Peanut Crab *Pinnotheres halingi*, a symbiotic commensal or parasite of Sandfish *Holothuria scabra*?

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**Abstract.** High mortality of sandfish *Holothuria scabra* broodstock is one of the main problems in sea cucumber hatcheries. Broodstock collected from wild are very difficult to keep alive for long periods because the broodstock readily eviscerate. One cause of evisceration and death is probably due to the presence of peanut crabs *Pinnotheres halingi* in body cavity as commensal. This study aimed to analyse the mortality of sandfish due to the presence of peanut crabs as commensal. Sandfish samples were collected in Liukang Tupabbing Utara District, Pangkep Regency in South Sulawesi, Indonesia. During the study, 139 sandfish were observed in rearing nine tanks at the laboratory. The results of this study are not strong enough to state that peanut crab is a symbiotic commensal or parasite. The peanut crab malignancy as a predator can cause the death of 139 sandfish in 92 days. This is thought to be the reason why broodstock is very difficult to rear for a long period in a controlled tank in a laboratory or hatchery.

1. Introduction

The *Holothuria scabra* sandfish is a species of sea cucumber with high economic value which is found in Indonesian waters [1,2]. Sandfish are the most studied sea cucumber species in Indonesia. Previous research has reported on various aspects of biology [3,4], growth [5], reproduction [6-8], hatchery [9], cultivation [2,5,10], fish predation [11], catching [12], and sandfish processing [9,13-15].

The high economic value causes the natural population of sandfish to suffer from over fishing [16]. Increasing production of sandfish through aquaculture has been done for a long time, but until now it has not been successful. One of the problems faced in sea cucumber cultivation is the limited number of sandfish seeds.

Various trials have been carried out to produce sandfish seeds in the hatchery. On a small scale in the laboratory, sandfish seeds have been successfully produced [9], but sandfish seeds cannot be mass
produced yet, one of the causes is the limited broodstock. Broodstock is very difficult to be reared in a long period in the controlled tank in the hatchery; one of the causes is the presence of other organisms.

So far, what are known as sea cucumber predators are copepods, ciliates and predators that attack larvae [17] and adult sandfish [11]. Therefore, the control of predators and other nuisance animals focuses on copepods, ciliates and predators.

The presence of crustacea, namely peanut crabs, as a symbiont of sandfish has been reported that peanut crab is an obligate symbiont of sandfish [18]. So far, the relationship between peanut crabs and sandfish is thought to be a symbiosis commensal relationship. However, the high mortality during broodstock treatment in the laboratory raises the suspicion that the peanut crabs and sandfish relationship is a symbiotic parasitic relationship. Therefore, a study is necessary to determine is relation between peanut crabs and sandfish is a symbiosis commensal or a symbiosis parasitism. This study aims to analyze whether the peanut crab is really a symbiosis commensal or parasites of sandfish?

2. Materials and Methods
This research was an observational research. Observations were made on reared sandfish in the laboratory. Sandfish was reared in 9 units of 100 x 200 x 90 cm tank. Each tank was filled with 60 cm of water so that the sandfish is visible enough for easy observation. Each tank was aerated and pumped to generate a small current in the tank. Each tank was filled with 15-16 broodstock, the total broodstock obtained from the wild stock was 139 sandfish. Sandfish are given artificial food as much as 20 ppm every day. The nutritional composition of the feed is protein 40-42%, minimum fat 6%, fiber maximum 3%, ash maximum 12%, and moisture maximum 10%.

Observations were made in the morning, afternoon and night to see the behavior of sea cucumbers. Every incident was recorded. Dead sea cucumber is measured its gutted weight. The causes of death were observed and recorded. The peanut crabs found are weighed. The observation was stopped when all the broodstock had died.

Size at first attack was estimated by using the equation: \( PCA_{50} = GW_{50} \), where \( GW_{50} \) was the gutted weight at which 50% of the sandfish was attacked by peanut crab. The first attack curve was calculated using a polynomial trendline in the Microsoft Excel software program.

3. Results

3.1. Sandfish Holothuria scabra being attacked by the peanut crab
A healthy sandfish that was attacked by a peanut was characterized by rolling over again on the bottom of the tank, and there was a body part that had contracted inward, as if choking (Figure 1a). Sandfish like this usually eviscerate soon after (Figure 1b-c). When evisceration occurs, peanut crab comes out with internal organs (Figure 1d), but not always, more evisceration is not accompanied by peanut crab discharge. In certain cases, the peanut crab remains in the body cavity, precisely in the arborescent organ (respiratory organ) (Figure 1e). Generally peanut crabs are found in pairs, one male (small) and one female (large) (Figure 1f).

