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CORAL REEF CULTIVATION AT PT. SRI KANDI AQUARIUM, BANYUWANGI: ANALYSIS OF STAGES AND RESULTS OF TRANSPLANTATION of *Acropora formosa, Acropora granulosa, and Euphyllia glabrescens*

Budidaya Terumbu Karang di PT. Sri Kandi Aquarium, Banyuwangi : Analisis Tahapan dan Hasil Transplantasi Acropora formosa, Acropora granulosa, Euphyllia glabrescens

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ABSTRACT

Indonesia is a region known for its abundant natural resources, such as coral reefs. Coral reef ecosystems in Indonesia have begun to decrease, it was recorded that 35.15% of coral reefs in Indonesia entered into poor status or declared damaged. This is due to several factors such as damage caused by the illegal trade of coral reefs carried out by unscrupulous entrepreneurs because of the illegal trade of coral reefs, knowledge and skills are needed regarding transplantation methods in the cultivation of A. formosa, A. granulosa and E. glabrescens to find out the stages and results of transplantation methods in coral reef cultivation. This study was conducted at PT Sri Kandi Aquarium, Banyuwangi Regency, East Java on June 24, 2024 until August 24, 2024. The primary data collection methods used include observation and active participation, while for secondary data using literature studies. The transplantation process in coral reef cultivation consists of several activities, namely the preparation of transplantation tools and materials, making transplantation media, cutting parent fragments, transplantation, maintenance and harvesting. The results of transplantation are then classified based on sizes S, M, L and XL. Thus the transplantation method can be carried out in coral reef cultivation which consists of several stages including preparation of transplantation tools and materials, making transplantation media, cutting coral fragments, attaching the results of cutting fragments to the substrate, sowing corals on the transplantation table under the sea and periodic monitoring and maintenance of corals. The transplantation results obtained will be categorized based on size, namely S, M, L and XL.

Key words: Coral, Cultivation, Transplantation

ABSTRAK

Indonesia merupakan kawasan yang dikenal memiliki kekayaan alam yang melimpah seperti halnya terumbu karang. Ekosistem terumbu karang di Indonesia sudah mulai berkurang, tercatat bahwa sebesar 35,15% terumbu karang di Indonesia masuk kedalam status miskin atau dinyatakan rusak. Hal ini dikarenakan beberapa faktor seperti kerusakan yang diakibatkan karena perdagangan terumbu karang secara ilegal yang dilakukan oleh oknum pengusaha karena perdagangan terumbu karang secara ilegal maka diperlukannya pengetahuan dan keterampilan mengenai metode transplantasi pada budidaya *A. formosa, A. granulosa* dan *E. glabrescens* untuk mengetahui tahapan serta hasil dari metode transplantasi pada budidaya terumbu karang tersebut. Studi ini dilaksanakan di PT. Sri Kandi Aquarium, Kabupaten Banyuwangi, Jawa Timur pada tanggal 24 Juni 2024 sampai dengan 24 Agustus 2024. Metode pengumpulan data primer yang digunakan meliputi observasi dan partisipasi aktif, sedangkan untuk data sekunder menggunakan studi literatur. Proses transplantasi pada budidaya terumbu karang terdiri atas beberapa kegiatan yaitu persiapan alat dan bahan transplantasi, pembuatan media transplantasi, pemotongan fragmen induk,transplantasi, perawatan dan pemanenan. Hasil transplantasi selanjutnya digolongkan berdasarakan ukuran S, M, L dan XL. Dengan demikian metode transplantasi dapat dilakukan pada budidaya terumbu karang yang terdiri atas beberapa tahapan diantaranya persiapan alat dan bahan transplantasi, pembuatan media transplantasi, pemotongan fragmen karang, penempelan hasil pemotongan fragmen pada substrat, karang disemai pada meja transplantasi pada bawah laut serta monitoring dan perawatan karang secara berkala. Hasil transplantasi yang diperoleh akan dikategorikan berdasarkan ukuran yaitu S, M, L dan XL.

