CHAPTER 6

CALLING BEHAVIOUR AND SOCIAL ORGANISATION

A. Calling behaviour

6A.1. Introduction

Vertebrates use a variety of signals to pass on information about status, alarm, food, breeding, territories etc to other individuals of their species. Plumage patterns, calls and songs in birds and scent marking and calls in mammals are some of the important channels of communication. Among acoustic signals in birds less attention has been paid to bird calls (Guttinger and Nikolai 1973, Thielcke 1976, Baker and Bailey 1987, Baptista 1990) although, some work has been done on bird song (Morse 1970, Emlen 1971, Lein 1971, Catchpole 1973, Krodosoma 1976, Mace 1986, Moller 1988, Birkhead and Moller 1992, Welling *et al.* 1995, Mountjoy and Lemon 1996).

Calls appear to be the usual form of communication in galliformes in addition to displays. A wide range of calls may be used for communicating in different situations. Some of the vocalisations that are known and have been described are advertisement calls, alarm calls, display calls and contentment calls. Among pheasants, vocalisations of the Common pheasant, *Phasianus colchicus* (Heinz and Gysel 1970), Red Jungle Fowl, *Gallus gallus* (Collias and Collias1967), Cheer, *Catreus wallichii* (Young *et al.* 1987), Malaysian Peacock Pheasant, *Polyplectron malacense* (McGowan 1992) and the *Tragopan* pheasants (Islam and Crawford 1996) have received some attention. Vocalisations of most pheasant species are

poorly known. An advertisement call is loud and can be heard over a large distance and is variously referred to as territorial calls, crowing and female attraction calls (Gaston 1980, Lelliott and Yonzon 1981, Johnsgard 1986, Islam and Crawford 1997).

Satyr Tragopan are highly territorial birds (Johnsgard 1986) and during their pre-breeding period in spring, the males give out loud calls especially in the morning and form part of the dawn chorus. Besides the advertisement call three other calls are known to be emitted by the species (Lelliott and Yonzon 1981, Islam and Crawford 1997). According to Beebe (1918-1922) the birds are silent during winter unless the hen communicates 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. Beebe (1918-1922) described the call note of the Satyr Tragopan males to be distinct from its alarm call as the former call was a high quavering sound, which could be heard over long distances. The hen was reported to have comparable calls, which were higher and shriller, uttered when separated from the nearly grown young. Wayre (1969) stated that the call of the male consisted of 12 –14 notes which gradually rose in volume until it became almost a shriek and the whole sequence lasted for 20-25 seconds. Jerdon (1935) described the wailing call of the Satyr as a deep bellowing sound while according to Hume (1879) it was a loud bleating cry chiefly heard in spring. Lelliott (1981b) distinguished four types of calls, which he considered to be an incomplete description of the species vocalisations.

1. The first call was a repeated monosyllabic note reportedly uttered by both the sexes at any time of the day during spring and autumn. The functions of these calls were probably courtship and possibly male to male aggression.

2. The second call was the less audible alarm call uttered by both the sexes when alarmed by humans and other animals. This call was commonly uttered during flushing.

3. The third call recognised was the short monosyllabic 'bleat' note similar to the bleat of sheep and goats, which preceded wailing. The call was heard only during the breeding season suggesting that it functioned in pair formation or courtship.

4. The fourth call recognised by Lelliott (1981b) was the drawn out mammal like call made by the male only and consisted of repeated series of notes ranging up to 33 seconds in length. Calling was greatest at dawn and the initiation was closely related to the time of sunrise. Lelliott (1981b) was uncertain about the function of this call but thought that it might be related to territorial advertisement.

Islam and Crawford (1996) in their work on Tragopan vocalisations described and acoustically analysed four types of calls of Satyr Tragopan.

1.Wing whir call: A single note performed on the ground or a perch and associated with a wing whir.

2. Alarm call: Emitted by both the sexes when the birds were disturbed and consisted of several single notes that were repeated *ad nauseum* in quick succession.

