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INFLUENCE OF HUMAN DISTURBANCE ON THE ABUNDANCE OF HIMALAYAN PHEASANT (AVES, GALLIFORMES) IN THE TEMPERATE FOREST OF WESTERN HIMALAYA, INDIA

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Influence of Human Disturbance on the Abundance of Himalayan Pheasant (Aves, Galliformes) in the Temperate Forest of Western Himalaya, India. Jolli V., Pandit M. K. — We conducted field studies in the Jiwa valley (Indian Himalayas) to examine the influence of human disturbance on Himalayan pheasants. We used the "call count" and "line transect" methods to estimate the abundance of pheasants in Jiwa valley. A human disturbance gradient defined by human population, agriculture activity, forest wood collection, grazing, vehicle, use of heavy machines, human settlements, dumping ground, and blasting was prepared. We assessed the pheasant numbers under two conditions (1) a decline in the gradient of human activity during two consecutive years (2009–2010) (2) in the presence of hydroelectric development activities. The numbers of koklass pheasants, Himalayan monal, cheer pheasant and Western tragopan declined significantly with anthropogenic activities. During spring 2010, hydroelectric construction activity was temporarily suspended in Manjhan adit, and a positive response was noted in terms of an increase in the pheasant numbers near the site. The response of pheasants to human disturbance has inferred that large scale development can lead to decline of Himalayan pheasant in Himalayan region.

Key words: call count, encounter rate, himalayan pheasant, human disturbance, Western Himalaya.

Влияние фактора беспокойства на численность гималайских фазанов (Aves, Galliformes) в умеренном лесу Западных Гималаев, Индия. Джолли В., Пандит М. К. — Проведены полевые исследования в долине Джива (Индийские Гималаи) для оценки влияния фактора беспокойства на гималайских фазанов. Для оценки численности фазанов в долине Джива использовали метод учета по голосам и трансектный метод. Градиент фактора беспокойства определен по оценке количества населения, сельскохозяйственной деятельности, вырубке лесов, выпасу, транспорту, использованию тяжелых машин, человеческим поселениям, использованию земли под свалки и направленным взрывам. Мы оценивали количество фазанов условно по (1) снижению градиента фактора беспокойства в течение двух последовательных лет (2009–2010) и (2) деятельности по развитию гидроэлектростанций. Количество клинохвостого фазана, гималайского монала, гималайского фазана и восточного трагопана значительно уменьшилось с антропогенной деятельностью. В течение 2010 года, деятельность по созданию гидроэлектростанций была временно приостановлена в Манджан адит, и было отмечено увеличение численности фазанов в этом районе. Ответ на фактор беспокойства означает, что широкомасштабное развитие региона может привести к снижению численности Гималайских фазанов в районе Гималаев.

Ключевые слова: учет по голосам, коэффициент случайности, гималайский фазан, фактор беспокойства, Западные Гималаи.

Introduction

The Indian Himalaya is a primary source of many perennial rivers that are exploited extensively for hydroelectric power. Government of India has planed to set up number of hydro power development projects to meet its ever increasing energy requirements. Central Electricity Authority (CEA) has formulated a preliminary feasibility reports for 162 new hydroelectric schemes (47,930 MW), 133 of which are in the Indian Himalayas

(CEA, 2009). This is a matter of concern because these hydro electric projects often lie close to protected forest, e. g., the Parvati Hydro Power Project was constructed near the Greater Himalayan National Park (GHNP). The presence of endemic and threatened bird species like Western tragopan (*Tragopan melanocephalus*) and cheer pheasant (*Caterus wallichi*) has raised the importance of this study area from conservation point of view (Birdlife International, 2010). Construction of these massive facilities creates disturbance, which has been defined as "any relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment" (White, Pickett, 1985). These disturbances can have cascading effects on the distribution of Himalayan bird species.

