Growth and survival rate of *Aaptos suberitoides* and *Petrosia sigricans* in the circulatory system

Beginer Subhan[1*], *Silvia Desrika* Hutagalung[1], *Dedi* Soedharma[1], *Siti Zanuba* Aisyah[1], *Meutia Samira* Ismet[1], *Inna Puspa* Ayu[2], and *Dondy* Arafat[1]

[1]Departement of Marine Science and Technology, IPB University, 16680 Bogor, Indonesia
[2]Department of Aquatic Resources Management, IPB University, 16680 Bogor, Indonesia

Abstract. Sponges are animals that can produce bioactive compounds. This use needs to be accompanied by sponge cultivation techniques to avoid decreasing the availability of sponge colonies in nature. This study aims to determine the growth rate and survival rate of sponges *Aaptos suberitoides* and *Petrosia nigricans* in a recirculation system and to determine the process of wound healing due to transplantation. The research was carried out in September – November 2010 at the Central Laboratory for Marine Science Studies – IPB University, North Jakarta. Sponges are taken from natural habitats and then transplanted into maintenance ponds. The center of the transplanted sponge fragment is passed through a polyethylene rope which is used as a substrate for the sponge. The survival of *Petrosia nigricans* is decreasing rapidly every week. At the 6th, week the viability of *Petrosia nigricans* was 0%. Meanwhile, *Aaptos suberitoides* has a value of 100% with several fragments of 20. The results of measurements of the *Petrosia nigricans* sponge for 12 weeks show an average and standard deviation of growth rate in length of -0.04±0.24 cm/week and width of -0.02±0.16 cm/week. Meanwhile, the *Aaptos suberitoides* sponge is 0.06±0.07 cm/week and 0.05±0.09 cm/week wide. Signs of wound closure in *Petrosia nigricans* were visible on the fourth day after transplantation, while *Aaptos suberitoides* experienced wound closure on the second day after transplantation. The measurement value for ammonia in the pool is 0.9542 mg/L, nitrate is 0.3544 mg/L, nitrite is 0.0060 mg/L and salinity is 28-38 $^0/_{00}$, and the temperature is 27-29 °C. The sponge *Aaptos suberitoides* has a better growth response and has a wider survival tolerance than the sponge *Petrosia nigricans* in maintaining survival in the recirculation system.

1 Introduction

Sponges are animals from the phylum Porifera that live and settle at the bottom of the waters and are spread throughout almost all Indonesian sea areas. The number of sponge species in Indonesian waters is estimated at 850 until 1500 species [1]. Sponges are filter feeders whose body structure is very simple. Sponges have a porous body that is useful for filtering water which carries small particles as food, such as zooplankton and phytoplankton.

* Corresponding author: beginersubhan@apps.ipb.ac.id

Sponges are known to contain natural compounds in biopharmaceutical development. One type of sponge that is found in Indonesia and has bioactive ingredients as raw material for medicines is the *Aaptos suberitoides* and *Petrosia nigricans* sponges. *Aaptos suberitoides* is a type of sponge that contains alkaloid compounds thathave antitumor, antiviral, and antimicrobial activity and inhibit Herpes Simplex Virus-1 (HSV-1) infection [2]. *Petrosia nigricans* contains bioactive compounds of the polyacetylene group and sterol group. These compounds have antibacterial, antifungal and antifouling properties [3].

The various benefits and uses of bioactive sponges will increase the demand for and use of sponge colonies in nature. Continuous harvesting of sponges will reduce the availability of sponge colonies in nature [4]. This can also disrupt the condition of the surrounding aquatic ecosystem and the life of other marine biota, that sponges are very important organisms in coral reef ecosystems [5]. This problem can be overcome by using sponge propagation methods to preserve the existence of sponges in nature. One method used is transplantation. Sponge transplantation can be done in the sea [6], in ponds [7], and through cell culture [8].