3. Advertisement call: Emitted by male birds while perched.

4. Metallic clicking sounds: Produced during frontal display and were audible as a single click metallic sound.

During my studies on the Satyr Tragopan in the Singhalila National Park I found that the most distinct/prominent call of this species was the wailing (Lelliott 1981b) or advertisement call (Islam and Crawford 1996). The alarm calls were recorded every time the birds were flushed and were quite difficult to quantify systematically as they had no regularity of occurrence over any specific time period/season.

Other less pronounced calls were not audible. In this chapter I have discussed the calling behaviour of the Satyr Tragopan with reference to its advertisement call which formed a distinct chorus during the breeding season. The following were the aims and objectives of my studies on the calling behaviour of the Satyr Tragopan.

1. To study the general pattern of dawn calling in the Satyr Tragopan.
2. To assign probable functions to calls.

6A. 2. Methodology

Call counts as described in Chapter 3 were conducted to collect data for studies on calling behaviour. A total of 27 mornings of sampling in 1995 and 18 each in 1996 and 1997 were spent to collect data on calling. The whole exercise was mainly spread over the months of April and May in 1996 and 1997 although June was also included in 1995. Calling was mainly monitored between 0430h – 0600hrs.

6A.2.1 Analyses: The entire dawn chorus comprised of several bouts/sequence of calling and each sequence/bout consisted of several calls, while each call comprised of several notes. A 'bout' or sequence was defined, as the duration in which there was more or less continuous calling and counter calling with an interval (silent period) not exceeding 15 minutes. A call was defined as the component within the calling bout/ sequence, which comprised of several continuous notes. Calling rate was defined as the number of bouts/unit time (hr) and the calling effort was defined as the number of calls/unit time (10 minutes). The calling frequency for a particular day was expressed as the percentage of the number of birds heard calling on a given day from a particular point divided by the maximum number of birds heard calling from that particular point. Duration of chorus was recorded on the basis of a bout, as there were long periods of silence between bouts, which if considered in the analyses would give spurious figures for the length of dawn chorus. Pearson and Spearman Rank Correlation Coefficient were used for all correlation analyses. Mann Whitney U tests and Wilcoxon Signed Rank tests were used to compare sets of independent and related data respectively. Parametric and Kruskal -Wallis One Way ANOVA were used for differences in more than two variables. All tests were two way unless when specified. Weather conditions were categorised into clear, clearing, cloudy, mixed clear and foggy, approaching fog and rainfall. These were ranked according to the increase in deterioration in weather conditions with clear weather having the lowest rank and rainfall the highest.

6A. 3. Results

A typical dawn chorus from an observation point would consist of calls and counter calls of birds from all directions at various distances around that observation point.

6A.3.1 Calling period: I conducted some dawn call counts in March on a trial basis and found that calling was very sporadic and the chorus was not well

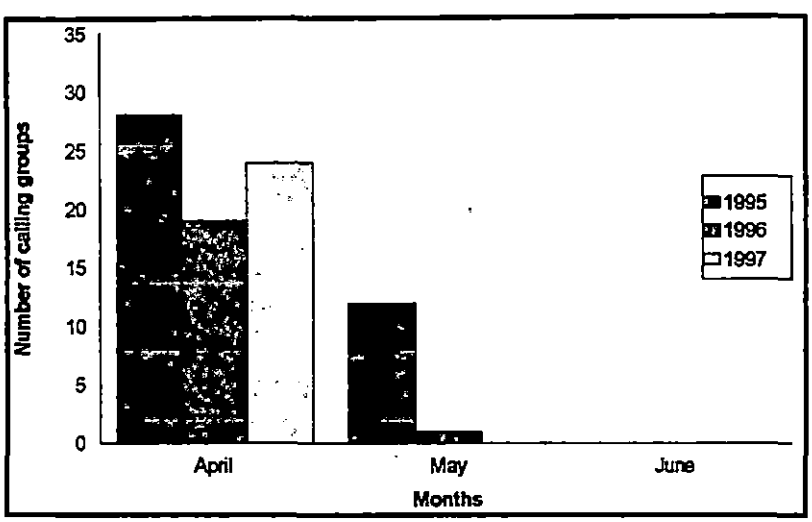

Fig 6.1: Number of calling groups of Satyr Tragopan during the breeding season

established until early April. I also eliminated data collected in June from my analyses because I never heard Satyr Tragopan calls during this month.

