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Cover: Mauve Stinger *Pelagia noctiluca* by Swaathi Na. Medium used is soft pastels and gelly roll.



A study on the breeding habits of Red-wattled Lapwing *Vanellus indicus* Boddaert, 1783 (Aves: Charadriiformes: Charadriidae) in the agricultural landscape of Muzaffarnagar District, Uttar Pradesh, India

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Abstract: This study investigated the breeding biology of Red-wattled Lapwing *Vanellus indicus* in the agricultural landscape of district Muzaffarnagar, Uttar Pradesh, India, during three consecutive breeding sessions (2019–2021). A maximum of 25 nests and average clutch sizes of 3.64 ± 0.49 were recorded in 2021. Hatching success estimated using the Mayfield method was 55% in 2019, 64% in 2020, and 65% in 2021; values obtained using the traditional method were 42%, 58%, and 53%, respectively. During 2019 and 2021, 3.8% and 3.3% (respectively) of eggs did not successfully develop, while no hatching failures were recorded in 2020. In total, 32% of eggs were destroyed during the study period by predators (cats, dogs, and foxes), and an average of 15% of eggs were destroyed due to anthropogenic activities such as agricultural practices. Red-wattled Lapwings displayed cryptic behavior and active defense against predators making them a successful open nesting species.

Keywords: Breeding season, clutch size, incubation period, hatching success.

Birds are good indicators of a healthy ecosystem (Gregory et al. 2003). Red-wattled Lapwings *Vanellus indicus* belong to the Charadriidae family and are recognized via a unique red wattle in front of the eye. This bird is widely distributed throughout the Indian subcontinent (Ali & Ripley 2002; BirdLife International

2017) and a loud alarm call is an important characteristics of this species (Anil & Sharma 2011). Lapwings are open field nesters, mostly living in small flocks near wetlands, agricultural fields, and human settlements and feed on vegetable waste, beetles, & snails (Ali & Ripley 2002; Grimmett et al. 2016), and commonly breed from March to June, with male lapwings choosing nest sites. The females lay eggs in open areas or on the ground, and nests are difficult to find since the eggs are cryptically colored, usually matching the ground pattern. The eggs are laid in a ground scrape or depression, sometimes fringed with pebbles and goat or hare pellets, which help to camouflage the eggs from predators (Saxena & Saxena 2013). Some studies (Saxena 1974; Koshy 1989; Anil & Sharma 2011; Sethi et al. 2011) have reported lapwings nesting on roof sites to protect their eggs from predators.

The Red-wattled Lapwing is considered a 'Least Concern' species according to the IUCN Red List of Threatened Species (IUCN 2021), with strong populations throughout the world. Few studies (Sethi et

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al. 2011; Khalil et al. 2018; Mishra & Kumar 2020) have been conducted on their breeding behavior. This study's primary aim is to document the lapwing's breeding biology, especially on rural agricultural ground, and to assess breeding parameters throughout the study period.

MATERIAL AND METHODS

Study area

The present study was carried out in the agricultural landscape in three villages of Muzaffarnagar District, Uttar Pradesh, India: Ghisukhera (29.5795°N, 77.6035°E), Chokra (29.5875°N, 77.5820°E), and Charthawal (29.5440°N, 77.5920°E) (Table 1; Image 1). About 60% of the area of these villages is occupied by agricultural land where seasonal commercial crops such as sugarcane, wheat, rice, and fodder grasses are cultivated. The temperature varies from 35°C in summer to 14°C in winter, with an annual average temperature of about 25 °C. The area receives about 120 mm rainfall annually (in monsoon).

Table 1. Geographical information about the agricultural landscape of district Muzaffarnagar, Uttar Pradesh.

	Name of study site	Geo-coordinates of sites	Elevation (m)
1	Ghisukhera Village	29.5795°N, 77.6035°E	246
2	Dahchand Village	29.5875°N, 77.5820°E	240
3	Charthawal Village	29.5440°N, 77.5920°E	252

Methods

The study was carried out in three agriculture fields during the lapwing breeding session (March–June). To assess breeding parameters (Sethi et al. 2011), key parameters including pairing, nesting, egg laying, incubation, and hatching were studied in 2019, 2020, and 2021. Data were collected in the morning (0700–1100 h) and evening (0400–0600 h) at two day intervals. In total, 10 visits were made to each study site, and observations were recorded using a Nikon Coolpix P1000 camera.

