ECOLOGIA BALKANICA

2013, Vol. 5, Issue 1 June 2013 pp. 57-68

# *Diet of Threatened Pheasant Species in Himalayas, India – A Faecal Analysis Approach*

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**Abstract.** The aim of this paper is to determine diet composition of threatened pheasant species i.e. Satyr Tragopan *Tragopan satyra*, Himalayan Monal *Lophophorus impejanus,* Kaleej *Lophura leucomelana* and Koklass *Pucrasia macrolopha* in their native forest which was never studied earlier. A study was conducted in the Kumaon region of western Himalaya for two years by collecting dropping material. Faeces were identified through direct sighting of defecating species. The diet items of each pheasant species mainly comprised plant materials followed by invertebrates and grit. A significant difference was observed in consuming food items by all pheasant species. Monal emerged as a specialist feeder on plants which were not eaten by other species. The Satyr and Koklass were more similar in terms of diet composition in both seasons while Kaleej and Monal were least similar, only invertebrates and grit were common in the diet of these species. No significant difference was observed in diet composition in different seasons of all pheasant species. The results expected to provide valuable information for the management of these pheasants in Himalayas.

**Key words:** Conservation, Faecal, Food Importance Index, Himalaya, Specialist feeder, Pheasants.

## Introduction

Pheasant species are amongst the best known and most spectacular species in their ecosystem (GARSON, 2007). They are generally viewed as potentially useful indicators of environmental quality because of used as a source of food and most of them live in forests (FULLER & GARSON, 2000). Our understanding of this importance is facilitated by information on the species' food habits and the extent of their dietary similarities. Very little quantitative information is available on the diet of Himalayan and other Asian pheasants in the wild however they are an important part of ecosystem. But it is far sure that the diet of pheasants includes all types of food matter and it depends to a large extent on their habitats and the availability of food resources (HILL, 1985; RIMLINGER *et al*., 2000).

There is considerable variation in diet composition among pheasants. Kinds of food eaten vary between groups and also by season, and even by habitat in some pheasant species. It includes seeds, roots, leaves, shoots, flowers, stems, buds, invertebrates and even reptiles (MCGOWAN, 1996). Little analogous work (KAUL, 1989 a; b; MOREBY, 1993; KHALING, 1999) has been conducted on avian taxa especially for the phasianidae family in the wild. Many studies have been conducted on direct observation of feeding behaviour of pheasants such as ZHENGJE (1989) studied feeding behaviour of Ring-

necked pheasant and found the species to be vegetarian in food habits and 83% food of the species was composed of plant materials, JIANQIANG & YUE (1989) observed the Brown-eared pheasant feeding ecology and recorded 62 plant and animal species. XIANGTAO & XIAOYI (1989) studied the diet and feeding habits of Crimson-bellied Tragopan and found the species to be vegetarian. LELLIOT & YONZON (1980) found the species feeding on the leaf litter and stream debris or on mossy areas during their studies in Central Nepal. They were also found feeding on the fruits of *Berberis* sp., *Symplocos* sp. and *Rhododendron* sp. They found leaf, moss, grass, roots, quartz fragments and an insect wing from faecal analysis, suggesting an omnivorous diet. BHANDARY *et al.* (1986) in Pipar (Central Nepal) found the moss and grass leaves as a main autumn diet of the species. DAVISON (1981) in his studies on the Crested-fireback pheasant in Malaysia observed majority of birds in moist areas with abundant invertebrates.

The present study is on the feeding ecology of Kaleej (*Lophura leucomelana*), Koklass (*Pucrasia macrolopha*), Himalayan Monal (*Lophophorus impejanus*) and Satyr Tragopan (*Tragopan satyra*) in the western (Kumaon) Himalaya, India. The Himalayan Monal and Kaleej pheasant are distributed in the northwestern, western, central and eastern Himalayas. Monal is found mostly between 2300–4875 m and down to 2000 m during winters while Kaleej is found below 2700 m. Koklass pheasant is distributed in the northwestern and western Himalayas between 2700-3300 m and down to 1500 m in winters. The Satyr Tragopan is distributed in the western, central and eastern Himalayas at elevations of 2400–4520 m, descending to 2000 m during late post monsoon season (SATHYAKUMAR & KAUL, 2007). These studied pheasants are protected under Schedule I and III (hunting is prohibited) in Wildlife Protection Act, India, 1972 (RISHI, 1972) so killing of these birds is neither permissible nor practicable for crop and gizzard analysis. Hence, faecal matter analysis was adopted as an alternative method to determine the diet of four pheasant species and to find out the seasonal variation in diet among them.

