CHAPTER 5

FOOD AND FEEDING ECOLOGY

5.1 Introduction

Food is basic to an animal's survival and thus a large part of an animal's activities is devoted to procuring these resources. The quality and quantity of food are important factors that determine many aspects of the physical condition, breeding performance and chick survival in several species of birds. There is tremendous radiation in the diets of each animal species (Alcock 1989). Even in some closely related species each member has its own food choice and feeding, e.g. the Galapagos finches (Lack 1971). The traditionally favoured hypothesis for dietary differences is that competition among different species conferred a reproductive advantage on those individuals that reduced overlap in food preferences. However some ecologists now believe that different diets of animals could be an incidental effect and had little or nothing to do with reduction of ecological overlap in food demands (Alcock 1989).

Among the phasianids diet varies between different groups and seasons though food is available either below or above the ground. Food of pheasants includes seeds, leaves, flowers, stems, buds, tubers, roots, insects, annelids and even reptiles (McGowan 1995). Very little quantitative information is available on the diet of Himalayan pheasants. Most of the available information is from naturalists who shot these birds as game in the last century or early part of this century. It is however certain that diet of pheasants include all types of food matter and depends to a large extent on their habitats and thus the availability of food resources.

Pheasants of the genus *Tragopan* are almost similar in their food habits to each other. According to Johnsgard (1986) all the Tragopan pheasants are herbivores and invertebrate feeders with a partiality towards insects. Food varies from leaves, seeds, berries, fruits, roots, buds, acorns, annelids, insects and molluscs. In captivity all the species are preferably vegetarian (Howman 1979, Sivelle 1979). Grit is another important part of the diet of phasianids. The gizzard is highly muscular with ridged inner lining adapted for grinding up fibrous vegetable food. Like domestic chickens they swallow small stones and grit which are retained in the gizzard to help grind up the food.

According to Hume and Marshall (1879-1881) the Satyr Tragopan feed on insects, young green shoots of bamboos and on some onion like bulbs. Hodgson (in Hume and Marshall 1879-1888) found wild fruits, rhododendron seeds, and in some cases entirely aromatic leaves, bastard cinnamon and daphne in the crop of Satyr Tragopan. According to Baker (1920) the favourite food of the Satyr was bulbs and roots of plants, which they dug up. They also fed on seeds, shoots and tendrils. However there was no evidence of the birds eating insects and reptiles. The Satyr Tragopan was considered to be omnivorous by Beebe (1918-1922) specialising in buds and leaves. He found leaves and flowers of paper laurel, rhododendron petals and insects to be the diet of the birds in their habitat. Ferns like *Diplazium* sp. and *Polypodum* sp. were also known to be eaten by the birds (Meinertzhagen 1926).

Lelliott and Yonzon (1980) during their studies in Central Nepal found the species feeding on the leaf litter and stream debris or on mossy areas. They were also found to be feeding on the fruits of *Berberis* sp., *Symplocos* sp. and *Rhododendron* sp.

From faecal analysis they found leaf, moss, grass, roots, quartz fragments and an insect wing suggesting an omnivorous diet. Yonzon and Lelliott (1980) observed the Satyr to be primarily a vegetarian feeding on moss lichen, leaves, grass, roots, buds and few insects. Quartz fragments as grit were also a part of their diets. While studying the diets of pheasants in Pipar (Central Nepal) Bhandary *et al.* (1986) found that moss and grass leaves were the two main autumn foods of the birds. Thus, it seems that by and large the Satyr Tragopan is an omnivorous species in its habitat in the wild. In captivity the species is largely vegetarian feeding on fruits and berries (Howman 1979). Apart from these they are also observed to feed on alfalfa grass, squash, cucumber, apples, raspberries, mulberries, cut grapes and even small-shelled green peanuts (Seville 1979).

Most of the phasianids feed on the ground although some may climb into bushes or even low branches of trees like *Rhododendron* sp. and *Symplocos* sp. The Satyr Tragopan confine their foraging activities to early morning and late afternoons but during cloudy days they forage at more irregular intervals (Johnsgard 1986). The species mainly feed on open edges of the forest or deep among the undergrowth where they scratch spots (Baker 1920, Beebe 1918-22). Lelliott and Yonzon (1980) observed the species feeding principally in the early mornings and late afternoons. A large part of their observations included arboreal foraging in *Berberis* sp., *Symplocos* sp. and *Rhododendron* sp. plants

Direct observations on the feeding and foraging behaviour of Satyr Tragopan were extremely rare due to the shy and elusive nature of the birds. I did not observe the birds feeding on more than 2-3 occasions during the tenure of my studies.

Therefore an alternative method to determine the diet of the species was necessary. Satyr Tragopan is a Schedule I species under the Indian Wildlife (Protection) Act 1972 and killing of the birds for merely taking crop, gizzard and stomach contents is neither permissible nor practicable. Thus analyses of the crop, gizzard and stomach contents were ruled out and the most non-invasive (Poulsen and Aebischer 1995) method of diet determination - faecal droppings analysis was adopted.

This chapter besides discussing the diet of the species also discusses the availability of different plant parts and invertebrates available in the habitat. I have addressed the following aspects:

1.Identification of the main food items of the Satyr Tragopan.

2. Seasonal fluctuation in the diet of the species.

3. Seasonal availability of plant parts and invertebrates.

4. Comment on the microtechnique used for galliform faecal analyses.

5.2 Methodology

5.2.1 Faecal analysis: This is one of the best and most widely used technique for diet determination though it is labour intensive and considered inaccurate by some workers (Slater and Jones 1971, Fitzgerald and Waddington 1979). Faecal analysis is based on the assumption that some part of the plant or animal material (plant epidermis, elytra, legs, mandibles, fangs, sometimes wings, seed and bracts) ingested by the species can resist the physiological process of digestion and pass through the gastrointestinal tract in an undigested form (Marti 1982, Mayers 1985).

The characteristic shapes of the epidermal cells of plant parts and the structure of the stomata are the keys in identifying the plant species in the microtechnical analyses of droppings (Fitzgerald and Waddington 1979)

5.2.1.1 Field: All the droppings of Satyr Tragopan that were found during regular trail monitoring as well as outside these were collected in plastic packets. They were then transferred to paper trays for air or oven drying depending on the season of collection. The droppings were then labelled and sealed in new polythene packets and stored in an air tight container with camphor and a desiccating agent like silica gel. All the places from where droppings were collected were temporarily marked for carrying out vegetation sampling studies. While monitoring the trails for evidences, care was taken to see that no faecal material was left behind at the site of collection.

5.2.1.2: Preparation of reference slides: Microtechnical procedures like faecal analyses require the presence of reference slides (Dusi 1949) of some plants representing the habitat of the species to aid in the identification of plant parts (Storr 1961). Baumgartner and Martin (1939) who developed the use of microtechnique in dietary analyses compared squirrel stomach contents with permanent reference slides. A reference collection comprising of plant parts was made by first preserving the freshly collected plants in 70% ethanol (Starling 1993) for 24 hours. Pieces of epidermis were then stripped off from the preserved plant parts. They were then passed through the ascending grades of ethanol for dehydration (30%, 50%, 70%, 90% and 100%) and then cleared in xylol. Permanent mounts were made by mounting in DPX or Canada Balsam. I did not use any staining technique to stain the materials as unstained mounts prepared from fresh plants required less time and was not cumbersome in the field. Besides Zyznar and Urness (1969) found that unstained mounts proved superior to staining techniques for identification.