We chose Himalayan pheasants as a candidate group of species to determine the effects of human disturbance on the montane ecosystem. These birds are known to be extremely sensitive to human exploitation (Fuller, Garson, 2000; Nawaz et al., 2000); their ecological characteristics capture the complexities of the ecosystem and yet are simple enough for easy monitoring. Among the pheasant species, the Himalayan monal (*Lophophorus impejanus*), koklass pheasant (*Pucrasia macrolopha),* cheer pheasant, and Western tragopan *have* strong habitat preferences. Changes in land use (Anonymous, 2001) and other anthropogenic pressures affect pheasant habitats (Bhattacharya, Sathyakumar, 2007; Ramesh, 2003). The sensitivity of these bird species to human disturbance may be the reason for their dwindling population.

Koklass and monal pheasants are usually found in oak/deodar, oak/pine or *Rhododendron* vegetation (Ali, 1983). The koklass prefers denser understory than the monal (Gaston et al., 1983), but they sometimes feed together in early spring (Gaston et al., 1981). Cheer pheasant inhabits precipitous hillsides or ravines covered with tall grass, scrubs, and oak forests (Ali, 1983). Pheasants are elusive birds that inhabit difficult mountain terrain, which makes population monitoring by line transects difficult (Ramesh, 2003). Call counts of some of the species, including western tragopan, cheer pheasant, and koklass pheasant, are useful in such landscapes. Call counts are a useful index of the relative population abundance over different sectors of terrain (Severinghaus, 1979; Gaston 1980; Duke, 1990; McGowan, 1990). We used call counts and line transects to determine the following: (1) Do the pheasant numbers increase along a gradient of human disturbance (from forest to disturbed habitat types)? (2) Which species among pheasants respond most strongly to human disturbance? Answers to these questions about pheasant responses to disturbance will help in understanding the effect of human disturbance on pheasant numbers and in better conservation management of Himalayan pheasant in GHNP.

Methods

Study area. The Jiwa valley study area is located in an ecodevelopment zone (where controlled human interference is allowed) adjoining the Great Himalayan National Park. The site is within thse Western Himalaya, in the Kullu District of Himachal Pradesh, ~45 km southeast of Kullu. Geographic coordinates are 31°49′20″—31°50′13″N and 77°20′24″—77°22′ 32″E (fig. 1). Study sites were on the Jiwa Nal River.

There are 3 distinct seasons in the study area (1) summer from April to June, (2) rainy season from July to September and (3) winter season from October to March when there is snowfall at high elevations. Heavy monsoonal rains cause landslides and soil erosion (FREEP-GFNP, 1995).

There is abundant mixed broadleaf and coniferous forest vegetation in addition to large mountain meadows and pastures. The description of habitats of each sampled sites are shown in table 1. The area is a rich bio-diversity zone of the western Himalaya. The GHNP falls within one of the globally important Endemic Bird Areas (D02: western Himalaya) identified by the International Council of Bird Preservation (ICBP) Biodiversity Project. A total of 183 bird species, including 51 non passerines and 132 passerines, have been recorded from this area. The Greater Himalayan National Park is under review for designation as a UNESCO World Heritage Site (UNESCO, 2009).

Sampling design. We sampled three sites along a gradient of human disturbance. The gradient was defined by human population, agricultural activity, forest wood collection, grazing, presence of vehicles, use of heavy machinery, human settlements, waste dump sites, and blasting. Manjhan adit was identified as a disturbed site because of trench weir construction as depicted in table 2. Manjhan village is 3 km from Manjhan adit. We selected another sampling site in Gatipath ~9 km from Manjhan adit. Gatipath had less anthropogenic pressure because the steep landscape limits firewood collection and it was distantly located site from disturbed forest site. Therefore, we assumed Gatipath as a control site during year 2009.

In 2010, we sampled inside GHNP boundary; Apgian (fig. 1), this site was relatively more pristine as compared to Gatipath (table 3). Therefore, we assumed Apgian as undisturbed forest site during year 2010.

We sampled Himalayan monal visually on transect walks because this species is easy to see along trails, but calls only sporadically (Kaul, Shakya, 2001). Koklass, cheer pheasants and western tragopan were sampled by call counts. These are elusive birds, but males make audible breeding calls at dawn during April—May; call counting is an effective procedure for measuring population abundances of such cryptic species (Kaul, 1989; Ramesh, 2003; Miller, 2008). Call counts gave an index of calling males per station in a given area. We compared the pheasant abundance estimates among Gatipath, Manjhan, and Manjhan adit during 2009 and Apgian, Manjhan, and Manjhan adit during 2010.

