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Ecology and Conservation Status of the Pheasants of Great Himalayan National Park, Western Himalaya

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SUMMARY

The Pheasants belong to the taxonomic family '*Phasianidae'* of the order '*Galliformes'*. Of the 51 species that have so far been recognized in the World, 50 are Asian in origin, the lone exception being the Congo peafowl (*Pavo congensis*). These species are distributed in wide range of area and occupy variety of habitat types ranging from lowland tropical rain forest (e.g. Crested fireback *Lophura ignita*) to alpine meadows (e.g. Chinese monal *Lophophorus lhuysii*). They are regarded as the most distinctive bird family of the Himalaya perhaps due to the charismatic features and also due to their significant role in the high altitude ecosystem as indicator of habitat quality and as major prey base for predatory birds and mammals. Large body size and brightly colored plumage have been the contributing factors for heavy hunting pressure on these species and as a consequence, many of the species are threatened in their native ranges which are rapidly shrinking and have restricted several population into fragmented patches. The large amount of available data accumulated by trophy hunters on the status and distribution of these pheasants lack essential scientific explanation, thus leading to scientific based surveys and studies. Although considerable number of surveys have been undertaken in the recent years, most of them concentrated on information related to status and distribution, and still there is want of data on population trend and habitat requirements of these pheasants, particularly the Himalayan pheasants. The present study though part of the major research project, focussed the gaps in this direction and aimed to help the managers with adequate scientific information needed for management and conservation oriented actions. This study was conducted from April 1997 to June 1999 with the major focus on ecology and conservation status of the pheasants. Although data were collected on all the pheasant species that occur in the Great Himalayan National Park (GHNP), intensive work was concentrated on only three species viz., Western tragopan (*Tragopan melanocephalus*), Himalayan monal (*Lophophorus impejanus*) and Koklass (*Pucrasia macrolopha*).

Due to the characteristic topographical features, the study had to depend upon trails and bridal paths, which are used by local people and livestock graziers. Based on the initial surveys and literature, an intensive study area of 16 km^2 was identified in Tirthan Valley. Six trails ranging from 0.7 km to 1.2 km were monitored twice a month sequentially and data on number, sex and flock size of these species were collected during the trail walk. Call count was carried out during spring season especially for Koklass since this species skulks under bush causing low delectability and gives loud chorus during their breeding season (spring). Abundance index expressed as encounter rate (Number of birds/km walk and Number of calling sites/sampling plots) was calculated for these species across season in different areas. Habitat use was studied using correlative approach and to generate distribution maps for the pheasants.

In total, 524 sightings of Himalayan monal, 126 sightings of Koklass, 45 sightings of Western tragopan, 11 sighting of Kalij (*Lophura leucomelanos*) and 3 sightings of Cheer pheasant (*Catreus wallichi*) were obtained during the study period. However, only 320 sightings of Himalayan monal, 90 sightings of Koklass and 30 sightings of Western tragopan were used for studying habitat use and relative abundance as use of other records obtained during opportunistic search and surveys had limitation. The data collected during the intensive study and surveys suggest that Western tragopan deserves priority conservation action followed by Cheer pheasant. Results indicate that relatively large proportion of the pheasant populations in GHNP is concentrated in Tirthan and Jiwa valleys. The distribution of the pheasants was found to be greatly affected by climate, altitude and aspect. Intensive study conducted on the three species indicates that they show immediate response to snow condition and consequently, they were seen concentrated in lower elevation areas during winter. Himalayan monal was mostly distributed between 2620 m and 3350m in summer and between 2000 m and 2800 m in winter. Western tragopan and Koklass followed similar distribution range and were found mostly from 2250 m to 2980 m in summer and from 1890 m to 2700 m in winter.

Relative abundance estimated in the recent year 1998/99 for Himalayan monal ranged from 1.5 ± 0.35 to 3.5 ± 0.38 birds/km walk (Mean ± standard error). For Koklass, the mean encounter rate estimated using call count was 2.5 ± 0.21 calling sites/sampling station. Relatively very low estimate was obtained for Western tragopan with the encounter rate of 0.3 ± 0.1 bird/km walk in 1998/99. Overall encounter rate estimates for Himalayan monal revealed a relatively high abundance in Chordhuar and the lowest in Rolla. Call encounter rate for Koklass ranged from 1.4 ± 0.38 calling sites/station in Koilipoi to 3.3 ± 0.31 calling sites/station in Dulunga. Western tragopan was seen only in four areas with the maximum encounter rate in Rolla (0.4 ± 0.1) and Chordhuar (0.3 ± 0.1). Excepting for Koklass, there was significant difference was detected in the abundance of Himalayan monal and Western tragopan between seasons, the maximum being in winter season. During the study period, the pheasant populations showed declining trend, and the circumstantial evidences suggested that mushroom collection practice was the major reason for this decline.

Climate played a major role in the selection of habitat of the pheasants in different seasons. Himalayan monal showed relative preference to sub alpine Oak Forest in spring and during winter they were concentrated in conifer dominated forests. There was no significant difference in the use of habitats by Koklass across seasons. Relatively high abundance for Western tragopan in mixed conifer & broad leaf forest with *Arundinaria* undergrowth indicated relative preference to this habitat in spring. During winter, they moved down to broad leaf dominated mixed forests. Data

collected based on opportunistic search indicated that cheer pheasant use open grassy slopes intercepted with sparse tree vegetation and 'nullas'. Kalij was not observed above 2200 m elevation and were found mostly in lower altitude broad-leave forest.

The group size of the Himalayan monal ranged from 1 to 11 individuals with the mean group size of 1.61 ± 1.21 (n = 526) individuals. Group size differed significantly across seasons. Maximum group size of 1.86 ± 1.48 (n = 227) and large group consisting of 11 individuals revealed winter congregation in Himalayan monal. Koklass and Western tragopan did not show significant difference in the group size between seasons. The mean group sizes for Koklass and Western tragopan were 1.23 ± 0.48 (n=126, range = 1 – 3) and 1.09 ± 0.29 (n=45, range 1 – 2) respectively. Excepting for Himalayan monal, data on group composition revealed that Koklass and Western tragopan either they live solitarily or in pairs. Skewed sex ratio (male: female) biased towards females was observed for Himalayan monal (10:13) and Western tragopan (10:13), while in Koklass the sex ratio favored the males (10:7). Conservation point of view, the pheasants in GHNP are faced with several impeding factors such as poaching; impacts due to mushroom collection which also includes egg stealing, destruction of nests, predation by domestic dogs; livestock grazing; fire and habitat destruction. With the achievement of final notification recently, the above factors can be controlled to a large extent. However, the vast extent of the area, inadequate manpower, coupled with dependency and heavy demand for mushrooms, have high potential to make the ban impractical. Awareness programmes, participatory approach and strict law enforcement against offenders will only help to counter such problems and to implement effective conservation actions in the park and other forested areas close to villages.

CHAPTER 1 : INTRODUCTION

1.1. THE PHEASANTS

The pheasants are large bodied, brightly colored, ground dwelling birds, which 'belong to Family '*Phasianidae'* and Order '*Galliformes'*. Pheasants along with other so called game birds such as Partridges and Quails have long been associated with social and religious status of people living in Asia and Europe. The use of term 'game' in British law in an Act of 1389 in the reign of Richard II was linked directly with the defining of property qualification or social status necessary for any one who wishes to hunt gentlemen's game (Mc Kelvie 1985). In particular, the word 'pheasants' is referred to those members of Subfamily 'Phasianinae' in which the birds exhibit greater sexual dimorphism in both size and plumage. Fifty-one species belonging to 16 genera have been recognized so far in the World. Interestingly, 50 of them are Asian in origin, the lone exception being the Congo peafowl (*Afropavo congensis*) confined to a small area in the virgin forests of east central Congo basin (Delacour 1977). The natural range of the pheasants spreads from Eastern Shore of the Black sea to the Caspian sea and along its southern shore. Its distribution then extends northward into Munchuria and Korea and southward to the borders of Viet Nam (Hill and Robertson 1988). Theses species inhabit wide range of habitats such as lowland tropical rainforest (e.g. Crested fireback *Lophura ignita*, Congo peafowl *Afropavo congensis*), montane tropical forest (e.g. Mountain peacock-pheasant *Polyplectron inopinatum*), temperate coniferous forest (e.g. Western tragopan *Tragopan melanocephalus*), subalpine scrub (e.g. Blood pheasant *Ithaginis cruentus*), alpine meadows (e.g. Chinese monal *Lophophorus lhuysii*), tropical dry-deciduous forests (e.g. Grey jungle fowl *Gallus sonnerati*) and agricultural lands (e.g. Indian peafowl *Pavo cristatus*) (McGowan & Garson, 1995).

Pheasant populations in most of their range have long been undergone heavy depletion due to excessive hunting and poaching for their brightly colored plumage and meat. Besides a large tract of their natural habitat has been encroached upon for other human needs. A total of 29 species (57%) of the entire group are listed as rare, endangered or vulnerable in the Mace-Lande threat category, provided by the IUCN/SSC/Pheasant Specialist Group (PSG) (McGowan and Garson 1995). The proportion of species in Phasianidae that are threatened as a result of man's activities is amongst the highest in any bird family and there is a chance that many species will become extinct during the next 100 years (McGowan in del Hoyo, *et. al.*1994). Recent assessment of conservation status of partridges and pheasants in Southeast Asia also has documented considerable reduction in population of several species (McGowan & Gillman 1997).

1.2. THE HIMALAYA AND THE PHEASANTS

The Himalaya is the highest and youngest mountain systems in the world, which extends over 2400 Kms as an arc from Northwest to Southeast and covers 150 to 250 Kms in width (Devan 1988). Well recognised for its ecological, socio-cultural and aesthetic values, the Himalayan mountain range is considered to be one of the most significant bio-geographical zones in India as it is situated at the junction of three bio-geographical realms viz., Palaearctic, Africo-tropical and Indo-Malayan (Mani, 1974). This unique feature has let free flow of variety of wildlife species from different faunal realms into the Himalaya. Characteristically, pheasants of the Himalaya are the most charismatic and conspicuous of all fauna of this region. They are regarded as the most distinctive bird family of the Himalaya due to their high endemicity and brightly coloured plumage (Ali 1981). They also play a significant role in the high altitude ecosystem by forming a major prey base for predatory birds and mammals (Johnsgard 1986). Since the Himalaya are of recent origin, the endemics confined in this mountain system could have colonised later than Pliocene, indicating that the pheasants which first evolved in Europe could have colonised in Asia and radiated further reaching the Himalaya in early Miocene and then moved down to southeast Asia.

Of the 51 species, 20 (39%) are endemic to the Himalaya, which include the genera of *Ithaginis* (Blood pheasant), *Tragopan* (Tragopans or Horned pheasants), *Lophophorus* (Monal pheasants), *Lophura* (Kalij pheasant), *Pucrasia* (Koklass pheasant), *Catreus* (Cheer pheasant), *Crossoptilon* (Eared pheasant) and *Polypectron* (Peacock pheasant). The Indian Himalaya is represented by 16 species of pheasants, which occupy various vegetation and altitudinal gradients. The life of the Himalayan pheasants has been controlled by severe climatic condition. The large size and heavily built plumage in pheasants are possibly due to the physiological requirements to withstand the typical climate, terrain and low-atmospheric pressure in high altitudes. Winter in this region play a major role in their survival. During winter, when the ground is snow covered and very little resources are available, they are compressed to lower elevations where they face inter and intra-specific competition for resources and also get poached for meat and plumage.

1.3. SPECIES CHARACTERISTICS

The Order ‘Galliformes’ comprises 57 genera and 214 species which are represented by three families viz., Phasianidae (pheasants, Turkeys, Grouse and Partridges), Numididae (Guinea fowls) and Odontophoridae (New world quails) (Sibley and Monroe 1990). There are marked differences present within each group of pheasants in anatomical, morphological and biological characteristics. The main **morphological characteristics** of the various genera of pheasants reside in the general

pattern and color of the feathers, presence or prominence of wattles, crest, hackles and spurs, shape and structures of tail, wings and bill (Delacour 1977). Large size, multicolored plumage pattern and presence of other above-mentioned features have clearly distinguished this group of birds from others. In comparing pheasants to mammiferous animals, they exhibit most analogy with ruminants in internal structures. It is evident from their food habit that they primarily feed on vegetative materials though they also consume insects and other invertebrates. However, the **anatomical characters** within pheasant tribe vary to a small extent. **Biological characters** such as genera behaviour and habit voice courtship, display, mating and nesting hold greatest value in pheasants (Delacour 1977).

1.4. BACKGROUND KNOWLEDGE

Though there has been considerable number of surveys conducted on pheasants, present knowledge on individual taxon is deficient. Baring the few ecological studies undertaken by Hill and Robertson 1988, Islam 1982, Kaul 1989, Ahmed and Musavi 1997, Khaling 1997, Kumar 1997, Young *et. al.* 1991 and McGowan 1992, most of information available are anecdotal and have mostly come from surveys (Severinghaus 1979; Garson 1983; Gaston *et.al*. 1983a; Duke 1990; McGowan 1990; Kaul and Ahmed; 1993; Balen and Holmes 1993; Choudhry 1993; Cu and Eames 1993; Gaston *et.al*. 1993; Guang-Mei and Zheng-Wang 1993; Kaul and Garson 1993; Pandey 1993; Prasad 1993; Sathyakumar *et.al*. 1993; Shah 1993; Sharma 1993; Shrestha 1993; Yatim 1993; Pandey 1994 and Ramesh 1995). These surveys were generally conducted in small isolated areas, usually over a shorter duration of time. There are still many areas which have not been explored, leaving our knowledge on even the presence/absence and distribution of many pheasant species incomplete.

The status of pheasants of Indian Himalaya remains same as that of other region with very few intensive ecological studies (Kaul 1989 on the Cheer pheasants in Uttar Pradesh hills, Ahmed and Musavi 1997 on Kalij pheasants in Kumaon hills, Khaling 1997 on Satyr tragopan (*Tragopan satyra*) in Darjeeling hills and Kumar 1997 on Himalayan monal in Kedarnath Wildlife Sanctuary). Want of information on many of the pheasants has lead to lack of adequate conservation strategies. In the Great Himalayan National Park (GHNP) where this study was carried out, five species of pheasants are present. They are; Western tragopan (*Tragopan melanocephalus*), Koklass pheasant (*Pucrasia macrolopha*), Himalayan monal (*Lophophorus impejanus*), Cheer pheasant (*Catreus wallichii*) and Kalij pheasant (*Lophura leucomelana*). This Park is one of the only two National Parks in the world to support a substantial population of the endangered Western tragopan (Collar & Andrew, 1988). Under the Indian Wildlife (Protection) Act, 1972, all these pheasants have been given adequate

protection by their placement in Schedule I and Schedule IV. The Mace-Lande threat category provided by Pheasant Specialist Group (PSG) considers Western tragopan and Cheer pheasant as 'Vulnerable' and other three species as 'Safe' (McGowan & Garson, 1995). However, it is also known that the future of these species in many parts of their range is unsafe due to several anthropogenic factors. Needless to emphasize that for effective conservation of the pheasants, it is necessary to have a forehand knowledge on their status, distribution and habitat requirements. Ironically, it is apparent that field knowledge on this aspect for the Himalayan pheasants is still inadequate.

Keeping the above-mentioned points in view, an ecological study on the pheasants of GHNP was proposed with main focus on three sympatric species viz. Western tragopan, Koklass pheasant and Himalayan monal. They are under severe threat due largely to the ongoing human activities such as mushroom and medicinal plant collection, extensive grazing and poaching. This study holds a significant value as this is the first of its kind and focuses on one of the rarest birds of the World, Western tragopan whose estimated world population is less than 5,000 individuals (Gaston *et.al.* 1983b).

1.5. OBJECTIVES

This study was conducted with the following four broad objectives,

1. To determine the conservation status and distribution of pheasants of GHNP.
2. To study the spatio-temporal variation in the group size, sex ratio and relative abundance of the pheasants and their responses to biotic and abiotic factors.
3. To study the habitat use in terms of the factors affecting the relative habitat preferences of the pheasants along seasonal gradient.
4. To develop a protocol to monitor pheasant populations and formulate conservation strategies for the pheasants of the GHNP.

CHAPTER 2 : STUDY SPECIES AND LITERATURE REVIEW

2.1. INTRODUCTION

Though data were collected on all five species which occur in GHNP, intensive ecological study was focussed on only three species viz., Western tragopan *Tragopan melanocephalus* Gray 1829, Himalayan monal *Lophophorus impejanus* and Koklass *Pucrasia macrolopha.* These species inhabit upper temperate region, coexisting in same vegetation types during most of their life period with marked differences in the usage of microhabitat variables. Information on evolutionary history of pheasants reveals that these three species evolved from the same ancestor (Johnsgard 1986). Winter forms crucial part of their life, as they require to undergo severe climatic conditions and are having to face the resource crunch limited by heavy snowfall. Spatial distributions of these pheasants show a distinct pattern with individual pheasants occupying restricted range. Three of them occur together only in Northwest and part of western Himalaya and as they move to east, Western tragopan is replaced by Satyr tragopan (*Tragopan satyr*) and Koklass does not move further to east which is the eastern most range of Himalayan monal.

2.2. WESTERN TRAGOPAN

Western tragopan or Western horned tragopan is considered to be rarest of all living pheasants. This monogamous endangered pheasant is endemic to North-western Himalaya with a narrow range from Hazara in North Pakistan through Jammu & Kashmir to Garhwal in India (McGowan in del Hoyo, *et. al.*1994). The declining world population of this species has been estimated to be ranging from 1600 to 5000 individuals (Gaston *et.al.* 1983; Johnsgard 1986). Due its beautiful plumage and magnificent size, this bird is locally called **"*Jijurana*"** which actually means the "King of Birds". It inhabits forests of spruce (*Picea smithiana*), deodar (*Cedrus deodara*) and brown oak *(Quercus semecarpefolia*) at the upper edge of the tree line between 2600 and 3000 msl in summer, and in winter, dense coniferous and broad leave forests between 2000 to 2800 m elevations. They mostly feed on leaves, shoots, seeds, but also consume insects and other invertebrates. Like most of the pheasants, they roost on trees singly or in pairs.

2.2.1. Species and subspecies

There are five species recognised under the genera *Tragopan*, Viz. Western tragopan (*Tragopan melanocephalus* Gray 1829), Satyr tragopan (*Tragopan satyr* Linnae 1758), Blyth's tragopan

(*Tragopan blythi* Jerdon 1870), Temminck's tragopan (*Tragopan temmincki* Gray 1831) and Cabot's tragopan (*Tragopan caboti* Gould 1857). Excepting for the Cabot's tragopan, which is distributed in China, all other tragopans are found in India. No subspecies has so far been recognised for Western tragopan.

2.2.2. Species description

It is a medium sized, brightly plumaged bird with the male and female weighing about 1800 – 2200 g and 1300 – 1400 g respectively. Length of the male is 65 – 75 cm and of the female is 60 – 65 cm. The male possesses red-tipped long crest, feathered with reddish back, and side of the neck and face are red. Upper part is covered with buffish grey and black with prominent white spots. Crest feather is absent in females and they lack red colour excepting in the face and leg which is pinkish. Pale brownish grey upper part with finely vermiculated and spotted with black and most of the feathers have black patches and central white streaks. Immature males resemble female birds, but larger in size and higher on leg with variable amount of black on head and red on neck. Male possesses unique feature in the form of naked throat which, during breeding, is called as lappets and is displayed for attracting females. Moreover, they also call loudly during breeding season (April – August) for attracting females and for defending territory.

2.2.3. Conservation status

Population of western tragopan is threatened by several anthropogenic factors throughout its range. As a consequence, it has been listed as 'Vulnerable' in Mace-Lande threat category provided by IUCN/SSC/Pheasant Specialist Group (McGowan and Garson 1995) and has also been placed under Schedule I of Indian Wildlife (Protection) Act, 1972 (Anon 1972). CITES has listed this species in Appendix I in order to discourage selling of its feathers. Representing the endemic bird area D02 (Western Himalaya), western tragopan has been described as a range-restricted species (ICBP 1992).

2.3. HIMALAYAN MONAL

Himalayan monal together with other two counter parts secures distinct position among the pheasants due to heavy shape, brilliantly garmented plumage and highly exhibited sexual dimorphism (Delacour 1977). These features have complemented this montane bird with the status of being National bird of Nepal and State bird of Himachal Pradesh. Its natural range spreads from eastern Afghanistan through the Himalayas including countries of Pakistan, India, and Nepal to

Bhutan and northeast Assam. It occupies upper temperate forests of conifer and oak with open grassy slopes between 2400 – 4500 m, mostly concentrating in a narrow belt of 2700 – 3700m. They are observed to be exhibiting high level of altitudinal migration reaching as low as 2000m in winter. They, however, show tolerance to snow and have been observed to dig out snow for shoots and invertebrates. Their food primarily consists of tender leaves, shoots, tubers, nuts and insects and other invertebrates. Seen in pairs during breeding season (April to August), they form large coveys and involve in communal roosting during winter (P*ers. observ.*).