Data Analysis

Data were analyzed using one-way ANOVA (Analysis of Variance) and t-test as described by Clark (2007). MS

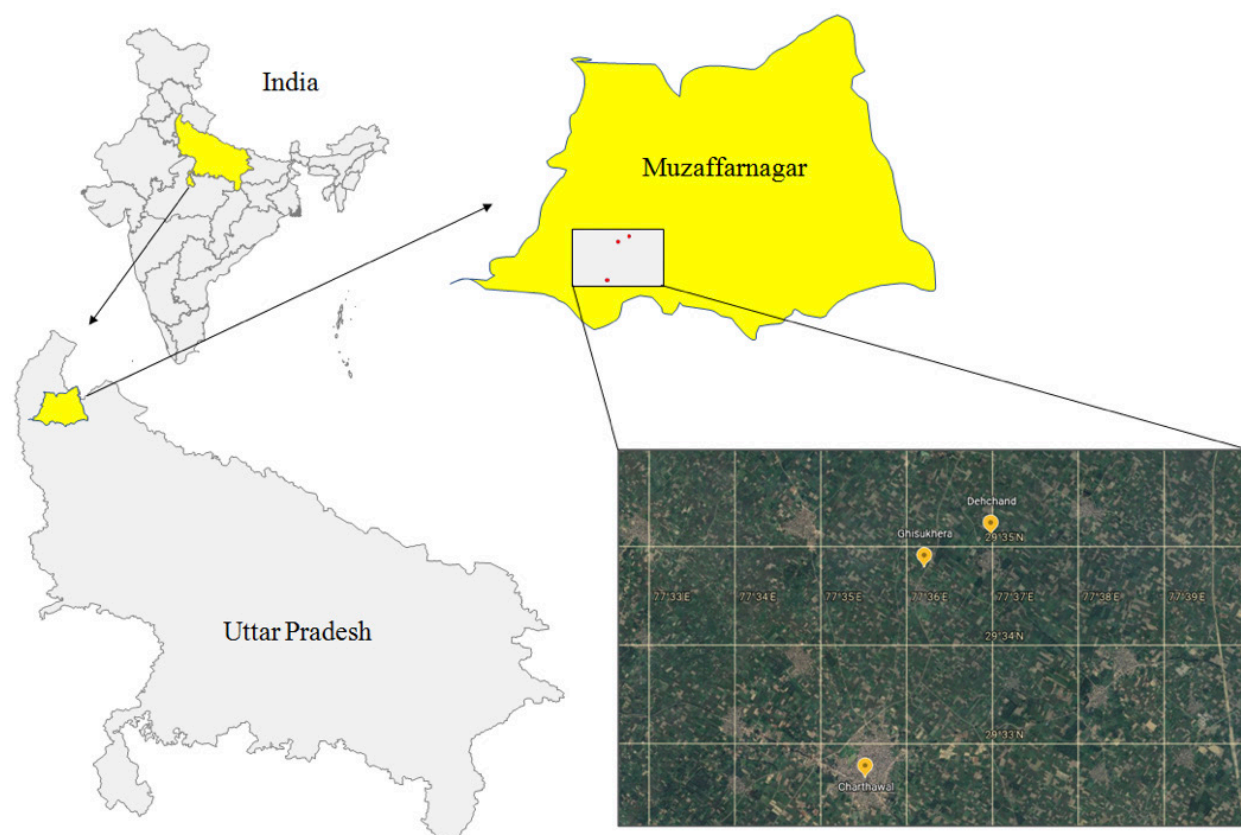


Image 1. The study area of the agricultural landscape in Muzaffarnagar District, Uttar Pradesh. Source: Google Maps.

Office Excel (version 10) was used for the data analysis. We used Mayfield's method to reduce error and biases in the determination of egg hatching success (Mayfield 1975; Johnson 1979) according to the formula:

$$\text{Hatching success} = 1 - (\text{total number of failed nests} \div \text{total number of exposure days}) \times 100$$

Lapwing egg hatching success was also calculated using the traditional method formula:

$$\text{Hatching success} = (\text{No. of Eggs hatched} / \text{Total No. of eggs laid}) \times 100$$

RESULTS

The results showed that the Red-wattled Lapwings started breeding in April in the study area and continued until June. We observed that when female lapwings incubate the eggs, males protect the nest, and vice versa. After hatching, both parents participate in parental duties, as reported in previous studies (Ali & Ripley 1998; Ali & Sharma 2011; Khalil et al. 2019). A total of 22, 18, and 25 nests were recorded in 2019, 2020, and 2021, respectively. During those years the average clutch sizes were 3.59 ± 0.50 , 3.67 ± 0.49 , and 3.64 ± 0.49 ; and the mean number of eggs hatched successfully per clutch was 1.5 ± 1.77 , 2.11 ± 1.97 , and 1.92 ± 1.80 (Table 2).

