



Full Length Article

Reproductive Patterns and Threats Affecting Chukar Partridge (*Alectoris chukar*) Population in Scrub Forest of Swat, Khyber Pakhtunkhwa, Pakistan

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Abstract

The Chukar partridge (*Alectoris chukar* Gray, 1830) is experiencing population decline due to overexploitation for eggs, meat, and recreational hunting. This study investigated its reproductive patterns and threats within the Swat scrub forest of Khyber Pakhtunkhwa, Pakistan. Ten sampling sites were monitored during the breeding season (March–June) to record mating calls, nesting locations, clutch sizes, and hatching success. Additionally, structured questionnaires were administered to local residents to assess the range and severity of threats to the partridge population. The findings revealed a distinct breeding pattern, with male vocalizations initiating the season, followed by pair formation and nest building. Peak nesting activity occurred in April, with females laying clutches of 20–25 eggs in nests on inclined terrains dominated by *Dodonaea viscosa* vegetation. The study documented a high average hatching success rate of approximately 86.96%. However, the partridge population faces significant threats, primarily from illegal hunting and poaching, followed by habitat degradation. This research highlights the vulnerability of the Chukar partridge despite its high reproductive potential and underscores the need for effective conservation measures to safeguard this regionally significant bird species.

Keyword: Breeding behavior; Chukar; Clutch size; Swat; Threats

Introduction

Renowned for its striking plumage and adaptability, the Chukar partridge (*Alectoris chukar* Gray, 1830), also known as Chakar, is a medium-sized bird species belonging to the class Aves, order Galliformes, family Phasianidae, and subfamily Phasianinae. Within the genus *Alectoris*, there are 16 subspecies distributed globally. This game and cage bird is a significant member of the avian community, known for its adaptability and unique characteristics within its taxonomic classification (Ahmed *et al.* 2017; Khan *et al.* 2021). Native to mountainous regions of Central Asia, its range extends to diverse habitats from mountain slopes to arid plains in countries like India, Pakistan and Afghanistan (Christensen 1996). Its range also extends westward to Palestine and Lebanon, and eastward to Iran, reaching its northernmost point in the Western Himalayas of Nepal (Bird Life International 2016). In Pakistan, the Chukar partridge

can be found throughout various regions including Punjab, Sindh, Balochistan, Khyber Pakhtunkhwa, FATA, Lower and Upper Dir, Malakand Agency, Swat, Chitral, Margalla Hills, Kurram Mountain, Kohistan and Gilgit Baltistan. This distribution highlights the extensive range and adaptability of the Chukar partridge across diverse habitats in the region (Khan *et al.* 2021). Chukar partridges are monogamous and form pairs in spring (Mahmood *et al.* 2019). The male initiates breeding with a courtship display involving a head-tilt and displaying his barred flanks. Both sexes then participate in a "tidbitting display" by pecking at objects (Hoyo 1994; Christensen 1996). Breeding typically occurs once a year, with the timing varying depending on elevation. At lower elevations, breeding starts as early as late March, while in the Himalayas, birds delay nesting until late June due to snow-covered pastures. This contrast highlights the remarkable adaptability of the Chukar to different environmental conditions (Roberts 1991). The breeding

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season typically starts in February, with peak months being March and April, during which frequent breeding calls are observed (Mahmood *et al.* 2019). Clutch size also varies geographically, with the Salt Range typically seeing clutches of 6 to 9 eggs, while areas with heavier rainfall may have clutches as large as 15–19 eggs (Robert 1991).

Despite its adaptability, the Chukar partridge population in Pakistan faces threats such as habitat loss due to urbanization, agriculture, and mining. Hunting for meat and feathers also contributes to population decline. Climate change impacts food and water availability affecting breeding success (Khan *et al.* 2022). Predation by jackals, foxes, eagles, and snakes poses significant threats to their survival. Human exploitation for eggs, meat, and hunting purposes further exacerbates population decline (Ahmad *et al.* 2015). An interaction between humans and Chukar partridges is challenging, leading to habitat destruction and biodiversity decline (Hamilton *et al.* 1992; Pavel *et al.* 2023).

