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NOTES ON THE ROSEATE TERN *Sterna dougallii* BREEDING IN KARIMUNJAWA ISLANDS, JAVA, INDONESIA

Hary Susanto*[1,2], Imam Taufiqurrahman[3], and Tulus Wicaksono Bayu Aji[1]

[1]*Balai Taman Nasional Karimunjawa, Semarang 50273, Central Java, Indonesia*
[2]*Balai Konservasi Sumber Daya Alam Yogyakarta,*
Wadas, Tridadi, Sleman, Yogyakarta 55514, Indonesia
[3]*Birdikari, Kota Tangerang Selatan, Banten, Indonesia*
[*]*Corresponding author:harysalwasusanto@gmail.com*

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ABSTRACT

Roseate Tern *Sterna dougallii* is a rare to uncommon resident and migrant species in Greater Sundas, with only a handful records in Java. On 24 May 2021, a nest containing a single egg of the species was found in Karang Ketel islet, Karimunjawa Islands and constitute the first breeding record of Roseate Tern in the area, filling the breeding information gap of the species in Java for about 80 years since it first reported. Follow up surveys after the findings carried out for three consecutive years from May 2021–June 2023, reveals the species regularly breed in three locations, i.e., Karang Ketel islet, Karang Kapal islet, and Krakal Besar I. Breeding recorded from May to August, with only small colony of 2–20 birds present.

Key words: breeding, Karimunjawa, resident, seabird, *Sterna dougallii*

INTRODUCTION

Roseate Tern *Sterna dougallii* is a rare resident and uncommon migrant to the Greater Sundas (Eaton et al., 2022; Taufiqurrahman et al., 2022). In Java, the species first reported by Max E. G. Bartels from Pulu Pajung Ketjil, Tausendinseln (now Payung Kecil I., Seribu Is.) on 14 September 1906 (Finsch, 1907; Bartels, 1908). Up to date, there were only a handful published record of the species in Java and its satellite islands, mostly from western and northern coast, i.e., Krakatau Is. (Hoogerwerf, 1953a), Panaitan I. (Hoogerwerf, 1953b), Ujung Kulon (Hoogerwerf, 1969), Pulau Dua (Milton & Marhadi, 1985), and Jakarta Bay (Tirtaningtyas & Yordan, 2017).

In Java, the species was reported to breed in April and May (Hoogerwerf, 1949a; Hoogerwerf, 1949b; Hellebrekers & Hoogerwerf, 1967), with only Pulau Dapur, Jakarta Bay and an unspecified location in West Java known as the breeding location. Record in Pulau Dapur came from a single egg collected in May by Bartels (Hellebrekers & Hoogerwerf, 1967). Max Bartels Jr. (Bartels, 1939) in his response to Hoogerwerf & Siccama (1937), informed that his father Max Eduard Gottlieb Bartels once collected the egg of Roseate Tern from Teluk Batavia (another name for Jakarta Bay). The egg, housed at the Naturalis Biodiversity Center in Leiden (catalogue number RMNH.AVES.33422), was collected on 28 May 1926 by M.E.G. Bartels & sons (Fig. 1) (Naturalis Bioportal, 2024g). A single odd shell from Hoogerwerf's own collection recorded

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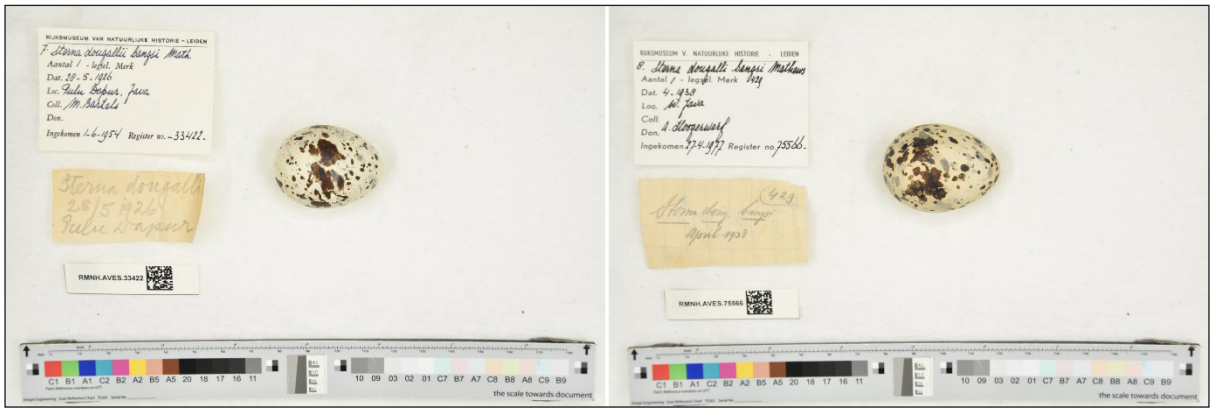
from somewhere in West Java, without mentioning any specific date or location (Hellebrekers & Hoogerwerf, 1967). This egg refer to another egg in the Naturalis Biodiversity Center (RMNH. AVES.75566), collected in April 1938 (Fig. 2) (Naturalis Bioportal, 2024h).