5.2.1.3 Preparation of faecal droppings slides: All the faecal droppings were analysed according to seasons and therefore all droppings belonging to one season were considered as one major sample. From the preserved major sample 1-5 droppings were pulverised which comprised of a pooled sample and was used for the main analysis. This was cleared in 10% NaOH solution and boiled for 3-5 minutes times with 3-4 changes of the NaOH solution. The excess solution was then drained off and the settled volume poured on a petri-dish. A dropper extracted 10 sub-samples from this sample on 10 glass slides. The sub-samples/materials were allowed to air dry after which they were mounted in glycerol (Bhandary *et al.* 1986, Kaul 1989). The slides were examined in 50X and 100X magnification levels interchangeably (Holechek and Valdez 1985). Plant parts were counted by recording the frequency of occurrence of plant fragments in a microscopic field of view (presence/absence). Although frequency of occurrence tends to overestimate rare and underestimate common species (Hanson 1970) it is still the most widely used technique. Twenty frequency/fields of observations per slide and five slides per sample were considered adequate for a reasonable estimation of species comprising 20% or more of the diet (Holechek and Vavra 1981). For more adequate representation I made 20 fields/frequencies of observation per slide for ten slides per sample (major sample) to identify and enumerate the proportions of different plants present in the droppings. I did not use separate slide preparation for identifying invertebrate parts in the faecal droppings but I made an attempt to classify the different invertebrate parts observed in the slides by using the keys provided by Moreby (1987, 1993) and assigned them to their classes, orders and families where possible. However I made no attempts to classify the size of invertebrates nor rounded up numbers of their parts to the nearest whole number of individuals.

5.2.2 Phenology: As Satyr Tragopan are primarily ground feeders, phenological studies were carried out in the intensive study area to record the phenophases of some herb species which may be potential food items of the Satyr Tragopan. Phenological studies were carried out along one of the trails used for regular monitoring and which was situated nearest to ~~form~~ the base camp because of convenience and also because of a stringent field schedule. Monthly records of the phenophases for all plant types were made by assigning abundance ratings (Frankie *et al.* 1974, Guy *et al.* 1979, Opler *et al.* 1980, Balsubramanium and Bole 1991) where 0= none, 1 = few and 2 = many. For ground cover which included 19 species, phenological records were made in 1m x 1m permanent quadrats and the parameters recorded were leaf bud, immature leaf, mature leaf, flower bud, flower, immature fruits, mature fruits, fallen fruits and dead plants (annual species).

5.2.3 Pitfall trap sampling: Satyr Tragopan is known to feed on certain insects and invertebrates. Thus it was found necessary to sample these for estimation of invertebrate availability. For this 9 pitfall traps were laid in a grid of nine pitfall traps 1 m apart (Southwood 1978) in different habitat types. Each pitfall was a plastic cup of 2.5cm diameter and 12 cm height. Each was filled with a mixture of detergent and water to reduce surface tension to enable the trapped invertebrates to sink. Fortnightly collections were made and the collected specimens were preserved in 70% ethanol, labelled and sealed for identification.

5.2.4. Core sampling: While conducting vegetation sampling, the ground cover was quantified in two 1 m x 1 m quadrats within the animal and random plots. From every such plot soil samples were collected by means of an iron core which was 4 cm in diameter and 4 cm in height. Soil samples along with its contents were preserved in polythene packets by loosely tying up the mouths of the packets. Once in the laboratory the soil samples were subjected to the Tullgren funnel method of extraction. The extracted microarthropods were then preserved in 70% ethanol and sent for identification to the Zoological Survey of India.

5.2.3 Analyses: The prevalence of each food item was expressed as a Food Importance Index (Beck 1952 in Bhandary *et al.* 1986). Beck (1952) developed the food rank index to represent the importance of food items in the diet of any animal species using the principal measurable factors involved in food habits data like volume, weight and occurrence. It was derived by the formula x.y.z = R, where x = % volume of food times 100, y = % occurrence of food, z = specific gravity of the food item. This index was mainly useful for studies done by crop analysis, as the derivation of the formula requires the measurement of specific gravity of the food items. In studies involving the diet of Himalayan pheasants including the Satyr Tragopan where crop analysis is not practicable the index has been used by suitable modifications, as a food importance index i.e. Food Importance Index = Frequency% + Composition%/2 (Bhandary *et al.* 1986).

According to Holechek and Gross (1982), dividing the frequency of occurrence of each species by the total frequencies of occurrence of all species was found to be a slightly more accurate representation of dry weight composition than converting frequency to relative density or actual density (Sparks and Malchek 1968). Therefore I divided the frequency of occurrence of a particular food item in a sample slide by the total frequencies of occurrence of all food items occurring in that sample slide to obtain percent composition (multiplying by 100). Kruskal-Wallis One Way ANOVA and Parametric One Way ANOVA were used to test for differences in variables. Mann-Whitney U tests were used for testing differences between any two variables.

Compositional analysis was used to determine food selection among the important ground cover species identified from the faecal droppings of the Satyr Tragopan. The method of compositional analysis (Aitchison 1986) has been specifically developed for analyses of multivariate data in the form of a set of proportions that sum up to one (known as composition). One of the main principles underlying this method is that all the sample types (habitat types, plant species) have to be considered simultaneously so that the results obtained are independent. Aebischer *et al.* (1993) has discussed the application of this statistical technique on data generated from radio telemetry in detail. Although it was designed to analyse multivariate habitat data from radio telemetry it can also be used for activity budgets and dietary analysis (Aebischer *et al.*1993).

For compositional analysis eight food items were identified based on their food importance index and their consistency of occurrence in all four seasons through dietary analysis. These were ferns, *Pilea scripta, Poa annuae, Primula* sp., *Theropogon pallidus, Valeriana jatamansi, Vaccinium nummularis* and others (*Impatiens sulcata, Senecio* sp. *Stachys sericea*). Food utilised was determined from proportions of each of the 8 dietary items per slide for a total of 10 slides giving a sample size of 10. This was expressed as percentage food composition and was calculated by the frequency of occurrence of the particular food plant in one sample slide divided by the total frequency of occurrence of all the other food plants in that given slide multiplied by 100. Thus in compositional analysis one slide was treated as a single sample and on the whole the sample size per season was 10. The availability of each plant species was derived by the formula Availability = number of plants of each species + average height of each species/2. The density and height were recorded in 1m x 1m quadrats together with ~~other~~ other phenological data. The availability and utilisation of each of these plant species was expressed as proportions which when summed equalled one and could not be considered independent from each other (unit sum constant). These proportions were made independent from each other by 'logratio' transformations or In (p/q) where q=1-p used as a standard in the analysis of proportions. In this study the proportions of availability and utilisation were obtained by dividing the proportions of the seven food types by the proportion of the eighth. The results obtained were independent of the plant species used as the denominator. The hypothesis to be tested by this analysis was that if there was no food selection then the logratio difference across all the sample slides would be zero. This was tested by using the multivariate analysis of variance, Wilks Lambda (λ), the significance of which would indicate a non-random use of the food plants. The preference and avoidance of each plant species was calculated by considering all the logratios of each plant species and by subtracting matching logratios for availability and utilisation of each plant species used. The signs of logratio difference were set into a matrix from which the different plant items were ranked. A complete row of + signs indicated a high preference for that plant item and a row of - signs indicated an avoidance of that plant item. To test for significant deviation of logratio difference from zero a t- test was used.

5.3 Results

5.3.1. Food resources availability: Food was available to the Satyr Tragopan in the form of plant materials and invertebrates. The over all availability (density and height of ground cover) differed across the seasons (density $F_{3,128} = 2.782$, p=.044; height $F_{3,128} = 8.626$, $p \leq 0.0001$) and also between the predominant species of ground cover (density: $F_{10,121} = 16.73$, p = ~~.000~~ <0.001; height: $F_{10,121} = 8.269$, p = ~~.000~~ <0.001). The density and height of some annual species of ground cover plants fluctuated across the four seasons (Table 5.1). Ground cover density was maximum during the monsoon and post-monsoon months and scarce in late winter and early pre-monsoon (Fig 5.1).