This study focuses on the reproductive patterns and threats faced by the Chukar partridge population in the Swat scrub forest. By examining breeding season, behavior, clutch size, incubation and hatching percentage, this research aims to contribute to a better understanding of this vital bird species and inform conservation efforts.

Materials and Methods

Study area

Swat Valley, located in the Khyber Pakhtunkhwa province of Pakistan at 35.2227° N latitude and 72.4258° E longitude, is characterized by a high mountain landscape with significant variations in elevation. This elevational variation creates ecologically distinct habitats within the valley, encompassing scrub, subtropical Chir pine forests, and temperate zones. Land use in Swat Valley is primarily divided between agriculture, forestry, and grasslands. The scrub forests of Swat Valley are dominated by shrubs and small trees, with a diverse understory of shrubs and grasses that provides essential habitat and food for various wildlife species, including birds, mammals, and insects. The dominant tree species of the study area include *Salix tetrasperma*, *Ficus palmata*, *Platanus orientalis*, *Pinus roxburghii*, *Olea ferruginea*, *Quercus* sp., *Ziziphus nummularia*, *Gymnosporia royleana*, *Periploca aphylla*, *Calotropis procera*, *Morus alba*, *Eucalyptus camaldulensis*, *Acacia modesta* and *Melia azedarach*. Shrubs include *Dodonaea viscosa*. The major wildlife species of the area comprise of Cape hare (*Lepus capensis*), Asiatic Jackal (*Canis aureus*), Indian crested Porcupine (*Hystrix indica*), Chukar partridge, Black francolin (*Francolinus francolinus*) and grey francolin (*F. pondicerianus*) (Fig. 1).

Methodology

In order to choose sampling locations in Lower Swat and

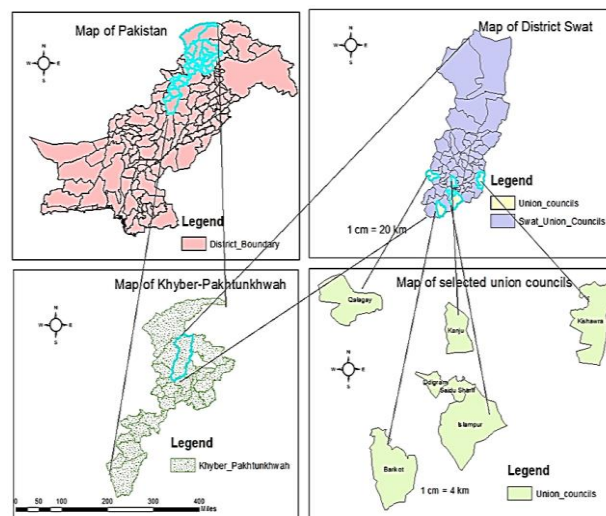


Fig. 1: Map of Marghuzar valley, district Swat

identify possible Chukar habitat, a reconnaissance assessment of the study region was carried out in March 2023. The initial phase involved gathering information on Chukar partridge distribution and habitat suitability within the study area. This information was obtained from various stakeholders, including local hunters, wildlife department personnel, and other knowledgeable individuals through unstructured interviews and meetings. The methodology outlined by Mahmood *et al.* (2019) was employed to identify potential sampling sites. This approach considered three key criteria: accessibility for researchers, security of the sites, and suitability as Chukar partridge habitat. Based on the stakeholder input, ten sampling sites were chosen across seven union councils in Lower Swat (Table 1).

Study design

Within each chosen site, the area was divided into equal-sized grids. Tracks were then randomly selected within these grids, ensuring variation in topography and landscape features known to influence Chukar partridge behavior. Following the methods described by Buckland *et al.* (2001), nest searching and monitoring of breeding activity were conducted along these pre-defined tracks.

Trained dogs were utilized to locate nesting sites, following the methodology described by Besnard *et al.* (2010) for efficient data recording. Field visits were conducted regularly from 15th March to 15th June 2023 to search for Chukar nests. The onset of the breeding season was determined by the number of breeding calls, with continuous calling, presence of nests, fresh eggs, and newly hatched chicks indicating active breeding.

