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Population, Nest Distribution, and Nest Characteristics of Great Egret in Pulau Rambut Wildlife Sanctuary, Jakarta Bay

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ABSTRACT

Pulau Rambut, a 45-hectare island in Jakarta Bay, is a major nesting and roosting location for waterbirds, especially the great egret (*Ardea alba*). This species has faced population constraints due to habitat loss, oil spills, and waste. Bio-ecological data on this species has been lacking. The purpose of this study was to quantify population size, analyze nest tree distribution, investigate nesting associations, and describe nest and egg features during the peak breeding season (March–April 2025). The birds were counted in the morning when they flew away and, in the evening, when they returned to the island. Nest trees were mapped, and nest tree attributes were assessed on trees discovered throughout the search. Field observations revealed an estimated 135 great egrets, mostly on the island's eastern side. Nests were mostly found in the uppermost canopy of *Rhizophora mucronata* (average height 13.8±2.3 m; diameter 20.0±7.1 cm; *n* = 19) and *Rhizophora stylosa*. Nests were cup-shaped, twig-based constructions measuring 46.8×38.5 cm with a depth of 42.3 mm. Purple herons (*Ardea purpurea*) were regularly observed to nest together. The clutch size averaged 2.2 eggs per nest (range: 1−4; mode: 2). The eggs were oval, pale blue-green, and averaged 50.9×35.8 mm in size, weighing 35.9±6.3 g (*n* = 19). These data represent the first thorough bio-ecological baseline for great egrets on Pulau Rambut. Conservation and restoration of mangrove ecosystems, particularly *R. mucronata*, is critical for sustaining great egret breeding numbers and minimizing future population decreases in the sanctuary.

Keywords: *Ardea alba*, nest characteristics, *Rhizophora mucronata*, waterbird

INTRODUCTION

Pulau Rambut Wildlife Sanctuary is a small (45 ha) island utilized for breeding and roosting, as well as a key refuge for thousands of waterbirds and terrestrial birds (Mashudi and Mahento 2016). It is located 4 km from Java Island and was designated a Ramsar site in 2011, recognizing its significance as an international wetland conservation area. The dominating ecology on this island is mangrove forest, which comprises both primary and secondary mangrove forests. *R. mucronata* and *Ceriops tagal* are the dominant species in these woodlands.

Approximately 12 waterbird species breed on the island between November and May, including great egrets (*A. alba*). Great egrets live in temperate and tropical locations around the world, are protected by Indonesian government rules and are classed as "least concern" by the IUCN. Despite this, the population of great egrets on Pulau Rambut has decreased significantly, from an estimated 390 individuals (Mardiastuti 2001) to between 115 and 235 individuals (Mashudi & Mahento 2016; Firdausy *et al.* 2021). This population drop is due to the degradation of wetland ecosystems in the surrounding areas, particularly along Jakarta Bay's northern coast, which has reduced food supply. Great egrets are forced to do longer foraging flights, which increases energy consumption (Mardiastuti 2022). The consequences include smaller clutch sizes, fewer eggs per nest, and an increased risk of hunger for both adult and juvenile birds. The destruction of mangrove forests because of a massive oil leak in 2019, along with the accumulation of garbage brought from Java Island, has seriously harmed breeding grounds. These environmental concerns endanger juvenile survival and may cause breeding season desertion or permanent migration of waterbirds, exacerbating population reductions (Mardiastuti 2022).

Although previous studies have provided general insights into Pulau Rambut's waterbirds, there is still a paucity of recent and thorough data, particularly on the great egrets' population dynamics, regional distribution, and nesting ecology. Existing research frequently covers the entire Ardeidae family without focusing on specific nesting features such as nest dimensions, clutch size, and environmental characteristics of the great egret (Firdausy *et al*. 2021). Given the ongoing habitat alterations and population decreases, it is critical to conduct species-specific study to determine the present population status, nesting locations, nesting relationships, and nest characteristics of great egrets on Pulau Rambut. A species-specific focus on

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great egrets offers tremendous benefit by offering detailed insights into their distinct habitat preferences, habits, and ecological problems, allowing for more targeted and effective conservation measures that address their special needs. These data are critical for informing and improving conservation plans and management techniques in Pulau Rambut Wildlife Sanctuary, ensuring species survival and the area's ecological integrity.

