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Breeding Ecology of Chukor Partridge (*Alectoris chukar*) in Lower Dir District, Khyber Pakhtunkhwa, Pakistan

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ABSTRACT

The Chukor or Chukar Partridge (*Alectoris chukar*) is a game bird of family Phasianidae. In Pakistan it occurs in a wide range of rough, sloping and dry regions rising to the higher foothill valleys of the internal Himalayan ranges and western Himalayas and plains, Balochistan, and dry hillsides of the Punjab and Sindh. It is the "National Bird" of Pakistan, however, very little is known about its ecology and breeding in its native range in the north of the country. The present study investigated breeding ecology of the bird in its native range of Lower Dir district of Khyber Pakhtunkhwa (KP) province from September 2016 to August 2017. Results show that breeding season of the species starts from February: peak breeding months being March and April, during which frequent breeding calls were heard. The calling frequency ranged from 0.15 per minute to 0.3 per minute. Six active nests of Chukor were found at five different sampling sites; nest location was mostly on sloping areas under sanatha *Dodonaea viscosa* shrubs. Nesting material consisted of dry leaves of annual grass *Poa annua*, small twigs of bushes and downy feathers. The depth of nest ranged between 5-10 cm. Clutch size ranged from 8-20 eggs while the incubation period was found to be 22-24 days. Hatching success was up to 85% (range 75 to 85%) in different nests. The dense vegetation consisting of *Dodonaea viscosa* and *Poa annua* provided shelter, cover and abundant supply of insects to the chicks. The study concludes that the breeding season of Chukor partridge in Dir Lower starts from February and lasts up to July, with successful nesting, egg laying and hatching.

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TM and IA designed and planned the study. IA collected the data. TM, FA and MSN analyzed the data and wrote the article. A Hussain, MW and A Hamid helped in data collection.

Key words
Chukor, Partridge, Breeding, Clutch, Incubation, Hatching.

INTRODUCTION

The Chakor or Chukar Partridge (*Alectoris chukar* Gray, 1830) is a widely occurring game bird of Phasianidae family. Its native range in Asia includes Palestine, Lebanon, Turkey, Iran, Afghanistan, Pakistan and India, along the inner ranges of the Western Himalayas to Nepal (BirdLife International, 2016). It is generally found at an elevation ranging from 2000 m to 4000 m above mean sea level (amsl) while in Pakistan it also occurs at 600m (Rasmussen and Anderton, 2005).

In Pakistan, Chukor is very adaptable to all kinds of arid, rocky and hilly areas ascending to higher mountain valleys of inner Himalayan ranges. It is distributed in Khirthar range in Sindh, in the Salt range around Sakesar and common in Chinji Reserved forest and the Margalla Hills in Punjab. It occurs in higher valleys of Swat and Indus Kohistan, and throughout Balochistan. It is still widespread in the Kurram valley and Waziristan. In summer it is also seen in some areas of Chitral, and in western Gilgit (Roberts, 1991).

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The Chukor usually breeds once a year, depending upon ecological conditions, albeit two broods may be raised while settling conditions are great (WA, 2011). The bird species is monogamous; pair formation occurs in spring season when the male plays out a "romance show" including a head-tilt and a showing up of his expelled flanks. Both male and female start to call and partake in a "tidbitting show" pecking at different items (del Hoyo *et al*., 1994; Christensen, 1970, 1996).

In the field, Chukor can be found in gatherings of 2-4 or generally 5-7 birds. They start mixing from March and raise the brood in the midst of early April to July, contingent upon elevation. The breeding starts right on time at low height when contrasted with the higher rise (Roberts, 1991) that in the Himalayas it trips to snow-topped fields and does not start raising until late June (Roberts, 1991).

Roberts (1991) reported that nesting of Chukor occurred over a long period according to altitude and latitude. Some birds in Himalayas ascend to alpine pastures and do not start breeding until late June. However, at lower elevations, breeding may start early (from late March). Main nesting season is April to May in the Salt Range with a normal clutch size of 6 to 9 eggs, however, in heavier rainfall areas, the clutch size may vary from 15 to 19 eggs. Most of the nests in Balochistan were found at the end of

April up to July (Roberts, 1991).