Data collection. We hiked a total of 16 km starting from Pashi beat located at coordinates 31°49′20″ N, 77°20′24″ E, to Manjhan adit at 31°50′08″ N, 77°22′15″ E in April 2009 to identify the potential habitats of pheasants around the Hydro-electric Project (HEP) activities affected areas. On the trail, we recorded pheasant presence/absence. We used Magellen GPS equipment to record details such as name, exact loca-

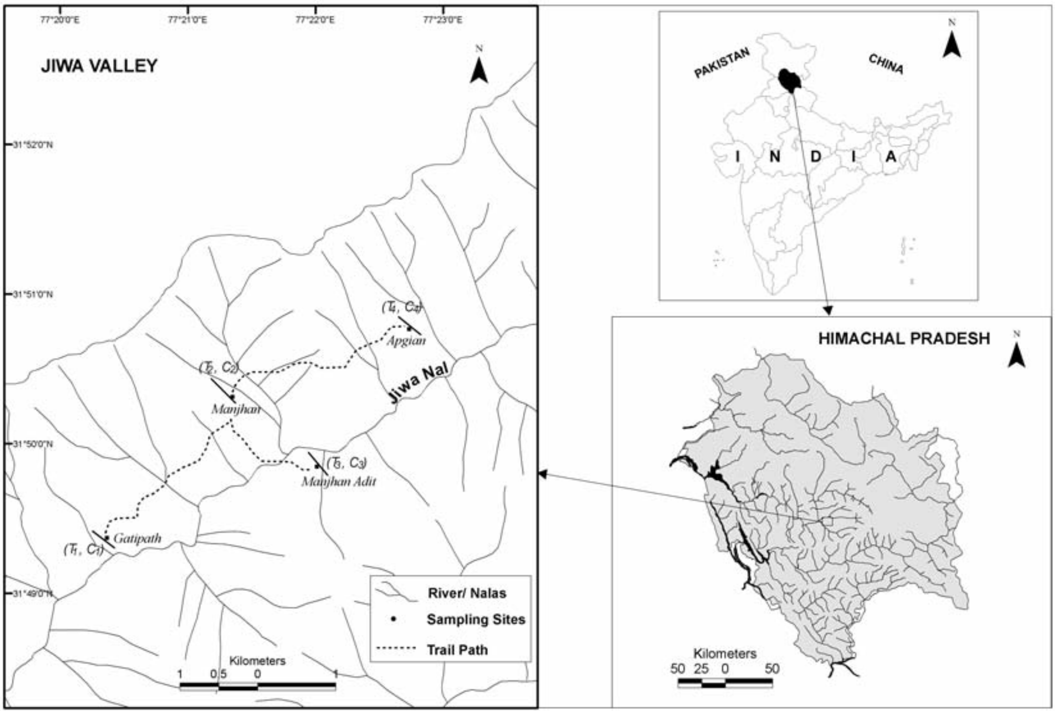

Fig. 1. Location map of sampling sites in Jiwa Valley of Western Himalaya.

Рис. 1. Карта исследованных мест в долине Джива в Западных Гималаях.

Table 1. Description of habitat types surveyed in Jiwa valley

Таблица 1. Описание типов мест обитания, исследованных в долине Джива

Apgian	Mixed broadleaf and Coniferous forest lies in the GHNP	31°51'08"N 77°23'07"E, 2750 m	T_4, C_4
Gatipath	Charaterised by broad-leaf and coniferous forest lies in eco-development zone of GHNP	31°49'47"N 77°20'57"E, 2602 m	T_1, C_1
Manjhan	Mixed broadleaf and Coniferous forest makes boundary between eco-development zone and GHNP	31°50'36"N, 77°21'51"E, 2630 m	T_2, C_2
Manjhan adit	Mixed broadleaf forest lies in eco-development zone of GHNP connected by road characterised by adit construction work	31°50'08"N 77°22'32"E 2430 m	T_3, C_3

Table 2. Components of human disturbance index ranked in increasing order of disturbance Where, 1 = low, 2 = medium, 3 = high

