to attain the tree habit. Many exotic tree species have been introduced near the fishponds and nursery areas, such as *Bombax ceiba* (Simbal), *Bauhinia variegata* (Kachnar), *Dalbergia sissoo* (Sheesham), *Callistemon viminalis* (Bottlebrush), *Eucalyptus camaldulensis* (Safeda) and few others.

Among shrubs the most dominant species is *Dodonaea viscosa* (Sanatha) followed by *Ziziphus nummularia* (Mallah). Some noxious weedy species like *Lantana camara* and *Prosopis glandulosa* (Mesquite) are the invading species, slowly overtaking habitat, particularly at the lower altitudes replacing the native flora. *Otostegia limbata* (Chitti bui), *Lantana indica*, *Justicia adhatoda* (Bhaikar), *Periploca aphylla* (Bata), *Capparis decidua* (Karir), *Calotropis procera* (Aak), *Acacia hydasppica* and *Carissa opaca* (Granda) are some other dominant shrubs. *Nerium oleander* (Kaner) occurs only along water channels.

Pupalia lappacea and *Dicliptera bupleuroides* are the most common herbaceous species, found throughout the forest area. *Tribulus terrestris* (Bhakra), *Solanum incanum*, *Sida cordata*, *Evolvulus alsinoides*, *Polygala eriopetala* and *Aerva javanica* (Bui) also are quite frequent species.

Tall tussock forming grasses are abundant in the forest area. Dominant species are *Heteropogon contortus* (Suriala), *Chrysopogon serrulatus*, *Cymbopogon jwarancusa* (Khavi), *Aristida adscensionis*, *Digitaria sanguinalis*, *Chloris dolychostachya*, *Eragrostis tenella*, *Sporobolus diander*, *Setaria pumila* and *Dichanthium annulatum* (Palwan). *Cynodon dactylon* dominate over the valleys, while *Dactyloctenium scindicum* restricted to hilltops.

Vegetation along water channels is specific. It includes species like *Launaea nudicaulis*, *Phyla nodiflora*, *Nerium oleander* (Kachnar), *Paspalidium flavidum*, *Cynodon dactylon* (Khabbal), *Fimbristylis bisumbellata*, *Saccharum spontaneum* (Kahi), *Euphorbia hirta* *Setaria pumila* and *Oxalis corniculata* (Khatkal).

Vegetation around fishponds comprised of *Typha domengensis* (Dab), *Ipomoea carnea*, *Fimbristylis bisumbellata* and *Phragmites karka* (Nari) that dominate more or less the aquatic habitat. *Saccharum spontaneum* (Kai), *Cynodon dactylon* (Khabbal) and *Xanthium strumarium* are dominant on the banks. In addition to native species, a number of ornamentals are planted in the vicinity of fishponds, as well as the nursery area. Nursery probably has been the cause of introducing some agricultural weeds like *Conyza ambigua*, *Cyperus rotundus*, *Euphorbia granulata*, *Echinochloa colona*, etc.

At Site 1 (inside the Wildlife Enclosure 1), *Acacia modesta* was the only tree species that dominated foothill region, mid region and top hills (Fig. 2.a). Among grasses, *Cymbopogon jwarancusa* singly dominated the foothills, however, at mid region it was equally dominated by *Chrysopogon serrulatus*. Importance value of *Chrysopogon serrulatus*, however, greatly reduced at the top hills, but *Cymbopogon jwarancusa* was again the most dominant species.

Site 2 (outside the Wildlife Enclosure 1) was dominated by *Acacia modesta*, the only tree species recorded at the site (Fig. 2.b.). However, its dominance increased with the altitude, as its importance value considerably increased at top hills. *Chrysopogon serrulatus* was the most dominant grass at this site and again its importance value increased with increasing height. Other grasses like *Cynodon dactylon* and *Heteropogon contortus* shared the habitat at this site but only at foothill region.