2.3.1. Species and subspecies

Himalayan monal (*Lophophorus impejanus* Latham 1790) is one of the three species classified under genera *Lophophorus*, the other two being Sclater's monal (*Lophophorus sclateri* Jerdon 1870) and Chinese monal (*Lophophorus ihuysi* Hilaire 1866), which are distributed in north-east hills of India and south-east china respectively. There is, so far, no confirmed record of subspecies in Himalayan monal.

2.3.2. Species description

It is relatively large sized bird with reference to family phasianidae. With about 70 cm in length, the weight of male and female ranges from 1980 – 2380g and 1800 – 2150g respectively. Adult males possess long crest, feathered with multicoloured plumage throughout its body while the female, like other pheasants, are dull in colour with the upper parts covered with dark brownish black feathers. Notable features in males are, long crest which is metallic green, changeable reddish copper in back and sides of neck and prominent white back while on flight. Tail feathers of male uniform rufous with darker towards the tips where as lower tail coverts of female is white, barred with black and rufous. Female has a prominent white patch in fore neck and a white strip on tail. First year male and immature resemble female, but larger in first year male and the immature is less distinctly marked (Delacour 1977).

2.3.3. Conservation status

Mace-Lande threat category provided by IUCN Pheasant Specialist group considers Himalayan monal as safe (McGowan and Garson 1995), but Indian Wildlife (Protection) Act has given adequate protection by placing this species under Schedule I. Population of this species most of its range is threatened due to hunting and poaching and other human induced factors. Male monal had been under heavy hunting pressure for its crest feather, which was used to ornament hats of Himachal men, until 1982 when legal hunting was banned.

2.4. KOKLASS PHEASANT

Koklass is a medium sized elusive bird confined to high altitude forests from Afghanistan to central Nepal, and in north-eastern Tibet to northern and eastern China (Delacour 1977), sharing the habitat with Western tragopan and Himalayan monal. Like Western tragopan, it does not extents its range above tree line. One of the less colourful pheasants, Koklass exhibit moderate sexual dimorphism. Though it skulks under bush, which evades direct sighting, they give loud chorus call during breeding season and also during autumn, revealing their presence. Like Himalayan monal and Western tragopan, Koklass also do altitudinal migration during winter to avoid harsh climatic condition. However, they remain in pairs or small family groups throughout the year. Being omnivorous, they feed on leaves, shoots, tubers and invertebrates. Nesting on ground, it spends night on roosting in trees or under rock overhangs.

2.4.1. Species and subspecies

Koklass (*Pucrasia macrolopha* Gray 1841) is a monotypic species of genera *Pucrasia,* with nine subspecies having been recognised viz., Indian koklass (*Pucrasia macrolopha macrolopha)*, Western koklass (*P. m. castanea*), Kashmir koklass (*P. m. biddulphi*), Nepal koklass (*P. m. nipalensis*), Meyer's koklass (*P. m. meyeri*), Orange-collared koklass (*P. m. rufficolllis*), Yellow-necked koklass (*P. m. xanthospila*), Joret's koklass (*P. m. jorentiana*) and Darwin's koklass (*P. m. darwini*). This study deals with the subspecies *P. m. biddulphi,* which is resident from Kashmir east to Kullu in India. With exception of the subspecies *nipalensis, castanea* and *macrolopha,* which are endemic to southern side of Northwest and western Himalaya, other five are confined to China and Mangolia (Johnsgard 1986).

2.4.2. Species description

Upper parts of male Koklass covered with silver-grey plumage streaked velvety-black down the centre of each feather, and it owns unique feature of black head, chestnut breast and prominent white patches on the sides of neck. With the white patches on the sides of neck, the females differ from male with the upper parts covered with pale brown plumage. Both sex, however, have distinct elongated tail tipped with pale feathers. The males are reported to weigh about 1135 – 1415g and the female about 1025 – 1135g with the body length varying from 58 – 64cm and 18 – 22cm respectively. Immature and juvenile resembles adult female in plumage pattern.

2.4.3. Conservation status

Population status of Koklass has poorly been understood. IUCN and Mace-Lande threat category adjudge this species to be safe throughout its range (McGowan and Garson 1995). However, based on threat perception by local conservation communities, it has been listed under Schedule I of Indian Wildlife (Protection) Act, 1972 which extends adequate protection to this species. Hunting and secondary impacts caused while collecting Non Timber Forest Produce have resulted in population decline.

2.5. OTHER PHEASANTS OF GHNP

Cheer (*Catreus wallichi* Hardwicke 1827) and Kalij pheasant (*Lophura leucomelanos* Latham 1790) are the other two pheasants that occur in legal area of GHNP. Indian peafowl (*Pavo crstatus*) has, however, been observed, but in ecodevelopment project area which borders the GHNP on eastern part.

2.5.1. Cheer pheasant

Cheer pheasant is a medium sized montane species of subtropical and temperate region distributed spatially from Hazara district of Afghanistan through Pakistan and states of Kashmir, Himachal Paradesh and Uttar Pradesh in India, and to Nepal. Covered with greyish plumage, both sexes have long crest and tail, but smaller in females. This monotypic species affects open grassy slopes with scattered trees and scrubs, even close to human habitations. It has been designated as 'Vulnerable' by IUCN Pheasant Specialist Group's Mace-Lande threat category (McGowan and Garson 1995) and has been listed under Schedule I of Indian Wildlife (Protection) Act, 1972 and Appendix I of CITES.

2.5.2. Kalij pheasant

Kalij pheasant is one of the twelve pheasants recognised under genera *Lophura* or popularly called 'Gallopheasants'. There are nine subspecies recognised by Delacour (1977) distributed from Indus to Northeast Assam, southward to Burma and Western Thailand. The GHNP harbours the subspecies *Lophura leucomelanos hamiltoni* (White crested kalij) which is widespread in Western Himalayas. It inhabits secondary forests and scrub from foothills to 2400m elevations, having direct contact with human being near habitation. Sexual dimorphism is highly conspicuous in this medium-sized bird. Conservation point of view, this species is safe as per IUCN Pheasant

Specialist Group and Indian Wildlife (Protection) Act (1972), both of which have not listed this bird in any of the threat categories.

2.6. LITERATURE REVIEW

Literature review on the study species reveals that the ecology of these species is virtually not known and the existing information gathered are insufficient to evolve conservation action. Besides Duke (1990) who attempted to estimate population in Pakistan, there was only one ecology study was available on Western tragopan (Islam 1983). However, this study was carried out for six months duration and managed to obtain information only on summer habitat use and population in Pakistan. It is noteworthy that before initiation of the present study, no attempt had been made to study the ecology of western tragopan in India, which is another stronghold for this species. Nevertheless, considerable number of surveys has been undertaken to collect baseline information on status and distribution (Gaston *et al.,* 1981, 1983a, Gaston & Garson 1992, Gaston *et. al*. 1993, Islam 1982, Sharma and Pandey 1989, Narang 1993, Pandey 1993, Prasad 1993, Sharma 1993, Pandey 1994, Ramesh 1995, Ramesh *et.al.* 1998, Whale 1996 and Jandrotia 1999). Excepting for Kumar (1997) who documented winter habitat use and the information gathered by Sathyakumar *et.al*. (1993) on relative abundance in Kedarnath Wildlife Santuary, other information available on Himalayan monal are anecdotal and have been obtained from surveys (Gaston *et al.,* 1981, 1983, Gaston & Garson 1992, Gaston *et. al*. 1993, Choudhry 1993, Gaston *et.al*. 1993, Kaul and Garson 1993, Pandey 1993, Sharma 1993, Yahya 1993, Ramesh 1998 and Jandrotia 1999). Apparently, Koklass has relatively been poorly studied, possibly due to its skulking behaviour and not being under any threat category for priority conservation. Severinghaus (1979), Khan & Shah (1982) and Shah (1993) who conducted their studies in Pakistan attempted to monitor the population and habitat use respectively. Besides these two studies, other information available on this species have come from status surveys and along side study on other animals (Gaston *et al.,* 1981, 1983, Gaston & Garson 1992, Gaston *et. al*. 1993, Choudhry 1993, Gaston *et.al*. 1993, Kaul and Garson 1993, Pandey 1993, Sathyakumar *et.al*. 1993, Sharma 1993 and Jandrotia 1999).

CHAPTER 3 : STUDY AREA

3.1. HISTORY AND CONSTITUTION

The Great Himalayan National Park (GHNP), where this study was carried out, has come to existence after having undergone several developments. The Government of Himachal Pradesh after achieving autonomous statehood in 1971, showed an active interest in establishing protected areas to preserve the natural wealth of the state. It was Shri Dilaram Shabab, then legislator from Seraj region, who first proposed parts of Tirthan and Sainj valleys as protected areas in 1971 (Shabab 1997). Consequently, an area of 84 km^2 was notified as Tirthan Wildlife Sanctuary on 17th July 1976, but 23 km^2 was later added to the National Park area thus making 61 km^2. During 1978 – 80, under the banner of "Himachal Wildlife Project I", a team of biologists carried out extensive surveys in most localities within the state. Convinced by the rich wildlife assemblage and minimal biotic disturbances, their survey report suggested the Tirthan and Sainj valleys as potential site for creation of a National Park (Gaston *et. al.* 1981). As a result, the Himachal Government declared its intention to create this area as a National Park and on 1st March 1984, the Great Himalayan National Park was established with 620 km^2 areas under core zone. Subsequently, the park was renamed as Jawaharlal Nehru National Park in 1989, but the original name has been more popular and is in current use. The year 1990 evidenced the cancellation of lower Sainj valley from National Park due to the presence of several villages. Again on 22nd February 1994, the Government of Himachal Pradesh issued a notification for adjusting boundaries with the addition of 145 km^2 from Parvati valley to the park, but 90 km^2 area comprising the villages of Shakti and Marour was carved out to create Sainj Wildlife Sanctuary. The National Park was, however, constituted legally on 23rd June 1999 with the final notification through which the Government excluded 10.6 Km^2 from Jiwa valley and thus making the National Park area to 754.4 km^2.

3.2. PHYSICAL ATTRIBUTES

3.2.1. Location

The GHNPCA (Great Himalayan National Park Conservation Area) is situated in the Kullu District of Himachal Pradesh and lies between 31^o 33' 00" and 31^o 56' 56" latitudes and between 77^o 17' 15" and 77^o 52' 05" longitudes. Located at the junction of two great faunal realms viz., Palaearctic to the north and Oriental to the south (MacKinnon *et al*. 1986), this p ark falls under the biogeographic zone 2A - Northwest Himalaya (Rodgers and Pawar 1988). Pin Valley National Park, Kanawar Wildlife Sanctuary and Rupi Bhaba Wildlife Sanctuary surround the Park on north, north-west and east respectively (Fig. 3.1).

3.2.2. Area

The study area encompasses an area of 1,171 km^2, which includes the GHNP (754.4 Km^2), Sainj Wildlife Sanctuary (90 Km^2), Tirthan Wildlife Sanctuary (61 Km^2) and the Ecodevelopment Project Area (265.6 Km^2) (Fig 3.2).

3.2.3. Topography

Topography of the study area is characterised by highly undulating, rugged and steep mountains with diverse slope, aspect and elevation categories. Altitude of the study area ranges from 1,344 m (Seund at the confluence of Jiwanal and Sainj rivers near Sainj) to 6,248m (an unnamed Peak in Khirganga Protected Forest in Parvati valley). Distribution of 68.4% of the total area above 3,200m elevation together with 57.4% of the area under 27 - 45° slope category indicates the steepness and higher elevation of the study area (Negi 1996). South, southeast and southwest aspects together represent 44% (510 Km^2) of the total area. Pleistocene glaciation has greatly influenced the topography of this park and has left extensive moraines, river terraces and hanging valleys (Gaston *et. al.* 1981). Distinctively, 209 Km^2 (18%) of the study area is covered by permanent snow (Naithani, *in prep.*).

3.2.4. Drainage pattern

Major tributaries of river Beas such as Tirthan, Sainj, Jiwanal and Parvati drain the GHNPCA and flow out of the area in east-west direction meeting the Beas near Larji. Of the 2787 minor tributaries covering 2074.15 Km distance, GHNP is represented by over 50% (1416) of the streams and *nullas* which covers about 1208 Km distance. However, drainage density that is defined as distance covered / unit area by Negi (1996) does not vary much indicating that each of the areas has balanced representation with reference to the availability.

3.2.5. Geology and edaphic characters

The GHNPCA including other parts of Himachal Pradesh represents Central Crystallines belt, one of the four geological belts classified on the basis of geological characters (Jhingran 1981). The others are Siwalik, Lesser Himalaya and Tethyan. Named as Vaikrit series, the rocks in the area are quartzite, schists, phyllites, dolomites, limestones, shales, slates, gneisses and granites which play significant role in the formation of soils and greatly responsible for different vegetation types (Jaiswal, cited by Negi 1996). Influenced by these rocks, there are three soil types found in GHNPCA

viz., alluvial, podsolic and brown soil. During the study period, data collected from various vegetation types on soil temperature and soil moisture varied from 3.6 to 15.8 ^{o}C and 21.5 to 45% respectively (Singh 1999).

3.3. ECOLOGICAL ATTRIBUTES

3.3.1. Climate

The climate of the study area is typically the Western Himalayan temperate and alpine type. There are three distinctive seasons recognised for the park viz., spring (April – June), rainy/summer (July – September) and winter (October – March). However, months of October and November stands deviant from these seasons and can be recognised as autumn, thus forming four seasons for this park. Precipitation is moderate over most of the year and abundant during monsoon from mid-June to mid-September. During winter, the precipitation is in the form of snow even in lower elevation (1,560m) and higher elevation areas experience heavy snowfall of over 2m depth.

Mean annual rainfall recorded at Niharni and Sainj in Sainj valley for the years 1992 was 1155.7 mm and 1158.3 mm respectively. High fluctuation in the temperature, which varies from minus 10° to 40° C, greatly influences the distribution and diversity of flora and fauna.

3.3.2. Vegetation types and Flora

Forested area of GHNPCA is relatively less and covers only about 17% of the total area (Naithani *in prep.*). The plant communities are representatives of the temperate, subalpine and alpine regions, which includes oak and coniferous forests, high altitude mixed forests and subalpine and alpine pastures. Fourteen forest types of Champion and Seth (1968) classification are found in the Park viz., 1. Ban Oak Forest, 2. Moist Deodar Forest, 3. Western Mixed Coniferous Forest, 4. Moist Temperate Deciduous Forest, 5. Kharsu Oak Forest, 6. Western Himalayan Upper Oak - Fir Forest, 7. Montane Bamboo Brakes, 8. Himalayan Temperate Park Land, 9. Himalayan Temperate Pastures, 10. Western Himalayan Sub-Alpine Fir Forest, 11. Sub-Alpine Pastures, 12.Birch /Rhododendron Scrub Forest, 13. Deciduous Alpine Scrub and 14. Alpine Pastures. However, Singh (1999) has recognised following nine vegetation types based on physiognomy and dominance of species. 1. Temperate broad-leaved forests, 2. Temperate conifer forest, 3. Upper temperate broad-leaved and mixed conifer forest, 4. Sub alpine birch-rhododendron forest, 5. Alpine scrubs, 6. Alpine meadows and *Thaches*, 7. Riverine forets, 8. Temperate grassy slopes and 9. Temperate secondary scrub.

Very little information was available on flora of the GHNP prior to initiation of the multidisciplinary project. Mehta *et.al.* (1993) reported 309 species of flora from the GHNPCA. Recently concluded detailed study by Singh and Rawat (1999) has documented a list of 832 plants species representing 128 families and 427 genera, which covers 26% of the total flora of Himachal Pradesh. There were 794 species of Angiosperms, 11 species of Gymnosperms and 27 species of ferns included in the list.

3.3.3. Faunal diversity

GHNPCA is bestowed with variety of fauna which includes several charismatic, endangered and endemic species. Mammalian fauna is represented by over 31 species belonging to six orders viz., Primates, Carnivora, Artiodactyla, Insectivora, Rodentia and Lagomorpha (Ramesh and Sathyakumar 1997; Vinod and Sathyakumar 1999). Endangered musk deer (*Moschus chrysogastor*), endemic Himalayan tahr (*Hemitragus jemlahicus*) and elusive Snow leopard (*Uncia uncia*) are among the few notable mammals of the area. Birds form a significant constituent of the biodiversity of the study area. 183 species of birds have been reported by Gaston *et.al.* (1993). However, this study documented an addition of 20 species making the total species to over 200 (Ramesh *et.al. in Prep.*). Pheasants occupy a prominent place in the birds of the area on account of their large size, charismatic and conspicuous appearances, besides being indicators of habitat types. Of the seven species of pheasants found in western Himalaya, this park hold five species including Western tragopan and Cheer pheasant which are rare (legally designated as 'Vulnerable' by IUCN) and occupy different vegetation and altitudinal gradients. GHNP is among the only two National Parks in the World to support a substantial population of the endangered Western tragopan.

There are 127 species of insects representing 6 orders and 111 genera reported from the study area (Uniyal and Mathur 1999). Julka (1999) has reported 11 species of Earthworms, 3 species of Leeches and 14 species of Molluscs from the area. Information on other faunal elements such as Reptiles and Amphibians has been collected by Dutta (*in Prep.*).

3.4. SOCIOLOGICAL ATTRIBUTES

3.4.1. Local people

People of GHNPCA, administratively, come under eight *Kothis* and 13 *Phantis* (revenue villages). There are 127 hamlets with a total of 14,025 people located in buffer zone of the study area (Kumar *et. al.* 1999). However, the park authorities for the implementation of ecodevelopment

programme have recognized 141 villages including scattered hamlets. With the exception of three villages that are located in Sainj Wildlife Sanctuary, all others are concentrated in ecozone, but their proximity to the park is within five km distance. Male and female population is divided into 52% (7, 248 individuals) and 48% (6,732 individuals) respectively. Age class of the local people reveals that maximum people are in the age class of between 16-30, which is resemblance to natural human population (Kumar *et. al.* 1999).

Literacy rate of local population is only 17% (Negi 1996) which is equally represented by both sexes. Hindus being the dominant society with 71% of the population, three distinctive caste groups are found in the area viz., Rajputs, Brahmins and Scheduled castes. Contrary to most of the societies in India, social freedom is enjoyed impartially by women in this area.

3.4.2. Resource use

Although agriculture has been primary source of subsistence economy for the local people, they enjoy unrestricted access to nearby forests for firewood, timber, bamboo and several medicinal herbs. Between years 1886 and 1896, the then Commissioner of Kullu Alex Anderson, issued legal settlement of the forests of Kullu, which limited the open access (Anderson 1886). However, people of the area continued to use the forested area of the park for timber, medicinal herbs/Non timber forest produce (NTFP) and for pastoralism. Singh (1999) and Kumar *et. al* (1999) have given detailed information on the resource use by local people.

Mass hunting during festival periods for meat of ungulates and pheasants was common in this area till 1982 when the hunting was legally banned in Himachal Pradesh. Besides for meat, pheasants were also killed using snares for their brightly colored plumage which was used to ornament the hat of the people (Sharma 1998 *in press*). Himalayan musk deer and black bear were poached for musk and gall bladder respectively. Traditionally, the people have also been using certain parts of the park for pilgrimage.

3.4.3. Pressure on Wildlife

The aforesaid resource use by local people, coupled with poaching and habitat destruction has threatened the future of the endangered species of this park. However, collections of NTFPs and grazing have been the major pressure on the park till this study was underway. Over 60 species including those listed under IUCN threat category were being collected for commercial use (Singh 1999). Digging and uprooting these medicinal herbs and mushroom by a large number of people

over several decades have caused drastic decline in their population and degradation of the habitats due to camping and other practices such trampling, burning, etc. Branches of tree species such as Kharsu oak (*Quercus semecarpifolia*) and Pine tree (*Pinus wallichiana*) and several other shrubs are cut for collection of lichens which is sold to outside contractors. Circumstantial evidences reveal that mushroom collection has serious negative impact on pheasants (Ramesh *et.al.*1999 *in Press*). Grazing by about 20,000 migrant sheep and goats during summer season in alpine and sub alpine region has greatly changed the vegetation composition in these pastures (Singh 1999). Presence of large number of people and livestock in alpine pastures are suspected to play negative role in the life mountain ungulates in terms of competition for resources. Although hunting was prevalent during 70s, current scenario in this park does not evidence severe hunting possibly due to the law imposed against hunting in 1982 by Himachal Government and also due to declaration of National Park. With final notification achieved on 23rd June 1999, all the above pressures are, however, expected to diffuse in due course of time.

3.5. ADMINISTRATIVE UNITS AND INFRASTRUCTURE

The park is divided into three forest ranges namely Tirthan, Sainj and Jiwa. There is no motor road network inside the park, but bridal paths managed by graziers and park management connect areas within the park. There are few patrolling huts available inside the park, which help accommodating at least four persons at a time. Landslides effected by heavy monsoon rain prevent accessibility to the park during rainy season. Upper ridges can not be approached during winter due to heavy snow up to 2m depth.

3.6. INTENSIVE STUDY AREA

A 16 Km^2 area was identified in Tirthan valley for conducting intensive ecological study on pheasants (Fig. 3.1.). This area consists of Rolla RF and Rekhundi RF and the altitude ranges between 1,960 and 3,660m. Tirthan River flows in Northern most part of the study area. This area was chosen for intensive study because, (i) it is relatively less disturbed from human activities and accessible and (ii) it supports rich wildlife diversity and abundance. Vegetation and other topographical features in the intensive study area are representative of GHNPCA. Temperature of the intensive study area varies from minus 5° C to 38° C with varying mean minimum and temperature over months (Table 3.1).