METHODS

Study Area

The investigation was conducted at the Pulau Rambut Wildlife Sanctuary in Kepulauan Seribu, DKI Jakarta Province (Figure 1). Geographically, the sanctuary is located between 106°41'14"−106°41'46" E longitude and 5°56'47"−5°56'57" S latitude.

Pulau Rambut has a low and swampy topography, with elevations ranging from 0 to 1.5 m above sea level, and a Schmidt and Ferguson climate type C. The dry season lasts from May to October, with an annual rainfall of around 1,152.9 mm, and the wet season lasts from October to March, with average monthly rainfall above 100 mm. Maximum temperatures range from 31.2°C to 36.8°C, while average low temperatures range from 22.8°C to 23.7°C. Pulau Rambut's mangroves were mostly classified as primary and secondary (Mardiastuti *et al*., 2020). The island provides as a nesting ground for great egrets from diverse places. The island's mangrove environment provides significant food resources (Firdausy *et al*. 2021). Pulau Rambut's environmental conditions are relatively stable, with limited human impact. Its strategic placement along major migratory bird routes adds to its importance as a nesting habitat.

Procedures

The study was conducted between March and May 2025, during the great egret nesting season. Data on the size of the great egret population were taken at the Pulau Rambut Jetty. Nesting trees and nest characteristics were observed across the mangrove forest area. Population data were collected using the census method. The observations were carried out 30 times (15 in the morning and 15 in the afternoon), from 05.30 to 07.30 AM, when the birds leave the island to forage, and from 16:00 to 18:00 PM, when the birds return to Pulau Rambut in the afternoon. The population was counted every five minutes. Weather conditions were also recorded visually without the use of devices; therefore, the data is just qualitative (strong winds, light winds, sunny, rain). To increase the accuracy of the counts and decrease bias, we counted all great egret nests and calculated the number of breeding pairs using the hypothesis that each nest contained two great egrets.

Data on nesting trees were acquired by watching all nesting trees discovered during investigation, which covered the entire island. The positions of nesting trees were marked with Avenza Map. The following parameters were measured for nesting trees: (1) tree species, (2) total height, (3) diameter, (4) branch-free height, (5) tree health condition, (6) number of nests per bird species in each tree, (7) height of great egret nests from the surface, and (8) amount of plastic waste found near the tree. Data on nesting connections of great egrets with other species were gathered by exploring nest trees, examining whether other species were nesting concurrently with the great egrets, and determining the closest distance between great egret nests and nests of other birds.

Data on nest and egg characteristics were obtained from 20 nests and 23 great egret eggs. The nest

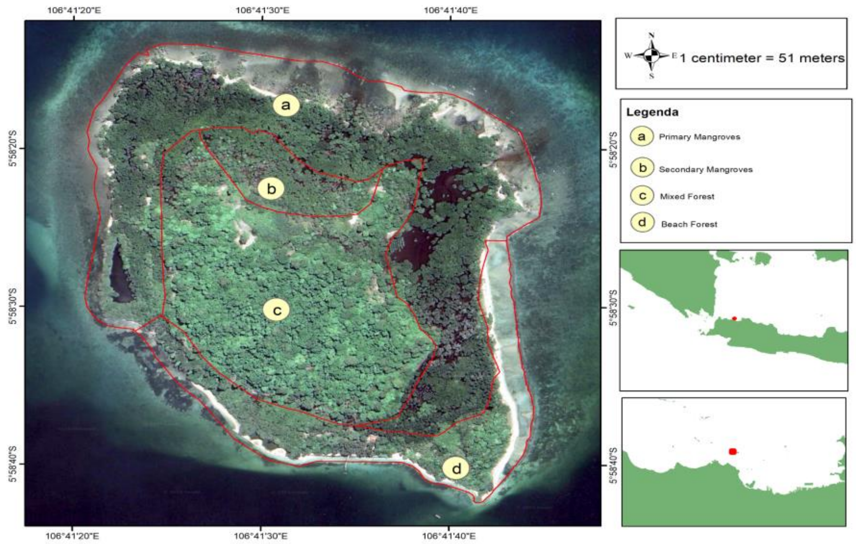

Figure 1 Map of Pulau Rambut Wildlife Sanctuary in Jakarta Bay (Indonesia).

