

Flocking and habitat use pattern of the Red Junglefowl *Gallus gallus* in Dudwa National Park, India

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Abstract: The habitat use and flock composition of the Red Junglefowl *Gallus gallus* in Dudwa National Park, India was studied between 1991 and 1994. Six habitats were monitored during winter and summer throughout the study period. Data on habitat use, flock size and flock composition were collected from monitoring of six line transects and regular sightings along the road. Bonferroni simultaneous confidence interval was constructed to determine habitat use by Red Junglefowl. It showed preference for mixed forest and showed avoidance for teak forest. A total of 1174 individuals were seen more in summer, especially females. Maximum flock size was observed in sal forest in winter 1992. More than 80% (n=465) of the total observations were of single bird. The Red Junglefowl though not threatened and a species of less concern, needs continuous monitoring and proper management inputs so that it does not follow the fate of some other pheasant species.

Resumen: El uso del habitat y la composición de la parvada en el "junglefowl" rojo *Gallus gallus* en el Parque Nacional Dudwa, India, fue estudiada entre 1991 y 1994. Seis habitats fueron monitoreados durante el invierno y verano a través del período de estudio. Los datos sobre el uso del habitat, tamaño y composición de la parvada, fueron colectados del monitoreo de seis transectos y avistamientos regulares a lo largo del camino. Simultáneamente, se construyeron intervalos de confianza de Bonferroni para determinar el uso del habitat por el "junglefowl" rojo. Este mostró preferencia por el bosque mixto, mientras que evitó el bosque de teca. Un total de 1174 individuos fueron vistos en verano, especialmente hembras. El máximo tamaño de la parvada se observó en los bosques de sal en invierno de 1992. Más del 80% (n=465) de las observaciones totales fueron de una sola ave. No se pensó que el "junglefowl" rojo fuera una especie amenazada y menos afectada, por lo que necesita un monitoreo continuo e ingresos propios para un manejo que evite que no ocurra lo que a algunas otras especies de faisán.

Resumo: O uso do habitat e a composição dos bandos do faisão vermelho *Gallus gallus* no Parque Nacional de Dudwa, na Índia, foram estudados entre 1991 e 1994. Durante o inverno e o verão, ao longo de todo o período, foram controlados seis habitats. Os dados sobre o uso do habitat, dimensão e composição dos bandos foram coletados controlando seis transectos e observações visuais ao longo da estrada. O intervalo de confiança simultâneo de Bonferroni foi determinado para avaliar o uso do habitat pelo faisão vermelho. Este mostrou preferência pelas florestas mistas se bem que evite as florestas de teca. Um total de 1174 exemplares foram vistos mais no verão, especialmente fêmeas. A maior dimensão dos bandos foi vista nas florestas de shorea no inverno de 1992. Mais de 80% (n=465) do total das observações era constituído por uma única ave. Se bem que o faisão vermelho não seja uma espécie ameaçada e uma espécie que não suscite grande preocupação, necessita controlo continuo e gestão adequada para que não venha a ter a mesma sorte que algumas outras espécies de faisões.

Key words: Dudwa National Park, flocking, habitat use, Red Junglefowl, Sal forests.

Introduction

The Red Junglefowl *Gallus gallus* is distributed along the foothills of Himalayas from Myanmar to northwestern India extending southward into the hills of peninsular India (Ali & Ripley 1987). It also occurs in tropical and subtropical habitats in southern China and southeast Asia and has been introduced at several places (Delacour 1957; Sullivan 1991). The original distribution of the Red Junglefowl was from Indus river down through India, eastward across and down through Malaysia, Java and Lesser Sunda Islands (Howman 1993).

The Red Junglefowl *Gallus gallus* (Robinson & Kloss) is a resident bird and affects moist-deciduous forests and bamboo and scrub jungle interspersed with patches of cultivation (Ali & Ripley 1987). The Red Junglefowl is confined to the sal forest. Finn (1985) reported this species occupying a small isolated patch of sal in Panchmarhi, Madhya Pradesh. Ali & Ripley (1987) reported that in Mahadeo hills and Mandla district in Madhya Pradesh the Red Junglefowl occurs with the Grey Junglefowl (*Gallus sonnerati*).