The Chukor Partridge is the National bird of Pakistan, and a game bird as well. Yet, it lacks sufficient scientific data related to its ecology and breeding in its native range in the country. Lower Dir District is included in its native range, but no data have been reported previously from this area. The current study is aimed at investigating breeding biology of the Chukor partridge in Lower Dir District of Khyber Pakhtunkhwa province, to record observations on its breeding season, clutch size, incubation period and the hatching success and survival rates of chicks.

MATERIALS AND METHODS

Study area

The present investigation was driven in District Lower Dir, that lies in the "Hidukush" range between 35° 10 to 35° 16 N Latitude and 71° 50 to 71° 83 E Longitudes. It is situated between Chitral and Peshawar, along the Afghanistan border, with a total area of 1,582 km^2 (Fig. 1). The district Lower Dir is a rugged zone with tops ascending to 4876 m in the north-east and to 3048 m along the watersheds with Swat toward the East and Afghanistan toward the West. The climate of the area varies with elevation. The lower plains are hot in summer with short winter in January while the higher elevation experiences severe cold in winter with pleasant summers. Rainfall occurs mostly during winter with annual rainfall being less than 750cm; monsoon rains are scanty and irregular, high hills also receive snow during winters.

The dominant tree species of the study area include *Pinus roxburghii, Olea ferruginia, Quercus* spp., *Salix tetrasperma, Ficus palmata, Platanus orientalis, Morus alba, Eucalyptus camaldulensis, Acacia modesta,* and *Melia azedarach.* Shrubs include *Dodonaea viscosa, Zizyphus nummularia, Sageretia theezan, Gymnosporia royliana, Periploca aphylla* and *Calotropis procera.* The major wildlife species of the area comprise of Cape hare (*Lepus capensis*), Asiatic Jackal (*Canis aureus*), Indian crested Porcupine (*Hystrix indica*), Chukor partridge, Black francolin (*Francolinus francolinus*) and Grey francolin (*Francolinus pondicerianus*).

Table I.- Selected sampling sites in Lower Dir District for collection of data on breeding biology of the Chukor Partridge.

Site name	Geographical coordinates	Dominant vegetation
Shahabad	N 34° 45.764 E 72° 20.434	*Dodonaea viscosa, Poa annua*
Parlamar	N 34° 46.898 E 70° 15.890	*Dodonaea viscosa, Poa annua*
Shenolay Payen	N 34° 50.847 E 71° 48.961	*Dodonaea viscosa, Poa annua, Zizyphus nummularia*
Ghalighy	N 34° 46.509 E 72° 26.194	*Dodonaea viscosa, Poa annua, Zizyphus nummularia*
Timargara	N 34° 45.866 E 74° 01.797	*Dodonaea viscosa, Poa annua, Zizyphus nummularia*
Badwan	N 34° 40.486 E 71° 58.755	*Dodonaea viscosa, Poa annua*
Loi Shodshing	Data not available	*Dodonaea viscosa, Zizyphus nummularia*

