

Population density, habitat preference, and breeding biology of Chukar Partridge (*Alectoris chukar*) in Malakand division, Khyber Pakhtunkhwa, Pakistan

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Abstract The field biology of Chukar Partridge (*Alectoris chukar*) was studied in Malakand division, which is an important range of its distribution in Pakistan. The abundance of the species at different altitudes was studied using both transect trails of various lengths and point counts at certain spots. The average monthly population density was estimated to be 1.448 ± 0.466 birds/ha. The population density in August, September, and October 2020 was significantly ($P < 0.05$) higher, as compared to the rest of the months. Chukar Partridge sightings were the lowest in December, with $\text{mean} \pm \text{SD} = 0.996 \pm 0.147$ birds/ha and the highest in October 2.333 ± 0.202 birds/hae in all the study sites. At each study site, maximum activity habitats were marked and selected for breeding ecology study. Data was collected on breeding time, nest site selection, nest size, incubation period, and hatching success. The breeding season in this species starts in February, with the peak months being March and April, when calls are frequently heard. The frequency of calls varied from 0.15 to 0.3 per minute. Throughout the breeding season, twelve nests were observed using binoculars and camera traps from a distance to avoid disturbance, wherever possible and without disrupting the species. Nesting sites were mostly on slopes under the eaves of *Dodonea viscosa*, *Calotropis procera* and *Zizyphus oxyphylla*. Dry leaves of *Poa annua*, *Cynodon dactylon*, *Dichanthium annulatum*, small twigs of bushes, and downy feathers were used as nesting materials. The average diameter of nest ($n=12$) was 25.43 ± 3.4 ($\text{mean} \pm \text{SD}$) cm. Overall, the mean clutch size was 94.5 ± 30.187 egg/nest with an incubation period of 22–24 days. The hatching success rate was 82% with 315 successfully hatched chicks, while the fledging rate was 83% (265 fledged out of 315 hatched in, $n=42$ nests).

Keywords: *Alectoris chukar*, population dynamics, nesting, ecological factors, Pakistan

Összefoglalás A csukár (*Alectoris chukar*) fészkelésbiológiáját vizsgáltuk Malakand tartományban, mely a faj pakisztáni elterjedésének fontos területe. A faj abundanciája tengerszintfeletti magasság szerinti mintázatát transekt- és pontszámlálásos módszert alkalmazva mértük fel. Az átlagos havi populációsűrűség értéke $1,448 \pm 0,466$ madár/ha volt. A populációsűrűség augusztusban, szeptemberben és októberben szignifikánsan ($P < 0,05$) nagyobb volt, mint a többi hónapban. A megfigyelések száma decemberben volt a legalacsonyabb ($0,996 \pm 0,147$ madár/ha), és októberben a legmagasabb ($2,333 \pm 0,202$ madár/ha). Fészkelésökológiai vizsgálatok elvégzésére az összes vizsgált területen kiválasztottuk és megjelöltük a maximális aktivitással jellemzett élőhelyeket. Ennek folyamán adatokat gyűjtöttünk a költés időzítéséről, a fészkelőhely-választásról, a fészkek méretéről, a költés időtartamáról és a költési sikerről. A faj költése februárban kezdődik, márciusban és áprilisban éri el csúcspontját, mikor a nászhangokat a leggyakrabban lehet hallani. A nászhangok gyakorisága $0,15-0,3$ /perc értékek között váltakozott. A költési időszakban 12 fészket figyeltünk kézitávosövek és kameracsapdák segítségével olyan távolságból, hogy ne okozzunk zavarást. A fészkek leggyakrabban *Dodonea viscosa*, *Calotropis procera* *Zizyphus oxyphylla* növényfajok takarásában kerültek elő. Fészkekanyagként főleg *Poa annua*, *Cynodon dactylon*, *Dichanthium annulatum* száraz levelei, illetve kisebb cserjeágak és pehelytollak szerepeltek. A fészkek átlagos átmérője $25,43 \pm 3,4$ cm ($n=12$) volt. Az átlagos fészkeljméret $94,5 \pm 30,187$ tojás/fészek volt. A költés 22–24 napig tartott. A 42 fészekből összesen 315 csibe kelt ki, a költési siker 82%-os volt, 265 fióka repült ki, a kirepülési siker 83% volt.