During the field surveys, data on clutch size, incubation period, egg production, and the number of chicks or new recruits were recorded at the ten sampling sites.

Table 1: Detail of sampling sites and union councils in Lower Swat

S. No.	Village	Union council	District	Forest type
1	Barikot	Barikot	Swat	Scrub Forest
2	Shaghai	Saidu Sharif	Swat	Scrub Forest
3	Akhonbaba	Saidu Sharif	Swat	Scrub Forest
4	Saidu sharif	Saidu Sharif	Swat	Scrub Forest
5	Baligarm	Saidu Sharif	Swat	Scrub Forest
6	Kanju	Kanju	Swat	Scrub Forest
7	Sher Atraf	Islampur	Swat	Scrub Forest
8	Sir taligram	Teligram	Swat	Scrub Forest
9	Kishwara	Kishwara	Swat	Scrub Forest
10	Odigram	Odigram	Swat	Scrub Forest

Additionally, observations were made on Chukar sightings, active and inactive nests, as well as signs of potential risks such as feathers, faeces, footprints and total calls.

To assess threats to the Chukar population in the research area, one hundred questionnaires were completed, ranking identified risks on a scale of 1 to 9. The reconnaissance survey identified population growth, poaching, illegal hunting, habitat damage, recreational hunting, climate change and agriculture as key risks.

Data analysis

Data collected from field surveys and questionnaires were then transferred to an Excel sheet for analysis, including calculations of mean, standard deviation and standard error. The results were presented in tables and graphs to facilitate interpretation and discussion of the findings.

Results

Distribution and abundance of Chukar partridge signs in the study area

A total of 382 Chukar partridge signs (147 sightings, 63 calls, 87 droppings, 45 footprints and 41 feathers) were recorded across 10 sample sites (Table 2). Sheratrf had the most signs (67), followed by Kanju (43), while Baligram exhibited the least activity (22 signs).

Breeding season vocalizations of Chukar in study area

Vocalizations related to breeding activities, commonly referred to as "Chukar calls," were audibly detected within the study area during the temporal span of March to May 2023, as documented in Table 3. Notably, the sites labeled as "sheratrf" and "Kanju" emerged as areas with the highest instances of recorded calls, totaling 78 and 64, respectively. Further analysis revealed a peak in calls during March, which continued into April, suggesting a breeding season within this timeframe. A noteworthy observation was made regarding the temporal intervals between successive calls. During breeding, intervals between calls ranged from 14 to 6 sec. Outside the breeding season, these intervals increased markedly to 50–60 sec, sometimes exceeding 2–3 min.

Clutch characteristics and nesting habits of the Chukar pheasant in the study area

Nesting patterns and site selection: A total of twelve nests were observed within the designated study area, distributed among ten separate sites, as presented in Table 3. The majority of nest sightings occurred predominantly during the month of April. Notably, the first two locations featured nests positioned on inclines, surrounded by abundant vegetation including *D. viscosa*, *Poa annua* (wakha), and *Berberis Iycium* (Karwaray) that bordered the approved pedestrian paths. Additionally, a supplementary nest was found beneath a cluster of *D. viscosa*. The remaining undamaged nests were hidden under rocks in depressions, surrounded by *D. viscosa* and *P. annua* (wakha). The rolling landscape (undulating topography) likely influenced nest placement with a preference for slopes.

Clutch size and hatching success: The average clutch size in the study area was 23 eggs per nest (Table 4). Notably, an average of 20 eggs hatched per nest, resulting in a hatching success rate of 86.96%.

Illegal hunting and habitat degradation: Major threats to the Chukar pheasant

Unlawful hunting and poaching pose the biggest threat to Chukar pheasants as indicated by a mean score of 6.17 out of 9, highlighting its prominent status as a major danger. Locals and outsiders alike hunt them for food, commercial gain or their songs. Habitat degradation (mean score 5.34) is another major concern. Infrastructure development, a growing human population, and recreational hunting further endanger this species within the study area (Fig. 2). Development, a growing human population and recreational hunting further endanger this species within the study area.

