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Research Article

STATUS AND DISTRIBUTION OF KALIJ *LOPHURA LEUCOMELANA* IN RANIKHET REGION OF KUMAON HIMALAYAS, UTTRAKHAND, INDIA

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ABSTRACT
To find out the status and distribution of kalij, 16 different places in and around ranikhet were surveyed. The surveys were conducted over an area of approximately 110 km², of which about 16 % was found suitable habitat for this species. A one- month survey was conducted in the intensive study area to select suitable sites for a close study and the line transect sampling method was used to sample the kalij population. in addition line transect data have also been used to generate encounter rate and to determine relative abundance of the species at different sites. Two forest trails were also established in the same stand of forest. These trails were monitored to generate the encounter rate. This was done in order to compare the results obtained by line transects with those of forest trails for abundance estimation. the overall density of kalij was 51± 17/km² and it showed significant seasonal variation. The encounter rate has been significantly different and consistently higher on trails than along the transects. There has been no significant difference in the encounter rates on the two forest trails. This is interesting since both trails differ in terms of biotic disturbance. It appears that kalij is not very sensitive to disturbance but it is certainly adversely affected when ground cover gets eroded.

Key Words: *Sampling Method, Kalij, Line Transect, Density Estimation, Encounter Rate, Relative Abundance, Biotic Disturbance*

INTRODUCTION

Due to their wide distribution and apparent tolerance of disturbance in their habitat the Kalij pheasant in the Himalayas may not be considered to be in immediate danger of extinction. However, the species has been a victim of poaching and habitat destruction and there is an apprehension that it may become threatened if timely effective remedial measures are not taken. The distribution of kalij throughout the Ranikhet region is patchy and if the current trends of deforestation and habitat fragmentation continue both its numbers and range may decline substantially. Poaching in winter and frequent fires in summer (May-June), the breeding season, has been very damaging. The information presented here had been gathered during the survey and intensive studies carried out from May 1991 to June 1994. The survey for the determination of status and distribution was conducted in and around the Ranikhet region at Ganiadeoli, Siun (Sonee), Ruinchi (Richee), Bhatronjkhan, Dewarpani, Billekh, Betalghat, Padholi, Kalika, Chilianaola, Dwarsyun, Kathpudia, Katarmal, Majhkhali, Pilkholi and Bamsyun (Figure 1).

STUDY AREA

The study area lies within the limits of the Ranikhet cantonment in Pali sub-division of Almora district (Fig.2). Ranikhet (29°29'50" North, 79°26'East) is situated on one of the ridges of the Kumaon Himalayas, which stretches half way across the district west to east and forms the northern boundary of the kosi basin. The cantonment comprises three distinct areas, Alma Barracks 1818 m, Deolikhet 1823m, and Chaubatia 2125m. Most of the area around Ranikhet is reserved forest and is more or less protected. The cantonment forest where the intensive studies were carried out, are bounded practically on all sides by the forest of the Ranikhet range of West Almora Forest Division. The forest is spread over a tract of rounded or flat ridges with subsidiary spurs and slopes of gentle-to-moderate gradient. The moderate slopes have given rise to deep and well drained-soils. In moist ravines and in places, generally north facing slopes, there is a good leaf-mold layer making the soil well suited to the growth of oak.

