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### RESEARCH ARTICLE

#### CLUTCH CHARACTERISTICS AND EGG DIAMETRICS OF INDIAN POND HERON (*ARDEOLA GRAYII*) IN JAMMU REGION (J&K).

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#### Abstract

The present study on clutch characteristics and egg diametrics of Indian Pond Heron (*Ardeola grayii*) was conducted for three consecutive years i.e., 2013, 2014 and 2015 in five different stations viz., station I (Haripur), station II (Mansar), station III (Gharana), station IV (Kalyana) and station V (Gho Manhasa) during the breeding season which commenced from May up to September. The overall mean clutch size was recorded to be  $3.71 \pm 1.06$  varying from 1 to 5. The clutch size was found to vary among different stations viz.,  $3.73 \pm 0.76$  (n=41) at station I,  $4.07 \pm 0.73$  (n=14) at station II,  $3.68 \pm 0.88$  (n=38) at station III,  $3.71 \pm 0.85$  (n= 32) at station IV and  $3.64 \pm 1.02$  (n=17) at station V. The eggs were recorded to be oval with greenish blue coloration and without any markings. Overall mean values of egg dimensions were recorded to be egg length ( $3.90 \pm 0.16$  cm), egg breadth ( $2.78 \pm 0.19$  cm), egg volume ( $15.57 \pm 2.41$  cm<sup>3</sup>), egg shape index ( $71.45 \pm 4.95$ ) and egg weight ( $17.93 \pm 2.71$  gm). A statistically significant correlation was registered between egg length and egg volume ( $r = 0.4852$ ) as well as between egg breadth and egg volume ( $r = 0.8274$ ).

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#### Introduction:-

Indian Pond Heron (*Ardeola grayii*) commonly known as "Paddy bird" belongs to family Ardeidae of Order Pelecaniformes. It is commonly seen frequenting paddy fields, ponds, reservoirs and other natural wetlands. It usually escapes notice by its dingy coloration until it springs to life with a flash of white wings. It is found throughout much of the Indian sub-continent except parts of northwest, northeast and Himalayas upto 2150m in Nilgiris and 1500 m in Himalayas (Grimett *et al.* 1998). In many bird species, egg size is often considered an important index of egg quality and is correlated with the survival of their offspring (Murton *et al.*, 1974; Amat *et al.*, 2001). Clutch size is one of the fundamental elements of the reproductive strategy of a species, as it represents the number of offsprings that a pair endeavours to produce in a reproductive attempt (Anderson, 2006). Egg size and clutch size in birds can vary with several factors that include ambient temperature, genetic component, female mass and body condition, parental age, seasonal variations, climate change and nutrient constraints (O' Connor, 1979; Hill 1984; Jarvinen, 1991; Amat *et al.*, 2001, Styrsky *et al.*, 2002; Dolenc, 2004 and Saino *et al.*, 2004). The studies on

egg and clutch characteristics are of paramount importance in determining the reproductive success of a species as the combination of egg size and clutch size determines the total energetic investment in clutch formation by a female (Flint and Sedinger, 1992). Thus, the present investigation was conducted to study clutch characteristics and egg diametrics and to analyse the correlation between various egg variables.

## Materials and methods:-

### Study Area:-

The present study was conducted in district Jammu of J&K State. Geographically, it lies between 32°27' and 33°30' N latitude and 74°19' and 75° 20' E longitude. Altitudinally, it extends from 250 meters to 410 meters above mean sea level. During the period of present investigation, five stations were selected in the study area.

1. **Station- I: Haripur:** The latitude and longitude of this station are 32°36'27.56"N and 74°43'57.29" E respectively and it is located at an altitude of 271 meters from mean sea level. The station is at a distance of 31 km from Jammu city. The main water source at this station is Ranbir Canal.
2. **Station-II: Mansar:** This station is located at a distance of 64 km east of Jammu city. It lies between 32°41'48.36" N latitude and 75°08'44.70" E longitude at an elevation of 666m above msl. This lake harbours characteristic ichthyofauna, amphibians and reptiles and has an intimate association with the wildlife and wild avifauna migratory and non- migratory of the area.
3. **Station-III: Gharana, R.S. Pura:** It is situated between 32°36'51.52" N latitudes and 74°38'58.15" E longitudes. It is located at an elevation of 251 meters from msl. It is at a distance of 35 km from Jammu city.
4. **Station-IV: Kalyana:** The latitude 32°49'62.69" and longitude 74°73'66.33" are the geo-coordinates of this station. It is at a distance of 26.6 km from Jammu city. The major area of this station is under cultivation.
5. **Station-V: Gho-Manhasa:** This station lies between 32°43'39.59" N latitude and 74°45'41.36" E longitude at an altitude of 311 m above the mean sea level. It is at a distance of 10.9 km from the Jammu city in Marh tehsil. The Gho-Manhasa stream is the main source of water at this station. The stream itself is fed by river Chenab and it traverses through the area supporting many villages. The stream harbours thick macrophytic vegetation and provide suitable habitat for many waterbirds particularly waders.

