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Original Article

Population structure, behavior, and distribution pattern of the river lapwing *Vanellus duvaucelii* (Lesson, 1826)

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ABSTRACT

A field study was carried out to investigate the population status, behavior, and distribution pattern of river lapwings during the study period of 2015–2017 in the Raebareilly district, Uttar Pradesh, India. There was a significant difference in the mean population of river lapwings along the study sites but less significant difference in the mean population seasonally. An average of 541 individuals of river lapwings have been reported during the study period. The mean population size was maximum (164.5 ± 28.67) at Gegaso in 2016 and minimum (56.25 ± 28.34) at Sultanpur Barhaia in 2017, whereas the seasonal population status showed maximum (199.5 ± 2.12) count in the summer season at Gegaso and minimum (52.0 ± 4.2) in winter at Sultanpur Barhaia. Moreover, maximum ($n = 38$) nesting pairs were estimated at Gegaso and least ($n = 11$) at Unchahar. There was less significant difference in the number of chicks counted in both the breeding seasons (2016 and 2017), but significantly a higher number of chicks ($n = 86$) were documented at Gegaso and least ($n = 25$) at Sultanpur Barhaia. Overall, there was no significant difference in the behavioral activities during the breeding and nonbreeding season. The present study clearly indicates that the river bank was the most preferred habitat type and that the distribution pattern was found to be clumped in river lapwings.

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Introduction

The lapwings are an example of waders, which predominantly prefer open habitat that contains plenty of water. They possess long stout legs, short straight bill, and wings with rounded edges (Kazmierczak 2000). They share a range of habitats such as low wet grasslands, edges of lakes, sandy inland, river banks, steppes, arable, and dry grasslands (Ali and Ripley 1980; Duckworth et al 1998; MacDonald and Bolton 2008; Maruyama et al 2010). Around 22 species of plovers or lapwings come under the genus *Vanellus* (Perrins and Middleton 1984), numerous of which commonly breed in agricultural areas (Sonobe and Usui 1993). The IUCN has recently declared river lapwings as a near threatened species (The IUCN Red List of threatened species 2016).

The river lapwing ranges over Northern and Southern India, Nepal, Bhutan, Bangladesh, and Myanmar and extends into

Indochinese subregion (Salim 2002). They are distributed mostly along the River Ganges in the Raebareilly district. Restricted range and threatened bird species need major attention from ecologist and conservationists compared with wide-ranging and common species. Macroecological relationships between local abundance and distribution or range size have recently received greater attention (Gaston and Lawton 1990). The distribution of animals is usually thought to be restricted by the availability of greater feeding areas, with predators and disease organisms determining the quality of such areas in addition to resource abundance (Newton 1998). It is well established that the abundance of waterbirds depends on the degree of the availability of suitable habitats (Sampath 1989). Data regarding the status and distribution of threatened birds help in the prediction of disturbance level and implementation of conservation measures at all potential sites of their occurrence (Riley 2002; Robin and Sukumar 2002; Stattersfield et al 1998).

Population fluctuation has been detected in lapwings throughout the last two centuries (Gibbons et al 1996). The recent decline in lapwings is primarily attributed to anthropogenic habitat changes from agricultural intensification, drainage of ground water, afforestation, and invasion of shrubs. Moreover, hunting has

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possibly contributed to population declines in the lapwings (Bird Life International 2011; Petersen 2009). The actual population size of river lapwings is difficult to determine. According to Perennou et al (1994), global population estimate of river lapwings is <25,000 individuals. However, according to Wiersma and Kirwan (2016), the population of river lapwings may possibly be not more than 15,000 individuals.

River lapwings seem to be primarily sedentary, enduring at one place (Hayman et al 1986; Johnsgard 1981). They usually show vigilance, food intake, running, walking, preening, stretching, and crest-rising behavior. Primarily, they prefer to live in flocks or groups. Barnard (1980) has reported that group living is a general strategy among birds which offers advantages such as the increase in individual protection against predators and a high probability of finding and capturing prey (Krebs and Davies 1996). McNamara et al (1987) reported that the sequential organization of behavior has evolved because its benefits favor maximization of individual fitness, as the time committed to one activity limits the time available for other activities.