Sponge transplantation research has been carried out previously using various research methods and locations. A study has conducted research on transplantation of the sponges *Aaptos suberitoides* and *Petrosia nigricans* in the waters of Pari Island in the Seribu Islands, Jakarta [6]. The, same research on the transplantation of the sea sponge *Petrosia nigricans* [9]. Sponge transplantation activities have been applied to the sponge *Petrosia* sp. using different shelves [10], the *Aaptos suberitoides* sponge on Pari Island, Seribu Islands [11], and transplanting *Aaptos suberitoides* in an artificial pond in Ancol [7]. Another study also studied the growth and survival of the fragmented sponge *Aaptos suberitoides* under two different conditions [12].

This research used the sponge types *Aaptos suberitoides* and *Petrosia nigricans* from the Demospongia class. This sponge was chosen considering that the types of sponges *Aaptos suberitoides* and *Petrosia nigricans* are commonly found in Indonesian waters at relatively shallow depths and are easy to adapt [9]. The sponges *Aaptos suberitoides* and *Petrosia nigricans* are often found in the waters of the Seribu Islands [13]. The sponge was maintained in controlled ponds with a supply of sea water originating from Ancol, North Jakarta. This research used ponds with the consideration of protecting the sponges from predators that could disrupt the growth and survival of live sponges, one of which is the fish *Thallasoma lunare* [6], and avoiding sedimentation, which can cover the ostium and hinder water circulation. This research used a polyethylene rope substrate because it was proven to increase sponge survival and was a modification of [14]. The rearing method in a controlled habitat (an artificial pond) is expected to be able to obtain maximum survival rates and growth rate values.

2 Methods

This research was conducted at the Central Laboratory for Marine Science Studies-IPB University, North Jakarta, Indonesia. The research was conducted from September 2010 to November 2010.

2.1 Research procedure

2.1.1 Preparation of pool

Water conditions with supporting water quality are very important for the life of sponges. Therefore it is necessary to pay attention to the condition of the pond. The rearing tank is a new habitat for sponges so it is arranged in such a way that it is the same as its natural habitat and the sponges can survive for a long time. This maintenance pool is equipped with an aerator for providing air circulation in the pool, and a protein skimmer as a trap for ammonia and toxins contained in the pool water. The pool is equipped with two water pumps placed in the protein skimmer and filter tank. Water flows and circulates for 24 hours. The maintenance pool is 5 meters long, 1.5 meters wide and 1.5 meters high (Figure 1). This maintenance pool is divided into three parts, namely filtering, circulation pump section and maintenance tank. The filtering section measures 1 meter long and 1.5 meters wide. The circulation pump section measures 1 meter long and 0.5 meters wide.

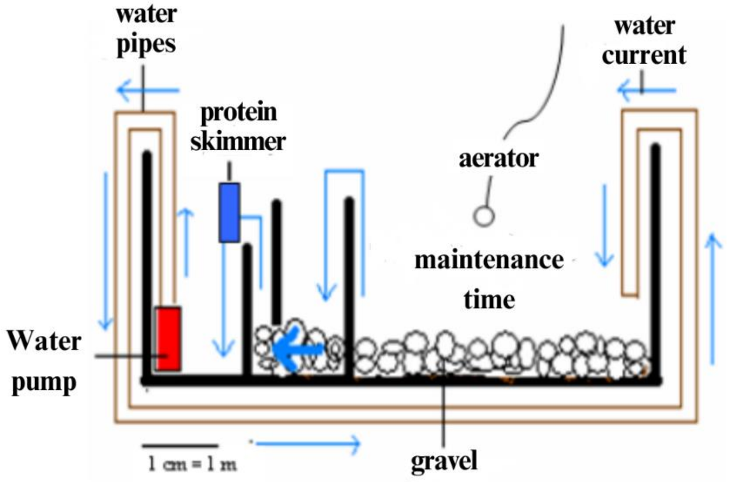

Fig. 1. Water flow circulation scheme in the maintenance pond

2.1.2 Collection of sponges

This research used the *Aaptos suberitoides* and *Petrosia nigricans* sponges taken from the southwest of Pramuka Island. This sponge is brought aboard the ship and then cut in a large coolbox filled with water using a diving knife. The cutting process is carried out completely in water. The sponge that has been cut on the boat is then pierced with a needle through which the nylon rope thread has been passed. The sponge that has been passed through the kenur thread is then taken into the sea water in its natural habitat to be acclimatized. Strands of sponge are tied to the dead coral and artificial reefs located around the acclimatization location. The sponges are acclimatized for one month in their natural habitat before being taken to the rearing pond. The sponges are taken and packaged to be taken to the rearing pond after a one-month acclimatization process in the natural habitat. Packaging is carried out using transparent plastic which is filled with oxygen and then placed in a cool box containing ice cubes.