Таблица 2. Компоненты индекса фактора беспокойства, расположенные в порядке возрастания

Human activity	Apgian	Gatipath	Manjhan	Manjhan adit
Human population	1	1	2	3
Agricultural activity	1	1	3	3
Forest wood collection	1	2	3	2
Grazing	1	2	3	2
No. of Vehicles	1	1	1	3
Use of Heavy machines	1	1	1	3
Human settlement	1	1	2	3
Dumping	1	1	1	3
Blasting	1	1	1	3
Total	9	11	17	25

tion, altitude range and general forest type. Suitable call stations were identified for monitoring pheasant abundance.

We sampled three call stations three times a month in spring season. Call count stations were fixed circles with 300 m listening radii. On each trail, one or two stations were positioned ~500 m apart to avoid listening overlap between observers (Kaul, 1989; Ramesh, 2003). We sampled one call station each morning, with one observer making measurements from each station (following seasonal light shifts, arrival times ranged from 5.30 a. m in early April to 4.15 a. m by late May and 6.00 a. m). We began sampling at the first audible call and stopped 1 hour after sunrise, a period previously determined to be the most effective for call counting both koklass and western tragopan (Ramesh, 2003; Miller, 2008). Calls were recorded by species, time, distance, and cardinal direction. After sampling, observers compared times and directions of calls to eliminate multiple counts of the same bird from different stations. There was no sampling in adverse weather (thick fog, heavy rainfall or strong winds) because these conditions alter pheasant activity and/or obscure observer abilities to accurately measure bird presence (Khaling et al., 2002).

On each site, one transect was laid to monitor the monal abundance. As it was difficult to lay transects on steep slopes, we used pre-existing footpaths of 1 km length at each sampling site for monitoring monal abundance. We walked three times a month on each transect at an average speed of 1 km/h. We walked transects in the mornings before 10.00 a. m, when monals forage on the ground around their roosting sites (Ramesh, 2003). For each monal encounter, we recorded gender, sighting angle, sighting distance, time and location. Walking pace was standardized to reduce irregularities in sampling effort and abundance estimates.

In November 2009, excavation (adit construction) was suspended at Manjhan adit because of technical reasons. This reduced anthropogenic disturbance at the site. We used this opportunity to investigate whether disturbance in Jiwa Nal was attributable to the hydroelectric power project. Thus, we compared pheasant abundances of Manjhan adit in spring 2009 and 2010.

Data analysis. We calculated encounter rates for each replicate by dividing the number of birds observed by distance (transect walks) or station (call counts). The arithmetic means for transects or call stations were pooled to calculate mean encounter rate ± Standard error (SE) of each site.

We have developed a human disturbance index, and ranked each component parameter in increasing order. The parameters selected were human population, agriculture activity, forest wood collection, grazing, vehicle presence, heavy machine use, human settlements, waste dump sites, and noise levels table 2. The human population and settlement data for Manjhan village was collected from Raila Panchayat office in Sainj, Himachal Pradesh. While the population in Manjhan adit was estimated by direct counting of individual on the site. Presence/absence survey was conducted to identify the agriculture, forest wood collection and grazing activities among the three sites. Noise levels were recorded two times a day during morning and evening using a sound meter (Cygnet D 2023). Combined rank values of all the parameters were derived, giving a human disturbance intensity value for each sampling site.

The abundance data of pheasants was entered into PAST version 2.05 and analysis was carried out using this statistical software (Hammer et al., 2001). We used non parametric test to analyze our data. Kruskal-Wallis one way ANOVA was used to analyze across site variation in data. Mann-Whiteny test was used to compare two sites. While, Wilcoxon paired test was performed to analyze the change in pheasant abundance during year 2009–2010.

