

DISTRIBUTION, POPULATION, HABITAT UTILIZATION, AND
THREATS TO *ALECTORIS CHUKAR* IN DISTRICT KOHATArshad Iqbal¹, Shehzad Zareen^{*2}, Zulaikha Ahmad khan³, Musharraf Khan⁴, Abdul Majid⁵,
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Abstract

The Chukar Partridge (*Alectoris chukar*), the national bird of Pakistan, is an ecologically important galliform species inhabiting rocky and mountainous landscapes. This study investigated the distribution, population status, habitat utilization, and major threats affecting *A. chukar* in District Kohat, Khyber Pakhtunkhwa, Pakistan. Field surveys were conducted from January to May 2024 using line transects, point counts, direct observations, and indirect evidence, including vocalizations, feathers, and fecal droppings. Questionnaire surveys were also conducted to assess habitat preferences and perceived threats. A total of 246 individuals were recorded across four study zones, with the highest abundance observed in Zone D (44.5%), followed by Zones B (30.2%), C (20.8%), and A (4.9%). The species showed a strong preference for rocky habitats with dense shrubby vegetation, while urbanized and highly disturbed areas supported significantly lower populations. Habitat destruction (87.9%), illegal hunting (75.8%), increasing human population (69.7%), and bird capturing (48.5%) were identified as the principal threats to the species, whereas natural predation by jackals and foxes had comparatively lower impacts. The findings demonstrate that habitat quality is the primary factor influencing the distribution and abundance of *A. chukar* in District Kohat. Effective conservation measures, including habitat protection and restoration, enforcement of wildlife protection laws, regulation of illegal hunting, and community-based conservation initiatives, are essential to ensure the long-term survival of this ecologically and culturally significant species.

1. INTRODUCTION

The Chukar Partridge (*Alectoris chukar*) is a medium-sized galliform bird belonging to the family Phasianidae. It is one of the most widely distributed partridge species in Asia and is well adapted to arid, semi-arid, and mountainous

environments. Owing to its remarkable ecological adaptability, the species inhabits a wide range of habitats, including rocky hillsides, grasslands, scrublands, open woodlands, and agricultural landscapes (Arugh & Hamed, 2019). Its ability to survive under harsh environmental conditions

and exploit diverse food resources has enabled it to establish stable populations across much of its native range.

The natural distribution of *A. chukar* extends from southeastern Europe and the Middle East through Central and South Asia, including Turkey, Palestine, Lebanon, Iran, Iraq, Afghanistan, Pakistan, India, and Nepal (BirdLife International, 2016). The species occupies predominantly mountainous regions and is commonly recorded at elevations ranging from 1,000 to 4,500 m above sea level, although it may descend to lower altitudes during winter or in response to environmental conditions (Rasmussen & Anderton, 2005). Because of its adaptability and economic value, the Chukar has also been successfully introduced into several countries outside its native range, including the United States, Canada, New Zealand, and parts of Europe, where self-sustaining populations have become established.

In Pakistan, the Chukar Partridge holds exceptional cultural and ecological significance as the national bird. It is widely distributed throughout the mountainous and sub-mountainous regions of Khyber Pakhtunkhwa, Gilgit-Baltistan, Azad Jammu and Kashmir, Balochistan, northern Punjab, Sindh, and the Margalla Hills (Rasmussen & Anderton, 2005). Locally, it is commonly known as "Chakor," while in several parts of Khyber Pakhtunkhwa it is referred to as "Zark" for the male and "Zarka" for the female (Pavel *et al.*, 2023). The species occupies rocky slopes interspersed with shrubs and grasses, where suitable nesting sites, food resources, and escape cover are readily available. Its broad distribution and ecological tolerance make it one of the most recognizable game birds in Pakistan.

Taxonomically, the genus *Alectoris* comprises seven recognized species of red-legged partridges distributed across Europe, North Africa, the Middle East, and Asia. Among these, *Alectoris chukar* exhibits the widest geographic distribution and includes several geographically distinct subspecies adapted to different ecological conditions (Mandiwana *et al.*, 2014). Although taxonomic relationships within the genus have

been debated due to hybridization and overlapping morphological characteristics, molecular and morphological evidence consistently recognizes *A. chukar* as a distinct species occupying much of western and central Asia (Shivambu *et al.*, 2020).

The feeding ecology of *A. chukar* reflects its opportunistic foraging strategy. Adult birds consume a wide variety of plant materials, including seeds, grains, grasses, leaves, buds, shoots, and fruits, while animal matter constitutes a relatively small proportion of their diet. In contrast, chicks rely heavily on insects and other invertebrates during early development because of their high protein requirements for rapid growth (Sulaiman *et al.*, 2020). Seasonal fluctuations in food availability influence habitat selection, daily movement patterns, and reproductive performance. Water availability also plays an essential role in determining local distribution, particularly during the hot summer months when birds frequently concentrate around springs, streams, and other permanent water sources (Robinson *et al.*, 2009).