2.1.3 Handling sponges

The sponge that has arrived at the maintenance pool is then put into the pool water and remains in the packaging without opening the plastic packaging for approximately one hour. The sponge is removed from the plastic packaging and then placed on the ceramic at the bottom of the pool. The *Aaptos suberitoides* sponge was observed every day for one week during its acclimatization process. The *Petrosia nigricans* sponge is acclimatized for a longer time, namely one month because the survival rate of *Petrosia nigricans* is very low during acclimatization in controlled artificial ponds.

2.1.4 Sponge transplantation

Each sponge fragment is cut with an area ranging from 3 to 5 cm^2 because fragments cut with this area have better growth and survival rates [15]. A polyethylene rope is inserted into each transplanted sponge [15] which is used as a substrate. The observed samples were arranged parallel with the distance between each sample in one strand being around 5 cm, and the distance between each strand being around 30 cm (Figure 2). The sponges observed in this study were transplanted with 20 fragments. Each cut sponge is arranged so that it has a small wound and there are many layers of pinacoderm on the daughter sponge fragments. To prevent the bioactive substances that come out from the sponge from contaminating the sea water in the rearing pond, the sponge is cut into 4 fragments every three days for 15 days to reach 20 fragments.

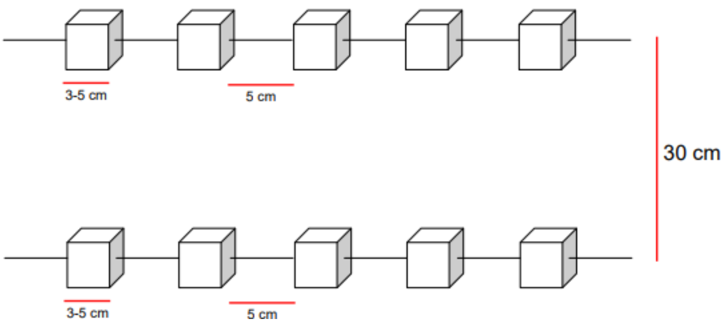

Fig. 2. Strands of sponge fragment

2.1.5 Feeding

Feeding is carried out since acclimatization in the pond. The natural food provided is phytoplankton. Sponges usually live in circulating water, so these animals often live in water that is high in nutrients. The flow of water that passes through the sponge carries with it waste substances from the sponge's body so it is important that the water that comes out through the osculum is thrown away from the body because this water does not contain food but contains nitrogen waste and carbon acids which are toxic to the sponge itself [16]. Additional feed is provided in the form of Liquifry Marine, which is additional feed for filter feeder organisms, which is concentrate. Liquifry Marine has a protein composition of 34.5%, oil 13.2%, fiber 1.0% and ash 4.4%

2.1.6 Measurement of growth rate and wound closure

Data for sponge morphometry which includes length and width was taken using an underwater camera, Canon A640 type with reference to the image scale using a caliper. Wound closure rate and growth rate measurements were carried out every week. The growth rate and wound closure process were measured using a caliper as a measurement scale and Image-J 1.38x was used as an aid in calculating body length (PT) and body width (LT) on the sponge as well as wound length (PL) and wound width (LL). Each position refers to the polyethylene rope substrate.

3 Results and Discussion

3.1 Sponges survival

The *Petrosia nigricans* sponge was collected from nature in August 2010 and was successfully acclimatized for approximately 30 days (September). Sponges that were successfully acclimatized were transplanted until 18 living fragments remained, which decreased continuously every week. This sponge was unable to survive in the rearing pond within 6 weeks after being transplanted (Figure 3).

