

Biometrics, distribution, and breeding notes of Savanna Nightjar (*Caprimulgus affinis*) in several islands of Indonesia

WAHYU WIDODO[✉], EKO SULISTYADI

Research Center for Biology, Indonesian Institute of Sciences, Cibinong Science Center, Jl. Raya Jakarta-Bogor Km 46, Cibinong, Bogor 16911, West Java, Indonesia. Tel.: +62-21-87907604, ✉email: bultok44@gmail.com.

Manuscript received: 10 September 2020. Revision accepted: 22 April 2021.

Abstract. Widodo W, Sulistyadi E. 2021. *Biometrics, distribution, and breeding notes of Savanna Nightjar (Caprimulgus affinis) in several islands of Indonesia. Biodiversitas 22: 2756-2762.* The Savanna Nightjar *Caprimulgus affinis* Horsfield, 1821, a member of the family Caprimulgidae, is a sexually dimorphic, insectivorous nightjar species commonly found in Southeast Asia, including Indonesia. A least-concern species, Savanna Nightjar has diverse habitats from grasslands to shrubs to high-rise rooftops in the middle of the city. Yet, its breeding habits, particularly in urban areas, remain obscure. The purpose of the research is to discuss the biometric measurement, distribution pattern and notes of the breeding of Savanna Nightjar, through analyzing 50 specimens originating from Java, Sumatra, Billiton, Borneo, and Nusa Tenggara Islands belonging to the Museum of Zoology Bogor (MZB) in Cibinong and through a series of observation. The morphological measurements of specimens include the measurements of the length of the bodies, the wings, the tails, the bills, and the tarsi. One-way ANOVA analysis showed that the length of the body and the tail of Savanna Nightjar in Nusa Tenggara are significantly longer than those of Savanna Nightjar in Java, Sumatra, Billiton, or Borneo islands. The biometric differences could have been contributed to different habitat characteristics. Additionally, it was found the likelihood of breeding habit of Savanna Nightjar in urban areas with that of the countrysides because of the resemblance of semi-natural ecosystems in the city such as artificial rivers, small lakes, and parks to Nightjar's open landscape natural habitats, which facilitates the breeding habits. Still, the migration of Savanna Nightjar from open country-landscapes to the metropolitan areas remains elusive and requires a more detailed study.

Keywords: Biometric, breeding, *Caprimulgus affinis*, distribution, Savanna Nightjar

INTRODUCTION

The characteristics of Savanna Nightjars *Caprimulgus affinis* Horsfield, 1821, are generally observed from its diel activity pattern, biometrics, distribution areas and breeding habits. Savanna Nightjar is nocturnal in terms of diel activity patterns (Chavan et al. 2017; Johnson 2019). As insectivores bird (Koli 2014), insect-eating bird, Nightjars are especially needed to maintain balance in the ecosystem as they devour insect pests, such as moths named *Helicoverpa* sp., which tend to attack various field crops (Jathar et al. 2014). Their main diet are flying ants, grasshopper, beetle, crickets, termite, and *Hemiptera* (MacKinnon 1990; Eaton et al. 2010; Chavan et al. 2017). Pertaining to biometrics, Savanna Nightjar is characterized by a wide mouth, big head and eyes, long tail and wings, and short legs. Additionally, its most distinctive feature is the mustache plumage that is used to trap flying insects, their main prey.

Furthermore, Savanna Nightjars is included in the family Caprimulgidae and spread from the western portion of Indonesia, such as Java, Sumatra, and Borneo islands to the eastern regions of Indonesia, especially Bali, Nusa

Tenggara, Moluccas, and Celebes (Eaton et al. 2010; MacKinnon et al. 2010). Although the natural habitats of the nightjar are in open forest landscapes, Savanna Nightjar has recently been spotted in a cement factory complex of Tarjun, Kotabaru district, South Kalimantan and been frequently seen in residential areas in populous cities in Indonesia, such as Jakarta, Bandung and Denpasar (MacKinnon et al. 2010; Riefani et al. 2019). Additionally, the species is found not only in Indonesia but also in the neighboring countries, namely India, Malaysia and Singapore. Despite its ubiquitous presence, only a limited number of references document their breeding habits available (Lamont 2000). Considering the limited availability of references, this research, therefore, aims to enhance understanding of Savanna Nightjars breeding habits by analyzing the biometrics, the distribution, the habitat, and the records of breeding season of the species from a collection of specimens belonged to the Museum of Zoology Bogor (MZB). The comprehensive biological basic data presented in this study can also serve as a vital reference for future studies aiming at preserving Savanna Nightjars.

