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Population Density and Habitat Analysis of Grey Francolin (*Ortygornis pondicerianus*) in Taunsa Wildlife Sanctuary, Punjab, Pakistan

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SUMMARY

The Grey Francolin (*Ortygornis pondicerianus*) is a bird native to Pakistan, found in regions ranging from the Indus valleys to the Himalayan foothills, including Balochistan, Punjab, Sindh, and Khyber Pakhtunkhwa provinces. According to the 2018 IUCN Red List of Threatened Species, the Grey Francolin is either common or of Least Concern. However, there is a lack of documented information on the population density and habitat association of the Grey Francolin in various habitats of the Taunsa Wildlife Sanctuary in Pakistan. Therefore, this study aimed to investigate the population density and habitat association of the Grey Francolin in the Taunsa Wildlife Sanctuary from February 2017 to July 2018. The study area was divided into two different habitat types: cultivated land and forest with associated grassland. Data collection was conducted along three fixed transects in each habitat type, each with a length of 200 m and a width of 50 m. Population density statistics were taken in the early mornings before sunrise and in the afternoons before nightfall. To examine the habitat, the quadrate approach was used to conduct a vegetative survey of the chosen research locations. Each fixed transect yielded ten quadrats, bringing the total to 60 across the two habitat locations. All plant species present in Grey Francolin environments had their relative density, frequency, cover, and significance value index measured. The study area had a Grey Francolin population density of 1.03 birds per hectare. In contrast to natural forests, developed land had significantly higher population density ($P<0.05$).The probable habitat for the Grey Francolin in the research region supported a total of 31 plant species, including 11 trees, 6 shrubs, 6 herbs, and 8 grasses.

Keywords: *Francolinus pondicerianus*, Population, Taunsa Wildlife Sanctuary

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INTRODUCTION

The Grey Francolin is a member of the Galliformes order and the Phasianidae family. It makes an excellent game as well as table bird, as well as a caged and free combat bird (Khan, 1997). The body length of the Grey Francolin is 33−35cm (Roberts, 1991; Islam, 1999). The male and female have similar plumage color, which makes it

difficult to identify them in field surroundings. The male can be differentiated from the female because of metatarsal spurs and a broader head and larger body mass (Islam, 1999). The Grey Francolin is widely distributed in ranges predicted to be around 10,000,000 km² and is evident in plains and drier parts of South Asia (Birdlife International, 2012). It is dispersed from the Indus valley to the Himalayan foothills in open cultivated lands as well as thicket forests (Del Hoyo et al., 1994).

Recent studies have highlighted the significance of understanding the ecological requirements and population dynamics of the Grey Francolin for effective conservation strategies (Mahmood et al. 2010). Changes in land use patterns, habitat degradation, and hunting pressure are recognized as major threats to its survival (Khalil and Anwar, 2016). Therefore, comprehensive research focusing on population density and habitat analysis is crucial for informed conservation management. By assessing the current status of Grey Francolin populations and identifying key habitat preferences in the Taunsa Wildlife Sanctuary, this study aims to contribute valuable insights towards the sustainable management of this species within its natural range.

Further, scanty work is reported from the country pertaining to the population dynamics of the Grey Francolin in different regions. Keeping in view the declining trend of the population, the present study was undertaken to record baseline data on habitat preference and population in Taunsa Wildlife Sanctuary that would be useful for its conservation and sustaining the population of this important game bird in this area.

MATERIALS AND METHODS

STUDY AREA

The Taunsa Wildlife Sanctuary, which is situated in District Muzaffargarh at 30° 31' N and 70° 51' E, was the study site. This sanctuary was created in 1972 to save the Taunsa Barrage's fauna and flora. The Punjab Wildlife (Protection, Preservation, Conservation, and Management) Act, 1974 governs this 6,576-hectare area. The sanctuary's substantial migratory waterfowl population led to its designation as a Ramsar Site in 1996.

The region has an arid and semi-arid climate. Summers are typically very hot, with temperatures ranging between 39 and 46 degrees Celsius. Winters, on the other hand, are mild, with temperatures ranging between 19 and 5 degrees Celsius. The majority of the annual rainfall, which ranges from 150 to 200 mm, occurs during the summer. The Sanctuary is primarily composed of sandy plains. Near the western edge of the sanctuary, there are mud plains that form wide and deep fissures when they dry up.

