

The evidence of cloaca display as an indicator to validate breeding behavior during the matchmaking phase on local Indonesia female White-rumped Shama (*Copsychus malabaricus*)

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Abstract. Putranto HD, Nurmeilliasari, Harahap AS, Brata B, Sutriyono, Yumiati Y. 2023. The evidence of cloaca display as an indicator to validate breeding behavior during the matchmaking phase on local Indonesia female White-rumped Shama (*Copsychus malabaricus*). *Biodiversitas* 24: 486-491. White-rumped Shama bird, which Indonesian bird lovers call the Murai Batu bird (*Copsychus malabaricus*), has been a favorite bird for almost a decade. This bird is well-known among bird keepers for its colors and male singing voices. Generally, we recognize some biological behaviors that are trusted as avian behaviors. However, some specific behaviors in wild and domesticated birds are still not detected and unclear. The objective of this study was to validate and analyze the scientific evidence, frequency, and duration of cloaca display appearance as indicators of the female White-rumped Shama birds breeding behavior during the matchmaking phase. By animal focal sampling method, 18 sexually mature females of local White-rumped Shama captivated and observed by the research peer team were observed intensively for cloaca display activity during 22 days of matchmaking observation duration. Those 18 female samples were treated for matchmaking with another 8 males. For the cloaca display frequency and duration parameter, a time sampling method was used by dividing a total of 6 hours of daily behavior observation into 3 hours of observation duration, 2 times a day with 6 hours of distance between one observation and to next observation. Daily behavior observation conducted between 06.00 am to 09.00 am continued from 03.00 pm to 06.00 pm. Cloaca display frequency was counted as how often a female shows a cloaca exposure to her male matchmaking partner during the daily observation period. Then, a cloaca display duration was measured in the unit of seconds for each cloaca display behavior confirmed. Seventeen (17) female White-rumped Shama birds (94% samples) exhibited motion of cloaca display, with 21 motions of cloaca display behaviors confirmed. The earliest cloaca display behavior was confirmed on day 15 after matchmaking began, and the latest behavior was confirmed on day 22 after matchmaking began. These behaviors were seen on average of day 18.9 ± 2.256 after matchmaking began. The shortest duration of cloaca display behavior lasted for 1.62 seconds, and the longest lasted for 6.26 seconds, with an average duration of 4.37 seconds for each motion. The average daily confirmed cloaca display frequency among that female White-rumped Shama was 0.053 times in 22 days of matchmaking observation duration. Cloaca display motion is seen daily (21 days) during 22 days of observation conducted, and the relative frequency percentage of cloaca display behavior was 95.45%. There is no proven info about the breeding behavior of this bird, and based on our scientific results, we strongly believe cloaca display motion can be validated as the main indicator of Indonesia's local female White-rumped Shama birds' breeding behavior. It can be read from the relative frequency percentage of cloaca display motion of female White-rumped Shama, which is overtopped 95% or dominant motion in its breeding behavior.

Keywords: Cloaca display, female bird, matchmaking phase, sexual behavior

INTRODUCTION

Keeping birds as pets have become a daily custom and traditional culture for bird lovers in Asian countries, including Indonesia (Putranto et al. 2021). The previous report stated that the habit of keeping birds has long been known in Indonesian society, and even in some cultures, this habit is still preserved traditionally (Iskandar et al. 2016). Studies by Putranto et al. (2019a, 2021) said hobbies, economic values, conservation, scientific studies, and even prestige or a high ranking level in a certain social status became the main reasons for bird keepers to have these birds as pets. In addition, a previous study reported that birds are kept giving satisfaction to their owners because they can

provide a natural atmosphere in the form of beautiful appearances, colors, and songs (Putranto et al. 2021). That is confirmed by Ratcliffe et al. (2013), who wrote that listening to birds' chirp can benefit the brain and body, which would be caused human body relaxation.

Keeping a favorite pet, such as White-rumped Shama or *Copsychus malabaricus*, can lead to an uncontrol situation, a decreasing population for some avian species in the wild caused by poaching (Putranto et al. 2019a, 2020, 2021). However, scientific information about Indonesia's White-rumped Shama birds, in terms of biological data and its intensive daily management in captivity and the wild, is still very limited. Furthermore, some preliminary studies reported on the growth of White-rumped Shama feathers

(Putranto et al. 2021), the growth rate and morphometric size of some body parts of White-rumped Shama chicks (Putranto et al. 2020), the reproductive ability and egg production of female birds (Putranto et al. 2018), and domesticated White-rumped Shama bird populations (Putranto et al. 2019a). However, there is no scientific data on its reproduction and breeding behaviors. Understanding the sexual behavior of males and females will contribute to important factors in animal conservation programs.

