

OBSERVATIONS ON BREEDING BEHAVIOUR AND VOCALIZATIONS IN RED-WATTLED LAPWING, *VANELLUS INDICUS* (AVES: CHARADRIIDAE) FROM NORTHERN INDIA

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ABSTRACT – We studied some aspects of breeding behaviour and vocalizations of an avian species, the Red-wattled Lapwing, *Vanellus indicus*. Both male and female participated in nest formation, incubation and other parental duties. The average nesting period was 7.83 ± 1.08 days ($n=6$). Female laid 3-4 eggs per clutch (mean: 3.71 ± 0.18 ; $n=7$). Average incubation period was 28.75 ± 0.48 days ($n=4$). Nesting on roof was also observed. Individuals used different types of vocalizations such as territorial calls, alarm calls and tit...tit... calls. Territorial calls were loud, stereotyped, wide band (6.64 ± 0.022 kHz) and produced to advertise/ defend the territories. The alarm calls were relatively fast (72.12 ± 1.37 calls per min), wide band (7.56 ± 0.165 kHz), and stereotyped. The minimum, maximum and dominant frequencies were 2.38 ± 0.039 kHz, 9.94 ± 0.159 kHz and 4.85 ± 0.154 kHz, respectively. These calls were produced to alert young ones, family/ flock members regarding the presence of predator.

Key words : *Vanellus indicus*, Red-wattled Lapwing, bio-acoustic, breeding behaviour, vocalizations.

INTRODUCTION

Birds use a wide range, species specific contextual vocalizations in their communication. Vocal signals play important role in the sociobiology of birds, namely social contact, parent-offspring interactions, cohesiveness among flock/ family members, threat and danger (Catchpole and Slater, 1995; Marlar and Slabbekoorn, 2004). Most avian species produce specific alarm vocalizations, when they encounter predators (Blumstein, 1999; Ficken and Popp, 1996). Some species produce a single invariant call, while others produce multiple types of vocalizations. Because alarm calls convey specific information about environmental events (Blumstein, 1999). Some avian species use the songs and calls to advertise their territories and for coordination with mate (Falls, 1978; Bhatt *et al*, 2000).

The study of vocalizations falls under the interdisciplinary branch of science known as 'bio-acoustics'. The importance of bioacoustic studies in behavioural ecology and sociobiology, evolutionary biology, conservation biology, taxonomy and neurobiology has been established globally. In Indian sub-continent large number of avian species inhabits, which are known for their elaborate, complex and varied vocalizations, yet scientific studies on their acoustic communication are scanty (Kumar, 2003). Till date, vocalizations of only a few species could be documented systematically (Kumar and Bhatt, 2001; Katti, 2001; Kumar, 2004; Ishtiaq and Rahmani, 2005). To fill the gap in information, extensive

long term investigations are needed for the characterization and documentation of vocal repertoire of Indian birds. In the present investigation, an effort has been made to describe the physical characteristics and temporal organization of some vocalizations in the Red-wattled lapwing, along with some observations on breeding biology.

MATERIALS AND METHODS

Species studied : Red-wattled Lapwing, *Vanellus indicus* (Boddaert, 1783) belongs to order Charadriiformes and family Charadriidae. It is a common, wide spread, resident in Indian subcontinent (BirdLife International, 2009). It is distributed from West Asia (namely Iraq, South West Iran and the Arabian/Persian Gulf) to eastwards across South Asia (namely Pakistan and Afghanistan). Often migrate locally or altitudinally in spring and autumn (such as in North West Pakistan). It is a territorial ground living bird usually forage upon insects, snails and other invertebrates. It is a sexually alike species having red coloured bill and facial wattles with yellow coloured long legs. The upper face, flank, belly and tail are white, while wings and back are light brown with a purple sheen. In flight, prominent white wing bars formed by the white on the secondary coverts. Usually fly in slow manner with deliberate flaps of the wings, and well known loud calls phonetically rendered as "Did-he-do-it". The breeding season is mainly March to August. The eggs are laid in a ground scrape or depression about 3-4 black-blotched buff and cryptically coloured. Both male and female share the parental duties (Ali and Ripley, 1987).