CHAPTER 4 : GENERAL METHODOLOGY

4.1. INTRODUCTION

There has been considerable advancement in the field of wildlife ecology during past few decades with several workers attempting to develop new methods and redefining the existing ones to acquire reliable empirical data on ecology of wildlife species. As a result, several standardized techniques are now available to study the ecology of birds (Emlen 1956, James & Shugart 1970, Muller-Dembois & Ellenberg 1974, Caughley 1975, Burnham *et. al.* 1980, Anderson & Ohmart 1981, Manuwal & Carey 1991, Bibby *et.al*. 1992, etc). However, with the exception of Ring-necked pheasant (*Phasianus colchicus*) which is found in plenty in open areas and have been well studied in Europe, studies on all other pheasants have proved to be challenging and demand specialized techniques. This can possibly be attributed to their skulking behavior and the type of habitats they occupy. Although Gaston (1980) has given detailed account on the census techniques for Himalayan pheasants, there are limitations in the applicability of these methods for individual pheasant taxon in different field conditions.

4.2. STUDY DESIGN AND PERIOD

The study was designed to be conducted in three phases to accomplish the objectives proposed. During the first phase of the study, a reconnaissance survey was carried out from October to December 1995 in different parts of GHNP to identify intensive study area and also to understand relative abundance and distribution of the pheasants. Based on the survey, an area of 16 Km^2 was selected in Tirthan valley and intensive ecological study was conducted from Apri 1997 to March 1999 to obtain information on habitat requirements and population status of three sympatric pheasants viz., Western tragopan, Himalayan monal and Koklass pheasant. Third phase was planned from April 99 - December 1999 for a rapid survey to gather information to determine the status and distribution of the pheasants including Cheer and Kalij pheasants. However, this phase could not be completed due to technical constraints.

4.2.1. Stratification

Intensive study area was stratified into different habitat types, altitudinal zones and aspects. Based on physiognomy and dominance of tree species, seven habitat types were identified viz., 1. Broad-leaved dominated mixed forest, 2. Conifer dominated mixed forest, 3. Mixed conifer and broad-leaved forest with *Arundinaria* under growth, 4. Mixed conifer and broad-leaved forest without

Arundinaria under growth, 5. Temperate mixed conifer forest, 6. Sub alpine oak forest and 7. Alpine meadows. Altitude was divided into five categories such as <2000m, 2000 – 2500m, 2500 – 3000m, 3000 – 3500m and >3000m. Aspects were stratified into North and Southern aspects.

4.2.2. Sampling methods

Since study on pheasants warrant specialized techniques, combination of several methods were adopted to meet the objectives of this study. Survey was conducted using existing trails to determine the status and distribution of the pheasants. Remote Sensing and GIS technologies were used for spatial analysis and also to generate distribution maps for these pheasants. To estimate relative abundance, encounter rate and call counts were used. Habitat use was studied by adopting correlative and focal bird approaches. Data on human use were collected by monitoring park check post and also by interviewing local people. These methods have been discussed in detail in the following chapters.

4.2.3. Analytical methods

Relative abundance was calculated using encounter rate *i.e.* Number of birds seen / Km walk or Number of calling station / Sampling plot (Caughley 1975). Bootstrap statistics and Kruskal Wallis one way ANOVA were performed using Symstat and SPSSPC statistical softwares respectively. Similar nonparametric statistics were done to understand the spatio-temporal variation in the sex ratio and group size of the pheasants. Principal Component Analysis was done to study the factors that affect the relative habitat preference of the pheasant. Density estimate was made using DISTANCE program. GIS softwares such as Arcinfo and Arcview were used for spatial analysis.

4.2.4. Measurement of habitat and environmental variables

The following equipments were utilized to measure various habitat and environment variables in this study.

1. Altitude was measured using Altimeter with 1m accuracy.
2. Sighting angle and aspect categories at eight level viz., North (337º - 22º), South (158º - 203º), East (68º - 112º), West (248º - 292º), Northeast (23º - 67º), Southeast (113º - 157º), Northwest (293º - 336º) and Southwest (204º - 247º) were measured using Sunnto compass with 1º accuracy.
3. Slope was measured by ocular estimation.

4. Digital thermometer with the range between -10ºC and 50ºC
5. Spring balance weighing a maximum of 1 Kg was used to measure soil-wet weight and dry weight.
6. Anemometer for measuring wind velocity
7. Binoculars - 7 X 36 for field identification of the birds
8. SLR Camera with 35 - 70 mm lens for recording purposes
9. Habitat variables such as tree cover, shrub cover, herb cover, grass cover, distance from water resources, screening efficiency, etc. were measured from focal bird plots.

4.2.5. Sampling intensity

Eight trials were initially used for the estimation of encounter rate and for conducting call counts. However, two trails distributed in alpine meadows and lower altitude (<1800 m) were discarded due to virtual absence of the birds. The trails used in this study constitute 70% of the total trails available in the 16 Km^2 intensive study area. Ranging from 0.7 Km to 1.2 Km, the trails represented different strata of habitat types and altitudinal zones (Table 4.1.). Each trail was walked twice a month in all but rainy season. Landslides caused by continuous heavy rain and other logistical constraints prevented field data collection during rainy season. Eleven sampling stations were established on the trails distributed across different vegetation types for call count and dawn calls were counted twice a month from each sampling station during April and May. Sampling period (months and time) were selected based on literature and initial observations in the field. Data were collected from 10 m radius plots laid at every 100 m interval on both sides of the trail to describe the habitat types. At every bird location, habitat parameters were quantified from 10 m and 5 m radius plots and 1 m quadrates to study the microhabitat use of these pheasants.

4.3. Organization of field work

Fieldwork for the whole study was operated from one Base Camp (located at Banjar) and two field stations, one at Rolla and another at Shilt. A total of 528 days with an average of 22 days per month were spent for 24 months, which includes 21 months of intensive fieldwork and 3 months of survey period. Camped at Rolla station, fieldwork was conducted in Rolla, Basu and Dulunga trails. Fieldwork for Chordhuar and Shilt trails was conducted from Shilt station while for other trails, tents and patrolling huts were used. Mornings were spent on trail walks and call counts while the evenings on roost site search and behavioral study.

Table 4.1. Characteristics of trails in the Study Area

Trail Name	Vegetation Type	Length (Km)	Elevation (m)	Aspect
Rolla	Broad-leaved dominated mixed forest	1	2290-2640	South East
Dulunga	Mixed conifer and broad-leaved forest with *Arundinaria* under growth	1	2700-2770	East
Shilt	Mixed conifer and broad-leaved forest without *Arundinaria* under growth	0.7	2900-2920	South
Chordhuar	Sub alpine oak forest	1.2	2900-3010	South
Basu	Temperate mixed conifer forest	1	2420-2655	North
Koilipoi	Conifer dominated mixed forest	1	2710-2870	South East

4.4. LIMITATIONS

Mountain ecosystem has always been challenging for field ecological study. This can be attributed to the steep and rugged terrain compounded with harsh climatic condition and the inherent variation in the distribution of animals. Since the trails used in this study were curve linear and were not distributed in random fashion, the methods that are used in plains could not be adopted. Cutting new transects, which are representative and replicated, were unfeasible due to inaccessible terrain and had to solely depend upon the existing trails. The available trails were very few and were not representative of the habitat types and thus, enforcing bias to the population estimate. Besides the topographical features, typical behavior of individual pheasant namely skulking behavior of Koklass and elusive nature of Western tragopan also played a major role in the biased population estimate. Unpredictable weather in the form of sudden rain also prevented considerable amount of fieldwork.

CHAPTER 5 : STATUS AND DISTRIBUTION

5.1. INTRODUCTION

The pheasants, once abundant over a wide range of area, are now threatened in most of their range due to large-scale habitat alteration and poaching for their meat and plumage. In addition to range-wide population declines, the distribution and abundance of many pheasant species are highly variable in space and time, which complicates conservation plans for these bird species. Based on Mace-Lande threat category provided by Pheasant Specialist Group, pheasant conservation action plan for the year 1995-1999 has inducted 43 pheasant taxon (including subspecies) into the list of threatened and insufficiently known pheasant taxon (McGowan and Garson 1995). Of these, 29 species (57%) have been reported to be rare and endangered and are under the risk of extinction if effective conservation measures are not taken at the earliest. Information gathered from trophy hunters, who can otherwise be called as source of information, reveals that the Himalayan pheasants including the rare Western tragopan had wide distribution and abundant population in the past (Humes and Marshal, 1879). Attracted by bright colored plumage and heavy body, hunting has been the major threat to the survival of the pheasants besides the other factors such as habitat loss, fragmentation, collection of NTFP, etc. Consequently, the pheasants have now been forced into many discontinuous pockets with several fragile populations being threatened by the ever-increasing human population. However, GHNP has been an exception and is one among the few areas in the Western Himalaya, which still support substantial population of these pheasants (Gaston *et.al.* 1981). Prior to initiation of this study, there was only one published information was available on avifauna of this park (Gaston *et. al.* 1993). Although Himachal Pradesh Department of Forest Farming and Conservation conducted a series of surveys under the banner of Himachal Wildlife Project between 1981 and 1991 (Gaston & Garson, 1992), the information gathered on birds especially pheasants were scanty. To fulfill the lacuna and help the managers for conservation of this species, this study documented the present population status and distribution of the pheasants in this Park.

5.2. METHODS

Existing trails, ridges and other accessible paths were used to reach different parts of the study area to gather baseline information on the status and distribution of the pheasants. During the reconnaissance survey conducted from October 1995 to December 1995, general information on presence/absence and relative abundance were collected from parts of Tirthan, Sainj and Jiwa

valleys. Intensive works carried out on mammals (January 1996 - December 1996) and pheasants (April 1997 – March 1999) in Tirthan valley also enabled to obtain information on relative abundance, habitat use and distribution of pheasants from other parts Tirthan valley. Besides these, parts of Sainj and Jiwa valleys were also visited during the intensive study periods and information on distribution and relative abundance of pheasants were gathered. Excepting for Jiwa valley, other valleys have been extensively covered during the study period (Fig. 5.1). All the sightings were plotted on 1:50,000 scale map of Survey of India. Secondary data (Gaston *et. al.* 1981, Gaston and Garson 1992, Himachal Pradesh Forest Dept., National Park records, personal communication from fellow researchers working in GHNP and local people) were also used to generate distribution map of the pheasants. The data was later transformed to base map prepared using Remote sensing and GIS techniques and distribution maps were prepared with the help of Arcinfo and Arcview softwares.

To highlight the conservation priority for the five pheasants, scores were assigned based on following seven criterions viz., International importance (Mace-Lande threat category provided by IUCN/ SSC/Pheasant Specialist Group), National importance (Indian Wildlife (Protection) Act, 1972), Population status in GHNP, Population trend, Local threat perception (direct and indirect threat from local human population), Rarity and Endemism. **International importance**: 1 = Safe, 2 = Vulnerable, 3 = Endangered, 4 = Critical. **National importance**: 1 = Schedule V, 2 = Schedule IV, 3 = Schedule III, 4 = Schedule II, 5 = Schedule I. **Population status**: 1 = Abundant, 2 = Moderate, 3 = Low. **Population trend**: 1 = Increasing, 2 = Stable, 3 = Declining. **Local threat perception**: 1 = No danger, 2 = Moderate, 3 = High, 4 = Very high. **Rarity**: 1 = Common in India and elsewhere, 2 = Rare in India, common globally, 3 = Rare in India and elsewhere, 4 = Very rare with limited range. **Endemism**: 1 = Present in more than two countries with equal proportion, 2 = More than two countries, but large proportion in India, 3 = Found in only two countries, but large proportion in India, 4 = Restricted to India. Ranking was done based on the scores obtained by the species and the priority conservation action has been recommended as per the merit of the ranking.

5.3. RESULTS

5.3.1. Population status

A total of 524 sightings of Himalayan monal, 126 sighting of Koklass and 45 sightings of Western tragopan were recorded from GHNP during the study period. Mean flock size for these pheasants were 1.6, 1.2 and 1.1 respectively. Winter provided maximum sightings of these pheasants followed by spring (Fig. 5.2.). This was probably due to high visibility and congregation of the pheasants in lower altitudes. Since the intensive study was confined to Park area, there were very few sightings of Kalij (11 sighting) and Cheer pheasants (3 sightings), which are low altitude species. Calls of cheer pheasants, however, were frequently heard in eco zone. With the systematic approach, the estimated mean encounter rate (# of birds/ Km walk) for Himalayan monal in the intensive study area ranged between 1.5±0.35 and 3.9±0.32 birds/ Km walk. Encounter rate estimate for Koklass ranged from 0.3 ± 0.08 to 1.4 ± 0.18 birds/Km while for Western tragopan, it was between 0.1 ± 0.06 and 0.3 ± 0.10 birds/ Km walk (Table 5.1). The relative abundance values obtained from both the surveys and intensive study revealed that the Himalayan monal was relatively high in abundance followed by Koklass and Western tragopan (Fig. 5.3. see also chapter 5) in GHNP. The abundance estimates, however, is low when compared to other known areas. Declining population trend in the recent years has likely influence on the low population in GHNP. Evidently, observed population decline per year for Himalayan monal, Koklass and Western tragopan were 45%, 18% and 17% respectively. The present population in GHNP is threatened directly or indirectly by the local human population, particularly the secondary impact of mushroom collection, which coincides with the breeding season of the pheasants, plays a dominant role (see also Chapter 6 for further explanation).

Declining population trend in the recent years has likely influence on the low population in GHNP. Evidently, observed population decline per year for Himalayan monal, Koklass and Western tragopan were 45%, 18% and 17% respectively.

Figure 5.2. Distribution of pheasant sightings in different seasons

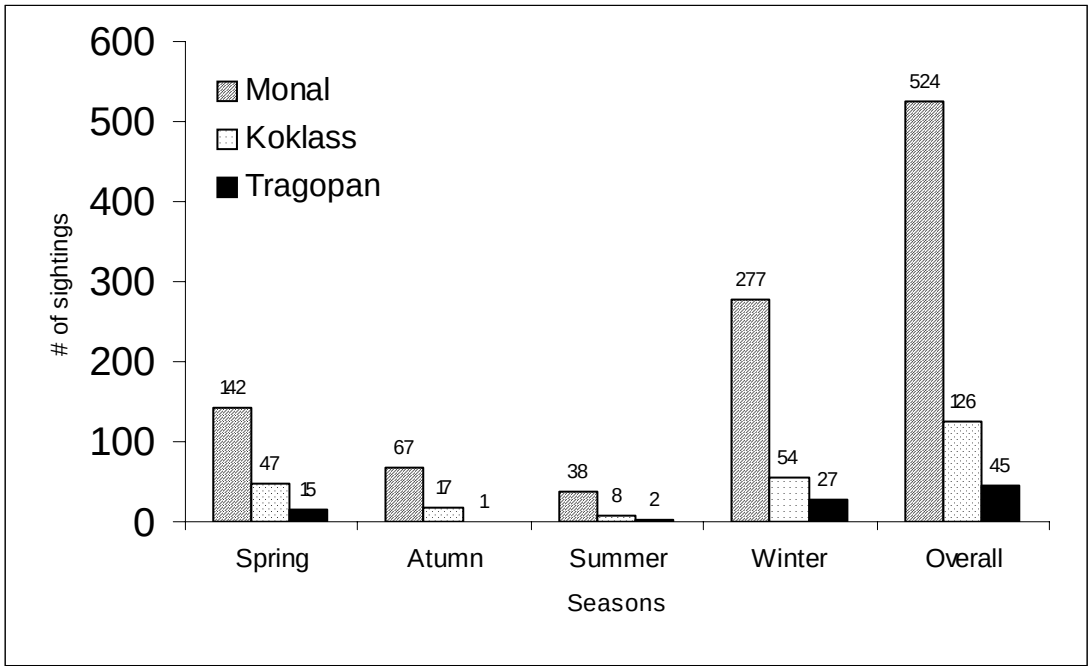
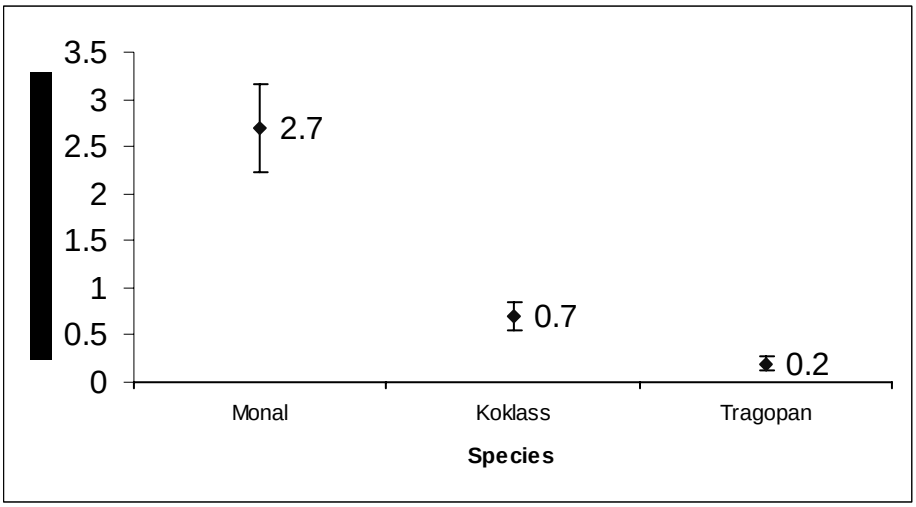


Table 5.1. Encounter rate estimates (Mean ± Standard Error/Km walk) for the study species in the intensive study area (pooled across seasons and years)

SPECIES	LOCALITIES					
	ROLLA	BASU	DULUNGA	SHILT	CHORDHUAR	KOILIPOI
Monal	**1.5±0.35**	**2.7±0.54**	**3.5±0.38**	**2.7±0.45**	**3.9±0.32**	**1.9±0.35**
Koklass	**1.4±0.18**	**0.3±0.09**	**0.3±0.08**	**0.9±0.17**	**0.5±0.12**	**0.7±0.20**
Tragopan	**0.4±0.14**	**0.1±0.04**	**0.2±0.09**	**0.0**	**0.3±0.10**	**0.1±0.06**

Figure 5.3. Overall mean encounter rate for the study species in intensive study area (bar indicates the standard error)



5.3.2. Conservation values

Western tragopan has been ranked at the top with 2.4 scores in the conservation priority assessment, indicating higher conservation priority for this species (Table 5.2.). Insignificant difference in the scores of Cheer pheasant (2.0) and Himalayan monal (1.8) suggests that both the species require equal conservation priority in GHNP.

Table 5.2. Assessment scores for priority conservation action for the pheasants of GHNP

Criterions	Western tragopan	Cheer	Himalayan monal	Koklass	Kalij
International importance	2	2	1	1	1
National importance	5	5	5	2	2
Population status	3	2	1	1	1
Population trend	3	2	3	3	1
Local threat perception	4	3	3	2	1
Rarity	4	3	3	3	1
Endemism	3	3	2	1	1
Score in 10 point scale	**2.4**	**2.0**	**1.8**	**1.3**	**0.8**

5.3.3. Distribution

5.3.3.1. Spatial distribution

Although attempts were made to gather information on all the five species, complete distribution maps could be generated only for Himalayan monal, Koklass and Western tragopan. However, available information based on empirical data collected during this study and other secondary sources (Gaston and Garson, 1992 and interviews with local people) indicate that Cheer and Kalij have sparse distribution in GHNP. Himalayan monal and Koklass are distributed widely in forested areas of GHNP with high concentration in Tirthan valley followed by Jiwa (Fig. 5.4. and Fig. 5.5.). On contrary, Western tragopan shows a discontinuous distribution occurring in areas, which were identified to be supporting under storey environment (Fig.5.6.). Sainj valley, though with large area under forest, support relatively very low population of these pheasants possibly due to human presence around the core area and also due to insufficient understorey forest. Cheer and Kalij pheasants were recorded from few localities mostly in buffer zone or ecodevelopment project zone (Fig. 5.4. and Fig. 5.5.). Jiwa valley, particularly the open grassy slopes before Gathipat and south facing slopes in ecozone of Tirthan valley are perhaps the two major strong holds for Cheer pheasant in GHNP.

5.3.3.2. Ecological distribution

The pheasants were observed to be exhibiting immediate response to local climatic conditions and showed relative preference to various topographic features. Distribution pattern of these pheasant with respect to season, aspect and elevation have been explained based on the intensive study conducted in Tirthan valley. Distinct pattern was observed in the distribution of all the study species between summer and winter (Figs. 5.7, 5.8, and 5.9). During winter, majority of the population were observed to be concentrated in lower elevation, while in summer they dispersed in wide range of area. These species favored south facing slopes irrespective of seasons, however marginal differences were seen in the use of various aspect categories between species (Figs. 5.10, 5.11 and 5.12). Himalayan monal mostly distributed between 2620 m and 3350m in summer and between 2000m and 2800m in winter (Fig. 5.10). Though there were few records of Koklass obtained above 3500m, most of them were distributed between 2250m and 2980m in summer and between 1890m and 2700m in winter (Fig. 5.11). Excepting for the fact that the sightings of Western tragopan was relative low, this species followed similar altitudinal distribution pattern as that of Koklass (Fig.12).

