



Attachment Phenomenon of Thick-shelled Squid Eggs on Selected Substrates: A Case in Barru Regency of South Sulawesi, Indonesia

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Squids, when spawning, attach their eggs to the preferred substrate to develop well in the selected conditions. Experimental fishing research was conducted by direct observation of squid activities in the spawning area where squid eggs were attached to different substrates. The adult squid would first conduct an inspection and then attach their eggs to the selected substrate. The results showed that squid egg attachment time was conducted in the morning from 06.00 AM to 07.00 AM for 15 minutes at a duration of about 10-30 seconds. The number of egg capsules found in squid houses and various substrates in nature was 1,698 and 1,568 egg capsules. Squid eggs were found at a depth of 1-7 meters, with the most at a depth of 3 meters with 2,718 egg capsules.

Keywords: Squid; morning; substrates; squid-eggs.

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1. INTRODUCTION

Squid is one of the most economically important marine biological resources. Squid, as a high-protein food, currently only relies on capture from the sea, while the sea has limited carrying capacity due to uncontrolled fishing and high pollution in the sea. efforts can be made to conserve squid with squid houses. a squid house is a type of basic fad specifically designed to stimulate squid to spawn safely and securely. inside the squid house, substrates favored by squid attach their eggs. the squid fads installed in the waters can function as a place of nurturing and enlargement; various types of fish forage and play around with the fads so that they can form a new ecosystem at a certain time [1].

Squid, On The Eve Of Spawning, Form Groups (Scholing) And Migrate To Coastal Areas [2] And [3]. The Daily Migration Of Squid Is Influenced By The Presence Of Predators And Food Distribution. During The Day, They Group Near The Bottom Of The Water And Will Disperse In The Water Column At Night [3]. Furthermore, [4] said that squid usually choose depth and various types of substrates to attach their eggs. Substrate types such as seaweed, seagrass, sponge, rocks, corals, bamboo traps, coconut leaves, PVC pipes, ropes, plastic baskets, wooden branches, tree roots, palm fibers, anchor ropes, fishing nets and dead corals at depths between 1-7 meters.

Egg attachment of this thick-skinned squid (*Sepioteuthis lessoniana*) is found on safe, hidden, sheltered, and camouflaged substrates [5] and [4]. Furthermore, it is said that the shape and model of the substrate is a round bar on the bottom of the water that is sandy and slightly muddy. Eggs of thick-skinned squid were found in the form of pods attached to the substrate. The number of eggs produced in one spawning is between 78 - 551 egg pods or 194 - 2241 eggs in one colony [6].

Thick-skinned squid attach their eggs to a preferred substrate. however, the phenomenon of selected substrate selection is not widely understood/known. there is limited information that reveals this phenomenon in detail, so this study aims to reveal/describe the phenomenon of squid in spawning and selecting substrates on the duration of time, frequency and number of eggs attached to the selected substrate and recommend the shape and type of substrate as an effective egg attachment medium to

fishermen and government in squid resource management and the importance of creating potential and sustainable squid spawning areas in coastal areas that contribute to optimal squid fishing ground.

2. MATERIALS AND METHODS

This research was conducted in Pute Anging Island, Barru Regency, South Sulawesi, at coordinates 04° 29' 13" South latitude and 119° 34' 23" East longitude. The island is surrounded by coral reefs and a few seagrass beds starting from the South to the North through the West, while in the East, a little to the South and the North mixed sand coral. The site selection was intended to get an idea of where squid often spawns in the waters of this island, planting squid houses as substrate media and tracing the traces of squid egg laying in these waters.

The requirements for planting squid FADs quoted from [5] are that the bottom of the waters must be sandy or coral sand, clear water conditions up to 4-5 meters deep, the topography of the seabed is rather sloping, close to coral reefs and seagrass beds, the current speed in the area is not more than 0.5 knots, often found squid laying eggs at that location.

Potential squid fishing areas are in the North and southwest. Squid fishing is conducted in the morning and evening using a hand line. The type of squid caught is thick-skinned squid.

The squid house was installed in the water with a 10 mm diameter rope substrate at a depth of 3-4 meters and stood upright on the bottom of the water (Fig. 1). The number of substrate strands in the squid house is 32 strands. Other substrates are natural substrates that are widely available in nature around these waters and occupied by squid attaching eggs, such as ship anchor ropes at a depth of 5 and 7 meters, tree roots at a depth of 3-meter, wooden tree branches at a depth of 3 meters, dead corals at a depth of 2 meters, and chunks of anchor ropes at a depth of 1 meter.

The method used was descriptive qualitative analysis (case study) by conducting experimental fishing or direct observation of the phenomenon of squid egg attachment of squid during spawning on selected substrates both in the squid house and natural substrates that are widely scattered near the squid house.

Data collection was conducted in the morning and evening at 06.00 - 07.00 and 17.00 - 18.00 in the field using diving equipment (life jacket, mask, snorkel, diving flashlight, underwater camera). Photographs and moving images were documented on the water surface to observe and calculate the time, frequency and duration of egg laying. Egg data collection was carried out by diving and carefully raising the substrate to the surface of the water and then counting the number of colonies and the position of the egg attached to the substrate.