### Methodology:-

Recurrent surveys were conducted to different stations from 0600 hrs to 1200 hrs in morning and 1300 hrs to 1900 hrs in evening to record the data on clutch size and egg characteristics of Indian Pond Heron during three consecutive years from March 2013 to February 2016. The birds were observed with naked eye and through binoculars (Bushnell 7x 50 U.S.A. made). Moreover, photography was done with the aid of Canon EOS camera fitted with 300mm zoom lens and Nikon D 330 with 300 mm zoom lens. Moreover, the nests located were examined to record various egg parameters like shape, colour, texture, length, breadth and weight. Clutch size was recorded after laying had been completed.

1. **Egg size and weight:** The length and breadth of eggs were measured with the aid of Digital Vernier Calliper and egg weight was recorded to the nearest 0.01gm with the help of an electronic weighing machine in the field.
2. **Egg Volume:** The egg volume (V) was calculated by using the formula developed by Hoyt (1979).

$$V = 0.51 \times L \times B^2$$

Where L= Length

B= Breadth

3. **Egg Shape Index (ESI):** It was computed using the formula

$$ESI = B/L \times 100$$

**Statistical Analysis:** The correlation between various egg variables were calculated using Pearson's correlation using SPSS 20 software.

## Results and discussion:-

Breeding season of Indian Pond Heron (*Ardeola grayii*) commenced from May to September with June and July being the peak breeding months. A total of 142 nests were located in five study stations during March 2013 to February 2016. The nests were platform shaped generally made up of dried twigs and solid sticks but in some instances it was recorded to expend considerable effort for breaking leafy twigs and branches off the nesting tree itself. The nests were located near streams, marshes as well as agricultural fields.

**Clutch characteristics:-**

During the present study period, clutch size was recorded to vary from 1 to 5 with a mean clutch size of  $3.71 \pm 1.06$ . Among 142 nests studied, clutch size of 4 eggs per nest was reported to be the most common ( $n=70$ ) with a percent share of 49.29% followed by clutch size of 3 ( $n=33$ ) contributing 23.23%. Moreover, there were 26 nests with clutch size of 5 (18.30%); 9 nests with clutch size of 2 (6.33%) and 4 nests with clutch size of 1 (2.81%). Thus, it is evident from **table-1** that nests with clutch size of 4 were significantly more common. The clutch size of herons may differ between years (Custer *et al.*, 1983) or it may remain constant (Tremblay and Ellison, 1980). Earlier workers Whistler (1949) and Ali and Ripley (1969) have reported the clutch size to be 4 to 6. Seedikkoya *et al.* (2008) have recorded the clutch size of 3 to be the most common. Jaman (2012) ascertained the clutch size to range from 3 to 4 eggs with an average of 3.7 eggs. Fazilli (2014) however observed clutch size of Indian Pond Heron to vary from 2 to 6 with an average of  $3.47 \pm 0.98$ . In the present study, the mean clutch size was however recorded to vary during three breeding seasons viz.,  $3.8 \pm 0.78$  in 2013,  $3.74 \pm 0.85$  in 2014 and  $3.67 \pm 1.0$  in 2015. Besides, the average clutch size and its range at five selected study stations was recorded to be  $3.73 \pm 0.76$  (2-5 eggs) at station I,  $4.07 \pm 0.73$  (3-5 eggs) at station II,  $3.68 \pm 0.88$  (1 to 5 eggs) at station III,  $3.71 \pm 0.85$  (1 to 5 eggs) at station IV and  $3.64 \pm 1.02$  (1 to 5 eggs) at station V (**Table- 2**). Klomp (1970) stated that the mean clutch size in birds can vary with different factors like food supply, habitat, population density, age of the breeding adults, latitude, longitude and altitude. The present findings are in consonance with Zhao *et al.* (2002 b) and Du B *et al.* (2014) who stated that clutch size in birds can vary with different factors.