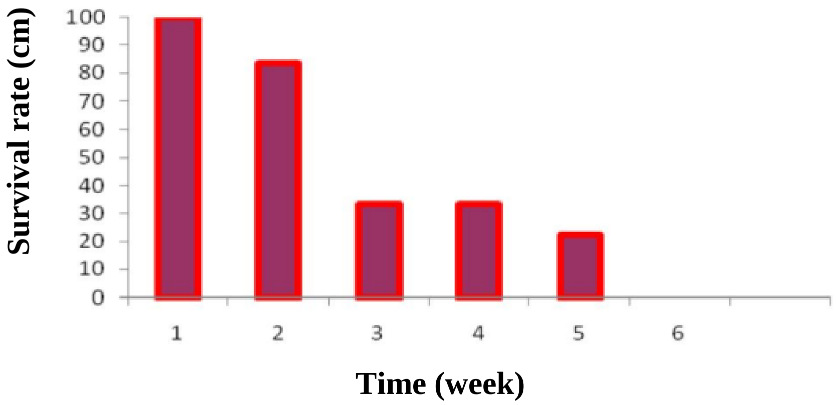

Fig. 3. Survival rate of *Petrosia (petrosia) nigricans*

In this study, the survival rate of the *Petrosia nigricans* sponge rapidly declining. The average survival rate per week only 45.37% in measurements for 12 weeks. The survival rate greatly decreased in the third week in October. This can be caused by organisms that stick to the surface sponge bodies such as: algae and moss. Sponge death can also be caused the inability of sponges to tolerate nitrate, nitrite and ammonia content in the maintenance pond does not comply with sea water quality standard. Inappropriate nitrate and nitrite content can interfere with the process metabolism of microsymbionts in sponges, in addition to the high ammonia content can pollute pond water and disrupt the survival of sponges. Sponge symbiont microbes, apart from their role in producing bioactive compounds, it also plays a role in maintaining the stable growth and health of sponges. These symbionts have an important role in providing energy and nutrition [15]. Inhibiting pathogenic microbes [17], as well as protection against radiation Ultraviolet light and producing antioxidant enzymes [18].

Previous research was carried out in natural habitats [9], where in the first (August), second (September) and third (October) months mortality in *Petrosia nigricans* sponge fragments was only 4%. The death of the *Petrosia nigricans* sponge was caused because the transplanted sponge was unable to adapt to the aquatic environment and did not have chemical defense capabilities as a defense response to environmental changes. A study regarding the survival of the *Petrosia* sponge (*petrosia*) *nigricans* on Pari Island had high values ranging from 95.12 – 100% for 4 weeks and a salinity of 32-34 $^{0}/_{00}$ [6]. Another study with the same species with a research period of 5 weeks had a survival rate of *Petrosi*a sp. 95.12% - 100% [10].

The death of the Petrosia *nigricans* sponge in this study began with the peeling of the surface layer of the sponge, followed by the appearance of white and brittle spicules. Sick sponges can be easily recognized by their visible inner skeleton [15]. Sponge diseases are caused by attacks by pathogenic microorganisms. These pathogenic microorganisms first damage the outer fibrous layer of the sponge, then spread rapidly into the body of the sponge and damage living tissue. The fiber becomes easily crushed and peels. Its characteristics and flexibility are lost.

3.2 *Aaptos aaptos*

The *Aaptos suberitoides* sponge observed for 12 weeks had a survival rate of 100% (Figure 5), where the number of biotas from the start of cultivation to the end of cultivation was 20 fragments. The sponge *Aaptos suberitoides* experienced pressure on its body after transplantation, the same as the sponge *Petrosia (petrosia) nigricans*, but did not cause death, only experienced a reduction in body length and width or body shrinkage (Figures 11 and 12).

Fig. 4. Aclimatitation of *Aaptos aaptos*

The *Aaptos suberitoides* sponge can adapt to the pond water environment during the acclimatization period of one week, as can be seen from the body parts that are attached to the substrate and the osculum on the surface of the body (Figure 4). This study resulted in a higher survival rate than previous research, which was carried out in maintenance ponds with a survival rate of 91.84% during nine weeks [7].

