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RESEARCH ARTICLE

A STUDY ON CLUTCH AND EGG CHARACTERISTICS OF WHITE-BREASTED WATERHEN, *AMAURORNIS PHOENICURUS PHOENICURUS* IN JAMMU (J&K), INDIA

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ABSTRACT

The present research on clutch and egg characteristics of White-breasted Waterhen (*Amaurornis phoenicurus phoenicurus*) was carried out during 2013-2015 in Jammu district of J&K State. A total of 67 clutches were studied. The overall mean clutch size was recorded to be 5.97 ± 1.35 varying from 3 to 8. The clutch size of 6 was recorded to be the most common (29.85%). Eggs were oval, cream in colour and marked with light and dark brown and purple blotches and spots. Mean values of egg dimensions and their range was: egg length = 40.6 ± 0.19 mm (37-46 mm), egg breadth = 30.9 ± 0.09 mm (28-34 mm), egg weight = 18.86 ± 0.63 gm (17.5-20.5gm), egg volume = 19.95 ± 1.94 cm^3 (15.86-25.35 cm^3) and egg shape index = 76.22 ± 3.05 (66.66-82.05). A statistically significant and strong positive correlation was recorded between egg volume and egg length and egg volume and egg breadth as well as of egg weight with egg length, egg breadth and egg volume while a strong but negative correlation was registered between egg length and egg shape index and between egg volume and egg shape index. The correlations between egg length and egg breadth were also statistically significant.

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INTRODUCTION

Clutch size is one of the fundamental elements of the reproductive strategy of a species, as it represents the number of offspring that an individual (or pair) endeavours to produce in a reproductive attempt (Anderson, 2006). The egg dimensions are also important life-history variables in birds as hatching mass is highly correlated with egg size for a large number of bird species (Hegyi, 1996). Egg size and clutch size in birds can vary with several factors including genetic component, ambient temperature, female mass and body condition, parental age, position in the laying sequence, seasonal variations, climate change and nutrient constraints (Styrsky *et al*., 2002; Saino *et al*., 2004; Jarvinen, 1991; Amat *et al*., 2001; Dolenec, 2004; Hill, 1984; Jarvinen, 1994; O' Connor, 1979). The combination of egg size and clutch size determines the total energetic investment in clutch formation by a female (Flint and Sedinger, 1992) which in turn determines the breeding investment and reproductive success.

The White-breasted Waterhen (*Amaurornis phoenicurus*) is a common and familiar bird of the rail and crake family Rallidae and belongs to order Gruiformes. It is locally known as Jal kukkari. It is found throughout the Indian union upto the base of the Himalayas and also Bangladesh, Pakistan, Sri Lanka, Maldives, Myanmar and Andaman and Nicobar (Ali and Ripley, 1983). Three subspecies are generally recognised: *A. p. phoenicurus*, *A. p. insularis* and *A. p. leucomelana* (ITIS, 2010) with some also recognising a fourth, *A. p. midnicobaricus*. The subspecies are separated mainly by the extent of grey on the head and flanks and by the colour of the underparts, which are more olive in *A. p. midnicobaricus* (Hoyo *et al*., 1996 and Robson, 2007). Although, their habitat is similar to other rails but they are less shy than most of the family and often feed in open and on quite dry land (Grimmett *et al*., 1998). They do swim but very occasionally. They are omnivore and feed on insects and their larvae, molluscs, worms, spiders, seeds and shoots and roots of marsh plants (Whistler, 1949; Ali and Ripley, 1969; Grewal *et al*., 2002). Detailed studies on breeding habits of this rail species are very limited particularly from this region. Thus, in light of this background, the present investigation was carried out to study its clutch and egg characteristics along with investigating the correlation between the egg variables.

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MATERIALS AND METHODS

Study Area

The study was carried out in district Jammu of J&K State. Geographically, it lies between 32º27′ and 33º30′N latitude and 74º19′ and 75º20′E longitude. The climatic conditions in

and around the study area are sub-humid to arid with four well marked seasons in a year. Three stations were selected in the study area for carrying out the present work.

Station I- R. S. Pura area: The latitude and longitude of this station are 32º36´27.56″ N and 74º43´57.29″ E respectively and it is located at an altitude of 271 msl. It is at a distance of 31 km from Jammu city. The main water source at this station is Ranbir canal. The area is gifted with the famous Gharana wetland that provides a good habitat for water birds and also acts as an important wintering ground for migratory birds. The major area is under cultivation of paddy and wheat. The paddy and wheat fields serve as an important feeding site for many birds.

Station II- Gho-Manhasan area: This station is located at a latitude and longitude of 32º43´39.55″ N and 74º45´41.36″ E respectively and at an altitude of 311 msl. The village is at the distance of 10.9 km from Jammu city. The Gho-Manhasan stream is the main source of water at this station. The stream is fed by river Chenab and it traverses through the area supporting many villages. The stream harbours thick macrophytic vegetation and provides a suitable habitat for many waterbirds particularly waders. The area is mainly under cultivation.

