CHAPTER 1

INTRODUCTION

1.1 Background

Galliformes is a group of birds, which are popularly known as "Game birds" and have formed a valuable food resource for man from ancient times. Birds belonging to this group are terrestrial in habit with stout unfeathered legs usually with spurs. Majority of these birds are ground nesting with nidifugous young. Pheasants, partridges, quails, megapodes, cracids, turkeys, grouse and guinea fowls belong to this group of birds. Pheasants are a group of terrestrial birds with a plump body, short stout bill, short, rounded wings and short or very long tail. The plumage in the male of most pheasants is striking while the females are cryptic. Facial adornments in the form of crests, wattles, ruffs and hackles are present in pheasant males. Many of the pheasant species have been kept in captivity because of their spectacular plumage patterns (males) and have also been considered as "ornamental" birds.

1.1.1 Taxonomy: One of the earliest to attempt taxonomy of this group was Beebe (1914a) who used the sequence of moulting in the retrices (tail feathers) as the main criterion of generic groupings. According to this criterion *Ithaginis* (Blood Pheasants) and *Tragopan* (Tragopan pheasants) along with partridge like species were included in the subfamily Perdicinae (centrifugal moulting pattern) while the typical pheasants were included in Phasianinae (centripetal moulting pattern). The typical peafowls (moulting beginning from the second retrices from the outermost, with outermost moulting before the inner ones) and Peacock and Argus pheasants (moulting beginning with third from central and proceeding outward and inwards

simultaneously) were exceptions to this and were placed in the group Pavoninae and Argusianinae respectively. Peters (1934) included all the Old World partridges, their relatives and the typical pheasants in the subfamily Phasianinae. Delacour (1977) included the New World quails also in the subfamily Phasianinae and though he found *Ithaginis* and *Tragopan* related to the partridges he considered them sufficiently pheasant-like. Verheyen (1956) proposed a new classification based on measurements of the skeleton. According to his classification the pheasants were included in three subfamilies - Phasianinae which included most of the pheasant like species, Afropavoninae which included the Congo Peafowl and Pavoninae which included the peafowls. Wetmore (1960) placed pheasants as a separate family Phasianidae under the superfamily Phasianoidea. Sibley and Ahlquist (1972) suggested the typical pheasants to be included in a separate subfamily Phasianinae. Johnsgard (1973, 1986) classified pheasants as a separate subfamily Phasianinae under the broad family Phasianidae. This subfamily was further classified into the tribe Phasianini that included the pheasants exclusively. Wolters (1975-1982) considered the guinea fowl to be one of the 15 subfamilies of the family Phasianidae and proposed that the typical pheasants be divided into eight separate subfamilies. This is the most widely used form of classification of pheasants. More recently Sibley and Monroe (1990) classified the pheasants and the Old World partridge, quail and francolin species under family Phasianidae.

Sixteen genera (Delacour 1977) and 51 species (69 taxa) of pheasants are known to science and out of these 50 species are endemic to Asia (McGowan and Garson 1995). Only one species, the Congo Peafowl, *Afropavo congensis* is native to Zaire in Central Africa (Crowe *et al.* 1986). Several species of native pheasants have

been introduced to various parts of Europe and USA and the globally distributed domestic fowl, is believed to be derived from the Red Jungle Fowl, *Gallus gallus* (Wood-Gush 1959). Silver Pheasant, *Lophura nycthemerus* and Golden Pheasant, *Chrysolophus pictus* were introduced around 1865 and 1932 respectively by captive breeding in a farm and released in Kuar Islands between 1907 and 1914. The Lady Amherst Pheasant, *Chrysolophus amherstiae* was released in Ohau, Hawaii in 1933. However all these species failed to survive (Caum 1933). One of the most common and wide spread pheasant introduced in Europe and North America is the Chinese Ring-necked pheasant, *Phasianus colchicus*.

In Asia, pheasants are distributed from Indonesia at 8° S through to northeastern China at 50° N and from 45° E in the Caucasus to 145° E in Japan. Along their distribution pheasants are found in diverse habitats like lowland tropical forests (Mountain Peacock Pheasant, *Polyplectron inopinatum*), temperate coniferous forests (Western Tragopan, *Tragopan melanocephalus*), subalpine scrub (Blood Pheasant, *Ithaginis cruentus*), alpine meadows (Chinese Monal, *Lophophorus lhuysii*), montane grass scrub (Cheer Pheasant, *Catreus wallichii*), broad-leaved evergreen forests (Kaleej Pheasant, *Lophura* spp. and Koklass Pheasant, *Pucrasia macrolopha*) to name a few.

According to McGowan and Garson (1995), there is very little basic ecological information available on 47 taxa (68%) of pheasants. Most of the pheasant distribution areas in Asia are remote and inaccessible and most of the species are secretive and silent often rendering surveys a time and labour intensive exercise. Even the most vocal species show strong seasonal fluctuation and cannot be easily

detected. Of the 69 taxa of pheasants 4 (6%) are critically endangered with extinction, 16 (23%) are endangered, 24 (35%) are Vulnerable, 19 (27%) are categorised as safe from extinction and 6 (9%) are considered to be insufficiently known to be assigned a threat category (Fig1.1). Threats that affect most pheasants along their distribution range are in the form of habitat loss and fragmentation, poaching for food sport and trade, hybridisation and use of pesticides.

