

PCA (Principal Component Analysis) application to differentiate hybrid and pure black-winged myna (*Acridotheres melanopterus*)

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Abstract. Black-winged myna (*Acridotheres melanopterus*) is an endemic bird of Java and Bali that is currently critically endangered based on International Union of Conservation for Nature (IUCN) since 2010. Hybridization in captivity occurs between the *Acridotheres melanopterus* with other species of myna. It is difficult to distinguish hybrid and pure black-winged myna without thorough observation. The study was conducted to determine the differences between hybrid and pure black-winged myna based on the morphometric characteristics using Principal Component Analysis (PCA). The samples were selected using purposive sampling method at Cikananga Conservation Breeding Center located in Sukabumi, West Java in May 2017. The morphometric data were taken directly from 44 black-winged mynas with ≥ 2 years old. Data collection was done by measuring body length, body width, body circumference, span of wings and weight. The morphometric data were analyzed by PCA using the SPSS V.20 program. The results showed that body circumference and wing span were the morphometric factors which the most distinguish between them with eigenvalue of 0.943 and 0.811 respectively. In addition, the existence of morphological anomalies is also a sign that the black-winged mynas are hybrids.

1. Introduction

Although the myna was common until recently, the paucity of records in the field and the increasing rarity of individuals in the cage-bird trade suggest that it has undergone an extremely rapid decline over the past 13 years (three generations). This has resulted in the current wild population now numbering fewer than 50 mature individuals. It is clear that the decline is continuing and the extinction of the species' wild populations is imminent [1,2]. As such, this species qualifies as Critically Endangered, and urgent conservation action is required to halt its unsustainable exploitation [3,4]. Commercial animal trade in Indonesia including birds has been going on for a long time and there are even animal markets that specifically sell only a variety of birds, one of them is the black-



winged myna which is in Latin named *Acridotheres melanopterus*. Not a few rare birds are still traded in animal markets [5]. Black-winged myna can still be legally traded if it comes from captivity [6]. Therefore, many breeding birds are emerging and specifically breed the black-winged myna to be traded.

Black-winged mynas are still widely traded in the animal market despite their protected status. Therefore, many bird breeders are emerging and breeding the black-winged myna to meet market needs. It is very surprising to note that many of these birds are being breeds in Klaten, Central Java, Indonesia [7, 8]. The abundance of the breeder is increasing the potential for hybridization between species of black-winged myna which is motivated by the lack of knowledge of breeders on black-winged myna that has two closely related species. The two species are *Acridotheres tricolor* and *Acridotheres tertius* [9-11]. Birds in captivity are even deliberately hybridized to get hybrid individuals that expected to have better characters from their parent, all of which are done to satisfy market interest [20] Although hybridization plays an important role in the evolutionary process, hybridization on the other hand can lead a species toward extinction because pure species can slowly disappear [12, 13].

Although hybridization plays an important role in the evolutionary process, hybridization on the other hand can lead a species toward extinction because pure species can slowly disappear [14-15]. The study was conducted to understand the criteria of hybrid black-winged myna better and to provide better understanding to the breeder about it. There are some researches that has been conducted to other species sowing how hybridization can affect the population. It is showing how hybridization become one of the extinction factors (9, 12, 18). Similar research has not been done before to black-winged starling so this research becomes very important. The results of this study have great potential to serve as the basics of knowledge for breeders in breeding the black-winged myna for commercial purposes or most importantly for the future conservation effort [16, 17, 18].

2. Method

2.1. Study area

The data was taken at Cikananga Conservation Breeding Center (CCBC) located in the southern Sukabumi, West Java, Indonesia (figure 1). The goal of CCBC is to breed Indonesia's endemic species, threatened from extinction to preserve their integrity (through managed breeding) and release them back into their habitats in their geographic range. One of the animals is black-winged myna. CCBC is very successful in the breeding program of the bird. They also have a good management and record of it and it is helping the research in many ways. The research was focused on black-winged myna, and the birds at CCBC are available for the research. The location of CCBC can be seen on the image below (figure 1).



Figure 1. Cikananga conservation breeding center location map.

2.2. Procedure

The identification of BWS morphometric characteristics was performed on 14th until 20th of May 2017 at CCBC captive facilities. Purposive sampling has been used as the method to choose the sample. All birds should be at least 2 years old to ensure that both hybrid and pure black-winged myna are in their mature phase. The 250g dynamometer or spring scale and a cloth bag are used as the tools for weight measurement process. Another tool is needed to measure the wingspan, length, width and circumference of the body. A measuring tape with one meter long was used to measure them. The body parts that will be measured can be seen on figure 2.