During this study, research members have observed intensively for months sexual behavior displayed by domesticated endemic Indonesian female White-rumped Shammas. Sexual or reproductive behavior can be defined as all movements or changes in motion shown by an individual female bird when she responds to sexual stimuli appearance from her partner, or an active motion shown by the female bird to seduce her male partner sexually. This motion can validate her receptiveness to her male partner and her next mating activities. As well known for avian species, including poultry species, dancing-like activities such as waltz movements can be validated as an indicator of sexual behavior. A behavior pattern is assumed as an organized behavior with a specific function. It can be a single or integrated sequential action and usually appears in response to a stimulus from the environment.

In this study, female White-rumped Shama sexual motion called cloaca display was monitored intensively. Cloaca display is defined as when a female White-rumped Shama bird lifts its tail feathers to exhibit its cloaca in front of their male partner. This sexual motion seems to be a dominant activity, and this is the main sign indicating the matchmaking process has been successfully carried out. Cloaca display motion as sexual behavior by a female bird can also be interpreted as a mating invitation to seduce her male bird partner. As a female bird lift its tail feathers and displays its cloaca, it can also be interpreted as a sign of receptiveness to the male bird partner. Usually, it will be followed by a mating activity. Study results on green peahen reproductive behaviors by Nareswari et al. (2017) showed that reproductive hormone concentration in every age level of female birds would affect their sexual behavior pattern. The duration, frequency, and sequence of younger female green peacock birds' sexual behavior will differ from that of an older green peacock. Another factor that can be confirmed as a causal factor affecting sexual behavior is individual age. It is common among local breeders in Indonesia to apply a matchmaking activity before a real mating process. Matchmaking can be defined as an intensive activity of taking and positioning the ready-to-mate male White-rumped Shama bird closer to the sexually ready-to-be-mate female bird for approximately 24 hours and continues until the female bird shows the appearance of accepting or rejecting the male partner. The matchmaking process can take longer. Usually, it is well known that matchmaking can last up to 1 month (discussion with bird keepers).

As a conservation effort to preserve the existence of endemic Indonesian White-rumped Shama species and to enrich a deeper knowledge of breeding conservation, it is urgently required to conduct a fundamental exploration of its

biological and behavioral study. Therefore, this study aimed to validate and analyze the scientific evidence, frequency, and duration of cloaca display appearance as indicators of the endemic Indonesia female White-rumped Shama birds breeding behavior during the matchmaking phase.

MATERIALS AND METHODS

This study lasted approximately 10 months (December 2020 to September 2021) and 22 days for the matchmaking phase. Started by building a modified ex-situ environment (an isolated room with a free fresh air access hole). Then, every bird was placed in their individual wooden cage, length: 120 cm, width: 60 cm, and height: 90 cm. Cages were equipped with individual feed, drinking water, and shower trays. The tools used were the camera, digital stopwatch, digital hand counter, and stationaries.

Feeding and drinking water

Feed and drinking water are provided ad libitum. Feed is given as naturally as possible such as crickets (*Gryllus bimaculatus*), red ant eggs (kroto), and lesser mealworms (*Tenebrio molitor*) in a proportional number and weight of feed per each feeding time.

White-rumped Shama bird samples

In this study, female and male bird samples were crossbreeding between Medan and North Bengkulu-origin birds; 18 female White-rumped Shama birds aged between 10-12 months, and 8 male White-rumped Shama birds aged between 10-12 months were monitored in this study. All samples are bought from local breeders at 2 months of age for previous morphometric studies conducted by team researchers, and all chicks have been maintained in individual cages until this study began. All shammas were healthy and had reached their sexual maturity. Several works of literature inform that Indonesian White-rumped Shama can reach sexual maturity at the age of 10-12 months.

Matchmaking process

In this study, matchmaking was done by positioning the male bird cage closer to the female cage (Figure 1).

Definition of cloaca display as breeding behavior parameter

Cloaca display is defined as when a female White-rumped Shama bird lifts its tail feathers to exhibit its cloaca in front of her male partner (Figure 2). The duration of the cloaca display motion was recorded since the female began to lift her tail feathers, exhibiting the cloaca part and lower back of its tail feathers. The duration of the cloaca display motion was measured in a unit of seconds per motion. Before the study began, all researchers were trained to confirm the cloaca display definition based on the ethogram. There is a difference between lifting the tail during mating and defecating. When they defecate, the bird releases feces or liquid from the cloaca, as researchers easily see. However, the cloaca display motion as its breeding behavior is seen only during the matchmaking phase, and no feces or liquid is released from its cloaca.