Insects, mites and spiders were available as animal food items to the Satyr Tragopan. These were either Dipterans (flies), Coleopterans (beetles), Hymenopterans (ants) and Arachnids (spiders) (Table 5.2)

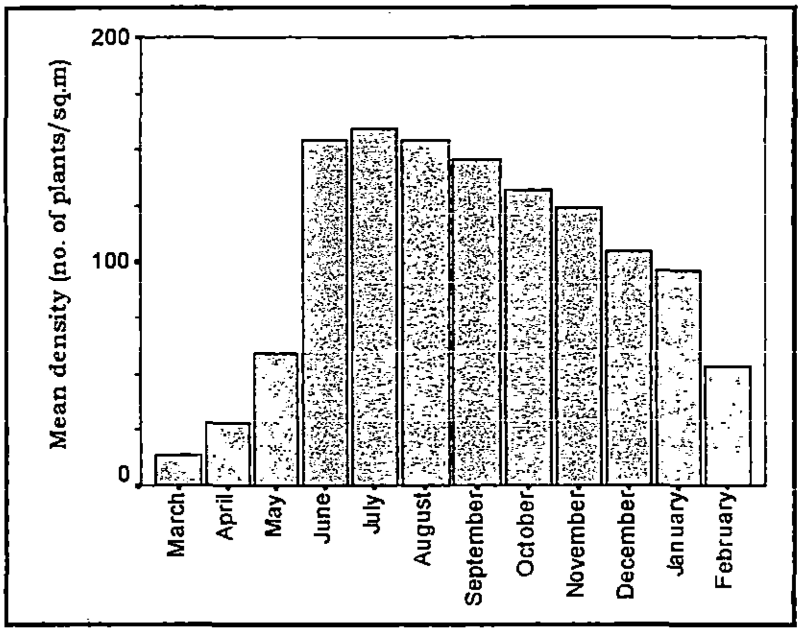
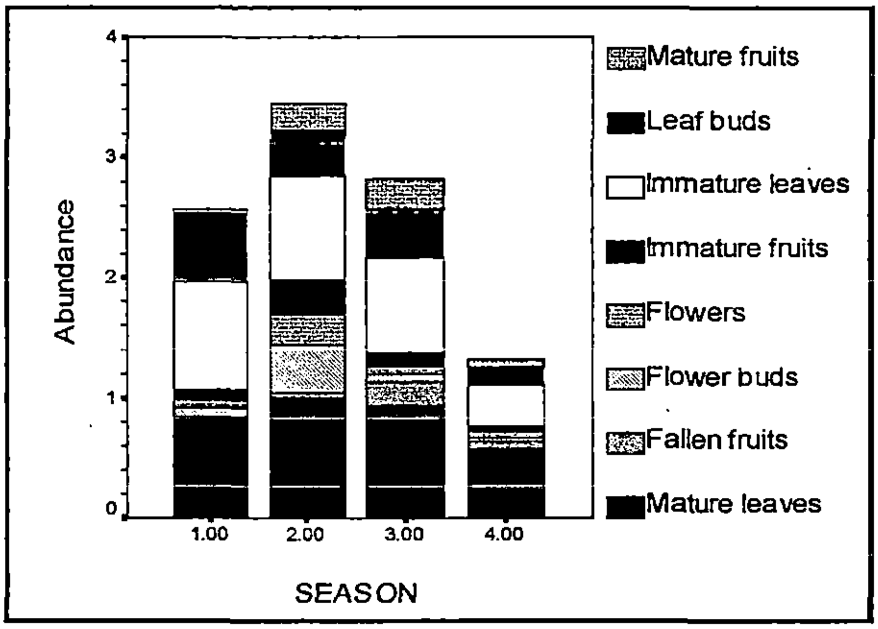


Fig. 5.1: Monthly availability (density) of dominant cover ground cover in the Singhalila National Park



Legends: Season: 1= pre-monsoon, 2= monsoon, 3= post-monsoon, 4 = winter
Abundance: 0= none, 1 = few, 2= many, 3= abundant

Fig. 5.2 Showing the different phenological phases of dominant ground cover species across the seasons

Table 5.1: Showing F values (df 3,8)obtained by One Way ANOVA on density and height of ground cover food items across four seasons in Singhalila NationalPark.

Species	Density (stems/km^2)	Height (cm)
Erigeron sp.	5.714*	1.396
Fern	1.308	4.915*
Impatiens sulcata	3.707	1.256
Pilea scripta	2.427	3.881*
Poa annuae	5.081*	8.257*
Primula sp.	3.909*	.745
Stachys sericea	2.874	8.257*
Senecio sp.	11.067*	2.874
Theropogon pallidus	3.153	6.044*
Vaccinium nummularia	3.153	6.044*
Valeriana jatamansi	4.393*	11.672*

* = $p < .05$. Rest ~~insignificant~~ non-significant

Table 5.2: Showing the various orders and families of arthropods available to the Satyr Tragopan as animal food items in the SNP.

Order/Family	Family
Diptera	Tipulidae
	Biblionidae
	Sciaridae
	Mycetophilidae Phoridae
	Tephritidae
	Muscidae
	Calliphoridae
	Tachinidae
Coleoptera	Carabidae
	Cerambycidae
Hymenoptera	Ichneumonidae
	Brachonidae
	Formicidae
Arachnida	Clubionidae
	Agelenidae

5.3.2 Direct observations: In the field I observed the Satyr Tragopan to be ground feeders and they were observed to feed on plants like *Pilea scripta, Theropogon* *pallidus, Stachys secricea, Saxifraga nutans* and ferns. On one occasion I found the seed of *Symplocos theifolia* in the droppings.

5.3.3 Diet from faecal analysis: A total of 23 food items were identified from the faecal droppings of the Satyr Tragopan in all the four seasons of the year. The highest variety in the diet was found in the post-monsoon season and the monsoon season when 23 and 20 items were present respectively in the diet. In the colder and drier seasons i.e. the pre-monsoon and winter 17 and 18 food items were present respectively which perhaps indicated a slightly greater variety of food items consumed by the birds during the wet and moist seasons of the year than in the drier ones. *Arundinaria maling* was the most important food component identified from the diet of the Satyr Tragopan in all four seasons. Besides this other perennial plants like *Pilea scripta, Theropogon pallidus, Vaccinium nummularia, Cotaneaster microphyllus*, annuals like ferns and non-plant material in the form of quartz fragments were the major components identified in the droppings of the Satyr Tragopan (Table 5.3). Based on the percent composition of each food item identified from the droppings, the food items of Satyr Tragopan can be categorised into three groups (i) Major food components or those food items forming more than 10% of the total composition; (ii) Minor food components or those food items forming less than 10% but more than 1% of the total composition and (iii) Trace food items which form less than 1% of the total composition.Kruskal Walis One Way ANOVA showed that out of the 23 food items in the diet of the Satyr Tragopan, the percent composition of only 7 food items fluctuated across the four seasons (Table 5.4). This perhaps indicated that although the main food components in the diet remained the same some of the minor components of the diet changed with the seasons .

On the other hand, apart from the seven food items the percent composition of four other food items varied significantly between two seasons. This indicated that the diet of the species may vary between any two given seasons (Table 5.5) although this variation may not be apparent across all the seasons.

Table 5.3: showing the seasonal Food Importance Indices (FII) of different food items identified in the faecal droppings of Satyr Tragopan in SNP, Darjeeling.