MATERIALS AND METHODS

Place and duration

The research was conducted at the Ornithological Laboratory, Zoology Division (Museum of Zoology Bogor (MZB), Research Center for Biology, Indonesian Institute of Sciences (LIPI) in Cibinong, Bogor District, West Java, Indonesia from 1 April 2018 to 7 June 2019.

Samples

As many 50 male and female specimens of Savanna Nightjars (*Caprimulgus affinis*) and of their subspecies originated from several Islands in Indonesia were used in this study. The specimens originated from Java (26), Borneo/Kalimantan (2), Billiton/Belitung (4), Sumatra (14) and Nusa Tenggara/ Lesser Sunda Islands (4). Other than specimens, this study also conducted a field observation on a pair of Savanna Nightjars and their young that were found in the area of the “Widiyasatwaloka Building” in Cibinong on July 6, 2018.

The procedures

The external morphological characters recorded were the color of the irises, of the bill, and of the legs, and the biometric measurements. The biometric measurements consist of the length of body (BL), of the wings (W), of the tail (TA), of the bill (B), and of the tarsus (TR) that were measured using Krisbow’s digimatic caliper and metal ruler and recorded in millimeter unit. Other equipment included binoculars, a camera, and a mobile phone, including its stationery.

Data analyses

The research data were analyzed as follows: (i) Biometric data used to group the size measure of every specimen body. (ii) The data distribution pattern was used to determine their area distribution in Indonesia. (iii) The data of habitat and breeding of Savanna Nightjars were used to understand the importance of Nightjars’ roles in nature. (iv) The measurement of each species of Savanna Nightjars was analyzed by One-way ANOVA test.

RESULTS AND DISCUSSION

Throughout the observation period, a total of 50 male and female specimens of *C. affinis* belonging to MZB were recorded. The specimens originated from Java (40), Borneo (2), Celebes (2), Billiton (4), Sumatra (19) and Nusa

Tenggara (4). The morphological characteristics of the irises, bill, and legs of the *C. affinis* subspecies can be seen in Table 1.

As shown in Table 1, it can be seen that there is a similarity in the morphological characteristics of the upper parts and the lower parts of both male and female Savanna Nightjar. The upper parts of Nightjars, particularly the irises and the bills, are dark brown, whereas the lower parts, the legs are light brown or light grey. Commonly, *Caprimulgus affinis* is divided into five subspecies, namely *Caprimulgus affinis affinis*, *Caprimulgus affinis kasuidori*, *Caprimulgus affinis undulatus*, and *Caprimulgus affinis timorensis* (Eaton et al. 2010). *C. affinis affinis* primarily occupies the Greater Sunda Islands (Java, Sumatra, and Borneo) and Lombok, whereas *C.a.propinquus* dwells on the other side of the Greater Sunda island (Celebes). *C. affinis affinis* specimens originating from Java, Strait Sunda, Borneo (Loa Basah, East Borneo), and Billiton were found to have brown irises, reddish-brown bills, and dark red legs, matching to the typical morphological characters of *C. a. affinis* described by MacKinnon (1990). In this study, *C. a. affinis* originating from Palopo that was not available in the collection of MZB’s specimen was included. *C. a. propinquus* was also found in Palopo, South Celebes. Meanwhile, other subspecies *C. a. kasuidori*, *C. a. undulatus*, and *C. a. timorensis* are commonly found in the Lesser Sundas islands. *C. a. kasuidori* colonizes Sumba and Sawu, while *C. a. timorensis* and *C. a. undulatus* inhabit the East Lesser island and West Lesser Sunda Islands, respectively. *C. a. timorensis* is particularly spread on the East Lesser Sunda Islands, such as Alor, Timor, Rote, Kisar, and Leti islands (Birdlife Inertanional, 2012). As for the *C. affinis* on the West Lesser Sunda Islands (Sumbawa, Komodo, and Flores), it is named *C. a. undulatus* and its signature characteristics are dark brown irises, dark brown or black bills, and light brown or light grey legs.

Furthermore, Table 2 shows the results of biometric measurements of *C. affinis*. The measurements focus on five variables, namely the length of bodies, wings, tails, tarsi, and bills. The biometric study is conducted to identify individual birds’ morphological characters of the same species. In this study, particularly, *C. affinis* in Indonesia that is in the family Caprimulgidae is known to have a wide distribution area, thus, birds of a different place of origin may differ in morphological characters. Moreover, it is important to understand the biometric of an individual bird in order to be able to determine the variation of characters between their intra-species and within species.