composition parameters measured were: (1) nest length, width, and depth; (4) nest position on the tree, (5) number of eggs per nest (clutch size), (6) egg length, width, and weight. width, and weight. All data were statistically evaluated to determine the maximum, minimum, mean, mode, and standard deviation values. To ensure data consistency, a one-sample *t*-test was performed using data from prior studies [12]. Distribution maps were created by entering the locations of nesting trees into the software and processed with ArcGIS 10.8 software.

RESULTS AND DISCUSSION

Bird Population

Between 5:00 and 8:00 a.m., several bird species, including great egrets, leave the island in search of food. The great egret is commonly observed flying alone toward Java Island, but it also flies in groups, either with other great egrets or with flocks of tiny egrets. According to the statistics collected, the population size varied greatly, ranging from 43 to 135 individuals. During each session, the number of great egrets observed was consistently larger in the morning than in the afternoon. This is because rain and strong winds frequently fall in the afternoons throughout the study period, preventing the great egrets from returning to Pulau Rambut. As a result, they stayed on Java Island in the afternoon before returning to Pulau Rambut the following morning. The change in the number of great egrets seen flying during each hour is an interesting thing to investigate. The findings revealed that the number of people in flight varied from hour to hour (Figure 2).

Great egret population counts may be skewed due to their comparable morphology to other egret species (small egrets, intermediate egrets, reef egrets, and cattle egrets), particularly under low light or poor weather circumstances. Heavy rain, severe gusts, and varied light intensity impair bird movement and vision, resulting in undercounting at times of day.

According to previous research, the population of great egrets on Pulau Rambut has fluctuated in recent years. The great egret population was found to be 234 individuals (Mashudi & Marhento 2016). By 2021, the number had dropped to 115 (Firdausy *et al*. 2021). These studies found that the proportion of great egrets among waterbirds has decreased from 3.8% (390 individuals in 1990) to 2.3% (115 individuals in 2022) (Mardiastuti 2022). This drop has been largely related to the 2019 oil disaster, which caused considerable habitat damage and wildlife mortality, harming the great egret population. Recent measurements in 2025 show a population rise of 135 individuals, indicating a comeback from the prior fall. It is more likely related to conservation initiatives and mangrove restoration, which have improved habitat conditions. Effective mangrove management promotes the increase of bird populations, particularly migratory species, on Pulau Rambut by increasing habitat diversity and quality (Kurnia *et al*. 2024).

Breeding and Nesting

Most waterbird species on Pulau Rambut have preferred breeding places. Great egrets select nesting locations in stages, beginning with a general vegetation type, then a specific area within that vegetation, and ultimately the precise nesting site (Mardiastuti 1992). Choosing the right vegetation is critical, as areas with ideal conditions for survival and reproduction have a better chance of long-term viability than random site selection (Mardiastuti 1992). According to data acquired in 2025, the majority of great egrets nest mainly in the eastern side of the island (Figure 3).

Great egrets do not nest in certain regions of the island, particularly the forests on the south, west, and north sides. Great egrets nest exclusively in primary