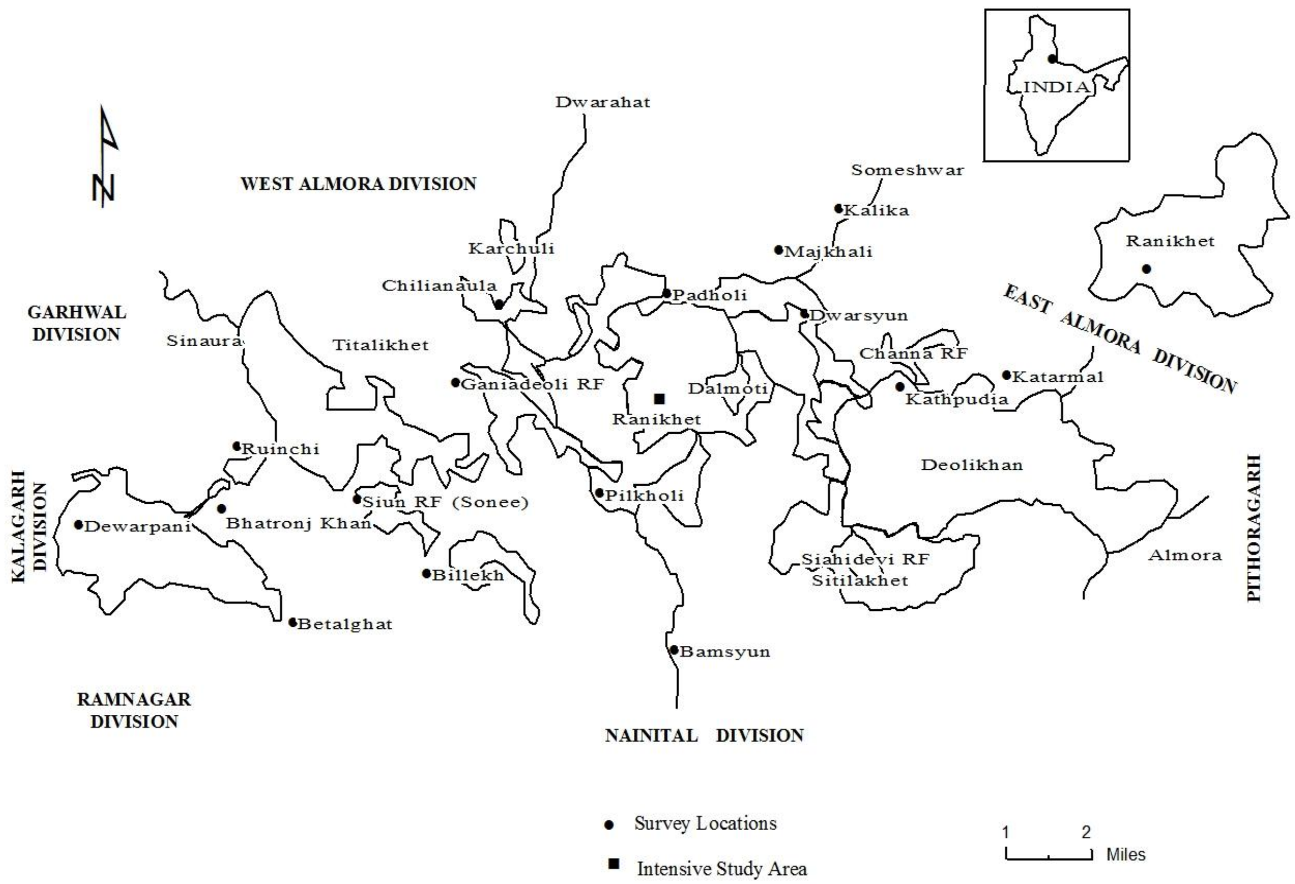

Fig.1 Map of the survey locations

On some of the ridges and southerly aspects in the chir-zone, more especially where grazing has been heavy in the past, the soil is poorer, shallow and dry. The basic pattern of weather and climate over the Himalaya is governed by the summer and winter monsoon system of Asia (Mani 1981). For all the seasonal regularity of the monsoon winds and rainfall, the local climate along the Himalayas is quite variable. Weather changes are unpredictable and erratic.

MATERIALS AND METHODS

The surveys were conducted over an area of approximately 110 km², of which only about 16% is a suitable habitat for the species. Areas with thick undergrowth where the kalij is most likely to be present, received special attention. More time was devoted to these places and less in the areas having chir-pine with no undergrowth. The data collected during the surveys were analyzed to find out the encounter rates (group/100hrs of effort) of kalij at different sites. Approximately 33.8 km² of area around the Ardee Estate, Jhula Devi, and Chaubatia (Fig.2) was surveyed to locate the species. The places where the birds were found (either direct sightings or indirect evidences such as droppings or feeding signs) were plotted on a map of 1:1000 scale. A one- month survey was first conducted to select suitable sites for intensive studies on density estimation, habitat use, social organization and roosting behavior. These sites have been referred to in the following text as S1, S2, S3, S4 and S5.

