Correlation Between Egg Size (Length, Width and Weight) and Hatching Weight of White-Nest Swiftlets (*Collocalia fuciphaga*) from Buntok, Central Kalimantan

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Abstract. This study aimed to determine the correlation between egg size (length, width, and weight) and hatching weight of white-nest swiftlets (*Collocalia fuciphaga*) from Buntok, Central Kalimantan. The materials used in this study were 240 fertile eggs of white-nest swiftlets from Buntok, Central Kalimantan. The variables measured were egg length, egg width, egg weight and hatching weight. The correlation between egg size and hatching weight was then evaluated using Pearson's correlation test. The egg length of white-nest swiftlets was ranged from 1.83 to 2.24 cm (mean = 2.01 cm). The egg width of white-nest swiftlets was ranged from 1.20 to 1.40 cm (mean = 1.29 cm). The average egg weight of white-nest swiftlets was ranged from 1.32 to 2.05 g (mean = 1.73 g). The hatching weight of white-nest swiftlets was ranged from 1.03 to 1.67 g (mean = 1.36 g). The results showed that egg length and hatching weight were significantly correlated ($r = 0.458$, $P < 0.001$). The correlation between egg width and hatching weight were also significant ($r = 0.572$, $P < 0.001$). Moreover, egg weight and hatching weight also indicated a significant correlation ($r = 0.754$, $P < 0.001$). Based on the results of this study, it can be concluded that there is a moderate and positive correlation between egg length and hatching weight as well as between egg width and hatching weight of white-nest swiftlets from Buntok, Central Kalimantan. Furthermore, the correlation between egg weight and hatching weight of white-nest swiftlets from Buntok, Central Kalimantan is strong and positive.

Keywords: Correlation · Egg Length · Egg Width · Egg Weight · Hatching Weight

1 Introduction

Indonesia is the largest producer and exporter of swiftlet nests on an international scale. Around 75–85% of swiftlet nests marketed globally come from Indonesia. The production and delivery of swiftlet nests abroad has increased significantly from year to year. This is evidenced by data from the Indonesian Central Statistics Agency which noted that from 2012–2020, the export volume of swiftlet nests to foreign countries increased

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from 405.3 tons to 1,312.5 tons with the export value of swiftlet nests amounting to US$ 153,404.9 to US$ 540,361.6 [1]. Swiftlet's nests are sent to many countries around the world with the greatest demand from Hong Kong for the Asian region and the United States for the western region.

High market share can be achieved supported by the swiftlet cultivation process which can be carried out in almost all parts of Indonesia. The spread of swiftlet cultivation occurs evenly on several islands, including Java, Kalimantan, Sumatra, and Bali. According to Syahputra [2], geographical conditions, the availability of food and water, the presence of pests and predators, temperature and humidity conditions are some of the factors that need to be considered before cultivating swiftlets for their nests.

Along with the development of primary knowledge related to the benefits of swiftlet nests, people began to think about domesticating swiftlets. Swiftlet species that are widely developed by swiftlet breeders are white-nest swiftlets (*Collocalia fuciphaga*). Hatching eggs by letting the mother incubate the swiftlet eggs until they hatch is considered effective enough to increase the swiftlet population, but this is considered inefficient because it produces low nest quality and takes a long time for the mother to produce new nests [3]. According to Malik et al. [4], microclimate conditions in hatching eggs include temperature and humidity set according to needs, namely at a temperature of 36.5 °C and a relative humidity of 80%. The length of time for hatching swiftlet eggs in the incubator is quite diverse, considering the age of each egg is different.

The condition of swiftlet chicks at hatching is one of the factors that can be accommodated to be improved by selecting eggs to be hatched. Selection that can be made on swiftlet eggs is by candling to determine egg fertility, weighing eggs to determine egg weight and measuring egg length and width to determine egg dimensions. The selection made on eggs to be hatched in terms of egg size is considered to have a positive correlation on the drop weight of swiftlet chicks. Based on this, it is necessary to conduct research to find out and provide information related to the correlation between hatching egg size and hatching weight of white-nest swiftlet originating from Buntok, Central Kalimantan.