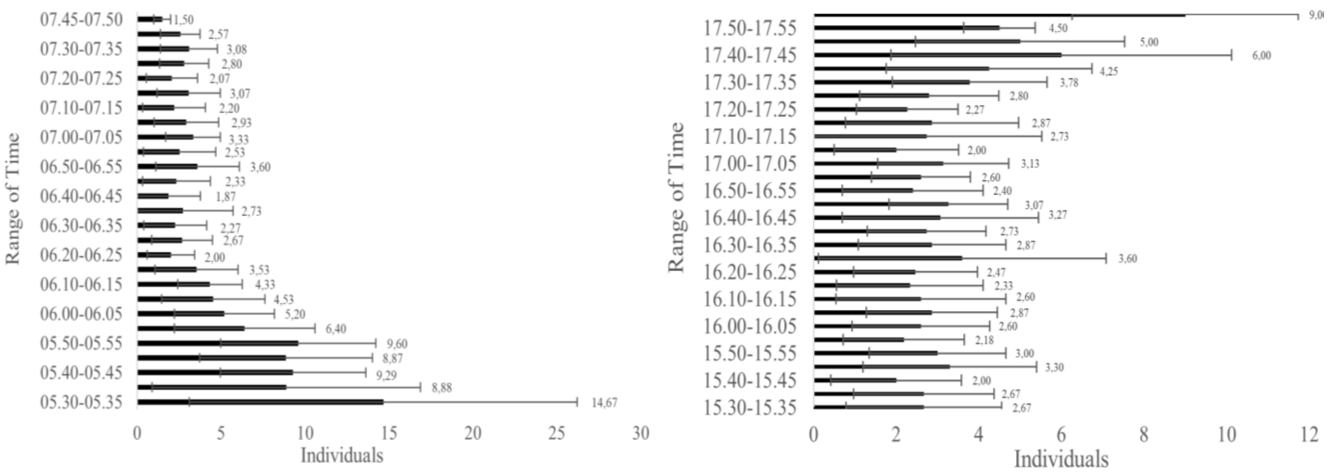

Figure 2 The average number of great egrets departing in the morning (left) and returning in the afternoon (right).

mangrove forest areas with mud and coral bottoms. The nesting places of great egrets on Pulau Rambut alter with the wind direction. When winds blow from the east, most waterbirds nest and rest on the island's west side; when winds blow from the west, they prefer the east side (Mardiastuti 2001). Great egrets were recorded nesting in the east in 2025, in contrast to previous research (Mardiastuti 1992; Firdausy *et al*. 2021), which reported nesting in the island's north and west. Great egrets are selective in their choice of nesting trees, according to observations of plant types used as nesting sites. Among the 20 nesting trees observed, two mangrove species were identified as preferred: *R. mucronata* and *R. stylosa*. This implies that great egrets choose certain tree species that match nesting requirements (Table 1).

Great egrets use *R. mucronata* trees for nesting because they are larger and can hold more nests than *R. stylosa* trees. Larger trees, such as *R. mucronata*, are more likely to host great egret nests. The great egret prefers larger trees with larger sizes and structures, as evidenced by the pattern of nest location in each tree. Great egret morphology, particularly body size, is known to be intimately related to vegetation choices, with body size being an essential factor influencing habitat choice (Mardiastuti 1992). Great egrets typically like to nest in towering trees. To give more information about the vertical distribution of nests, the following table displays the average percentage of nest height in each species of nesting tree (Table 2).

The distance between nest and surface in both tree species indicates that great egrets prefer to build their nests at the highest point or within the canopy of the nesting tree. During inspections on the island, no nests were discovered at the bottom or middle of the trees. The percentage of nest placement in both species was nearly identical, at more than 92%, indicating that despite the different tree species used for nesting, great egrets had a strong tendency to place their nests at the top of the trees. Nests are placed in tree canopies to increase birds' view of predators, make it simpler for birds to leave the nest, and make it more difficult for predators to reach them (Burger 1985). The nest's elevated position is one of the great egrets' protection techniques to support egg hatching success and juvenile-to-adult development. As a huge species,