Figure 1. Matchmaking process between a couple of White-rumped Shama bird

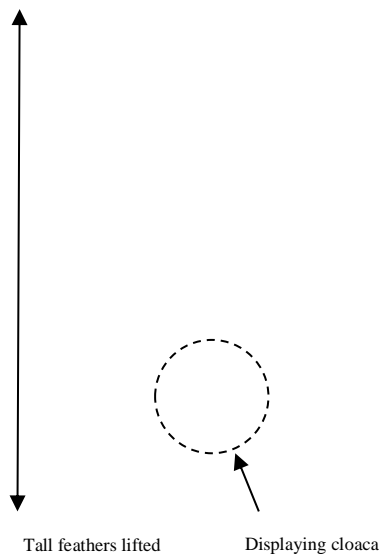


Figure 2. An illustration for cloaca display motion in female White-rumped Shama Bird

Breeding behaviors data collection method

This research was conducted using a focal animal sampling method. The researcher recorded all activities seen in their daily activities, and the time sampling method was used to divide the time for behavioral observation (Nareswari et al. 2017). Observation of the time sampling method is to record the frequency and duration of daily behavior at periods of three hours for a total of 6 hours of observation daily starting at 06:00-09:00 am and 03:00-06:00 pm. Then the next day, observation repeated, starting at 09:00-12:00 am and from 01.00-03.00 pm. Sexual behavior in the form of cloaca display observations was made directly assisted by a camera recorder. To monitor each female bird sample carried out by 5 students who have previously been trained and given an understanding of the

research knowledge, observation parameters, and technical data collection so that it is assumed that students have understood the technical behavior of this behavioral research correctly.

Data analysis

Study results were analyzed using a modified Sudjana formula cited by Saputro et al. (2016) below:

$$\text{Average of Cloaca Display Appearance} = \frac{\text{Total of cloaca display appearance/ number of female bird samples}}{\text{number of collecting data days}}$$

$$\text{Relative Frequency Percentage} = \frac{\text{total of cloaca display appearance}}{\text{total number of sexual behavior}} \times 100\%$$

RESULTS AND DISCUSSION

This study result would be the first information on Indonesian White-rumped Shama bird sexual behaviors. Researchers strongly believe this valuable data will enrich world avian reproductive information. For a continuous conservation program, this study result can be classified as a validation of evidence on specific female sexual behavior, which is cloaca display. There are limited recent studies on fauna-specific sexual behaviors such as matchmaking or cloaca display, especially in avian members (Beauchamp et al. 2013; Nareswari et al. 2017). In poultry members such as red jungle fowl (*Gallus gallus*) (Nurcholis et al. 2020) and Berugo chicken (*Gallus gallus gallus*) (Putranto et al. 2019b), and mammals (Gobay et al. 2020) reported on the sexual behavior of Rusa Timor (*Cervus timorensis*). In this study, before a mating activity began, a matchmaking phase treated these female and male White-rumped Shama bird samples for approximately 3 weeks. According to local breeders' experience, a matchmaking process duration varies from one day to 30 days. If couples are successfully paired by matchmaking activity, the female bird will accept the male bird partner. On the contrary, if a matchmaking activity is failed, both individual birds will reject each other and exhibit a fight.

The researcher successfully validated the evidence of Indonesian female White-rumped Shama sexual behavior called cloaca display motion during the matchmaking phase. It is confirmed by the serial appearance of female birds lifting their tail feathers to exhibit their Cloaca part in front of their male partner. Study result data on frequency, duration, and day of cloaca display appearance are shown in Table 1. The average data of cloaca display appearance and relative frequency percentage are presented in Table 2.

As a specific female White-rumped Shama sexual behavior, cloaca display clearly can be seen in the average day- 18.9 ± 2.3 of the matchmaking phase. The earliest cloaca display was recorded on day 15 of the matchmaking phase, and the latest was on day 22 (Table 1). The frequency data of the cloaca display in Table 1 shows that this motion was about 1.2 times intensively exhibited by every female bird in this study. The relative frequency of cloaca display

motion was approximately 95% or an average of 0.05 times per 22 days of observation (Table 2). Based on study results, the frequency of cloaca display percentage was close to 100% (approximately 95%), confirmed and clearly witnessed by researchers. This percentage number can be classified as high, which means that cloaca display motion was dominant and can be a valid indicator for female Indonesian White-rumped Shama bird sexual behavior. Regarding the duration time of cloaca display motion, this study found that once a female White-rumped Shama exhibited cloaca display motion, the average duration was approximately last for 4.37 seconds, with a range varies between the shortest was 1.62 seconds and the longest was 6.3 seconds (Table 1).