Table 1. Variation of irises, bill, and the legs of *Caprimulgus affinis* subspecies in the MZB’s collection, Cibinong, Indonesia

Scientific names	Irises	Bill	Legs
<i>Caprimulgus affinis affinis</i> (Java)	Dark brown	Black	Light brown
<i>Caprimulgus affinis affinis</i> (Sumatra)	Dark-light brown	Dark brown-black	Light brown-grey
<i>Caprimulgus affinis affinis</i> (Nusa Tenggara)	Dark brown	Dark brown-black	Light-fleshy brown or grey
<i>Caprimulgus affinis affinis</i> (Billiton)	Brown	Black	Unknown
<i>Caprimulgus affinis affinis</i> (Borneo)	Unknown	Unknown	Unknown

Table 2. Measurements of characters of Savanna Nightjars in several islands of Indonesia

Measurements (mm)	Java	Sumatra	Billiton	Borneo	Nusa Tenggara	p value
Body length	204.55±7.07	208.89±9.45	215.67±7.39	203.5±2.88	213.25±10.2	0.01248*
Wings length	156±3.08	160.11±6.51	155.5±6.53	156.83±3.82	166±9.41	0.5513
Tail	92.77±3.56	97.55±2.65	93.67±2.8	97±0.89	98.5±6.24	4.326E-11*
Tarsus	20.28±1.48	20.46±1.01	19.92±1.05	20.25±0.67	20.02±1.39	0.5004
Bill	11.35±0.84	11.25±0.77	10.91±0.7	11.47±0.34	11.54±0.91	0.1523
N	10	10	10	10	10	

Note: *: significantly different (P<0.05)

Table 3. Further test with Tukey Pairwise of tails of Savanna Nightjar subspecies on several islands in Indonesia

Locations	Java	Sumatra	Billiton	Borneo	Nusa Tenggara
Java		0.931	0.4778	0.0062*	5.77E-11*
Sumatra	1.123		0.9131	0.0508	7.66E-10*
Billiton	2.326	1.203		0.2899	1.32E-08*
Borneo	5.132	4.009	2.807		1.12E-05*
Nusa Tenggara	13.07	11.95	10.75	7.939	

Note: *: significantly different (P<0.05).

Table 4. Further test with Tukey Pairwise of body length of Savanna Nightjar subspecies on several islands in Indonesia

Locations	Java	Sumatra	Billiton	Borneo	Nusa Tenggara
Java		0.93	0.03564*	0.9827	0.8164
Sumatra	1.126		0.2046	0.6708	0.9986
Billiton	4.214	3.088		0.0085*	0.3318
Borneo	0.7628	1.889	4.977		0.4939
Nusa Tenggara	1.526	0.4	2.688	2.288	

Note: *: significantly different (P<0.05).

Table 5. Average body size of Savanna Nightjars (*Caprimulgus affinis affinis*) when compared between locations and sex on several islands in Indonesia

Sex	Characters (mm)	Locations					F	p-value
		Java	Sumatra	Billiton	Borneo	Nusa Tenggara		
Male	TL	202.2±14.15	215.4±8.56	222.4±7.43	204±2.35	212.4±10.26	3.943	0.01614*
	W	161.6±7.23	157.4±7.98	160.2±2.49	156.4±4.27	158.8±4.82	0.667	0.6222
	TA	94.4±5.02	91.8±4.89	96±1.58	98.8±52.6	106±3.81	8.103	0.00047*
	TR	20.15±1.53	20.11±0.73	19.84±1.02	20.58±0.59	21.16±0.32	1.52	0.2343
	B	11.02±0.86	11.98±0.22	10.75±0.6	11.35±0.19	10.96±0.59	3.749	0.01965
Female	TL	208.8±5.72	201.8±11.32	211.8±2.95	202.8±2.94	207±1.58	2.399	0.08427
	W	153±2.91	163±4.95	153±4.74	162.6±2.3	157.6±1.17	8.059	0.00048*
	TA	89.2±9.56	94.6±4.61	93.4±2.88	97.6±1.14	110.2±1.48	34.68	9.821E-09*
	TR	20.59±1.07	19.87±1.05	19.68±1.08	19.87±0.42	19.57±0.25	1.101	0.3833
	B	11.92±0.88	10.95±0.52	10.81±0.59	11.11±0.81	11.25±0.36	2.103	0.1183

Note: BL: body length, W: wings, TA: tail, TR: tarsus and B: bill. *: significantly different (P<0.05)

In this research, the measurements of the morphological characters of Savanna Nightjar specimens were then grouped based on the origin and sex. One-way ANOVA results seen in Table 2 show the body length and tail length of Savanna Nightjars from five islands are significantly different (P<0.05). *P's value* for the body length is at 0.01248 and *p's value* calculated on tail length is 4.326E-11. Yet, one-way ANOVA revealed the differences in terms of the length of wings, tarsi, and bill were not significant.

