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BRIEF NOTE

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Vegetation structure of subtropical forest of Tabai, South Waziristan, Pakistan

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Abstract Phytosociological parameters, soil and temperature conditions, importance values of species, life form, leaf size, and biomass were investigated at the village Tabai during autumn 2006. There was very little difference in air and soil temperature due to similar elevation. There was a great difference in biomass production for various stands. The original vegetation structure has been altered due to deforestation and overgrazing. There is a need for restoration of the habitat.

Keywords phytosociology, South Waziristan, *Olea*, *Quercus*

1 Introduction

The vegetation is a reflection of the climate, soil and human activities, biodiversity, and natural resources of an area. Hussain and Badshah (1998) and Hussain et al. (2006a) reported the vegetation and ethnobotany of Pirghar hills, Waziristan. Many studies have been made on various parts of Pakistan: Mansehra (Marwat and Qureshi, 2000), Nara Desert (Qureshi and Bhatti, 2005), Chagharzai (Sher and Khan, 2007), Manzaray Baba (Ullah et al., 2007), Chakwal (Chaudhry et al., 2001), Swat (Awan et al., 2002), Kotli (Malik and Malik, 2004), and Kotli Azad Kashmir (Nazir and Malik, 2006).

Tabai, South Waziristan, lies at the latitude of 31°55′ to 32°40′ North and longitude of 69°15′ to 70°15′ East, with the average altitude of 1500 to 1600 m. Although no exact climatic data is available yet summer is moderate with cold winter. There used to be *Quercus* and *Olea* forests in the past with combination of *Monotheca* at the Raghzai area and Gurasar. However, now, such forests are almost nonexistent due to heavy erosion and deforestation. Costa (2006) observed that climate and soil fertility affect density and diversity at large scales in central Amazonia, which agrees with our findings. The present study provides an insight to existing vegetation structure and its productivity. The vegetation of Tabai is partially protected owing to jirga system as compared to the neighboring area. The area is unexplored; no more references exist on the phytosociological aspect of South Waziristan Agency. However, Badshah et al. (2004) and Hussain et al. (2000, 2004, 2005, 2006a, 2006b) wrote a series of papers on the flora of hilly areas of Pakistan.

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2 Materials and methods

The investigated area is a plain with no sharp altitudinal changes. Therefore, four sites, namely, Raghzai, Bandkharai, Tharkha, and Ghurasar, all lying at an altitude of 1500–1600 m were selected. In each of the stands, herbs, shrubs, and trees were randomly sampled using 1 m × 1 m, 2 m × 4 m, and 2 m × 10 m quadrats, respectively. These values were changed to relative values, which, when added together, gave importance values for each species (Hussain and Shah, 1989). For trees, the circumference at breast level was measured and changed to basal area. The communities were named after three species with highest importance values. The importance values for all trees, shrubs, and herbs species was summed to get the total importance values (TIV) for each group.

Leaf size and life form spectra of plants were prepared following Hussain and Shah (1989) and Hussain and Badshah (1998). Plants were dried, preserved, and identified with the help of Flora of Pakistan (Nasir and Ali, 1971, 1995; Ali and Qaisar, 1995–2005). Fresh weight was analyzed using 0.5 m × 0.5 m quadrats; soil and air temperature was determined with the help of air and soil thermometer, following that of Hussain and Badshah (1998).

3 Results and discussion

3.1 Habitat feature

As there were no altitudinal variations, soil and air temperature were almost similar at all the locations (Table 1). The soil was of sandy loam and sandy in texture. The nitrogen and $CaCO_3$ contents were almost similar in all stands except the Tharkha area, where the $CaCO_3$ contents were comparatively low. Organic matter was high at Ghurasar. Phosphorus contents varied from 4.16 $mg \cdot kg^{-1}$ to 22.08 $mg \cdot kg^{-1}$, while potassium contents ranged from 360 $mg \cdot kg^{-1}$ to 432 $mg \cdot kg^{-1}$. The electrical conductivity and total soluble salt were also similar among the various sites. The water holding capacity varied from 10.3% to 14.9%. It appeared that erosion and deforestation had reduced nutrient contents of the soil.

3.2 Community set up

The Raghzai area had *Quercus baloot-Olea ferruginea-Quercus dilatata* community (Table 2). Of the 19 species present in this community, three were trees, 5 shrubs, and 7 herbs. *Quercus baloot* and *Olea ferrugenea* were the dominant species with total importance values of 163.4. Phenerophytes and therophytes dominated the community, while nannophyllous species were more than the others (Table 3).

