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Research Paper

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Estimation of Egg Parameters of the House Crow (*Corvus splendens*) at Punjab Agricultural University, Ludhiana, Punjab, India

Manpreet Kaur* and K S Khera

Department of Zoology,

Punjab Agricultural University, Ludhiana - 141 004, Punjab, India

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A B S T R A C T

The experiment was designed to estimate egg parameters of the House Crow at Punjab Agricultural University, Ludhiana. A total of 8 eggs were collected for the estimation. Digital vernier caliper was used to measure egg length and breadth and digital weighing balance was used to determine egg weight. Weight of egg components (yolk, albumen and shell) were also measured using digital weighing balance. Average egg length, breadth, shape index, egg weight, albumen weight, yolk weight, shell weight, albumen percentage, yolk percentage, shell percentage, egg volume and specific gravity were 38.31 ± 1.043 mm, 27.86 ± 0.520 mm, 64.45 ± 1.613, 8.01 ± 0.207 g, 4.41 ± 0.081 g, 2.42 ± 0.130 g, 1.18 ± 0.104 g, 55.15 ± 0.966%, 30.19 ± 1.322 5%, 14.66 ± 1.046%, 15.16 ± 0.584 cm^3 and 0.53 ± 0.013 g/cm^3, respectively. This study provides important information that can help the avian taxonomists in species classification, as bird's egg diverges widely in shape, volume, weight and percentage of albumen, yolk and shell. Therefore, we can use the egg parameters as additional information in bird systematic.

Key words: Egg parameters, House crow, Morphometry, Specific gravity, Shape index

The common house crow (*Corvus splendens*) is a medium sized black bird with short and somewhat round tail. The house crow belongs to the Corvidae family, which also includes ravens, jays, magpies, treepies, choughs and nutcrackers (Clayton *et al.* 2005). They can be easily seen and heard throughout India (Gadgil 2001). Indian House Crow is 42–44 cm long (body and tail) and weighs 250–350 g. Their plumage is dark black and polished, with the exception of the scruff, sides of the head, upper back and bosom, which are grey and not reflexive. Their bills, legs and feet are dark black. The males and females are comparative; however, the males are marginally bigger. Juveniles have little or no shine to their plumage (Department of Agriculture and Food 2008). Their bills are strong with rigid, straight bristles that extend almost to the middle. The jungle crow is recognized from the House Crow by the nonappearance of any grey on the rear neck and bosom (Rasmussen and Anderton 2005). Morphometrics in general refers to measurements of the body parts (Kabir *et al.* 2012).

Egg morphometric parameters such as egg length, breadth, weight and shape index are relevant to a number of studies, such as population and ecological morphology (Narushin 2005), predicting chick weight (Narushin *et al.* 2002), egg hatchability (Narushin and Romanov 2002 a,b), avian biology, taxonomy, classification and genetics. Internal egg quality parameters such as albumen weight and yolk weight are very important from nutritional and cholesterol content for human consumption (Sparks 2006). Both internal and external egg parameters are affected by genotype. Genetic differences in eggshell quality characteristics exist between species, and between breeds, strains and families within the lines. Genotype has direct influence on egg weight and eggshell characteristics (Hrncar *et al.* 2014). Internal egg quality parameters such as albumen weight and yolk weight are very important from nutritional and cholesterol content for human consumption (Sparks 2006). Studies on house crow breeding biology in recent past have been extensively carried out by number of workers in Punjab, India as well as worldwide. However, little research is carried out on egg parameters of house

***Corresponding author:** Dr. Manpreet Kaur, Department of Zoology, Punjab Agricultural University, Ludhiana - 141 004, Punjab

e-mail: binner_manpreet@yahoo.com

crow, but no such study was done in Punjab, India. So, in view of the above details present study was planned to provide first hand data on egg parameters of House Crow in Punjab Agricultural University, Ludhiana, Punjab.

