Studies of Himalayan pheasants in Nepal with reference to their conservation

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STUDIES OF HIMALAYAN PHEASANTS IN NEPAL WITH REFERENCE TO THEIR CONSERVATION

by

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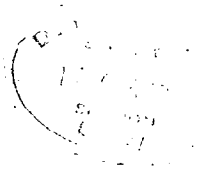

Dedicated to the memory of my father,

Denis W. Lelliott

ABSTRACT

The Blood Pheasant Ithaginis cruentus, Satyr Tragopan Tragopan Satyra, Koklass Pheasant Pucrasia macrolopha, and Himalayan Monal Lophophurus impeyanus, were studied for seven months in the South Annapurna region, North of Pokhara, Nepal, in 1979 and 1980. Study was concentrated in the Pipar area, between 3000m and 4000m altitude, where population densities were estimated by counting the numbers of calling males (Tragopan and Koklass), and by Direct Counts of birds (Blood Pheasant and Monal). Population densities ranged from 2.5 to 4.8 pairs per km^2 for the first three species, and although a slight decline was noted in the 1980 densities, the populations were considered to be quite healthy. An assessment of the habitat preferences of each species was made, which showed that these overlapped considerably. Diet and feeding behaviour were studied and compared with observations made by previous workers. All species showed overlapping food preferences, but these were different in detail.

Aspects of the behaviour of each species were studied, including protective behaviour, daily activities, breeding behaviour, and vocalizations. The latter were tape recorded, analysed sonagraphically, and most are described here in detail. The male Tragopan and Koklass were observed to make dawn challenge calls; the function of these and the calls of the other species are discussed. Observations made on breeding biology and territoriality were compared with those in the literature and are also discussed.

A fifth species, the Cheer Pheasant Catreus wallichii, was sought for in the Athhazar Parbat region, North-west of Pokhara, Nepal. A

small population was located in 1980, and observations were made on these for four days in May. The Cheer is included in the relevant sections along with the other four species.

A study of human influence on all the species was undertaken, which included the effects of livestock herds, hunting, burning, and forest clearance. In the South Annapurna region, pressure on the pheasants was not considered to be too great at present, but it is thought likely to increase in the near future. The status of the study species is considered and recommendations for their conservation are made. These include the setting up of a reserve, regulations for hunting, forest production and pastoralism, and recommendations for education and research.

ACKNOWLEDGEMENTS

I am very grateful to His Majesty's Government of Nepal, in particular to the Ministry of Forests and the National Parks and Wildlife Conservation Office for permission to work in Nepal. This project was carried out under the auspices of the World Pheasant Association, and funds were made kindly available through Mountain Travel/Tiger Tops (Nepal) Ltd. In particular, I would like to thank: Lt. Col. J. O. M. Roberts and Mr. K. Sakya, Chairman and Secretary respectively of W.P.A. Nepal, who both devoted much of their time to the success of the project; Mr. P. B. Yonzon and Ms. Heather Wright for their helpful co-operation in the fieldwork; Mr. K. C. R. Howman and Mr. C. D. W. Savage who helped plan and execute the study from England; and Dr. P. R. Evans who kindly supervised the preparation of this thesis. Bob Gibbons, Patrick Robinson, Michael Green and the other members of the Durham University Himalayan Expedition provided the original inspiration to work in Nepal, and I am grateful to them for their continued interest and advice.

Dr. Peter Slater and Dr. John Coulson both made available to me the use of Kay Sonagraph machines, Mr. Ron Kettle provided tape, Dr. John Munro provided medical supplies, Dr. Tusi Butterfield examined pheasant faecal pellets, Mr. Jon Scott helped with statistical analysis, Mr. Dave Schofield drew Figure 20, Messrs. Alan Eddy and Arthur Chater identified plant specimens, Miss Barbara Patterson typed the thesis, and Ms. Antonia Salvage translated German literature and provided help and encouragement.

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CONTENTS

DECLARATION

None of the material contained in this thesis has previously been submitted for a degree in this or any other University.

STATEMENT OF COPYRIGHT

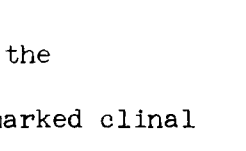
1. INTRODUCTION

This thesis documents the results obtained during twelve months of study of five species of pheasants in Central Nepal in 1979 and 1980. Woodland pheasants are difficult to observe in the wild (Severinghaus 1977), and I have therefore integrated my somewhat limited findings with all published information, to build up a more complete picture of the ecology of the five species.

The pheasants are a group of loosely-related game birds of the Family Phasianidae and Sub-Family Phasianinae. According to Delacour (1977) the criteria for distinguishing a pheasant are not well-defined, but the male bird should possess highly coloured, ornate plumage and be of 'large size'. Other related birds lacking these characteristics are placed in various groups such as Snowcocks, American Quails, and Francolins. The five species of Nepalese pheasant to be discussed in this study are placed in the tribe Phasianini which comprises sixteen genera that are distinctly separate and probably of polyphyletic origin (Delacour 1977). Plumage descriptions can be found in Appendix 1.

1.1 Blood Pheasant (Plate 1)

The Blood Pheasant, genus Ithaginis, Wagler 1832, Isis col. 1228, consists of only one species, Ithaginis cruentus, which can be divided into fourteen subspecies (Delacour 1977) which range through the Himalayas into the mountains of West-central China, showing marked clinal geographic variation. Vaurie (1965) however, recognises only eleven subspecies.



The bird occurring in Nepal is the Himalayan Blood Pheasant, Ithaginis cruentus cruentus which occurs across northern Nepal from approximately 83°E longitude to northwestern Bhutan, where it intergrades

Plate 1 Male Blood Pheasant on low branch of tree.

Plate 2 Male Satyr Tragopan on branch of Rhododendron barbatum tree

with I.c. tibetanus. Its local names in Nepal are 'Chilme' (Nepali) and 'Chermung' (Sherpa).

Habitat: Resident. Occurs in steep pine, birch, dwarf rhododendron, dense ringal bamboo and juniper forest and scrub. Usually found close to the snow line between c 3600 and 4300m altitude during the summer and moving seasonally with the snow line down to perhaps 2700m in the winter (Ali and Ripley 1969). Delacour (1977) records them descending below 2700m in the coldest part of their range "but never below 7000 feet" (2135m).

1.2 Satyr Tragopan (Plate 2)

The Tragopans, genus Tragopan, Cuvier 1829, consist of five separate species and one subspecies occurring along the Himalayan range into central and eastern China. The species encountered in Nepal is the Satyr Tragopan, Tragopan satyra, which occurs roughly from the Alaknanda river, in Gharwal province, through Nepal to 'Darrang', North of the Brahmaputra river in Assam (Ali and Ripley 1969). At the extreme western and eastern limits of its range, its relationship to the neighbouring species (T. melanocephalus and T. blythi respectively) is unknown. The local name for this pheasant in Nepal is 'Monal', which should not be confused with the Himalayan Monal (Impeyan Pheasant, Lophophurus impeyanus).

Habitat: Resident. Occurs in Rhododendron, oak, deodar, and bamboo forest, often on steep inaccessible slopes with thick undergrowth, between 2400 and 4250m, and down to c 1800m in severe winters (Ali and Ripley 1969). These heights represent the extremes of range for this species which is usually found between 2150 and 3500m throughout most of the year.

1.3 Koklass Pheasant (Plate 3)

Like the Blood Pheasant, the Koklass (Genus Pucrasia, Gray 1841), consists of only one species, Pucrasia macrolopha, which can be divided into ten (Delacour 1977), or nine (Vaurie 1965) subspecies ranging along the Himalayan range from eastern Afghanistan to West-central Nepal, and from north-eastern Tibet to northern and eastern China. Their absence from the eastern Himalayas to western China is difficult to explain, but geographic variation is marked and clinal, especially in the Himalayas. Systematically, Delacour finds them difficult to place, but believes their similarities to the other mountain pheasants outweigh their affinity to the other groups such as Syrmaticus and Phasianus. In Nepal, P.m. nipalensis occurs from western Nepal, where it intergrades with P.m. macrolopha, eastwards to approximately 84°E longitude at least as far as the Madi river, (Roberts 1980), where it abruptly disappears. Its local name in Nepal is 'Pokras'.

Habitat: Resident. Occurs in Nepal between 2100 and 3650m altitude in Rhododendron, oak, and coniferous forests with heavy scrub and ringal bamboo. In China, P.m. meyeri has been collected at 14000 - 16000 feet (4270 - 4880m) in Northwest Yunnan, whereas P.m. joretiana has been found at only 2000 feet (600m) in Anhwei (Vaurie 1965).

1.4 Himalayan Monal or Impeyan Pheasant (Plate 4)

The Monal Pheasants, Genus Lophophurus, Temminck 1813, are comprised of three species occurring along the Himalayan range from eastern Afghanistan to the mountains of western China. The species found in Nepal, Lophophurus impeyanus, has the widest range of the three species, from Afghanistan through the Himalayas to Bhutan and Arunchal Pradesh; it has also recently been discovered in Burma (Yin 1970). Its local name in Nepal is 'Danfe'.

Plate 3 Male Koklass Pheasant on branch of Rhododendron barbatum tree.

Plate 4 Male Himalayan Monal digging in a small field in the Everest National Park.

Habitat: Resident. Occurs in Birch, Rhododendron, fir and high oak forest interspersed with open pastures and steep craggy hillsides with grassy ledges. In Nepal, usually between 2450 and 4600m seasonally with the snowline on more open areas than the other pheasants described.

1.5 Cheer Pheasant (Plate 5)

Systematically "the Cheer Pheasant stands alone" (Delacour 1977). The genus Catreus, Cabanis 1851, consists of only one species and no subspecies. It is allied to Phasianus but shows features of other genera including Syrmaticus, Crossoptilon and Lophura. The species, Catreus wallichii, occurs discontinuously along the Himalayas from Durung Galli and Hazara in North-West Pakistan through India to West-central Nepal. Delacour (1977) shows its range extending to the Sikkim border, but this is incorrect and probably it does not occur East of the Kali Gandaki valley (Roberts 1980). Its distribution throughout the length of its range is very local and sporadic, and the species is included in the I.U.C.N. Red Data Book (1979) as an endangered species. Its local name in Nepal is 'Chir'.

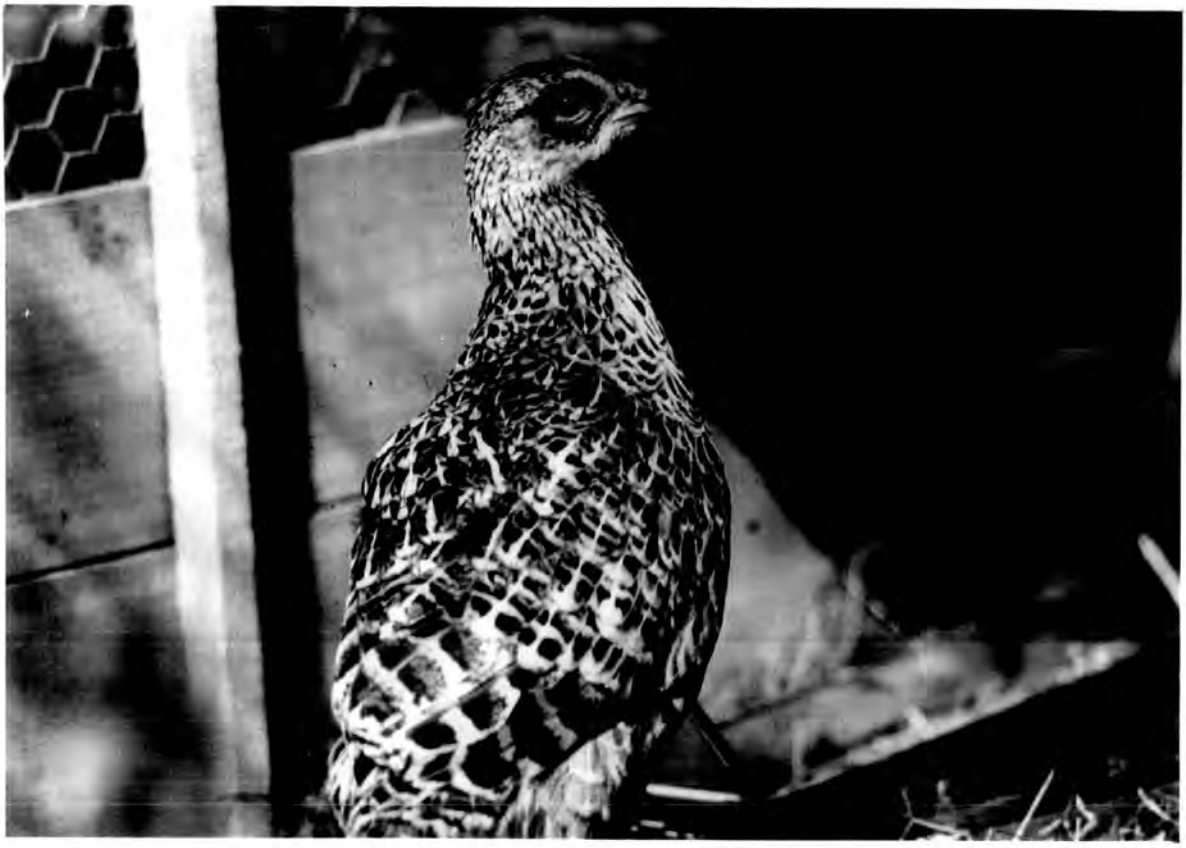
Habitat: Resident. It occurs on very steep craggy hillsides and cliffs broken by narrow grassy and scrubby ledges. Also the adjacent lightly wooded ravines and hollows of oak and Berberis. Found between 1400 and 3000m, usually restricted to about 2300m in Nepal with slight seasonal migration.

1.6 Research to Date

Apart from descriptions of shot specimens, the first reports in the literature concerning the above pheasant species were written by British sportsmen in nineteenth century India. They include authors such as Hodgson (1846), F. Wilson, Capt. Baldwin, A. Hume, and C. Marshall (all in Hume and Marshall 1879), and Blanford (1898). While their reports

Plate 5 Male Cheer Pheasant in captivity.

Plate 6 Himalayan Monal digging area in tussock grassland.



were unscientific and very subjective, they nevertheless provide us with important accounts of distribution, abundance, and behaviour, which would otherwise be lacking from this period.

The first more serious study was made by William Beebe, who wrote the classic 'Monograph of the Pheasants' (1918-22) which was largely based on his own observations of pheasants in the wild. This is not a scientific work, but is an excellent treatise which provides the basis on which modern research can be carried out. Since Beebe's time most books on pheasants have relied heavily on his work, and that of Hume and Marshall (1879) for the bulk of their text on Himalayan Pheasants. Such authors include Baker (1930), Bates and Lowther (1952), Wayre (1969), Ali and Ripley (1969), Roberts (1970), Fleming et. al. (1976), and Delacour (1977); although the last four also have integrated their own observations from the wild.

Serious scientific study did not begin until 1975, when Howman, Mirza and others began censusing pheasants in Pakistan (Howman 1977, Mirza et. al. 1978 a and b). Since then, a few studies have taken place in Pakistan and India, and have been mainly concerned with census work and re-introduction of Cheer Pheasants (Severinghaus 1979, Severinghaus et. al. 1979, Gaston 1979, Gaston 1980a, Gaston and Singh 1980). The First International Pheasant Symposium in Kathmandu, November 1979 provided a platform for all current workers on Himalayan Pheasants, and its proceedings contain a number of papers on this subject (Gaston 1980b, Lelliott and Yonzon 1980b, Mirza (1980 a, b and c), Roberts 1980, Sakya 1980, Shrestha and Nepali 1980, Yonzon and Lelliott 1980, Zeliang 1980).

Details of avicultural research on the study species can be found in relevant journals such as American Pheasant and Waterfowl Society Magazine, Cage and Aviary Birds, Avicultural Magazine, Annual Report of

the Ornamental Pheasant Trust (now the Pheasant Trust), and Journal of the World Pheasant Association.

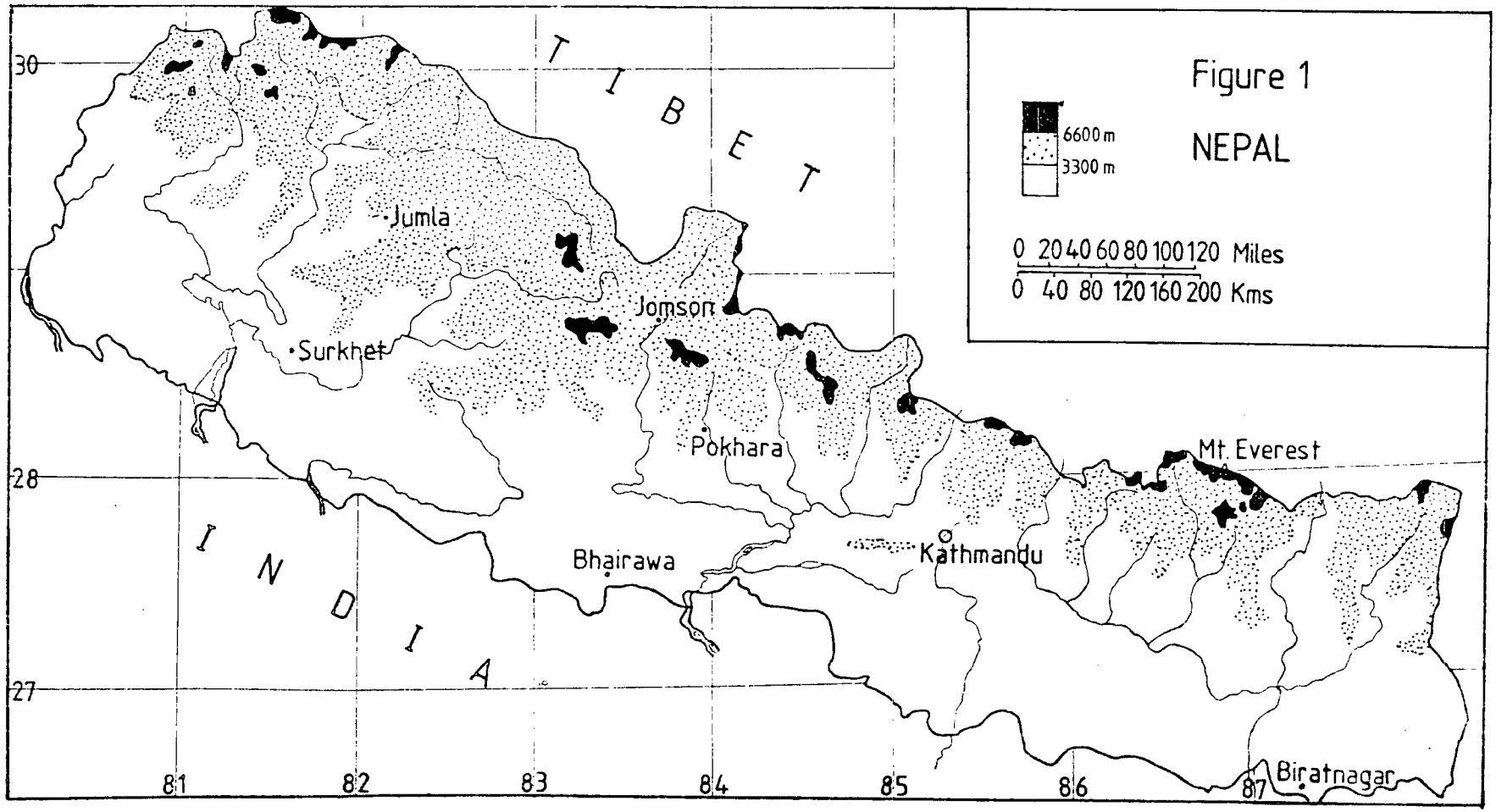


Figure 1
NEPAL
6600 m
3300 m
0 20 40 60 80 100 120 Miles
0 40 80 120 160 200 Kms
TIBET
INDIA
Jumla
Jomson
Surkhet
Pokhara
Mt. Everest
Bhairawa
Kathmandu
Biratnagar
30
28
27
81
82
83
84
85
86
87

2. THE PRESENT STUDY

My study of Himalayan Pheasants in Nepal was undertaken as World Pheasant Association Project Number 103. It was carried out in collaboration with the National Parks and Wildlife Conservation Office of His Majesty's Government of Nepal. The project aims were to study the status and ecology of highland pheasants in selected areas, to assess the degree of human influence on their habitats and populations, and to make preliminary recommendations to HMG regarding an area which could be considered as a pheasant or 'game' reserve in the future.

The project ran from April to November 1979, and from March to May 1980. It concentrated on one study area, while short visits were made to other areas for comparison. During the course of the research, certain periods of absence from fieldwork were necessary for visa requirements, the writing of reports, and other matters. For the duration of the spring 1979 field season, I was joined by Pralad B. Yonzon, M.Sc., Assistant Lecturer in Zoology at Tribhuvan University, Kathmandu, who shared the fieldwork and made a special study of human influence on the pheasants (see Yonzon and Lelliott 1980). In addition, Heather A. Wright, B.Sc., assisted in the fieldwork in May and June 1979.

2.1 Description of the Study Area and other areas visited.

2.1.1 Pipar

Pipar is the name of a small hillock at 3325m elevation on a ridge of the Annapurna Himal, North of Pokhara, Kaski Zone. (See Figures 1 to 5). In this thesis it refers to the study area around Pipar hill, 28° 25'N Latitude; 83° 57'E Longitude. It is situated on a minor North-South oriented ridge due South of Machhapuchhare (Fish Tail Peak) and separating the Mardi and Seti river valleys draining from the

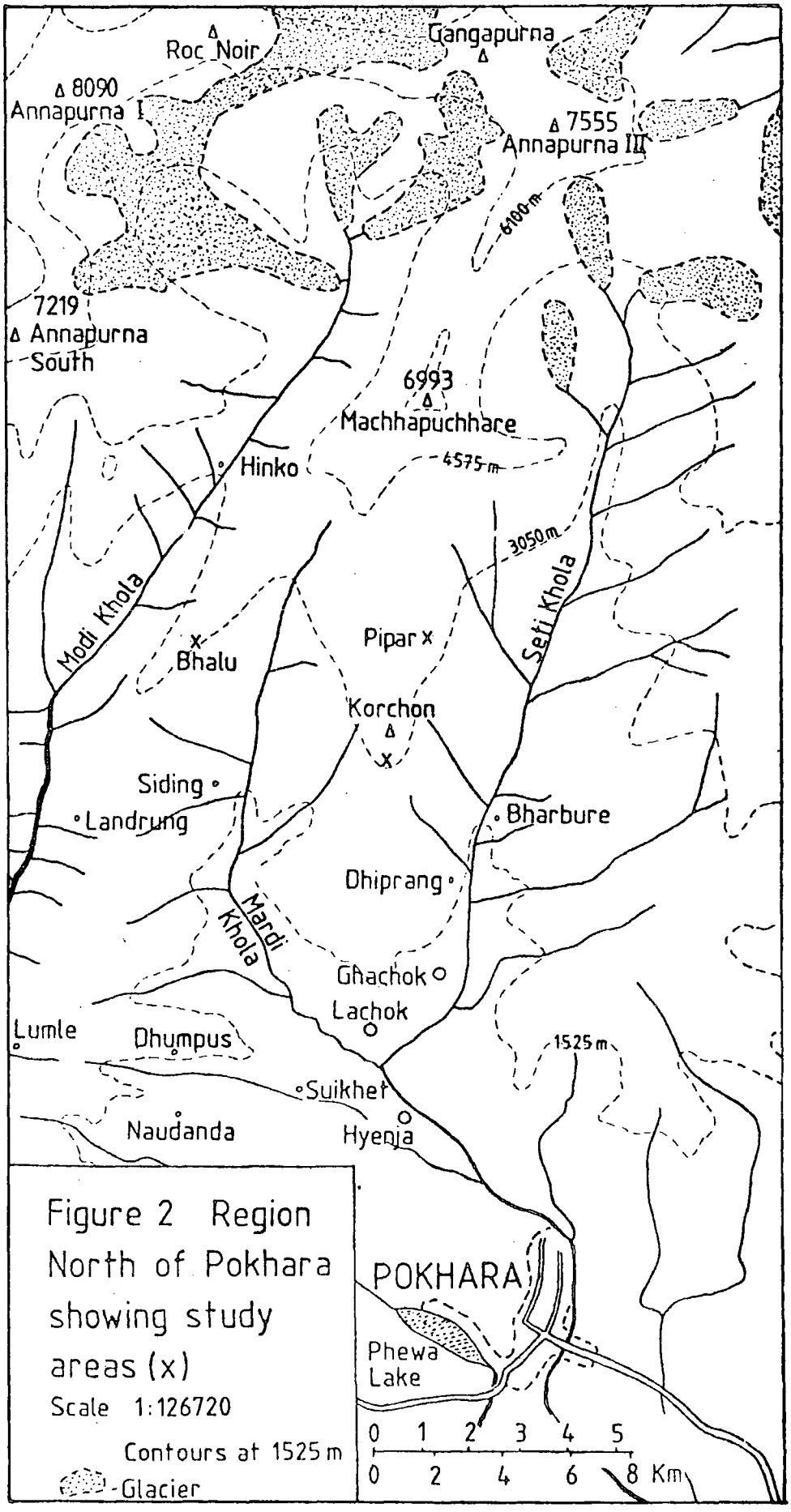


Figure 2 Region North of Pokhara showing study areas (x)
Scale 1:126720

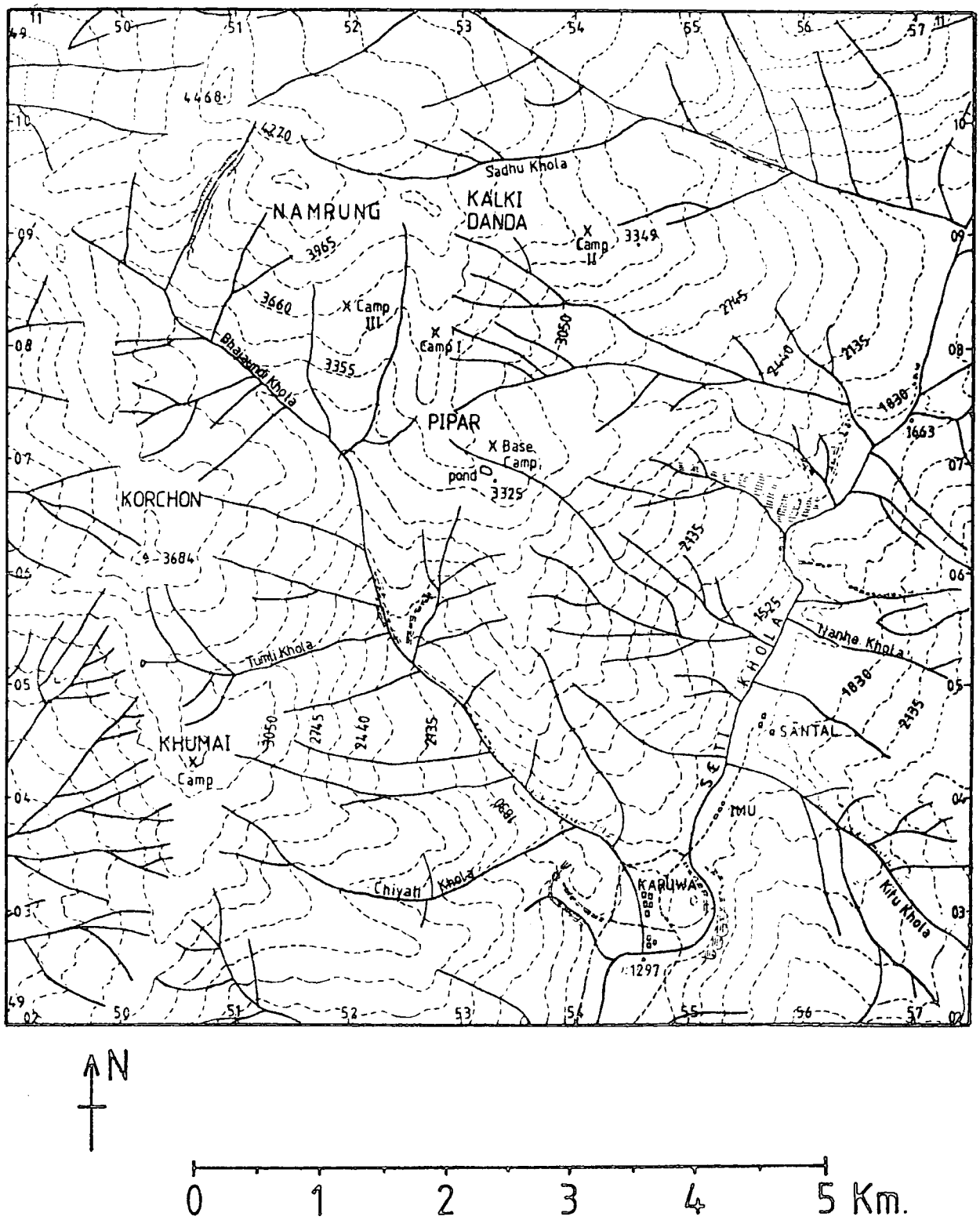


Figure 3: Location of the Study areas in the upper Seti valley
Based on One Inch Survey of India Series 1958-59

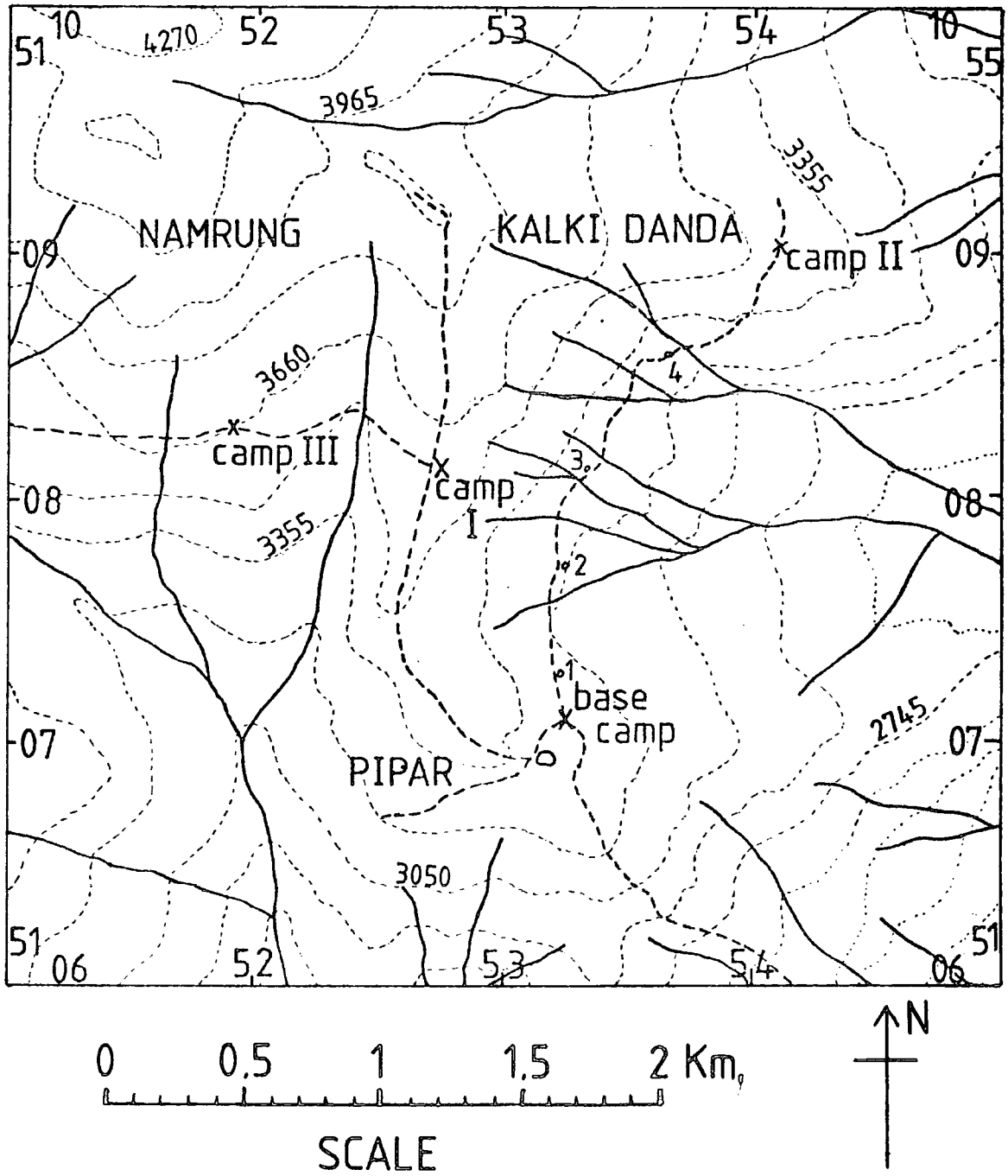


Figure 4: Detail of the Pipar area, showing camp sites, main trails, census points, and stream systems.

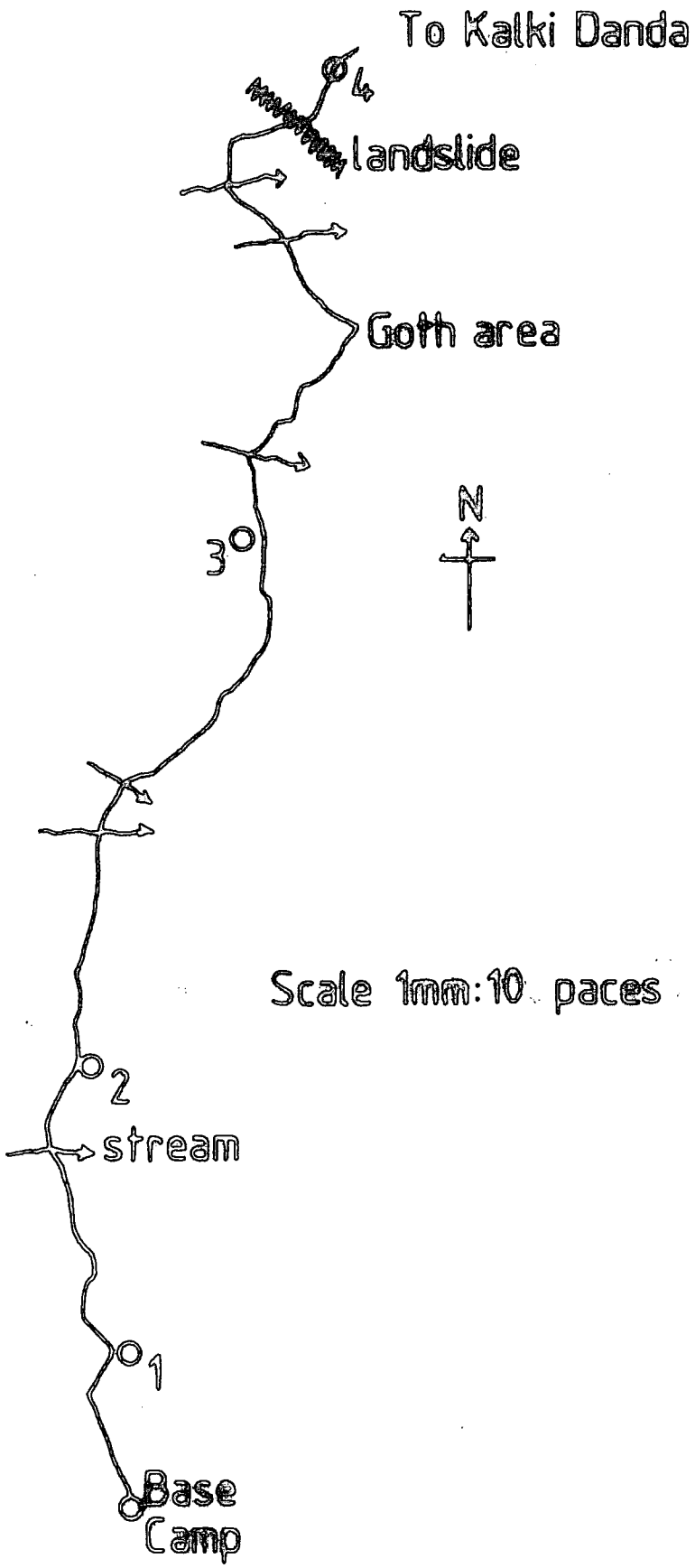


Figure 5: Detailed map of trail at Pipar showing census points.

Himalayan ridge. The nearest permanent settlements are nearly 2000m below Pipar in the Seti river valley to the East. There is however, one cattle 'goth' and a number of sheep/goat 'goths' at Pipar. These goths are open wooden huts used by herdsmen for themselves and their livestock during the summer months, when the latter are grazed in the high level pastures or 'kharkas'.

Study was concentrated on the eastern side of the Pipar ridge in an area of forest, scrub, and open tussock grassland dissected by small gullies or 'nullahs'. To the South and South-West of the ridge, slopes are very steep and parts of the forest are almost impenetrable. The ridge and its upper flanks are covered with a tough tussock grass and are grazed by livestock during the monsoon (June to September). In the northern part of the area the ridge joins another, locally named 'Namrung' and 'Kalki Danda', which runs approximately East-West. The total ground area covered by the map of Figure 4 is approximately 16 km^2. Study was carried out at Pipar from 2 April to 28 May 1979, 21 September to 24 October 1979, and from 8 April to 3 May 1980.

2.1.2 Bhalu

Bhalu is the name given to the camp (see Figure 2) set up at an altitude of 3150m, 28° 26'N Lat., 83° 52' E Long., six km. North of Siding village in the Mardi village. The area is situated on the East-facing slopes of a major ridge separating the Mardi and Modi river valleys, draining from the Annapurna range, and consists of tussock grassland and adjacent forest. This ridge consists of rocky crags and steep nullahs with similar forest to that of Pipar. The alpine meadows are used as kharkas (grazing areas) in the summer months. A visit was made to this area between 1 and 9 June 1979.

2.1.3 Kumai

Kumai is a hill at 3260m altitude on the principal ridge West of Pipar running southwards from Machhapuchhare. It lies 3.3km South-West of Pipar and approximately 3.6km. North-West of Mirsa village in the Seti valley (see Figures 2 and 3). Attention was concentrated on the ridge and East-facing slopes around Korchon (3684m peak), Kumai, and down to 2960m. Again, forest is similar in composition to Pipar and there are numerous goths and kharkas in evidence. A visit was made to this area from 27 October to 9 November 1979.

2.1.4 Athhazar Parbat Region

This hilly area lies West of the Kali Gandaki river and includes part of the Myangdi river valley in the Dhaulagiri zone of Nepal. The areas visited are situated at approximately 28° 32' N. Lat., 83° 22' E. Long., 70km. North-West of Pokhara. Study was concentrated on the steep grassy cliffs and adjacent scrubby forest above Khibang, Dara, and Muri villages at approximately 2300m altitude (see Figure 6). These areas were visited on trek from Pokhara between 11 and 25 August 1979, and between 4 and 25 May 1980.

2.2 Climate

The southern slopes of the Annapurna and Dhaulagiri Himal experience some of the highest rainfall in Nepal for two main reasons:

a) Heavy spring thunderstorms occur almost daily as cloud builds up on the ridges.

b) The hill and mountain ranges to the South are low (less than 2500m), so that during the monsoon period (June to September) rain clouds sweep in from the South-East to precipitate their full load on the South-facing slopes of the main Himalayan ridge. During this season, there is almost

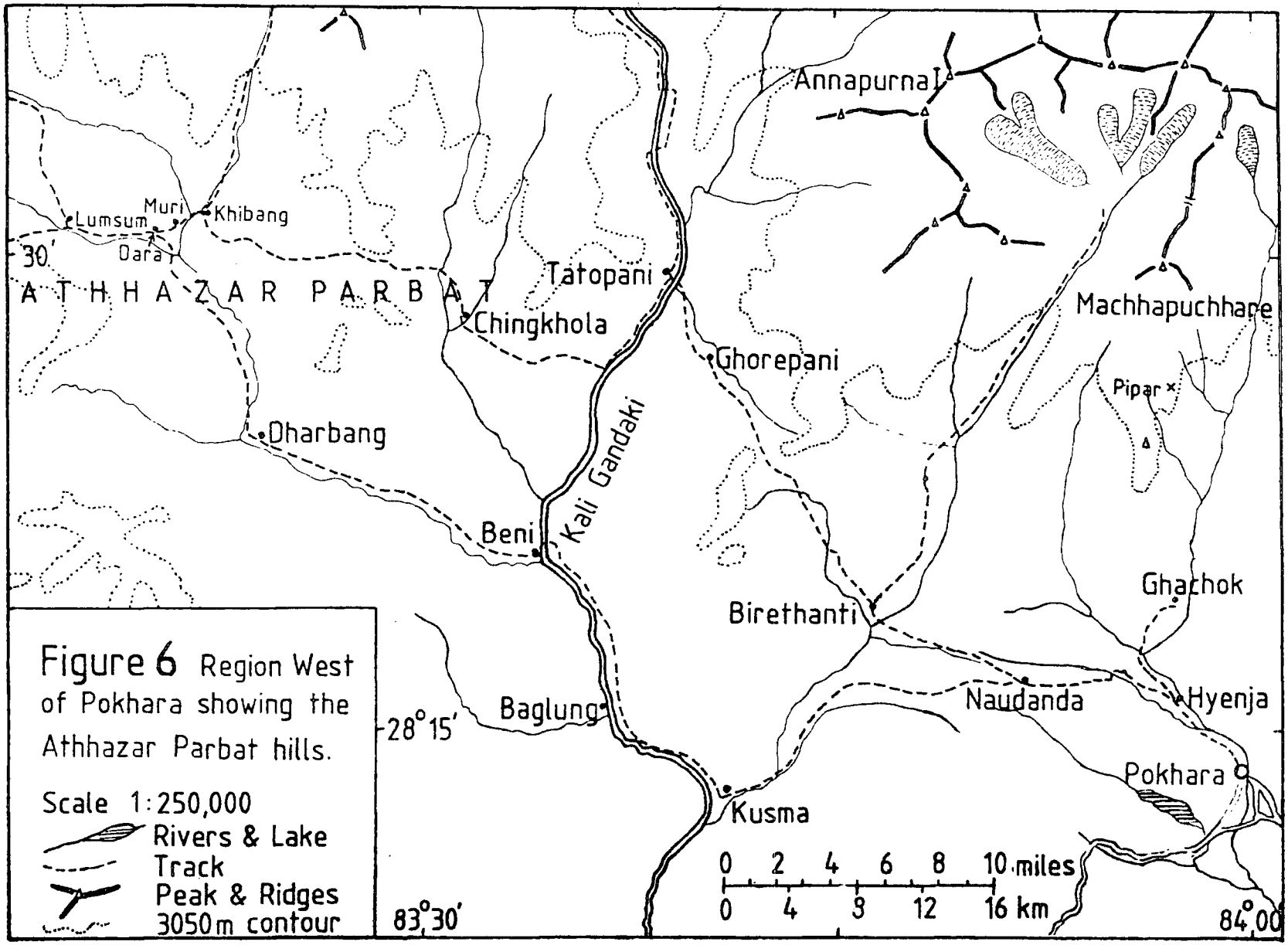


Figure 6 Region West of Pokhara showing the Athhazar Parbat hills.

continuous low cloud and drizzling mist at altitudes above 2100m, limiting the height at which crops can be grown.

Table 1 shows the mean monthly rainfall at Pokhara 1957-65 (from Stainton 1972). We made qualitative observations of rainfall at Pipar, comparing it with that of Pokhara (which is visible from Pipar). On more than twenty occasions precipitation was noted at Pipar while Pokhara could be seen clear of any rain. I therefore consider that a 30% increase in the annual Pokhara rainfall would be a conservative estimate of the mean annual rainfall at Pipar, totalling 4520mm (178in.).

In Spring 1979, precipitation in the form of heavy rain, hail, or snow fell on 36 of the 64 days (56%) spent above 3000m in the field, usually during the afternoon or evening. On 25 days (39%), low cloud below 3350m (fog) was experienced, usually from late morning to shortly before dusk, but sometimes as early as 08.00. During this period, the dawns were usually clear and cloud developed during the mornings, descending as fog on occasions. Precipitation would often fall during the afternoons, but this would cease by dusk to give a clear frosty night.

In autumn 1979, precipitation fell on 22 of the 43 days (51%) spent about 3000m, and low cloud (fog) was experienced on 36 days (84%). The pattern of weather was similar to that of the spring. The persistence of so much low cloud in the autumn field season was unexpected, since the post-monsoon season is renowned for its good weather. However, it seems that while the mountains are clear of cloud above about 4500m, and the valleys are also clear, a belt of cloud often forms at c2800m - 4500m resulting in precipitation and poor visibility between these altitudes. In spring 1980, precipitation fell on 15 of the 26 days (58%) spent above 3000m, but low cloud was experienced on only 4 days (15%). Temperature values were not recorded, but were estimated to vary

TABLE 1 Rainfall at Pokhara 1957-65

	Mean mm	Mean in
January	35	1.4
February	30	1.2
March	49	1.9
April	82	3.2
May	174	6.8
June	654	25.7
July	807	31.8
August	925	36.4
September	515	20.3
October	170	6.7
November	22	0.9
December	14	0.5
Total:	3477mm	136.9in

TABLE 2 Comparison of Vegetational Classifications of Stainton (1972) and Dobremez et. al. (1971) in the South Annapurna/Dhaulagiri region.

Altitude (m)	STAINTON	DOBREMEZ AND JEST	
4400	MOIST ALPINE SCRUB	ALPINE MEADOWS	
4000			
3600	BETULA UTILIS FOREST / RHODODENDRON FOREST	RHODODENDRON-BIRCH-FIR FOREST	BAMBOO "FACIES"
3200			
2800	UPPER TEMPERATE MIXED BROAD LEAVED FOREST	RHODODENDRON-OAK-TSUGA FOREST (QUERCUS SEMECARPIFOLIA)	
2400	QUERCUS LAMELLOSA FOREST	QUERCUS LAMELLOSA FOREST	
2000			

between -3°C (night) and 20°C (midday) during Spring 1979 and 1980.

2.3 Major Vegetation Types

The vegetation of this region of Nepal has been surveyed by Dobremez and Jest (1971), and Stainton (1972). They used similar forest zoning systems (see Table 2), but those of Stainton best reflect the vegetation types encountered in areas 2.1.1 to 2.1.3, South of the Annapurna Himal:

Rhododendron Forest 2600-3700m	Distinguished from 'upper temperate broadleaved mixed forest' by dense growths of Rhododendron arboreum with other species such as R. barbatum, Acer, and Sorbus, scattered amongst them. Forest at Pipar was predominantly of this type at this altitude, with Berberis and Viburnum forming scrub at edge.
Betula utilis Forest 3200-4000m	Often on East- and North-facing slopes and forming a band at the upper forest limit. Consists of Betula utilis, R. campanulatum, Berberis, and Viburnum.
Moist Alpine Scrub Treeline 4500m	Uppermost forest is B. utilis with R. campanulatum. Tussocks of grasses and sedges, and arcto-alpine species predominate.

Ringal bamboo (Arundinaria sp.) is probably the most important 'shrub' component in these forests. It is found as large stands and scattered throughout the forest between 2000m and the tree line. The abundance of this genus and the high proportion of Rhododendron forest on the southern slopes of the Annapurna Himal may be due to the very high rainfall in this area. Stainton (1972) suggests that "heavy rainfall on steep rock slopes leaves only a thin layer of soil which is sufficient for the shallow rooted Rhododendron (and bamboo), but not for larger species". Grubb (1971) suggests that the types of tropical forest growing at certain altitudes can be governed by the presence of low cloud (fog) causing a higher soil water content and a decrease in the mineralization of organic matter. Certainly in Nepal, Rhododendron forest cover shows positive correlation with the incidence of highest rainfall and cloud cover (central and far East Nepal).

Conifers (mostly Abies spectabilis) are uncommon in the study areas, and Stainton (1972) suggests they have been "driven out" by the high rainfall which is equivalent to the wettest areas of easternmost Nepal.

Vegetation of 2.1.4

The vegetation in the Athhazar Parbat region, South of the Dhaulagiri Himal is, below 2700m, significantly different to that of the area South of the Annapurna Himal. According to Dobremez and Jest (1971) this is due to the lesser rainfall in the Dhaulagiri area, except on the mountain summits. The altitude zone at which Cheer Pheasant were present above Muri village (2200-2450m), lies in the Dry Oak zone (Quercus lanuginosa) of Dobremez which is equivalent to the Quercus lamellosa zone of the South Annapurna region (see Figure 7). The Dry Oak zone includes R. arboreum, Symplocus spp., and Lyonia sp. Above this zone the forest types are similar to those of the South Annapurna region, but were not visited in this study.

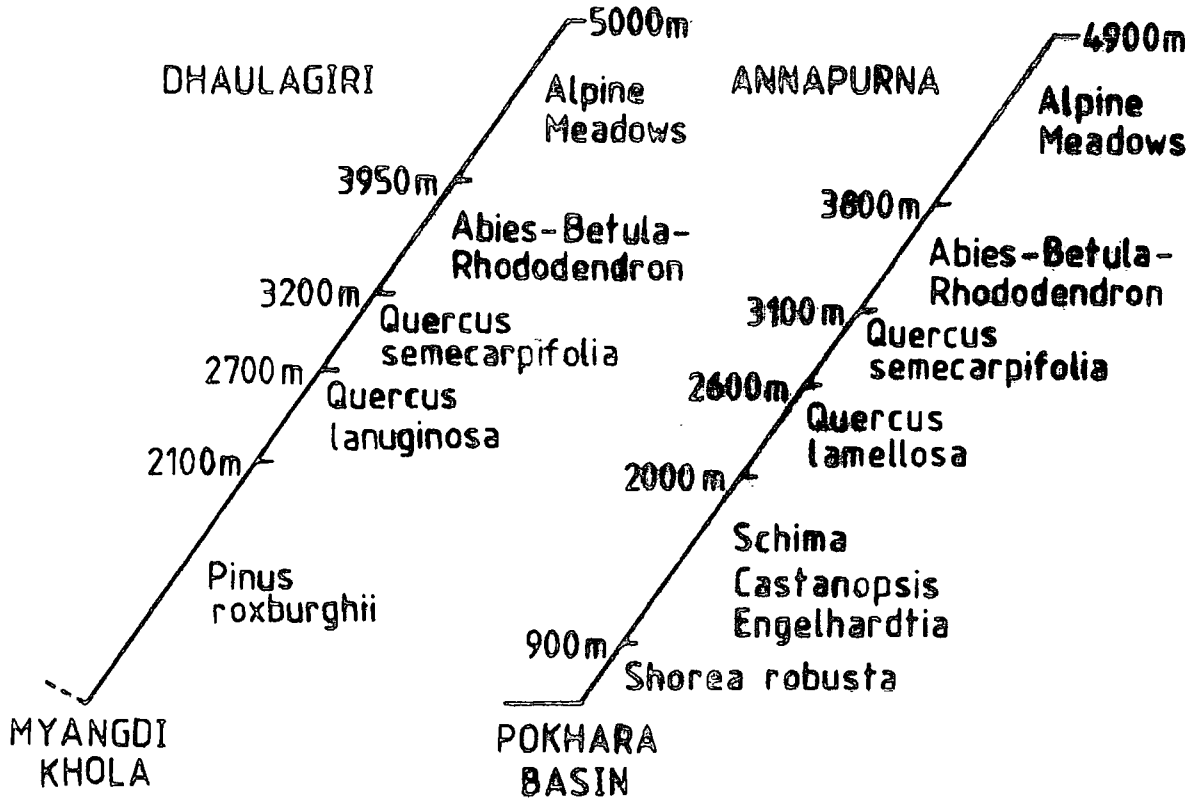


Figure 7: Vegetation stages South of the Annapurna and Dhaulagiri massifs (from Dobremez and Jest 1971).

