VEGETATION DESCRIPTION OF THREE SCRUB FORESTS OF SALT RANGE

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Abstract

Phytosociological investigations were carried out at three forest reserved (*i.e.* Hahatul Mir, Khura West and Khura North) at Salt Range of Pakistan. At each locations following plant communities and pure stands were recognized…

1. *Olea ferruginea* – Acacia modesta community
2. *Olea ferruginea* pure stand
3. *Acacia modesta* pure stand
4. *Dodonaca viscose – Justica adhatoda* community
5. Residual community

In addition each community and pure stand quantitatively described at its boundary area, middle area and core area at each forest. Comparative analysis of all sites were also presented.

Introduction

The Salt Range is situated between longitude 71.30° and 73.30° East and between the parallels of 32.23 and 33.0 North latitude. Soan Valley in District Khushab (Punjab) Pakistan is considered the heart of the Salt Range. It falls within the subtropical region with variable topography. Average height of the hills in this valley varies from 400 to 1000 m above sea level (Khan, 1960). The highest point in the range is Sakesar 1527m (5,010 ft.); shows a typical aspect of having steep cliffs to the south but, descending gently to the plateau to the north (Ahmad, 1964). It comprises the famous lake "Khabeki" which was declared as "Ramsar, Wetland Habitat", for migratory birds by the Government of Pakistan in 1976 (WWF, 1994; Hussain, 2002).

The range of hills extending in an irregular arc from the Jhelum River on the east to the Indus River in the west constitutes this Salt Range covering a length of about 150 miles. It takes its name from the important salt deposits, which are being quarried at present at Khewora, Warchha and Kalabagh (Ahmad, 1964).

The climate of valley is characterized by a relatively low annual precipitation (500mm or 20 inches) as compared to Sub-Tropical forests of Himalayan foot hills and average minimum temperature is 1°C in January while average maximum temperature is 36°C in June. Hot dry winds and prolonged period of drought are frequent during summer and winters are accompanied by frost. Little is reported in the related literature about geological history of the Salt Range vegetation while fossil records indicate that the angiosperms date back to the tertiary period while pre-tertiary fossils have no angiosperm affinities (Hussain 2002). *Pinus roxburghii* and the indigenous palm species of Pakistan, the Mazri (*Nannorhops ritchieana*) can be seen on elevated northern aspects of Sakesar area and the nullahs of the slopes respectively with suitable moisture conditions. The effect of aspect in Scrub Forest can only be observed near Chirpine zone due to sharp temperature signals and higher elevation as compared to the Salt Range area.

Phytosociological analysis and vegetation description of various parts of Pakistan was presented by various workers *i.e.* Said (1956) Khan(1960), Ahmed (1964), Champion *et al* (1965), Ahmed *et al* (1976), Khan (1994), Ahmed (2002), Ahemd *et al* (2006), Ahmed *et al* (2008), Hussain and Parveen (2009), Abbas *et al,* (2009), Ahmad (2010). Siddiqui *et al* (2011), Hussain *et al* (2011) Akber *et al* (2011), Khan *et al* (2013).

However no quantitative vegetational information is available from scrub reserved forests of Hayatul Mir, Khura west and Khura north sites of salt range. Therefore the purpose of present study was to describe these forest quantitatively.

Materials and Methods

The quadrat method with 10m × 10m size (Clements, 1916) was used and trees and Shrubs occurring in each quadrat were enlisted, the diameter at breast height level of trees was measured with the help of diameter tape and the cover of trees & shrubs was estimated on visual basis. The determination of forest stock present per unit area, here the harvest of the trees being substituted for count of plant units multiplied by the girth obtained per quadrat is an indirect estimate of bulk of standing crop.

The Site Selected For Sampling: All selected forests were divided in to three regions i.e. boundary, mid and core areas. The boundary area comprised of outer most one hundred meter belt along the boundary lines. The mid area zone comprises of 300 meters from the end of boundary zone. The rest of the inner zone was declared as core area.

A complete systematic design (Barbour *et al*. 1987) located stands and sub-samples within stands by reference to a grid superimposed over the survey area. Intersections North-South and East-West lines at one scale defined stands to be sampled and intersections at a finer scale defined sample points within stand.