MATERIALS AND METHODS

The present study on estimation of egg parameters of the house crow was carried out in the fields of Punjab Agricultural University (PAU), Ludhiana, Punjab, India from June to July, 2016 (Fig 1). The university is situated in the outskirts of Ludhiana city towards west and lies at latitude of 30°56' N and 247 m above the means sea level. In addition to various teaching departments and research laboratories of the constituent colleges, playgrounds and grassy lawns, the campus has a large stretch of agricultural fields. The field area is distributed under different categories of crops such as wheat, maize, rice, vegetables, fodder and orchards.

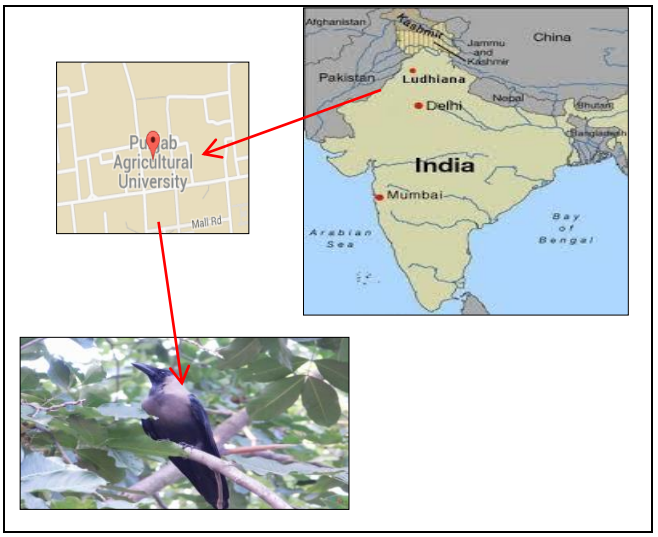
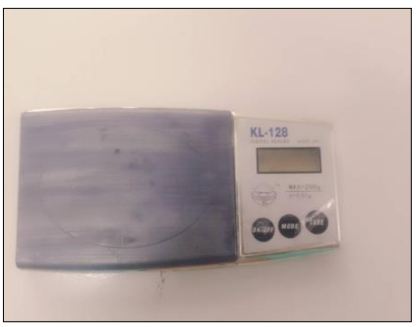


Fig 1 Study area

(A) Egg of House Crow

(B) Digital vernier caliper



(C) Digital weighing balance

Fig. 2 House Crow egg and instruments used

Eight freshly laid house crow eggs were collected from different nests without developed embryo from fields of Punjab Agricultural University, Ludhiana and brought to laboratory and stored in refrigerator at 4°C until estimation. Egg length (mm) and width (mm) were measured using digital vernier caliper while egg weight (g) was measured using a digital weighing balance (Fig 2). Egg volume was estimated from length (L) and breadth (B), data were calculated using an empirical formula ((0.51) × (L) × (B^2) × 10^{-3}ml) calibrated to house crow eggs by Hoyt (1979). Specific gravity (Egg weight (g)/Egg volume (cm^3)) and shape index ([egg width/egg length] ×100) were determined according to Stadelman and Cotterill (1995). Weights of the egg shell, yolk and albumen materials were determined using a digital weighing balance after cracking the shell and separating the yolk from albumen materials. Percentage of the egg components (shell, yolk and albumen materials) as a ratio to total egg weight were determined by using the equation (Egg weight (gm)/Egg weight (gm) × 100) (Stadelman and Cotterill 1995).

The values were expressed as mean ± standard error.

RESULTS AND DISCUSSION

The bird's egg is one of most complex and highly differentiated reproductive germinal cell accumulates relatively enormous amounts of food substances (yolk and albumen material). Bird's egg diverges widely in shape, volume, weight and the amount of yolk, albumen and shell. The shape of the egg is recognizable species characteristic. Species within a genus lay egg diverge widely from oval to conical shape, with one end rounded and the other more pointed (Al-Obaidi and Al-Shadeedi 2012).