Importance value of *Acacia modesta* was the maximum at mid region at Site 3 (around Darat Forest area), whereas its dominance was much reduced at foothills (Fig. 2.c.). Among grasses *Chrysopogon serrulatus* was the most dominant species, especially at mid region and top hills. *Dactyloctenium scindicum* showed maximum importance value at top hill but much reduced at foot hill region among other grasses, *Aristida mutabilis* and *Heteropogon contortus* shared this habitat equally but only at foothill region.

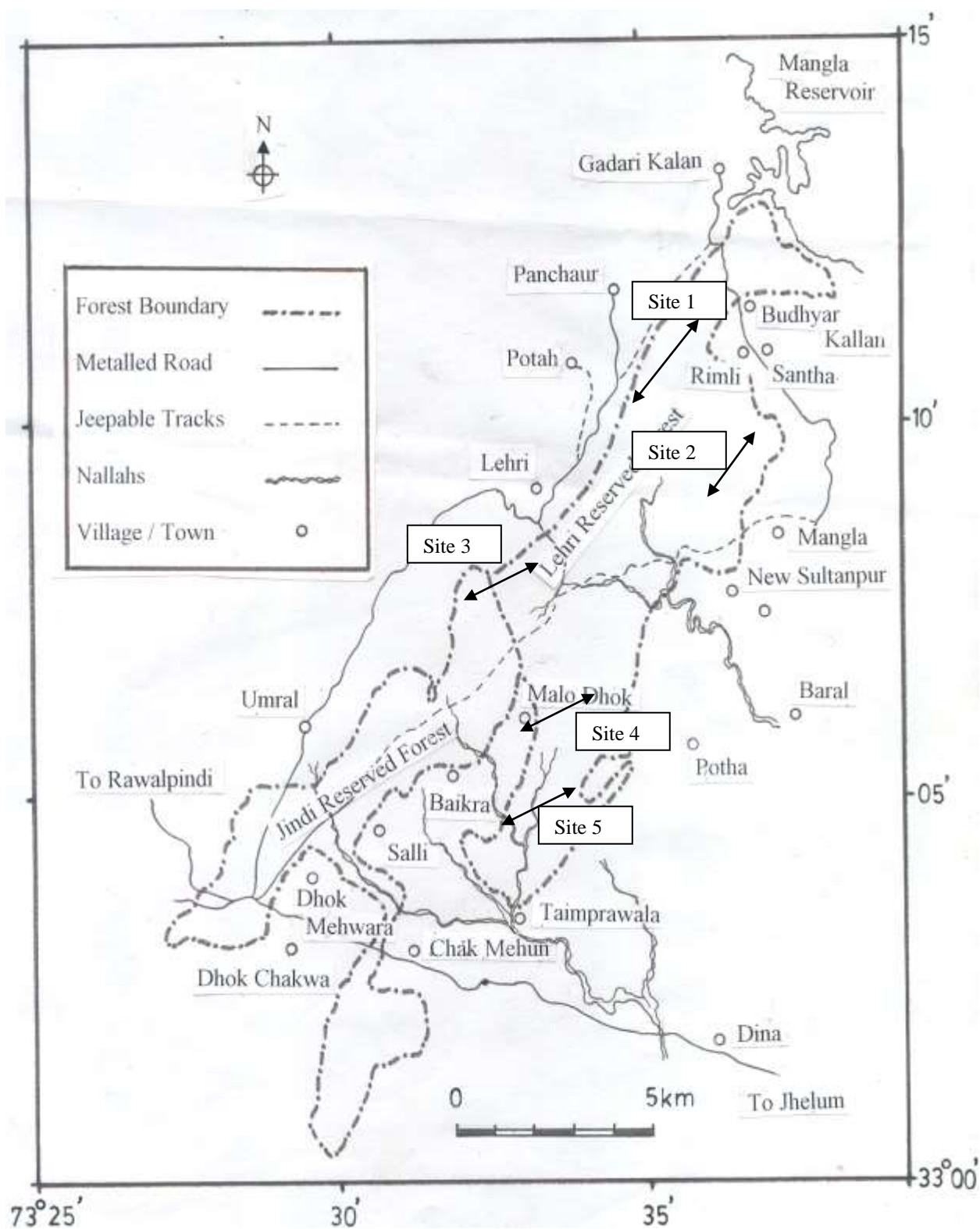


Fig. 1. Map of Lehri and Jindi forest showing vegetation collection ()