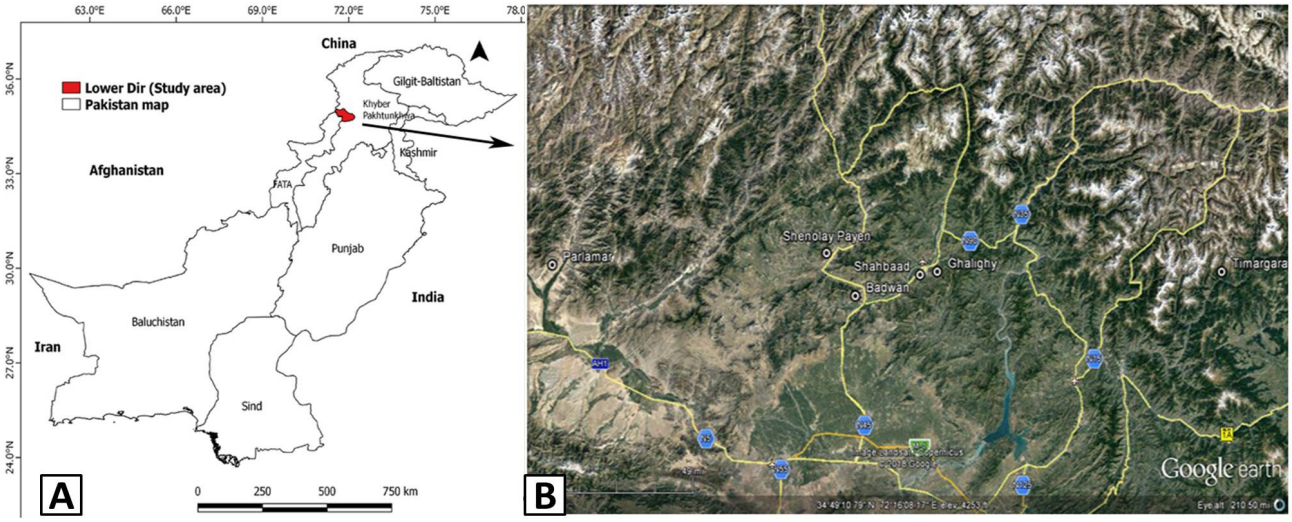

Fig. 1. **A**, Map of Pakistan showing location of Lower Dir District (shaded) the study area. **B**, a satellite image of the area showing sampling sites (modified from Google Earth). The seven sampling sites used for data collection, including Shahbaad, Parlamar, Shenolay Payen, Ghalighy, Timargara, Badwan and Loi Shodshing.

Reconnaissance survey of the study area was conducted in September 2016 to identify potential habitat of Chukor and select sampling sites in the Lower Dir District. Information was also collected from the local people, local hunters, and provincial wildlife department staff of the study area, through unstructured interviews. For this purpose, meetings were held with the people of different ages and occupations. Based on the survey and collected information, seven different sampling sites (Fig. 1; Table I) were selected in the study area for data collection. Fortnightly field visits were made to the selected sites for searching the nests of bird species.

The study started in September 2016 and continued until August 2017. The number of breeding calls was used as indicator for the onset of breeding season. The Chukor was found gregarious outside the breeding season, during the fall when 20 to 30 birds could routinely gather. These may be family groups as a pair, can raise tremendous broods (Roberts, 1991). Continuous calling, presence of the nest, fresh eggs and newly hatched chicks indicated the breeding season of Chukor partridge.

The number of calls of Chukor and time spent at each site were recorded. Calling frequency was calculated by using the following formula:

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

Since, the species is ground nesting; its nests were searched at seven different sampling sites, marked and measured for their characteristics such as nest size and composition. After identification, Chukor nests were focused for subsequent breeding activity to record clutch size, and incubation period following Westerkov (1950). Twenty-one field surveys were conducted to record signs of Chukor. Out of seven sites surveyed, four sampling sites were found to have nests.

After locating the nesting sites, their geographical position was determined using GPS (Global Positioning System). A distinction was made between active and inactive nests. A nest was considered active when a female was observed at the nest on more than one occasions. The structure and composition of the nest and its measurements were recorded and dominant vegetation surrounding the nest was identified. The activities of both sexes were recorded near the nest. The exact location of the nest, where the female laid eggs was also determined. Clutch size refers to the number of eggs found in the nest. Number of eggs from each nest was recorded. The incubation period (number of days chukor incubated their eggs in the nest) was recorded at each nesting site. Total number of chicks or new recruitment was noted after successful incubation of eggs. The nesting success was determined by the number of hatchlings/chicks in the nest.

One-way Analysis of Variance was used to analyze data recorded on call counts during different months of the study period.

RESULTS

A total of 92 different signs of Chukor were recorded at the seven sampling sites that included 15 direct sightings, 39 calls, 13 faecal droppings, 6 foot prints, and 19 feathers (Table II). Among seven selected sampling sites, Shahbaad had the maximum signs of the species (26.09%), followed by Shenolay Payen (19.57%), while Timargara/Talash (5.43%) had the least number of signs. The field sighting of the bird was difficult due to dense vegetation and probably because of the small population of Chukor in the area.