Food items	PRM	MON	POM	WIN
Arisaemia griffithii	-	16.25	15.75	17.25
Arundinaria maling	75.75	70.25	64.5	68.25
Cotoneaster microphyllus	31.5	10.75	15.75	21
Erigeron sp.	5.25	10.5	26.75	26.5
Hemiphragma sp.	-	5.25	5.05	-
Impatiens sulcata	5.25	-	5.05	-
Pilea scripta	64.25	58	58.5	68
Primula sp.	54.25	45.75	47.75	41
Poa annuae	39	27.25	32.5	26.5
Polygonum molley	10.5	10.5	27	32.25
Plantago sp.	-	16	27	-
Saxifraga nutans	10.75	15.75	5.05	5.25
Stachys serecia	-	-	16.25	21.75
Senecio sp.	-	10.5	10.5	-
"Simjhar"	5.25	16.25	5.25	29
Thalictrum virgatum	-	-	5.25	-
Theropogon pallidus	51.75	49.75	55	66
Valeriana jatamansi	5.25	17	21.5	32.5
Vaccinium nummularia	53	25.25	39.25	57.25
Fern	58.25	37.75	21.5	17.5
Moss	29	5.25	55	22.5
Grit	21.46	56.75	70.5	79
Invertebrates	-	5.25	56	15.75

Table 5.4: Showing the χ^2 values obtained by Kruskal Walis One Way ANOVA for percent composition of seven food items across four seasons in the diet of Satyr Tragopan in the SNP.

Food items	χ^2	P value
Ferns	15.59	.0014
Grit	21.15	.0001
Moss	17.85	.0005
Primula sp.	7.82	.0500
Stachys sericea	8.34	.0394
'Simjhar'	13.08	.0045
Invertebrates	20.52	.0001

Table 5.5: Showing the Mann Whitney values for difference in percent food composition between two seasons at $p<0.05$.

Food items	PRM & MON	PRM & POM	PRM & WIN
Arundinaria maling	Z= 1.95	N.S.	Z=1.97
Valariana jatamansi	Z=1.96	N.S.	Z=1.96
Theropogon pallidus	Z=1.97	N.S.	Z=1.97
Plantago sp.	N.S.	Z=2.48	N.S.

5.3.3.1 Pre-monsoon: I identified 17 food items from the faecal droppings of Satyr collected in the pre-monsoon season. Fifteen of these were plant material, 1 was grit or quartz fragments and 1 invertebrate parts. Of these the major food items were *A. maling, P. scripta*, and *Poa annuae* which comprised 55% by composition of the pre-monsoon food items identified. *Primula* sp., *C. microphyllus, T. pallidus, V. nummularia*, fern, moss, grit and invertebrates comprised 43% by composition of identified items and were categorised as minor items, while *Erigeron* sp., *S. nutans*, "simjhar", *P. molley, I. sulcata* and *V. jatamansi* comprised 2% by composition of identified food items and were categorised as trace items (Figure 5.3).

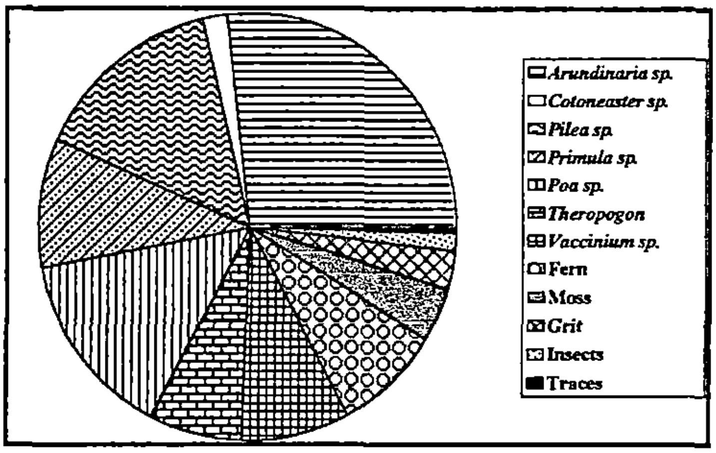


Fig. 5.3 Percent composition of food items in the diet of Satyr Tragopan (Pre-monsoon season)

Invertebrates alone comprised only 1.28 % composition of the diet during pre-monsoon and comprised of insects and annelids (Table 5.6).

Table 5.6 Invertebrate structures identified from the faecal droppings of Satyr Tragopan in the pre-monsoon season

CLASS	ORDER/FAMILY	STRUCTURE	NUMBER
Insecta	Hemiptera-Miridae	labium	3
	Hemiptera Cicadellidae	hind tibia	1
	Coleoptera-Scarabidae	front tibia	1
	Coleoptera-Scarabidae	mid tibia	1
Annelida	-------		1

During pre-monsoon season there was a non-random use of the ground cover as food items (λ= .00192, p = .008, MANOVA). Fern was the most preferred plant item besides which *Vaccinium nummularia, Primula* sp., *Theropogon pallidus* and *Pilea scripta* were also significantly preferred. The Satyr Tragopan avoided *Valeriana jatamansi, Poa annuae* and others during this season (Table 5.7 and 5.8).

Table 5.7: Mean logratio differences (±1) between utilisation and availability of ground cover species identified in the diet of the Satyr Tragopan in SNP (Pre-monsoon season)

	Ferns	*P.scripta*	*P.annuae*	*Primula* sp	*T.pallidus*	*V.jatamansi*	*V.nummularia*	Others
Ferns	.	+2.79±.86**	+.92±1.35**	+1.98±0.75*	+2.02±0.90*	+6.79±0.56**	+1.98±065*	+7.74±1.02**
P.scripta	-2.79±.0.86**	.	+3.18±.99**	-0.80±.0.27	-0.81±1.41	+4.09±.77**	-2.05±1.29	+5.46±1.12**
P.annuae	-6.92±1.35**	-3.18±0.99**	.	-4.40±1.16**	-4.94±1.74*	-.021±1.29	-5.61±1.84*	+1.92±1.49
***Primula* sp**	-1.98±0.75*	+0.80±0.27	+4.40±1.16**	.	+0.36±1.44	+4.56±.84**	-1.51±1.31	+5.75±1.05**
T.pallidus	-2.02±0.90*	+.81±1.41	4.94±1.74*	-0.36±1.44	.	+3.97±1.02**	-0. 71±0.79	+5.78±1.62 **
V.jatamansi	-6.79±0.56**	-4.09±0.77**	+.021±1.29	-4.56±0.84**	-3.97±1.02**	.	-5.50±0.87**	+1.96±0.90
V.nummularia	-1.98±0.65*	+2.05±1.29	+5.61±1.84*	+1.51±1.31	+0. 71±0.79	+5.50±0.87**	.	+4.42±0.61**
Others	-7.74±1.02**	-5.46±1.12**	-1.92±1.49	-5.75±1.05**	-5.78±1.62**	-1.96±0.90	-4.42±0.61**	.

** = p < .01, *= p < .05, others not significant

Table 5.8: Ranks of plant species in the diet of Satyr Tragopan during the Pre-monsoon season

	Ferns	***P.scripta***	***P.annuae***	***Primula* sp**	***T.pallidus***	***V.jatamansi***	***V.nummularia***	**Others**	**Ranks**
Ferns	.	+++	+++	++	++	+++	++	+++	7
P.scripta	---	.	+++	+	-	+++	-	+++	3
P.annuae	---	---	.	---	--	-	--	+	1
Primula sp	--	+	+++	.	+	+++	-	+++	5
T.pallidus	--	+	++	-	.	+++	-	+++	4
V.jatamansi	---	---	+	---	---	.	---	+	2
V.nummularia	--	+	++	+	+	+++	.	+++	6
Others	---	---	-	---	---	-	---	.	0

+++/- - - = p <. 01, ++/- - = p< .05, +/- = not significant.