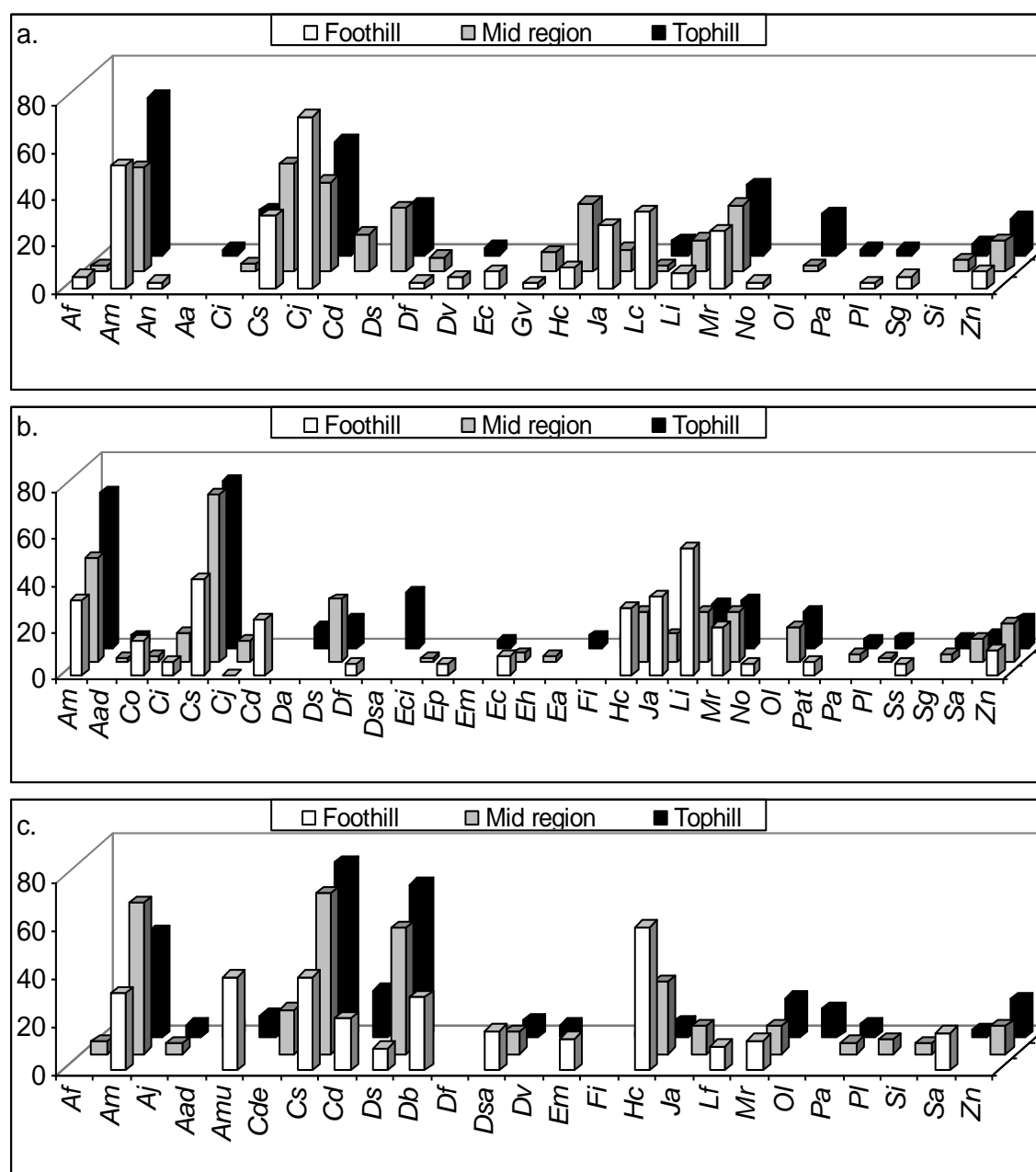


Fig. 2. Importance value of some dominant plant species recorded at (a) Site 1-inside the Wildlife Enclosure 1, (b) Site 2-outside the Wildlife Enclosure 1, and (c) Site 3-around Darat Forest Area (Af = *Abutilon fruticosum*, Am = *Acacia modesta*, An = *Acacia nilotica*, Aa = *Achyranthes aspera*, Aj = *Aerva javanica*, Aad = *Aristida adscensionis*, Amu = *Aristida mutabilis*, Cde = *Capparis decidua*, Co = *Carissa opaca*, Ci = *Chloris incomplete*, Cs = *Chrysopogon serrulatus*, Cj = *Cymbopogon jwarancusa*, Cd = *Cynodon dactylon*, Da = *Dactyloctenium aegyptium*, Ds = *Dactyloctenium scindicum*, Db = *Desmostachya bipinnata*, Df = *Dichanthium foveolatum*, Dsa = *Digitaria sanguinalis*, Dv = *Dodonaea viscosa*, Em = *Eragrostis minor*, Ep = *Eragrostis pilosa*, Ec = *Eriophorum comosum*, Eh = *Euphorbia hirta*, Ea = *Evolvulus alsinoides*, Fi = *Fagonia indica*, Gv = *Grewia villosa*, Hc = *Heteropogon contortus*, Ja = *Justicia adhatoda*, Lc = *Lantana camara*, Li = *Lantana indica*, Lf = *Lespedeza floribunda*, Mr = *Maytenus royleanus*, No = *Nerium oleander*, Ol = *Ostostegia limbata*, Pat = *Panicum atrosanguinum*, Pa = *Periploca aphylla*, Pl = *Pupalia lappacea*, Sg = *Saccharum griffithii*, Ss = *Saccharum spontaneum*, Si = *Solanum incanum*, Sa = *Sporobolus arabicus*, Zn = *Ziziphus nummularia*)