In all the three years of observations maximum groups of calling birds for all the years were recorded in April (28,19,24). Chorusing declined through May (12,1,0) and there was no chorus by the end of May or beginning of June

(Fig. 6.1). The calling frequency varied from 33% to 88% mornings. This indicated that in very few cases do birds call every morning even in April when calling was maximum. April was the most vocal month both in 1995 and 1996 ($U = 2.69$, $p = .0071$; $U = 3.38$, $p = .0007$, Mann Whitney U test) while there were no records of calling birds in May 1997.

6A.3.2 Duration of chorus: The mean duration of chorus was 20.7 minutes (± 1.27, n =129) over all the trails. The mean length of chorus in April was 20.9 minutes (± 1.38, n = 114) and in May the mean length of chorus was19 minutes (±3.27, n =15). There was no significant difference between the length of chorus in the two months ($t = .482$, d.f.= 127, $p = .630$, t test). There was no significant change in the length of chorus between 15 day time periods in April and May ($F_{2,24} = .991$, $p = .374$, 1 Way ANOVA) . The length of chorus was positively correlated to the number of calling groups,($r = .446$, $p = .000$, n = 129) indicating that the activity of calling and counter calling increased with the increase in the number of calling males (Fig. 6.2)

6A.3.3 Bouts: The mean number of bouts across all the trails was 1.40 (± .05, n=159) which indicated that the dawn chorus usually comprised of one main bout through which functions of either attraction of mates or territory defence or both were accomplished. After this the calls became sporadic and there was no pronounced chorus. This pattern of chorusing with one main bout was

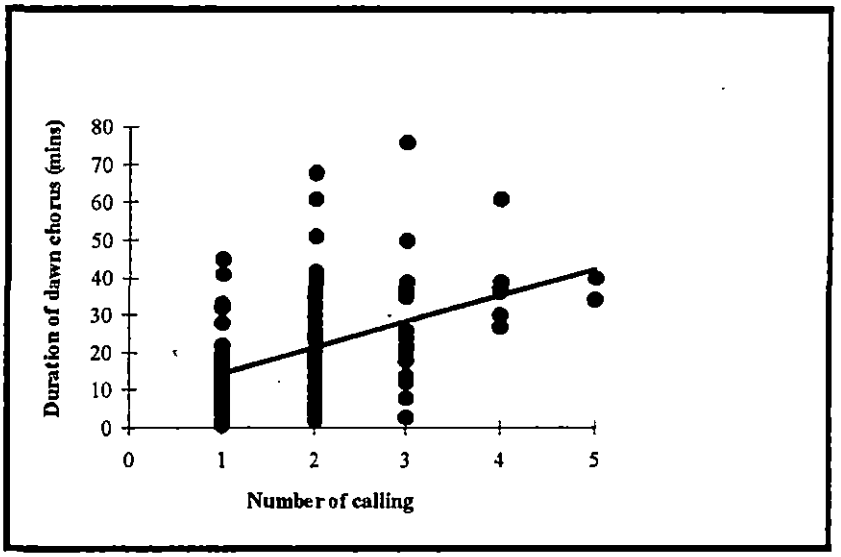

Fig 6.2: Relationship between the length of dawn chorus and the number of calling groups of Satyr Tragopan

uniform over all the trails ($F_{2,155}$ = 2.389, p = .0956 n.s. 1 Way ANOVA) and in both the calling months (Z = - .9019, p =.2671 n.s., Wilcoxin Signed Rank Test). The bouts of calling increased with increase in the number of calling groups across the trails (r = .2443, p = .002, n = 159, Pearson Correlation Coefficient) indicating the increase of calling activity in the presence of rival males.