2 Materials and Methods

2.1 Location

This research was conducted at PT. Koloni Walet Indonesia (Surabaya, Indonesia).

2.2 Experimental Design

The number of samples of hatching eggs of white-nest swiftlet used in this study were 240 eggs from Buntok Village, Central Kalimantan with varying or random egg ages. The eggs used are hatching eggs that have gone through the candling or the observation stage to ensure the eggs are in normal and fertile conditions, then the eggs are measured in length, width and weighed before being put into the incubator. Hatching eggs that have been measured are put into the incubator by being placed one by one on imitation swiftlet nests and labeled on each imitation nest for easy observation. The eggs are incubated for approximately 22–23 days until it is confirmed that the eggs have hatched completely. Swiftlet chicks that hatched were then weighed to determine hatching weight.

2.3 Statistical Analysis

Primary data of egg size and hatching weight obtained were tested for normality using the Kolmogorov-Smirnov method. Data on egg length, egg width, egg weight and hatching weight were identified as normal, so it was continued with correlation analysis to determine the relationship between the independent variables and the dependent variable observed in this study. Correlation analysis uses the Pearson correlation analysis method which is used to determine the value and direction of the correlation of the two variables. Statistical analysis in this study was carried out with the help of IBM SPSS Statistic v26 software.

3 Results and Discussion

The white-nest swiftlet eggs from Buntok, Central Kalimantan has a minimum length of 1.83 cm and a maximum length of 2.24 cm, with an average length of 2.01 ± 0.09 cm. The minimum and maximum width of white-nest swiftlet eggs were 1.20 and 1.40 cm, while the average width was 1,290 ± 0.03 cm. These results are in line with research conducted by Andaruisworo [5], who found that the average length and width of swiftlet eggs are 2.01 and 1.35 cm. The minimum weight of white-nest swiftlet eggs was 1.32 g, while the maximum weight was 2.05 g, and the average weight was 1.74 ± 0.13 g. The average weight of the white-nest swiftlet eggs in this study was relatively smaller as compared to those found by Andaruisworo [5], who observed that the average weight swiftlet eggs was of 1.97 g. Meanwhile, this current finding was relatively similar to those found by Saepudin [6], who reported that the average egg weight of swiftlets was 1.81 ± 0.23 g.

As can be seen on Table 1, the hatching weight of white-nest swiftlet has a minimum value of 1.03 g and a maximum value of 1.67 g, while the average value was 1.36 ± 0.12 g. This finding is in line with the study reported by Saepudin [6], who found the hatching weight of swiftlets ranged from 1,25 to 1,66 g. In harmony with this current result, Amin et al. [7] also found that the average hatchings weight of swiftlet with artificial hatching was 1.37 ± 0.12 g, while those with natural hatching was 1.42 ± 0.11 g.

Table 2 shows the correlation coefficient (r) between egg length and hatching weight has a value of 0.458 ($P < 0.001$) which mean that there was a moderate and positive

Table 1. The average, standard deviation (sd), minimum, and maximum value of egg length, egg width, egg weight, and hatching weight of white-nest swiftlets eggs from Buntok, Central Kalimantan

Variable	n	Minimum	Maximum	Average	SD
Egg length (cm)	147	1.83	2.24	2.01	0.09
Egg width (cm)	147	1.20	1.40	1.29	0.04
Egg weight (g)	147	1.32	2.05	1.74	0.14
Hatching weight (g)	147	1.03	1.67	1.36	0.13

Table 2. Correlation and coefficient of determination between the egg size and hatching weight of the white-nest swiftlets eggs

Variable	Hatching weight (g)			
	Correlation coefficient (r)	Determination coefficient (R^2)	P-value	N
Egg length (cm)	0.458	0.210	<0.001	147
Egg width (cm)	0.572	0.327	<0.001	147
Egg weight (g)	0.754	0.568	<0.001	147

relationship between egg length and hatching weight of white-nest swiftlet eggs. Similar results were also found in a study of Bagh et al. [8] on Japanese quail eggs, which showed that there was a significant correlation between egg length and body weight of gray and white Japanese quails.

