



## Diet of Chukar Partridge *Alectoris chukar* (Gray): Histological analysis of the droppings

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**Abstract:** Undigested remains from droppings of Chukar partridge *Alectoris chukar* (Gray) were examined under the microscope for qualitative and quantitative information on the food and feeding habits of this popular sport bird. Findings suggested that the Chukar partridge feed both the plants and animals along with grits throughout the year. The vegetative parts was comprised by overall  $87.73 \pm 12.31\%$  of faecal remains and represented by total 24 species of plants, belonging to 13 families while non-vegetative part was  $9.36 \pm 2.46\%$  and represented by hard body parts of 8 Orders of arthropods. Other than plants and animals, average  $2.84 \pm 1.17\%$  grits was also recorded from undigested faecal remains. The leaves, roots and seeds of plants like *Saccharum*, *Brachiaria*, *Chloris*, *Echinochloa*, *Oryza*, *Apluda* (of the family Poaceae) and seeds of *Cajanus*, *Vigna* and *Glycine* (family Fabaceae), and grasshoppers (order - Dissoptera) and flies (order - Diptera) are identified as major components of the diet of Chukar partridge.

**Key words:** Histological analysis, Faeces, Undigested, Chukar partridge.

### Introduction

Chukar partridge *Alectoris chukar* (Gray) is a most popular game bird of the hillside countries. Its total sixteen sub-species have been known to occur in different parts of the Europe and South Asia enjoying from sea level to 5000m. asl (Hume and Marshall 1879, Ali and Ripley 1983 and Madge and McGowan 2002). As a game species, it has been introduced in many countries like the North America, South Africa, Hawaii, New Zealand and St. Helena Island etc (Galberath and Moreland 1953, Christensen 1996 and Watson 1966). In the Indian sub-continent, Chukar partridge is found in Punjab, Jammu and Kashmir, Himachal Pradesh and Uttrakhand and known as "Chakor" in vernacular language (Ali and Ripley 1983, Bisht and Kukreti 2010). In the hills of Uttrakhand Chukar partridge is also considered as a pest species because large flocks of this bird are some time seen in freshly sown crop fields. Information on the feeding habits of this bird is very little till date and based on the field observation, made by a simple visual method in

which feeding birds are observed by binoculars (Green, 1984 and Cole *et al.*, 1995, Christensen *et al.* 1996). Previous studies suggested that the Chukar partridge feeds on leaves of grasses, fruits and seeds of wild forbs, fallen seeds from crop fields etc. Histological analysis of the droppings or faecal pellets is one of the most important and reliable method of study of the food and feeding habits of any wild animals including the birds. Because this method does not need any sacrifice of animals or a painful regurgitation of food. Many avian scientists like Eastman and Jenkins (1970), Butterfield and Coulson (1975), Younzon and Lelliot (1981), Marti (1982), Bhandary *et al* (1986) and Phurailatpum *et al* (2005) has been As a good correlation had established a very good correlation between undigested faecal remains and diet of many game birds. To obtain the authentic information on the diet and also to confirm a pest habit of Chukar partridge histological analysis of the droppings/faecal pellets were carried out in district Pauri Garhwal, Uttrakhand.

### Material and Methods

Chukar partridge *Alectoris chukar* (Order-Galliformes, Family-Phasianidae) is a bird of the open hill-side countries. It inhabits open, arid, rugged slopes covered with scattered trees (*Pinus*

