Short communication – The first inventory of the nest placement of horseshoe crab (Tachypleus gigas) in Indonesia

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Abstract. Previous studies have reported that extant horseshoe crabs, including Atlantic and Asian horseshoe crab, spawned in intertidal zone during high tide season. Limited information about spawning nest of the horseshoe crab especially Tachypleus gigas in Indonesia has not been known yet. Moreover, according to the IUCN, the conservation status of T. gigas is still data deficient. During the fieldwork, we found the location that indicated as the spawning ground or nest placement of T. gigas. This is the first time when the spawning area of horseshoe crab is found in Subang, Indonesia. There were three clutches of eggs and the total number was 375-534 eggs in varying depth (5-20 cm) below the sand. The second observation in the same location on January 16, 2020, found a pair of T. gigas laying their eggs and the number was 244 eggs in varying depth (5-15 cm). The characteristics of nest placement of T. gigas that found in Subang was located on the small island in the middle of the sea. The island is an uninhabited island that has mangrove area and sandy substrate. Thus, based on what was found Burung island indicated as the spawning ground of coastal horseshoe crab (T. gigas).

Keywords: eggs; horseshoe crab; spawning site

1. Introduction
Previous studies have reported that extant horseshoe crabs, including Limulus polyphemus, Carcinoscorpius rotundicauda, Tachypleus tridentatus, and T. gigas, spawned on intertidal zone during high tide season [1-3]. Breeding peak of Limulus polyphemus happened at high tide during full and new moon season [4], and its similar with an observation on T. gigas, C. rotundicauda [5], and T. tridentatus [6]. Three of the four species, breed in the sandy areas whereas only C. rotundicauda breeds in the muddy or mangrove areas along the intertidal beaches of the estuarine coasts [7-8]. Generally, the male attaches to the female, amplexus condition, swims towards the high tide line for nesting and laying thousands of eggs which are fertilized externally by the male. Selectiveness in the nest placement of these crabs is facilitated by appendage setae (chemoreceptors) which can detect the suitable sandy or muddy substrate for laying their egg also for egg incubation [9].
All of the Asian horseshoe crabs can be found in Indonesian waters. Both coastal horseshoe crab (*T. gigas*) and mangrove horseshoe crab (*C. rotundicauda*) are present in the northern Java sea, whereas tri-spines horseshoe crab (*T. tridentatus*) is restricted in a certain area such as Balikpapan, East Kalimantan and Gorontalo, North Sulawesi. According to the IUCN status, tri-spines horseshoe crab is an endangered species [10] while the coastal horseshoe crab and mangrove horseshoe crab are data deficient [11]. Appropriate understanding of the reproduction aspect of horseshoe crabs is important for the management of populations for conservation purposes, including information about the spawning area. Several countries in Asia such as Malaysia, Singapore, China, and Japan have been found and starting to promote and keep the spawning area of this crab, but in Indonesia, the spawning area or nest placement has not been found before. Furthermore, detailed information about the physical and chemical environment especially in the spawning ground is still limited, also the egg clutch of this crab. Regarding to our finding, we found the egg clutch of the coastal horseshoe crab (*T. gigas*) and counted the eggs in the small island which is Burung Island in Subang, West Java, Indonesia.

2. Methods

This research was conducted from October 2019 to February 2020 in Mayangan, Subang, West Java (figure 1). A clutch of eggs was discovered manually by hands. Information about the location of the spawning site was obtained from local fishermen who usually mine sand on the Island. The observation was carried out during high tide season in each month. The marked nests were revisited after the tide receded. Each nest was dug, and the depth is measured from the surface until the first egg was exposed. The eggs were separated from the sand using a gentle wooden spoon and carefully carried out. Then the eggs are placed on a plastic sieve, and counted one by one. The next, returned the eggs to the nest and buried in their original condition as possible.

![Figure 1](image_url)

**Figure 1.** Sampling location in Mayangan, Subang, West Java. The red mark indicates the sampling area of the nest placement of coastal horseshoe crab (*Tachypleus gigas*).
3. Results and discussion

3.1. Eggs description and spawning habitat of Tachypleus gigas

The egg clutch of coastal horseshoe crab (T. gigas) was found for the first time on October 24, 2019 by shoveling sediment around the beach covered by sand (figure 2). Each nest of eggs that have been found is buried under the sediment surface at the depth up to 5-20 cm. The type of substrate that used as nest placement for coastal horseshoe crab in Subang, West Java, Indonesia was sand. There was three clutches of egg that was found. The distance between one clutch and another was approximately 100-250 cm (figure 3b) while the number of eggs found in each clutch was 125-178 eggs. The total of all egg that found in three clutches was around 375-534 eggs. A female horseshoe crab was capable of laying eggs up to 200-300 [12] with depths ranging from 5-20 cm under the sediment [13, 14]. The result of spawning output was influenced by local environment and season in the spawning area such as the geographic location, beach topography, seasonal water current also the hydrology condition [15-17].

