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EFFECTIVENESS OF SQUID ATTRACTOR MADE FROM FIBER BIOCOMPOSITE (*ARENGA PINNATA MERR*) IN LEMBEH STRAIT WATERS BITUNG CITY NORTH SULAWESI

Efektivitas Atraktor Cumi-cumi Berbahan Biokomposit Serat Ijuk (*Arenga Ppinnata Merr*) di Perairan Selat Lembeh Kota Bitung Sulawesi Utara

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ABSTRACT

One effort to increase squid resources in aquatic areas is by installing a squid attractor, which is used as a place for squid to release their eggs. The aim of installing a squid attractor is to create an artificial coral reef, so the construction of a squid attractor should follow the requirements for artificial coral reefs. This artificial coral reef will later become a new ecosystem in a body of water. This research aims to determine the effectiveness of a squid attractor made from palm fiber biocomposite. The research method uses a direct-trial experimental method. Data analysis uses descriptive analysis and analysis of the effectiveness of squid attractors. The research findings indicate that biocomposite attractors made from palm fiber are categorized as effective based on the number of attractors successfully attracting squid eggs. The squid species (Sepia, sp.) adhered their eggs to these attractors. The effectiveness analysis calculations show that the obtained effectiveness rate is 60%. Apart from that, this attractor made from palm fiber biocomposite effectively forms new ecosystems. This is indicated by the significant biofouling growth in the attractor made from palm fiber biocomposite. Apart from that, a fish association is around installing this squid attractor made from palm fiber biocomposite.

Keywords: Fish Associations, Palm Fiber Biocomposite, Squid Attractor, The Effectiveness of Squid Attractors

ABSTRAK

Salah satu upaya meningkatkan sumberdaya cumi-cumi di suatu kawasan perairan yaitu dengan memasang atraktor cumi-cumi yang digunakan sebagai tempat cumi-cumi melepaskan telurnya. Pemasangan atraktor cumi-cumi bertujuan sebagai pembentukan terumbu karang buatan (*artificial reef*) sehingga pembuatan atraktor cumi-cumi sebaiknya mengikuti persyaratan terumbu karang buatan. Terumbu karang buatan ini nantinya akan menjadi ekosistem baru di suatu perairan. Penelitian ini bertujuan untuk mengetahui efektivitas dari

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atraktor cumi-cumi berbahan biokomposit serat ijuk. Metode penelitian menggunakan metode eksperimen uji coba langsung. Analisis data menggunakan analisis deskriptif dan analisis efektivitas atraktor cumi-cumi. Hasil penelitian menunjukan bahwa atraktor berbahan biokomposit serat ijuk dikategorikan efektif ditinjau dari jumlah atraktor yang berhasil ditempeli telur cumi-cumi. Cumi-cumi yang menempelkan telur pada atraktor adalah jenis sotong (*Sepia* sp). Berdasarkan hasil perhitungan analisis efektivitas atraktor, nilai efektivitas yang diperoleh adalah 60%. Selain itu pula atraktor berbahan biokomposit serat ijuk ini sangat efektif dalam pembentukan ekosistem baru. Hal ini ditunjukkan dengan terjadinya pertumbuhan *biofouling* yang signifikan pada atraktor berbahan biokomposit serat ijuk. Selain itu adanya asosiasi ikan disekitar pemasangan atraktor cumi-cumi berbahan biokomposit serat ijuk ini.