The male of Red Junglefowl differs from the Grey Junglefowl in having a distinctive deep orange red in the head and yellow hackles on the neck and a prominent white rump. The Grey Junglefowl is overall grey.

The Red Junglefowl is common with no apparent threats and is considered safe (Collar *et al.* 1994). Hence it is an ideal candidate to study aspects of habitat use and ecology and long-term monitoring of population. In spite of this fact, very few studies have been undertaken on the biology of this species in India except for Collias & Collias (1967) and Kalsi (1992). A comparative study was also conducted to look at the Red Junglefowl behaviour in semi-wild to wild habitats and also demonstrate as how parallel studies can be conducted (Dawkins & Hillgarth 1992).

Studies in Dudwa National Park were carried out to study habitat use and flock composition of Red Junglefowl *Gallus gallus*. The species mostly confined to the protected areas within its distribution range is an important bird to evaluate the effects of various management activities. The Red Junglefowl is particularly vulnerable during the breeding period to fires in the sal *Shorea robusta*

and mixed forest, the two habitats frequently used for breeding. Populations of such commonly occurring species provide an ideal opportunity to examine the effect of various biotic pressures, human activity and land use changes, patterns very common in most of the south and south-east Asian countries. This makes the junglefowl an ideal species for a long-term monitoring and research programme while the species is still common. Such studies would allow an assessment of problems in areas with varying degrees of disturbance, mostly outside protected areas and effects of various management activities within the protected areas. This would help in formulating suitable management strategies for the conservation and management of galliformes in general and Junglefowls in particular.

Material and methods

Study area

Dudwa National Park is situated on the Indo-Nepal border (28°18' and 28°42' N and 80°28' and 80°27' E) in Nigahsan subdivision of Lakhimpur-Kheri district in Northern Indian state of Uttar Pradesh. The area falls under the Terai-Bhabar biogeographic subdivision of the Upper Gangetic Plain (7A) biogeographic classification of the Rodgers & Panwar (1988).

The Himalayan foothills lie about 30 km to the north of the Park. The topography is flat, with a maximum elevation of 182 m above MSL. In 1977, area was declared as a national park with a core zone of 490 km² and a buffer zone of 124 km². The buffer zone in Dudwa National Park (DNP) is located to the north of the core zone and includes villages inhabited by *tharu* tribes. About 30,000 people continue to live in a band of approximately 5 km wide in and around the Park (Singh 1982). These people are partly dependent on forest for thatch, fodder and fuelwood, thus creating an important management issue (Javed 1996). Intensive study area was located in Sonaripur and Sathiana region (Fig. 1).

Data collection

Data on aspects of habitat use and flock composition were collected between 1991 and 1994 by monitoring six open-width line transects to study the avian community structure. Each transect

was 1250 m in length and monitored twice a month. During three years 107 monitoring were done in winter and 80 in summers for all the six transects. All these transects were further subdivided into 50 m segments each for intensive vegetation studies. Observations on transects were further supplemented by recording observations from regular walks on the trails. The two main seasons, winter and summer, were covered for three years. For every sighting of the Red Junglefowl, we recorded data on numbers, sex, flock size and flock composition. Of the six transects two were located in woodland, one each in the riparian and sal forest. The remaining four were in grasslands, from open grassland to wooded grasslands.

Transects were monitored during winter (November to February) and summer (March to June). All transects were monitored from November 1991 to June 1992, November 1992 to June 1993 and December 1992 to June 1993. All transects were again monitored in the winter of 1994 (November to mid March). The data collected from these transects spread over two seasons, winter and summer. No data collection was possible in monsoon, from June to October because of the inaccessibility to most of the areas due to rains.