Habitat selection is one of the most important ecological factors affecting the distribution and abundance of Chukar populations. The species generally prefers open, dry, rocky slopes with scattered shrubs and grasses that provide nesting cover while allowing unobstructed visibility for predator detection. Dense forests and heavily vegetated habitats are usually avoided because they restrict movement and reduce visibility (Huang *et al.*, 2005). In Pakistan, Chukar populations are commonly found between 1,000 and 4,500 m above sea level, although seasonal altitudinal migrations occur in response to snowfall, vegetation growth, and water availability (Rasmussen & Anderton, 2005). During winter, birds often descend to lower elevations where food resources are more accessible, returning to higher altitudes with the onset of spring.

Despite its wide distribution, the Chukar Partridge faces numerous threats throughout its range. Habitat degradation resulting from deforestation, agricultural expansion, infrastructure development, overgrazing, mining

activities, and increasing human settlement has substantially reduced suitable habitats in many regions (Khalid *et al.*, 2017). Unsustainable hunting pressure, particularly during the breeding season, further contributes to local population declines (Bhattacharya *et al.*, 2009). In addition, excessive livestock grazing alters vegetation structure, reduces nesting cover, and increases vulnerability to predators, ultimately affecting breeding success and population density (Blaum *et al.*, 2007; Chambers *et al.*, 2007; Lindbloom, 2003). The widespread use of pesticides and herbicides, habitat fragmentation, recurrent wildfires, and climatic variability also pose significant conservation challenges (Gaudioso *et al.*, 2002; Powell, 2008). Hybridization with closely related *Alectoris* species in some parts of the world has emerged as an additional concern for maintaining the genetic integrity of natural populations (Panayides *et al.*, 2014).

Pakistan encompasses exceptional ecological diversity, extending from coastal ecosystems along the Arabian Sea to the high mountain ranges of the Himalayas, Karakoram, and Hindu Kush. The country supports numerous protected areas, including national parks, wildlife sanctuaries, and game reserves, which provide important habitats for diverse avian fauna (Khan *et al.*, 2010). Nevertheless, increasing anthropogenic pressures continue to threaten wildlife populations across many regions, highlighting the need for comprehensive ecological studies that generate scientific information for evidence-based conservation planning (Altaf *et al.*, 2014).

District Kohat, situated in southern Khyber Pakhtunkhwa, comprises a mosaic of rocky hills, scrub vegetation, rangelands, and agricultural fields that provide favourable habitat for the

Chukar Partridge. However, information regarding its current distribution, population status, habitat utilization, and associated threats within the district remains limited. Most previous studies have focused on broader geographic regions, leaving significant knowledge gaps at the local scale. Reliable baseline data are essential for understanding population dynamics, evaluating habitat quality, identifying conservation priorities, and developing effective wildlife management strategies.

Therefore, the present study was undertaken to investigate the distribution, population status, habitat utilization, and major threats affecting *Alectoris chukar* in District Kohat, Khyber Pakhtunkhwa. The findings are expected to provide valuable scientific information that will contribute to the conservation and sustainable management of the species while supporting future ecological research and wildlife conservation initiatives in Pakistan.

2. MATERIALS AND METHODS

2.1 Study Area

The present study was conducted in District Kohat, Khyber Pakhtunkhwa, Pakistan, to investigate the distribution, population status, habitat utilization, and potential threats affecting the Chukar Partridge (*Alectoris chukar*). District Kohat is situated at approximately 33°35'13" N latitude and 71°26'29" E longitude, covering an area of approximately 2,973 km² with an average elevation of 489 m above sea level. According to the 1998 national census, the district had a population of 562,640, which has subsequently increased to an estimated 782,070 inhabitants, with nearly 80% residing in rural areas (WHO, 2014).