Kulcsszavak: *Alectoris chukar*, populációdinamika, fészkelés, ökológiai tényezők, Pakisztán

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Introduction

Chukar Partridge (*Alectoris chukar* Gray, 1830) is a game bird belonging to the order Galliformes, family Phasianidae, and subfamily Phasianinae. (Ahmad *et al.* 2017). Chukar Partridge can be found in Mongolia, China, South Russia, Pakistan, India, Afghanistan, Southwest Asia, and North east Africa (Roberts 1991). In mountainous regions of Pakistan, the Chukar Partridge is widespread. Sindh, Baluchistan, Punjab, Khyber Pakhtunkhwa, Malakand division, Margalla hills, Kohistan, and Gilgit Baltistan are among the provinces in Pakistan where the species is found. Chukars normally breed once a year, depending on environmental factors, but two broods may occur if sedentary conditions are favorable (WA 2011). Males perform a display in the spring, involving a head tilt and a pop-out wing, to attract females. Male and female began calling and participating in “tidbitting gigs,” (del Hoyo *et al.* 1994). Chukars can be found in flocks of 2–4 or 5–7 birds in the region. Depending on the elevation, they start copulating in March and raise their brood mostly in mid or early April to July. The breeding starts right on time at low height when compared to higher elevation (Roberts 1991) that in the Himalayas it moves to snow-topped fields and does not start breeding until late June (Roberts 1991). The Chukar is mostly found at an elevation of 1000 to 4500 m but in Pakistan, they may move down to 600 m elevation above mean sea level (asl) (Rasmussen & Anderton 2005). Chukars are upland birds that prefer dry rocky hills and ravines with little vegetation or scrub. In cold season they inhabit low altitudes ranging from 1,000 to 1,500 m. During the summer they inhabit high elevation areas up to 4500 m. They prefer areas mostly close to crop fields on steep slopes and forage in the mountains and gorges cultivated in the hills. They live in groups in the spring and late summer, but this is not the case in the fall. (Roberts 1991). The Chukar Partridge population has dropped sharply in many countries in recent years (Cetin *et al.* 1997). Habitat depletion, predators, agricultural technology, growth of bird-breeding farms, widespread use of herbicides and insecticides, and excessive hunting are all factors contributing to the population decline (Gaudioso *et al.* 2002, Grimmett *et al.* 2008). Increased human population has a negative impact on the Partridge’s population and habitat (Bhattacharya *et al.* 2009). The Chukar population is also impacted by predators and harsh environmental factors. (Christensen 1996). Chukar Partridge is the national bird of Pakistan. However, this bird lacks sufficient scientific data on the population ecology and breeding of its native areas. Although the Malakand division is part of its native home range, no data from this region has previously been recorded. The aim of this study is to analyses the population density, habitat preferences and some aspects of Chukar Partridge breeding biology in the Malakand division. Highly favored environments have been established, and breeding populations have been identified for long-term tracking studies to determine nesting, incubating, and reproductive success.