No strip width was fixed and all transects were open width and all birds seen on or near the transects were used in analyses. Most of the sightings were within 50 m on either side of the transect line, though it varied from one habitat to another.

All monitoring of the transects were done 15 minutes after sunrise and only on clear days. Each monitoring was completed in about two-to two and half hours on a clear day.

Data analysis

We used the number of sightings of the Red Junglefowl in each habitat and the area of each habitat to analyse differential habitat use. Bonferroni confidence interval was constructed following Neu *et al.* (1974) and Byers & Steinhorst (1984) to calculate habitat preference by comparing observed (π_i) with expected (π_{i0}) proportional use of each habitat type. We used Prefer (Prasad & Gupta 1992) to compute the confidence intervals which is based on calculating chi-square and then constructing the confidence interval using the Bonferroni statistics. Simultaneous Bonferroni confidence interval was constructed for actual proportion of usage (π_i) using the following formula:

$$\pi_i - Z_{0.05/2k} \sqrt{\pi_i(1-\pi_i)/n} \leq \pi_i \leq \pi_i + Z_{0.05/2k} \sqrt{\pi_i(1-\pi_i)/n}$$

k = number of habitats used

Results

Flock size

More than 80% of the total observations (n=465) were of single bird (Table 1). Maximum flock size of 20 birds was observed in sal forest in winter 1992. Bigger flocks with more than 10 birds were observed in forest-grassland mixed forest and sal forest habitats. Mean flock size in winter (Table 2) was highest for sal forest (5.7 ± 0.62) followed by mixed forest (4.0 ± 0.57) and forest-grassland interface (3.1 ± 0.48). In summer the mean flock size was highest in the teak forest (2.56 ± 0.26) followed by forest-grassland interface 2.55 ± 0.10). Mixed forest and sal forest had a mean flock size of (2.52 ± 0.10) and (2.4 ± 0.11). Smallest mean flock size was observed in grassland habitat (Table 2). The mean flock size did not differ significantly between winter and summer (Mann-Whitney U Test, U=4, P > 0.05).

Flock composition

A total of 1174 individuals of the Red Junglefowl were seen during the study period, out of which 994 were seen in summer and 180 in winter. Overall, the number of hens was higher than the

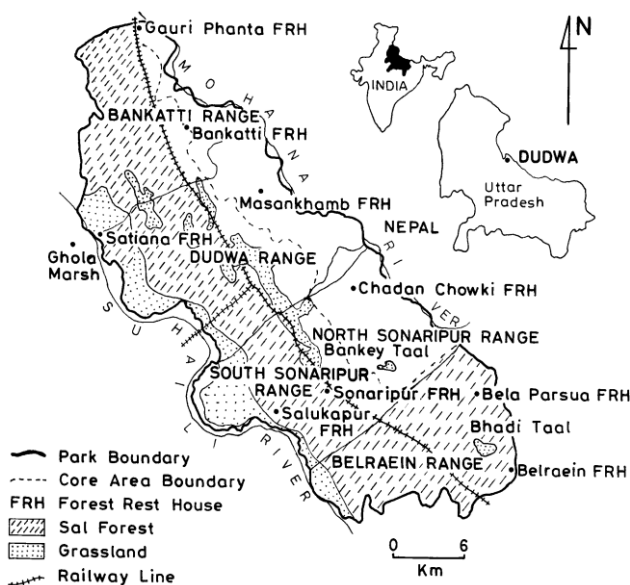


Fig. 1. Map of Dudwa National Park.

number of cocks; both during summer (510 females to 369 males) and winter (93 females to 84 males) across the habitats (Table 3). Male to female ratio was 0.75:1.0 (n = 465) with 0.90:1.0 (n = 48) in winter and 0.72:1.0 (n = 417) in summer.

Table 1. Flock size of Red Junglefowl in Dudwa National Park.