6A.3.4. Calling effort and calling rates: The mean calling effort across all the trails was 4.05 (± 0.32, n = 129) and this was higher at the end of the calling period (April = 3.70, ± 0.23, n = 115; May = 6.77.42, ± 2.26, n = 14). The mean calling effort of the Satyr Tragopan differed significantly between April and May (t = -2.927, df = 127, p = .004). The mean calling rate of Satyr Tragopan was 6.63 bouts/hr (±. 0.61, n = 129) and the calling rate decreased in May when the duration of chorus was shorter and lesser number of birds were calling (April = 6.76, ±

0.674, n = 115; May = 5.69, ± 1.011 n = 15). There was no heterogeneity in the calling rate of Satyr Tragopan across the three trails (t= .555, df = 127, p = .580, t test).

6A.3.5 Calls according to sunrise: The Satyr Tragopan were early callers and in all the trails the dawn chorus was initiated any time between 3-52 minutes before sunrise while the maximum number of calls were heard 30-40 minutes before sunrise. The initiation of chorus was negatively correlated to the intensity of light/adverse weather conditions (r_s = -.273, p <0.001 ~~= .000~~, n = 226, Spearman Correlation Coefficient). Here the intensity of light was categorised by the weather conditions. A foggy and cloudy condition depicted conditions of low light intensity which resulted in a late initiation of dawn chorus, while initiation of chorus was early in clear conditions due to the good light conditions. Thus the results indicate that weather conditions affect initiation of dawn chorus in Satyr Tragopan. A mean of 13.75 calls (± 1.97, n = 32) were heard before sunrise as compared to 3.03 calls (± 0.63, n =32) after sunrise. There was significant difference in the number of calls heard before sunrise and after sunrise in April (U = -3.9624, p= .001, n= 21 Mann Whitney U Test) and May (U = -.26502, p = .0080, n = 11 Mann Whitney U test) implying that the actual chorusing was completed before sunrise. The maximum number of calling groups was recorded in the 0445 - 0500 hrs time period (Fig 6.3). After this there was a decline in the number of calling groups and no calls were heard after 0600 hrs probably implying that the birds begin calling from their roosts or close to it before they move out for their other activities.

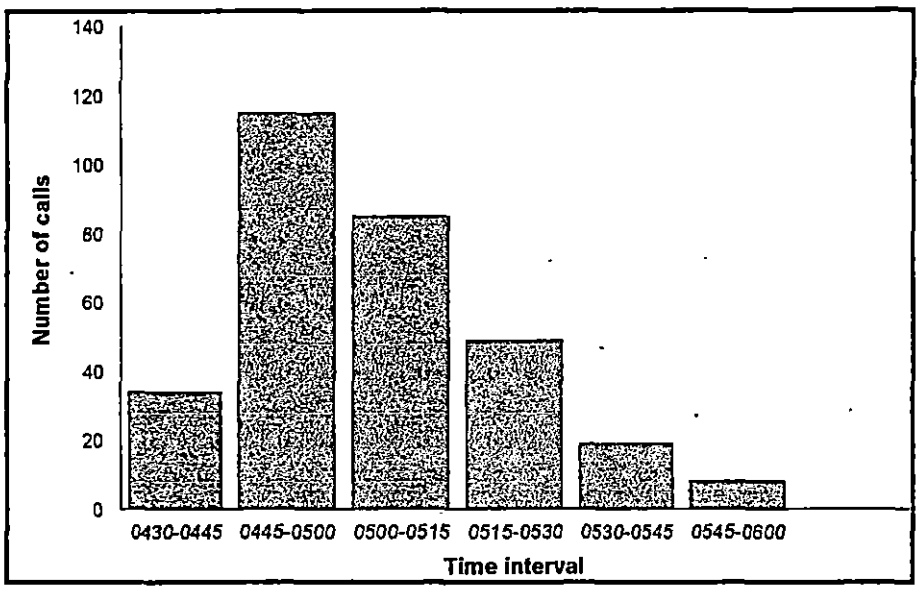

Fig. 6.3: Number of calls heard at different time periods in the morning
in 1995, 1996, 1997.

6A.3.6 Effect of weather conditions: Calling groups were negatively correlated with adverse weather conditions ($r = -.306$, $p = .001$, $n = 225$, Pearson correlation coefficient) and wind conditions ($r = -.134$, $p = 0.044$, $n = 225$, Pearson correlation coefficient).