Chukor calls were heard in the study area from January 2017 to July 2017 (Table III). Maximum calls were recorded at Shahbaad and Parlamar sites (eight calls each) and the least at Talash site (two). Maximum calls were recorded in the months of February (twelve), followed by March (eleven) 2017, indicating its breeding period. Difference between the first and second call was 14-6 seconds during the breeding season, whereas during non-breeding season, this difference was 50-60 seconds or even more than 2-3 min. Similarly, calling frequency (number of calls per minute) was also the highest during January (0.15), February (0.3), and March (0.28) indicating

Table II.- Field signs of Chukor Partridge recorded at different sampling sites in Dir Lower during current study.

Site	Calls	Field sightings	Feathers	Faecal droppings	Foot prints	Total signs	Percentage (%)
Shahabad	8	4	7	2	3	24	26.09
Parlamar	8	2	2	1	1	14	15.22
Shenolay payen	7	4	4	2	1	18	19.57
Ghaligy	5	1	4	3	1	14	15.22
Timargara	2	1	0	2	0	5	5.43
Loi Shodshing	3	1	2	1	0	7	7.61
Badwan	6	2	0	2	0	10	10.87
Mean ± SE	5.5 ±0.89	2.1 ± 0.50	2.7 ± 0.91	1.8 ± 0.26	0.85± 0.5	13.1 ±2.47	-

Table III.- Breeding Calls of the Chukor Partridge recorded at selected sampling sites in Dir Lower from January to July 2017.

Site	Jan. 17	Feb	Mar	Apr	May	Jun	Jul	Total calls	Percent (%)
Shahabaad	2	-	3	2	1	-	-	8	20.51
Parlamar	1	3	2	1	1	-	-	8	20.51
Ghalighy	1	1	2	-	1	-	-	5	12.82
Badwan	-	4	2	-	-	-	-	6	15.38
Loi shodshing	2	-	-	1	-	-	-	3	7.69
Talash/Timargara	-	-	2	-	-	-	-	2	5.13
Shenolay Payen	-	4	-	-	-	2	1	7	17.95
Total	6	12	11	4	3	2	1	39	-
Mean ± SE	0.8±0.34	1.7±0.71	1.5±0.42	0.5±0.29	0.4±0.20	0.2±0.28	0.1±0.14	5.5±0.89	-

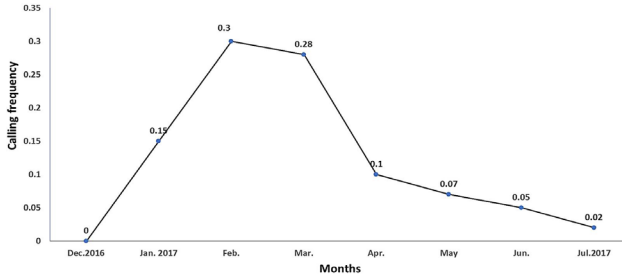

Fig. 2. Record of calling frequencies of Chukor Partridge in the study area, Dir Lower, Pakistan.

the onset of breeding season, as compared to the rest of months (Fig. 2). This was the time when males and females started to pair up. One Way Analysis of Variance (ANOVA) showed a significant difference ($df = 6$, F 2.60, $p < 0.05$) in call counts during different months of the year.

Breeding season of Chukor in Dir lower started from January 2017. During this period (from January to July 2017), the birds were observed in groups of 4-6 or sometimes 7–10. The pair formation started in February 2017 to March 2017 while breeding period lasted from early April to July 2017, indicated by breeding calls, pair formation, nest construction, egg laying and incubation. February and March were the peak months when maximum number of breeding calls were recorded (Table III).

Seven nests were found in the study area at four different sites including three nests at Shenolay Payen and one nest each at Shahbaad, Parlamar, Ghaligay and Talash (Fig. 3; Table IV). The only nest at Shahabad remained inactive since it was not utilized for egg laying and incubation purpose by the Chukar partridge while the one at Parlamar site was found unsuccessful as the only egg laid was aborted.