Egg dimensions

Average egg length (mm) and average breadth (mm) were shown in (Table 1). 8 eggs were investigated for this purpose and measurements were taken; average length of the eggs measured was 38.31 mm (Range= 33.14 mm-42.44 mm). While average breadth of the eggs measured was 27.86 mm (Range= 25.94 mm-30.11 mm). Awais *et al*. (2015), measured the average length and breadth of 71 house crow eggs as 38.68×26 mm in Mansehra, Pakistan. Ali (2008) in Islamabad-Rawalpindi reported average house crow egg length and breadth of 37.5×26.4 mm. In Durban, South Africa average house crow egg length and breadth was 37.7×26.9 mm (Allan and Davies 2005). Therefore, it was concluded that average length of the eggs measured in present study was somewhat similar to all these investigations (38.1×27.86 mm), but eggs were somewhat broader as compared to above studies.

Table 1 House crow egg parameters

Egg parameters (n=8)	Mean ± SE
Egg length (mm)	38.31±1.043
Egg breadth (mm)	27.86±0.520
Egg shape index	64.45±1.613
Egg weight (g)	8.01±0.207
Egg albumin weight (g)	4.41±0.081
Egg yolk weight (g)	2.42±0.130
Egg shell weight (g)	1.18±0.104
Egg albumin (%)	55.15±0.966
Egg yolk (%)	30.19±1.322
Egg shell (%)	14.66±1.046
Egg volume (cm^3)	15.16±0.584
Egg specific gravity (g/cm^3)	0.53±0.013

Egg volume, shape index and specific gravity

The volume of the avian egg is a reflection of diverse aspects of the reproductive process, including the environmental conditions faced by females prior to breeding (Klaassen *et al.* 2001); maternal genotype or phenotype (Sandercock *et al.* 1997) and offspring size (Grant 1991), quality (Galbraith 1988) and survival (Bolton 1991). Eggs of house crow are just like the other birds eggs, have an oval shape, with one end rounded and the other pointed. This shape results from the egg being forced through the oviduct. Muscles contract the oviduct behind the egg, pushing it forward (Sturkie 1986). The egg's wall is still shapeable, and the pointy end develops at the back side. Cliff-nesting birds often have highly conical eggs. They are less likely to roll off, tending instead to roll around in a tight circle, this trait is likely to have arisen due to evolution via natural selection. In contrast, many hole-nesting birds have nearly spherical eggs (Romanoff and Romanoff 1949). Average volume and egg shape index of the eggs calculated was 15.16 cm^3 (Range=13.40 cm^3- 18.47 cm^3) and 64.45 (Range= 57.59-70.47). While, specific gravity of house crow eggs was ranged from 0.45 g/cm^3 to 0.57 g/cm^{-3}. Average specific gravity of house crow eggs was 0.53g/cm^3 (Table 1, Fig 3). According to Awais *et al.* (2015), average egg volume observed in house crow was 13.34 cm^3, lower than the recorded average volume in this study. Egg shape index of quail eggs was 76.54 (Kabir *et al.* 2012). The shape index of house crow egg observed in present study was lower than observed by Kabir *et al.* (2012) in quail. The shape indices of Pheasant, Chukar and guinea fowl eggs showed the range from 77.30 to 79.63 (Powrie 1977), which were larger than that of house crow eggs. The shape index of present study was also lower than that of egg of Ogol fowl (72.60) reported by Baek (1990). According to Luquett *et al.* (2004)**,** specific gravity for 3 broilers of different age (30 weeks, 45 weeks and 60 weeks) was 1.085, 1.082 and 1.082 g/cm^{-3}, respectively.