5.4. CONCLUSION

The present status of pheasant population in GHNP is relatively low, threatened and is declining. Besides occasional hunting, the secondary impacts resulted during mushroom collection and grazing in forested areas have contributed substantially to the poor status of the pheasant population in GHNP Suggested by the conservation value assessment, it becomes essential to expedite immediate conservation actions for Western tragopan, Cheer and Himalayan monal on priority basis. The distribution pattern of the pheasants in GHNP reveals that the majority of the pheasant populations in GHNP are confined to Tirthan and Jiwa valleys. Any immediate efforts to monitor and manage these populations would be effective if focused in these areas. More surveys need to be conducted in ecodevelopment area to identify other populations of Cheer and Kalij pheasants. Distinct distribution pattern observed between summer and winter recommends a management approach which is effective and can be adopted in different season of the year.

CHAPTER 6 : RELATIVE ABUNDANCE

6.1. INTRODUCTION

Prior knowledge on population structure and dynamics is imperative for effective management and conservation of any wildlife species. Estimating populations of free ranging vertebrates has typically been challenging and is subject to considerable amount of errors due to inherent variation in the distribution and behavior of the animals, compounded with other topographical features. Inhabiting in high altitude environment, which is characterized by undulating, rugged terrain and harsh climatic conditions, the Himalayan pheasants defy reliable population estimates. These birds are very sensitive to human presence and have the habit of either flushing at greater distances or skulking under bush, which further complicates the estimate in great deal and thus, demanding specialized approach for population estimate. Although Gaston (1980) has documented comprehensive account on census methods for Himalayan pheasants, the effectiveness of the methods is highly variable depending on the local topography and behaviour of the individual bird species. However, most of the current management requirements content with relative abundance estimate, which is nothing but an index of population and helps in detecting the spatial and temporal changes in the population.

6.2. METHODS

Population index and changes across different strata and time were studied in a sample area of 16 km^2 identified in Tirthan valley. The methods described by Bibby *et. al.* (1992) and Manuwal & Carey (1991) for main land birds and those by Gaston (1980) for Himalayan pheasants were taken into consideration for identifying applicable methods for long-term monitoring. The following techniques were employed in this study for estimating relative abundance of the pheasants.

6.2.1. Encounter rate

Encounter rate (ER) is expressed as number of individuals seen per unit effort (Caughley, 1975) i.e. ER = n / L, where as n = Number of sightings or birds detected and L = Distance involved. This method involves walking on trail and counting the birds encountered on both sides of the trail. The usage of this technique for estimating and monitoring population trends of Galliformes has been common since the recent past (Islam 1982, Gaston and Garson 1992, Kaul and Ahmed 1993 and Sathyakumar *et al.,* 1993). Six trails ranging from 0.7 to 1.2 km were walked sequentially twice a month and the encounter rate was estimated for all but rainy season. Count was done only in

mornings to avoid the expected bias originates due to temporal movement of the birds. It was assumed that morning estimate will give an unbiased estimate as the birds seen in mornings in any particular habitat is an indication of the birds using the habitat for roosting, thus indicating their preference for the habitat concerned. Data on species, number, sex, sighting distance and sighting angle were recorded for further analysis.

6.2.2. Call count

This is a slight modification of the fixed-radius point count, a method that is used for studying bird communities in relation to vegetation structure. Western tragopan and Koklass are elusive and mostly occur in thick under growth forest, which makes direct sighting difficult. The males, however, give loud chorus during dawn hours during their breeding season. Counting the calls will give useful index of the population in a given area (Severinghaus 1979, Gaston 1980, Duke 1990, McGowan 1990 and Garson 1998). Dawn calls were counted from 10 sampling stations during April to May when the calling was maximal. Positioned at 500 m apart, calls were counted by more than one person depending on the length of the trail. In the case of two people involvement, starting time was synchronized and the compass bearing was taken for each call to discard double counts.

Estimate of call counts are expressed as ER = n/ P, where n = Number of calling stations (from where the birds were calling) and P = Unit effort, i.e. sampling plots. Time of call count was standardized based on preliminary study and existing literature (Severinghaus 1979, Gaston 1980 and Duke 1990). Weather conditions, wind velocity and topographical features such as slope, aspect, altitude etc., were also recorded to control for the variability arising out of these potential factors.

6.2.3. Opportunistic sampling

Besides the systematic data collection using trails and call counts, data on abundance and distribution were also collected while on movement from one area to other and also during surveys. Bootstrap analytical method was used to bring this data into meaningful statistical analysis. The data collected by opportunistic sampling was mainly performed to explain seasonal distribution of the pheasants.

6.3. RESULTS

6.3.1. Relative abundance; between species

A total of 320 sightings of Himalayan monal, 90 sightings of Koklass and 30 sightings of Western tragopan were obtained during intensive study period. Opportunistic sampling accounted for another 204 sightings of Himalayan monal, 36 sightings of Koklass and 15 sightings of Western tragopan, thus making the total sighting to 524, 126 and 45 respectively. Biased distance measurement caused by rugged and steep terrain greatly influenced the density estimate and as a result, DISTANCE program calculated an over estimate of the population (Fig. 6.1). Nevertheless, estimated abundance index i.e. encounter rate for the pheasants in GHNP reveals that Himalayan monal and Koklass hold relatively large population in this area (Fig. 6.2.). Mean encounter estimate derived for Himalayan monal in the recent year 1998/99 ranged from 1.5 ± 0.35 to 3.5 ± 0.38 birds/Km walk. For Koklass, the mean encounter estimate ranged between 0.3 ± 0.08 and 1.4 ± 0.18 birds/Km walk. Estimate for Western tragopan was relatively very low, with the maximum estimate of 0.4 ± 0.14 birds/Km walk. The estimate obtained for Koklass and Western tragopan is expected to have considerable error due to the shy and skulking nature of the birds, which caused high probability of the birds to go undetected by the observer. It is evident from high variability in the data with the maximum estimate not exceeding more than one individual per kilometer walk (Fig. 6.3). Apparently, call count provided reliable population estimate with less variability, which explains high precision in the estimate (Fig. 6.4.). Overall mean call count estimate for Koklass in 1998 was 2.5 ± 0.21 calling sites / sampling station. Three calling sites indicating presence of six individuals were recorded for Western tragopan in the intensive study area.

Figure 6.1. Density estimate for the study species using line transect method (Error bar indicates 90% confidence interval)

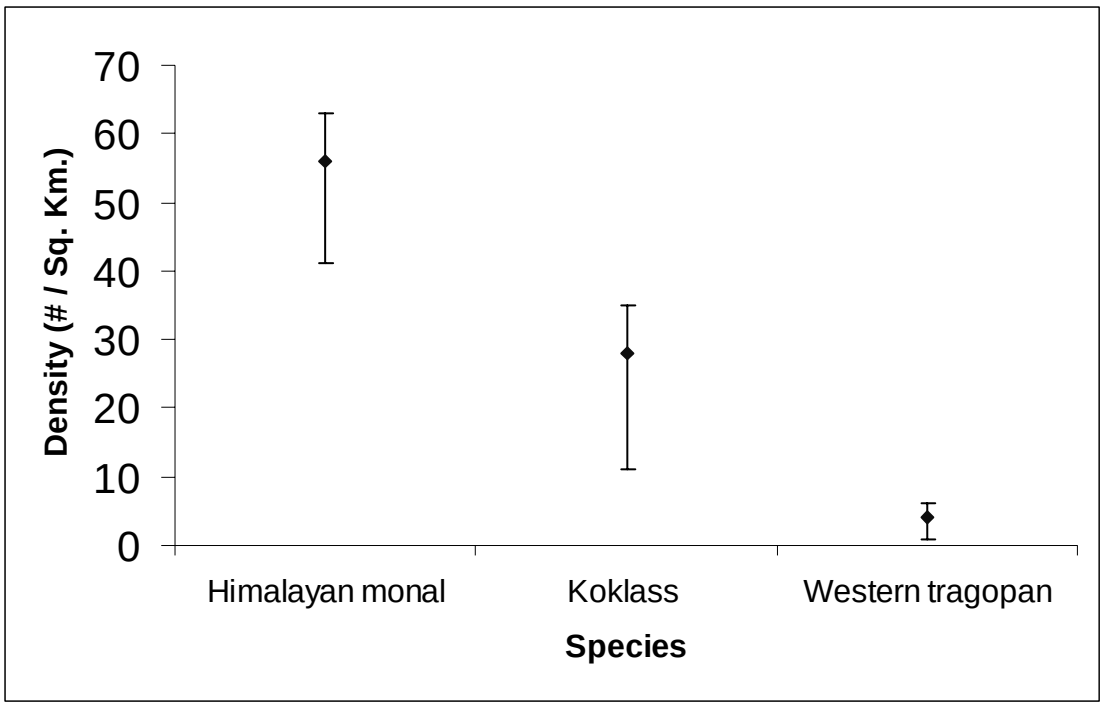


Figure 6.2. Abundance estimate for the study species in the intensive study area (Error bar indicates Standard Error)

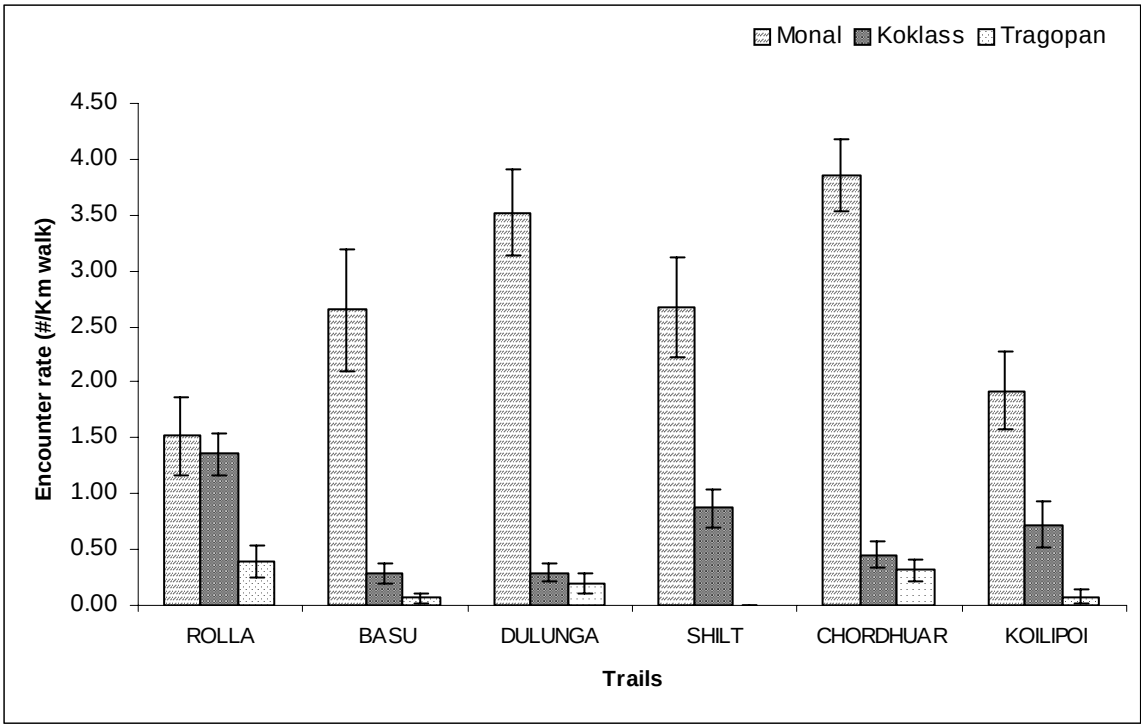


Figure 6.3. Mean encounter rate estimate for Koklass in spring 1997 using direct observation (Error bar indicates Standard Error)

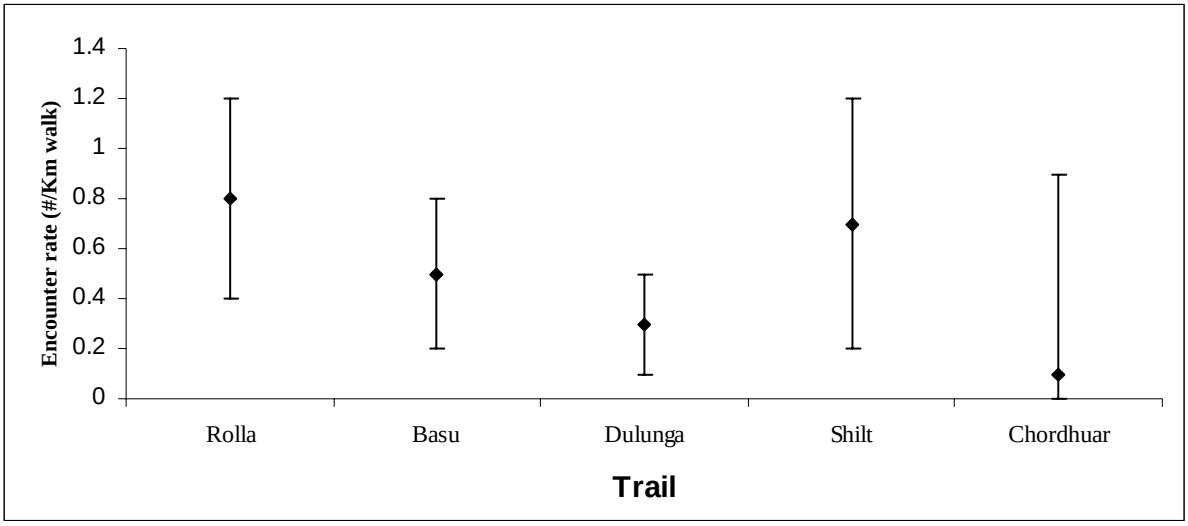
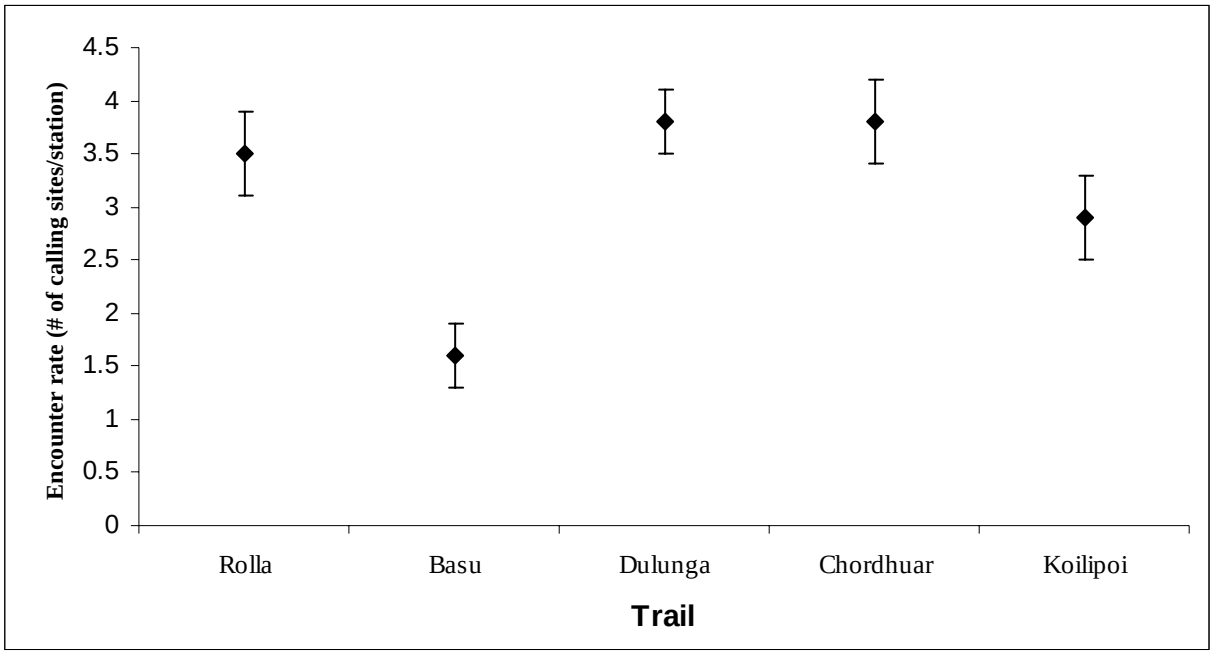


Figure 6.4. Mean encounter rate estimate for Koklass in spring 1997 using call count (Error bar indicates Standard Error)



6.3.2. Relative abundance: between areas

Encounter rate for Himalayan monal was relatively high in Chordhuar (3.4 ± 0.32/km) and Dulunga (2.6 ± 0.38/km) areas irrespective of seasons while other areas showed distinct fluctuation in response to seasons (Table 6.1). Lowest estimate was obtained for Rolla (1.0 ± 0.35/km) followed by Basu (1.2 ± 0.54/km). Koilipoi and Shilt had similar estimate of 1.7 birds / Km walk. Encounter rate estimate for Koklass indicated a relatively high abundance in Rolla (1.4 ± 0.18) and Koilipoi (0.9 ± 0.20), while in other areas the estimate ranged between 0.3 and 0.6 birds / Km walk (Table 6.2). On contrary, encounter rate using call count was estimated to be higher in Dulunga (3.3 ±0.48) and Chordhuar (3.1 ± 0.48) followed by Rolla (2.8 ± 0.45) (Table 6.3).

Table 6.1. Encounter rate estimate (#/Km walk) for Himalayan monal in different areas (Mean ± SE)

Season	Rolla	Basu	Dulunga	Shilt	Chordhuar	Koilipoi
Spring	0.6 ± 0.40	1.0 ± 0.45	2.0 ± 0.55	2.3 ± 0.58	3.5 ± 0.55	1.0 ± 0.32
Autumn	1.5 ± 0.65	1.5 ± 0.65	2.5 ± 0.29	1.4 ± 0.82	3.5 ± 0.71	1.5 ± 0.65
Winter	1.0 ± 0.26	1.0 ± 0.52	3.2 ± 0.65	1.4 ± 0.52	3.1 ± 0.35	2.5 ± 0.76
Overall	**1.0 ± 0.35**	**1.2 ± 0.54**	**2.6 ± 0.38**	**1.7 ± 0.45**	**3.4 ± 0.32**	**1.7 ± 0.35**

Table 6.2. Encounter rate estimate (#/Km walk) for Koklass in different areas (Mean ± SE)

Season	Rolla	Basu	Dulunga	Shilt	Chordhuar	Koilipoi
Spring	1.0 ± 0.32	0.2 ± 0.20	0.4 ± 0.24	0.6 ± 0.58	0.5 ± 0.34	0.4 ± 0.24
Autumn	1.3 ± 0.25	0.3 ± 0.25	0.3 ± 0.25	0.7 ± 0.40	0.6 ± 0.40	0.5 ± 0.29
Winter	1.8 ± 0.65	0.3 ± 0.21	0.5 ± 0.22	0.5 ± 0.30	0.3 ± 0.18	1.7 ± 0.61
Overall	**1.4 ± 0.18**	**0.3 ± 0.09**	**0.4 ± 0.08**	**0.6 ± 0.17**	**0.5 ± 0.12**	**0.9 ± 0.20**

Table 6.3. Encounter rate estimate (# of calling sites/ sampling station) for Koklass in different areas (Mean ± SE)

Year	Rolla	Basu	Dulunga	Chordhuar	Koilipoi
1997	3.5 ± 0.38	1.6 ± 0.32	3.8 ± 0.31	3.8 ± 0.41	2.9 ± 0.44
1998	2.8 ± 0.45	2.1 ± 0.50	3.3 ± 0.31	3.1 ± 0.48	1.4 ± 0.38

Although differences is shown in Table 6.4., abundance estimate for Western tragopan was very low to make useful comparison. However, direct observation and call count indicated that Chordhuar and Rolla represented relatively higher abundance in spring and winter respectively.

Table 6.4. Encounter rate estimate (#/Km walk) for Western tragopan in different areas (Mean ± SE)

Season	Rolla	Basu	Dulunga	Shilt	Chordhuar	Koilipoi
Spring	0.0	0.0	0.2 ± 0.20	0.0	0.3 ± 0.20	0.2 ± 0.20
Autumn	0.0	0.0	0.0	0.0	0.4 ± 0.43	0.0
Winter	1.2 ± 0.54	0.0	0.0	0.0	0.3 ± 0.28	0.0
Overall	**0.4 ± 0.14**	**0.0**	**0.1 ± 0.09**	**0.0**	**0.3 ± 0.10**	**0.1 ± 0.06**

6.3.3. Relative abundance: between seasons

The study pheasants exhibited noticeable fluctuation with respect to changes in the climatic condition. Excepting for Koklass, the seasonal variation in the abundance of Himalayan monal and Western tragopan revealed higher relative abundance in winter (Fig. 6.5). However, Kruskal-Wallis statistical test detected a significant difference in the abundance only for Himalayan monal (χ^2 test = 8.043, $P < 0.01$). The relative abundance estimated in different seasons did not vary significantly for Koklass ($\chi^2 = 0.166$, $P < 0.92$) and Western tragopan ($\chi^2 = 2.867$, $P < 0.23$).