Previously, studies regarding the population status, distribution pattern, and general behavior of river lapwings have not been carried out in India. Consequently, information on population structure and distribution pattern of this species is negligible. The aim of the present study is to understand the current population structure, behavior, and distribution pattern of the river lapwing on the basis of rigorous observation and monitoring of different selected sites in the study area. The survey data were initially used to estimate the breeding population of these birds in the Raebareli district to evaluate the importance of the area in terms of its breeding bird populations. Furthermore, they were used to investigate the distribution pattern along the river banks.

Material and methods

Study area

The field study was performed along the River Ganges in the district Raebareli, Uttar Pradesh (India). The River Ganges provides a wintering and staging ground for a number of migratory waterfowl and breeding ground for resident birds (Mishra et al 2016). In the study period of August 2015–November 2017, numerous adults and chicks of river lapwings were investigated along the River Ganges. This was followed by detail surveys across a 5-month period of February–June during the breeding season. The detailed study coincided with the egg-laying season of the river lapwing. This helped to minimize pseudoreplication because the birds remained close to their nests during this time to protect the nesting area and eggs. Sampling sites were selected randomly, and their GPS coordinates were noted down (Appendix 1) for the assessment of distribution pattern and occurrence of river lapwings.

Population monitoring

The survey on lapwings was executed continuously traveling a fixed route recording birds on either side of the observer. We followed the survey methods used by Shrubbs and Lack (1991), Wilson et al (2001). A total of 60 transects were selected, covering the length of 35 km along the river bank (Table 1) for the analysis of population structure of river lapwings.

To accomplish the assessment of population status and behavior of river lapwings, six study locations were visited (Figure 1). Most of the field work was completed in areas close to the river banks, and observed individuals were evaluated (Hagemeijer and Blair 1997). River lapwings were observed and counted during 278 field

Table 1. Length and number of transects surveyed (500 meters of each transect).

S.N.	Study stations	Surveyed length (km)	Number of transects
1	Rampur Kala	5	10
2	Gegaso	8	16
3	Dalmau	6	12
4	Chandpur Loop	5	10
5	Sultanpur Barhaia	5	10
6	Unchahar	6	12
	Total	35	70

surveys. An average of six field surveys were made in a month at regular intervals. During the surveys, individuals were counted at each location. While observations were conveyed, individuals of river lapwings were not disturbed. Apart from counting the number of birds (chicks and adults), the number of birds in different habitat types were also investigated.

The line transects and point count methods were applied to accomplish this investigation. The line transect method was based on recording birds along a predetermined route within a predetermined survey unit. In this method, researchers traversed a line and detected animals as the target objects (Burnham et al 1980). The point count method (Bibby et al 2000) was also applied along the predetermined transects for sampling the birds.

Behavior sampling

The behavioral study was conducted during the breeding and nonbreeding seasons. At 20-minute intervals, body postures of the river lapwings were recorded by using the scan and focal sampling methodology (Altmann 1974). The birds were observed during three separate periods of the day: 06:00–9:00 am, 11:00–01:00 pm, and 04:00–6:00 pm. For this purpose, four to eight pairs of river lapwings were selected randomly from different habitat types, viz natural vegetation, crop field, river island, and river bank.

The behavior of each river lapwing was recorded for 420 hours (7 hours daily; 210 hours per season). The behavior included (1) locomotion (i.e. running, walking, and flying), (2) maintenance (i.e. preening, shaking, stretching, and wing flapping), (3) foraging (i.e. food intake and drinking), (4) social behavior (i.e. interspecific and intraspecific completion), (5) vigilance, (6) vocalizations, (7) defense (threat displays and attacking), (8) inactivity (sleeping), and (9) miscellaneous. Because the birds were not tagged, we possibly made repeated observations of the same bird in some cases. About this possible deviation in data, we suggest some mitigating factors. If we recorded a bird more than once, it was on a different date and time as we did not observe the same individual within the same observational session.

Statistical analysis

All analyses were carried out using GraphPad Prism software (version 5.01) and Paleontological software (PAST, version 3.12). The two-way analysis of variance (ANOVA) was performed to compare the population status of river lapwings in different seasons (Factor-1) and at various study sites (Factor-2). The number of nesting pairs and chicks counted at various study station (Factor-1) and in different years (Factor-2) was statistically analyzed by using two-way ANOVA. The frequency of river lapwings in different habitat types was evaluated by using one-way ANOVA. All the behavioral activities were compared between the breeding and nonbreeding seasons using Mann–Whitney–Wilcoxon *t* test (nonparametric). Data were presented as mean \pm standard deviation, and a probability level of 5% was used as the minimal criteria of significance.

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