Kata kunci: Atraktor Cumi-cumi, Serat Ijuk, Asosiasi Ikan, Efektivitas Atraktor Cumi-cumi

INTRODUCTION

Squid has become one of the main catches, along with fish and lobster, due to the high market demand for squid (Mulyanto et al., 2022). One of Indonesia's export products with high economic value is squid (Rapi et al., 2023). Environmentally unfriendly fishing practices, sedimentation, environmental pollution, and land conservation pressures from development have triggered a high rate of habitat degradation for squid spawning and growth in coastal areas. Applied technology that can help squid reproduce easily is greatly needed. This aims to maintain the squid population as the catch has increased, but stock enhancement efforts have not followed (Baskoro et al., 2017). It's time for efforts to utilize squid resources to be accompanied by proper fishing regulations, as well as aquaculture activities starting from the spawning process (hatchery) to releasing juveniles into the wild. These activities can restore squid resources through stock enhancement. Thus, the sustainability of squid resources can be improved and preserved (Rizal, 2017).

One effort to conserve and enhance squid resources in aquatic areas is the installation of squid attractors, which function as places for squid eggs to be laid. Aziz et al. (2023), explain that the right technology to increase squid stock is squid attractors, which serve as an alternative place for squid eggs to adhere, providing a safe spawning area from predators.

Aquatic areas where squid attractors are installed will become potential areas for squid resources. These areas will also serve as squid nurseries (M S Baskoro, 2016). Rizal (2017), states that using attractors to encourage squid to lay eggs in such areas is not yet widely practiced. Besides this function, the installation of squid attractors also aims to create artificial coral reefs, so the construction of squid attractors should follow the requirements for artificial reefs. These artificial reefs will eventually become new ecosystems in a body of water perairan (Baskoro et al., 2011), (Sudrajat et al., 2022) and (Mulyono et al., 2023). To enable longer-lasting and more significant benefits from installing squid attractors, technological engineering is required (Sudrajat, 2020).

According to Baskoro (2010), explains that when placing attractors, things that must be taken into account include the sloping bottom of the waters, sandy beach substrate or rocky sand or coral fragments. Sudrajat et al. (2022), stated that the squid attractor installation zone has a current speed that does not exceed 5 knots both vertically and horizontally. Atmojo et al. (2017), stated that the dominant current speed at all depths in the waters of the Lembeh Strait is 0.5 – 1 m/s. Meanwhile, according to Hiwari (2020), the current speed in the waters of the Lembeh Strait is between 0.04 – 0.24 m/s and Rori et al. (2023), explains that the current speed in the waters of the Lembeh Strait during high tide or low tide in each season has values that are not much different. The current speed ranges from 0 – 0.7 m/s.

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Soewito (1990) in Aras (2013), stated that squid inhabit waters with a salinity of between 8.5 – 30 ppt and a temperature of between 8℃ – 32℃. Samudra et al. (2016), stated that the rate of length and width of Sepioteuthis lessoniana eggs is influenced by temperature and salinity. Maximum egg growth at a temperature of 29℃- 30℃ and salinity of 20–30 ppt. Oceanographic factors that influence are temperature 29℃- 30℃, salinity 31-32 ppt, current speed 0.02-0.05 m/s, visibility 4-5 meters, depth 3-5 meters and sandy bottom with little mud (Aras & Hasmawati, 2016a).

Cuttlefish squid will migrate into shallow waters to spawn. They usually choose sheltered bays, with bottom waters consisting of sand and small coral fragments. Spawning of cuttlefish (*Sepia* sp.) occurs throughout the year, but the peak occurs between June and July (Zulfahmi, 2017). Squid egg capsules are usually attached to substrates such as seaweed, sponges, seagrass, rocks, coral, bamboo, PVC pipes and ropes, at depths ranging from 1-7 meters. Egg attachment generally occurs at a depth of 4-7 meters and often occurs at night (Aras & Hasmawati, 2016b).

Cuttlefish squid generally lay their eggs in shallow water, especially at depths between 4 and 21 meters. They tend to choose shallow coral flat zones as the main place to lay their eggs, which are characterized by sandy substrates, the dominant presence of macroalgae, and dead coral (Wiadnyana *et al*., 2022). Cuttlefish can be found in bays, the open sea, and even in the depths of the ocean. Cuttlefish are animals that usually live on the seabed and tend to live their own lives. Cuttlefish are often found around corals, and at night, cuttlefish move into shallow waters to look for prey such as small fish (Asmaradhanthi, 2017).