Behavioural observations and recording of signals: Opportunistic behavioural observations were made on nine individuals, in and around Gurukul Kangri University Campus, Haridwar (29°55'N, 78°8'E) during January 1996 to December 1999. The habitat of the area was sub-urbanized composed of small gardens, mixed tree patches, shrubs, hedges, open grass fields and fragmented agriculture fields. Observations on three individuals/ pairs were made in Doon valley during March 2002 to February 2005. Main study site was Wildlife Institute of India (WII) campus, Dehradun and adjacent area (30°26'N; 78°06'E). Mostly, behaviour of the target birds was observed with the help of 7x50 field binocular. Vocalizations of seven individuals were recorded. All birds recorded in their natural habitat with out any disturbance. To avoid recording the same individual twice, each bird was recorded only when it was within view and recordings were made in each area only once. Signals were recorded using Sony CFS 1030S or Sony PCM-M1 or Marantz PMD 222 sound recorders and JVC MZ-500 or Sennheiser ME-66 microphones. Behavioural correlates were used to infer the possible meanings of the vocalizations.

Bio-acoustic analysis: Recordings were transferred digitally to computer. After editing, cuts of high quality

recordings were analyzed with the help of sound analysis software, Avisoft SAS Lab Pro (version 4.1). Spectrograms were displayed on a computer monitor and measurements of variables were made using frequency and time cursors. Dominant frequency of given call was analyzed generating power spectrum. The frequency of highest peak was recorded. All spectrograms were calculated using following setting of SAS Lab,

1. **Frequency Resolution:-** FFT-length: 512; Frame size: 100%; Window: Flat Top.
2. **Temporal Resolution:-** Overlap: 87.5%; 1/ Bandwidth: 5.674 ms; Fix resolution: 2.667 ms; in sample units: 64.

In the present study, minimum frequency, maximum frequency, range of frequency, dominant frequency (frequency of maximal amplitude), duration and gap in calls were measured to characterize the signals. Structure of elements in calls, frequency modulation patterns and rate of production (calls per minute) were described/ calculated to define the acoustical features of vocalizations. Results were expressed as mean±SE. Number of calls/ elements used for analysis were shown as *n*.

RESULTS AND DISCUSSION

Breeding behaviour: In northern India this species

Table 1 : Details of nests studied, their locations and breeding performance in Red-wattled Lapwing.

Nest ID	Nesting location	Nesting period in days (from— to—)	Clutch size (no. of eggs)	Incubation period in days (from-- to—)
Study site 1: Haridwar (29°55'N; 78°08'E)				
H-1	In the open grass field located outside the main entrance of Gurukul Kangri University.	9 days (29.03.97 to 06.04.97)	4 Eggs	30 days (29.03.97 to 27.04.97)
H-2	In side the campus of Gurukul Kangri University	4 days (09.05.97 to 15.05.97)	4 Eggs	28 days (15.05.97 to 11.06.97)
H-3	On the Roof of Department of Zoology, Gurukul Kangri University	7 days (29.05.98 to 04.06.98)	4 Eggs	28 days (04.06.98 to 01.07.98)
H-4	On the Roof of Department of Zoology, Gurukul Kangri University	-	3 Eggs	Observed on 30.03.99
H-5	Near Roadside, Bheemgoda barrage, Haridwar	8 days (21.05.98 to 28.05.98)	4 Eggs	28.05.98 to ... ?
Study site 2: Dehradun (30°26'N; 78°06'E)				
D-1	Inside the WII Campus	12 days (11.04.03 to 22.04.03)	4 Eggs	29 days (22.04.03 to 20.05.03)
D-2	Inside the WII Campus	7 days (17.05.04 to 23.05.04)	3 Eggs	23.05.04 to ... (on 28.05.04 eggs eaten by unknown predator)



Fig. 1 : Different aspects of breeding biology of Red-wattled Lapwing (A) Adult individual is foraging near nest, (B) Courtship behaviour, (C) Nest with eggs, and (D) Fledgling in grass field.