Weights of egg and egg components

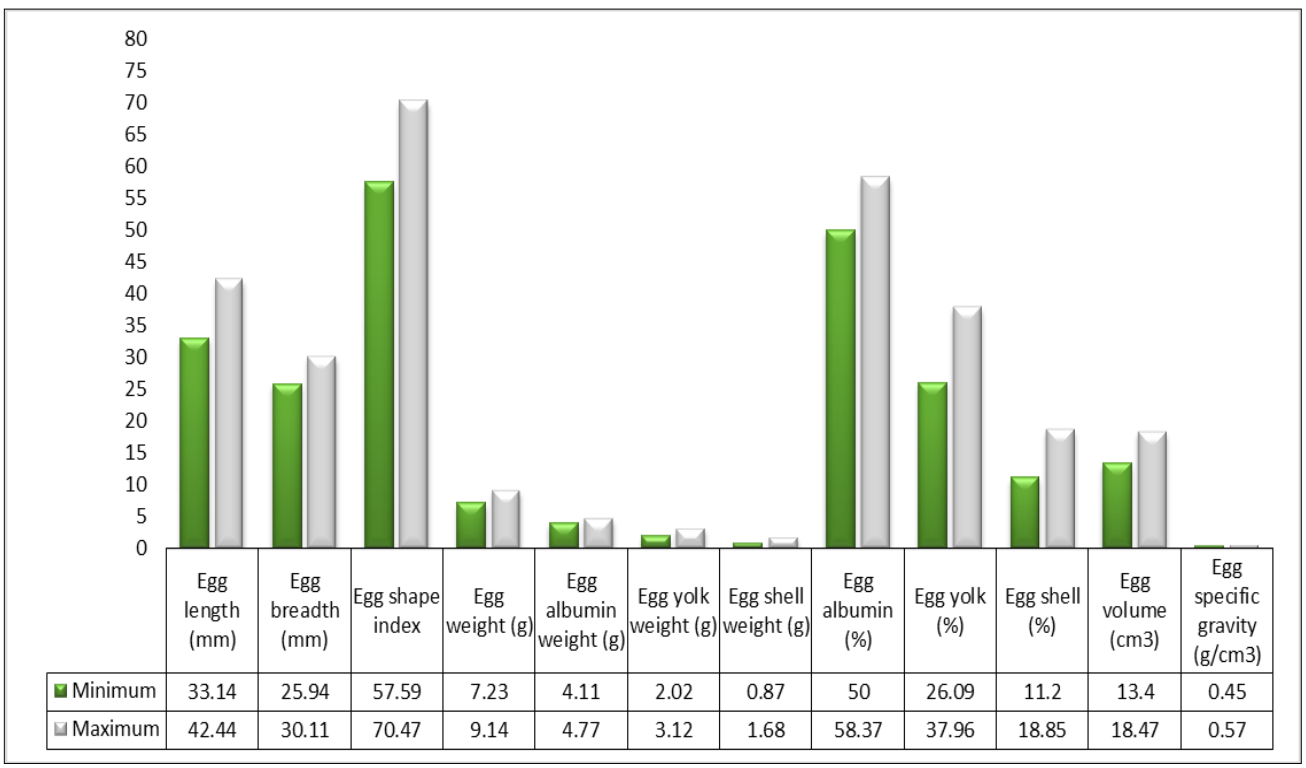
The egg weight is expressed in terms of size; there is an enormous range in egg size among different species and within the species between individuals. The size of the eggs laid by one individual may differ widely from those laid by another of the same species and breed. Egg size is influenced by climate, the amount of available food, parent's body size, evolutionary status and some other factors (Stadelman and Cotterill 1995). Average weight of the eggs was found to be 8.01 g and ranged from 7.23 g -9.14 g (Table 1, Fig 3). According to Ali (2008) average weight of the eggs recorded was 12.85 g. Average weight of the eggs recorded on Kharg Island was 12.6 g (Behrouzi-Rad 2010). And average weight of eggs in Durban recorded was 13.2 g (Allan and Davies 2005). Therefore, average egg weights observed in present study were much lower than Ali (2008), Behrouzi-Rad (2010), Allan and Davies (2005) egg weights. Average albumen, yolk and shell weights of house crow were given in (Table 1). It was also observed that average albumen, yolk and shell weights were 4.41 g (Range= 4.11 g to 4.77 g), 2.42 g (Range= 2.02 g to 3.12 g) and 1.18 g (Range= 0.87 g to 1.68 g), respectively.