The design was modified to accommodate topographic pattern. The object of modification was to avoid bias and to reflect representation of natural vegetation. 51 quadrats from Hayatul Mir, 36 from Khura West and 33 from Khura North were taken because of the extent of the area of these forests. The Hayatul Mir has 1646.55 hectares, Khura West has 351.93 hectares and Khura North has 186.71hectares. Quadrats were taken from each site to assess the dominance, basal area, volume, structure and physiognomy of the vegetation, following Ahmed and Shaukat (2012).

Modified version (Muller-Dombois and Ellengberg, 1974; Ahmed and Shaukat, 2012) of Braun-Blanquet approach was used for vegetation analysis. The communities formed on the basis of recognizable differential species were further delineated on the basis of structural characteristics. Plant communities can be classified by the following criteria depending upon which of the properties are emphasized. The structural criteria consist of dominant life form and combination of life forms of climatic climax vegetation. Plant specimens were collected from the area, dried, pressed, and mounted properly. The nomenclature was identified mainly with the help of Flora of Pakistan (Ali and Nasir 1989-91, Ali and Qaiser, 1992-2007). The plant specimens were submitted to Dr. Sultan Ahmad Herbarium, Botany Department GC University Lahore, Pakistan, after posting accession numbers.

Results and Discussion

1. Hayatul Mir

i. ***Olea ferruginea-Acacia modesta*** **Community Type:** This was the representative bi-climax community type which was abundantly represented in core areas of all the three forests. The status of three forests regarding the communities as was discussed below.

Boundary Area: Five quadrats (29%) of boundary area were representative of this community. The mean number of *O. ferruginea* and *A. modesta* tree per quadrat was 11.4 and 4.6 respectively a ratio of 2:1. The mean total number of trees of both species per quadrat was 16.6. The total cover percentage of *O. ferruginea* and *A. modesta* was 18.6% and 41% respectively. The mean total girths of both species were 15.5 cm and 46.2 cm respectively. The total number of trees of *O. ferruginea* and *A. modesta* in these five quadrats were 57 (71%) and 23 (29%) out of which 96% of *O. ferruginea* and 65% of *A. modesta* falls under tree girth class I.

The boundary area of Hayatul Mir have two quadrats (40%) in which mesquite presence was recorded. Number of trees was 6 and 3 with cover percentage 30% and 3% respectively (1.5% cover per quadrat).

Mid Area (Buffer Zone): Eight quadrats (47%) of mid area were representative of this community. The mean number of *O. ferruginea* and *A. modesta* tree per quadrat was 9.4 & 3.5 respectively a ratio of 3:1. The mean total number of trees of both species per quadrat was 12.9. The total cover percentage of *O. ferruginea* and *A. modesta* was 26.9% and 10.1% respectively. The mean total girths of both species were 19.6 cm and 21.1 cm respectively. The total number of trees of *O. ferruginea* and *A. modesta* in these eight quadrats were 75 and 28 out of which 91% of *O. ferruginea* and 93% of *A. modesta* falls under tree girth class I.
The mid area of this Forest has one quadrat (12.5%) in which one tree of mesquite with 2% cover was present.

Core Area: Nine quadrats (53%) of core area were representative of this community. The mean number of *O. ferruginea* and *A. modesta* tree per quadrat was 20.6 & 3.4 respectively a ratio of 6:1. The mean total number of trees of both species per quadrat was 24. The total cover percentage of *O. ferruginea* and *A. modesta* was 43.9% and 29.3% respectively. The mean total girths of both species were 18.6 cm and 41.5 cm respectively. The total number of trees of *O. ferruginea* and *A. modesta* in these nine quadrats were 185 and 31 out of which 90.81% of *O. ferruginea* and 67.74% of *A. modesta* falls under tree girth class I.

The core area of Hayatul Mir has one quadrat (11.1%) in which one tree of mesquite with 5% cover was present.

Fig. 1. Mosaic Forest Stand of *O. ferruginea-A modesta* Community in Hayatul Mir.