Material and Methods

Study area

The proportion of suitable habitat and the distribution patterns of species are greatly affected by variations in elevation gradient, topography, and vegetation characteristics in the Malakand division. On the basis of altitudinal range and vegetation structure differences, four zones were selected for the current study. Three line transects were formed in each zone (Figure 1). The dominant tree species of the selected zones include *Ficus racemose*, *Melia azedarachta*, *Eucalyptus lanceolate*, *Pyrus pashia*, *Ficus palmate*, *Cedrus deodara*, *Quercus baloot*, *Pinus wallichiana* and *Pinus roxburghii* Sarg. Shrubs include *Desmodium elegans*, *Berberis lyceum*, *Datura stramonium*, *Dodonea viscosa*, *Calotropis procera*, *Zizyphus oxyphylla*, *sarcococca saligna*, *Hedera nepalensis*, *Jasminium officinalis* and *Rubus fruticosus*. Herbs include *Sorghum helepense*, *Poa annua*, *Stachys parviflora*, *Heliotropium strigosum*, *Stellaria media*, *Origanum vulgare*, *Solanum xanthocarpum* and *Hypricum perforatum*. Wild sheep, bears, jackals, wolves, rodents, monkeys, foxes, Indian Crested Porcupine (*Hystrix indica*), Chukar Partridge (*Alectoris chukar*), Black Francolin (*Francolinus francolinus*), Grey Francolin (*Ortygornis pondicerianus*) and other avian species are among the area's major wildlife.

Throughout the study period, the climatic factors studied (air temperature, relative humidity, wind speed, wind direction, cloud cover, rainfall, and relative humidity) are given in (Table 1). The climate of this area is semi-arid with moderate hot, long summer and short, cool, windy, rainy winter.

Table 1. Climatic parameters recorded in Malakand division from January to December 2020
1. táblázat Makaland tartományban 2020 január és december között mért klimatikus paraméterek

Months	Temperature (°C)			Relative Humidity (%)	Wind speed	Wind direction	Cloud cover (%)	Rainfall (mm.)
	Max	Min	Mean					
January	12.5	8.7	11	64%	8	S	8	81
February	14.0	10.5	12.2	60%	3.8	N	6	98
March	18.3	15.0	17	76%	4	SE	7	125
April	21.8	17.8	20	78%	5.5	SE	9	105
May	27.3	23.0	25	43%	7	N	9	47
June	29.0	26.0	28	44%	9	S	7	30
July	35.6	31.3	34	70%	4	SW	2	135
August	38.8	33.6	36.2	78%	8.3	SE	3	132
September	32.3	27.0	30	63%	9.5	SW	6	64
October	28.2	23.8	26	30%	7	NE	6	28
November	23.0	20.0	22	31%	11	SE	5	22
December	19.2	16.0	18	33%	6.8	S	9	48

Sampling strategies

The area is divided into equal-sized grids in the distribution range, and the grids for the tracks were selected randomly. Since the distribution of Chukar Partridge in the study region is not random, but is more determined by variations in topography and landscape characteristics, tracks were walked as the behavior of the species and landscape characteristics. Monitoring was carried out by the line transect method (Buckland 2001), while dogs were used during the non-breeding season to increase the chances of observation (Besnard *et al.* 2010). The sites were chosen because they were on an elevation gradient and were at least 20–30 km apart. Due to the vast distance among sites, the first trail was completed within the first two weeks of a month at each site, followed by the second trail during the remaining two weeks. During the study, 288 trails with a total length of around 1 km were walked. For population density, both direct and indirect data were used. The number of sighted birds was divided by the transect area to get the density (number of birds per ha) ($100 \text{ ha} = 50 \text{ m} \times 1000 \text{ m}$, length \times width of transect). Feathers, droppings, nests, and voice calls were used to look for bird nests and determine where they roost and feed. Vegetation associated with nesting was also reported. The number of calls of Chukar and time spent at each site were recorded. The following formula was used to determine the frequency of calls:

$$\text{Calling frequency} = \frac{\text{Total No of calls}}{\text{Total observation time}}$$

All experimental results were examined by statistical package for social sciences IBM (SPSS) version 20 software database. Observations were considered statistically significant at ($P < 0.05$).