Kata Kunci: Budidaya, Karang, Transplantasi

INTRODUCTION

Indonesia is an area known for its abundant natural resources such as coral reefs. Indonesia itself is one of the countries included in the coral triangle region, because it is home to 76% of coral reef species from all over the world (Siswanto & Wijaya, 2023). Banyuwangi is an area known for its marine wealth, along the coast in Banyuwangi you can find a variety of beautiful and diverse coral reef species. This is because the condition of the waters in the Banyuwangi area is very supportive of the growth of coral reefs so that they can grow well in Banyuwangi waters. The coral reef population is very important as a supporter of the life of marine ecosystems such as fish, molluscs and other marine biota (Ramadhan *et al.*, 2023).

According to Siswanto & Wijaya (2023), the coral reef ecosystem in Indonesia has begun to decline, it was recorded that 35.15% of coral reefs in Indonesia were included in poor status or declared damaged. This is due to several factors such as damage caused by fish bombing and illegal coral reef trade carried out by irresponsible businessmen because the illegal coral reef trade is carried out by irresponsible businessmen, because the coral reef trade is one of the promising livelihoods for businessmen (Siswanto & Wijaya, 2023). Coral reef cultivation activities are efforts made to reduce coral reef mining activities that can damage coral reef populations, one of which is PT. Sri Kandi Aquarium which is engaged in coral reef cultivation in the Banyuwangi area.

PT. Sri Kandi Aquarium has successfully cultivated many coral reef species such as *Acropora formosa, Acropora granulosa*, and *Euphyllia glabrescens*. with the transplantation method. Coral reef transplantation is a coral colony multiplication technique by utilizing coral asexual reproduction through fragmentation (Subhan *et al.*, 2014). The transplantation method is one of the coral reef cultivation techniques asexually so that it can be grown in other places (Saiful, 2023). PT. Sri Kandi Aquarium was chosen as a coral reef cultivation center because

it is classified as a large company that focuses on coral reef cultivation and export in Banyuwangi, and has a strategic location. PT. Sri Kandi Aquarium is also one of the companies that are members of the Indonesian Ornamental Coral Cultivation Group. According to a survey that has been conducted, the advantage of this company is that it has a fairly large international scale market so that it is able to compete with predecessor companies that have long focused on this field.

Based on the background above, knowledge and skills are needed regarding the transplantation method in the cultivation of *A. formosa, A. granulosa* and *E. glabrescens* at PT. Sri Kandi Aquarium, Banyuwangi Regency, East Java. The purpose of this study is to determine the stages and results of the transplantation method in coral reef cultivation.

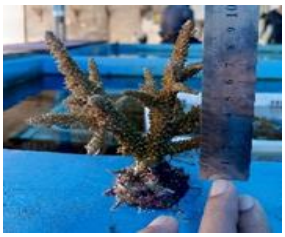
RESEARCH METHODS

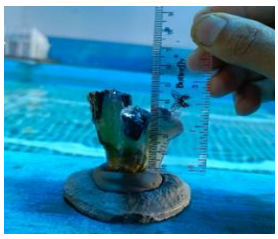
The study on the transplantation method in the cultivation of *A. formosa, A. granulosa* and *E. glabrescens* at PT. Sri Kandi Aquarium, Banyuwangi Regency, East Java was carried out on June 24, 2024 to August 24, 2024. The tools and materials that need to be prepared for transplantation activities are brushes, kapi, cement, tagging paper, *Acropora Formosa, A. granulosa, E. glabrescens* that have been cut from the parent using a cultivation table cutting pliers measuring 2.5 m x 1 m, 60 cm high with 13 mm threaded iron raw materials and a substrate ratio of 2: 1, for example 2 kg of cement to 1 kg of sand. The working method used in this study is descriptive with primary data collection using observation and active participation, while for secondary data using literature studies.