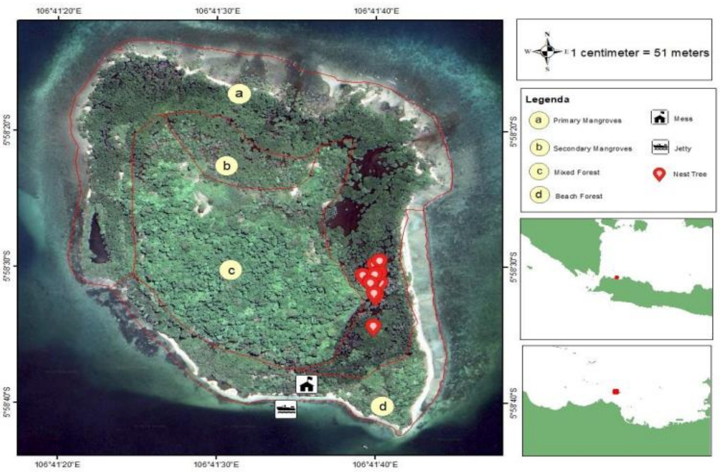

Figure 3 Map of the distribution of great egrets nesting trees in west monsoon.

Table 1 Nest trees characteristics of *R. mucronata* (n=18) and *R. stylosa* (n=2)

Variable	Mean ± standard deviation	
	R. mucronata (*n* = 18)	*R. stylosa* (*n* = 2)
Total height (m)	13.8 ± 2,3	11.0 ± 0
Branch free height (m)	9.9 ± 1,9	7.5 ± 0.7
Diameter (cm)	20.0 ± 7,1	12.3 ± 3.8
Height of great egret nests from the surface (m)	12.7 ± 2,3	10.0 ± 0
Number of great egret nests in each tree	2.4 ± 1,0	1.0 ± 0
Number of nests* in each tree	6.7 ± 2,8	3.5 ± 0.7

Remark: *All waterbird species.

Table 2 Average percentage of nest height on each nesting tree

Tree species	Total height (m)	Height of great egret nests from the surface (m)	Percentage (%)
R. mucronata (*n* = 18)	13.8	12.8	92.8%
R. stylosa (*n* = 2)	11.0	10.3	93.2%

great egrets require robust trees that can sustain their nests well.

Bird Association

Many great egrets were observed breeding alongside other waterbird species. The birds showed no signs of disturbance, and there was no evidence of competition or conflict among the many species that used the same nesting trees. This implies a neutral to positive relationship between great egrets and other waterbirds during breeding season. The most common neutral-positive connections were found between great egrets and the purple heron (*A. purpurea*), oriental darter (*A. melanogaster*), grey heron (*A. cinerea*), milky stork (*M. cinerea*), and black-crowned night heron (*N. nycticorax*) (Figure 4).

When two species coexist in the same vegetation type, it may imply a relationship. They sometimes nest together on the same trees, establishing mixed-species colonies of hundreds to thousands of individuals (Mardiastuti 1992). Such extensive relationships help everyone by minimizing predation and increasing reproductive success (Park *et al*. 2011; Shin et al. 2018). These connections describe partnerships in which species share resources without harming one another, demonstrating tolerance and minimal competition in nest site selection. Species nesting in proximity with limited variety likely to be more tolerant of great egrets, but those nesting further apart may avoid direct interaction or have more precise spatial requirements.

The observation shows that great egrets coexist with a variety of other waterbird species, including purple heron, grey heron, oriental darter, milky stork, and black-crowned night heron. This contradicts a previous study, which discovered no special tendency for great egrets to nest near or avoid species such as the milky stork, black-crowned night heron, and grey heron (Mardiastuti 1992). Previous studies also found that there were taller and massive mangrove trees around the island. In contrast, nesting trees are exclusively found on the island's eastern side, resulting in a more diversified association in that area. Negative relationships were seen among congeneric species with similar habitat requirements, such as tiny egrets, reef egrets, intermediate egrets, and cow egrets. To limit competition, these closely related species avoid each other (Mardiastuti 2001). Negative connections emerge when one species reduces the likelihood of another's occurrence. Also, closely related species of the same genus frequently share similar anatomy, physiology, behavior, and ecology, allowing them to