**Egg Diametrics:-**

The eggs of Indian Pond Heron were oval in shape with one end broader and other end slightly pointed. They were greenish blue in colour without any markings. The texture of eggs was smooth. The present findings are in consonance with that reported by Yesmin *et al.* (2001), Seedikkoya *et al.* (2008) and Fazili (2014). Moreover, egg laying pattern was studied on daily basis which revealed that Indian Pond Heron laid one egg in a day usually during night or early morning hours at an interval of 24 hrs until the clutch was completed. Similar findings were put forth by Seedikkoya *et al.* (2008) and Fazili (2014). Same egg laying pattern has been reported for a number of other avian species (Prather and Cruz, 1995 and Kumar *et al.*, 1999). The average length of 150 eggs was measured to be  $3.90 \pm 0.17$  cm ranging from 3.5 to 4.2 cm. The average breadth was  $2.78 \pm 0.19$  cm ranging from 2.4 – 3.2 cm. The average egg weight was recorded to be  $17.93 \pm 2.71$  gm ranging from 14.18- 24.37 gms. Furthermore, the egg volume was calculated to be  $15.57 \pm 2.41$  cm<sup>3</sup> with minimum 10.86 and maximum 20.88 cm<sup>3</sup> while egg shape index was determined to be  $71.45 \pm 4.95$  with minimum 58.53 and maximum 83.78 (**Table-3**). Besides, the mean egg dimensions recorded at five different study stations were as follows: At Station-I, the mean length, breadth, weight, egg volume and egg shape index of 40 eggs was  $3.91 \pm 0.15$  cm,  $2.71 \pm 0.18$  cm,  $17.63 \pm 2.95$  gm and  $14.82 \pm 2.33$  cm<sup>3</sup> and  $69.47 \pm 4.51$  respectively; at Station-II, dimensions of 17 eggs were  $3.91 \pm 0.20$  cm,  $2.61 \pm 0.12$  cm,  $19 \pm 1.81$  gm,  $13.92 \pm 1.56$  cm<sup>3</sup> and  $67.28 \pm 4.69$  respectively and at Station-III, egg diametrics of 30 eggs were  $3.89 \pm 0.16$  cm,  $2.82 \pm 0.20$  cm,  $16.94 \pm 2.88$  gm,  $15.76 \pm 2.34$  cm<sup>3</sup> and  $72.38 \pm 6.02$  respectively. Moreover, the mean values of egg dimensions at Station-IV ( $n=43$ ) and Station-V ( $n=20$ ) were  $3.9 \pm 0.16$  cm,  $2.84 \pm 0.16$  cm,  $17.98 \pm 2.61$  gm,  $16.18 \pm 2.31$  cm<sup>3</sup> and  $72.99 \pm 3.34$  and  $3.92 \pm 0.18$  cm,  $2.9 \pm 0.14$  cm,  $18.97 \pm 2.07$  gm,  $16.91 \pm 2.19$  cm<sup>3</sup> and  $73.94 \pm 3.23$  respectively (**Table-2**).

**Correlation between various egg variables studied:-**

A statistically significant and strong positive correlation was recorded between egg length and egg volume ( $r=0.4852$ ) as well as between egg breadth and egg volume ( $r=0.8274$ ). The egg weight also had a positive correlation with egg length ( $r=0.125$ ) while a negative insignificant correlation with egg shape index ( $r=-0.070$ ). Besides, a strong negative correlation was reported between egg length and egg shape index ( $r=-0.339$ ). Panda (1996) stated that egg length and egg shape index have negative relationship because egg length is the denominating factor in estimating shape index. However, a strong positive correlation was registered between egg breadth and egg shape index ( $r=0.788$ ) and plausible reason for this might be the fact that shape index is directly proportional to egg breadth. The correlations between egg length and egg breadth ( $r=0.301$ ) were also statistically significant (**Table-4**).

**Conclusion:-**

From the present study it can be inferred that the optimum clutch size of Indian Pond Heron (*Ardeola grayii*) was recorded to be 4 and showed significant positive correlation between egg length and egg volume.