Several squid fishermen also obtained information on squid phenomena in spawning areas. All data collected were tabulated and then analyzed.

Data collected from observations, documentation and interviews were then analyzed inductively so that an accurate picture or conclusion could be given about what happened. The empirical facts found are then matched with the existing theoretical basis.

3. RESULTS AND DISCUSSION

Adult squid, before attaching their eggs to a new substrate, first survey the location; no detailed data has been found on how many days squid come back to attach their eggs after surveying. information obtained from this study said 3 - 14 days after surveying a new location. the squid was surveyed in groups of up to 4 pairs of squid. the second arrival of the squid immediately approached the substrate in the ocean current direction. some rotated 90 and 360 degrees, then stopped for a moment, then the female squid,

accompanied by the male, moved forward to check the substrate where the eggs would be attached, then retreated again after a few seconds, then moved forward again to attach the eggs accompanied by the male squid. the squid did this repeatedly for approximately 15 minutes and then left the substrate. Fig. 1 showed the position of the female and male squid when they were about to attach their eggs to the substrate.

The substrate that squid attach their eggs to is a long round stem with a diameter of 10mm (rope substrate). On tree roots, squid prefers long root stems of 6-10mm diameter close to the bottom of the water and hide. Squid on tree branches prefers twig stalks near the main stem that are 6-8 mm in diameter and protected from foliage. On chunks of ship anchor ropes, squid chose rope substrates with a small but elongated size; the location of the chosen rope was close to the bottom of the water and protected. In the net, fishermen found squid eggs attached to the bottom rope/weight rope with a diameter of 5 mm at a depth of 7 meters.

Largefin squid eggs are pea-like, white and transparent with a gelatinous coating that protects the eggs. A colony of eggs attached to the substrate looks like a cage of grapes. The first egg attachment was found in the squid house on day 35 (November 22) after deployment and continued to increase until day 60. There were 2, 4, 6, 1 and 3 colonies, respectively, with 1698 egg capsules. The egg attachment time was done in the morning at around 06.00 - 07.00, after which no more squid pairs were seen around the squid house.

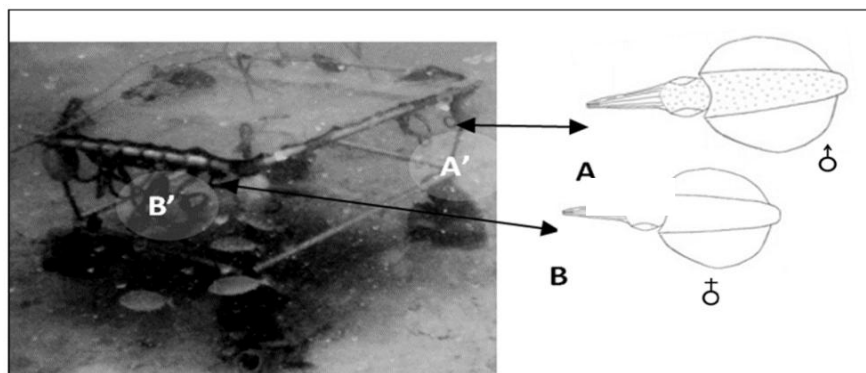


Fig. 1. Position of male and female squid while laying eggs on the substrate

Description:

A - A': Movement of the male squid (back and forth) when accompanying the female squid to lay eggs.

B - B': Movement of the female squid (back and forth) during egg attachment

Table 1. Some egg capsules are based on substrate type, water bottom and sea depth

No.	Type of Substrate	Seabed Material	Sea Depth (mm)	No egg Capsule
1	Ship Anchor Chunks	Sand	100	54
2	Dead Coral	Coral sand	200	75
3	Wood Tree Root	Mud sand	300	390
4	Wood Branch	Mud sand	300	630
5	Rope	Mud sand	300	1698
6	Anchor Rope	Mud sand	500	380
7	Net Sheet	Mud sand	700	39

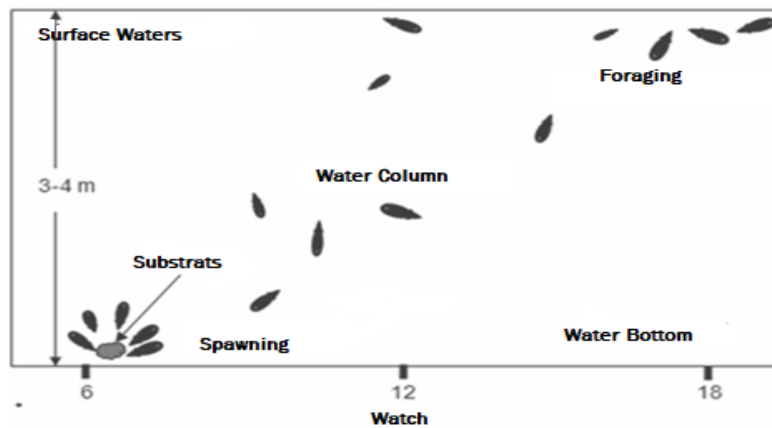


Fig. 2. Squid distribution and activity in spawning areas

In natural substrates most eggs were found very hidden and protected in various natural substrates, so they were sometimes not visible from above sea level. The number of egg colonies in natural substrates was one colony, each with varying numbers of egg capsules. The number of egg capsules by substrate type and depth can be seen in Table 1.