Discussion

This study aimed to investigate the reproductive patterns and threats affecting Chukar partridge populations in the scrub forests of Swat, Khyber Pakhtunkhwa, Pakistan. Our findings contribute new insights into the breeding ecology and key threats to this avian species in the region.

Table 2: Detail of signs observed in ten sampling sites in the study area

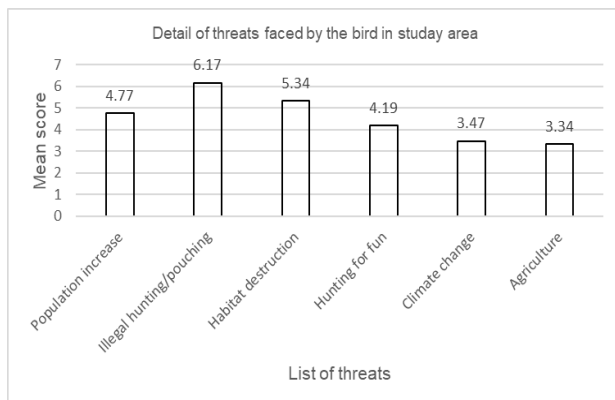
Sites name	Total calls	Field sighting	Feathers	Fecal droppings	Footprints	Total	Percentage
Barikot	6	19	3	10	2	39	10.24
Shahgai	6	10	1	7	2	25	6.63
Akhonbaba	4	13	3	12	6	38	9.81
Saidu sharif	7	13	2	10	6	36	9.50
Kanju	11	17	3	7	5	43	11.16
Sheratrf	13	22	10	14	8	67	17.39
Sir taligram	4	16	6	10	5	40	10.33
Kishwara	5	15	3	5	3	31	8.15
Baligram	3	7	3	5	4	22	5.75
Odigram	7	16	7	9	4	42	11.03
Total	63	147	41	87	45	382	100
Mean $\pm$ SE	6 $\pm$ 1	15 $\pm$ 1	4 $\pm$ 1	3 $\pm$ 1	4 $\pm$ 1		

Table 3: Breeding Calls of the Chukor Partridge recorded at selected sampling sites

Site name	10-Mar	15-Mar	20-Mar	26-Mar	1st April	10 th April	Total calls	%age
barikot	4	4	4	5	8	8	33	8.71
shahgai	6	6	6	3	7	5	33	8.71
akhonbaba	4	3	3	4	6	4	24	6.33
saidu sharif	8	8	8	6	5	4	39	10.29
kanju	12	12	12	10	9	9	64	16.89
sheratrf	14	13	13	7	10	21	78	20.58
sir taligram	1	1	1	8	5	6	22	5.80
kishwara	4	4	4	4	4	9	29	7.65
baligram	1	1	1	6	6	3	18	4.75
odigram	5	5	5	5	7	12	39	10.29
Mean $\pm$	5.9 $\pm$ 1.36	5.7 $\pm$ 1.32	5.7 $\pm$ 1.32	5.8 $\pm$ 0.66	6.7 $\pm$ 0.60	8.1 $\pm$ 1.69	37.9 $\pm$ 6.01	-

Table 4: Clutch size and hatching success of Chukor Partridge at selected sampling sites

Site name	Nest	Clutch size	Eggs hatched	Unhatched eggs	% age
barikot	1	16	13	3	81.25
shahgai	1	22	18	4	81.82
akhonbaba	2	38	31	7	81.58
saidu sharif	1	22	17	5	77.27
kanju	0	18	15	3	83.33
sheratraf	2	40	33	7	82.50
sir taligram	1	25	22	3	88.00
kishwara	2	37	35	2	94.59
baligarm	1	18	15	3	83.33
odigram	1	23	20	3	86.96
Total	12	259	219	40	
Mean $\pm$ SE		25.9 $\pm$ 2.85	21.9 $\pm$ 2.57	4 $\pm$ 0.56	