Further statistical test Tukey Pairwise, presented in Tables 3 and 4, showed significant differences in the length of the tail and the body of each individual Savanna Nightjar on Java, Sumatra, Billiton, Borneo, and Nusa Tenggara.

Table 3 shows that the tail length of Savanna Nightjar setting on Java, Sumatra, Billiton, and Borneo is significantly shorter than that of Savanna Nightjar on Nusa Tenggara islands. Table 4, meanwhile, presents the results of the difference in the body length. It can be seen that the Savanna Nightjar population in Billiton had the longest body size compared to that of the same species on other

islands. Furthermore, Table 5 compares the results of Tukey Pairwise measurements between the male and female Savanna Nightjar.

It is revealed that male Savanna Nightjar has robust differences in terms of body length (BL) and tail length (TA). It can be seen that the body length (BL) of the male specimens from Billiton, namely at 222.4 mm, was longer than that of the male specimens from Java, Sumatra, Borneo, and Nusa Tenggara, namely at 202.2 mm, 215.4 mm, 204 mm and 212.4 mm, respectively. For the length of the males' tails (TA), meanwhile, it was found that the male Savanna Nightjar from Nusa Tenggara had the longest tails at 106 mm, compared to 94.4 mm (Java), 91.8 mm (Sumatra), 96 mm (Billiton), and 98.8 (Borneo). Similarly, the female Savanna Nightjar from Nusa Tenggara also had the longest tail (TA) when compared to that of the females in Java, Sumatra, Billiton, and Borneo at 110.2 mm, 89.2 mm, 94.6 mm, 93.4 mm, and 97.6 mm, respectively.

Other than the tail length (TA), the female Savanna Nightjar had a significant difference in terms of the length of wings (W). In Sumatra, the female Savanna Nightjar was found to be the ones with the longest wings at 163 mm, compared to those of female Savanna Nightjar in Java, Billiton, Borneo, and Nusa Tenggara with 153 mm, 153 mm, 162.6 mm, and 157.6 mm, respectively. The results showed that the population of Savanna Nightjar in Nusa Tenggara had the longest wings compared to the wings of Savanna Nightjar on other islands. This is possibly influenced by the vast availability of grasslands in Nusa Tenggara, whereas high risks surround other islands. Regions with a high number of open spaces enable avian populations, including Savanna Nightjar, to flex and extend their wings as wide as possible while flying. Meanwhile, birds in "concrete-jungle" regions, such as Java Island adapt to their habitat by limiting their wings extension. Therefore, the geographical difference has certainly affected the morphometric variations in intra-species of Savanna Nightjar (Sun et al. 2017). Overall, the wings of the females were likely longer than those of the males due to its function of incubating and protecting the young.

Pertaining to the distribution area, the habitats of nightjars vary from the lowlands forests to the highlands, and Savanna Nightjar *Caprimulgus affinis* is a type of nightjars commonly found in lowlands. Majority of the MZB's specimens were obtained from the Greater Sunda Islands, which are Java (West Java, Central Java, and small islands in the Sunda strait), Sumatra (Lampung, Palembang, Tapanuli, and Aceh), and Borneo, whereas, small portions of specimens were sourced from the Wallacea region, including East Nusa Tenggara, Moluccas, and Celebes. The distribution starts from Kotacane (Aceh), to Tapanuli (Sumatra), to Lampung, to Borneo, to Central Java, to West Java, to small islands in the Strait Sundas, to Celebes, to East Nusa Tenggara, and to the ending distribution point of Moluccas. The subspecies scattered over Java, Sumatra, Aceh, Bangka-Belitung, Borneo, Southeast Central Celebes, and a part of Nusa Tenggara (Lombok) is the *C. a. affinis*. The ones in North Central Celebes and Palopo are the *C. a. propinquus*. Meanwhile,

in the Lesser Sunda Islands, specifically in Sumba and Sawu, in the West Lesser Sunda Islands (Sumbawa, Komodo, and Flores), and in the East Lesser Sunda Islands (Alor, Roti, Kisar, Timor) are the subspecies of *C. a. timorensis*, *C. a. kasuidori* and *C. a. undulatus*, respectively (BirdLife International 2012).