6.3.4. Population trend

Abundance index estimated for all three species showed declining trend in the population between years. Encounter rate estimate for Himalayan monal was significantly lower in 1998 when compared

to 1997 (Wilcoxon matched pair test Z = -4.518, P< 0.001). The decline was observed in all the trails that were monitored during the study period (Fig. 6.6). Abundance index estimated using call count for Koklass also exhibited similar trend in the population (P< 0.05) (Fig. 6.7). Sighting of Western tragopan was very few to allow meaningful statistical tests. However, the reduction of sighting from 18 individuals in 1997 to 15 individuals in1998 (pooled data) and indicates a decline in population (see also Fig.6.8). The abundance index for Himalayan monal, Koklass and Western tragopan indicated an overall percentage decline of 45%, 18% and 17% respectively.

Figure 6.5. Relative abundance (Mean encounter rate with 95% confidence interval) of the pheasants in different seasons

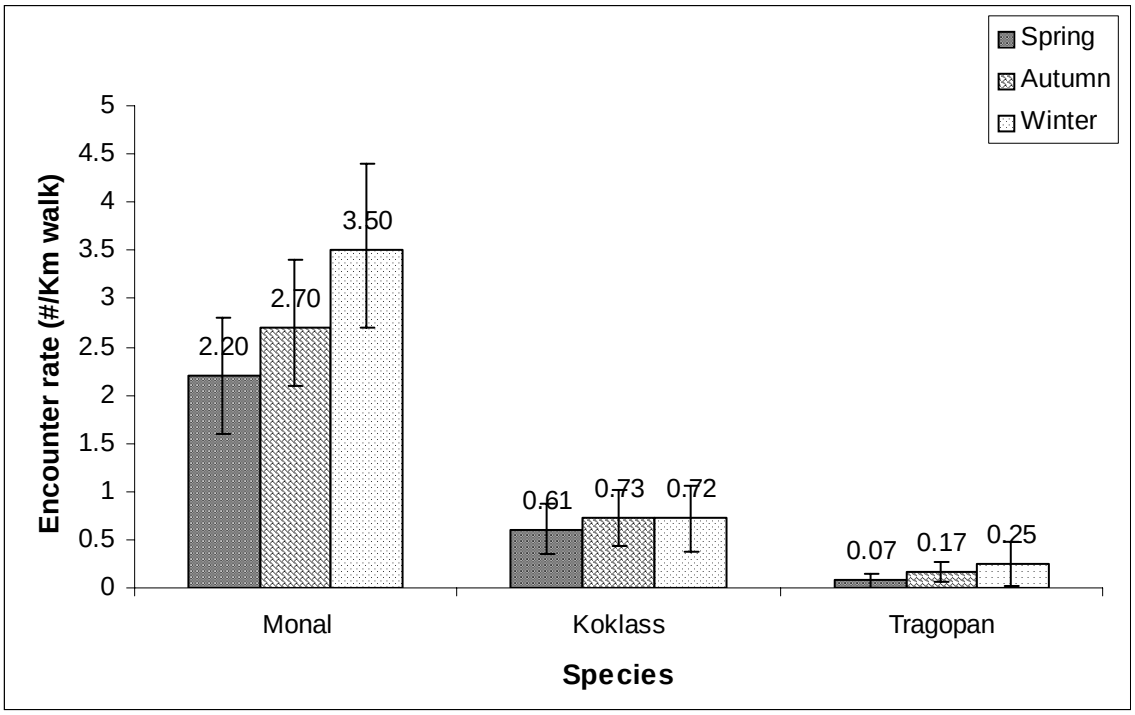


Figure 6.6. Abundance estimate (Mean with standard error bar) indicating decline in 1998 for Himalayan monal

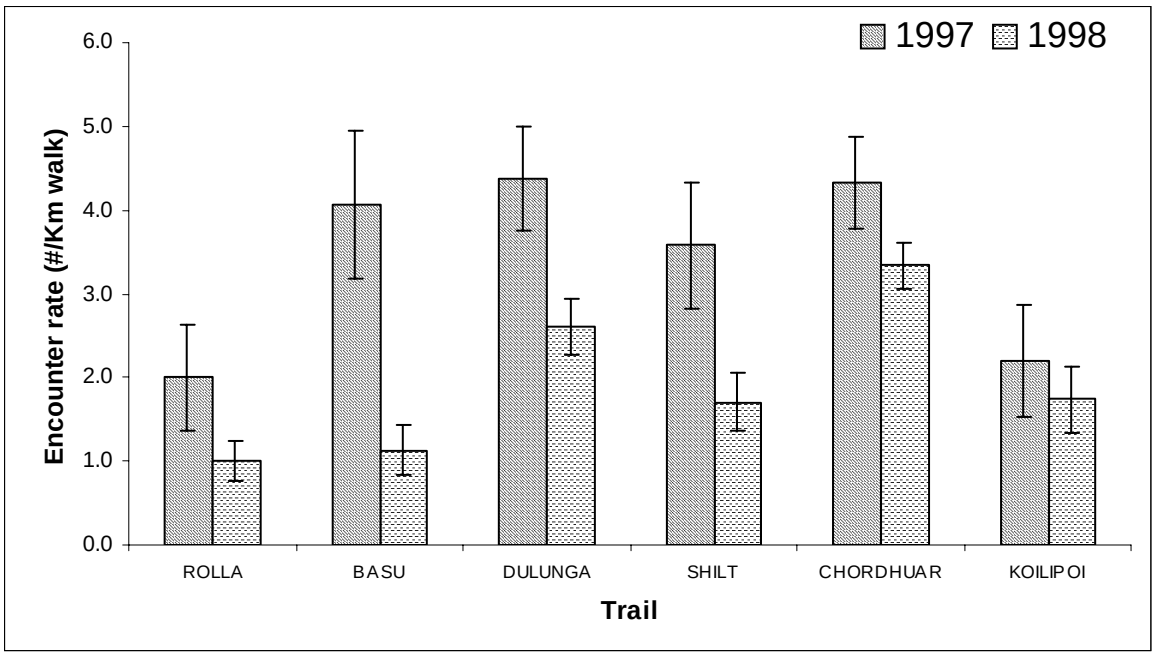


Figure 6.7. Call count estimate (Mean number of calling sites/ calling station) for Koklass in 1997 and 1998 (Error bar indicates standard error)

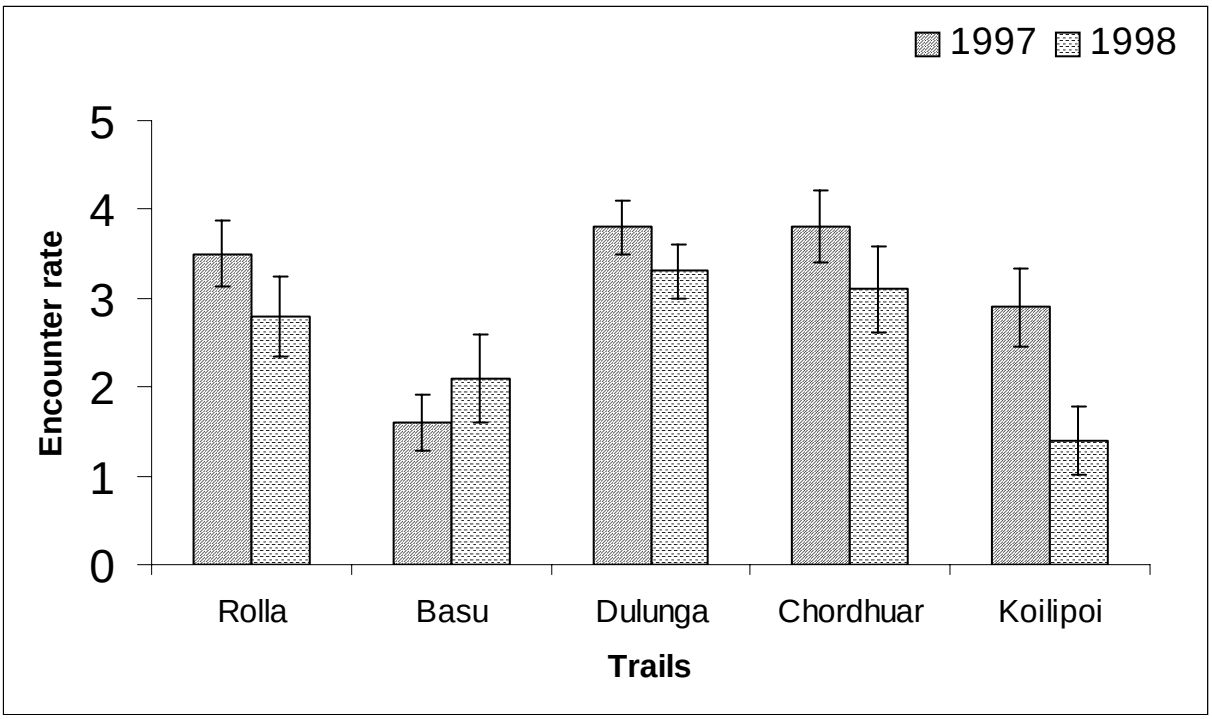
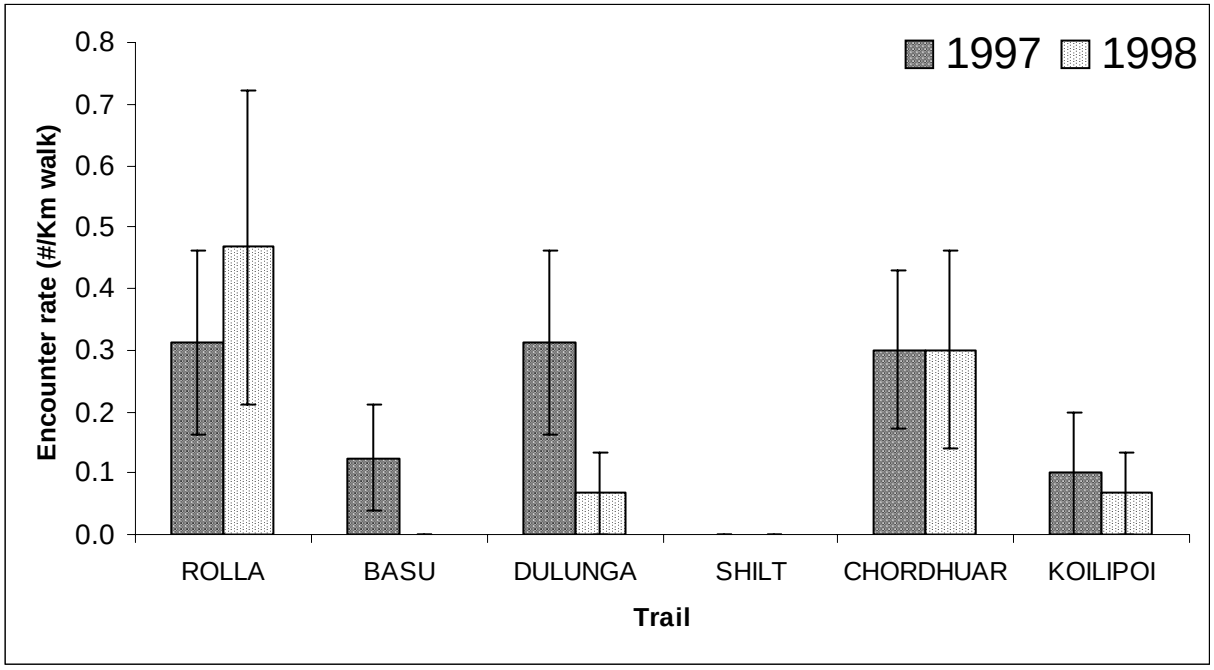


Figure 6.8. Differences in the relative abundance estimate for Western tragopan between 1997 and 1998 (Error bar indicates standard error)



6.4. CONCLUSION

As the winter offers an ideal situation to detect the majority of the population during transect walk, it can be stated that the encounter rate method is suitable for estimating relative abundance of the species and also for long-term monitoring. Whereas reliable abundance estimate for Koklass can be obtained by adopting call count method. However, both the techniques need to be employed for Western tragopan as this species occur in very low density and every information collected on this species would help the management of this species. Based on the encounter rate obtained for Himalayan monal, the study area comprising of different trails can be classified into three abundance zones, viz., Low (Rolla and Basu), moderate (Shilt and Koilipoi) and high (Dulunga and Chordhuar). However, during winter Koilipoi was observed to be relatively higher abundant area. With the Dulunga and Chordhuar as higher abundance area, other trails did not show distinct difference in the relative abundance estimate for Koklass and Western tragopan. Winter season accounted for relatively large abundance estimate for Himalayan monal and Western tragopan. Higher visibility and concentration in lower altitudes enabled higher abundance estimate for these pheasants in winter. Spring season was proved to be the only season when reliable call count estimate can be obtained for Koklass.

Comparison of abundance estimate between 1997 and 1998 revealed an apparent decline in 1998 in all the study species. An over all decline of 45%, 18% and 17% was observed for Himalayan monal, Koklass and Western tragopan in this study. The decline in the population is recent and is evident from the abundance estimate provided by Gaston and Garson (1992). For all these pheasants, Gaston and Garson presented encounter estimate of 0.9 birds per hour search in 1980 and 0.8 birds per hour search in 1991, indicating 5% decline in the population between 1980 and 1991. The recent decline is, presumably, due to the extreme level of disturbance caused by the uncontrolled mushroom collection practiced by the local people. Since the mushroom collection is done during spring season which is also the breeding season of the pheasants, the breeding success of the pheasants is greatly affected. Though there was no control experiment to prove that the mushroom collection is solely responsible for the decline, there are evidences to indicate the mushroom collection to have major influence towards the decline in the population. A study on Brown-eared pheasant in China has confirmed that mushroom collectors reduced breeding success to a large extent (Zhang Zheng-wang 1995). Secondary data collected by interviewing known mushroom collectors revealed that stealing of eggs of pheasant species is taking place in GHNP. Besides this, dogs that are taken to forest were also seen involved in nest predation (N=2). The negative impact of mushroom collection is evident from the heavy dependency on mushroom by local people. Of the eight NTFP under extraction in GHNP, mushroom is the most preferred one and is been collected by 60% of the local population (Fig. 6.9). Though the collection started in late eighties, the intensity of collection increased since early nineties. This is evident from the increase in the market price in recent years (Fig. 6.10). One Kg of dried mushroom was sold for Rs.900 in 1994, and it is Rs. 2500 in 1998, with constant increase at every year. Fifty to sixty people were recorded to visit the study area every day from late March to early June. Besides people, a total of 70-80 dogs entered the area along with the ‘gucchii’ collectors. The recent development in the mushroom collection has been one of the major reasons for the decline of pheasant population in recent years.

Figure 6.9. Trend in the rise of market price of morel mushroom (*Morchella esculenta*) from 1994 to 1998 in buffer zone of GHNP

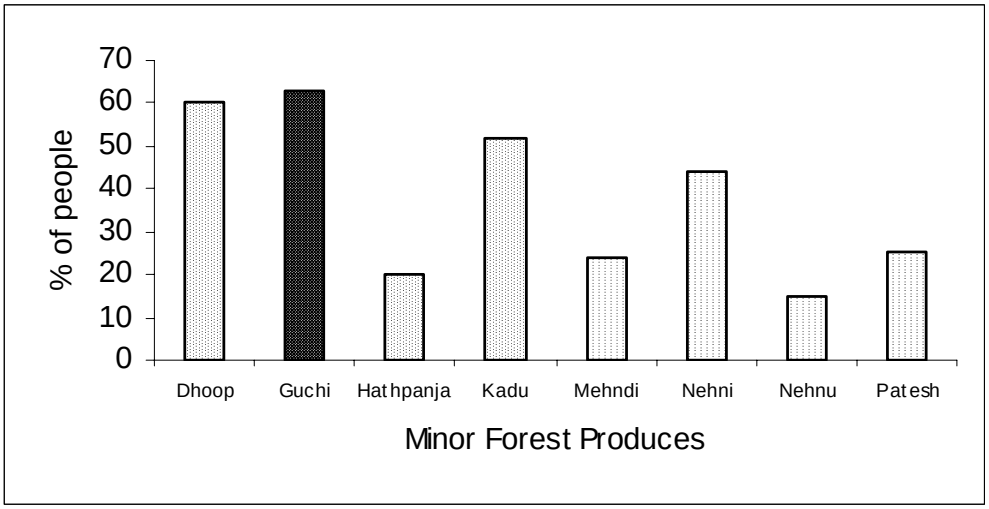
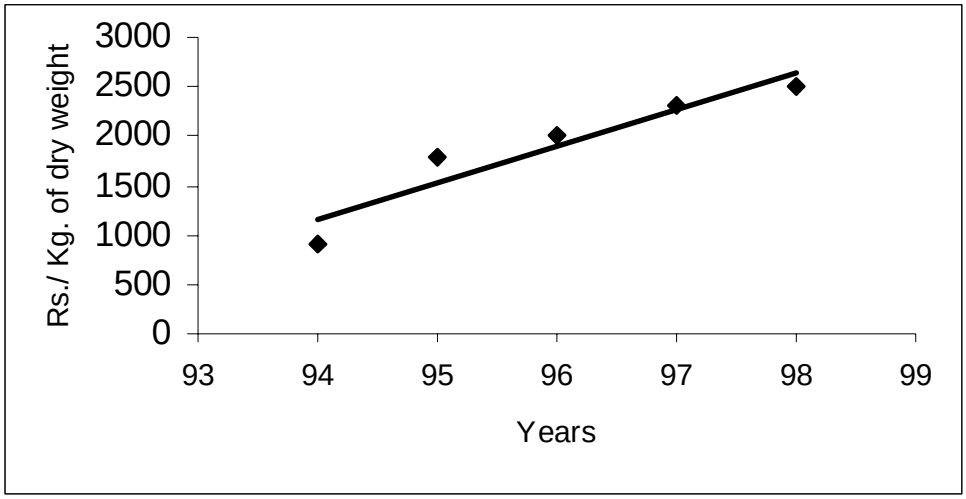


Figure 6.10. Non Timber Forest Products (NTFP) collection by local people in Tirthan valley of GHNP



CHAPTER 7 : HABITAT UTILIZATION

7.1. INTRODUCTION

Characterization of habitat forms an essential component in the ecological study of any organism. Although Odum (1975) describes the habitat as address of an organism, it generally denotes the physical and biological environment, in which a species is usually found (Morrison *et. al.* 1992). Habitat occupancy by a species is dominantly governed by two factors viz., proximate and ultimate factors. The proximate factors (or otherwise called psychological factors) enable the species to motivate settling behavior, whereas the ultimate factors are those factors that influence the survival and reproductive success of individuals (Orians 1971). Hence, knowledge on relative habitat preference by any species qualifies vital for conservation and management-oriented action. The ecological studies focusing on the habitat selection by pheasants have relatively been very few and the other available information accumulated by trophy hunters lack essential scientific explanation. In case of Himalayan pheasants, climate plays a major role in the selection of habitats in different seasons. Winter proves to be critical period in the habitat selection of the pheasants in this region as the harsh climate in the form of heavy snow forces these birds to lower elevation areas where they need to coexist with other species facing inter and intra specific competition for resources. The present study attempts to fulfill the paucity of information on this aspect and provides detailed account on the habitat use of the Himalayan monal, Koklass and Western tragopan across seasons.

7.2. METHODS

The habitat use by pheasants was studied by following correlative approach (wherein the abundance of pheasants was related with the major habitat characteristics including the pattern and various phases of the vegetation). Abundance index (encounter rate) of the pheasants calculated using trail walk (see Chapter 6) in the seven habitat types were used to correlate with habitat parameters that were identified based on plots laid at both sides of the monitoring trail. The seven habitat types are, 1. Broad-leaf dominated mixed forest (BDMF), 2. Conifer dominated mixed forest (CDMF), 3. Mixed conifer and broad-leaved forest with *Arundinaria* under growth (MCBA), 4. Mixed conifer and broad-leaved forest without *Arundinaria* under growth (MCB), 5. Temperate mixed conifer forest (CF), 6. Sub alpine oak forest (SAO) and 7. Alpine scrub and meadows (see Chapter 4 for habitat description). However, data collection was not focussed in alpine meadows due to virtual absence of the pheasants in this zone. Habitat quantification was done once in every season to describe the changes in the habitat. Kruskal-Wallis statistical test was performed to test the null hypothesis that the habitat use by the pheasants is identical across habitats and seasons.