During the months of February, March, April, May and June, the study site for the nest was assessed, considering the equal potential of all habitats for Chukar Partridge hosting and breeding activities. They were frequently visited and watched for signs of nesting around their habitat prior to the start of the breeding season. i.e., the last week of February. The nests were spotted by walking across the study area on an existing route, while randomly encountered female birds were followed to their nests. Once an active nest was confirmed, it was labelled and given a unique number. The nest's location, general appearance, and composition are all noted. Signed nests were visited twice a week with the utmost caution to ensure that breeding birds were not disturbed. After egg laying, the frequency of visits was increased on alternating days to monitor incubation and hatching times. The date of the first and last egg laid, the number of eggs, the date of hatching, and the number of eggs hatched were all recorded.

Habitat preference

Along its distribution range, the Chukar Partridge uses a variety of habitat types and favors different breeding grounds. We also recorded the vegetation cover and habitat components associated with Chukar breeding habitat preferences and breeding ecology through various

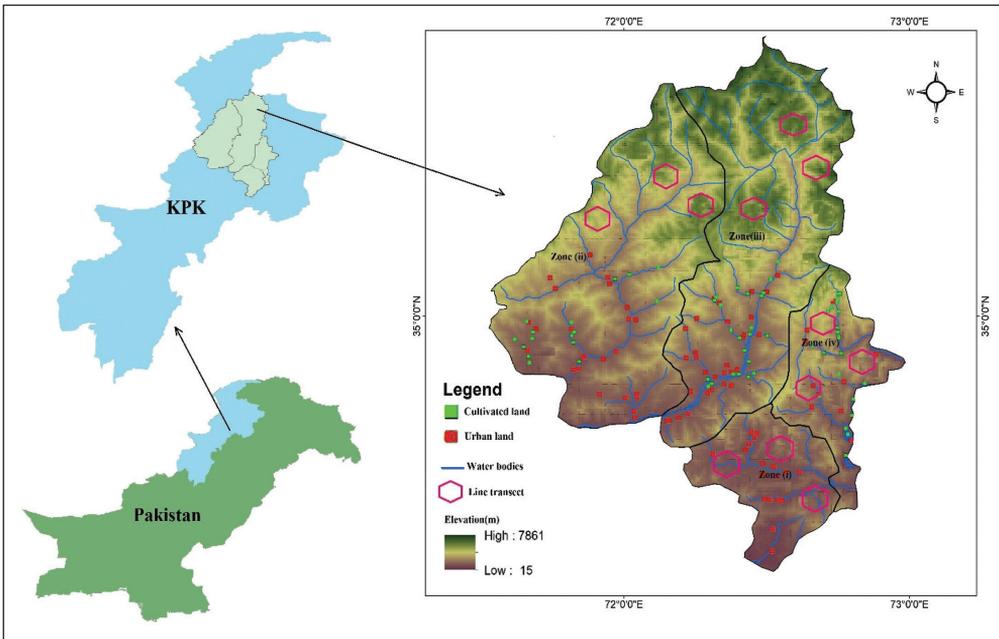


Figure 1. Map of Malakand division, Pakistan showing administrative details and site of the study area

1. ábra Makaland tartomány térképe (Pakisztán), amely mutatja a közigazgatási határokat és a vizsgált területet

vegetation zones. The study sites were located between 200 and 7,861 m asl. Based on differences in altitudinal range and vegetation structure, the study sites were divided into four main habitat types (Figure 1). Zone – I at lower elevation between 400 to 2300 m asl were dominated by *Zizyphus oxyphylla*, *Sarcococca saligna*, *Dodonea viscosa*, *Hedera nepalensis*, Zone – II located between 680 to 3,800 m asl dominated by *Berberis lyceum*, *Datura stramonium*, *Dodonea viscosa*, *Zizyphus oxyphylla*. Zone – III at higher elevation with cultivated land located between 500 to 7,861 m asl dominated by *Desmodium elegans*, *Dodonea viscosa*, *Calotropis procera* and Zone – IV located between 875 to 4,400 m asl near to agriculture land dominated by *Dodonea viscosa*, *Jasminium officinalis*, *Rubus fruticosus*.