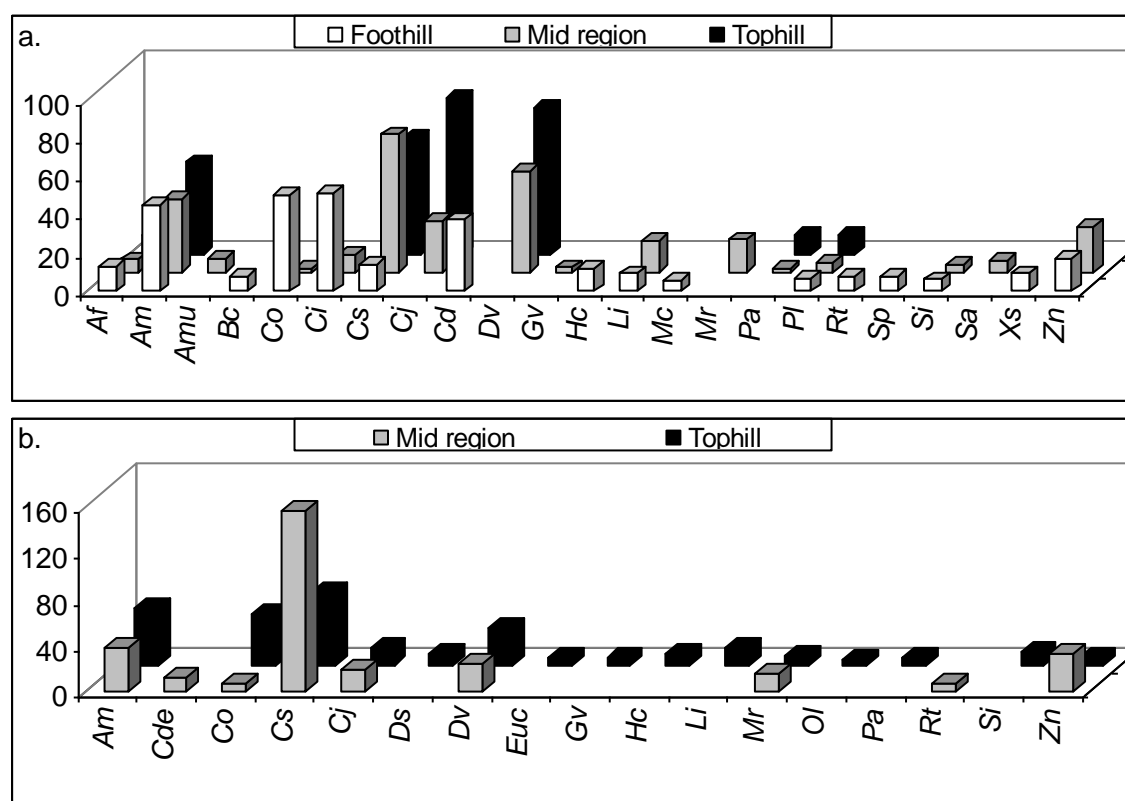


Fig. 3. Importance value of some dominant plant species recorded at (a) Site 4-inside the Wildlife Enclosure 2, and (b) Site 5-outside the Wildlife Enclosure 2 (Af = *Abutilon fruticosum*, Am = *Acacia modesta*, Amu = *Aristida mutabilis*, Bc = *Barleria cristata*, Cde = *Capparis decidua*, Co = *Carissa opaca*, Ci = *Chloris incomplete*, Cs = *Chrysopogon serrulatus*, Cj = *Cymbopogon jwarancusa*, Cd = *Cynodon dactylon*, Ds = *Dactyloctenium scindicum*, Dv = *Dodonaea viscosa*, Gv = *Grewia villosa*, Hc = *Heteropogon contortus*, Li = *Lantana indica*, Mc = *Malvastrum coromandelianum*, Mr = *Maytenus royleanus*, Ol = *Otostegia limbata*, Pa = *Periploca aphylla*, Pl = *Pupalia lappacea*, Rt = *Rhamnus triquetra*, Sp = *Setaria pumila*, Si = *Solanum incanum*, Sa = *Sporobolus arabicus*, Xs = *Xanthium strumarium*, Zn = *Ziziphus nummularia*)

Table 1. Checklist of plant species recorded at Lheri and Jindi forests.

Family	#	Plant species
Acanthaceae	3	<i>Barleria cristata</i> , <i>Dicliptera bupleuroides</i> , <i>Justicia adhatoda</i>
