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Populations of Western Tragopans Tragopan melanocephalus were studied at two areas (Machiara and Salkhala) in the Neelum Valley of northeastern Pakistan. A total of 130 sightings of birds was noted during the breeding seasons in 1982 and 1983, but only 100 were relocated for vegetation analysis. More sightings of birds were recorded at Machiara; 54% of the locations were in an oak stand. Contrastingly, 63% of the sightings were in a maple stand at Salkhala. The remaining birds were found in mixed and deciduous stands. Only 30% of locations of tragopans were in coniferous stands at Machiara and none at Salkhala. There was little selection at the stand level. Structural components were the most important aspects of tragopan habitat and both sexes were associated strongly with shorter life-forms (shrub, short deciduous, short coniferous) at each study area. There was no association with particular plant species.

Habitat Use By Western Tragopans In Northeastern Pakistan

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HABITAT USE BY WESTERN TRAGOPANS IN NORTHEASTERN PAKISTAN

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INTRODUCTION

Western Tragopans Tragopan melanocephalus are one of five species of tragopans (Family: Phasianidae) endemic to Asia (Beebe 1926, Delacour 1957, Ali and Ripley 1980). Historically, Western Tragopans occurred from Swat in northern Pakistan to Garhwal in India (Jerdon 1877, Hume and Marshall 1878, Peters 1934, Whistler 1963, Ali and Ripley 1980, King 1981). Accounts by early naturalists indicated tragopans were localized in distribution and were the rarest pheasant in the western Himalayas (Jerdon 1877, Hume and Marshall 1878, Beebe 1926, Whistler 1926). Recent information indicated that the distribution of this species was fragmented into two areas: the Neelum Valley in northeastern Pakistan and a larger area extending from Kistwar in the Chenab Valley to Kinnaur, Sutlej Valley, in northwestern India (Gaston et al. 1983, Islam 1983, Islam in press). During the past several decades, populations of Western Tragopans declined in both India and Pakistan with the result that they were accorded

endangered status by the U.S. Fish and Wildlife Service and the International Union for the Conservation of Nature and Natural Resources (Fisher et al. 1969, Grzimek 1972, Roles 1976, Ferguson 1978, Wayre 1979, Gaston 1980, King 1981). The decline was attributed to destruction of habitat, interference from grazing livestock (goats), and human predation through egg collecting, hunting, and trapping by local villagers (Wayre 1969, Roberts 1970, Littlewood 1972, King 1981). The world population in 1982 was estimated at less than 5000 birds (Gaston et al. 1983).

Western Tragopans were reported to frequent forests of deodar Cedrus deodara, Kharsu oak Quercus semicarpifolia, and spruce Picea smythiana during summer at altitudes ranging from 2500 to 3600 m, and in winter, they were found in mid-elevational (2000-2800 m) dense coniferous or mixed forests with a northern aspect (Jerdon 1877, Hume and Marshall 1878, Whistler 1926, Littlewood 1972, Gaston 1979, Ali and Ripley 1980, King 1981). Undergrowth of ringal Arundinaria falcata and other species of bamboo, where available, characterized both summer and winter habitats (Jerdon 1877, Hume and Marshall 1878, Whistler 1926, Ali and Ripley 1980). In India, Western Tragopans were reported in coniferous, mixed, and oak forests at high elevations (Gaston et al. 1981).

In Pakistan, this species reportedly inhabited dense forests characterized by steep slopes in a transition between moist and dry temperate zones (Mirza et al. 1978). Western Tragopans generally were associated with forests of spruce and silver fir Abies pindrow on precipitous cliffs where accessibility to humans was restricted (Roberts 1970). In addition, the favoured habitat of this species contained undergrowth of Skimmia laureola (Roberts 1970).

No quantitative data were collected on habitat use by Western Tragopans in previous works. The objectives of this study were to quantitatively describe habitat components used by Western Tragopans during the breeding season and to determine habitat selection by these birds on three levels (stand, structure, and species) in Pakistan.