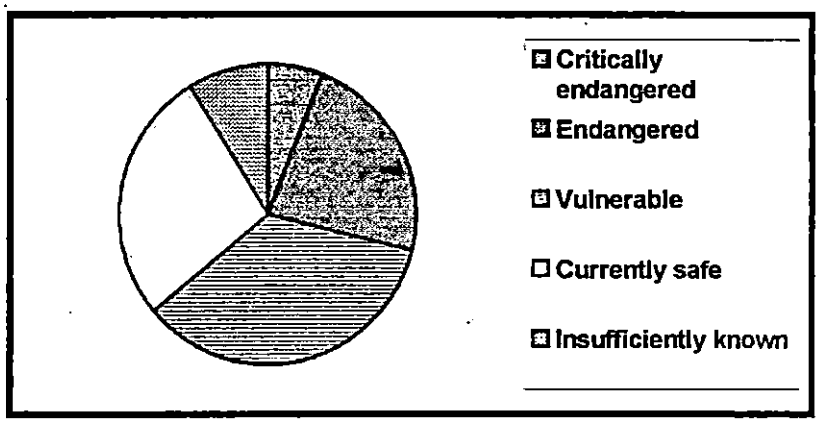

Fig. 1.1 Showing the threat categories of 69 pheasant taxa

Of the 51 species of pheasants 17 species occur in India. These are mentioned below. Adjacent to each species their threat categories are given in parenthesis.

a. Blood Pheasants (Safe): A single species *Ithaginis cruentus* and three subspecies represent this group. The *I.c. affinis* is distributed in Sikkim, *I.c. tibetanus* in central Arunachal Pradesh and *the I. c. kuseri* in central to eastern Arunachal Pradesh.

b. Tragopan pheasants (Endangered and Vulnerable): These include four species, the Western Tragopan,*Tragopan melanocephalus* distributed in the western Himalaya, Satyr Tragopan, distributed in Garhwal, Kumaun, Darjeeling hills, Sikkim and Arunachal Pradesh, Blyth's Tragopan, *T. blythii blythii* distributed in Assam, Mizoram and Manipur and Temmick's Tragopan, *T. temmickii* distributed in Arunachal Pradesh.

c. Koklass Pheasants (Safe): These are found in the western Himalaya and are represented by a single species - *Pucrasia macrolopha* and two subspecies. The Kashmir Koklass, *P.m. biddulphi* is found in northern Kashmir and Himachal Pradesh while the Common Koklass, *P.m. macrolopha* is found from southern Kashmir to Garhwal.

d. Monal Pheasants (Safe): This group of pheasants is represented by two species, the Himalayan Monal, *Lophophorus impejanus* found along the Himalaya from west to the east and the endangered Sclater's Monal, *L. sclateri* found in the northern fringes of Arunachal Pradesh.

e. Jungle Fowls (Safe): Are represented by two species. The Red Jungle Fowl, *Gallus gallus* is represented by two subspecies, the Indian Red Jungle Fowl, *G.g. murghi* which is found along the Himalayan foothills and up to 2000m from Kashmir to Arunachal Pradesh and southwards in parts of Uttar Pradesh, Madhya Pradesh, Bihar, Orissa, West Bengal and Assam. The other subspecies, Burmese Red Jungle Fowl, *G.g. spadicus* is confined to eastern Mishmi hills in Arunachal Pradesh. The Grey Jungle Fowl, *G. sonnerati* found in peninsular India which

includes southern Rajasthan, Madhya Pradesh, Gujrat, Maharashtra, Tamil Nadu and Kerala represents the second species of Jungle Fowl found in India.

f. Kaleej Pheasants (Safe): This is represented by one species, *Lophura leucomelana* and four subspecies - White Crested Kaleej Pheasant, *L. l. hamiltonii* found in the western Himalaya, Blackbacked Kaleej Pheasant, *L.l. melanota* found in east-central Himalaya, Blackbreasted Kaleej Pheasant, *L. l. lathami* found in Arunachal Pradesh, hills adjoining Myanmar and Manipur and William's Kaleej Pheasant, *L.l. williamsi* distributed in southeast Manipur and hills of Mizoram contiguous with the Chin hills of Myanmar.

g. Eared-pheasants (Endangered): In India this genus of pheasants is represented by the endangered Tibetan Eared-pheasant, *Crossoptilon harmani* found in northern areas of Arunachal Pradesh.

h. Cheer Pheasant (Vulnerable): *Catreus wallichii* is the only representative of its genus and is distributed in the Himalaya from Kashmir through Garhwal to Kumaun in India.

i. Hume's Pheasant (Endangered): This is represented by a single subspecies, *Symatricus humiae humiae* distributed in Manipur, Patkai, Naga and Mizo hills of northeast India.

i. Peacock Pheasants (Safe): This group is represented by a single species, the Bhutan Peacock Pheasant, *Polyplectron bicalcaratum bakeri* distributed in Sikkim,

North Bengal, Arunachal Pradesh, Assam, Manipur and Nagaland. There is a possibility of the occurrence of another subspecies of Peacock Pheasant, the Burmese Peacock Pheasant, *P.b. bicalcaratum* in southern Mizoram adjoining the Chittagong hill tracts of Bangladesh.

j. Peafowls (Safe and Endangered):There are two species of peafowls in India. The common Indian Peafowl, *Pavo cristatus* distributed up to 1800m throughout the country and the rare and endangered Green Peafowl, *Pavo muticus spicifer* is suspected to be distributed in the areas lying adjacent to southeastern Bangladesh.

Tragopan or horned pheasants are medium sized montane pheasants in which the sexes are highly dimorphic. Five species and four subspecies are recognised in the genus *Tragopan* all ~~of-that-are~~ endemic to south Asia. Four species of Tragopan pheasants occurring in India have been mentioned in the preceding pages and the fifth species is the Cabot's Tragopan with two subspecies, *T caboti caboti* and *T. c. guangxiensis* which are endemic to China.

The males of Tragopan pheasants have strikingly bright plumage colours with a red or black head and colourful face and lappet. The body is red or crimson with spots and ocelli on the back, breast and wings. The female plumage is comparatively dull with colours like brown, creamy buff and rufous predominant (Johnsgard 1986). In the Satyr Tragopan male, the face and throat are thinly feathered. The general plumage pattern according to Finn (1911) is "rich red on the neck and below and mottled black and brown above with round white spots edged with black all over. The head and tail are black with the tail having a black band. The bend of the wing

is red with red patches on the mottled brown plumage of the rest of the wing and rump. The bill is blackish brown, the horns sky-blue, skin of face and throat rich deep blue, the bib blue, with large red lateral spots when expanded, the eyes are dark and the legs are flesh coloured". The female Satyr Tragopan is rich brown, with paler underparts grizzled and mixed with black and buff. The beak is dark horn-colour and the legs are fleshy grey. Plumage colour in young birds is similar to the females but distinctly streaked with buff. Male Satyr Tragopan weighs from 1600-2100 g (Ali and Ripley 1978) and has a wingspan of 245-285 mm and a tail of 250-345 mm. The females weigh 1000 - 1200 g (Ali and Ripley 1978) and have a wingspan of 215-235 mm and a tail of 195 mm.