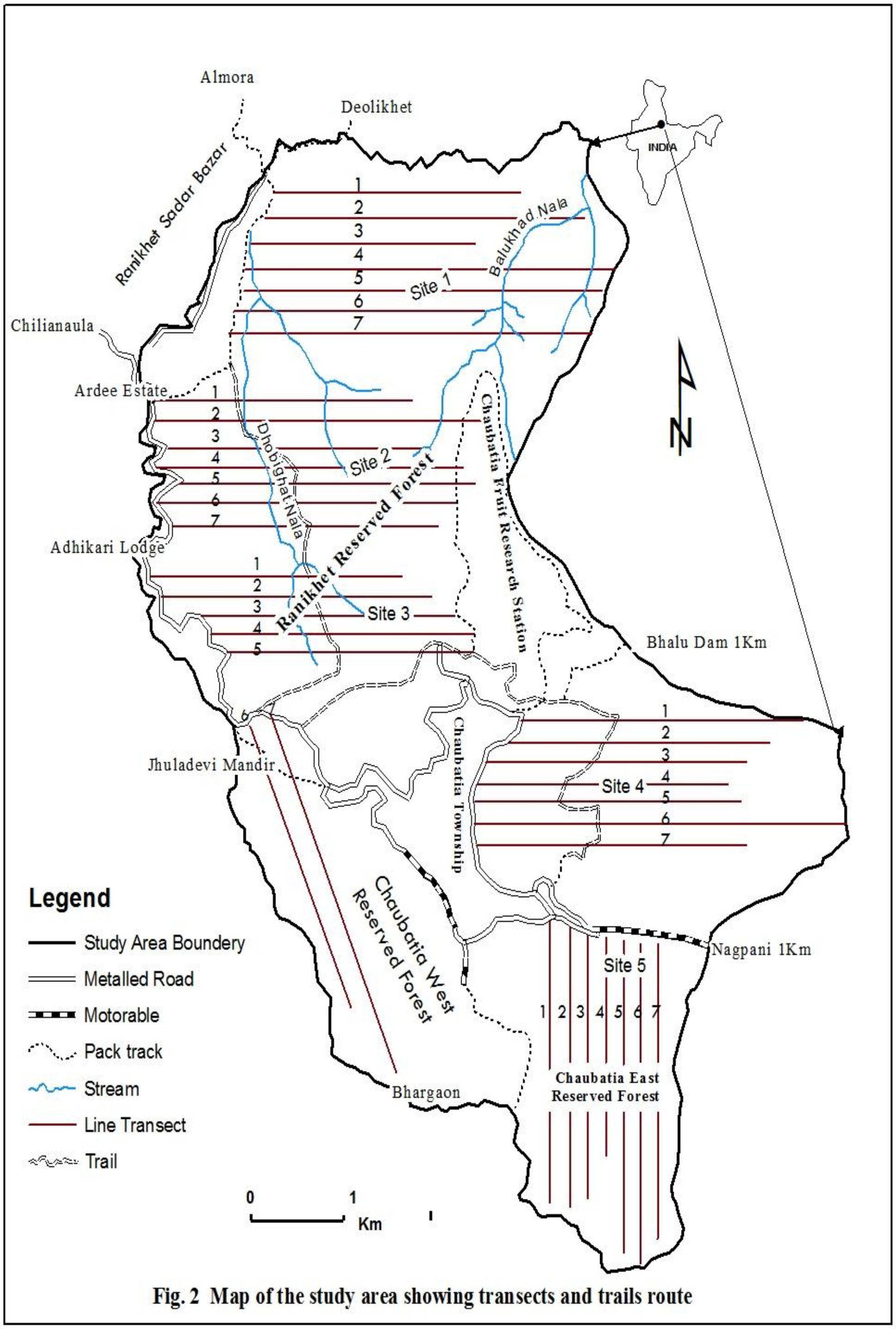

Fig. 2 Map of the study area showing transects and trails route

Table 1: Length of the transect and the number of monitoring at different sites. L = Total length of the transect in km, N = No.of monitoring, M = Average length monitored, PM=Post monsoon, W=Winter, S=Summer

S.No.	Seaons	Site 1			Site2			Site 3			Site 4			Site 5		
		L	N	M	L	N	M	L	N	M	L	N	M	L	N	M
1.	PM	12	21	1.71	11.6	21	1.65	10.5	23	1.5	11.2	24	1.6	9.9	23	1.41
2.	W	12	41	1.71	11.6	40	1.65	10.5	40	1.5	11.2	38	1.6	9.9	38	1.41
3.	S	12	26	1.71	11.6	26	1.65	10.5	28	1.5	11.2	28	1.6	9.9	27	1.41
Total		36	88	1.71	34.8	87	1.65	31.5	91	1.5	33.6	90	1.6	29.7	88	1.41

Table 2: Length (in km) of the transects at different sites

S.No.	Sites	Transects							Total
		1	2	3	4	5	6	7	
1.	S 1	1.5	1.9	1.3	2.1	1.8	1.4	2.0	12.0
2.	S 2	1.4	1.9	1.4	1.9	1.9	1.6	1.5	11.6
3.	S 3	1.3	1.9	1.4	1.9	1.4	1.5	1.9	10.5
4.	S 4	1.8	1.5	1.4	1.4	1.5	2.1	1.5	11.2
5.	S 5	1.4	1.4	1.3	1.1	1.6	1.6	1.5	9.9
Total		7.4	8.2	6.8	8.0	8.2	8.2	8.4	55.2

The line transect sampling method (Burnham et al. 1980, Gaston 1980) was used to sample kalij population in the intensive study area. The area to be covered at each site was marked in advance on the map and 7 transects were established at each of the five study sites for monitoring. The total length of the seven transects was 55.2 km (Tables 1 & 2). Each transect was more than 1 km long and all transects were placed 100 m apart. These transects were marked on the ground and were carefully routed along a set compass line. The sites were visited at dawn and two hours before dusk. The transects at each site were monitored once in a month. Visits to the sites were in rotation to give equal attention to all the sites. There were 444 monitoring of line transect covering a length of 702 Km. The sighting data collected on line transects at each site were separately pooled seasonally and used to calculate the density of kalij by the Fourier series estimator. The analysis was done by computer program “Transect” (Laake et al. 1979). All kalij sightings were grouped into 0-5 m distance intervals and analyzed using grouped option.