**Materials and methods**

*Study area*. This study site lies in district Bageshwer, Uttarakhand, India (30° 08' N and 79° 57' E) in the Kumaon Himalaya encompassing an area of 58.25 sq. km (Fig. 1). The area represented temperate (1500-3500 m) to alpine (>3500 m) climatic conditions (CHAMPION & SETH, 1968). Being very close to Pindari, Kafni and Sunderdunga glaciers, the area experience extreme weather conditions. Annual rainfall peaks at about 1200 m altitude (4100 mm) and gradually declines to 670 mm at 2700 m. The monsoon starts at the end of June and ceases by the middle of September. The mean temperature varies from 15°C to 25°C in pre monsoon season while below 0°C to 10°C in the post monsoon season (SAXENA *et al*., 1985). The boundary of the study area touches the Nanda Devi Biosphere Reserve and can be reached by three days trekking from the last motorable road. The vegetation is moist temperate type (CHAMPION & SETH, 1968). The major tree species in the study area included *Quercus semecarpifolia, Quercus floribunda*, *Abies pindrow, Taxus baccata, Betula utilis* in association with *Rhododendron barbatum, Acer caesium, Lyonia ovalifolia, Alnus nepalensis, Aesculus indica*. The dominant shrub species included *Arundinaria falcata*, *Athyrium* sp., *Polystichum* sp., *Pteris cretica*, *Daphne papyracea., Urtica dioca* and *Pyrancantha crenulata* etc. (HUSSAIN *et al*., 2008).

*Methods*. Faeces collection was made on the selected forest trail and through random search in the study area. These pheasant species occupy different altitudinal range (HUSSAIN, 2002; SATHYAKUMAR & KAUL, 2007) so doubt of mixing of droppings was ruled out. These were identified by direct sightings and directly defecated droppings were collected for reference and further used in data collection. The spots from where faeces were collected were cleared to avoid collection of the same materials during subsequent monitoring. The collection was made for both seasons (pre monsoon; March – June and post monsoon; September –

December, the rest of the year is inaccessible in the study area) for two years for food items comparison. Sixty faeces of each pheasant species for each season per year were collected. They were air dried, labelled and sealed in plastic packets and stored in an airtight container with camphor. Major ground vegetation species were collected in a 10m radius circular plot from the places where feaces were found and in which pheasants were seen feeding directly.