The Tragopan pheasants are distributed from Indus Kohistan in Pakistan through the Himalayas in India, Nepal and Bhutan to Hunan in the Yunan Province in eastern China. The Western Tragopan is found in oak and coniferous forests or moist/dry forests (Johnsgard 1986, Islam and Crawford 1987) at 2000 - 3600m. Satyr Tragopan is known to inhabit oak- rhododendron or mixed broad-leaved forests with dense ringal understorey (Lelliott and Yonzon 1980, Young and Kaul 1987, Inskipp and Inskipp 1993a & b, Kaul *et al.* 1995). Blyth's Tragopan is found in Rhododendron forest at 2400-2600m with dense undergrowth of ringal bamboo and ferns (Ali *et al.* 1973 in press). The Temmick's Tragopan is known to occur in evergreen or deciduous broad-leaved mixed forests at 1600 - 2700m (Li Xiangtao and Lu Xiaoyi 1989) whereas the eastern most species the Cabot's Tragopan is found to inhabit evergreen broad-leaved forests at 800- 1400m (Young *et al.* 1991). Males of the genus *Tragopan* are vocal particularly during the breeding season in which they give out a very distinctive advertisement or breeding call (Johnsgard

1986, Islam and Crawford 1996). This call has been used effectively to count the species in their habitat ((Lelliott and Yonzon 1980, Sharma and Panday 1989, Duke 1990, Kaul *et al.* 1995, Ghose 1997, Kaul 1998).

Out of the five species of Tragopan pheasants four are considered threatened in their respective distribution range. The Temmick's Tragopan is considered safe, the Satyr, Western and Cabot's Tragopan as 'Vulnerable' species and the Blyth's as 'Endangered' according to the Mace-Lande threat categories (McGowan and Garson 1995). Except for the Cabot's Tragopan the other four Tragopan pheasants are distributed along the Himalayas in Pakistan, India, Nepal and Bhutan. Of the four Tragopan pheasants found in India, the Western Tragopan is restricted to the western Himalaya, the Satyr Tragopan is an east-central species while the Blyth's Tragopan and the Temmick's Tragopan are strictly eastern in their distribution. In the eastern Himalaya the range of the Satyr Tragopan and the Temmick's Tragopan are suspected to overlap and may form a sympatric population in certain areas. Very little is known about the ecology of Tragopan pheasants. Most of the attempted studies on this genus have provided sketchy accounts of the species probably as a result of difficulties imposed by remote areas of their distribution and the rugged terrain inhabited by them while their shy and elusive nature compounds this problem.

All along their distribution in the Himalaya the Tragopan pheasants have been closely associated with the local human population. They are much admired for their aesthetic value and form an integral part of the culture (Nepal, Himachal Pradesh, Pakistan), in some parts of their distribution they are protected for

religious reasons (Bhutan) whereas they are also hunted for meat in most areas. Over the last century the increase in human population has put severe pressures on our natural resources. This increased consumption has resulted in severe threats to the survival of most of these pheasant species. One of the main threats is habitat destruction and fragmentation through deforestation, conversion of land for agricultural purposes, excessive livestock grazing and firewood and fodder collection. It has also been suggested that removal of medicinal plants especially in Western Himalaya might have serious consequences on the Western Tragopan populations (Garson and Gaston 1992). Tragopan pheasants are also threatened by poaching for meat, sport and sale.

1.2 Literature Review

1.2.1 Overview of pheasant studies in Europe and America:

The Chinese Ring-necked Pheasant or the common pheasant, *Phasianus colchicus* is the most common gamebird in Britain and breeds in every county (Sharrock 1976). It is an introduced species, which has been resident since at least the eleventh century (Yapp 1983) in Britain. Although attempts to introduce pheasants in America were not successful in the initial years of introduction, by 1900 the pheasant had spread over most of United States of America. By 1920 with the increase in the rates of stocking and release, hunting of pheasants as game became a common activity (Mctee 1945, Allen 1956 in Warner and Eatter 1986). In Britain the bird is widely hunted for sport and to ensure high densities for shooting, a large number of hand reared birds are released each summer (Hill and Robertson 1988, Robertson and Dowell (1990). With the establishment of introduced pheasants in

Europe and America studies on almost all aspects of the Ring - necked Pheasant ecology and behaviour have been conducted over the years with over 600 references of published papers available on the species (Carroll 1988).

1.2.1.1 Habitat and cover use: Gates and Hale (1974) using radio collars studied distribution patterns of Wisconsin Pheasants during winter. Since high mortality was reported in winter the studies made recommendations for winter management of the pheasants. Habitat studies by Guthery and Whitesade (1984) revealed that the Ring-necked Pheasant used reed fringed wetland scrub in America when woodlands were absent. Robertson (1985) studied the winter habitat use of the Common Pheasant in Ireland and found that scrub land and woodland with scrub underlayer were selected. Woods with bare grassy under layer; hedge-groves or open fields were avoided. There was differential habitat selection among male and female birds. Hill and Robertson (1988b) observed that the Common Pheasant showed seasonal variation in habitat use. Woodlands were used extensively during winter and the birds moved out into growing crops during spring and summer. Ditches and dykes were used in treeless farmland. The females in southern Wisconsin preferred food patches and brush and avoided pastures and croplands (Gatti *et al.* 1989). In southern Idaho Common Pheasants preferred sagebrush, wetland and herbaceous cover types to grassland as their winter habitat in agricultural cover types (Leptich 1992). Robertson *et al.* (1993) studied the winter density of the Common Pheasant in the U.K. Woodlands with a high proportion of shrubby cover and the provision of supplementary food were associated with high pheasant densities.