Agavaceae	2	<i>Agave cantula</i> , <i>Sansevieria trifasciata</i>
Aizoaceae	1	<i>Trianthema portulacastrum</i>
Amaranthaceae	4	<i>Achyranthes aspera</i> , <i>Aerva javanica</i> , <i>Digera muricata</i> , <i>Pupalia lappacea</i>
Apocynaceae	2	<i>Carissa opaca</i> , <i>Nerium oleander</i>
Araliaceae	1	<i>Hedera nepalensis</i>
Asclepiadaceae	5	<i>Calotropis procera</i> , <i>Ceropegia bulbosa</i> , <i>Cynanchum auriculatum</i> , <i>Pergularia daemia</i> , <i>Periploca aphylla</i>
Bombacaceae	1	<i>Bombax ceiba</i>
Boraginaceae	3	<i>Cynoglossum lanceolatum</i> , <i>Heliotropium strigosum</i> , <i>Trichodesma indicum</i>
Caesalpiniaceae	3	<i>Bauhinia variegata</i> , <i>Cassia occidentalis</i> , <i>Parkensonia aculeata</i>
Capparidaceae	3	<i>Capparis deciduas</i> , <i>Capparis spinosa</i> , <i>Cleome scaposa</i>
Casurinaceae	1	<i>Casurina equisetifolia</i>
Celastraceae	1	<i>Maytenus royleanus</i>
Compositae	7	<i>Artemisia scoparia</i> , <i>Centaurea iberica</i> , <i>Conyza ambigua</i> , <i>Eclipta alba</i> , <i>Launaea procumbens</i> , <i>Vernonia cineria</i> , <i>Xanthium strumarium</i>