Figures 1 (left) **& 2** (right). Egg specimen RMNH.AVES.33422 collected by M. Bartels from Pulau Dapur, 28 May 1926 (left) and egg specimen RMNH.AVES.75566 collected by A. Hoogerwerf from West Java, April 1938 (right). Photographed by Pepijn Kamminga (Naturalis Biodiversity Center, the Netherlands).

Elsewhere in Indonesia, the species recorded nesting in Ree I., Tayandu Is., Maluku (Hartert, 1901). No published report from Obi Is., but there are a series of six catalogued collections (RMNH.AVES.183547-RMNH.AVES.183552) containing 54 of eggs in total in the Naturalis Biodiversity Center, collected from the areas during 3 July-1 September 1862 by Heinrich Agathon Bernstein (Naturalis Bioportal, 2024a; Naturalis Bioportal, 2024b; Naturalis Bioportal, 2024c; Naturalis Bioportal, 2024d; Naturalis Bioportal, 2024e; Naturalis Bioportal, 2024f). They were presumed to be breeding in Aruah Is. (or now Arwah Is., part of Riau province, Sumatra) (Robinson, 1907; Gibson-hill, 1956) (Fig. 3).

There has been no record of Roseate Tern in Karimunjawa Is. from previous study (Susanto, 2012). Therefore this study aims to report and provide information on the occurrence of this species in Karimunjawa Is. Observations on colony size and breeding sites are provided.