Based on the description above, in this research a trial was carried out to install an attractor made from palm fiber biocomposite (Arenga pinnata) which had been made previously. This research aims to determine the effectiveness of a squid attractor made from palm fiber biocomposite.

METHODS

Place and Time

This research was carried out from March to May 2024. The location for installing a squid attractor made from palm fiber biocomposite in the waters of the Lembeh Strait on the coast of Serena Besar Island, Bitung City with coordinates 1°27'39.4"N-125°13'54.8"E. The research location is as in Figure 1.

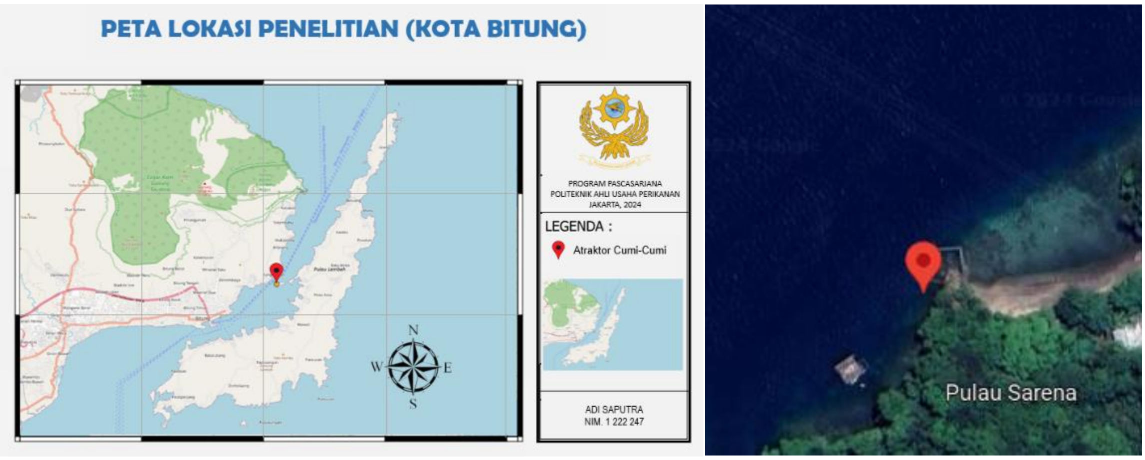

Fig 1. Squid Attractor Installation Location

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Tools and Materials

The materials and equipment used in this research activity are as in Table 1.

Table 1. Research materials and tools

Tools and Materials	Utility
- Squid attractor made from palm fiber composite	- As a medium for attaching squid eggs
- Boat and outboard motor 15 PK	- To bring the attractor to the research location and check the attractor periodically
- Sign buoy	- To provide signs of the location of squid attractors
- String of raffia	- To tie the sign buoy and anchor to the squid attractor
- Diving equipment (mask and snorkel)	- Used when installing squid attractors and during periodic controls
- Underwater camera	- To document research activities
- Refractometer	- To measure water salinity
- Litmus paper	- To measure the pH of water or the degree of acidity of water
- DO meter	- To measure dissolved oxygen levels and water temperature

Data collection

The data collected is primary data obtained from the trial process of operating the squid attractor and secondary data from literature studies. The attractors that were tested were 10 attractor units consisting of 5 (five) squid attractors made from palm fiber biocomposite and 5 (five) squid attractors made from used drums. The dimensions of the squid attractor made from palm fiber biocomposite that is installed are 0.9 meters long, 0.7 meters wide and 0.5 meters high. The attractor installation distance is between 2-5 meters. The installation pattern for the squid attractor alternates between a squid attractor made from palm fiber biocomposite and a squid attractor made from used drums. The attractor was installed irregularly because it adjusted to the waterbed with an installation area of approximately 400 square meters. The data collected includes the placement of squid attractors, fish associations in the area where squid attractors are installed, and the effectiveness of squid attractors made from fiber biocomposites.