**Fig. 2:** Detail of various threats faced by the chukar in the study area

In the present study Chukar partridges in Swat formed social groups of 5–7 individuals, similar to the average group size of 5.8 reported by Kukreti and Bisht (2006). These groups preferred open areas with sparse vegetation near cultivated lands, likely due to easier access to food sources. The breeding season for Chukar partridges in Swat occurred between March and June, aligning with the findings of Roberts (1991). During this period, groups aggregated and initiated breeding activities. However, breeding commenced earlier in the lowlands compared to higher altitudes due to harsher weather conditions, including snow cover in the Himalayan regions. Our observations support this trend, with breeding starting in March and peaking in June. A slight discrepancy exists with Mahmood *et al.* (2019), who reported breeding season initiation in January and February. This difference could be attributed to

variations in altitude between the study sites. Our study documented a high hatching success rate (86.96%) with an average clutch size of 23 eggs per nest. These findings are comparable to those reported by Mahmood *et al.* (2019), who observed a hatching success rate ranging from 75 to 85% with clutch sizes between 8 and 20 eggs. The slightly larger clutch size and higher hatching success rate observed in our study could be attributed to several factors, such as potential variations in food availability, predator presence, or microhabitat conditions across the study sites. Further research investigating these factors could provide valuable insights into the breeding ecology of Chukar partridges in different regions.

Present study aligns with previous research by Ullah and Khan (2021) and Mahmood *et al.* (2019) in finding a preference for nesting on slopes. We observed a preference for nesting on slopes, possibly due to the rolling landscape (undulating topography) offering improved camouflage and predator deterrence. Additionally, the surrounding vegetation, including *D. viscosa*, *P. annua* and *B. lycium*, likely provided further concealment and protection for the nests.

Our study identified illegal hunting as the most significant threat to Chukar partridges in Swat, surpassing habitat degradation. This aligns with Khan *et al.* (2022), who highlighted various threats to avian populations, including habitat loss, poaching and human disturbances. The habitat degradation observed in our study likely resulted from factors like deforestation, agricultural practices, and infrastructure development, as reported by Khalid *et al.* (2017) and Ahmad *et al.* (2015). Furthermore, our research identified predation by jackals, foxes, and eagles as significant threats to Chukar partridges. Additionally, our findings confirmed the role of snakes (unidentified) in preying on eggs, supporting previous research (Mahmood *et al.* 2019).

This study revealed that illegal hunting and habitat degradation pose the most significant threats to Chukar partridge populations in Swat's scrub forests. The unsustainable hunting practices by local communities and the pressures exerted by rapid infrastructure development endanger this avian species. While natural predation contributes to population dynamics, human activities pose a far greater threat. These findings emphasize the urgent need for stricter regulations on hunting, coupled with habitat restoration and conservation programs, to ensure the long-term survival of Chukar partridge populations in Swat.

Conclusion

This study sheds light on the breeding ecology of the Chukar partridge in the lower Swat scrub forest, highlighting its successful breeding proclivity during the months of March through June. The study provides empirical data on the reproductive parameters of the species, including clutch dimension, incubation period, and hatching

success rate. However, the Chukar partridge faces several threats, including unlawful hunting and poaching, habitat degradation and the intrusion of infrastructure projects. The study underscores the need for concerted conservation initiatives to mitigate the downward trajectory of the Chukar partridge population and safeguard its ecological persistence.

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Author Contributions

Sultan Muhammad and Kaleem Mahmood: Field survey, Data Collection and Methodology; Adil Jamal and Syed Asfandiar Bacha: Data collection and manuscript writing; Data analysis was performed by Muhammad Tayyab Khan; Faiz Ur Rehman: Reviewing and Editing; Sultan Muhammad supervised the research and approved the manuscript for submission.

Conflicts of Interest

The authors have declared that there is no conflict of interest regarding the publication of this article.

Data Availability

Data will be provided upon request to corresponding author.

Ethics Approval

Ethics approval and permissions for research involving human subjects, animals or cell lines not Applicable.

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