Fig. 2. *Olea ferruginea* stand in Hayatul Mir.

Fig. 3. Acacia modesta stand in Khura West.

Fig. 4. *Dodonaea viscose-Justica adhatoda* Community in Khura North.

Fig. 5. *Nannorrhops ritchieana* (Mazri).

Fig. 6. *Prosopis juliflora* (light green) Invasion in Core area of Hayatul Mir.

ii. ***Olea ferruginea* stand**

Boundary Area: Seven quadrats (41%) of boundary area were representative of this stand. The mean number was 11.7, cover percentage 33.6% per quadrat and total mean girth of *O. ferruginea* trees per quadrat was 15.5 cm. The total number of trees of *O. ferruginea* was 82 in these quadrats out of which 95% of *O. ferruginea* falls in girth class I.

Middle Area: Six quadrats (35%) of mid area were representative of this stand. The mean number was 9.2, cover percentage 23.3% per quadrat and total mean girth of *O. ferruginea* trees per quadrat was 15.8 cm. The total number of trees of *O. ferruginea* was 55 in these quadrats out of which 96% of *O. ferruginea* falls in girth class I

Core Area: Seven quadrats (41%) of core area were representative of this stand. The mean number was 24.4, cover percentage 61.4% per quadrat and total mean girth of *O. ferruginea* trees per quadrat was 19.7 cm. The

total number of trees of *O. ferruginea* was 171 in these quadrats out of which 95% of *O. ferruginea* falls in girth class I.

In this stand, the core area of Hayatul Mir has one quadrat (14.28%) in which mesquite presence was recorded. Number of trees was 5 with cover percentage 25% (1.13% cover per quadrat). The mesquite was absent in the boundary and mid areas of Hayatul Mir.

iii. ***Acacia modesta* stand**

Boundary Area: Three quadrats (18%) of boundary area were representative of this stand. The mean number was 1.3, cover percentage 11.7% per quadrat and total mean girth of *A. modesta* trees per quadrat was 31.9 cm. The total number of trees of *A. modesta* was 4 out of which 75% falls under girth class I.

In *A. modesta* stand, the boundary area of Hayatul Mir have one quadrat (33.3%) in which mesquite presence was recorded, number of trees was 3 with cover percentage 20% (1.0% cover per quadrat).

Mid Area: Three quadrats (12%) of mid area were representative of this stand. The mean number was 5.5, cover percentage 22.5% per quadrat and total mean girth of *A. modesta* trees per quadrat was 31.2 cm. The total number of trees of *A. modesta* was 11 out of which 64% falls under girth class I. The mesquite was absent.

Core Area: This stand was absent in core area of Hayatul Mir.

iv. ***Dodonaea viscosa* and Variant: *Justicia adhatoda* Community**

Boundary Area: One quadrat out of seventeen (6%) was the representative of this community. The total cover was 30% of the *D. viscosa*. In this quadrat, mesquite presence was recorded, number of trees was 2 with cover percentage 20% (6.66% cover per quadrat).

Mid Area: One quadrat out of seventeen (6%) was the representative of this community. The *D. viscosa* was present with 25% and *J. adhatoda* with 5% cover percentage respectively. Mesquite was absent and mazri with 20% cover was present.

Core Area: Only one quadrat out of seventeen (6%) was the representative of this community. Total cover of the *D. viscosa* was 50%. This community represented 30% cover percentage of *D. viscosa* in Hayatul Mir. Presence of mesquite was not recorded.

Residual Community: This community was represented by one quadrat in the boundary area of Hayatul Mir and in this quadrat (100%) mesquite presence was recorded, number of trees was 9 with cover percentage 70%. *J. adhatoda* was present in four quadrats out of five and the *D. viscosa* was absent. This community was absent in mid and core area of this reserved forest.

2. Khura West

i. ***Olea ferruginea-Acacia modesta* Community**

Boundary Area: (Annexure-IV) Four quadrats (33%) of boundary area were representative of this community. The mean number of *O. ferruginea* and *A. modesta* tree per quadrat was 3.3 & 9.5 respectively with a ratio of 3:1. The total cover percentage of *O. ferruginea* and *A. modesta* was 6.3% and 33.8% respectively. The mean total girths of both species were 10.4 cm and 26.5 cm respectively. The total number of trees of *O. ferruginea* and *A. modesta* in these four quadrats were 13 and 38 out of which 100% of *O. ferruginea* and 39% of *A. modesta* falls under tree girth class I.