Results

The distribution of Chukar Partridge population was found to vary greatly in the different study areas. Male calls were abundant throughout the breeding season, and individuals remained active during the day. Female calls were also heard at certain locations, likely as a result of predator or other nearby danger. Males, however, were extremely vocal during the breeding season, and were seen consistently calling throughout the habitat.

We first assessed their abundance at all sites, based on direct encounter or male breeding calls, in order to investigate some aspects of Chukar Partridge breeding ecology (Table 2).

Table 2. Mean Chukar Partridge density (ind/ha) in the Malakand division based on direct sightings and call counts at all study sites. The values provided are (Mean±SE)

2. táblázat A csukár átlagos állománysűrűsége (egyed/ha) Makaland tartományban, közvetlen megfigyelések és nászhang-felmérések alapján (átlag±SD)

S. No.	Months	Zone-I	Zone-II	Zone-III	Zone-IV	Sum of all Zones
1	Aug	0.357±0.021	0.550±0.050	0.403±0.025	0.467±0.015	1.777±0.186
2	Sep	0.470±0.020	0.666±0.015	0.540±0.020	0.593±0.025	2.270±0.185
3	Oct	0.476±0.015	0.666±0.015	0.563±0.015	0.626±0.015	2.333±0.202
4	Nov	0.280±0.026	0.463±0.015	0.373±0.015	0.443±0.025	1.560±0.227
5	Dec	0.173±0.011	0.323±0.015	0.236±0.020	0.263±0.015	0.996±0.147
6	Jan	0.270±0.020	0.336±0.015	0.276±0.015	0.343±0.025	1.226±0.070
7	Feb	0.230±0.010	0.380±0.010	0.350±0.020	0.37±0.020	1.330±0.217
8	Mar	0.203±0.025	0.320±0.020	0.253±0.015	0.280±0.020	1.056±0.128
9	Apr	0.186±0.020	0.303±0.020	0.250±0.020	0.276±0.015	1.016±0.153
10	May	0.240±0.010	0.320±0.020	0.263±0.015	0.296±0.020	1.120±0.086
11	Jun	0.246±0.020	0.370±0.010	0.293±0.015	0.336±0.020	1.246±0.118
12	Jul	0.336±0.025	0.373±0.015	0.346±0.020	0.396±0.025	1.453±0.092
Total = 1 year		0.289±0.100	0.422±0.130	0.345±0.107	0.391±0.118	1.448±0.466

In December, Chukar sightings were minimum, with 0.173±0.011 birds/ha in Zone – I, 0.236±0.020 birds/hae in Zone – III, and 0.263±0.015 birds/ha in Zone – IV, in various habitat types. Sightings greatly increased from July to November then began to fall in December. Study site at the lower temperate region Zone – II had the highest abundance (0.666±0.015 birds/ha), followed by Zone – IV (0.626±0.015 birds/ha) having shrubby habitat and proximity to agriculture land and Zone – III (0.563±0.015 birds/ha) with abundant shrubs and cultivated land. As compared to the other Zones the population of Zone – I was slightly less abundant even at the peak breeding season (0.186±0.020 birds/ha) which is a similar habitat as the other study area, possibly due to hunting, trapping and harsh environmental condition.

Breeding behavior

Late January marked the start of Chukar breeding season in Malakand division. The birds were seen in groups of 4–8 or occasionally 9–12 during this period (from late January to July). Pair-bonds started to form from February to March, whereas the breeding period lasted from March to June, marked by breeding calls, nesting, egg laying and incubation. The

Table 3. Chronology of Chukar Partridge breeding behavior

3. táblázat A csukár költésének kronológiája

Breeding behavior	Months
Breeding call begin	Late January
Frequent call heard	February
Pairing formation	February
Nesting	March/April
Incubation	April/ May
Hatching	May/June
Fledgling	July

maximum number of breeding calls were recorded in the months of February and March, indicating its breeding period (Table 3). During the breeding season, the difference between the first and second calls was 8–12 seconds, while in the non-breeding season, it was 1–2 minutes or even longer than 2 minutes. Similar to the rest of the months, calling frequency (number of calls per minute) was maximum in February (0.3) and March (0.26), indicating the start of breeding season. Males and females started to form pairs during this time. One way (ANOVA) showed a significant difference in call counts during various months of the year ($df=6$, $F 2.60$, $P < 0.05$).

