Determination of generation status of white-breasted starling (Acridotheres melanopterus) population based on cranial measurements

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Abstract. The objective of this study was to determine the generation status of White-breasted Starling based on cranial measurements. The research was done on July 2018 in Kudus and Klaten regencies. Forty four males and 43 females of mature White-breasted Starling. Vernier callipers and recording form of White-breasted Starling were used in this research. Length and wide of head White-breasted Starling were used as variable. The results of measurement were compared with generation status. Descriptive, correlation and regression analysis were used in this research. The result of the research showed highly strong correlation (r = 0.92) for generation status and head wide of male bird; strong correlation (r =0.70) for generation status and head length of male bird; highly strong correlation (r = 0.88) for generation status and head wide of female bird and Strong correlation (r = 0.74) for generation status head length of female bird. The regression equation was shown between head wide and length as dependent variable and generation status as independent variable of male and female White-breasted Starling, respectively. In conclusion the generation status of White-breasted Starling can be determine based on craniometri. Head wide is the best parameter of craniomateri for determination of generation status.

1. Introduction

White-breasted Starling (*Acridotheres melanopterus*) is one of an endemic bird in Indonesia from *Sturnidae* family. Java, Bali and Lombok Island are location with the most distribution of White-breasted Starling [1]. It has white plumage on its head, breast, back, rump, and also in base point of wings and tail. Meanwhile in the tip of wings and tail is black. Other specific features of White-breasted Starling are yellow beak and yellow circle around its eyes [2]

The latest status of White-breasted Starling existence in 2010 was critically endangered IUCN (*International Union for Conservation of Nature*) due to depression of population in nature [1]. That status make White-breasted Starling belong to protected animal together with other 563 species based on decree of ministry of environment and forestry (No. P.20/MENLHK/SETJEN/KUM.1/6/2018)**.** Based on the reason above, a conservation strategy that aims to increase White-breasted Starling population is necessary. It is also required to avoid extinction, to prevent inbreeding and to create

directed conservation of White-breasted Starling. So, conservation program can be done properly. Unfortunately, in the local captivity determination of generation status of White-breasted Starling is not clear [3]. This condition will affect to the unclear certification by the Natural Conservation Authority and uncontrolled generation status of White-breasted Starling population. Therefore, finding the simple method for determination of generation status is needed.

Cranical measurements especially head width, can be used to determine generation status on White-breasted Starling [4]. The decreasing of head wide is in line with increasing generation status. Unfortunately, the standardization of cranial measurements for determining generation status is not yet exact. Therefore, objective of this study to determine the generation status of White-breasted Starling based on cranial measurements.

2. Materials and Methods

The research was done on July 2018 in 10 captives breeding own by small farmer in Kudus and Klaten Regency, Central Java. Data analysis was done on genetics, Breeding and Reproduction Laboratory, Faculty of Animal and Agricultural Sciences, Universitas Diponegoro, Semarang, Indonesia.

Materials of this research were 44 males and 43 females of mature White-breasted Starling. *Vernier callipers* and recording form of White-breasted Starling were used in this research. Observational method was used in this research with the direct measurement to the research object. Purposive random sampling was used with recommendation from Central Java Natural Conservation Authority. Length, wide and ratio of head White-breasted Starling were used as variable. The results of measurement will compared with generation status. Length and wide head measurement showed on illustration 1. Ratio of head White-breasted Starling was counted by dividing of length by wide of head.
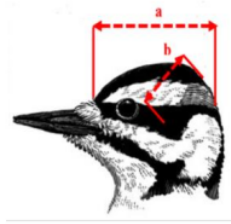

Figure 1. Length (a) and wide (b) of head measurement

Variable of this research was tabulated using descriptive analysis (Mean and standart deviation for each generation status). Then, Length, wide and ratio of White-breasted Starling on different generation status were analyzed using correlation and regression with SPSS 25.0 tools. Descriptive analysis (Maximum and Minimum analysis) was used for significant variable to arrange the range of measurment for each generation status.

3. Results and Discussion

3.1 Length, Wide and Ratio Head of Male White-breasted Starling on Different Generation Status in Captivity

Length, wide and ratio head of male White-breasted Starling for each generation were measured. The head measurements of male White-breasted Starling were shown on Table 1.