Convolvulaceae	4	<i>Convolvulus glomeratus</i> , <i>Evolvulus alsinoides</i> , <i>Ipomoea carnea</i> , <i>Merremia dissecta</i>
Cucurbitaceae	2	<i>Momordica dioica</i> , <i>Mukia maderaspatana</i>
Cupressaceae	1	<i>Thuja orientalis</i>
Cyperaceae	4	<i>Cyperus niveus</i> , <i>Cyperus rotundus</i> , <i>Eriophorum comosum</i> , <i>Fimbristylis bisumbellata</i>
Equisetaceae	1	<i>Equisetum debile</i>
Euphorbiaceae	4	<i>Euphorbia clarkeana</i> , <i>Euphorbia granulata</i> , <i>Euphorbia hirta</i> , <i>Euphorbia serpens</i>
Labiatae	4	<i>Leucas cephalotes</i> , <i>Leucas nutans</i> , <i>Otostegia limbata</i> , <i>Salvia aegyptiaca</i>
Liliaceae	1	<i>Asparagus adscendens</i>
Lythraceae	2	<i>Lagerstroemia indica</i> , <i>Woodfordia fruticosa</i>
Malvaceae	4	<i>Abutilon fruticosum</i> , <i>Hibiscus caesius</i> , <i>Malvastrum coromandelianum</i> , <i>Sida cordata</i>
Menispermaceae	1	<i>Tinospora malabarica</i>
Mimosaceae	4	<i>Acacia hydasypica</i> , <i>Acacia modesta</i> , <i>Leuceana leucocephala</i> , <i>Prosopis glandulosa</i>
Moraceae	2	<i>Broussonetia papyrifera</i> , <i>Ficus palmata</i>
Myrtaceae	1	<i>Callistemon viminalis</i> , <i>Eucalyptus camaldulensis</i>
Nyctaginaceae	1	<i>Boerhavia procumbens</i>
Oleaceae	3	<i>Jasminum grandiflorum</i> , <i>Jasminum humile</i> , <i>Jasminum sambac</i>
Oxalidaceae	1	<i>Oxalis corniculata</i>
Papilionaceae	7	<i>Astragalus psilocentros</i> , <i>Butea monosperma</i> , <i>Dalbergia sissoo</i> , <i>Indigofera cordifolia</i> , <i>Lespedeza floribunda</i> , <i>Rhynchosia minima</i> , <i>Tephrosia strigosa</i>

Table 1 cont.

Pinaceae	1	<i>Pinus roxburghii</i>
Poaceae	40	<i>Aristida adscensionis</i> , <i>Aristida cyanantha</i> , <i>Aristida mutabilis</i> , <i>Arthraxon lancifolius</i> , <i>Bothriochloa ischaemum</i> , <i>Brachiaria ramosa</i> , <i>Brachiaria reptans</i> , <i>Cenchrus pennisetiformis</i> , <i>Cenchrus setigerus</i> , <i>Chloris dolichostachya</i> , <i>Chrysopogon serrulatus</i> , <i>Cymbopogon jwarancusa</i> , <i>Cynodon dactylon</i> , <i>Dactyloctenium aegyptium</i> , <i>Dactyloctenium scindicum</i> , <i>Desmostachya bipinnata</i> , <i>Dichanthium annulatum</i> , <i>Dichanthium foveolatum</i> , <i>Digitaria ciliaris</i> , <i>Digitaria sanguinalis</i> , <i>Echinochloa colona</i> , <i>Eleusine indica</i> , <i>Eragrostis ciliaris</i> , <i>Eragrostis minor</i> , <i>Eragrostis pilosa</i> , <i>Eragrostis tenella</i> , <i>Eulaliopsis binata</i> , <i>Heteropogon contortus</i> , <i>Hordeum murianum</i> , <i>Leptochloa panicea</i> , <i>Melanocenchris abyssinica</i> , <i>Ochthochloa compressa</i> , <i>Panicum atrosanguinum</i> , <i>Paspalidium flavidum</i> , <i>Phragmites karka</i> , <i>Saccharum griffithii</i> , <i>Saccharum spontaneum</i> , <i>Setaria pumila</i> , <i>Sporobolus arabicus</i> , <i>Tragus roxburghii</i>
Polygalaceae	2	<i>Polygala arvensis</i> , <i>Polygala erioptera</i>
Polypodiaceae	1	<i>Adiantum pedatum</i>
Rhamnaceae	2	<i>Rhamnus triquetra</i> , <i>Ziziphus nummularia</i>
Rutaceae	1	<i>Murraya paniculata</i>
Sapindaceae	2	<i>Cardiospermum halicacabum</i> , <i>Dodonaea viscosa</i>
Solanaceae	2	<i>Solanum incanum</i> , <i>Solanum surratense</i>
Tamaricaceae	1	<i>Tamarix aphylla</i>
Tiliaceae	1	<i>Grewia villosa</i>
Typhaceae	1	<i>Typha domingensis</i>
Verbenaceae	2	<i>Lantana camara</i> , <i>Phyla nodiflora</i>
Zygophyllaceae	2	<i>Fagonia indica</i> , <i>Tribulus terrestris</i>