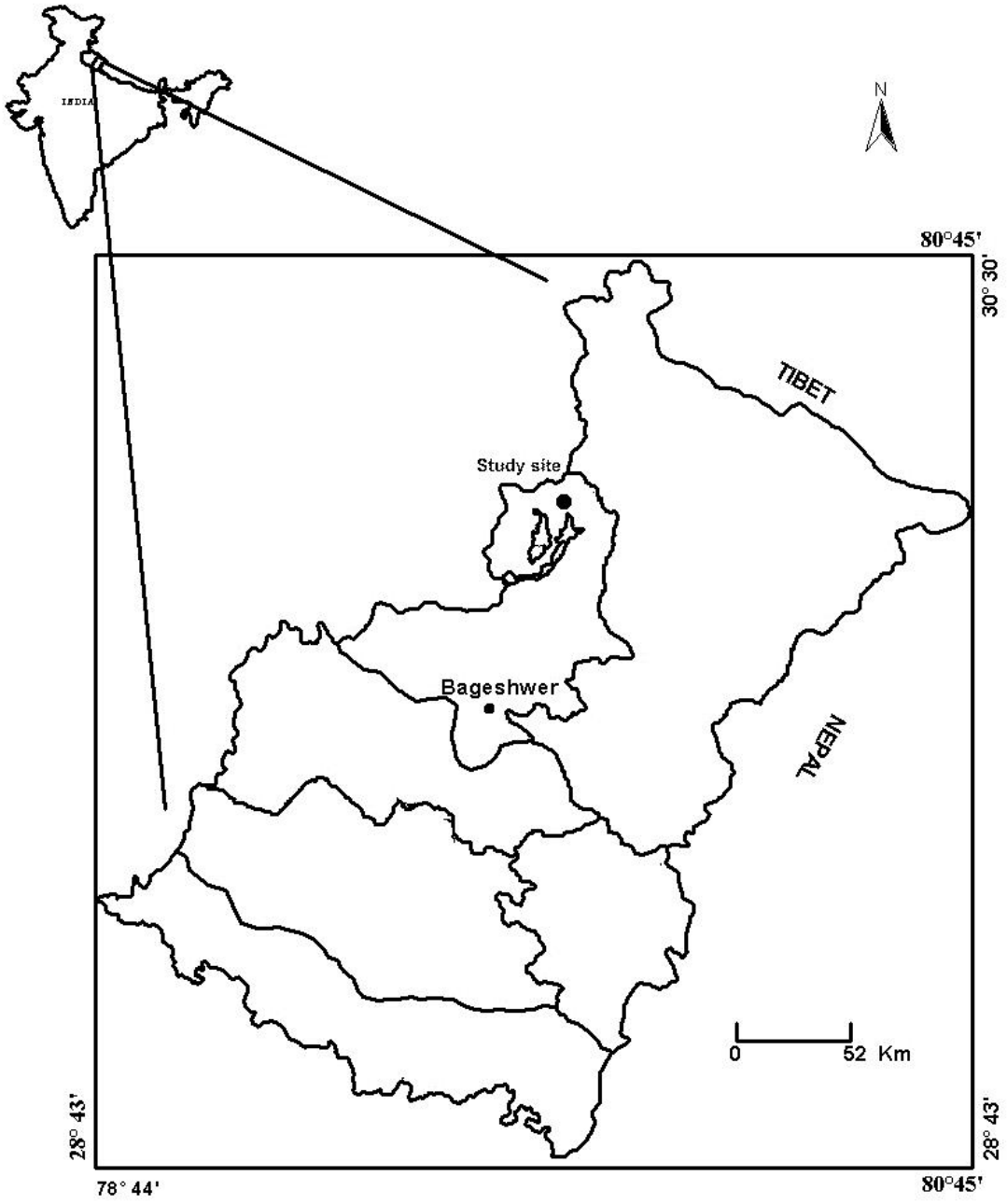


**Fig. 1.** Location of the study site in District Bageshwer, Kumaon Himalayas, Uttarakhand, India.

*Preparation of plant sample slides.* Reference slide of each plant species was prepared micro histological and each showed unique epidermal characteristics that allowed easy identification. First the plant species were preserved in 10% formalin. Epidermis of plant species were then stripped off and then passed through the ascending grades of ethanol for dehydration (30%, 50%, 70%, 90% and 100%) (HOLECHEK

*et al*., 1982) and then cleared in xylol. Permanent slides were made by mounting in Canada balsam. A total of 50 reference slides of different plant species was prepared.

*Preparation of faecal sample slides.* All the collected faeces were pooled season wise and species wise. A total of 120 faecal samples per season per species in two years were ready for preparing major samples accordingly. The samples were gently crushed by hand. Samples were grounded and sieved to homogenize the size of fragments. They were cleared in 10% NaOH solution and boiled for 3-4 minutes with 3-4 changes of the NaOH solution (KHALING, 1998). The excess solution was drained off and the settled material was poured into a petri dish. A dropper extracted 10 sub samples from this sample on 10 glass slides. The sub samples were allowed to air dry later they were mounted in glycerol (BHANDARY *et al*., 1986). The slides were examined in 50X and 100X magnification levels interchangeably (HOLECHEK & VALDEZ, 1985). The frequency (presence / absence) occurrence of plant fragments was recorded in a microscopic field of view. Every fragment could be identified using reference slides and which fell wholly or partly with the view, was recorded. Although the frequency of occurrence of fragments (plant or animal part) present in the slide tends to overestimate rare and underestimate common species (HANSON, 1970), it is still the most widely used technique. It is expected that the degree of fragility of cuticle differs from species to species (STORR, 1961; STEWART, 1967) so we made ten slides of each pheasant species faecal matter. Then each slide was divided into 20 frequencies to identify and enumerate the proportions of different food items present in the droppings. The identification of invertebrate part in the faecal analysis was also made from the same slides. We have however made no attempt to classify different invertebrate parts but only presence / absence of them was recorded from the microscopic view.

*Analyses.* The occurrence of each food item was expressed as a Food Importance Index (FII) (BHANDARY *et al*., 1986). According to BECK (1952), the formula needed specific gravity also, which is possible only by crop analysis. In the present study involving the diet of Himalayan pheasants where crop analysis is not practicable and viable, only the frequency and composition of food items were considered so the following formula was used:

Food Importance Index = % Frequency + % Composition/2

The frequency of each food item was calculated by dividing the occurrence of the particular food item by all frequencies whereas percent composition was calculated by dividing the occurrence of a particular food item in a sample slide by the total occurrence of all food items.