Station III- Jammu University Campus: It lies between the latitudes of 32º67´ N and the longitudes of 76º50´ E with an altitude of 340 msl. It is at a distance of about 2 km from Jammu city. It encloses departments, residential quarters, canteens, botanical garden, zoological park and cactus garden. Vegetation is mainly dominated by tree canopy.

METHODOLOGY

The data on clutch and egg characteristics of White-breasted Waterhen was gathered during three breeding seasons from 2013 to 2015. For locating nests, intensive field searches were carried out in the three study stations. Observations were made with the help of field binoculars (Bushnell 7X50 U.S.A. made) or by direct visual method as required. Regular inspections were made to the located nests to determine various egg characteristics like shape, colour, texture, length, breadth and weight. The clutch size which is defined as the number of eggs per nest was recorded after laying was completed.

(a) Egg size and weight: The length and breadth of eggs were measured with Digital Vernier calliper. Eggs were weighed to the nearest 0.01 gm with the help of an electronic weighing machine in the field.

(b) Egg Volume: The egg volume (V) was computed from the length (L) and breadth (B) of each egg, using the formula developed by Hoyt (1979): $V = 0.51 \times L \times B^2$.

(c) Egg shape index (ES): The shape index of eggs was calculated using the formula: $ES = B/L \times 100$.

(d) Statistical analysis: The correlations between egg dimensions were assessed with Pearson's correlation by using SPSS 20 software.

RESULTS AND DISCUSSION

The White-breasted Waterhen, *Amaurornis phoenicurus phoenicurus* is a common resident breeding waterbird in the study area with nesting season extending from March to September. A total of 67 nests were located in three study stations during 2013 to 2015. The nests were observed to be open shallow cup shaped usually rough in appearance (Fig. 1). The nests were bulky and were constructed by using plant material including stems, twigs, grass blades, roots, paddy straw and leaves. The nests were found on ground among marsh vegetation, on shrubs as well as on small to tall trees at varying heights. The nests were located near canals, marshes, streams, natural and artificial ponds as well as flooded agricultural fields.

Fig. 1. Nest of White-breasted Waterhen with eggs

A. Clutch Characteristics

The clutch size during present study was observed to vary from 3 to 8 eggs with mean clutch size of 5.97 ± 1.35. Among 67 nests, there were 3 nests (4.48%) with clutch size 3, 6 (8.96%) with clutch size 4, 15 (22.39%) with clutch size 5, 20 (29.85%) with clutch size 6, 12 (17.91%) with clutch size 7 and 11 (16.41%) with clutch size 8. Thus, nests with clutch of 6 eggs were significantly more common (Table 1). Earlier workers Baker (1929), Whistler (1949) and Ali and Ripley (1969) have reported clutch size to be 4 to 8. Gopakumar and Kamal (2008) recorded the clutch size to vary from 3 to 7 with mean clutch size of 5.3. The mean clutch size was observed to vary significantly during three breeding years. It was 5.84 ± 1.3 in 2013, 6.36 ± 1.32 in 2014 and 5.73 ± 1.4 in 2015. Besides, the average clutch size and its range at three study stations was recorded to be: 6.0 ± 1.32 (3-8 eggs) at station I, 5.65 ± 1.41 (3-8 eggs) at station II and 7.0 ± 0.81 (6-8 eggs) at station III (Table 2). Klomp (1970) stated that the mean clutch size can vary with food supply, habitat, population density, age of the breeding adults, latitude, longitude, altitude and other factors.

B. Egg Characteristics

The eggs of White-breasted Waterhen were oval in shape with one end broader and other slightly pointed. They were cream in colour and were marked with light and dark brown as well as purple blotches and spots that were scattered over the entire surface. However, the broader end was observed to be more profusely spotted and appeared darker. The texture of the eggs was smooth and slightly glossy. Similar observations were made by Dhindsa *et al*. (1983), Kumar (2006), Gopakumar and Kamal (2008) and Samsoor Ali *et al*. (2011). Daily observations regarding egg-laying pattern revealed that the White-breasted Waterhen laid an egg each day at a time interval of nearly 24 hrs until the clutch was completed.