6A.4. Discussion

The dawn chorus is a well-known phenomenon in several bird species where the males begin their vocal activity for sometime before sunrise and then stop or decrease it for the rest of the day (Hinde 1952, Morton 1975, Mace 1987b). This activity does not make sense immediately that song birds which cannot feed overnight should indulge in an energy consuming activity like dawn chorus, unless there are strong selection pressures favouring dawn advertisement activity (Horsfall 1983). The dawn chorus in passerine birds has been explained variously as a means of extra energy consumption, sperm competition and mate defence

(Mace 1987b). One characteristic feature of the advertisement call of the Satyr Tragopan was that it occurred very early in the morning and comprised a dawn chorus established before sunrise. In fact, in the study area this species was one of the first birds to break into a chorus in the morning. This is perhaps because the chances of efficient transmission of calls can change during the course of the day as many other background noise and sounds rise and fall. Kacelink and Krebs (1982) suggested that territorial Great Tits (*Parus major*) sing at dawn because that is the relatively quiet part of the day. Numerous studies have documented that wind and air turbulence increase after dawn, which produce noises that attenuate bird songs. Moller (1991) linked the higher singing activity of birds at dawn to the ability to signal to its neighbours about its defensive capabilities. Apart form this other necessary and exclusive behaviour may change with the passage of the day as in the Great Tit besides singing, the major competitive activity is feeding which is unprofitable in poor light at dawn (Kacelink and Krebs1982). According to Welling *et al.* (1997) in Willow Tits (*Parus montanus*) dawn could be the best time to sing for mate defence even if there were other functions. This is because singing would have low costs early in the morning, as once the females emerge males would spend much of their time in mate guarding. Thus early calling in territorial birds like Satyr Tragopan could be linked to efficient projection of messages over a fairly large area as well as to the unprofitability of other activities at those early hours of the day. Besides efficient transmission, song activity at dawn is linked to the fertile period of the female (Mace 1986, Cuthill and Macdonald 1990) as females are believed to be fertile early in the morning

(Birkhead and Møller 1992). These studies suggest that the dawn chorus is a part of a strategy by males for paternity assurance.

The dawn chorus of the Satyr Tragopan lasted a little over 20 minutes and comprised a single main bout. Later in the morning the chorus consisted of shorter but sporadic bouts. This first bout was probably the most important and efficient component of the species communication either for mate attraction or territorial defence or for both. The duration of chorus during the pairing might have been affected by the emergence of the female birds. If the function is mate attraction then the dawn chorus shows a relationship with the emergence of females as suggested by Welling *et al.* (1995). Their experiments showed that delay in emergence of females prolonged singing activity of Willow Tits while there was appreciable decrease in singing with the approach of females. Calling during the first bout which occurred in the first 20-25 minutes of the dawn chorus were also important indicators to assess the density of calling and therefore breeding male Satyr Tragopan around any particular point.

In Pipar (Central Nepal) most of the surveys were conducted in late April and early May (Lelliott and Yonzon 1980, Piccozzi 1987) whereas in SNP chorusing peaked in April after which there was a sharp decline and only sporadic calls were heard in the later half of May. Location of SNP at the more eastern longitudes where the monsoon sets in earlier probably contributes to a much-reduced calling period of the Satyr Tragopan. Also the calling period appears to start earlier at eastern longitudes. Such instances were observed in western Blyth's Tragopan (*Tragopan*

blythii) in the Phwangpui National Park, Mizoram India, which is at more eastern longitudes. Here the calling period lasted even less than one month (Ghose 1997) because the rains set in even earlier in this area.