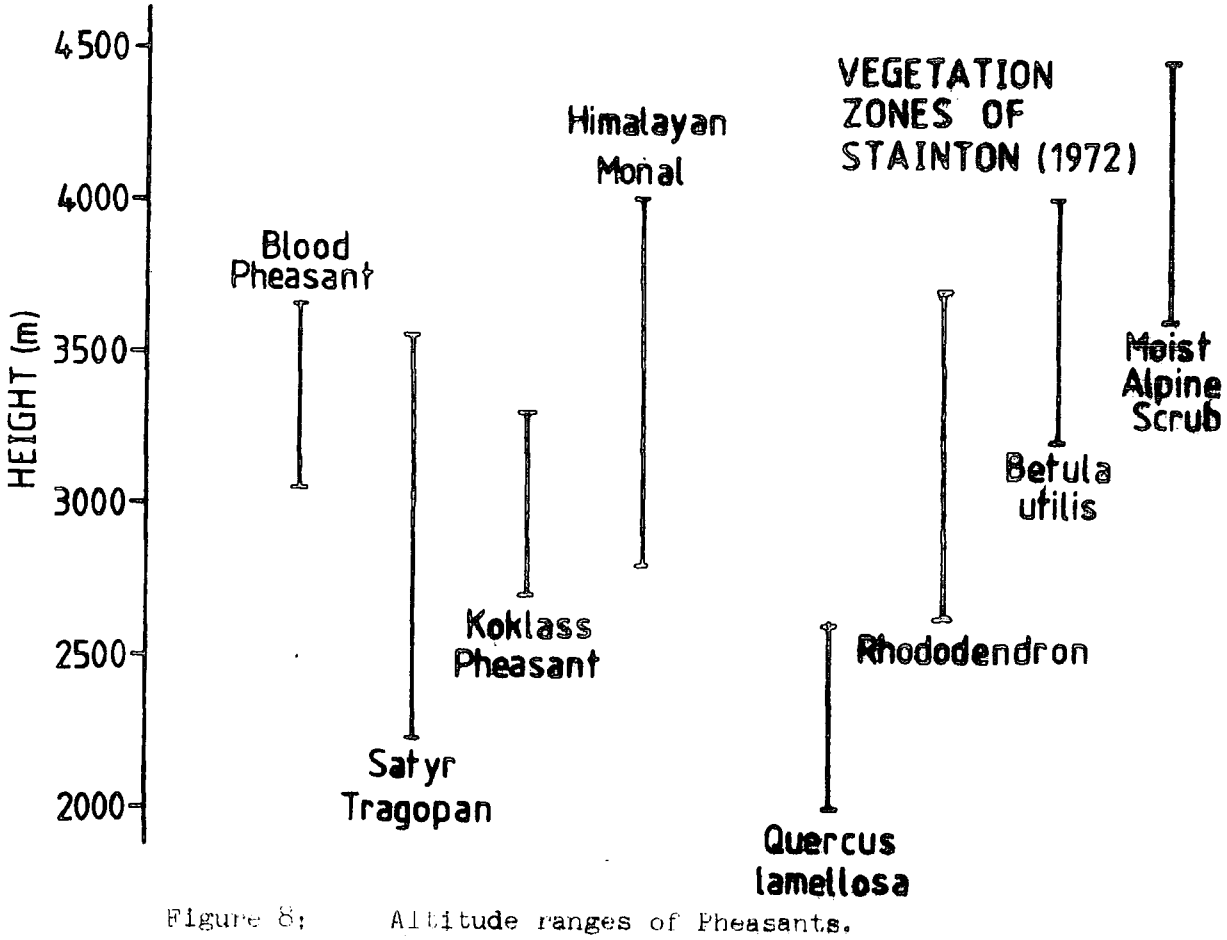


Figure 8: Altitude ranges of Pheasants.

3. METHODS

3.1 Fieldwork

3.1.1 Trapping

Capture, tagging, and releasing was not carried out on the study species for a number of reasons. First, the populations I was studying were relatively small in size, and the possibility of mortality or injury resulting from the types of snare used by the locals (see section 8.1.2) was too great. Any other methods of trapping were considered time-consuming and impractical. Secondly, in such a short study it was not considered that the returns from retrapping or observations of marked individuals would be worthwhile. Thirdly, we aimed to set a 'good example' to the local people (who hunt the pheasants for food) by observing the birds, not snaring them. Finally, in small, fairly sedentary populations, snaring could disturb the birds and result in even greater avoidance of humans.

However, to test the efficiency of the snaring method, two trap-lines were set up in October 1979 for four days, resulting in the capture of one Satyr Tragopan alive. Also, in April 1980 a porter set up a trap-line and snared one Blood Pheasant dead. (see section 8.1.2).

3.1.2 Data Collection

This was carried out using a method based on that of Severinghaus (1977), by Direct Encounter of pheasants. In all the areas visited, the author and other fieldworkers (P. Yonzon and H. Wright in 1979; Ram Kaji Mangar and Nema Chotta Sherpa in 1979 and 1980) would search the study area and record all visual and auditory encounters with pheasants on Direct Encounter cards (See Appendix 2) based on those of

Severinghaus. A daily record of weather, rough areas searched, notes on other species, etc. was also kept. In searching for pheasants I (and the other observers) usually made use of the few small trails in the areas (used by herdmen and livestock) but also searched areas where there were no such trails. The chances of sighting pheasants were greatly increased if the observer was silent and inconspicuous. Walking through trail-less forest created substantial noise by the cracking of branches and leaf litter underfoot. Despite this, the paucity of trails in the areas made off-trail walking frequently necessary.

A survey of plant species composition in the study areas was not carried out due to lack of time, lack of facilities for rapid plant identification in Nepal, and the fact that a botanist was not available to join me in the field.

3.1.3 Use of Hides

A number of hides were constructed in the Pipar study area for longer observations of pheasant species at close quarters, and for photography, recording and playback. Hides were built of the surrounding materials in the forest (e.g. dead wood, moss) at sites where pheasants had been noted to occur. The area adjacent to the hide was not baited. Hides were usually entered before dawn and occupied for up to three hours after sunrise. A total of approximately 65 hours was spent in hides.

3.1.4 Photography

Photographs of pheasants, their habitats, and other species were taken with a Pentax KM camera, 200mm Vivitar lens, and a 2x Vivitar Teleconverter. In the case of the Blood Pheasant, photographs were taken directly without the use of a hide by approach to within 3m of the birds, due to their tame nature. Other species were photographed from

hides at Pipar shortly after sunrise. Koklass and Satyr Tragopan were decoyed to approach the hides by playback of their calls. Himalayan Monal were also photographed by stalking while feeding in potato fields in the Everest National Park, East Nepal. Cheer Pheasants were not photographed.

3.1.5 Tape Recording

All five species were recorded in the field using a Uher 400 Report-L recorder and a Grampian DP 6 microphone, usually mounted in a fibreglass 22-inch (508mm) parabolic reflector. Recorded on EMI and Agfa Long Play tape at $7\frac{1}{2}$ inches per second. Playback of certain calls of Koklass, Satyr Tragopan and Blood Pheasant was carried out and in some cases resulted in those species approaching the recordist.

3.1.6 Information from local villagers

Information concerning the presence or absence of pheasant species was gained from local villagers, especially shikaris (hunters), and most identification was thought to be reliable, since pheasant posters in Nepali had been distributed to villages in the Seti and other valleys (Savage 1978). Regarding numbers however, the villagers' information was unreliable, and there was a general tendency to tell the questioner what he wanted to hear rather than the truth. This was especially prevalent near Muri and Khibang in the Athhazar Parbat. Therefore, unlike Severinghaus (1977), Reported Encounters from the questioning of locals are not included in the data, except for a few qualitative observations, and in Section 8.1.

3.1.7 Census

For methods see section 4.3.1.

3.1.8 Faeces Collection

Fresh pheasant droppings were collected where encountered in 1979 and preserved in formalin solution. It was considered that Blood Pheasant and Himalayan Monal droppings were easily identifiable in the field, the former by their small size and cylindrical shape, and the latter by their dull dark green colour and their presence on Monal digging areas (see Plate 6). Koklass and Satyr Tragopan droppings were difficult to tell apart and no distinction was made in 1979. Faeces of all four species were analysed for parasites by Mrs. J. B. Howman.

In 1980, further collections were made of pheasant faeces, and in some cases where the birds were observed, distinction could be made between Koklass and Tragopan faeces. All samples were baked in the sun for several days until completely dry, after which they were stored in sealed plastic bags, a method recommended by Green (1978). A number of droppings of each species were analysed by Dr. J. Butterfield in January 1981. No droppings of Cheer Pheasant were collected in either year.

3.1.9 Nest Search

Searches for nests of pheasants were made in both years. Only one nest was found, that of a Tragopan in 1979, and this was by the accidental flushing of the hen bird. Intensive searching by many people may be more effective, but time-consuming.

3.2 Laboratory Work

Faecal Analysis - Dr. J. Butterfield kindly analysed samples of 6 droppings from each pheasant species by separating the contents in alcohol solution and examining them through a microscope.

Sonagraphic Analysis of Vocalizations - Sonagraphic analysis of

recorded calls was made on a Kay Electric 6061-B Sonagraph with amplitude contour display and scale magnifer. All Sonagrams except those of the Koklass Pheasant were made using the narrow (45Hz) filter. Unless otherwise stated, Sonagrams show frequency (0-8 kHz) on the ordinate and time along the abscissa. On the Koklass sonagrams the wide band filter was used, and relative amplitude is indicated by contours 6dB apart, the darkest being the loudest.

3.3 Questionnaire

A questionnaire on aspects of pheasant vocalizations and behaviour (see Appendix 3) was sent to fifty-five members in possession of any of the study species in August 1980. Eleven replies were received, and the results are discussed in the relevant sections.

4. HABITATS AND POPULATION DENSITIES

4.1 General Habitats in the South Annapurna Region

WOODLAND

a) Below 3000m Mixed forest with bamboo

Primary tree species Rhododendron arboreum and Quercus spp. Secondary species Sorbus sp., Acer sp., Symplocos spp., Litsea spp. and other unidentified species. Canopy height 15 to 20m. Shrub layer consists largely of ringal bamboo, Arundinaria spp., which can form large stands dominating areas of forest, especially on South- and East-facing slopes. Ground cover: mostly leaf litter, with a few low-light intensity species such as Arisaema spp.; other unidentified.

b) 3000-3300m Mixed Rhododendron Forest (see Plate 7)

Primary tree species Rhododendron arboreum, Acer sp., R. barbatum. Secondary species Sorbus sp., Betula utilis, R. campanulatum, and other unidentified species. Canopy height up to 15m. Shrub layer consists of ringal bamboo scattered amongst forest, not growing as large stands; Viburnum sp., Berberis sp., and other unidentified species. Ground cover: herbaceous species common during and after monsoon season, largely unidentified. Leaf and branch litter prominent.

c) 3300-4000m (treeline) Betula Forest (see Plate 7)

Primary tree species B. utilis, R. campanulatum, R. barbatum. Secondary species Alnus sp., others unidentified. Canopy height up to 10m. Shrub layer consists of R. campanulatum, bamboo, Viburnum, Berberis spp. and other unidentified species. Ground cover: herbaceous species dense during and after monsoon season, including Primula denticulata, Gentiana spp., Anemone sp., and others largely unidentified.

Plate 7 Rhododendron/Betula/Berberis habitat in the census area, Pipar

Plate 8 Tussock grassland habitat, South side of Pipar Hill

FOREST SCRUB

3200m to treeline (see Plate 7)

Primary species Berberis asiatica, Viburnum grandiflorum, R. barbatum, R. campanulatum. Shrub height up to 7m. Ground cover: grasses and herbaceous species such as Arisaema griffithi, Primula denticulata, Impatiens spp., et. al. Much moss on tree trunks and ground. Deep leaf litter.

TUSSOCK GRASSLAND

3000 to above 4600m Livestock Pastures and Alpine Meadows (see Plate 8) Occurs on South-facing slopes down to 3000m where livestock grazing has taken place. Above the treeline, alpine meadows of grassland predominate to the limit of vegetation (4900m in places). With the exception of the Himalayan Poppy, Mecanopsis paniculata, and Gentiana spp., the grasses and other plant species in this zone have not been identified.

4.2 Habitat Preferences of Pheasants

4.2.1 Blood Pheasant

For this species, 39 out of the 53 Direct Encounters (74%) were made in the "woodland" and "woodland/scrub" categories of the Direct Encounter cards (see Table 4). Primary tree and shrub species were noted, and in every case consisted of a combination of Rhododendron, Betula, Berberis, and Viburnum forming forest and adjoining scrub; in 19 cases (36%) ringal bamboo was also in evidence. In the forest, the tree height ranged from 4 to 12m and the canopy was up to 70% closed. Understory vegetation was usually lacking except for dense stands or more scattered areas of ringal bamboo in various stages of growth from seedling to maturity depending on position. All the ringal bamboo (Arundinaria) species have a very slow growth rate and long life cycle, taking up to 50 years to mature, flowering once, and then dying. The

TABLE 3 Summary of Altitudinal Distribution of Pheasants 1979-80

Season	Direct Encounters	Average Altitude (m)	Lowest Altitude (m)	Highest Altitude (m)
Blood Pheasant				
Spring 1979	35	3260	3170	3500
Autumn 1979	2	3245	3230	3260
Spring 1980	14	3370	3200	3600
Satyr Tragopan				
Spring 1979	39	3140	2750	3450
Autumn 1979	9	3110	2900	3550
Spring 1980	12	3230	3080	3350
Koklass Pheasant				
Spring 1979	20	3170	3050	3260
Autumn 1979	3	3300	3300	3300
Spring 1980	6	3270	3170	3320
Himalayan Monal				
Spring 1979	70	3320	2930	3960
Autumn 1979	12	3380	3170	3660
Spring 1980	26	3290	2840	3570
Cheer Pheasant				
Spring 1980	4	2280	2230	2320

TABLE 4 Summary of Pheasant Occurrence in broad categories of habitat

	Percentage of Direct Encounters					
	Woodland	Woodland/Scrub	Scrub	Grassland/Scrub	Grassland	Grassland/Woodland
Blood Pheasant	51	23	19	7	-	-
Satyr Tragopan	83	12	3	-	-	2
Koklass	38	45	10	7	-	-
Himalayan Monal	8	3	1	11	67	9

result is large areas of bamboo either dead, or in different stages of maturity. In the forest, ground vegetation was scarce in spring, and consisted largely of ferns and small shrubs with much moss. Leaf and branch litter was deep with numerous rotting fallen trunks. Snow drifts were present in shaded areas until late May. In the post monsoon season, ground cover was greater with herbaceous species present in addition to ferns and shrubs. Rock exposures of gneiss and schist were numerous, sometimes forming crags. The forest where most observations of Blood Pheasants were made was growing on East-facing slopes with gradients ranging from flat ridge tops to 50° slopes, but mostly 0° - 40°.

10 observations (19% of sightings) were made in open scrub. This consisted predominantly of Berberis, Viburnum, and small R. campanulatum bushes up to 5m in height. There was no canopy, and ground vegetation consisted of grasses, mosses, and a few herb species. Most of the scrub was a result of heavy grazing by livestock during the monsoon months, so that grass was short and clearings were numerous. Four encounters (7%) were made in scrub with grassland, but no observations were made in pure grassland which extended down to 3000m on the South-facing slopes of Pipar, or in the alpine meadows above the tree line.

Altitude: in spring 1979, Blood Pheasant were encountered between 3120m and 3510m, at an average height of 3260m from 34 observations. In autumn 1979, they were only encountered on two occasions, but droppings were found at Kumai and Korchon as low as 3050m and as high as 3650m. In spring 1980 Blood Pheasants were found between 3200m and 3600m at an average height of 3350m from 14 observations.
Data are summarised in Table 3 and Figure 8.

Slope and aspect: both of these topographic features influence vegetation types and therefore indirectly influence pheasant distribution. Of the

fifty-three Direct Encounters, nine (17%) were on ridge tops or flat land, and 41 (77%) were on slopes of less than 40^{o}. Of these, eighteen (34%) were on slopes of between 11^{o} and 20^{o}.

As regards aspect, Blood Pheasants were almost always found on slopes with an easterly component of aspect. Thirty (57%) occurred on East-facing and only one (2%) was found on slope with a westerly aspect. Data are summarised in Tables 5 and 6.

DISCUSSION

The Direct Encounters with Blood Pheasant suggest that it prefers forest and adjoining scrub on East-facing slopes between 3050m and 3600m: and is associated with the genera Rhododendron, Betula, Berberis, and Viburnum with stands of Arundinaria. However, a certain amount of bias is present in the results due to a number of factors, including:

1. No fieldwork was carried out below 3000m or above 4100m.
2. No fieldwork was carried out during the monsoon season in July and August, or during the winter (December to March).
3. A high proportion (approximately 70%) of the hours spent searching for pheasants was carried out between 3200m and 3650m.
4. Distinct differences between 'forest', 'forest/scrub', and 'scrub' are difficult to define and are therefore subjective.
5. Field searching time was significantly less in thick tangled forest on steep slopes (generally West-facing) than in more open forest scrub or grassland on gentler slopes.
6. Although times were not recorded, most pheasant searching took place in the morning and mid to late afternoon, when the birds appeared to be more active.
7. Birds are more difficult to locate in certain habitats than in others, (e.g. thick forest) and can be warned of the searcher's approach more quickly.

TABLE 5 Occurrence of Pheasants on different angles of slope

Blood Pheasant	Total 53	Direct Encounters
Flat	9	(17%)
0-10°	5	(9%)
11-20°	18	(34%)
21-30°	8	(15%)
31-40°	10	(19%)
41-50°	2	(4%)
>50°	1	(2%)

Koklass Pheasant	Total 29	Direct Encounters
Flat	0	(-)
0-10°	1	(3%)
11-20°	11	(38%)
21-30°	11	(38%)
31-40°	3	(10%)
>40°	1	(3%)
Unknown	2	(7%)

Satyr Tragopan	Total 60	Direct Encounters
Flat	5	(8%)
0-10°	0	(-)
11-20°	15	(25%)
21-30°	16	(27%)
31-40°	13	(22%)
41-50°	3	(5%)
>50°	1	
Unknown	7	(11%)

Himalayan Monal	Total 108	Direct Encounters
Flat	18	(17%)
0-10°	2	(2%)
11-20°	13	(12%)
21-30°	22	(20%)
31-40°	29	(27%)
41-50°	14	(13%)
>50°	3	(3%)
Unknown	7	(6%)

TABLE 6 Occurrence of Pheasants on Slopes of different aspect

Blood Pheasant 53 Direct Encounters

N-NE	0-8
E-SE	30-3
S-SW	2-0
W-NW	0-1
Exposed (no aspect)	9

Satyr Tragopan 60 Direct Encounters

N-NE	0-8
E-SE	30-4
S-SW	6-1
W-NW	5-1
Exposed (no aspect)	5

Koklass Pheasant 29 Direct Encounters

N-NE	0-5
E-SE	23-0
S-SW	1-0
W-NW	0-0
Exposed (no aspect)	0

Himalayan Monal 108 Direct Encounters

N-NE	3-2
E-SE	13-8
S-SW	43-15
W-NW	6-0
Exposed (no aspect)	18

Having taken these factors into consideration however, the above statement of Blood Pheasant habitat preference in this area still remains valid in my opinion. It compares favourably with the species' habitat described in the literature except for the absence of conifers, which is thought to be due to the high rainfall (section 2.3). Delacour (1977) states that they frequent "fir and rhododendron woods and the scrub above ..... Wherever bamboo is found, they are partial to it". According to Ali and Ripley (1969) they occur in "steep pine forest, dwarf rhododendron, and dense ringal bamboo". Both these authors also state that the Blood Pheasant lives at higher elevations than any other Himalayan pheasant, and this may well be true in areas where the treeline is at a high altitude such as eastern Nepal and China. However, I never encountered the species living out of the forest, and since the treeline is at approximately 3650m in the study areas, I do not believe it to live above this height in central Nepal. The Himalayan Monal however, does live above the treeline and occurred at consistently higher altitudes than the Blood Pheasant in the study areas. This view is supported by recent observations made by Major I. Grahame (in Delacour 1977).

Regarding the apparent preference for slopes with an easterly facing component, I consider that this is partly due to the greater number of man-hours spent searching East-facing slopes, and partly due to the abundance of more suitable habitat on these slopes.

4.2.2 Satyr Tragopan

Of sixty-one Direct Encounters of this species, fifty-seven (93%) were made in the 'woodland' and 'woodland/scrub' categories of the cards. Of these, fifty (82%) were made in pure woodland (see Table 4). Primary species encountered were R. arboreum, R. barbatum, Betula, and Arundinaria. Other genera such as Quercus occurred more commonly

at lower altitudes. The height of canopy trees in the forest ranged from 5m to 20m, but averaged 8m to 12m, and the canopy was from 30% to 100% closed depending on tree height and age. Understory vegetation was scarce except for ringal bamboo, here considered as a primary species in the forest. Ground vegetation in the forest was restricted to ferns, mosses, and a few herbaceous species (e.g. Araesmia sp.) in spring. Like Blood Pheasant habitat, with which it has much in common, leaf and branch litter was thick, and rock exposures numerous. Damp areas and small streams were usually present in Tragopan habitat.

Seven observations (12%) of Tragopan were made in 'woodland/scrub' habitat category like that described in 4.2.1, while only three observations (5%) were made in open scrub. No observations of Tragopan were made in open grassland or alpine meadows except the occurrence of a nest in tussock grass (see section 7.2.3).

Altitude: The Satyr Tragopan has a much wider and lower altitudinal range than the Blood Pheasant, but this is not very clear from the Direct Encounters. The study area was at the upper end of the Tragopan's range, and it was encountered up to 3550m, but at an average height of 3150m. However, the species was on occasion heard and seen down to 2230m when I was on trek to or from the study areas. Data are summarised in Table 3 and Figure 8.

Slope and Aspect: Of the sixty Direct Encounters, five (8%) were on ridge tops or flat land and 44 (74%) were on slopes of less than 40^{o}. Of these, sixteen (27%) were on slopes of $21\text{-}30^{o}$.

With regard to aspect, thirty Encounters (50%) were on East-facing slopes, but this data is considered to be very biased (see discussion). Data are summarised in Tables 5 and 6.

DISCUSSION

Since the study areas lie within only the top half of the documented altitudinal range of the Satyr Tragopan, any results should be examined with this in mind when considering the habitat as a whole. The Direct Encounters indicate that it prefers mixed Rhododendron forest up to 3500m consisting of R. arboreum, R. barbatum, Betula, and Arundinaria. The factors of possible bias listed for Blood Pheasant apply equally well to this species.

Although the majority of sightings were made in the eastern part of the study area North of the campsite (see Figure 4), this is entirely due to the greater number of man-hours spent searching this area of relatively easy terrain. When other areas such as the southern and western slopes of the Pipar ridge were surveyed at dawn in an attempt to census by crow-count methods (see section 4.3.3), up to six calling male Tragopans were heard in Mixed Forest with bamboo and Mixed Rhododendron forest from 3200m downwards out of hearing range. These areas of forest were only searched on three occasions due to their extreme density and steep slopes, but it is clear that their habitat supports sizeable numbers of Satyr Tragopans. In addition, this species has been heard from Thulokhobang (2300m), which lies on the trail from the Seti valley to Pipar in Quercus lamellosa forest (Stainton 1972) on steep slopes (up to 50°). The presence of Tragopans on these slopes demonstrates the much wider range of habitat, slope angle and aspect that the species lives in than is shown by the Direct Encounters.

Since the Satyr Tragopan exhibits a fairly wide altitudinal range (up to 1350m), this means that they live in a wide range of habitat zones from Quercus lamellosa forest through Rhododendron forest to Betula forest. The descriptions of habitat in the literature are there-

fore necessarily vague: "wooded mountains of the Central and Eastern Himalayas" (Delacour 1977); "damp evergreen forests and bamboo groves" (Fleming, et al 1976). Ali and Ripley (1969) however, are more precise "oak, deodar, and rhododendron forest in 'khuds' on steep hillsides with scrubby undergrowth and ringal bamboo", but they give an unusally high figure of 4250m for the top of the Tragopan's range. In contrast, Delacour (1977) states that it "only occasionally enters the zone of the Blood Pheasant". However, in the study areas these two species overlapped in altitudinal range by up to 600m (maximum at Kumai in October 1979) - see Figure 8.

4.2.3 Koklass Pheasant

Twenty-nine Direct Encounters were made of this species, and twenty-four (83%) were made in the 'woodland' and 'woodland/scrub' categories. Of these, thirteen (45%) were in 'woodland/scrub' (see Table 4). Primary species in this category were R. arboreum, R. barbatum, R. campanulatum, Berberis, and Viburnum. In eight (28%) of the Direct Encounters ringal bamboo was noted. The tree height in this forest and scrub ranged from 5m to 15m, averaging 8m to 10m, and the canopy was from fully open to 75% closed. Understory vegetation consisted of ringal bamboo in the forest and Berberis bushes in the scrub. Ground vegetation in the forest, consisted of ferns, mosses, and grasses with a few herbaceous species, the density depending on canopy cover. Leaf and branch litter was deep. In the scrub areas, ground vegetation consisted principally of grasses and moss during spring. Rock exposures were common. Five observations (17%) of Koklass were in open scrub/grassland similar to that described in 4.2.1. No Koklass were encountered in pure open grassland.

Altitude: From the Direct Encounters, this species was recorded between 2700m and 3300m, which in this area appear to be the limits of

its altitudinal range. The study areas were at the upper end of this range. Data are summarised in Table 3 and Figure 8.

Slope and aspect: twenty-two of the twenty-nine Direct Encounters (76%) were made on slopes between 10° and 30°. No observations were made on flat land or ridge tops and only one Encounter was on a slope of more than 40°. With regard to aspect, all observations were made on East- or North-East-facing slopes. Data are summarised in Tables 5 and 6.

DISCUSSION

Direct Encounters with Koklass indicate that it prefers Rhododendron Forest and adjacent Berberis/Viburnum scrub with ringal bamboo on East-facing slopes between 2700m and 3300m. The factors of possible bias listed for Blood Pheasant should again be taken into consideration. The above habitat description, while typical of the study areas, seems atypical for the species when compared to Koklass habitat described in the literature. Severinghaus (1979) provides a good review of previous work on the Koklass and describes their general habitat as being "mixed hardwood-conifer forests with good under-growth". The Koklass he studied in Pakistan lived predominantly in mixed conifer forests with dense understory, but not scrub. However, Gaston (1979) reported from Dachigam Sanctuary, Kashmir, that below 2100m "Koklass were concentrated in Parratiopsis scrub, coniferous forest, particularly where mixed with Indigofera scrub and mixed broadleaved/coniferous forest". Gaston (pers. comm.) considered that Parratiopsis scrub structure bore a close resemblence to the Berberis scrub in the Nepal study areas. Both Severinghaus and Gaston were studying Koklass at lower altitudes (2200-2800m and 1830-3050m respectively) than those in the Pipar study area.

Like the other two species, Koklass appear to show preference for East-facing slopes from analysis of the Direct Encounter cards. However,

unlike Tragopan, this preference may be more real than apparent since only one Koklass was heard from South- and West-facing slopes of Pipar in 1980, and only one was seen there in 1979. At Kumai, in October 1979, Koklass were heard calling from both western and eastern slopes of the ridge. The apparent preference at Pipar for East-facing slopes is probably due to the scarcity of Berberis scrub on South- and West-facing slopes.

Severinghaus (1979) noted that Koklass occurred on slopes from nullah bottoms to ridgelines "but preferred the upper slopes and ridgelines". Other workers have made different observations, 'Pine Martin' (1910) and Bates (1936) found Koklass mainly in nullah bottoms, while Hume and Marshall (1879) and Beebe (1922) felt that Koklass preferred upper slopes. All my own Koklass observations were made on upper hill slopes, but factors such as habitat availability, seasonal movements, and disturbance are likely to affect the birds' distribution on a hillside.

4.2.4 Himalayan Monal

One hundred and eight Direct Encounters were made of this species, of which seventy-one (66%) were made in the 'grassland' category. 'Grassland/scrub' and 'grassland/woodland' accounted for a further twenty-two observations (19%), while nine (8%) were made in pure woodland. (See Table 4). Primary species on the grassland were largely unidentified but consisted principally of a tussock grass. Herb species included Mecanopsis paniculata and Primula spp. Species composition presumably varied with altitude but no details are known. Scattered Berberis and Viburnum bushes and Rhododendron trees or shrubs were often present. Adjacent 'woodland' and 'scrub' habitats are as described previously.

Altitude: this was the highest living species of pheasant studied, occurring at an average altitude of 3300m to 3400m, and ranging as high as 4000m and as low as 2800m. Data are summarised in Table 3 and Figure 8.

Slope and aspect: of the 108 Direct Encounters, eighteen (17%) were made on ridge tops, while forty-three (40%) were made on slopes of 20° to 40°; seventeen (16%) were observed on slopes greater than 40°. There was an apparent preference (41%) for slopes of a South-facing aspect, which is discussed below.
Data are summarised in Tables 5 and 6.

DISCUSSION

From all the observations made in this study, Himalayan Monal appears to favour a habitat of open grassland adjoining forest and/or scrub at and above the tree-line. While the bird clearly does not spend all its time on the open hillside, it is often very easily visible in such terrain, hence the number of sightings on grassland rather than in the forest. In addition to direct observations on grassland, the birds' feeding habits, which involve digging for roots and forming numerous digging areas, present further evidence of the species' preference for this habitat. But as with the other species described, there is a certain degree of bias in the methods of fieldwork, and the factors listed in Discussion of Blood Pheasant should be considered. In addition to the habitats described above, I have also seen the species in mixed Abies forest, open hillsides, and cultivated fields in the Khumbu valley, Everest National Park, East Nepal.

Delacour (1977) states that "The birds frequent open forests, particularly those of oak, birch, and rhododendron, with open glades and grassy slopes, where they feed". Ali and Ripley (1969) refer to "high oak, rhododendron, and deodar forest interspersed with open glades and

sheep pastures, and precipitous hillsides". Gaston (1979) at Dachigam in Kashmir observed the species in "mixed broadleaved/coniferous forest, open Kail Pine forest" and "among rocky outcrops in grassland" from 2360-3000m.

Perhaps even more than the Blood Pheasant, this species is said to move up and down with the snowline. Certainly at Pipar in September/ October 1979, when the snowline was at about 5200m the Monal was not seen below approximately 4300m until mid October, when the birds presumably began to move down from the high alpine meadows and pastures. Ali and Ripley (1969) record the Monal ascending as high as 5000m in summer.

From the Direct Encounter Records, the Monal showed a preference for the South- and South-West-facing slopes of the Pipar and Kalki Danda ridges. The bulk of the fieldwork was concentrated on these ridges, which consisted of forest and scrub on the northern and eastern sides, with open grassland and precipitous slopes on the southern and western sides. The Monal's preference for the latter habitat largely explains their affinity for South- and West-facing aspects.

4.2.5 General Discussion

A summary of the occurrence of all four species in broad habitat categories is shown in Table 4. Comparing the apparent habitat preferences of the study species, it appears that while there is a considerable degree of overlap between Satyr Tragopan, Blood and Koklass Pheasants, the Tragopan was mainly encountered in pure woodland (82% of Encounters), the Koklass was nearly equally split between woodland/scrub (45%) and woodland (38%), and the Blood Pheasant was found mainly in woodland (51%), and less in woodland/scrub (23%). The primary tree and shrub genera of Rhododendron and Berberis were common

to all three species, in addition Betula and Viburnum were common to two species. The Himalayan Monal stands apart from the other three species in that it prefers grassland (66%) and was rarely found in pure woodland (8%).

Since three and sometimes four species occur in a superficially similar habitat, it is probable that each has its own niche which is determined by its food and feeding habits. This is discussed in section 5.2

Figure 8 shows the complete altitude ranges of the four study species in the South Annapurna area. While the Himalayan Monal possesses a broad altitudinal range (2800-4000m) in the upper part of the scale, and the Saytr Tragopan shows a broad range (2230-3550m) in the lower part of the scale, the Blood Pheasant (3050-3600m) and Koklass Pheasant (2700-3300m) exhibit more restricted ranges within the ranges of the two former species. In addition, from 3050-3300m all four species overlap during the spring season (April to June). It seems therefore, that the habitats at this elevation, which lie within the Rhododendron forest and lowermost Betula utilis forest zones of Stainton (1972), and within my broad category of Mixed Rhododendron forest, must be particularly rich in potential food at this season. The areas of forest and alpine meadows above this zone are mostly still under snow until late May, so that food is not available. The two species found in the uppermost habitats, Blood Pheasant and Himalayan Monal, are therefore found just below the snowline in spring. Below the zone of overlap, food is readily available at this time, but while the Tragopan and Koklass do occur down to their lowest limits, they are also found in the rhododendron forest and scrub up to 3300m. Inter-specific competition for food is discussed in section 5.2.

4.3 Population Densities of Pheasants

4.3.1 Census Methods

Techniques for censusing pheasants and other game birds have been developed in North America and Europe to a high degree of sophistication. A number of techniques are in general use, and, when this study was planned, a review of the possible methods available was undertaken. Severe logistical constraints became apparent when planning to census pheasants in the Nepalese Himalayas, as compared with surveys in North America. These include the very steep topography, absence of roads, scarcity of trails, the small number of personnel available, and the lack of human settlements above 1800m. Techniques reviewed for possible use in the study areas included the following:

Lincoln Index - Census is by noting the ratio of marked to unmarked adults. Large scale capture of adults throughout the study area is required. Birds can be tagged with back-tags, ringed, and partly dyed if necessary. Surveys are then carried out: the first immediately after tagging, and subsequent ones at fixed intervals. The problems with this type of census are immediately apparent: it is very time consuming and would be difficult to execute over mountain forest terrain, tagged birds would be very difficult to see in forest, and the ratio of tagged to untagged birds needs to be 1:5 or higher (Bergerud and Mercer 1966).

Direct Count (a) - The area is systematically censused using line transects and dogs to locate coveys/individual birds. This method again relies on the tagging of birds and so presents the same problems as the

Lincoln Index in addition to laying a number of straight lines through forest on steep slopes.

Direct Count (b) - One or more transects are made through a study area attempting to cover all vegetation types. The observer notes all birds disturbed within a fixed distance from the line. This method was feasible in Nepal for non-vocalizing or poor-vocalizing species, but analysis of the results needs care (Gaston 1980a).

King Strip Census - Involves walking along a number of systematically spaced line transects recording the number of birds and the distances at which they flush from the observer. Problems presented are similar to those stated above.

Aerial Census - Transect lines are flown low over the study area. This method would be difficult in mountainous terrain, although it has been successfully carried out to survey mammals and birds in Russia (Kovalev, 1979). Expense and lack of aircraft ruled out this method in Nepal.

Call Count Census - Observers are spaced along paths or roads. They listen and note down the direction and calling times of birds. Individual results are compared to give an index of the population. This method appeared to be the most viable in Nepal, and it had already been used with success by Howman (1977), Mirza (1978), and Severinghaus (1979) in mountainous regions.

Other methods include observing birds or their tracks at water holes, noting tracks in snow, and noting the abundance of droppings on trails or roosts. None of these methods were used in Nepal.

Gaston (1980a), in his recent review of Himalayan Pheasant censusing techniques distinguished between Absolute methods and 'Comparative' or 'Index' methods. Due to the problems encountered in Nepal stated above, it was decided that only Index methods would be suitable for census work during the study, so the Call Count and Direct Count (b) methods were carried out.

CALL COUNT CENSUS METHOD

In the South Annapurna study areas, two of the four pheasant species, the Tragopan and Koklass males, give characteristic calls at dawn and sometimes during the day. In addition both sexes of Monal, and the Cheer Pheasant (further West), call morning and evening. A count of the calling males in a known area gives an estimate of the number of males in that area, and if the ratio of males to females is known, an estimate of the breeding population can be obtained. Alternatively, if both sexes are calling, a direct estimate of population can be determined.

The method at Pipar was similar to that used by Howman (1977); four census points were marked along the trail which passes through forest and scrub from the main campsite northwards to Kalki Danda (see Figures 4 and 5). It was considered in 1979 that four was the maximum number of points needed to effectively census the area, and in 1980 the position of point number 4 was moved to a location slightly North of the original (see Appendix 6 for description of census point locations). Census takers walked the trail in daylight and were informed at which point they were to stand; in addition they were played the calls of Koklass and Tragopan so that they fully understood what they were listening for.

On the morning of each census, each worker was required to take up position at his pre-allocated census point well before first light, to ensure readiness and so that birds were not disturbed as they were waking. It was considered that disturbance at this point could result

in non-calling.

Each worker then recorded the following details:

a) Name and census point number.

b) Date, time of start of census, time of finish (pre-arranged).

c) Weather conditions: cloud cover, wind speed, precipitation, temp.

d) The direction and approximate distance from which each individual bird called, and if possible, the time of its first and last calls.

These details were recorded on a diagram similar to that in Figure 9.

Immediately after the census was completed the workers met to analyse the results in order to eliminate any uncertainties regarding positions of birds. All the diagrams were compared, and by relating the position of each census point along the trail, the position of each bird recorded, and the time it began/finished calling, a good estimate of birds heard along that trail could be made.

In order to estimate the number of birds in an entire block of forest, it is necessary to extrapolate the results from the census along a single trail, and Gaston (1980a)gives details on how to do this. At Pipar, due to the topography of the land I considered that our censuses covered the area from the treeline down to approximately 3000m, which gives an area of roughly 2.3 km^2 of relatively uniform habitat for the Satyr Tragopan and Koklass Pheasant.

The technique is based on the assumption that all males in a certain area will call every day, which partly depends on the time of year. Kimball (1949) noted seasonal trends of crowing of the Ring-necked Pheasant (Phasianus colchicus) with a peak in May. Gaston (1980a) provides a table (here Table 7) showing the approximate calling periods of four western himalayan pheasants. Gates (1966) believed that

SPECIES: Koklass Pheasant
CENSUSER: Tony Lobbit
DATE: 20/5/79
WEATHER:
TIME START: 0415
TIME FINISH: 0530
CENSUS POINT NUMBER: 3

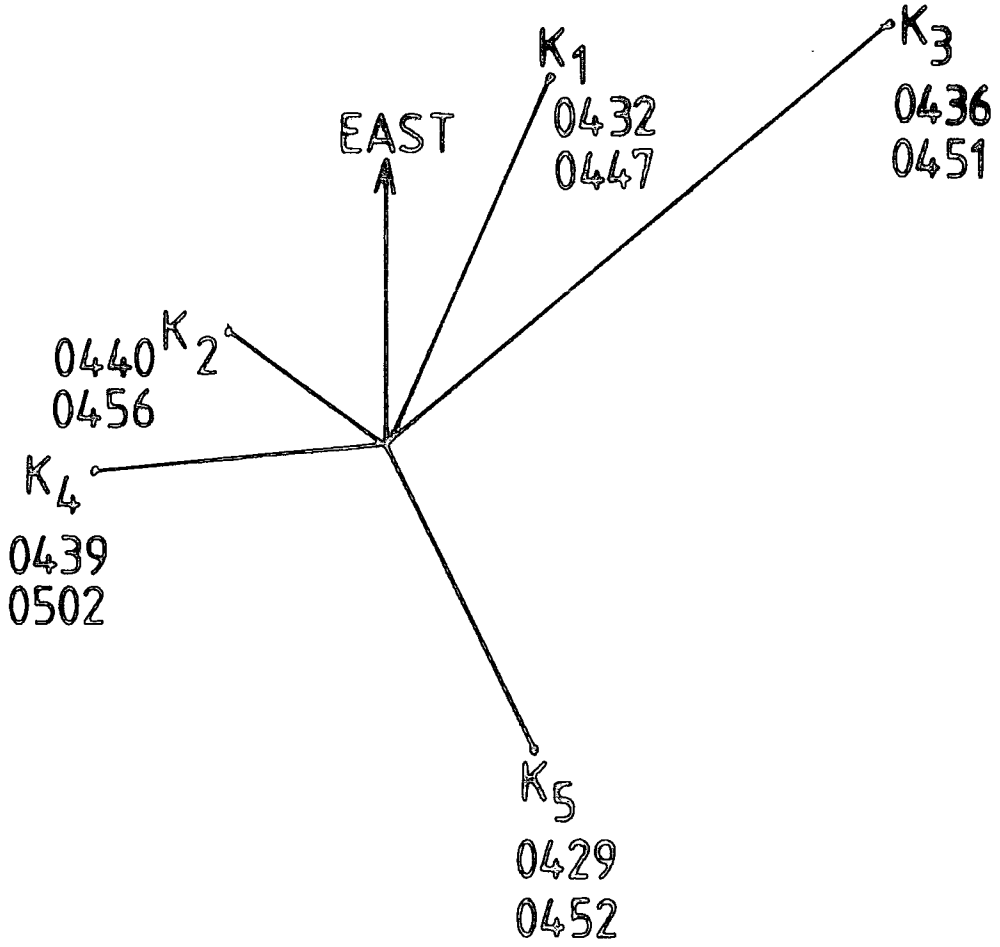


Figure 9: Example of a completed census sheet.

non-crowing was minimal in Ring-necked Pheasants in Wisconsin, however, data for himalayan pheasants is not documented. K. C. R. Howman (pers. comm.) stated that in captive Koklass, autumn calling was predominently by young males, and that captive first-year Tragopan and Monal males do not call in spring, although other aviculturalists have not noted this. The age of sexual maturity in himalayan species is not recorded, but it is possible that non-breeding males are silent in Spring.

TABLE 7 Seasonal timing of dawn calls in 5 pheasant species (Adapted from Gaston 1980a)

	J	F	M	A	M	J	J	A	S	O	N	D
Koklass Pheasant	----------										----------	
Himalayan Monal		----------								----------		
Western Tragopan			----------									
Satyr Tragopan			?	----------								
Cheer Pheasant	----------						?		----------			

A number of possible variables have to be standardised if this census technique is to be successful:

1. Time of day; calling in Tragopan and Koklass is usually restricted to a short period just before sunrise. Figure 10 shows the calling rates of chorusing Koklass males on 16 April, 24 April, and 3 May, 1980. Censusing was carried out on these species at this time since individual birds call only sporadically (if at all) during the rest of the day, and give no reliable population index, see section 6.3.4. Cheer Pheasants may possibly be censused at dusk, since they are known to call equally well at dusk as at dawn (Hume and Marshall 1879, Beebe 1937, Gaston 1980a). However, when encountered in Nepal, they never called at dusk, and only a little at dawn (see section 6.5.2).

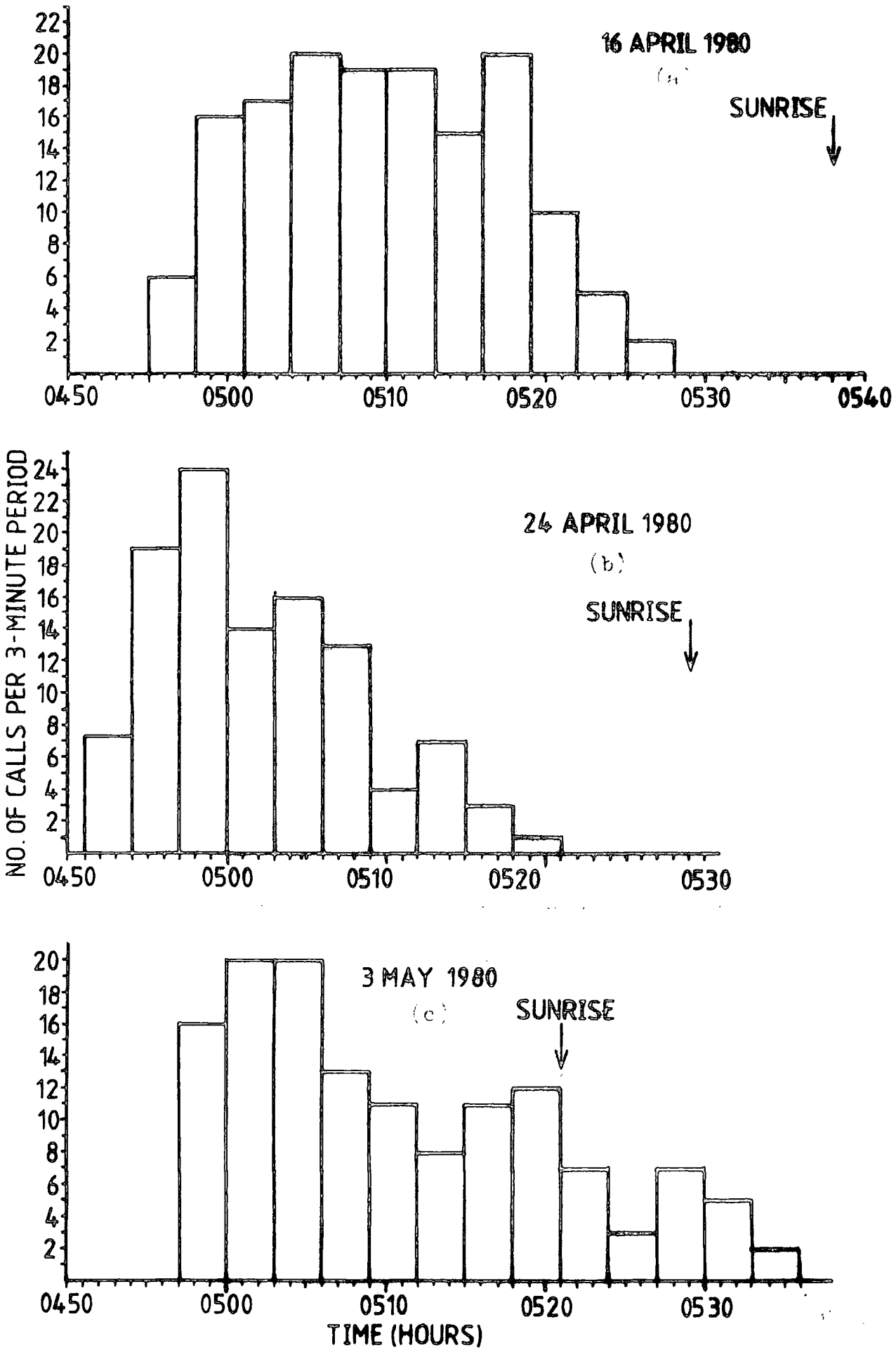


Figure 10: Records of Koklass Pheasant calling intensity for three individual mornings, expressed in crows per 3 minute period.

2. Census points: these were plotted on a large scale map in addition to being marked on the ground by a cairn or a blaze. In successive censuses, the same points should be used.

3. Weather: a number of workers (Kimball 1949, Gates 1966) stress the need for similarity of weather on days that censuses are carried out. The two most important variables are wind velocity and cloud cover, so ideally the morning should be calm and clear; censuses should never be conducted in windspeeds of greater than 13 k.p.h. In most censuses carried out at Pipar, the sky was less than $\frac{1}{4}$ covered and the wind nil.

4. Time of year: for comparison of a population from year to year, censuses should be carried out as close to the date of previous census as possible. This is in order to standardise such variables as altitudinal movement and breeding seasons.

Regarding the other two species in the Pipar area, the Blood Pheasant and Himalayan Monal, censusing was more difficult. While Monals do call at dawn, and to a lesser extent at dusk, it appears to be irregular, females call as well as males, and since first-year males are similar in appearance to females, an idea of numbers is difficult to assess. Gaston (1980a)states that in the Monal,dawn calling "appears to bear little relationship to the numbers of birds present", while P. J. Garson (pers . comm.) considers that calling is initiated only by a stimulus such as a predator. The Blood Pheasant on the other hand, has no dawn calling period and cannot be censused by this method.

Direct Count (b) appears to be the best method for the Monal, but it can only be carried out shortly after dawn or before dusk since at other times of day (unless the weather is very overcast, raining or foggy), the birds will not flush. This method is not very effective for

the Blood Pheasant however, since the species does not flush, and large coveys in winter cover a very wide area, while pairs in spring are usually parochial. The latter fact enables them to be mapped over several visits to an area, especially if individual males can be recognised (for example by the amount of 'blood streak' feathers on their breast or the number of spurs on their legs).

Population estimates are given only for the Pipar study area (except in the case of Himalayan Monal) since the time spent at the other study areas was insufficient for population surveys to be conducted.

4.3.2 Blood Pheasant

This species was roughly censused by mapping the position of each pair over the areas of suitable habitat visited up to 15 times. In April and May 1979, in an area of 2.4 km^2 (240ha) of possible habitat, an estimated population of between six and nine pairs were present. This gives an average density of 2.5 to 3.8 pairs per km^2 of suitable habitat. In April 1980, between six and eight pairs were again believed to be present in the same area, though the pairs were not frequenting exactly the same local areas as in 1979.

As far as is known, this is the first attempt to census Blood Pheasants and so no comparisons with other areas can be made. In my opinion, these figures represent a reasonably healthy population of Blood Pheasant and it should be borne in mind that the study areas lie at the western edge of the range of the species, where its numbers may be thinning out.

The species was also observed by the author in the Everest National Park in March 1980 where one covey of fourteen birds (approximately seven males and seven females), and another covey of six birds (five males and one female) were seen. However, these observations were made

prior to covey breakup for breeding, and no estimates of population density can be made.

4.3.3 Satyr Tragopan

This species was censused by the call count method in both 1979 and 1980. On 21 and 23 May, 1979 dawn counts of calling males were conducted along two kilometres of the trail running North from the main campsite at Pipar; on both occasions a total of ten birds were heard calling (see Table 8). The area censused has been measured and estimated to be approximately 2.3 km^2, giving a minimum density of 4.4 pairs per km^2 of suitable habitat, assuming monogamy. In 1980, one Tragopan census was carried out on 1 May along the same trail, but with only two counters (due to lack of manpower). A total of seven calling males were heard (See Table 8), giving a minimum density of 3.0 pairs per km^2.