Data analysis

Data obtained from the attractor operating process were then analyzed descriptively. The effectiveness of the squid attractor was calculated using equations that have been used in previous studies. The level of effectiveness of the squid attractor (EA) can be determined by referring to the formula created by Baskoro and Mustaruddin (2006). The effectiveness of squid attractors can be analyzed by calculating the success rate of squid attractors in collecting squid eggs. The equation that can be used in analyzing the effectiveness of squid attractors is the following equation: EA = Number of attractors attached to squid eggs: Number of attractors installed X 100%. The indicators used in calculating the effectiveness analysis of this squid attractor are if the EA value is greater than 60% then the squid attractor is categorized as very effective, if the EA value is smaller than 60% and greater than 30% then it is categorized as effective and if the value EA is smaller than 30%, so the squid attractor is categorized as less effective.

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RESULT

Apart from the spawning season and weather conditions, water quality conditions also influence the success of squid attractor installation. Water quality measurements before installing the attractor are necessary to ensure that the location of the water is suitable for installing a squid attractor. The results of measuring water quality parameters in the area around the placement of the squid attractor are temperature 29.70℃, salinity 29 ppt, pH 7, dissolved oxygen 5.9 mg/l. The location where the squid attractor is installed has a sloping water bottom with a coral fragment substrate. The squid attractor is installed at a depth of 3-7 meters. The condition of the bottom substrate of the waters where the squid attractor operates is as shown in Figure 2.

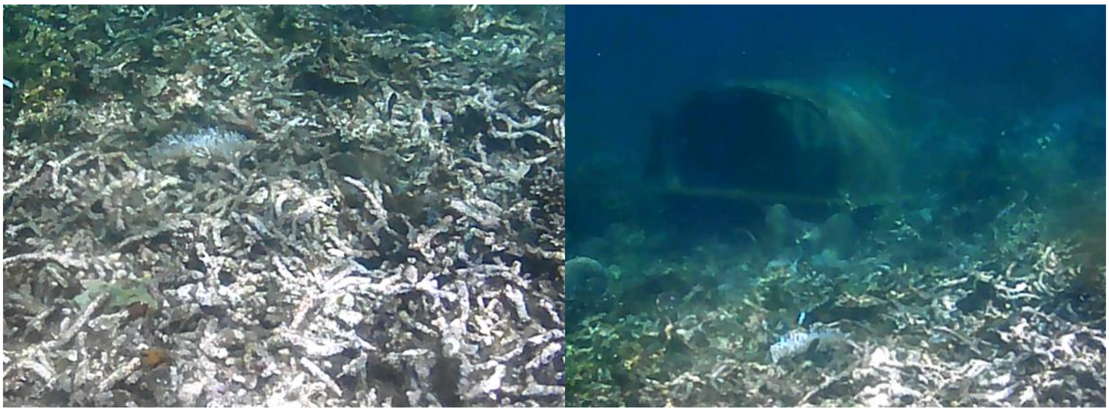

Fig 2. Basic Substrate Conditions of Squid Attractor Placement Waters

The effectiveness of installing a squid attractor made from palm fiber is obtained from the success in attaching squid eggs to the attractor. The observation results show that the type of squid that attaches its eggs to the squid attractor made from palm fiber biocomposite is a type of cuttlefish (Sehia sp). This is known from the appearance of the eggs which are different from the eggs of the Loligo sp squid. The appearance of the egg is a collection of larger egg capsules like grapes. Apart from that, based on the catches of fishermen who usually carry out fishing operations around the attractor, it shows that the catch is cuttlefish (*Sepia* sp.)

The appearance of the egg is a collection of larger egg capsules like grapes. Apart from that, based on the catches of fishermen who usually carry out fishing operations around the attractor, it shows that the catch is cuttlefish (*Sepia* sp).