Sorenson similarity index (MAGURRAN, 2004) was calculated for different pheasant species by taking food items into account. This index was calculated by combining both seasons.

$$S = 2A / (B + C)$$

where A is the number of diet components eaten commonly by both species, B is the number of diet components eaten by one species and C is the number of diet components eaten by other species.

Some food item index fluctuated between seasons so paired sample t–test was performed to observe significant differences between seasons for different pheasant species. Kruskal-Wallis one-way ANOVA and t-test were performed (ZAR, 2009) on different food items to observe significant differences among studied pheasant species season wise.

Based on composition, each food item was categorized into three groups, 1) Major food components or food items forming >10% of the total composition; 2) Minor food components or items forming <10% but >3% and 3) Trace items which formed <3% of the total composition (KHALING, 1998).

**Results**

*Diet composition of different pheasant species.* Total 38 food items were identified from the faecal matter of Kaleej, Koklass, Himalayan Monal and Satyr Tragopan. Out of these 36 food items were plant materials and the rest were grit and invertebrates (Table 1), other 14 plants were recorded from the area but not found in the faecal matter. Invertebrates were found to be a major food item in the diet of Kaleej (FII = 25.5) and Monal (FII = 8.60) during post monsoon season whereas grit was a major food item of Satyr during pre monsoon season (FII = 14.9). Diet composition of Kaleej, Koklass, Monal and Satyr varied significantly between seasons (Table 1).

The FII of some of the food items fluctuated between seasons such as *Viola* sp., invertebrates, *Geranium wallichianum*, *Rubus biflorus* and *Myrcine africana* in Kaleej and likewise in other pheasant species. So, Paired sample t-test was performed on the composition of these food items (Fig. 2). Some diet components differed significantly between seasons for all species.

**Table 1.** Food importance index (FII) and different food items found in the droppings of different pheasant species during pre monsoon and post monsoon seasons in Kumaon Himalaya, India. One way ANOVA was performed on different food items for each species in each season. * = significant at 0.00 level. Paired sample t-test showed no significant difference in seasons for each species regarding diet composition. The category has been defined in the methods section.

| Species | Food items | Pre monsoon season | | Post monsoon season | |
|---|---|---|---|---|---|
| | | FII | Category | FII | Category |
| Kaleej | *Geranium wallichianum* | 8.28 | Minor | 26.3 | Major |
| | *Rubus biflorus* | 23.3 | Major | 6.0 | Minor |
| | *Rubus ellipticus* | 21.1 | Major | 12.8 | Minor |
| | *Viola* sp. | 13.5 | Minor | 29.3 | Major |
| | *Berginea legulata* | 15.8 | Major | 6.75 | Minor |
| | *Myrcine africana* | 16.6 | Major | 6.0 | Minor |
| | *Thalictrium foliolosum* | 6.77 | Minor | 9.75 | Minor |
| | *Boeninghausienia albiflora* | 9.03 | Minor | 6.75 | Minor |
| | *Fragaria* sp. | 15.1 | Major | 11.3 | Minor |
| | Invertebrates | 10.5 | Minor | 25.5 | Major |
| | Grit | 9.03 | Minor | 9.75 | Minor |
| | | Not significant | | *$F_{10, 109}$= 5.13 | |
| Koklass | *Daphne papyracea* | 4.93 | Minor | 7.81 | Minor |
| | *Skimmia laureola* | 9.87 | Minor | 8.59 | Minor |
| | *Athyrium* sp. | - | - | 15.62 | Major |
| | *Polystichum* sp. | 6.58 | Minor | 12.49 | Minor |
| | *Rubus ellipticus* | 7.40 | Minor | 5.46 | Minor |
| | *Nerium* sp. | 18.92 | Major | 25.77 | Major |
| | *Mondo intermedius* | 10.69 | Minor | - | - |
| | Moss | 19.74 | Major | 1.56 | Trace |
| | *Myrcine africana* | 4.93 | Minor | 7.03 | Minor |
| | *Urtica dioica* | - | - | 6.25 | Minor |
| | *Berberis aristata* | 5.75 | Minor | 2.34 | Trace |
| | *Pteris biaurita* | 3.29 | Trace | 7.81 | Minor |
| | *Potentilla fulgens* | 4.11 | Minor | 5.46 | Minor |
| | *Fragaria* sp. | 13.98 | Major | 18.74 | Major |
| | Invertebrates | 7.40 | Minor | 1.56 | Trace |