STUDY AREAS

The study was conducted in the Neelum Valley of Azad Kashmir in northeastern Pakistan (Fig. 1). Rugged and precipitous slopes characterize this mountainous area, which is part of the Karakorum or Himalayan range. Both moist and dry temperate forests, composed of coniferous, deciduous, and mixed stands, occur in this region. The coniferous forests consisted of silver fir, blue pine Pinus wallichiana, and yew Taxus wallichiana, whereas the deciduous forests were composed of kharsu oak, horse chestnut Aesculus indica, maple Acer caesium, and birch Betula utilis. Mixed forests contained a combination of the above species and walnut Juglans regia, cherry Prunus padus, and spruce. The undergrowth typically included Viburnum foetens, Skimmia laureola, and bracken fern Pteridium aquilinum.

Seven locations were censused for tragopans during 1982 in the Neelum Valley (Islam 1983, Islam in press). Tragopans were found only at Salkhala, Kuttan, and Machiara; very few birds were observed at Kuttan and this area was not used in subsequent work. Study areas, each 800 ha in size, were selected at Salkhala and Machiara (Fig. 1). Machiara contained coniferous, deciduous, and mixed forests, whereas only deciduous and mixed forests were present at Salkhala.

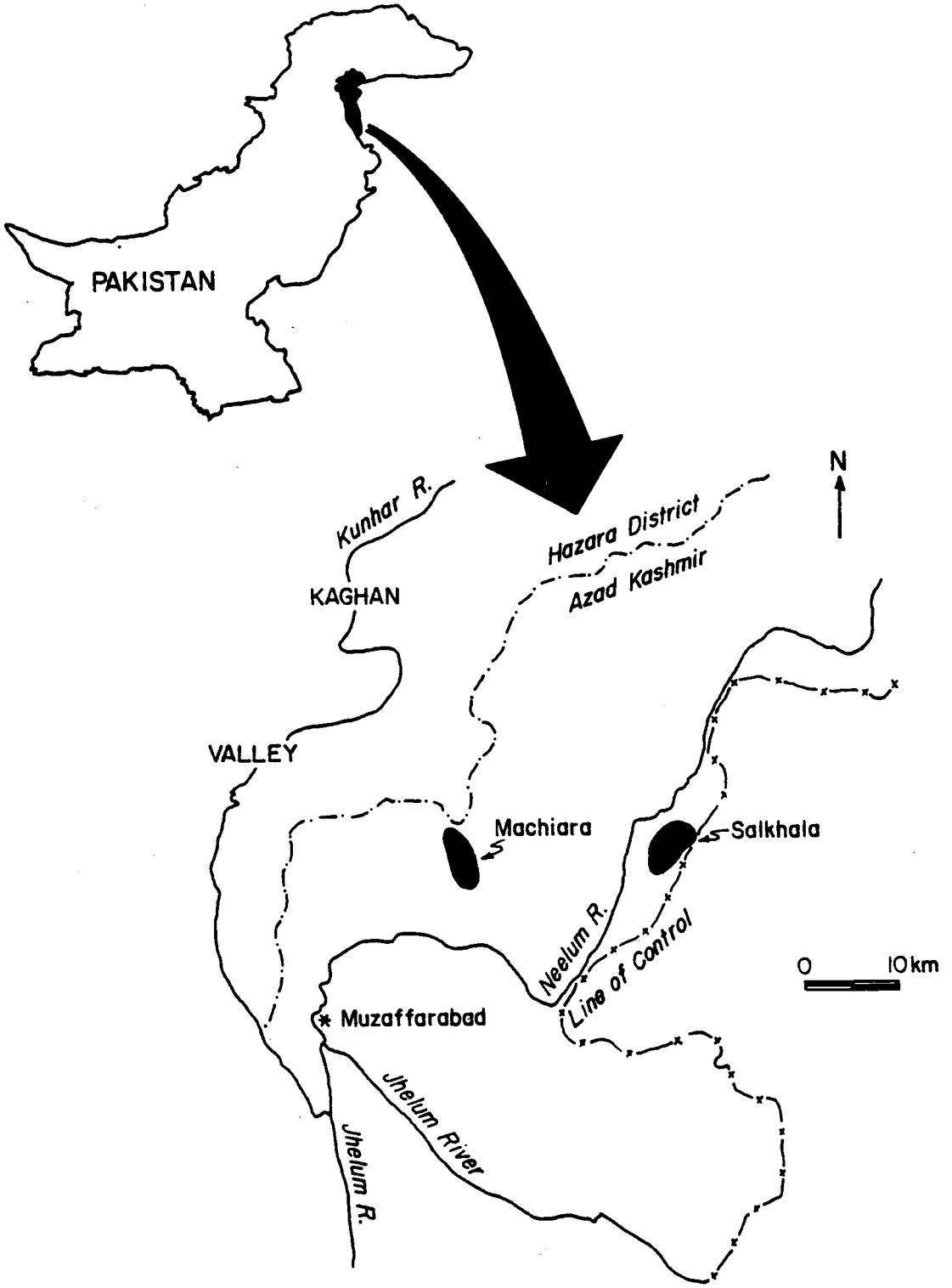

Fig. 1 Location of Machiara and Salkhala study areas in Neelum Valley, Azad Kashmir, northeastern Pakistan.

METHODS

Field research was conducted from 1 May to 7 September, 1982 and 1 April to 7 October, 1983, which encompassed the breeding season for tragopans. In 1982, tragopans were censused from 2300 to 3100 m in all suitable habitats. Since birds were located only between 2400 m and 3000 m, censusing in 1983 was conducted within this elevational range.

Birds were located throughout the field season during both years with the use of a hunting dog in each of the study areas. In addition, methods such as hand-clapping and beating an axe handle or stick against hollow tree trunks were randomly employed to elicit vocal responses. Locations or sightings of birds and