The results of the analysis of the effectiveness of the squid attractor, it was found that the effectiveness of the squid attractor was 30% for both types of attractor materials. Of the 5 units of squid attractors made from palm fiber biocomposite that were installed, there were 3 attractor units that had cuttlefish (*Sepia* sp) type squid eggs attached to them. So the effectiveness of a squid attractor made from palm fiber biocomposite is 60%. Thus, the installation of a squid attractor made from palm fiber biocomposite can be said to be effective, because it has an effectiveness value of 60%. Squid eggs attached to an attractor made from palm fiber biocomposite and types of cuttlefish that are often caught by fishermen around the attractor are shown in Figure 3.

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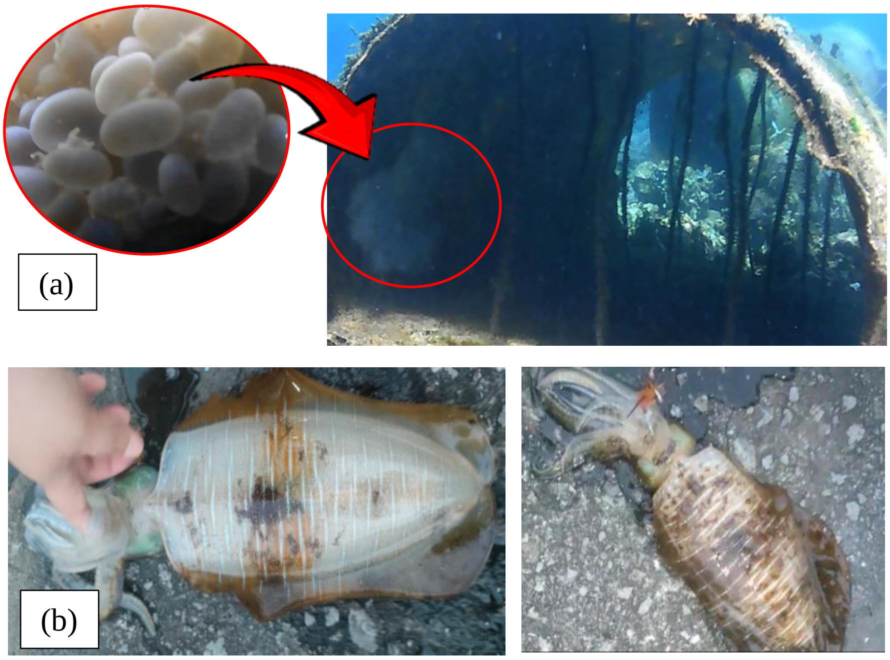

Fig 3. (a) Cuttlefish eggs attached to the squid attractor; (b) Types of cuttlefish caught by fishermen around the attractor installation

The installation of a squid attractor made from palm fiber biocomposite also shows the formation of a new ecosystem. This is indicated by the significant growth of biofouling in the squid attractor made from palm fiber biocomposite. In the second week, the squid attractor made from palm fiber biocomposite began to grow with biofouling. The growth of biofouling in squid attractors made from palm fiber biocomposites is faster when compared to attractors made from used drums. This is because the squid attractor made from palm fiber biocomposite has a rougher surface compared to the attractor made from used drums which is smoother. Biofouling growth became more significant in the fourth week. The biofouling attached to the squid attractor becomes food for plankton and small fish. In this way, it invites other fish to associate around the squid attractor area. There are fish associations that occur around the installation of squid attractors, thus forming a new ecosystem which can become an artificial coral reef as a place for fish to take shelter and find food. Biofouling growth and fish associations as in Figure 4.