In addition, line transect data have also been used to generate encounter rate (groups/ monitoring and groups/100hrs) and to determine relative abundance of the species at different sites. Two forest trails were also monitored in the same stand of forest between Ardee Estate and Chaubatia. These trails were monitored weekly to generate the encounter rate (groups/monitoring and groups/100 hrs. This was done to compare the results obtained by line transects with those of the forest trails to find out the validity of the use of the forest trails for abundance estimation. The first and the second trails were monitored 26 and 27 times covering 105.3 km and 108.6 km, respectively. These trails, also, provided a good opportunity to assess the impact of biotic pressures on the species. This is because they suffered from varying intensity of human pressures such as browsing, lopping, collection of resin and other minor forest products. The intensity of the pressures was more on Trail 1.

With each kalij sighting on transects and the trails following data were also recorded:

a) Time spent
b) Habitat type
c) Number of individuals
d) Sex
e) Activity of the bird at the time of sighting

The sighting data collected on line transects at each site and two forest trails were separately pooled and analyzed to calculate the encounter rate (ER) (groups/monitoring and groups/100 hrs) for different sites, trails and seasons.

Comparisons have been made between the encounter rates at different sites, and along the transects and trails by one-way analysis of variance (ANOVA) and student's t-test following Fowler & Cohen (1986).

RESULTS AND DISCUSSION

Survey Result

Table 3 contains a summary of the results of the overall survey carried out in Ranikhet region . Out of 16 places surveyed, a record of kalij presence (direct & indirect evidence) was obtained only from 6 sites. The survey covered an altitudinal range from 1400-1950 amsl (Table3, Fig. 2). The kalij were sighted in three habitat types, i.e. oak, oak-scrub and riverine forest. The maximum ER (28 groups/100 hrs) was recorded at Sonee and the minimum (9 groups/100 hrs) at Ruinchi as well as Kalika.

Table 3: Sighting records and indirect evidences of kalij (N =21) at different locations in the Ranikhet region during status survey from October 1991- January 1992. (I/S = Individuals / sighting, + = Present, - = Nil, D = Dropping, FS = Feeding sign.

S.No.	Location	Altitude (m)	No. of groups	No.of kalij	I/S	Indirect evidences D	Indirect evidences FS	Man hrs	Records/ 100 hrs
1.	Ganiadeoli	1400-1600	2	6	3.0	-	-	20.5	10
2.	Sonee	1550-1680	6	23	3.8	+	+	21.05	28
3.	Ruinchi	1420-1650	2	7	3.5	+	+	21.3	09
4.	Bhatronjkhan	1400-1750	6	18	3.0	+	+	18.4	33
5.	Dewarpani	1500-1700	3	6	2.0	-	-	18.4	16
6.	Kalika	1700-1950	2	16	8.0	+	-	21.3	9
7.	Padholi	1600-1800	-	-	-	-	-	12.0	-
8.	Chilianaola	1500-1700	-	-	-	-	-	10.2	-
9.	Dwarsyun	1500-1640	-	-	-	-	-	4.5	-
10.	Kathpudia	1500-1650	-	-	-	-	-	6.3	-
11.	Katarmal	1400-1650	-	-	-	-	-	8.3	-
12.	Majkhali	1500-1750	-	-	-	-	-	10.1	-
13.	Betalghat	1350-1500	-	-	-	-	-	18.55	-
14.	Billekh	1400-1600	-	-	-	-	-	19.25	-
15.	Pilkholi	1500-1660	-	-	-	-	-	5.3	-
16.	Bamsyun	1400-1500	-	-	-	-	-	6.1	-

***Kalij density*:** Table 4 presents a summary of the average density of kalij in the intensive study area. It was estimated to be 51 kalij/km². The density has been found to vary seasonally and was highest during the post-monsoon season (70 ± 18 kalij/km²) and lowest in summer (18 ± 22 kalij/ km²).

Table 4: Seasonal estimate of the density (± 95 % confidence interval) for kalij by Fourier Series Estimator.

S.No.	Seasons	No. of groups	Line length (km)	Mean group size	Density	
					Groups/km²	Individual/km²
1.	**Post-monsoon**	82	176.6	2.8	25	70 ± 18
2.	**Winter**	145	310	2.8	24	66 ± 11
3.	**Summer**	93	215	3.0	6	18 ± 22

***Kalij encounter rate*:** Table 5 provides seasonal encounter rates (groups/monitoring) of kalij on line transects at different monitoring sites during 1991-92 and 1992-93.