Important plant species in the sanctuary include, Aksin (*Withania somnifera*), Bakhra (*Tribulus terrestris*), Bansi Gha (*Panicum antidotale*), Barhami Booti (*Centella asiatica*), Bhann (*Populus euphratica*), Dhaman (*Fagonia bruguieri*), Hodil Booti (*Oxystelma esculentum*), Jand (*Prosopis cineraria*), Jhao (*Tamarix dioica*), Kana, Sarkanda (*Saccharum bengalense*), Kandiari (*Solanum surattense*), Kanhan (*Saccharum spontaneum*), Khavi (*Cymbopogon jwarancusa*), Khip (*Leptadenia pyrotechnica*), Kikar (*Acacia nilotica*), Koondar (*Typha domingensis*), Makko

(Solanum nigrum), Nara *(Arundo donax)*, Okan *(Tamarix aphylla)*, Orvain (*Equisetum arvense)*, and Shisham *(Dalbergia sissoo)* (Nawaz et al., 2016).

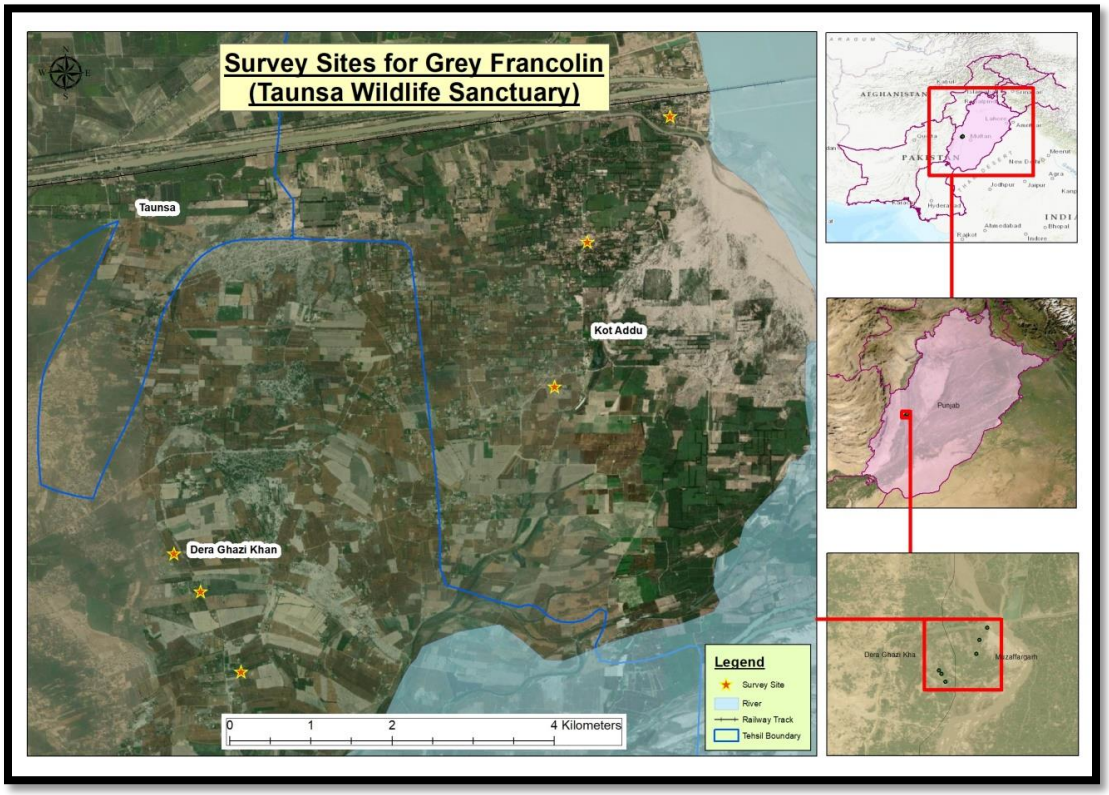

Figure 1: Map Showing Selected Study Sites in Taunsa Wildlife Sanctuary, Punjab Pakistan.

STUDY DESIGN

The study was conducted from February 2017 to July 2018. Two different habitats were selected based on a pilot surveillance for Grey Francolins presence: i) Forest and associated grassland (30.705557 N and E70.657776), ii) cultivated land (30.703421 N and E70.648702). In both habitat types, three transects, each measuring 200 m in length and 50 m in width, were selected and marked. For vegetation analysis, 10 quadrats were recorded along each transect. Throughout the research, data on population density and vegetation were gathered in six set transects once per month.