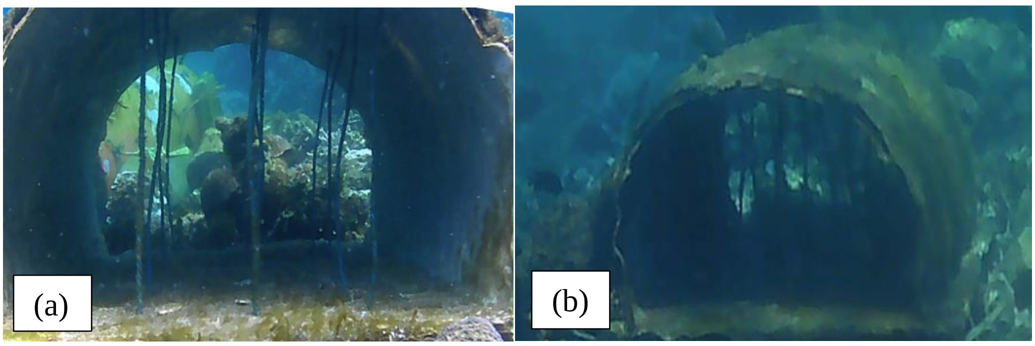

Fig 4. (a) Biofouling growth process in the 2nd week attractor; (b) 4th week

DISCUSSION

Squid Attractor Placement

Before carrying out trial operation of the attractor, a survey of the location where the attractor will be installed is first carried out. This aims to ensure a suitable place to install the squid attractor. Apart from conducting location surveys, we also conducted interviews with

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local fishermen to gather information about locations where squid eggs are usually found according to their experience.

Based on the results of field surveys and interviews with fishermen as well as literature studies, the location chosen for placing the squid attractor was the coast of Serena Island in the waters of the Lembeh Strait. This location was chosen because it has a sloping water bottom with a coral fragment substrate. Baskoro (2010), explains that when placing attractors, things that must be taken into account include the sloping bottom of the waters, sandy beach substrate or rocky sand or coral fragments. Sudrajat et al. (2022), states that the squid attractor installation zone has a current speed of not exceeding 5 knots both vertically and horizontally. Current speed around the water. Atmojo et al. (2017), stated that the dominant current speed at all depths in the waters of the Lembeh Strait is 0.5 – 1 m/s. Meanwhile, according to Hiwari (2020), the current speed in the waters of the Lembeh Strait is between 0.04 – 0.24 m/s and Rori et al. (2023), explains that the current speed in the waters of the Lembeh Strait during high tide or low tide in each season has values that are not much different. The current speed ranges from 0 – 0.7 m/s. Soewito (1990) in Aras (2013) stated that squid inhabit waters with a salinity of between 8.5 – 30 ppt and a temperature of between 8º – 32ºC. Samudra et al. (2016), stated that the rate of length and width of Sepioteuthis lessoniana eggs is influenced by temperature and salinity. Maximum egg growth at a temperature of 29º - 30ºC and salinity of 20 – 30 ppt. Oceanographic factors that influence are temperature 29-30°C, salinity 31-32 per mile, current speed 0.02-0.05 m/second, visibility 4-5 meters, depth 3-5 meters and sandy bottom with little mud (Aras & Hasmawati, 2016).

Placement of the squid attractor made from palm fiber biocomposite begins with lowering the squid attractors one by one from the boat. One diver prepares to position the squid attractor on the bottom of the water. The conditions surrounding the installation of the attractor are taken into account to minimize damage to the surrounding coral. After all the attractors have been installed properly, the sign buoy is lowered.

Effectiveness of Squid Attractors Made from Palm Fiber Biocomposite

It is necessary to assess the shape and material as well as the installation depth of the squid attractor to determine its effectiveness (Baskoro et al., 2017). Squid attractors are installed with the aim of allowing squid to attach their eggs so that squid resources in these waters can increase (Mulyono et al., 2023).