Table 5: Mean encounter rate (groups/monitoring) of kalij at different sites during 1991-92. n = Number of groups seen, E = Encounter rate ± Standard error.

S.No.	Season	Site1		Site 2		Site3		Site4		Site5		Overall	
		n	E	n	E	n	E	n	E	n	E	n	E
1.	PM	10	0.83	11	0.91	13	0.92	11	0.78	9	0.64	54	0.82 ± 0.05
2.	W	15	0.75	17	0.80	18	0.85	13	0.72	13	0.72	76	0.77 ± 0.02
3.	S	7	0.53	10	0.71	11	0.78	9	0.64	7	0.53	44	0.64 ± 0.04
Overall		32	0.70 ± 0.08	38	0.81 ± 0.05	42	0.85 ± 0.04	33	0.71 ± 0.04	29	0.63 ±0.05	174	0.74 ± 0.05

Table 6: Mean encounter rate (groups/monitoring) of kalij at different sites during 1992-93. n = Number of groups seen, E = Encounter rate ± Standard error, PM=Post-monsoon, W=Winter, S=Summer.

S.No.	Season	Site1		Site 2		Site3		Site4		Site5		Overall	
		n	E	n	E	n	E	n	E	n	E	n	E
1.	PM	6	0.66	5	0.55	5	0.55	9	0.90	8	0.88	33	0.70 ± 0.07
2.	W	15	0.71	13	0.68	11	0.57	16	0.80	19	0.95	74	0.74 ± 0.06
3.	S	12	0.92	8	0.66	11	0.78	12	0.85	13	0.92	56	0.82 ± 0.04
Overall		33	0.76 ± 0.07	26	0.63 ± 0.04	27	0.63 ± 0.04	37	0.85 ± 0.02	40	0.91 ± 0.02	174	0.74 ± 0.58 ± 0.2
Overall Encounter Rate (Combined for the entire duration of the study)													
Overall			0.73 ± 0.03		0.72 ± 0.09		0.74 ± 0.11		0.78 ± 0.07		0.77 ± 0.14		0.66 ± 0.08

During 1991-92, the mean encounter rate was highest in the post-monsoon season (0.820 ± 0.05) and the lowest in the summer season (0.643 ± 0.04). The mean ER differed significantly between different sites (F 4, 10 = 9.3, P<0.01) and in different seasons (F= 2, 12 = 16.59, P<0.01). The encounter rates were consistently higher at S3 and the lowest at S5.

During 1992-93 the mean ER (groups/monitoring) was highest in summer (0.82 ± 0.25) and lowest in post monsoon (0.70 ± 0.07). The encounter rates differed significantly between sites (F 4, 10 = 8.06, P<0.01) but did not differ significantly in different seasons (F 2, 12 = 3.13, P> 0.05). There was however no marked pattern in encounter rates at different sites during different seasons. The overall encounter rates (combined for the entire duration of the study) ranged from 0.72 groups/ monitoring at S2 to 0.78 groups/ monitoring at S4. There was no significant difference in overall encounter rate in 1991-92 and 1992-93 (t = 0.64, d. f. = 2, P > 0.05).

Table 7 & 8 provides the encounter rates (groups/100hrs) of kalij at different sites during 1991-92 and 1992-93. During 1991-92, a maximum of 17 groups/ 100 hrs was recorded at S4 and minimum 12 groups/100 hrs at S1. The mean ER was highest (15.2 ± 0.73) in the post-monsoon season. During 1992-93 a maximum of 23 groups/100 hrs was recorded at S5 and a minimum 13 groups/100 hrs at S2 and S3.

Table7: Kalij encounter rate (groups/ 100 hrs) in different seasons at different sites during 1991-92. N = Number of kalij groups, T = Time spent in hrs, E = Encounter / 100 hrs, PM = Post-monsoon, W = Winter, S = Summer.

S. No.	Season	Site1			Site 2			Site3			Site4			Site5			Overall	
		N	T	E	N	T	E	N	T	E	N	T	E	N	T	E	N	E
1.	PM	10	78.0	13	11	73.3	16	13	83.5	16	11	65.1	17	9	64.2	14	54	15±0.73
2.	W	15	127.4	12	17	117.3	14	18	129.2	14	13	75.5	17	13	78.3	17	76	14 ±0.96
3.	S	7	57.0	12	10	61.2	16	11	62.0	18	9	58.2	15	7	55.0	13	44	14±1.06
Overall		32	262.4	12 ± 0.33	38	251.8	15 ± 0.66	42	274.7	16 ± 1.15	33	199.2	16 ± 0.66	29	198.8	15 ± 1.20	174	14±0.33

Table8: Kalij encounter rate (groups/ 100 hrs) in different seasons at different sites during 1992-93. N = Number of kalij groups, T = Time spent in hrs, E = Encounter / 100 hrs ± Standard error, PM = Post-monsoon, W = Winter, S = Summer.