Results

Presence absence survey. In presence/absence survey we recorded five species of pheasants; Himalayan Monal, Koklass, Cheer pheasant, Western tragopan and Kalij pheasant. Western tragopan was recorded only in Apgian while cheer pheasant was present in all the four sampled sites

Pheasant abundances in Jiwa valley. Figure 2 shows across site differences in mean abundances of pheasants in the spring season of year 2009. The mean abundance of koklass in Gatipath was 3.75 ± 0.86 (± SE) which dropped significantly in Manjhan to 1.62 ± 0.46 (Mann-Whittney U = 12.5, P = 0.04); we did not record koklass call from Manjhan adit. The mean abundance of Himalayan monal in Gatipath was 2.87 ± 0.22 which decreased significantly to 1.87 ± 0.2 (Mann-Whittney U = 12, P = 0.03); and further dropped to 0.42 ± 0.2 and was significantly less than Manjhan (Mann-Whittney U = 4.5, P = 0.005). The mean abundance of cheer pheasant in Gatipath was 1.25 ± 0.25 which dropped down to 0.5 ± 0.26 in Manjhan (Mann-Whittney U = 15, P = 0.06); while there was significant difference in mean abundance between Gatipath and Manjhan adit (Mann-Whittney U = 4, P = 0.001)

Figure 3 shows across site differences in mean abundance of pheasant during the spring season of 2010. Himalayan monal mean abundance in Apgian was 2.67 ± 0.21 (S. E)

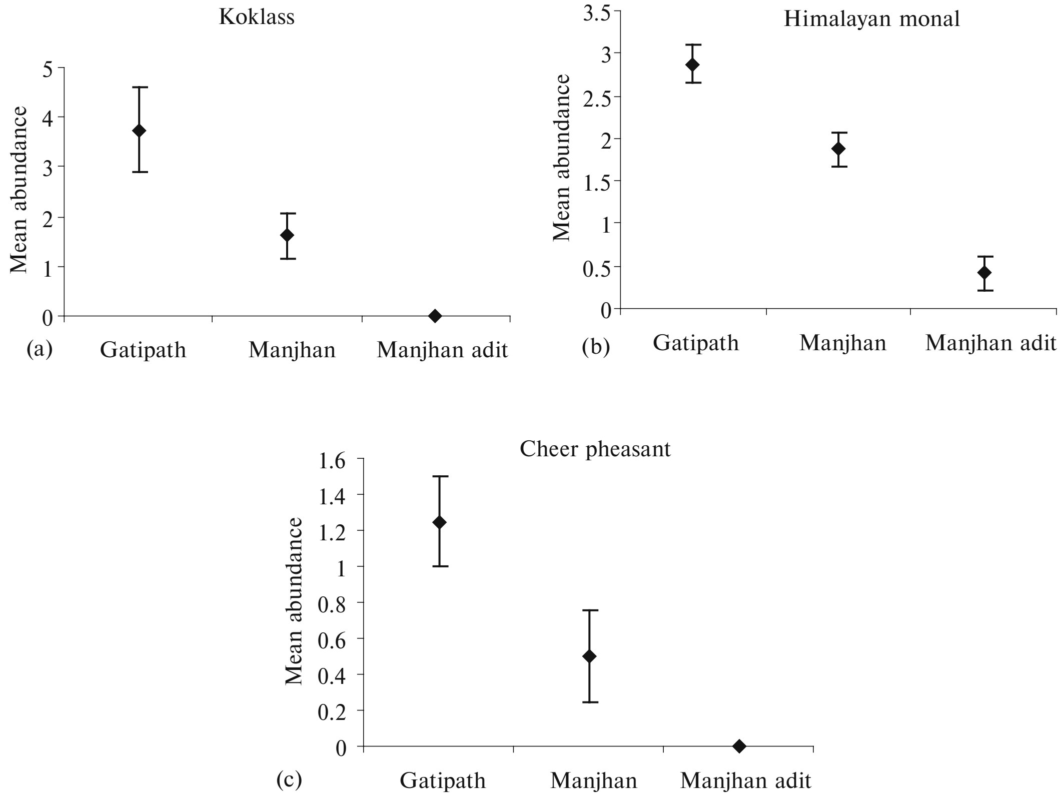

Fig. 2. Mean abundance of (a) Koklass (Kruskal-Wallis H = 15.81, P = 0.0004) (b) Himalayan Monal (Kruskal-Wallis H = 14.53, P = 0.0007) and (c) Cheer pheasant (Kruskal-Wallis H = 9.12, P = 0.01) along the disturbance gradient in the temperate forest of Western Himalaya, India (2009). Error bar represent standard error.