*roxburghii*, *Abies*), scrubs (*Berberis*, *Rubus*, *Rhus*, *Rosa*, etc) and long grasses like *Saccharum*, *Chloris*, *Heteropogon*. In the present study, droppings of Chukar were collected from the south facing slopes at 1950m altitude in the



district Pauri Garhwal, Uttrakhand ( $30^{\circ} 15' N$  and  $78^{\circ} 30' E$ ). Every month, fresh faecal pellets were collected from feeding and roosting habitats in the sealed plastic bags, brought to the laboratory, and dried in an oven at  $60^{\circ}C$  temperature for 30 minutes to remove the residual moisture. Once weighed, the pellets were stored in air dried polythene bags. For histological analysis, 10-12 dried pellets were soaked in water for 3 to 5 days; large pieces were broken by using the dissecting needle and sieved through a  $212\mu m$  brass mesh (Moreby 1993 and Ralph *et al.*, 1985). The material retained was evenly distributed on a 10cm Petri dish scored with  $1\text{cm}^2$  grids and examined under a polarized light microscope. The photographs of each undigested food fragments were taken at 50x and 100x magnifications and identified with the help of text books (Sharp 1968a & b, Warburton 1968), photographic aids (Satakopan 1972, Ralph *et al.* 1985; Moreby 1993). The reference slides were also prepared from the herbarium and insects samples collected by using sweep net and pitfall traps from study area for easy identification of food elements. The frequency occurrence of fragments of each species/family/order) and the percentage of field of view covered by it were recorded. Then undigested organic material of petri dish was washed, air dried and weighed for dry-weight of plant, non-vegetative food and grits.

### Results and Discussion

In the histological study of undigested remains from the droppings of Chukar partridge both plants and animals parts along with grits were observed. The plants part constitutes a major portion of faecal remains as average  $87.73 \pm 4.31\%$  of dry weight (Table 1), and exhibit a seasonal variation with maximum value during September  $91.57 \pm 2.78\%$  (of dry weight) and minimum  $84.66 \pm 6.43\%$  during April. In the non-vegetative matter, hard body parts of arthropods were recorded with overall value  $9.36 \pm 1.46\%$  (ranging from  $13.33 \pm 1.66\%$  during April to  $6.60 \pm 1.05\%$  during September). The fine organic matter (F.O.M) along with grits was recorded with

overall value  $2.84 \pm 1.17\%$  of mean dry weight (ranging from  $6.21 \pm 1.73\%$  in August to  $1.02 \pm 0.66\%$  in the month of March).

**a) Plant or vegetative diet:** From the droppings of Chukar partridge, fragments of the leaves, flowers, seeds, fruits, roots, tubers etc of more than 24 plant species belonging to 13 families namely Anacardiaceae, Asteraceae, Berberidaceae, Cruciferae, Cyperaceae, Fabaceae, Malvaceae, Menispermaceae, Plumbaginaceae, Poaceae, Rosaceae, Saxifragaceae, and Utricaceae were identified (Table 2, Plate 1). Parts of the some plants like *Indocourtoisia*, *Cajanus*, *Rumex*, *Saccharum*, *Brachalaria*, *Rubus*, *Rosa* and *Berginia* were encountered consistently in all the months and seasons. All the plant families except Malvaceae were represented in the diet during the winter season (November to February) when some of the plants were recorded with a very high frequency more than fifty percent occurrence such as *Brassica campestris* ( $66.55 \pm 7.42\%$ ), *Boehmeria platyphylla* ( $61.71 \pm 9.63\%$ ), *Vigna mungo* ( $51.88 \pm 9.08\%$ ), *Glycine max* ( $42.89 \pm 6.73\%$ ), *Indocourtoisia cyperoides* ( $51.82 \pm 3.60\%$ ), *Rumex hastatus* ( $50.12 \pm 6.25\%$ ) etc. In the summer season (March to June) also, all families were encountered in the faecal contents. The grasses like *Chloris dolichostachya* and *Heteropogon contortus* were recorded with hundred percent frequency occurrence followed by wheat grains (*Triticum aestivum*) ( $54.52 \pm 2.86\%$ ), *Oryza sativa* ( $50.42 \pm 11.27\%$ ), *Echinochloa colona* ( $49.79 \pm 2.57\%$ ), *Berberis asiatica* ( $40.74 \pm 8.40\%$ ) and *Berginia ciliata* ( $40.22 \pm 8.50\%$ ). During the monsoon period (August to October), again all families except Cruciferae were encountered in the faeces. The plants with high frequencies were identified as *Hibiscus trionum* ( $80.53 \pm 12.67\%$ ), *Artemisia nilagirica* ( $75.87 \pm 1.71\%$ ), *Stephania elegans* ( $71.97 \pm 9.87\%$ ), *Apluda mutica*, ( $57.36 \pm 3.79\%$ ) *Rhus parviflora* ( $54.72 \pm 5.23\%$ ), *Echinochloa colona* ( $50.20 \pm 6.93\%$ ) and *Oryza sativa* ( $49.57 \pm 9.22\%$ ).