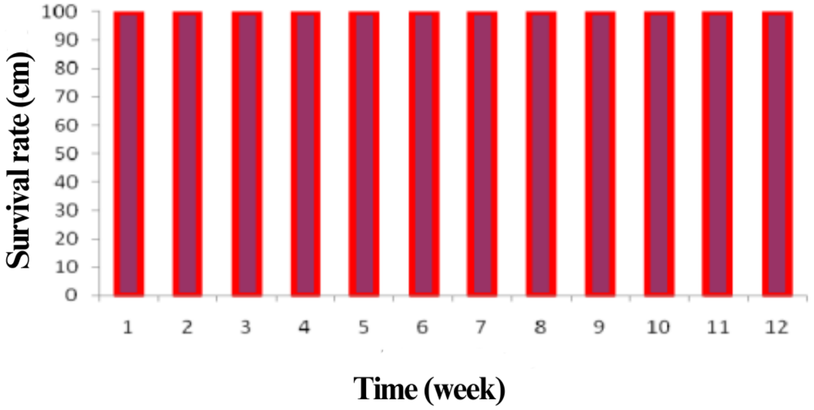

Fig. 5. Survival rate of *Aaptos aaptos*

Research on the same type of sponge for 6 months on Barrang Lompo Island with a survival rate of 60.83% and on Samalona Island of 35.87% [15]. Research by Kaworoe (2009) in the waters of Pari Island had survival rates ranging from 36.54% - 52.46%. Where, at locations with high brightness values, there are predators and low current speeds. On the waters of Pari Island for 4 weeks, a survival rate for the *Aaptos suberitoides* sponge ranged from 36.54% to 54.95% [6]. The results of research on survival rates carried out in nature can be categorized as low, this can be caused by predators, sedimentation, high levels of brightness and movement of water masses which can cause sponges to detach from the substrate [6]. The high survival rate of the *Aaptos suberitoides* sponge in rearing ponds can be caused by the absence of predators in the rearing ponds and the bottom substrate of the pond is stable so there is no sedimentation.

3.3 Sponges growth rate

3.3.1 Petrosia (petrosia) nigricans

Measurements of the growth rate of the *Petrosia nigricans* sponge were carried out after the samples were transplanted and had undergone acclimatization for one month so that they were estimated to have been able to adapt to their new environment. The *Petrosia* sponge (*petrosia) nigricans* which was transplanted in this study, was not able to survive in the rearing pond environment. This can be seen from the decreasing number of sponge samples and is indicated by the increasingly whitening of the surface color, which can also be seenfrom the brittleness of sponge spicules (Figure 6).

Fig. 6. Sponge *Petrosia (Petrosia nigricans)*

The average and standard deviation for the length growth rate of the sponge *Petrosia nigricans* is -0.04±0.24 cm/week and the average and standard deviation for the sponge width growth rate is -0.02±0.16 cm/week. The average growth rate in length (Figure 8) and width of this sponge has decreased with minus values in measurements every week (Figure 9).

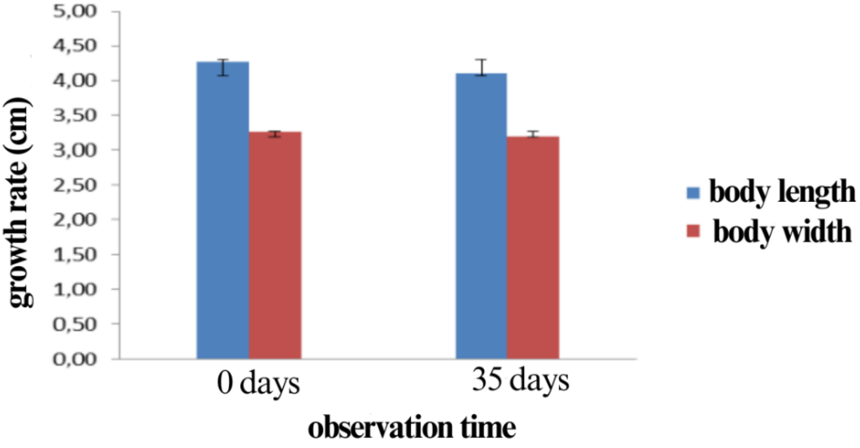

Fig. 7. Mean and standard deviation of growth Petrosian sponge *(petrosia) nigricans*