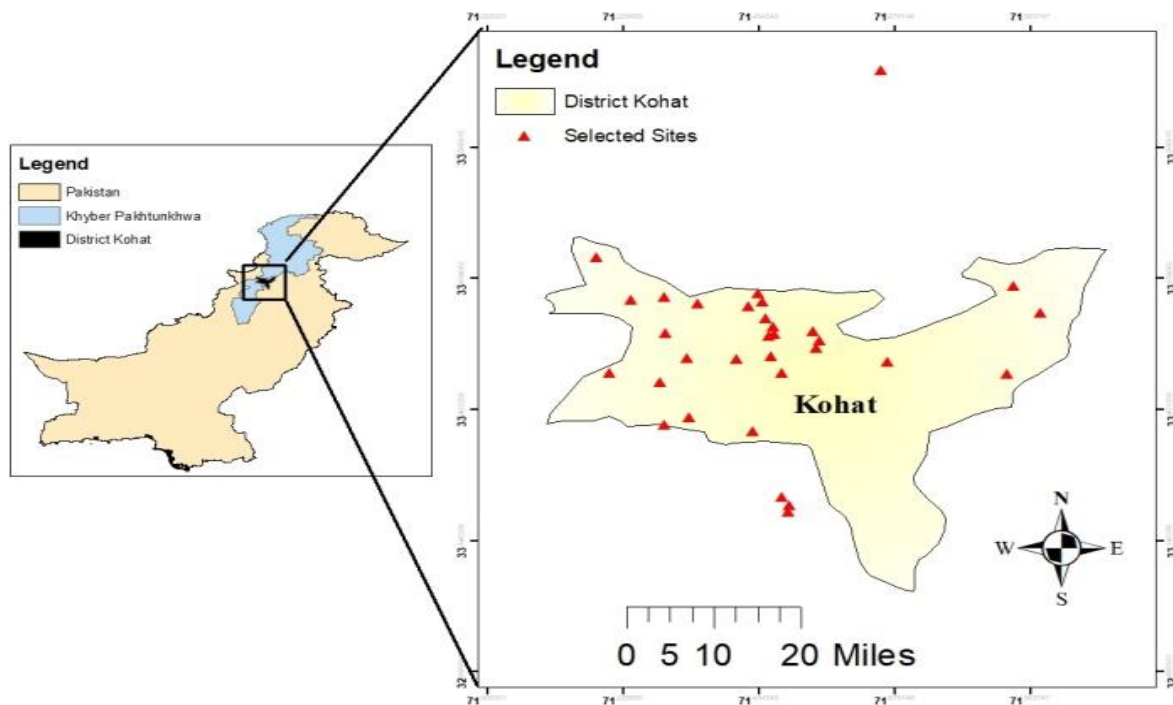


Figure 1: Map of Kohat, Pakistan showing site of the study area

The study area is characterized by rugged mountains, rocky hills, scrub vegetation, and agricultural land that provide suitable habitat for *A. chukar*. The climate is predominantly semi-arid, with extremely hot summers and cold winters. The district receives an average annual rainfall of approximately 400 mm. Kohat shares its boundaries with District Karak to the south, District Nowshera to the northeast, District Hangu and District Orakzai to the northwest, and Punjab Province to the southeast (WHO, 2014).

2.2 Study Duration

Field investigations were conducted over a period of five months, from January to May 2024. Surveys were carried out at regular fortnightly intervals to document seasonal variations in the distribution, abundance, habitat utilization, and ecological characteristics of *Alectoris chukar*.

2.3 Materials and Equipment

Field data were collected using standard wildlife survey equipment. The materials included binoculars (8 × 40 and 7 × 50), a spotting scope

mounted on a tripod, a digital camera, a Global Positioning System (GPS) receiver, a digital watch, field notebooks, pencils, pens, drawing sheets, field bags, measuring sticks, Google Maps for navigation, and drinking water for field personnel. These instruments facilitated accurate observation, identification, recording, and documentation of the target species and its habitat throughout the study period.

2.4 Study Design

Four representative study sites were selected within District Kohat based on the known distribution of *Alectoris chukar* and the availability of suitable habitat. Each study site was divided into four sampling zones, designated as Zones A, B, C, and D. Surveys were conducted every two weeks using standardized wildlife sampling techniques described by Bibby *et al.* (1992).

Both line transect and point count methods were employed to estimate population abundance and evaluate habitat utilization. At each study site, three to four line transects and three to four point count stations were established. Each transect

measured approximately 1,000 m in length with an effective survey width of 200 m (100 m on either side of the transect line). Point count stations were established at intervals of approximately 1,000 m, with each observation point covering a radius of 100 m.

The primary objectives of the survey were to estimate the population density and distribution of *Alectoris chukar*, assess habitat utilization, and identify ecological factors influencing the occurrence of the species within the study area.

2.5 Survey Methods

Field surveys were conducted during periods of maximum bird activity to increase detection probability. Observations were carried out twice daily, during the early morning (07:00–11:00 h)

and late afternoon to evening (16:00–19:00 h), under favourable weather conditions. Surveys were postponed during heavy rainfall, dense fog, or other adverse weather conditions that could reduce visibility and influence bird activity.

Data collection was based on both direct and indirect survey techniques following the methodology described by Ahmad *et al.* (2015).

2.5.1 Direct Survey Method

Direct observations involved systematic visual surveys along established transects and at fixed point count stations. Individuals of *Alectoris chukar* were detected using binoculars and a spotting scope, allowing identification without disturbing the birds. Whenever possible, digital photographs were taken to verify field observations.



Figure 2: field observation of *Alectoris chukar*

For each sighting, detailed field records were maintained, including the date and time of observation, geographic coordinates (latitude and longitude), elevation, habitat type, number of

individuals observed, observer identity, and behavioural activities such as feeding, resting, calling, or movement. GPS was used to record

precise locations, while Google Maps assisted in navigation and mapping of survey routes.

2.5.2 Indirect Survey Method

Indirect evidence was used to confirm the presence of *Alectoris chukar* in areas where direct sightings were limited. Evidence included feathers, footprints, droppings (fecal pellets), and characteristic vocalizations. Fresh signs were carefully examined and recorded to determine species occurrence and habitat use. Playback of previously recorded Chukar calls was occasionally employed to increase detection probability by eliciting vocal responses from nearby individuals.

