Breeding season of Cormorant (*Phalacrocorax sulcirostris*) at Tanjung Rejo, Sumatera Utara

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Abstract. Cormorant is one of waterbirds which inhabit Tanjung Rejo mangrove as breeding site and feeding ground. This research is aimed to obtain economic potential of cormorant eggs as an alternative source of animal protein to coastal communities with limited economic efforts. The research was conducted during February to May 2018. Observation of cormorant nest was focused on 5 nests. Observations were conducted every two days from the first egg laying until nestlings, consisted of breeding season, clutch size, and egg morphology. Data were analyzed descriptively using MS. Excel. The results showed that the breeding season of cormorant occurred in two periods: February to May and August to December. The clutch sizes ranged from 1 to 4 eggs. Egg-laying varied on 2 to 4 d of interval and incubation began after the first egg laying. The eggs hatched after being incubated for 21-25 d. In conclusion, the eggs are one of the most important cycle for breeding succes of cormorant.

1. Introduction

Little black cormorant (*Phalacrocorax sulcirostris*) is a family of Phalacrocoracidae with members having medium to large size (body length 45 to 100 cm). The color of feathers from both sexes has same morphology and size while the males generally have a size and mass greater than females. The beak is long and sharp with a hook at the end and cylindrical, S-shaped neck. The legs are short and located far behind with webbed foot (totipalmate). The wings are relatively short, strong while the tail is hardy [1].

Little black cormorants are included in birds that feed in waters, especially in the ponds and oceans by swimming and diving later classified as shorebirds. The main feed of the cormorant is fish. Their feeding habit by consuming fish from pond, sea and fishing nets is considered as pest to fishermen. Little black cormorant (*Phalacrocorax sulcirostris*) is one of many waterbirds species which utilize mangrove forest in Tanjung Rejo region, Deliserdang Sumatra as their breeding sites. Breeding site is a strategic location to observe various aspects of reproduction during the breeding season. Tanjung Rejo is a mangrove area that is currently experiencing a lot of habitat changes and land conversion as ponds, plantations, fishing grounds and rice fields. This is feared to affect the success of breeding of various waterbirds including cormorants [2].

Along with economic needs, there is a shift in the population of cormorants in Tanjung Rejo, due to bird hunting as protein source for chicken substitutes. In 2013, the population could reach 5,000...
individu [3], but recently are estimated to be less than 3,500 individu. The population and existence of cormorants are greatly dependent on the success of breeding season by utilizing available food and environmental resources. The success of breeding season is also determined by optimum parental care in providing adequate food and shelter for nestlings in order to maintain species and clutch size in the wild. Bird populations in a region may experience habitat alteration and environmental changes which affect habitat selection and breeding success [4]. Habitat loss will then lead to higher competition among species [5]. Our study then will describe several factors affecting breeding success of little black cormorant (Phalacrocorax sulcirostris) in Tanjung Rejo.

2. Methods

2.1. Breeding season and clutch size
Calculation of breeding time was based on Julian calendar that January 1\textsuperscript{st} is equivalent to the day 1 and December 31\textsuperscript{st} equivalent to the day 365. The number of eggs observed was 51 eggs from 15 nests. The cormorant breeding season is characterized by the formation of pairs and the construction of nests and morphological changes in feather colors. The beginning of the breeding season is determined based on the time the cormorant start laying eggs in the nest until no additional eggs.

2.2. Breeding success
Breeding success was observed for every 2 d on nests containing cormorant eggs. Each eggs were measured for its length, width and mass. Furthermore, the egg laying distances were recorded among egg placement, in addition to the distance of egg hatching and the number of hatching eggs which survived as nestlings.

3. Results and Discussion

3.1. Breeding season
Breeding season is defined as a period of birds producing eggs or hatching eggs into nestlings. These birds will lay eggs and raise their offspring when the food is available abundantly in habitat [2]. The season for tropical waterbirds may occur in contrast to the subtropical regions. In Tanjung Rejo, breeding season occurred twice a year from September to December and March to June (Table 1).

| Tabel 1. Waterbirds breeding season in Tanjung Rejo |
|-------------------|------------|-----------|---------|---------|---------|---------|---------|---------|---------|---------|
| Species           | Aug.      | Sept.     | Oct.    | Nov.    | Dec.     | Jan.    | Feb.     | Mar.    | Apr.    | May     | June    |
| Egretta alba      | -         | ✓         | ✓       | ✓       | ✓        | -       | -        | ✓       | ✓       | ✓       | ✓       |
| Egretta garzetta  | -         | -         | ✓       | ✓       | ✓        | -       | -        | -       | -       | -       | -       |
| Bubulcus ibis     | -         | -         | -       | -       | -        | -       | -        | -       | -       | -       | -       |
| Ardea cinerea     | ✓         | ✓         | ✓       | ✓       | ✓        | ✓       | ✓        | ✓       | ✓       | ✓       | ✓       |
| P. sulcirostris   | -         | -         | -       | -       | -        | -       | ✓        | ✓       | ✓       | ✓       | ✓       |
| N. nycticorax     | ✓         | -         | -       | -       | -        | -       | ✓        | ✓       | ✓       | ✓       | ✓       |