5.3.3.2: Monsoon: In the monsoon season the major food items were *Arundinaria maling, Pilea scripta, Theropogon pallidus* and grit comprising 68 % of the total food composition. The minor food items comprised 28 % and were represented by *Arisaemia griffithii, Primula* sp., *Poa annuae, Plantago* sp., "simjhar", *Valeriana jatamansi, Vaccinium nummularia* and fern. Trace items comprised 4 % and ~~was~~ were represented by *Cotoneaster microphyllus, Erigeron* sp., *Hemiphragma* sp., *Polygonum molley, Saxifraga nutans, Senecio* sp., moss and insects (Fig 5.4). Invertebrates formed only 0.31% of the food composition during this season and were represented by spiders and annelids (Table 5.9).

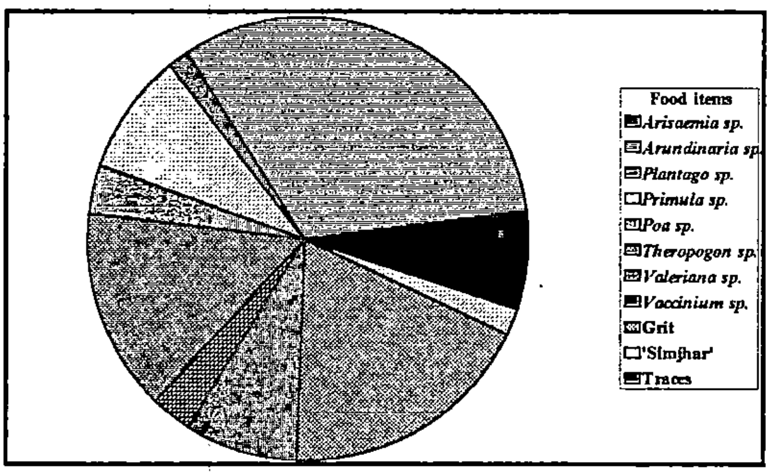


Fig. 5.4 Percent composition of food items in the diet of Satyr Tragopan. (Monsoon season)

Table 5.9: Invertebrate structures identified from the faecal droppings of Satyr Tragopan in the monsoon season.

CLASS	ORDER/FAMILY	STRUCTURE	NUMBER
Arachnida	Opiliones (harvestman)	fang	1
Annelida	-----		3

Table 5.10 : Mean logratio differences (±1) between utilisation and availability of ground cover species identified in the diet of the Satyr Tragopan in SNP (Monsoon season)

	Ferns	*P.scripta*	*P.annuae*	*Primula* sp	*T.pallidus*	*V.jatamansi*	*V.nummularia*	Others
Ferns	.	+0.51±1.51	+4.97±2.24	+0.02±1.65	-1.09±0.58	+2.32±2.14	+1.17±0.94	+-4.32±1.85*
P.scripta	-0.51±1.51	.	+4.70±1.22**	+-0.23±0.67	-1.82±1.57	+3.28±1.17*	+0.48±1.81	+5.47±1.18**
P.annuae	-4.97±2.24	-4.70±1.22**	.	-6.39±1.22**	-6.47±1.94**	-0.96±1.07	-4.36±2.09	+0.83±1.67
Primula sp	-.02±1.65	-0.23±0.67	+6.39±1.22**	.	-0.43±1.77	+4.30±1.08**	+1.01±1.95	+5.96±1.01**
T.pallidus	+1.09±0.58	+1.82±1.57	+6.47±1.94**	+0.43±1.77	.	+5.30±1.68*	+2.051±0.98	+7.02±1.14**
V.jatamansi	-2.32±2.14	-3.28±1.17*	+0.96±1.07	-4.30±1.08**	-5.30±1.68*	.	-1.02±1.99	+1.92±1.03
V.nummularia	-1.17±0.94	-0.48±1.81	+4.36±2.09	-1.01±1.95	-2.051±0.98	+1.02±1.99	.	+4.89±1.45**
Others	-4.32±1.85*	-5.47±1.18**	-0.83±1.67	-5.96±1.01**	-7.02±1.14**	-1.92±1.03	-4.89±1.45**	.

** = p < .01, * = p < .05, rest not significant.

Table 5.11: Ranks of plant species in the diet of Satyr Tragopan during the Post-monsoon season

	Ferns	*P.scripta*	*P.annuae*	*Primula* sp	*T.pallidus*	*V.jatamansi*	*V.nummularia*	Others	Rank
Ferns	.	+	+	+	-	+	+	++	6
P.scripta	-	.	+++	+	-	++	+	+++	5
P.annuae	-	---	.	---	---	-	-	+	1
Primula sp	-	-	++	.	-	+++	+	+++	4
T.pallidus	+	+	+++	+	.	++	+	+++	7
V.jatamansi	-	--	+	---	--	.	-	+	2
V.nummularia	-	-	+	-	-	+	.	+++	3
Others	--	---	-	---	---	-	---	.	0

+++/- - - = p <.01, ++/- - = p< .05, +/- = not significant.

The mean difference in availability-utilisation logratios during this season was $\lambda = .0237$, $p = .092$ (ns) indicating more of a random use of ground cover species. *Theropogon pallidus* and ferns were the most highly preferred items in proportion to others. *Pilea scripta, Primula* sp. were next in preference while *Vaccinium nummularia, Valeriana jatamansi, Poa annuae* and others were significantly avoided (Table 5.10 and 5.11).

5.3.3.3: Post-monsoon: In this season *Arundinanaria maling, Pilea scripta*, moss and grit made up the major food items which comprised 59% of the food composition. The minor food items consisted of *Erigeron* sp., *Primula* sp., *Poa annuae, Polygonum molley, Plantago* sp., *Theropogon pallidus, Valeriana jatamansi, Vaccinium nummularia*, fern and insects that comprised 36% of the food items. The trace items made up 4.5% of composition of food items and were represented by *Arisaemia griffithii, Cotoneaster microphyllus, Hemiphragma* sp., *Impatiens sulcata, Saxifraga nutans, Stachys sericea*, "simjhar", *Thalictrum virgatum* (Fig 5.5).

The invertebrates comprised 6.82% of the diet during the season which was the highest amongst all the seasons and were represented by a larger number of families (Table 5.12)

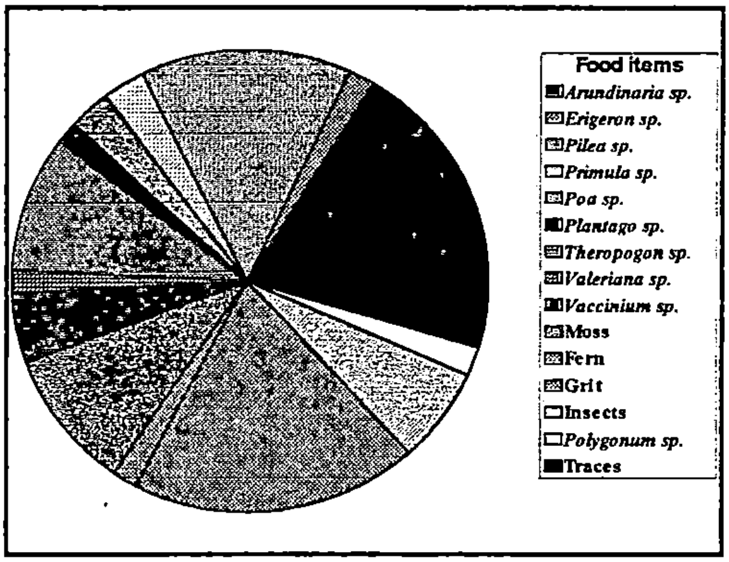


Fig.5.5: Percent composition of food items of Satyr Tragopan (Post-monsoon season)

Table 5..12: Invertebrate structures identified from the faecal droppings of Satyr Tragopan in the post-monsoon season.