2.6 Population Estimation

Population estimates were obtained using a combination of visual encounters and auditory detections. During transect walks and point counts, all individuals observed or heard within the predetermined survey area were recorded. Double counting was minimized by carefully monitoring bird movements and maintaining sufficient spacing between observation points. Visual Encounter Technique (VET) was adopted for direct observations, using binoculars to scan suitable habitats. Birds located at longer distances were observed through a spotting scope and photographed whenever possible. Population density was estimated by combining visual observations with vocal responses recorded during surveys.

2.7 Habitat Utilization Assessment

Habitat utilization was assessed by recording the occurrence of *Alectoris chukar* within different habitat types encountered during the study. Habitat characteristics including vegetation type, slope, elevation, availability of water, rocky substrate, shrub cover, and agricultural land were documented at each observation site.

The frequency of bird observations in different habitat categories was used to determine habitat preference. Comparative analyses were subsequently performed to evaluate differences in habitat utilization among sampling sites.

2.8 Ecological Parameters

Several ecological variables were recorded throughout the study to evaluate their influence on the distribution and habitat preference of *Alectoris chukar*. These variables included elevation, geographic coordinates, ambient temperature, rainfall, vegetation composition, water availability, and dominant plant species.

In addition, evidence of predation, grazing intensity, anthropogenic disturbances, and habitat degradation was documented during each survey. Information obtained from field observations was supplemented with interviews conducted with local residents, hunters, and shepherds to identify major ecological pressures affecting Chukar populations within the study area.

2.9 Identification of *Alectoris chukar*

Species identification was based on standard field guides and diagnostic morphological characteristics described by Grimmett *et al.* (2016). Individuals were identified by their distinctive grey plumage, white throat bordered by a prominent black gorget, black facial markings extending across the eyes and neck, rufous flanks with black barring, and bright red beak and legs.

Both visual characteristics and vocalizations were used to confirm species identity. Observations were made using binoculars and a spotting scope mounted on a tripod to ensure accurate identification, particularly for individuals observed at greater distances.

2.10 Statistical Analysis

All field data were compiled and entered into Microsoft Excel before being analyzed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics were used to summarize population distribution, habitat utilization, and ecological variables.

One-way Analysis of Variance (ANOVA) was employed to determine significant differences among study sites and habitat variables. Independent sample *t*-tests were performed to compare habitat utilization between selected habitat categories. Statistical significance was determined at a probability level of $P < 0.05$.

CHAPTER 3

RESULTS

The present study was conducted over a period of five months to investigate the distribution, habitat utilization, and major threats affecting *Alectoris chukar* in the study area. Data were collected through direct field observations and questionnaire surveys from different sampling sites distributed among four study zones (A, B, C,

and D). Evidence of the species was recorded through direct sightings, vocal calls, feathers, and fecal droppings. The collected data were analyzed using descriptive statistics, including frequencies, percentages, and totals, to evaluate the distribution pattern, habitat preference, and perceived threats to the species. The results are presented below in the form of tables and supported by scientific interpretations.

3.1 Distribution of *Alectoris chukar*Table 3.1. Zone-wise distribution of *Alectoris chukar* recorded during the study period.

Zone	Number of Individuals	Percentage (%)
A	12	4.9
B	74	30.2
C	51	20.8
D	109	44.5
Total	246	100

The survey recorded a total of 246 individuals of *Alectoris chukar* across the four study zones. Zone D supported the highest number of individuals (109; 44.5%), followed by Zone B (74; 30.2%) and Zone C (51; 20.8%). Zone A exhibited the lowest population, with only 12 individuals (4.9%). The mean number of individuals recorded per zone was 61.5 ± 40.0 (SD). The observed variation among zones indicates an uneven distribution of

the species, suggesting that habitat quality and environmental conditions differed considerably across the study area. The comparatively larger population in Zone D indicates the presence of more suitable habitat conditions for *A. chukar*, whereas the lower abundance in Zone A may reflect habitat degradation, increased disturbance, or limited availability of preferred resources.

3.2 Population Distribution of *Alectoris chukar* in Zone ATable 3.2. Distribution of field evidence of *Alectoris chukar* in Zone A.

Site	Calls	Field Sightings	Feathers	Fecal Droppings	Total Signs
Urban-I	5	3	11	9	28
Urban-II	0	0	0	0	0
Urban-III	0	0	0	0	0
Urban-IV	3	5	8	2	18
Urban-V	0	0	0	0	0
Urban-VI	0	0	0	0	0
Sher Kot	0	0	0	0	0
Alizai	8	4	1	5	18
Total	16	12	20	16	64

A total of 64 field signs of *Alectoris chukar* were recorded in Zone A. Feathers constituted the most frequently recorded evidence (20; 31.3%), followed by calls (16; 25.0%), fecal droppings (16;

25.0%), and direct field sightings (12; 18.8%). Urban-I showed the highest number of total signs (28; 43.8%), followed by Urban-IV and Alizai, each with 18 signs (28.1%). No evidence of the

species was observed in Urban-II, Urban-III, Urban-V, Urban-VI, or Sher Kot. These findings indicate that *A. chukar* was restricted to selected

localities within Zone A, with its occurrence likely associated with favorable habitat conditions and lower levels of anthropogenic disturbance.