First and second nest were found in the month of April at Shahabad and Parlamar sites, third in the month of May at Ghaligay site , while fourth, fifth, and sixth nests were discovered in June and the seventh in July at Shenolay Payen site (Tables III and IV). Two nests at the first two sites were formed on slopes, with dense vegetation of *Dodonaea viscosa*, *Poa annua* (wakha), and *Berberis lycium* (Karwaray) along the walking track and one nest was under the bunch of *Dodonaea viscosa*. The remaining four nests at Shenolay Payen and Timargara were found beneath the stones in small depressions on the ground with dense vegetation of *Dodonaea viscosa* and *Poa annua* (wakha). The nests were generally found to be established at sloping locations in the area being hilly (Fig. 3).

Fig. 3. Field photograph of an active nest of Chukor Partridge having 8 eggs (black circle), found at Shenolay Payen site in Dir Lower, KP.

The material used by the Chukor to construct its nests in the study area (Dir Lower) consisted of dry leaves of annual grass species *Poa annua* (wakha), downy feathers, and few twigs. A sloping area about 5-10 cm was selected to make a small depression in the soil, using its feet and beak, for laying eggs.

Out of seven nests six were found active while one nest in Shahabad site was inactive that did not have any egg. Nesting season in the study area started from early

Table IV.- Clutch size and hatching success of Chukor Partridge at seven selected sampling sites in Lower Dir District of KP province, Pakistan during study period 2017.

Site	Nests (n)	Month	Clutch size	Eggs hatched	Unhatched eggs	Hatching success (%)
Shahbaad	1	April	-	-	-	-
Parlamar	1	April	1	-	1	-
Ghaligay	1	May	19	16	3	84
Shenolay Payen	1	June	8	6	2	75
Shenolay Payen	1	June	15	12	3	80
Shenolay Payen	1	June	20	17	3	85
Talash/Timargara	1	July	12	10	2	83
Total	7	-	75	61	14	-
Mean ± SE	1 ± 0	-	12.5 ±3.05	12.2± 2.64	2.00 ± 0.50	81.4

April to May, as in earlier months breeding calls started and pair formation occurred. However, the breeding calls indicating the onset of breeding season started from January that continued up to July 2017. A total of 75 eggs were laid in six active nests (Table III), ranging from one to 20 eggs with a mean of 12.5 eggs per clutch; 61 eggs were incubated by females. Hatching success was 81.4 %; 18.6 % (n = 14) eggs did not hatch and got wasted/aborted. The incubation period in the study area was found to be 22-24 days. One nest at Parlamar got destroyed due to some unknown reason and the remaining one nest of Shahabad site was reportedly destroyed by local people while stealing eggs from it. Dominant vegetation around the Chukor nests was *Dodonaea viscosa* while Asiatic Jackal *Canis aureus*, Common Crow *Corvus splendens* and snakes (unidentified species) were reportedly found its natural nest predators in the study area.

DISCUSSION

The Chukor Partridge is categorized by IUCN as "Least Concern" and its population trend is stable, the population size is also extremely large (BirdLife International, 2016). Rich *et al*. (2004) estimated its global population to number c. 2,000,000 individuals. However, there are reports about its population decline from some parts of the world, for example, in Europe the small population is estimated to be decreasing at a rate approaching 30% in 11.7 years (three generations) (BirdLife International, 2015). In Lebanon the population is considered to be locally reduced, elsewhere the population is suspected to be stable or locally increasing (McGowan and Kirwan, 2016).

Breeding is an important phenomenon in the life stages of birds; the successful breeding results in stable populations of a species in an area. Successful nesting is important for birds in their habitat because their embryos in the eggs must develop outside the bird's body exposed to the changing conditions of the environment. Optimum temperature for embryonic development is 37-38°C; lower temperatures can disrupt embryo development and temperatures above 42°C can be lethal. So the nest in some cases provides conditions to keep eggs at higher temperatures than ambient temperature and in some cases to lower temperature than the environment. A nest not only has to provide the appropriate conditions for egg development, but it must, in some cases, also provide concealment and protection for eggs and later chicks. It also helps hide the incubating adults, which in many cases attend the eggs 100% of the time during incubation.