Cloud cover, relative humidity and amount of dew show no effect on crowing counts whereas extremes of temperature would perhaps show some rare effects like decline in calling or reduced audibility but counts would be severely affected by rain or snow (Kimball, 1949). On the other hand Little and Crowe (1992) found no correlation between the calling and the ambient temperature in the calling activity of Grey Wing Francolin (*Francolinus africanus*) whereas they found relative humidity to be positively correlated with the calling activity. They suggested that this might indirectly stimulate calling because of the triggering effect of precipitation on the onset of reproductive activity on South African game birds (Crow and Siegfried 1978; Berry and Crow 1985). In SNP weather conditions like thick fog and heavy rainfall affected the calling of Satyr whereas temperature, cloud cover and relative humidity appeared to have no measurable effect. Windy conditions like gales probably had more effect on the hearing capacity of the observers than calling by distorting the intensity and direction of the calls. A negative correlation was obtained between the wind speed and calling activity of Grey wing Francolin (Little and Crow 1992). Apart form weather and wind conditions acoustical signals may also be absorbed by the vegetation (Alcock 1989) and physical features like valley bottom, cliff and folds in the topography may distort the quality of sound and reduce the number of receivers they reach.

Three inferences can be drawn about the functions of dawn calls of the Satyr Tragopan:

1. Function of calls is the defence of a reproductive territory. Therefore calling should occur throughout the breeding period. Song quality was known to serve as a cue to the females of many passerines in providing information about the territory quality of the male (Moller 1983, Radesater and Jakobsson 1989). In SNP the Satyr Tragopan called in a pronounced dawn chorus during the onset of pairing and then called intermittently towards the end of the breeding season. The calls probably communicated their highly territorial conditions during the breeding season.

2. If the main function of calling is the attraction of females, then calling should occur only in the initial stages of the breeding season (Puglisi *et al.* 1997). Many studies on European birds (Catchpole 1980, Yasukawa *et al.* 1980, Searcy 1984, Gottlander 1987, Mountjoy and Lemon 1995) have shown that the female mate choice was based on male song quality (repertoire and rate). These studies imply that the song in these species served as a measure of male fitness and provided the function of attracting females during the breeding season. In the Satyr Tragopan there was an initial peak in calling during the onset of pairing. This was not confined to the initial stages of the breeding season but extended beyond, perhaps up to the nesting, laying and hatching season suggesting that the function of the calls was not exclusively mate attraction.

3. If these two functions co-exist, there should be a pronounced initial peak followed by the maintenance of a certain territorial calling activity. Studies on the calling activity of the genus *Tragopan* (Johnsgard 1986, Islam and Crawford 1996) and the results of the present studies suggest that both the functions coexist in the calling behaviour of the Satyr Tragopan.

Searcy and Anderson (1986) reviewed many studies that provided evidences that the predominant role of singing in birds was mate attraction. However studies have shown that individual birds who acquired mates tend to sing throughout the breeding season suggesting therefore that song may have further functions (eg. Greig-Smith 1982 and Moller 1988). There is very little information on the breeding season of the Satyr Tragopan in the wild but according to Johnsgard (1986) it evidently occurs during May and June or about a month after the peak of male calling. Satyr Tragopan are known to be territorial species and the males give out loud calls especially in the morning exclusively during their pairing period in spring. These observations suggest that the dawn chorus functions as a female attractant as well as a reproductive territorial defence mechanism in the species. The dawn chorus of advertisement calls probably has dual functions in the Satyr Tragopan. It serves to attract potentially receptive females or intersexual selection (Moller 1991) as well as to ward off other male competitors or territory intruders (Welling *et al.* 1997) and may have evolved in the context of female choice and male-male contest (Islam and Crawford 1996). Merila and Sorjonen (1994) observed the song of blue throats to peak before or during pairing and ceased after that, which suggested a primarily mate attraction function. Song of the same

species was observed to be used also in territory defence (Goransson *et al* 1974) and since some birds sang during the egg-laying period it was suggested that the song might be used in mate retention. Similar pattern of call function can be inferred in the case of the Satyr Tragopan. The calling pattern in terms of effort and rate were uniform throughout the three trails but there were slight differences in these aspects during the two calling months as would be expected.

These observations on dawn calling of Satyr Tragopan suggest that calling does not remain confined to perform an exclusive function rather the context of calling changes over the calling period. At the beginning of the season the calls in the morning may be used for attracting female birds by advertising fitness and resources available in the territory. Once pairing has been accomplished the context of calling perhaps shifts from being primarily mate attraction to intra sexual so that the calls advertise the identity and fitness of the paired male to the unpaired ones (male-male conflict). The same calls when performed during the laying period perhaps functions as a female retention function for protecting paternity assurance.