3.3 Population Distribution of *Alectoris chukar* in Zone B

Table 3.3. Distribution of field evidence of *Alectoris chukar* in Zone B.

Site	Calls	Field Sightings	Feathers	Fecal Droppings	Total Signs
Nusrat Khel	2	3	5	11	21
Shah Pur	14	11	9	3	37
Sur Gul	9	14	18	12	53
Summari	3	8	16	21	49
Jarma	2	6	3	2	13
Bahadar Kot	0	2	1	0	3
Togh-I	1	4	1	0	6
Kharmato	22	13	21	28	85
Dhoda	5	8	4	3	20
Usterzai	2	5	3	1	11
Total	60	74	81	81	296

Zone B yielded a total of 296 field signs. The highest number of observations was recorded at Kharmato (85 signs; 28.7%), followed by Sur Gul (53; 17.9%) and Summari (49; 16.6%). Bahadar Kot exhibited the fewest signs (3; 1.0%). Overall, feathers and fecal droppings were the dominant forms of evidence (81 observations each; 27.4%),

followed by field sightings (74; 25.0%) and calls (60; 20.3%). The wide variation in the number of observations among sampling sites suggests that habitat suitability within Zone B was heterogeneous, with Kharmato representing the most favorable habitat for *A. chukar*.

3.4 Population Distribution of *Alectoris chukar* in Zone C

Table 3.4. Distribution of field evidence of *Alectoris chukar* in Zone C.

Site	Calls	Field Sightings	Feathers	Fecal Droppings	Total Signs
Togh-II	4	13	7	2	26
Billitang	6	9	3	4	22
Gumbat	2	2	0	0	4
Ziarat Sheikh Allahdad	5	10	3	0	18
Chor Lakki	2	2	0	0	4
Khushal Garh	7	15	9	3	34
Total	26	51	22	9	108

A total of 108 field signs were recorded in Zone C. Khushal Garh showed the greatest abundance with 34 observations (31.5%), followed by Togh-II (26; 24.1%) and Billitang (22; 20.4%). Gumbat and Chor Lakki recorded only 4 signs (3.7%) each. Field sightings represented the most common evidence (51; 47.2%), followed by calls (26;

24.1%), feathers (22; 20.4%), and fecal droppings (9; 8.3%). These results indicate that *A. chukar* was more frequently detected through direct observation in Zone C, suggesting relatively open habitats and favorable visibility during surveys.

3.5 Population Distribution of *Alectoris chukar* in Zone D

Table 3.5. Distribution of field evidence of *Alectoris chukar* in Zone D.

Site	Calls	Field Sightings	Feathers	Fecal Droppings	Total Signs
Lachi Urban	0	0	0	0	0
Lachi Rural	14	21	11	7	53
Mandoori	8	19	6	1	34
Sudal	6	14	10	7	37
Shakardara Urban	0	0	0	0	0
Shakardara Rural-I	26	31	19	13	89
Shakardara Rural-II	19	24	8	5	56
Total	73	109	54	33	269

Zone D produced the highest number of field observations, with 269 total signs recorded. Shakardara Rural-I was the most productive site, accounting for 89 signs (33.1%), followed by Shakardara Rural-II (56; 20.8%) and Lachi Rural (53; 19.7%). No evidence of *A. chukar* was

recorded from the urban localities of Lachi and Shakardara. Field sightings were the most frequent observations (109; 40.5%), followed by calls (73; 27.1%), feathers (54; 20.1%), and fecal droppings (33; 12.3%). These findings indicate that rural mountainous habitats provide more suitable environmental conditions than urbanized areas.

3.6 Habitat Utilization

Table 3.6. Habitat preference of *Alectoris chukar* based on respondents' opinions (n = 33).

Habitat Type	Number of Respondents	Percentage (%)
Rocky and shrubby vegetation	25	75.8
Rocky and herbaceous vegetation	10	30.3
Barren hills	5	15.2

The questionnaire survey included 33 respondents to assess habitat preferences of *Alectoris chukar*. The majority of respondents (75.8%) identified rocky areas with shrubby vegetation as the preferred habitat. Rocky habitats dominated by herbaceous vegetation were selected by 30.3% of respondents, whereas barren hills were identified

by only 15.2%. Because respondents could identify more than one habitat type, the percentages exceed 100%. Overall, the findings suggest that *A. chukar* shows a strong preference for rocky habitats containing dense shrub cover, which likely provide shelter, nesting sites, and protection from predators.

3.7 Threats to *Alectoris chukar*

Table 3.7. Major threats affecting *Alectoris chukar* according to respondents (n = 33).