POPULATION DENSITY

For the estimation of the population of Grey Francolin in the area under study, observations were made using the "Visual Encounter method (VEM)" by direct sighting. The observations were recorded along transects to observe the birds on or near the line, depending on the topography of the land and the characteristics of vegetation in different types of habitats (Burnham et al., 1980). Three permanent transects of 200 m in length and 50 m in width were established at each study site. During field surveys, utmost care was taken to avoid duplication and overlapping of observations on a particular transect. Data was collected every month at both dawn

and dusk to determine the population density of Grey Francolin. The formula used for this purpose was developed by Burham et al. in 1980.

$$D = \frac{\sum N}{2LW}$$

Where,

N = Avian species number
D= Density
W= Transect width
L = Transect length of

HABITAT ASSOCIATION

To conduct habitat analysis, we employed the quadrate method outlined by Schemnitz (1980) to survey the vegetation at selected study sites. Along each fixed transect, ten quadrats were positioned with different sizes designated for trees (10x10m), shrubs (4x4m), and herbs (1x1m). In total, we sampled 90 quadrats across two habitat sites. We used a measuring tape to lay out the quadrats and subsequently calculated the density, relative density, frequency, relative frequency, and dominance of different plant species. The importance value index was utilized to evaluate the vegetation.

THE FOLLOWING FORMULAE WERE USED FOR VEGETATION ANALYSIS

Density (D) = Total no of individuals of species / Total area sampled

Relative Density (RD) = Total no of individuals of speciesx100 / Total no of individuals of all species

Frequency (F) = No of quadrates in which species occurs / Total no of quadrates

Relative Frequency (RF) = Frequency value of species x100 / Total frequency value of all species

Dominance (D) = Cover of individuals of a species / Total cover of all species

Relative Dominance (RD) = Total basal area of individuals speciesx100 / Total basal area of all species

Importance value index (IVI) of each species was calculated as follows:
IVI = Relative Density + Relative frequency + Relative cover

STATISTICAL ANALYSIS

Data obtained was analyzed by using student t-test to compare the various selected habitats to find out the preferred habitat and population density of the Grey Francolin in different habitats in the study area.

RESULTS AND DISCUSSION

POPULATION DENSITY

The highest number of individuals of Grey Francolin (7.67 ± 2.79) were recorded from cultivated land, followed by forest and associated grassland (4.67 ± 0.95) (Table 1). The highest number of birds were recorded in March (18) in cultivated land, followed by February and April (11). Khan (2010) and Roberts (1991) recorded the highest numbers of this species from March to May because these birds breed during this time.

Table 1: Month-Wise Observations of Grey Francolin (Birds/Ha) Recorded During Different Calendar Months in Study Area.

Month of Visits	Forest and Associated Grassland	Cultivated Land
Feb 2018	4	11
Mar	2	18
Apr	3	11
May	7	4
June	8	2
July	4	0
Mean SE	4.67± 0.95	7.67 ± 2.79

The overall population density of Grey Francolin recorded in the two habitat types combined was 1.03 birds/ha (Table 2). Cultivated land has the highest population density of 1.29 birds/ha, while forest and associated grassland habitat has a density of 0.78 birds/ha. Analysis of the data revealed that population densities of Grey Francolin were significantly different ($P < 0.05$) between the two habitats.

Table 2: Population Density of Grey Francolin in Taunsa Wildlife Sanctuary.

Study Sites	Area of Transects (Ha)	Average Number of Grey Francolin	Population Density/Ha
Cultivated land	3	7.67	1.29
Forest and associated grassland	3	4.67	0.78
Mean Density			1.03/ha

The population density of Grey Francolin was found to be higher in cultivated land compared to forest and associated grasslands. This was due to cultivated crops such as wheat, barley, and maize in fields during the study period. This habitat provides more food opportunities and trees at the margins of the cultivated land habitat were used for shelter and roosting by the birds. Hussain et al. (2009) also recorded a higher density of Grey Francolin in cultivated habitat compared to forest habitat. The fields were continuously grown, providing the best supply of food for Grey Francolin species. However, the population was also equally high in the forest area during the summer and winter months. During the autumn season, the minimum population was recorded in both habitats. Khan (2010) stated that there was a

reduction in the population of Grey Francolin in the extreme hot and cold months in hilly and grassland areas compared to wetland habitat due to the advantage of water in wetlands.