The time of egg laying on the natural substrate in this study is not valid data, this means that to draw a more valid conclusion, further research with a specific time frame is needed, which was not done in this study, but many squids were found interacting in the morning at 06.00-07.00 around the substrate and in the afternoon was not found. In the afternoon, squid tended to be in the coral reef area to the North of the study site, an area of squid fishing activity. The distribution and activity of squid in the spawning area can be seen in Fig. 2.

The frequency of egg attachment to the substrate in the squid house is not valid, but research data says every 1 - 12 days. The average frequency of each egg attachment that occurs in the squid house is 3-6 days. With egg attachment to the substrate, squid do it repeatedly with a 10 - 30 seconds interval for approximately 15 minutes,

after which the adult squid pair leaves the egg attachment site.

The preferred position of the squid egg attachment on the substrate was hanging from the upper end of the substrate in the dimly lit part of the squid house. In the squid house, 13 substrates were found that the squid chose to attach their eggs. The substrate of wood tree roots was found to have squid eggs attached near the bottom of the water until it touched the bottom.

Largefin squid eggs are pea-like, white and transparent with a gelatinous coating that protects the eggs. A colony of eggs attached to the substrate looks like a cage of grapes. According to [7], the capsules, when released, are small and then expand 2-3 times their initial size by absorbing water and giving a cavity to each egg. Furthermore, [8] explains that after the squid eggs are fertilized, they will be released one by one in gelatin capsules. The gelatinous substance is a substance that protects the eggs and is not favored by fish.

Squids attach eggs based on the sight and feel of the mother on the substrate. The substrate most favored by the squid is the substrate in the

form of bars or sprigs of wood twigs and ribbon-shaped substrate, the rope substrate attached to the attractor resembles a bar and looks like a sprig of twigs because it is intertwined so that the squid chooses this substrate to attach their eggs. [7] states that the most preferred substrates resemble ribbons and stems/twigs; the substrate material is not the object of squid attention but rather the shape and location of the substrate. The location of the substrate favored by the squid is in a rather dimly lit and hidden substrate position. [8] found squid attached their eggs to rope substrates. [5] found squid egg attachment substrate made of hemp rope. A squid attractor operated on Bangka Island used a rope substrate and worked well.

Tallo I [3] found eggs in squid attractors at week two after unloading in August-September. [8] found squid eggs in August. In Bangka Island waters, squid attaches their eggs in October - December. Furthermore, [9] suggested that squid lay eggs throughout the year with a peak season that varies according to the geographical area.

The number of colonies and the timing of squid spawning in each season varies. According to [10], each said that the number of eggs produced in one spawning ranges from 78 - 408 egg pods with a total of 194 to 1350 egg capsules, and the number of squid egg pods ranges from 380 - 551 with a total of 700 - 2241 egg capsules, each pod containing 1 to 6 egg capsules. In Tanzania, [11] found 180 - 1180 egg capsules with an average of 680 egg capsules per individual, and in Australia found, 218 - 1922 egg capsules. Research in Bangka Island waters found eggs in as many as 820 egg capsules in squid attractors.

In Table 1, it can be explained that squid mainly laid eggs at a sea depth of 3 meters on elongated stem substrates between 6 - 10 mm in diameter. The material and type of substrate were not a measure for the squid but rather a slightly hidden and protected position. [3] found eggs on the attractor in the 2nd week after it was lowered in August - September at a depth of 5 meters. [12] found squid eggs in the attractor in the 4th week of August at a depth of 5 - 7 meters. In Bangka Island waters, squid attached their eggs to the attractor in October - December at a depth of 3 - 7 meters. [13] said that squid egg attachment activity on substrate occurred during the day and did not find at night. Similarly, Tallo (2006) found that squid eggs were attached to the squid attractor during the attractor removal

period in the early morning. Furthermore, Hatfield et al. (2002) suggested that squid spawns throughout the year with peak seasons that vary according to the geographical area.

The squid egg attachment activity on the substrate occurred during the day and did not find at night [14]. Similarly, [3] found that squid eggs were attached to the squid attractor during the attractor removal period in the early morning. Furthermore, [9] suggested that squid spawns throughout the year with peak seasons that vary according to the geographical area.

4. CONCLUSION

The phenomenon of adult squid laying eggs on the substrate was carried out in pairs in the direction of the ocean current in the morning with a time interval of 10-30 seconds for 15 minutes. The most common type of substrate selected for egg attachment was a protected elliptical shape with a diameter of 6-10 mm at a depth of 3 meters.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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