vocalizations were recorded. When more than one tragopan was sighted at a specific locality, each bird was treated as a separate location. At locations, signs of tragopans (eg. tracks, droppings) were noted to further confirm the presence of the bird and to insure that general use of the habitat was assessed and not simply escape cover. These sites were marked with surveyor's tape to aid in relocation for sampling vegetation. Two persons assisted in each study area.

Censuses were conducted once per month at each study area and approximately 7-10 days/month were expended at each study area. Approximately 100 ha/day were searched

in each area. During 1982, 108 hours at Machiara and 72 hours at Salkhala were expended looking for tragopans. In 1983, 504 hours and 588 hours were spent searching for tragopans in Machiara and Salkhala, respectively.

SAMPLING OF HABITATS

In 1983, plant stands were identified by inspection within the study areas. These stands were defined on the basis of one or more of the most prominant woody species. Four plant stands were present in Machiara (pine, fir, oak, and horse chestnut) and three plant stands occurred at Salkhala (birch, yew-maple, and maple). Each stand was searched for tragopans in relation to its availability on the study areas.

The line-intercept method (Mueller-Dombois and Ellenberg: 90-92 1974) was used to estimate % cover of woody vegetation. Each transect was 10 m in length. Percent cover of shrubs (up to 1.5 m) was estimated by measuring the length of a transect intercepted by a particular species. Shrubs taller than 1.5 m and all trees were measured by taking ocular estimates of overhead % cover with the mirror of a Brunton compass, every 2 m along a transect. The % of field of the mirrored surface covered by a particular species was determined. Each woody species recorded was placed into a life-form category. DuReitz's (1936) life-form classification was

modified to arrange the habitat structurally (shrub <2.0m, short coniferous and short deciduous 2.0-12.0 m, and tall coniferous and tall deciduous >12.0 m).