CLASS	ORDER/FAMILY	STRUCTURE	NUMBER
Arachnida	Araneae	pedipalp	2
	Araneae	legs	20
	Opiliones	fang	2
Insecta	Hemiptera-Homoptera Cicadellidae	hind tibia	1
	Hemiptera--Homoptera Aphidae	tibia	3
	Hemiptera-Neuroptera	mandibles	1
	Diptera-Tipulidae	leg	1
	Coleoptera-Carabidae	mandibles	1
	Hymenoptera-Ichneumonidae	leg	1
Annelida			2

There was a significant difference in availability -utilisation ratios during this season (λ = .010, p = .039, MANOVA) indicating non-random use of the ground cover species available to the Satyr Tragopan in its habitat. *Theropogon pallidus* was the most preferred species after which *Vaccinium nummularia, Pilea scripta,*

Table 5.13: Mean logratio differences (±1) between utilisation and availability of ground cover species identified in the diet of the Satyr Tragopan in SNP (Post-monsoon season)

	Ferns	*P.scripta*	*P.annuae*	*Primula* sp	*T.pallidus*	*V.jatamansi*	*V.nummularia*	Others
Ferns	.	-1.32±1	+3.44±.11**	-2.21±0.81*	-3.05±1.59	+0.343±0.917	+2.821±1.41	+1.82±1.5485
P.scripta	+1.32±1	.	+4.56±1.02**	+0.11±1.78	-3.11±1.28**	+2.19±1.09	+0.92±1.41	+3.61±1.78
P.annuae	-3.44±.11**	-4.56±1.02**	.	-4.85±1.27**	-7.98±1.22**	-2.70±1.10*	-6.378±1.44**	-1.96±1.69
***Primula* sp**	+2.21±0.81*	-0.11±1.78	+4.85±1.27**	.	-1.82±0.98	+2.00±0.86*	-1.18±0.92	+3.75±1.01**
T.pallidus	+3.05±1.59	+3.11±1.28	+7.98±1.22**	+1.82±0.98	.	+4.80±1.05**	+1.371±0.94	+5.88±1.37**
V.jatamansi	-0.343±0.917	-2.19±1.09	+2.70±1.10*	-2.00±0.86*	-4.80±1.05**	.	-2.82±1.365	+1.41±1.51
V.nummularia	+2.821±1.41	-0.92±1.41	+6.38±1.44**	+1.18±0.92	-1.371±0.94	+2.82±1.365	.	+4.47±1.13**
Others	-1.82±1.5485	-3.61±1.78	+1.96±1.69	-3.75±1.01**	-5.88±1.37**	-1.41±1.51	-4.47±1.13**	.

** = p < .01, * = p< .05, rest not significant

Table 5.14: Ranks of plant species in the diet of Satyr Tragopan during the Post-monsoon season

	Ferns	*P.scripta*	*P.annuae*	*Primula* sp	*T.pallidus*	*V.jatamansi*	*V.nummularia*	Others	Ranks
Ferns	.	-	+++	--	-	+	-	+	3
P.scripta	+	.	+++	+	--	+	-	+	5
P.annuae	---	---	.	---	---	--	--	-	0
Primula sp	++	-	+++	.	-	++	-	+++	4
T.pallidus	+	++	+++	+	.	+++	+	+++	7
V.jatamansi	-	-	++	--	---	.	-	+	2
V.nummularia	+	+	++	+	-	+	.	+++	6
Others	-	-	+	---	---	-	---	.	1

+++/- - - = p <.01, ++/- - = p< .05, +/- = not significant.

and Primula sp. were the next batch of preferred species. Ferns, *Valeriana jatamansi,* Others and *Poa annuae* were significantly avoided (Table 5.13 and 5.14)

Winter: The major food items in winter were *Arundinaria maling, Pilea scripta, Theropogon pallidus* and grit or quartz fragments, which comprised 70% of the total composition. The minor food items were represented by *Arisaemia griffithii, Erigeron* sp., *Primula* sp, *Polygonum molley, Stachys sericea*, "simjhar", *Valeriana jatamansi*, *Vaccinium nummularia*, fern and moss that together comprised 28% of food composition. *Cotoneaster microphyllus, Saxifraga nutans* and insects made up the trace items and they comprised 2% of the food composition identified (Fig. 5.6).

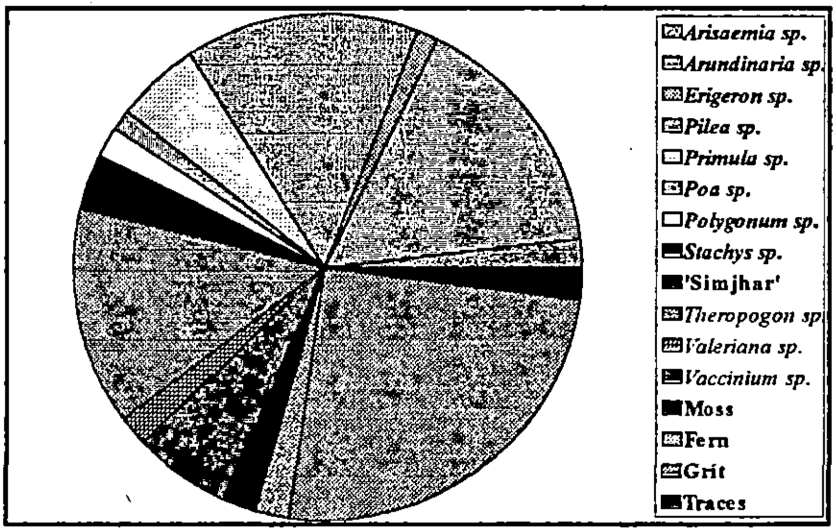


Fig. 5.6: Percent composition of food items of Satyr Tragopan. (Winter season)

Invertebrates alone comprised 0.66% of composition of the Satyr Tragopan's winter diet and was formed of spiders and annelids (Table 5.15).

Table 5.16 : Mean logratio differences (±1) between utilisation and availability of ground cover species identified in the diet of the Satyr Tragopan in SNP (winter season)

	Ferns	*P.scripta*	*Primula* sp	*T.pallidus*	*V.jatamansi*	*V.nummularia*	Others
Ferns	.	-2.26±1.18	-1.58±1.99	-4.53±1.52*	-2.25±1.528	-3.75±1.38*	+0.27±1.36
P.scripta	+2.26±1.18	.	-3.59±1.43*	-3.42±0.77**	-0.51±1.34	+2.13±0.86*	+2.80±0.86**
Primula sp	+1.58±1.99	+3.59±1.43*	.	-2.00±1.17	+3.31±0.90**	-3.891±1.46	+2.67±1.32
T.pallidus	+4.53±1.52*	+3.42±0.77**	+2.00±1.17	.	+2.50±0.95*	+2.13±0.27**	+3.70±0.80**
V.jatamansi	+2.25±1.528	+0.51±1.34	-3.31±0.90**	-2.50±0.95*	.	-1.60±1.15	+0.88±1.53
V.nummularia	+3.75±1.38*	-2.13±0.86*	+3.891±1.46	-2.13±0.27**	+1.60±1.15	.	+4.08±0.79**
Others	-0.27±1.36	-2.80±0.86**	-2.67±1.32	-3.70±0.80**	-0.88±1.53	-4.08±0.79**	.