Threat	Number of Respondents	Percentage (%)
Illegal hunting	25	75.8
Capturing	16	48.5
Habitat destruction	29	87.9
Jackal predation	10	30.3
Fox predation	7	21.2
Human population increase	23	69.7

The questionnaire survey revealed that habitat destruction was perceived as the most serious threat to *Alectoris chukar*, being identified by 87.9% of respondents. Illegal hunting ranked second (75.8%), followed by increasing human population (69.7%) and capturing of birds (48.5%). Natural predation by jackals (30.3%) and foxes (21.2%) was considered comparatively less important. These findings indicate that anthropogenic pressures constitute the principal factors affecting the distribution and survival of *A. chukar* in the study area. Habitat degradation and unsustainable hunting practices appear to exert greater influence on population decline than natural predators, emphasizing the need for habitat conservation, public awareness, and effective enforcement of wildlife protection regulations.

DISCUSSION

The present study investigated the population distribution, habitat utilization, and major threats affecting *Alectoris chukar* in District Kohat, Khyber Pakhtunkhwa, Pakistan. Data collected over a five-month period through direct field observations and questionnaire surveys provided valuable information regarding the ecological status and conservation challenges of this species. The combined use of visual encounter surveys, vocal call records, feathers, fecal droppings, and information obtained from local communities enhanced the reliability of the findings and provided a comprehensive understanding of the ecology of *A. chukar*. Similar integrated approaches have been recommended for galliform birds because they improve the accuracy of population assessment and habitat evaluation (Kafley, 2008; Mahmood *et al.*, 2019).

The results demonstrated that *Alectoris chukar* was unevenly distributed throughout the study area. A total of 246 individuals were recorded from four study zones, with Zone D supporting the highest population (109 individuals), followed by Zone B (74 individuals), Zone C (51 individuals), and Zone A (12 individuals). The higher abundance observed in Zone D indicates that this area provides comparatively favorable ecological

conditions, including extensive rocky terrain, shrub-dominated vegetation, reduced anthropogenic disturbance, and suitable nesting and foraging habitats. In contrast, the lower abundance recorded in Zone A is likely associated with habitat fragmentation, urban expansion, and increased human activities. These findings agree with Roberts (1991), who reported that *A. chukar* is primarily associated with rugged mountainous landscapes throughout Pakistan, particularly in Khyber Pakhtunkhwa, Balochistan, the Salt Range, and the western Himalayan foothills. Likewise, Rasmussen and Anderton (2005) reported that the species prefers rocky mountain slopes between 600 and 4,000 m elevation, where suitable shelter and food resources are available.

The considerable variation in population abundance among study zones demonstrates the strong influence of habitat quality on the distribution of *A. chukar*. Previous studies have shown that chukar partridges are closely associated with rocky slopes, sparse shrub vegetation, and dry mountainous environments that provide suitable nesting sites, escape cover, and abundant food resources (BirdLife International, 2016; Afrasiab *et al.*, 2013). The present findings support these observations, as the highest populations were consistently recorded in rural mountainous habitats, whereas urbanized localities showed either very low abundance or complete absence of the species. Such habitat preferences may reflect the species' adaptation to dry, rugged ecosystems where natural vegetation offers protection against predators and human disturbance.

Site-specific observations also revealed marked differences in the abundance of field signs. Localities such as Kharmato in Zone B and Shakardara Rural-I in Zone D exhibited the highest numbers of calls, direct sightings, feathers, and fecal droppings, whereas Urban-II, Urban-III, Urban-V, Urban-VI, Lachi Urban, and Shakardara Urban showed little or no evidence of the species. These observations suggest that *A. chukar* avoids heavily disturbed urban habitats and remains dependent on relatively undisturbed rocky landscapes with natural shrub vegetation. Similar habitat associations have been documented by

Grimmett *et al.* (2008), who reported that increasing human disturbance has resulted in the decline of chukar populations in several regions of Pakistan.

The present study demonstrated that direct field sightings, supported by indirect evidence such as feathers and fecal droppings, provide reliable indicators for assessing the occurrence of *A. chukar*. The use of multiple field indicators reduced the possibility of underestimating population size and improved the overall reliability of the survey. Visual Encounter Techniques (VET), together with indirect evidence, have been widely used for monitoring galliform birds because they provide accurate estimates of species presence while minimizing disturbance to wildlife (Mahmood *et al.*, 2019). Furthermore, the inclusion of questionnaire surveys allowed incorporation of local ecological knowledge, thereby improving the understanding of seasonal occurrence, habitat use, and conservation threats.

Habitat utilization recorded during the present study indicates that *A. chukar* strongly prefers rocky habitats dominated by shrubby vegetation. Approximately three-quarters of the respondents identified rocky shrublands as the most suitable habitat, whereas fewer respondents selected rocky herbaceous areas or barren hills. These findings are consistent with those reported by Afrasiab *et al.* (2013), who observed that *A. chukar* is predominantly associated with high mountain valleys and rocky slopes supporting scattered shrubs. Similarly, Roberts (1991) described rocky hillsides with shrub vegetation as the preferred breeding and foraging habitat of the species throughout Pakistan. Shrub-dominated habitats provide nesting sites, protective cover, shade during high temperatures, and abundant seeds and invertebrates that constitute major components of the species' diet (Scheid, 1986; Kukreti *et al.*, 2013).