**Table 1: Mean dry weight composition of the droppings of Chukar partridge.**

<b>Month</b>	<b>Faecal dry weight (g)</b>	<b>% dry weight composition</b>		
		<b>Vegetative parts</b>	<b>Non-vegetative parts</b>	<b>F.o.m+Grits</b>
July, 2008(9)	0.89±0.05	84.76±4.21	10.83±0.83	4.41±2.23
August(10)	1.00±0.09	85.46±3.64	7.33±1.80	6.21±1.73
September(8)	1.45±0.11	91.57±2.78	6.66±1.05	1.77±0.37
October(7)	1.11±0.04	88.78±4.57	7.12±0.91	3.10±1.32
November(6)	1.03±0.04	86.66±4.37	8.33±1.66	5.01±1.83
December(7)	1.30±0.02	89.20±7.47	7.00±1.22	3.80±0.82
January, 2009(7)	0.80±0.05	89.83±1.23	8.00±1.22	2.20±0.94
February(9)	1.62±0.07	88.86±2.24	9.16±2.27	1.98±0.57
March(11)	1.04±0.07	86.87±4.68	11.66±1.66	1.02±0.66
April(10)	1.16±0.04	84.66±6.43	13.33±1.66	2.01±1.12
May(12)	0.89±0.03	88.66±5.43	10.00±2.23	1.34±0.63
June(8)	1.63±0.25	87.66±4.70	11.00±1.00	1.34±0.61
<b>Annual(104)</b>	<b>1.15±0.05</b>	<b>87.73±4.31</b>	<b>9.36±1.46</b>	<b>2.84±1.17</b>

Figure in the parenthesis are number of samples analyzed.

**b) Non-vegetative diet:** The fragments of hard body parts like mandibles, maxillae, antennae, wings, legs and elytra of insects (Arthropods) belonging to eight orders namely Araneae, Diptera, Dissoptera, Heteroptera, Hymenoptera, Isoptera, Lepidoptera and Zoraptera were identified from the faecal remains of Chukar partridge (Table 3, Plate 2).

During the winter, body parts of termites (Isoptera) were observed with highest value (42.41±6.24%), followed by the Coccinella (Zoraptera) 41.34±3.12%, spiders (Araneae) 40.55±4.35%, butterflies (Lepidoptera, 33.10±1.10%), ants Hymenoptera (32.92±3.31%), Heteroptera (31.42±6.97%) and flies (Diptera, 27.90±2.27%). Grasshoppers (Dissoptera) were not recorded in any month of the winter season

(pre breeding period). In the summer season, fragments of the body parts of all 8 Orders were encountered in the faeces, with highest frequency occurrence of grasshoppers (65.79±10.64%), followed by Heteroptera (49.50±2.85%), butterflies (45.10±6.02%), Coccinella (39.05±3.23%), spiders (37.25±2.0%) and etc. In the monsoon season (July to October), all Orders of arthropods were represented in the faeces. Diptera (flies) were recorded with highest frequency occurrence (51.37±5.18%), followed by termites (42.24±5.43%), grasshoppers (34.20±0.89%), ants (26.35±6.32%), spiders (22.19±2.08%), butterflies (21.79±3.87%) and Heteroptera (19.07±1.45%). Unidentified body parts of arthropods were recorded throughout the year in range of 30.91% (summer season) to 34.97±% (winter months).