Table 1. Length, Wide and Ratio head of Male White-breasted Starling on Different Generation Statusin Captivity

PARAMETER	GENERATION STATUS		
	F0	F1	F2
Head Wide, cm	2.32 ± 0.04	2.20 ± 0.05	2.06 ± 0.07
Head Length, cm	3.76 ± 0.04	3.62 ± 0.08	3.44 ± 0.17
Head Ratio	1.62 ± 0.03	1.64 ± 0.05	1.67 ± 0.11

The results showed decreasing trend of the length and wide of male White-breasted Starling in Captivity along with increasing generation. Otherwise, the head ratio was increasing along the increasing of the generation status. Highest correlation was found in head wide of male White-breasted Starling among three parameters followed with length of head. While, weak correlation was shown by head ratio of White-breasted Starling. Highly strong correlation (r = 0.92) between generation status and head wide of male White-breasted Starling shown in this research with the regression equation:

$$Y = 2.41 - 0.10X$$

This regression equation showed that decreasing 1 level generation status of White-breasted Starling will showed lowering measurement of 0.10 cm of head wide with the maximum measurement on 2.41 cm and minimum 1.98 cm. Strong correlation (r =0.70) also shown for the relation between generation status and head length of male White-breasted Starling with the regression equation:

$$Y = 3.81 - 0.08X$$

This regression equation showed that decreasing 1 level generation status of White-breasted Starling will showed lowering measurement of 0.08 cm of head length with the maximum measurement on 3.81 cm and minimum 3.32 cm.

3.2 Length, Wide and Ratio Head of Female White-breasted Starling on Different Generation Status in Captivity
Length, wide and ratio head of female White-breasted Starling for each generation was measured. The head measurements of female White-breasted Starling were shown on Table 2.

Table 2. Length, Wide and Head Ratio of Female White-Breasted Starling on Different Generation Status in Captivity

PARAMETER	GENERATION STATUS		
	F0	F1	F2
Head Wide, cm	2.23 ± 0.04	2.14 ± 0.02	2.03 ± 0.07
Head Length, cm	3.44 ± 0.06	3.33 ± 0.11	3.31 ± 0.15
Head Ratio	1.55 ± 0.05	1.56 ± 0.05	1.63 ± 0.10

The results shown declining trend of the length and wide of female White-breasted Starling in Captivity along with increasing generation status. Otherwise, the head ratio was increasing along the increasing of the generation status of female White-breasted Starling. Highest correlation was found in head wide of female White-breasted Starling among three parameters followed with length of head. While, weak correlation was shown by head ratio of female White-breasted Starling. Highly strong correlation (r = 0.88) shown for the relation between generation status and head wide of female White-breasted Starling with the regression equation:

$$Y = 2.27 - 0.10X$$

This regression equation showed that decreasing 1 level generation status of female White-breasted Starling will showed lowering measurement of 0.10 cm of head wide with the maximum measurement on 2.27 cm and minimum 1.89 cm. Strong correlation (r = 0.74) also shown on head length of female White-breasted Starling with the regression equation:

$$Y = 3.45 - 0.05X$$

This regression equation showed that decreasing 1 level generation status of female White-breasted Starling will showed lowering measurement of 0.05 cm of head length with the maximum measurement on 3.45 cm and minimum 3.25 cm.

3.3 Standardization of Head Wide of White-Breasted Starling For Determination Generation Status
The results of the regression analysis shown the highly strong correlation of head measurements of White-breasted Starling among three parameters is wide head. The result showed that wide head of male and female White-breasted Starling reduce along with increasing generation status. This results was corroborated the research that stated increasing generation status will reduce the head wide of White-breasted Starling [3Maulana]. The regression equation of wide head of male and female White-breasted Starling can use as standardization for each generation. Standardizations of wide head of White-breasted Starling for each generation are shown on Table 3.

Table 3. Standarization of Wide Head of White-breasted Starling for Each Generation

SEX	HEAD WIDE OF WHITE-BREASTED STARLING		
	F0	F1	F2+
	.... cm		
Male	> 2,31	2,22-2,31	< 2,22
Female	> 2,17	2,08-2,17	< 2,08

The wide of head is one of the parameter of cranial measurements. Cranial measurements is one of the measurement of body part that only affected by genetics, especially maternal genetic [5]. In human, maternal genetic factors explained 19% of the variation in birth length and cranium circumference [6]. Development of cranium is different with other bone in the body. Other bone in the body is not only affected by genetics, but also affected by feed intake and environment [7]. Cranium is the bone in the body that the development process was control by genetics [8]. Reduction of cranial measurements was happened along with increasing generation status of bird as well as deformities phenomena that affected by the inbreeding in one captive breeder. Inbreeding affected to the gene expression including gene that have responsibility to the bone development [9].

4. Conclusion
Cranial measurements of White-breasted Starling can be used for the determination of generation status. Wide head of White-breasted Starling is the parameters of cranial measurements with the highest correlation for determination of generation status. Determination of generation status used cranial measurements is only the alternative for determination of generation status. Furthermore, good recording practice of White-breasted Starling is the responsibility of the captive breeder.

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