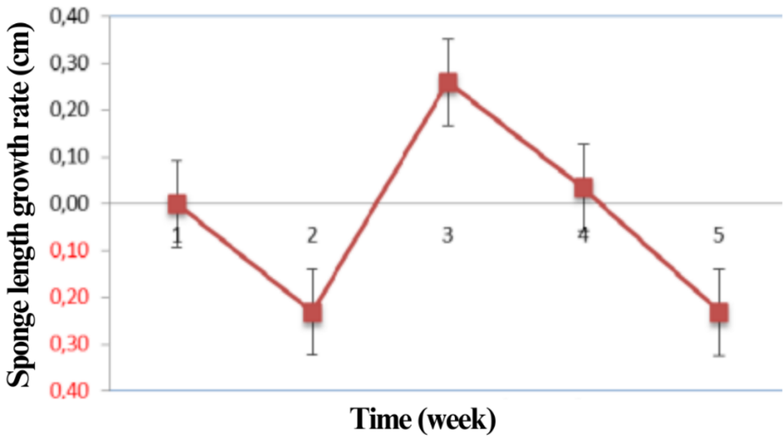

Fig. 8. Mean and standard deviation of sponge length growth rates *Petrosia (petrosia) nigricans*

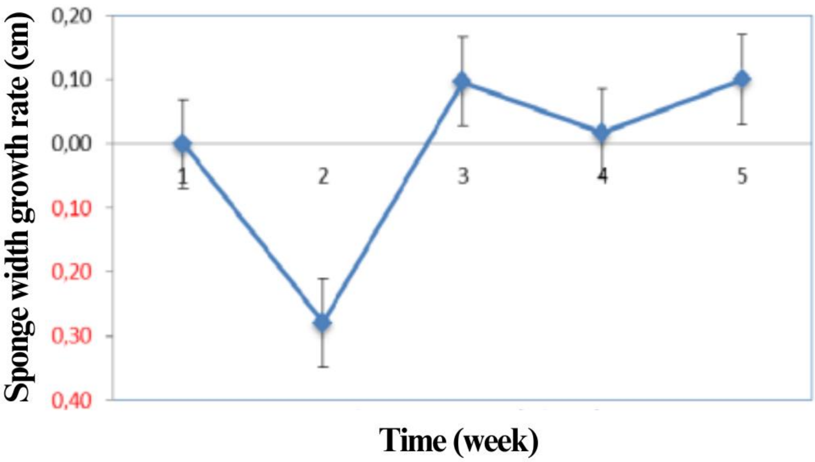

Fig. 9. Mean and standard deviation of sponge width growth rates *Petrosia (petrosia) nigricans*

Growth with a minus value can indicate that some of the tissue on the sponge is missing or the bacteria associated with this sponge is decreasing in number. A decrease in size can be caused by the loss of part of the tissue, while death is characterized by the covering of the entire surface of the sponge by a kind of white fungus and the release of the pinacoderm from the body surface because the tissue shrinks and is destroyed [15]. Low nitrate content and high nitrate and ammonia values in pond water can affect the growth of sponges, and low salinity values in pond water can inhibit sponge growth because sponges first adjust to the conditions of the pond water.

In previous research, the growth of the *Petrosia nigricans* sponge in the waters of Pari Island and Pramuka Island ranged from 402.34-540.93% [9], the results of this research were classified as faster than other studies. Research during four weeks in the waters of Pari Island obtained an increase in body volume ranging from 1.39 cm^3 – 4.98 cm^3 [6]. Then, other research in the waters of Pari Island had an average absolute growth volume over 5 weeks ranging from 1.39 cm^3 - 4.92 cm^3 [10]. This research is very different from the results conducted in natural habitats, where those reared in ponds experienced a negative average growth rate while those in open water had a fast average growth rate.