7.3. RESULTS

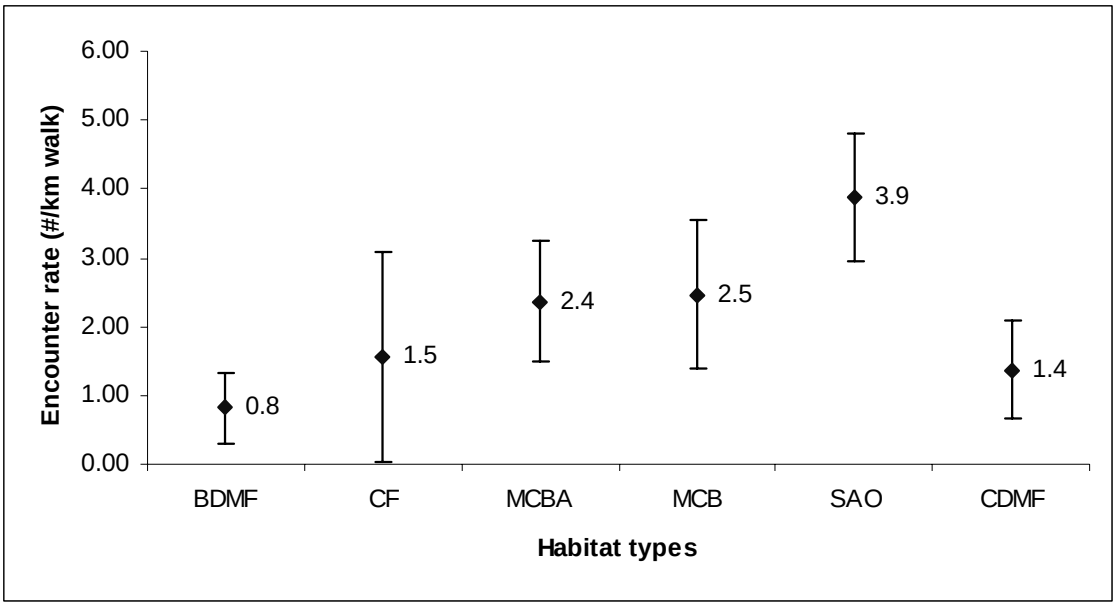
7.3.1. Himalayan monal

Abundance estimates revealed that monal showed relative preference to habitats across different seasons. There was a significant difference in the use of habitats observed in spring (Kruskal-Wallis $\times^2 = 22.640$, $P < 0.001$) with the Sub alpine Oak Forest (SAO) being used relatively higher (3.9 birds/km walk) (Fig. 7.1). The mixed broadleaved forests had moderate use while broad leave dominated mixed forest (BDMF), conifer dominated mixed forest (CDMF) and pure conifer forest (CF) had relatively lower use by Himalayan monal. With SAO at higher elevation between 2900m and 3,330m, the altitudinal use by Himalayan monal was observed to be concentrated at higher altitudes followed by moderate use habitats (middle elevation) and low use habitats (lower elevation). On the contrary, middle elevation and lower elevation habitats had higher use in winter (Fig. 7.2), which is due to altitudinal migration forced by heavy snowfall at higher elevation zones. The null hypothesis that the monal uses all the habitats in similar fashion during winter, was rejected and it was inferred that they showed significant difference in habitat use between the habitats ($\times^2 = 15.415$, $P < 0.009$). However, there was no significant difference in the use of habitats in autumn ($\times^2 = 5.364$, $P < 0.373$).

7.3.2. Koklass

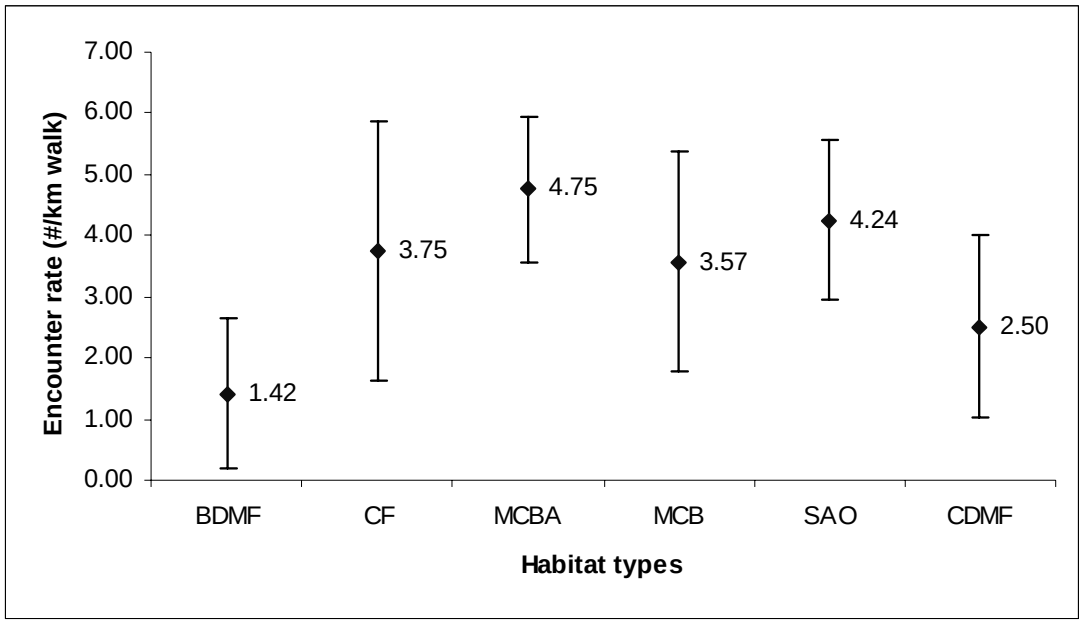
Like Himalayan monal, Koklass also exhibited similar pattern in terms of altitudinal use, but Koklass differed from Himalayan monal in relative habitat preference. The null hypothesis, that the Koklass uses all the habitat types equally in autumn season, could not be rejected and it was concluded that there was no significant difference in using the habitat types by Koklass ($\times^2 = 14.449$, $P < 0.130$). However, there was a significant difference observed between habitats in spring ($\times^2 = 14.655$, $P < 0.012$) and winter ($\times^2 = 20.243$, $P < 0.001$). Habitat use in spring was relatively high in broad leaf dominated conifer forest and mixed conifer & broad leaf forests (Fig. 7.3). SAO was used moderately while other habitats had relatively lower use by Koklass in spring. During winter, broad leave dominated mixed forest and conifer dominated mixed forests were in higher use when compared to other habitat types that were available (Fig. 7.4). Other mid elevation and higher elevation habitats were used in low proportion in winter, revealing that like Himalayan monal, Koklass also undergoes altitudinal migration.

Figure 7.1. Habitat use by Himalayan monal during spring 1997 and 1998 in the study area



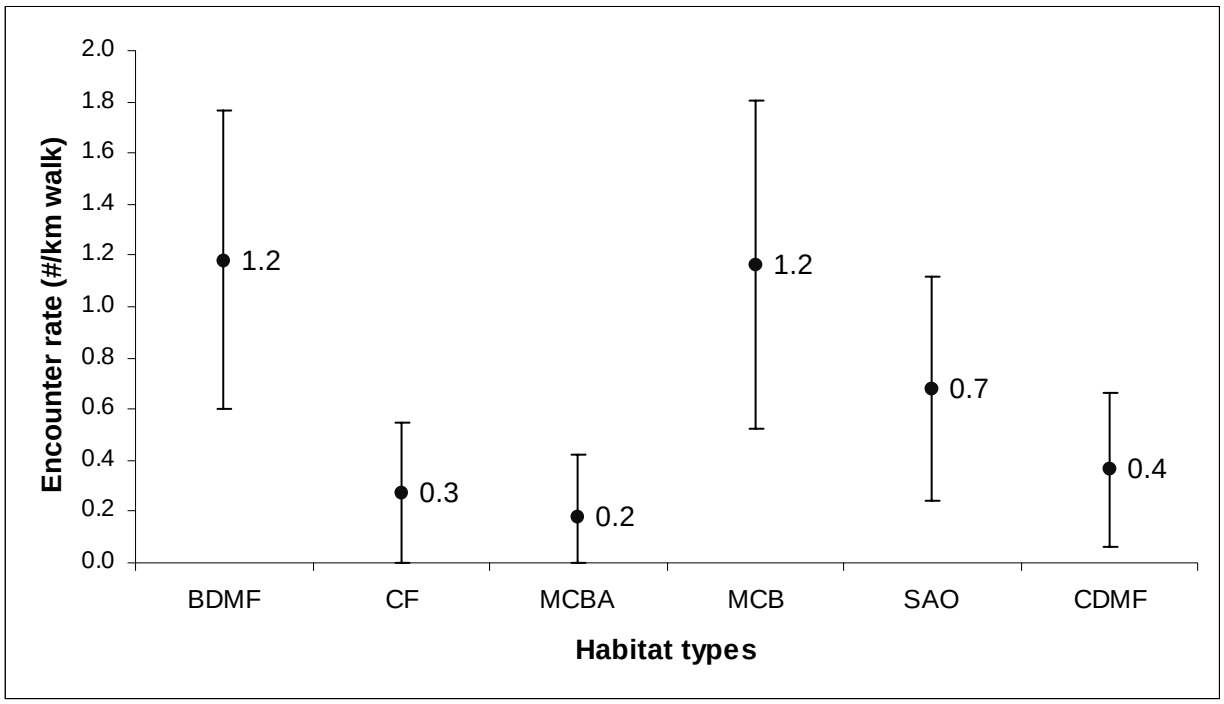
(Error bar denotes 95% confidence interval)

Figure 7.2. Habitat use by Himalayan monal during winter 1997 and 1998 in the study area



(Error bar denotes 95% confidence interval)

Figure 7.3. Habitat use by Koklass during spring 1997 and 1998 in the study area

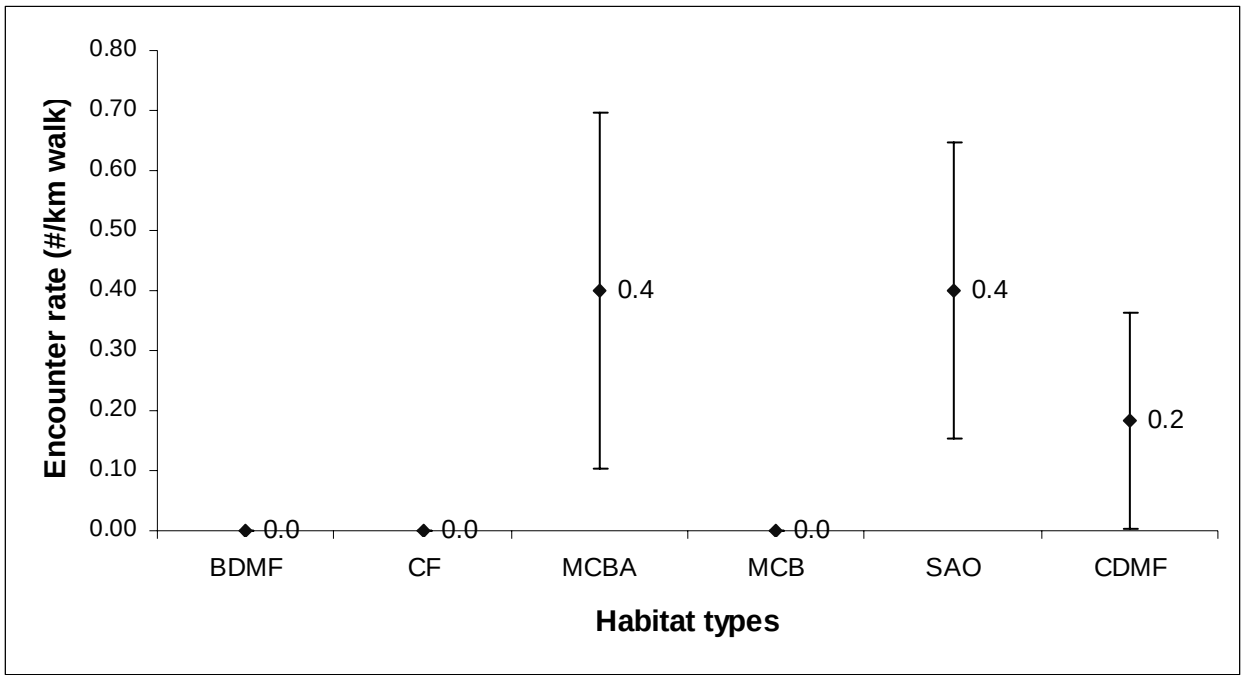


(Error bar denotes 95% confidence interval)

7.3.3. Western tragopan

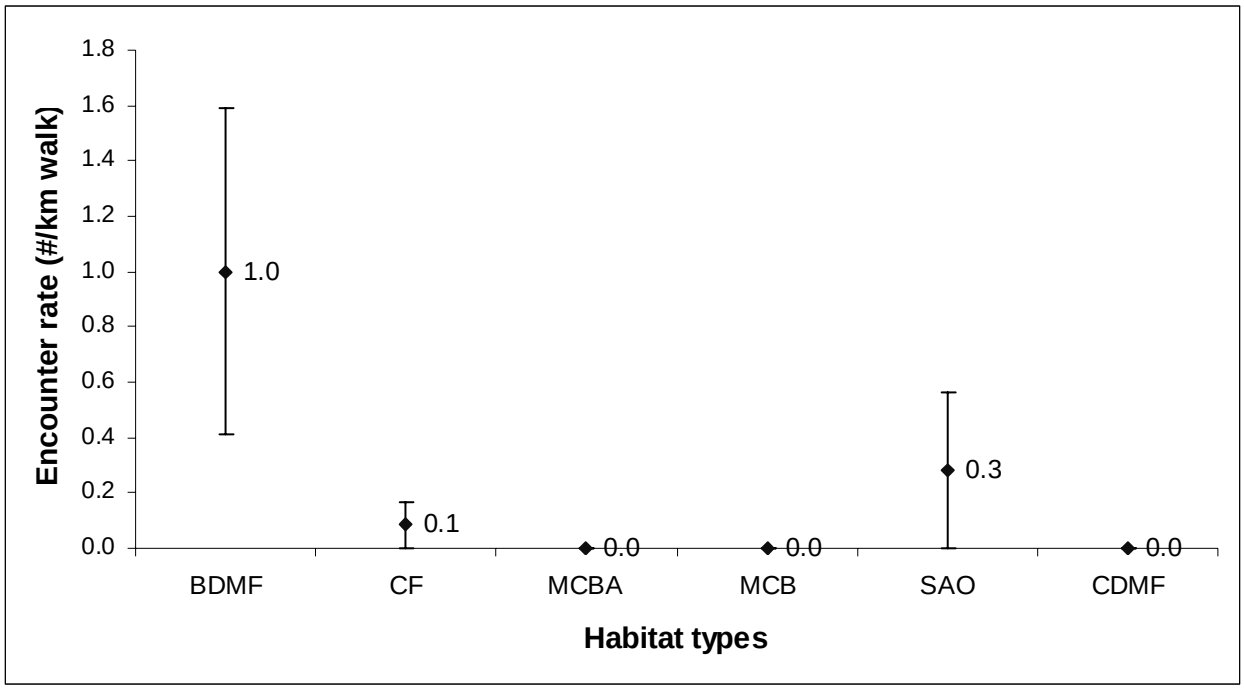
Habitat use data by Western tragopan revealed that there is a significant difference in the use of different habitats in spring ($\times^2 = 17.609$, $P < 0.003$) and winter ($\times^2 = 23.383$, $P < 0.001$), while in autumn Western tragopan did not exhibit significant difference between habitats ($\times^2 = 3.137$, $P < 0.679$). Of the six habitat types, Western tragopan was observed to be use only three habitats showing maximum use in mixed conifer & broadleaved forest with A*rundinaria* undergrowth and Sub alpine oak forest in spring season (Fig. 7.5). This species was not recorded in BDMF, CF and MCBF during spring season. In winter, majority of the Western tragopan used the habitats that were devoid of deep snow cover. Located at lower altitude (2000 – 2600m), broad leaf dominated mixed forest accounted maximum concentration of this species during winter. Rest of the habitats had either minimal use or was not seen using other habitat types in winter.

Figure 7.5. Habitat use by Western tragopan during spring 1997 and 1998 in the study area



(Error bar denotes 95% confidence interval)

Figure 7.6. Habitat use by Western tragopan during winter 1997 and 1998 in the study area



(Error bar denotes 95% confidence interval)

7.3.4. Cheer pheasant

Due to inadequate sampling outside park area, reliable explanation could not be drawn on relative habitat preference by Cheer pheasants in GHNP. However, the data collected based on opportunistic search and courtship calls (direct sighting = 3, calling sites = 3) indicate that the cheer pheasant uses open grassy slopes intercepted with sparsely distributed tree vegetation. They were observed to be using the areas that support considerable grass or herb cover coupled with streams or 'nullas'. Since park area does not support such habitats, most of the cheer population is confined to ecozone. Such habitats are being used as 'ghasnis', from where local people cut grass for stall-feeding their livestock. South facing slopes generally offer such habitats and are being used by Cheer pheasant.

7.3.5. Kalij pheasant

Of the 11 sightings recorded for Kalij pheasant, nine of them were in secondary forests close to human habitation. Other two records were obtained from lower altitude broad-leaved forest. Kalij was not observed above 2200-m elevation in GHNP, thus indicating its concentration in ecodevelopment area.

7.4. CONCLUSION

Himalayan monal, Koklass and Western tragopan were proved to be the forest dwellers in GHNP and it was evident from the virtual absence of these pheasants in the alpine area, which resulted in discontinuation of trail walk in this zone after preliminary sampling. All the three species exhibited altitudinal migration favoring low altitude forests in winter. During spring and autumn, they dispersed in wide range of habitats occupying mostly in mid elevation and low elevation habitats. Although there were few sightings of Himalayan monal in alpine meadows, Koklass and Western tragopan were not recorded above tree line. Himalayan monal showed relative preference to sub alpine oak forest in spring and conifer mixed forests in winter, while Koklass was observed to be occupying broad leaf dominated mixed forests. As expected, Western tragopan used the mixed conifer forests with sufficient under growth, and in spring they mostly occupied sub alpine Oak Forest. It is to be noted that comparison of the pheasants between the habitat types have been done assuming that all the pheasants had equal probability of sighting across habitats and seasons. Caution is needed, as it might not be true in the case of areas which support closed under storey environment.

The differential habitat use by these pheasants between habitat types and seasons necessitates management strategy on seasonal basis. Concentrations of all the pheasants in lower altitude forests in winter indicate the need for adequate protection of these species from hunting and other impeding factors.

CHAPTER 8 : SOCIAL ORGANIZATION

8.1. INTRODUCTION

Social organization implies characteristic behavioral responses exhibited by a species while interacting with other individuals in a group. According to Crook (1965), social organization is complex behavioral characteristics that determine the mode of dispersion of a population and the inter-individual encounters within it. Most of the studies that attempted to understand this aspect of ecology of birds appeared to have concentrated mainly on reproductive situation (Matthysen 1990), thus leaving paucity of data on other characteristics such as seasonal congregation, segregation, group composition and sex ratio. With the exception of few species, the pheasants are always seen as group living birds interacting with other individuals at least during some time of a year. Himalayan pheasants, in particular, display such behavioral patterns with varying group size, group composition and sex ratio in response to climatic changes. Most of the Himalayan pheasants are reported to form flocks during winter, when they move down to lower altitude to avoid harsh winter and are expected to face resource crunch for food and habitat. Living in groups arguably benefits the birds in great deal to procure food more easily and helps in minimizing the risk of predation (Hill and Robertson 1988). Changes in the group size and sex ratio can also provide insight to the interacting nature of the population and would augment scope for further management implications. Research work on this aspect of ecology is deficient for Himalayan pheasants and the available information is also confined to limited seasons (Kaul 1989, Islam and Crawford 1993, Sathyakumar *et. al.* 1993 and Kumar 1997).

Habitat quality influenced by disturbance play a major role in the group size and composition of these birds. Considering the fact that the male pheasants have always been vulnerable to poaching by human for their bright colored plumage, this study attempted to document the nature of the population of Himalayan monal, Koklass and Western tragopan with a view to group size, composition and sex ratio. Understandably, resultant information would have direct management implication for the conservation of these species.

8.2. METHODS

During the systematic search of pheasants using trails, data on sex, group size and composition were collected from the intensive study area. Opportunistic surveys which were carried out during the study period enabled to collect similar data from other parts of Tirthan, Sainj and Jiwa valleys. Descriptive analysis using SPSS statistical software was done to calculate mean group size and

frequency distribution. Bootstrap analytical method was performed to draw conclusion from the data with unequal sample size. Estimated confidence limit using this method was used to differentiate significant differences in the group size between seasons. Data was pooled across seasons and areas to estimate sex ratio for the study species.

8.3. RESULTS

8.3.1. Group size

A total of 524 groups sighted during the course of the study were used to describe the group size characteristics of Himalayan monal, while for Koklass and Western tragopan the total groups were 126 and 45 respectively. Group size differed significantly across seasons (Kruskal-Wallis test χ^2 = 27.663, P < 0.001). The group size of the Himalayan monal ranged from 1 to 11 individuals with a overall mean group size of 1.61 ± 1.21 individuals. With the maximum of 277 sightings (52.8%), winter accounted the maximum mean group size for monal (Table 8.1). Highest congregation up to 11 individuals in a group was also recorded in this season, thus indicating congregation of individuals during winter months. Mann-whitney U test revealed that group size of Himalayan monal had significant difference between autumn and spring (Z = -1.969, P < 0.049), summer and winter (Z = -2.533, P < 0.011) and between spring and winter (Z = -4.886, P < 0.001). The group size and group range were relatively low in spring season which is the breeding season of the pheasants.