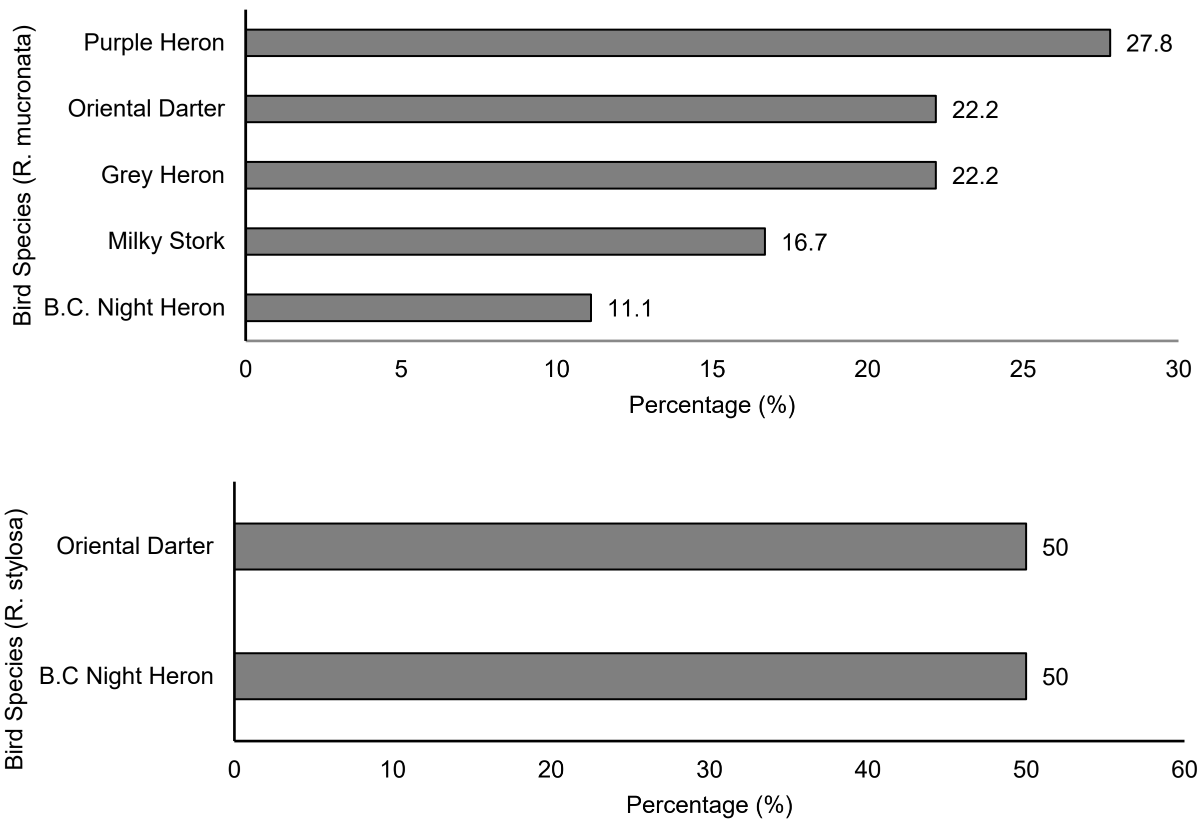

Figure 4 Association between great egrets on *R.mucronata* (*n = 18*) (left) and *R. stylosa* (*n* = 2) (right).

occupy similar environments and avoid direct competition through spatial isolation (Mardiastuti 1992).

Nest and Egg Characteristics

Great egrets often build their nests out of natural materials such light twigs and leaves (Figure 5). Their nests are comparable in size and shape to those of the heronry group (purple and grey herons). Compared to heron nests, which are neater and more firmly woven, great egret nests appear more loosely placed and less tidy. Great egrets' nests are often bowl-shaped and relatively large. When these nests are newly built, they are noticeably neater and stronger. The nests will eventually be abandoned once the kid has fledged. The nests become more loosely constructed, have cracks, and appear unstable.