3.3.2 Aaptos suberitoides

The body texture of the *Aaptos suberitoides* sponge is softer than the *Petrosia nigricans* sponge, and it is easier to adapt than the *Petrosia nigricans* sponge when reared in ponds. Then, after acclimatization and transplantation, growth and wound closure were measured in the *Petrosia nigricans* sponge. The average and standard deviation of sponge length growth per week is 3.97±0.23 cm (Figure 11) and the average and standard deviation of sponge width growth is around 2.85±0.20 cm (Figure 12).

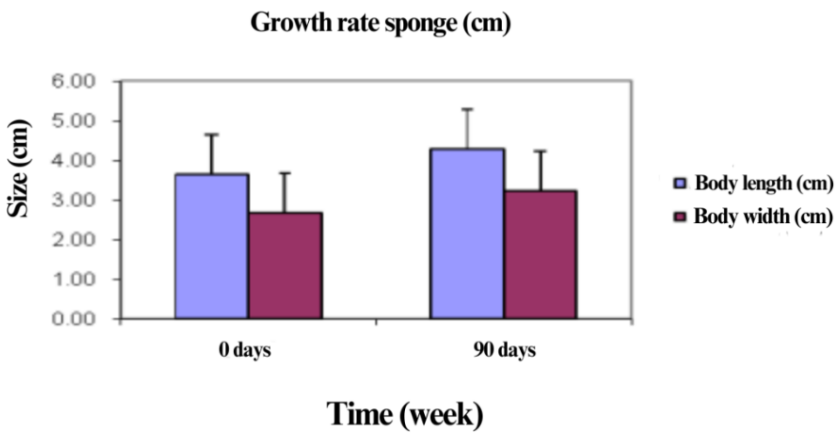

Fig. 10. Mean and standard deviation of growth *Aaptos aaptos*

The average growth rate of sponge length and width in this study experienced a process of increasing and decreasing (Figure 11,12), which could be caused by water quality and salinity in the rearing pond. Inappropriate pond water conditions can cause the drainage holes (ostia and osculae) to close, followed by a reduction in the size of the sponge's body.

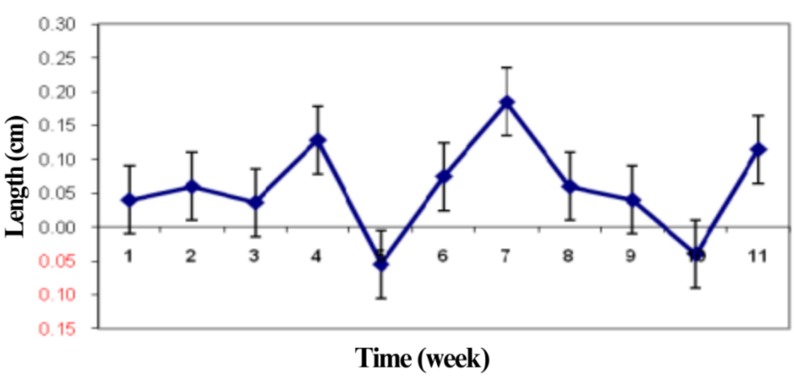

Fig. 11. Mean and standard deviation of sponge length growth rates *Aaptos aaptos*

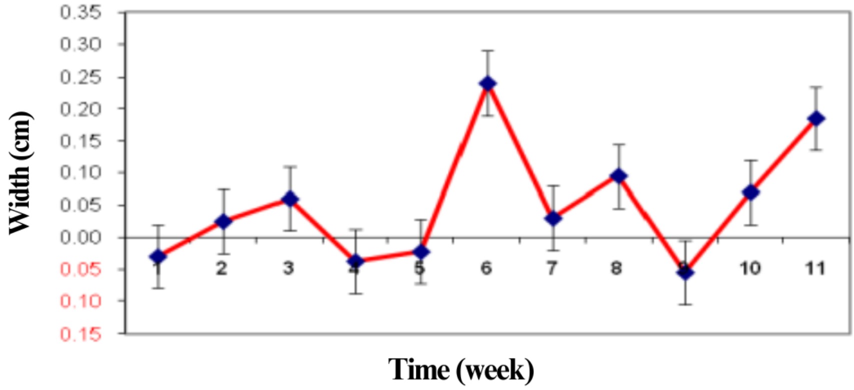

Fig. 12. Mean and standard deviation of sponge width growth rates *Aaptos aaptos*