Рис. 2. Плотность кокласса (Kruskal-Wallis H = 15.81, P = 0.0004), (b) гималайского монала (Kruskal-Wallis H = 14.53, P = 0.0007) и (c) гималайского фазана (Kruskal-Wallis H = 9.12, P = 0.01) по градиенту фактора беспокойства в умеренном лесу Западных Гималаев, Индия (2009). Шкала погрешностей стандартная.

which rose slightly in Manjhan and Manjhan adit to 2.83 ± 0.4. Mean abundance of koklass in Apgian was 3.5 ± 0.22 which increased to 4.3 ± 0.33 in Manjhan (Mann-Whitney U = 7.5, $P > 0.05$) and dropped in Manjhan adit at 3.3 ± 0.4 and was not different from Manjhan (Mann-Whitney U = 5, P = 0.22). Western Tragopan was recorded only in Apgian with mean abundance of 2.5 ± 0.42. Mean abundance of cheer pheasant in Apgian was 0.33 ± 0.2 which increased significantly in Manjhan to 3 ± 0.8 (P = 0.004) which further dropped to a level of 0.3 ± 0.2 in Manjhan adit ($P < 0.004$).

Response of pheasants to Hydro-electric project disturbance. We compared pheasant's abundance in Manjhan adit site during spring season of 2009—2010. The mean abundance of koklass increased significantly from 0 to 3.3 ± 0.21 during year 2010 (Wilcoxon Z = 2.27, df = 5, P = 0.02). Himalayan Monal also recorded sharp rise in abundance from 0.16 ± 0.16 to 2.83 ± 0.4 (Wilcoxon Z = 2.2, df = 5, $P < 0.02$). While we recorded no change in cheer pheasant abundance (Wilcoxon Z = 1.62, df = 5, P = 0.1).

Discussion

Jiwa valley supports sizeable population of Himalayan pheasants. The Western Tragopan, a flagship species, is confined in Apgian. The Tragopan calls are not recorded in other calling stations. The presence of this species in the interior of forest infers that this species is sensitive to human presence. The other sites are well suitable for Tragopan