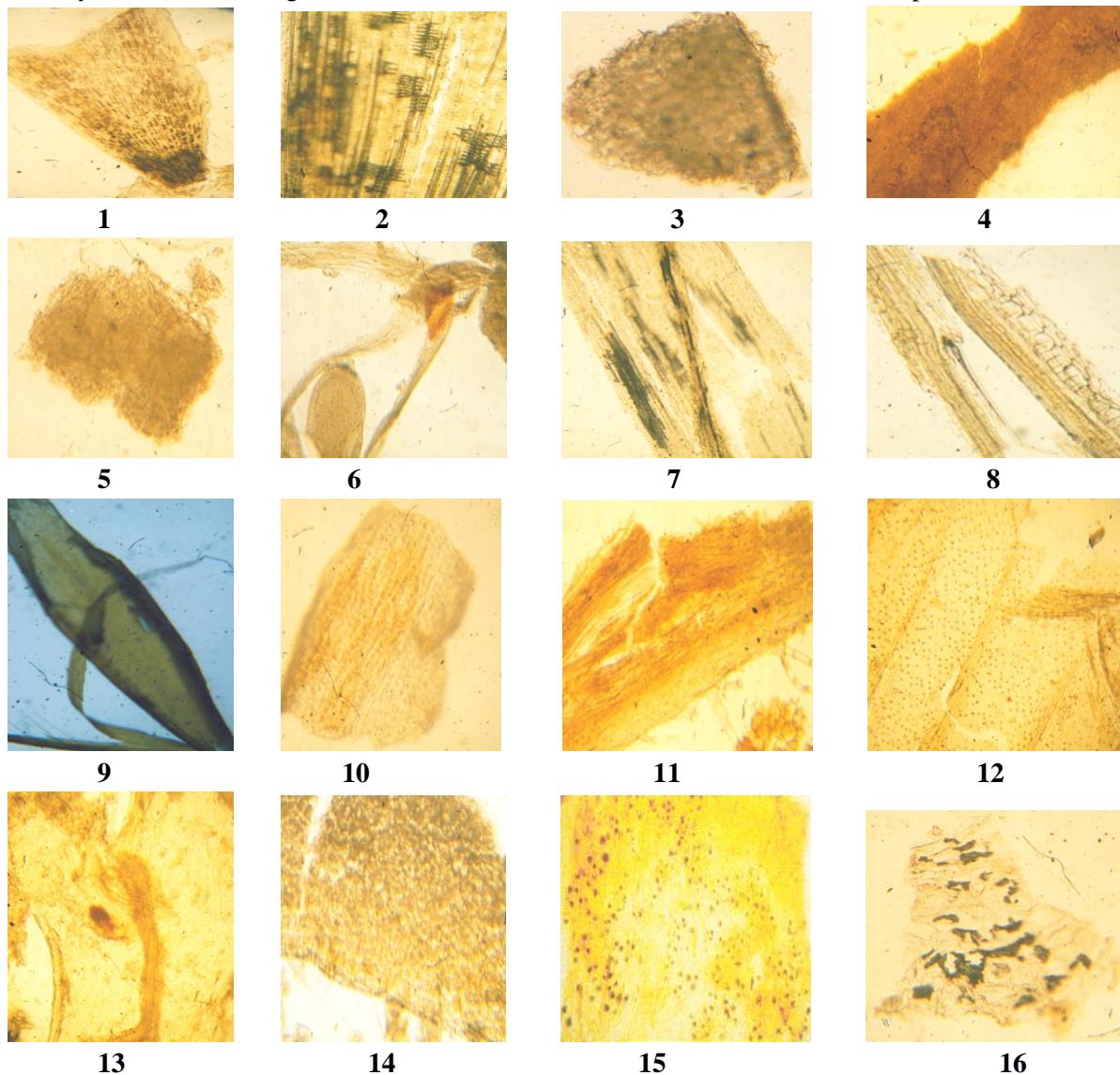
**Table 2: Frequency occurrence of the plant parts in faecal contents of Chukar partridge.**