Nest site selection

Forty-two active nests with a mean 10.5 ± 3.354 were found in the study area at twelve different sites including six nests at Zone – I, fifteen at Zone – II, nine at Zone – III and twelve nest at Zone – IV (Table 4). 27 out of forty two nests were built on slopes, with dense vegetation of *Dodonea viscosa*, *Calotropis procera* and *Zizyphus oxyphylla* along the walking trail (Figure 2a), 9 nests were created on the ground with a shallow depression, a scrape with dead leaves of *Desmodium elegans*, *Heliotropium strigosum*, *Solanum xanthocarpum*, soft stems and downy feathers. The remaining 6 nests were found in small depressions on the ground with dense vegetation of *Stellaria media*, *Dodonea viscosa*, *Poa annua* and *Stachys parviflora* under the stones. All the related morphometry and nesting materials were measured only when the nests were left after hatching. Twelve nests were measured one in each transects. Shapes of the nests were round to partial round. The average diameter (cm) of the nest ($n=12$) (25.43 ± 3.4) with cup diameter (23.32 ± 3.1) and cup depth (6.20 ± 1.2).

Incubation and hatching success

During the incubation period, only twelve nests were observed. The remaining nests were detected during incubation or after hatching. Wherever possible, all nests were monitored regularly at various habitats using either camera traps or binoculars (Table 4). The average clutch size was 94.5 ± 30.187 eggs, ($n=42$ nests) with a minimum of 6 and a maximum of 14 eggs per nest. The incubation period was between 22–24 days (22.75 ± 0.830). At the

Table 4. Breeding performance of Chukar Partridge at different sites
4. táblázat A csukár költési adatai az egyes vizsgált területeken

Study area	Nests (n)	Month	Average eggs hatched/nest (n=9)	Incubation period (days)	Hatching success (n) (%)	Chick mortality rate (n) %	Fledgling success (n) (%)
Zone – I	6	April	54	24	(41) 76%	(11) 26%	(30) 73%
Zone – II	15	March	135	22	(119) 88%	(14) 12%	(105) 88%
Zone – III	9	April	81	22	(67) 82%	(9) 13%	(58) 87%
Zone – IV	12	April	108	23	(88) 81%	(16) 18%	(72) 82%
Mean±SD	10.5±3.35		94.5±30.18	22.75±0.83	78.75±28.59	12.5±2.69	66.25±27.04



Figure 2. (a) showing field photograph of Chukar Partridge active nest (b) Hatching stage and leftover nest of Chukar Partridge (c) unsuccessful nest after hatching

2. ábra (a) a csukár aktív fészke, (b) sikeres költés utáni elhagyott fészke, (c) sikertelen fészke

nest, only female was seen incubating eggs. After being incubated by a female, a minimum number of eggs were fail to hatch (Figure 2b). The hatching success was 82% in Zone – III, 81% in Zone – IV, 76% in Zone – I and 88% in Zone – II respectively. Of total 315 hatched chicks, 265 survived, whereas others were observed dead for unknown reasons (Figure 2c). Overall the fledging success was 83% (n=42 nests) (Table 4).