S. No.	Seasons	Site1			Site 2			Site3			Site4			Site5			Overall	
		N	T	E	N	T	E	N	T	E	N	T	E	N	T	E	N	E
1.	PM	6	37.4	16	5	39.0	13	5	39.5	13	9	43.5	21	8	46.1	17	33	16±1.48
2.	W	15	93.0	16	13	83.5	16	11	87.0	13	16	95.0	17	19	83.3	23	74	17±1.64
3.	S	12	59.0	20	8	52.1	15	11	59.4	18	12	58.3	21	13	56.5	23	56	19±1.36
Overall		33	189.5	17 ± 1.33	26	175.0	15 ± 0.88	27	185.9	15 ± 1.66	37	196.8	20 ± 1.33	40	185.9	21 ± 2.0	163	17±0.88

The encounter rate was highest (19.4 ± 1.36) in summer and lowest (16.0 ± 1.48) in the post-monsoon. There was a significant correlation in groups/monitoring and groups/100 hrs during the two years (rs =0.55, n = 12, P<0.05).

Table9: Mean encounter rate (groups/monitoring) of kalij on two trails during 1991-92.
n = number of groups, E = Encounter rate ± Standard Error, PM=Post-monsoon, W=Winter, S=Summer.

S. No.	Seasons	Trail 1		Trail 2		Overall	
		n	E	n	E	n	E
1.	**PM**	10	2.5	9	2.2	19	2.35 ± 0.15
2.	**W**	16	2.6	14	2.3	30	2.45 ± 0.15
3.	**S**	6	1.5	9	2.2	15	1.85 ± 0.35
Overall		32	2.2±0.35	32	2.2 ± 0.03	64	2.21 ± 0.18

Table10: Mean encounter rate (groups/monitoring) of kalij on two trails during 1992-93.
n = number of groups, E = Encounter rate ± Standard Error.

S. No.	Seasons	Trail 1		Trail 2		Overall	
		n	E	n	E	n	E
1.	**PM**	8	2.6	6	3.0	14	2.3 ± 0.5
2.	**W**	8	1.3	9	1.5	17	1.4 ± 0.1
3.	**S**	6	1.5	8	2.0	14	1.7 ± 0.25
Overall		22	1.8 ± 0.4	23	2.1 ± 0.4	45	1.96 ± 0.42

Table 9 and 10 provides seasonal ER (groups/monitoring) for two forest trails for 1991-92 and 1992-93. The overall encounter rates were considerably higher ($P>0.05$) on forest trails compared to transects. During 1991-92, the overall ER was highest (2.45±0.15) in the winter and lowest (1.85 ± 0.35) in summer (Table 9) where as during 1992-93, it was highest (2.3 ± 0.5) in the post monsoon season and lowest (1.4 ± 0.1) in winter (Table 10).

Table11: Kalij encounter rate (groups/100hrs) in different seasons on two trails during 1991-92.
N = Number of kalij groups, T = time spent in hrs, E = Encounter / 100 hrs ± Standard error.

S.No.	Seasons	Trail 1			Trail 2			Overall	
		N	T	E	N	T	E	N	E
1.	PM	10	30.15	33	9	29.6	30	19	31 ± 1.5
2.	W	16	46.2	34	14	48.1	29	30	31 ± 2.5
3.	S	6	34.3	17	17	34.0	26	15	21 ± 4.5
Overall		32	110.6	28± 6.5	32	111.7	28± 6.2	64	28 ± 3.3

Table12: Kalij encounter rate (groups/100hrs) in different seasons on two trails during 1992-93. N = Number of kalij groups, T = time spent in hrs, E = Encounter / 100 hrs ± Standard error.

S. No.	Seasons	Trail 1			Trail 2			Overall	
		N	T	E	N	T	E	N	E
1.	**PM**	8	24.1	33	6	15.1	40	14	36 ± 3.5
2.	**W**	8	44.25	18	9	44.15	20	17	19 ± 1.0
3.	**S**	6	31.1	19	8	32.4	25	14	22 ± 3.0
Overall		22	99.45	23±4.84	23	91.65	28± 6.0	45	26 ± 5.4

Table 11 and 12 provides ER (groups/100 hrs) on forest trails during the two years. In 1991-92 the mean encounter rate was recorded 31.5 ± 1.5 for the two seasons; post-monsoon as well as winter. In summer it was 21.5 ± 4.5. There was no significant difference in the encounter rate on forest trails during the two years ($P > 0.05$).

The maximum encounter rate during 1992-93 was (40 groups/100 hrs) in the post-monsoon period on Trail 2 and the minimum was (18 groups/100hrs) in winter on Trail 1. The overall encounter rate on the two trails was 23 groups/ 100 hrs on trail 1 and 28 groups/100 hrs on trail 2.