In addition to Savanna Nightjar, Indonesia also houses other Nightjar species, namely the Large-tailed Nightjar (*Caprimulgus macrurus*), Salvadori's Nightjar (*Caprimulgus pulchellus bartelsi*), *Caprimulgus indicus jota* (Grey Nightjar), and the Bonaparte Nightjar (*Caprimulgus concretus*). The large-tailed Nightjar *Caprimulgus macrurus* spreads from lowlands to uphill forests. The lowland subspecies of *Caprimulgus macrurus macrurus* has mainly been found in West, Central, and East Java. In West Java it has been found in the Mount Andir forest, Sangiang Island, and lowland forests of Cihandeleum, Ujung Kulon. Meanwhile, *C. m. macrurus* in Central Java has been recorded in the Gedangan teak forest, Semarang and Wonosalam. Based on specimen collections of MZB, in East Java, *Caprimulgus macrurus macrurus* has been found in the Ijen Reserve (970 m from above sea level) and Tanjung Barat, Panaitan lowland forest. Additionally, *Caprimulgus macrurus macrurus* has been found in Bali, namely in the Sumber Klampok forests, West Bali. Other than on Java and Bali islands, the Large-tailed Nightjar has been seen in Sumatra (in Muara Baru, and in the *Avicennia* mangrove forest), Pontianak, West Borneo, Mount Latimojong, and South Celebes. Our observation, *Caprimulgus macrurus* was seen in and around the Cungur Resort, flying slowly from the shoreline to the inner forest of the Alas Purwo National Park area, on 24 May 2015 (Widodo 2016). This Large-tailed Nightjar was recorded on position S 8° 36' 04.5" and E 114° 14' 07.6"; 24 m, flocking on the plant named *Calophyllum inophyllum* at Nyamplung beach, Waru laut (*Thespesia populnea*), a little stretch savanna, and bush of *Lantana camara*. As for the highland Nightjars, there are two common types namely Salvadori's Nightjar *Caprimulgus pulchellus bartelsi* and *Caprimulgus indicus jota* (Grey Nightjar). The Salvadori's Nightjar is considered an endemic species in Java commonly inhabiting West Java mountains namely in Mount Salak and Mount Gede Pangrango, at 1350 m, and Mount Halimun, at 2000-2500 m above sea level, respectively (Prawiradilaga 2016). Additionally, it has been spotted in Mount Selamet, Central Java, and Nongkojajar Tengger Mountain forest, East Java. Meanwhile, the *Caprimulgus indicus jota* (Grey Nightjar) occupies primary and secondary forest more than 900 m and less 3000 m above sea level (Eaton et al. 2010), such as in Mount Pangrango that stands at 3000 m above sea level (MacKinnon 1990). According to Dalvi et al. (2017), *Caprimulgus indicus jota* (Grey Nightjar) is highly migratory, and moves in small groups—between September and November. It moves southward from Sumatra, Java, Borneo, Malaysia and the Philippines to Eastern China, and possibly across the South China sea, to winter in Southern China, and Indochina.

Other nightjar is the Bonaparte's Nightjar *Caprimulgus concretus*. The habitat of Bonaparte's Nightjar was

recorded in the primary forests with an altitude of 500 m above sea level (MacKinnon et al. 2010). This species is endemic in Sumatra and Borneo. Most of Bonaparte's Nightjar spread widely from Central and East Belitung (Billiton) Islands to East Kutai, East Borneo. Olah and Simay (2007) stated that Way Kambas National Park, in Sumatra South-eastern, is also the distribution area of nocturnal birds such Bonaparte's Nightjar. The Way Kambas National Park is lowland rainforest and the position is between S 4° 37'-5° 16' and E 105° 33'-105° 55', standing at an altitude of 0-50 m. Based on the latitude and longitude coordinate it can be inferred that the distribution area of Bonaparte's Nightjar is centered on South Sumatra to East Borneo with the central population found on Belitung (Billiton). Additionally, through detailed evaluations on the composition of Nightjars, it was known that there are 7 species of Nightjars in swampy forests of Sumatra and Papua is the house of 6 Nightjar species.