Within each plant stand, a minimum of 40 transects were established to describe the available vegetation. The number of transects necessary to adequately ($\pm 0.20\bar{x}$) describe the % cover of dominant plants (>10% cover) was computed by the "n" formula at $p \leq 0.10$ (Snedecor and Cochran:441-443 1980). Sampling was stratified according to elevation. A minimum of eight transects was conducted randomly at every 150 m gain in elevation from 2400 to 3000 m within stands. If 40 transects were inadequate, additional transects were randomly established at every 30 m gain in elevation. A total of 280 and 240 transects were conducted at Machiara and Salkhala, respectively. These samples were sufficient to describe all dominant species in all stands within predetermined statistical limits.

Measurements of % cover for all woody species and structural features were taken at each location where tragopans were found. Methods were identical to those used to collect information about the vegetation stands. However, location of the bird acted as a focal point from which 10 m transects radiated in the four cardinal directions; a minimum of four transects were examined at each location. Adequate samples were obtained for one or more

dominant plant species at 84% of the tragopan locations and for 49% of all dominant plants. All vegetation measurements were collected from July to October 1983.

DATA ANALYSIS

Ivlev's electivity index ($\frac{r-p}{r+p}$ where r=% used and p=% available, Ivlev 1961) was used to calculate selection of stands, life-forms, and plant species by Western Tragopans. Only those life-forms and plant species that occurred with cover of 10% or more on either of the study areas were used for further analysis.

Discriminant function analysis (DFA) (Klecka: 434-467 1975) was computed for all life-forms (5) and dominant plant species (7) to compare, separately, % vegetation available and % vegetation used between the two study areas. Multivariate analysis of variance (MANOVA) (Hull and Nie:1-79 1981), with the same 12 variables, was calculated to test for differences in % available vegetation between the two study areas. In addition, comparisons were made of % use of vegetation between males and females within and between each study area. Also, MANOVA was used to compare % use of the habitat with that available to the birds. These comparisons were made between males and females within and between study areas. Chi-square (Snedecor and Cochran:73-78 1980) was used to treat for differences in abundance of birds at the two study area.

RESULTS AND DISCUSSION

BIRD LOCATIONS

Twenty-four tragopans, 14 and 10 in Machiara and Salkhala, respectively, were located in 1982. These sightings represented 24 different birds. Ten males and four females were noted at Machiara and three males, six females, and one brood (with one juvenile) were obtained at Salkhala. In 1983, 106 sightings; 59 and 47 at Machiara and Salkhala, respectively, of tragopans were obtained. A minimum of 22 (Machiara) and 17 (Salkhala) different birds were present in the study areas. Locations of 30 males, 22 females, two broods (with one juvenile/brood), and five birds of undetermined sex and age were recorded at Machiara. At Salkhala, sightings of 26 males, 12 females, one brood (with four juveniles), and five birds of undetermined age and sex were noted. Of 130 sightings, only 100 locations (57 in Machiara and 43 in Salkhala) were relocated for vegetation analysis. These 100 locations consisted of 30 males, 22 females, and 5 undetermined birds at Machiara and 26 males, 12 females, and 5 undetermined birds at Salkhala. Juveniles, which always were in the company of adults, were excluded from the analysis. Although more sightings of tragopans were located at Machiara, no difference ($p \leq 0.5$) existed between the number of birds/100 hours of searching at Machiara (11.9) and Salkhala (8.6).

AVAILABLE HABITAT

The dominant plant species in the tall coniferous life-form were blue pine and silver fir at Machiara and yew at Salkhala; silver fir (<10%) was a less common species at Salkhala (Table 1). The major plant species in the short coniferous life-form were silver fir (<10%) and yew (<10%) at Machiara and yew (<10%) at Salkhala. Kharsu oak and horse chestnut at Machiara and maple at Salkhala were dominant species in the tall deciduous life-form, and maple (<10%) was less abundant at Machiara. Birch was the only dominant plant species in the short deciduous category at Salkhala and horse chestnut (<10%) was a common species at Machiara. Viburnum foetens (<10%) at Machiara and Lonicera sp (<10%) at Salkhala were the major shrubs. Plant species that constituted <10% cover were not included in statistical analysis.