The correlation coefficient (r) between egg width and hatching weight has a value of 0.572 ($P < 0.001$) which means that there is a moderate and positive relationship between egg width and hatching weight. Similar results were also found in a study conducted by Ayeni et al. [9] who found that there was a highly significant correlation between egg size including egg width, egg length, egg weight and hatching weight of chickens [9].

The correlation coefficient (r) between egg weight and hatching weight has a value of 0.754 ($P < 0.001$), which mean that there was a strong and positive relationship between egg weight and hatching weight. These results are in line with the research conducted by Ismoyowati et al. [10], who observed that the correlation coefficient between egg weight and hatching weight was 0.723 [10]. This study also in harmony to the research conducted by Abo-Samaha & El-Kazaz [11], who reported that there was a highly significant correlation between egg weight and hatching weight of quails.

Based on Table 2 the value of the coefficient of determination with the regression model can be explained by using the coefficient of determination, with the assumption that the greater the value, the better the model. The coefficient of determination of egg length, egg width, and egg weight were 0.210, 0.327, and 0.568, respectively. The coefficient of determination value of egg weight was the highest as compared to the egg length and egg width. This data shows that the egg weight variable has a greater influence on hatching weight than the egg length and egg width. The value of the coefficient of determination (R^2) of 0.568 indicates that there is an influence of egg weight on hatching weight of 56.80%. Likewise, the effect of egg length and egg width on hatching weight was only 21.0% and 32.70%, respectively.

The hatching weight of the white-nest swiftlets will increase along with the increase in the value of egg size which includes egg length, egg width and egg weight. Ayeni et al. [9] stated that the egg size has an influence on egg and chick quality. In addition, the most influential parameter on the hatching weight of chicks is evidenced by the coefficient of determination (r^2) of egg weight and hatching weight of 0.57. This means that 57% of hatching weight is influenced by egg weight and the rest is influenced by other factors such as environment or habitat and maintenance management.

Table 3. Analysis of factors affecting hatching weight of white-nest swiftlet eggs model summary[a]

Model	R	R square	Adjusted R square	Std. error of the estimate
1	0.776[b]	0.601	0.593	0.081285

[a]Dependent variable: hatching weight in grams
[b]Predictors: (Constant), Egg Length, Egg Width, Egg Weight

Analysis of the factors that affect the hatching weight of white-nest swiftlet eggs, in this study included the variables of egg length, egg width, and egg weight. The analysis used is a multiple regression test as can be seen in Table 3.

The regression model can be explained using the coefficient of determination, with the assumption that the greater the value, the better the model. Based on Table 3, the R Square value is 0.601, which means the coefficient of determination is 60.10%. This means that the variable X (egg length, egg width, and egg weight) has an influence and contribution to the Y variable (hatching weight) of 60.10%. Thus, the remaining 30.90% is influenced by other factors outside the variable X.

Based on the study conducted by Iqbal et al. [12], the egg size consisting of egg length, egg width and egg weight has a significant effect on hatching weight of chickens. The effect of egg size is expressed from the measurement parameters of chicken weight and chicken body length. Diversity in egg size which has a correlation with hatching weight can be influenced by two factors which consist of internal and external factors of the swiftlet. Internal factors can be in the form of physiological conditions of the swiftlet such as age, body weight, reproductive ability, genetics. In a study by Ahmadani & Rahimi [13], in addition to internal factors, there are external factors that affect the external quality of eggs such as nutrition, drinking water quality, stress by environmental microclimate conditions such as temperature and relative humidity of the air. Furthermore, the geographical conditions where swiftlets live also may affect the egg quality.

4 Conclusions

Based on the results of this study, it can be concluded that there is a positive correlation between egg size including egg length, egg width, and egg weight on hatching weight of white-nest swiftlets. Egg weight has the highest correlation to hatching weight compared to egg length and egg width.

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