It is also confirmed that the matchmaking process took approximately 15 days or more from the first-day matchmaking process. This finding is a few days shorter than another research that stated that the matchmaking process could be taken as long as 30 days. It is well known that Indonesian White-rumped Shama birds in captivity do not recognize a specific mating season. After mating and being put into a captive cage, they usually mate immediately in a relatively short time, marked by both partners bringing and collecting nesting material such as leaves and hays. Usually, after mating, the female can lay 2-3 eggs. A younger female lays up to 3 eggs, while an older female only lays a maximum of 2 eggs.

During 22 days of observation in the matchmaking phase, this study recorded female White-rumped Shama birds, which showed an average of about 1.17 ± 0.51 times of cloaca display motion per female. More than 90% of female birds in this study (17 out of 18 samples) showed a clear cloaca display motion. However, 72.2% of female bird samples (13 females) demonstrated only one cloaca display motion, and 22.2% (4 female birds) demonstrated two times cloaca display motions during the matchmaking phase. Generally, some signs of female birds ready to mate include female birds often lifting feathers or dry leaves fiber and bringing them to the nest, just liking to be close to their partner, and often flapping their wings when their partner approaches. During the matchmaking phase, the cloaca of the female bird seems more shiny and open. In natural matchmaking activities, it is done slowly, starting from the first step, the introductions. The second step is approaching, and the third is intimating between two individuals. These steps minimize the fight between two individuals; therefore, all three must be done absolutely patiently.

We recorded that the average cloaca display motion duration was 4.37 ± 1.29 seconds per motion. The duration time for cloaca display varies between 1-6 seconds per motion. Based on formulas, the average cloaca display appearance occurred 0.053 times during 22 days of the matchmaking phase. Then, the relative frequency percentage of female cloaca display motion was calculated at 95.45%. We assumed this sexual motion seems a dominant activity, which is the main sign indicating that the matchmaking process has been successfully carried out. It can be read from the relative frequency percentage of cloaca display motion of Indonesian female White-rumped Shama, which is over 95%. Cloaca display motion as sexual behavior by a female

bird can also be interpreted as the mating invitation to seduce her male bird partner. As a female bird lifts its tail and displays its cloaca, it can also be interpreted as a sign of receptiveness to the male bird partner.

During the matchmaking phase and mating activity, male White-rumped Shama birds will demonstrate more aggressive behavior than females. The male bird will show attractive behavior by wagging his tail and making a musical sound to attract the female's attention. To respond to this seduction, the female bird will bend down and spread her wings. In love birds (*Agapornis fischeri*), the behavior carried out by males to attract partners is by approaching the female while nodding their head while the female opens her wings (Dewi 2015). As a step further after matchmaking, a mating activity normally occurs. The average percentage of lovebird mating frequency is 2.4% for 2.76 minutes. The average percentage of the frequency of making out for female lovebirds (24.39%) for 13.02 minutes was higher than that of males (12.69%) for 6.55 minutes (Dewi 2015).

Table 1. Cloaca display motion appears, frequency, and duration of cloaca display recorded in female White-rumped Shama bird samples

Female bird identification number	Day of cloaca display seen*	Freq.	Duration of time**
1	No available data	0	No available data
2	20	2	5.69
	21	1	3.37
3	21	1	4.27
4	19	2	5.44
	20	1	3.51
5	16	1	6.1
6	15	1	2.21
7	21	1	3.63
8	20	1	4.16
9	18	1	5.25
10	22	2	1.62
	20	1	4.43
11	19	1	2.54
12	18	1	3.63
13	15	1	4.16
14	17	1	5.25
15	21	1	6.26
	22	1	5.34
16	19	1	4.15
17	15	1	4.63
18	18	1	6.06
Average***	18.905±2.256	1.17±0.51	4.367±1.29

Note: *: recorded on h-day of matchmaking phase; **: unit in second per each motion; ***: ±SD

Table 2. Average of cloaca display appearance and relative frequency percentage

Average of cloaca display appearance	0.053 times during 22 days
Relative frequency percentage	95.45%

There are 5 natural sexual behaviors in avian class members. Those behaviors were identified as (i) courtship; (ii) the stage of rising above the back and adjusting the position (mounting and positioning); (iii) female stimulating; (iv) male erection and ejaculation; and (v) post-coital display. Behaviors and general signs indicating that male birds are ready to mate include male birds often singing, vocalization, active, aggressive, male genitalia protruding and reddening, eager to be close, and starting to feed their partners. More than 90% of bird species demonstrated a monogamous mating system. Furthermore, it is said that generally, bird species that have a monogamous mating system tend to choose permanent partners. Still, there are always opportunities to conduct copulation or mating with more than one female as a non-permanent partner (Hidayat and Kayat 2014).