Blue pine was the dominant species for one stand and silver fir for another stand at Machiara and these species composed 15% (~120 ha) and 23% (~185 ha), respectively, of the total study area (Table 1). The stand of horse chestnut composed 8% (~65 ha) and the largest stand, oak, encompassed 54% (~430 ha) of the study area. At Salkhala, stands of maple, birch, and yew-maple composed 62% (~495 ha), 23% (~185 ha), and 15% (~120 ha), respectively, of the area (Table 1).

TABLE 1

Percent cover available and used of woody plant species within stands at Machiara and Salkhala study areas, Pakistan, 1982-83

Species	Life-form[1]	Stands (% available cover/% cover used) Pine[2]	Fir	Horse chestnut	Oak	Maple	Yew-maple	Birch
Blue pine	TC	76/43	2/10		0/t[3]			
	SC	1/0	0/5		t/0			
	S	2/t	t/t		0/t			
Silver fir	TC	3/0	73/27	0/33	2/4	6/23	2/7	2/5
	SC	3/0	0/2	0/2	1/1	t/3		t/0
	S	1/0	1/1	0/t	1/0	t/1		2/1
Spruce	TC	0/1	t/4	0/4	t/4	0/5	t/10	0/1
	SC				t/t		0/t	
	S				t/t	0/t	0/t	t/0
Yew	TC	0/20	3/4	0/8	t/t	0/8	75/7	0/1
	SC		1/1		2/3	3/13	0/4	
	S		2/4	0/t	t/1	t/1	t/2	1/0
Deodar	TC					0/6	0/5	
Cherry	TD		t/1	t/0	3/7	2/t		
	SD		t/1		t/1	0/t	0/S	0/1
	S				1/t	0/t	t/1	3/0
Horse chestnut	TD		1/1	80/42	1/4	5/t		
	SD		3/0		0/t	2/1	t/2	
	S		1/t	t/1	t/1	3/2	t/0	0/t
Maple	TD		4/8	6/2	2/1	72/26	21/32	0/11
	SD		0/1		0/t	0/t	0/11	5/4
	S			0/t	0/t	0/t		0/t
Birch	TD					0/1	1/0	0/27
	SD		0/1					72/23
	S							0/2
Oak	TD				75/51			
	SD				0/t			
	S				t/2			
Walnut	TD			0/1		t/0	t/4	
	SD						0/3	
	S			t/t				
Sorbaria lanata	TD					t/t	t/0	
	SD		0/2			t/t	1/3	5/2
	S		0/t			0/t		0/5
S. tomentosa	S	0/3	0/t		t/0			
Populus ciliata	TD				0/t			
Cotoneaster spp.	S	t/1	0/t		t/t	t/t	t/t	1/t
Viburnum foetens	S	5/2	3/5	4/1	7/10	1/2	1/1	1/4
V. cotinfolium	S	t/1	t/3		1/1	t/1		1/0
Lonicera spp.	SD		0/t					
	S	2/t	1/4	t/t	t/1	t/3	t/t	8/8
Berberis spp.	S	t/t				0/t		
Spiraea spp.	S	t/0	t/1		t/t	t/1		3/5
Syringa emodi	S		t/2	0/t	t/t			0/1
Salix spp.	SD		0/3					
	S		t/3		0/t			
Skimmia laureola	S	0/t	2/3	0/t	t/3	1/9	1/1	t/t
Rosa spp.	S		t/2		t/1	t/1	0/t	2/2
Rubus spp.	S		t/t	t/t	t/0			
Ribes himalense	S		t/t		t/1	0/t		
Indigophera spp.	S	0/2	t/0	0/t	1/t	t/t		0/t
Rhamnus purpurea	S			0/t	t/t	0/t		

Notes: [1]TC=tall coniferous, SC=short coniferous, TD=tall deciduous, SD=short deciduous, S=shrub.
[2]Pine, fir, horse chestnut, and oak stands were present at Machiara. Maple, yew-maple, and birch stands were located at Salkhala.
[3]t=<0.5% cover.