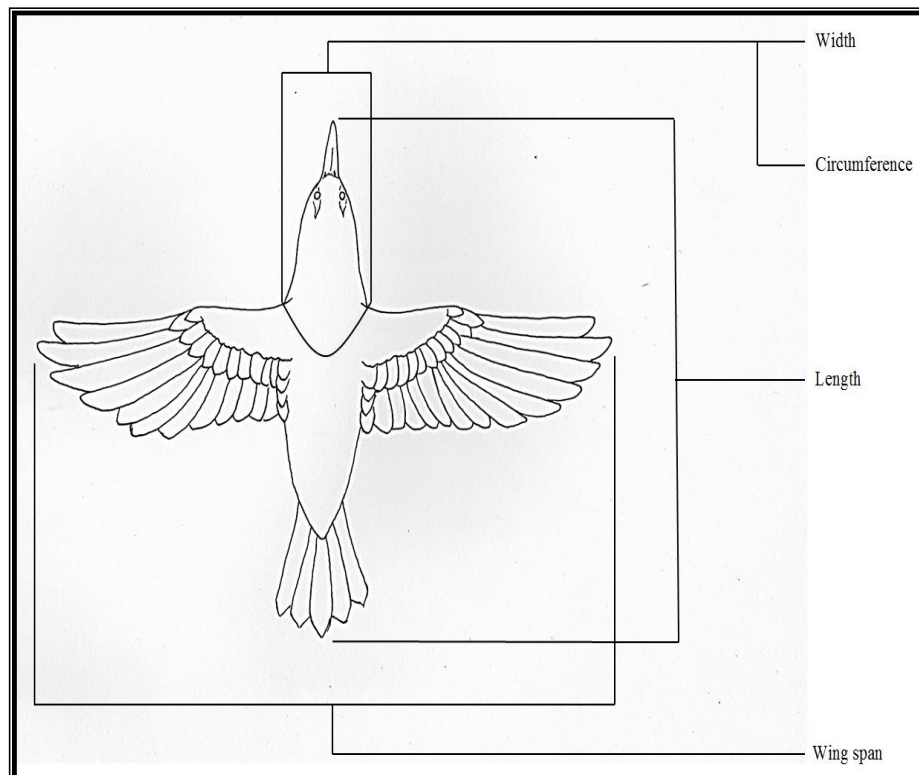


Figure 2. Black-winged myna measurement detail.

All the data collection should be done in the morning, around 06.00 AM until 09.00 AM is a good time to do it. It is to minimize the bird's stress level because of the increasing temperature from the sun light. The first process is to catch the bird and put it into the prepared bag, weight it with the hanging scale. The bird identity is needed to be noted before the work. After the measurement of weight was done, the bird should be taken from the bag. An experienced man needed in this step to hold the bird until all the data collection process was done.

Measurement was done by measuring the length of the body (from the beak to the tail). After that, a camera digital was used to take a full body picture from the right and left side, from above and below the body and also the wingspan. Gradually, take the photos of the back, rump, right shoulder, left shoulder and chest. Write down the present-absent data of abnormal feather if it is observed while the examination. The data taken will be written on the sheet prepared before.

2.3. Data analysis

SPSS V.20 was used to analyze the collected data, the analysis method was Principal Component Analysis (PCA). The method was used to define which factor is the most distinctive between all the factors recorded. Through PCA, the factors are reduced into fewer number of component based on the correlation between all the factors, it can show which factor is the most distinctive from each component. The first step is to see how many components are created from the factors reduction. The

SPSS will analyze the data and produce a component based on the eigenvalue of each factors. In the end, a scatter dot graph was made based on the component data. Analyzing the result of the SPSS analysis will show the conclusion.