Economically important egg parameters such as weight, albumen and yolk contents are quantitative traits that show continuous variability (Chatterjee *et al.* 2007, Islam and Dutta 2010). It is also an established fact that the weight of an egg is a direct proportion of shell, albumen and yolk that it contains and this varies significantly between breeds or strains of the bird species (Jones *et al.* 2010, Momoh *et al.* 2010). Weights of egg albumen, yolk and egg shell recorded by Kabir *et al.* (2012) in pigeon were 6.30 g, 3 g and 2.40 g, in dove were 4.30 g, 3.30 g and 1.60 g. Significantly different as compared to egg albumen, yolk and egg shell weights recorded in present study.

Proportions of egg components

The bird's egg is a glorious, wondrous feat of engineering. Of the total egg, shell comprises 10.5%, yolk 31% and albumen 58.5% (Cook and Briggs 1986). Yolk is actually not just a blob of yellow in the centre of the egg. Looked at carefully it can be seen to be a series of concentric thick layers of yellow yolk with very thin layers of white yolk separating them. The amount of yolk in an egg varies from species to species. Kiwis not only lay the largest eggs in proportion to their body weight, but also have the highest percentage yolk content, over 50%. In other species of birds the percentage of yolk varies from about 50% in ducks to about 15% in cormorants. As a general rule, species with precocial young have less yolk than those with altricial young. The albumen or white is the developing embryo's chief supply of water and also acts as a shock absorber and temperature regulator for the very young embryo (Ramel 2009). The embryo always rests on the top of the yolk. This is to ensure that the yolk which is quite dense does not crush the early embryo. However, in order to keep the temperature even within the egg, incubating birds must occasionally turn the eggs over. Also, the eggs of some birds can roll around in their minimal nests. Therefore, in order to ensure that the yolk always remains the right way up, it is suspended within the egg from the long ends by a pair of jelly-like springs called the chalaza. These anchor the yolk and ensure that even when the egg is rolled over it always has the embryo on top (Ramel 2009). The most visible thing about an egg is the shell. This is white in some birds and coloured in others. Birds with white eggs tend to be either those who lay their

eggs in dark and enclosed spaces such as holes in trees or special nests, i.e. owls and kingfishers, or primitive birds such as pelicans and cormorants. Birds which lay their eggs in more open and visible places have more coloured eggs, mostly this colouration is cryptic i.e. it helps make the egg hard to see against the background. In some species which nest on the ground this cryptic colouration is excellent (Ramel 2009). Birds are grouped according to the relative amounts of the yolk and albumen; they fall naturally into two classes. Egg in which the yolk constitutes between 15 to 30% of the total weight (lower percentage) belong to the class altricial species; egg in which the yolk constitutes between 40 to 50% or more of the total weight (high percentage) belong to the Precocial species class (Romanoff and Romanoff 1949). Proportions of albumen, yolk and shell to the weight of whole egg were shown in (Table 1, Fig 3). It was observed that proportions of albumen, yolk and shell weights were ranged from 50% to 58.37%, 26.09% to 37.96% and to 11.20% to 18.85%, respectively. Average albumen, yolk and shell proportions of house crow eggs were 55.15%, 30.19% and 14.66%. According to Prelipcean *et al.* (2012) proportions of albumen, yolk and shell to the weight of whole egg albumen in Quail were 59.18%, 32.94% and 7.88%, respectively.



	Egg length (mm)	Egg breadth (mm)	Egg shape index	Egg weight (g)	Egg albumin weight (g)	Egg yolk weight (g)	Egg shell weight (g)	Egg albumin (%)	Egg yolk (%)	Egg shell (%)	Egg volume (cm3)	Egg specific gravity (g/cm3)
Minimum	33.14	25.94	57.59	7.23	4.11	2.02	0.87	50	26.09	11.2	13.4	0.45
Maximum	42.44	30.11	70.47	9.14	4.77	3.12	1.68	58.37	37.96	18.85	18.47	0.57

Fig 3 Maximum and minimum range of egg parameters of house crow eggs

Generally, it can be concluded that house crow had less proportion of yolk content, its chicks show altricial development. It was also observed that external and internal egg parameters of house crow are somewhat similar with house crow egg parameters reported by other workers but significantly different from other bird species. The present report provides important information that can help the avian taxonomists in species classification.

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