Yet, there are two common South East Asian Nightjar species, namely the Mees's Nightjar *Caprimulgus meesi* and the Philippine Nightjar *Caprimulgus manillensis* which are still not yet gathered as specimens by the Museum of Zoology Bogor (MZB). The Mees's Nightjar is known as endemic species in Indonesia and the distribution area is mainly in Nusa Tenggara. Meanwhile, the Philippine Nightjar is restricted range-bird species in North and Centre Celebes; yet, it is uncommon in lowland Buton forest (Eaton et al. 2010). In total, this study used 50 Nightjar specimens (Table 6). Additionally, in Figure 1, it can be seen that the distribution of Savanna Nightjar (*C. affinis*) spreading across Indonesian islands was higher than that of other Nightjar species.

Savanna Nightjars are sexually dimorphic, with a clear distinction of the color of males' and females' body plumage. The males have distinctive white patches in their throat, wings and tail. Meanwhile, the females have subtle white patches and their feathers look redder without white

spots on the tail (MacKinnon 1990). According to Ganpule (2010), the male, female, and juvenile birds can be described as follows:

Male: The general coloration is brownish-grey. The main identification mark of a male is the all-white tail that can be spotted when they are flying, but difficult to see when the birds are roosting. A clear buff-colored "V" is seen from shoulder to center of back when roosting. There is no marking/streaking on the head. Prominent, round buff-colored spots are present on the coverts extending up to the secondaries.

Female: The general coloration is greyish. Upper parts are mottled grey. Buff-coloured "V" is also present, though not very prominent. Outer tail feathers are mottled. In-flight, spots on primaries are rufous buff in color. Buff-colored spots on the coverts and secondaries are smaller and not prominent.

Juvenile: The general coloration is brownish-grey. Upper parts are mottled. There is no "V" on the upper parts. There are almost no spots on the coverts.

Table 6. Specimen collections of *Caprimulgus affinis* in MZB,, Cibinong, Bogor District, Indonesia

Islands	Province	Specimen
Biliton (Belitung)	West Belitung	2 (♂)
	East Belitung	2 (♀)
Java	Banten	4 (2♀; 2♂)
	DKI	14 (9♀; 5♂)
	West Java	2 (1♀; 1♂)
	Central Java	6 (3♀; 3♂)
Borneo	East Borneo	1 (♀)
	Unknown	1 (♂)
Nusa Tenggara	East Nusa Tenggara	2 (1♀; 1♂)
	West Nusa Tenggara	2 (♂)
Sumatra	North Sumatra	12 (6♀; 6♂)
	West Sumatra	2 (1♀; 1♂)
Total		50

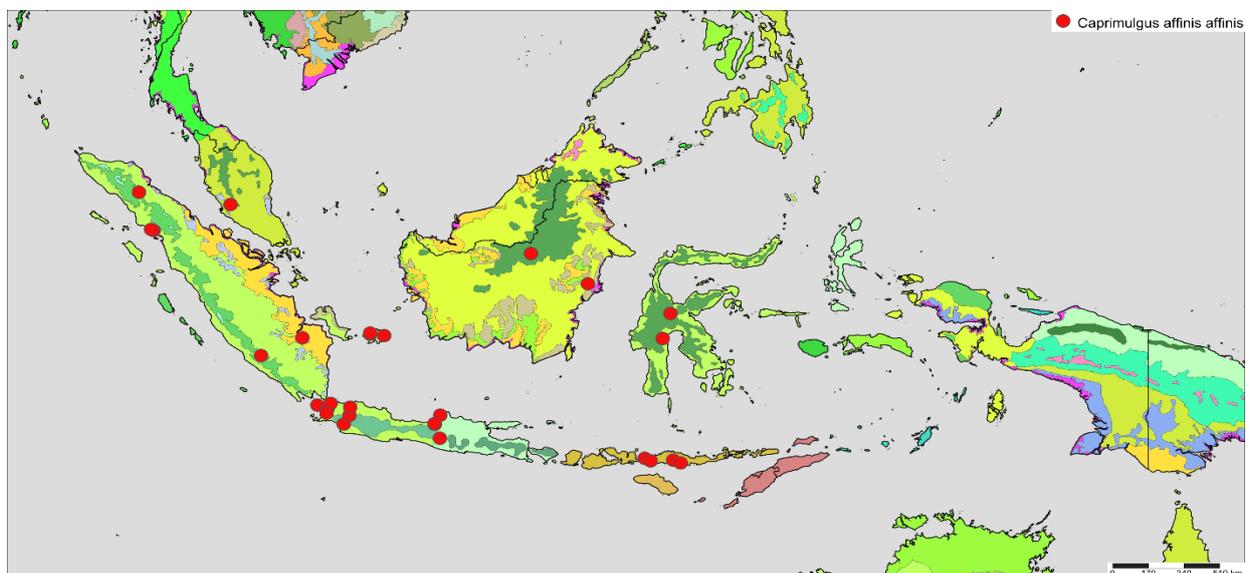


Figure 1. Distribution of *Caprimulgus affinis affinis* based on MZB collection on several islands in Indonesia