Habitat	Observations	Flock Size				
		1	1-2	2-5	5-10	10-25
Sal Forest	113	94	6	9	3	1
Mixed Forest	181	154	14	8	4	1
Riparian Forest	14	13	0	0	1	0
Teak Forest	17	17	14	1	2	0
Grassland	47	43	1	3	0	0
Forest-Grassland	93	60	13	12	7	1
	465	378	35	34	15	3

Table 2. Mean flock size (SE) of Red Junglefowl in Dudwa National Park.

Habitat	Observations	Summer		Winter	
Sal Forest	113	2.4	0.11	5.70	0.62
Mixed Forest	181	2.5	0.10	4.00	0.57
Riparian Forest	14	1.8	0.36	-	-
Teak Forest	17	2.5	0.26	-	-
Grassland	47	1.6	0.11	2.25	0.54
Forest-Grassland	93	2.5	0.17	3.15	0.48

During summer more hens than cocks were seen in all the habitats except forest grassland. Number of females seen in summer was significantly greater than the number of males ($X^2 = 26.1$, $P < 0.05$) whereas it was not so in winter.

Habitat use

The Bonferroni confidence statistics determined the differences in actual and expected use of the habitats by the Junglefowl. The Red Junglefowl showed preference for mixed forest, whereas it showed avoidance for teak forest. The overall habitat use was significantly greater in mixed forest ($P < 0.05$) and the expected utilization of this habitat was more as compared to sal forest which was utilized less in proportion to availability (Table 4).

Table 3. Flock composition in Red Junglefowl in Dudwa National Park.

Habitat	Males	Females	Sub adults	Chicks	Total
Sal Forest (113)					
Summer	71	114	29	21	235
Winter	44	48	0	0	92
Mixed Forest (181)					
Summer	152	234	24	6	416
Winter	16	22	0	0	38
Riparian (14)					
Summer	10	6	5	4	25
Teak Forest (17)					
Summer	23	21	1	0	45
Grassland (47)					
Summer	38	29	2	0	69
Winter	4	5	0	0	9
Forest-Grassland (93)					
Summer	75	106	23	0	204
Winter	20	18	3	0	41

The summer habitat use by the Red Junglefowl showed similar pattern of habitat use as in the overall usage (Table 5). The forest-grassland edge habitat was also used in significantly greater proportion to its availability, whereas rest of the habitats were used less in proportion to their availability.

There were very few sightings of the Red Junglefowl during winter. But the results were similar to the habitat use pattern in summer as the mixed forest was used more than sal forest (Table 6).

Discussion

The Red Junglefowl in Dudwa is common and occurs in different habitats such as sal forest, mixed forest and teak forest. Sullivan (1991) described it to occur in a variety of habitats from forest edge, scrub, lightly logged and particularly bamboo forest and felt that the name junglefowl is a misnomer. Sighting of single bird is more common as more than 80% of the total observations were of single bird, either male or female. This shows that the Red Junglefowl in Dudwa remains solitary for most of the time except during pre-breeding and post-breeding periods. Sightings of solitary bird were also very common in the Ceylon

Table 4. Overall habitat use by Red Junglefowl in Dudwa National Park ($Z = 2.24$).

Habitat	Total Area	Relative area	Expected usage	Observed usage	Expected Usage (Proportional)	Observed Usage (Proportional)	Bonferroni Confidence Interval	
Sal Forest	332.35	0.571	265.661	113	0.571	0.243	0.198	Pi 0.288*
Mixed Forest	43.11	0.074	34.460	181	0.074	0.389	0.339	Pi 0.440*
Riverine Forest	31.92	0.055	25.515	14	0.055	0.030	0.012	Pi 0.048*
Teak Forest	40.11	0.069	32.062	17	0.069	0.036	0.017	Pi 0.056*
Grassland	113.14	0.195	90.437	47	0.194	0.101	0.070	Pi 0.132*
Forest-Grassland	21.10	0.036	16.866	93	0.036	0.201	0.158	Pi 0.242*

Table 5. Summer habitat use by Red Junglefowl in Dudwa National Park ($Z = 2$).