1.2.1.2 Cover: Alfalfa was the most extensively used cover during night and day in all months by Common Pheasants in east central Dakota (Hanson and Progulske 1973). Warner (1979) also studied the use of cover by pheasant broods in eastcentral Illinois and found that broods roosted mostly in oats and hay. Use of cover did not change in response to weather conditions but appeared to be more of a function of brood age than of crop phenology or harvest. Snyder (1984) in his studies on the nesting ecology of pheasants in northeastern Colorado found that winter wheat and post harvest stubble were the dominant nesting cover in spring. The height and density of this cover was affected by the amount of precipitation accumulated in the soil. In their studies on the use of cover types by Common Pheasant broods in Oregon (Myers *et al.* 1988) observed that the survival of broods was related to cover types and in some cover types survival was a function of the age of the brood.

1.2.1.3 Population studies: Errington and Hammerstrom (1937) studied the nesting losses and juvenile mortality of Ring-necked Pheasants, while Green (1938) analysed the importance of food and cover relationships in the winter survival of pheasants in northern Iowa. Eklund (1942) studied the mortality factors affecting the nesting of pheasants in the Willamette Valley while Bach (1944) studied the population fluctuations of pheasants in North Dakota. Arnold (1951) worked on red fox predation of ring-necked pheasants, Buss *et al.* (1952) assessed the significance of adult pheasant mortalities in spring to autumn while Gondahl (1953) studied winter behaviour of pheasants with relation to winter cover in Winnebago country. Blouch (1955) analysed the factors affecting pheasant populations in Michigan.

Comprehensive studies were conducted on the population ecology of Wisconsin pheasants between 1946-1961 (Wagner *et al.*1965). Highest pheasant densities occurred in areas with 55-70% cultivated land and showed progressive decline in areas where either more or less than 55 - 70% land was cultivated. Population trends of pheasants were monitored throughout the year and the fluctuations were attributed to winter chick survival. Dumke and Pils (1973) used radio telemetry to study the mortality of pheasants and found that the maximum mortality occurred in winter when predation was highest. Gates and Hale (1974) studied the reproduction of Ring-necked Pheasant in central Wisconsin and found that harvesting operations were principally responsible for mortality of pheasants. Chicks from earlier season, which were older, were less vulnerable to mowing. Wollard *et al.* (1977) attributed the limited growth of a released population of South Korean pheasants, *Phasianus colchicus karpowi* in Missouri to the lack of suitable nesting cover. Dumke and Pils (1979) studied the renesting dynamics of pheasants in Wisconsin. Establishment of 31% nests was successful while 69% were disrupted. Of this 68% renested but 71% of the second clutches were terminated. 41% of females renested and produced 40% of the broods. Warner (1981) reviewed the population, ecology and distribution of pheasants in Illinois from 1900-1978. Greater population densities were attributed to high winter cover and more hay and small grain fields. Except for some areas there was a general decline in the population and for management purposes he suggested that efforts be directed towards establishment of habitat for nesting, brood foraging and improvement of habitat on agricultural lands.

1.2.1.4 Breeding: Hill and Robertson (1986) found that pheasants were polygamous with a harem size of 2.4±0.4 hens. Similar results have been obtained from Ireland

(Robertson 1986), Sweden (Goransson 1980) and America (Trautman 1982). In New Zealand the average number of hens per cock were just over one (Westerskov 1956). Koubek and Kubista (1990) studied the daily activity pattern of lekking pheasant males in Europe. The peak sexual behaviour occurred in the first ten days of April after which there was a distinct decline in May. Feeding and walking were the only behaviour that showed peak daily activity. Koubek and Kubista (1990) observed that in southern Moravia (Czechoslovakia) male *P.colchicus* preferred territories with activity centers having cover while open fields were avoided. Changes in the development of vegetation were proportionately reflected in the quality of individual pheasant territories (Koubek and Kubista 1991). Individual territories were divided into various activity centres. Male spacing, before females had initiated a clutch did not differ with male attractiveness and indicated that female choice might have affected the males' spacing behaviour (Grahn *et al.*1993). Ligon and Zwartjes (1995) tested the role of male plumage of Red Jungle Fowl in female mate choice. Though females discriminated between males, the plumage was not the target of female's attraction but males with larger combs were. Experiments and correlation data were used to investigate the role of male ornaments in male-male agonistic encounter (Mateos and Corranza 1997). Sexual selection traits did not have any effect. Head ornaments functioned as signals to rival males about readiness to fight, fighting ability and resource holding power. All the male-male conflict behaviourial traits were correlated with testosterone levels.

1.2.1.5 Feeding: Scwartz and Schwartz (1951) studied the food of an isolated population of Ring-necked pheasant in the Hawaiian Islands. From 191 crops and

gizzards, 152 food types of food items were recorded and graded according to their importance. Kopischke and Nelson (1966) in their studies in Minnesota and South Dakota observed that laying hens consumed about 50 percent more grit by weight than nonlaying hens and they could selectively pick calcium- and magnesium bearing grit. Hill (1985) studied the feeding ecology and survival of pheasant chicks on arable farmland. Arthropods in the diet of the chicks were found to be important for their survival. Moreby (1987 and 1992) described methods to identify arthropod fragments in the diet of game bird chicks through diagnostic parts specific to certain groups of arthropods.

1.2.1.6 Management: The end of the war brought a complete change in agricultural practices in the USA with the availability of more efficient machinery, better quality crop hybrids and commercial fertilisers. With better crop yields many agricultural areas or farmlands were converted to urban development areas. Such a change in land use pattern adversely affected the pheasant population as lower harvesting returns indicated. Changing land use especially increased cultivation was once again responsible, but this time for the expansion (Hallett 1987) of the breeding range of the Ring-necked Pheasant in Missouri to 22,000km^2 in 1986 (30% increase from 1947). Robertson *et al.* (1988) surveyed butterfly numbers in a woodland in southern England. Areas managed for pheasants recorded significantly higher number and species of butterflies than unmanaged areas. Their studies suggested that woodland management for pheasants could benefit many of the declining butterfly species. Robertson *et al.* (1993) studied the effect of land use in breeding pheasant density. Territorial male density was limited by habitat quality. By quantifying the effect of land use on breeding density it could be possible to

assess implications of future changes in land use. Their studies suggested that new woodland planting and management could increase the breeding pheasant density.