Figure 2. A. The hen and a pair young of Savanna Nightjars took rest on the flat rooftop of the Widyasatwaloka Building on August 6, 2018. B. The young of Savanna Nightjars on 6 August 2018 (Photographs by W. Widodo)

The breeding season of nocturnal birds of the Caprimulgidae is rarely known as can be inferred from the lack of relevant references. In Indonesia, the reproductive records of the Caprimulgidae birds are mostly gathered from the MZB's specimens of Savanna Nightjar (*C. affinis affinis*), and they generally show comprehensive biometric measurements. Yet, the records are not sufficient in elucidating its breeding pattern. For example, the specimens of *C. affinis affinis* from Belitung (Billiton) island named MZB 14938 (Male) and MZB 14937 (Female), which were deposited around April 1937 only undisclosed the measurement of male testicles and the small granular form of ovaries in female.

Due to the limited references, we conducted a comprehensive year-long study, between 2018 and 2019, on Savanna Nightjar (*C. affinis*) to document its biometric measurements, distribution pattern, and breeding habits. Then, on 6 August 2018, we found a pair of the Savanna Nightjars sleeping with their chicks resting side by side, whereas the male was sitting closely from them (about 1 m) as observed by us from a distance on the rooftop of our institution building. The female and the chicks were seen of about 2 m and illustrated in Figures 2.

The office building where the Savanna Nightjar nested is high rise located in a downtown area. Although it is a high rise, the observation site has a large open space on the rooftop, which is well lit, and is quiet at night, making it attractive for the birds to flock. It was observed between July and August, which are considered as the months of breeding period of Savanna Nightjar in urban areas. The documentation and direct observation results showed that the appearance of the nested birds matched the *C. affinis*'s morphological characters described in the literature and the MZB collections. These include white streaks on their eyebrows, the long, curvy speckled outer plumages, and three white stripes on the outer side of their tail feathers. When the male flew, the white spots on the wings of the adult *C. affinis* were clearly visible. Overall, the adult

feathers of *C. affinis* are reddish and their young feathers are smooth, white and greyish. As the male, hen, and the young Nightjars lie down during the day of the observation, we estimated that July and August are the breeding season of Savannah Nightjars, particularly in the Bogor urban area, West Java. According to MacKinnon (1990), the breeding season of Savanna Nightjars in Java lasts from May to December.

In the mating season, the male Nightjars will attract the females while perching on the rooftops or the trees, by producing high-pitched shrieks of around 4.2 kHz/90 decibels (dB). The frequency of the call in the town and in the countryside is similar. The call, additionally, is also done to mark their territory and they will constantly stay within their territory waiting for their hatchlings. On the other hand, the females tend to squeak as a sign of their solitary area at a period of laying eggs and brooding. The occurrence of mating habits is higher in open verdant areas in noisy urban environments (Tseng et al. 2017). Previously, this species tends to occupy natural habitats like savannah and river areas around forest. Yet, the rapid development of semi-natural ecosystems in the middle of urban areas has attracted this species to populate urban areas by nesting on tall buildings' roofs (Cheng et al. 2019). For example, Iswandar et al. (2020) reported on the existence of Savanna Nightjar around the University of Lampung, Indonesia. Another presence of Savanna Nightjar was recorded in Islamabad (Abbas et al. 2017). One of the possible attractions of the urban areas could be the absence of predators. Although the Savannah Nightjar has survived in both urban and countryside areas, the reasons for migration from the rural to metropolitan areas remain unclear. Furthermore, the impact of the Savanna Nightjar's migration on the food chain of crepuscular and nocturnal animals also needs to be investigated further.

It can be concluded that Savanna Nightjar has different biometric characteristics based on its distribution area (island) which is influenced by the characteristics of the

habitat. Significant differences were found in the characteristics of body length and tail length, especially in the Nusa Tenggara region. Savanna Nightjar in Indonesia is spread from Greater Sunda, Lesser Sunda, and parts of Sulawesi. Breeding information of Savanna Nightjar is still limited, however, this study reveals that this species is still found breeding on a flat and high roof in some office areas.