6B. SOCIAL ORGANISATION:

6B.1 Introduction

The Satyr Tragopan is a shy solitary species (Lelliott and Yonzon 1980), and even during winter there is little evidence of gregariousness in these birds though females may be found in family parties through winter (Beebe 1918-1922). Though there are very few evidences from studies in the wild the male Satyr Tragopans are believed to remain with a single female only until egg-laying or early incubation after which the male birds may remate with a different female (Lelliott 1981b, Ridley and Hill 1987). Gaston (1980) assumed an equal sex ratio in many Himalayan pheasants including the Satyr Tragopan which were considered to be monogamous species and suggested that a total breeding population could be obtained by doubling the number of calling males. Islam and Crawford (1992) in their studies on the Western Tragopan as well as from other studies suggested a 60:40 (male:female) sex ratio in the species. The following problems were addressed while studying the social organisation of Satyr Tragopan in the Singhalila National Park.

1. The sex ratio of Satyr Tragopan in the study area.
2. The group size and composition.
3. To verify any changes in group size and composition of the species.

6B.2. Methodology

As mentioned in Chapter 2 the intensive study area comprised of 12 trails that were walked for routine monitoring to obtain evidences of the Satyr Tragopan.

Monitoring parties consisted of one to four people who recorded the date, time, locality, general vegetation, number, sex and age category (adults, juveniles, chicks) for all visual encounters with Satyr Tragopan.

6.B.2.1. Analyses: The sample sizes for the visual evidences were small and as the sampling was done in frequencies, I used non-parametric tests (Siegel, 1956) for the entire data set. Chi-square goodness of fit test was used to determine the differences in group compositions across the seasons while Mann- Whitney U test was used to determine the differences between any two independent samples. Descriptive statistics were performed on the frequencies to obtain mean values.

6B.3 Results

Fifty seven separate visual evidences of the Satyr Tragopan in the form of solitary birds, paired birds and family groups were obtained while monitoring the trails demarcated in the intensive study area. The frequency of visual evidences of males was far higher (70%) than those of females (42%) and juveniles/chicks (5%). These visual evidences comprised of 74 individuals of which males made up 54% (40), females 36.5% (27) and juveniles and chicks 9.5% (7). The high frequency of male sightings should not necessarily indicate a higher number of males in the study area. This may occur because of the difference in detectability of the male and female birds in the study area. When encountered during monitoring the birds were found to be solitary i.e. group size = 1 most of the time. The mean group size during pre-monsoon was 1.069 (± .047, n= 31), monsoon 1.64 (±.187, n = 25),

post- monsoon 1.5 (± .354, n = 2) and winter. The group size across the trails were no different than those across the seasons (Table 61).

The groups encountered comprised mainly of solitary birds. I encountered more solitary males (72%) than solitary females (28%) probably indicating a highly solitary behaviour of the males except when paired with the females during the breeding season. The females on the other hand were observed in same sex paired groups, family groups or paired with males. There was a significant difference in the frequency of group composition across different seasons $\chi^2 = 19.167$ (d.f = 9, p = 0.05) for all birds i.e. all sexes combined. Chi-square test showed no difference between observed male : female ratio and the hypothetical 50 : 50 or equal ratio suggested by Gaston (1980) for the species.

Table 6.1: Showing the overall sightings and group size of Satyr Tragopan across monitoring trails in SNP.

Trails	Number of sightings	Number of individuals	Mean group size
0	4	6	1.5 (±.25)
1	3	3	1
2	18	20	1.11 (±.108)
3	3	3	1
4	9	13	1.44 (±. .228)
5	12	19	1.58 (± .275)
6	6	10	1.67 (±.192)
8	2	2	1
9	1	1	1
12	1	1	1

Sex ratios were obtained by pooling data across the four years (1994- 1997). The unweighted sex ratios for 57 instances of sightings was 60:40 or 1:1.5 (males = 40, females 27). In the pre-monsoon season this frequency was 2.2:1, monsoon 1.2:1,

post-monsoon 1:2 and winter 1:1. These figures may not, however predict the accurate sex ratio of the species because of the low sample sizes. Though the frequency of observing the male was much higher than the female the number of individual males and females sighted across the trails showed no significant difference (U = 41.500, p = .517, n = 100). implying that the sighting of females was rare . This was probably because of the dull mottled plumage of the female Satyr Tragopan, which gets well cam~~aflaouged~~ouflaged in its surroundings rendering its detectability difficult.