Nest measurements were also collected to offer a clear, quantitative description of the physical properties of great egret nests. Table 3 shows the average nest length and width in *R. mucronata* and *R. stylosa* trees. The standard deviation for nest width is the greatest of the parameters, showing that nest width varies significantly. On the other hand, the nest size recorded in *R. stylosa* trees is based on a single sample (*n* =1) with no variation (SD = 0). Because of the little data available, strong judgments about the typical nest size for this tree species cannot be drawn. Larger nest sizes provide benefits such as improved shelter from extreme weather and predators, as well as the ability to host more offspring, reflecting the space required for both parents and chicks. In contrast, smaller nests may allow for speedier nesting, possibly due to differences in building materials such as branches and grasses used by great egrets. Well-built nests of the appropriate size reduce predation risk and improve comfort for both parents and chicks (Lambrecths *et al.* 2011). Figure 6 depicts the form of the eggs and the look of baby egrets.

Great egret nests normally contain two oval-shaped eggs (type VI) (Mardiastuti 1992), although not all nests held eggs (some had already hatched, while others had not yet received eggs). Nests lacking eggs were typically new or had already been inhabited by fledgling great egrets. A total of 23 eggs were found throughout 20 nests. The quantity of eggs discovered during data collection varied according to their availability at the time and ease of access. Newly laid great egret eggs

Figure 5 Great egret nest on *R. mucronata* tree (left) and nest containing great egret on *R. mucronata* tree (right).

Table 3 Average nests size on *R. mucronata* (*n* = 19) and *R. stylosa* (*n* = 1)

Variable	Mean ± Standard Deviation	
	R. mucronata (*n* = 19)	*R. stylosa* (*n* = 1)
Length (cm)	46.8 ± 6.5	43.0
Width (cm)	38.5 ± 9.2	42.0
Depth (mm)	42.3 ± 4.5	42.0

Figure 6 A newly laid great egret egg (left) and hatched great egret (right).

are pale blue with a slightly deeper tone, spotless, and have a smooth, slippery, matte surface. Over time, eggs will grow paler, dirtier, duller, and lighter in color. Observations show that clutch sizes range from one to four eggs per nest. Table 4 has detailed information about clutch size.

The clutch size varies between great egret nests found in *R. mucronata* and *R. stylosa*. On R. *mucronata trees*, the most common clutch size was two eggs per nest, as seen in seven nests. In comparison, clutch size statistics for *R. stylosa* are scarce, with only two nests documented. As a result, the data for *R. stylosa* may not fully reflect the overall clutch size for the species on this tree. Egg dimensions were also measured to supplement data on clutch size. The average length, width, and weight of eggs found in *R. mucronata* trees are shown in Table 5.

Eggs laid in *R. mucronata* are larger and vary in size, as seen by the comparatively high standard deviations across all measurements. In contrast, eggs found in *R. stylosa* are often smaller and more uniform in size, as seen by lower average dimensions and significantly smaller standard deviations. Heavier eggs are usually freshly laid, whereas lighter eggs are close to hatching. Variations in egg size parameters may be impacted by external factors such as the quality of food available to the parent birds and the nesting environment.

A one-sample *t*-test comparing egg sizes to those rep orted in a previous study (Mardiastuti 1991) revealed significance values (2-tailed) for the length, width, and weight of eggs from *R. mucronata* trees that were all higher than 0.05. In contrast, the significance levels for the length, width, and weight of eggs from *R. stylosa* trees were all less than 0.05. These findings show that the egg sizes found in *R. mucronata* are similar with those reported in the previous study, however those of *R. stylosa* differ significantly. External factors, such as the quality of nutrition available to parent birds and the environmental conditions of the nesting site, can influence variations in each egg size characteristic.

CONCLUSION

During the breeding season (March−April 2025), the great egret population on Pulau Rambut grew from 43 to 135 individuals, with an average of 84 daily interactions. The eastern section of the island is selected for nesting. Nesting trees include *R. mucronata* and *R. stylosa*, which have robust and dense branches at their uppermost canopy. The primary ecological challenges confronting great egrets on Pulau Rambut today are habitat degradation, pollution from previous oil spills and plastic waste, and changing environmental conditions that endanger their nesting success and long-term survival, necessitating immediate conservation actions centered on habitat protection, pollution control, and adaptive management.

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REFERENCES

Burger J. 1985. *Habitat Selection in Temperate Marsh–nesting Birds*. New York (US): New York Academic Pr.