At Bandkharai, *Quercus baloot-Olea-Withania* community existed with a TIV of 164.3. *Quercus incana* and *Cotoneaster felconeri* were the associated species. Of the total 13 species, 8 were herbs, 3 trees, and 3 shrubs (Table 4). The total importance values for trees, shrubs, and herbs were 205.4, 16.3, and 77.5, respectively (Table 4). Phenero-therophytic species dominated the community, while the dominants leaf classes were lepto- nannophyllous (Table 3).

At Tharkha, *Olea-Quercus incana-Sophora* community was established (Table 1). The total importance value for the dominants was 146.0. *Chenopodium ambrosoids* and *Oxalis carniculata* were associated species. The importance values for trees, shrubs, and herbs were 199.8, 60.5, and 39.2 (Table 4), respectively. The dominant biological spectra were lepto-nano-mesophyllous and phenero-therophytic (Table 3).

Olea–Quercus baloot–Monotheca community consisting of 16 species was present at Ghurasar fields. Five shrubs, namely, *Clematis barbellata*, *Cotoneaster felconeri*, *Berberis lyceum*, *Saussoria hetromella*, *and Daphne mucronata* had a TIV of 31.5, while the remaining, six herbaceous species contributed a TIV of 35.9 (Table 4).

This site possessed a mixed type of life form and nano-leptophyllous leaf spectra (Table 3). The area was highly degraded due to over exploitation and overgrazing. The index of similarity showed that all the four communities differed from each other (Fig. 1).

QOQ			
QOW	33.6		
OQS	20.76	8.9	
OQM	51.8	30.5	6.8

Fig. 1 Matrices of indices of similarity (%) at different stands of Tabai

Note: QOQ, QOW, OQS, and OQM represent *Querccus-Olea-Quercus* community, *Querccus-Olea-Withania* community, *Olea–Quercus-Sophora* community, and *Olea-Quercus-Monotheca* community, respectively.

The area was partially protected; however, due to the increase in population, there was a tremendous pressure on the plants of the area for fuel wood, timber wood, and fodder, which is primarily extracted from the nearby forests. Overgrazing hampered the regeneration of not only

Table 1 Physico-chemical properties of soil at different stands of Tabai

item	stand/community			
	Raghzai	Bankharai	Tarkha	Gurasar
soil temperature/°C	24	24	23	21
air temperature/°C	28	27	25	26
WHC/%	14.9	12.9	6.5	10.3
Ec/($d \cdot sm^{-1}$)	0.14	0.11	0.11	0.21
Tss/%	0.05	0.04	0.04	0.67
$CaCO_3$/%	21.25	21.75	4.50	21.75
organic matter /%	2.76	2.24	1.13	3.45
N/%	0.14	0.11	0.06	0.19
P/($mg \cdot kg^{-1}$)	4.16	11.2	9.28	22.08
K/($mg \cdot kg^{-1}$)	378	432	270	260

Note: WHC, Ec, and Tss stand for water holding capacity, electrical conductivity, and total soluble salt, respectively.

Table 2 Importance values of various species in different communities/stands of Tabai