RESULT

Banyuwangi is an area with the largest coastal area in East Java. This condition makes the area have the potential for coral reef cultivation. PT. Sri Kandi Aquarium is one of the companies engaged in coral reef exports. Various types of coral reefs have been cultivated using the transplantation method, including *Acropora formosa, Acropora granulosa*, and *Euphyllia glabrescens*. The shape and morphology of each coral have different characteristics. The morphology of Acropora formosa, Acropora granulosa, and Euphyllia glabrescens corals can be seen in Table 1.

Table 1. Morphology of *Acropora formosa, Acropora granulosa*, and *Euphyllia glabrescens*

No.	Picture	Coral Reef Species Names	Morphology
1.		*Acropora formosa*	It is tubular in shape with a rounded or oval opening and is arranged evenly and closely together. It has branched colonies with each branch having a pointed tip.

2.		*Acrophora granulosa*	Has rounded colonies with blunt ends and spots (granules), Small and round corallites
3.		*Euphyllia glabrescens*	Has the special characteristic of long tentacles with white tips, has branching colonies

The stages of coral reef transplantation at PT. Sri Kandi Aquarium using the transplantation method can be seen in Figure 1.

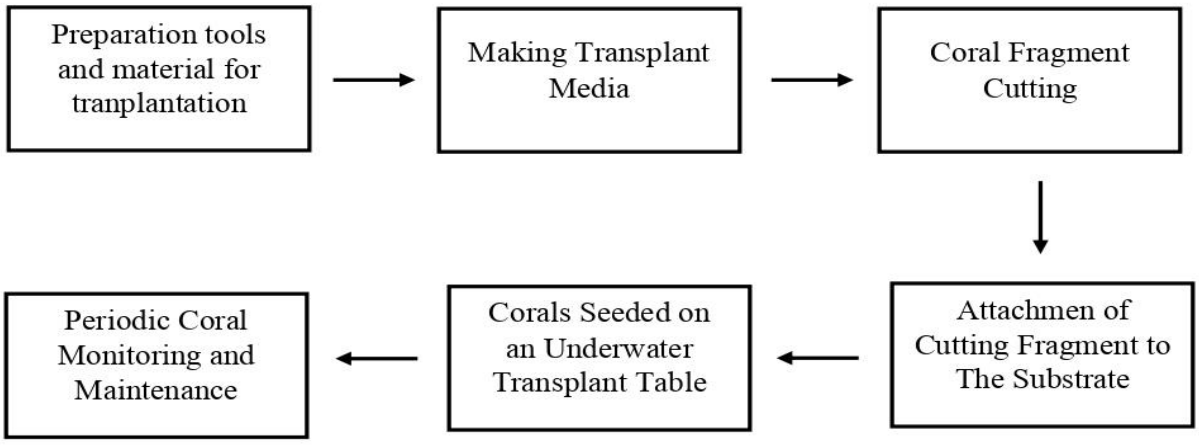


Figure 1. Flowchart of coral reef cultivation stages at PT. Sri Kandi Aquarium using the transplantation method

Coral reef cultivation using the transplantation method requires a substrate for the growth medium of the coral. Determination of substrate size is based on several categories that can be seen in Table 2.

Table 2. Substrate sizes used for transplantation activities

Substrate Size	Diameter	Basin Diameter	Basin Depth
S	3-4 cm	2 cm	1 cm
M	6-7 cm	4 cm	1 cm
L	9-10 cm	6 cm	2 cm
XL	15-17 cm	8 cm	2 cm

The results of the transplantation obtained at PT. Sri Kandi Aquarium are based on the harvest size which can be seen in Table 3.

Table 3. Coral Harvest Size Category

Coral Size Category	Decorative Coral Pictures	Information
S		2-3 Branches
M		4-5 Branches
L		6-7 Branches
XL		8 Branches

DISCUSSION

Acropora formosa is a type of branching coral species with a slender, fat branching shape. The characteristics of *A. formosa* are that it has a branching colony, has sharp branch tips and has green, light blue and brown colors (Rizqika *et al.*, 2018). This type of coral has a main network, namely axial corallites (Septianti *et al.*, 2022). The radial corallites of this coral are tube-shaped with rounded or oval openings arranged evenly and tightly. The color of this coral

is light brown, dark brown and blue (Kusuma *et al.*, 2023). In addition, according to Johan *et al.*, (2007), *A. formosa* has an arborescent growth form or vertical long growth. This species is known as the fastest growing coral on coral reefs and a good coral reef builder (Xin *et al*., 2013).