Families/Plants	Parts used	Frequency occurrence (in %)		
		Winter	Summer	Monsoon
<b>Anacardiaceae</b>				
<i>Rhus parviflora</i>	Leaves & fruits	28.92±3.98	16.35±2.06	54.72±5.23
<i>Artimisia nilagirica</i>	Leaves & roots	15.63±1.50	8.48±2.90	75.87±1.71
<b>Asteraceae</b>				
<i>Aster albescens</i>	Leaves & roots	30.61±4.09	34.21±7.62	35.17±3.39
<b>Berberidaceae</b>				
<i>Berberis asiaticus</i>	Flowers & fruits	31.86±1.78	40.74±8.40	27.38±3.42
<b>Cruciferae</b>				
<i>Brassica campestris</i>	Leaves, flowers & seeds	66.55±7.42	33.45±3.91	0.0
<b>Cyperaceae</b>				
<i>Indocourtoisia cyperoides</i>	Leaves	51.82±3.60	33.19±4.73	14.25±2.11
<b>Fabaceae</b>				
<i>Cajanus volubilis</i>	Fruits, seeds & roots	31.87±6.03	35.85±5.91	32.27±2.17
<i>Vigna mungo</i>	Seeds	51.88±9.08	10.51±1.55	37.59±3.94
<i>Glycine max</i>	Seeds	42.89±6.73	28.47±3.11	28.62±2.98
<b>Malvaceae</b>				
<i>Hibiscus trionum</i>	Seeds	0.0	19.46±3.45	80.53±12.67
<b>Meninspermaceae</b>				
<i>Stephania elegans</i>	Leaves & fruits	19.6±1.67	8.40±1.90	71.97±9.87
<b>Plumbaginaceae</b>				
<i>Rumex hastatus</i>	Leaves & seeds	50.12±6.25	37.74±3.97	13.30±5.60
<b>Poaceae</b>				
<i>Saccharum rufipilum</i>	Leaves & roots	32.11±0.96	34.41±1.01	33.46±5.43
<i>Brachiaria villosa</i>	Leaves & roots	33.07±3.91	35.38±2.75	31.54±1.68
<i>Triticum aestivum</i>	Leaves & grains	45.47±6.62	54.52±2.86	0.0
<i>Chloris</i>	Leaves & roots	0.0	100.00±0.0	0.0
<i>Dolichostachya</i>				
<i>Heteropogon contortus</i>	Leaves & roots	0.0	100.0±0.0	0.0
<i>Apluda mutica</i>	Leaves & seeds	42.63±7.64	0.0	57.36±3.79
<i>Echinochloa colona</i>	Leaves & seeds	0.0	49.79±2.57	50.20±6.93
<i>Oryza sativa</i>	Seeds	0.0	50.42±11.27	49.57±9.22
<b>Rosaceae</b>				
<i>Rubus ellipticus</i>	Leaves, flowers & fruits	41.17±5.68	18.82±3.21	30.44±1.11
<i>Rosa brunonii</i>	Leaves, flowers & fruits	39.01±1.96	30.51±5.41	28.97±2.89
<b>Saxifragaceae</b>				
<i>Bergenia ciliata</i>	Rhizomes	33.41±1.09	40.22±8.50	26.35±2.67
<b>Utricaceae</b>				
<i>Boehmeria platyphylla</i>	Leaves & seeds	61.71±9.63	12.76±1.07	25.52±3.57
Findings of the present study based on the histological analysis of droppings for the first time suggest that the Chukar partridge <i>Alectoris chukar</i> is an opportunistic bird, feed all types of vegetarian and non vegetarian food including the		forbs seeds, grasses, fruits, crop grains, insects etc. But presence of a high amount of plants parts (dry weight) in faecal remains in all months and seasons revealed that - i) the Chukar is a more vegetarian bird and ii) diet selection is related to		



the availability of food in nature. For example the annual plants like *Rhus*, *Berberis* were eaten in all seasons. Presence of hard body parts of arthropods (mostly insects) in undigested remains does not