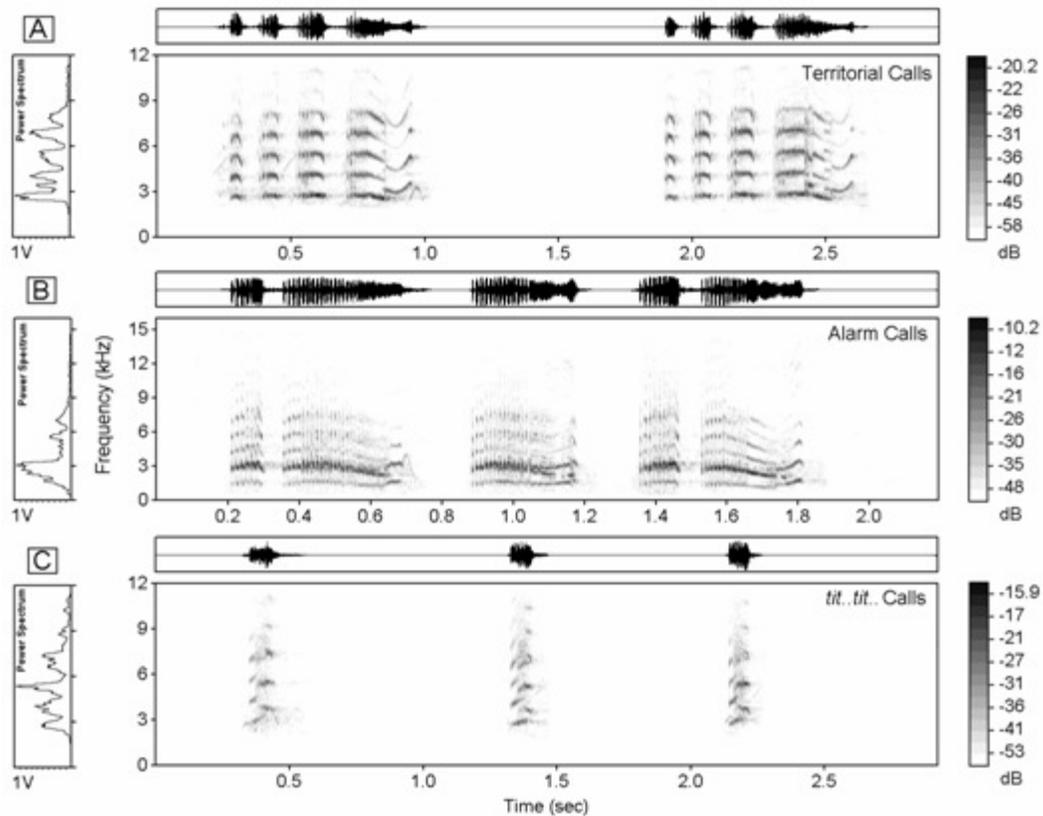


Fig. 2 : Spectrograms of the different types of vocalizations in Red-wattled Lapwing.

breeds March to July. After searching a suitable nesting place, both sexes participated in nest formation for about 4 to 12 days (7.83 ± 1.08 , $n=6$). However, initiation of nest formation was not marked with any specific behaviour. When both male and female started to inspect a particular place, it was assumed that the place is selected as nesting site. Later on, it is confirmed with frequent presence of both individuals at that place and deposition of some pebbles, and sometime droppings (if available) also. The nest was a depression usually fringed with pebbles, goat or cattle droppings/ dung. After completion of the nest, female laid 3-4 eggs (mean, 3.71 ± 0.18 , $n=7$). Eggs were cryptically coloured and matched with background of the nest. They were glossless, pyriform, light creamish or greenish in colour with irregular tobacco brown to coffee brown blotches (figure 1). Both male and female incubated the eggs. Average incubation period was 28.75 ± 0.48 days ($n=4$). After hatching both sexes participated in parental duties.