Acropora granulosa colonies are rounded, if the colony is more than 1 m in size it will be like a table. The main branch will be filled with small branches that are sometimes composed of more than one axial corallite. Radial corallites are small in size that surround the axial corallite (Purnama *et al.*, 2020). In general, short and creeping branching forms are often found in areas close to reef slopes associated with strong currents. The Acropora coral species is one of the hard coral species that dominates tropical areas because of its easy-to-grow nature and its resistance to the environment (Loupatty *et al.*, 2023).

Euphyllia glabrescens morphological characteristics have a colony branching form that is paceloid. Septa without teeth with a smooth surface. Columella is absent, costa are not well developed but can still be seen. Large and long polyps. *Euphyllia glabrescens* has the special characteristic of long tentacles with white tips (Akhyar, 2022). *Euphyllia glabrescens* coral can grow through a process called budding. New polyps can develop from parent polyps to enlarge the colony or create new colonies. Coral development and growth can be influenced by limiting factors. These limiting factors include temperature, salinity, brightness, current velocity, depth, pH, dissolved oxygen, phosphate and nitrate. The most influential limiting factor for coral growth is depth because it can affect light penetration, temperature, current velocity and other limiting factors (Prawira *et al.*, 2022).

The initial stage of the transplantation activity is the preparation of the tools and materials to be used, including cutting pliers to cut the coral. Kapi functions to clean the coral from pests and algae attached to the substrate. Diving equipment functions as an aid when checking and monitoring on the seabed. The basket functions as a container when moving coral on the seabed. The transplant table functions as a place for planting coral reefs, measuring 2.5 m x 1 m, 60 cm high with 13 mm threaded iron raw materials. and substrate. The transplant table is made of 13 mm threaded iron with a table length of 2.5 meters, a height of 60 cm and a table width of 1 meter. The transplant table is made using 7 mm perlon strings that are tied between the sides of the table tightly so that they can support the weight of the coral reef and are woven with rubber tires measuring approximately 7 mm with a distance of 5 to 7 cm so that they can clamp the substrate of the planted coral. The materials used for transplantation activities include coral seed fragments that have been cut from the parent, cement mixture made from cement and water mixed with a ratio of 1:2 which is used as an adhesive between the fragments and the substrate, labeling using laminated HVS paper and inside there is the PT logo. Sri Kandi Aquarium area code, company code, year of planting, genus and species of coral planted, planting sequence number, month of planting. Labeling also aims to make it easier to track the number of offspring, their offspring and make it easier to control and monitor (Kasmi *et al.*, 2021).

Preparation of transplantation media is the initial stage of the coral reef transplantation process, the substrate used is made of sand and cement with a ratio of 1:2. The mixture of cement and sand is made with a higher cement ratio so that it hardens faster (Tuahatu & Lokollo, 2022). This material was chosen because it has a cheaper price so that the variable costs incurred are lower than using other raw materials and has sufficient calcium carbonate content so that the material can affect coral metamorphosis (Prasetyo *et al.*, 2018). The substrate is molded into a circle with a diameter according to Table 2. The purpose of providing a depression is to use it as a place to plant the transplanted coral.