Table 13 and 14 provides comparative encounter rates at transects and trails during 1991-92 and 1992-93. The mean ER (groups/monitoring) was 0.745 on transects compared to 2.21 on forest trails during 1991-92 and the difference was significant ($t = 10.4$, d. f. = 2, $P < 0.01$). The mean ER on transect and trail was 0.75 and 1.8 groups / monitoring during 1992-93 but the difference was not significant ($P>0.05$).

Table13: Encounter rates of kalij (groups/monitoring and groups/100 hrs ± SE) on transects and trails in different seasons during 1991-92. T1 = Transect, T2 = Trails. * Mean, SS= Seasons, PM= Post monsoon, W=Winter, S= Summer,

S.No. SS monitoring	No.of sighting		No. of individuals		No. of monitoring		Groups/ Spent		Time 100 hrs		Sighting/	
	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
1.	PM 15	66 31	8	54	19	165	98 ± 0.05	0.820 ± 0.15	2.35	364.1	61.05	
2.	W 14	98 32	12	76	30	176	133 ± 0.07	0.772 ± 0.15	2.45	528.1	94.35	
3.	S 15	68 22	8	44	15	130	67 ± 0.04	0.643 ± 0.35	1.85	293.4	68.30	
Overall	232	28	174	64	471	298	0.745* ± 0.05	2.21* ± 0.18	1186.0	224.1	15	28

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Table14: Encounter rates of kalij (groups/monitoring and groups/100 hrs ± SE) on transects and trails in different seasons during 1992-93. T1 = Transect, T2 = Trails. * Mean, SS= Seasons, PM= Post monsoon, W=Winter, S= Summer

S.No.	SS monitoring	No. of sighting		No. of individuals		No. of monitoring		Groups/ Spent		Time 100 hrs		Sighting/	
		T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
1.	PM	46	5	33	14	86	60 ± 0.07	0.70 ± 0.5	2.3	205.4	39.2	16	36
2.	W	99	12	74	17	245	76 ± 0.06	0.74 ± 0.1	1.4	442.2	88.4	17	21
3.	S	67	8	56	14	176	64 ± 0.04	0.82 ± 0.25	1.7	285.4	63.5	20	22
Overall		212	25	163	45	507	200	0.75* ± 0.03	1.8* ± 0.26	933.0	191.1	17	18

Table 15 presents the summary of the data. However, the pooled data for the entire study period showed a significant variation in encounter rates on trail and transect (t = 6.1, d. f. = 2, $P < 0.05$).

Table 15: Mean encounter rates (groups/monitoring & groups/100hrs) of the entire study period on transects and trails for kalij during 1991-93.
(n = number of groups, A = groups/monitoring, groups/ 100hrs)

S.No.	Seasons	n	Transects		n	Trails	
			A	B		A	B
1.	Post-monsoon	87	0.76 ±0.05	15.27 ± 0.23	33	2.6	32.91
2.	Winter	150	0.75 ± 0.73	15.45 ± 0.45	47	2.0	25.71
3.	Summer	100	0.73 ±0.09	17.27 ± 0.06	29	1.8	22.0
Mean		337	0.75 ±0.008	16.00 ±0.63	109	2.14 ±0.23	26.87 ±3.20

DISCUSSION

Information on status, distribution and other ecological requirements of pheasants in India is inadequate. Gaston (1983) reviewed the current knowledge of pheasant distribution and integrated the information on ½ º grid square maps. The maps give an overall picture of distribution of pheasants based on past works.

The maps show wide gaps in distribution indicating further need of status survey. Pheasants, in general are a difficult group to study. Satisfactory techniques for field studies, such as abundance estimation, social or other behavioral studies have not yet been fully developed because the birds are evasive, their habitats are opaque and not easily accessible. The lack of dependable and applicable techniques for field studies is also due to the fact that relatively fewer studies have been and are being conducted on pheasants and the techniques in-vogue need refinement. Past research efforts on pheasants in general have concentrated more on development and refinement of techniques available to be used for collection of data on abundance and distribution (Garson 1980, 1989 & 1993, Gaston 1980 & 1983). A review of available literature in general suggests that call count (Gaston 1980, Garson 1980 & 89, Young et al. 1987, Duke 1989, McGowan 1989) has been developed and used quite extensively on almost all those species which have a prominent dawn chorus.

Apart from that encounter rates have also been used to generate measures of abundance through random walks, monitoring of roads and forest trails, and casual observations. While results of call counts have been best reviewed by Duke (1989), there is a genuine need to establish the validity of encounter rates. The encounter rates have so far been expressed in terms of sightings of pheasant groups in relation to distance covered, monitoring efforts or total time spent. The encounter rates thus generated have been used for relative abundance estimation rather than absolute measures of abundance. However, the encounter rates generated by monitoring of forest trails, roads and exploratory surveys suffer from the following drawbacks:

1. The birds may avoid / select areas around the trails and forest roads due to open conditions on roads and consequently one can have significantly lower or higher encounter rates. Results from number of studies show this confounding effect on roads and trails (e.g. Sathya *et al.*1993).