1.2.2 Overview of pheasant studies in Asia: In this section I have not touched upon work done in India as I have dealt with this in a separate section of the chapter. Generally very little is known about the distribution and ecology of pheasant species in Asia though the introduced Common Pheasant has been a subject of a large amount of research in Europe and North America. There have been a few intensive studies on pheasant species in China, Nepal, Malaysia, India and Pakistan but most of the available literature are on surveys and short term studies. British sportsmen or naturalists documented most of the work on pheasants in Asia in the nineteenth century. Some of them are Hodgson (1846), Wilson and Jerdon (in Jerdon 1877), Hume and Marshall (1879), Blandford (1898) and Osmaston (1935). Although they did not work on any pheasant species, their anecdotal accounts provided valuable information on the general distribution and habits of pheasants found in the subcontinent. Beebe's "Monograph of the pheasant" (1918-1922) was considered the classic book on pheasants as after that authors provided information on the pheasants based on that book (Baker 1935, Bates and Lowther, 1952, Ali and Ripley 1969, Delacour 1986).

1.2.2.1 Surveys and general habitat studies: Pheasant surveys in Pakistan (Mirza *et al.* 1978) recorded the presence of five species of pheasants. Attempts were made to locate the Cheer pheasants in west central Nepal (Lelliott 1980-81). Very few birds were seen or heard which according to their observations indicated its scarcity and shyness. The species was found at 2200-2440 m altitude in open scrubby

forests and cliffs at close proximity to human habitation. Duke (1989) conducted call count surveys of Western Tragopan at four sites in Pakistan Himalaya and recorded relative density estimates ranging from 28 -195 birds. Of these the mid-Palas contained the largest surviving population of Western Tragopan.

Islam and Crawford (1987) studied the habitat of Western Tragopan in Pakistan and observed very little consistency in the selection of major plant species association. The species selected shorter life forms and avoided taller vegetation and it was concluded that structural components influenced habitat use by Western Tragopan more than forest type or plant association. Hen Fen Qi (1988) studied the ecology of Chinese Monal and observed the species to inhabit alpine scrub, subalpine and alpine pastures and exposed rocky and cliffy mountainsides. Studies on the Elliot's Pheasant (Syrmaticus elliotii) in China (Ding Ping and Zhugo Yang 1989) recorded that the species occurred at 300-1500 m altitude and occupied shrubby zone in winter and early spring, mixed and coniferous forest in the breeding season and high mountain zone in autumn. McGowan *et al.* (1989) studied the habitat of Palawan Peacock Pheasant (Polyplectron emphanum), and its habitat pressures. The distribution of the species was determined by the level of human disturbance in its habitat because of which the species faced a bleak future due to habitat loss. Severinghaus and Severinghaus (1989) studied the ecology and behaviour of the Mikado (Syrmaticus mikado) and Swinhoe's (Lophura swinhoii) Pheasant in the Yushan National Park (Taiwan). Swinhoe's Pheasant occurred at 1000-2000 m in warm temperate zone in broad-leaved forests with gentle slopes while the Mikado Pheasant occurred at 1900-3800 m and inhabited cold temperate zones in coniferous and mixed forest on steep slopes. Though sympatric the two species were separated by distinct habitat characteristics. Young *et al.* (1991) observed that

during winter in southwestern China the Cabot's Tragopan used areas with thick undergrowth, a greater percentage of bare ground, proximity to water sources and a gentle slope. *Daphniphyllum macropodum* was an important food plant and roosting site for the species. Bland and Han Lixian (1992) studied the ecology of Lady Amherst Pheasant in China. Li Xiang Tao (1992) studied Brown-eared Pheasants in the Dongling Mountain area in China and found the species associated with broad-leaved and coniferous mixed forests at 1300-2200 m with a density of 1/km^2. The habitat was seriously under threat from changes due to agriculture. Malaysian Peacock Pheasant were found to be clustered and not evenly distributed in their available habitat in Peninsular Malaysia (McGowan 1994). These clusters were located in areas that were away from the river and more stable. Presence and absence of ground vegetation directly influenced the dispersion of display scrapes in the species. In another study in China the Brown Eared-Pheasant was found to inhabit broad-leaved and coniferous forests at 800-1800 m (Li Xiantao 1995). Temmick's Tragopan showed differential habitat use during different seasons (Ding Chang Quing and Zheng Guang-mei 1993, Shi Hai-tao *et al.* 1996). In summer they were associated with areas having good cover and abundant bushes. In autumn they affected broad-leaved mixed forest while in winter the range increased and they occurred in a variety of broad-leaved bamboo mixed forests.

1.2.2.2 Population studies: Chinese Monal were gregarious with changeable sex ratio. Population density estimate was found to be 1.5-2/km^2 and some birds of prey were its natural enemies (Heng Fen Qi 1988). Zhang Junping and Zheng Guang-Mei (1989) surveyed population structure and number of Cabot's Tragopan in Wuyanling Nature (China). Fifty birds were recorded with a density estimate of

7.1birds'km^{-2} and the sex ratio was almost equal. Population fluctuated through the season with the highest number observed in May and the least in winter. Li Xiangtao and Lu Xiaoyi (1989) in their studies on Temmick's Tragopan in winter found the male birds to be solitary or in family units of 2-5 birds. Studies on the Western Tragopan by Islam and Crawford (1992) found that sex ratios were biased towards the males at all study sites and they suggested 60:40 sex ratios as more appropriate than the equal one.