The transplantation method for hard corals such as *A. formosa*, *A.granulosa* and *E. glabrescens* at PT Sri Kandi Aquarium has the same technique. The transplantation process in

coral reef cultivation consists of several activities, namely cutting fragments and planting the results of the cutting fragments on the prepared substrate. Cutting of the coral broodstock by PT. Sri Kandi Aquarium is carried out when it is under the sea using cutting pliers. The coral to be cut is categorized as broodstock, according to Luthfi (2016), coral broodstock that is ready to be transplanted has a minimum diameter of 30 cm and does not take more than 10% of the area or diameter of the broodstock to be cut. This is because if it exceeds 10% of the diameter, it will cause the broodstock to experience stress due to injury and can cause death. The coral broodstock is cut into several fragments with a minimum length of five centimeters. This is in accordance with the opinion of Rani *et al.*, (2017), the size of the fragment used for transplantation has a branch length of 5-12 cm. This is in accordance with the opinion that smaller coral sizes tend to have a higher mortality rate compared to larger fragment sizes (Hermanto, 2015). The results of the fragment cutting are then planted on the substrate. However, previously the fragments used as seeds measuring at least 5 cm were placed in a planting tub filled with seawater first. This aims to prevent stress on the coral. Then the coral seeds are attached to the substrate that has been given cement adhesive and tagged which aims to facilitate control and monitoring and to find out the ancestry and origin of the coral (Kasmi *et al.*, 2020). The coral seeds that have been glued to the substrate are then transferred to a rack which will later be sown on the seabed. The table can accommodate 200 coral seeds.

Coral seeds that have been planted on the substrate are then monitored and maintained. This maintenance is carried out by monitoring periodically to determine the condition of the coral reef that has been transplanted to the seabed. The care and maintenance of coral reefs after cutting the fragments aims to determine whether the coral is stressed or not, where coral that is stressed is marked by the presence of mucus on the coral (Ketjulan, 2011). Coral damage due to stress can be caused by environmental factors. There are physical and chemical factors that limit the distribution and growth of coral reefs, namely brightness, temperature, salinity, sedimentation and current. The brightness factor is closely related to light intensity, where brightness can affect the rate of zooxanthella photosynthesis and will affect the respiration and calcification processes (Supriyadi *et al.*, 2020). According to Rizqika *et al.* (2018), temperature affects coral growth, in addition, this type of coral can live in a temperature range of 16-40^{o}C, but this coral grows optimally at a temperature of 28-32^{o}C where this temperature is good for the life and reproduction of coral reefs. Coral growth is also affected by salinity, extreme salinity can reduce the rate of coral growth and the decrease in growth rate depends on the coral's tolerance to salinity, where the optimal salinity in coral growth is 30-35 ppt (Prayoga *et al*., 2019). The effect of sedimentation on coral reefs can cause death if it covers the entire coral surface with sediment, can directly affect coral growth, can inhibit coral planula from attaching themselves and developing on the substrate and can increase the ability of coral to adapt to sediment (Erika *et al.*, 2019). Currents function to help clean corals from sedimentation, as well as provide oxygen, prevent the deposition of coral colonies, and bring food, food for coral colonies in the form of plankton (Erika *et al.*, 2019).

Coral reefs that are diseased are placed in a quarantine aquarium measuring 2.5 x 1 meter which has been filled with water with a controlled temperature of 26°C using a chiller. Corals that enter the aquarium are fed using Red Sea products with a dose of 4 ml per 100 liters of water. The use of Red Sea is expected to meet the nutritional needs of coral reefs because it contains carbohydrates, amino acids, fatty acids and vitamins that can meet the needs and growth of corals. Coral reefs whose conditions do not allow for improvement will be cut into fragments using cutting pliers with the aim of preventing the spread or spread of disease in the coral (Aulia & Sari, 2020). Furthermore, the results obtained from coral reef cultivation using the transplantation method are categorized based on size according to table 3. Based on these

results, they have a size that meets the criteria according to Zam (2022), which states that the size of coral reef exports that have been set does not exceed 25 cm.

CONCLUSION

Based on the results of the study that has been conducted, it can be concluded that the transplantation method can be carried out on coral reef cultivation. The stages of coral reef transplantation activities include preparation of transplantation tools and materials, making transplantation media, cutting coral fragments, attaching the results of the cut fragments to the substrate, corals are sown on the transplantation table under the sea, and monitoring and maintaining corals periodically. The transplantation results obtained will be categorized based on size, namely S, M, L and XL.

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