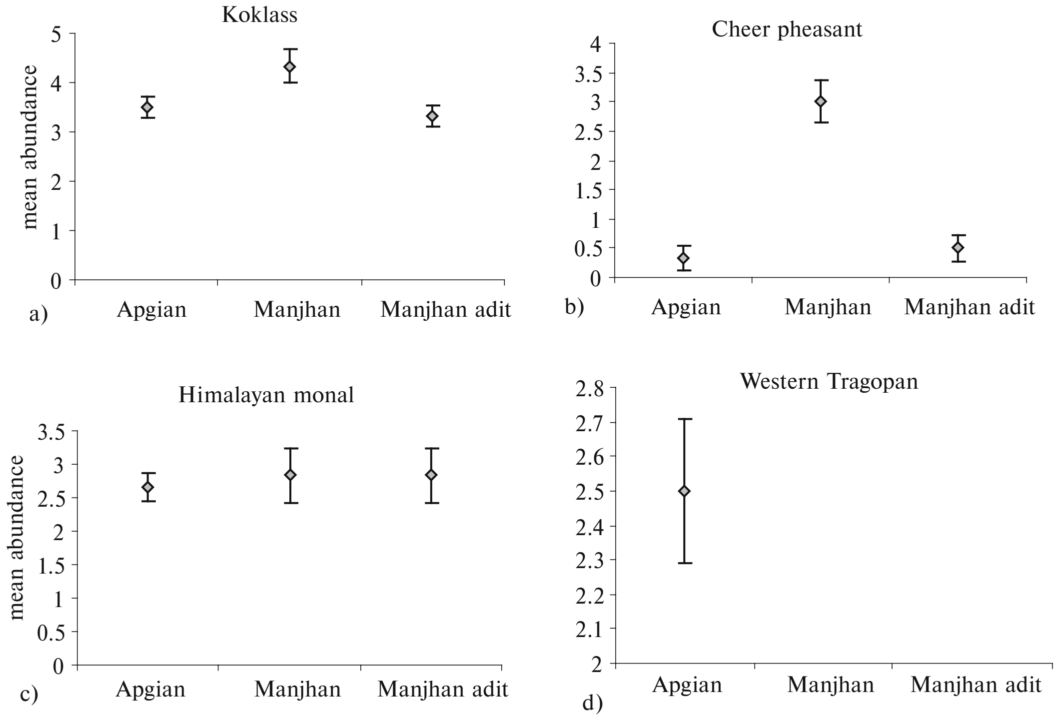

Fig. 3. Mean abundance of (a) Koklass (Kruskal-Wallis H = 5.05, P = 0.079), (b) Cheer pheasant (Kruskal-Wallis H = 11.47, P = 0.003), (c) Himalayan Monal (Kruskal-Wallis H = 0.035, P = 0.98) and (d) Western Tragopan (Kruskal-Wallis H = 11.37, P = 0.003) along the disturbance gradient in the temperate forest of Western Himalaya, India (2010). Error bar represent standard error.

Рис. 3. Плотность (a) кокласса (Kruskal-Wallis H = 5.05, P = 0.079), (b) гималайского фазана (Kruskal-Wallis H = 11.47, P = 0.003), (c) гималайского монала (Kruskal-Wallis H = 0.035, P = 0.98) и (d) западного трагопана (Kruskal-Wallis H = 11.37, P = 0.003) по градиенту фактора беспокойства в умеренном лесу Западных Гималаев, Индия (2010). Шкала погрешностей стандартная.

but the presence of anthropogenic activities makes it unfavorable for its survival. It descends down to 1500 m during winter season (Kazmierczak, 2009) but human presence in the lower altitudes make it restricted to higher range which may result in higher mortality during winter. Cheer pheasant is another endemic and threatened species of pheasant recorded in Jiwa valley. Manjhan support relatively more number of cheer pheasant compared to other sites. The presence of secondary vegetation along with moderate level of human disturbance like, farming and grazing in upland rural areas are the preferred habitats for cheer pheasant. Koklass and Himalayan monal are abundant in Manjhan, and Apgian. They remain confined to the tree line and were not reported below 2500 m altitude. They respond negatively with hydroelectric project activity and were not recorded during year 2009 while their abundance increased significantly during year 2010. During our study the HEP construction activity was halted due to some contract related disputes since November 2009 till the present bird call count. This caused reduction in human disturbance, and thus attracted some the pheasants around Manjhan adit. This has proved our hypothesis that pheasant are sensitive to intense human activity. Moreover, the susceptibility to noise is relatively higher in Phasianidae compared to Passeriformes (Ryals et al., 1999) thus they avoid places where noise levels are high. Blasting, labour colonies and project vehicles keep this site disturbed.

There is a possibility that pheasants will adapt to human disturbance in due course of time e. g. adapt to coexist with human settlements. However, pheasants are wild animals and to maintain their wilderness, entry into the ecozone area should be regulated. Moreover, there are increased chances of homogenization in montane birds under an anthropogenic influence (Soh et al., 2006), in which only few species will dominate as they can tolerate human disturbance better than other species.

Blasting sound was heard during their crowing time in both seasons, and both Koklass and Cheer pheasant calls were not reported after blasting. They call loudly during spring season for demarcating their territory from rival and to attract females. So, blasting should be restricted at least during early morning of breeding period (CISMHE, 2000).

Finally, we would suggest comprehensive long term monitoring of pheasants in Greater Himalayan National Park by GHNP staff. More emphasis should be given in protecting the Cheer pheasant and Western tragopan. They are important species from conservation point of view. Their habitats are fragmented in Western Himalaya and need special protection. The recovery of pheasants during spring 2010 in Manjhan adit showed that HEP activity has displaced the pheasants. The territorial behavior in koklass and Western tragopan is very predominant during breeding season and territoriality is directly related to size of bird (Schoener, 1968). As pheasants are comparatively large birds they need more space to defend. The congregation of pheasant in adjacent region would increase competition among males for food, mates and space which can reduce fitness of males. It can lead to extirpation of pheasant locally. So we suggests from our finding that large scale development activity pose serious threat to the existence of pheasants in the Himalayas.

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