1.2.2.3 Breeding and Nesting: Nesting ecology of the Cabot's Tragopan in China (Zheng-Wang and Zheng Guang-mei 1989) revealed that the birds nested in forest edges on trees of *Pinus taiwanensis* with a clutch size of 2-6 eggs. Nest losses occurred due to predation, inclement weather conditions or collection of eggs by the locals. Of these 74% was attributed to predation (Eurasian Jay, Grey Tree Pie and small mammalian carnivores). Breeding in Hume's Pheasant (*Syrmaticus humiae*) occurred in February- June and nests were made on the ground with fairly dense cover (Liu Xiao Hua *et al.* 1989). Birds were reared exclusively by the female till July, accompanied by the cock up to early August when the males in the brood began to assume their adult plumage. Zhao Zhengjie (1989) studied the breeding ecology of the Ring-necked Pheasant in China. The species was found to inhabit low mountain plains in shrubs and grasses in natural secondary Oak Forest. Flocking occurred in autumn and winter while in spring and summer the pheasants were single or in pairs. Cock pheasants were territorial during the breeding season, which lasted from May-July. Nests were built on grassy or bushy ground with a clutch size of 10-19 eggs. Habitat destruction was one of the main threats to this species. Swinhoe's and Mikado Pheasants were generally solitary seen in pairs during the

breeding season or in family parties (Severinghaus and Severinghaus 1989). Li Xiantao (1995) studied the status of the Brown Eared Pheasant in the Dongling Mountain (China). The status of the species was found to be stable with low population density and poor breeding success. High rate of egg loss to predators and local people were the main cause responsible for decline in breeding success.

1.2.2.4 Diet: Davison (1981c) in his studies on the Crested Fireback Pheasant in Kuala Lompat (Malaysia) observed the majority of the birds in moist areas with abundant invertebrates. The diet of Cabot's Tragopan was primarily vegetarian and crop content consisted of 95% dry weight of fruits (Li Xiang Tao and Lu Xiang 1989). Studies on Hume's Pheasant (Liu Xiaohua *et al.* 1989) found the species to be ground foragers and primarily vegetarian in diet. The Ring-necked Pheasant in China was found to be mainly vegetarian in food habit, and vegetarian food comprised up to 83% of the crop and stomach contents of 42 birds (Zhao Zhengjie 1989).

1.2.3 Overview of Pheasant studies in India

Except for the works of Kaul (1989), Sharma (1990), Iqbal (1992) and Ahmed (1994) there has been no detailed work on any of the pheasant species in India. However numerous and short term studies on various aspects of the behaviour, ecology and distribution of pheasants have been conducted from time to time.

One of the first studies conducted on pheasants in India was the work of Collias and Collias (1967) near Dehradun on the vocalisations of Red Jungle Fowl. Their studies revealed that crowing was used by the dominant male to advertise territorial

rights and assert dominance. These studies suggested that the breeding behaviour and vocal repertoire of the Red Jungle Fowl in nature were similar to those of the domestic fowl and considered the Red Jungle Fowl to be its ancestor. In the 1980s there were a series of surveys in various locations, which contributed to the information about the distribution of pheasants in India. Bland (1980) made observations on gallinaceous birds in western and central Himalayas. Within Indian limits Western Tragopan were observed in Uttar Pradesh for the first time in nearly twenty years while Koklass were observed in plenty in Kulu (Himachal Pradesh). Gaston and Singh (1982) surveyed the Chail Sanctuary in Himachal Pradesh for Cheer Pheasants. 12 Cheer was sighted and nine pairs were located through calls. Birds were mainly seen on steep grassy slopes in areas scattered with trees and bushes. Lamba *et al.* (1982) censused pheasants in Kashmir and found the Monal and the Koklass Pheasants to be commonly distributed but were not able to locate the Western Tragopan and Cheer Pheasants in the valley. Gaston *et al* (1983a) carried out surveys in 1979 and 1980 in the Upper Beas Valley in Kulu district (Himachal Pradesh) and in some adjacent parts of Ravi and Sutlej Valleys and western most part of Yamuna catchment. Seven species of pheasants were reported and habitat destruction was identified as the most immediate threat to pheasants in the Western Himalayas. Gaston *et al.* (1983b) carried out wildlife and habitat surveys in the upper Ravi, Beas and Sutlej catchments of Himachal Pradesh. Five species of pheasants (Cheer, Monal, Koklas, Kaleej and Western Tragopan) were recorded. Altitudinal distribution for all species except Kaleej was broadly similar extending from lower part of the temperate zone to the subalpine forests. Hunting and habitat destruction were identified as the two main threats to wildlife in that area. Kaul (1986) surveyed the Limbar valley in Jammu and Kashmir, India and

recorded an area with a Western Tragopan population. Young and Kaul (1987) carried out surveys in Kumaun Himalayas and documented the presence, calls, habitat and distribution of five species of pheasants (Cheer, Koklass, White Crested Kaleej, Himalayan Monal and Satyr Tragopan). Young *et al.* (1987) studied the calling behaviour of Cheer Pheasant in the Almora district of Uttar Pradesh. Five types of calls were identified with long dawn choruses in April-May and though the chorus was shorter, they were most consistent in June. The results suggested that 'passive' transect surveys were best in late May-early June. Response to broadcast of calls was immediate before sunrise while response to broadcast later in the day or before dusk elicited short response. Bisht *et al.* (1989) studied the status and habitat utilisation of Monal Pheasant at four sites of Kedarnath Wildlife Sanctuary. Population of the species was found to be low in areas with substantial human interference. The pheasant used temperate forests, sub-alpine coniferous forests/scrub and alpine forests in the different seasons. Chandola-Saklani *et al.* (1989) investigated some behaviourial traits and seasonal movements of the White crested Kaleej Pheasant at three sites in Garhwal. There was a significant negative correlation emergence and day length and a positive correlation between return of the birds and day length. Female birds showed greater foraging activity and a decline in the feeding rate during the breeding season. Nine different populations of White Crested kaleej Pheasant were monitored in Garhwal Himalaya (Sharma and Chandola-Saklani 1993). Breeding in the species occurred from March - July with some variation in successive years. Surveys in the Shimla hills confirmed the occurrence of pheasants in 23 sites of Himachal Pradesh (Sharma and Panday 1989). Ahmed and Musavi (1992) estimated the density of White Crested Kaleej Pheasants to be 5 birds/km^2 and most of the birds (65%) were observed in scrub