**= p < .01, * = p <.05, rest not significant

Table 5.17: Ranks of plant species in the diet of Satyr Tragopan during the winter season

	Ferns	*P.scripta*	*Primula* sp	*T.pallidus*	*V.jatamansi*	*V.nummularia*	Others	**Rank**
Ferns	.	-	-	--	--	--	+	1
P.scripta	+	.	--	---	-	--	+++	2
Primula sp	+	++	.	-	+++	-	+	4
T.pallidus	++	+++	+	.	++	+++	+++	6
V.jatamansi	+	+	---	--	.	-	+	3
V.nummularia	++	++	+	---	+	.	+++	5
Others	-	---	-	---	-	---	.	0

+++/- - - = p <.01, ++/- - = p< .05, +/- = not significant.

Table 5.15: Invertebrate structures identified from the faecal droppings of Satyr Tragopan in the winter season.

CLASS	ORDER/FAMILY	STRUCTURE	NUMBER
Arachnida	Araneae	fang	2
	Myriopod	leg	3
Annelida	--	--	4

During winter there was a significant difference between availability- utilisation of the ground cover diet of Satyr Tragopan ($\lambda = .032$, $p = .029$). *Theropogon pallidus* ranked as the most preferred among the species. *Primula* sp. and *Vaccinium nummularia* were the other preferred food plants while *Valeriana jatamansi*, ferns and others were avoided (Table 5.16 and 5.17).

5.4. Discussion

Despite the constraints of techniques, which prevented detailed quantitative work on the diet of the Satyr Tragopan, the results of this study are vital in determining the diet of the species and the relative abundance of different food items in the diet during different seasons. According to Stewart (1967) the possibility of identifying all the species eaten in the faeces of herbivores is inconclusive. Martin (1954) was able to identify only 16 out of the 40 species of plants suspected to be ingested by sheep (*Ovis aries*) from faecal and stomach content analysis. Similarly Croker (1959) could not identify in sheep faeces 1 out of every 25 species of grass in a pasture. Likewise in the present studies on the diet of Satyr Tragopan there may have been a number of plant and invertebrate species present in the study area that were not recorded from faecal analysis. All these observations can have three implications:

(i) Many of the plant and invertebrate species consumed by the Satyr may have undergone complete digestion or may have been reduced to such small fragments that they were not identifiable. This is possible in the case of soft-bodied plant and animal parts. In ~~case of~~ the present study, th~~is~~es types of plant species (ephemeral) formed either the trace food items or ~~was~~ were inconsistent in their appearance in the droppings and compositional analysis showed that they had low ranks in all the seasons of the year. The bulk of the diet in the Satyr Tragopan consisted of hard bodied or fibrous perennials and *Arundinaria maling* which have been identified as top ranking food plants in the study by compositional analysis and by food importance indices in the case of *Arundinaria maling* and have appeared predominantly as expected in the droppings. Most of the soft bodied herbs were annual species and thus their availability was restricted to certain seasons of the year. However these species cannot be ranked as less important.

(ii) The bird might not have eaten the unrecorded species recently enough for fragments to be represented in the faeces. If the unrecorded species formed an important part of the diet of the species they would be expected to be consistently present in the diet of the species and thus in the droppings. All the high ranking food plants in the diet of the Satyr Tragopan have appeared consistently across all the seasons therefore the unrecorded species may have been eaten inconsistently and cannot rank as an important of the diet of the species.

(iii) The unrecorded species may not have been eaten in sufficient amount for traces to appear in the faecal droppings. If the unrecorded species formed a major part of the diet of the Satyr Tragopan they are expected to be eaten in sufficient amount to be represented in the faecal droppings of the species. Some of the food items may have appeared as trace items in the diet of the satyr Tragopan but these may be important to the animals in various ways.

Therefore the food items identified from the faecal droppings of the Satyr Tragopan reflect the general if not exclusive diet of the species in the wild.
The food important indices allotted gives a general importance gradient for each food item recorded in the diet of the Satyr Tragopan through different seasons of the year.

Studies on the diet of Satyr Tragopan in the Singhalila National Park by faecal analyses revealed that vegetable matter formed the bulk of the diet in all the four seasons indicative of the primarily herbivorous habit of the species. The results of my studies thus corroborated the findings of other workers (Table 5.18) about the diet of the Satyr Tragopan in other areas of its distribution.

Arundinaria maling was the most dominant plant species identified from the faecal droppings of the Satyr in all the seasons of the year. As an understorey cover the spread of this bamboo species is quite extensive throughout the National Park and being a perennial plant which dies after flowering its leaves were available throughout the year in abundance as revealed by its phenophases. The fragments of the species could be identified even macroscopically from the droppings. This is probably because like all bamboos, *Arundinaria maling* has a very high content of indigestible fibre and is loaded with abrasive siliceous compounds which are difficult to eat and digest (Roberts 1992). The undigested parts are excreted out from the gastrointestinal tract of the Satyr in a highly identifiable form.

Table 5.18: Food items of Satyr Tragopan derived from various observations.

Sites	Food items	Reference
unknown	leaves and flowers of paper laurel, rhododendron petals, earwigs, ants cockroach, spiders and centipede.	Beebe (1918-1922)
Sikkim	leaves and fern materials of *Diplazium* sp. and *Polypodium* sp.	Meinertzhagen (1926)
--------	insects, bamboo shoots, onion like bulbs	Hume and Marshall (1879-1888)
---------	wild fruits, aromatic leaves, bastard cinnamon and *Daphne* sp	Hodgson (in Hume and Marshall 1879-1888)
Central Nepal	fruits of *Berberis* sp., *Symplocos* sp., *Rhododendron* sp.; leaf, moss, grass, roots, buds and insects.	Lelliott and Yonzon (1979)
Central Nepal	moss, lichen, leaves, grass, roots, buds and few insects	Yonzon (1981)
Central Nepal	moss, grass, leaves and insects	Bhandary *et al.* (1986)

In Pipar *Arundinaria* sp. along with other species of plants like *Meconopsis* sp., *Potentilla* sp. and *Fragaria* sp. formed the second group of important food items in the autumn diet of pheasants, which included the Satyr Tragopan (Bhandary *et al.* 1986). *Fragaria* sp. and *Potentilla* sp. which were found as one of the main ground cover species of the Satyr Tragopan habitat in Singhalila National Park were not observed in the diet (droppings) of the species. Ground cover species, which formed the major food items of the Satyr after bamboo, were all perennial and thus there appeared to be no dearth in the availability of food items in any of the seasons of the year. Annuals like *Poa annuae* and ferns were also listed among the major food items in my studies but their absence in certain seasons would not perhaps affect the Satyr, as the perennials, which formed the major diet items, were always available thus ensuring food to the species. Another very significant component found in the diet of the Satyr Tragopan were grit or quartz fragments. According to Greely (1962) the major source of calcium and magnesium in the diet of birds like pheasants is grit and levels of 1.09% of calcium in the diet was necessary for full egg production by hen pheasants. Kopischke and Nelson (1966) in their studies in Minnesota and South Dakota observed that laying hens consumed about 50 percent more grit by weight than non-laying hens and they could selectively pick calcium and magnesium bearing grit. Besides, the action of grit in a bird's gizzard grinds the food into a digestible paste. *Grit is important if grass forms an important part of the* diet (Howman 1993). The presence of grit or quartz fragments in such high percent composition in the diet of the Satyr Tragopan in all seasons may be attributed to the fact that being mainly vegetarians these fragments help in the grinding of the vegetative matter in the gizzard for proper digestion.