![Figure 2. The clutch of egg that found on October 24, 2019.](image-url)

At the second observation on January 16, 2020 on the same island, there was a pair of horseshoe crabs come to the beach area during the hide tide and moves towards the highest tide line. There was no indication of the satellite of horseshoe crab or the crab was monogamy (one male and one female). A common behavior of the Asian horseshoe crab was tended to be monogamous [18, 19]. The time of the pair comes to the beach around 12 pm until 1 pm. In addition, a female began to bury itself into the sand which indicated the nesting activity. Nesting activity of horseshoe crab began when a female started digging into the sand [6]. On the other hands, this female crab also released bubbles while a female started to dig itself into the substrate. Releasing of bubbles by the horseshoe crab in amplexus condition for more than two minutes indicates that this crab digging into the sand for laying eggs [20]. The nesting location of this crab will be exposed as a whole after the water receded. There was only
one clutch of egg found during the second observation and the depth of the nest was around 5-15 cm. The number of eggs found was 244 eggs while the diameter of eggs was approximately 3 mm (figure 4b).

Figure 3. Condition during low tide (a) condition during high tide (b); the circle red mark is the location of a clutch of eggs.
The characteristics of spawning nest of *T. gigas* found in Subang, West Java, Indonesia is located on a small island in the middle of the sea (figure 5). The island is an uninhabited island that has a mangrove area and sandy substrate. Around this island, there is a puddle which has calm water in the middle of the island and still affected by sea current (figure 3b). The distance of the location from the mouth of the estuary is about 20 minutes using a boat. In ancient times, this island was connected with the mainland. Based on local fishermen's information, the island where the coastal horseshoe crab spawned was a large fishpond area but over time the area separated from the mainland. The thing that caused the area to be separated was allegedly due to abrasion which resulted in extensive ponds being covered in sea level. So now, the spawning nest appears as an island in the middle of the sea. Other information from locals, the island is often used as a target of sand mining. Moreover, this area is sometimes visited by local tourists on weekends with not a lot of numbers. Thus, the discovery of an egg clutch and a pair of horseshoe crab releasing their eggs on Burung Island, Subang, West Java, Indonesia, proves that the area is a spawning ground or the nest placement of coastal horseshoe crab (*T. gigas)*.

![Figure 4](image4.png)

**Figure 4.** A pair of horseshoe crab (left) and the clutch of eggs (right) that found on January 16, 2020.

![Figure 5](image5.png)

**Figure 5.** Spawning nest of *Tachypleus gigas* in Subang, West Java, Indonesia.

### 3.2. Further study in the spawning area of *Tachypleus gigas*

The egg size of the coastal horseshoe crab (*T. gigas*) a day after spawning season is 3 mm but the egg size in each stage during embryonic development has been recorded yet. There is no study investigated about spawning habitat characteristics of the coastal horseshoe crab in Indonesia. Furthermore, the
environmental aspects especially the physical and chemical conditions in the spawning nest area of the coastal horseshoe crab remain unknown. For conservation purposes, understanding the life-history mechanism and the adaptive capability of this crab must be described. It is crucial to gather information about the spawning area and habitat use of each life stage of this crab. Detailed information about nest placement of *T. gigas* in Indonesia has not been described before. Study about the reproductive behavior of coastal horseshoe crab needs to be investigated such as the time used for the process of laying egg, the certainty of fertilization carried out by a male or satellites, the number of eggs and the number of the nest placement of a pair, also the number of pair that comes to the beach in a different season. Moreover, the whole time that used in the spawning process. Further studies on the reproductive strategy of *T. gigas* in Subang, West Java, Indonesia must be investigated in the future.

4. Conclusion
The waters of Mayangan, Subang, West Java indicate as a spawning ground or nest placement area of *T. gigas*. The number of egg clutch that was found in this area was three and the number of the egg was around 244-534. All the egg clutch was buried in the sand in the mangrove area. Nest placement area or spawning ground is one of the critical habitats for coastal horseshoe crab (*T. gigas*) and also for the offspring.

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