Table 1. Frequency and percentage of different clutch sizes in three study stations

Station	Clutch Size												Total No. of Nests
	3		4		5		6		7		8		
	No. of Nests	%	No. of Nests	%	No. of Nests	%	No. of Nests	%	No. of Nests	%	No. of Nests	%	
ST-I	1	2.9	3	8.8	8	23.5	11	32.4	5	14.7	6	17.6	34
ST-II	2	7.7	3	11.5	7	26.9	7	26.9	4	15.4	3	11.5	26
ST-III	-	-	-	-	-	-	2	28.6	3	42.8	2	28.6	7
Total	3	4.48	6	8.96	15	22.39	20	29.85	12	17.91	11	16.41	67

Table 2. Clutch and Egg Characteristics in three study stations during 2013-2015

Stations	Total no. of nests	Mean Clutch size ± SD	Clutch size Range	Mean Egg Length ± SD	Mean Egg Breadth ± SD	Mean Egg Volume ± SD	Mean Egg Shape Index ± SD	Mean Egg Weight ± SD
I	34	6.0 ± 1.32	3-8	41.1 ± 0.22	30.8 ± 0.11	20.04 ± 2.30	75.04 ± 3.25	18.80 ± 0.64
II	26	5.65 ± 1.41	3-8	40.8 ± 0.13	31.1 ± 0.13	20.20 ± 1.45	76.50 ± 2.16	18.72 ± 0.55
III	07	7.0 ± 0.81	6-8	39.3 ± 0.13	30.9 ± 0.13	19.22 ± 1.58	78.82 ± 2.09	19.27 ± 0.62

Table 3. Range and mean values of Clutch size and Egg dimensions

Parameters	Minimum	Maximum	Mean	SD
Clutch size	3	8	5.97	1.35
Egg Length (mm)	37	46	40.6	0.19
Egg Breadth (mm)	28	34	30.9	0.09
Egg Volume ($cm^{3)}$	15.86	25.35	19.95	1.94
Egg Shape Index	66.66	82.05	76.22	3.05
Egg Weight (gm)	17.5	20.5	18.86	0.63

Table 4. Pearson's correlation coefficients (2-Tailed) between Egg variables

Variable	Egg Breadth	Egg Weight	Egg Volume	Egg Shape Index
Egg Length	0.529^{**}	0.355^{**}	0.840^{**}	$- 0.762^{**}$
Egg Breadth	-	0.463^{**}	0.903^{**}	0.144
Egg Volume	-	0.474^{**}	-	$- 0.292^{**}$
Egg Shape Index	-	-0.058	-	-

Statistical significance at level $p<0.01$

Similar egg-laying pattern has been reported for a number of other avian species (Aguon and Conant, 1994; Prather and Cruz, 1995; Dhanda and Dhindsa, 1998 and Kumar *et al*., 1999). The average length of 110 eggs was measured to be 40.6 ± 0.19 mm ranging from 37 - 46 mm. The average breadth was 30.9 ± 0.09 mm ranging from 28 – 34 mm. The average egg weight was recorded to be 18.86 ± 0.63 gm ranging from 17.5 – 20.5 gm. Baker (1929) reported the average egg size for 100 eggs to be 40.5 × 29.7 mm. Gopakumar and Kamal (2008) recorded mean egg length, breadth and weight to range from 43.2 – 45.3 mm, 29.8 - 31.8 mm and 18.3 – 19.5 gm respectively. Further, the average egg volume was calculated to be 19.95 ± 1.94 cm^3 with minimum 15.86 cm^3 and maximum 25.35 cm^3 while the egg shape index was 76.22 ± 3.05 with minimum 66.66 and maximum 82.05 (Table 3). Besides, the mean egg dimensions recorded at three different study stations were as follows: At station I (R. S. Pura area) the mean length, breadth, weight, egg volume and egg shape index of 52 eggs was 41.1 ± 0.22 mm, 30.8 ± 0.11 mm, 18.8 ± 0.64 gm, 20.04 ± 2.3 cm^3 and 75.04 ± 3.25 respectively; at station II (Gho-Manhasan area) of 37 eggs was 40.8 ± 0.13 mm, 31.1 ± 0.13 mm, 18.72 ± 0.55 gm, 20.2 ± 1.45 cm^3 and 76.5 ± 2.16 respectively and at station III (Jammu University Campus) of 21 eggs was 39.3 ± 0.13 mm, 30.9 ± 0.13 mm, 19.27 ± 0.62 gm, 19.22 ± 1.58 cm^3 and 78.82 ± 2.09 respectively (Table 2).

C. Correlation between Egg variables

A statistically significant and strong positive correlation was recorded between egg length and egg volume (r = 0.840) as well as between egg breadth and egg volume (r = 0.903). The egg weight also had a strong positive correlation with egg length (r = 0.355), egg breadth (r = 0.463) and egg volume (r = 0.474) while a low negative insignificant correlation with shape index (r = -0.058). Abanikannda *et al*. (2007) putforth that relationship between egg breadth and egg weight is stronger than association between egg length and egg weight. Besides, a strong negative correlation was registered between egg length and egg shape index (r = -0.762) and between egg volume and egg shape index (r = - 0.292). According to Panda (1996) the reason for negative relationship between egg length and shape index is that the egg length is the denominating factor in estimating shape index. However, an insignificant low but positive correlation found between egg breadth and egg shape index (r = 0.144) may is due to the fact that shape index is directly related to egg breadth. The correlations between egg length and egg breadth (r =0.529) were also statistically significant (Table 4).

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