The hatching success during the period with the Mayfield method was found to be 55.10% in 2019, 63.90% in 2020, and 64.5% in 2021. The hatching success rates with the traditional method for the eggs hatched were 41.77% in 2019, 57.58% in 2020, and 52.75% in 2021. Un-hatched eggs or hatching failure was also reported during the study; hatching failure was 3.80% in 2019 and 3.30% in 2021. However, no hatching failures were recorded in 2020 (Table 3). The results indicated that an average of 32.11% of lapwing eggs were destroyed during the study period (2019, 2020, and 2021) by predators (cats, dogs, foxes). Similarly, 14.82% of eggs were destroyed due to anthropogenic activities such as agricultural practices during the study period (Table 3).

DISCUSSION

In the present study, we found that the breeding

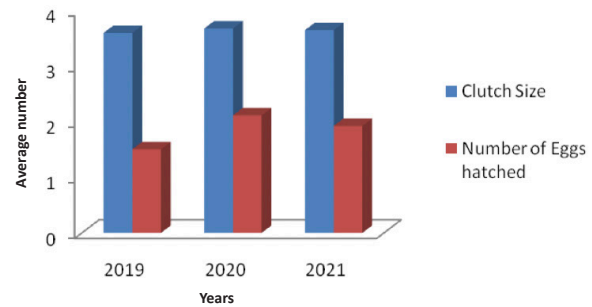


Figure 1. The average clutch size and hatched eggs during the study period.

Table 2. Breeding parameters studies in agricultural landscape (Ghisukhera, Dahchand, and Charthawal Villages) from 2019 to 2021.

Parameters	Years		
	2019	2020	2021
Incubation period	28 ± 0.10	25 ± 1.58	29 ± 0.40
Nest formation in months	April	March	March
No. of nests (n)	22	18	25
Clutch size (Mean ± SD)	3.59 ± 0.50	3.67 ± 0.49	3.64 ± 0.49
Number of eggs hatched (Mean ± SD)	1.5 ± 1.77	2.11 ± 1.97	1.92 ± 1.80

period of Red-wattled Lapwing ranged from April to June, with a peak in April. Some previous studies (Kumar et al. 2011; Sethi et al. 2011) were conducted in the plain areas of Haridwar, and our results on breeding season support their findings. The breeding parameters of Lapwing species, clutch size (3–4 eggs), the average number of eggs hatched (2–3 eggs), and the incubation period (25–30 days) recorded in the present study are very close to those reported by previous studies (Desai & Malhotra 1976; Ali & Ripley 1998; Sethi et al. 2011) conducted in different regions of India.

In our study, we found that the agricultural landscape is very suitable for the lapwing breeding success; maybe the open harvested ground is not attractive to livestock, and the harvested land soil serves as an effective camouflage against the predators. However, in some cases, cattle reportedly crushed the eggs of ground-

Table 3. Nesting and breeding parameters of Red-wattled Lapwing *Vanellus indicus* in the agriculture landscape of Muzaffarnagar, Uttar Pradesh.

Year	Number of nests observed	Eggs laid	Eggs hatched	Hatching success calculated by Mayfield method (%)	Hatching success calculated by traditional method (%)	Eggs destroyed due to predation (%)	Eggs destroyed due to anthropogenic activities (%)	Hatching failure (%)
2019	22	79	33	55.10	41.77	40.51	13.92	3.80
2020	18	66	48	63.5	57.58	27.27	15.15	0
2021	25	91	38	64.9	52.75	28.57	15.38	3.30

nesting Lapwing (Hart et al. 2002). Lapwings, both males and females, often aggressively attack predators like dogs, cats, cattle, or humans who approach their nests. Some previous studies (Beintema & Muskens 1987; Khali et al. 2019) have also reported lapwing camouflage behavior and attack on predators. Lapwing have used different types of nest protection mechanism for successful breeding.

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Erratum

In the article describing the Rajendran's Shieldtail *Uropeltis rajendrani* by Ganesh & Achyuthan (2020), inadvertently, the details of the scientist in whose honour the new species was named, Dr. M.V. Rajendran were unfortunately miswritten. It is here clarified that Dr. M.V. Rajendran was a professor of Zoology in St. Xavier's College Palayamkottai and was a Founder Trustee with the Madras Snake Park Trust (now Chennai Snake Park Trust). This inadvertent handslip in furnishing his details and whereabouts is regretted.

Ganesh, S.R. & N.S. Achyuthan (2020). A new species of shieldtail snake (Reptilia: Squamata: Uropeltidae) from Kolli Hill complex, southern Eastern Ghats, peninsular India. *Journal of Threatened Taxa* 12(4): 15436–15442. <https://doi.org/10.11609/jott.5680.12.4.15436-15442>

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