In the present studies invertebrates and small arthropod components formed a minor and seasonal portion in the diet of the Satyr Tragopan. It is however known from studies in Britain that in galliforms for good survival rates of chicks a protein rich diet is essential (Green 1984, Hill 1985) and this is largely obtained from their invertebrate intake (Moreby 1992). Being primarily herbivorous, invertebrates formed a very small component in the diet of Satyr Tragopan. Kaul (1989) observed a total lack of insect food in the adult droppings of Cheer Pheasant while in Pipar insects comprised a very small (0.1%) portion of the autumn diet of pheasant species (Bhandary *et al.* 1986). I analysed only adult droppings of Satyr Tragopan for food items and it is apparent that these did not contain a high proportion of invertebrates. However analysis of chick droppings might have revealed a much higher animal content in the diet of the species (Green 1984, Hill 1985 and Green 1986). A large portion of the soft-bodied invertebrates is digested and therefore the likelihood of their remains appearing in the droppings is remote and liable to be missed.

During all the seasons of the year major food items of the Satyr Tragopan except ferns remained the same. Only the minor and trace food items of the species changed according to their availability and the diet showed the widest variety during the monsoon and the post-monsoon season as these were the wettest seasons with abundant growth of ground cover species. Although most birds complete their entire breeding cycle during one season the timing of breeding is closely associated with food supply (Perrins and Birkhead 1983). Breeding in birds is so timed that the chicks hatch and develop at a time of maximum food availability (Lack 1968) and for this they have to forage in habitats that provide most food (Baines *et al.* 1996). Little is known about the breeding of Satyr Tragopan in the wild except this event probably occurs during May and June (Ali and Ripley 1983).

During the pre-monsoon season the ground cover species in the diet of the Satyr Tragopan were not utilised by the bird in proportion to their availability. At the onset of this season especially the early part of March, dry conditions were still prevalent and all the annual plants were dead and many of the perennials withered. Evergreen perennials like *Vaccinium nummularia, Primula* sp. and *Theropogon pallidus* thus provided an important food resource which were utilised as shown by their higher ranks and greater preference relative to the other species. Annual plants like *Poa annuae, Erigeron* sp., *Impatiens sulcata* and *Senecio* sp (others) and *Valeriana jatamansi* though present in abundance were not in their full growth forms which probably attributed to their low ranks or avoidance in the pre-monsoon diet. The high preference for ferns probably coincides with the diet of the species towards the middle or the end of the pre-monsoon season. As the phenological recordings of ferns show that ferns in various phenophases were present for the birds at this part of the season. Ferns were known to be eaten by the Satyr Tragopan (Meinertzhagen 1926).

In the monsoon season extremely wet conditions prevailed in the study area. The major food items did not change much and instead 6 more secondary and trace food items were identified in the droppings of the species probably indicating a greater variety of food consumed during the season. All the important ground cover food items were utilised more or less as expected relative to their availability. Ferns and *Theropogon pallidus* were still highly ranked in the diet with *Pilea scripta* as the next important species instead of *V. nummularia* as in pre-monsoon. Perennial herbs seemed to once again form an important part of the diet of the species even during this season though many other species were available. However there was no overall difference in their utilisation and availability reflecting the absence of a real preference or avoidance of any particular group of plant species.

The largest number of food items was identified from the post-monsoon faecal droppings. This is perhaps because there was an increase in the availability of both plant and animal food resources. The phenological data for all these species revealed that all plants were in their full growth forms and phenophases but there was a non-random pattern of use of ground cover species by the Satyr Tragopan. The bird showed marked preferences for species like *Theropogon pallidus*, *Vaccinium nummularia*, *Primula* sp. and *Pilea scripta* during this season. There was an increase in the percent composition of invertebrates in the droppings. This may be attributed to the increase in invertebrate biomass during the wet seasons (Kaul 1989). The food items during the post-monsoon appeared to be more and such trends have also been reported from Nepal (Yonzon 1981, Bhandary *et al.* 1986).

In winter there was a marked increase in the percent composition of perennial plants because most of the ephemeral species were either in a dormant stage or dead, especially by midwinter. Invertebrates were found as trace items only. Though there was less diversity in the winter diet, the differential use in the ground cover species was significant. As expected the evergreen perennial plants were the most important components of the diet of the Satyr Tragopan while annuals like ferns, others and *Poa annuae* were either avoided or totally absent from the study area in that particular season..

Faecal analyses is one of the best and most widely used techniques for diet determination especially in a threatened species like the Satyr Tragopan because of its non invasive character. However some inherent problems, which I experienced with the technique, were:

1. Though faecal droppings are considered to be easily collected and stored (Fitzgerald and Waddington 1979) the situation was quite different in Singhalila National Park for birds like the Satyr Tragopan. Droppings could be collected fairly easily in the pre-monsoon and the winter season but during the wet seasons the collection of these samples reduced drastically. Likewise it was quite easy to preserve and store the samples collected during the drier months by simply air drying whereas during the wet seasons the samples were very prone to fungal growth rendering them useless.

2. Preparation of reference slides of different parts of plants in areas having a very large number of species can be very tedious.

3. Many of the soft- bodied annuals and ephemerals may undergo complete digestion or are reduced to such small fragments that they are not recognisable at the microscopic level and hence are not recorded.

4. On the other hand those plant species which are high in indigestible fibre content will tend to occur constantly during observation and will be over represented in the diet of the species.

5. Many of the soft bodies and easily digested groups like Collembola, Dipterans, larvae and nymphs of certain groups may escape records and may be not be represented in the samples. Meanwhile species with indigestible parts (spiders, bugs, beetles etc) may be over represented amongst the invertebrate food items.

6. The quantitative estimation of the diet is quite difficult because the proportion in which the various items represented in the diet may or may not be similar to the proportions in which they were eaten. This is because the digestive processes in the animal's body and the processes of preparing the sample for observation may alter the proportions.

7. Analysis through faecal droppings requires knowledge and expertise, which takes a long time to acquire.

Many of the authors have used crop and stomach draining or dissection methods (Davison 1940, Beck 1952, Kopischke and Nelson 1966, Prys-Jones 1974, Allen 1980, Dahlgren 1982) and feeding trials (Stewart 1966, Fitzgerald and Waddington 1979 and Holchek and Valdez 1985), for differential digestion indices in their dietary studies. None of these methods were practicable in my field conditions and therefore I chose to do dietary studies by faecal analysis. In spite of its many difficulties this method was simpler and less time consuming. If reference slides for the plant species of the study area can be prepared then fairly good results can be obtained about the plant species ingested by the species. If the frequency data are treated to some proportions then other extrapolations and analyses can be carried out.

8. Conclusions:

Like all its other congeneric species the Satyr Tragopan was found to be primarily a vegetarian/herbivore in its food habits although animal matter in the form of invertebrates also formed a minor and seasonal part of its diet. The major food items of the species comprised of perennial herb species and their percent composition in the diet was consistent throughout the year, while the percent composition of some of the minor and trace food items fluctuated. As expected, during the two wettest seasons of the year i.e. monsoon and the post-monsoon, there was an increase in the number of plant food items and invertebrates ingested by the Satyr Tragopan. Most of the food items especially the perennial ones were available throughout the year and perhaps accordingly the bird chose its diet. *Arundinaria maling* was found to be the most important component in terms of its percent composition and occurrence in the droppings through all the seasons. In all the seasons except monsoon there was non-random use of the available major ground cover species. Lack of appropriate methodology and detailed quantitative estimation compounded by practical problems made it difficult to identify the exact diet of the species as well as the importance of each food item comprising the diet of the species. Therefore the results that I have obtained represent the general diet of the species in the Singhalila National Park and the food importance indices give an indication of the importance of various food items in the diet of the species. The present studies also clearly reveal that the Satyr Tragopan specialise in vegetative matter and is not an exclusive feeder on any one or two species but the diet of the species depends on whatever is available to the bird in its habitat. Since more accurate but highly invasive methods like crop and stomach draining are not practicable on such threatened species, studies through feeding trials would perhaps be one of the ways for more detailed quantitative estimation of the diet of the Satyr Tragopan.