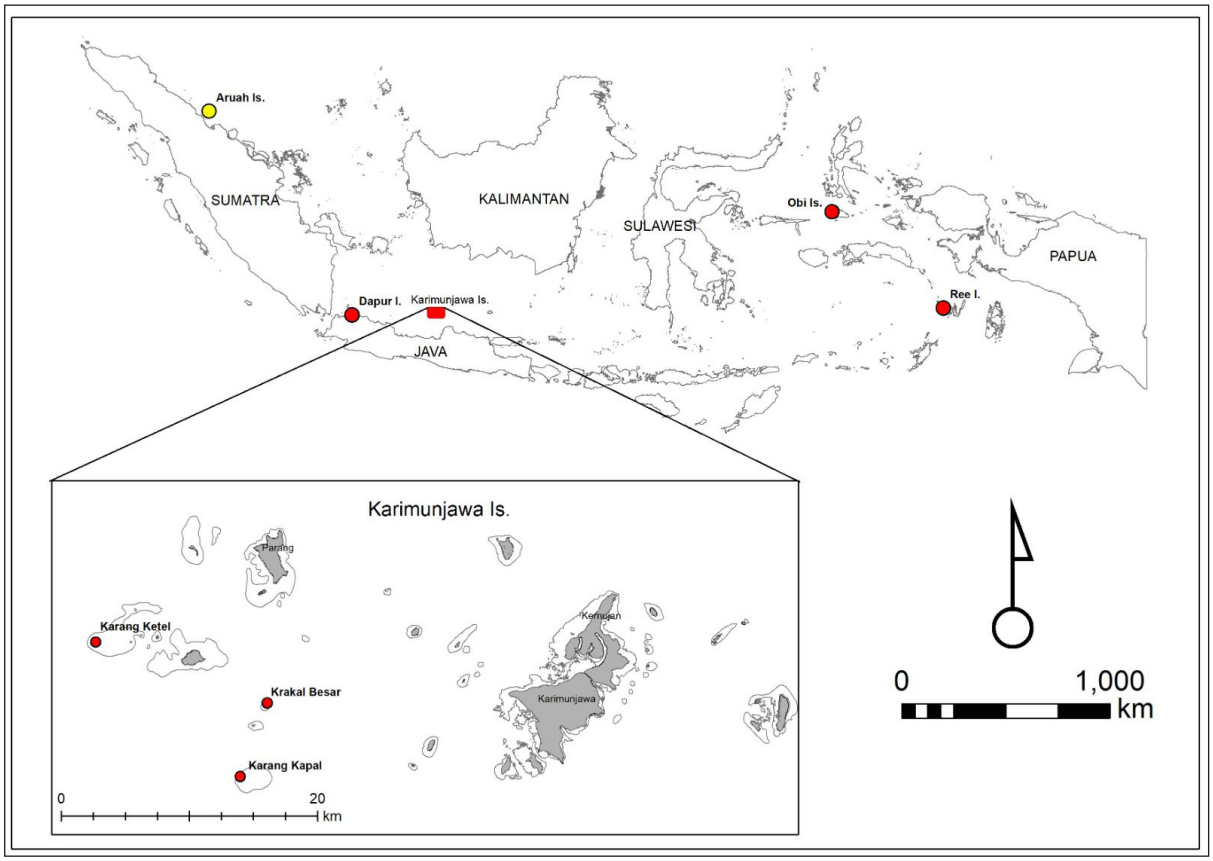


Figure 3. Map showing nesting locations of Roseate Tern in Indonesia. Confirmed nesting locations in red and possible nesting location in yellow.

MATERIALS AND METHODS

Surveys to locate the breeding colony of Roseate Tern in Karimunjawa Is. were conducted during May 2021-June 2023. Efforts to search and count the nests, eggs, and chicks were made. To minimize disturbance, no measurements were taken of the nests, eggs, and chicks.

Study areas

Of the 12 main islands and islets in Karimunjawa Is. used as a breeding location for seabirds, the Roseate Tern was found to be breeding in three locations, i.e., Karang Ketel, Karang Kapal and Krakal Besar (see Fig. 3). General information to these locations is described below.

Karang Ketel

A small coral islet of 0.3 ha wide, consists of coral gravel's stacks exposed at both high and low tides (5°48'01.9"S 110°08'27.0"E). The islet is located west of Katang I., thus sometimes called Karang Katang. Other seabird breeding in the location is the Black-naped Tern.

Karang Kapal

About 1 ha submerged coral islet, performing a narrow stretch of coral gravel's stacks approximately 1 km in length (Fig. 4). The area is located south of Krakal Kecil I., about

20 km west of Karimunjawa I. (5°54’14.8”S 110°13’17.7”E). This open area is also used by Black-naped Tern to breed.

Krakal Besar I.

A 3.1 ha island covered by a coastal forest, dominantly by Beach She-oak tree *Casuarina equisetifolia* (5°50’55.0”S 110°14’23.5”E). There is c.0.725 ha coral gravel stacks around the island and also used by Black-naped Tern to breed.

Figure 4. View of Karang Kapal islet, with narrow stretch of coral gravel’s stacks, 18 June 2022. Photographed by Hary Susanto.

RESULTS

Breeding discovery in Karimunjawa Is.

Presumably the Roseate Tern has only recently occupied the area. The species’ occurrence was noticed by the first author on 24 May 2021, from the presence of a pair in full breeding plumage in Karang Ketel islet (Fig. 5). The birds showed a conspicuous red bill and legs, full black capped, and pinkish tone underpart. One bird was observed in incubating position, with a single egg being incubated, while the other one stood nearby.

Figure 5. A pair of Roseate Tern at nest, Karang Ketel, 24 May 2021. Photographed by Hary Susanto.

The egg seems to be just laid on the surface of the coral gravels, without any material or decoration (Fig. 6). It is shown as an oval shape, light brown or tan color appearance, marked with dark and bold patches. It differs from (Hellebrekers & Hoogerwerf, 1967) that describe it as "greyish with dark brown spots, smears and underlying shell-marks" and asserted to be very similar to the Black-naped Tern *S. sumatrana*. However, in our observations, we found the egg can be distinguished from the more common Black-naped Tern, especially by its colour and marks pattern, where the latter have a whitish appearance covered by small dots (Fig. 7). Variation in the Roseate Tern's egg appearance may occur as evidently shown in the two egg specimens from Java (see Fig. 1 & 2), even if it came from one clutch as shown in Wuyu Islet (Hu et al., 2013).