| | | | | | |
|---|---|---|---|---|---|
| | Grit | 9.87 | Minor | 12.49 | Major |
| | | *F $_{13, 106}$= 5.31 | | *F $_{14,105}$= 7.75 | |
| **Himalayan Monal** | *Eulophia compestris* | 3.58 | Minor | - | - |
| | *Nordostachis jatamansi* | 9.56 | Major | 1.72 | Trace |
| | *Picrorhiza kurroa* | 4.78 | Minor | 3.44 | Minor |
| | *Aconitum heterophylum* | 4.78 | Minor | 3.44 | Minor |
| | *Potentilla fulgens* | 13.1 | Major | 6.88 | Minor |
| | *Artimisea nilgirica* | 15.5 | Major | 6.88 | Minor |
| | *Hedychium spicatum* | - | - | 3.44 | Minor |
| | *Skimmia laureola* | 3.58 | Minor | 5.16 | Minor |
| | *Ainsliaea* sp. | 7.17 | Minor | 6.88 | Minor |
| | *Satyrium nepalense* | 2.39 | Trace | 1.72 | Trace |
| | *Gaultheria nummularioides* | 3.58 | Minor | 1.72 | Trace |
| | Moss | 7.17 | Minor | 3.44 | Minor |
| | Invertebrates | 2.39 | Trace | 8.60 | Major |
| | Grit | 8.36 | Minor | 17.2 | Major |
| | | *$F_{12, 107}$ = 5.22 | | *$F_{12, 107}$ = 3.56 | |
| **Satyr Tragopan** | *Cotoneaster acuminate* | 12.9 | Major | 6.55 | Minor |
| | *Rubus biflorus* | 4.98 | Minor | 4.09 | Minor |
| | *Arisaema flavum* | 1.99 | Trace | 9.82 | Minor |
| | *Pilia* sp. | 12.9 | Major | 4.91 | Minor |
| | *Skimmia laureola* | 1.99 | Trace | 5.73 | Minor |
| | *Polygonum amplexicaule* | 1.99 | Trace | 7.37 | Minor |
| | *Potentilla fulgens* | 1.0 | Trace | 4.91 | Minor |
| | *Valeriana wallichii* | 1.99 | Trace | 7.37 | Minor |
| | *Daphne papyracae* | 2.99 | Trace | 5.73 | Minor |
| | *Viola* sp. | 1.0 | Trace | 9.82 | Minor |
| | *Arundinella nepalensis* | 20.9 | Major | 17.2 | Major |
| | *Poa annua* | 10.9 | Major | 4.09 | Minor |
| | *Polystichum* sp. | 1.99 | Trace | 8.18 | Minor |
| | *Pteris biaurita* | 2.99 | Trace | 6.55 | Minor |
| | Moss | 3.98 | Minor | 7.37 | Minor |
| | Invertebrates | 1.0 | Trace | 4.91 | Minor |
| | Grit | 14.9 | Major | 13.9 | Major |
| | | *F $_{16,103}$ = 9.01 | | *F $_{16,103}$ = 8.95 | |

Few plant species were exclusively consumed in a particular season only; plant species *Athyrium* (major) and *Urtica dioca* (minor) were found only in the post monsoon season diet of Koklass whereas it was *Mondo intermedius* (minor) in pre monsoon season (Table 1). Minor food items were found in higher percentage in most of the species' diet for both the seasons except for Kaleej and Satyr where major items were in more percentage in the pre monsoon season diet (Table 2). *Arundinella nepalensis* and grit were the major food items whereas *Rubus biflorus* and moss were the minor items of Satyr Tragopan for both the seasons. No trace elements were found in Kaleej faeces in both the seasons.

*Diet comparison among pheasant species.* The Sorenson similarity index showed highest similarity in diet composition between Koklass and Satyr monsoon in both seasons (pre monsoon S = 0.93; post mosoon S = 0.94) while Kaleej and Monal monson were least similar in their diet composition in both seasons (pre monsoon S = 0.2; post monsoon S = 0.2) (Table 3). Some plant species such as *Nordostachis jatamansi, Eulophia*

*compestris* and *Gaultheria nummularioides* were found only in Monal's faeces (Table 1). Grit and invertebrates were the common food items for all pheasants for both the seasons. One-way ANOVA showed a significant difference in the percent composition of invertebrates found in all pheasants during pre monsoon season (F = 3.78, d.f. = 3, 36, p = 0.018) and post monsoon season (F = 14.7, d.f. = 3, 36, p = 0.00). The percent grit composition did not differ significantly between seasons among pheasant species (pre monsoon season F = 1.24, d.f. = 3, 36, p = 0.308; post monsoon season F = 0.84, d.f. = 3, 36, p = 0.478)