TABLE 8 Censuses of Satyr Tragopans at Pipar in 1979 and 1980

Date	Number counted from each census point				Total After Correction	Weather
	1	2	3	4		
21 May, 1979	3	4	7	5	10	Sky clear, no wind
23 May, 1979	3	5	6	6	10	Sky overcast, no wind
1 May, 1980	-	-	7	5	7	Sky clear, no wind

The weather on 21 May, 1979 and 1 May, 1980 was similar, although no frost was recorded on 21 May. On 23 May, 1979 the sky was overcast, yet the same number of Tragopan were heard as on 21 May. The apparent decrease in population from 1979 to 1980 should not be taken at face value. One possible reason for the discrepancy is that the censuses were unavoidably carried out three weeks apart. The species shows seasonal altitudinal movement, and by 1 May, 1980 less male Tragopans may have reached the height of the census area than had by 21 May 1979. In addition, full territorial calls of the male Tragopan appear to

reach a peak around mid-May, so that fewer birds may be calling on 1 May than by 21 May. These points having been made, it was felt that less Tragopans were present at Pipar in April 1980 compared with April 1979 (12 Direct Encounters compared with 19 respectively). In addition, one freshly predated male Tragopan was found on 15 April 1980. It is felt that the census for 1980 does reflect a slight decrease in the Tragopan population at Pipar and further censuses are required in future years in this and other areas to compare population fluctuations.

Numbers of calling Tragopan males were also noted elsewhere around Pipar outside the census area, and on every occasion in suitable habitat below 3300m from two to six birds were heard, indicating moderate abundance (areas not measured). In addition it should be noted that the census area included forest from approximately 3000m to the tree line - the uppermost part of the altitudinal range of the species.

Although no data on Satyr Tragopan populations have been collected elsewhere, Z.B. Mirza (1978) has carried out some preliminary censuses of Western Tragopan (Tragopan melanocephalus) in Pakistan in 1977. In Salkhala Game Reserve in May 1977 Mirza recorded twelve calling males, and in addition two males and four females were flushed, giving a total of fourteen pairs (assuming monogamy) in 31 km^2 of forest, or 0.45 pairs per km^2. At Kuttan Game Reserve in May 1977, nine males were heard calling, seven males and four females were flushed - a total of up to sixteen pairs in 26 km^2 of forest, or 0.62 pairs per km^2. In Machyara in August 1977, a total of seven males and six females were flushed in an area of 8 km, although a total of 52 km^2 was surveyed. These give a maximum of 0.9 pairs per km^2. The Western Tragopan is listed as endangered in the Red Data Book (IUCN 1979), so its population densities would be expected to be low. Nevertheless, the figures for Satyr Tragopan from Pipar are encouraging, especially since the numbers of birds in the census area appear to reflect their abundance in the surrounding forests.

4.3.4 Koklass Pheasant

Like the Satyr Tragopan, this species was censused by the call count method in 1979 and 1980. On 20 and 22 May, 1979 dawn counts of calling males were carried out along approximately two km. of the trail running North from Pipar campsite. On both occasions, eleven males were heard calling (see Table 9) in the census area of approximately 2.3 km^2, giving a minimum density of 4.8 pairs per km^2 of suitable habitat, assuming monogamy. On 6 October and 11 October, 1979 similar counts totalled 6 and 8 calling males respectively, indicating densities of 2.6 and 3.5 pairs per km^2. In 1980, Koklass counts were carried out on 23 April and 1 May by two counters along the same trail. On both occasions a total of six calling males were heard (see Table 9), giving a minimum density of 2.6 pairs per km^2. On 20 May, 1979 the weather was low cloud to approximately 3300m and a temperature of c $8^{\circ}C$, while on the other three occasions it was clear and calm with a slight frost.

TABLE 9 Censuses of Koklass Pheasants at Pipar in 1979 and 1980

Date	Number counted from each census point				Total After Correction	Weather
	1	2	3	4		
20 May, 1979	5	6	7	5	11	Sky overcast. Low cloud to 3500m. No wind.
22 May, 1979	-	6	7	4	11	Sky mostly clear. Wind NW force 1.
6 Oct. 1979	-	6	4	-	6	Sky mostly clear.
11 Oct. 1979	-	7	5	-	8	Sky overcast, no wind. Rain during night.
23 April, 1980	-	-	5	2	6	Sky clear. No wind.
1 May, 1980	-	-	5	1	6	Sky clear. Wind force 1.

As with the Tragopan censuses, the apparent differences in population size between the two years should not be interpreted too literally. Factors such as the difference in date between the two years, and the smaller number of census takers should be taken into consideration. It should also be noted that the census area was at a comparatively high elevation in the species' range, and it can be assumed that the figures given are underestimates. However, it was noted that there appeared to be fewer calling Koklass present at Pipar throughout the 1980 field season than had been heard in 1979. Annual censuses of the area would be of great value in comparing future population fluctuations.

Unlike the Satyr Tragopan, Koklass were not heard calling from other areas around Pipar outside the census area. On the southern, western, and northern slopes of forest where Tragopans were heard calling, only a single Koklass was heard on two occasions. While it is unlikely that the species was entirely absent from these slopes, it may have occurred only at low densities.

A moderate amount of recent data has been collected on population densities of Koklass Pheasant in Pakistan by Howman (1977), Mirza (1978), and Severinghaus (1979). The latter author gives a good summary of population densities which I reproduce here (Table 10) having converted into metric units. The range in densities varies considerably from 1.5 to 10.4 pairs per km^2, while Severinghaus himself estimated a density of 22.5 pairs per km^2. He considers that these ranges cannot be explained in terms of habitat differences or disturbance, but instead by "the different methods used to estimate the land areas on which the densities were based". I believe this explanation to be the correct one, but while the Koklass densities determined by Howman, Mirza, and myself fall within the range of 1.5 to 10.5 pairs per km^2, Severinghaus' estimate appears to be highly anomalous. His census area

TABLE 10 Call Counts of Koklass Pheasants in Pakistan, India, and Population Densities derived therefrom (from Severinghaus 1979)

Locality	Date	No. of calling males counted	Area (km^2) Counted	Density (pairs/km^2)	Authority
PAKISTAN					
Kaghan Valley:					
Shogran	4 - 23/5/76	105	23.5	4.5	Mirza 1978
Shogran - 1	19/4/75	18	6.5	2.8	Howman 1977
Shogran - 2	20/4/75	42	8.0	5.4	Howman 1977
Kamalban	23/4/75	15	8.0	1.9	Howman 1977
Malakandi	4 - 23/5/77	33	11.5	2.8	Mirza 1978
Manshi	4 - 23/5/77	62	8.0	7.9	Mirza 1978
Galies:					
(Retli, Dunga	4 - 23/5/77	88	17	5.2	Mirza 1978
Gali, Darwaza)	late 4/79	11	0.5	22.5	Severinghaus 1979
Neelum Valley:					
Salkhala	4 - 23/5/77	60	31	1.9	Mirza 1978
Kuttan	4 - 23/5/77	40	26	1.5	Mirza 1978
Machyara	13 - 23/8/77	538	52	10.4	Mirza 1978
INDIA					
Dachigam, Kashmir	31/3 - 9/4/79	16	1.6	10.0	Gaston 1979
Kedarnath, U.P.	21/3/80	12	2.6	4.6	Green 1980
	5/80	13	2.6	5.0	Green 1980
	6/80	11	2.6	4.2	Green 1980
NEPAL					
Pipar	20 + 22/5/79	11	2.3	4.8	This study
	6/11/79	6	2.3	2.6	This study
	11/11/79	8	2.3	3.5	This study
	23/4/80	6	2.3	2.6	This study
	1/5/80	6	2.3	2.6	This study

size was "visually estimated to be 120 acres by Mr. Malek Ali Mohammed, an experienced forester", but from Severinghaus' densities I consider this may have been grossly inaccurate. Rough estimates of Koklass populations made by Gaston (1979) in Dachigam Sanctuary, Kashmir give density of approximately ten pairs per km^2. A comparison of the Pipar population densities with those from elsewhere shows that they lie in the mid range of most estimates.

4.3.5 Himalayan Monal

As noted above, this species was difficult to census, but on three occasions in 1979, Direct Counts of birds were made. On 10 May, 1979 a total of ten birds (four males, four females/immatures, two unknown) were seen and heard along a 800m stretch of Kalki Danda ridge between 3500 and 3680m elevation. The total area of suitable habitat along such a stretch was estimated to be 800 x 350m = 0.28 km^2, giving a density of approximately 37 birds per km^2 (see Table 11). On 22 May, 1979, a total of eleven birds (four males, seven females/immatures) were observed on the South-facing slope of Namrung, West of camp III (see Figure 3). They were seen in an area of approximately 0.7 km^2, giving a density of 16 birds per km^2. Finally, on 4 November, 1979, ten birds (five males and five females/immatures) were seen on the South-facing slopes of Korchon (see Figure 3). The birds were observed over an area of approximately 0.4 km^2 giving a density of approximately 25 birds per square km.

The errors involved in such estimates are likely to be very large, the main one being that at the time of day when the surveys were carried out (early morning 0530 - 0830 hours), the birds may have grouped together in high numbers over a localised area of hillside for roosting purposes, resulting in anomalously high density estimates. Because of the lack of extra manpower, other parts of the same hillside

TABLE 11 Censuses of Himalayan Monal in Pakistan and Nepal, and Population Densities derived therefrom

Locality	Date	Number of Birds Counted	Area Counted (km^2)	Density ($bird/km^2$)	Source
Pakistan:					
Kuttan and Salkhala	May 77	41	41.6	1.0	Mirza 1978
Machyara	Aug 77	50 - 61	34	1.5 - 1.8	Mirza 1978
Nepal:					
Pipar (Kalki Danda)	10 May 79	10	0.28	37	This study
Namrung	22 May 79	11	0.7	16	This study
Korchon	4 Nov 79	10	0.4	25	This study

were not surveyed to determine whether birds were present or not. However, it is felt that if surveys had been carried out later in the day when the birds had dispersed to feed over the hillside, they could only have been flushed with difficulty and many could have been missed. It should be noted that because this species may have a polygamous mating system, densities have been expressed in terms of birds per km^2 instead of pairs per km^2.

The only available data on Himalayan Monal population densities are those of Mirza (1978). Using a combination of the call count method, beating, and the use of dogs, in May 1977, he recorded a total of forty-one flushed in 41.6 km^2 in the Kuttan and Salkhala areas of Pakistan; a density of approximately 1 bird per km^2. In August 1977 at Machyara he recorded a total of fifty calling birds and eleven birds sighted in an area of 34 km^2 of comparitively gentle slopes, giving a density of 1.5 to 1.8 birds per km^2. Mirza also noted the difficulty of censusing these birds. In comparison to the densities I have noted at Pipar and Korchon, those of Mirza appear very low. But

while my own densities are probably over-estimates, I believe that Mirza's may be underestimates if surveys were carried out later than c 10.00 hours on clear days, when my own observations indicate that Monal feed less on open slopes and are only flushed with difficulty (see section 5.3.4).

4.4 Habitats and Occurrence of Pheasants in the Athhazar Parbat Region

Fieldwork was carried out between 2100m and 2600m above Khibang, Dara, and Muri villages (see Figure 6). Due to the lack of time available, no systematic data was collected on the habitats visited, but the area lies within the 'Dry Oak' (Quercus lanuginosa) forest division of Dobremez and Jest (1971). The habitat was subjected to considerable human disturbance in the form of crop cultivation (millet and wheat) up to 2320m altitude on South-facing slopes, and 2170m on North-facing slopes. Further disturbance was caused by the very large amount of wood-cutting for fuel and to a lesser extent, for building purposes; the grazing of sheep, goats and cattle; and the annual burning of grassland to stimulate new grass growth. Immediately above the limit of cultivation there was a zone of Berberis scrub with Quercus lanuginosa and Rhododendron arboreum. This was gradually succeeded by fuller forest of these species and others such as Symplocos sp. and Lyonia sp. in open to closed canopy up to 6m in height. However, most of this forest was heavily grazed by livestock throughout the year, with the result that understory and ground vegetation were light, and in some places completely absent.

Much of the country above the limit of cultivation consisted of steep, grass-covered and bare cliffs with small ledges. These ranged in gradient from 45° to vertical and in places held small patches of stunted trees and bushes. The grass covering was a tussock grass and appeared similar to that seen at Pipar and elsewhere further East.

4.4.1 Cheer Pheasant

Although this species was said by local villagers to be present in the forest and on cliffs above Khibang, Dara, and Muri villages, it was only located above the latter. Here it was seen and heard from 14 to 17 May, 1980 in open scrubby forest and grassy cliffs from approximately 2200m to 2440m altitude on East- and North-facing slopes above cultivated fields. Birds were only seen on four occasions, but heard on three more, always from the same area of hillside. Above Dara village the habitat was similar to that above Muri, and was situated just over the top of the hill, facing South. Sherpa Ram Kaji Mangar had seen and heard Cheer in this area in September 1977, but although we searched and listened from 10 to 13 May, we could not locate any. The area above Khibang village, on the opposite side of the Myagdi valley was visited from 16 to 18 August 1979, but no Cheer were seen or heard, probably because they do not call during the monsoon period. It was visited again for one evening/morning on 17/18 May, 1980, but no Cheer were located on this occasion either. In this locality the forest was similar to the other areas, and the slopes mostly faced North and West.

The above observations generally support those found in the literature concerning Cheer Pheasant. For instance Beebe (1922) stated that "The Cheer is extremely locally distributed, and seems to me very capricious in its choice of habitations: on one side of a river you meet with plenty in suitable spots; on the other side you may search 50 square miles of likely-looking country and never see one". Delacour (1977) describes its habitat as "wild country, haunting precipitous ravines, broken hillsides and cliffs with light and stunted forest, brush and grass."

With regard to the population of Cheer Pheasant in the area above

Muri, on only one occasion did the birds call sufficiently to provide a population index. Unlike those described by Gaston and Singh (1980) and others, the birds did not call regularly at dawn and dusk, but at 0815 on 14 May, 1980, four separate individuals were heard calling across an area of approximately 700m from cliff and forest at approximately 2230m altitude. Although Finn (1915) and Delacour (1977) state that the species occurs in parties of up to 15 birds, Gaston and Singh (1980) report that "in April, practically all appeared to be in pairs". An estimate of numbers in the Muri area would then appear to be approximately four pairs in 0.5 km^2. This figure should not be extrapolated over a larger area however, until more surveys have been carried out in the Athhazar Parbat region since the very local nature of its occurrence precludes even an approximate estimate of the population density of this species.

4.4.2 Other Species

In the areas visited in this region, only one pheasant species other than Cheer was encountered. This was a single Koklass male heard calling at dawn on 11 and 12 May at 2600m in stunted Quercus forest, above Dara village.

5. FOOD AND FEEDING BEHAVIOUR

This section deals mainly with reports from the literature, and, to a lesser extent, my own observations. The accounts in the literature are usually very general, and often quote reports of previous authors without acknowledgement. Pheasant species appear each to have a fairly wide range of diet over the whole year, but at a specific season it is probably much more restricted. A discussion section follows the reports on diet and feeding behaviour of individual species.

5.1 Diet

5.1.1 Blood Pheasant

See Tables 12 and 13. The accounts in the literature indicate that principal food items taken by this species are mosses, buds, young shoots, lichens, seeds, fruits, and insects. Although this is a rather general list, it should be noted that roots, tubers and grubs were never recorded as being present in its diet, and that leaves were unimportant. Beebe (1922) provided a useful, more detailed description of food items taken in April. He observed Blood Pheasants leaping at lily stems and seed cases at the edge of deep snow, knocking out the contents and eating them. When the birds had moved elsewhere, examination of the seed cases revealed the following contents: earwigs (Order Dermaptera), ladybird (coccinellid) beetles, dipterous larvae, spider, flies, staphylinid beetles, chrysomelid beetles, carab beetles, weevils, moths, mosquito, homopterous insect, and seeds.

Cheng (1963) provided the following list of items found in the stomachs of shot Blood Pheasants in China: Fragaria chiloensis, wild onions, primroses, Pedicularis resupinata, grasses, Clematis,

TABLE 12 Food items of different pheasant species as reported in the literature

Food Type	SPECIES				
	Blood Pheasant	Satyr Tragopan	Koklass Pheasant	Himalayan Monal	Cheer Pheasant
Seeds	ac[2]f[5]kmo	aj[3]	cefhjko	ceijk	cejk
Grain	a	-	h	-	ej
Fruits	abc[2]fkl	aj[3]m	cefhjk	cefjkm	cejk
Acorns	-	j[3]	efj	ef	-
Flowers	-	f	efk	-	-
Leaves	c[2]hkm	afijmlo	cefhjko	cei	gk
Buds/ Young Shoots	f[5]jm	dfj[3]mo	cfjk	eijk	k
Mosses	c[2]hijmo	o	efo	-	o
Lichens	jn	-	-	-	-
Fungi	i	-	-	f	-
Roots	-	j[3]o	efk	efjkm	ejkm
Tubers/Bulbs	-	d	j	fjlm	gjm
Pine and Juniper Tips	b[1]k[1]n	-	-	-	-
Grass	aio	o	ko	-	-
Insects	f[5]hkmno	dfj[3]m	cefjm	cfjko	cefjk
Grubs	h	-	-	e[4]fjkm	ecfjkm

Notes:
a - Hodgson (in Hume and Marshall 1879)
b - Hooker (1854)
c - Blanford (in Hume and Marshall (1879)
d - Hume and Marshall (1879)
e - Wilson (in Hume and Marshall 1879)
f - Beebe (1922)
g - Whistler (1926)
h - Cheng (1963)
i - Hellmich (1968)
j - Ali and Ripley (1969)
k - Wayre (1969)
l - Fleming et. al. (1976)
m - Delacour (1977)
n - Grahame (in Delacour 1977)
o - This study

1 - January
2 - September
3 - Western Tragopan
4 - Autumn
5 - April

Underline indicates that food item is regarded as important by author.

TABLE 13 Food Items present in pheasant droppings detected by simple faecal analysis

Species (number of samples)	Food Items (number of samples in which present)									
	Mosses	Roots	Grasses	Leaves	Buds	Seeds	Lichens	Unidentified	Insect Parts	Quartz Grains
Blood Pheasant (31)	31	-	1	-	-	1	-	25	2	19
Satyr Tragopan (9)	1	3	3	4	6	-	-	-	-	4
Koklass Pheasant (7)	2	-	7	1	-	-	-	7	-	-
Himalayan Monal (33)	33	33	-	1	-	1	-	33	1	24
Probable Satyr Tragopan (6)	4	1	2	4	-	-	3	-	-	5
Probable Koklass (3)	1	-	1	3	-	-	-	2	-	3

Thalictrum minus, Aletris japonica, Hemistepta lyrata, crowfoots, buttercups, Lonicera kunglana, L. koehneana, etc. Also beetles, larvae, and molluscs. The stomach contents of 14 Blood Pheasants shot in Khumbu, East Nepal, (Hellmich 1968) revealed much moss present in four, grass in two, fungus in two, and unidentified green plant material present in seven.

My own observations of feeding Blood Pheasants were quite extensive, and the birds were usually seen pecking at mosses, leaf litter, and grass. The results of superficial analysis of faeces collected in both autumn 1979 and spring 1980 are shown in Table 13, and they indicate that at Pipar, moss was the most important food item taken, although much unidentified vegetable matter and two insect wing cases were also present. Very fine quartz grains were present in most of the droppings, and these are probably used for grinding the vegetable matter in the stomach to facilitate digestion. These grains were smaller than those found in the droppings of the other pheasant species examined. Undoubtedly, there are seasonal changes in the principal food items taken, and these probably reflect food availability at different times of the year.

5.1.2 Satyr Tragopan

See Tables 12 and 13. From the reports in the literature, this species prefers to feed on leaves, buds, young shoots, fruits, seeds, insects, and to a lesser extent acorns, flowers, roots and tubers. This list of food items is similar to that of the Blood Pheasant, but it differs in that leaves and young shoots appear to be the most preferred vegetable food, and that moss was never recorded in their diet. Beebe (1922) recorded the stomach contents of three shot Satyr Tragopans: two held many torn leaves and flowers of 'paper laurel', and one of these had also eaten a number of insects - several small

earwigs, black ants, a good sized cockchafer, spiders, and a small white centipede. The third bird contained rhododendron flower petals and laurel leaves. Fleming et. al. (1976) report a Tragopan's crop full of the fern pinnae of Dryopteris wallichiana.

My own observations of feeding Tragopans showed marked differences between spring and autumn in the sort of items taken. Almost all the feeding birds sighted in the spring seasons of 1979 and 1980 were feeding on the ground, usually in streams and leaf litter. It is likely that insects would be plentiful at these sites as well as young shoots and seeds. In autumn 1979, eleven of the fifteen birds seen feeding were in trees or bushes, and were observed feeding on Berberis berries and Symplocos berries. Trees of the Genus Symplocos were very common on the area of ridge below Kumai hill, where we made a camp in November 1979. Tragopans (mostly females and/or immatures) were seen feeding in these trees every day from 5 to 9 November, sometimes only 15m from my tent, and they showed a marked attraction to the Symplocos fruits. The results of superficial faecal analysis carried out in autumn 1979 (Table 13) indicate that moss, lichen, leaves, grass, and roots were taken by the Tragopan, as well as some insects. While in spring 1980, buds were the main food item, with a little grass. The quartz fragments present in the droppings ranged up to 2mm in size. Clearly these faecal remains represent only a small proportion of the full diet of the Tragopan, and this is likely to vary considerably throughout the year.

5.1.3 Koklass Pheasant

See Tables 12 and 13. From the literature accounts, the Koklass shows food preferences similar to those of the Tragopan, including leaves, insects, seeds, fruits, and to a lesser extent acorns, flowers, buds/young shoots, mosses, roots and tubers in its diet. Shou Chen-huang (in Cheng 1963) reported the following stomach contents of two Koklass

Pheasants shot in China: Selaginella ferns, maize, seeds and fruits of solenaceous plants, seeds and tender leaves of pine, spruce, and others. The degree to which the Koklass is insectivorous is in dispute: according to Wilson (in Hume and Marshall 1879), Blanford (1898) and Wayre (1969), they are principally vegetarians. However, Beebe (1922) reported that they "prefer insect food to all else, and spend much of their time in search of it", and Delacour (1977) considers that they are more insectivorous than most pheasants.

My observations of feeding Koklass were limited to one sighting. This was of a female scratching in leaf litter adjacent to and within a small stream in April 1980. Tragopans and Blood Pheasants had been observed feeding at this site on occasions in 1979. Simple analysis of Koklass droppings collected in autumn 1979, (Table 13) revealed leaf, grass, and moss fragments, seeds and quartz fragments. Analysis of droppings from spring 1980 revealed mainly grasses, with a few large moss leaves. If they had been eating insects, at least some traces should have been visible in the faeces, as in those of the Tragopan.

5.1.4 Himalayan Monal

See Tables 12 and 13. The reports in the literature show that the food items taken by the Monal include roots, tubers/bulbs, insects, grubs, fruits, and to a lesser extent seeds, acorns, leaves, buds/young shoots, and fungi. This list differs from the other species, in that roots and tubers/bulbs are the most important food items, while leaves seeds and others are less important. Beebe (1922) reported that shot Monals' crops were full of tuber material which was very hard. He noted that "the edges of the upper mandible must perform an important function in cutting and splitting vegetable tissues of such firm consistency". Hellmich (1968) recorded the following items present in the stomachs of six shot birds in Khumbu, East Nepal: green leaves,

shoots, grass, buds, and seeds. Ali and Ripley(1969) specify berries of Cotoneaster microphylla being taken by the Monal.

All my observations of feeding Monal were of birds digging for food. In a number of cases when the digging areas were examined, the birds were found to have been pecking at the roots and tubers of herbaceous and woody plants which included Mecanopsis paniculata (Himalayan Poppy) and Arundinaria sp. On other occasions, the pheasants appeared to have been feeding on grass roots, moss, and possibly insects and grubs in the topsoil. In October 1979, a Monal was seen feeding on moss on a rocky surface. A sample of the moss was collected, and has been kindly identified by Mr. A. Eddy of the British Museum (Natural History) as being Rhacomitrium crispulum mixed with some Bryum sp. Simple faecal analysis carried out in autumn 1979 (Table 13) revealed mostly tuber fragments present in the Monal droppings, with some seeds, leaf fragments, and quartz grains less than 1mm in diameter. Analysis of droppings collected in spring 1980 showed mainly large moss or liverwort fragments with numerous rhizoids.

5.1.5 Cheer Pheasant

See Table 12. The accounts in the literature record that the Cheer feeds mainly on roots, tuber/bulbs, grubs, insects, and, to a lesser extent on seeds, fruits and grain. These food items are similar to the preferences of the Monal, but since their altitudinal ranges hardly overlap, the two species are unlikely to be in competition with each other. Beebe (1922) reports that the crop of a bird which was shot while digging revealed eleven wire worms and six cockchafer grubs. I made no observations of feeding birds during this study, and no faeces were found.

5.2 Discussion

In wild unmanaged populations of the Common Pheasant Phasianus

colchicus, the types of food items taken throughout the year vary according to the seasonal availability of food. The general seasonal pattern is of grass, leaves and roots taken during the winter and spring, seeds and insects taken in the summer, and grain, seeds, and fruits taken during the autumn (Collinge 1924-27, Hammer et. al. 1958, Lachlan and Gray 1973). Himalayan pheasants are likely to show similar seasonal changes in diet, and some evidence for this was seen in the Tragopan (section 5.1.2) and the Monal (section 5.1.4).

As has been stated previously (section 4.2.5), all four pheasant species present in the main areas can occur in similar habitat in the zone of their altitudinal overlap (3050m to 3300m) during the breeding season. However, it is unlikely that they are ever in direct competition for food since their food preferences, although overlapping with each other, are all slightly different, as follows:

Blood Pheasant: small mosses, grasses, seeds, and insects.

Satyr Tragopan: leaves, buds/shoots, insects, and fruits.

Koklass Pheasant: grass, leaves, seeds, insects, and fruits.

Himalayan Monal: roots, tubers/bulbs, large mosses, insects, grubs and fruits.

The two species with the most similar food preferences would seem to be the Koklass and the Tragopan. It is possible that they are in competition for food in the winter, when it is scarce, but for the rest of the year there is likely to be an abundant food supply, sufficient for both species. In addition, although only one sighting of a feeding Koklass was made, it is likely that this species feeds in more open areas than does the Tragopan (section 5.3.3.).

Further West, the Cheer Pheasant overlaps altitudinally with the Koklass and Tragopan, but neither were heard in the area where we located the Cheer. Moreover, it is unlikely that they are in competition

for food with a species that principally digs for roots, tubers, insects, and grubs.

Regarding animal food, P. colchicus is reported to take up to 20% (by volume) in August/September (Lachlan and Gray 1973), 43% in June/July (Collinge 1924-27), while Hammer et. al. (1958) recorded insects present in 60% of crops in June. Himalayan Pheasants are all reported to consume animal food, and I confirmed this for the Blood, Tragopan, and Monal. I consider that while the Monal may actively dig for insects and grubs, the other species eat them only when they come across them in their search for vegetarian food. Exceptions to this may occur where there is a super-abundance of insect food. Animal food probably forms a small but constant proportion of the items taken by himalayan pheasants, becoming more important in the summer months, in a similar way to insects in the diet of the Red Grouse Lagopus lagopus scoticus in Northern England (Butterfield and Coulson 1975).

5.3 Feeding Behaviour

5.3.1 Blood Pheasant

The Blood Pheasant was observed feeding at all times of the day, and the species did not appear to have any special feeding periods. However, it will be shown that the birds are most mobile between 0700 and 1000 hours, with significantly less mobility during the afternoon (section 6.1.3). If feeding is related to 'mobility' it would appear that feeding is greatest during the morning period 0700 to 1000 hours. However, non-mobile birds could also be feeding actively.

Of 46 occasions when the nature of a bird's activity could be determined, 36 (78%) encounters were with feeding birds. They fed by pecking at the ground, raising their heads only a little after each peck, although on some occasions wary birds assumed an upright, alert

posture after each series of about five pecks. Arboreal feeding was common; birds often fluttered or jumped up to a low branch of a tree or bush, and pecked at the moss covering. This was often done when birds were aware of an observer's presence; perhaps moving to a site above ground gave them some degree of security.

Blood Pheasants were never observed scratching at the ground with their feet in the manner of the domestic chicken (Gallus gallus) or the Common Hill Partridge (Arborophila torqueola). Neither were they ever seen digging in the ground with their bill. On one occasion (15 May, 1979), a male Blood Pheasant was observed twice jumping off the ground vertically, neck outstretched, in order to catch flying insects. However, on no other occasions were birds actually seen eating insects. Drinking was observed on only one occasion, 19 April, 1980, when the female bird of a pair crossed a small snow patch and pecked at it about seven times, tipping its head back slightly to swallow the melted snow.

5.3.2 Satyr Tragopan

The Tragopan was seen feeding at most times of the day, except between 1000 and 1200 hours. Beebe (1922) and other workers have reported that feeding takes place mainly in the early morning and the late afternoon, and my observations reported later, indicate greatest mobility before 0700, with a smaller peak during the mid afternoon (section 6.2.3). Of the 29 sightings of feeding birds (all made in forest habitat), 10 (34%) were feeding in damp areas or small streams, 10 (34%) were feeding in dry leaf litter, and 9 (32%) were feeding in bushes or trees. When feeding in streams or leaf litter, birds would scratch litter and debris backwards with their feet, in the manner of domestic chickens, and peck at what was revealed by this action. The technique was observed on only two occasions, but droppings, and other

evidence of Tragopans feeding in stream courses and damp areas, were seen on numerous occasions. When feeding in trees in spring, Tragopans were seen plucking and eating leaves and buds, while in the autumn, arboreal feeding was principally on fruits. Like the Blood Pheasant, this species was never seen digging for food with its bill.

5.3.3 Koklass Pheasant

Due to its very shy nature, the Koklass was seen feeding on only one occasion, although it was disturbed on a number of occasions when it was probably feeding. It is not reported to have any specific feeding periods, and my data regarding mobility levels (section 6.3.3) are heavily biased in favour of the early morning. The only bird observed feeding undisturbed was a female watched from a hide on 12 April, 1980. While feeding in a small stream, she acted in a very similar way to a Tragopan, scratching backwards with her feet, and pecking at the revealed litter. Later on, when feeding in dry leaf litter, she was walking very slowly, deliberately, and silently, pecking occasionally at the ground. It is likely that Koklass feed more quietly than either the Blood Pheasant or the Tragopan, since these species were often located while feeding, due to the noise they made in the leaf litter.

Unlike the Tragopan, it is likely that the Koklass feeds more often in scrub and at the edges of the forest (Severinghaus 1979). Probable feeding birds were disturbed from such locations on eight occasions, and in Gharwal, Beebe (1922) recorded pairs not uncommonly going out on to open rocky slopes and scratching deep holes in the turf. Similarly, M. W. Ridley (pers. comm. 1980) observed Koklass on cliffs and in a clearing on two occasions in Himachal Pradesh, in September 1980. Arboreal feeding was not observed in my study except for a female Koklass pecking at moss on a tree branch. This appeared to be a displacement activity rather than feeding (section 6.3.4).

5.3.4 Himalayan Monal

The Monal was observed feeding at all times of the day, and my observations regarding mobility indicate that the species was mobile throughout the day (see section 6.4.3). Of the 55 observations of feeding birds, 42 (76%) were feeding in grassland, 8 (15%) were feeding in woodland, and 5 (9%) were in scrub. However, it was noticeable that the incidence of birds feeding in open grassland was related to the weather, as shown in Table 14. When the sky was clear and the sun was shining, Monals were observed feeding in grassland only before 0900 hours, and generally before 0800 hours. However, if the sky was overcast, and especially if low cloud (fog) was present, Monal were seen feeding on open grassland at any time of day. Birds feeding in woodland and scrub were encountered at any time of the day whatever the weather.

It appears that Monal feed on open grassland in the early morning, often before sunlight has reached the slopes. If the rest of the morning is clear, it is likely that they then move to feed in woodland and scrub, where they are less easily encountered. If the day becomes overcast, with low cloud and/or rain (the usual pattern of weather at Pipar, see section 2.2), Monals return to or continue to feed on the open slopes. Qualitative observations of this nature have also been made by the Himachal Wildlife Project team, in Himachal Pradesh (M. W. Ridley pers. comm. 1980). I consider that this behaviour is due to the large size of the species and the male bird's conspicuous plumage (section 6.4.2). In the early morning, the sun is weak, is at a very low angle and casts long shadows; in addition, thermals are likely to be weak or absent at this time of day, so that large aerial predators such as eagles and vultures cannot use them (no large raptors were ever seen soaring before 0830 hours). The Monal therefore, can feed on open slopes without being too conspicuous, and there is less

TABLE 14 Incidence of Himalayan Monal feeding in different habitats in relation to weather conditions

Grassland		Woodland/Scrub	
Sky Clear	Sky Overcast	Sky Clear	Sky Overcast
0825**	1150+*	0630	1455[4]*
0550[1]**	0855+*	1240*	0920*
0905[2]* **	0800+**	0900*	1450[3]*
0600 3*	1720*	0615**	1450*
0710**	1620+*	1320*	1300*
0625*	1735+*		1525**
0550[1] 1*2**	1620+* **		1535* **
0600*	1440* **		
0848*	0930* **		
0440* **	1125+		
0615*	0745+* **		
1735-1810*	0450+*		
0545* **	1220+* **		
0815* 3**	1630*		
0600* **	1735**		
0650	1700[3]*		
0545 2*2**	1705+[3]*		
0545* **	0800+*		
	1445+*		
	1545+[3]**		
	1715 3**		
	1800-1850* **		
	1745-1830* 2**		
	0530-0610* **		
	1655-1850*		
	0950+* **		

Notes: 1 - Bird in shade
2 - Birds under bush
3 - Rain
4 - Hail

* - Male
** - Female

Figures indicate time of day (hours)

probability of attack from raptors. If the day continues to be clear and sunny, Monals feeding in the open are very exposed to view and prone to predation; therefore they move into scrub or wooded areas to feed in cover in such conditions. When it is overcast, foggy, or raining, Monals are much less easily seen, and therefore they move out to feed on open slopes again. This hypothesis makes a number of assumptions, including the following: (1) Monals prefer to feed on open slopes, (2) Both sexes act similarly despite the female's more cryptic coloration, and (3) Monals are more prone to predation on open slopes than they are in the forest.

Monals feed mainly by digging with their powerful bills, sometimes alone, but often in pairs or groups. At Pipar, no more than pairs and trios of birds were ever seen digging together, but in the Everest National Park, ten to fifteen birds were seen digging in a single group of fields. The digging technique involved pecking hard at the ground in order to dislodge earth and roots, and then scratching the loosened earch backwards with their feet. Birds were seen feeding on tubers in the ground, and also on food items dislodged by the pecking and scratching action. More casual feeding, involving pecking at moss, herbs, and grass leaves was also observed on a number of occasions. Arboreal feeding was never observed in the Monal.

5.3.5 Cheer Pheasant

Feeding in the Cheer Pheasant was not observed in my study except by Ram Kaji Mangar, a sherpa in my employment. He saw a male Cheer feeding in Dry Oak woodland on 14 May, 1980 at 1350 hours, and a female feeding on grassland on 16 May, 1980 at 0520 hours, but no details of feeding technique were recorded. Cheer are reported to feed mainly in the morning and evening, by digging in a manner similar to the Monal, and to have favourite digging places (Wilson in Hume and Marshall 1879, Beebe 1922).

6. BEHAVIOUR AND VOCALIZATIONS

This section deals with daily and seasonal patterns of behaviour of the five principal pheasant species studied. It concentrates on the information I obtained from wild birds in Nepal, and relates this to published observations made by other workers on both wild and captive birds. In addition, some useful material was obtained from individual members of the World Pheasant Association who replied to a short questionnaire sent to them. A copy of the questionnaire is included at Appendix 3.

6.1 Blood Pheasant

6.1.1 Wariness

This species was the least wary of all the five pheasants studied. In 53 Direct Encounters the cumulative amount of time for which I observed Blood Pheasants was approximately 1040 minutes, with an average observation time of 20 minutes per Direct Encounter. This alone gives some indication of the comparative ease of observation when compared to the other species (sections 6.2.1, 6.3.1, and 6.4.1). Most authors consider it to be of a confiding nature: Beebe (1922) stated that it is "not wary unless persecuted"; Ali and Ripley (1969) asserted that it is "tame and fearless to the point of stupidity, the members of a covey .... allowing bird after bird to be killed by the ambushed hunter". However, Beebe's point "unless persecuted" seems to be important in determining the bird's wariness, since Hooker (in Hume and Marshall 1879) described them as "very wild", and it can be assumed that the birds would develop some degree of cautiousness if heavily hunted by Man. My own observations suggest that the Blood Pheasant's wariness varies from individual to individual and depends

on the suddenness of approach to the bird. On a number of occasions in spring 1979, a covey of up to three pairs was approached, photographed, and recorded at a distance of 3m. Other pairs in the area, however, showed considerable alarm on being approached by a human, and usually retreated. In autumn 1979, coveys were rarely seen, and none were tame, while in spring 1980 only one pair was as approachable as those seen in 1979. In general, if birds were startled by sudden approach they would call in alarm and retreat, but if approach was gradual, with slow movements, the birds would often remain feeding, or watch the observer inquisitively.

6.1.2 Protective Behaviour

Escape - As described above, the reaction of the Blood Pheasant to Man was variable, but on close approach the bird would retreat. In every case, escape was on foot away from the observer, and birds were seen flying only up to or down from a low tree or bush, from which they would stare at the intruder. In addition, on 17 April, 1979, a male Blood Pheasant was seen flying approximately 30m over the camp down to the South-East out of sight. These observations of ground-escape are consistent with those from the literature: Hume and Marshall (1879) described the bird's flight as "short and feeble"; Ali and Ripley (1969) noted that it is a "swift and strong runner .... loth to take wing", while Delacour (1977) confirmed that "they rely on their legs to escape". Beebe (1922) however, observed that when suddenly alarmed, the covey would flush and scatter, but with less abrupt alarm the birds would run on foot "necks outstretched, heads and tails held rather high". It is possible that his first observation was made on open ground, in which case the birds might flush towards cover.

When a pair was escaping on foot through woodland, the noise made by the birds' feet, by disturbing leaf litter, was considerable. In

addition, one or both of the birds would often call in alarm. They usually stopped after retreating 10 to 15m away, and commenced feeding, uttering call types 1, 2, or 3. Such vocalizations (see section 6.1.4) were of great help in locating pairs or coveys in dense scrub or forest.

Reactions to other predators - Response to possible predators other than Man was only seen on one occasion. On 21 May, 1979 a single male was observed feeding for ten minutes. During this period an adult Lammergeier (Gypaetus barbatus) flew low (30m) over the scrub in which the bird was feeding. At the sound of its wings the Pheasant looked upwards and stood motionless without calling, but did not crouch down; the bird having passed over, the Pheasant resumed feeding. Beebe (1922) documented a similar observation in which an eagle flew over; in this case, a male Blood Pheasant squatted, turned its head sideways, and stared at the sky, remaining motionless for three minutes until the bird passed over.

Cryptic Coloration - The female Blood Pheasant shows ideal cryptic coloration for a forest bird, being an almost uniform brown, with fine streaks. On the other hand, the male shows a degree of both cryptic and phaneric colouring, for although parts such as the tail and breast are brightly coloured (streaked red), the overall impression of grey and green appears cryptic and disruptive when viewed in scrub and woodland. In display, the male puffs out his feathers to draw attention to his phaneric colouring,while in Beebe's observation of the Blood Pheasant's reaction to the eagle (see above), he noted that all the bird's red coloration remained hidden while it was in the crouched position.

Interspecific Communication - Severinghaus (1977) reported that the alarm call of Steere's Babbler (Liocichla steeri) probably had an effect on Swinhoe's Pheasant (Lophura swinhoei) and Mikado Pheasant

(Syrmaticus mikado), and may have caused them to escape or become silent and immobile; although he had no direct evidence to support this. On 19 April, 1979, I noticed that the alarm calls of Tits (Paridae) caused a pair of Blood Pheasants to become alert, looking around warily, but after 5 to 10 seconds they resumed feeding. On 14 May, 1979, I observed a single male react in a similar manner on hearing the alarm calls of passerines.

6.1.3 Daily Life

Mobility Levels

Table 15 shows the number of sightings of Blood Pheasant throughout the day. These may be partly biased by my own daily movements, in two main ways: (1) Generally, I made longer and more frequent attempts at observation in the morning period than in the evening; and (2) Morning observation attempts were sometimes made on different days from those in the evenings. Both of these sorts of bias were made due to better weather conditions occurring in the mornings than in the afternoons and evenings, making observation both more likely and more pleasant. For analysis the day was divided into five equal parts: 04.00-07.00, 0700-10.00, 10.00-13.00, 13.00-16.00, and 16.00-19.00 hours (see Figure 11). It was found that there was a significant difference in the number of observations between these intervals (X^2 = 19.29 v=4, p=0.1). The pattern of sightings throughout the day may be a measure of the mobility of the pheasants, since mobile birds are likely to be more easily seen. It then appears that mobility is greatest during the morning with a peak between 07.00 and 10.00, and is significantly less during the afternoon.

TABLE 15 Sightings of Blood Pheasant in relation to Time of Day, 1979 and 1980

Time of Day	Number Sighted
04.00 - 05.00	-
05.00 - 06.00	6
06.00 - 07.00	5
07.00 - 08.00	8
08.00 - 09.00	7
09.00 - 10.00	6
10.00 - 11.00	-
11.00 - 12.00	4
12.00 - 13.00	7
13.00 - 14.00	-
14.00 - 15.00	2
15.00 - 16.00	1
16.00 - 17.00	3
17.00 - 18.00	2
18.00 - 19.00	-
Unknown	2
	53

Roosting

I never observed this species roosting, but Beebe (1926) noted that it roosts communally in firs in winter and in low rhododendron bushes and scrub in spring. Grahame (in Delacour 1977) saw Blood Pheasant fly "up to roost at the top of a 20 foot tree", and he has subsequently reported (pers. comm. 1980) the species roosting in low trees and bushes. Hooker (in Hume and Marshall 1879) reported of this species that "during winter it appears to burrow under or in holes amongst the snow, for I

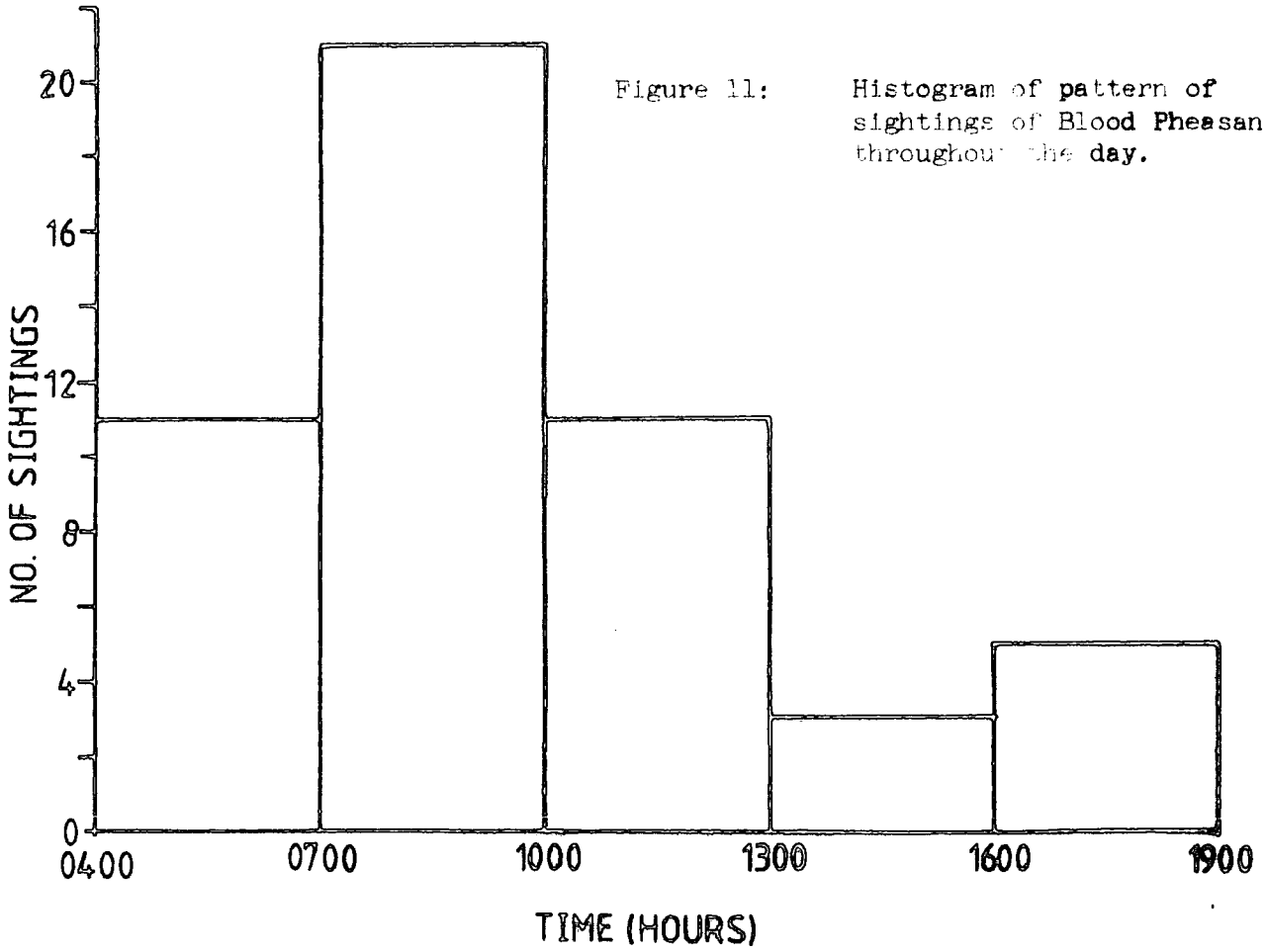


Figure 11: Histogram of pattern of sightings of Blood Pheasant throughout the day.

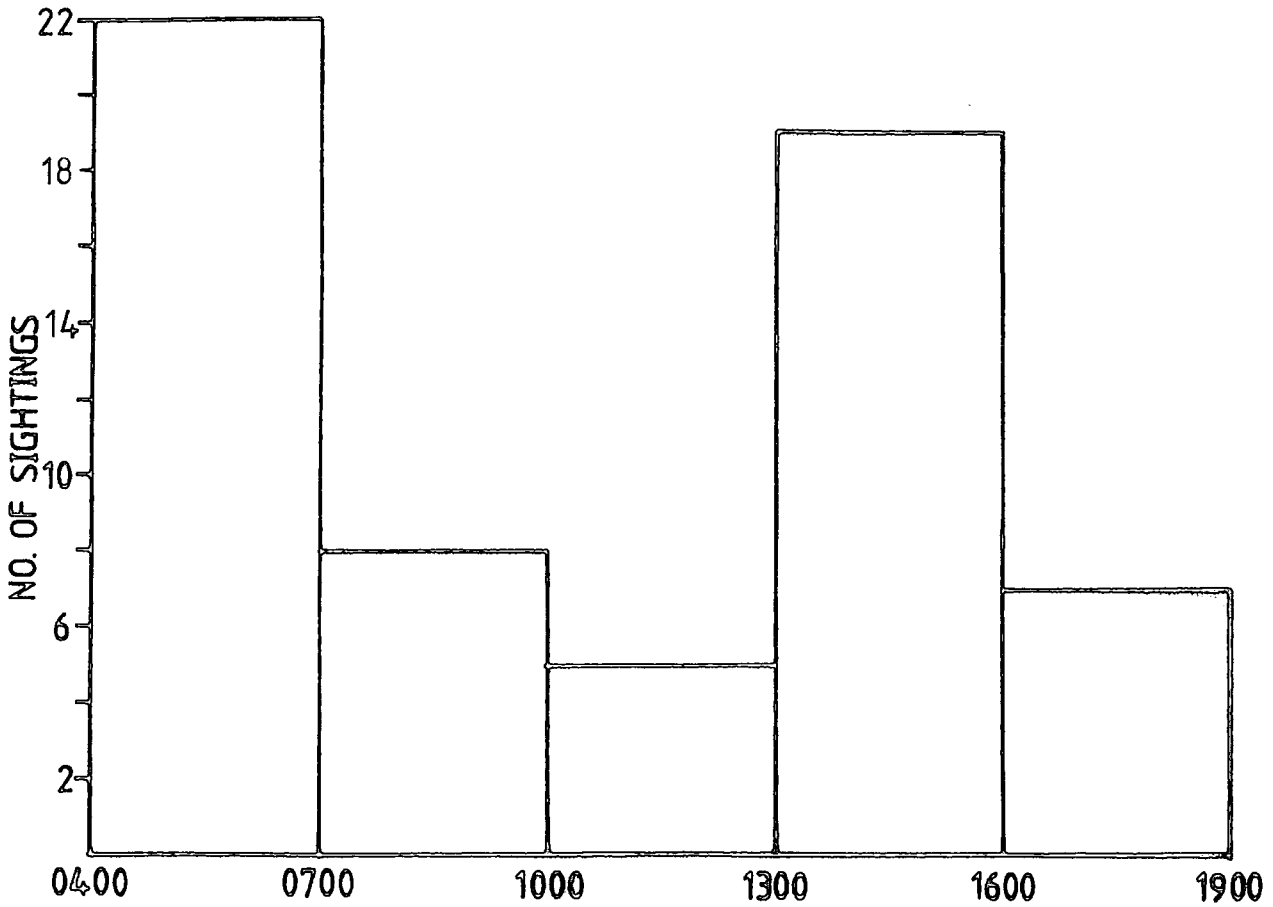


Figure 12: Histogram of pattern of sightings of Satyr Tragopan throughout the day.

have snared it in January in regions thickly covered with snow, at an altitude of 12000 feet" (3660m). I agree with Grahame that Hooker's evidence was incomplete and circumstantial, that the bird's build is not adapted to burrowing, and that the observation is unlikely to be true.

6.1.4 Vocalizations

Described here are five varieties of call of fairly definite meaning. As far as is known, two (Types 1 and 2) have not been described before, and none have been described in detail by any authors.

1. 'Sree' call - A high-pitched squeak of short duration, similar to the first syllable of the Type 3 'Squeal' call. While feeding, this was heard called from four to nine times per minute on average.

2. 'Trill' call - A high-pitched trill lasting approximately 0.8 seconds, often heard in conjunction with Type 3 call. The call appeared to be triggered by mild alarm, for instance if one bird of a pair could not see its mate, or if approach by a human was too close. While feeding, this call was heard from 0 to 4 times per minute.

These calls carried only a short distance (up to 20m) and were made at any time of day by both sexes. They were used to maintain contact between a pair of birds, usually while feeding, when they formed an intermittent low 'chatter'. Appendix 4.1 shows a sonagram of call 2 and shows that the trill is made up of an initial part lasting approximately 0.4s beginning as a pure tone at 4200 hertz rising to a diffuse tone at 6000hz. The second part of the call consists of a series of 7 frequency modulations ranging in frequency from 1300hz at their troughs to 6000hz at their peaks. The first modulation lasts 0.08s, and the remaining six last 0.24s; the total call lasts about 0.8s.

On five occasions, single males were seen and heard calling these contact calls although no other birds were in evidence; in three of these cases the birds were calling Types 3, 4, and 5 (see below), in addition to the contact calls. These calls appear to be similar in function to those of the Bobwhite Quail Colinus virginianus (Stokes 1967) and the Chukor Partridge Alectoris graeca (Stokes 1961), in which the food contact call "serves to keep the birds aware of others in the group".

3. 'Squeal' call - A piercing muted squeal: 'Sree cheeū cheeū cheeū' lasting up to 3.2 seconds depending on the number of repetitions of the 'cheeū' syllable (range 2 to 6, n = 14). Appendix 4.2 shows a sonagram of this call showing the initial 'sree' syllable to have a fundamental frequency at about 700 to 1300 hz, with sets of overtones at 3500-4200 hz and 8700-9300 hz. The first 'cheeū' syllable lasts about 0.4s and successive ones become more attenuated, down to 0.15s on a fifth repetition. Each 'cheeū' syllable is composed of a frequency modulation from approximately 1500 hz peaking to 5500 hz and down to a series of very rapid modulations at about 3000 hz which give rise to a harsh tone in the call. These syllables also show a pure tone fundamental at about 800 hz with a set of harmonics repeated every 800 hz. The interval between syllables ranges from 0.12 to 0.18s.

This call carried a long distance, up to 200m on a calm day, and was made by both sexes at any time of day. Its possible functions are interesting: it appeared to serve to bring scattered individual members of a covey together in a similar way to the "Rally call" of the Chukor (Stokes 1961), the "Group movement calls" of the Bobwhite (Stokes 1967), and the "Social contact call" of the California Quail Lophortyx californicus (Williams 1969). Of the nine occasions when more than one pair of birds was observed, in eight cases they were making this call while feeding through scrub or woodland; in addition there were a number of occasions

on which calling was heard but no birds were seen. All the members of a covey could make the call; if a bird became separated from the rest it would call, and, upon hearing answering calls from the other members, move to join them. The call was also used for contact between both the sexes of a single pair - of the 29 occasions when a single pair was observed they made this call on 21 occasions.

Stokes (1961 and 1967) suggests for the Chukor and the Bobwhite that the rally call also serves the functions of repelling intruding males, and spacing out coveys by keeping neighbouring coveys informed of a covey's location. He noted that a female Bobwhite easily recognised the call of her mate, and when separated from him would respond only to his call. He therefore considers that the birds of a single covey can be attracted by the recognisable calls of members of their covey when scattered, but be repelled by calls from another covey. In the Blood Pheasant I found circumstantial evidence supporting this theory when I recorded a covey of three pairs and immediately played back their own 'Squeal' calls to them. Three birds (two males and one female) then approached the recorder with great curiosity and tameness, calling loudly. On cessation of the playback they rejoined the covey. However, when this same recording was played back on five occasions to other pairs and coveys known to be in other areas around Pipar in 1979 and 1980, no birds ever approached the recorder, but on one occasion there was a vocal response of the 'Squeal' call from an unknown number of birds. Thus, the playback of the call of one covey to other birds may have served to repel them.

Stokes (1961) also suggests that the rally call of the Chukor may be sexual in function, serving to attract females. But in the Blood Pheasant pair formation is likely to occur within the covey, and I saw no evidence of males attracting females by calling. However, I consider that the 'Squeal' call probably has a third function in this

species, that of 'mild alarm'. Of the 14 occasions when the Type 4 'Chik' call and alarm behaviour (see below) was observed, on 12 of these the 'Squeal' call was given in association with them. In addition, a pair disturbed suddenly while feeding quietly would often make the 'Squeal' call up to five times each, and if not approached more closely would resume feeding.

Williams (1969) suggests that the structure of the social contact call of the California Quail is a compromise between the selective pressures of the need of the bird to announce its location (to other Quails), but not to indicate it too readily to possible predators. He considers that the restricted frequency range of the call combined with its extended duration is the compromise: an intermediate between the easy-to-locate, wide frequency range, short duration call and the difficult-to-locate, narrow frequency range, extended duration call. In structure, the 'Squeal' call of the Blood Pheasant shows some similarities to the California Quail's "cu ca cow" (assembly) call. The latter lasts for an average of 0.73s and is repeated 1 to 9 times, whereas the Pheasant's call syllables last from 0.15 to 0.4s and are repeated 2 to 6 times. However, the Quail's call shows a frequency range of 1500-3125 hz and an average of about 2160 hz, whereas that of the Blood Pheasant ranges from 1400-5600 hz with a mean frequency of approximately 3350 hz. Although the calls are not identical,these similarities suggest that the covey call is similar in function to the assembly call of the California Quail, and may have evolved in the same way.

In the literature, this call type has been described by Blanford (in Hume and Marshall 1879) as "a peculiar long cry like the squeal of a kite". Beebe (1922) described the species inaccurately as "remarkably silent" and the "covey call alarm note" as a "drawn out 'see-e-e-e-e-lpe' snapping off short at the end". In my opinion, Fleming et. al. (1976)

have provided the most accurate phonetic rendering: "a loud grating alarm screech 'kzeeuuk-cheeu-cheeu-chee'".

4. 'Chik' call - A high pitched, strident 'chik' of short duration repeated at intervals of approximately one to two seconds. This call was heard on twelve occasions uttered by both sexes, and in the case of the male bird was usually accompanied by call 5 and alarm behaviour (see below).

5. 'Buzz' call - A 'buzzing' noise of short duration (1 second) made by the male bird only. I suspect that this noise is not made by the respiratory tract of the bird, but by its feathers. Grahame (1976) describes the display of the male as accompanied by "a 'purrh' made by suddenly fanning out the fail feathers"; this may be the same noise that I heard on a number of occasions.

Neither of these calls were recorded. The former carried a moderate distance (up to 50m) and both were heard in spring and autumn. If approached suddenly by Man, alarm in both sexes was shown by erect crest feathers, upright stance and fanned tail, following by strutting around a small area (about $1m^2$) with a pronounced forward movement of the head and neck with each step. In addition the head would be bobbed down close to the ground every few seconds. If closer approach was made to the birds they would usually run or flutter away calling Types 3, 4, and 5, but if the intruder approached no closer and remained quiet, the alarm would wane and they would resume feeding. Few studies have been made of the alarm behaviour of pheasants, but the above description of the Blood Pheasant shows much in common with the behaviour of the Chukor Partridge and Bobwhite Quail which have been intensively studied.

The 'chik' call (4) was described by Hodgson (in Hume and Marshall 1879)

as "ship .... ship", while Blanford (op. cit.) noted a "short monosyllabic note of alarm" and Beebe (1922) reported "a sharp sudden series of notes 'seep! seep! seep!'"

6.1.5 Breeding Behaviour

Courtship Display

This was not observed in the wild, but mating was seen on one occasion when a pair were feeding together on moss-covered rocks and leaf litter in forest. The female stood on a raised rock and made the 'Trill' call to the male; the former then squatted down on a rock, the male walked over and quickly mounted her while both called softly. The male then copulated for 10 to 15 seconds while holding on to the female's nape feathers with his bill, then jumped off and both birds continued feeding quietly. Beebe (1922) describes the display of the male as follows: "The cock spreads its tail and wings, dropping the latter and raising the crest, puffs out the breast feathers, and struts before the hen, turning around and around". He also noted males fighting fiercely. According to Grahame (1976) the display is similar to that of the Koklass Pheasant (which is lateral), but silent except for the "purrh" noise (probably call type 5) made by the fanning of the tail feathers. He observed much display between two pairs kept in adjacent aviaries between which there was free passage for the birds. In many cases, chasing of male after male and male after female took place, but no pugnacity was evident.

Mating Systems

My own observations on Blood Pheasants were made principally during the breeding season. Out of 49 observed Direct Encounters at this season, 35 (71%) were of pairs or pair-multiples, 10 (20%) were of single males, one was of four males and one was of a single female.

In addition, on 5 June, 1979, two pairs were seen with five unfledged chicks and two apparently 'loose' males. This evidence would suggest that monogamy was the normal mating system in my study areas since the single and 'loose' males could have been paired but their mates were incubating. Blanford (in Hume and Marshall 1879) and Beebe (1922) noted a 1:1 ratio of males to females, or a slight preponderence of males, in pre-breeding season coveys, and stated that the species was monogamous. In Ithaginis cruentus tibetanus however, Sheriff (in Ludlow 1944) noticed a ratio of two males to one female during the breeding season on three occasions and was informed by the local Tibetans that both polygamy and polyandry were practised by the species. In February, Grahame (1971) reported ratios of at least four males to one female in coveys of I.c.affinis in the Everest region. However, recent observations made by sherpas via Col. J. Roberts (pers. comm. 1979), again on I.c. affinis in the Everest region, suggest a purely monogamous relationship in April and May, but with male-only coveys in late May, when the female birds were probably incubating.

Gregariousness

With the exception of the Eared Pheasants (Genus Crossoptilon), the Blood Pheasant is probably the most gregarious of the family Phasianidae. In the mid-nineteenth century Hodgson (in Hume and Marshall 1879) reported from Nepal "flocks of 20 to 30 birds" and also "packs .... of as many as 70 to 100 birds". While it is unlikely that numbers as high as the latter are found today, coveys of up to 30 to 40 birds have been observed in Nepal in recent years (K. Sakya pers. comm. 1979). In Sikkim Beebe (1922) noted flocks of 15 to 40 birds, while Ali and Ripley (1969) usually found coveys of 5 to 10 birds, and sometimes more than 30. In this study, I only ever saw coveys of up to six birds (though on one occasion with five young). Sightings in the autumn field season were disappointingly few: one observation of four

males, and the other of an unknown number of birds. Extensive searches at Kumai and Korchon revealed localities with ten to fifteen fresh droppings suggesting that a covey (or coveys) were present in the area, although not seen. In mid March 1980 I saw one covey of fourteen and another of six birds in the Everest National Park, East Nepal.

It appears that after the breeding season and during the winter, coveys of family groups form and move around a localised area which includes each pairs' breeding 'home range'. At the approach of the breeding season in April, the coveys break up into pairs, which sometimes associate loosely during May and June. Col. J. Roberts (in Grahame 1976) reported from the Everest National Park that "On 29 April .... the birds had all paired, but laying had not started ..... only (up to 21 May) found pairs. The covey instinct had disappeared it seemed". This covey and pairing characteristic, along with other behavioural and anatomical features, is another way in which the Blood Pheasant resembles the Partridge family more closely than it does the Pheasants.

6.2 Satyr Tragopan

6.2.1 Wariness

Tragopans are known to be shy and wary, but because I was able to observe them from hides, the cumulative amount of time for which I watched Satyr Tragopans was 615 minutes, in 48 visual Direct Encounters. All authors agree regarding the birds' wariness: Hume and Marshall (1879) considered it "very difficult to observe, keeping to the thick undergrowth". Ali and Ripley (1969) considered it like the Western Tragopan (T. melanocephalus) to be "very shy and wild", while Delacour (1977) stated it was "extremely shy and wary". Of the 48 observations, in only 8 (17%) the bird was not disturbed and did not flee from the

observer. Sightings were usually very brief, the modal observation time being less than 1 minute per Direct Encounter. Usually the bird was encountered without warning while the observer was searching through forest, and quickly escaped by running into thick cover or flying into trees or bushes out of sight. On only one occasion did this not happen: On 11 April, 1979 I suddenly came across a pair of Tragopan feeding quietly during a heavy hail- and thunderstorm; both birds saw me, continued feeding on leaf litter in woodland without alarm, and I moved off before they did. Presumably they were not warned of my approach due to the noise of the storm.

6.2.2 Protective Behaviour

Escape - Of the 39 observations of escaping birds, 20 were ground escapes, and 19 were by flushing. Unlike the Blood Pheasant the Tragopan is very arboreal in its habits - of the 50 Direct Encounters in which the bird's position was known, 20 (40%) were made of birds in trees. If a bird was approached when in a tree, it would always fly down to the ground and run into cover out of sight; although on two occasions a bird flew from tree to tree to escape. Birds disturbed on the ground ran or flushed into cover out of sight, though usually not into a tree. On initial escape from an intruder, the noise made by the bird running, fluttering or flying was very considerable and was often accompanied by the 'wah wah' call which was continued after the bird was out of sight. This often enabled the bird to be re-located, but after a second disturbance it would move much further away, so that detection was very difficult.

My own observations agree well with those from the literature: Finn (1915) described the species as "arboreal", Beebe (1922) stated that it was "not uncommon in trees", while Delacour (1977) records that "They are very arboreal, more so than any other Pheasants".

There are few notes on the actual methods of escape recorded by other workers, but Ali and Ripley (1969) noted the closely related Western Tragopan "skulking away through thick undergrowth on the least disturbance or flying up and concealing itself most effectively in densely foliaged branches of trees".

'Freezing' Behaviour - 'Freezing' behaviour was observed on one occasion, 16 May, 1979, shortly after mating had taken place. At 05.58, after feeding amongst leaf litter in a small stream, the female of a pair stood motionless just as the sunlight reached this part of the forest. She stood alert and immobile for 21 minutes, and then resumed feeding as before. It is probable that the male was acting in a similar manner, because he was seen close to the female as soon as she began moving again, but had not been observed while she was 'freezing'. It was possible that I was the cause of this behaviour and the female was reacting to my presence, but since I was well concealed in a natural hide (tree roots) and had been observing the birds since 05.25, I consider this unlikely. Another possibility is that the bird was reacting to another predator in the area which I could not see.

Cheke and Coles (1975) observed similar behaviour in the Pheasant (Phasianus colchicus) in England when three birds were on a tree. It is very possible that Tragopans might show 'freezing' behaviour when perched in a tree. If so, many birds could have been missed in my study areas.

Cryptic Coloration - The female Satyr Tragopan shows good cryptic coloration, being rufous brown above blotched with pale markings. It would be better camouflaged than the male if sitting on the nest, and probably carries out the incubation. The male, although brightly coloured around the head, neck and breast, is a dull brown on its

wings and lower back, giving a degree of cryptic colouring when viewed from above or behind. In the dull light of the forest, even the red coloration of the neck and breast are much less noticeable.

Interspecific Communication - It is probable that the Tragopan reacts to the alarm calls of most species by escaping or becoming silent. When on 27 May, 1979 a Koklass Pheasant was disturbed from a tree, and flew down to the ground calling in alarm, a nearby male Tragopan, which had been uttering the 'wail' call (see section 6.2.4.), ceased as the Koklass alarm sounded and shortly afterwards flew to the ground to escape.

6.2.3 Daily Life

Mobility Levels

Table 16 shows the daily number of sightings of Tragopan. These are probably biased towards the early morning by a greater amount of time spent in hides at this time of day and the factors listed in 6.1.3. On analysis, dividing the day into 5 equal parts (04.00-07.00, 07.00-10.00, 10.00-13.00, 13.00-16.00, and 16.00-19.00. see Figure 12) it was found that there was a very significant difference in the number of sightings between these intervals (X^2 = 19.58 v=4 p=0.1). Again, if the number of sightings is indicative of mobility levels, it would appear that this species is most mobile in the early morning. Mobility then decreases after 07.00, rises again in mid afternoon, and falls off in the later afternoon. Mobility may be related to feeding times (discussed in section 5.3.2).

Roosting

The Tragopan was always encountered roosting in trees, (12 birds heard, 2 seen), either Rhododendron barbatum or Betula utilis. The

TABLE 16 Sightings of Satyr Tragopan in Relation to Time of Day, 1979 and 1980

Time of Day	Number Sighted
04.00-05.00	4
05.00-06.00	13
06.00-07.00	5
07.00-08.00	-
08.00-09.00	5
09.00-10.00	3
10.00-11.00	2
11.00-12.00	-
12.00-13.00	3
13.00-14.00	6
14.00-15.00	10
15.00-16.00	3
16.00-17.00	4
17.00-18.00	2
18.00-19.00	1
	61

height above the ground ranged from 5m to 12m. When calling at dawn in spring, the males moved from branch to branch, usually descending the tree, as the light strengthened. After a period of up to 60 minutes they finally flew to the ground. In April-May 1979, one male was known to roost in the same small group of rhododendron trees for up to 38 consecutive nights, while other males were known to roost in the same tree for 7 or more consecutive nights. Ali and Ripley (1969) refer to the Tragopan having the habit of roosting in trees, but other authors do not mention it - probably because they assumed it was likely in such an arboreal species.

6.2.4 Vocalizations

I have distinguished 4 types of call, but this is by no means a complete description of all the calls of this species.

1) 'Wah wah' call

Uttered by both sexes, this call was a loud, rapid, staccato "wah, wah, wah ..." heard at any time of the day in spring and autumn. It was recorded on only one occasion (that of a male on 24 May, 1979), and the sonagram is shown in Appendix 4.3. The structure of this call is monosyllabic, with each 'wah' syllable repeated, and having the same harmonic structure of a fundamental at about 400 hz and sets of overtones at 800 hz, 1200 hz, and about 1600 hz, though the top harmonic is slurred downwards from 1800-1400 hz. Each 'wah' syllable lasts about 0.15s, repeated every 0.32s, giving a rate of about 130 per minute. The bird was also recorded responding to playback of its own call (see below). The structure of the new call was similar, but included another strong harmonic at approximately 2100 hz, and none of the harmonics were slurred downwards.

The call was also given by females. This was not heard at close range but appeared to be identical to that of the male, although Beebe (1922) stated that it differed in the 2 sexes.

The function of the call is uncertain since only three observations were made while the call was being uttered, although it was frequently heard in the distance. Beebe (1922) suggested that the "cock utters it as a herald to his nuptual display - a high, rather quavering baa! baa! baa! baa! Where this is heard the hen is usually nearby, and, unless something occurs to alarm the birds, a display is almost sure to follow. The hen utters a call comparable to this when separated from her nearly grown young, the call in this instance being given

singly and in a slightly higher shriller tone". The only uninterrupted sighting of a male uttering this call (on 16 May, 1979) occurred just before display and mating, which adds some support to Beebe's suggestion. However, I heard the call on a number of occasions in the autumn field season when it probably had no connection with display. On 24 May, 1979 the male's call was recorded from a hide and played back to the bird. It immediately flew from a tree to the ground, approached the hide to within 12m, and resumed calling in response to the playback. For 90 minutes the bird remained in the area, calling and staring at the hide intermittently. It flew on to a rhododendron branch and remained there occasionally pecking at young leaves and moss, sometimes while calling simultaneously. Playback to male birds was also carried out during 1980, and although it usually resulted in a bird approaching the recorder, it did not elicit a vocal response on these occasions. It is possible that the call may signify antagonism between males, like the alarm call of the Ring-neck Pheasant P.colchicus (Heinz and Gysel 1970). The only observations of the female uttering the call were made when on 16 May, 1979 the hen was answering the male bird, prior to display.

This call has been described by other authors, but no other attempts have been made to explain its function. H. Stevens (in Ali and Ripley 1969) reported "a loud pitched 'wak' repeated several times" while Fleming et. al. (1976) noted a "wank-wank".

2) 'Wak Wak' call

This call was similar to the 'contact call' but of lower amplitude and therefore less audible. It consisted of a "wak ... wak ...." repeated at 1-2 calls per second for up to 2 minutes. It was uttered by both sexes when alarmed on being disturbed by a human, and probably by other predators. The bird retreated on being disturbed,

and made this call until out of sight of the intruder; approach towards the bird would often elicit further calling and retreat. Of the 19 observations of flushed birds, 11 (58%) gave the 'wak wak' call as they flew. Beebe (1922) described the flush alarm-call as "a series of loud raucous notes 'quak! quak! quak! quak! '". Fleming et al (1976) reported the alarm call as a "ca-rook". Other authors do not refer to the alarm, except for Delacour (1977) who quotes Beebe.

3) 'Bleat' call

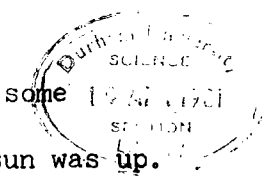
A single monosyllabic, short call like the truncated bleat of a sheep or goat, lasting approximately 1.0 second was heard called by the male bird. Due to the poor quality of recordings of this call, it has not been analysed on the sonagraph. It has not been mentioned in the literature, but has been noted by pheasant breeders (pers. comm). In my experience, the call commonly preceded the 'Wail' call (Type 4) and was heard in association with wing whirring. On only about 5 occasions was it heard without subsequent calls. On 3 May and again on 26 May, 1979 a male Tragopan was heard in Berberis/Arundinaria scrub, calling with type 3 whenever I made a loud noise, such as cracking branches. The bird was not seen, despite careful stalking using the call as a guide, although a female was observed close by. M. Sawyer (pers. comm.) noted his captive male Satyr Tragopan to use call-type 3 in association with side display when wing whirring on the ground. His bird never gave the 'Wail' call at any time, to his knowledge. The facts that this call was heard only in the breeding season, was heard in the wild in association with call-type 4 and wing whirring, and has been noted in captivity in association with display, suggest that it is a breeding call.

4) 'Wail' call

This is a drawn out monosyllabic animal-like wailing call made by the male bird only, and is repeated a number of times to form the complete call. Beginning at low-pitch, the repetitions become louder, more prolonged and crescendo towards the end of the call. Rendered phonetically the call is: 'Wah ..... ooāh .... ooāh ..... ooāh'. The structure (see Appendix 4.4 and 4.5) of each note 'ooāh' is similar and consists of a fundamental at about 500 hz rising slightly to 600 hz by the end of the call. 16 visible sets of overtones are present from 1000-10500hz, the second, fifth and sixth ones being strongest. Each harmonic rises in frequency from the beginning to the end of the note, which lasts approximately 0.4-1.2s, the later repetitions being longer than the earlier ones.

Details of recorded call lengths and calling patternscan be found in Appendix 7 and Figure 13. The length of each call depended on the number of repetitions of the ooāh note, and ranged from 11-33 seconds (n=25). The number of repetitions in all the birds tape recorded ranged from 4 to 12 (n=28), with a mode of 6 repetitions. A single individual male's calling pattern was noted on 15-17, 18, and 25 May, 1979, and its number of repetitions varied between 4 and 7 (n=62) with a mode of 5. The pauses between each full call ranged from 1 to 8 minutes, with a mean of 2 min. 10 seconds. It is possible that each male may have a calling pattern peculiar to itself and can therefore be recognised by this, but the number of birds calls studied in detail was insufficient to test this hypothesis. Local villagers stated that young males call with fewer repetitions and with longer spaces between full calls than do older birds, but I was unable to confirm this.

Calling was greatest at dawn, before sunrise, though some individuals continued to call for a short time after the sun was up.



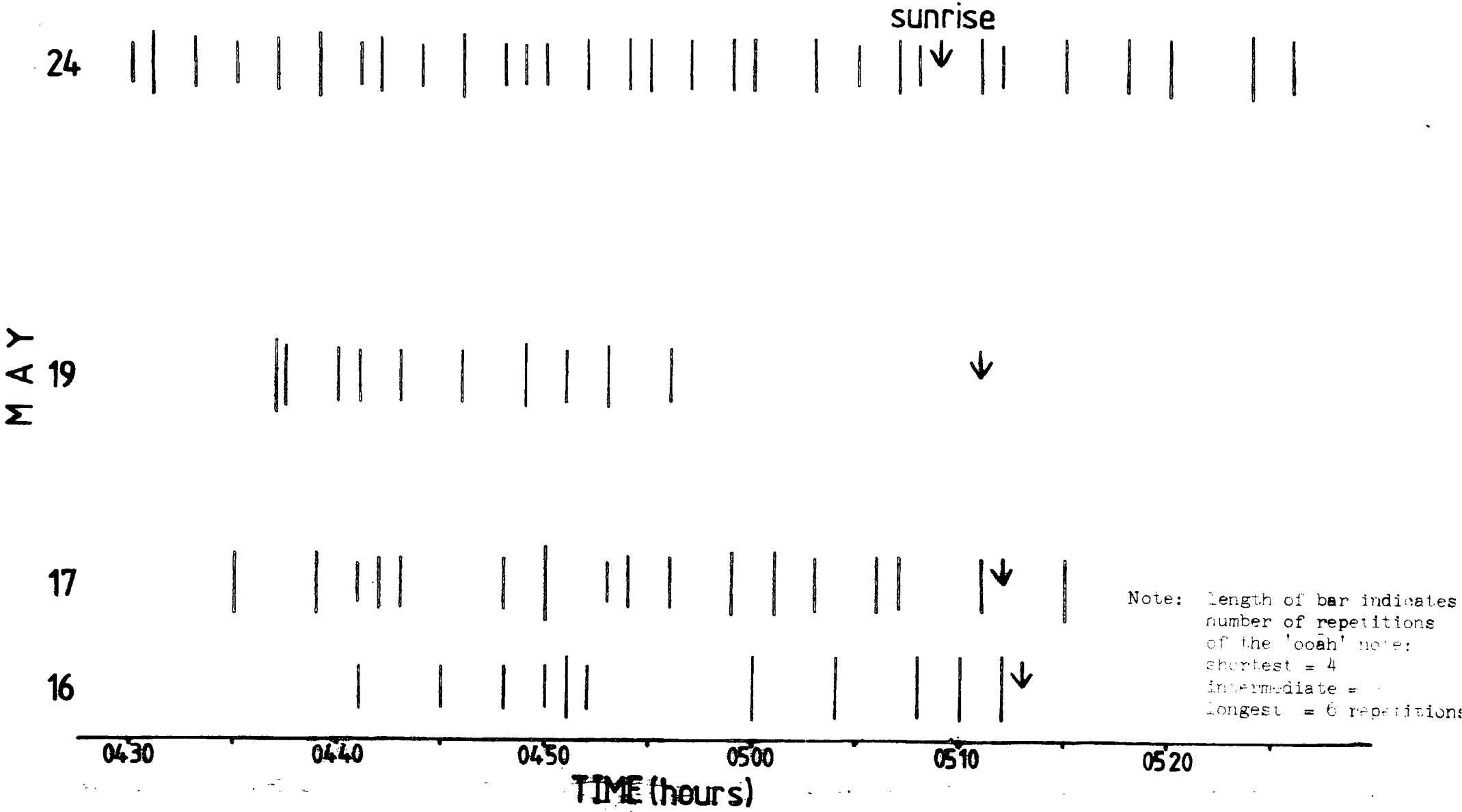


Figure 13: Dawn calling pattern of one male Satyr Tragopan on four mornings in May 1979.

Details of the calls of one individual on 15, 16, 17, 19, and 25 May, 1979 were the only ones noted: the bird's pattern can be seen in Figure 13. It shows a considerable variation in pattern, with the calling period ranging from 19-56 minutes, usually extending up to or just beyond sunrise. It is possible that the bird on 19 May was disturbed and hence did not call after 04.56. Time of first calling of the Tragopan is given in Appendices 5.1, 5.2, and 8 and Figure 14. Calling began 27-51 minutes before sunrise, and showed positive correlation with the calculated times of sunrise, which were concordant with observed sunrise times. On Figure 14, times of first calling were plotted against date, along with the calculated sunrise times. The two appear to show good correlation, so time of first calling was plotted against time of sunrise on a scatter diagram (Appendices 5.1 and 5.2) and the correlation coefficient calculated. This was found to be 0.93 for the 1979 data, ($v = 48$, $p = 0.001$) and 0.84 ($v = 20$ $p = 0.001$) for 1980. Both coefficients indicate a good positive correlation between sunrise time and the time of first call, significant at the 0.1% level. As with the Koklass Pheasant it is possible that timing of the first call of the Tragopan is influenced by external factors such as the weather (see section 6.3.4). Times of first calling were divided into 2 categories: 'clear mornings' (less than half of sky covered by cloud, no rain in night) or 'cloudy mornings' (more than half of sky covered, and/or rain in night) and are listed in Appendix 9. On clear mornings (n=29), the mean time of first calling was 38.2 (S.E. = 1.0) minutes before sunrise, whereas on cloudy mornings (n=13) the mean was 34.0 (S.E. = 1.5) minutes before sunrise. However the difference between these 2 figures is not significant ($v = 40$ $t = 1.36$ $p = 0.1$) suggesting that weather conditions have no effect on the times of first calling. Further research, with captive birds and artificial daylengths would be useful in determining the effects of light intensity on calling behaviour.

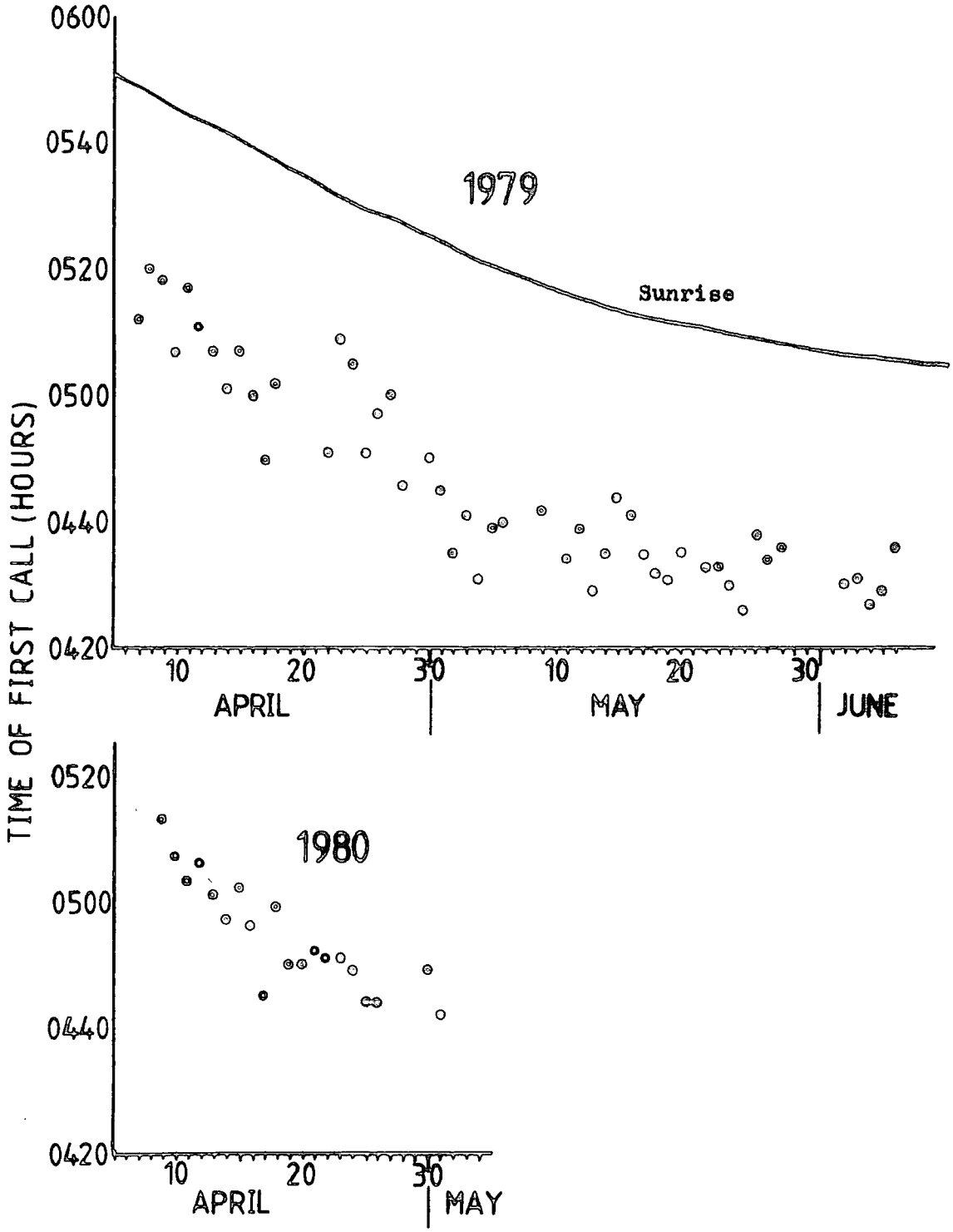


Figure 14: Times of first call of Satyr Tragopan in relation to sunrise.

After the early morning peak, the 'Wail' call was heard irregularly and occasionally throughout the rest of the day. From qualitative observations I noticed that it was heard more often when it was misty and raining than when clear and sunny. Certain individuals also called at dusk, but none were recorded. Ali and Ripley (1969) stated that the Western Tragopan made "calls at intervals throughout the day, more often at dusk and daybreak (every 5-10 minutes, sometimes longer)".

Call-type 4 was heard only in the breeding season. I heard it as early as 2 April in 1979 at Pipar, and birds were still calling on 6 June, 1979 at Bhalu. No birds were heard giving call-type 4 during the autumn field season or during a 2 day visit to the study area on 26/27 November. Gaston (1980a)has heard Western Tragopan calling from March until June. See Table 7.

The exact function of the wailing call is uncertain. In the Ringnecked Pheasant, Heinz and Gysel (1970) noted that the crow call may have alerted a male to the intrusion of another male into its territory, but considered that there was no evidence to support the hypothesis that crowing inhibits one male from entering into another's defended area. In the Satyr Tragopan the occurrence of territoriality has not been established (see section 7.2.4), but observations I made after playback of the 'wah wah' call suggest that the male believed its own recorded voice was an intruding male. Likewise, playback of call-type 4 on 15 April and 26 April elicited a similar response - on both occasions the male birds approached the recorder, but did not call. Recent work on passerines has shown that calling may be at a peak at dawn in order to advertise occupied territories at the time when invasion by territory-less males is greatest (J. R. Krebs pers. comm.). And Kacelnik (1979) has suggested that early morning calling takes place before it is light enough to feed efficiently. Both of these are

possible reasons for dawn calling in both the Tragopan and the Koklass, and the latter theory would help to explain why calling is delayed on cloudy days, when presumably light intensity levels are lower.

The frequency of calling seems to be considerably reduced in captive birds. Although calling has been heard from April to June (W. Prescott pers. comm.), it is generally restricted to a short period each morning. Wayre (1966) noted that both Satyr and Temminicks Tragopan (Tragopan temminicki) "only call once or twice each day as dawn is breaking." K. Chalmers-Watson (pers. comm.). reported a calling period of about half an hour, while W. Prescott's birds called for only 30 seconds each morning. (pers. comm.). K. Howman (pers. comm.) considered that in captive conditions, the close proximity of so many other birds affected the timing of call of all species. He also noted that first-year male Tragopans did not call.

Descriptions of the call of the male Tragopan have been attempted by many authors, including Jerdon (in Blanford 1898), Hume (in Blanford 1898), Beebe (1922), Wayre (1966), Ali and Ripley (1969), Fleming et. al. (1976), and Delacour (1977), but these have all been phonetic and highly subjective.

6.2.5 Breeding Behaviour

Courtship Display

Display by the male was observed on only one occasion, on 16 May, 1979, from a hide at Pipar. The bird was heard to use call-types 3 and 4, the latter a total of 11 times over a period of 31 minutes. It was also heard wing-whirring 3 times before using call-type 4. At 05.20, two further wing-whirrs were heard from the bird on a tree branch, and at 05.25 a female was seen flying from a tree to the ground approximately 35m away. The male appeared only 15m away with his feathers puffed out and the female walked towards him. The male then displayed frontally

towards her with puffed-out feathers, fanning his tail, opening wings slightly and quivering violently at the same time as lowering his wings and tail. At this time he was standing very erect so that the larger of his breast ocelli were easily visible. The male then ran at the female with his blue fleshy 'horns' erect and his blue lappet expanded. He mounted the female, copulating for 5-10 seconds, after which she ran out from under him with considerable fluttering and escaped downhill out of sight. The male, with feathers sleeked back on his body then walked uphill, also out of view. At 05.35 both birds were seen feeding on leaf litter in a small stream, moving slowly down stream about 10m apart. No further display was observed.

Display has been observed frequently in captivity, and was first described by Bartlett in Murie (1872). Hume and Marshall (1879) noted three types:

1. The male quivering and "blown up" showing his wattle and horns.
2. The male with erect feathers but no show of horns.
3. The male standing erect on a perch and shaking head to expose horns and wattles.

Finn (1915) recorded a frontal and a side display.

Full courtship display is probably lengthy and variable. Delacour (1977) described the following sequence: "The courtship consists of several actions representing gradual approaches, varying in intensity, to the final performance: (1) A stately walk around the female, the wing toward her lowered and partly spread, the shoulder on the farther side raised, the body being thus flattened, with much of the upper plumage in view. This is the general side display of all Pheasants; (2) A sudden rush with partly spread wings, with or without the erection of the horns or spreading of the wattle; (3) In the last phase, the bird suddenly stops. The plumage of most of the lower parts is fluffed out;

the half-spread wings move slowly up and down, with wrist edges well out from the body and the tips pressed inwards and downward; the head and neck are shaken spasmodically until the horns and wattle are spread out to their utmost. The lappet is spread and retracted with astonishing ease and rapidity. Soon the bird reassumes a normal posture, walks off, picks up food, only to start display again in a moment". My own observations of Tragopan display were similar to phases (2) and (3) of Delacour's description, but I never observed the lateral display (phase 1).

Specific calls by the male bird while displaying have not been documented, but M. Sawyer (pers. comm.) noted call-type 3 being uttered by a captive bird while wing-whirring on the ground, a fact also recorded in the wild (this study). He also noted that side display was "very common", while frontal display was less commonly seen.

Mating Systems

In the 1979 and 1980 breeding seasons, Tragopans were seen either in pairs (10 Direct Encounters, 17%), as single males (22 Direct Encounters, 38%), single females (13 Direct Encounters, 22%), or unknowns. In autumn 1979, birds were seen in small coveys (up to 4 birds) which presumably were family groups. Although the species was secretive and the observations were of comparatively short duration, the evidence suggests that it is monogamous. Since so little is known about its breeding behaviour in the wild, its mating system is not documented. However, for avicultural purposes, they are usually kept in pairs, although fertile eggs can be obtained from the ratio of 1 male to 2 females.

Gregariousness

The Satyr Tragopan is generally a solitary bird. Of 58 Direct Encounters, 37 (64%) were of single birds, 13 (22%) of pairs, and the remainder (16%) were of groups of up to 4 birds, mostly family parties. This solitary behaviour is also recorded by Beebe (1922), Delacour (1977), and Ali and Ripley (1969). The latter, describing the general behaviour of the genus, also noted small family parties in the non-breeding season and birds feeding in company with Cheer, Kalij (Lophura leucomelana) and Koklass pheasants in "out of the way places".

6.3 Koklass Pheasant

6.3.1 Wariness

The Koklass was the pheasant observed least often in the study areas. A total of approximately 145 minutes observation was made in 19 visual Direct Encounters, though 45 minutes of this were from a single Encounter. Most observations (74%) were of less than five minutes duration. I found that the Koklass was by far the most difficult pheasant to study by observation, because of its exceptional shyness and ability to conceal itself. Only four (22%) Koklass sightings were made of undisturbed birds, all the others were of escaping birds. Observations from hides were not successful (one sighting), since birds did not roost in the same group of trees for more than three consecutive nights, so that productive placement of hides was difficult.

Except for Beebe (1922) and Delacour (1977) few authors refer to the bird's shyness. It was, however, the most vocal species studied, so that birds could be easily located and censused, if not actually seen.

6.3.2 Protective Behaviour

Escape

Of 19 Direct Encounters of escaping birds, ten were by ground escape, and nine were by flight. Generally, ground escape took place where cover was dense and if birds could hear an intruder approach from a distance. Flushing usually took place when birds were approached suddenly, or when they were in trees. This species is not reported to be as arboreal as the Tragopan, but of 23 Direct Encounters where the bird's position was known, seven (30%) were made of birds in trees, although all of these were made shortly after dawn. Unlike the Tragopan, the ground escape of the Koklass was usually remarkably silent and was never accompanied by a call. Flushed birds always called in alarm, which on occasion was continued for up to five minutes, but usually ceased shortly after the bird had alighted. The silent ground escape was of considerable advantage to the bird in remaining undetected. On some occasions I attempted to 'stalk' Koklass when they were calling at sunrise. The birds would usually detect my presence, stop calling, and walk or run away before they could be seen. On three occasions birds were actually glimpsed, but escape was rapid and further detection was impossible unless by chance.

Their escape behaviour was well known to sportsmen in India, since the Koklass was prized as a game pheasant. Hume and Marshall (1879) recorded that it was difficult to flush and had a rapid flight. Blanford (1898) noted that "this bird is swift and difficult to shoot". Bates and Lowther (1952) stated "They afford excellent shooting, being very fast on the wing, for they have the habit of rising well above the cover and then, turning down the slope, they hurtle downhill on half-closed wings". Ali and Ripley (1969) reported that the bird "lies close in cover and difficult to flush without a dog".

'Freezing' behaviour

'Freezing' behaviour of the Koklass was not observed in this study. However, Roberts (1970) reported that "When startled, they first of all freeze, and if possible slink away into the undergrowth rather than taking to flight". Similarly, Fleming et. al (1976) noted that "When approached it often freezes on branch of tree". It is probable that 'freezing' behaviour in the Koklass is quite common, but is so effective that it is rarely observed.

Cryptic coloration

Both sexes of the Koklass show well-developed disruptive cryptic coloration in the streaked and mottled black, brown and buff plumage. The male is the brighter of the two sexes and although possessing disruptive patterning in his plumage, uses this patterning to great effect when displaying the crest, cheek patches and tail (see section 6.3.5).

Interspecific communication

It seems likely that Koklass react to the alarm calls of other species. On 12 May, 1979, while I was recording a male Koklass calling close by at dawn, a pair of Red-headed Laughing Thrushes (Garrulax erythrocephalus) noticed my presence and began calling in alarm. The Koklass stopped calling as soon as the thrushes started to call and was heard to fly to the ground and escape by foot into dense cover.

6.3.3 Daily Life

Mobility Levels

Table 17 shows the daily frequency of sighting of the Koklass. Since there were only 29 Direct Encounters with the species, it is felt

that these were too few to adequately assess mobility levels. However, the frequency of sighting was analysed in the same way as those of Blood Pheasant and Satyr Tragopan (see Figure 15), resulting in a significant difference ($X^2 = 49$ $v = 4$ $p = 0.1$) between early morning and the rest of the day. Assuming that the number of encounters is related to level of mobility, it appears that Koklass is very mobile until 07.00 hours, and is almost inactive for the rest of the day. However, I believe that the daily pattern of sightings was heavily biased by: a) The greater amount of time spent searching for Koklass in the early morning, b) By the early morning crowing of the Koklass making location and observation more likely, and c) Morning observation attempts were sometimes made on different days from those in the evening.

TABLE 17 Sightings of Koklass Pheasant in relation to Time of Day, 1979 and 1980

Time of Day	Number Sighted
04.00-05.00	1
05.00-06.00	16
06.00-07.00	3
07.00-08.00	2
08.00-09.00	2
09.00-10.00	-
10.00-11.00	-
12.00-13.00	1
13.00-14.00	3
14.00-15.00	1
15.00-16.00	-
16.00-17.00	-
17.00-18.00	-
18.00-19.00	-
	29

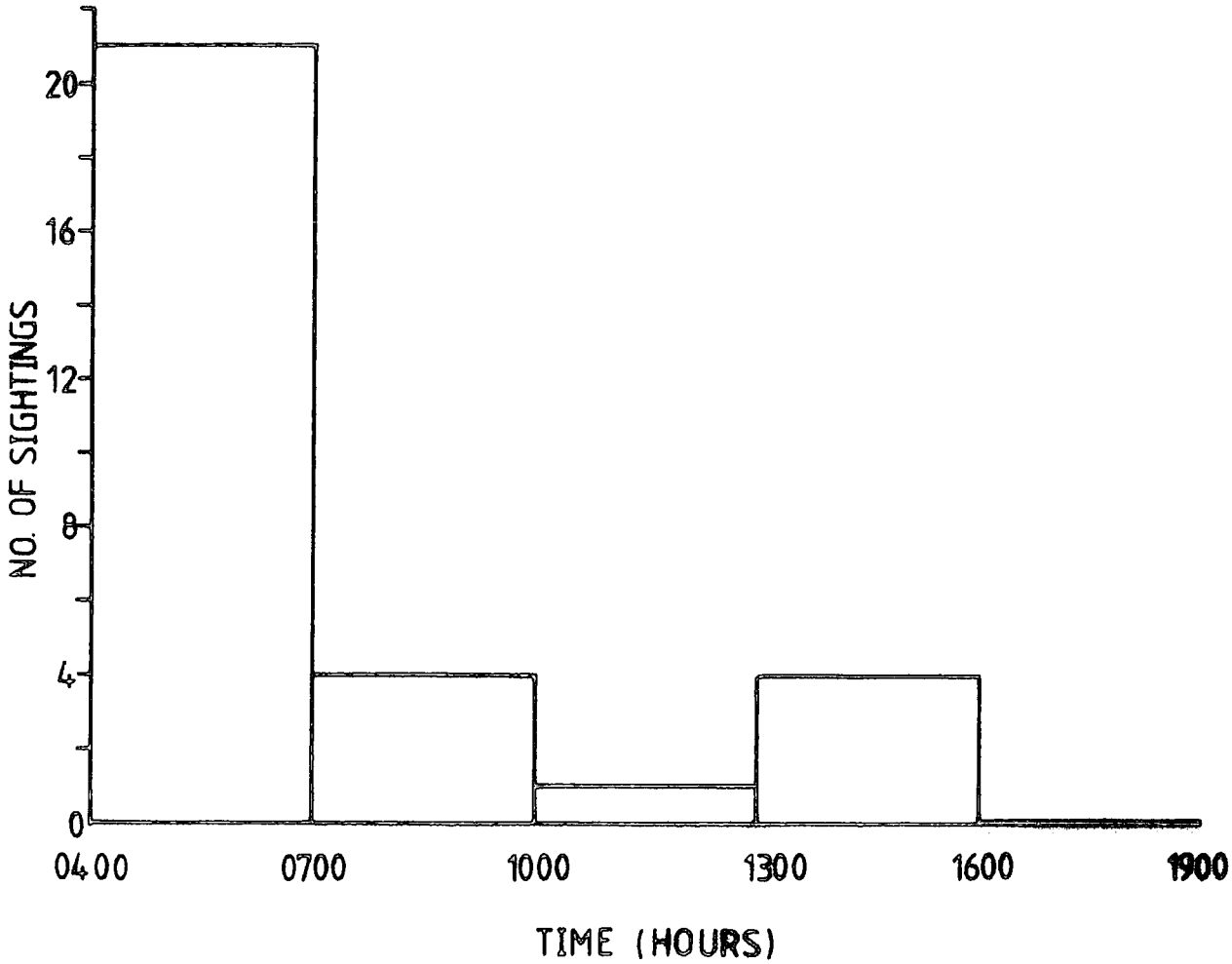


Figure 15: Histogram of pattern of sightings of Koklass Pheasant throughout the day.

Roosting

Koklass were noted to roost always in trees, usually on a branch of a Rhododendron sp. or Betula utilis from 4m to 10m above the ground. Birds were disturbed from their roosts on six occasions. At Pipar, in the area North of the main campsite, some males could be distinguished by their calling patterns. By noting roughly the position from which the birds were first heard calling each morning, it was noticed that any one bird did not roost in a particular tree or group of trees for more than three consecutive nights. This probably helps to reduce predation by night-feeding animals. During the breeding season, pairs probably roost together or in adjacent trees until incubation begins. On 12 April, 1980, a male was observed roosting in one tree, and a female in an adjacent tree approximately 15m from the male. When the male called its morning crow, the female sometimes called immediately afterwards with a soft call (see section 6.3.4, call-type 5). This call-and-answer had also been heard in April and September 1979 (then unexplained), and it is now assumed that it was uttered by pairs roosting close together. After the breeding season, family groups may roost together. This pair-roosting behaviour was also noted by Beebe (1922).

6.3.4 Vocalizations

1) 'Kuk kuk' call

This call consisted of a harsh, rapid, staccato "kuk-kuk-kuk-kuk-kuk ..." called as the bird flushed on alarm when disturbed by a human. The call was heard on eight occasions, once when no human intruders were present, and was never heard uttered by a bird which escaped on foot. On flushing, the call was often continued after the bird had alighted, once for up to five minutes. Most of the descriptions of

this call documented in the literature are similar to mine: Beebe (1922) described the alarm of the male as a "kuk! kuk! kuk! kuk! ko-ka! ko-ka! ko-ka!". The female's call was not noted. Delacour (1977) reported "a loud 'kuk! kuk! kuk! .... kok! kok! kok! kok! kok! ka! ka! ka!", while Severinghaus (1979) only once heard the alarm "a rapid, loud and raucous ka-ka-ka-ka-ka, etc.".

2) 'Aw-cūk' call

This call was heard on seven occasions but was not tape-recorded. It consisted of a low-pitched, subdued clucking: 'aw-cūk aw cūk aw-cūk ...." repeated for up to 15 minutes by both sexes. It appeared to be uttered when a bird was confronted by an unfamiliar object, such as a sitting human. In two cases, the bird was followed in thick scrub, and although it could hear or partly see the intruder, it was not sufficiently alarmed to escape immediately, and gave this anxiety call. On 12 April, 1980 a pair of roosting birds was observed at close range at dawn. At 05.05 hours the male began this call from its roost, and then crowed regularly until 05.30. The nearby female, which had been calling softly (Type 5) to its mate, moved towards me and began to give the 'aw-cūk' call. She continued this for 15 minutes, acting nervously and showing displacement behaviour, such as pecking at the moss on the tree branch. Becoming increasingly nervous, she eventually flew off calling Type 1 at 05.50, while the male flew down silently five minutes later.

3) 'Clucking' call of male

In their report on the display of the Koklass, Harrison and Wayre (1969) described the forward threat of the male as being accompanied "by a continually repeated, subdued, and rather melodious clucking - a six-syllable call 'Chuk-cher-ra-ka-pa-tcha'." No other workers have recorded such a call.

3) 'Crow' call of male

This call consisted of a series of harsh, raucous syllables (usually four or five), uttered at the same pitch. In my study I tape-recorded four variations of the call, and these are displayed phonetically in Table 18 and compared with the variants that Severinghaus (1979) noted in Pucrasia macrolopha castanea in Pakistan. The calls were analysed by means of a sonagraph which showed that the call types differed in the number of syllables, the duration of the call, the duration of each syllable and the space between syllables. In addition it was noted qualitatively that the amplitude of each syllable also varied. Appendices 4.6 - 4.9 show sonagrams of call types A-D.

TABLE 18 Phonetic Descriptions of male Koklass Pheasant calls recorded in Nepal, and comparison with those recorded in Pakistan (Severinghaus 1979).

Call Type	Phonetic Description[a]	Call Type (Severinghaus 1979)
A	ka-WOW	-
B	ka ka KAAA KA	1
C	ka ka ka - KAAA	-
D	ka KA ka - KAAA ka	5
D*	ka KA ka - KAAA ka kow[b]	-
-	ka ka KAAA ka ka	2
-	ka ka KAAA ka ka[b]	3
-	ka ka ka - KAAA ka	4

Notes: a - Capital letters indicate amplitude. Length of 'AAA' indicates length of syllable. Hyphenated notes are called in quick succession.
b - last 'ka' given at lower pitch than previous one, distinguishing it from the previous call.

In general, the structure of the crow is multisyllabic, with each syllable having a fundamental frequency of approximately 1500 - 2000 hz and a harmonic of weak amplitude at approximately 3000 hz. Frequency and amplitude modulations give rise to the harsh quality of the call. Table 19 shows the call length and rhythm of syllables for call Types A-D, and it can be seen that the differences between Types A and B, and Types C and D merely involve the addition of extra syllables, with no great difference in the rhythm of the calls. The difference between Types B and C however, involves a change of rhythm in syllables 3 and 4, with syllable 3 being nearly twice as long in B, and syllable 4 being longer in C. The mean calling rate ranged from 1.3 to 2.6 calls per minute.

Two further possible call types were also noted but were not considered above. They consisted of Types C and D, but each with an extra syllable given at a lower pitch and amplitude than the previous ones. Severinghaus (1979) distinguished a similar call (his Type 3). A possible explanation for these call-types is that they were made by birds inhaling after crowing. Gaunt and Gaunt (1977) observed in the chicken (Gallus gallus), that to terminate the crow call the bird can reverse the flow of air by inhaling "which may be accompanied by a distinct, sometimes quite loud, wheezing sound". This description sounds similar to the abnormal Koklass calls reported above, and since it is likely that the two species have similar tracheal structure and syringeal mechanisms, this inhalation activity may provide the explanation.

The call types however, do not allow individual birds to be recognised by their voice alone. On any morning, a given bird would usually shift call types from (for example) A to B to D. Full details of individual birds' shift of call types can be seen in Appendix 10.

TABLE 19 Syllable and call lengths of the male Koklass Pheasant at Pipar, Nepal (Time sec.)

Call Type	Serial Number	Syllable 1	Pause between Syllables 1-2	Syllable 2	Pause between Syllables 2-3	Syllable 3	Pause between Syllables 3-4	Syllable 4	Pause between Syllables 4-5	Syllable 5	Total Length of Call
A	10155			0.23							
	10176	0.11	0.24	0.27							0.63
B	10168(a)	0.17	0.09	0.26	0.18	0.37	0.02	0.29			1.39
	10168(b)	0.12	0.17	0.23	0.24	0.34	0.10	0.26			1.46
	10175	0.12	0.11	0.26	0.18	0.33	0.04	0.23			1.29
C	10151(a)	0.10	0.15	0.22	0.22	0.14	0.10	0.33			1.33
	10151(b)	0.14	0.14	0.24	0.23	0.18	0.08	0.35			1.36
	10168(a)	0.18	0.09	0.29	0.16	0.18	0.06	0.33			1.29
	10168(b)	0.13	0.15	0.23	0.24	0.22	0.09	0.32			1.40
	10175	0.09	0.15	0.21	0.23	0.15	0.08	0.29			1.21
D	10151	0.13	0.15	0.23	0.23	0.16	0.08	0.35	0.12	0.17	1.63
	10155	0.11	0.11	0.21	0.21	0.18	0.03	0.35	0.03	0.18	1.42
	10167	0.13	0.21	0.25	0.16	0.19	0.03	0.33	0.04	0.27	1.62
	10168	0.13	0.12	0.25	0.20	0.16	0.05	0.31	0.09	0.19	1.51

The reason for this shift is unknown. All birds began their morning calling with between one and fourteen Type A calls, these were followed by Type B and/or C, after which Type D usually made up the bulk of the morning calling, though sometimes alternating with Types B and/or C. From all the recorded calling periods (n=25), I have totalled the number of each type of call in Table 20.

TABLE 20 Relative numbers of Koklass call-types recorded.

Call Type	Number of Calls heard	Percentage of total
A	96	21
B	32	7
B/C[1]	38	8
C	43	9
D	250	53
D*	9	2

Notes: D* is the Type D call with the extra syllable given at a lower pitch and amplitude as referred to above.
1 undetermined: either Type B or Type C.

Clearly Type D was the call uttered most frequently in the study areas. This contrasts with P.m. castanea in Pakistan (Severinghaus 1979) which used call-type B (his Type 1) most frequently. He also noted that only two birds (out of seven recorded) clearly shifted call types, and that no birds called with Type A. This contrasts with the results from this study in which all birds shifted call types and began with Type A. In study species P.m. nipalensis, it was as though the physical act of crowing needed 'warming up' each morning: a number of short, 2-syllable crows had to be made (Type A) before the full crow call could be produced. This explanation however, is considered unlikely (R. Brackenbury pers. comm.), so it is possible that call-type shifting has a behavioural function.

Further, Severinghaus (1979) suggests the possibility that vocalizations may help in the identification of different races of the Koklass Pheasant. He noted that the calls recorded in K. Howman's aviaries in England (probably P.m. macrolopha) differed considerably from the calls of P.m. castanea from Pakistan. Similarly, the calls of P.m. nipalensis differ somewhat from those of P.m. castanea recorded by Severinghaus. However, only by detailed recording and analysis of calls from different subspecies and habitats could this hypothesis be tested.

Nevertheless, certain individuals could be recognised in the area North of the campsite at Pipar. Some birds had distinctive calling patterns such as ten Type A repetitions before more complex call types (most birds used call Type A only one to three times each morning.). Individual recognition in a longer study could be used to look for the presence or absence of territories or 'home ranges' if the birds' calling positions were mapped in detail. In my study, however, lack of manpower, continuity, and the positive individual recognition of only two birds allowed only limited observations of this nature to be made (see section 7.3.4). Miller (1978) has shown that in the Red Jungle Fowl (Gallus gallus) there is an acoustic basis for individual recognition, and that since the crow call appears to be territorial and possibly sexual in function, there is selective pressure for the birds to distinguish themselves as individuals on the basis of these calls.

In the Koklass, calling was greatest at dawn before sunrise. Figure 10 shows the frequency of calling per 3-minute period on three mornings in April and May 1980. On these occasions, the calling period lasted from 30 to 39 minutes (mean 34 minutes), whereas Koklass recorded in Himachal Pradesh in January 1979 (Gaston 1980a)called for 21 minutes. It is possible that the species has a longer calling period during the breeding season. The shapes of Figure 10 a-c are all quite different,

and it must be assumed that variation in the pattern of morning calling is considerable. Figure 10(a) shows a flat-topped peak of calling which is greatest at 32 minutes and 20 minutes before sunrise. Figure 10(b) shows a distinct peak earlier in the calling pattern, at 31 minutes before sunrise, while Figure 10(c) shows a more prolonged calling period extending to after sunrise, with a peak at only 18 minutes before sunrise. The weather was clear with a slight frost on all three mornings. Taber (1949), in his study of the Ring-necked Pheasant (Phasianus colchicus) noticed that as the season advanced, the morning peak of crowing became gradually later, until by late May it was only 10 minutes before sunrise (in mid March it had been 40 minutes before sunrise). Although I made only three observations of Koklass crowing, they began to show a similar trend - the peak of crowing becoming later, from 32 min. before sunrise on 16 April to 18 minutes before on 3 May.

Time of first calling of the Koklass is given in Appendices 5.3, 5.4 and 8, and Figure 16. Calling began 24 to 48 minutes before sunrise in 1979, and 29 to 53 minutes before sunrise in 1980. It showed positive correlation with calculated sunrise times, (Appendices 5.3 and 5.4) which were concordant with observed sunrise times. Severinghaus (1979) suggested that "onset of calling appeared to be related to early morning light conditions and the extent to which these were influenced by local weather". Aschoff (1967) and many other workers have described circadian rhythms in the daily onset of activity in birds, and while pheasants probably possess such an internal rhythm (Williams and Stokes 1965), it appears that the exact timing of the calling is at least modified by external factors such as weather. Times of calling before sunrise were divided (as for the Tragopan) into two categories, clear and cloudy days, and they are given in Appendix 11. On clear mornings (n= 20), the mean time of calling was 36.2 minutes (S.E. = 1.1) before sunrise, whereas on cloudy mornings (n=14), the mean was 30.4

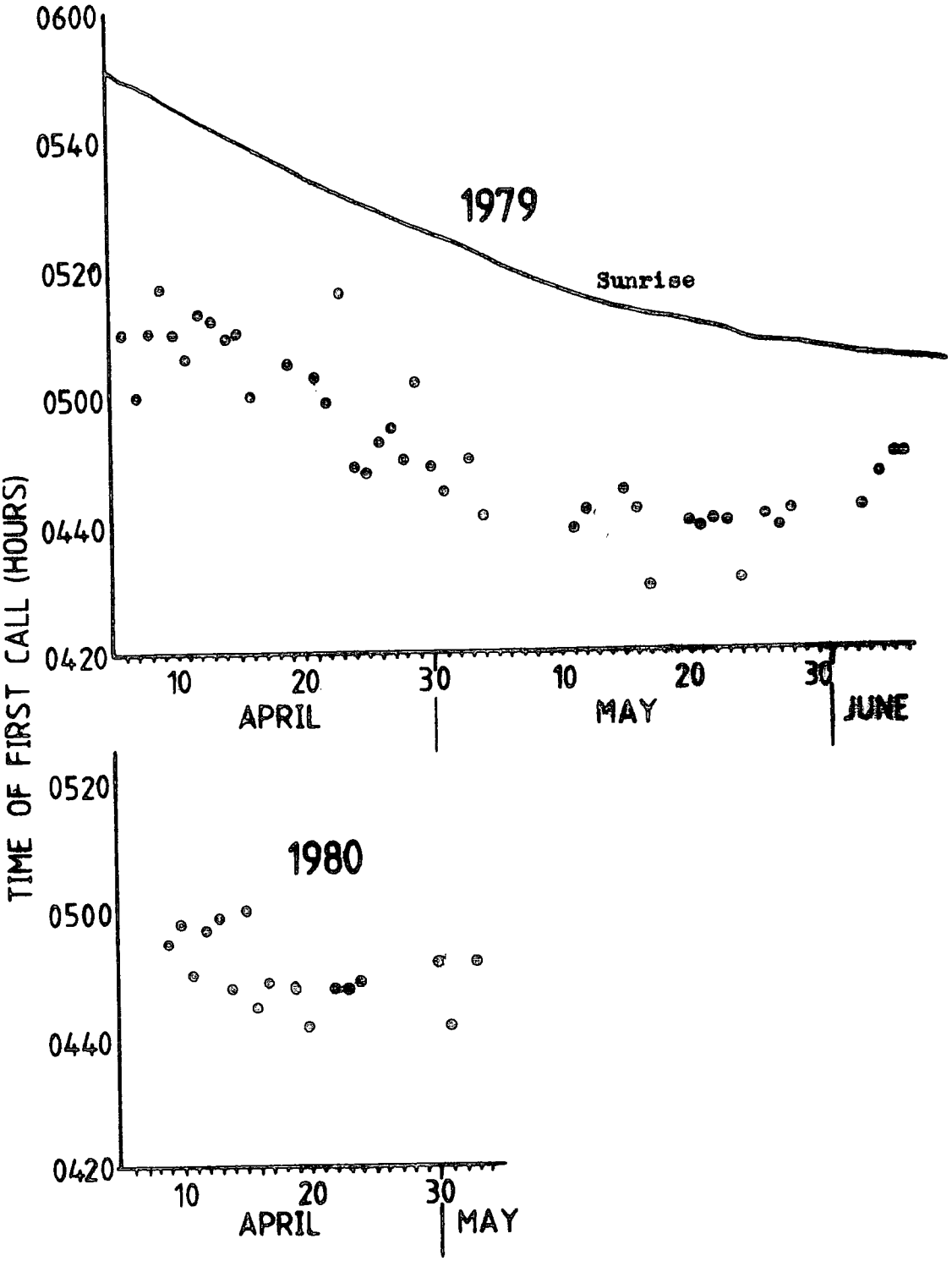


Figure 16: Times of first call of Koklass Pheasant in relation to sunrise.

minutes (S.E. 0.9). The difference between these two figures is significant ($v=32$, $t=2.70$ $p=0.02$) and indicates that cloudy weather in some way delayed the start of calling. It is probable that lower light intensity levels on cloudy days were responsible for this delay, but further research is needed to confirm this with the use of light meters to assess light intensity accurately.

My observations agree with those of Howman (1977) and Mirza (1978) in that the birds call for approximately 30 to 40 minutes from their roost sites, and then descended to the ground to feed. In some cases, certain individual birds called from the ground while they moved about feeding. This accounts for the pattern in Figure 10(c) in which calling is shown to continue after sunrise. The fact that only certain individuals crow from the ground whilst feeding would help to explain why Mirza made the same observation as myself, whereas Howman (1977) and Severinghaus (1979) did not.

Scattered crowing was often heard throughout the day. Gaston (1979) analysed the rate of calling throughout the morning at Dachigam Sanctuary, Kashmir, and noticed that, following the pre-dawn peak, there was a minor burst of activity of about 8 calls per hour between 08.00 and 09.00 ($1\frac{1}{2}$ to $2\frac{1}{2}$ hours after sunrise). At Pipar, day-time crowing appeared to be more sporadic and was not analysed, although it was observed that the sound of thunder, or an avalanche, would often stimulate birds to crow, but only once or twice each. This observation has been reported by other workers (Beebe 1922, Fleming et. al. 1976, M.W. Ridley pers. comm.).

Unlike the wailing call of the Tragopan, the Koklass crow was heard in both spring and autumn. It was heard from 3 April to 6 June, from 22 September to 9 November, and again on 28 November. These dates reflect the time periods I spent in suitable habitat. Gaston (1980a)

recorded that the Koklass could be heard between September and June, but not during July and August, the monsoon months (see Table 7). I. Grahame (pers. comm. 1980) has recorded captive birds calling from mid-September to mid-July, and "most intensively" from March to June. K. Howman (pers. comm. 1980) observed that first year males called only during the autumn, but Grahame did not find them calling at a different time from the adults.

The function of the crow-call of the Koklass is uncertain. Williams and Stokes (1965) believed that "calling in pheasants (P.colchicus) has little or no relation to aggressive encounters between pheasants either during or after fighting .... Pheasant crowing may be essentially sexual in function". J. R. Krebs (pers. comm.) and Kacelnik (1979) have suggested explanations for dawn calling in passerines (see section 6.2.4), and these are possible reasons for Koklass calling. I found some evidence that the crow of the Koklass is probably territorial in function: playback of the Koklass crow was carried out on approximately twelve occasions in 1979 and 1980. On five occasions a male bird approached the tape recorder, and on seeing me became alarmed and retreated. Playback usually evoked a response from surrounding Koklass in that they would answer the crow. On some occasions, playback started after the main dawn crowing had ceased would result in a second smaller chorus of crowing. These observations would support the suggestion of Heinz and Gysel (1970), that a male is alerted to the presence of another male into its territory. Leffingwell (1928) and Allen (1956) suggested that crowing in P. colchicus may have attracted females, but no females ever approached playback crowing in this study. Harrison and Wayre (1969) reported that in Koklass display in captivity, the male crowed once or twice during relaxed moments.

Severinghaus (1979) gave a summary of phonetic renderings of the crow call of the Koklass Pheasant as described in the literature. The

races described were P.m. macrolopha, P.m. castanea, and P.m. nipalensis. The phonetic renderings were very variable, ranging from a simple "Kokras" (Fulton 1904) to "Ah! croaak! croaak-croaak! crok!" (Beebe 1922). Such descriptions of bird song and calls are highly subjective, and I consider the variations that Severinghaus tabulated are due almost entirely to personal interpretation. However, a survey of all the wild races of Koklass including the Chinese subspecies might show subspecific differences in their calls; and possibly these could be used in delimiting their geographical distribution, as Severinghaus suggests, since the species shows marked clinal geographic variation.

5) 'Oowow' call of the female

On a number of occasions in spring and autumn 1979, a soft 'reply' call was heard immediately after the crow call of the male. Phonetically, the reply could be described as a soft 'oowow' or 'kerwakow'. It was suspected that the call was being uttered by a female bird roosting or feeding close to the male. This was proved on 12 April, 1980 when I observed a pair at dawn at a roost site (see sections 6.3.3 and 6.3.4). The call could be interpreted as a contact call, informing the male that the female was close by.

6.3.5 Breeding Behaviour

Courtship Display

Display was not observed during this study. In captivity it has been described briefly by Delacour (1977): "he (the male) struts about, puffing out the body feathers and erecting vertically the long black tufts of the sides of the head, the brown crest raised between them." Harrison and Wayre (1969) have described the display of the Koklass in considerable detail which I shall not repeat here, and considered that the display to the female was principally lateral with some clucking

calls (Type 3), but generally silent. In captivity, display outside the breeding season has been observed from late December onwards (I. Grahame pers. comm. 1980), and until September (K. Chalmers Watson pers. comm. 1980).

Mating Systems

Out of thirty Direct Encounters with Koklass, four were of pairs of birds, two were of single females, and the rest (80%) were of single males. No birds were seen in groups, and although comparatively few observations of the species were made, it appears to be monogamous. This view has also been taken by most previous workers, including Hume and Marshall (1879), Beebe (1922), Bates and Lowther (1952), Ali and Ripley (1969), and Delacour (1977). The first two workers suggested that birds pair for a number of years. For avicultural purposes they are usually kept in ratios of males to females of 1:1 or 1:2. K. Howman (pers. comm. 1980) has kept ratios of up to 1:5, but breeding success in these cases is unknown.

Gregariousness

In this study, the Koklass was found to be very solitary, even after the breeding season. Only four observations (13%) were made of more than one bird, and there were no observations of more than two birds together. However, from the more extensive observations documented in the literature, it appears that pairs of birds are not infrequently encountered. Hume and Marshall (1879) and Blanford (1898) referred to single birds and pairs in spring, with family parties remaining together through the autumn and winter. Ali and Ripley (1969) noted "though not gregarious, several birds frequently haunt a particular hillside .... day after day"; and Delacour (1977) stated that "during the winter, numbers of adults can be flushed within a short distance of one another, but they do not live in parties".

6.4 Himalayan Monal

6.4.1 Wariness

This species was the most regularly observed of all the pheasants I studied in Nepal. The cumulative observation time was 1100 minutes in 108 Direct Encounters. However 57 sightings (53%) were of escaping birds, which were viewed for only a matter of seconds before they flew out of sight, while only 14 (13%) were for more than 20 minutes. The fact that birds lived principally on grassland and less in the adjacent forest meant that they were very wary on open slopes and would sometimes flush when a human intruder was a long distance (300m) away. However, if an observer was able to locate a Monal without being seen first, he could then sit still and view it for a long period of time (up to 125 minutes) without disturbing it.

It appears that the wariness of the Monal is predominantly the result of hunting by Man (as it may be in the other species). In the Everest National Park (East Nepal) the Monal is not trapped or hunted in any way because the inhabitants of the mountains in this region are the Buddhist sherpas, who do not kill birds to eat. In addition, in this area there are villages up to 3800m altitude, well within the range of the Monal. The result is that the species is accustomed to human presence and has little fear of Man. In March 1980, the Monal in the Everest region tolerated slow approach by a human to within about 8m without alarm, but closer approach resulted in ground escape or flying. This tameness appears to be peculiar to the National Park region; elsewhere in Nepal (R. L. Fleming Jr. pers. comm.) and in the Western Himalayas (A. J. Gaston pers. comm.) the species is very wary, and flushes on sight of Man.

There is little reference to the species' wariness in the literature,

but even in the last century Wilson (in Hume and Marshall 1879) reported that "wherever they are rare, they are also sure to be very wild and shy". Bates and Lowther (1952) also refer to them as shy and not often seen.

6.4.2 Protective Behaviour

Escape

Most of the observations of escaping birds in the study areas were of birds flying. The only ground escapes seen occurred when an intruder was still distant (more than 150m) and the bird could quickly run over a ridge or into a gully out of sight. When a bird was disturbed in forest, the escape was always by flushing - the bird flying up through the canopy to alight out of sight, usually in a tree. Flushing on open ground always resulted in the bird flying downhill, often for up to 300m. This form of escape was always accompanied by alarm calls in the female Monal, and usually also in the male. In contrast, the Monals observed in the Everest National Park in March 1980 usually escaped by walking or running, both on open slopes and in the forest.

Wilson (in Hume and Marshall 1879) reported that "In the forest, when alarmed, it generally rises at once without calling or running far on the ground; but on grassy slopes ..... it will, if not hard pressed run or walk slowly away in preference to getting up". He also recorded that when suddenly alarmed it flushed with much calling. Bates and Lowther (1952) noted that "when disturbed the Monal hurls itself downhill emitting a volley of shrill whistles and often flies a considerable distance before sweeping to rest". Ali and Ripley (1969) gave a similar account and also observed: "when suddenly come upon in the forest, especially if accompanied by small chicks, it flies up with much cackling into .... a tree and freezes".

'Freezing Behaviour'

This was observed on many occasions, but usually only noticed once the bird began to move again. Invariably, when a bird was come upon suddenly in cover, it would momentarily 'freeze' (or sometimes 'freeze' until it was approached closely), and then flush. On open slopes, birds would often 'freeze' on first seeing an intruder, then, depending on whether it approached or retreated, would flush or remain still. Lengthy 'freezing', such as that observed in the Satyr Tragopan was never seen in the Monal.

Cryptic Coloration

The female Monal shows good cryptic coloration, being almost uniform brown above and below, with a white rump. She carries out the incubation of the eggs (Roberts 1970), as would be expected, since the male is brightly coloured and iridescent. His phaneric colouring is used to full advantage in the courtship display (section 6.4.5), but such exotic plumage seems incongruous on a bird which spends much of its time on open slopes where predation appears to be easy. However, the Monal appears to have a pattern of feeding behaviour whereby it feeds on open slopes only in poor light conditions (see section 5.3.4). It is possible that the habit of living on open slopes is a relatively recent development in the species' evolution, and that it was originally strictly a forest bird (as would be suggested by the male's bright plumage). Its present habitat may be the result of forest clearance and disturbance by livestock grazing and herders in the summer months (in the study areas and in India), and by general disturbance by humans (in the Everest region).

Interspecific Communication

Like the other pheasants studied, this species is thought to respond to the alarm calls of other species. On 11 April, 1979, while a male Monal was being watched, a Large Scaly-bellied Woodpecker (Picus squamatus) was heard calling a number of times. The Monal looked up, very alert, each time the call was made. To the human ear, the call of the Woodpecker sounded similar to the plaintive 'whistle' call of the Monal (see section 6.4.4, call Type 2). On 26 April, 1979 I disturbed a male Monal at close range, and it flew off a crag downhill uttering the 'piping' call very loudly. I noticed that, as it began the alarm, the numerous passerines (including Sunbirds Aethopyga, Leaf Warblers Phylloscopus, and Black-capped Sibias Heterophasia capistrata) feeding in the trees below, immediately alarm-called briefly in response. Once the Monal had flown over (a matter of seconds), the passerines resumed their normal feeding chatter.

On 13 April, 1980 a pair of Monal were being watched feeding on open grassland above forest. Another Monal was heard calling from the forest whereupon a Serow (Capricornis sumatraensis, a goat antelope) began barking in alarm. The pair then stopped feeding and stood upright in an alert posture, looking around, and facing downhill towards the Serow. After three minutes both birds flew off silently downhill.

6.4.3 Daily Life

Mobility Levels

Table 21 shows the frequency of sightings of Monal throughout the day. Unlike the pattern found for the other species of pheasants studied, this is not considered to be heavily biased, since a large number of sightings are involved, and the time spent searching for

Monals was spread throughout the day. The results were analysed by recording the number of observations made for each hour of the day, from 05.00 to 19.00 hours. On this basis there was no significant difference in the frequency of sightings between any hour of the day (X^2= 17.86 v=13, p=0.1). Figure 17 illustrates the results as a histogram, with the day divided into five three-hourly intervals, as for the other species. If the frequency of sighting is indicative of mobility levels, then the results imply that the Monal is mobile throughout the day. The histogram however, does show a greater number of sightings in the morning, signifying a greater mobility during the period 04.00 to 10.00, but this is not statistically significant. Some mobility appeared to be related to feeding - see section 5.3.4.

TABLE 21 Sightings of Himalayan Monal in relation to Time of Day, 1979 and 1980

Time of Day	Number sighted
04.00-05.00	1
05.00-06.00	13
06.00-07.00	11
07.00-08.00	7
08.00-09.00	11
09.00-10.00	10
10.00-11.00	3
11.00-12.00	5
12.00-13.00	9
13.00-14.00	4
14.00-15.00	8
15.00-16.00	7
16.00-17.00	5
17.00-18.00	10
18.00-19.00	4
	108

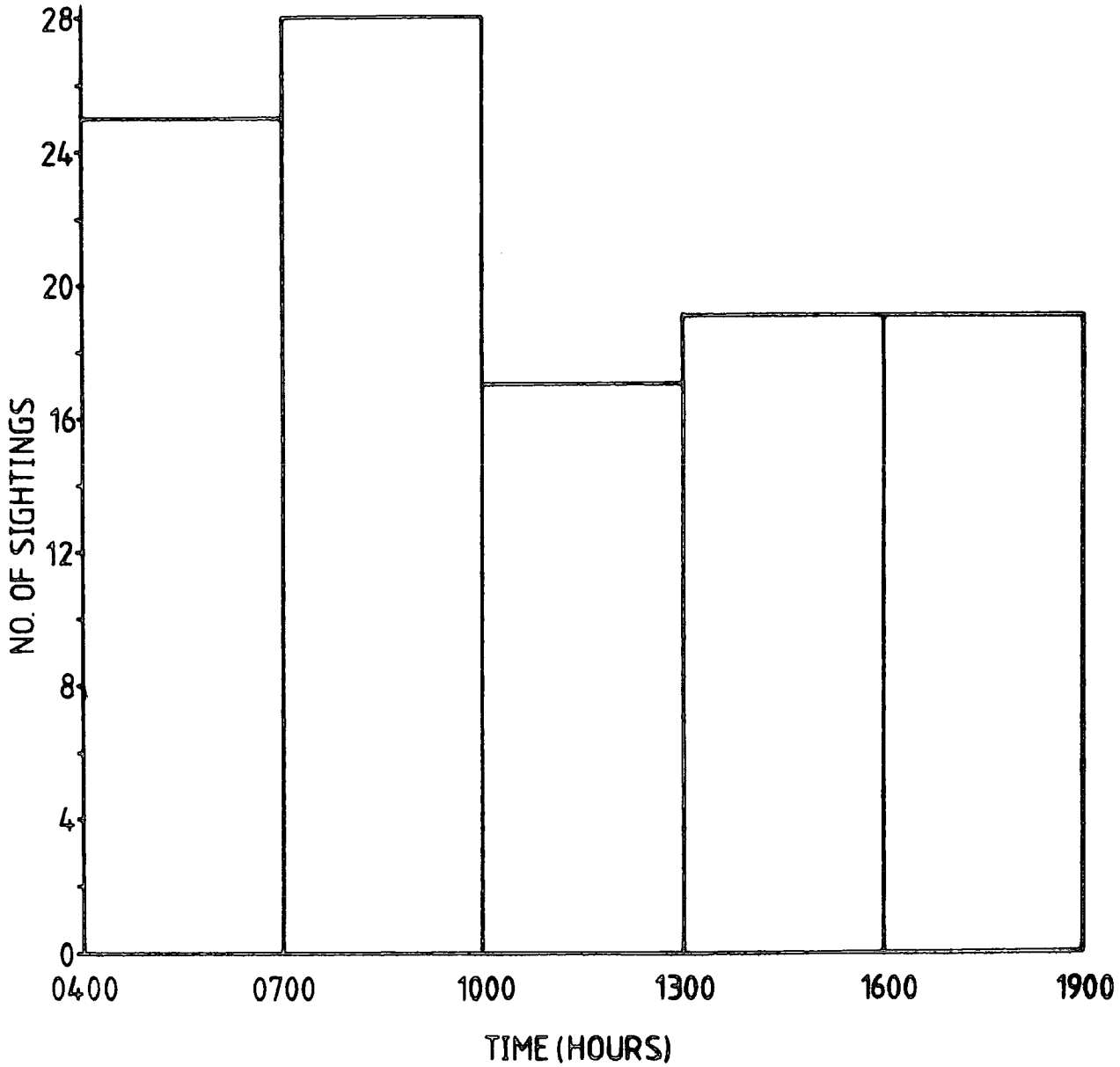


Figure 17: Histogram of pattern of sightings of Himalayan Monal throughout the day.

Roosting

Monal were heard and seen roosting both on rocks and in trees. In early April 1979 a bird was flushed from a Whitebeam (Sorbus sp.) before dawn, and birds were subsequently heard calling from woodland roosts on a number of occasions. Monal were tape-recorded calling at dawn from roosts on crags at Pipar in early May, at Bhalu in early June, and at Kumai in late October 1979. At Bhalu, on a crag roost at c3350m altitude, approximately 30 Monal droppings were found, indicating lengthy roosting at this sight. Communal roosting was not observed, but crag-roosting birds were heard calling close together. On 11, 13 and 14 April, 1980, a pair of birds which had been watched feeding for up to 55 minutes each evening, flew off together at twilight (about 18.30 hours) down to the forest, probably to roost together.

Wilson (in Hume and Marshall 1879) referred to the Monal roosting in large forest trees "but in summer on ground or rocks". Beebe (1926) noted that they roost in trees "communally but alone", and that in the summer and early autumn the parents and young roost together. Since the birds are known to ascend the mountains during the spring and summer as the snow retreats, it would appear necessary that they roost on rocks when above the treeline, which would account for Wilson's observation.

6.4.4 Vocalizations

I have distinguished three types of call made by the Monal:

1) 'Piping' call - This is a succession of high pitched piping notes beginning very rapidly, and becoming more spaced out towards the end of the call which lasts up to 10s, (See Appendix 4.10). Each note lasts for about 0.14s and the intervals between notes begin at 0.10s, lengthening to approximately 1.0s as the call progresses. Each note is

composed of an upward and downward slurred sound with a fundamental peak at about 3500 hz, and a set of overtones at 7000 hz. This call was often given by alarmed birds especially when flushed. (All flushed females and seven (77%) flushed males). It was also given by birds on the ground, and in these cases appeared to have a different but unknown function. At dawn, the call would accompany the 'crescendo' call (Type 3), although the birds appeared not to be alarmed (see under Type 3). Beebe (1922) accurately described this call as "a rapid succession of shrill, screeching, whistling notes ..... multiplied terror-induced modifications of the common call note: weep! weeep! weeeep! weeeeep!"

2) 'Whistle' call - This is a loud high-pitched whistle, either single or double toned, similar to the call of the Curlew (Numenius arquata). Appendix 4.11 shows the structure of this call, approximately 0.5s in length, with a fundamental frequency at about 2300 hz and overtones at 4800 hz and 7300 hz. The call was usually heard as an extension of the 'piping' call - the ultimate note of the piping was lengthened into a pure tone and repeated at intervals of one to five second to form the 'whistle' call. The usual sequence of behaviour was that the bird would flush uttering the 'piping' call, fly down, then alight while still calling. The call would then develop into the 'whistle' call, which would be uttered for up to five minutes, while on the ground or in a tree. This call was never heard uttered by a bird in flight, and was actually seen to be called only by females/immature males. However, since adult males were observed calling Types 1 and 3, it is assumed that they too made this call, although perhaps less frequently than females.

The function of the 'whistle' call is uncertain. Since it was an extension of the 'piping' call (which was often uttered as an alarm

response), it may have an alarm function - possibly in the nature of an 'anxiety call'. Monals were seen to respond to the 'whistle' calls of other Monals on a number of occasions by becoming alert and uttering the same call. This response was also observed by M. W. Ridley (pers. comm.) in Himachal Pradesh, October 1980.

Hume and Marshall (1879) made very similar observations to mine regarding this call. Beebe (1922) referred to the common call note as: "a shrill loud whistle, with but little cheeriness". Others, such as Hellmich (1968) and Ali and Ripley (1969) have likened the call to that of the Curlew.

3) 'Crescendo' call - This consisted of a piping whistle of two to five notes, each set repeated faster, with increasing frequency and amplitude to a crescendo set, followed by a slowing and diminuendo of sets. Appendix 4.12 shows $1\frac{1}{2}$ sets of three notes: each one has a fundamental frequency at 2000-2700 hz with sets of overtones at 4500-5100 hz and 6900-7600 hz. Notes last approximately 0.30s, and intervals between notes in a set range from 0.10s to 0.15s.

This call was uttered by both sexes both in spring and autumn, though it is probably made throughout the year, except during the monsoon (see Table 7). The call was given principally at dawn like call-types (4) and (3) of the Tragopan and Koklass. Quantitative measurements of calling frequency in this species were not obtained, but it appeared to be irregular and sporadic until about 06.00 hours. To a lesser extent, calling took place at twilight, but again no systematic notes were taken for this species. M. Sawyer (pers. comm. 1980) has heard captive Monal calling all year round, with some birds calling at night, (no time specified). From my observations in the wild, calling during the day depended on the weather - if it was clear and sunny, Monal would rarely call by day except for calls 1 and 2 if disturbed. However, if

precipitation was falling and/or it was misty, sporadic calling could be heard. The irregular dawn calling of this species was observed by Beebe (1922): "The early morning calling is rather inexplicable. I have known of 4 birds, old and young, roosting at a certain place night after night, and yet, early in the morning, all 4 would regularly go through a period of repeated calling. The calling was less noticeable and of shorter duration when the dawn was lowering and cloudy than when .... bright and clear. It seems probable that it can only be a mere concomitant of the nervous excitement of awaking and preparing for another day". Gaston (1980a)noted that "dawn calling occurs sporadically throughout most of the year, but appears to bear little relationship to the numbers of birds present".

The times of first calling of the Monal in 1979 are listed in Appendices 5.5 and 8, and Figure 18. Calling began 13-44 minutes before sunrise and, like the Tragopan and Koklass, showed positive correlation with calculated sunrise times ($r=0.8989$ $v=31$ $p=0.001$). Onset of early morning in relation to weather was also tested to see if there was a relationship between the two, as in the Koklass. On clear mornings ($n=23$), the mean time of first calling was 34.4 minutes (S.E.=1.4) before sunrise, while on cloudy mornings ($n=5$), the mean was 23.5 (S.E. = 3.2) (see Appendix 12). The difference between these two times however, is not significant ($v=26$ $t=0.84$ $p=0.1$), indicating that the time of first call was not related to early morning weather conditions. However, the number of cloudy mornings was very small (5), and it is possible that this is the reason for the non-significance. The functions of the 'crescendo' call are more difficult to assess than the dawn calls (Types 4 and 3) of the Tragopan and Koklass. It is possibly territorial in function, but since it also uttered outside the breeding season, when the territorial instinct is probably dormant (section 7.4.4), this explanation is not very likely. As in the

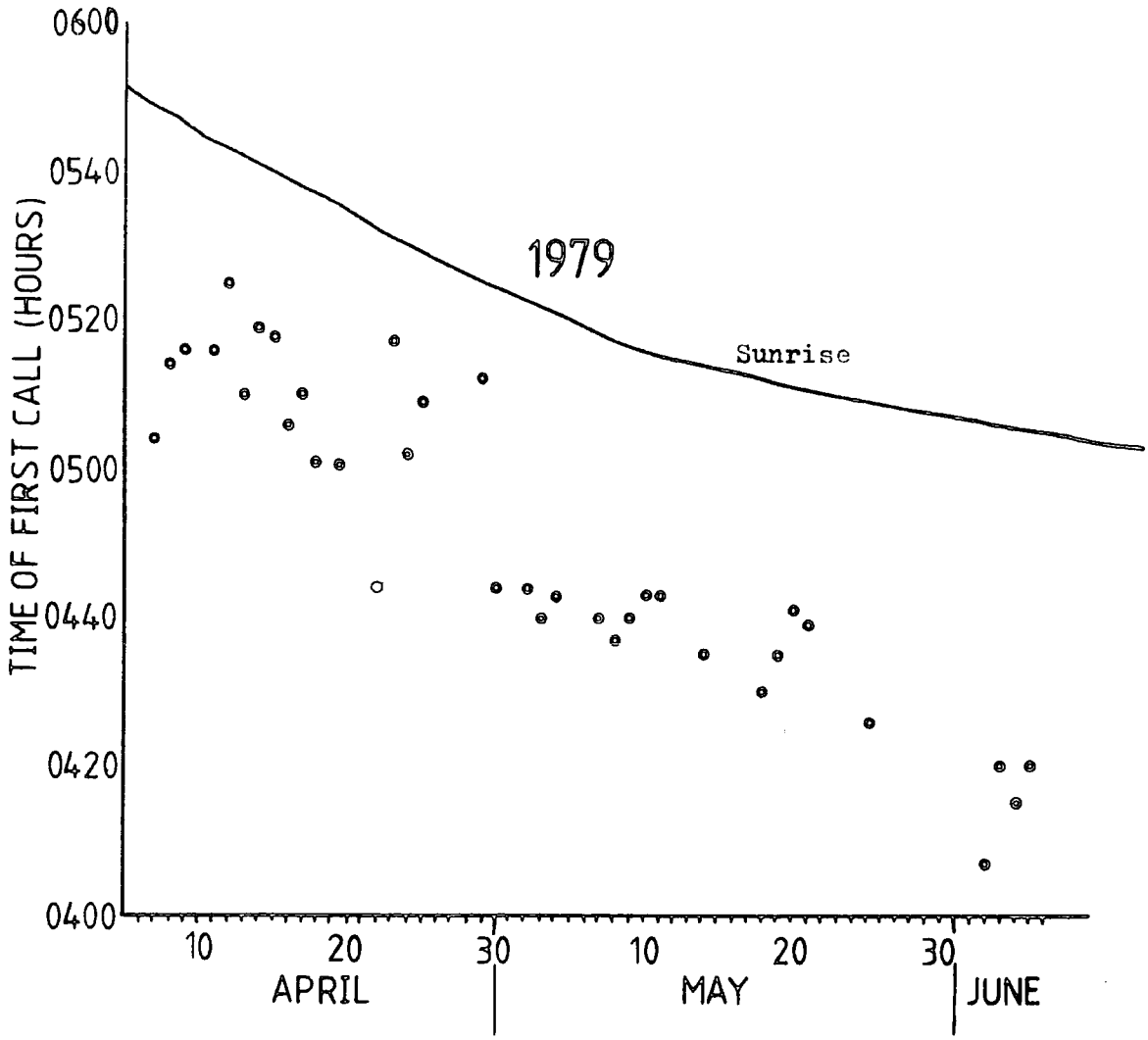


Figure 18: Times of first call of Himalayan Monal in relation to sunrise.

discussion of the Tragopan and Koklass calling may be related to the fact that foraging cannot begin until the light intensity reaches a certain minimum value (Kacelnik 1979). This observation has only been made in passerines however, and at present the functions of Monal calling remain obscure.

6.4.5 Breeding Behaviour

Courtship Display

The male's display was seen on two occasions: on 17 April, 1979 at 17.20 hours, with no other Monal in sight, a single male stood and fanned his tail. He then began jerking his body and raising his wings slowly above his head while holding his fanned tail erect. The silent display lasted for 10 to 15 seconds, whereupon the bird walked up the slope feeding casually and was not seen to display again. On 21 April, 1980, at 05.45 hours, a male was observed displaying in the same manner to a female which was feeding in tussock grassland. The birds in this case were slightly obscured by vegetation and it is possible that copulation took place. Two further advances to the female resulted in the latter retreating to feed further away from the male. However, when he flew approximately 150m across the slope, she joined him and both continued feeding.

On a number of occasions in spring 1979, and on 13 and 14 April, 1980 male birds were observed making a "display flight". The Monal initially stood on a prominent rock on an open slope tussock grassland. It then suddenly flew off, gliding horizontally but slowly downwards with its wings held high above its body, and with the white patch on its lower back prominently displayed. While gliding down the bird would call softly, uttering a similar sound to a muted Type 1 'piping' call. It would then alight on a rock and look around. In 1980, a female was observed feeding on the same slope on one occasion of display flight.

The observations of Finn (1915), G. S. Rodon (in Beebe 1922), Whistler (1926), Bates and Lowther (1952), and Ali and Ripley (1969) were of an essentially frontal display similar to my own sightings. Delacour (1977) described the lateral and frontal display seen in captivity. "He (the cock) approaches the hen with long groping steps, describing wide circles about her, always with the inner wing lowered to such an extent that the feet and legs are completely hidden. The neck is extended, the bill held downwards close to the neck, the crest standing erect and vibrating. As he gets more excited he pecks nervously at the ground. He then assumes a frontal position and the tail is raised and spread to its widest extent, with head and beak to the ground, wings spread, the bird bowing rhythmically forward and back. The feathers of the back and wings are only slightly raised, but the mantle and neck plumage fluff out, encircling the head. It shows to the best advantage the beautiful metallic colours, the white back and the rufous tail". Both frontal and side display have been observed by a number of World Pheasant Association members possessing captive Monal. Whistler (1926) and Ali and Ripley (1969) also described the brief display flight of the male referred to above, and in September 1980, members of the Himachal Wildlife Project (1979-1980), reported observing display flight by males (M.W. Ridley pers. comm.). Ridley also observed that the Monal is unique among pheasants in having a display flight.

Mating Systems

The main problem of attempting to define the mating system of the Himalayan Monal is the apparent similarity of first-year male to female birds. Wilson, (in Hume and Marshall 1879) reported that young males resemble females for the first year, but that the plumage has a darker and more glossy appearance. When changing their plumage during the first moult, they "appear spotted all over with the metallic hues of the adult".

He also considered that at four months old, young males were "easily distinguishable" from females and this view is supported by present-day keepers of captive Monal. However, I found that in the field I could not distinguish between young males and females, either in the spring or autumn; the birds appeared to be either distinct males or distinct females. Members of the Himachal Wildlife Project working in the Himachal Pradesh, India, also could not distinguish between females and immature males (P. J. Garson pers. comm.).

From my own observations of 38 Direct Encounters of more than one Monal together, the following is a list of the numbers of birds observed:

TABLE 22 Numbers of Monal Observed during the Direct Encounters

Pairs	More than 2 females	More than 2 males	1 male with 2 females	1 male with 3 females	Multiple males & females	Unknown
18	6	3	3	3	3	2

Because I could not distinguish young males, it is possible that some were mistaken for females. However, since more consorting pairs were seen than any other sex ratio, my encounters suggest that the Monal does pair in the normal sense and is monogamous. This view however, is not generally supported by reports from the literature: Wilson (in Hume and Marshall 1879) stated that "It may be questioned whether they do pair or not in places where they are at all numerous; if they do, it would appear that the union is dissolved as soon as the female begins to sit, for the male seems to pay no attention whatever to her whilst sitting, or to the young brood when hatched, and is seldom found with them". Wilson, (op. cit.) took a similar view, while other workers, such as Beebe (1922) do not refer to it. Ali and Ripley (1969) and Delacour (1977) both refer to probable polygamy but report no new evidence to

support the idea. In response to my questionnaire (section 3.3), seven members of the WPA who possess Monal in captivity reported keeping birds in a sex ratio of 1:1 for the best results.

The above evidence indicates that the Himalayan Monal is probably monogamous, but that the male bird takes no part in incubation or care of the young, and is in fact segregated from them for much of the year (Beebe 1922). In certain regions where the sex ratio in the population is biased so that there is a greater number of females (for example where males are heavily hunted, such as Pakistan), it is possible that polygamy may take place. Only intensive study of this species in the wild will definitely establish the nature of its mating system.

Gregariousness

The Monal is probably best termed as loosely gregarious species. They were usually encountered singly (70 Direct Encounters, 65%), or in pairs (18 Direct Encounters, 17%) and less often in greater numbers (see Table 22). However, on a number of occasions, I encountered up to 11 birds irregularly spaced across a slope or set of crags at Kalki Danda and Namrung (Pipar), and also at Korchon in November 1979. These birds, while not concentrated in a flock, did show a degree of gregariousness and most would respond to an alarm call given by one of their number. These observations were all made before 09.30 hours, and it is believed that after this time the birds dispersed to feed over a wider area, and did not congregate again until evening.

Hume and Marshall (1879) did not refer to the sociability of the Monal, but noted that in autumn and winter the birds are fairly dispersed in forests, and that the females keep together more than the males. Blanford (1898) reported that the Monal were "not in flocks or coveys, but singly or in twos or threes". Beebe (1922) stated they "seem to a

large extent gregarious, but ties between members of a flock are extremely lax". He observed a group of fourteen males digging together in spring, while Fleming et. al. (1976) records "a dozen cocks" feeding together.

6.4.6 Aggressive Behaviour

Aggression between males was observed on one occasion, 7 May, 1979, on Kalki Danda ridge between 05.50 and 06.45 hours. One male appeared from the South side of the open ridge, crossed over, and walked into the woodland on the North side, joining two more males there. The birds moved out of sight, and Types 1 and 2 calls were heard, accompanied by much fluttering. When the birds came back into view, I saw that two males were fighting by flying at each other and attacking with their bill and spurs. They were also flying up into low branches of the trees intermittently. The third male took no part in the fighting, but stayed with the other two and fed occasionally. All three birds moved slowly up slope in the wood to the North-West, with the fighting continuing sporadically, until they moved out of sight. Ram Kaji Mangar (a sherpa) had seen similar behaviour between two males on the ridge top on the previous morning.

Delacour (1977) records aggressive behaviour by Monals in captivity. If females were present he found that the dominant (oldest) male would always chase away or kill the younger ones. However, with no females present he found that several males would live in peace for several years. M. Sawyer (pers. comm. 1980) made the following observations on three pairs of Monal kept together: "Beginning of April, 1 cock becoming dominant, chasing his brother about, but ignoring cock that was resident when all put together. Threat posture when sighting another cock was to puff up feathers, especially neck, and to run 7-8 paces forward then stopping, tail fanned out. As season progressed, attacks more often.

Split up: dominant cock with 3 hens. Resident cock then chased other slightly, but more interested in hens in adjacent pen".

6.5 Cheer Pheasant

Since only 4 Direct Encounters with Cheer Pheasant were made in this study, my own observations are very limited. This section is therefore drawn largely from the available literature.

6.5.1 Wariness and Protective Behaviour

The Cheer is known to be a very secretive and wary species. Despite searching suitable habitat in August 1979 no birds were found, while in May 1980 Cheer were seen only when they had drawn attention to themselves by calling or flying. While earlier authors do not specifically refer to the wariness of the species, more recent ones do: Ali and Ripley (1969) refer to it as "an extreme skulker" while Roberts (1970) relates that "they rely for survival on a habit of extreme caution and wariness".

All four observations of escaping birds were by flushing, which is in contrast to most of the records from literature. The Cheer is well known for its habit of squatting down, remaining concealed and motionless until the last possible moment before flushing. This practice of concealment and great reluctance to flush has been reported by most workers, including Hume and Marshall (1879), Beebe (1922 and 1931), Ali and Ripley (1969), Roberts (1970) and Fleming et. al. (1976). They also refer to its marked preference for escaping by foot uphill, rather than flushing. However, when the bird does flush, it is extremely rapid in its descent downhill with its wings pulled in at the sides. However, my only good observation of a Cheer was one of walking across a steep grassy slope, calling, and after 3 minutes flying down into scrubby oak forest.

Cryptic coloration of both sexes is well developed. They are generally barred buff, rusty black and grey which is ideally suited to the open grassland and scrub which they frequent. Beebe (1926) observed that "they can be closely approached due to their complete trust in their concealing plumage".

Their roosting habits have been reported conflictingly. Hume and Marshall (1879) stated that they perch little in trees, but went on to say that they usually roost above ground. Beebe (1922) reported that they usually roost on the ground "sometimes in trees and bushes", while in 1926 he observed "never seen to roost in trees", but on the ground. However Ali and Ripley (1969) report Cheer roosting in company in patches of oak forest, while Roberts (1970) recorded them roosting in tall trees on the forest edge. I consider that both are possible, but bearing in mind that the birds live in steep rocky areas, they are most likely to roost on small crags. In May 1980, birds were heard calling from cliff roosts about 60m above the hill slope near Muri village.

6.5.2 Vocalizations

The Cheer has a varied and noisy repertoire of clucks, cackles, and crows, but the principal call can be rendered phonetically as: 'Chook-chook-chook-cherweewa-cherweewa', with the 'wee' syllable uttered at a higher pitch than the rest of the call. The call is illustrated in Appendix 4.13, the first syllable 'chook' having a wide slurred frequency range with the fundamental at about 1500-2000 hz. The first syllable of the second part of the call 'cher' is similar to the 'chook' syllable in harmonic structure, with a fundamental at 1500-2000 hz and sets of overtones at 4500 hz and 6500 hz. The 'wee' syllable consists of a frequency modulation from 1500 hz to a peak at 5000 hz and back down to 1500 hz. It appears to have a harmonic at more

than 8000 hz. The final 'wa' syllable consists of a small frequency modulation at about 2000 hz. The full 'cherweewa' call last approximately 0.4s, and is repeated at intervals of about 0.5s.

Most authors (Hume and Marshall 1879, Blanford 1898, Finn 1915, Beebe 1922, Ali and Ripley 1969, Delacour 1977) report the call of the Cheer to be a very varied 'Chir-a-pir, chir-a-pir, chir, chir, chirwa, chirwa". Whistler (1926) gave a more detailed description: "a series of noisy squeaks and chuckles, which ring out .... with the clamour that one is accustomed to associate with a Guinea-fowl. Some of the notes resemble those of that bird; others are an exaggerated version of the squeak of the Silver Pheasant, while some recall the Chukar".

In my study, Cheer Pheasant were heard calling only in the mornings, as follows:

14 May - 08.15 intermittently until 08.45,

15 May - 04.50 briefly. 07.50 briefly,

16 May - 05.00 intermittently until 05.50.

17 May - 04.45 to 05.00. 05.25. 05.55.

The fact that the species was heard calling only in the mornings was inconsistent with most reports in the literature which state that it is most vocal at dusk (including Beebe 1926, Whistler 1926, Gaston and Singh 1980). Playback of the normal call of the Cheer was carried out on two occasions during the day on 15 and 16 May, but it elicited no response from the birds.

Beebe (1922) also refers to three more call types not heard in this study:

1) Flush alarm: "a series of screeching chuckles",

2) Contented calls: "a low sleepy 'waaaak, waak, waak'",

3) Suspicion: "a sharp 'tuk tuk tuk'".

6.5.3 Breeding Behaviour

Display was not observed in the wild. Delacour (1977) reported that "the cock's display is lateral; it is simpler than that of the Long-tailed and Common Pheasants, lacking the vibration of open wings or erect postures, and is generally similar to that of the Eared Pheasants" (Crossoptilon). The Cheer is reputedly monogamous (Ali and Ripley 1969, Delacour 1977) and they are usually kept in male:female ratios of 1:1 in captivity, or occasionally 1:2. They are gregarious throughout most of the year, and have been seen in coveys of between five and fifteen (Beebe 1922, Ali and Ripley 1969, Delacour 1977), though in this study, only single birds were seen. Two or more birds however, were heard calling from the same points on three occasions.

This pheasant is probably the least studied of the Himalayan species, and for this reason the observations made in the literature are both scanty and out of date. Since it is an endangered species, further research into its status, biology, ecology and behaviour is considered to be of great importance.

7. BREEDING BIOLOGY AND TERRITORIALITY

In my project information gathered on breeding biology and territoriality in the pheasant species was limited, due to difficulties of observation and nest location. The following short account is based on my own field observations combined with the available accounts from the literature.

7.1 Blood Pheasant

7.1.1 Breeding Season

The exact timing of the Blood Pheasant's breeding season probably varies considerably throughout its geographical and altitudinal range. With regard to the Himalayan subspecies, Hodgson (in Hume and Marshall 1879) was informed by Nepalese villagers that the breeding season lasted from April to May, and that the young flew in July. Hooker (1854) however, saw young birds in May in East Nepal. E. M. Bailey (in Inglis 1931) observed a captive pair at Gangtok (Sikkim) in 1924, which laid eggs in late May and incubated for 29 days. J. Roberts (in Grahame 1976) reported from the Everest National Park that pairing of Blood Pheasants was completed by the end of April, and eggs were found on 13 May.

Clearly, altitudinal and climatic factors play an important role in the timing of the breeding season in different areas. In my study areas, it was observed that pairing had taken place by the beginning of April, and mating was observed on 19 April, 1980. It is likely that the cryptically coloured females carry out the bulk of the incubation, and, in support of this, single males were seen feeding alone from 27 April onwards in both years. Young birds were seen only in 1979, when two adult pairs were observed with two fledged and two unfledged young on

3 June, and a total of five unfledged chicks were seen accompanied by six adults on 5 June. In the Himalayan region it appears that breeding takes place between late March, when coveys break up to form pairs, and early July, by which time most young have fledged.

7.1.2 Eggs

The eggs are "pinkish buff, profusely speckled and blotched with rich brown" (Delacour 1977), but are "extremely variable in colour" and average 48mm x 33mm in size (Grahame 1976). Clutch size is 5 to 12 (Delacour 1977). No eggs were found during my study.

7.1.3 Nest

Hodgson (circa 1846, in Ali and Ripley 1969) reported that a loose nest of grass and leaves is placed on the ground in grass and bushes. Inglis (1931) recorded the captive Blood Pheasants at Gangtok making a nest as "a mere depression in the ground with a few dead grass stems will pressed into it .... well concealed beneath the bush". According to Delacour (1977): "The nest is a hollow in dead leaves or moss, usually near a boulder, a stump, or under a bush". No nests were found during my study despite extensive searching.

7.1.4 Territoriality

The concept of territoriality or fixed home range in the Blood Pheasant has not been put forward in the literature. In the Pipar study area, it was noted that during the spring certain pairs of birds frequented very localised areas during April and May. In 1979, two pairs were individually recognised (on the basis of the number of leg spurs on the male bird), and of these, one pair or a single male was observed in the area below the main camp site on at least twelve occasions. Similarly, in 1980, another pair was seen close to census

point 4 on at least five occasions. This circumstantial evidence indicates that individual pairs may restrict their activities to a definite area during the breeding season, which might be termed their 'home range'. It is likely that this area is not defended, and overlaps with the home ranges of other Blood Pheasants. This is indicated by the observation of temporary coveys of up to three pairs within areas thought to be the home range of one pair; no aggressive behaviour was observed on these occasions, although some inter-sex chasing took place.

Although no observations were made during the monsoon season, it is likely that home ranges break down after the breeding season. Coveys consisting of family groups probably form and range over wide areas to feed, thus accounting for the relatively few sightings of Blood Pheasants in the 1979 autumn season. The coveys probably persist throughout the winter, until pairing begins in the following Spring, and home ranges are again acquired.

7.2 Satyr Tragopan

7.2.1 Breeding Season

Due to its wide altitudinal range (2230m to 3550m), the timing of the breeding season in the Tragopan shows considerable altitudinal variation. It is reported to last from May until June in the wild (Ali and Ripley 1969), while in captivity, males have been observed displaying in March (Delacour 1977). Hellmich (1968) shot females on 13 and 16 May, both of which had well developed ovaries. In the study areas, the breeding calls of the male (section 6.2.4) were heard as early as March, (J. Roberts pers. comm. 1979), and continued throughout April, May, and early June. In 1979, mating was observed on 16 May at 3300m altitude at Pipar, while below Bhalu, Rinzing Sherpa saw a female Tragopan with four fledged young on 31 May at 2640m. At Bhalu camp

site itself, we found a Tragopan's nest at 3160m which contained three fresh eggs on 6 June. These three pieces of breeding evidence show the variability in timing which can exist in the wild. Like the Blood Pheasant, the full breeding season probably runs from late March, when the breeding calls of the male begin, until early July, when most young should have fledged.

7.2.2 Eggs

These are "reddish buff, freckled all over with deeper brick red. Size c65mm x 42mm" (Ali and Ripley 1969). Clutch size 3 to 6; incubation period 28 days (Delacour 1977). In my study, only one nest was found: it contained two eggs on 4 June, and three eggs on 6 June, 1979. Success of hatching was not determined because we had to leave the area three days later.

7.2.3 Nest

Members of the Tragopan genus are reported to nest in trees, often high up, and to use old nests of Crows and other birds in which to deposit their eggs (Delacour 1977). Females apparently carry grass, twigs, and leaves up to the nest and line it with these items (Beebe 1922, Harrison 1968 and 1969, Moody 1976, Delacour 1977). At Bhalu, the nest found was at 3160m altitude, but on the ground in long tussock grass approximately 10m above the edge of Berberis scrub adjacent to Rhododendron forest. The nest was merely an unlined depression in the grass under a large tussock (about 0.5m tall), on a slope of about 45° of open grassland with small patches of rock exposure. The nest was located by chance, as the female bird flushed silently off the nest down into the forest when two people were walking past. On a subsequent visit two days later, the sitting bird did not flush until we approached to within one metre.

7.2.4 Territoriality

The existence of territoriality in the Tragopan has not been reported in the literature. At Pipar, certain individual males could be recognised by their calling patterns in the breeding season (section 6.2.4). This enabled these individuals to be located at dawn, and it was noted that one bird always called from the same group of trees, for up to 38 consecutive mornings. Other birds were not studied in such detail, but up to five called regularly from certain locations, and no two birds were ever heard calling from the same place.

In Passerines, song, display, and active fighting are regarded as mechanisms of territorial defence (Howard 1948), and all of these have been recognised in the Pheasant Phasianus colchicus (Cramp 1980). Although display towards intruders and fighting were not observed during my study, the wailing call can be regarded as a challenge call used to advertise the presence of a territorial male (Beebe 1922). Playback of calls (section 6.2.4) resulted in male birds approaching the source of playback, and the response of one male certainly indicated antagonism towards what he regarded as another male, probably within his territory. The existence of territoriality could easily be tested in captivity by observing the behaviour of male birds. In the wild, it would be interesting to use playback and decoys within the postulated territories, and to observe their effect on the birds.

Breeding calls were not made by Tragopans in the autumn, and it is likely that any territoriality breaks down outside the breeding season. Further research in this field is necessary.

7.3 Koklass Pheasant

7.3.1 Breeding Season

The breeding season of the Koklass is likely to be similar in timing to that of the Tragopan. Hume and Marshall (1879) reported the Koklass breeding from mid-April to mid-June between 1830m and 2750m, while Wilson (in Hume and Marshall 1879) extends the breeding range by 300m either side. Beebe (1922) states that nesting begins in late April at 2140m and that it becomes later at higher altitude until terminating in mid-June. These dates are also reported by Blanford (1898), and by Ali and Ripley (1969).

The dawn calling of the male Koklass can be heard for most of the year (Gaston 1980a), so it cannot be used as a guide to the time of breeding as it can in the Tragopan. No direct evidence of breeding in the study areas was obtained in either 1979 or 1980, but since birds were present in the areas during the breeding season, it is likely that breeding did take place.

7.3.2 Eggs

These are "glossy, creamy buff with dots and blotches of dark reddish or chocolate brown", averaging 52mm x 37mm in size, and with a clutch size of 4 to 9 (Delacour 1977, P.m. macrolopha).

7.3.3 Nest

A scrape in the ground roughly lined with sticks, leaves, and grass, concealed under dense bushes or rocks (Ali and Ripley 1969, P.m. macrolopha).

7.3.4 Territoriality

Territoriality in the Koklass has not been reported in the literature. Like the Tragopan, certain individuals could be recognised by their calling patterns every morning at Pipar. However, birds tended to change their roost sites every few days, and no two males were every heard calling from the same roost. The call of the Koklass can be heard more or less continuously from September to June (see Table 7), and it has not been determined whether there is a noticeable increase in crowing intensity during the breeding season. However, the crow call of the male can probably be regarded as a territorial display call, like that of the Satyr Tragopan. Playback of crow calls close to a calling male resulted in the bird approaching the source of playback (section 6.3.4) which indicates that he was alerted to the presence of another male which was probably within his "territory". This response was evoked equally well in spring and autumn, suggesting that if the bird is territorial, the territories may be maintained after the breeding season. Like the Tragopan, further research into this aspect of the bird's ecology should be carried out, both in captivity and in the wild.

7.4 Himalayan Monal

7.4.1 Breeding Season

Living at the highest altitudes of the four pheasant species studied, the Monal is likely to have a later breeding season than the others. Hume and Marshall (1879) and Blanford (1898) recorded the breeding season as May to June, while Ali and Ripley (1969) also include April. Bates and Lowther (1952) found nests on 7 May (no height recorded), 24 May at 3050m, and 26 June at only 2440m. The latter date seems very late for such a low elevation, and it may have been a second clutch. Hellmich

(1968) shot an egg-laden female on 7 May at 3500m.

In the study areas, frontal display by male birds was observed on 17 April 1979 and 21 April 1980 at about 3270m, and flight display was observed during both spring field seasons. No nests were found in either year, but it is likely that breeding took place within the study areas in both years.

7.4.2 Eggs

The eggs are "pale yellowish or reddish buff, freckled and spotted with reddish brown". Size 64mm x 45mm. Clutch size 4 to 6. (Ali and Ripley 1969).

7.4.3 Nest

A scrape in the ground under the shelter of a rock or in undergrowth on a steep hillside, hidden by grass or ferns etc. It may be partly lined with leaves, grass, or moss (Ali and Ripley 1969, Bates and Lowther 1952).

7.4.4 Territoriality

The presence or absence of territoriality in the Monal is very difficult to determine. Its dawn call is not regarded to be a challenge call (as it is in the Tragopan and Koklass), and although it feeds on open slopes for parts of the day, interactions between males were seen only on two occasions. On 6 and 7 May, two male Monals were observed fighting in the early mornings, with one other male looking on (section 6.4.6). The reasons for this were unclear, but it is possible that it was territorial aggressive behaviour. Delacour (1977) has described pugnacity between captive male Monals (see section 6.4.6), which could also be construed as being territorial in function. In the wild, it appears that if territoriality does exist in the Monal, the male

probably establishes a territory sufficient for all breeding activities. Advertisement could be both by dawn calling and aerial display to attract a mate. After the breeding season, any territoriality may die down, allowing birds to congregate during the autumn and winter, as has been observed (Hume and Marshall 1879, Beebe 1922, Hellmich 1968, Fleming et. al. 1976).

Further research, using marked birds is needed to determine the occurrence of territoriality in this species.

7.5 Cheer Pheasant

7.5.1 Breeding Season

According to Hume and Marshall (1879), Blanford (1898), and Ali and Ripley (1969), the Cheer breeds between 1200m and 2450m from April until June. In the Athhazar Parbat region, I observed the species briefly during May 1980, but the sightings were too few to determine whether or not breeding was in progress.

7.5.2 Eggs

The eggs are dull creamy white to pale grey-buff, sparsely freckled and blotched with light reddish brown. Clutch size 9 to 14. (Ali and Ripley 1969). Egg size 53mm x 39mm. (Baker).

7.5.3 Nest

A scrape or depression roughly lined with a few leaves and grass at the foot of a boulder in open forest, usually well concealed (Ali and Ripley 1969).

7.5.4 Territoriality

Nothing has been reported in the literature regarding territoriality

in this species. My own observations were insufficient to provide any evidence, and further research on the Cheer is urgently required.

8. HUMAN INFLUENCE ON THE PHEASANTS AND RECOMMENDATIONS FOR THEIR CONSERVATION

Pralad B. Yonzon, M.Sc., carried out the principal study of human impact on pheasant habitats for this project in May-June 1979, and his findings have been published (Yonzon and Lelliott 1980). He devised a questionnaire, (see Appendix 13), and interviewed a total of 38 villagers in the Seti and Mardi valleys on various aspects of forest production and hunting. His results are used in this chapter, along with further data collected myself during the period September to November 1979, and April to May 1980.

8.1 Factors of Human Influence

8.1.1 Gothalos

Gothalos are herdsmen who travel around with grazing livestock, both in the valleys and in high level pastures. In this study, we were concerned only with livestock which were being grazed above 2000m, thus excluding all grazing in and around villages.

At Pipar, the herdsmen operated in small units of one to five men and come from a village or group of villages in the Seti valley. In 1979, only one group of herdsmen was encountered at Pipar, and they were questioned concerning the activities of other groups in the area. Each group lives in seasonal 'goths' (temporary huts) which are either re-used every year, or else new ones are built. Unlike the stone goths found in the Langtang region (DUHE 1977), the ones at Pipar mostly consist of simple wooden frames made of long straight branches bound together to form an open lattice. Principal species used in the frame construction are Rhododendron sp., Betula utilis, and Arundinaria sp.

The frames are then enclosed by the addition of woven bamboo mats, carried up from the villages, to form the roof and walls. High-altitude goths (over 4000m) are usually built of rocks, with the addition of wooden roof frames and bamboo mats.

The general distribution of goths in the study area is shown in Figure 19, and tended to be influenced by the availability of moderately flat ground, which is found mainly on the ridgelines. The principal pasture areas ranged from low-level ones such as Sanokhobang (1700m), through intermediate areas such as Pipar (3300m), to high level grazing areas (known as 'kharkas') such as those at the northern edge of the study areas at more than 4000m.

Gothalos can be divided into two distinct categories: those with cattle and water buffalo, and those with sheep and goats; all keep up to three Tibetan Mastiff dogs for the protection of the herds. The former groups begin grazing at low-level pastures in mid May, and move to mid-altitude ones in late June, as the monsoon approaches. A group was encountered at Sanokhobang with about 25 head of cattle on 5 May, 1979 and 3 May, 1980, prior to moving up to intermediate areas such as Pipar. Evidence of the presence of cattle gothalos was common at Pipar, Bhalu, and Korchon in the form of recently-used goths, tracks and faeces of cattle, and grazed slopes and bushes. No such evidence was seen in the areas above 3500m, and it is probable that this height represents the approximate limit of cattle and buffalo grazing in this area. Medium-altitude pastures such as Pipar are probably used only between late June and early to mid September, since no herds were encountered at this height either in early June, or in late September.

Sheep and goat gothalos move away from the valleys in late May or early June (we encountered a party at Thulokhobang on 28 May, 1979), and they then spend most of the summer at higher altitudes than the cattle

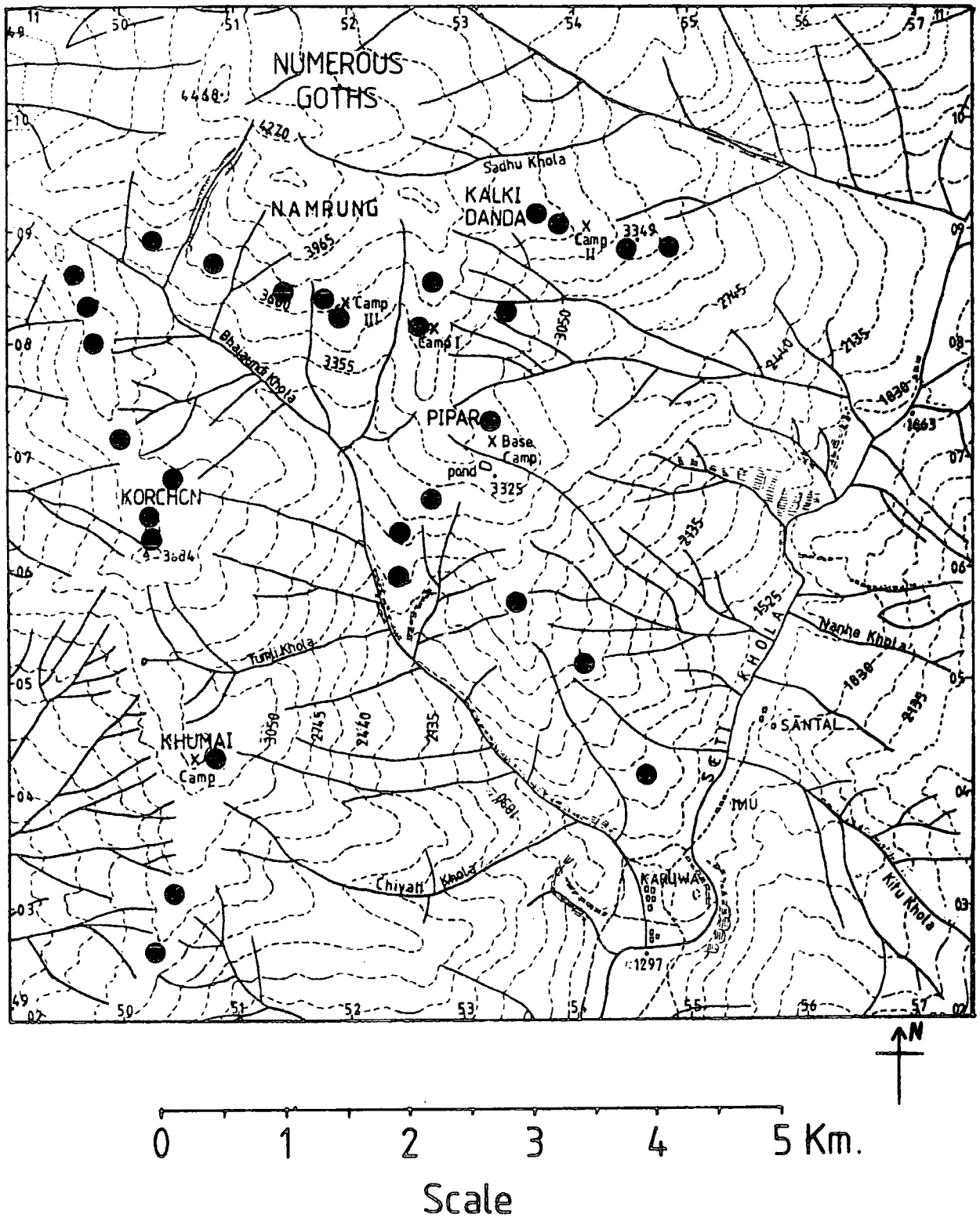


Figure 19: Approximate distribution of known goth sites in study areas.

herders. In September 1979, a group of three gothalos was present at Kalki Danda with about 48 head of stock. They stated that six goth-groups were present at and beyond the northern edge of the area shown on Figure 19 during the summer. Three groups were from Ghachok village, two were from a village near Lachok, and they themselves were from Mirsa. Initially seen on Kalki Danda ridge on 22 September, 1979, they moved down to a goth area between census points 3 and 4 (see Figure 5) early in October, passed through Pipar campsite on 8 October, and spent the rest of the month and early November on the southern and eastern slopes of Pipar. They expected to return to their village in late November, and had done so by the 27th.

From questioning local villagers in Karuwa, it appears that most villages employ up to five men from among their number to look after the livestock during the summer. These gothalos, who were implied to be the less intelligent members of the community, are paid a small amount of money and given food by the owners of livestock in return for looking after them. The reason for the upward migration of the livestock is principally to avoid crop damage in the fields, and presumably because food is plentiful during the monsoon, even at high altitudes.

In many parts of the world, the effect of wandering livestock herds on forest and grassland habitats is very serious. In this study, the effects of grazing were assessed purely in a visual manner, and no measurements were taken. It was noted that the forest adjacent to village, extending up to approximately 1500m had been intensely grazed in certain areas, and showed a considerable lack of understory growth. Similarly, in areas immediately adjacent to regularly-used pastures such as Sanokhobang, Thulokhobang, and Hile, the lack of ground vegetation and understory was evident, indicating heavy grazing in these areas too. The effects in mid-range pastures are more difficult to

assess. At Pipar and Kumai, some of the vegetation is characterised by open slopes of tussock grassland, some of which are the result of forest clearance, while others may be of natural occurrence. Some areas show a predominance of Berberis scrub, especially the edges of the forest. This shrub is an unpalatable species known to flourish in areas of clearance and overgrazing (DUHE 1977), and its presence at Pipar indicates moderately heavy grazing, probably by cattle. Rhododendron forest at Kumai was noted to be very denuded of ground vegetation in the area close to the goths, but this became proportionately less pronounced with increased distance from the goths. In all the study areas, the 'kharka' pastures above the treeline were only visited in autumn 1979, when they were clear of snow. Grazing pressure was not assessed quantitatively, but erosion was negligable, and grass was still abundant, showing no signs of overgrazing.

The other main ways in which gothalos affect habitats is by disturbance, trapping, and hunting. All of these are localised to the area in which a goth-group operates, and the overall effect on the habitat depends on the density of such groups. It is probable that disturbance causes birds such as pheasants to move away from the local area, thereby reducing the likelihood of predation by trapping or hunting. No new traps were seen in the Pipar or Kumai areas in autumn 1979 after the gothalos had left.

The principal way in which pheasants are affected by livestock grazing is the reduction of forest ground cover. This is one of the most important features of pheasant habitat, since it provides protection and safety for the birds, which are mostly very shy and wary, and its loss will certainly be detrimental to them. The complete clearing of forest to make way for pasture land is even more deleterious to the pheasants, except perhaps the Monal. However, above 3000m the

present levels of clearance and grazing do not appear to be severely affecting the pheasants in the study areas, although annual monitoring of livestock grazing and clearance should be carried out. The large areas of almost untouched forest, supporting good numbers of pheasants, owe their continued presence to the fact that they are situated on very steep and inaccessible slopes where grazing of cattle is impossible. However, these slopes can be grazed by sheep and goats, and if their numbers are allowed to increase, such areas may become threatened.

8.1.2 Shikaris

In this study, the term 'shikari' refers to a man who, for part of the year, hunts wild game for food and profit. Each village visited in the Seti and Mardi valleys contained one or more resident professional or amateur shikari. From analysis of the results of Yonzon's questionnaire (the raw data of which is deposited in Kathmandu), at least eighteen professional shikaris from ten nearby villages were active, and they ranged in age from 25 to 50 years.

Shikar (hunting) parties usually consisted of two to nine men, depending on the total number of hunting days, which ranged from three to twelve.

Shikaris hunt mainly by trapping or shooting their prey. Few professional shikaris own a gun, and most (80%) are borrowed from rich villagers who take a share in the prize. Both old-fashioned muzzle-loading and more modern breech-loading guns are used. When out shooting, shikaris prefer to kill large game such as Serow, Ghoral (Nemorhaedus ghoral), or Barking Deer (Muntiacus muntjak), but if success with these is limited, as is often the case, then pheasants will be shot. In spring 1979, a 'shikar party' of six men (carrying three guns), spent a total of 108 man-hours hunting without observing

a single wild mammal. Similarly, from 10 to 12 October, 1979, a shikar party of seven men with four guns spent three days hunting with no success.

From the results of Yonzon's questionnaire concerning pheasants shot, the Kalij Pheasant (occurring from 304m to 2450m altitude) accounted for 70% of the total kill, followed by the Satyr Tragopan with 27%. Both of these species range well below the study area, and it is thought that shooting of pheasants takes place mainly below 2600m. The technique of flashlighting is used by shikaris to kill Kalij Pheasants near to villages. It involves finding a Kalij roost, visiting it by night, and dazzling the roosting birds with a powerful beam of light. The birds can then be shot singly, as they remain sitting on the branches (Roberts 1980, Severinghaus 1977).

Details of trapping are less easy to come by, but the principal method is by the foot snare. This involves a trigger mechanism releasing a 'spring' which tightens a noose around the bird's leg. The mechanism is illustrated in Figure 20 and described in detail in Appendix 14. A brush fence of small branches about 1m high and up to 50m long is set out in a likely spot of forest or grassland. A number of 'gates' are made in the fence, each set with a snare, and they are checked periodically (preferably twice per day) for trapped birds. Yonzon's questionnaire showed that in 1978 the trapping totals of pheasant species were as follows: Kalij 43%, Satyr Tragopan 36%, Himalayan Monal 21%. The success rate of trapping is not known, but is not likely to be very high, as Severinghaus (1977) found in Taiwan. In October 1979, I set two 7-gate trap lines in Rhododendron forest and Berberis scrub, which in four days resulted in one male Tragopan caught alive. In April 1980, a porter at Pipar campsite set a 5-gate trapline for more than seven days, but only succeeded in catching one male Blood Pheasant.

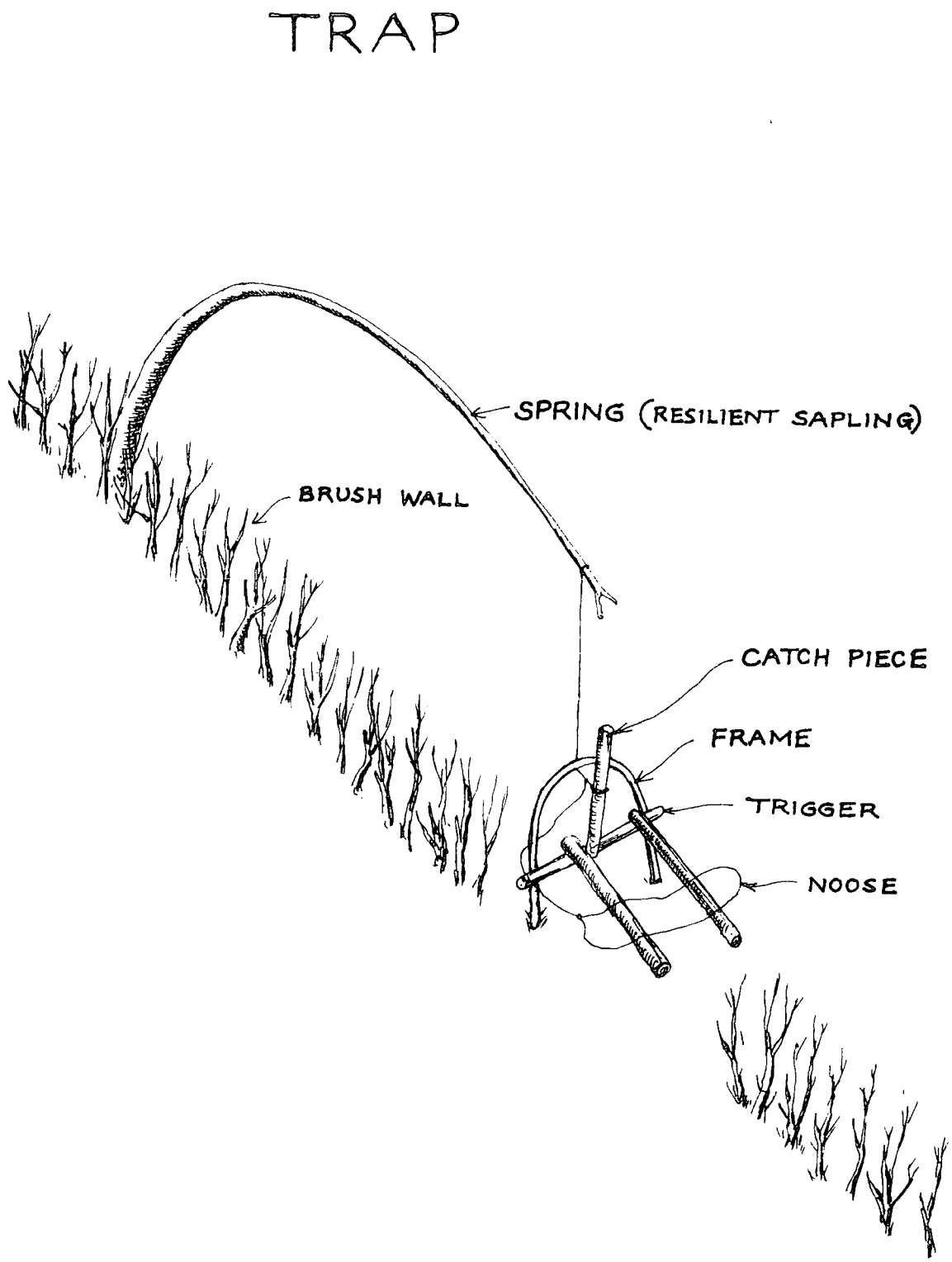


Figure 20: Diagrammatic sketch of pheasant snare.

Trapping did not appear to be carried out very commonly at Pipar, since only old (pre-1979) trap fences were seen in both years, and they were completely absent from Kumai, Korchon, and Bhalu. It is thought that trapping takes place mainly at lower levels, near villages, and also in areas where shikaris commonly go out on hunting expeditions. At present levels it is not detrimental to pheasant numbers, but shikaris with some knowledge of the birds' movements, and by intensive setting of traplines, could probably catch large numbers of birds in localised areas.

8.1.3 Land Burning

Local villagers carry out burning of scrubland and grassland in certain areas during February and March each year. It is done in order to promote new growth in the tussock grass which is favoured by the livestock herds grazed on these areas in the summer months. Such burning also helps to prevent the formation of scrub and woodland on these areas.

Burning was particularly noticed on the southern slopes of Pipar and Kalki Danda, and on the hillsides above Dara and Muri villages in the Athhazar Parbat region. At Pipar, the burnt slopes were dry and blackened with numerous short tussocks of stiff grass in early April 1979 and 1980. Growth of new shoots began in late April, and by late May all the slopes were becoming covered with new growth; in September 1979 they were thickly covered with very varied herbaceous vegetation and tussock grass. In the Athhazar Parbat region, burnt slopes had not begun significant new growth in mid May 1980, but were well covered in mid August (1979).

Apart from the effect of preventing the regeneration of scrub and forest, the practice of burning grassland has two main effects on the

vegetation. First, burning exposes bare ground which is subjected to the heavy spring precipitation which occurs in the study areas. This has led to a small amount of erosion at Pipar, which is likely to increase in the future if the practice of burning is continued. Secondly, fires frequently appear to get out of hand, with the result that adjoining edges of forest and scrub become burnt. This was evident in a number of places at Pipar, and even more so West of Dara village in the Athhazar Parbat region where large numbers of Rhododendron trees were badly burnt. Continued accidental burning of forest adjacent to grassland will slowly increase the latter and reduce the forest cover.

8.1.4 Ringal Bamboo Cutting and Medicinal Plant Collecting

Ringal bamboo (Arundinaria sp.) is an important raw material used in the making of numerous household items such as carrying-baskets and matting, some of which are sold in bazaars on a regular basis. Cutting of ringal bamboo is carried out throughout the year in most areas, although in the Siding area, Mardi valley, the local Panchayat Authority (government) has been practising a seasonal ban on cutting from mid-May until September. On 6 April, 1980, a total of about 30 bamboo cutters was seen passing through Dhiprang village, travelling from the upper Seti valley to Ghachok village. Each man was carrying up to fifteen bamboo stems approximately 6m in length which makes a total day's cut of 450 lengths. The cutting is not indiscriminate: only the suitable sized mature stems are chosen, and young shoots are mostly left uncut. The problem with bamboo growth is that it is extremely slow, some himalayan species requiring 40 or more years to grow, before flowering once and dying. Regeneration is therefore very slow, and if large areas of bamboo are cut before they have flowered and dropped their seeds, new growth is only possible by vegetative means. At present, cutting is carried out up to only approximately

3000m, but since regeneration is so slow, lower stocks might soon become exhausted, necessitating cutting at higher altitudes. Tragopan and Koklass Pheasant are the species principally affected by present levels of cutting, and the removal of cover is likely to be detrimental to these species' habitats. Continuous monitoring of the amount of bamboo cropped in selected areas would provide a useful index for future management of stocks.

Medicinal plant collecting takes place during the post-monsoon season. In September and October 1979, groups of up to five men visited the Pipar area in order to collect roots and leaves of certain species to sell in the villages for medicinal purposes. In some cases, though I did not observe it, pheasant snares are set on the way to the collection sites, but the number of pheasants trapped in this manner is likely to be small.

8.1.5 Fuelwood Collection

An excellent report on the fuelwood requirements of villagers in the Langtang National Park and elsewhere in Nepal, can be found in DUHE (1977 pp. 56-65). Details of fuel consumption by villagers in the Seti and Mardi valleys were not noted in this study, but the general principles given in the DUHE report apply throughout much of Upland Nepal. The authors estimated in the Langtang region, that from three to over twenty tonnes (air dried) of firewood is used annually by each household in its permanent settlement. They state that consumption per household depends on:

(i) The distance between the source of wood and the settlement.

(ii) The seasonality in the availability of the fuel source.

(iii) The altitude of the household.

(iv) The number of people in the household.

(v) The wealth of the family.

From observations made in private households in the upper Seti valley, I estimate that an 'average' family burns approximately one 'load' of wood (approximately 40kg.) per day, or 14.6 tonnes per year. In the upper valley, wood is both plentiful and no great distance away, so that collection is easy. This is not the case as one progresses down the valley, and it is likely that wood consumption is cut down as factor (i) increases and factor (iii) decreases. However, accurate estimates of the fuel consumption of the whole valley can be determined only by studies of this problem.

A general trend in the whole area is for firewood to be cut closest to villages, so that the slopes of the lower valleys (towards Pokhara) have largely been cleared of forest and are terraced for cultivation. The upper slopes are less denuded, but since fuelwood is now scarce on the lower slopes, the former are coming under increasing pressure, so that there is a constant 'attack from below' along the lower forest edges. The pattern is complicated by wood cutting by gothalos and shikaris. The former are cropping fuelwood from the areas surrounding their goths in the low and mid-altitude ranges, while the gothalos who use kharkas for grazing their herds are cutting wood at the treeline. The affect of this cropping depends on: (a) The density of gothalos in an area, (b) How regularly they visit the same areas, and (c) Whether their herds are grazing above or below the treeline. Questioning of the gothalos in the Pipar area in autumn 1979 revealed that they used about 1 to 2 'loads' of wood per day where it was easily available, depending on the altitude. This was because a fire was often kept burning during the night to ward off wild animals, and to keep warm. Gothalos living above the treeline would manage with less than this, despite the cold, because of the greater distance it had to be carried.

Deforestation leads to loss of habitats and therefore of pheasant species, but it has much wider and more serious implications in terms of erosion, flooding, and famine, so that reduction of deforestation is an absolute necessity. In view of the ever-increasing pressure on the forests in this area and throughout Nepal, it is essential that alternative sources of energy be investigated for use in place of firewood and that re-afforestation programmes be implemented.

8.2 Status of the Study Species in Captivity

Appendix 15 shows the full censuses for the study species carried out by the World Pheasant Association in 1976 and 1979. The totals for each species are listed in Table 23.

TABLE 23 Censuses of the Study Species of Pheasants in Captivity, 1976 and 1979

Species	Captive Population in 1976	Captive Population in 1979	Percentage increase/decrease
Blood Pheasant	12	18	+ 50%
Satyr Tragopan	351	395	+ 12%
Koklass Pheasant	78	262	+ 236%
Himalayan Monal	1238	1170	- 5%
Cheer Pheasant	838	705	- 16%

The censuses are stated by the co-ordinator to be underestimates, and therefore should only be used as a rough guide. Assuming they are accurate to within approximately 20%, they indicate that three of the species have roughly stable populations in captivity, while the Blood Pheasant has increased by about 50%, and the Koklass by about 240% in three years. It is encouraging to note that although these two species are the most difficult to keep in captivity (Delacour 1977), their numbers are increasing, suggesting that rearing techniques are improving. However, compared with the other species, the

Blood Pheasant numbers are still very low. The only endangered species of Nepal, the Cheer Pheasant shows an apparent slight decline in captive population, but its numbers are still relatively high.

8.3 Status of the Study Species in the Wild

8.3.1 Blood Pheasant

World status of this species is difficult to assess at present due to the fact that only two of the eleven subspecies, I.c.cruentus and I.c.tibetanus, occur in areas from which information on their status is readily available. The remaining subspecies occur in Tibet and China, for which Cheng (1963) is the only available reference. He states that it was "quite numerous" in the areas he visited in 1956, such as the Ch'in Ling and T'ai-pai Shan mountains in Shensi and Szechwan provinces. Hodgson (in Hume and Marshall 1879) reported that prior to 1850, the species was common in Nepal, and that packs of 70 to 100 birds were often seen. No reports of the species' status in Nepal were available for the next century because the country was closed to foreigners until 1950. Since then, Ali and Ripley (1969) have described it as "common and abundant in the high Himalayas in central and eastern Nepal"; while Fleming et. al. (1976) state that it is "fairly common" (i.e. "in suitable habitat, the chances of seeing them are about 50%"). In contrast, Grahame (1971), from his limited observations in the Everest region and India believed the species to be "nowhere common". In this study, I found approximate densities of 2.5 to 4 pairs per km^2 in suitable habitat. This is relatively sparse, but compares favourably with densities of birds such as woodland grouse in Europe (Lovell 1979), which are managed for hunting, and Koklass Pheasant in Pakistan (see Table 10 and Severinghaus 1979). However, further surveys should be conducted in Nepal and elsewhere before attempting extrapolation to estimate the world population. In general, it would appear that while

it is unlikely to be as common as it was in Hodgson's time, the Blood Pheasant is certainly in no danger at present.

Future Prospects: This species, having a fairly restricted altitudinal range, at high levels (approximately 3000m to 3600m, see Figure 8) will most probably receive heavy pressures in the future from expanding human settlements and activities. In the study areas, pressures will initially be the increased forest clearance and livestock grazing rather than the establishment of permanent settlements. However, in eastern Nepal, and probably Sikkim, Bhutan, and China, these problems will be accompanied by an increase in size and number of villages within the high-level range of the Blood Pheasant.

The habitat destruction resulting from forest clearance could easily give rise to the formation of a number of 'islands' of suitable habitat, each supporting separate populations of Blood Pheasants, and surrounded by altered habitat. Diamond (1975) has studied such 'islands' and forms a number of conclusions from his work. These include the following:

(i) Larger reserves, and reserves situated close to other reserves, can hold more species than small isolated ones.

(ii) Different species require different minimum areas to ensure viable populations.

(iii) The smaller the reserve, the higher the extinction rate.

Although no surveys have been carried out on Blood Pheasants in other areas in Nepal or elsewhere, it is assumed (and hoped) that the 'island' phenomenon is still a long way off. To ensure the species' survival, it nevertheless needs a number of reserves in which its habitat will be protected from destruction. It is known to occur in moderate numbers in the Everest National Park (R.L. Fleming Jr. pers. comm. 1979) and in

the Langtang National Park (DUHE 1977). Its survival in these two areas should be assured if poaching and habitat deterioration can be stopped, but the species would benefit from further protection, especially in an area containing no major human settlements such as Pipar. Recommendations for the creation of a reserve in this area are presented in section 8.4.1.

8.3.2 Satyr Tragopan

The world status of this species is also difficult to assess, though for different reasons to the Blood Pheasant. Early authors such as Hume and Marshall (1879) or Blanford (1898) give no indication of its abundance, but it was likely to have been more common than it is at present since its habitat was presumably more widespread throughout its range. Even recent authors do not state whether it is common or not, and the reference of Fleming et. al. (1976) to "occasional" ("usually not seen") alludes to the bird's secretiveness rather than its abundance. No surveys have been carried out on this species, so I can base its status only on the densities recorded in the study areas. These were approximately 3 to 4.5 pairs per km^2 of suitable habitat which were roughly similar to the densities of Blood Pheasant, and considerably greater than the densities of the endangered Western Tragopan in Pakistan (less than 1 pair per km^2 - Mirza 1978). After further surveys have been carried out in other areas, it might be possible to extrapolate densities to estimate the size of the world population of the Satyr Tragopan.

Future Prospects: The Tragopan has a fairly wide altitudinal range (roughly 2230m to 3550m, see Figure 8), which shows that it can exploit a wider variety of habitat than can species such as the Blood Pheasant. Nevertheless, its lower level habitats are likely to come under very great pressure from deforestation in the next few decades.

In the Seti and Mardi valleys, adjacent to the study areas, tree cutting for firewood is being carried out at a high rate (section 8.1.5) and as wooded areas near the villages become exhausted, exploitation of forest within the range of the Tragopan is inevitable. In fact it has probably already happened, and the present range of the species in these regions is likely to be smaller than it was in the past. Unless alternative fuel becomes freely available to the local people, the present high rates of fuelwood cropping are certain to continue, and probably increase. If this happens, pressure on Tragopan habitat will also increase, and the numbers are likely to decline, although birds living at higher altitudes will not be affected as soon as those at lower levels. The 'island' phenomenon (Diamond 1975) is likely to develop in the same way as it will for the Blood Pheasant (section 8.3.1) i.e. areas of suitable habitat may become fragmented and separated by larger areas of altered habitat.

Although present areas of suitable habitat appear to be in reasonable quantity in the regions I have visited in Nepal, almost none of these are actually protected. The Tragopan is unlikely to occur within the Everest National Park, although I found the remains of one male outside, which had probably been killed by people less than 15km from the Park boundary. The Durham University Himalayan Expedition did not encounter the species within the Langtang National Park, although J. L. Fox did so in 1974 (Fox 1974). I have no information for the third National Park, Lake Rara. All three of these National Parks cover areas which lie predominently above the altitude range of the Tragopan, and can therefore not be regarded as protecting the species. It would be beneficial to preserve an area such as Pipar in order to protect the habitat of the species in the centre of its range. Recommendations for the setting up of a reserve at Pipar can be found in section 8.4.1.

8.3.3 Koklass Pheasant

Five of the nine subspecies of P.macrolopha occur only in China. Regarding their status, Cheng (1963) states that "numbers are not very numerous, and attention should be given to regulated hunting and planned breeding". For the other four subspecies, which all occur in the Himalayas, it is also difficult to obtain information of their status, except for a few recent surveys. Wilson (in Hume and Marshall 1879) reported of P.m.macrolopha that they were found on nearly all hillsides that were covered with trees and bushes, which implies a fairly widespread distribution. White (1925) and Davidson (1896, in Bates and Lowther 1952) reported from Kashmir that P.m. biddulphi could be found "in some numbers", and that they were "common". More recently, workers such as Bates and Lowther themselves (op. cit.) and Ali and Ripley (1969) refer to the presence of the Koklass in Kashmir, India, and Nepal, but give no indication of its abundance. Roberts (1970) states that in Pakistan "they are now rare and encountered only with difficulty and after diligent search in areas where even in the last ten years they were plentiful".

Table 10 shows a summary of the results of censuses carried out in Pakistan, India, and Nepal in the last four years, which show ranges in population denisty from 1.5 to 10.5 pairs per km^2 (excluding Severinghaus' estimate, section 4.3.4). The mean density of Koklass in Pakistan is 4.4 pairs per km^2 (n=10), so the results from the Pipar area of an average of 3.2 pairs per km^2 (n=5) compare quite favourably. Gaston's figures from the Dachigam Sanctuary, Kashmir, of 10 pairs per km^2 are based on only one survey, but are also encouraging as are those of Green (1980). Gaston also states (1980b) that Dachigam, Khajiar, and Simla water catchment areas all probably support several hundred pairs of Koklass.

Future Prospects: In the study areas, the Koklass occurs within a fairly limited altitudinal range (2700m to 3300m, see Figure 8), within that of the Tragopan, but the species as a whole is reported to occur between 600m and 4880m in China (section 1.3). It is therefore possible that it may be able to adapt to a wide range of habitats and altitudes, but at present in Nepal, P.m. nipalensis would appear to be under similar pressures to the Tragopan. These are principally deforestation and grazing, and the discussion in section 8.3.2 applies equally well for this species.

However, unlike the Tragopan, the Koklass is limited to western Nepal, where little is known of habitat suitability because of its inaccessibility. It is probable that suitable habitat is still present in reasonable quantity in West Nepal, but surveys should be carried out to confirm this. Lake Rara National Park is known to contain Koklass Pheasant (National Parks and Wildlife Conservation Office staff, Kathmandu, pers. comm. 1979), but this is the only area in which protection is reasonably assured. Since the Koklass is present in reasonable numbers at Pipar, which is near the eastern edge of its range, it would be advantageous to protect this area.

8.3.4 Himalayan Monal

Early reports of the abundance of this species indicate that it was very common last century, but that hunting was reducing its numbers drastically in India. Hume and Marshall (1879) referred to Wilson sending home 1000 to 1500 skins per year for thirty years! Roberts (1980) expresses some scepticism at these numbers, but it seems reasonable to assume that the bird was very common, at least up until the mid-nineteenth century. Since then, there is little information concerning numbers of birds. Bates and Lowther (1952) report that it is "not at all numerous" in Kashmir except in a few localities, while Roberts (1970)

gloomily reports from Pakistan that "it has now become very rare in all the forests where even ten years ago it was plentiful". In Nepal it was never likely to have been hunted with as much intensity as it was in India and Pakistan (Roberts 1980). Hellmich (1968) considers it to be widespread in Nepal but not very abundant, while Fleming et. al. (1976) record it as "common" ("usually seen") in suitable habitat. The census results from my study are overestimates (see section 4.3.5), but even taking this into account, they compare very favourably with Mirza's counts from Pakistan (see Table 11), which are probably underestimates.

Future Prospects: The Monal is found over most of the altitudinal range of the Koklass and Blood Pheasants, but also occurs higher than either of these species, having a range of 2800 to 4000m in the study areas (see Figure 8). This wide range is advantageous to the species in that if one part of its habitat is exploited, it may be able to adapt to living only within the remaining part. However, the Monal is likely to face similar pressures to both the Koklass and the Blood Pheasant in the form of expanding human settlements within its habitat. Its ability to live in areas above the treeline during the summer may be important in the future if deforestation becomes a major problem in the Himalayas. Its high altitude range may also help to prevent its habitat becoming fragmented into 'islands' of suitable habitat, referred to earlier, but this possibility cannot be ruled out.

The Monal enjoys the status of being Nepal's most protected pheasant species. In addition to being the national bird of Nepal, it occurs commonly in the Everest and Langtang National Parks, and possibly also occurs in the Shey Gompa Wildlife Reserve (Dolpo Region) and Lake Rara National Park. The bird and its habitat are given reasonable protection in all these areas, so that its future is fairly secure. However, its presence in a possible reserve in the Pipar area

would mean that five of Nepal's six pheasant species would be protected in one area.

8.3.5 Cheer Pheasant

From the accounts in the literature, this endangered species has always had a very local distribution throughout its range, although it was sometimes quite common where present (Hume and Marshall 1879, Blanford 1898). Throughout much of its present range in India and Pakistan, the Cheer is even more locally distributed than it was, and where it does exist, its numbers are probably significantly less than they were last century. Roberts (1970) reports that it may face complete extenction in Pakistan, and knows of only two locations, in Hazara and the lower Neelum Valley (Azad Kashmir) where it exists. Severinghaus et. al. (1979) and Mirza (1980a) consider that it is now extinct except from some areas of Azad Kashmir. However, since 1977, the World Pheasant Association Pakistan Chapter has been carrying out experimental re-introduction of Cheer into the Margala Range National Park, with some success. No data was forthcoming from India until a survey of the Chail Wildlife Sanctuary, Himachal Pradesh was made by Gaston in April 1979 (Gaston and Singh 1980). He and a number of observers saw twelve Cheer in the course of five days, and at least nine pairs were located by call count censusing. This gave an extrapolated total of approximately forty pairs in the reserve, the largest population currently known anywhere. The Red Data Book (IUCN 1979) states that the species is "endangered in most parts of its range, and possible extinct in Pakistan. Becoming increasingly rare and local in the West Himalayan foothills, where habitat destruction and hunting have caused a serious deterioration in its status".

Very little is known about numbers of Cheer Pheasants in Nepal, but they are known to occur in reasonable numbers at Dhorpatan (Fleming et. al.

1976), and Roberts "found them not common, but not so scarce as to warrant listing as an endangered species" at Dhorpatan in 1976 (Roberts 1980). In this study, I found four pairs present near Muri village in an area of approximately 0.5 km^2 (see section 4.4), but no Cheer were located in the surrounding area. Both Dhorpatan and Muri are very close to the eastern limit of the geographical range of this species.

Future Prospects: Having carried out so little fieldwork on the Cheer Pheasant, I find it difficult to assess its prospects for the future. It lives at a lower altitude (2200 to 2440m) than the other species studied, and was observed living in close proximity to much human activity such as livestock grazing, fuelwood cutting, and arable farming. However, precisely because it was seen existing with such heavy human influences, I consider that it may have been able to adapt to these, and inhabit areas close to human settlements. If so, then as long as man's activities do not become too destructive, and that deforestation can be brought under control, the Cheer may be able to survive. The effect of the 'island' phenomenon (see section 8.3.1) on the Cheer is also difficult to assess. Since it has always been of local occurrence, it would seem that the 'island' phenomenon has existed in its distribution since the last century, but that its effect has been accelerated as the loss of habitat has increased.