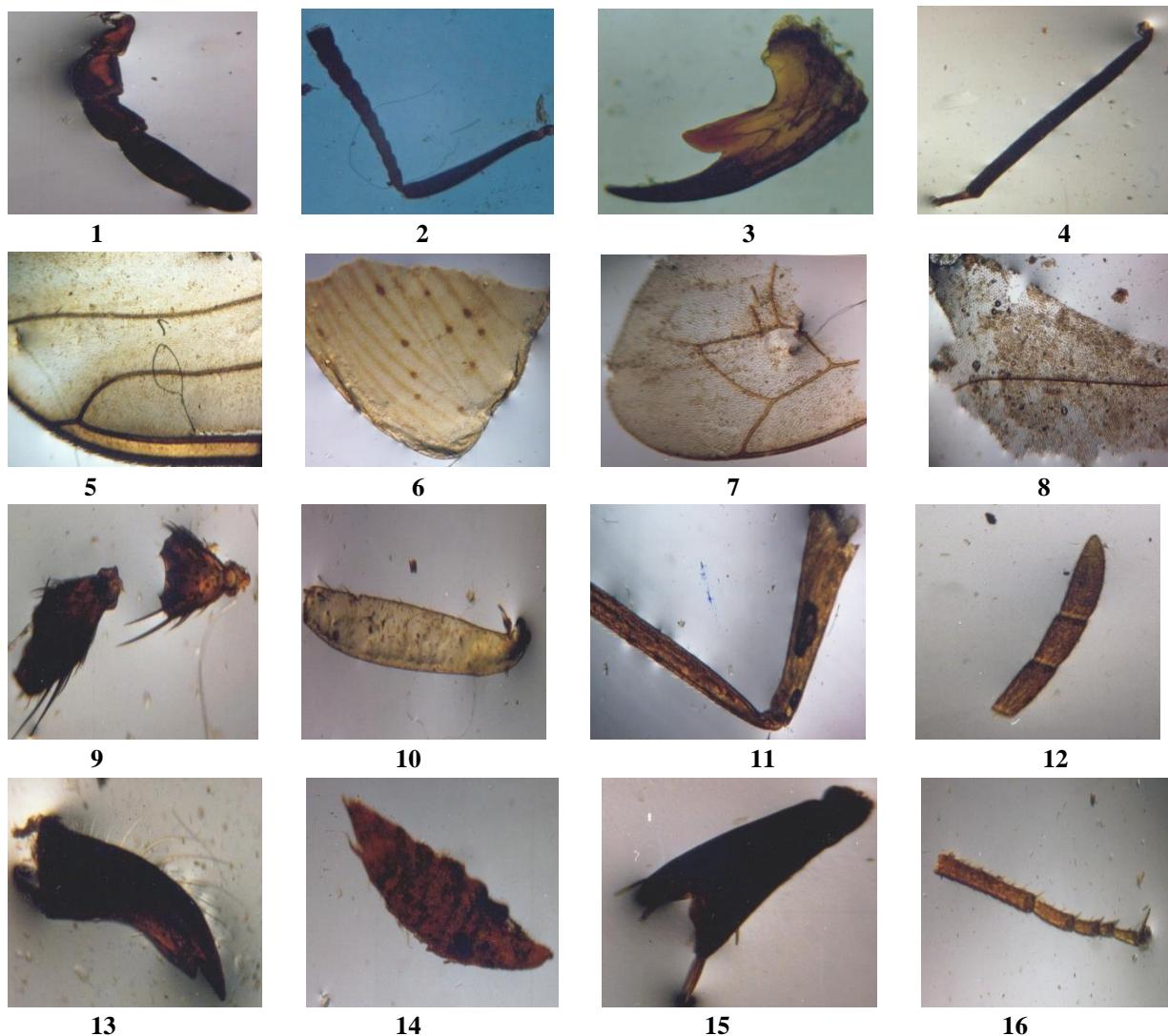
mean that the Chukar partridges not feed on the soft bodied animals like worms, grubs, larvae, small reptiles, snails etc. Christensen (1996) had suggested that the Chukar partridge also feed on worms, snails, small reptiles etc.



