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Short Communication

Population Ecology of Chakor Partridge (*Alectoris chukar*) in District Bajaur, Khyber Pakhtunkhwa, Pakistan

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ABSTRACT

The population density and ecological factors affecting chakor partridge (*Alectoris chukar*) were studied in district Bajaur, Khyber Pakhtunkhwa during May, 2017-April, 2018. Known habitats were divided into three categories: 1) vertical barren rocks 2) rocky vegetation slopes and 3) grassy mountainous slopes near agricultural fields. The average monthly population density was 0.198±0.04/ha by line transect method. During the period June, July, September and October 2017, significantly ($P<0.05$) high population density was recorded as compared to the population density recorded during May, August, November and December 2017and January-April 2018 both in the morning and evening. Significantly ($P<0.05$) high population density (0.0060±0.002/ha) was recorded during the autumn season. Different ecological factors possibly affect the population of chakor partridge include illegal hunting, eggs collection from their nests, nest destruction, predators, fire, habitats loss, overgrazing, disease and harsh environmental conditions. Awareness campaigns and enforcement of legislation are recommended to save the population of chakor.

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Key words
Chakor partridge, Bajaur, Ecological factors, Population density

Chakor partridge (*Alectoris chukar*), a normal sized game and cage bird belongs to class Aves, order Galliformes, family Phasianidae and sub family Phasianinae. The genus *Alectoris* includes 16 sub species, 7 breeds and 24 sub breeds worldwide (Ahmad *et al*., 2017).

Chakor partridge is widely distributed in mountainous areas of Pakistan. Chakor occurs in Pakistan, Afghanistan, India, Southwest Asia and North East Africa, western Himalayas to central Nepal (Roberts, 1991). It is distributed throughout Pakistan including Punjab, Sindh, Balochistan, Khyber Pakhtunkhwa, FATA, lower and upper Dir, Malakand Agency, Swat, Chitral, Margalla hills, Kurram mountain, Kohistan, and Gilgit Baltistan.

Chakor when faced with a variety of possible habitat types, mostly select the environment which best fulfills their life requirements specifically, most-liked food and suitable habitats for nesting sites. Chakor 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 (Rasmussen and Anderton, 2005). The chakor is remarkably a highland bird occupying dry rock slants and ravines, lightly spread with small grass and shrubs. In cold season they inhabit low altitudes ranging from 1000 to 1500 m. During the summer they inhabit high elevation areas up to 4500 m. Mostly it inhabits areas near crop fields on mountainous slopes and feeds in the cultivated hilly and mountainous cultivated gorges. In spring and in late summer they live in flocks but in autumn this phenomenon is not seen in these birds (Roberts, 1991).

The population of chakor partridge in some countries have extensively declined in recent years (Cetin *et al*., 1997). The reasons of population decline are the loss of habitats, predators, use of farm machinery and technology, development of game farms that breed birds, common use of herbicides and insecticides and intensive hunting (Gaudioso *et al*., 2002; Grimmett *et al*., 2008). Increasing human population badly affects its population, territory and the habitats (Bhattacharya *et al*., 2009). Predators and harsh environmental conditions also impact chakor population (Christensen, 1996). The current study investigated the relationship between ecological parameters and population density of chakor partridge in district Bajaur, Khyber Pakhtunkhwa, Pakistan.

Materials and methods

The current research was carried out in mountains of district Bajaur, lying between 34˚38 to 34˚46 North latitudes and 71˚20- 00 to 71˚39 - 984 East longitudes, 800 to 2400 m elevation and a total area of 1290 km^2 (Supplementary Fig. 1). Four zones were selected on the basis of locations and barriers: Zone-I (mountainous stretch of Kingnaster to Niag Banda with edge ways mountain belt from Kawser to Umary, N 34˚43-44, E 71˚24-25 and 1050-1630 m elevation), Zone-II (mountain belt Inzaree to Ghawando, N 34˚ 38-39, E 071˚20-23 and 1100-1700 m elevation), Zone-III (mountain running from Mandal to Samsay, N 34˚39-

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40, E 071˚24-26 and 1100-1470 m elevation), and Zone-IV (Koh-i-Moor, N 34˚39-41, E 071˚33-35 and 1020-2400 m elevation).