Sandfish that have suffered from evisceration did not always die, some remain active (Figure 2a), ammunition also shows signs of death, namely slimy tegument (Figure 2b) then crushes and dies (Figure 2c). In the dead sandfish, a living peanut crab can be found in the body cavity (Figure 2d-i). In the body cavity of the dead sandfish, peanut crab was not always found; more often it was not found peanut crab. If the peanut crab was not found in its body cavity, it was possible that the peanut crab has left before the sandfish dies. During the observation, peanut crab was found which was coming out of the sandfish body cavity through the body wall or tegument (Figure 3).
3.2. Sandfish Size Attacked by Peanut Crab
Sandfish that were found dead measured 7.80-363.51 g of gutted weight, with an average weight of 103.78 ± 80.22 g (Figure 4). Of the 139 sandfish at the starting observation day, all sandfish died over a period of 92 days. 20 sandfish died with peanut crab (14.39%) (Figure 5). The number of cases of peanut crab found in pairs on dead sandfish was 10 sandfish (50%).

Figure 1. Sandfish *Holothuria scabra* condition that is being eviscerated

Figure 2. Sandfish *Holothuria scabra* condition that was attacked by peanut crab *Pinnotheres halingi*
Figure 3. Peanut crab *Pinnotheres halingi* condition when exiting the body cavity of sandfish *Holothuria scabra*

Figure 4. The gutted weight distribution of sandfish *Holothuria scabra* found during the observation.

Figure 5. Sandfish *Holothuria scabra* percentage that died with and without peanut crab (PC) related to class size of gutted weight.
3.3. *Peanut Crab Size*

The peanut crab size range that attacks the sandfish was 0.06-0.83 g, with an average weight of 0.31 ± 0.20 g (Figure 6). If it was assumed that all sandfish that died were caused by peanut crab attacked, then the sandfish gutted weight at the first attack would be 113 g (Figure 7).

![Figure 6. Total weight of peanut crab *Pinnotheres halingi* found during observation in the controlled tanks](image)

![Figure 7. Gutted weight of sandfish *Holothuria scabra* at first attack by peanut crab](image)

4. *Discussion*

Peanut crabs (*Pinnotheridae*) were known as symbionts of sea cucumbers, there were at least twelve species of *Pinnotheridae* that were known to be symbiotic with holothurians in the Indo-Pacific [19].
Previous studies have reported that peanut crabs are obligate symbionts of holothurians [18]. The results of other studies reported that peanut crabs were commensal, inquilistic, parasites or unidentified symbionts [20, 21]. Previous studies have reported that peanut crabs have no or little effect on their host, peanut crab does not feed on host tissue, or causes other adverse effects, except to slightly injure the walls of the respiratory tree or cloaca, forming membranaceous cysts [20-23], or cause atrophy in the right respiratory tree of sandfish [18]. However, there were also previous studies which reported that the peanut crab is a parasite on the sea cucumber [24, 25]. Apart from sandfish, peanut crab was also associated with asteroids, echinoids [19, 23], bivalves and gastropods [26-31].

The result of this study is not strong enough to state that peanut crab is symbiotic commensal or parasite. It looks like the peanut crab is an obligate symbiont. Under normal conditions, peanut crabs do not attack sandfish, but under certain conditions it can disturb or cause death to the sandfish. The condition that is thought to cause changes in peanut crab behavior is hunger. During observation, there was no food input other than for sandfish. This is thought to starve the peanut crab so that it preys on the sandfish internal organs, thus changing its status from an obligate symbiont to a predator. In the habitat of sandfish, this is thought not to happen because naturally there is enough food for the crab peanut, so it does not attack the internal organs of the host.

The peanut crab's predatory viciousness caused the rapid death of 139 sandfish. The thirty peanut crabs found seemed to have moved from one sandfish (host) to another, so that within 92 days, all the sandfish died (100% mortality). If broodstock comes from nature, an average of 350 g [32], it is almost certain that there is peanut crab in the body cavity of the sandfish, so if the broodstock rearing tank in the hatchery is not available food for the peanut crab, there is a high risk of dying from predation of the sandfish's internal organs by the peanut crab. This may explain why broodstock mortality was so high in controlled tanks in a laboratory or hatchery.

5. Conclusion
The results of this study are not strong enough to state that peanut crab is a symbiotic commensal or parasite. The peanut crab is thought to have turned into a predator when it starved. Peanut crab malignancy as a predator can cause the death of 139 sandfish in 92 days. This may explain why broodstock mortality was so high in controlled tanks in a laboratory or hatchery.

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