Khalil et al. (2015) described that the population density of Grey Francolin species remains low in winter and starts increasing progressively in summer. Grey Francolin prefer cultivated land for nesting and shelter due to the presence of bushes. That's why Grey Francolin migrates from forests to cultivated land. The origin of this species allows it to live easily in cultivated areas where it can find cover, food, and ground for nesting (del Hoyo et al., 1994).

Mahmood et al. (2010) recorded the highest density of Grey Francolin during October 2008 (1.29 ± 0.44/ha) and recorded it until May 2009 (0.14 ± 0.005/ha). However, from June 2009 onwards, its density presented an increasing tendency, and during July 2009, it was 0.78 ± 0.02/ha.

This species is potentially hunted for game due to its delicate flavor and also serves as an important source of bush meat for impoverished people in Asia (Fuller et al., 2000). In local communities, francolin meat is highly valued for its claimed aphrodisiac properties (Altaf et al., 2018). However, in Pakistan, Francolins are classified as Schedule-I and are protected in the study area under the Punjab Wildlife Acts and Rules 1974. The game management for francolins is carried out by issuing special hunting licenses for specific days, and illegal hunting can result in financial fines, which can be several thousand rupees.

HABITAT ANALYSIS OF STUDY AREA

25 plant species were recorded from the forest and associated grass land where trees were dominant (Table 3). Dominant tree species recorded were *Acacia nilotica* (IVI= 44.32), dominant shrubs species recorded were *Withania somnifera* (IVI= 21.91), dominant herbs species recorded were *Oxystelma esculetum (*IVI= 9.54) while dominant grass were *Cynodon dactylon (*IVI= 10.68).

Table 3: Vegetation Analysis of Forest and Associated Grassland in Taunsa Wildlife Sanctuary.

Sr.	Botanical Name	Relative Density	Relative Frequency	Relative Cover	Importance Value Index
1	*Acacia nilotica (T)*	13.0	10.58	20.74	44.32
2	*Albizia lebbeck (T)*	10.69	10.05	7.62	38.37
3	*Tamarix dioica(T)*	8.33	10.37	17.33	36.03
4	*Dalbergia sissoo (T)*	5.78	5.82	10.37	21.97
5	*Eucalyptus camadulensis (T)*	1.73	6.87	9.33	17.94
6	*Ziziphus mauritiana(T)*	2.60	4.23	6.74	13.57
7	*Mangnifera indica (T)*	2.31	2.64	2.07	7.03
8	*Phoenix sylrestris (T)*	2.02	2.11	2.25	11.92
9	*Moru laevigata (T)*	1.44	2.11	4.57	8.09
10	*Morus alba (T)*	1.44	2.64	4.92	9.01
11	*Azadirachta indicac (T)*	1.15	2.11	4.9	8.1
12	*Withania somnifera (S)*	4.04	12.16	5.7	21.91

13	*Withania coagulans (S)*	2.31	5.29	3.88	0.49
14	*Datura inoxia(S)*	3.46	11.64	0.51	15.62
15	*Ziziphus nummularia (S)*	1.15	1.5	0.02	2.76
16	*Acacia jacquemontii (S)*	0.57	0.06	0.01	1.65
17	*Oxystelma esculetum(H)*	7.22	2.11	0.20	9.54
18	*Euphorbia granulata (H)*	2.60	1.58	0.02	4.21
19	*Boerhavia procumbens (H)*	2.02	1.58	0.002	3.61
20	*Cynodon dactylon (G)*	7.80	0.16	0.23	10.68
21	*Desmostachya bipinnata (G)*	7.22	2.11	0.25	9.60
22	*Saccharum arandinacium(G)*	8.67	2.64	0.38	6.16
23	*Cenchrus ciliaris(G)*	4.04	2.11	0.1	6.26
24	*Saccharum spontaneum (G)*	3.46	1.5	0.03	5.09
25	*Saccharum munja (G)*	2.31	1.05	0.02	3.39

23 plant species were recorded from cultivated land (Table 4). Dominant tree species recorded were *Acacia nilotica (*IVI= 57.59), dominant shrubs species recorded were *Withania coagulans* (IVI= 9.20), dominant herbs species recorded were *Chenopodium album* (IVI= 8.74) while dominant grass were *Cynodon dactylon* (IVI= 9.18).

Table 4. Vegetative Analysis Cultivated Land in Taunsa Wildlife Sanctuary.