In each zone three line transects, 1000 m long 200 m wide and 1000 m apart were established. Transects were walked fortnightly both in the morning (500 to 800 h) and in the evening (1500 to 1900 h) as described by (Bibby *et al*.,1992). For authentic data collection both direct and indirect observations were recorded. Direct data collection and survey was done through Visual Encounter Techniques (VET). The indirect data were recorded from fresh fecal droppings, feathers and calls i.e. hundred meters on the right and left side along the transect. We listened to the recorded calls before the start of the study in order to maximize the detection of chakor (Bibby *et al*., 1992). The distance at which birds were sighted was recorded with measuring tape. Binoculars (Bushnell 7 x 50 mm) were also used to record observations. Information regarding global positioning system (GPS) locations, temperature, rainfall and elevations was recorded. Population density was calculated by employing the following formula:

$$D=\sum n / 2LW.$$

D, density; Σ, sum; n, total number of detected individuals; L, length of transect in selected habitat; W, width of transect.

Results and discussion

Chakor partridge population dynamics and effective ecological factors were recorded during four seasons i.e. summer (May-July), autumn (August-October), winter (November-January) and spring (February-April) of the year 2017-2018. Chakor partridge was recorded in all four study sites with varied population density and ecological factors in different seasons, from month to month and from zone to zone. Mostly the chakor were recorded in the form of flocks that ranged from 2-15 birds. Increase in population density was recorded in May (0.0085±0.01/ha) up to July (0.0310±0.01/ha). However, a varied decreasing trend was noted from September (0.0296±0.01/ha) to April (0.008±0.02/ha) (Table I).

In Zone-I the highest average population density was recorded during October (0.0058±0.004/ha), and the lowest in April (0.0016±0.004/ha). The overall average population density was (0.0381±0.04/ha). Among all the zones Zone-I was considered highly threatened area as local hunters collected eggs from four nests in the breeding season. During hunting season six chakor were trapped. During the whole survey two symptoms and signs of predated chakor were reported.

In Zone-II the highest population density was recorded in July (0.0099±0.003/ha) and the lowest in August (0.0005±0.0003/ha). The overall average population density was (0.0530±0.05/ha). During the whole survey period eggs were collected from two nests by locals, nine chakor were trapped and three predated.

In Zone-III population density remained approximately the same from June to September (0.0051/0.0047±0.001/ha) and the lowest in the month of December (0.0009±0.0001/ha). The overall average population density was (0.0362±0.02/ha). Locals collected eggs from three nests and 13 birds were trapped during hunting season. Only one chakor was predated.

In Zone-IV the highest average population density was recorded during the period July, August and September (0.0120±0.009, 0.0130±0.003 and 0.0120±0.003/ ha). The

Table I. Zone-I, II, III and IV average monthly population density/ha (Mean±SD) of *Alectoris chukar* in different zones through line transect method in district Bajaur, Khyber Pakhtunkhwa, Pakistan from May 2017 to April 2018.

S. No.	Months	Zone-I	Zone-II	Zone-III	Zone-IV	Sum of all zones
1	May	0.0020±0.005	0.0032±0.006	0.0011±0.001	0.0022±0.004	0.0085±0.01
2	June	0.0034±0.003	0.0096±0.001	0.0051±0.001	0.0043±0.003	0.0224±0.008
3	July	0.0042±0.001	0.0099±0.003	0.0049±0.001	0.0120±0.009	0.0310±0.01
4	August	0.0034±0.001	0.0005±0.0003	0.0051±0.002	0.0130±0.003	0.0220±0.009
5	September	0.0033±0.001	0.0096±0.004	0.0047±0.002	0.0120±0.003	0.0296±0.01
6	October	0.0058±0.004	0.0048±0.002	0.0040±0.002	0.0067±0.001	0.021±0.01
7	November	0.0042±0.007	0.0033±0.008	0.0011±0.001	0.0051±0.001	0.0138±0.01
8	December	0.0019±0.004	0.0023±0.008	0.0009±0.0001	0.0008±0.0003	0.005±0.01
9	January	0.0035±0.006	0.0031±0.009	0.0033±0.002	0.0034±0.001	0.013±0.01
10	February	0.0028±0.001	0.0022±0.005	0.0026±0.001	0.0029±0.004	0.010±0.01
11	March	0.0020±0.006	0.0027±0.006	0.0022±0.005	0.0047±0.001	0.011±0.01
12	April	0.0016±0.004	0.0018±0.003	0.0012±0.006	0.0039±0.008	0.008±0.02
Total= 1 year		0.0381±0.04	0.0530±0.05	0.0362±0.02	0.0710±0.04	0.198±0.04

