Abundance waterbirds and the distribution of trees nesting in Pulau Rambut (Rambut Island) wildlife sanctuary, Jakarta Bay, Indonesia

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Abstract. Pulau Rambut is a small island in Jakarta Bay that has been used as a breeding and roosting habitat for various waterbird species. The study aimed to estimate waterbird's abundance, comparing waterbirds species and abundance data with previous studies in 1990 and 2001, and mapping the distribution of nesting trees. The study was conducted in January-February 2020. Birds were counted using the census method, while the coordinates of nesting trees were taken to map their distribution. There were 13 species of waterbirds (5 egret species, 2 day-heron species, 2 Cormorant species, 1 night-heron species, 1 darter species, 1 stork species, 1 Ibis species). Two species, the Black-headed Ibis and the Little pied cormorant were not found anymore compared to previous studies. The abundance of waterbirds was 4,950 individuals dominated by cormorant species (32%), egret species (28%), and Black-crowned night heron (23%). The number of waterbirds decreased sharply compared to previous studies. Nesting trees were distributed mostly in the east of the island, consisted of 3 sub-colony.

1. Introduction
Pulau Rambut is a small island in Jakarta Bay that has been used as a breeding and roosting habitat for various waterbird species [1]. Most of the waterbirds on Pulau Rambut foraged in the morning to Java island or other islands around Kepulauan Seribu and return in the evening to rest [2]. The abundance and distribution of waterbirds in Pulau Rambut were reported based on previous studies in 1990 and 2001 [3,4]. The results of this study found 15 species of waterbirds which were grouped into settled and non-resident waterbirds. Based on previous studies, no recent research has been conducted on Pulau Rambut. Given the changing conditions of Pulau Rambut, it is necessary to research the abundance and distribution of nesting trees to obtain the latest data. The study aimed at estimating waterbird's abundance, comparing waterbird species and abundance data with previous studies in 1990 and 2001, and mapping the distribution of nesting trees. The study was conducted in January-February 2020. Waterbirds population information is important to understand the ecological status in conservation areas and as a reference for making policies regarding conservation area management. Compared to other animal species, birds are sensitive to environmental changes so that they can function as bio-indicators of environmental change. Changes in the land use of mangrove forests on the north coast of Java Island...
are a threat to the survival of the waterbirds on Pulau Rambut. This condition is also exacerbated by the pollution of rivers in Jakarta due to domestic and industrial waste. Conservation area management requires complete data and information regarding the number of animal species, the number of individuals for each species, the distribution of animals, and habitat conditions.

2. Methods
2.1 Study area
The study was conducted in Pulau Rambut Wildlife Sanctuary (106.5°41’30”E, 5.5°58’30”S), a small island (45 ha) located in the Jakarta Bay area. There are three types of forest ecosystems in Pulau Rambut Wildlife Sanctuary, there is coastal forest, lowland forest, and mangrove forest. There are approximately 46 bird species which are divided into two major groups, namely waterbirds and terrestrial birds. The species of waterbirds found on Pulau Rambut are Egret species (Egretta spp.), Heron species (Ardea spp.), Black-crown night heron (Nycticorax nycticorax), Little black cormorant (Phalacrocorax sulcirostris), Little cormorant (Phalacrocorax niger). In addition to bird species, other species of fauna are also found such as bats (Pteropus vampyrus), Asian water monitor (Varanus salvator), Mangrove snakes (Boiga dendrophila), and Pythons (Python sp.).

2.2 Field method
The tools used in this research are ArcGis 10.3 software, Global Positioning System (GPS), binoculars, camera, bird field guidebook [5], and Microsoft excel. Data were collected at the Pulau Rambut Wildlife Sanctuary in DKI Jakarta on January 21 to February 17 2020. The waterbird group in this study consisted of five families, consist of Ardeidae, Phalacrocoracidae, Anhingidae, Threskiornithidae, and Ciconiidae. Birds were counted using the census method by determining one point of concentration for the census at the Pulau Rambut jetty. The location is located in the southern part of the island facing Java Island. This counted is used to obtain the abundance value of birds by calculating as a whole for each individual, whether in groups or not in groups. The count was carried out at 05.30-7.00 am (GMT +7) to count the birds that came out from Pulau Rambut and 04.00-06.15 pm (GMT +7) to count the incoming birds to Pulau Rambut. The count was made 14 times in the morning observations and 15 times in the evening. Observation of the distribution pattern of nesting trees was carried out by exploring Pulau Rambut. The coordinates of the nesting tree were taken seven times on the island. The data taken were the types of nesting trees, weather, wind conditions, and the presence of litter around the nest. Data analysis using the maximum value of each waterbird species based on bird counting in the morning and evening. The distribution of nesting trees was analyzed spatially.

3. Result and discussion
3.1 Species, abundance, and composition of waterbirds in Pulau Rambut
There were 13 species from 5 waterbird families found in Pulau Rambut Wildlife Sanctuary during the research. The Ardeidae family dominates waterbird species, specifically 8 species out of a total of 13 waterbird species. The abundance of waterbirds in January-February 2020 is 4,950 individuals (1,592 Cormorant species, 218 oriental darters, 133 grey herons, 133 purple herons, 1,391 egret species, 115 great egrets, 1,129 black-crowned night herons, 78 milky storks, 135 glossy ibises). Weather, wind, and tidal factors affect the daily number of birds [6].