Discussion

The IUCN classifies the Chukar Partridge as “Least Concern,” indicating that its population trend is stable and its population size is also very large (BirdLife International 2016). According to Rich *et al.* (2004), the global population of the species is estimated to be around 2,000,000 individuals. However, there have been reports of a population decrease in some parts of the world; for example, a small population in Europe is projected to decline at a rate of nearly 30% in 11.7 years (three generations) (BirdLife International 2015). Recent telemetry studies provide real information, but are expensive and require more effort. Count calls and line transects are commonly used techniques, but they have biases and limitations

(Evans *et al.* 2007). The number of Chukar sightings was lower in December across all the study zones of Pakistan. Zone – I is the worst impacted region because of the surrounding residential areas, where residents hunt for Chukar and destroy its habitat by cutting the grass and pasture (*Figure 1*). Overgrazing can alter vegetation structure and composition, which can lead to changes in biodiversity and predator-prey relationships (Blaum *et al.* 2007). Chukar population densities in the study area varied from month to month due to differences in trapping, hunting, predation and diseases. The highest population density was recorded in Zone – II in September and October. Vegetation cover provides a variety of essential components for population survival and reproduction. This could be the reason for the increase in the number of birds observed per trail as vegetation cover with sufficient ground cover increased gradually in April and beyond at all the study sites. Chukar population densities were mostly higher in cultivated grass, slopes and barren rocks. According to Roberts (1991), Chukars could live in Pakistan arid, rocky, and hilly terrain. From August to October, however, the highest population density was observed in Zones – III and IV. Predation, hunting, and harsh environmental conditions caused the population decline in Zone – III to start in December and reach its lowest density in May. Chukar are preys of raptors that are frequently reported throughout the Great Basin and has been observed in Golden Eagles nests (*Aquila chrysaetos*) (Bloom & Hawks 1982). But in Zone – IV the lowest population was recorded in December, as a result of very harsh cold climate and territorial and altitudinal migration. Our results are consistent with those of Roberts (1991) and Christensen (2020). Overall the population density showed a nearly growing trend in September and October. Since this bird breeds in the summer, this number may be due to its breeding success. Population decline in December may be attributed to changes in activity

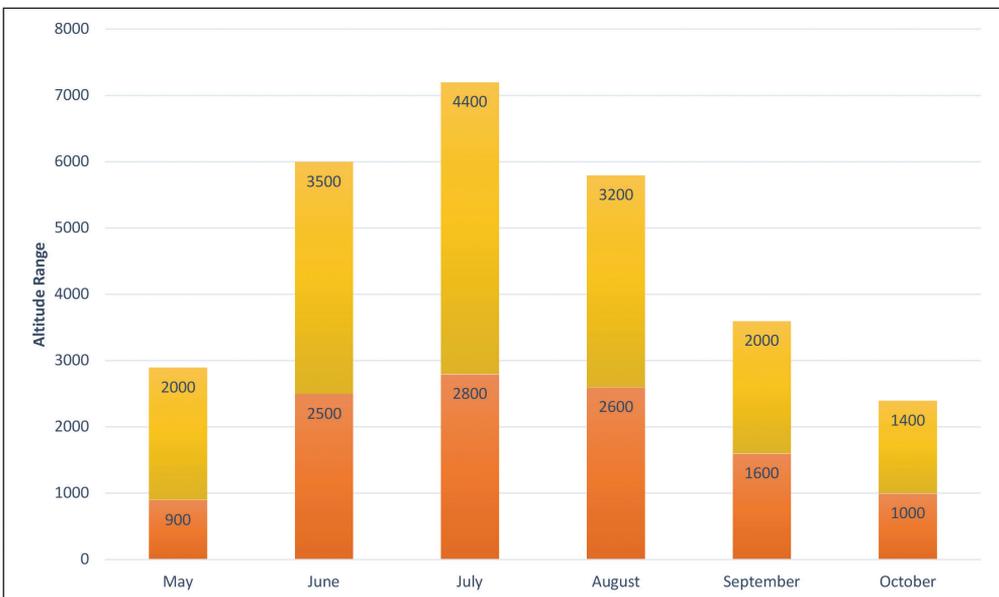


Figure 3. Altitudinal variation of Chukar Partridge in different months of the study area