The Koklass, however, did not show significant difference in the group size between seasons (Kruskal-Wallis test χ^2 = 1.860, P < 0.602). The group consisting of three individuals was the maximum group size observed for this species. Other group size characteristics of Koklass have been given in Table 8.2. One sighting of a male with two female birds during breeding season (spring) indicated a possible ambiguity of the general observations that they are strictly monogamous.

Table 8.1. Group size characteristics of Himalayan monal in different seasons

Seasons	Mean	Std. Deviation	Minimum	Maximum	N	% Of Sightings
Spring	1.25	0.51	1	4	142	27.1
Summer	1.37	0.91	1	6	38	7.3
Autumn	1.49	0.93	1	7	67	12.8
Winter	1.86	1.48	1	11	277	52.8
Overall	**1.61**	**1.21**	**1**	**11**	**524**	100.0

Table 8.2. Group size characteristics of Koklass in different seasons

Season	Mean	Std. Deviation	Minimum	Maximum	N	% Of Sightings
Spring	1.17	0.43	1	3	47	37.3
Summer	1.38	0.74	1	3	8	6.3
Autumn	1.24	0.56	1	3	17	13.5
Winter	1.26	0.44	1	2	54	42.9
Overall	**1.23**	**0.48**	**1**	**3**	**126**	100.0

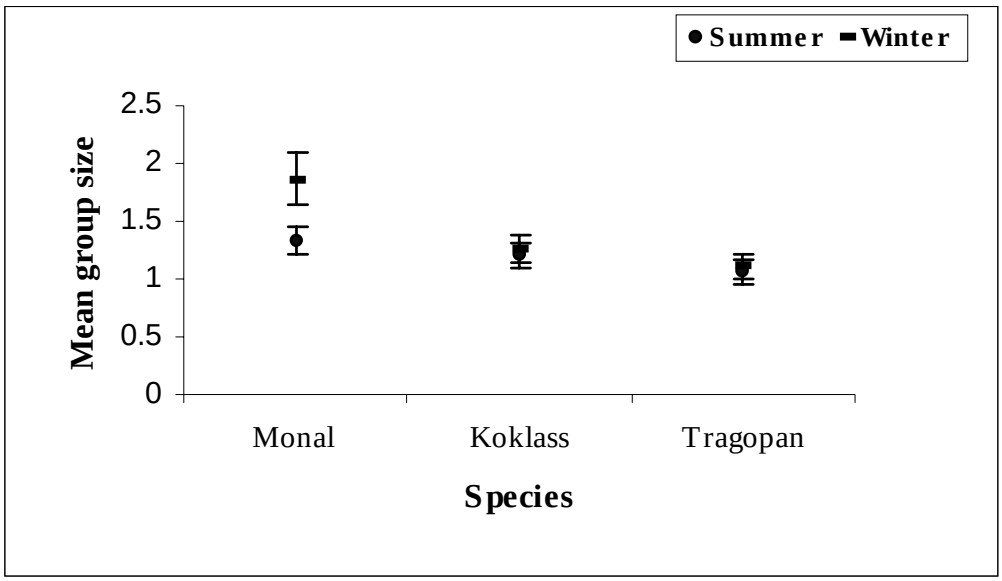
Group size of Western tragopan did not exceed more than two individuals in all the seasons. Estimated overall mean group size for this species was 1.09 ± 0.29 birds. Due to data deficiency, the sightings were grouped into two seasons viz., winter and summer (which includes spring, summer and autumn) for statistical analysis. The null hypothesis stating that the Western tragopan shows similar group size pattern across seasons could not be rejected and it was inferred that this species did not exhibit significant differences in the group size in response to season (Kruskal-Wallis test $´^2 = 0.402$, $P < 0.526$). The group size data presented in table 8.3 substantiates this observation.

Table 8.3. Group size characteristics of Western tragopan in different seasons

Season	Mean	Std. Deviation	Minimum	Maximum	N	% Of Sightings
Spring	1.07	0.26	1	2	15	33.3
Summer	1.00	0.00	1	1	2	4. 5
Autumn	1.00	0.00	1	1	1	2. 2
Winter	1.11	0.32	1	2	27	60.0
Overall	**1.09**	**0.29**	**1**	**2**	**45**	100.0

Confidence interval constructed using bootstrap technique also demonstrated the foreseen observation for these species. The mean group size with overlapped confidence limits in Koklass and Western tragopan reveal a insignificance difference in the group size between summer and winter, while for Himalayan monal the difference is apparent as depicted in the Fig. 8.1.

Figure 8.1. Seasonal changes in the group size of the pheasants



(Error bar denotes 95% confidence interval)

8.3.2. Group composition

Himalayan monal in this area was seen solitarily more often than groups. Of the 524 sightings, they were recorded to be solitary in 336 occasions (64%) and 124 occasions in pairs. Although they flocked up to 11 individuals, the group sizes with more than three individuals were observed to be very low (Fig. 8.2). There were considerable number of sightings, males and females forming unisexual groups. All male groups and all female were recorded in 228 and 216 occasions respectively, while mixed groups were seen only in 80 occasions. Seasonal observations of these group categories have been given in table 8.4. All male groups were relatively high in all but winter season when congregation of all female groups accounted for 133 records as against 101 for all female groups.

As expected, Koklass was mostly seen in singles or in pairs. Of the 126 observations, 79% (100 records) contributed by solitary birds and the remaining 21% consisted of breeding pairs (23 records) and three individuals (Fig. 8.3). Notable observation on group composition of Koklass was the mixed groups with more than two birds in a group.

Figure 8.2. Group composition of Himalayan monal in the GHNP

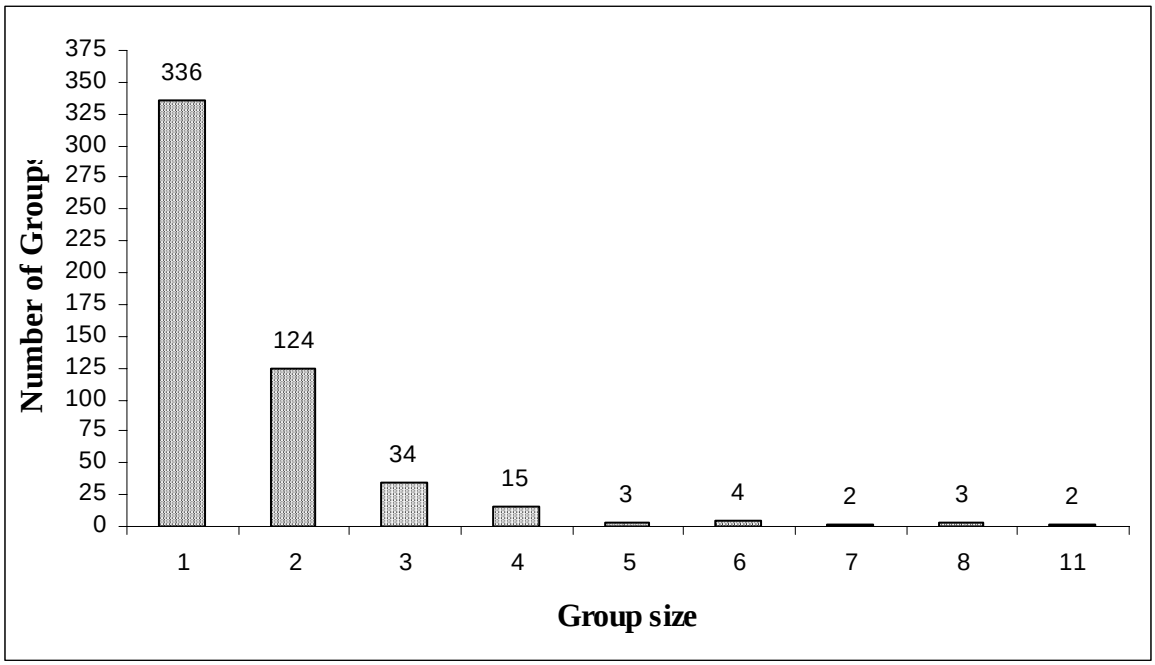
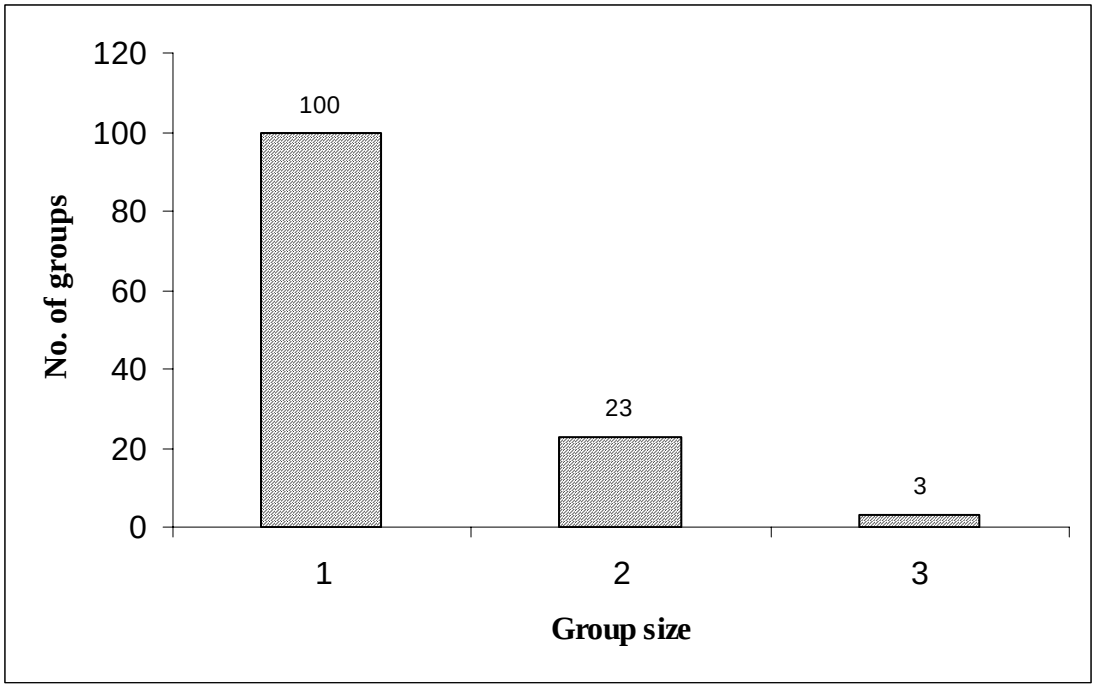


Table 8.4. Unisexual and mixed group formation in Himalayan monal in different seasons

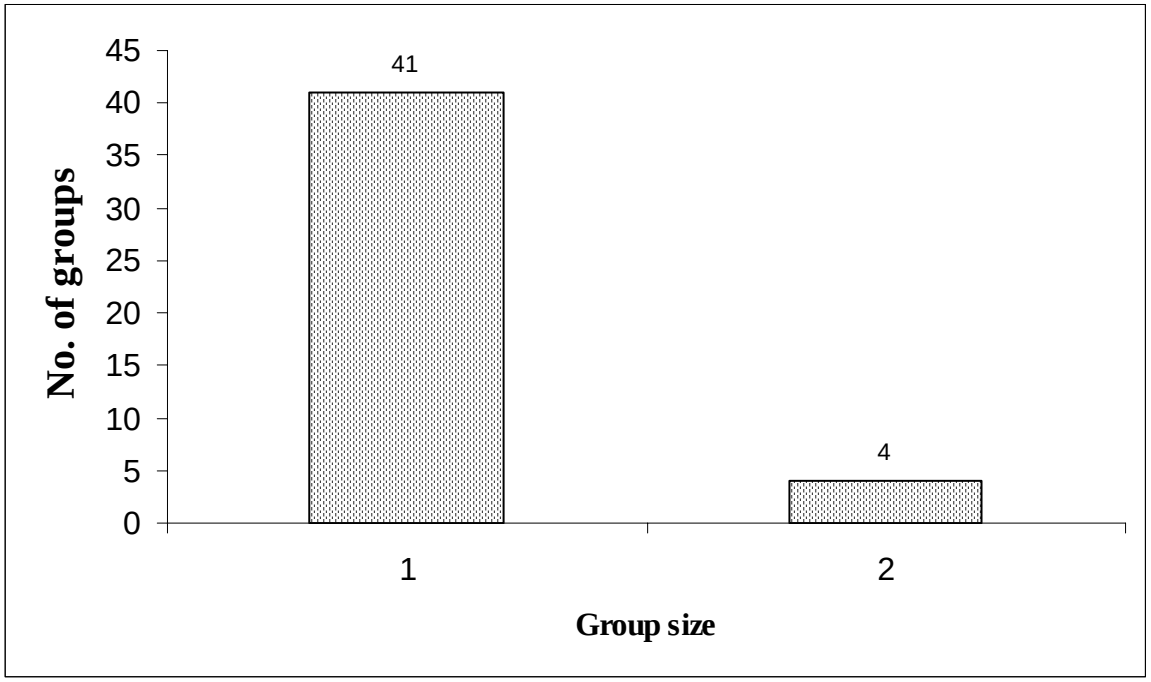
Seasons	All male	All female	Mixed group	Total
Spring	73	46	23	142
Summer	19	14	5	38
Autumn	35	23	9	67
Winter	101	133	43	277
Overall	**228**	**216**	**80**	**524**

Figure 8.3. Group composition of Koklass in the GHNP



Data collected on Western tragopan strongly suggested that they are primarily solitary birds except during breeding season. During the study period, they were seen singly in 91% (41 records) occasions, while only four records were pairs (Fig. 8.4).

Figure 8.4. Group composition of Western tragopan in the GHNP



8.3.3. Sex ratio

The estimated sex ratio for Himalayan monal and Western tragopan was found to be biased towards females, but in the case of Koklass the skewed sex ratio was favoured towards males (Table 8.5). In all, for every 10 males there were 13 females recorded for Himalayan monal and Western tragopan, and for Koklass, there were only 7 females per 10 males. Considering the fact that winter season offers reliable information on the pheasants largely due to high visibility and congregation of the pheasants in the lower altitude areas, the sex ratio estimated for this season revealed a highly skewed sex ratio towards females. These observations could have been biased due to the resemblance of adult males with females. There were 317 females seen as against 173 males in Himalayan monal during this season, indicating 18 females per 10 males. The sex ratio for Western tragopan was highly skewed with every 10 males needed to support 24 females. The sex ratio for Koklass was, however, comparable as that of overall estimate.

8.4. CONCLUSION

Studies on social organization and behaviour though considered to be contributing largely to the ecology/biology of the species, the importance of such knowledge cannot be neglected while formulating management plan for the conservation of the species concerned. Variation in group

size, composition and sex ratio of a species is considered to be associated with several biotic and abiotic factors that warrant immediate management concerns. Group size of Himalayan monal in this study was relatively higher in winter followed by autumn as has been reported by Kumar (1997) in Kedranath Wildlife Sanctuary. However, the mean group size of this species in this area is lower when compared to Kedarnath Wildlife Sanctuary. The large mean group size along with flocking of more than ten individuals indicates that the Himalayan monal exhibit some amount of group congregation during winter. Flocking during winter has been evidenced by Hill and Robertson (1988) in the Common pheasants. Lack of such data for Koklass and Western tragopan from other areas defies similar comparison on group size. The empirical data collected during this study, however, reveal that these two species did not differ significantly in the group size across seasons. The data brought out by this study on group composition presented a large number of solitary individuals even for Himalayan monal, which is supposedly polygamous. This observation seems to suggest that the population is either with skewed sex ratio or there is a problem of resource crunch for food. Observation of a male Koklass with two females during breeding seasons and several records (11 records) of male monal continuing the pair bond even after the chicks are hatched, indicates a possible disproval of the notion that the Koklass is strictly monogamous and the Himalayan monal is polygamous.

Table 8.5. Estimated sex ratio for the pheasants in GHNP (pooled data across seasons and areas)

SPECIES	MALE	FEMALE	*SEX RATIO (Male : Female)*
Monal	342	456	**10 : 13**
Koklass	77	51	**10 : 7**
Tragopan	17	22	**10 : 13**

The sex ratio of the study species was skewed towards females in the case of Himalayan monal and Western tragopan and was biased towards males in the case of Koklass. Islam and Crawford (1993) and Kumar (1997) have also made similar observations for Western tragopan and Himalayan monal respectively. The low records for these two species probably due to their vulnerability to hunting and predation. Considering these facts, the skewed sex ratio observed in the present study strongly suggests that caution needs to be taken while arriving at population estimates that considers 1:1 sex ratio for the pheasants particularly for Koklass and Western tragopan.

CHAPTER 9 : MANAGEMENT ISSUES AND CONSERVATION

9.1. INTRODUCTION

In natural ecosystems, the management of wildlife species and other associated natural resources has proved to be challenging and ineffective, particularly in areas such as the Himalaya where the characteristic topographic features and climate have been the major limiting factors. Additionally, the inadequacy of scientific information on the ecology and behavior of these species has also come as disadvantage to the managers while formulating management strategies. The fast increasing human population and consequent over-exploitation of natural resources leading to rapidly declining levels of biodiversity have further complicated this problem. Although India shares major responsibility in the conservation of pheasants specially because, a large proportion of endangered and endemic pheasants including the rare ones such as the Western tragopan and Cheer pheasant occur in its territory, there has not been significant contribution in this direction. This is largely because, the pheasants are elusive and are inhabitants of thick understorey forests which preclude proper understanding of these species; and also due to decreasing habitats caused by increasing human requirements and extensive hunting for meat and plumage.

Incidentally, GHNP supports five of the seven species that occur in the Western Himalaya including the Western tragopan and Cheer pheasant. Though considered to be one of the strong holds for these species, long-term resource use practices and other recent anthropological developments have threatened the survival of these pheasants in GHNP. Consequently, the need for management steps which are backed with essential scientific information was realized by the management and hence, this study. This study attempted to document various issues pertaining to management, and provides possible mitigation measures for the long-term monitoring and conservation of these pheasants.

9.2. CONSERVATION THREATS

The resource use and other human activities were observed to be playing a significant role on the survival of the pheasants in GHNP. Due to these reasons, it is necessitated to have a well-planned management strategy, which guarantees sufficient safeguard to the pheasants and at the same time, does not undermine the interest of the people who are dependent on the park resources. Although most of the disturbances caused by the local population have high influence on the status of the pheasants, some of them are direct leading to immediate negative results. During the study, the following factors were identified to be responsible for the disturbance to the natural population of the pheasants in GHNP.

9.2.1. Poaching

Hunting of pheasants especially of Himalayan monal was prevalent before 1982 when the hunting was declared illegal by the State Government. Although the study species enjoy legal protection under Indian Wildlife (Protection) Act, 1972, the ban was specifically imposed in GHNP with the initial notification in 1984. The pheasants were mainly hunted and poached for their meat and the bright colored feathers, which were used to ornament the hat of the men in this region. With the growing awareness and advancement among the young generation, the interest for feathers is fast diminishing. Poaching though not large scale, is however in practice mainly aiming at meat. Altitudinal movement, even down to human habitation, forced by heavy snowfall seems to play major role in the occasional hunting of these species in GHNP. The licensed firearm obtained for crop protection and traditional knowledge in trapping birds enable the people in these activities.

9.2.2. Mushroom collection

Morel mushroom, locally called '*gucchhi*' (*Morchella esculenta*) is a recently found resource by the local people due to the increase in the national and international market demand (Tandon 1998). This mushroom grows mostly between 1500m to 4000m in lower and upper temperate conifer and mixed broad-leaved forests during spring season. This is one of the 11 species of true morels found in the Himalaya (Singh 1997). They are highly priced in the national and international market due to increasing demand for its delicacy. This has resulted in forcing the local people to search almost the entire forested area and ultimately, they have become more dependent on mushroom than any other NTFP (Non Timber Forest Products). The extraction of mushroom force negative impact on the pheasants because the mushroom grows in prime pheasant habitats and more importantly, the extraction coincides with the breeding season.

The mushroom collection offers ideal ground for some people to undertake illegal activities such as hunting, poaching and egg collection. Mushroom collection is becoming a serious problem in GHNP since there is a rapid increase in the number of people in the breeding ground of pheasants. A survey conducted by Kumar *et al*. (1999) estimated that 60% (4,200 people) of the local population collect mushroom, indicating a large dependency on this resource. Being shy and have little ability to tolerate human intervention, the pheasants are forced to dissert the nests on frequent visit of the people to the nesting area causing significant reduction in the breeding success. Decreasing population trend in this area has indicated this explanation (See also Ramesh *et. al. 1999*). Moreover, removal of litter and trampling while collecting mushroom can have negative impact on invertebrate population, which is primary source of food for growing chicks.

9.2.3. Egg stealing and destruction of nests

People movement inside the park during breeding season of the pheasants was found to be detrimental for the breeding pheasants. There were evidences that the people visit the park for mushroom collection and collection of lichen often directly involve in removing eggs from the nests and destroys the nest (N=5). Secondary information collected based on interviews with known local people substantiates this observation.

9.2.4. Predation by domestic dogs

The domestic dogs, which are taken into forest by the mushroom collectors and graziers, contribute significantly to the disturbance factors. A total of 70-80 dogs were recorded in spring 1998 in the intensive study area, however Vinod and Sathyakumar (1999) has documented an average of 3.6 ± 0.3 dogs per days for a year in the Tirthan Valley. Secondary data reveals that these dogs cause serious consequences in the breeding success as they either directly consume the eggs or chase the birds away from the nest leading to eventuality of the birds to abandon the nests.