vegetation in Ranikhet (Uttar Pradesh, India). Iqbal 1992 studied the patterns of habitat use by White Crested Kaleej Pheasant at two sites in the Himalaya. In Kumaun the birds were observed to prefer grassy openings and scrub while in Himachal Pradesh the species showed preferences for oak and chirpine mixed forest and avoided terraced and open pastures. Garson *et al.* (1992) studied the ecology and conservation of the Cheer Pheasant in Kumaun Himalaya. These studies described how the stock and land management systems had a number of features that maintained the Cheer habitat throughout the year. Habitat preference studies on the Red Jungle Fowl in Kaleswar Reserve in Haryana (Kalsi 1992) revealed that the species preferred mixed forests with cultivation to Sal and mixed forest. Pheasant surveys conducted in the upper Beas Valley recorded six species of pheasant (Panday 1992). Cheer Pheasants were confirmed at ten new sites, White Crested Kaleej Pheasant at nine sites, Monal and Koklass Pheasant were seen at six sites each while Western Tragopan, Red Jungle Fowl and Peafowl were recorded from two sites each. Human interference occurred in all the protected areas of this valley. Preliminary surveys of the Western Tragopan in Daranghati Sanctuary (Himachal Pradesh, India) by Panday (1992) recorded a density of 1.5 birds'km^2 in their winter habitat. Sathyakumar *et al.* (1992) studied the abundance and habitat of Kaleej and Monal Pheasants in Kedarnath Wildlife Sanctuary. 16/17 pairs/km^2 and 10-16 pairs /km^2 of Kaleej and Monal Pheasants were estimated in the study area. Kaleej pheasants inhabited temperate forests at 1600 - 2000 m altitude in north, northeastern and eastern aspects while the Monal Pheasant were found in subalpine forests at 2600-3300 m in south, southeastern and southwestern slopes. The main threats to the pheasants were poaching, habitat destruction by grazing, collection of bamboo and litter and forest fire. Western Tragopan were searched for and

observed at six localities in Himachal Pradesh (Narang 1992). The species was distributed in 2700-3300 m altitudinal range in the upper half of the temperate belt. Distance to habitat in the form of grazing, collection of forest produce, timber distribution, clearing for cultivation up to tree line and poaching were some of the threats to the Western Tragopan. Though extremely common there are very few studies have been conducted on the peafowl. Sathyanarayana and Veeramani (1992) observed the Peafowl to use eight species of trees as roosting sites. 78.4% of the birds used *Acacia sundra* for roosting and most of the birds roosted at a height of 16 - 33 m above the ground. Yasmin (1995) studied the roosting behaviour of Blue Peafowl in India. Peafowls used trees with greater heights, girths and heights of first branch. Analysis of roost sites in relation to availability revealed that *Dalbergia sisso* was the most preferred tree species for roosting. Ghose (1997) studied the ecology of Blyth's Tragopan in the Blue Mountain National Park (Mizoram, India). The species was found to inhabit the cliff side vegetation with less tree, shrub and ground cover. Four pairs of birds were heard during the calling season. Poaching, clearing of land for shifting cultivation, forest produce collection and unmonitored human movement in the protected area were the main threats identified by the study. Kumar *et al.* (1997) studied the winter habitat use of the Monal Pheasant in the Kedarnath Wildlife Sanctury. Monal Pheasants showed a strong preference for dense wooded areas with a high litter cover during autumn and winter and were found near cliffs and open areas during spring. During autumn the male and female birds were observed in loose groups which changed to distinct groups in winter. The males remained in groups for a short period and with the advent of spring moved to higher altitudes and became solitary.

1.2.4 Overview of Satyr Tragopan studies

Literature on observations made on the Satyr Tragopan were available from the pioneering works of. Jerdon (1863), Beebe (1918-1922), Meinertzhagen (1926), Baker (1928), Whistler 1926, Inglis 1933a and Bailey (in Inglis 1933a). There were reports of the bird from the Darjeeling hills from the last century (Hickell 1842 in Inglis 1933a, Jerden1863 and Inglis 1933a & b). Ludlow & Kinnear 1937 observed the Satyr Tragopan to be distributed in eastern and western Bhutan between 2743 m -3353 m. Ludlow (1944) also reported the species from the Chumbi valley in Tibet adjacent to Sikkim.

1.2.4.1 Distribution: Review of reports form various sites of Satyr Tragopan distribution revealed that there was severe paucity of information about the distribution of the Satyr Tragopan from the Garhwal Himalaya as observed by Gaston(1982). In Kumaun, Young and Kaul (1987) in their surveys recorded the birds in the Pindari and Milam valleys in the inner ranges of the Kumaun Himalaya at altitudes of 2400-4250 m. In very recent surveys in Kumaun, Shah *et al.* 1997) ~~Kumaun~~ the species was reported from two sites. The Satyr Tragopan has been in reported in surveys all over the Nepal Himalayas (Lelliott and Yonzon 1980, Forster & Lelliott 1982, Roberts 1983, Picozzi 1985, 1987, Roberts 1987, Inskipp 1989, ~~Inskipp 1989~~, Amatya 1997, Maskay 1997). The Satyr Tragopan was reported to be distributed throughout the hills of Sikkim in thick canopy of tree or climbers in the Kanchanjunga National Park (Pazo 1982, Lepcha 1997) and is considered to be fairly common in its sites of distribution throughout the country. The species has been was recorded from various sites in Bhutan (Ali *et al.* 1972 & in press, Inskipp & Inskipp 1993b, ~~Inskipp 1993b~~, King 1996, Bishop1997, ~~Murphy 1994, Inskipp 1996,~~ Pradhan

1983, Clements 1992, Dreyer 1995, King 1995, Holt 1996, Bishop 1997, King 1996, Tymstra *et al.* 1996). Surveys were conducted in Arunachal Pradesh to record the presence of galliformes. The Satyr Tragopan was recorded in the Thingbu and Mago area of Tawang district (Kaul and Ahmed 1992, Singh 1994, Kaul *et al.* 1995). In China Cheng (1989) reported the species from Mount Jumulong Ma (Quomolangma) National Park in the southwest border of the Tibetan Autonomous Region. Recent surveys in the Gaologongshan Region in the Yunan Province of China have recorded Satyr Tragopan in Dulongjiang (Nushian Nature Reserve) (Zheng Guang-mei 1992, Xian1995, Ma Shilai *et al.* 1996).