**Fig Plate I.** Plant parts encountered in the faeces of Chukar partridge. 1. Seed of *Echinochloa colona*, 2. Seed of *Oryza sativa*, 3. *Macrotyloma uniflorum* seed part, 4. *Vigna mungo* seed part, 5. Seed part of *Glycin max*, 6. Flower part of *Brassica rapa campestris*, 7. leaf part of *Alpuda mutica*, 8. Flower part of *Rosa brunonaii*, 9. Leaf part of *Chloris dolichostachya*, 10. Fruit parts of *Berginia ciliata*, 11. Leaf part of *Aster albescens*, 12. Fruit part of *Cajanus sacra*, 13. Fruit part of *Berberis asiatica*, 14. Leaf part of *Inocourtisia cyperoides*, 15. stone cell in fruit of *Rubus*, 16. Leaf part of *Rumax*.

This diet selection of animals depends upon availability of food in habitats. For example the body parts of certain grasses (*Hisbiscus*, *Chloris*, *Heteropogon*) as well as grasshoppers were not encountered in faeces during the winter season

because they were also not available in the habitat during this period. During the summer and monsoon seasons, consumption of grasshoppers and flies was found with a high frequency when their abundance was quite well.



**Fig Plate II.** Arthropod parts encountered in the faeces of Chukar partridge. 1. Spider labium, 2. Coleopteran antenna, 3. Staphylened mandible, 4. Mouth part of *Micropteryx aruncella*, 5. Heteropteran wing, 6. Dipteran wing, 7. Coccinella hind wing, 8. Wing of flies, 9. Mandible of micropterygidae, 10. Dipteran middle leg, 11. Antenna of Grasshopper, 12. Dipteran antenna 13. Scarabid larva of butterflies, 14. Lepidopteran larva, 15. Termite mandible and 16. Ant hind leg.

**Table 3: Frequency occurrence of the arthropods body parts in faecal contents of Chukar partridge.**

Arthropods /Orders	Frequency occurrence (in %)		
	Winter	Summer	Monsoon
Araneae (Spiders)	40.55±4.35	37.25±2.00	22.19±2.08
Diptera (Flies)	27.90±2.27	20.73±3.90	51.37±5.18
Dissoptera (Grasshoppers)	0.0	65.79±10.64	34.20±0.89
Heteroptera ( <i>Spilostethus pondurus</i> )	31.42±5.97	40.72±2.85	26.35±1.45
Hymenoptera (Ants)	32.92±3.31	15.34±2.44	42.24±6.32
Isoptera (Termites)	42.21±6.24	15.34±4.02	42.24±5.43
Lepidoptera (Butterflies)	33.10±1.10	45.10±6.02	21.79±3.87
Zoraoptera ( <i>Coccinella</i> )	41.34±3.12	39.05±3.23	19.59±1.50
Unidentified	34.11±4.09	30.91±2.48	34.97±2.10



Importance of protein rich food during breeding and post breeding (during summer and monsoon times) in many game birds has been reported by many field biologists like Ford and Middleton (1938), Vickerman and Bryan (1979), Southwood and Cross (1969), Bhandary *et al.* (1986), Kaul (1990) and Phurilatpum *et al.* (2005). Presence of the fragments of grains of *Triticum*, *Oryza*, *Glycine*, *Vigna* and *Brassica* suggest the grainivorous habit of Chukar partridge but during the study this bird was never observed feeding on the standing crops (Bisht and Kukreti 2010). Occasional sighting of Chukars on freshly sown crop fields do not confirms its pest habit. Christensen (1996) and Weaver and Haskel (1967) also reported that the Chukar partridge feed on the fallen grains only.

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