9.2.5. Livestock grazing

The livestock grazing has been reported to have negative influence on vegetation community and wild ungulate populations in GHNP (Singh 1999, Vinod and Sathyakumar 1999), despite the argument put forth by Richard (1999) questioning some of the general concepts pertaining to grazing pressure. Grazing in GHNP has relatively less impact on the pheasants, possibly because most of the grazing activities are done in alpine meadows, which is not a preferred habitat of pheasant. Nevertheless, during their course of movement towards the high altitude pastures, they camp at regular intervals in '*thaches'* and move through the forested areas. During this period, they are expected to cause considerable disturbances to the breeding pheasants. Large numbers of livestock moving through the forests cause destruction to ground cover which forms vital component of the pheasant habitats. Positive role of the grazing was, however, found to be the man made '*thaches'* and dung deposition. Though the pheasants are primarily forest dwellers, field observation suggests that they use the '*thaches'* extensively, and feed on the worms found in the dung deposition.

9.2.6. Fire

Small-scale forest fires were frequently observed especially during the period of mushroom

collection. It is a generally believed among the local people that fire will enhance the production of mushroom and hence, they set fire in the forested areas. Large portion of areas in the ecozone is regularly burnt in order to increase the productivity of grasses. Though Cheer pheasant inhabits the same areas, which are burnt, the impact due to the fire was very minimal. During spring 1999, the Himachal Pradesh including the GHNP experienced series of wide spread forest fire reaching as high as 3000m elevation. The possible impact on the pheasants could not be documented due to lack of time.

9.2.7. Habitat destruction

Collection of montane bamboo (*Arundinaria spathiflora*) for household industry and extraction of lichen by lopping/cutting trees and shrubs by local, contribute considerably to the habitat destruction. Bamboo patches were identified to be ideal habitat for Western tragopan and removal of the bamboo from places like Chordhuar and Basu areas can have serious impact on this species. Grazing of livestock particularly cows in the forest patches reduce the suitability of the understorey environment for the pheasants. Though with large area under forest cover, the low abundance of the pheasants in Sainj valley is perhaps the result of such impacts. Changes in the landuse pattern documented by Naithani and Mathur (1999) indicates that the habitats of Kalij and Cheer pheasants have undergone consequential changes in the past decades. However, these species have been proved to be tolerant of such biotic factors.

9.3. Current management actions

The ongoing Ecodevelopment project, aiming at the conservation of the pheasants and other component of biodiversity, has yet to play positive role on the pheasant population. Nevertheless, recently the park management in collaboration with the local NGOs has been successful to initiate a series of programmes mobilizing the local people for Wildlife conservation. Bridal paths and watchtowers have been constructed to increase the efficiency of patrolling and easy access of the forest staff. With the insufficient manpower, the management is finding it difficult to patrol much of the park area especially during winter when illegal activities are maximal. Plantations are being done in park area in order to provide adequate cover for the wildlife species including the pheasants. Autumn and winter censuses are being carried out every year to monitor the population of Musk deer and pheasants and other wildlife respectively. On 23 June 1999, the Government issued a final notification of the park with the settlement of rights mentioned in the Anderson settlement report (Anderson 1886). And through this award, all the human activities inside the park area were restricted from open access. Since a section of people, who are genuinely dependent on the park

resources, have not been adequately compensated under the award, recent developments evidenced few acrimonious situations in this area, with some people trying to undermine the award.

9.4. RECOMMENDATIONS

The current status of vegetation *vis a vis* habitats in GHNP is assumed to be acceptable and maintaining this status without being exacerbated would help in improvement of habitat and the pheasant population. Although nothing can be done on the effect of lighting, landslides and erosions can be minimized by adopting the methods suggested by Negi (1996). By strict follow of the law laid down under National Parks in the Wildlife (Protection) Act (1972), much of the human induced problems can be controlled. However, the dependency and heavy demand for valuable medicinal plants can have likely influence to make the ban impractical as is evidenced by other National Parks in the country. To counter such problems and conserve the pheasants not only in GHNP but also in other forested areas surrounding the villages, following management recommendations can be considered.

- Create awareness among the local villagers emphasizing the need of conservation and legal consequences on violation of the Forest and Wildlife (Protection) Acts.
- Involvement of local people for the implementation of management programme would be effective and help in controlling much of the secondary impacts caused during resource collection by the people.
- There is an urgent need to adequately compensate the people who are not been mentioned in the Anderson's settlement report, but claim genuine stake on the forest resources.
- Regulate biotic activities such as mushroom collection and grazing at least on experimental basis, and impose strict ban on domestic dogs entering the park.
- Educate and empower the front line staff with the Wildlife (Protection) Act, 1972 and enforce strict legal action against the offenders.
- Park staff needs to be adequately helped with proper field equipments and increased manpower to effectively patrol the area, which is characterized by steep and rugged terrain.
- Patrolling should be improved in winter, as illegal activities such as hunting and poaching are maximal during this season.
- Suggested research problems and long-term monitoring of the pheasants should be considered on priority basis.

9.4.1. Awareness programme

The local people seem to have little knowledge on the importance of National Park and legal consequences. The awareness programmes that have been envisaged in the ecodevelopment project document should be expedited so as to prevent the eventualities. Awareness compaign should target the dependent people who often visit the park and the local human population. Involvement of local NGOs and other social workers involved with Nehru Yuvakendra, National literacy mission, etc. would be effective in undertaking the awareness programmes. It should be stressed with the evidence presented by the research works that competition for resources leading to removal of herbs and mushroom at early stages of growth would lead to devastating results in terms of decline in the production and disturbance to the ecosystem. People should also be made aware that the egg stealing and other illegal activities would invoke legal action against them. Young generation particularly students in ecozone and nearby areas should also be taken into consideration while formulating awareness activities.

9.4.2. Alternative income

It is evident from the research works carried out under the project that considerable numbers of local populations generate maximum income from the natural resources available in GHNP (Singh 1999, Kumar *et. al.* 1999 and Mehra and Mathur, 1999). The ecodevelopment project offers ample scope for alternative income for the local people. Steps should be taken to cultivate mushroom and encourage people to grow other cash crops in their own land.

9.4.3. Regulation of biotic activities

Migratory route and stay at 'thaches' should be regulated to prevent acceleration of impacts. Regulation of mushroom collection and accessibility in limited areas would decrease the pressure drastically.

9.4.4. Legal actions

Though priority should be given to participatory approach, wrongdoers should be penalized under the Wildlife (Protection) Act. After fulfilling the demand of genuine right holders, violation of wildlife act should be taken seriously and lawbreakers should be brought under the book. Front line staff should be educated with wildlife act to execute the legal actions against the incorrigible people.

9.4.5. Long-term monitoring and research

Occupying different vegetation and altitudinal strata, the pheasant can be considered as indicator species of disturbance and monitoring of these species would give useful insight to the population status of other birds particularly ground dwelling birds. This study suggests that encounter rate and call count would be ideal for monitoring the population of Himalayan monal and Koklass respectively. Due to the low density and secretive behaviour, both above techniques would be required for monitoring western tragopan. Kalij and cheer pheasants can be monitored using encounter rate and call count. Winter season is ideal for undertaking monitoring activity for Himalayan monal and Western tragopan, while spring is ideal for Cheer, Koklass, Kalij and also for recording calling Western tragopan. Chordhuar and Basu areas are suggested for monitroing pheasants in Tirthan valley. Homkani and Jognidhar in Sainj valley and Gatipat in Jiwa valley are other sites recommended for long-term monitoring of the pheasants. A comprehensive account on monitoring protocol for the pheasants has been given in Ramesh *et. al.* (1998).

Considering this study as baseline data on the ecology of the pheasants, further research on this direction is suggested to validate the findings. Information on food habit and behavior in response to biotic and abiotic factors are urgently needed to understand the requirements of the pheasants. An extensive survey based on the data collected on habitat use and the extensive work on Remote sensing and GIS would provide vital information for the management of these species, especially Cheer pheasant which could not be concentrated during this study. With the ban imposed on human activities inside the park, this area offers ideal situation to study the extent of impact of mushroom collection practice on the pheasants. Research work leading to successful growth of mushroom in the cultivated land would offer immense help in reducing the pressure.

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* - Original not referred.

APPENDIX I - Birds of Great Himalayan National Park

	COMMON NAME	ZOOLOGICAL NAME
	PHASIANIDAE	
1	Snow partridge	*Lerwa lerwa*
2	Himalayan snowcock	*Tetraogallus himalayensis*
3	Chukar	*Alectoris chukar*
4	Black francolin	*Francolinus francolinus*
5	Hill partridge	*Arborophila torqueola*
6	Western tragopan	*Tragopan melanocephalus*
7	Koklass pheasant	*Pucrasia macrolopha*
8	Himalayan monal	*Lophophorus impejanus*
9	Kalij pheasant	*Lophura leucomelanos*
10	Cheer pheasant	*Catreus wallichii*
11	Common peafowl	*Pavo cristatus*
	PICIDAE	
12	Speckled piculet	*Picumnus innominatus*
13	Brown-fronted woodpecker	*Dendrocopos auriceps*
14	Himalayan woodpecker	*Dendrocopos himalayensis*
15	Scaly-bellied woodpecker	*Picus squamatus*
16	Grey-headed woodpecker	*Picus canus*
17	Great Barbet	*Megalaima virens*
	UPUPIDAE	
18	Eurasian hoopoe	*Upupa epops*
	HALCYONIDAE	
19	White-throated kingfisher	*Halcyon smyrnensis*
	CERYLIDAE	
20	Crested kingfisher	*Megaceryle lugubris*
	CUCULIDAE	
21	Pied cuckoo	*Oxylophus jacobinus*
22	Large hawk-cuckoo	*Cuculus sparverioides*
23	Indian cuckoo	*Cuculus micropterus*
24	Common cuckoo	*Cuculus canorus*

	ACCIPITRIDAE	
24	Common cuckoo	*Cuculus canorus*
25	Oriental cuckoo	*Cuculus saturatus*
	PSITTACULIDAE	
26	Rose-ringed parakeet	*Psittacula krameri*
27	Slaty-headed parakeet	*Psittacula himalayana*
28	Plum-headed parakeet	*Psittacula cyanocephala*
	APODIDAE	
29	Himalayan swiftlet	*Collocalia brevirostris*
30	White-throated needletail	*Hirundapus caudacutus*
31	Fork-tailed swift	*Apus pacificus*
	STRIGIDAE	
32	Mountain scops-owl	*Otus spilocephalus*
33	Rock eagle-owl	*Bubo bengalensis*
34	Tawny owl	*Strix aluco*
35	Collared owlet	*Glaucidium brodiei*
36	Brown wood owl	*Strix leptogrammica*
37	Short-eared owl	*Asio flammeus*
	CAPRIMULGIDAE	
38	Grey nightjar	*Caprimulgus indicus*
	COLUMBIDAE	
39	Rock pigeon	*Columba livia*
40	Snow pigeon	*Columba leuconota*
41	Speckeld wood-pigeon	*Columba hodgsonii*
42	Wedge-tailed green-pigeon	*Treron sphenura*
43	Oriental turtle-dove	*Streptopelia orientalis*
44	Eurasian collared-dove	*Streptopelia decaocto*
	SCOLOPACIDAE	
45	Eurasian woodcock	*Scolopax rusticola*
46	Solitary snipe	*Gallinago solitaria*

55	Golden eagle	*Aquila chrysaetos*
56	Booted eagle	*Hieraaetus pennatus*
	FALCONIDAE	
57	Eurasian hobby	*Falco subbuteo*
58	Common kestrel	*Falco tinnunculus*
	CORVIDAE	
59	Eurasian jay	*Garrulus glandarius*
60	Black-throated jay	*Garrulus lanceolatus*
61	Yellow-billed blue-magpie	*Urocissa flavirostris*
62	Red-billed blue-magpie	*Urocissa erythrorhyncha*
63	Grey treepie	*Dendrocitta formosae*
64	Spotted nutcracker	*Nucifraga caryocatactes*
65	Red-billed chough	*Pyrrhocorax pyrrhocorax*
66	Yellow-billed chough	*Pyrrhocorax graculus*
67	Large-billed crow	*Corvus macrorhynchos*
68	Common raven	*Corvus corax*
69	Eurasian golden-oriole	*Oriolus oriolus*
70	Black-hooded oriole	*Oriolus xanthornus*
71	Long-tailed minivet	*Pericrocotus ethologus*
72	Yellow-bellied fantail	*Rhipidura hypoxantha*
73	White-throated fantail	*Rhipidura albicollis*
74	Black drongo	*Dicrurus macrocercus*
75	Ashy drongo	*Dicrurus leucophaeus*
76	Asian paradise-flycatcher	*Terpsiphone paradisi*
	CINCLIDAE	
77	Brown dipper	*Cinclus pallasii*
	MUSCICAPIDAE	
78	Chestnut-bellied rock-thrush	*Monticola rufiventris*
79	Blue rock-thrush	*Monticola solitarius*
80	Blue-whistling thrush	*Myiophonus caeruleus*
81	Plain-backed thrush	*Zoothera mollissima*
82	Scaly thrush	*Zoothera dauma*

83	Long-billed thrush	*Zoothera monticola*
84	White-collared blackbird	*Turdus albocinctus*
85	Grey-winged blackbird	*Turdus boulboul*
86	Eurasian blackbird	*Turdus merula*
87	Chestnut thrush	*Turdus rubrocanus*
88	Mistle thrush	*Turdus viscivorus*
89	White-browed shortwing	*Brachypteryx montana*
90	Dark-sided flycatcher	*Muscicapa sibirica*
91	Asian brown flycatcher	*Muscicapa dauurica*
92	Rusty-tailed flycatcher	*Muscicapa ruficauda*
93	Rufous-gorgeted flycatcher	*Ficedula strophiata*
94	Little-pied flycatcher	*Ficedula westermanni*
95	Ultramarine flycatcher	*Ficedula superciliaris*
96	Slaty-blue flycatcher	*Ficedula tricolor*
97	Verditer flycatcher	*Eumyias thalassina*
98	Rufous-bellied niltava	*Niltava sundara*
99	Small niltava	*Niltava macgrigoriae*
100	Blue-throated flycatcher	*Cyornis rubeculoides*
101	Grey-headed canary-flycatcher	*Culicicapa ceylonensis*
102	White-tailed rubythroat	*Luscinia pectoralis*
103	Orange-flanked bush-robin	*Tarsiger cyanurus*
104	Golden bush-robin	*Tarsiger chrysaeus*
105	Blue-capped redstart	*Phoenicurus caeruleocephalus*
106	Black redstart	*Phoenicurus ochruros*
107	Blue-fronted redstart	*Phoenicurus frontalis*
108	White-capped water-redstart	*Chaimarrornis leucocephalus*
109	Plumbeous water-redstart	*Rhyacornis fulginosus*
110	Grandala	*Grandala coelicolor*
111	Little forktail	*Enicurus scouleri*
112	Spotted forktail	*Enicurus maculatus*
113	Common stonechat	*Saxicola torquata*
114	Grey bushchat	*Saxicola ferrea*

STURNIDAE

115	Common myna	*Acridotheres tristis*
116	Jungle myna	*Acridotheres fuscus*

SITTIDAE

117	White-tailed nuthatch	*Sitta himalayensis*
118	White-cheeked nuthatch	*Sitta leucopsis*
119	Wallcreeper	*Tichodroma muraria*

CERTHIIDAE

120	Eurasian treecreeper	*Certhia familiaris*
121	Bar-tailed treecreeper	*Certhia himalayana*
122	Winter wren	*Troglodytes troglodytes*

PARIDAE

123	Fire-capped tit	*Cephalopyrus flammiceps*
124	Rufous-naped tit	*Parus rufonuchalis*
125	Rufous-vented tit	*Parus rubidiventris*
126	Spot-winged tit	*Parus melanolophus*
127	Grey-crested tit	*Parus dichrous*
128	Great tit	*Parus major*
129	Green-backed tit	*Parus monticolus*
130	Black-lored tit	*Parus xanthogenys*
131	Yellow-browed tit	*Sylviparus modestus*

AEGITHALIDAE

132	Black-throated tit	*Aegithalos concinnus*
133	White-throated tit	*Aegithalos niveogularis*
134	White-cheeked tit	*Aegithalos leucogenys*

HIRUNDINIDAE

135	Red-rumped swallow	*Hirundo daurica*
136	Barn swallow	*Hirundo rustica*
137	House martin	*Delichon sp.*

	REGULIDAE	
138	Goldcrest	*Regulus regulus*
	PYCNONOTIDAE	
139	Himalayan bulbul	*Pycnonotus leucogenys*
140	Black bulbul	*Hypsipetes leucocephalus*
	CISTICOLIDAE	
141	Striated prinia	*Prinia criniger*
	ZOSTEROPIDAE	
142	Oriental white-eye	*Zosterops palpebrosus*
	SYLVIIDAE	
143	Chestnut-headed tesia	*Tesia castaneocoronata*
144	Brownish-flanked bush-warbler	*Cettia fortipes*
145	Grey-sided bush-warbler	*Cettia brunnifrons*
146	Eurasian chiffchaff	*Phylloscopus collybita*
147	Tickell's leaf warbler	*Phylloscopus affinis*
148	Buff-barred warbler	*Phylloscopus pulcher*
149	Ashy-throated warbler	*Phylloscopus maculipennis*
150	Lemon-rumped warbler	*Phylloscopus chloronotus*
151	Hume's warbler	*Phylloscopus humei*
152	Greenish warbler	*Phylloscopus trochiloides*
153	Western crowned-warbler	*Phylloscopus occipitalis*
154	Blyth's leaf-warbler	*Phylloscopus reguloides*
155	Golden-spectacled warbler	*Seicercus burkii*
156	Grey-hooded warbler	*Seicercus xanthoschistos*
157	White-throated laughingthrush	*Garrulax albogularis*
158	Striated laughingthrush	*Garrulax striatus*
159	Streaked laughingthrush	*Garrulax lineatus*
160	Variegated laughingthrush	*Garrulax variegatus*
161	Chestnut-crowned laughingthrush	*Garrulax erythrocephalus*
162	Rusty-cheeked scimitar-babbler	*Pomatorhinus erythrogenys*
163	Scaly-breasted wren-babbler	*Pnoepyga albiventer*

164	Black-chinned babbler	*Stachyris pyrrhops*
165	White-browed shrike-babbler	*Pteruthius flaviscapis*
166	Green shrike-babbler	*Pteruthius xanthochlorus*
167	Chestnut-tailed minla	*Minla strigula*
168	White-browed fulvetta	*Alcippe vinipectus*
169	Rufous sibia	*Heterophasia capistrata*
170	Whiskered yuhina	*Yuhina flavicollis*
	NECTARINIIDAE	
171	Fire-breasted flowerpecker	*Dicaeum ignipectus*
172	Purple sunbird	*Nectarinia asiatica*
173	Crimson sunbird	*Aethopyga siparaja*
174	Mrs Gould's sunbird	*Aethopyga gouldiae*
	PASSERIDAE	
175	House sparrow	*Passer domesticus*
176	Eurasian tree sparrow	*Passer montanus*
177	Russet sparrow	*Passer rutilans*
178	White wagtail	*Motacilla alba*
179	Grey wagtail	*Motacilla cinerea*
180	Tree pipit	*Anthus trivialis*
181	Olive-backed pipit	*Anthus hodgsoni*
182	Rosy pipit	*Anthus roseatus*
183	Upland pipit	*Anthus sylvanus*
184	Rufous-streaked accentor	*Prunella himalayana*
185	Rufous-breasted accentor	*Prunella strophiata*
186	Scaly-breasted munia	*Lonchura punctulata*
	FRINGILLIDAE	
187	Fire-fronted serin	*Serinus pusillus*
188	Yellow-breasted greenfinch	*Carduelis spinoides*
189	European goldfinch	*Carduelis carduelis*
190	Plain mountain-finch	*Leucosticte nemoricola*
191	Spectacled finch	*Callacanthis burtoni*
192	Dark-breasted rosefinch	*Carpodacus nipalensis*

193	Common rosefinch	*Carpodacus erythrinus*
194	Pink-browed rosefinch	*Carpodacus rodochrous*
195	Red crossbill	*Loxia curvirostra*
196	Brown bullfinch	*Pyrrhula nipalensis*
197	Orange bullfinch	*Pyrrhula aurantiaca*
198	Red-headed bullfinch	*Pyrrhula erythrocephala*
199	Black-and-yellow grosbeak	*Mycerobas icterioides*
200	Collared grosbeak	*Mycerobas affinis*
201	Spot-winged grosbeak	*Mycerobas melanozanthos*
202	White-winged grosbeak	*Mycerobas carnipes*
203	Rock bunting	*Emberiza cia*

APPENDIX II - Data sheet for encounter rate

Area (Valley): Trail Name:

Starting Time: Observer:

Finishing Time: Weather:

S.No.	Date	Species	Number				Remarks
			Male	Female	Sub adult/ Chicks	Unknown	

APPENDIX III - Data sheet for call count

Area (Valley):

Trail Name:

Calling Station No.:

Observer:

Starting Time:

Finishing Time:

Weather: