**An ecological study on Pheasants of the Great Himalayan National park, Western Himalaya**

**Abstract**

Pheasants (Family *Phasianidae*, Order *Galliformes*) are large, ground dwelling birds with brightly colored plumage. They inhabit diverse habitats in the tropical and temperate forests of Asia and Africa. With the exception of one species (Congo Peafowl *Afropavo* *congensis*) found in the central African rainforests, the rest 50 species are native to Asia. Out of which 17 are distributed in India and 14 are restricted to the Himalayan ranges. These birds have long been exploited for meat and plumage, causing a decline in their populations. Currently, 29 species (57%) are listed as rare, endangered or vulnerable in the IUCN/Pheasant Specialist Group’s Conservation Action Plan. Many pheasant species are likely to go extinct within the next 100 years, if the over exploitation and habitat destruction continues. The current state of knowledge on the Himalayan pheasants is sketchy and it is necessary to obtain scientific data to better understand their behavior and ecological requirements. This would, in turn, lead to effective management and conservation. This Ph.D. study was conceived in this background and is an essential step towards bridging the knowledge gap.

The primary focus of the study was to describe the ecological and spatial distribution of three sympatric pheasant species, namely Himalayan monal (*Lophophorus impejanus*), koklass (*Pucrasia macrolopha*) and western tragopan (*Tragopan melanocephalus*) in the Great Himalayan National Park (GHNP; 31˚ 33’ – 31˚ 57’ N and 77 ˚ 17’ - 77 ˚ 52’ E) in Himachal Pradesh, India. The specific were to: (i) review and test the currently available count techniques and provide estimates of relative abundance; (ii) document group size characteristics; (iii) develop a spatial model to predict availability of the potential habitats and the probability of occurrence of the study species.

The study design included three broad approaches, namely, 1) field sampling, to estimate relative abundance and other behavioral and ecological parameters, 2) associative approach, to establish a relationship between the ecological distribution of the study species and habitat characteristics, and 3) Geographical Information System (GIS) based predictive spatial modeling. An area of 16 km2 was selected within GHNP, based on reconnaissance survey and literature, to serve as an intensive study area. This area supported a considerable abundance of the study species, is representative of the habitat diversity and favored efficient sampling. The field study was done during October to December 1995, winter (January-March) of 1996, April 1997 to November 1999 and winter (January) of 2000. Intensive sampling was done from April 1997 – November 1999.

The potential count techniques relevant for the study species were gathered from literature for field validation and for estimation of relative abundance. Six trails or bridle paths (each 0.7 to 1.2 km long) representing various vegetation types and elevation gradients were identified in the intensive study area. These trails were monitored from counting birds twice a month in all the seasons (Spring, Autumn and Winter) except during the monsoon. During the breeding season, calling males were counted for three hours in the mornings from 10 fixed stations on the trails. Each station, with a minimum radius of 300m, was sampled twice a month during the breeding season for two years. In addition, surveys and opportunistic searches were made to record occurrence and group size characteristics of the species in other parts of GHNP. Evidence of species occurrence (both sighting and indirect signs such as calls, faeces, tracks, and feathers) were recorded and marked on 1:50,000 topographic maps. Habitat use was measured at two hierarchical levels, represented macrohabitat (vegetation type, elevation, aspect and slope) and microhabitat (immediate environment such as tree cover, shrub density and litter cover). Abundance estimates were related to the macrohabitat parameters to assess the relative habitat preference of the species. Microhabitat variables were measured at each bird location and these data were used to describe microhabitat use. One western tragopan was fitted with a radio-transmitter and studied for seven months (May-November 1999). This radio tracking assisted in getting additional information on this rare species. Using the field data and the spatial database on habitat characteristics derived from satellite imagery and topographic maps of the study area, a model was developed to predict the potential habitat availability and the probability of occurrence of each species. Parametric, non-parametric and classification tree procedures were used for aspatial data analysis. For spatial analysis, Boolean logic, logistic and autologistic modes were used.

There is no common method that could be applied to estimate abundance of all the study species. This is primarily because of the different behavioural traits of the species. The Himalayan monal was conspicuous but does not give breeding calls, whereas the koklass and the western tragopan were secretive, but made loud calls during the breeding season. The trail count was found to be efficient for obtaining an index of abundance and a density estimate for the Himalayan monal, whereas, call count gave a relatively unbiased abundance estimate for koklass and western tragopan. Spot mapping was found to be a useful method for estimating abundance of western tragopan. The count techniques adopted in the study have assumed equal probability of detection across habitat types. The detection probability is likely to be constant for the Himalayan monal because of its characteristic behavior of giving alarm calls or flushing at greater distances, even in dense habitats. However, for the koklass and western tragopan that tend to skulk under bush/rock cover, the detection probabilities may vary. These methods are applicable for long term monitoring of population trends, as the probability of detecting the species is likely to be constant over the years, unless the habitat undergoes major changes. To apply these count techniques to the rest of the distribution range of the study species, modification is needed to include a correction factor that accounts for the variation in detection probabilities across sampling areas.

320 sightings of Himalayan monal, 90 sightings of koklass and 30 sightings of western tragopan were obtained in trail counts. Surveys and opportunistic searches provided 204 more sightings of Himalayan monal, 36 sightings of koklass and 15 sightings of western tragopan, thus taking the total to 524, 126 and 45 respectively. Himalayan monal was the most frequently sighted species with an encounter rate ranging between 0.6 and 6.5 birds/km, giving a pooled mean of 2.5 (± 0.26 SE, n= 35) birds/km. Pooled mean of the encounter rate obtained for koklass, based on trail count was 0.7 bird/km, but the call count gave 2.9 (± 0.19 SE, n=20) calling males/call station. Western tragopan was only occasionally sighted and the pooled mean of encounter rate was 0.3 bird/km and only 3 calling males were recorded in the entire intensive study area. Within the study area, the abundance of these species varied significantly between localities. There were seasonal variations in abundance of Himalayan monal and western tragopan, with consistently higher encounter rates in winter for both the species. Koklass did not show any such seasonal variation in the encounter rates. The estimated densities for Himalayan monal (14-27/km2) and koklass (14-21/km2) revealed that these two species are not significantly different in terms of population abundance. The low encounter rates and density estimates (1.5-2/km2) confirmed that western tragopan is a rare species. Noticeable differences were detected in the abundance of the study species over successive years, perhaps indicating a declining trend in the population. Circumstantial evidences suggested that the decline could be due to disturbances caused by local people collecting mushrooms during the breeding season of the pheasants. Group size of the Himalayan monal ranged from 1 to 11 individuals with an average of 1.6 (± 1.2 SD). There were several observations of unisexual group formation in this bird. Also, larger groups were seen during winter, suggesting that Himalayan monal tend to congregate in winter months. Koklass and western tragopan were mostly seen singly or in pairs and the mean group sizes of these bids were 1.3 (± 0.5 SD) and 1.1 (± 0.3 SD) respectively. There was no seasonal difference in the group sizes of these two species.

The three study species are basically forest dwellers, largely occupying middle elevation areas (2600-3000m) and showed a preference for well-developed understory environment. All the species appeared to have a strong preference for broad leaf associated vegetation. Himalayan monal was a generalist in using various habitat types, but showed a marked preference to areas dominated by mixed and subalpine forests interspersed with cliffs, regardless of seasons. Koklass and western tragopan seemed to prefer broadleaf forests, with sufficient understory vegetation represented by species of *Cotoneaster*, *Indigofera*, *Viburnum* and ringal bamboo (*Thamnoclamus spathiflorus*). Himalayan monal showed high variation in elevation use and they used areas between 2340m and 3660m in summer. In winter, these birds descended to areas below 3100m in response to heavy snow cover in the higher altitudes. Koklass maintained a relatively constant elevation use, found between 2220m and 3060m throughout the year. Western tragopan too responded strongly to snow conditions in the higher altitude by descending from the summer distribution areas of 2575 – 3200 m, to lower elevations between 2220 and 2970m during winter. All these species appeared to prefer south and east facing aspects and gentle to moderate slopes (24-45˚) in summer season. The winter distributions were skewed towards south and southeast facing aspects and slightly steeper slopes. Twelve microhabitat variables (three physical – elevation, aspect and slope; and nine biological – vegetation type, tree density, canopy cover, shrub species composition, shrub density, bare ground availability, litter cover, soil depth and distance to water) were found to have strong association with microhabitat use of the species in the summer season. Fallen log density and rock cover were two additional variables that also had a strong association with the microhabitat use by the species in winter. Himalayan monal appeared to be a habitat generalist, while western tragopan, a habitat specialist. Koklass appeared to show a consistent preference for understory microhabitat in both the seasons. Broadly, these three species seem to live in the same habitat types, but at a smaller scale of analysis, there was mutual exclusion either spatially or temporally.

Availability of potential habitat for all the study species was proportionately very low (22% for Himalayan monal, 12% for koklass and 10% for western tragopan) as compared to the total area of GHNP (1171 km2) and is also fragmented in space. About 50% of the available habitats have been predicted to be in the ecozone (outside PA network), where the pheasant populations have either been extirpated or occur in very low abundance. It was possible to predict spatial distribution of these species at a coarse scale based on four spatial coorelates, namely, vegetation type, normalized difference vegetation index (surrogate of vegetation cover), elevation and aspect. Logistic regression model accounted for over 60% of the variance for all the species, and provided overall classification accuracy of 83.6%, 86.5% and 82% for Himalayan monal, koklass and western tragopan respectively. Improved versions of the model (autologistic model) that incorporated spatial autocorrelation function in the model equation explained 80% of the variance and increased the accuracy of the model prediction to over 90% for all the specie. Validation (based on independent data set) substantiated that the probability of occurrence predicted by the model were largely true for the intensive study area and for parts of GHNP. The results of this study have been presented both numerically and as maps. These findings have high potential to provide a basis for management of the area for pheasants.

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