Although the species showed a clear preference for rocky shrublands, the present study also indicates considerable ecological adaptability. *Alectoris chukar* was observed utilizing herbaceous slopes and sparsely vegetated rocky hills where food

resources and shelter remained available. Such habitat flexibility has also been reported by BirdLife International (2016), which described the species as occupying a wide variety of dry mountainous habitats across its geographical range. This ecological adaptability likely contributes to the species' broad distribution throughout western and southern Asia. However, continuous habitat degradation may eventually reduce the availability of suitable breeding and feeding areas, thereby limiting its long-term persistence.

The questionnaire survey identified habitat destruction as the most significant threat affecting *A. chukar* populations in District Kohat. Respondents indicated that agricultural expansion, road construction, quarrying, deforestation, infrastructure development, and increasing human settlements have resulted in fragmentation and degradation of natural habitats. Habitat destruction reduces vegetation cover, nesting opportunities, and food availability while simultaneously increasing human disturbance. These findings are in agreement with Roth (2003), who identified habitat destruction and fragmentation as two of the greatest threats to global biodiversity. Similarly, Ahmad *et al.* (2015) reported that habitat degradation and range fires significantly reduce suitable habitats for chukar populations, while BirdLife International (2016) recognized habitat alteration as one of the major conservation concerns throughout the species' native range.

Illegal hunting was identified as the second most important threat affecting *A. chukar*. Respondents reported that hunting pressure is particularly intense during winter and recreational hunting seasons, leading to direct reductions in breeding populations. Similar observations were reported by Grimmett *et al.* (2008), who concluded that uncontrolled hunting has contributed substantially to the decline of *A. chukar* populations in Khyber Pakhtunkhwa. Hunting pressure not only removes reproductive adults from the population but also disrupts breeding behavior and reduces recruitment of juveniles into the breeding population. Mateo-Tomás and Olea

(2010) similarly emphasized that hunting pressure can alter ecosystem functioning and negatively influence wildlife population dynamics when not properly regulated.

The increase in human population was also identified as an important conservation challenge. Expansion of settlements, cultivation, and transportation networks has progressively reduced natural habitats while increasing disturbance levels throughout the study area. Similar observations have been reported by Asatrian *et al.* (2014), who suggested that human-induced habitat modification and land-use changes are among the principal drivers of biodiversity loss in mountain ecosystems. Consequently, continued urbanization may further reduce habitat suitability for *A. chukar* if appropriate conservation measures are not implemented.

Predation by jackals and foxes was recognized by respondents as an additional factor influencing *A. chukar* populations. Although predation forms a natural component of ecosystem functioning, excessive habitat fragmentation may expose nesting birds and chicks to increased predation risk by reducing protective vegetation cover. Larsen *et al.* (2007) reported that a variety of mammalian and avian predators, including foxes, wildcats, raptors, and hunting dogs, prey upon chukar partridges, particularly during the breeding season when eggs and chicks are highly vulnerable. However, both the present study and previous investigations suggest that natural predation generally exerts less influence on population decline than anthropogenic factors such as habitat destruction and illegal hunting.

Environmental conditions also appear to play an important role in determining the distribution of *A. chukar* within District Kohat. Variations in altitude, topography, vegetation structure, and climatic conditions create differences in habitat suitability across the study area. Rocky mountain slopes containing scattered shrubs consistently supported larger populations than cultivated valleys or urbanized landscapes. Similar habitat preferences have been documented throughout the species' geographical range, where mountainous environments provide favorable

microclimatic conditions, nesting sites, and reliable food resources (Roberts, 1991; Rasmussen & Anderton, 2005; BirdLife International, 2016). The ecological importance of *Alectoris chukar* extends beyond its value as a game bird. The species contributes to ecosystem functioning through seed dispersal, regulation of insect populations, and serving as prey for higher trophic-level predators. Christensen (1996) also emphasized its economic importance as a game species, whereas Scheid (1986) highlighted its ecological role in grassland and mountainous ecosystems. Conserving *A. chukar* therefore contributes not only to maintaining regional biodiversity but also to preserving ecological processes within mountain ecosystems.

The findings of the present study provide valuable baseline information regarding the ecology and conservation status of *Alectoris chukar* in District Kohat. The results demonstrate that habitat quality is the principal factor determining species distribution, while anthropogenic pressures, particularly habitat destruction, illegal hunting, and increasing human activities, represent the greatest threats to its long-term survival. These findings are consistent with previous studies conducted in Pakistan and other parts of the species' distribution range (Roberts, 1991; Grimmett *et al.*, 2008; BirdLife International, 2016). Consequently, conservation efforts should focus on protecting rocky shrubland habitats, strengthening enforcement of wildlife protection laws, reducing illegal hunting, restoring degraded habitats, and promoting community-based conservation programs. Such measures will contribute significantly to the long-term conservation of *Alectoris chukar* and the maintenance of biodiversity within the mountainous ecosystems of Khyber Pakhtunkhwa.