Mid Area: The three quadrats (25%) of mid area were representative of this community. The mean number of *O. ferruginea* and *A. modesta* tree per quadrat was 3.3 and 6.0 respectively with a ratio of 1:2. The mean total number of trees of both species per quadrat was 9.3. The total cover percentage of *O. ferruginea* and *A. modesta* was 8% and 30% respectively. The mean total girths of both species were 19.2 cm and 26.6 cm respectively. The total number of trees of *O. ferruginea* and *A. modesta* in these five quadrats were 10 and 18 out of which 90% of *O. ferruginea* and 72% of *A. modesta* falls under tree girth class I.

Core Area: Nine quadrats (75%) of core area were representative of this community. The mean number of *O. ferruginea* and *A. modesta* tree per quadrat was 9.1 and 8.1 respectively, with approximate ratio of 1:1. The mean total number of trees of both species per quadrat was 17.2. The total cover percentage of *O. ferruginea*

and *A. modesta* was 21.3% and 35.6% respectively. The mean total girths of both species were 12.1 cm and 23.7 cm respectively. The total number of trees of *O. ferruginea* and *A. modesta* in these five quadrats were 82 and 73 out of which 100% of *O. ferruginea* and 84.93% of *A. modesta* falls under tree girth class I.

ii. ***Olea ferruginea* stand**

Boundary Area: One quadrat (8%) of boundary area was representative of this stand. The mean number was 6.0 with cover percentage 10% per quadrat and total mean girth of *O. ferruginea* trees per quadrat was 9.3 cm. The total number of trees of *O. ferruginea* was 6 in these quadrats out of which 100% of *O. ferruginea* falls in girth class I.

Mid and Core Area: This stand was absent in mid and core area.

iii. ***Acacia modesta* stand**

Boundary Area: Four quadrats (33%) of boundary area were representative of this stand. The mean number was 5.3, cover percentage was 28.8% per quadrat and total mean girth of *A. modesta* trees per quadrat was 33.1 cm. The total number of trees of *A. modesta* was 27 out of which 59% of falls under girth class I.

Mid Area: Six quadrats (50%) of mid area were representative of this stand. The mean number was 5.0 with cover percentage 38% per quadrat and total mean girth of *A. modesta* trees per quadrat was 36.4 cm. The total number of trees of *A. modesta* was 29 out of which 62% of falls under girth class I.

Core Area: Three quadrats (25%) of core area were representative of this stand. The mean number was 9.8, cover percentage 40% per quadrat and total mean girth of *A. modesta* trees per quadrat was 17.8 cm. The total number of trees of *A. modesta* was 39 out of which 97.44% fall under girth class I.

iv. ***Dodonaea viscose - J. adhatoda* community**

***Justicia adhatoda*:** Only one quadrat out of twelve was the representative of this community. Total cover of the *D. viscosa* and *J. adhatoda* were 20% and 10% respectively. This community was absent in mid and core area of this reserved forest.

The average cover percentage of *D. viscosa* was 66.6% and 6.66% of *J. adhatoda* per quadrat in Khura West.

Residual Community: Only two quadrats each out of twelve were the representative of this community in boundary and mid areas of this reserved forest. Total cover of *J. adhatoda* in both areas was 9% and 20% respectively. One mazri plant in boundary area with 5% cover was also present. Mean cover of *J. adhatoda* was 7.25% per quadrat (Annexure-IV).

3. Khura North

i. ***Olea ferruginea-Acacia modesta* Community**

Boundary Area: Three quadrats (27%) of boundary area were representative of this community. The mean number of *O. ferruginea* and *A. modesta* tree per quadrat was 3.3 and 3.0 respectively a ratio of 1:1. The mean total number of trees of both species per quadrat was 6.3. The total cover percentage of *O. ferruginea* and *A. modesta* was 15% and 25% respectively. The mean total girths of both species were 21.6 cm and 34.6 cm respectively. The total number of trees of *O. ferruginea* and *A. modesta* in these four quadrats were 10 and 9 respectively out of which 100% of *O. ferruginea* and 67% of *A. modesta* falls under tree girth class I.