REFERENCES

- Abbas ER, Shamim S, Khan FM. 2017. A study on the birds of Urban Islamabad in Moonsoon season. *J Bioresour Manag* 4 (2):46-56. DOI: 10.35691/JBM.7102.0072.
- Chavan SP, Jondhale, Walke D, Jadhav P. 2017. Habitat for camouflage is priority in preference besides harsh physical conditions in three species of Nightjar (Aves: Caprimulgiformes). *Intl J Fauna Biol Stud* 4 (6):5-10.
- Cheng B-Y, Shyu G-S, Wu S-C, Lin, H-H, Hsu C-H, LePage BA, Fang W-T. 2019. Fragmented riverine habitats in Taiwan have spatio-temporal consequences, re-distributing *Caprimulgus affinis* into urban areas leading to a human-wildlife conflict. *Sustainability* 11 (1778):1-12. DOI: 10.3390/su11061778.
- Dalvi S, Kataria G, Shah M, Jabestin A, Casper J, Vishnupriya S. 2017. First record of Grey Nightjar *Caprimulgus indicus* jotaka/hazarae from the Nicobar Islands, India. *Indian Birds* 12 (6):162-164.
- Eaton JA, van Balen B., Brickle NW, Rheindt FE. 2010. *Birds of the Indonesian Archipelago Greater Sundas & Walallacea*. Lynx Editions, Barcelona.
- Ganpule P. 2010. Roosting behaviour of Franklin's Nightjar *Caprimulgus affinis*. *Indian Birds* 6 (4&5): 92-94.
- Iswandaru D, Novriyanti N, Banuwa IS, Harianto SP. 2020. Distribution of bird communities in University of Lampung, Indonesia. *Biodiversitas* 21 (6): 2629-2637. DOI: 10.13057/biodiv/d210634.
- Jathar G, Anpat S, Bhangare B, Patil D. 2014. Unusual congregation of Savanna Nightjars (*Caprimulgus affinis*) in a wheat field. *J Bombay Nat Hist Soc* 111 (2):135-136. DOI: 10.17087/jbnhs/2014/v111i2/72239.
- Johnson S. 2019. The Feeding Habits of Nightjars. <https://www.beautybirds.com>. [Available online 23 October 2019]
- Koli VK. 2014. Diversity and status of avifauna in Todgarh-Raoli Wildlife Sanctuary Rajahtham, India. *J Asia Pac Biodivers* 7: 401-407. DOI: 10.1016/j.japb.2014.10.005.
- Lamont AR. 2000. Breeding habits and behaviour of Large-tailed Nightjar *Caprimulgus macrurus* in Singapore. *Forktail* 16: 166-167.
- MacKinnon J. 1990. *Field Guide to the Birds of Java and Bali*. Gadjah Mada University Press, Yogyakarta.
- MacKinnon J, Phillipps K, van Balen B. 2010. *A Field Guide to the Birds of Borneo, Sumatra, Java and Bali*. Puslitbang Biologi-LIPI, Bogor.
- Olah J, Simay A. 2007. Way Kambas National Park, Sumatra, Indonesia: The best Asian night-birding. *BirdingASIA* 8: 39-44.
- Prawiradilaga DM. 2016. *Birds of Halimun-Salak National Park, West Java, Indonesia: Endemism, conservation and threatened status*. *Treubia* 43:47-70.
- Riefani MK, Soendjoto MA, Munir AM. 2019. Bird species in the cement factory complex of Tarjun, South Kalimantan, Indonesia. *Biodiversitas* 20 (1): 218-225. DOI: 10.13057/biodiv/d200125.
- Sun Y, Li M, Song G, Lei F, Li D, Wu Y. 2017. The role of climate factors in geographic variation in body mass and wing length in a passerine bird. *Avian Res* 8:1-9. DOI: 10.1186/s40657-016-0059-9.
- Tseng S, Li Y-Y, Yang Y-C, Wang Y, Lin WL. 2017. Injury feigning in the Savanna Nightjar: A test of the vulnerability and brood value hypotheses. *J Ornithol* 158: 507-516. DOI 10.1007/s10336-016-1400-0.
- Widodo W. 2016. Distribution and diversity of restricted-range bird species in the Alas Purwo National Park. *Proc Biol Edu Conf* 13 (1): 690-700. [Indonesian]