In the present study, this species was observed to nest on the top of roof also, during May 1998, a nest namely H-3 (Table 1) was observed on the roof of second story building of Department of Zoology, Gurukul Kangri University. The nest was placed in north-eastern corner of roof boundary (height about 2 ft). The nest was lined with pebbles. Four eggs were laid and hatched successfully after completion of usual incubation period (28 days). It was very interesting (and surprising!) to note that just after 3 days, two young ones came down on ground through rain-water drainage pipe, without any injury. When inspected, rests of the two young ones were missing. It seems that most probably both were eaten by an unknown

avian predator. While due to predation pressure rest of the two came down on ground accidentally. During next 10 days, both chicks were seen accompanied with parents and foraging in the play ground adjacent to Department of Zoology. After nine days, the lapwing family abandoned the play ground and shifted to adjacent Ganga canal area, comprised of grass patches, plenty small shrubs and scattered trees (seems relatively safer), probably due to anthropogenic pressure aroused owing to playing students. It seems that in first half of fledgling phase they were able to survive easily in play ground due to small size and cryptic plumage camouflaged in small grass of play ground. But later on it would have been difficult to hide them inside small grass owing to their growing size and relatively limited foraging opportunities.

During March 1999, breeding activities were also observed at the same nesting location *i.e.* on the roof of Department of Zoology. Three eggs were observed on 30.03.99. Unfortunately, nesting failed as disturbed by unknown predator. During the same time period, nesting on roof was also reported by a person from an adjacent area *i.e.* Kankhal, about three km. from the University premises. But observations could not be made due to some logistic reasons. However, the person informed that for last three years the lapwing nesting on roof of his ashram, every year.

The nesting on roof has been reported by some earlier workers also (Saxena, 1974; Koshy, 1989). Mundkar (1985) observed several nests on the roofs of different double/ triple story buildings in Poona. The roofs, which were selected for nesting had some common characters such as roofs were flat or very slightly sloped with

Table 2 : Physical characteristics of different types of vocalizations of Red-wattled Lapwing.

Types of vocalizations? Physical Characteristics?	Territorial Calls	Alarm Calls	Tit...Tit... Calls
Minimum Frequency (kHz)	2.34 ± 0.016 (n=16)	0.85 ± 0.016 (n=22)	2.39 ± 0.012 (n=9)
Maximum Frequency (kHz)	8.90 ± 0.015 (n=16)	10.93 ± 0.016 (n=22)	11.15 ± 0.012 (n=9)
Range of Frequency (kHz)	6.64 ± 0.022 (n=16)	10.05 ± 0.018 (n=22)	8.84 ± 0.022 (n=9)
Dominant Frequency (kHz)	2.71 ± 0.024 (n=16)	3.06 ± 0.018 (n=22)	5.34 ± 0.024 (n=9)
Duration of Call (sec)	0.72 ± 0.048 (n=16)	0.47 ± 0.012 (n=22)	0.15 ± 0.052 (n=9)
Gap between Calls (sec)	0.93 ± 0.0421 (n=10)	0.35 ± 1.12 (n=22)	0.88 ± 0.722 (n=9)
Rate of Production (calls per min)	38.26 ± 2.42 (n=5)	72.12 ± 1.37 (n=18)	55.67 ± 0.92 (n=4)

numerous scattered pebbles and stones; absence of tall brick walls or railings; and presence of water in nearby area. When compared to present study, we also observed same characteristics at nesting location.

On 28.05.1998, when, observing the nest no. H-5, the belly-soaking behaviour was performed by incubating bird for, two times (with in a period of half an hour). It was a hot day and opportunistic observations were made on this breeding pair between 12.30 pm to 2.00 pm. The belly-soaking behaviour was almost similar as reported in a previous study (Sundararaman, 1989). This behaviour has been reported by some earlier workers also (Dharmakumarsinhji, 1964; Jayakar and Spurway, 1965).

Vocalizations: Individuals used different types of context specific, wideband vocalizations made up of mostly complex structured, stereotyped elements with warbles (rapid frequency shifts) and harmonics.

1. Territory Advertisement Calls: Red-wattled Lapwing is a territorial species. Individuals advertise and guard their territories using these vocalizations, often accompanied with aerial display namely undulating flight with fully spread wings and tail. Both male and female used these calls, phonetically rendered as '*did-he-do-it*'. These calls were uttered in night also. The minimum, maximum and dominant frequencies were 2.34 ± 0.016 kHz, 8.90 ± 0.015 and 2.71 ± 0.024 kHz ($n=16$) respectively (Table 2). The average duration of calls was 0.72 ± 0.048 sec ($n=16$) preceded and followed with temporal gap (average: 0.93 ± 0.042 sec; $n=10$). The rate of production was 38.26 ± 2.42 calls per minute ($n=5$).