Life-forms and plant species differed between study areas. Short deciduous, shrub, and tall deciduous life-forms (DFA and MANOVA) as well as tall coniferous life-form (DFA) were different ($p<0.001$) between areas. However, only 64% of the groups were correctly classified. Plant species composition was different ($p<0.001$) and 99% of the groups were correctly classified. Each of the seven plant species that were entered into the model differentiated the two study areas. In addition, the stands identified at the study areas were different from one another. Thus, for analytical purposes, the study areas were treated separately.

HABITAT USED BY TRAGOPANS

At Machiara, most birds (54%) were located in the oak stand and utilized it according to availability (54%). Although pine composed 15% of the study area, only 7% of tragopans were sighted in this stand and it was not selected (SI=-0.67). Twenty-three and 16% of the tragopans frequented fir and horse chestnut stands, respectively. Fir stand was utilized as it occurred on the study area. However, the horse chestnut stand was used in greater proportion (SI=+0.33) than it occurred (8%). The horse chestnut stand occurred at a lower elevation and tragopans were observed in this area largely during April. By May, birds moved to other stands which were higher in elevation.

The majority of tragopans (63%) at Salkhala were found in the maple stand, whereas the remaining birds were almost equally distributed in the birch (21%) and yew-maple (16%) stands. All stands were utilized as they occurred on the study area. Results from this study indicated that birds were associated more commonly with deciduous or mixed forests rather than coniferous forest in both areas. Generally, there was little selection at the stand level.

Use of short deciduous life-form (DFA and MANOVA) differed ($p=0.002$) between study areas. However, 68% of the groups were correctly classified, which indicated that the two study areas were not used differently on the basis of life-forms by the birds. Thus, birds were associated with similar life-forms in both study areas, which suggested that structural components are an important aspect of the habitat of Western Tragopans. Percent use of five of the seven plant species was different ($p<0.001$) between study areas. Two variables (kharsu oak and blue pine) were not entered into the model since they were not present in both study areas. A total of 81% of the groups were correctly classified. From these results it was inferred that % use of plant species was different between the two study areas and that the birds were not associated with particular plant species.

Use of life-forms between males and females at

Machiara was not significantly different. However, % use of shrub life-form at Salkhala was dissimilar ($p=0.03$) between males ($\bar{x}=5\%$) and females ($\bar{x}=21\%$) (Table 2). Comparisons of males showed that % use of short deciduous life-form was different ($p=0.04$) between Machiara ($\bar{x}=1\%$) and Salkhala ($\bar{x}=10\%$) (Table 2) but there was no difference in % use of life-forms by females. These results indicated that overall use of life-forms was almost identical between sexes within and between study areas. These results further suggested that birds were associated with structural components of habitat, particularly the shorter life-forms. Results of % use of plant species between males and females within each study area indicated that there was no significant difference. There was a significant difference in % use of plant species when comparisons were made of males and of females between study areas. Maple, birch, horse chestnut, and kharsu oak were used disparately ($p<0.001$) by males at Machiara and Salkhala (Table 3). Maple was the only species used differently ($p=0.06$) by females between Machiara ($\bar{x}=3\%$) and Salkhala ($\bar{x}=19\%$) (Table 3). These results revealed that % use of plant species by sexes within each study area were virtually identical. However, % use was different between areas because of differences in plant species composition. Use of life-forms was consistent between study areas, however.

TABLE 2

Percent cover available and used of life-forms at Machiara and Salkhala study areas, Pakistan, 1982-83

	% available cover/% used cover					
	Machiara			Salkhala		
Life-form	Male	Female	All birds	Male	Female	All birds
Tall coniferous	31/19	31/19	31/20	27/16	27/20	27/21
Short coniferous	2/5	2/5	2/5	2/10	2/15	2/12
Tall deciduous	42/37	42/30	42/34	41/36	41/22	41/30
Short deciduous	1/1	1/3	1/2	10/10	10/3	10/7
Shrub	8/10	8/14	8/12	5/5	5/21	5/9