Habitat	Total Area	Relative area	Expected usage	Observed usage	Expected Usage (Proportional)	Actual Usage (Proportional)	Bonferroni Confidence Interval	
Sal Forest	332.35	0.571	238.222	98	0.571	0.235	0.193	Pi 0.277*
Mixed Forest	43.11	0.074	30.905	165	0.074	0.395	0.348	Pi 0.444*
Riverine Forest	31.92	0.055	22.883	14	0.055	0.033	0.016	Pi 0.051*
Teak Forest	40.11	0.069	28.754	17	0.069	0.040	0.021	Pi 0.060*
Grassland	113.14	0.195	81.109	43	0.195	0.103	0.073	Pi 0.133*
Forest-Grassland	21.10	0.036	15.126	80	0.036	0.191	0.153	Pi 0.230*

Table 6. Winter habitat use by Red Junglefowl in Dudwa National Park ($Z = 2.63$).

Habitat	Total Area	Relative area	Expected usage	Observed usage	Expected Usage (Proportional)	Actual Usage (Proportional)	Bonferroni Confidence Interval	
Sal Forest	332.35	0.571	27.422	15	0.571	0.312	0.136	Pi 0.489*
Mixed Forest	43.11	0.074	3.558	16	0.074	0.333	0.154	Pi 0.513*
Riverine Forest	31.92	0.055	2.632	0	0.055	0.000	0.000	Pi 0.000*
Teak Forest	40.11	0.069	3.310	0	0.069	0.000	0.000	Pi 0.000*
Grassland	113.14	0.195	9.337	4	0.195	0.083	0.000	Pi 0.189*
Forest-Grassland	21.10	0.036	1.741	13	0.036	0.270	0.101	Pi 0.440*

Junglefowl (de Silva *et al.* 1992-93). Bigger congregations were observed during the post-fledgling period when hen and chicks fed together. Fewer numbers of observations limited any worthwhile comparison between winter and summer seasons.

Flocks in Dudwa mostly consisted of males and females. More females than males were seen, which was higher in summer as compared to winter. Collias & Collias (1967) observed a higher male to female ratio in the Red Junglefowl during summer in another moist deciduous habitat in India, whereas an unpublished study on the Grey Junglefowl in 1992 also observed a higher male to female ratio (Parikshit Gautam, Pers. comm.). The higher female to male ratio in summer is pos-

sibly due to the fact that females become more visible in the post-fledgling period as they come out in the open to feed alongwith their chicks.

Habitat use pattern in the Park did not differ significantly across the seasons. The Red Junglefowl used mixed forest more in proportion to availability as compared to the sal forest, which was used less in proportion to its availability. Our findings are similar to that of Kalsi (1993) who observed that mixed forests and plantations were used more in proportion to their availability. In summer the forest-grassland edge habitat was also used in significantly greater proportion to its availability. In winter again habitat use was similar to the summer and overall habitat use pat-

terns, though no major conclusions are drawn from this because of smaller sample size.

Conservation Outlook: Management Activities

Management activities in Dudwa are largely aimed at improvement of habitat for endangered species (Javed & Rahmani 1997). Pre-summer burning of the leaf litter in sal forest along the road is a regular management activity, but area away from road are not burnt in the same manner and are highly vulnerable to burning by accidental fires. The removal of understory and thinning in sal forest are done on an irregular basis and perhaps do not significantly influence the Red Junglefowl. Accidental fires in the forest during early summer may have some adverse effect on Red Junglefowl as they start breeding from mid April and chicks hatch during first week of May. One such fire in 1992 burnt a large part of the understory in one block of the Sathiana study area and was possibly responsible for the low recruitment of the Red Junglefowl due to nest destruction or chick mortality. Removal and timely burning of leaf litter, well before the commencement of breeding of the Red Junglefowl will reduce chick mortality and increase population.

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