Glossy Ibis is only observed in the evening, so it is not counted in the morning. Based on the morning and evening averages, the count of waterbirds in January-February 2020 was less than the previous studies’ data in 1990 and 2001. The composition of waterbirds in Pulau Rambut is dominated by cormorant species (32%), egret species (28%), and black-crowned night heron (23%). The composition of egret species in the January-February 2020 count increased compared to previous studies.

3.2 Time of movement of waterbirds
The departure and return times of waterbirds different according to each species. Based on calculations carried out in the morning and evening, there are species that leave and enter Pulau Rambut throughout the day in groups such as cormorants and egrets. There are species that enter and enter the island
individually and in small numbers by the larger birds, namely, milky stork, herons, and great egret. These species tend to increase after sunrise. This is because birds use soaring by utilizing the hot air column obtained from sunlight [7]. The bird's uptime affects the abundance of waterbirds, Black-crowned night heron which returns to Pulau Rambut in the morning and goes out foraging in the afternoon.

3.3 Distribution of nesting trees
There is a difference in the distribution of nesting trees in January-February 2020 compared to the distribution data for nesting trees in January-March 1990 [8]. Most of the waterbirds nest on the eastern part of Pulau Rambut. There are 3 sub-colony in the distribution of waterbirds on Pulau Rambut. In a part of the primary mangrove forest - the north gates, there are Milky stork, Purple heron, Little cormorants, and Great egret. Parts of primary mangrove forest in the middle – northeast floodgates, namely Black crowned-night heron and cormorants. Part of the eastern primary mangrove forest, namely milky stork, the grey heron, the little egret, the intermediate egret, and cormorants.
In January-February the waterbirds in Pulau Rambut are scattered in the central and eastern parts of the primary mangrove forest in the north and northeast (figure 1). The waterbirds occupy the *Rhizophora mucronata* community as a nest and perch located on the edge of the mangrove forest. The vegetation criteria of *R. mucronata* as a nesting site are those with a height of 9-16 m. The species that occupy the mixed forest are the milky stork, purple heron, grey heron, great egret, and the cormorant species.

![Map Distribution of Waterbird's Nesting Trees on Pulau Rambut](image)

**Figure 1.** Distribution map of waterbird's nesting trees on Pulau Rambut.

3.4 Nesting preferences and nest shape of waterbird
The thick, dense, and convex-shaped nests form the nests of little cormorant and little black cormorant. Cormorant species tend to choose coastal areas as nesting sites because these areas are dominated by *R. mucronata* with a wide canopy so that they can withstand winds [9]. The thin, flat, and tenuous nest is
a form of bird's nest that has a larger size, like a Milky stork. The form of such a nest aims to keep away from predators, avoid wind, and support the body loads [10].

Grey heron and purple are species from the Ardeidae family. In terms of size, the two types of birds are almost the same but there are differences in body color. The spread of the two types was not observed to be close to each other. Grey heron was observed to choose nesting trees closer to the beach which borders the cormorant's nest and is in the highest canopy of *R. mucronata*, while purple heron is in the middle mangrove forest near the north floodgate, there are some grey herons near purple herons, but not many were found.

![Figure 1](image1.png)

**Figure 1.** (a) Little cormorant's nest, (b) milky stork's nest.

3.5 Threats to Pulau Rambut

Continuous accumulation of litter results in disruption of the cycle of seawater in and out during tides into mangroves. This affects the death of forest vegetation and disturbed biota ecosystems in river flows, thus affecting nesting sites for waterbirds [11]. There tends to be less litter found in the eastern part of Pulau Rambut. There are many ropes to make a nest. The presence of a rope in the nest can cause the bird to become entangled in the rope.

Oil contamination exposure poses another threat to Pulau Rambut. As a result of the oil spill in 2019, oil exposure was found in the northern and north-eastern parts of primary mangrove forests on the mud substrate so that they are categorized as areas with a heavy level of contamination [12]. The impact of exposure to oil pollution on mangrove forests cannot be seen in a short time [13]. This is anticipated by the management of the Pulau Rambut Wildlife Sanctuary, which routinely implements mangrove seedlings as an effort to rehabilitate the mangrove forests on Pulau Rambut. Mangrove forests are in good condition and growing, but not evenly distributed throughout the area.

4. Conclusion

The abundance of waterbirds in January-February 2020 is 4,950 individuals. The January-February 2020 count is lower than the 1990 and 2001 studies. There are three distribution areas for waterbirds nesting trees on Pulau Rambut. Monitoring measures regarding the abundance and distribution of nests of waterbirds in Pulau Rambut need to be taken to determine the availability of nests for waterbirds and to clean up the trash regularly. Rehabilitation efforts in the form of planting mangrove seedlings along the coast are expected to become new breeding areas for waterbirds.

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