Sr.	Botanical Name	Relative Density	Relative Frequency	Relative Cover	Importance Value Index
1	*Albizia lebbeck (T)*	11.21	13.33	27.56	22.12
2	*Tamarix dioica(T)*	8.33	10.37	17.33	36.03
3	*Acacia nilotica (T)*	12.82	14.07	30.70	57.59
4	*Dalbergia sisoo (T)*	4.48	4.40	16.29	29.78
5	*Eucalyptus camadulensis (T)*	4.48	11.11	0.58	16.18
6	*Ziziphus mauritians (T)*	2.56	5.18	0.33	8.08
7	*Mangnifera indica (T)*	3.84	4.44	0.50	8.08
8	*Phoenix sylrestris (T)*	1.92	3.7	0.25	5.87
9	*Moru laevigata (T)*	0.96	2.22	0.12	3.30
10	*Morus alba (T)*	1.28	2.96	0.16	4.41
11	*Azadirachta indica (T)*	0.96	2.22	0.12	3.30
12	*Withania coagulans (S)*	2.24	6.66	0.29	9.20
13	*Abutilon muticum (S)*	0.86	1.58	0.02	2.47
14	*Chenopodium album(H)*	5.76	2.22	0.75	8.74
15	*Achyranthus aspera (H)*	5.12	2.22	0.66	8.01
16	*Solanum surattense (H)*	0.20	2.96	0.58	6.75
17	*Euphorbia proetrate (H)*	0.13	0.82	0.53	1.48
18	*Cynodon dactylon (G)*	7.37	1.48	0.33	9.18
19	*Desmostachya bipinata (G)*	6.41	1.48	0.96	8.85
20	*Saccharum arandinaceum(G)*	3.84	1.48	0.83	6.16
21	*Saccharum spontaneum (G)*	1.22	1.23	2.47	4.92

22	*Saccharum munja (G)*	1.68	2.46	0.62	4.76
23	*Typha domingenis (G)*	3.84	0.03	0.25	4.8

Khalil et al. (2015) reported that reported that potential habitat of Grey Francolin had prominent vegetation of *Acacia modesta, Acacia nilotica, Dalbergia sissoo, and Olea ferruginea,* in salt range (Punjab) which provide shelter to Grey Francolin for nest building and for roosting during night time. Grey francolin is preferred grass land shrubs, and shore forest having thorny trees in dry and low elevation areas often seen on well-watered or human altered environment. It is also often seen along roadsides at dawn or dusk (Scott et al., 1986; Pratt et al., 1987). In the present study, Grey Francolin was recorded at an elevation of 131-133m, which was a suitable habitat for Grey Francolin. Geography plays an important role in the habitat of Grey Francolin. It is generally found below 610m but occasionally as high as 1400m (Roberts, 1991).

The above results and discussion reveal that cultivated land is the preferred habitat for Grey Francolin, with trees, herbs, and shrubs that provide food and cover for the bird. However, forests with no availability of cultivated crops reduce the feeding resources. Hence, cultivated land is a favorable habitat for Grey Francolin in the study area.

The cultivated land habitat type lies at an elevation of around 133m, covered with dense vegetation, agricultural fields, and availability of water sources that fulfill all the requirements of Grey Francolin. The most abundant vegetation in this habitat includes agricultural fields and trees at the margins that provide cover and food for the bird. Grey Francolin is also known as an indicator species of farmland ecosystems, which is why they are mostly seen near cultivated fields (Chaudhary and Bhatti, 1992; Islam, 1999). Their omnivorous diet has allowed them to adapt to human-altered environments such as cultivated fields, irrigated plantations, golf courses, and roadsides (Cramp and Simmons, 1980; Del Hoyo et al., 1994).

Habitat use by Grey Francolin in various habitat types was recorded by Mahmood et al. (2010) who divided the study area into three habitats. In all habitats types the major plants species were common but with different values. It was concluded that the preferred habitat type recorded in the study area was open cultivated land, as it fulfilled all the requirements of the Grey francolin. This habitat was dominated by crops, trees, shrubs, herbs, and grasses, followed by forest land which was dominated by trees, herbs, shrubs, and grasses.

CONSERVATION RECOMMENDATIONS

Taunsa Wildlife Sanctuary in Pakistan provides a suitable habitat for the Grey Francolin. To effectively manage the population of Grey Francolin in the study area, it is important to consider the habitat characteristics when devising a conservation plan for this species.

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