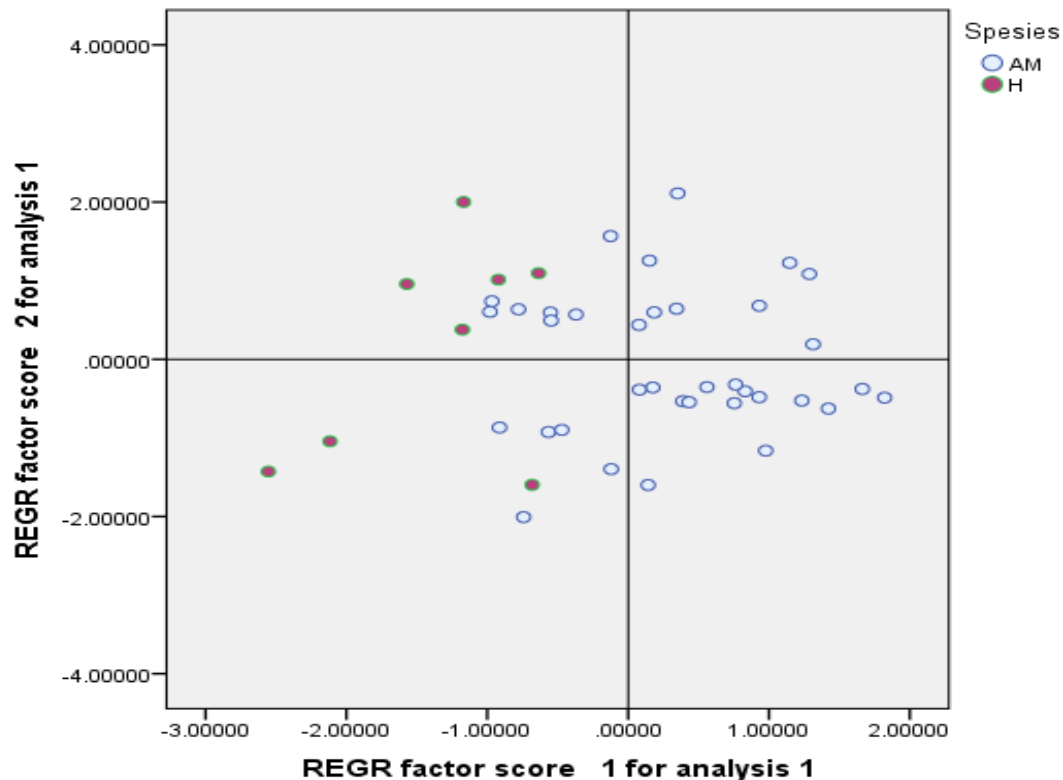


Figure 3. Scatter dot graph of hybrid and pure black-winged myna morphometric data. (AM: Pure *Acridotheres melanopterus*, H: Hybrid).

3. Results and discussion

3.1. Result

Table 1. Principal component analysis result.

Factors	Component 1	Component 2
Weight	0.785	
Length	0.686	
Width	0.490	0.672
Circumference		0.943
Wingspan	0.811	
Anomaly feather	-0.645	
Eigenvalue	2.405	1.500
Variance %	40.087	24.997
Cumulative %	40.087	65.084

At the beginning of the analysis, it has been set that the eigenvalue of the counted component should at least 1.0. Component 1 and 2 are the component with the value more than 1, they are 2.405 and 1.500 consecutively. But from the table above (table 1), the variance from component 2 is very small (24.997). Usually, the score need to be around 30% or 40% to say that the variance is good. In the end, the cumulative score is high enough to represent the group. The anomaly feather only can be found at

component 1 and it is becoming a very distinctive factor between the hybrid and pure black-winged myna. The anomaly usually occurred at the back and the wings of the bird. Sometimes black or grey feather can be found on the back and the wings of black-winged myna. Some cases even show that the anomaly feather can be found on the flank and breast of the bird. The comparison between the hybrid and pure black-winged myna can be found on image below (figure 3).

The pure black-winged myna is dominated by white feathers, black feathers can only be found on the wings and the tail of the bird. For the hybrid, some black or gray feathers can also be found on the back, nape, breast and flank of the bird. It is not normal and becoming the characteristics of hybrid birds. Morphologically, the hybrid can easily identified by noticing the anomaly feathers. it is important to make sure that the birds are on their mature age which is at least two years old. it is very important to ensure the bird will not experiencing morphological change anymore. Based on the morphometric data that has been analyzed using PCA method, there are three main factors that can be the most distinctive factors. There are wingspan from component 1, circumference from component 2 and anomaly feather from component 1. Figure 4 will shows how the hybrid and the pure black-winged myna data in a scatter dot graph based on the data and the analysis result.



Figure 4. (A) pure and (B) hybrid black-winged myna.

3.2. Discussion

Hybridization plays an important role in the evolution process, but at the other hand hybridization also can lead a species toward extinction because pure species can slowly disappear [15, 12]. When the uncontrolled hybridization is happening, the hybrids population could suppress the pure population. In the end, pure black-winged myna will slowly disappear replaced by the new hybrid population [19, 20]. Morphologically, the characteristics of hybrid black-winged myna can be identified by thorough observation. But sometimes the anomaly feather is hidden under the wings or behind the white feather. It is important to observe the bird in our hand or with someone help so the observation can be done more thorough. The knowledge about hybrid bird characteristics is important for the breeders because it can prevent them from doing the hybridization coincidentally. The result shows that the differences between the hybrid and the pure black-winged myna not only based on the morphology but also the morphometric. By measuring the morphometric factors especially, the circumference and the wingspan, they can be distinguished from each other. The average length, weight and wingspan of pure black-winged myna are bigger than the hybrid. It is not surprising remembering the size from another species is slightly smaller and it is likely affecting the size of their offspring including if it's producing a hybrid.

Many species of birds known as common animals before, now they are facing a drastically reducing populations because of human activities [5, 2]. The fact is inseparable from the uncontrolled exploitation of birds in the wild as a pet and this also has led many species of birds to the brink of extinction [7]. There is a surprising finding of the discovery of many legal or illegal breeders in Klaten, Central Java Province, Indonesia. The breeder breeds a variety of birds including endangered birds in very large numbers. All captivity in Klaten is intended for commercial purposes that meet the demand of bird markets from various regions in Indonesia [7]. There are a lot of hybridizations happen at the private breeding facility because they don't even know how to differ the species. The result from this research can be a simple basis for them to differentiate the species based on a simple morphological and morphometric characteristic. Researches related to the black-winged in a lot of aspect are needed in the future to support the conservation effort of the species. It is very sad that the bird is common at the captivity but already critically endangered in the wild which means human is overexploit it.

4. Conclusion

Remembering how similar the hybrid with the pure black-winged myna, PCA analysis can be one of the method used to differentiate them. The result from PCA analysis is showing how the characteristics of the birds can be clustered, the scatter dot graph is a perfect way present the analysis result.

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