Territory advertisement vocalizations are the regular features of vocal repertoire of many avian species (Marlar and Slabbekoorn, 2004). Some species, such as Oriental Magpie Robin, *Copsychus saularis* use territorial calls during winter/non-breeding season and song during summer/breeding season for the advertisement of territories (Bhatt, *et al.* 2000). In the present study, we could not concentrate regularly on territorial behaviour of Red-wattled Lapwing. It is difficult to say whether this species defend territories throughout the year or only during breeding season. However, Vyas (1997) reported large flocks of Red-wattled Lapwing (26 to over 200 individuals) in pre-breeding/ non-breeding season. Individuals disperse with the onset of breeding season and actively defend their territories after pair formation. It seems that Red-wattled Lapwing defend only breeding territories using territorial calls accompanied with some aerial displays as reported by Vyas (1997), also.

2. Alarm Calls: In the presence of predators, both male and female used these vocalizations. Human

presence (observer) near the nest was enough to elicit these vocalizations. When nest/ chicks were approached, both male and female produced these calls at higher rate, loudness with an attack on observer. These signals were composed of elements with wide frequency range (10.05 ± 0.018 kHz, $n=22$). The minimum, maximum and dominant frequencies were 0.85 ± 0.016 kHz, 10.93 ± 0.016 and 3.06 ± 0.018 kHz ($n=22$) respectively (Table 1). The average duration of calls was 0.47 ± 0.012 sec ($n=22$) with temporal gap (0.35 ± 1.12 sec; $n=41$). The rate of production was 72.12 ± 1.37 calls per minute ($n=18$).

Alarm calls and their possible functions have been studied in many avian species (Ficken and Popp, 1996; Leavesley and Magrath, 2005). The alarm calls may include more than one category/ pattern of vocalizations, based on degree of predation pressure, type of predator or position of predator (Kumar, 2004). The possible functions of alarm calls may include warning of kin and unrelated conspecifics (Sherman, 1985), coordination of flocking (Cresswell, 1994), communicating degree of risk (Ficken, 1990) and anti-predator behaviour (Yahner, 1980). In the present study, Red-wattled Lapwing produced loud, wide band, frequency modulated signals. These are more easily locatable than narrow band signals (Klump and Shalter, 1984). It is suggested that most probably Red-wattled Lapwing used these signals to divert the attention of predator from chicks/ nesting site and may facilitate the recruitment of other birds to harass the predator to leave the vicinity.

3. Tit-Tit Calls: Individuals produced fast, wide band and stereotyped calls, phonetically rendered as *tit...tit* (figure 2). These signals were composed of elements with wide frequency range (8.84 ± 0.022 kHz, $n=9$). The minimum, maximum and dominant frequencies were 2.39 ± 0.012 kHz, 11.15 ± 0.012 and 5.34 ± 0.024 kHz ($n=9$) respectively (Table 1). The average duration of calls was 0.15 ± 0.052 sec ($n=9$) with temporal gap (0.88 ± 0.722 sec; $n=9$). The rate of production was 55.67 ± 0.92 calls per minute ($n=4$). These calls were produced during courtship and during territory advertisement also.

Vyas (1997) also observed the utterance of some vocalizations by male bird during courtship display of Red-wattled Lapwing. It is reported that during courtship, male bird flies off, circles the area several times with vocalizations, and approach a prospective female with raised head and fluffed breast feathers. In the present study, we observed that during courtship male bird fluffed the feathers with raised head and *tit...tit...* vocalizations, approached female and mounted for insemination (figure 1). However, it will be too early to conclude the purpose of *tit...tit...* calls. These calls were used by individuals

during territory advertisement also. Meaning of these calls is ambiguous. It seems that male produce these calls for mate acquisition and/ or to contact with female. Further investigations are needed to understand the biological significance of these calls.

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