CONCLUSION

The present study provides valuable baseline information on the population distribution, habitat utilization, and major threats affecting *Alectoris chukar* in District Kohat, Khyber Pakhtunkhwa, Pakistan. Field surveys and questionnaire data demonstrated that the species

is widely distributed within the study area; however, its abundance varies considerably among different zones according to habitat quality and the level of human disturbance.

The results indicate that *A. chukar* shows a strong preference for rocky habitats with shrubby vegetation, which provide suitable nesting sites, food resources, and protection from predators. Higher populations were recorded in rural and mountainous localities, whereas urbanized areas supported comparatively fewer individuals, highlighting the importance of natural habitat characteristics in determining the distribution of the species.

The study further revealed that anthropogenic activities represent the major threats to *A. chukar* populations in the study area. Habitat destruction resulting from agricultural expansion, infrastructure development, deforestation, and increasing human population pressure was identified as the most significant conservation concern. Illegal hunting and capturing of birds were also recognized as important factors contributing to population decline. Although natural predators such as foxes and jackals were reported to affect the species, their impact was considered less significant than human-induced threats. Local respondents also identified snakes as potential nest predators because they prey on eggs and chicks.

Despite these conservation challenges, *A. chukar* continues to persist in suitable habitats within District Kohat, indicating a degree of ecological adaptability. Nevertheless, continued habitat degradation and unsustainable hunting practices may adversely affect the long-term viability of local populations if appropriate conservation measures are not implemented.

The findings of this study emphasize the need for habitat protection, restoration of degraded landscapes, effective enforcement of wildlife protection laws, and increased public awareness to ensure the long-term conservation of *Alectoris chukar*. Furthermore, the present study establishes an important baseline for future ecological monitoring and provides scientific information that can assist wildlife managers and policymakers

in developing effective conservation strategies for the species in Khyber Pakhtunkhwa.

RECOMMENDATIONS

Based on the findings of the present study, several recommendations are proposed to ensure the long-term conservation and sustainable management of *Alectoris chukar* in District Kohat, Khyber Pakhtunkhwa. Since the species showed a strong preference for rocky habitats with dense shrubby vegetation, these habitats should be protected from deforestation, habitat fragmentation, quarrying, and unplanned infrastructure development. Conservation and restoration of natural habitats are essential for maintaining suitable breeding, nesting, and foraging sites, thereby supporting healthy populations of *A. chukar*.

The study identified habitat destruction and illegal hunting as the major threats affecting *Alectoris chukar* populations in the study area. Therefore, strict implementation of wildlife protection laws is necessary to control illegal hunting, trapping, and other activities that threaten the species. Regular patrolling and monitoring by the Khyber Pakhtunkhwa Wildlife Department should be strengthened, particularly during the breeding and hunting seasons, to reduce human-induced mortality and protect breeding populations.

Habitat restoration programs should be initiated in degraded areas through afforestation and reforestation using native tree and shrub species. Restoration of natural vegetation will improve habitat quality by increasing food availability, nesting sites, and protective cover for *Alectoris chukar*. Sustainable land-use planning should also be encouraged to minimize habitat fragmentation caused by agricultural expansion, road construction, and other developmental activities. Environmental impact assessments should be conducted before implementing major development projects in ecologically sensitive areas to reduce adverse effects on wildlife habitats. Community participation is essential for the successful conservation of *Alectoris chukar*. Public awareness campaigns should be organized to educate local communities about the ecological,

economic, and conservation importance of the species. Active involvement of local residents in conservation programs will help reduce illegal hunting, discourage habitat destruction, and promote the sustainable use of natural resources. Community-based conservation initiatives can also strengthen cooperation between local people and wildlife management authorities.

Regular ecological monitoring should be undertaken to evaluate changes in the population status, distribution, breeding success, and habitat quality of *Alectoris chukar*. Long-term monitoring programs will provide valuable information for assessing the effectiveness of conservation measures and identifying emerging threats to the species. Future research should also focus on the breeding biology, seasonal movements, feeding ecology, genetic diversity, and disease status of *Alectoris chukar* to improve the scientific understanding of the species and support evidence-based conservation planning.

The present study demonstrated that District Kohat supports an important population of *Alectoris chukar*, with Zone D representing the most suitable habitat among the four study zones. However, continued habitat degradation and increasing anthropogenic pressures may threaten the long-term survival of the species if appropriate conservation measures are not implemented. Therefore, coordinated efforts involving government agencies, wildlife managers, researchers, conservation organizations, and local communities are essential to protect natural habitats, reduce human-induced threats, and ensure the sustainable conservation of *Alectoris chukar* in District Kohat and other suitable habitats of Khyber Pakhtunkhwa.

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