2. The observers are likely to walk through easily accessible areas and several locations preferred by pheasants may be missed. This may bring in an element of bias.

3. The third and most important point which has not been adequately addressed is the minimum sample size required to generate the encounter rates. Going through the literature one may see that in a majority of cases (e.g. Sathya *et al*. 1993) the encounter rates have been generated on the basis of small sample sizes which are simply misleading.

4. There is a tendency of producing density measures (groups/km² or number of individuals/km²) which produce very high density estimates and are not realistic.

The present study sought to address these, and several other points and the result support the apprehension expressed above. The line transect method (Burnham *et al* . 1980, Buckland *et al*. 1993) has been developed quite well on the conceptual level and there is enough support in the literature for the method which is simple, robust and produces more or less unbiased density estimates, provided the underlying assumptions are not violated. Gaston (1980) has recommended the use of line transect method in density estimation of kalij but a real field test is still not available. The present study used the line transect method along with monitoring of trails to estimate the density and to generate encounter rates.

The overall density of the kalij in the study area was 51± 17/ km² with significant seasonal variations. The density figures are very high and cannot be regarded as correct. However, this high density estimate should not be attributed to any shortcoming in the line transect method. The apparent cause of error is the subjective estimation of distances which couldn't be avoided due to hilly and forested terrain. Similar doubts have been expressed by Sathya *et al*. (1993) in regard to the flushing distance influencing density estimates. The encounter rates (groups/monitoring & groups/100 hrs) show significant variations; spatial, seasonal as well as annual. As for example the encounter rates were consistently higher at S3 and lower at S5 during 1991-92 which is reflected in overall means also for these sites.

This pattern was not distinctively obvious during 1992-93. The pooled data for 1991-92 and 1992-93 produce no significant variations either spatial or seasonal (Table 6). Variation was due to low sample sizes rather than the actual differences because these differences disappear when data are pooled. This suggests that such stochastic variations (Duke 1993) can be dealt with by reasonable sample sizes. There has been a significant correlation between estimates of groups/monitoring and groups/100 hrs suggesting a general agreement between these two estimates and either of them can be used with the same confidence.

The encounter rates (groups/monitoring & groups/100 hrs) have been significantly different and consistently higher on trails than on the transects. The encounter rates generated by transects are thus believed to be unbiased and realistic while trail encounter rates do not appear to be so. This conclusion has been drawn on the basis of this study. Therefore it should be interpreted with care in future studies. More sightings on the forest trails than on the transects may be due to the tendency of kalij to move about in pairs or small family parties while foraging on forest trails (Ali & Ripley 1982).Since the trails provide an open area the chances of predation are few. Adequate sunshine and even food are another draw (Sathya *et al*. 1993). There has been no significant difference in encounter rates between two forest trails which is interesting since both trails differ in terms of biotic pressure and disturbance. It appears that kalij is not very sensitive to disturbance but it is adversely affected when ground cover gets eroded. Moderate grazing and lopping might even favour good growth of ground cover. For example, the encounter rates were low near the Chaubatia forest as compared to Jhula Devi forest. The forest at Chaubatia is least disturbed and is almost closed canopy forest with little undergrowth. In contrast the forest at Jhula Devi is open and the ground cover is moderate with mild topography.

The presence of kalij pheasant in Ganiadeoli, Sonee, Ruinchi, Bhatronjkhan and Dwarpani and their absence from Pilkholi, Bamsyun, Majkhali, Dwarsyun, Katarmal, Billekh, Padholi, Kathpudia and Chilianaola can be related to the forest cover and its extent. Kalij is found present where there is a continuous extent of forest with heavy to moderate undergrowth. They are absent in places where there is no continuous extent of forest or no undercover, like in chir-pine stands. The fragmentation of habitat has also adversely affected their abundance. The high abundance at Sonee and low in Ruinchi and Kalika can also be attributed to the above mentioned factors. In general the forest around Ranikhet has suffered due to human disturbance. Even the reserved forest is disturbed by grazing, fuel collection, other human activities and deforestation for fuel and timber and for more land coming under terrace cultivation. If this pace of deforestation continues, chir-pine being ruderal in nature, (Singh & Singh 1987) can dominate the area (lower and middle altitude oak-zone and can be detrimental to both, the environment in general and pheasants in particular. The pheasants will be adversely affected because they belong to a highly specialized group of birds inhabiting a very fragile habitat where the least human exploitative pressure sets off an irreversible chain reaction. Kalij which is characteristic species of the lower half of the temperate zone (Gaston *et al.* 1981) can also be badly affected.

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