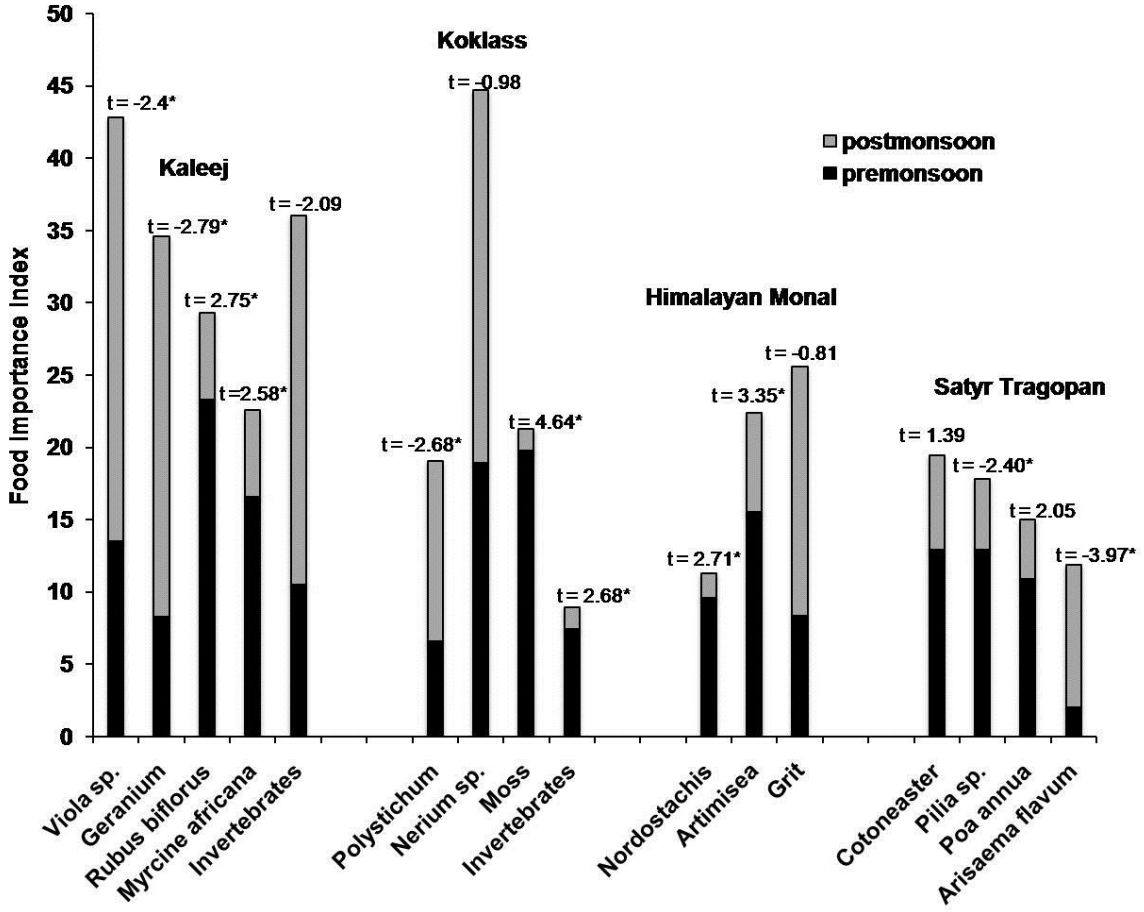


**Fig. 2.** Food Importance Index of some of diet components which found in pheasant species in Kumaon Himalayas in pre monsoon and post monsoon seasons. t- test was performed for each diet component and value was given. * = significant at $p < 0.05$

Six food items were found common for Kaleej, Koklass and Satyr so a t - test was performed on these food items between species. The percent composition of *Daphne papyracea* was significantly different in Koklass and Satyr during pre monsoon (t = 3.58, d.f. = 19, p = 0.002) and post monsoon season (t = 5.29, d.f. = 19, p = 0.00) and percent composition of *Pteris biaurita* also differed significantly in these species during pre monsoon and the post monsoon season (Table 4).