The Cheer is not thought to occur within any protected areas in Nepal, although the Dhorpatan area may soon be gazetted as a 'hunting block' to regularise and protect Blue Sheep (Pseudois nayaur) hunting to the North (J. Roberts pers. comm. 1980). I consider that a very high priority for future work is to carry out extensive surveys for Cheer Pheasant to the East and West of Dhorpatan, to try and provide some baseline data on the real status of this species in Nepal, after

which intensive studies of its ecology should be executed, so that its protection can be assured.

8.4 Recommendations for Future Conservation

One of the four original objectives of my project was: "To suggest an area that may be considered as a sanctuary in which Galliformes are fully protected, and further research can be undertaken" (Lelliott 1978). Therefore I list here a number of recommendations for their conservation.

8.4.1 Reserve Establishment

It is suggested that a 'Wildlife Reserve' be set up in the Pipar area. Members of staff of the National Parks and Wildlife Conservation Office, His Majesty's Government, Kathmandu should survey the area, using the suggestions below as guidelines for the establishment of a Reserve as soon as possible. The economic and logistical aspects of the creation of such a Reserve are beyond the limitations of my study and are not discussed here.

Considerations for the 'Pipar Wildlife Reserve'

1) The Pipar area supports moderate densities of four species of Himalayan pheasants: The Blood Pheasant, Satyr Tragopan, Koklass, and Himalayan Monal, (see section 4.3) and is the only area known where these species occur within such a narrow altitudinal range.
2) The protected area needs to be large enough to maintain stable populations of all four species, and preferably should also include a population of a fifth species, the Kalij Pheasant. Diamond (1975) states that different species have different probabilities of persisting on a reserve of a given size. These probabilities depend on the abundance of the species, the magnitude of its population

fluctuations, and other factors. No work has been done on the population dynamics of Himalayan Pheasants, so that choosing the minimum size of a self-supporting population is a matter of judgement. However, the bigger the reserve, the better are the chances of maintaining viable populations.

3) The 'Annapurna Sanctuary' is an area of considerable natural beauty at the headwaters of the Modi river valley, North-West of Pipar (see Figure 2), and is a popular tourist trek. It has been proposed (Sakya 1977) that this should be designated as a 'Recreation Area', which would give some degree of protection to the wildlife and forests within its boundaries. However, the Pipar area is unlikely to be included in this 'Recreation Area', since the Annapurna Sanctuary lies 15 km to the North-West and has well-defined natural boundaries.

4) For logistical purposes, Pipar has the advantage that it is relatively close to Pokhara (25km direct, approximately three days walk), which is the capital of Nepal's Western Development Region.

5) Access to much of the Reserve is very difficult due to steep slopes and unexplored dense forest, which however, is beneficial to the existing wildlife.

6) No permanent settlements are included in the proposed Reserve area except for Karuwa village (population approximately 40 persons), which lies in the extreme South-eastern corner. Its presence however, does not pose a threat to habitats and wildlife.

Possible Area for Pipar Wildlife Reserve (See Figure 21)

The area should be bounded on the eastern side by the Seti Khola, from its junction with the Sadhū Khola (Grid Ref. 574091) to its junction with the Bhajaundi Khola (546026) at Karuwa village. From there, the southern limit runs northwards up the Bhajaundi Khola for

approximately 1.2km to the junction with the Chiyali Khola (540038). From there it passes south-westwards up the Chiyali Khola, taking the southern of its two branches at (515034) to the ridge at 2960m (505035). The western limit runs from this point northwards, following the watershed over Kumai (506044) and Korchon (502062), continuing to the ridge branch at (494094), where it dog-legs north-eastwards to the peak at 4468m (14,648 feet) (508102). From this peak, the northern boundary runs south-eastwards to a peak at 4390m, and from there eastwards down the Sādhu Khola to its junction with the Seti Khola (574091).

This area includes Pipar, Kalki Danda, Korchon and Kumai hills and the Seti river in the East; a total area of approximately 46km^2. Boundary identification in the field is relatively easy since all the boundaries lie along natural landforms such as watersheds and streams. The eastern edge of the proposed reserve lies at a minimum altitude of about 1300m, which is well within the altitudinal range of the Kalij Pheasant. The species was seen at Sanokhobang (1700m) in the forest North of Karuwa village on 7 April, 1980. On the basis of the population densities of the other pheasant species expressed in section 4.3, and the estimated areas of suitable habitat available, Table 24 estimates the numbers of pheasants in this area.

TABLE 24 Possible Suitable Habitat and Pheasant Population Sizes in proposed Pipar Wildlife Reserve

Species	Area of suitable habitat (km^2)	Population Estimate (pairs of birds)
Blood Pheasant	14.7	37-56
Satyr Tragopan	28.6	86-126
Koklass Pheasant	13.4	35-64
Himalayan Monal	17.3	(275 birds)[a]

Note: a - estimate based on density of 16 birds km^{-2}, which is probably an overestimate (section 4.3)

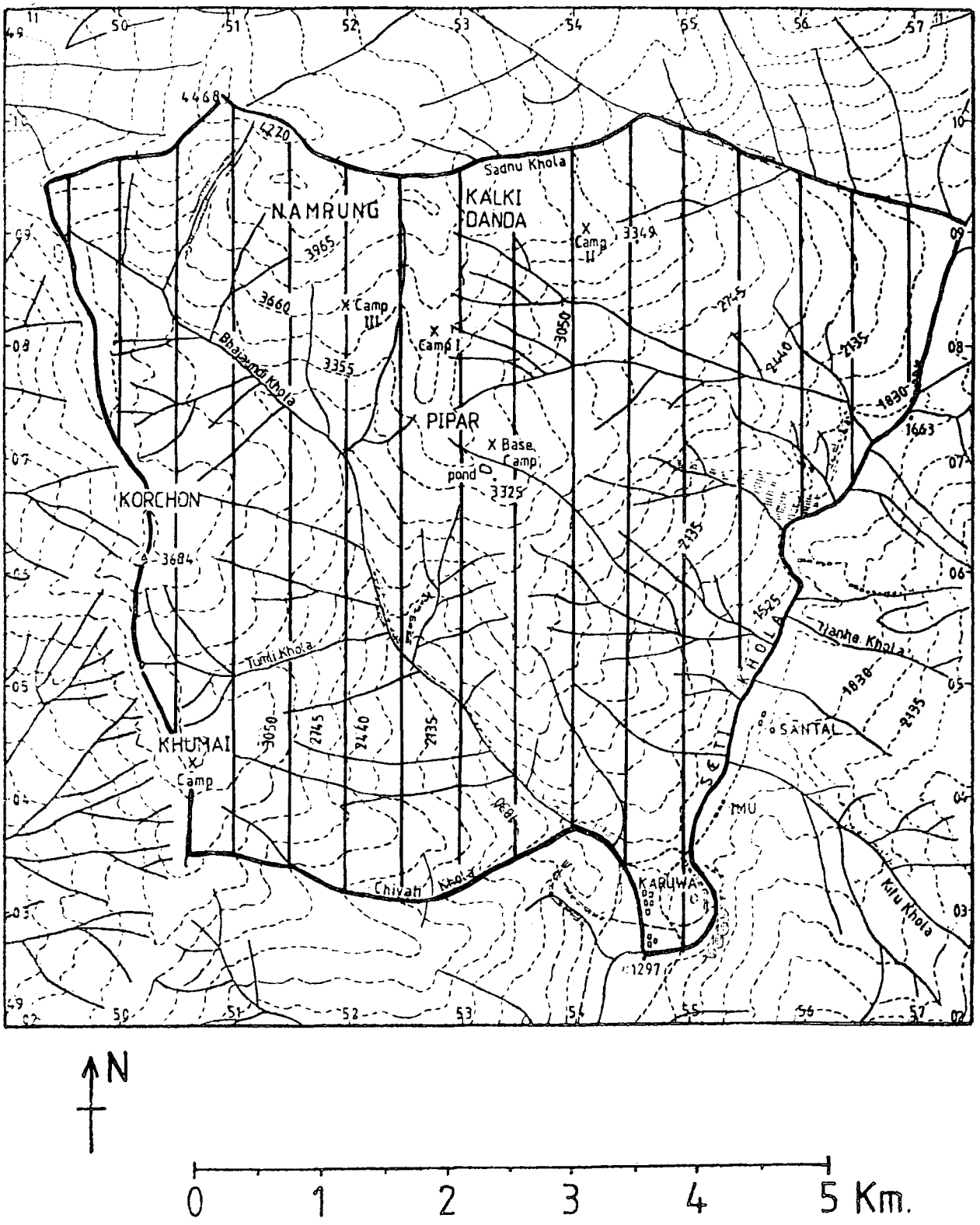


Figure 21: Map showing area of proposed Pipar Wildlife Reserve.

8.4.2 Regulations for Hunting

Under Section II of the National Parks and Wildlife Conservation Act 2029, it is illegal for any animal (listed in Schedule 2 of the act) to be hunted without licence. All pheasant species are included in this act, but it is not properly enforced throughout Nepal (DUHE 1977, Roberts 1980). The actual extent of illegal hunting is uncertain, but may be considerable in the Seti and Mardi valleys (Yonzon and Lelliott 1980), as elsewhere in Nepal. It is recommended that the existing game laws be enforced by the more obvious presence of District Forest Officers and other officials in the mountain areas.

It is further recommended that when the Pipar area is established as a Wildlife Reserve, a total ban on hunting of all animal and bird species be effected within its boundaries. However, licensed hunters should be allowed to continue operating outside the reserve, and it is not suggested at this stage that hunting be forbidden even during specified seasons.

8.4.3 Regulations for Forest Production

Fuelwood

Regulating the amounts of fuelwood collected and consumed presents considerable problems. Since the local people need wood for cooking and heating, it is likely that any proposals to limit wood cropping would meet with great opposition unless free fuel was provided in some other form. The cost and logistics involved in supplying even a small amount of fuel (such as kerosene) on a regular basis would be enormous. It is therefore proposed that a major education scheme be launched in the Seti and Mardi valleys (see section 8.4.5) which includes informing the local people of the need for forest conservation. It should suggest

that only minimum fuelwood needs should be cropped, and the villagers should be told of the detrimental effects of large-scale forest clearance. At this stage it is not proposed to attempt to regulate the cropping of fuelwood either within the reserve or elsewhere, because of the present lack of alternative fuels, and the difficulty of enforcing such a regulation. The Forest Department should ensure that cleared areas are given a maximum chance to regenerate.

Bamboo and Medicinal Plants

The cropping of bamboo within the proposed Reserve area should be allowed to continue, but only by the inhabitants of Santal, Imu, and Karuwa villages. Bamboo from the Reserve should be cut for the use only of the people of these villages, and should not be exported for sale elsewhere. Settlements lower down the valley will presumably continue to crop bamboo elsewhere, but they should be encouraged to plant bamboo in gulleys and along stream banks (see Hirsbrunner 1968 for suggestions).

Collection of medicinal plants within the proposed Pipar Reserve area should be carried out only by local villagers, and under the same arrangements as for bamboo cutting. They should be cropped only for local use, and under no circumstances should they be sold or exported elsewhere. A detailed survey of their abundance should be carried out to determine their distribution.

Re-afforestation

Re-afforestation should be encouraged in uncultivated cleared areas in the Seti and Mardi valleys in the education scheme. Seeds could be collected and distributed by the Department of Forests.

8.4.4 Regulations for Pastoralism

Although only limited observations were made during my study, it is felt that at present levels, the degree of livestock grazing within the proposed Pipar Reserve area is not detrimental to the total area of forest. It is recommended that villagers from the Seti and Mardi valleys be allowed to continue grazing livestock in their traditional pasture areas, but that there should be no increase in the number of livestock presently using the Pipar area. This necessitates a study of pastoralism in the proposed Reserve area. All gothalos should be informed of the Regulations for Hunting, and encouraged to use only dead wood for cooking and heating.

Within the proposed Pipar Reserve area, the burning of vegetation should be forbidden. It is suggested that the alleged benefits of pasture burning should be investigated (DUHE 1977), and, if shown to be beneficial, they could be re-introduced on a controlled basis.

8.4.5 Recommendations for Education

If the establishment of a Wildlife Reserve in the Pipar area is to be undertaken, it is imperative that a substantial education programme be devised, and implemented in the Seti and Mardi valleys. If this is not done, it is likely that misunderstandings will arise between the local villagers and the authorities who are setting up the Reserve. This could lead to the antagonism and opposition of the local people, which must be avoided at all costs. The education programme should include coverage of the following points:

1) Awareness of the limited life span of the forests if present clearance rates are continued without re-afforestation, and that such clearance will adversely affect future generations of human inhabitants.

2) Awareness that increased herd size of livestock can lead to overgrazing, and result in severe deterioration of pasture areas.

3) Awareness of the need for conservation of rare animals and birds.

4) Understanding that hunting without a licence is illegal, and that the law is to be enforced more strictly in the future, but that licensed hunting is perfectly permissible.

5) Information concerning the benefits of limited tourist treks to the Reserve area in the future.

Some conservation education has already been carried out in the valleys by members of the World Pheasant Association, the staff of Mountain Travel Ltd. (Savage 1978), and participants in my study. It is proposed that in future, it be carried out by staff of the National Parks and Wildlife Conservation Office or Forest Officers who have been trained in conservation principles (see DUHE 1977, p. 114). They should travel round the villages and educate the local people principally by discussing the practical necessities of conservation on an informal basis. Feedback should be obtained from the villagers concerning their views on conservation, and, if considered important, these should be reported back to the National Parks and Wildlife Conservation Office for consideration. The regulations and proposals outlined above can then be re-assessed.

8.4.6 Recommendations for Research

The following research should be carried out in the proposed Pipar Wildlife Reserve area as soon as possible:

(i) Continued annual censuses of pheasants and a more detailed study of the species' ecology (with special reference to habitat and food requirements) should be undertaken. The status and distribution of 'threatened' and rare mammals

such as the leopard, serow, and Musk Deer should be carried out.

(ii) A full botanical survey of the area, to include provision for permanent transects which can be used to measure quantitative vegetation changes. Forest cover should be monitored by Photography from opposite slopes.

(iii) An assessment of the extent to which fuelwood, timber, and bamboo is being cropped from the area, and the effects of grazing.

(iv) From studies made elsewhere in Nepal (various reports in National Parks and Wildlife Conservation Office, DUHE 1977), the effects of tourism should be assessed. It should be considered whether the introduction of limited tourist facilities on the approach to Pipar is advisable or not.

APPENDIX 1

Descriptions of the five study species of pheasant.

1.1 Blood Pheasant (see Plate 1): The Blood Pheasant is small in comparison to most other pheasants, and recalls a Partridge in general shape; in fact Beebe (1922) called it the Blood Partridge. It exhibits marked sexual dimorphism, the male being grey above and green below, streaked with yellow. The upper breast is marked with crimson (the 'blood stains') as are the wing and tail coverts. The forehead and face are black with a crimson throat and a red naked orbital patch and cere; bill black. The legs are red with up to three spurs. Young males are similar, but less brilliantly coloured. Length c 460mm (Ali and Ripley); wing 193-214mm (Baker); bill 11mm; Tail 164-178mm; tarsus 66-76mm (Delacour). The female is a bright rufous brown, finely vermiculated. Forehead and face yellow brown constrasting with grey nape and crest. Bill black, legs red, sometimes with small spurs. Length 394-420mm; wing 179-197mm; bill 9-11mm; tail 140-154mm; tarsus 56-70mm.

1.2 Satyr Tragopan (see Plate 2): The Satyr Tragopan is a large partridge-shaped bird with marked sexual dimorphism. The male is brilliantly coloured deep crimson red. The back is olive brown, the neck and upper breast orange red, and the lower breast deep red; all spotted with black-lined white ocelli which are larger on the lower parts. The shoulder of the wing is crimson and the rest is dark brown, mottled buff. Tail black. Head and crest are black, the latter with a crimson streak either side. Bill black, lappet blue and scarlet, fleshy horns blue. Legs

dull pink. First-year males are brown with red on upper breast and neck, with a few white ocelli. Length 670-720mm; wing 245-285mm; tail 250-345mm; bill 14-16mm; tarsus 85-95mm (Delacour). The female is variable, rufous to dull brown above, barred and blotched with black and buff. Tail barred rufous brown. Pale stripes on crown. Much paler and mottled below. Bill brown; legs pale. Length 575mm; wing 215-235mm; bill 11mm; tarsus 66mm; (Delacour).

1.3 Koklass Pheasant (see Plate 3): Koklass are medium-sized pheasants with considerable variation in the plumage and showing sexual dimorphism. The male is silver grey above, streaked with black and brown. The fully-feathered dark green head has a brown crest 100mm long, with long glossy black lateral tufts. There is a prominent white patch on either side of the neck. Rufous brown below, lightly streaked with black. Pointed wings and pointed wedge-shaped brown tail. Bill black, legs dark. Length c 610mm; wing 216-232mm; bill 27mm; tarsus 62mm; tail 203mm; (Fleming). The female is mottled black and reddish brown above, finely streaked with buff. Crown chesnut buff with shorter crest and no ear tufts. Underparts are pale buff, streaked black, narrowly on breast, broadly on flanks. Throat white. Bill brown, legs grey. Length 520mm; wing 212mm; bill 29mm; tarsus 55mm; tail 166mm; (Fleming).

1.4 Himalayan Monal (see Plate 4): The Himalayan Monal is a large dumpy pheasant similar to a Snowcock (Tetraogallus), but showing marked sexual dimorphism. The male is a brilliant iridescent, bronze-green, blue, and purple, with a large white back patch and a brest of long racquet-shaped green feathers.

The head is green with the back and sides of the neck an orange-copper colour. Underparts are a velvety-black. The short, broad, square tail is orange rufous. Orbital patch blue, large bill grey, legs dark. Length c 720mm; wing 289-320mm; bill 50-54mm; tarsus 70-80mm; tail 215-315mm; crest 75-88mm (Baker). First year male is like the female, but more mottled black and rufous with some metallic feathers above. Female is a variable brown, mottled and streaked with paler and darker brown, a short head tuft, blue orbit and white throat. White lower back and in tail. Bill buff, legs pale. Length 635mm; wing 300mm; tarsus 78mm; tail 200mm (Delacour).

1.5 Cheer Pheasant (see Plate 5): The Cheer is a long-tailed, barred brown pheasant with some sexual dimorphism. The male has buff and rusty upperparts, closely barred with black and grey. The head and crest are brown with a bright red naked orbital patch. Long pointed buff coloured tail barred black. Underparts pale buff grey, barred on flanks. Bill yellowish, legs grey. Length 950-1000mm; wing 235-270mm; bill 25-29mm; tarsus 74-78mm; tail 450-580mm. Immature is similar to female, but duller. Female is like the male but smaller with more chestnut below, shorter crest, and a dull red orbit.

APPENDIX 2

DIRECT ENCOUNTER CARD DETAILS

Species: Immature/young

Sex: Time:

Date: ID: vis/sound

Grid: Elev:

Weather: S.Asp:

Slope angle:

Woodland/Grassland/Scrub

Locality features:

Dm. Sp.:

Tree height: U.Density:

Top Canopy:

HI:

Length Obs.: Dist:

Escape: Gr/Fs Up/Down

Behaviour: Vocal/other

APPENDIX 3

QUESTIONNAIRE SUPPLIED TO W.P.A. MEMBERS

VOCALIZATIONS	Koklass	Satyr Tragopan	Monal	Cheer
Calling period(s)				
(Time of year)				
Do first year males call at different times of year to adult males? If so, when?				
Do females call? If so, when?				
Daily calling period:				
Morning only				
Morning & Evening				
Evening only				
Approx. length of daily calling period(s)				
If latter varies with time of year, please give details.				
FEEDING				
Preference for feeding:				
Morning				
All day				
Evening				
Morning & Evening				
Do birds dig for food?				
BREEDING				
Display by males, between which dates has this been observed?				
Mating, approx. dates observed.				
Has display been observed after mating has taken place?				
Has further mating between same pair taken place?				

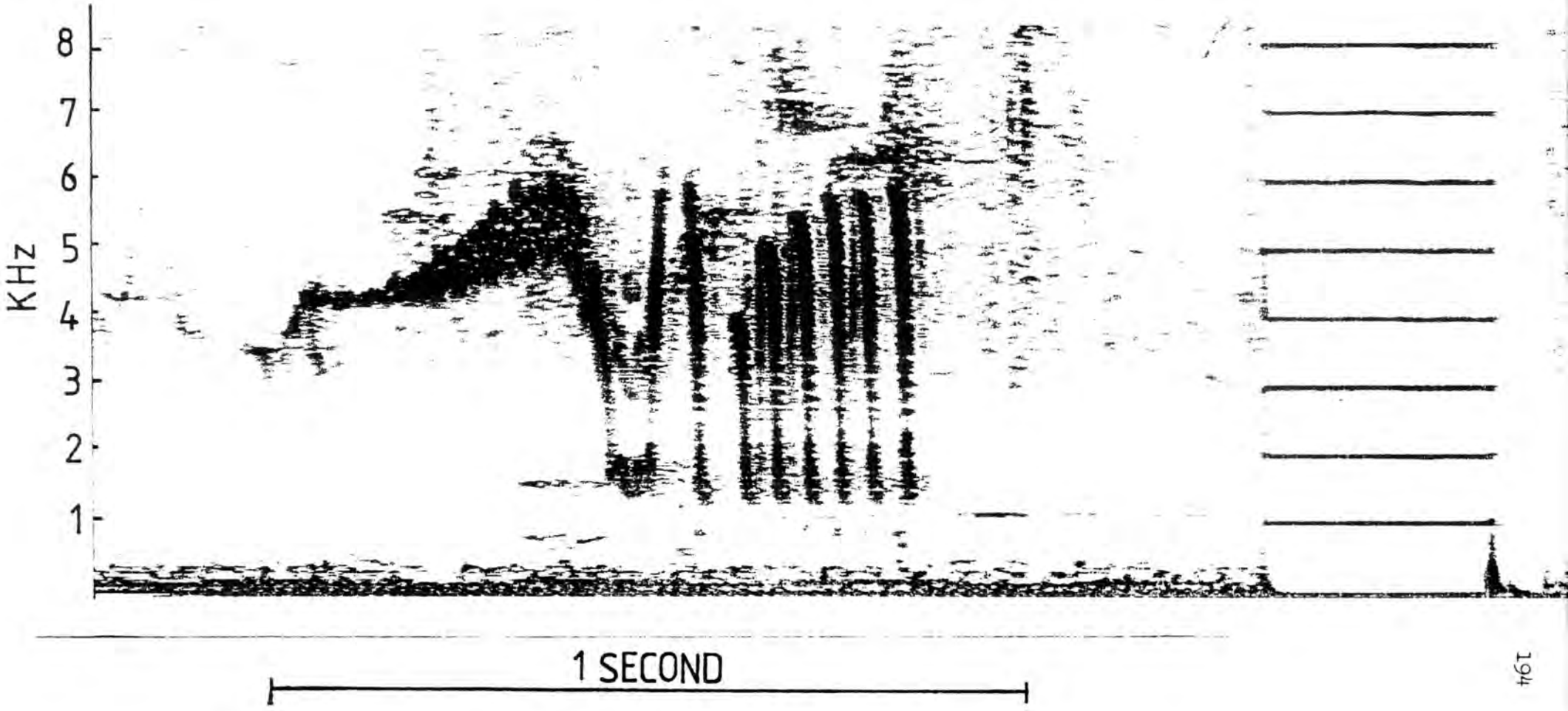
	Koklass	Satyr Tragopan	Monal	Cheer
Has agressive behaviour towards birds in adjacent pens been observed?				
If so, what species?				
Ratio of males to females during breeding season.				
Nest site preference (Ground or above ground)				
At what age can male birds be distinguished from females?				
Brief description of display of male.				
Any other notes which may be of interest.				

MEMBERS NAME:

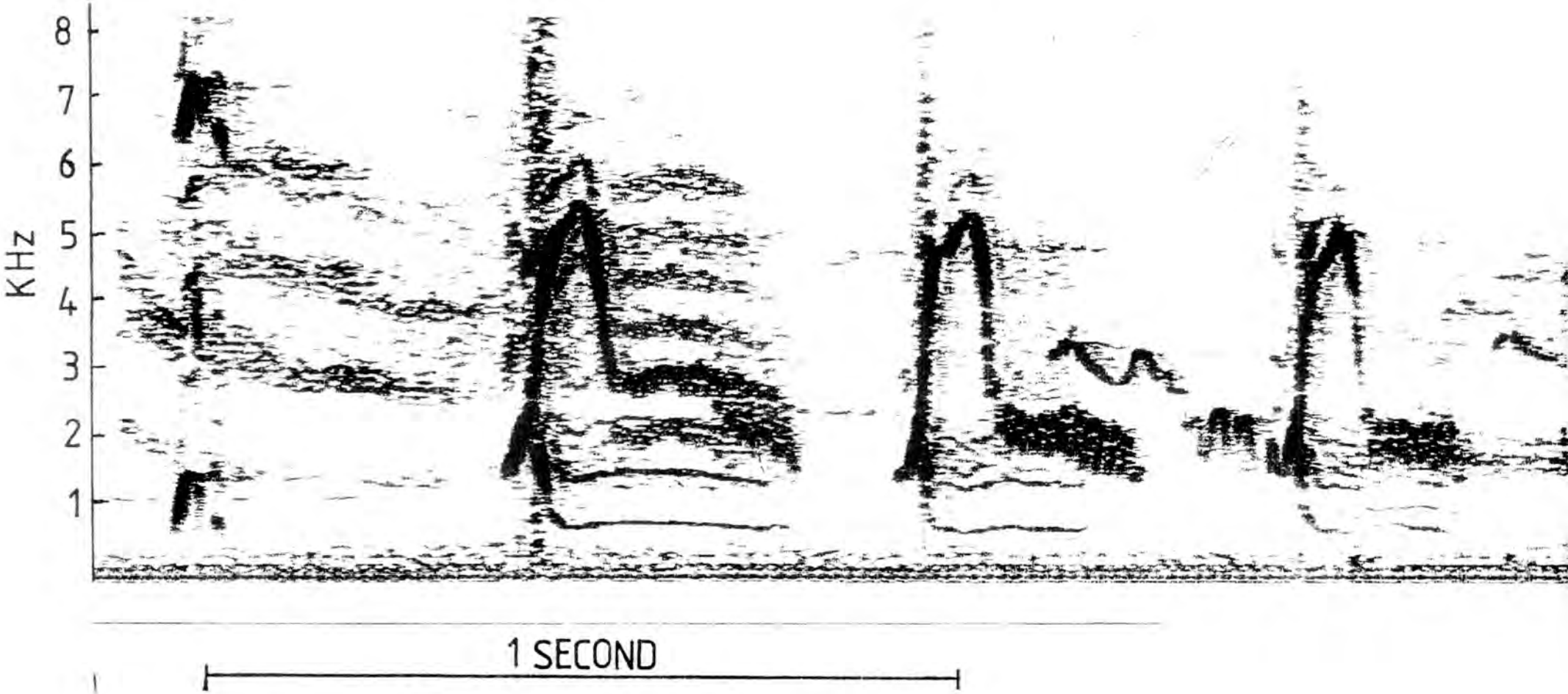
ADDRESS:

TELEPHONE NO:

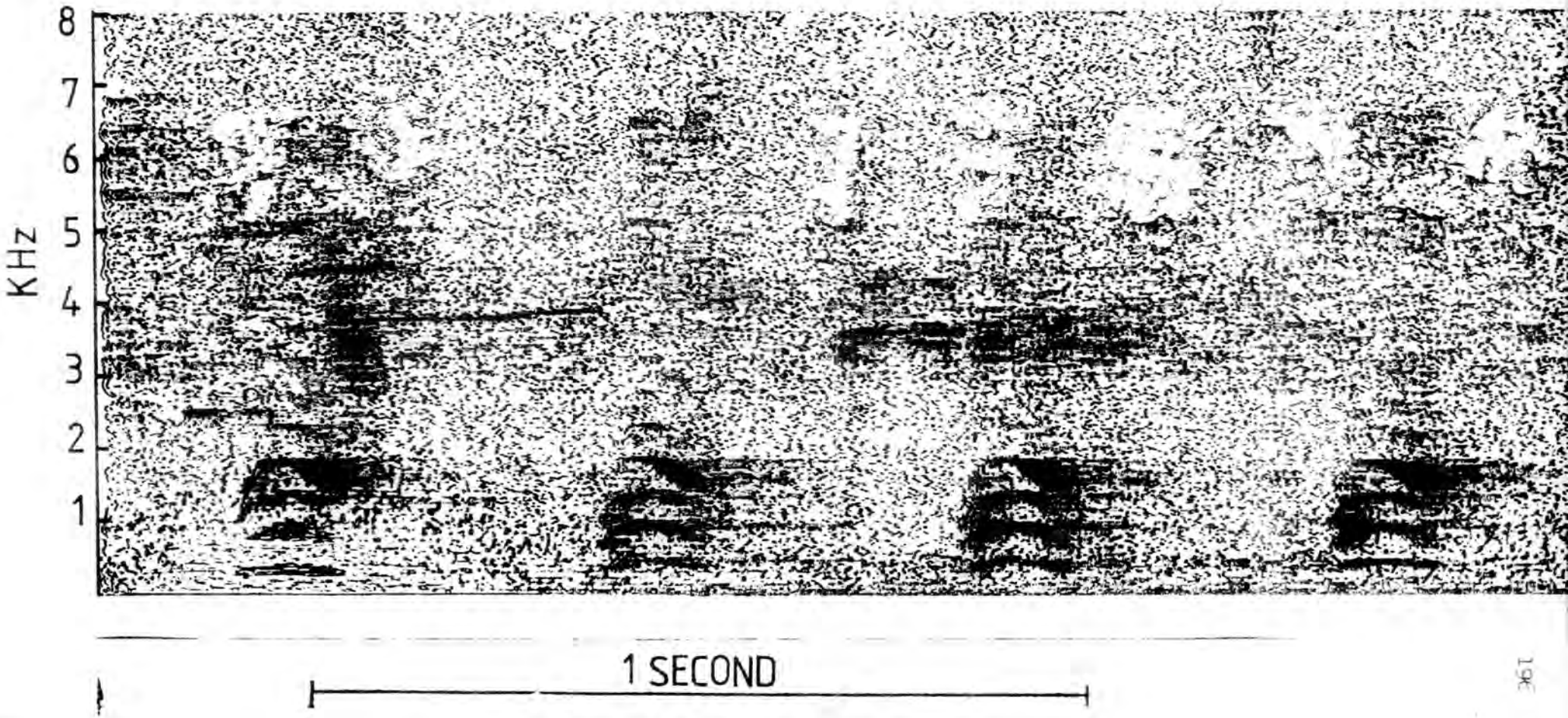
APPENDIX 4.1 Sonagram of Blood Pheasant Call-type 2: 'Trill'Call. Recording Serial Number 10163.



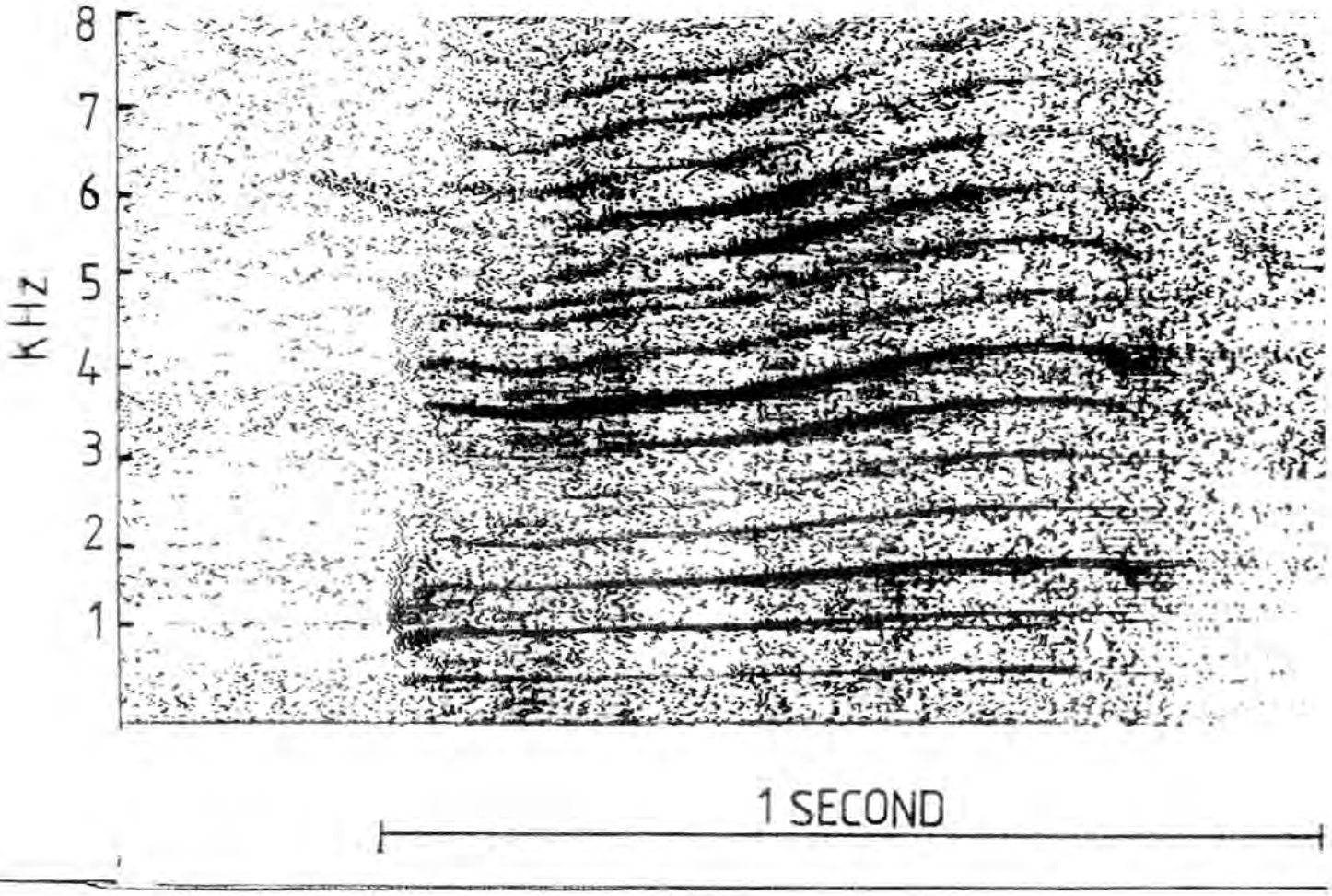
APPENDIX 4.2 Sonagram of Blood Pheasant call-type 3: 'Squeal' call. Recording Serial Number 10163



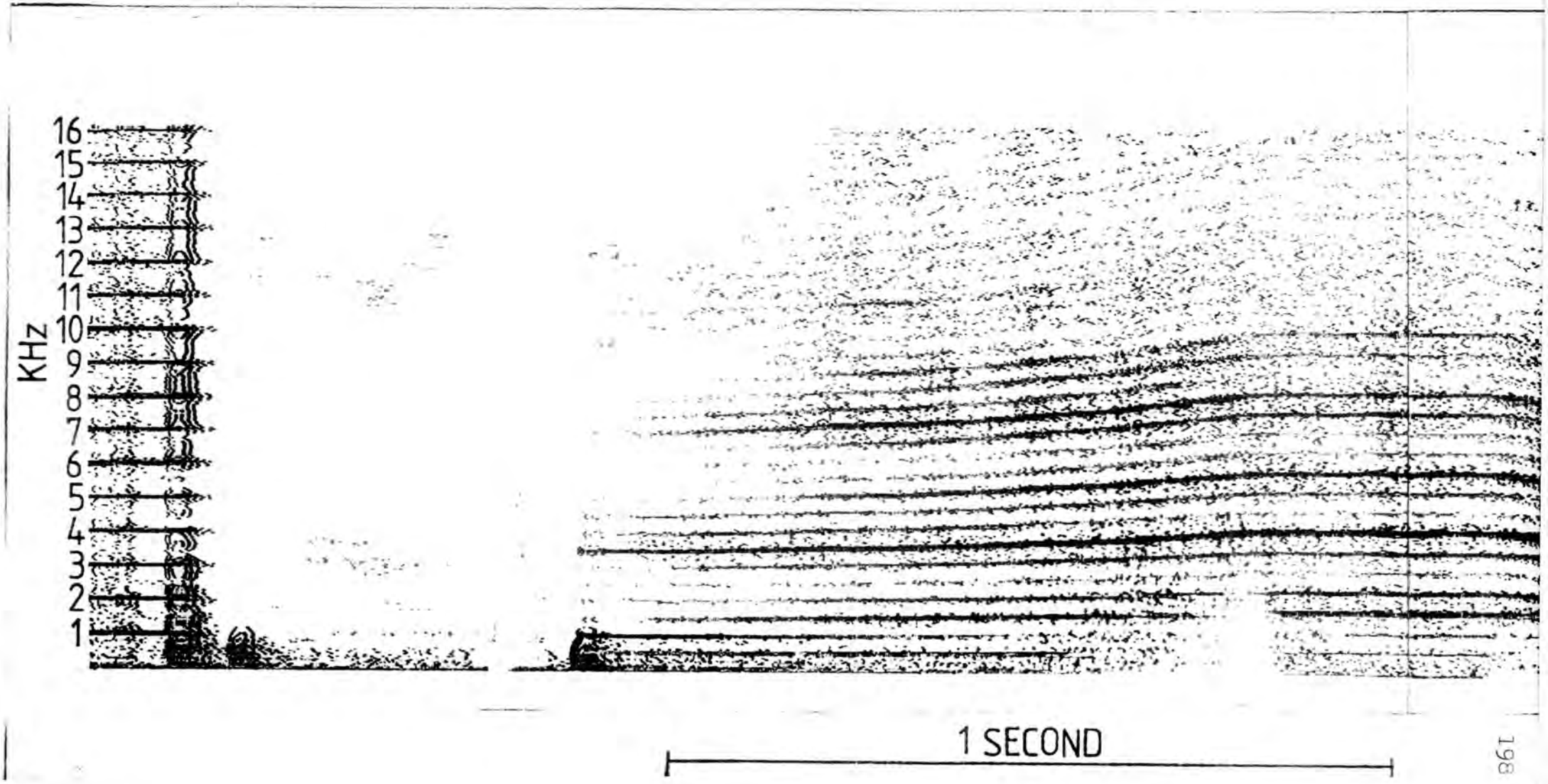
APPENDIX 4.3 Sonagram of Satyr Tragopan Call-type 1: 'Wah wah' call, Recording Serial Number 10170



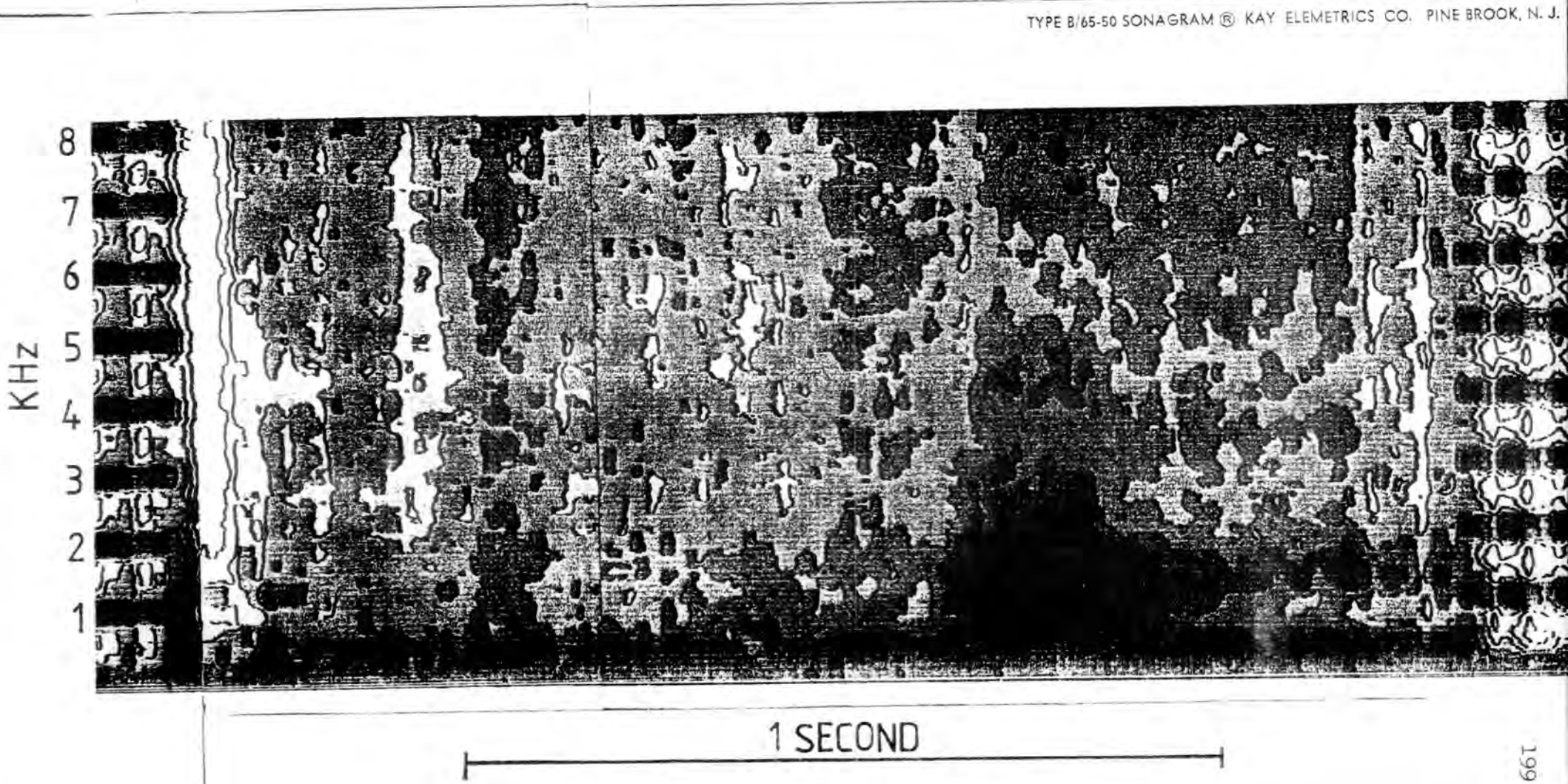
APPENDIX 4.4 Sonagram of Satyr Tragopan Call-type 4: 'Wail' call (0-8 KHz). Recording Serial Number 10154



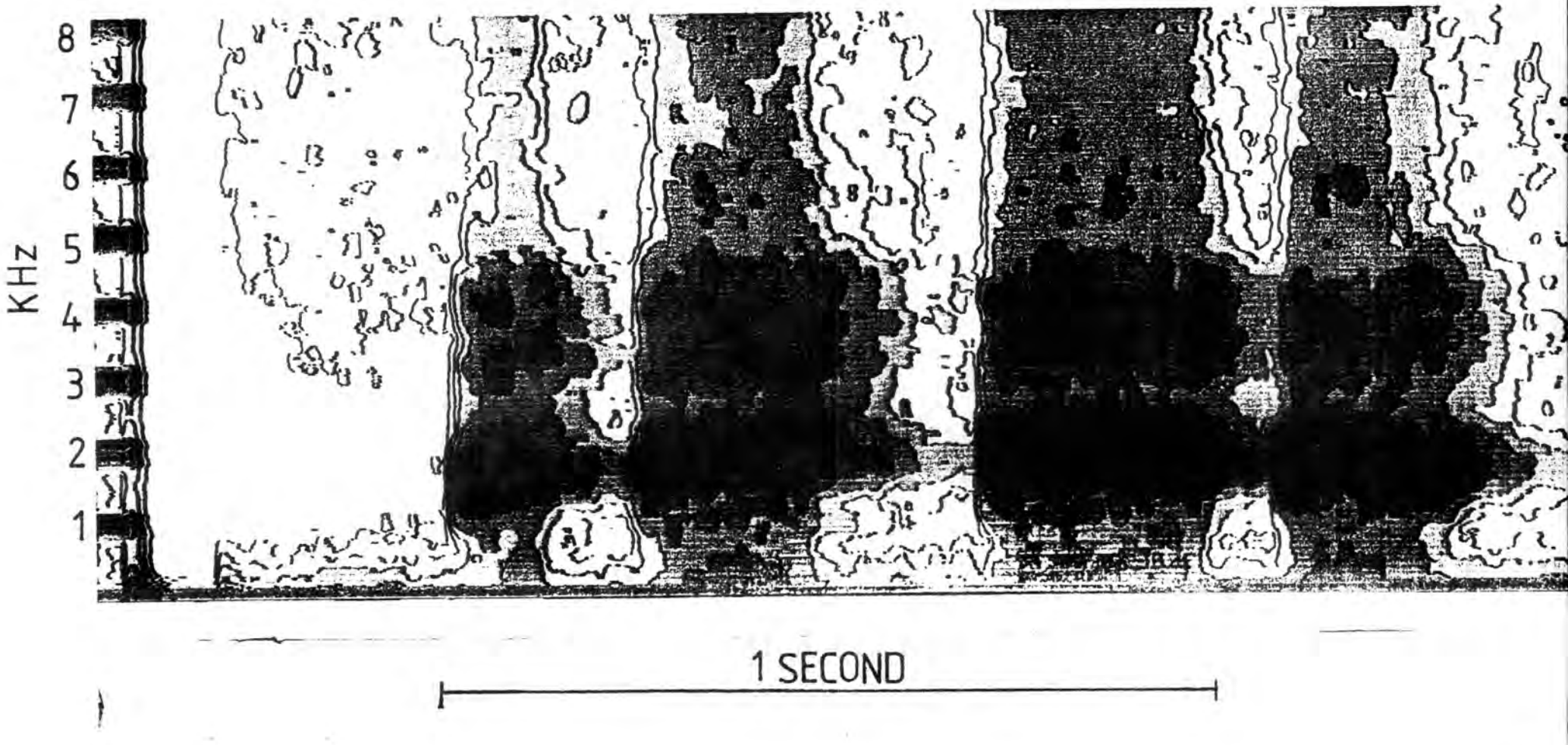
APPENDIX 4.5 Sonagram of Satyr Tragopan Call-type 4: 'Wail' call (0-16 KHz). Recording Serial Number 10154



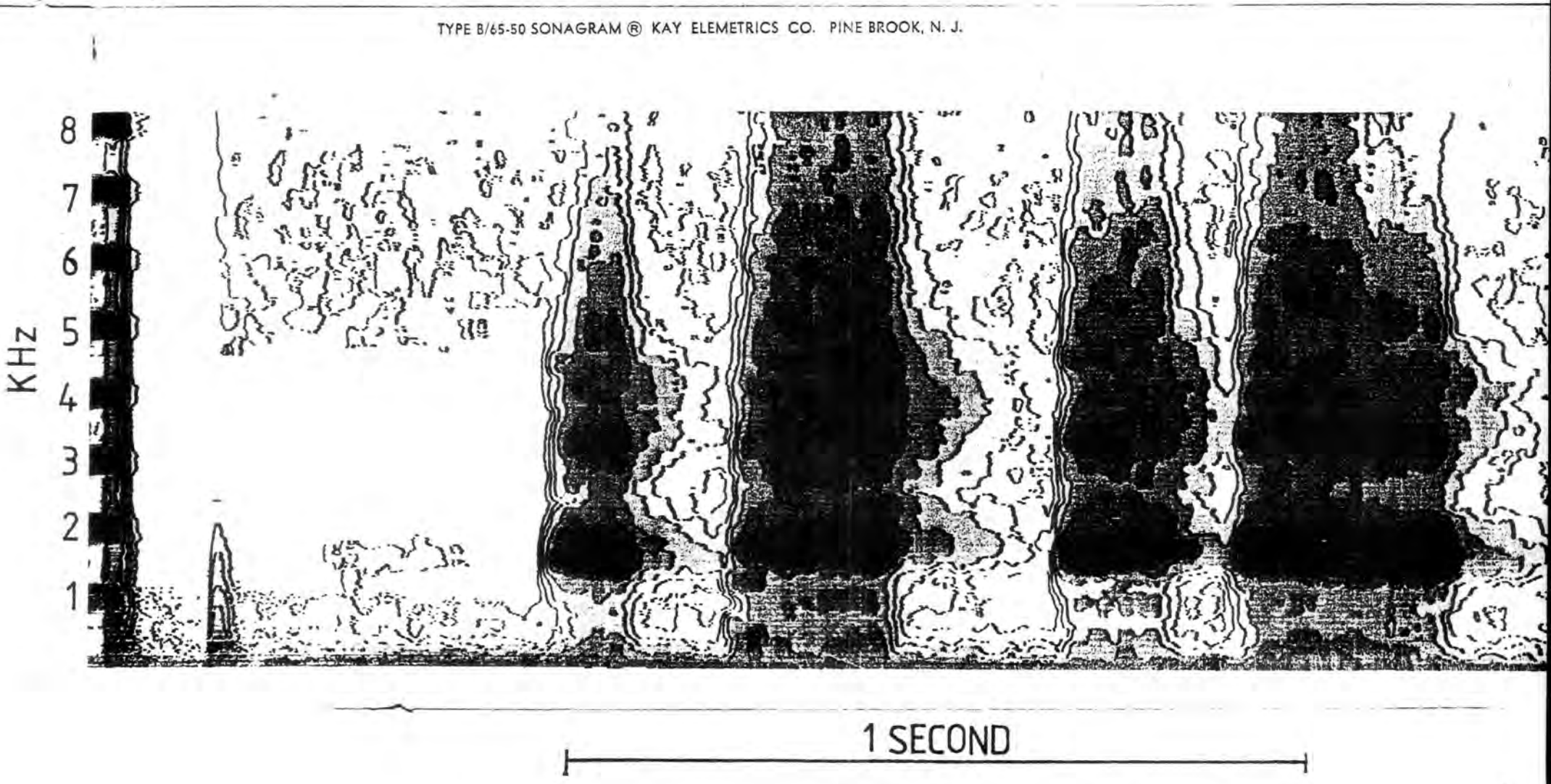
APPENDIX 4.6 Sonagram of Koklass Pheasant Call-type 3A: 'Crow' call A. Recording Serial Number 10155