TABLE 3

Percent cover available and used of plant species at Machiara and Salkhala study areas, Pakistan, 1982-83

	% available cover/% used cover					
	Machiara			Salkhala		
Plant species	Male	Female	All birds	Male	Female	All birds
Silver fir	22/13	22/8	22/11	4/11	4/20	4/17
Blue pine	11/5	11/9	11/6		Not present	
Yew	3/6	3/5	3/5	27/15	27/11	27/16
Kharsu oak	32/21	32/19	32/21		Not present	
Horse chestnut	13/21	13/9	13/10	4/1	4/1	4/1
Maple	3/3	3/3	3/3	44/32	44/19	44/26
Birch	0/0	0/1	0/t[1]	12/12	12/14	12/11

Note: [1] t=<0.5% cover

BIRD-HABITAT RELATIONSHIP

Means from % used and % available for life-forms and plant species (Table 1) within study areas, were used to interpret results from MANOVA. Percent of tall coniferous and tall deciduous life-forms was different ($p<0.001$) between areas used and those available at Machiara (Table 2) and tall life-forms were used neutrally or not selected by both sexes (Table 4). Males and females selected for the following life-form categories at Machiara: shrub, short coniferous, and short deciduous. At Salkhala, use of shrub, short coniferous, and tall deciduous life-forms was different ($p<0.001$) from availability. Tall coniferous and tall deciduous life-forms were used neutrally or not selected, whereas shrub and short coniferous life-forms were selected (Table 4). The short deciduous life-form was slightly selected by males and not selected by females. Short coniferous was the most strongly selected life-form by males in both areas. The short deciduous life-form at Machiara and the short coniferous life-form at Salkhala were strongly selected by females. Additional comparisons of % used and % available life-forms indicated that males used the tall deciduous life-form at Machiara and the short coniferous life-form at Salkhala differently ($p<0.001$) from availability (Table 2). The shorter life-form was selected, whereas the taller life-form was not (Table 4). Use by females of tall

TABLE 4

Selection indices for life-forms by Western Tragopans at Machiara and Salkhala study areas, Pakistan, 1982-83

Life-form	Machiara			Salkhala		
	Male n=30	Female n=22	All birds n=57	Male n=26	Female n=12	All birds n=43
Tall coniferous	-0.13	-0.24	-0.15	-0.14	-0.02	0
Short coniferous	+0.50	+0.43	+0.43	+0.67	+0.76	+0.71
Tall deciduous	-0.02	-0.10	-0.05	-0.11	-0.22	-0.12
Short deciduous	+0.33	+0.71	+0.50	+0.09	-0.58	-0.07
Shrub	+0.41	+0.43	+0.40	+0.03	+0.69	+0.37

Note: +1.0 Exclusive selection
-1.0 Total avoidance
0 Neutral use

coniferous life-form at Machiara and short coniferous, shrub, and tall deciduous life-forms at Salkhala was different ($p<0.001$) from that available (Table 2). Tall coniferous and tall deciduous life-forms were not selected, whereas shrub and short coniferous life-forms were selected (Table 4). In general, the shorter life-forms were selected and the taller life-forms were used either neutrally or not selected.

Comparisons of % use of plant species with availability at Machiara revealed that use of silver fir and kharsu oak was different ($p<0.001$) from availability (Table 3) and these species were used neutrally or not selected by either sex (Table 5). Blue pine was not selected by males and was used neutrally by females. Yew was selected and kharsu oak was not selected by males and females combined. Maple was used as it occurred by males but was selected by females. Although birch was strongly selected (+1.0) by females, it only accounted for 0.2% of the total vegetation sampled. The selection for yew may reflect that it occurred in the short coniferous category (Table 1) which was strongly selected by both sexes. Blue pine, silver fir, kharsu oak, and horse chestnut, which were used neutrally or not selected, were in the tall coniferous or tall deciduous life-forms. At Salkhala, use of silver fir and maple was different ($p<0.001$) from availability. Both sexes strongly selected