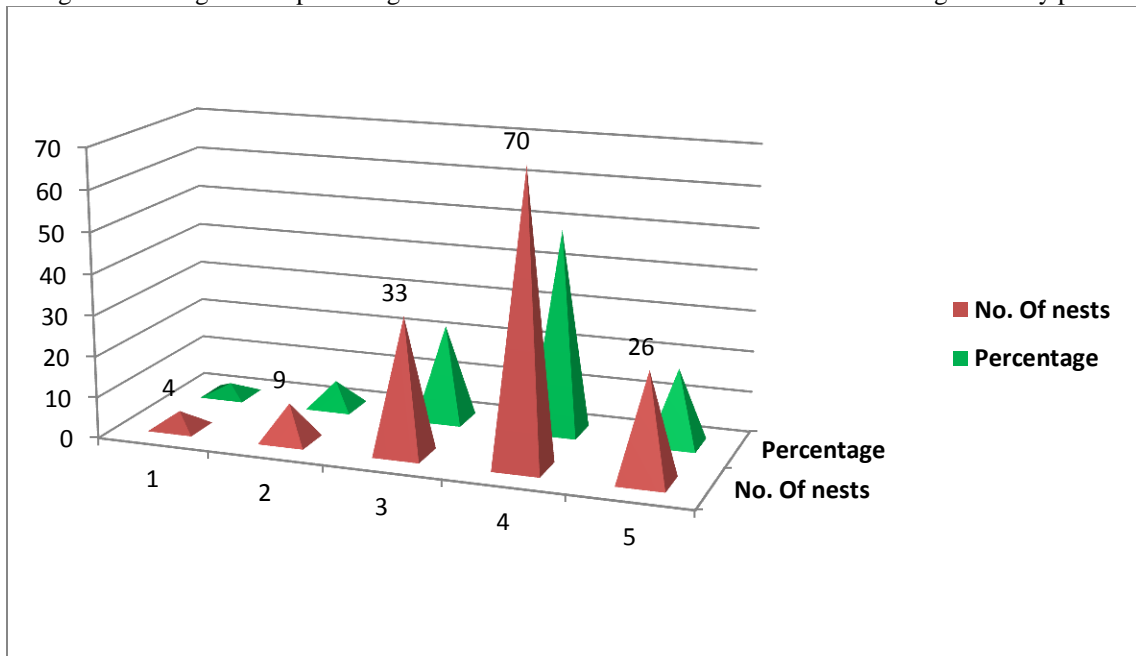
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**Table1:-** Frequency and percentage distribution of different clutch sizes of Indian Pond Heron (*Ardeola grayii*) in five study stations during 2013-2016.

Stations	Clutch Size										Total number of nests studied
	1		2		3		4		5		
	No. of nests	%	No. of nests	%	No. of nests	%	No. of nests	%	No. of nests	%	
I	-	-	2	4.87	13	31.70	20	48.78	6	14.63	41
II	-	-	-	-	3	21.42	7	50	4	28.57	14
III	1	2.63	2	5.26	9	23.68	21	55.26	5	13.15	38
IV	2	6.25	2	6.25	9	28.12	13	40.62	6	18.75	32
V	1	5.88	1	15.88	4	23.52	8	47.05	3	17.64	17

**Fig. 1:-** Histogram showing overall percentage of different clutches of Indian Pond Heron during the study period.



**Table2:-** Clutch characteristics and egg diametrics of Indian Pond Heron (*Ardeola grayii*) during 2013- 2016.

Stations	Total No. of nests	Mean clutch size± SD	Clutch size range	Mean Egg length (cm)± SD	Mean Egg breadth (cm) ± SD	Mean Egg Volume (cm <sup>3</sup> ) ±SD	Mean Shape Index ± SD	Mean Egg Wt. (gm)± SD
I	41	3.73±0.76	2-5	3.91± 0.15	2.71± 0.18	14.82± 2.33	69.47± 4.51	17.63± 2.95
II	14	4.07±0.73	3-5	3.91±0.20	2.61± 0.12	13.92± 1.56	67.28± 4.69	19±1.81
III	38	3.68±0.88	1-5	3.89± 0.16	2.82± 0.20	15.76± 2.34	72.38± 6.02	16.94± 2.88
IV	32	3.71±0.85	1-5	3.9±0.16	2.84± 0.16	16.18± 2.31	72.99± 3.34	17.98± 2.61
V	17	3.64±1.02	1-5	3.92±0.18	2.9± 0.14	16.91± 2.19	73.94± 3.23	18.97± 2.07

**Table3:-** Overall mean and range values of clutch size and egg dimensions of Indian Pond Heron during the study period.

Total no. of nests	Clutch size (Mean±SD)	Egg length(cm) (Mean±SD)	Egg breadth(cm) (Mean±SD)	Egg Wt.(gm) (Mean±SD)	Egg Vol.(cm <sup>3</sup> ) (Mean±SD)	Egg Shape Index (Mean±SD)
142	3.71±1.06	3.90±0.17	2.78± 0.19	17.93±2.71	15.57±2.41	71.45±4.95
Range	1-5	3.5 – 4.2	2.4 – 3.2	14.18-24.37	10.86-20.88	58.53-83.78

**Table-4:** Pearson's correlation coefficients (2- tailed) between egg variables.

Variables	Egg Breadth	Egg Weight	Egg Volume	Egg Shape Index
Egg Length	0.3016**	0.1253	0.4852**	- 0.339
Egg Breadth	-	0.001	0.8274**	0.7885**
Egg Volume	-	0.006	-	0.5061**
Egg Shape Index	-	- 0.070	-	-

\*\*Statistical significance at level p<0.01.

**Fig. 2:** Clutch size of three**Fig. 3:** A nest with four eggs

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