Total size of study area Zone-I = 9 km². Total area surveyed in Zone-I= 6 km²; total size of study area Zone-II = 8 km². Total area surveyed in Zone-II= 6 km²; Total size of study area Zone-III = 10 km². Total area surveyed in Zone-III= 6 km²; Total size of study area Zone-IV = 12 km². Total area surveyed in Zone-IV= 6 km²; Formulae calculating the population density from Line Transect data: D=∑ n/2LW.

Table II. Average seasonal population density/ha (Mean±SD) of *Alectoris chukar* in different zones through line transect method in district Bajaur, Khyber Pakhtunkhwa, Pakistan from May 2017 to April 2018.

S. No	Seasons	Zone-I	Zone-II	Zone-III	Zone-IV	Sum of all zones
1	Summer	0.0032±0.003	0.0075±0.003	0.0037±0.001	0.0061±0.005	0.0051±0.003
2	Autumn	0.0041±0.002	0.0064±0.003	0.0046±0.002	0.0105±0.002	0.0060±0.002
3	Winter	0.0032±0.005	0.0029±0.008	0.0017±0.001	0.0031±0.001	0.0027±0.004
4	Spring	0.0021±0.003	0.0022±0.004	0.0020±0.004	0.0038±0.004	0.0025±0.004
Total		0.0127±0.01	0.0176±0.01	0.0120±0.008	0.0236±0.01	0.0165±0.01

Table III. Selected study zones characteristics and ecological factors affecting chakor partridge in district Bajaur during May, 2017 to April, 2018.

Habitats	TA (m^2)	% A	€€	Study zones	Elevation (m)	Destroyed nest	Traps/ Predation	Avg livestock/ house
Vertical barren rocks	15000	39	300	**Zone-I:** Kingnaster-Banda,U-mary-Kawser Mountains	1000-1420	4	6/2	Cattle = 1.44 Sheep = 5.33
Rocky vegetation slopes	13000	33	325	**Zone-II:** Ghawando-Inzaree Mountains	980-1520	2	9/3	Goats = 2.94 Others = 1.26
Near agriculture and cultivated fields	11000	28	180	**Zone-III:** Samsy-Mandal Mountains	795-1325	3	13/1	
				Zone-IV: Koh-i-Moor	1124-2453	4	47/5	
Total	1290	100	805	Bajaur	3899-6718	13	75/11	

TA, total area; €€, total number of birds; Avg, average

overall average population density was (0.0710±0.04/ha). Eggs were collected from four nests by locals. A total of 47 partridges were trapped by local hunters and five predated, the highest of all zones.

Except for Zone-II the average seasonal population density was significantly high ($P<0.05$) inautumn (0.0041±0.002/ha). In Zone-I the highest seasonal population density was recorded during autumn (0.0041±0.002/ha), while the lowest was in spring (0.0021±0.003/ha). In Zone-II the highest seasonal population density was in summer (0.0075±0.003/ha) and the lowest in spring (0.0022±0.004/ha) (Table II).

Both the Zone-III and IV recorded the highest seasonal population density in autumn (0.0046±0.002/ha) and (0.0105±0.002/ha), respectively. Similarly, for both zones the lowest population density was recorded in winter (0.0017±0.001/ha) and (0.0031±0.001/ha) respectively (Table II).