Firdausy MS, Mardiastuti A, Mulyani YA. 2021. Abundance waterbirds and the distribution of trees nesting in Pulau Rambut (Rambut Island) Wildlife Sanctuary, Jakarta Bay, Indonesia. *IOP Conference Series: Earth and Environmental Science.* 771:

Table 4 Number of eggs per nest in *R. mucronata* (*n* = 16) and *R. stylosa* (*n* = 2) trees

Number of eggs per nest	Number of nests	
	R. mucronata (*n* = 16)	*R. stylosa* (*n* = 2)
1	4	1
2	7	0
3	5	0
4	0	1
Total	20	20

Table 5 Average eggs size on *R. mucronata* (*n* = 19) dan *R. stylosa* (*n* = 4)

Variable	Mean ± standard deviation	
	R. mucronata (*n* = 19)	*R. stylosa* (*n* = 4)
Length (mm)	50.9 ± 2.3	46.8 ± 0.8
Width (mm)	35.8 ± 3.4	32.8 ± 1.1
Weight (g)	35.9 ± 6.3	18.5 ± 1.9

012028. https://doi.org/10.1088/1755-1315/771/1/012028

Kurnia I, Rifai BA, Febriyanti EN, Kardina JR, Azzahra RNA, Satriawan MH. 2024. Keanekaragaman jenis burung di Pulau Untung Jawa Kepulauan Seribu Provinsi DKI Jakarta. *Jurnal Hutan Pulau-Pulau Kecil*. 8(1): 1–10. https://doi.org/10.30598/jhppk.v8i1.12062

Lambrechts MM, Aime C, Midamegbe A, Galan M, Perret P, Gregoire A, Doutrelant C. 2011. Nest size and breeding success in first and replacement clutches: an experimental study in blue tits *Cyanistes caeruleus*. *Journal of Ornithology*. 153(1): 173–179. https://doi.org/10.1007/s10336-011-0722-1

Mardiastuti A. 1991. Difference in size among waterbird eggs in Pulau Rambut: Some preliminary observations. *Media Konservasi*. 3(2): 66–71.

Mardiastuti A. 1992. Habitat and Nest–site Characteristics of Waterbirds in Pulau Rambut Nature Reserve, Jakarta Bay, Indonesia [dissertation]. East Lansing (US): Michigan State University.

Mardiastuti A. 2001. Ecology of avian community of Pulau Rambut: Population, nest site distribution, and foraging site. Bogor (ID): IPB University.

Mardiastuti A, Mulyani YA, Susanti NKY, Ivonnie RN, Oktavia CA. 2020. Oil spill in Pulau Rambut and its possible long–term impact on mangrove as waterbirds habitat. *IOP Conference Series: Earth and Environmental Science.* 528: 012015. https://doi.org/10.1088/1755-1315/528/1/012015

Mardiastuti A. 2022. Waterbird community in Pulau Rambut Wildlife Sanctuary, Jakarta Bay: Review on species composition and population size after thirty years. *IOP Conference Series: Earth and Environmental Science.* 950: 012031. https://doi.org/10.1088/1755-1315/950/1/012031

Mashudi A, Marhento G. 2016. Identifikasi keanekaragaman jenis burung dan kearifan tradisional masyarakat dalam upaya konservasi di Pulau Rambut Kepulauan Seribu. *Jurnal Formatif*. 6(2): 119–124. https://doi.org/10.30998/formatif.v6i2.945

Park S, Kim K, Chung H, Choi YI, Sung H. 2011. Vertical nest stratification and breeding success in a six mixed–species heronry in Taeseong, Chungbuk, Korea. *Animal Cells and Systems*. 15(1): 85–90. https://doi.org/10.1080/19768354.2011.555119

Shin M, Lee E, Cho H. 2018. Estimating the potential habitat of breeding egrets and herons (family Ardeidae) for urban forest management in Daejeon Metropolitan City, Korea. *Pakistan Journal Zoology*. 54(5): 2069–2076. https://doi.org/10.20944/preprints201808.0065.v1