Little black cormorant entered the breeding season together with other species, i.e. Egretta alba, E. garzetta and Bubulcus ibis in a year. This situation may be closely related to the safety issue of eggs and prospective offsprings. By starting breeding season together with other species, it guarantees to avoid disturbance from egg or nestling predators. Cormorants used this strategy by nesting in colonies to overcome predators issue and to guard their prospective offsprings. Nest selection within colonies and selection of nest trees which are able to refuse many nests are also strategies used by the cormorant to guarantee the success of breeding. This is in accordance with the statement from Environment Protection and Regulation Division of North East Branch [7], which stated several factors that must be fulfilled by waterbirds when entering the breeding season are selecting nest trees with good structures and maintaining nests and nestlings to avoid wind and predator disturbances.
Hormones, predators, environmental conditions and availability of food and nest are factors affecting bird breeding season regarding survivability of parent and offsprings [8,9]. Other factor that caused cormorant to breed in similar time with other species is because the cormorant has a different type of food and foraging place than others. Cormorant prefers to find fishes at shore in coastal area. Food availability also encourages cormorant to breed. Abundant food will guarantee generational maintain during nesting and incubation for its offsprings [5].

3.2. Eggs and Nestlings
Based on the results, cormorant eggs were V-shape ovoid eggs with ratio of length and width ± 43.53×28.14 mm (1: 1.55) and a mass of 20.32 g (Table 2). First egg was the largest in sizes among other eggs. It is assumed that first egg will produce vigorous nestling than others. Differences in egg masses indicate a different parental allocations during breeding season which may be related to food availability, parent life history traits and ages [9].

Table 2. Egg characteristics of cormorant in Tanjung Rejo

| Laying sequence | Length (mm) | Width (mm) | Mass (g) | Ratio L: W |
|-----------------|-------------|------------|---------|------------|
| 1<sup>st</sup>  | 43.78       | 29.79      | 21.58   | 1.00: 1.5  |
| 2<sup>nd</sup>  | 43.74       | 28.15      | 20.65   | 1.00: 1.6  |
| 3<sup>rd</sup>  | 43.35       | 27.44      | 19.63   | 1.00: 1.6  |
| 4<sup>th</sup>  | 43.26       | 27.33      | 19.39   | 1.00: 1.6  |
| Mean            | 43.53       | 28.18      | 20.32   | 1.00: 1.55 |

As comparison, little black cormorant and little cormorant (P. niger) eggs in Pulau Rambut had dimensional size of 51.26×32.83 mm/1: 1.56, with mass of 27.74 g and 43.62×29.00 mm/1: 1.5 with mass of 18.53 g, respectively. Our results on cormorant eggs in Tanjung Rejo showed a larger size than previous study. The difference in egg size is assumed due to geographical distinction, species and food availability. The size and shape of the eggs produced by the parent is strongly influenced by bird species in addition to physiological factors [2]. Furthermore, egg size is strongly influenced by food availability, parent age, egg laying time and parent experiences [11].

![Figure 1. A. Clutch size, B. Nesting and Hatching interval of cormorant](image)

The clutch size of cormorants in Tanjung Rejo ranged between 1 to 4 (Figure 1A). The size was in similar result with report from Pulau Rambut. The clutch size is heavily dependent on parental efforts in finding food and offspring survivability [2,10,11]. Birds will predict how many eggs will be laid based on their perception to sustain each generation. Different clutch size of same species in different region may also occur due to distinctive habitat characteristics. The clutch size is also result of natural selection adjusted to maximize parental physiological contribution to the next generation [12].
Egg laying interval or sequence and hatching is related to internal and external factors. Internal factors considering fitness of parent birds while external factors considering disturbance of predators and physical constraint of habitat which determined egg laying sequence by cormorants. In this study, the nesting and hatching intervals were not different from previous studies [10,13]. Breeding adults will predict its own successful laying sequence during breeding season or even performed asynchronous hatching under limited food resources [9].

![Incubation period and Breeding success of cormorants](image)

Figure 2. A. Incubation period, B. Breeding success of cormorants

Incubation period is strongly influenced by environmental factors, especially temperature and food. The incubation period of the cormorant is between 21 and 25 days, which is not different previous studies [13,14]. Based on the results, the breeding success of cormorant reached 88% while the hatching was 82%. The percentages showed that habitat is suitable for breeding cormorant nestlings indicating fitness and survival of offsprings. The percentages was higher than previous reports of 70% by *P. sulcirostris* in *Pulau Rambut* and of 77% by *P. pygmeus* at Northern Iran [11,13]. In addition, breeding success of cormorants does not always related to larger egg characteristics as found in this study. Egg sizes do not always correlated with hatching and breeding success, however the environmental and main physiological factors which have more contributions to the success [7,8].

4. Conclusions
Breeding season of cormorants in Tanjung Rejo occurred twice in a year. The percentage of cormorant breeding success reached 88% while its hatching success reached 82%. Factors affecting breeding success, i.e. food availability, precise breeding moment, nesting site selection, temperature, weather and parental care of cormorants.

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