Zone-I and III are the worst impact zones because of surrounding residential areas, the inhabitants of which hunt chakor and destroy their habitats through cutting of grass. Population density of chakor varied from month to month because of differential capturing, hunting, predation and diseases of chakor. In Zone-I, the highest population density was recorded in October because of a second breeding output. Population started to decline from December because of harsh climate, scarcity of water, food and high predation. Locally the month of January and February are considered to be the illegal hunting season as very low population density of chakor was recorded in March and April.

However, in Zone-II, the highest population density was recorded in June, July and September. The lowest population density was recorded in August, because the area of Zone-II contained suitable breeding habitat for hawks breeding, which preyed upon chakor. Chakor number drastically declined, and secondly availability of drinking water was very low due to failure of rains and the absence of natural springs compared with other zones.

However, in Zone-III and IV the highest population density was recorded from June to September. In Zone-III the population decline started in November reaching the lowest density in April caused by predation, hunting and harsh environmental conditions. 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 findings match with the reports made by Roberts (1991) and Christensen (1996).

The clutch size varied from 6 to 18 in the study area in district Bajaur. The covey size ranged between 2 and 15 birds. Chakor is monogamous; pairs are formed in mid-March after the males perform a courtship display involving a head tilt and a showing of his barred flanks (Perrins, 2003). Chakor breeds once yearly but during favorable environmental conditions may avail a second chance of laying. Breeding occurs from April to July, 7 to

20 eggs are laid per season, average time for hatching is 24 days (Christensen, 1996).

Mostly the population density of chakor was high in habitats that included cultivated grassy slopes and barren rocks. Roberts (1991) reported that in Pakistan chakor could inhabit the arid, rocky and hilly country.

Seasonal population fluctuation was partially explained under breeding output and chick loss pattern. Population density started to rise in summer and autumn season as newly recruited chicks joined in June gradually increasing till September. The lowest density was recorded in winter and spring seasons indicating the possible local movement of birds to the adjacent and lower elevations. The birds were also less active during winter indicating low population density. Higher mortality rate due to harsh environmental condition, and predation during winter resulted in low density in spring. These findings also agree to those reported by Roberts (1991) and Christensen (1996). During spring and summer they live in coveys but in autumn this phenomenon is not seen in these birds (Roberts, 1991). They were observed more often during morning h whereas their activities were less pronounced during afternoons and evenings. Roberts (1992) reported that chakor were more active early in the morning and after midday.

The local hunters illegally hunt during January, February and March hence the lowest density in each zone was recorded in April. In some countries however, chakor populations are stable or rising; less susceptible to factors responsible for the decline of population and their emigration. The constant human presence in alpine habitats disturbs the chakor and adversely affects their distribution (Bhattacharya *et al*., 2009).

Overgrazing can change the structure and composition of pastures followed by alteration in biodiversity and predator prey relationships (Blaum *et al*., 2007). Higher density of grazing animals leads to scarce grass cover, creating favorable conditions for spread of non-palatable plant species (Chambers *et al*., 2007). The intensive grazing affects adversely chakor density by changing composition of grass species, destroying shelters, nesting sites, and increased predation (Lindbloom, 2003). Several studies in the United States have confirmed that regular burning and intensive grazing reduce the density of nesting birds (Powell, 2008).

Conclusion

Chakor partridge occupies all habitats in district Bajaur Khyber Pakhtunkhwa. Anthropogenic activities viz., decline in habitat characteristics through overgrazing, cutting of vegetation, illegal hunting, killing, capturing, gun-firing, mining, construction, diseases, increase in human population and depredation adversely affect the population of chakor partridge. Addressing these factors especially the strict enforcement of legislation would help improve the population of chakor.

Supplementary material

There is supplementary material associated with this article. Access the material online at: https://dx.doi.org/10.17582/journal.pjz/20190806070800

Statement of conflicts of interest

The authors have declared no conflicts of interest.

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