layers		site			
		Raghzai/QOQ	Bandkharai/QOW	Tarkha/OQS	Gurasar/OQM
tree	*Olea ferrugenea* Royle	47.9 b	11.6	106.5 a	101.7 a
	Pistacea khinjek Stocks	9.1	–	–	8.8
	Ail anthus altissima (Mill.)	–	–	9.0	–
	Monotheca buxifolia (Falc.) done ex. Angler	29.7	–	–	44.1 c
	Quercus baloot Griffith	91.0 a	152.3 a	–	56.6 b
	Quercus dilatata Lindl ex. Royle	33.6 c	–	–	–
	Quercus incana Roxb	–	11.6	84.3 a	20.4
	Celtus australis L.	9.9	–	–	–
shrub	*Berberis lycium* Royle	7.0	–	–	9.4
	Cotoneaster falconeri G.Clotz	–	9.8	–	3.1
	Ficus carica L.	–	6.9	–	–
	Daphne mucronata Royle	–	–	–	9.4
	Clematis barbellata Edgew	–	–	–	3.1
	Plectranthus rugosus Wall. ex Benth	10.4	–	–	–
	Sophora mollis (Royle) Baker	7.0	–	60.5 c	–
	*Spiraea s*p.	3.4	–	–	–
	Saussuria hetromella (D.Don) Hand	–	–	–	6.5
	Lonicera obvata Royle	7.0	–	–	–
herb	*Achillea setacea* Waldst. & Kit.	–	–	–	5.4
	Amaranthus viridis L.	4.6	–	–	–
	Chenopodium ambrosoids L.	–	–	8.9	–
	Calendolla arvensis L.	–	–	6.8	–
	Digeteria nodusa Parl.	–	6.2	6.8	–
	Silene afghanica Rohrb.	–	13.8	–	–
	Conyza Canadensis (L.) Cronquist.	–	–	–	5.4
	Gallium boreale L.	–	6.0	–	–
	Gnaphallium leuteoalbum L.	–	–	–	2.5
	Menthe longifolia (L.) Huds.	–	–	–	11.8
	Oxalis carniculata L.	7.4	13.8	8.9	–
	Plantogo major L.	7.4	–	–	5.4
	Seteria gluaca (L.) P. Beaur	–	–	–	5.4
	Solanum nigrum Burm. f.	7.4	–	–	–
	Onosma thomsonii C. B. Clarke	–	6.2	–	–
	Taraxicum officinalis Webber	4.6	–	–	–
	Teucrium stocksianum Boiss	–	–	7.8	–
	Viola sp.	–	4.0	–	–
	Withenia coagulans (Stock) Dunal	–	53.3 c	–	–
	Xanthium sibericum L.	7.4	–	–	–

Note: QOQ, QOW, OQS, and OQM represent *Quercus-Olea-Quercus* community, *Quercus Olea Withania* community, *Olea-Quercus-Sophora* community, and *Olea-Quercus-Monotheca* community respectively. While a, b, and c, respectively, showed the first, second, and third dominants species.

fodder species but also medicinal and other species. (Badshah et al., 1996; Hussain and Badshah, 1998). The vegetation of the area could be classified as subtropical vegetation consisting of *Quercus baloot* and *Olea ferrugenea* forests.

3.3 Productivity (fresh mass)

The total fresh weight of 850 g was recorded at Raghzai area, which gradually decreased to 90 g at Bandkharai area (Table 5). The total biomass was 350 g at Tharkha,

Table 3 Biological spectrum in various communities at different sites of Tabai (%)

item		stand			
		Raghzai	Bandkharai	Tharkha	Gurasar
leaf size spectra	leptophylls	15.78	38.46	55.55	25.00
	nanophylls	63.15	38.46	22.22	50.00
	microphylls	5.26	15.38	–	18.75
	mesophylls	15.78	7.69	22.22	6.25
	community	NL	NL	LNM	NL
life form spectra	therophyte	31.57	23.07	33.33	18.75
	geophytes	–	15.38	–	–
	hemicryptophytes	5.26	15.38	22.22	18.75
	chameophytes	10.52	7.69	–	12.50
	nanophanerophytes	15.78	15.38	11.11	18.75
	phanerophytes	36.84	23.07	33.33	31.25
	community	PT	PT	PT	Mixed

Note: NL is nano-leptophyllous, LNM is lepto-nano-microphyllous, and PT is Phenero-therophytic.

Table 4 Comparative account of trees, shrubs, and herbaceous species and their importance values at different stands

item		stand/community			
		QOQ	QOW	OQS	OQM
trees	No.	6	3	3	5
	TIV	221.2	205.4	199.8	231.6
shrubs	No.	5	2	1	5
	TIV	34.8	16.3	60.5	31.5
herbs	No.	7	8	5	6
	TIV	13.8	77.5	39.2	35.9
TIV by three dominants		163.4	164.3	146.0	183.0
total species		18	13	9	16

Note: QOQ, QOW, OQS, OQM, and TIV represent *Querccus-Olea-Quercus* community, *Querccus-Olea-Withania* Community, *Olea-Quercus- Sophora* community, *Olea-Quercus-Monotheca* community, and total importance value respectively.

Table 5 The production of fresh biomass (grams) at various stands of Tabai

community	stands			
	Raghzai	Bandkharai	Tharkha	Gurasar
grasses and grass like	550	50	200	50
others (forbs)	300	40	150	130
total	850	90	350	300

which again decreased to 300 g at the Ghurasar (area) community.

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