We recorded different field signs of Chukor Partridge including its calls, feathers, faecal droppings, direct field sightings, and foot prints, to confirm its occurrence in the study area. Maximum total signs of the bird species were recorded at Shahabad. At this particular site, the dominant vegetation included the annual grass species "*Poa annua*" and one shrub species "*Dodonaea viscosa*". The occurrence of *Dodonaea viscosa*" at sloping locations provided the suitable habitat as well as the cover to Chukor Partridge to build its nest under this vegetation. However, level ground was also available to the species. The leaves of the annual grass *"Poa annua*" were utilized by the Chukor to build its nest, along with downy feathers, and few twigs of some other plants. This resulted in successful nesting of the Chukor at various sampling sites. Successful nests were established at four different sites in the study area. Some earlier studies have also reported that Chukor Partridge makes nest in a depression scratched in the ground worked under shrubberies or particularly secured by rocks and fences in unpleasant zones or may once in a while has a dump settle (Ollivier, 2005). Roberts (1991) showed that nesting of Chukor happens over a drawn out stretch of time as indicated by slope and elevation and the principal settling happens in April and early May when it gets settled with bits of dried grass.

Our results showed that the male Chukor in Lower Dir District started calling in January / early February following which the pair formation occurred. The peak breeding months were March and April, when nesting occurred. These months indicate the spring season in the study area. Our results regarding pair formation and breeding records of Chukor Partridge agree with the earlier studies by del Hoyo *et al*. (1994) and Christensen (1996).

The habitat destruction due to deforestation, agricultural activities, infrastructure and land sliding and disturbances by increasing human population are the major threats to avian fauna (Khalid *et al*., 2017). Nest success and re-nesting of Chukor are poorly documented in earlier published literature and no convincing data are available to dispute the possibility that Chukors re-nest. Christensen (1970) reported that most of Chukor re-nesting is supported only by the preponderance of late-hatch chicks in the fall, often occurring after an unusually wet spring.

We hereby report a clutch size of the Chukor ranging from 8-20 eggs, with a mean value of 12 eggs per clutch. The incubation period was extended up to 24 days, after which hatching occurred with a mean success rate of 81% (hatching success ranged between 75-85% in different nests and at different sampling sites). Earlier on Shahabuddin *et al*. (2016) had reported clutch size of Chukor as 7 to 14 eggs and the eggs hatched after an incubation period of around 23-25 days. In captivity, the Chukor can lay one egg each day in the midst of the breeding season if eggs are gathered day by day, up to 20 days. Roberts (1991) reported a typical clutch size of 6 to 9 eggs in drier regular environment, while Bates and Lowther (1952) in Kashmir found four clutches ranging from 15 to 19 eggs per clutch. According to Christensen (1970), the number of eggs found in the four active nests ranged between 10 to 21 eggs with a mean clutch size of 15.5 eggs. The incubation period reported was 24 days which is the finding of our study as well. The hatchlings were looked after both by male and female parents.

Our findings showed that eggs hatched in the months of May to July 2017, which is the summer season in the study area. This has also been reported by Shahabuddin *et al*. (2016) from Totalai Game Reserve, District Buner, Pakistan that summer was the breeding season of Chukor Partridge.

Major threats

Egg poaching, bird trapping, illegal hunting and habitat destruction, are reportedly the major threats to the population of Chukor partridge in Lower Dir area.

CONCLUSIONS

Our study concludes that the Chukor Partridge breeds successfully in its native range of Lower Dir district; the breeding season starting from January and February when males start calling, followed by pair formation and nest construction till the month of April when female lays eggs in the nest. The nests are built on sloping areas having a cover of *Dodonaea viscosa*. The clutch size ranges from 10-20 eggs, incubation period lasts up to 24 days with a mean hatching success of approximately 81%.

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