1.2.4.2 Call counts: From 1979 to 1998 fairly regular counts of pheasants have been conducted in the Pipar area of Central Nepal. Lelliott and Yonzon (1981) in late May counted 10 Satyr Tragopan and estimated a density of 4.2 pairs/km^2 for the Satyr Tragopan. Tamrakar and Lelliott (1981) recorded 13 birds in late April in 1981. In the next year there were records of 8 birds (Yonzon 1982) while 16 birds (Roberts in litt.) were recorded a couple of years after that. Picozzi (1987) recorded 19-21 calling Satyr Tragopan in April 1987 after which there were no call counts for the next three seasons. In 1991 Howman and Garson (1992) recorded 30 calling Satyr Tragopan which indicated a 50% increase in the number of Satyr Tragopan recorded in 1987. However Kaul and Shakya (1998) who conducted the most recent counts in Pipar and recorded eighteen Satyr Tragopan believe that the 1991 figure was exaggerated due to double counts. Kaul and Shakya (1998) obtained a density index of 9 groups/km^2 in Pipar and an encounter rate of 10.3 groups/100 party hours. In Kumaon Shah *et al.* (1997) obtained encounter rates of 16.6 groups/100

man-hours and 18.6 groups/100 man-hours from two sites in which they encountered the Satyr Tragopan.

1.2.4.3 Habitat: Beebe (1918-22) in his pioneering work on pheasant reported the Satyr Tragopan to inhabit broad-leaved forests with bamboo understorey in narrow side gorges with tiny streamlets. Ali and Ripley (1978) found the Satyr Tragopan associated with oak, fir and rhododendron forests in steep hillsides with scrubby undergrowth of ringal bamboo at 2400- 4250 m elevation. Lelliott and Yonzon (1980) studied the highland pheasants on the forested southern slopes of the Annapurna Himal in Nepal. Satyr Tragopan was associated with *Rhododendron-Arundinaria-Betula-Sorbus* forests with other broad-leaved species and *Berberis* sp. scrub in altitudes between 3000-3300 m.

1.2.4.4 Diet: Satyr Tragopan was considered a primarily herbivorous species though insects were also observed in its diet (Hume and Marshall 1879-1881, Hodgson in Hume and Marshall 1879-1888, Baker 1920, Beebe 1918-1922, Meinertzhagen 1926). More recently Lelliott and Yonzon (1981) found the species to be omnivorous. Yonzon (1981) and Bhandary (1983) observed the Satyr to be primarily a vegetarian. In captivity the species is largely vegetarian (Howman 1979). The species was found to be open area foragers or deep undergrowth foragers (Baker 1920, Beebe 1918-22) while Lelliott and Yonzon (1981) observed the species to be early morning and late afternoon feeders, which included arboreal feeding.

1.2.4.5 Calling and Social organisation: Johnsgard (1986) in his comprehensive book on pheasants reported the Satyr Tragopan to be highly territorial birds. Beebe (1918-1922) made several observations on the birds and found that the birds did not call during the winter unless the hen communicated with the nearly grown up young by low clucking calls. In case of sudden flight or distress both the male and the female give a series of loud raucous notes. Wayre (1969) observed the Satyr Tragopan call to gradually rise in volume until it became almost a shriek and the whole sequence lasted for 20-25 seconds. Jerdon (1864) described the wailing call of the Satyr as a deep bellowing sound while Hume (1879) thought it was a loud bleating cry chiefly heard in spring. Lelliott (1981) distinguished four types of calls, which he considered to be an incomplete description of the species vocalisations. Islam and Crawford (1996) in their work on Tragopan vocalisations described and acoustically analysed four types of calls of Satyr Tragopan.

1.3 Aims and objectives

- To obtain information about the presence and distribution of the Satyr Tragopan in the Singhalila National Park (SNP), Darjeeling. This would identify areas of high Satyr Tragopan distribution/presence in the Singhalila National Park and identify possible sites in the adjoining parts, which have not been included in the protected area.

- To formulate techniques for abundance indices. This would help to monitor the abundance of the Satyr Tragopan in the various areas of the National Park and also provide a crude population trend of the Satyr Tragopan.

- To study the habitat utilisation patterns of the Satyr Tragopan in the SNP. This would generate information on the broad characteristics of available and utilised habitats of the species (macrohabitat and microhabitat), yearly shift in habitat use, seasonal shift in habitat and habitat selection.
- To study and identify the food plants of the Satyr Tragopan and study their phenophases in the different seasons of the year. These studies would provide us with a range of food items that ~~from~~ form a part of the Satyr Tragopan's diet and also generate information on food availability and utilisation through different seasons of the year. On the whole the dietary requirements of the species will be available.
- To study the social organisation and calling behaviour of the species. Studies on social organisation would provide information on the group composition and group size at different times of the year and a rough estimate of sex ratio in the species. Calling behaviour studies would provide information on the calling period, duration of calling, possible factors affecting calling and will suggest possible functions of calling in the Satyr Tragopan.
- To study the effect of human pressures on the pheasant habitat like lopping fodder collection, forest produce collection and grazing and browsing by cattle from human habitats. These studies identify the various types and levels of activities that may be possible threats to the Satyr Tragopan in the Singhalila National Park. This would help in formulating conservation measures and management techniques for the Satyr Tragopan in particular and the Singhalila National Park as a whole.