*Potentilla fulgens* and *Skimmia laureola* are highly medicinal value plant and were commonly found in the droppings of Koklass, Monal and Satyr. The percent composition of *Potentilla fulgens* was significantly different among these pheasant species (F = 9.69, d.f. = 2, 27, p = 0.001) during pre monsoon season. Percent composition of *Skimmia laureola* showed significant difference during the premonsoon season (F = 4.66, d.f. = 2, 27, p = 0.018) as well as during the post monsoon season (F = 3.88, d.f. = 2, 27, p = 0.03) in Koklass, Monal and Satyr diet.

**Table 2.** Mean percent composition (± Standard Error in parentheses) of major, minor and trace food items found in the droppings of different pheasant species during pre monsoon and post monsoon seasons in Kumaon Himalaya, India.

| Species | Pre monsoon season | | | Post monsoon season | | |
|---|---|---|---|---|---|---|
| | Major% | Minor% | Trace% | Major% | Minor% | Trace% |
| Kaleej | 61.61 (5.23) | 38.38 (3.59) | - | 54.0 (3.41) | 46.0 (3.09) | - |
| Koklass | 41.29 (3.87) | 56.12 (5.18) | 2.59 (0.78) | 43.26 (4.96) | 52.8 (6.12) | 3.93 (0.91) |
| Himalayan Monal | 44.44 (4.34) | 50.0 (4.05) | 5.55 (1.21) | 36.58 (3.17) | 56.09 (4.94) | 7.31 (2.18) |
| Satyr Tragopan | 72.27 (6.19) | 8.91 (2.95) | 18.81 (2.56) | 24.2 (2.17) | 75.79 (7.13) | - |

**Table 3.** Sorenson similarity index in different pheasant species for food composition in pre monsoon and post mosoon seasons of Kumaon Himalaya, India.

| **Pre monsoon season** | **Kaleej** | **Koklass** | **Himalayan Monal** | **Satyr Tragopan** |
|---|---|---|---|---|
| Kaleej | 1.0 | 0.66 | 0.2 | 0.4 |
| Koklass | | 1.0 | 0.59 | 0.94 |
| Himalayan Monal | | | 1.0 | 0.42 |
| Satyr Tragopan | | | | 1.0 |
| **Post monsoon season** | **Kaleej** | **Koklass** | **Himalayan Monal** | **Satyr Tragopan** |
| Kaleej | 1.0 | 0.62 | 0.2 | 0.4 |
| Koklass | | 1.0 | 0.53 | 0.94 |
| Himalayan Monal | | | 1.0 | 0.5 |
| Satyr Tragopan | | | | 1.0 |

**Table 4.** t-test values for for common food items present in different pheasant species in pre monsoon and post monsoon season. *, signi. = significant

| Food items | Species | Pre monsoon | | Post monsoon | |
|---|---|---|---|---|---|
| | | t- value | signi. | t- value | signi. |
| *Daphne papyracea* | Koklass & Satyr | 3.58 | 0.002* | 5.29 | 0.000* |
| *Pteris biaurita* | Koklass & Satyr | 2.66 | 0.15 | 5.20 | 0.000* |
| *Rubus biflorus* | Kaleej & Satyr | 3.53 | 0.002* | 3.11 | 0.006* |
| *Myrcine africana* | Kaleej & Koklass | 4.56 | 0.000* | 3.04 | 0.007* |
| *Fragaria* sp. | Kaleej & Koklass | 5.24 | 0.000* | 3.93 | 0.001* |
| *Rubus ellipticus* | Kaleej & Koklass | 4.39 | 0.000* | 3.77 | 0.000* |

**Discussion**

Identification is influenced by the distinctiveness of each plant species as well as relative changes in the identifiable characteristics of each plant species as altered by digestion. When plants are succulent, and when the diet is composed of woody and herbaceous plants, the differential rate of digestion lead to highly variable results (VANDYNE, 1968). To obtain a mixture of

relative homogenous size, care was taken and samples were screened through appropriate sieves to remove unusually large items. The FII gave a general importance for each food item recorded in the diet of these pheasant species for pre monsoon and post monsoon seasons.

Despite the constraints of techniques which prevented detailed quantitative work on the diet of Kaleej, Koklass, Satyr Tragopan and Himalayan Monal, the results of this study were vital in determining the diet of the species during different seasons. In the present study there might have been a number of plant species present in the study area that were not recorded for faecal analysis. Plant species can be very specific to a particular habitat type and a wide selection of unknown food remains can easily result if a number of birds from different area studied (MOREBY, 1993). The food items identified from the faecal matter of studied pheasants reflected the general if not exclusive diet of these species in the wild because many of the plant species consumed by these species may have undergone complete digestion or may have been reduced to such small fragments that they were not identifiable.