The life cycle of White-rumped Shama birds in nature is affected by climate. During the rainy season, it is the most difficult period for the White-rumped Shama to find fresh insects. Putranto et al. (2021) stated that birds regulate reproduction and the period of moulting by molt in the period before the rainy season. That happens because, at these times, the supply of natural food resources is abundant, so their nutritional needs can be fulfilled. The breeding activities of tropical birds, including the White-rumped Shama, usually begin at the end of the rainy season between January and continue until August.

Male and female White-rumped Shama have a different sexual mechanism. Feeding in the form of ant eggs or other insects can stimulate White-rumped Shama sexual behavior; however, the amount of feed given must follow their needs. White-rumped Shama birds ready to reproduce will consume more to prepare their reproductive organs. Generally, male birds require more feed than females. If the feed consumption between males and females is the same, it will cause the female White-rumped Shama bird to be more aggressive than the male. As a result, the female bird will attack the male.

In Spotted Doves (*Spilopelia chinensis*) and Ring Doves (*Streptopelia risoria*), mating behavior would be divided into 3 stages: pre-copulation, copulation, and post-copulation. Pre-copulation is a behavior that is carried out before copulation is conducted. The objective of this behavior is to attract her partner to be ready and willing to copulate; this attracting or seducing a partner is usually done by male birds. However, in this study, we found that the female White-rumped Shama bird also actively seduces her male partner bird and confirmed her receptiveness by exhibiting an open cloaca part in front of male birds. This motion is what we call a cloaca display (Figure 2). We strongly believe that the frequent approach of the female towards the male, including actively exhibiting her open cloaca part, is assumed that female White-rumped Shama begins to be attracted to the male partner. The same exhibition is also shown on peacocks in which the male birds dance to attract the female green peacock and will approach them by circling. Female green peacock who is not interested will continue their activities such as eating, dust bathing, exploring, and drinking or ignoring male birds.

Furthermore, during pre-copulation, for example, the male dove moves his head towards the female, pecking or picking at the feathers. A report said that male dove creates distinctive voices, commonly known as sound sexual (sexual calling or sexual vocal). This sexual motion is well-known as vocalization. Unfortunately, researchers could not clearly confirm any vocalization in this study. Therefore, we assumed a deeper observation and specific tools required to recognize the voices. Generally, it is well recognized by ornithologists that pre-copulation behaviors of male birds are also indicated by the activity of preparing a nest by going out often entering the nest with grass or small branches into or out of the nest, staying for a while confirmed while inside nest while making sounds as sex call. Female birds who are not physiologically ready usually fly away while approached by a male. This pre-copulation behavior can last for a short time (a few hours) to a few days (2-3 days), and sometimes even up to a week or more, depending on the level of maturity and readiness physiologically of female birds. In the female birds who start to match and are ready to mate, it looks quiet if her male partner begins to approach, fondle and mount, and provide a ready-to-copulate response.

Prayitno and Sugiharto (2015) said that the age of an individual bird is a factor that can affect the sexual behavior of birds. Variations of sexual behavior patterns can be caused more by experience, mostly owned by older male birds. We also must reconsider the influence of reproduction hormones' role and feeding. Sexual or mating behavior will be affected by the concentration of reproductive hormones such as Luteinizing Hormone (LH). Nareswari et al. (2017) reported that in a healthy and sexually mature green peacock, their sexual behavior could also be affected by the female bird's reproductive hormone mechanism.

Furthermore, the mounting frequency can be several times (3-4 times or more) in a mating period. A ready-to-mate female bird also looks intensively out to enter the nest or learns to stay silent for a while in the nest to recognize the nest while making a vocalization. Basically, the whole series of pre-copulation behaviors aims to enhance the effectiveness of meeting sperm and egg or allow mating activity can occur successfully and effectively produce offspring. Then, copulation behavior is shown by the male bird mounting the female bird's back and depositing semen into the female reproductive tract. The lifting of the tail feathers of the female bird marks this copulation motion. Copulation could last a very short time, about 2-3 seconds. Generally, copulation occurs on the floor cage, although in some cases, the copulation occurs at the perch.

In conclusion, based on the evidence of study results, the cloaca display motion can be validated as an indicator of female White-rumped Shama birds' reproductive behavior. It also could be concluded that the relative frequency percentage of cloaca display motion of Indonesian female White-rumped Shama is overtopped 95% or dominant in its breeding behavior.

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