3. ábra A csukár elterjedése tengerszintfeletti eloszlásának havi mintázata a vizsgált területen

patterns as the climate becomes harsher and most of the study areas is devoid of crops and other vegetation cover that could change the behavior and activities of these birds. In the study region, Chukar was found in a variety of altitudinal ranges (*Figure 3*). It can be found at elevations ranging from 900 to 4400 m (asl), in different months of the study area, though it can also be found at 600 m in Pakistan (Rasmussen & Anderton 2005). According to Roberts (1991), in summer it has been seen at 3353 m in Chitral and up to 3962 m in western Gilgit.

Breeding is an important phenomenon in the life stages of birds; the successful breeding results in stable populations of a species in an area. Most of the nests were spotted around *Dodonea viscosa*, *Calotropis procera* and *Zizyphus oxyphylla* on a sloping location with an average diameter of (26.42 ± 3.3) , with nearby water sources was preferred nest building sites. According to Olliver (2005) and Roberts (1991) Chukars build their nests under the rocks in dense scrub in a small depression on the ground with a diameter varying from 21–30.5 (cm). The building material of nest included grasses, dead leaves of *Poa annua*, *Cynodon dactylon*, *Dichanthium annulatum* and soft stems, mainly identified as *Zizyphus oxyphylla*, *Sarcococca saligna* were found abundantly. This has resulted in successful nesting of Chukars at various sampling locations. The nests were established successfully at different sites in the study area. According to Olliver (2005) Chukar Partridge builds a nest in a depression scratched in the ground under shrubberies or in particularly protected by rocks and fences in unpleasant areas. Our findings revealed that male Chukar started calling in January and early February, followed by pair formation. The months of March and April were the peak for breeding and nesting. These months indicate the spring season in the study area. Our results regarding Chukar Partridge pair formation and breeding records are consistent with earlier studies by del Hoyo *et al.* (1994) and Christensen (2020). We observed a maximum clutch size of 14 and a minimum of 6. The nests spotted in Zone – I, Zone – III and IV were initially found with 3, 2 and 4 eggs, then 12, 5 and 14 eggs were found at these nest. It can be assumed that the female lays eggs on different days, not on the same day.

Roberts (1991) reported a clutch size of 6 to 9 eggs in a drier environment, whereas Bates and Lowther (1952) found four clutch ranging between 15 and 19 eggs per clutch in Kashmir. Clutch size of Chukar was reported to be between 7–14 eggs and eggs hatched after an incubation period of about 23–25 days (Shahabuddin *et al.* 2016). Christensen (2020) reported that the incubation period was 24 days which is also the finding of our study. Using camera traps and binoculars wherever possible to achieve closer distances, the incubation period in the twelve nests was observed regularly and lasted about 23 days (22.75 ± 0.830) . Our findings show that the eggs hatched from May to July which is the summer season in the study area. This was also reported by Shahabuddin *et al.* (2016) from Totalai Game Reserve, Buner, Pakistan that summer is the breeding season of Chukar Partridge. Furthermore, the Chukar Partridge is nesting in the ground and is more frequently affected by birds of prey than by mammals (Angelstam 1986). In this study 265 of the 315 hatched chicks survived, while the others were found dead. However, no nests were found to be threatened by predation, so the chicks found dead were most likely the result of a parasitic attack or harsh environmental condition. The study of abundance or distribution

estimates is important for the management and conservation of wildlife populations (Bibby *et al.* 1998). To increase the understanding on the status of a particular species, information about its distribution, habitat occupancy, population size and possible threats are very important. Unfortunately for chukar species in the region, quality information is not readily available. Although the current data reflects a ‘snapshot’ of the population, it does provide some valuable information on population status, habitat preference and some aspects of Chukar breeding biology in the Malakand division, Pakistan.

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