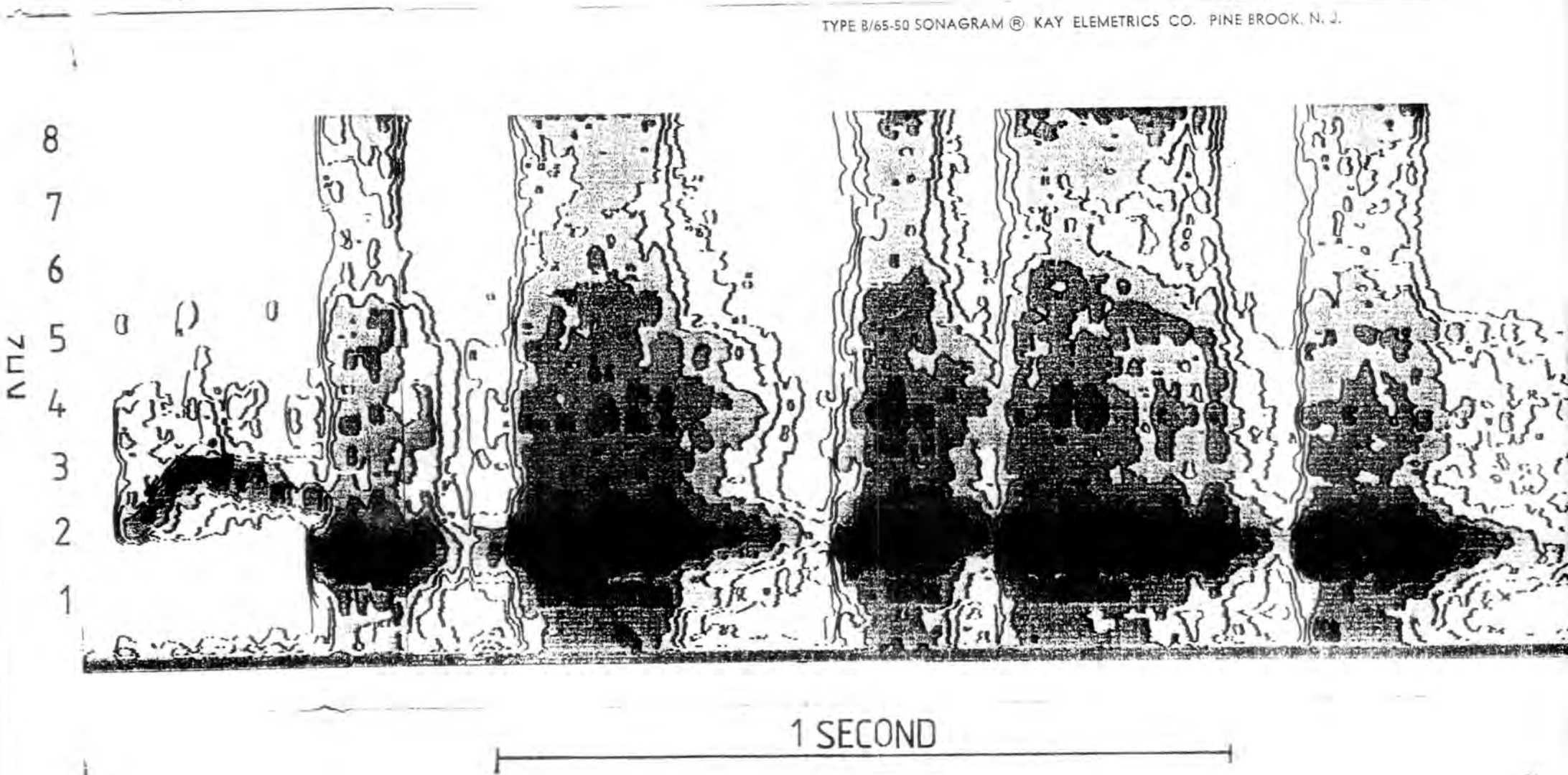
APPENDIX 4.7 Sonagram of Koklass Pheasant Call-type 3B: 'Crow' call B. Recording Serial Number 10175



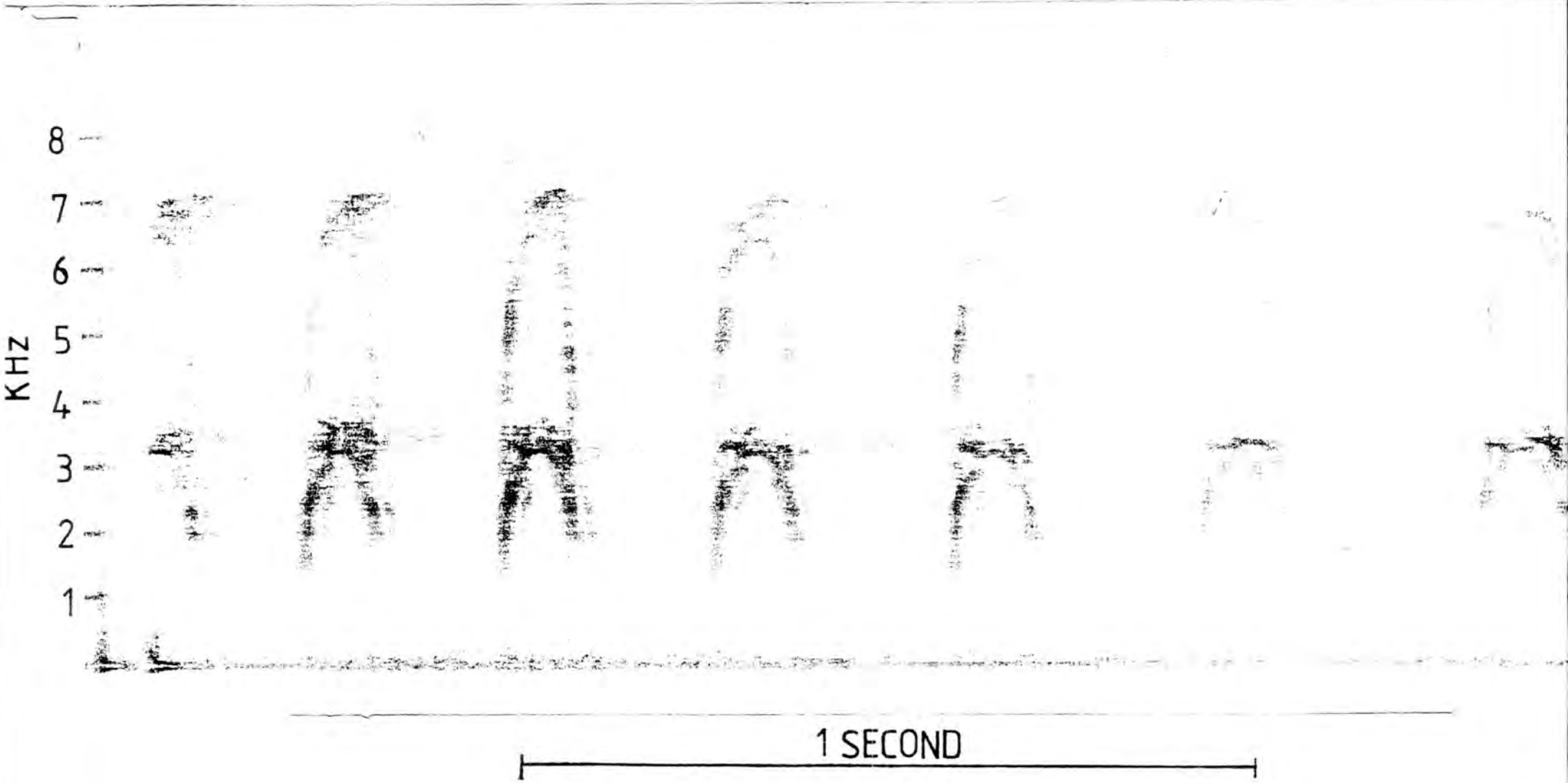
APPENDIX 4.8 Sonagram of Koklass Pheasant Call-type 3C: 'Crow' call C. Recording Serial Number 10175



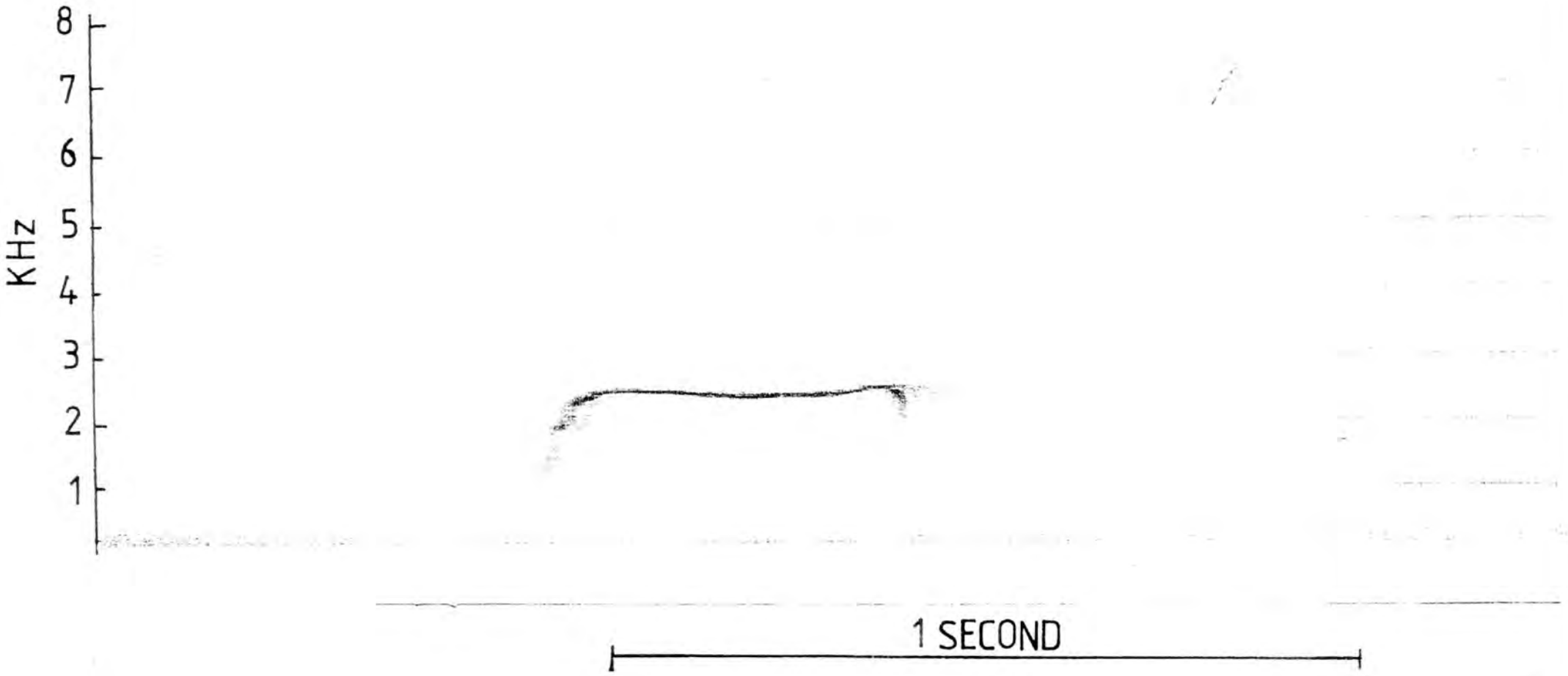
APPENDIX 4.9 Sonagram of Koklass Pheasant Call-type 3D: 'Crow' call D. Recording Serial Number 10168



APPENDIX 4.10 Sonagram of Himalayan Monal Call-type 1: 'Piping' call. Recording Serial Number 10160

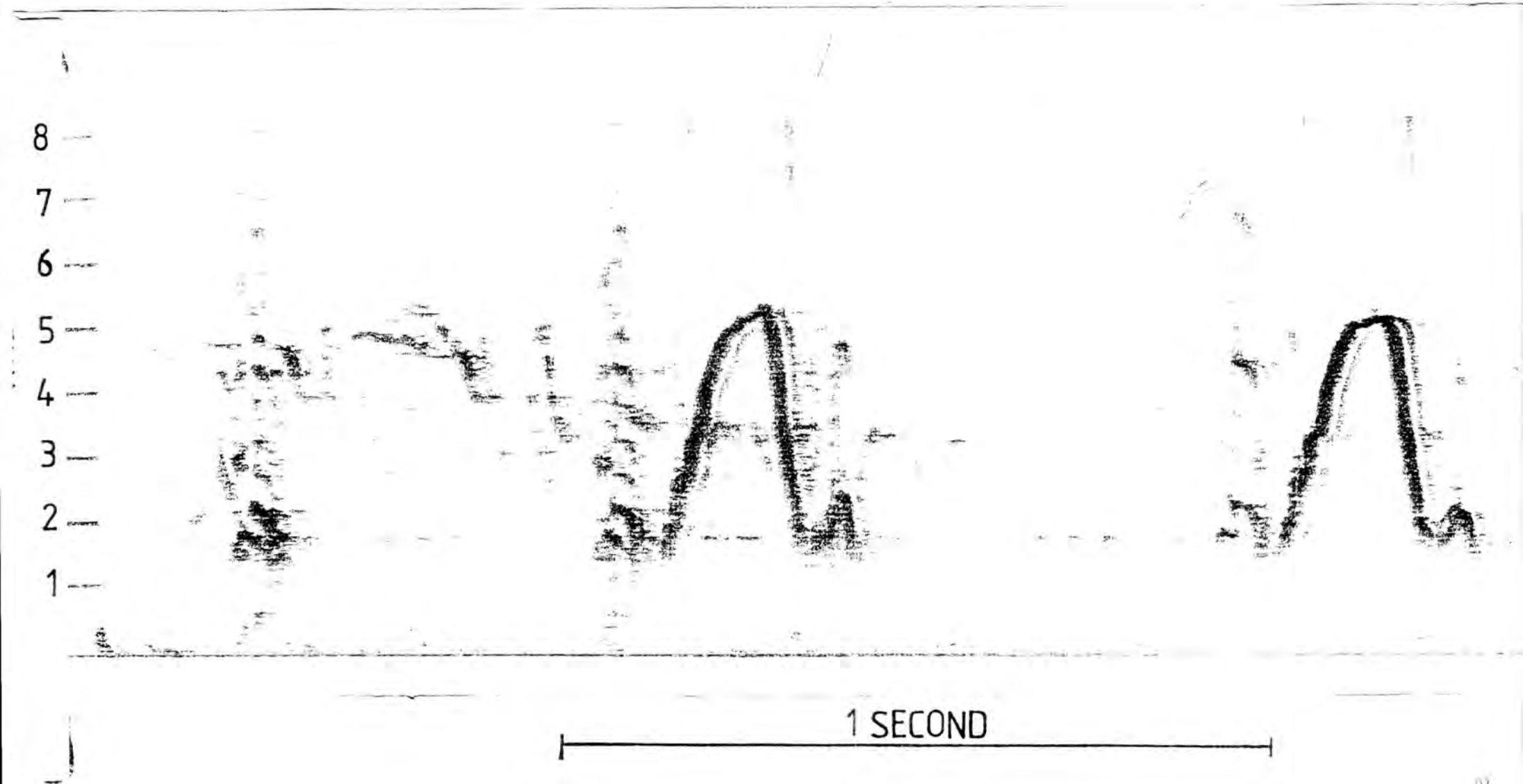


APPENDIX 4.11 Sonagram of Himalayan Monal Call-type 2: 'Whistle' call. Recording Serial Number 10160



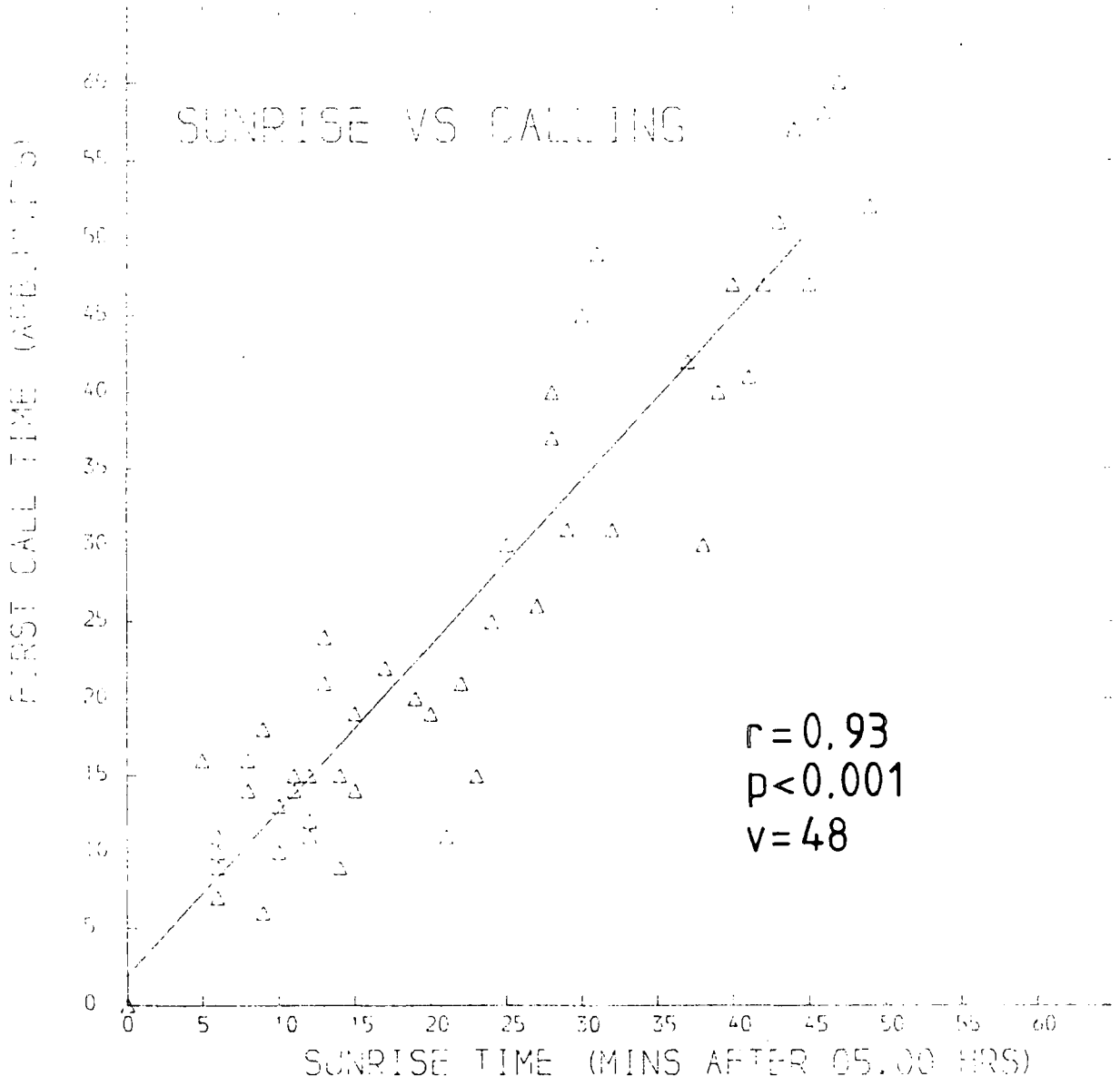
APPENDIX 4.12 Sonagram of Himalayan Monal Call-type 3: 'Crescendo' call. Recording Serial Number 10166

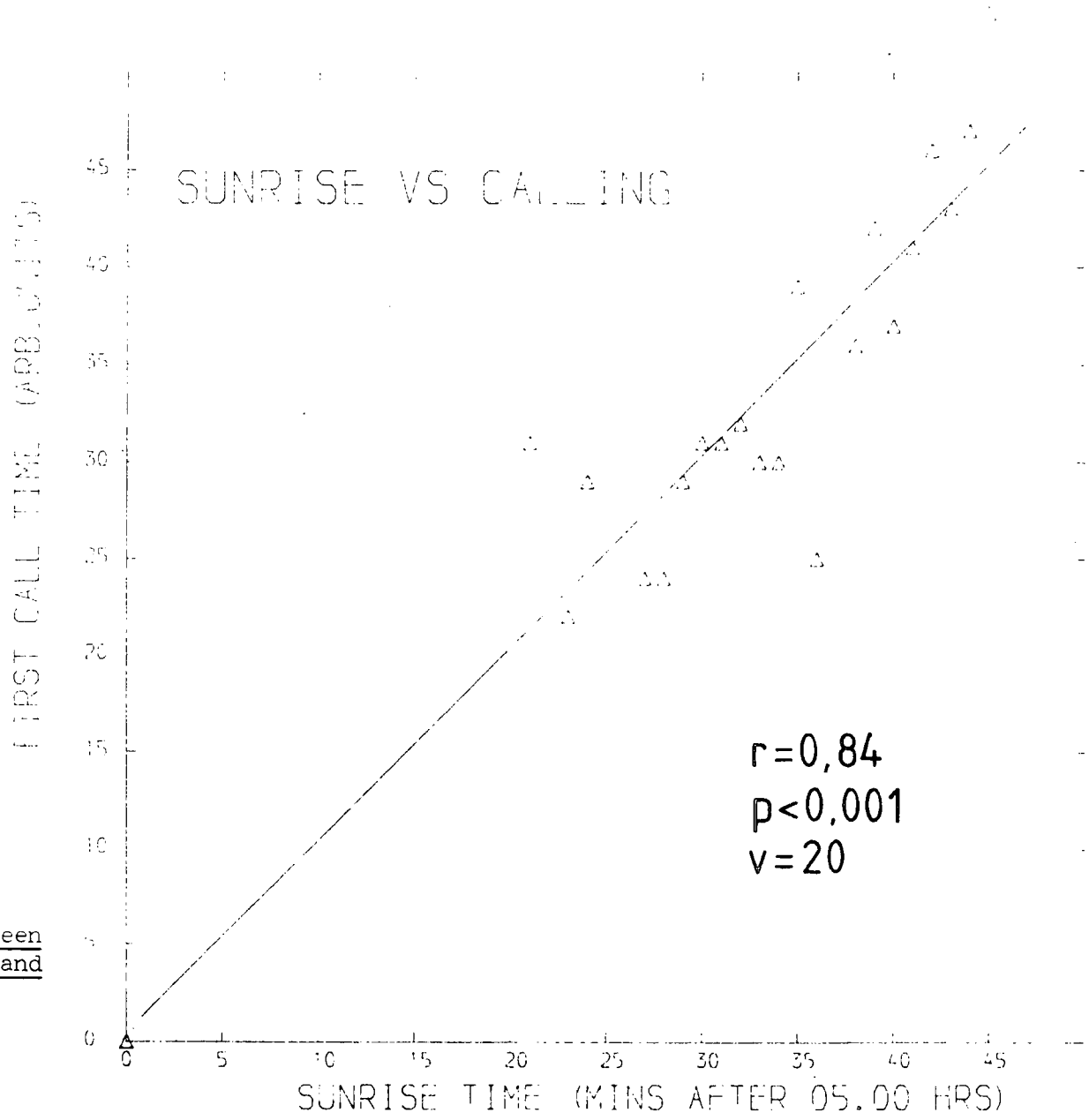
APPENDIX 4.13 Sonagram of Cheer Pheasant call. Recording Serial Number 10186.



APPENDIX 5.1

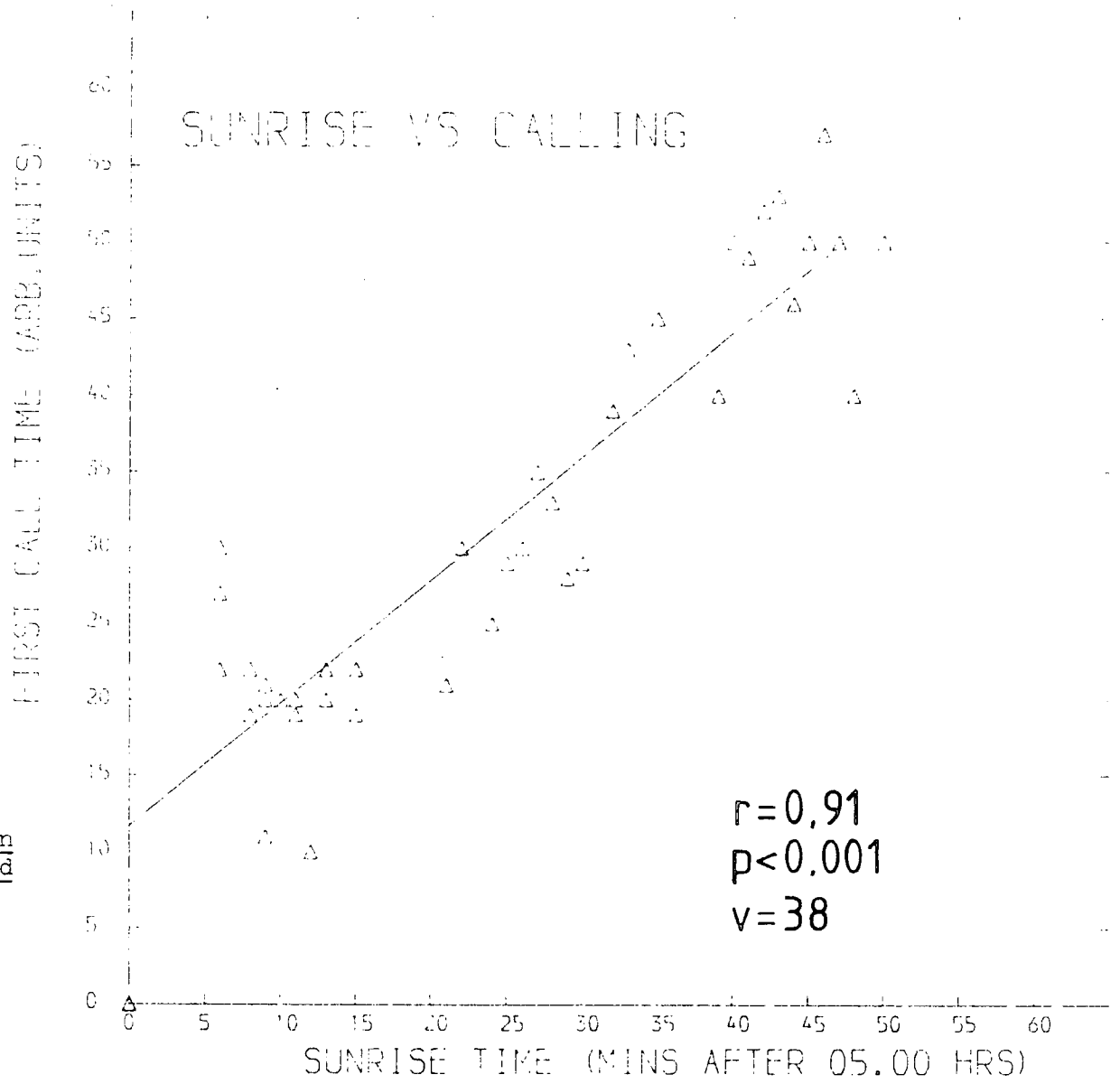
Correlation between first call time and sunrise time for Satyr Tragopan, Spring 1979.





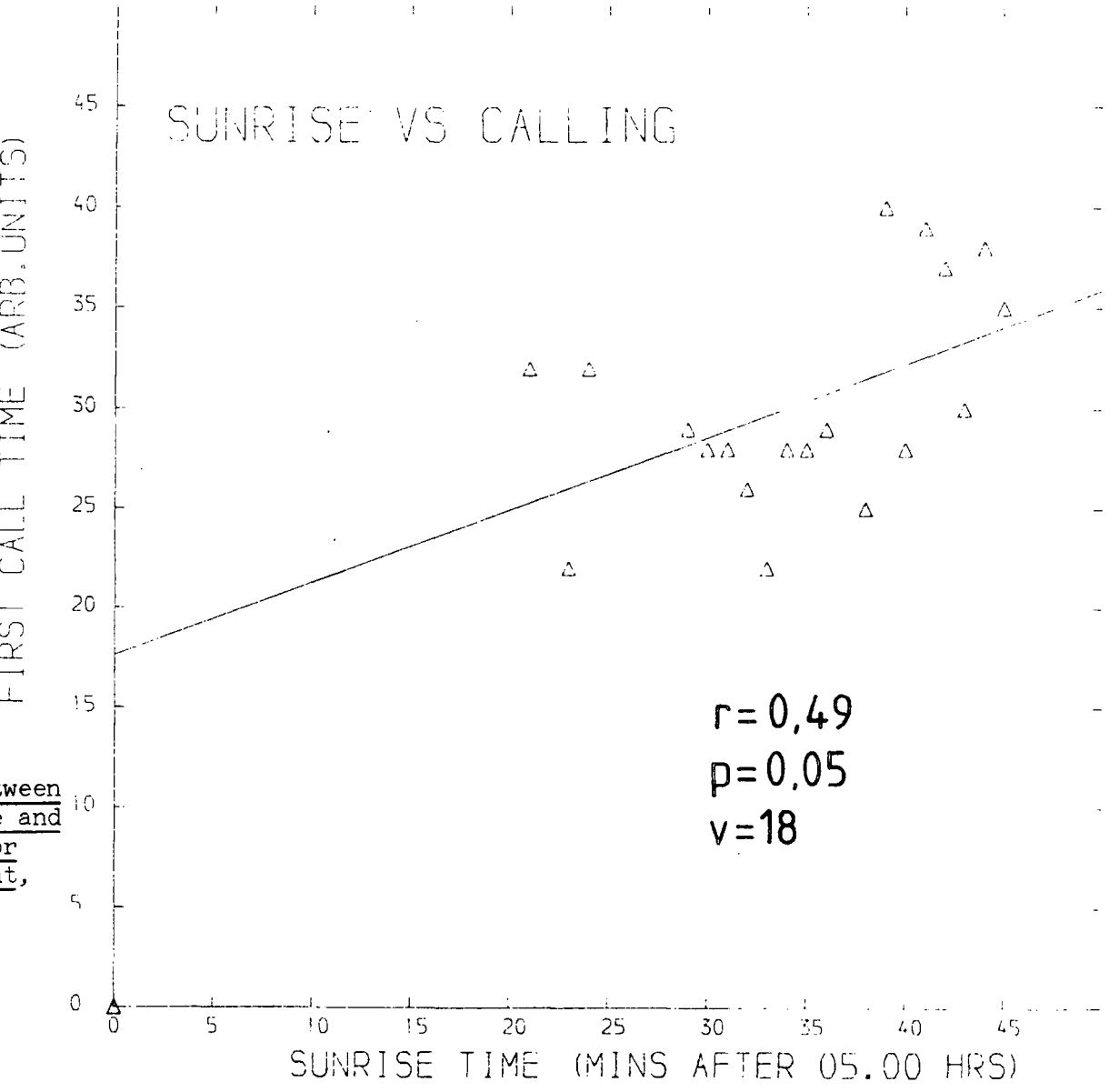
APPENDIX 5.2

Correlation between First call time and Sunrise time for Satyr Tragopan, Spring 1980.



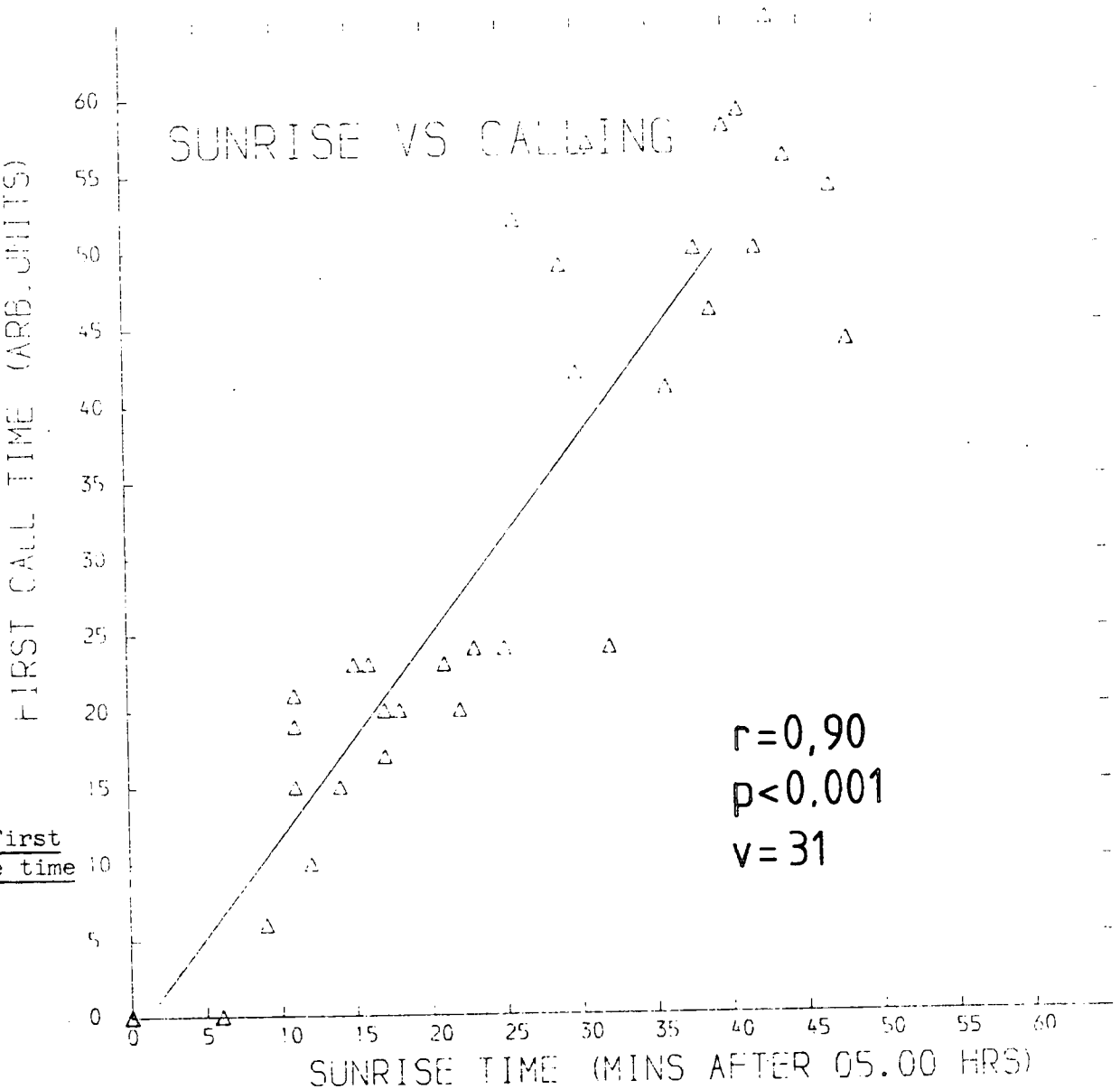
APPENDIX 5.3

Correlation between first call time and sunrise time for Koklass Pheasant, Spring 1979.



APPENDIX 5.4

Correlation between first call time and sunrise time for Koklass Pheasant, Spring 1980.



APPENDIX 5.5

Correlation between first call time and sunrise time for Himalayan Monal, Spring 1979

APPENDIX 6

Census Point Locations at Pipar

Census points 1 to 4 are shown in Figures 4 and 5.

Point 1 is a small knoll at the eastern edge of a flat scrubby area, about 150m North of the main camp site. The knoll lies at 3280m altitude and has a boulder on top marked with X1.

Point 2 is a knoll in Berberis scrub on the eastern side of the trail. It is marked by a small 3-trunked Rhododendron campanulatum tree, 3m in height, which has a large blaze on the right hand trunk. The knoll, which lies at an altitude of 3265m, has a small cairn on top, marked with X2.

Point 3 is a knoll on open tussock grassland 15m above (West of) the trail. To reach the knoll, walk along the trail into the forest under an arched Rhododendron branch. Before reaching a V-shaped Rhododendron tree with roots lying across the trail, climb perpendicularly uphill into the open grassland to the knoll. It lies at 3295m, and the rock below it is marked with ↑X3.

Point 4 lies on the trail in Rhododendron/Betula forest on a small ridge at 3295m. It is marked by a 50cm long vertical blaze in the bark of a double-trunked Rhododendron tree.

APPENDIX 7

Call lengths and number of repetitions within Call Type 3(b) of the Satyr Tragopan recorded at Pipar and Bhalu 1979

Recording Serial Number	Total Length of Call	Repetitions per call
10150	12	4
	-	4
	28	11
	15	6
	-	6
	13	5
	18	6
	25	8
	-	6
10151	27	9
	22	8
	13	6
	13	5
10152	12	6
10153	11	5
	11	6
10154	13	6
10155	12	4
	15	6
10162	14	6
	23	9
	21	7
	27	8
	20	7
10166	20	8
	16	5
	23	8
10172	33	12

n = 28, mode = 6

APPENDIX 8

Time of first call of three pheasant species with respect to weather and sunrise.

Date	Morning sky Conditions	Sunrise Time	Time of first call of: Satyr Tragopan	Koklass	Himalayan Monal
		P I P A R C A M P S I T E			
1979 April					
6	Clear	0550	-	0510(39)	-
7	Clear	0548	0512(36)	0500(48)	0504(44)
8	Overcast	0547	0520(27)	0510(37)	0514(32)
9	Clear	0546	0518(28)	0517(29)	0516(30)
10	Heavy rain 0400, overcast fog	0545	0507(38)	0510(35)	-
11	Night rain, clear	0544	0517(27)	0456(48)	0516(28)
12	Clear	0543	0511(32)	0513(30)	0525(18)
13	Clear, thin cloud	0542	0507(35)	0512(30)	0510(32)
14	Overcast, moon	0541	0501(40)	0509(31)	0519(22)
15	Overcast, moon	0540	0507(33)	0510(30)	0518(22)
16	Overcast, moon[a]	0539	0500(39)	0500(39)	0506(33)
17	Overcast, moon[a]	0538	0450(48)	-	0510(27)
18	Clear, moon	0536	0502(34)	-	0501(35)
19*	$\frac{1}{4}$ covered, moon	0535	-	0505(30)	-
20*	not noted	0534	-	not noted	
21*	Clear, moon	0533	-	0503(30)	-
22*	Clear, $\frac{1}{4}$ moon	0532	0451(41)	0459(33)	0444(48)
23*	Clear, $\frac{1}{4}$ moon	0531	0509(22)	0516(15)	0517(14)
24*	Clear, $\frac{1}{4}$ moon	0530	0505(25)	0449(41)	0502(28)

Date	Morning sky Conditions	Sunrise Time	Time of first call of: Satyr Tragopan	Koklass	Himalayan Monal
25	Clear, $\frac{1}{4}$ moon	0529	0451(38)	0448(41)	0509(20)
26	Clear	0528	0457(31)	0453(35)	-
27	Overcast	0527	0500(27)	0455(32)	-
28	Clear	0526	0446(40)[c]	0450(36)	-
29	Heavy night rain, overcast	0526	-	0502(24)	0512(14)
30	Clear	0525	0450(35)	0449(36)	0444(41)
May					
1	Clear	0524	0445(39)	0445(39)	-
2	$\frac{1}{4}$ covered	0523	0435(48)	-	0444(39)
3	Clear	0522	0441(41)	0450(32)	0440(42)
4	Clear	0521	0431(50)	0441(40)	0443(38)
5	Clear	0520	0439(41)	-	-
6	Clear	0519	0440[b](39)	-	-
7	Clear	0518	-	-	0440[b](38)
8	Clear	0517	-	-	0437[b](40)
9	Clear	0517	0442[b](39)	-	0440[b](37)
10	Clear	0516	-	-	0443[b](33)
11	Clear	0515	0434(41)	0439(36)	0443(32)
12	Clear	0515	0439(36)	0442(33)	-
13	$\frac{1}{2}$ covered	0514	0429(45)	0441(33)	-
14	$\frac{1}{4}$ covered, moon	0514	0435(39)	-	0435(39)
15	Heavy night rain, $\frac{1}{2}$ covered, moon	0513	0444(29)	0445(28)	-
16	Heavy night rain, $\frac{1}{4}$ covered	0513	0441(32)	0442(31)	-
17	Clear moon	0512	0435(37)	0430(42)	-
18	Clear, $\frac{1}{2}$ moon	0512	0432[c](40)	-	0430[c](42)
19	Clear, $\frac{1}{2}$ moon	0511	0431[c](40)	-	0435[c](36)

Date	Morning Sky Conditions	Sunrise Time	Time of first call of: Satyr Tragopan	Koklass	Himalayan Monal
20	Overcast	0511	0435(36)	0440(31)	0441(30)
21	$\frac{1}{8}$ covered, $\frac{1}{4}$ moon	0511	0434(37)	0439(32)	0439(32)
22	$\frac{1}{8}$ covered, $\frac{1}{4}$ moon	0510	0433(37)	0440(30)	-
23	Overcast	0510	0433(37)	0440(30)	-
24	Clear	0509	0430(39)	0431(38)	-
25	Clear	0509	0426(43)	-	0426(43)
26	$\frac{1}{2}$ covered	0509	0438(31)	0441(28)	-
27	Overcast	0508	0434(34)	0439(29)	-
28	Overcast	0508	0436(32)	0442(26)	-
	B H A L U C A M P S I T E				
June					
2	Clear	0506	0430(36)	0442(24)	0407[d](59)
3	Clear	0506	0431(35)	-	0420(46)
4	Clear	0506	0427(39)	0447(19)	0415(51)
5	$\frac{1}{2}$ covered	0506	0429(37)	0450[d](16)	0420[d](46)
6	Overcast	0506	0436(30)	-	-
1980					
April					
9	Clear, $\frac{1}{2}$ moon	0545	0513(32)	0455(50)	Not Noted in 1980
10	Overcast, $\frac{1}{2}$ moon	0544	0507(37)	0458(46)	
11	Clear, $\frac{1}{4}$ moon	0543	0503(40)	0450(53)	
12	Overcast, but very thin cloud	0542	0506(36)[d]	0457[d](45)	
13	Clear	0541	0501(40)	0459(42)	
14	$\frac{1}{4}$ covered	0540	0457(43)	0448(52)	
15	Clear	0539	0502(37)	0500(39)	

Date	Morning Sky Conditions	Sunrise Time	Time of first call: Satyr Tragopan	Koklass	Himalayan Monal
16	$\frac{1}{4}$ covered	0538	0456(42)	0445(53)	
17	Clear	0536	0445(51)	0449(47)	
18	Clear	0535	0459(36)	0448(47)	Not Noted in 1980
19	$\frac{1}{4}$ covered	0534	0450(44)	0448(46)	
20	Clear	0533	0450(43)	0442(51)	
21	Overcast	0532	0452(40)	0446(46)	
22	Clear	0531	0451(40)	0448(43)	
23	Clear	0530	0451(39)	0448(42)	
24	Clear	0529	0449(40)	0449(40)	
25	Clear	0528	0444[b](44)	-	
26	Clear	0527	0444[b](43)	-	
30	Clear	0524	0449(35)	0452(32)	
May					
1	Clear	0523	0442(41)	0442(41)	
3	Clear, $\frac{3}{4}$ moon	0521	0451(30)	0452(31)	

Notes: Sunrise times are calculated from Astronomical Ephemeris.
*-Approximate times only, due to timing inaccuracies.
a-moon very bright (full), and reflecting on snow on ground.
Morning weather conditions therefore classified as "sky clear".
b-birds heard from Camp II.
c-birds heard from Camp III.
d-birds began calling prior to this time.

APPENDIX 9 Satyr Tragopan: Times of first call in relation to morning weather conditions in 1979

Sky Clear		Sky overcast/rain in night	
Date	First Call (min. before sunrise)	Date	First Call (min. before sunrise)
April 7	36	April 8	27
9	28	10	38
11	27	14	40
12	32	15	33
13	35	27	27
16	39	May 13	45
17	48	15	29
18	35	16	32
25	38	20	36
26	31	23	37
28	41	26	31
30	35	27	34
May 1	39	28	32
2	48		441
3	41		
4	50		
5	41		
6	39		
9	35		
11	41		
12	36		
14	39		
17	37		
18	40		
19	40		
21	37		
22	37		
24	39		
25	43		
	1107		

n = 29, so $\bar{x}$ = 38.2

σ^2 = 28.6

σ = 5.35

S.E. = 0.99

n = 13, so $\bar{x}$ = 33.9

σ^2 = 28.3

σ = 5.32

S.E. = 1.48

$$\sigma^2_d = \frac{28.6}{29} + \frac{28.3}{13} = 0.99 + 2.18$$

$$= 3.17$$

$$t = \frac{38.2 - 33.9}{3.17} = 1.36$$

p = 0.1

Note: The period 19-24 April is excluded from this Table due to Timing inaccuracies during this interval.

APPENDIX 10 Shift in Call Types of individual Koklass males recorded at Pipar

Date	Shift in Call Types
	e.g. 2A-6D-3C means 2 Type A calls followed by 6 Type D calls, followed by 3 Type C calls.
1979	
April 5	2C-6D (cont.)
6	1D*-2D-1D*-1D-1D*-4D (cont.)
8	(i) 1B-3D*-3D-6D* (cont.)
	(ii) 5C-1D-1C-2D
	(iii) 15D (cont.)
10	3A-6D*-3D (cont.)
May 4	13D (cont.)
11	(i) 4A-5C-1D-1C-5D (cont.)
	(ii) 10A-1C-5D (cont.)
12	3A[a]-3B-1C-1B-3C-2D-1C-3D-1C-1D
13	3A-5C-5D (cont.)
20	(i) 2A-1D-4B/C
	(ii) 10A-6B/C-2D-1B/C-5D-9B/C-1D-5B/C (cont.)
	(iii) 2A-1B/C-5D (cont.)
	(iv) 2A-2B/C-6D-2B/C
28	6A-4D-2B/C-1D-2B/C-2D-1B/C-1D-2B/C-3D-1B/C
Sept 25	1B-2C-14D (cont.)
28	14A-2B-6D (cont.)
Oct 1	1A-2C-3B-3D-1B
3	12A-1B-21D (cont.)
5	1A-8B-2D-3B-2D
14	(i) 11A-1B-1C-15D (cont.)
	(ii) 3A-1C-13D (cont.)
15	8A-1B-1C-4D
Nov 2	3B-17D-Bird Flew-2B (cont.)
5	1A-1B-7C
1980	
April 19	1C-43D (cont.)

APPENDIX 11 Koklass Pheasant: Times of first call in relation to morning weather conditions in 1979

Sky Clear		Sky overcast/rain in night	
Date	First Call (min. before sunrise)	Date	First Call (min. before sunrise)
April 6	39	April 8	37
7	48	10	35
9	29	14	31
11	48	15	30
12	30	27	32
13	30	29	24
16	39	May 13	33
25	41	15	28
26	35	16	31
28	37	20	31
30	36	23	30
May 1	39	26	28
3	32	27	29
4	40	28	26
11	36		425
12	33		
17	42		
21	32		
22	30		
24	38		
	724		

$n = 20$, so $\bar{x} = 36.2$

$\sigma^2 = 24.99$

$\sigma = 4.99$

S.E. = 1.12

$n = 14$, so $\bar{x} = 30.4$

$\sigma^2 = 12.56$

$\sigma = 3.54$

S.E. = 0.95

$\sigma^2_d = 2.15$

$t = \frac{36.2 - 30.4}{2.15} = 2.7$

$p = 0.02$

Note: The period 19-24 April is excluded from this Table due to timing inaccuracies during this interval.

APPENDIX 12 Himalayan Monal: Times of first call in relation to morning weather conditions in 1979

Sky Clear		Sky overcast/rain in night	
Date	First Call (min. before sunrise)	Date	First Call (min. before sunrise)
April 7	44	April 8	32
9	30	14	22
11	28	15	22
12	18	29	14
13	32	May 20	30
16	33		120
17	27		
18	35		
25	20		
30	41		
May 2	38		
3	42		
4	38		
7	38		
8	40		
9	37		
10	33		
11	32		
14	39		
18	42		
19	36		
21	32		
25	43		
	798		

$n = 23$, so $\bar{x} = 34.7$

$\sigma^2 = 48.16$

$\sigma = 6.94$

S.E. = 1.45

$n = 5$, so $\bar{x} = 24.0$

$\sigma^2 = 53.02$

$\sigma = 7.21$

S.E. = 3.22

$\sigma^2 d = 12.69$

$$t = \frac{34.7 - 24.0}{12.69} = 0.84$$

$p = 0.1$

APPENDIX 13

Questionnaire devised by P. B. Yonzon for obtaining data in the Human Influence Study

1. Village:
2. In which year the settlement was established?
3. No. of families:
4. Is land crop production enough for an average family?
5. No. of - Goat/sheep/cow/buffalo in a village:
6. School: primary/secondary
   a. How many students? _____ What percent they make of the total children of a village.
   b. Where there are no schools, where (Distance) and how many children from a village attend school?
7. Do villagers collect tubers and herbs? No. of persons involved/ no. of days.
8. No. of families who sell bamboo - made stuffs:
9. Any specific bamboo-cutting season?
10. No. of gun holders:
11. Muzzle loader/Cartridge/Chamber feeder: Common:
12. No. of professional shikari:
13. Are they well off/nomad type/loner/Sarki Damai:
14. The most commonly hunted pheasant:
15. Hunting method:
16. Shikaris find which pheasant rare and why?
17. No. of persons involved in a shikar trip/days/age:
18. Game animals? - and the rare ones?
19. Pheasants which are trapped easily?
20. Trapping mostly done by - shikari/gothale?
21. Practice of trapping and hunting-round the year or specific season?

22. Any peak season? when the score is highest.

23. Of which species, eggs are commonly collected?

24. Any special methods for each species of pheasants?

25. Remarks and additional info.

APPENDIX 14

Method of Snare Mechanism (see Figure 20)

An 80cm length of supple branch is cut and bent to form a frame like a croquet hoop. A springy sapling branch is embedded in the ground about 1.5m perpendicular to the frame, and a piece of string is tied round the top end. A small (less than 10cm) piece of stick (the catch piece) is tied on the string about 30cm from the branch top, and a terminal slip-knot noose 20cm in diameter is tied in the string about 30cm from the catch piece. The springy branch is then bent down towards the frame, and the catch piece is held vertically against the opposite side of the frame by means of a short length of stick (the trigger). A number of twigs are placed with one end lying on the trigger, the noose is laid on this 'pan' and is camouflaged with twigs, grass, and leaves. A bird or animal which steps on the pan will jolt the trigger, sending the catch piece through the frame and allowing the springy branch to whip up into the air, pulling the noose tight so that the creature is trapped by its leg.

APPENDIX 15 Census of Study Species in Captivity (from Grahame 1979)

Species	Total	Europe (excl. U.K.)	U.K.	U.S.A.	Canada	Central and South America	Asia	Australasia
Blood Pheasant *Ithaginis cruentus*	18(12)	10(6)	2(4)	2(1)	4		(1)	
Satyr Tragopan *Tragopan Satyra*	395(351)	175(81)	43(48)	146(152)	18(29)	4(4)	9(37)	
Koklass Pheasant *Pucrasia macrolopha*	262(78)	54(18)	80(29)	96(28)	27		5(3)	
Himalayan Monal *Lophophurus impeyanus*	1170(1238)	204(128)	296(191)	518(616)	108(205)	1(10)	42(88)	1
Nepal Kalij *Lophura leucomelana leucomelana*	359(431)	64(58)	85(83)	30(75)	(12)	Africa 2(1)	55(153)	123(49)

Note: Figures in brackets denote numbers recorded in the 1976 census

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