#: Number of species recorded in each family

Acacia modesta was the only tree species frequently recorded at site 4 (inside the wildlife enclosure 2) as presented in Fig. 3.b. However, its dominance increased with increase in height as showed by its higher importance value at top hill region. Among shrubs *Carissa opaca* shared the habitat at foot hill region along with *Dodonaea viscosa* which is dominated at top hill region as its importance value increased with increase in height. This site was equally shared by grasses in which *Chloris incompleta* and *Cynodon dactylon* was dominated at foothill region

whereas the dominance of *Chrysopogon serrulatus* and *Cymbopogon jwarencusa* was increased with increase in height and maximum at top hill region.

At site 5 (outside the wildlife enclosure 2), there was very less vegetation at foothill region and increased abundance of species was recorded with increase in altitude (Fig. 3.a). *Accacia modesta* was the only tree species dominated this site, and its importance value was the maximum at top hill region. Among grasses *Chrysopogon serrulatus* was the dominant at mid region which was reduced with increase in altitude.

Quality of a wildlife habitat may influence the distribution and density of various wildlife species (Azam *et al.*, 2008). Wood cutting as was practiced in the unfenced areas outside the wildlife enclosures has a direct impact on habitat, and this will degrade habitat by edge effects, and ultimately decrease activity of many wildlife species, and potentially increase vulnerability to predation (Wolff 1975; Anderson and Boutin 2002).

In general habitat quality in relation to species diversity was much better in undisturbed and protected area (e.g. inside the fenced wildlife enclosures and Darat Forest area) than in the disturbed area (e.g. outside the wildlife enclosures) where human and livestock activities were constantly degrading the habitat. These findings are in accordance with that of Corbalán *et al.* (2006) who found higher quality habitat in the protected area than in the grazed area for small mammals.

Wildlife habitat at Lehri / Jindi Reserved Forests has been continuously degrading with the time, mainly due to high population pressure and livestock interference. Since many wildlife species rely on forests that produce quantities of food, shaded microclimates and nest cavities (Gurnell 1987; Steele and Koprowski 2001). At the present, many plant species are on a verge of extinction. Serious and immediate steps are required to save the remaining biodiversity unless it is too late to recover the native flora.

There is a need to improve the vegetation cover, especially those of tall vegetation. Artificial planting of native species like *Butea monosperma*, *Ficus palmata* and *Carissa opaca* will certainly improve the habitat condition, as these species have good potential to provide food and fodder to many wildlife species.

Species like *Olea ferruginea*, *Phyllanthus emblica*, *Punica granatum*, *Dalbergia sissoo* and *Pyrus pashia* may prove very useful for wildlife of the area and may quite easily adapt to the Lehri environments. Erratic introductions may result in the troublesome results, as was the case with *Prosopis glandulosa*, *Prosopis juliflora*, *Broussonetia papyrifera* and *Lantana camara*.

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