TABLE 5

Selection indices for plant species by Western Tragopans at Machiara and Salkhala study areas, Pakistan, 1982-83

Plant Species	Machiara			Salkhala		
	Male n=30	Female n=22	All birds n=57	Male n=26	Female n=12	All birds n=43
Silver fir	-0.14	-0.30	-0.20	+0.56	+0.74	+0.63
Blue pine	-0.41	0	-0.26		Not present	
Yew	+0.45	+0.25	+0.33	-0.23	-0.42	-0.20
Kharsu oak	-0.03	-0.12	-0.05		Not present	
Horse chestnut	-0.04	-0.22	-0.12	-0.75	-0.56	-0.56
Maple	0	+0.14	0	-0.10	-0.40	-0.21
Birch	-	+1.0	+1.0	0	+0.11	0

Note: +1.0 Exclusive selection
-1.0 Total avoidance
0 Neutral use

silver fir; yew, maple, and horse chestnut were not selected (Table 3). Birch was used as it occurred by males but was selected by females. Blue pine and kharsu oak were not present at Salkhala. Horse chestnut, maple, and yew were in the taller life-form categories, whereas birch was in the short deciduous life-form. However, silver fir was strongly selected even though it occurred in the tall coniferous life-form. Percent use of oak and fir by males was different ($p<0.001$) from availability (Table 3) at Machiara and neither was selected. At Salkhala, males used fir and maple differently ($p<0.001$) from availability (Table 3); maple was not selected and silver fir was selected (Table 5). Comparisons of % used and % available plant species by females showed that fir and oak were different ($p<0.001$) at Machiara from availability (Table 3) and were not selected. At Salkhala, fir and maple were different ($p<0.001$) from that available (Table 3) to the birds; silver fir was selected and maple was not selected (Table 5). In general, plant species characteristic of the taller life-forms were used neutrally or not selected.

The strong association with the shorter life-forms may be an indication of several factors. One possible explanation is that females that were nesting and raising broods during this study needed overhead cover for protection. Nests of tragopans were reported in trees (Beebe 1926,

Delacour 1957, Wayre 1969, Roberts 1970, Grzimek 1972, Ali and Ripley 1980). However, all sightings of nests by local villagers in the study areas were on the ground. Because Western Tragopans are monogamous (Ali and Ripley 1980), both sexes likely would be associated with the same life-forms in a particular habitat. Another possible reason may be food. Western Tragopans reportedly feed on leaves, buds, roots, seeds, berries, and fruits, and a small amount of animal food (Delacour 1957, Wayre 1969, Roberts 1970, Grzimek 1972, Ali and Ripley 1980). Most of these food items may be procurred most readily from plants in the shorter life-forms. A third explanation is that males are brilliantly coloured and dense cover from shorter life-forms would provide better protection from predators. However, this would not necessarily be an advantage to females because of their cryptic colouration.

Habitat selection by Western Tragopans occurred at the structural level but there was little or no selection at the stand and plant species levels. Although some of the previously published results were substantiated by this study, the majority of information contradicts previous findings. These differences may reflect that most studies on Western Tragopans were anecdotal and/or very small sample sizes of birds were used to base conclusions. Gaston et al. (1981) reported that Western Tragopans in

India preferred coniferous forests (silver fir and spruce) where over 75% (n=12) of sightings were located; the remaining birds were observed in mixed (horse chestnut, walnut, elm, birch, and bird cherry) and high altitude kharsu oak forests. Roberts (1970) stated that these birds generally were associated with forests of spruce and silver fir in Pakistan. However, results from this study indicated that Western Tragopans were more commonly associated with mixed or deciduous forests rather than coniferous forest.

Bamboo, characteristic of tragopan habitat in India, was absent from the study area; however, Viburnum foetens and Lonicera sp. probably provided structurally similar habitat. Even though the taller life-forms were used neutrally or not selected, they were a major structural component of six of the seven stands at the study area, were used by tragopans, and may be a necessary component of tragopan habitat.

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