Mid Area: Five quadrats (45%) of mid area were representative of this community. The mean number of *O. ferruginea* and *A. modesta* tree per quadrat was 3.8 and 4.0 respectively a ratio of 1:1. The mean total number of trees of both species per quadrat was 7.8. The total cover percentage of *O. ferruginea* and *A. modesta* was 6.4% and 18% respectively. The mean total girths of both species were 9.7 cm and 15.6 cm respectively. The total number of trees of *O. ferruginea* and *A. modesta* in these four quadrats were 19 and 20 respectively out of which 100% of *O. ferruginea* and 97% of *A. modesta* fall under tree girth class I.

Core Area: Five quadrats (45%) of core area were representative of this community. The mean number of *O. ferruginea* and *A. modesta* tree per quadrat was 4.6 and 2.8 respectively a ratio of 2:1. The mean total number of

trees of both species per quadrat was 7.4. The total cover percentage of *O. ferruginea* and *A. modesta* was 7.4% and 18.6% respectively. The mean total girths of both species were 11.1 cm and 26.8 cm respectively. The total number of trees of *O. ferruginea* and *A. modesta* in these four quadrats were 23 and 14 respectively out of which 100% of *O. ferruginea* and 85.71% of *A. modesta* fall under tree girth class I.

ii. ***Olea ferruginea* stand**

Boundary Area: One quadrat (9%) of boundary area was a representative of this stand. The mean number was 2.0, cover percentage 5% per quadrat and total mean girth of *O. ferruginea* trees per quadrat was 16 cm. The total number of trees of *O. ferruginea* was 2 in these quadrats which 100% falls in girth class I.

Mid Area: One quadrat (9%) of mid area was a representative of this stand. The mean number was 7.0, cover percentage 50% per quadrat and total mean girth of *O. ferruginea* trees per quadrat was 20.5 cm. The total number of trees of *O. ferruginea* was 7 in these quadrats out of which 86% falls in girth class I.

Core Area: Four quadrats (36%) of core area was representative of this stand. The mean number was 9.8, cover percentage 15% per quadrat and total mean girth of *O. ferruginea* trees per quadrat was 12.7 cm. The total number of trees of *O. ferruginea* was 39 in these quadrats out of which 100% of *O. ferruginea* falls in girth class I.

iii. ***Acacia modesta* Community**

Boundary area: Two quadrats (18%) of boundary area were representative of this stand. The mean number was 4.0, cover percentage 15% per quadrat and total mean girth of *A. modesta* trees per quadrat was 22.0 cm. The total number of trees of *A. modesta* was 8 out of which 64% trees fall in girth class I.

Mid area: Four quadrats (36%) of mid area were representative of this stand. The mean number was 7.8, cover percentage 26.3% per quadrat and total mean girth of *A. modesta* trees per quadrat was 18.3 cm. The total number of trees of *A. modesta* was 31 out of which 94% trees fall in girth class I.

Core Area: This stand was absent in core area of this forest.

iv. ***Dodonaea viscosa* - *Justicia adhatoda* Community**

Boundary Area: Five quadrats out of eleven (45%) were the representative of this community. Total mean percentage cover of *D. viscosa* and *J. adhatoda* per quadrat was 34% and 5% respectively.

Mid Area: Only one quadrat out of eleven (9%) was the representative of this community. Total cover percentage of *D. viscosa* was 60% and the *J. adhatoda* was absent.

Core Area: Two quadrats out of eleven (18%) was the representative of this community. Total mean cover of *D. viscosa* was 60% but the *J. adhatoda* was absent in this area. The mean cover of *D. viscosa* was 43.75% in all areas of this forest.

Residual Community: This community was absent in Khura North.