6B.4 Discussion

The frequency of sightings of male Satyr Tragopan was much higher than sighting of females or juveniles and chicks which implied a probable skewed frequency of visual evidence in favour of the males. A similar trend was observed in a population of the Western Tragopan in Pakistan (Islam and Crawford 1992). These observations may suggest that males were easier to sight and thus were more frequently encountered during monitoring the study area. The higher frequency of male sighting may also occur because of a bias in the sampling technique. Unlike the method used by Islam and Crawford (1992) where the birds were flushed by hunting dogs and both males and females had equal chances of being seen, in my studies at SNP, I used the non-invasive technique of trail monitoring. The male Satyr Tragopan has very bright and conspicuous plumage and similar to other birds it may be advantageous for sexual selection (Hill 1990, 1991, Anderson 1993) or anti- predator related behaviour (Gotmark1994, 1997) and also an easily sighted specimen . Chances of sighting or locating the male birds were further enhanced by

the calls they emit during the breeding season in contrast to females whose behaviour is cryptic due to mortality risks associated with incubation (Brown and Gutirezz 1980). The male: female ratio showed a slight decrease in skew as compared to the sighting frequency and this ratio was almost equal across the trails and seasons in the study area.

Sex ratio studies are of primary importance in population dynamics of species and also for predicting abundance of populations from call count indices (Dale 1952). Johnsgard (1973, 1983) suggested that there was an excess of adult males (55-59%) especially in a monogamous galliform population. The 1.5 : 1 male: female ratio therefore agrees with the sex ratio obtained by Islam and Crawford (1992) of the Western Tragopan and that suggested by Johnsgard (1973,1983). An almost equal sex ratio was however obtained in a population of Cabot's Tragopan in China (Zhang Junping and Zheng Guang-Mei 19890.

Inglis (1930), Gaston (1980), and Lelliott and Yonzon (1980) found the Satyr Tragopan to be solitary; forming pairs during breeding and in small family units after the chicks are hatched. Delacour (1956), Ali and Ripley (1980) and Johnsgard (1986) believe that Tragopans live in groups of 3-4 birds except during the breeding season. In SNP the male Satyr Tragopan except when paired with the female were observed singly and were never found in family units. The female birds were found in family units comprising of chicks or juveniles or sometimes in all female groups. Solitary males are considered to be highly territorial during the breeding season as was evident from their response to the playback of tape-

recorded calls (Lelliott and Yonzon 1980, Islam and Crawford 1992). In SNP the male birds were observed to respond very aggressively to such playback of calls and approached the source of the sound. On the other hand birds do not respond to any advertisement call of another congeneric species either in the wild or in captivity (Islam and Crawford 1996). This also clearly corroborates the earlier hypothesis that calling does not function simply in sexual attraction but also in territory defence.

Conclusion: A predominantly solitary species, the Satyr Tragopan uses four different types of vocalisations for inter and intra sexual communications of which the advertisement call was the most pronounced and audible. This vocalisation can therefore form an important and non-invasive technique by which scientific investigation about the presence /absence and abundance can be conducted. The calling activity of male Satyr Tragopan probably helps in female choice, reproductive isolation, fitness announcement, and announcement of individual identities

Considered to be a solitary species by some authors and also living in family units by some others, the Satyr Tragopan in the SNP were mainly observed as single birds. Conventionally considered a species with equal sex ratio the observations made in SNP support the 60:40 (1.5:1) ratio obtained for the Western Tragopan. The need for intensive studies to develop reliable techniques for obtaining pheasant sex ratios was felt more than four decades ago (Dale 1952). As of now sex ratios studies on Himalayan pheasants lack any reliable methods because for

such rare and threatened species population harvest technique is neither applicable nor possible.