After the finding, the first author inspected his photo collection and found several earlier documentation of the species, including other breeding evidence. The earliest record was on 2 May 2019 of at least three birds showing pinkish tone underparts and black bill, joining a flock with a number of Black-naped Tern in Krakal Besar I. (Fig. 8). Three months later, on 24 August 2019, a nest containing a single egg was found on the same island. On 18 June 2020, a pair was seen and eight eggs were found abandoned in Karang Kapal islet. These findings become the first breeding record of Roseate Tern in Karimunjawa Is. and fill the gap for 81 years since the second egg collected in West Java in 1938.

Figures 6 (left) **& 7** (right). A close inspection found the nest of Roseate Tern to contain a single egg, Karang Ketel, 24 May 2021 (left). Two eggs of Black-naped Tern found in the same area and day (right). All photographed by Hary Susanto.

Figure 8. At least three Roseate Terns (showing full black cap, black bill and pinkish tone underparts) in flock with Black-naped Terns in Krakal Besar I., 2 May 2019, which become the earliest record of the species in Karimunjawa Is. Photographed by Hary Susanto.

Further observations reveal the species as a regular breeding visitor in Karimunjawa Is. Here we report our findings, collated from field observations and photo inspection to describe its breeding and conservation. The Roseate Tern only occurs in Karimunjawa Is. during May-August (Table 1), where it comes to the islands for breeding. It corresponds with the earlier records on Java, Obi Is., Ree I., Tayandu Is., Maluku (Hartert, 1901) and Pulau Yu and Tokong Burung, Peninsular Malaysia (Gibson-hill, 1950). Our findings added previous available information for Java, where breeding was recorded in April and May (Hoogerwerf, 1949a; Hellebrekers & Hoogerwerf, 1967).

Nest shown as a simple structure on the coral gravels' surface and can be grouped in two types, with or without material. The nest without any materials shown as observed in the first

finding on 24 May 2021, where the egg just laid on the surface of the coral gravels (see Fig. 6) or formed a shallow point in the exposed area of coral gravel's, with one to two eggs in each clutch. Whilst nest type with material is constructed of untidy dried twigs of bamboos or other plants, where this type is least common to be found (Fig. 9).

The chick is a combination of dark brown and black pattern. It differs and can be easily distinguished with the chick of Black-naped Tern that is dominantly white with blackish in appearance (see Fig. 9-10). The two can be seen in the same location (Fig. 11).

Figures 9 (left) **& 10** (right). Nest of Roseate Tern containing a single egg and chick constructed of dried twigs found in Krakal Besar I. on 21 May 2022 (left). A clutch containing a single egg and chick of Black-naped Tern in Karang Kapal islet, 24 August 2019, for comparation (right). Photographed by Hary Susanto.

Figure 11. A chick of Roseate Tern showing a dark brown appearance (below) in group with two whitish chicks of Black-naped Tern, 20 July 2022. Photographed by Hary Susanto.

Table 1. Breeding records of Roseate Tern in Karimunjawa Islands, 2019-2023

Date	Location	Adult	Nest	Egg	Chick	Note
24 Aug 2019	Krakal Besar		1	1	-	photo inspection
18 Jun 2020	Karang Kapal	2	unknown	8	-	photo inspection
24 May 2021	Karang Ketel	10	1	1	-	This study
21 May 2022	Krakal Besar	20	10	14	4	This study
18 Jun 2022	Karang Kapal	3	2	3	-	This study
18 Jun 2022	Krakal Besar	10	1	2	-	This study
20 Jul 2022	Krakal Besar	16	1	1	3	This study
06 Jun 2023	Karang Kapal	3	1	1	-	This study
07 Jun 2023	Karang Ketel	4	1	1	-	This study

The Roseate Tern is found only in a small population of two to 20 birds and is always observed to join in a group of the more common Black-naped Tern. Of three breeding locations, the coral gravel stacks of Krakal Besar I. hold the biggest population number. On 21 May 2022, there were 20 breeding birds observed, with 10 nests found containing 14 eggs and four chicks. While on 20 July 2022, 16 adults were observed, with one nest, one egg and three chicks found.

In Katang Ketel, the highest number was 10 birds, with one nest and one egg found on 24 May 2021. While on 7 June 2023, four birds were observed, with one nest and one egg found. Karang Kapal holds the smallest number, with only three adults, two nests and three eggs found on 18 June 2022. However, the record seems to be lower, as on 18 June 2020, from photo documentation made prior to the survey, there were eight eggs found along with 112 eggs of Black-naped Tern (Fig. 12).