Attachment of eggs can also occur on flat surfaces, especially for cuttlefish (*Sepia* sp). Cuttlefish in nature usually look for flat coral surfaces to attach their eggs to. The same statement was put forward by Wiadnyana et al. (2022), that cuttlefish tend to prefer shallow coral flat zones as the main place to lay eggs. In this study, it was found that the cuttlefish eggs were attached to the wall/inner cover of the attractor. The rough and flat surface of the attractor cover is also indicated as the cause of the cuttlefish being attracted to attaching their eggs.

The level of effectiveness of this attractor made from palm fiber biocomposite is also quite good with an effectiveness value of 60% in terms of attachment to squid eggs. This is because the squid attractor building made from palm fiber biocomposite has a rougher surface and has dimmer lighting caused by the color of the palm fiber. Squid attractors made from palm fiber biocomposites are also very effective in forming new ecosystems because it is easier for biofouling to grow. The growth of biofouling on attractors made from palm fiber biocomposites is faster due to the rougher surface of the attractor. This biofouling becomes food for fish and other small biota so that a food pyramid is formed around the squid attractor installation. In this way a new ecosystem is formed and fish associations occur around the location where the squid attractor is installed.

Attachment of squid eggs in the squid attractor installation trial was less than optimal because the spawning season had not yet entered. Omar's (2005) research explains that, squid

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egg capsules are often found in June – July. Syari et al. (2014), explained that the number of squid egg attachments was greater in the east-west season (November-December 2012) with a percentage of 91.07% compared to the west-east transition season (April-May 2013) which was only 8.93%. Meanwhile Oktariza (2016), explained that during the 7 months of observation during the 7 months of observation (November – May) the most eggs were attached to the attractor. The results of research (Puspasari & Triharyuni, 2016) explain that spawning of L. chinensis and L. duvauceli squid occurs between June and October, while L. singhalensis occurs after October.

Fish Associations Around Squid Attractors

The benefit of installing a squid attractor in a body of water, apart from being a place to attach squid eggs, is also useful as an artificial coral reef. An alternative for creating new habitats to increase aquatic productivity is artificial coral reefs (Mujiyanto & Hartati, 2016). The installation of this squid attractor has formed a new ecosystem which is characterized by significant growth of biofouling in the squid attractor made from palm fiber biocomposite because it has a rough surface. Marhaeni (2012), stated that rough substrate surfaces grow more quickly with biofouling than smooth substrate surfaces. The biofouling attached to the squid attractor is a natural food ingredient for plankton and small fish. The presence of plankton and small fish will invite larger fish to come and look for food, thus forming a food pyramid. A similar thing was also stated by Jamal (2017), that the installation of a squid attractor will form a new ecosystem in the area where the squid attractor is installed. Research (Sudrajat *et al*. 2019), explains that squid attractors can also be useful as shelters for fish. Sudrajat (2020), also stated that the inside of the squid attractor is also protected from currents, causing the fish to be calmer in looking for food and playing.

The occurrence of fish associations around the squid attractor installation zone indicates that squid attractors made from palm fiber biocomposites are effective in forming new ecosystems. So it is hoped that there will also be an increase in fish resources around the area where the squid attractor made from palm fiber biocomposite is installed. Fish associations at the location where the squid attractor is installed are as shown in Figure 5.

Fig 5. Fish associations around squid attractor placement

CONCLUSION

In the trial of installing the squid attractor, it was seen that there were fish associations around the area where the squid attractor was installed. So that a new ecosystem is formed in the area where the squid attractor is installed. The results of the effectiveness analysis from the squid attractor installation trial obtained a value of 30%. Meanwhile, the effectiveness of squid attractors made from palm fiber biocomposites is 60%. This type of squid attractor made from palm fiber biocomposite is categorized as effective. This was demonstrated by the attachment of cuttlefish (*Sepia* sp.) squid eggs to three attractor units made from palm fiber biocomposite.

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Attachment of squid eggs to the attractor is less than optimal because the spawning season has not yet entered.

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