Comparative Analysis of all Sites of Selected Reserved Forests

***O. ferruginea*-*A. modesta* Community:** In case of *O. ferruginea*, maximum number of trees were present in core area of Hayatul Mir. The difference in boundary and mid areas of Khura West, Khura North and core area of Khura North was significantly higher than other sites.

In *O. ferruginea* diameter class I, maximum number of trees were observed in core area of Hayatul Mir. The difference in boundary area of Khura West and Khura North and mid area of Khura West was significantly higher than other areas.

In case of *A. modesta*, maximum number of trees has been observed in core area of Khura West. The difference among mid and core areas of Hayatul Mir and boundary & core area of Khura North was significantly higher than other.

In *A. modesta* diameter class I, maximum number was also observed in core area of Khura West. The difference among boundary and mid areas of Hayatul Mir and boundary & core areas of Khura North was significantly higher in other areas.

In diameter class II, maximum number was in boundary area of Khura West and the difference among other areas was significantly higher.

In diameter class III, maximum number was in mid area of Khura West and the difference among other was significantly higher.

***O. ferruginea* stand:** In *O. ferruginea* stand, maximum number of *O. ferruginea* trees found in core area of Hayatul Mir was significantly higher.

***A. modesta* stand:** In case of all sites of all forests regarding *A. modesta* stand, maximum number of *A. modesta* trees was found in core area of Khura West and absent in core area of Hayatul Mir & Khura North. In *A. modesta* diameter class I, statistically the difference among boundary, mid areas of Hayatul Mir, boundary areas of Khura West & mid area of Khura North was significantly higher than other areas of reserved forests. In diameter class II, the difference among all areas of all reserved forests was significantly higher than boundary and mid area of Khura West respectively.

Ranking of Hayatul Mir: According to ranking criterion described in ranking table 4.1**,** total points in boundary were twelve; mid area have nine and sixteen in core area. The overall points were fourteen in *O. ferruginea-A. modesta* stand.

In *O. ferruginea* stand, the boundary has nine, mid has eight and core area have fourteen points. The overall points in Olea stand were ten.

In *A. modesta* stand, boundary and mid areas have seven points each while core has only three due to absence of mesquite. The average points were seven. Overall position of this forest was that boundary area has twenty eight points, mid has twenty four while core area has thirty three.

This forest was surrounded by five settlements i.e. Kalial, Bayyakh, Ararra, Nulli and Khura and one settlement utilizes 812 acres for fuel wood cutting which shows a normal fuel wood cutting pressure as compared to other two forests.

Ranking of Khura West: In *O. ferruginea-A. modesta* community, total points in boundary and mid areas were ten, and thirteen in core area. The overall points of this community were eleven.
In *O. ferruginea* stand, mid and core areas have three points each only while boundary area has seven points. The overall points of this forest in *O. ferruginea* stand were seven.

In *A. modesta* stand, boundary area has eight points while mid and core areas have nine points. The average points were eight. The *D. viscosa* and residual communities have very less points as compared to other communities. Overall position of this forest with respect to all communities was that boundary and core areas have twenty five points while mid area has twenty two points.

This forest was surrounded by six settlements i.e. Chamnakki, Potha, Khura, Kund, Uchhala and Bhukki and 144 acres were being utilized by one surrounding settlement which clearly shows the higher pressure of fuel wood cutting.

Ranking of Khura North: All the areas have eight points and overall points of this forest were seven in *O. ferruginea-A. modesta* community. In case of *O. ferruginea* stand, the mid and core areas have eight points each and seven points were in boundary area. The overall points of this forest in *O. ferruginea* stand were seven.

In *A. modesta* stand, boundary and mid areas has seven points each while core has only three only due to absence of mesquite. The average points were seven. Overall position of this forest with respect to all communities was that boundary area has twenty two points, mid has twenty three points and core area has ninteen points. The overall points were twenty one.

This forest was surrounded by Khura, Uchhala, Bhukki and Bayyakh settlements and one settlement utilizes 115 acres of this forest continuously which indicates the highest pressure of fuel wood cutting from this forest. Overall position of these forests with respect to all communities was that Hayatul Mir has eighty five points, Khura West has seventy two and Khura North has sixty four points in all areas.

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