DISCUSSIONS

Our study confirmed that Karimunjawa Is. is a current breeding location for the Roseate Tern in Java. In the long absence of information from any breeding locations of this rare resident in Java, the small breeding colonies found in the islands are significant and noteworthy.

It is likely the species only recently breeding in the area, rather than being overlooked. This was supported by the absent of Roseate Tern from regular monitoring conducted by the national park. There is a possibility that the species recolonized its former breeding location as reported in Bermuda, where it returned after 150 years since excessive egg collection led to its extinction (Mejías et al., 2020). However, no historical records of the species present or breeding in Karimunjawa Is. since the avifauna was studied 135 years ago (Koorders, 1889).

Together with other records in Java, the breeding period takes place throughout April-August. Eggs or chicks can be found during all the breeding months, where in Karimunjawa Is. nesting started in May. The nesting site corresponds with the known characteristics for the species, where in tropics it tends to prefer sparsely vegetated, but in temperate zones prefer densely vegetated areas (BirdLife International, 2024). We found the nest sites totally exposed. In our observations, there are only a few young vegetations occuring, such as Red Mangrove *Rhizophora stylosa*, the seedling of Coconut *Cocos nucifera, Ipomoea sp* and *Scaevola sp*.

In general, our findings highlighted the importance of Karimunjawa Is. as one of the breeding locations for seabirds. Previously, six seabird species listed to be nesting in Karimunjawa Is., i.e., Black Noddy *Anous minutus*, Brown Noddy *A. stolidus*, Little Tern *Sternula albifrons*, Bridled Tern *Onychoprion anaethetus*, Greater Crested Tern *Thalasseus bergii*, and Black-naped Tern (Whitten et al., 1990). Of these, surveys by the national park observed only four species breed in the islands, i.e., Brown Noddy, Bridled Tern, Black-naped Tern, and this recently found Roseate Tern. Review on the current status of seabirds present and breeding in Karimunjawa Is. will publish elsewhere.

Threats and Conservation

We found no evidence of eggs or chicks predation by other species. No invasive species observed in all three breeding sites. However, White-bellied Sea-eagle *Haliaeetus leucogaster* and Asian Water Monitor *Varanus salvator* that occur in the islands might become potential predators.

Human disturbance might cause breeding colonies Roseate Tern deserted (Skerrett & Rocamora, 2007). The disturbance, such as collection of eggs, become one of the main threats to the species and other seabirds and might cause population decline and extinction (Hamza et al., 2016; Phillips et al., 2022). It has become a long practice in Karimunjawa Is., as it was documented in 1941 on Gundul I. (Hoogerwerf, 1947). On 18 June 2020 during patrol by the park ranger, about 130 eggs illegally collected by fishermen in Karang Kapal, where 112 eggs belong to Black-naped Tern and eight eggs belong to Roseate Tern (see Fig. 12).

Figure 12. A Karimunjawa National Park staff counting the abandoned eggs found during sea patrol, 18 June 2020. Photographed by Hary Susanto.

To protect and prevent the nesting colony from this illegal activity, the national park initiated a regular sea patrol. Sign boards containing a prohibition for egg harvesting were also set up in 2020, with five sign boards placed in five locations: Karang Kapal, Karang Ketel, Krakal Kecil, Krakal Besar and Batu I. (Fig. 13).

Figure 13. One of the sign boards inscribed "Do not take any egg's tern" was placed in Krakal Besar I. 13 August 2020. Photographed by Hary Susanto.

Potential threat might also come from sea-level rise as one of the climate change effects, and by the end of 21st century, the sea level predicted to rise 1-2 meter, thus inundated tropical atolls and other low-lying islands as the seabird nesting habitat (Hatfield et al., 2012; Phillips et al., 2022). This situation might wipe out all of the low-lying coral islets in Karimunjawa Is. used by Roseate Tern to breed as it is only less than 1 meter high from the water surface.

Regular monitoring of the Roseate Tern breeding colony, prevention of any potential threats, and public awareness campaign in locals is urgently needed. It is also noteworthy to search other breeding colonies of this uncommon species in Indonesia, particularly in Pulau Dapur, Ree I. and Obi Is. that previously known as the species' breeding location, and also Arwah Is. or any possible breeding location.

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