The study revealed that the main diet of all pheasant species was plant matter although invertebrate matter was also present but in low percentage. The dry conditions were still prevalent in early March or the onset of pre monsoon, the evergreen shrubs such as *Rubus biflorus* and *Rubus ellipticus* were the major source of food where as perennials like *Geranium wallichianum*, *Boeninghausienia albiflora* were also present in faecal matter but in minor composition. Such as in Koklass the major food items were *Nerium* sp. Moss and *Fragaria* sp. *Pteris biaurita* and *Polystichum* sp. (fern) were also present but in traces as they were available in the middle or end of the season. In Monal diet, the major sources were rare plants such as *Nordostachis jatamansi*, *Potentilla fulgens*, and *Artimisea nilgirica.* Other minor parts of the Monal diet were also the rare plants. Chinese Monal feeds on the roots and leaves of the plant (HE *et al*., 1988). In Satyr the *Arundinella nepalensis* formed the major portion of the food. It is perennial plant that die after flowering but its leaves were available throughout the year. It had a very high content of indigestible fibre and was loaded with abrasive siliceous compounds, which were difficult to eat and digest (ROBERTS, 1992). The undigested parts were excreted out from the gastrointestinal tract of the Satyr in a highly identifiable form. KHALING (1999) identified 23 food items from the droppings of Satyr tragopan in Eastern Himalayas, India and major portion of food was plant material. She identified *Arundinaria maling* (bamboo species) as a dominant plant species in the diet of Satyr whereas the present study showed another bamboo species *Arundinella nepalensis* in its diet.

During the post monsoon season, the invertebrates formed the major portion of the diet of Kaleej. After monsoon the insect availability increases so as in the diet of Kaleej. Other species were *Geranium wallichianum* and *Viola* sp., which were in full bloom after monsoon. The *Eulophia compestris, Nordostachis jatamansi*, *Picrorhiza kurroa* and *Achonitum heterophylum* were absent or present in minor composition in the diet of Monal during post monsoon season as these herbs were annual. In Satyr Tragopan, the *Arundinella nepalensis* again formed the major component of the diet. Other than these were *Cotoneaster acuminata*, *Rubus biflorus*, *Ariseama flavum*, *Pilia* sp. as these species were found in full-grown stage in the study area.

In the present study invertebrates formed a minor and trace portion in the diet for all pheasant species. It is known from studies in Britain that for high survival rates of Galliform chicks, a protein rich diet is essential (HILL, 1985) and during few weeks of life, this is obtained from insects. Thereafter, the vegetable matter increases until the bird becomes chiefly vegetarian. In this study, we analyzed only adult droppings of all pheasant species 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 invertebrate content in the diet of the species (GREEN, 1984; HILL, 1985).

Another very significant component found in the diet of all pheasant species was grit fragments. The presence of grit in such high percent composition of the diet of the pheasant species around the year may be attributed to the fact that being mainly vegetarians these fragments helped in the grinding of the vegetative matter in the gizzard for proper digestion.

These pheasant species occupied different altitude with a little niche overlap (HUSSAIN, 2002). The least similarity was found between Kaleej and Monal as Kaleej occupies lower altitude than Monal and plant species also differ on various altitudes. Koklass had a very wide range of habitat use so this species was moderately similar to other species in the context of food items intake. Since more accurate (SANDE *et al*., 2006) but highly invasive methods like crop and stomach draining (PARALIKIDIS *et al*., 2010) are not practicable on threatened and rare Galliformes species. These pheasants used different habitat types in the study area which were not free from biotic pressures (MCGOWAN, 2007). The information on diet items of these pheasants will help to conserve habitat having rare and threatened plant species in general and pheasants of this area and of Central Himalayas in particular.

**Acknowledgements**

We wish to thank Man and Biosphere progrmme, Ministry of Environment and Forests, Government of India for funding this study. We thank Dr. Jamal Khan for supervision and support. Thanks are due to Dr. S.S. Samant, G.B. Pant Institute of Himalayan Research and Development, Almora for identifying the plant species. We thank all forest officials of Kumaon for providing work permission in the reserve forest. We also express our thanks to anonymous reviewers for their many constructive comments and critical suggestions. Thanks due to field assistants for providing assistance in arduous field conditions of the Himalayas.

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Received: 12.12.2012
Accepted: 28.03.2013