The average growth rate in length was 0.06±0.07 cm/week and the average growth rate in width was 0.05±0.09 cm/week. This research shows that the absolute growth of the sponge *Aaptos suberitoides* is increasing, but has a fluctuating average growth rate. This is thought to be due to salinity conditions, algae and attached organisms. Every week during pond maintenance, *Chlorella* sp. phytoplankton is distributed. which functions as natural feed, Liquifry Marine also distributes it as additional feed given every 2 weeks.

The measurement of the average length growth rate experienced a large decrease in weeks 6-7 because during that week there was a rapid decrease in salinity, although it was still within the range for the sponge's survival tolerance. This is very far from sea water quality standards, namely 32-34 $^{0}/_{00}$, but it is not has an effect on reducing the temperature because it is still within the standard range of life tolerance for sponges. As a result of decreasing water salinity, the pressure on the life of the sponge *Aaptos suberitoides* is increasing, marked by the shrinking of the sponge body and the closing of the osculum and astiolum on the surface of the sponge body, so that the size of the sponge can change every week. The presence of attached organisms also greatly influences the survival and growth of sponges because they provide competition for obtaining food and sunlight.

The measurement of the average growth rate in width at week 7 experienced a high increase in contrast to the growth rate in length. This can be expected due to the increase in the width of the sponge body following the rope substrate has adhered tightly a week after piercing the substrate in contrast to the long growth not having a foundation to grow on. The *Aaptos suberitoides* sponge requires a substrate to attach to and the sponge responds relatively well to harder substrates [19].

Previous research was conducted for 9 weeks in rearing ponds with an average growth rate in length of 3.0573 mm per week and an average growth rate in width of 2.2713 mm per week [7]. Research conducted in the waters of Pari Island for 4 weeks ranged between 0.33-1.94 cm^3 [6], and research for 5 months obtained an average value of growth rate ranging from 75.92-83.64 cm [15]. These results indicate a fast average growth rate. It can be concluded that organic matter dissolved in open water when rearing sponges can increase the number of sponge fragment microsymbionts, increasing the number of sponges microsymbionts will increase their growth, so that pigmentation in sponges becomes more perfect in line with well-constructed water channels. The growth of transplanted sponges was generally relatively low in all methods and types, while survival was relatively high in all methods, except for the method using ropes for the *Latrunculia brevis* type [14, 15].

3.4 Rate of wound closure

3.4.1 Petrosia (petrosia) nigricans

The *Petrosia nigricans* type sponge had a stiffer body texture than the *Aaptos suberitoides* type sponge, the injured body parts of this sponge are marked with a fading brown color. This sponge was transplanted with an average fragment size of 3-5 cm, but only a small portion of the sponge survived after transplantation.

The regeneration process of *Petrosia nigricans* sponge due to transplantation can be recognized by the color on the wound surface and the appearance of a shiny film layer around the wound. This thin shiny layer can be seen on the fourth day after transplantation after which the fragments turn pale and then dead, so that wound closure and the number of osculums were not visible as in previous studies.

Sponge *Petrosia nigricans* had a healing period occurred in 1 month, marked by full pigmentation, the sponge fragments reconstituted the body to become round and reshaped the water channels [9]. That regeneration process of *Petrosia* sp. sponge fragments, begins shortly after the transplant takes place [10]. At the 4th week, the sponge fragments were dark brown with a clearly visible osculum and the fragments were attached to the string substrate. The results of this research show that the *Petrosi*a sponge *(petrosia) nigricans* has a life pressure that is more susceptible to stress and death in closed water systems, in contrast to in nature it has a higher survival rate [10, 6, 9]. This can be caused by a lack of nutrient content in the pool water, the depth of the pool also affects the sponge's exposure to direct sunlight. The survival and growth of *Petrosia nigricans* is higher in waters that are rich in nutrients (Pari Island) than in waters that are low in nutrients (Pramuka Island) [9]. The growth and survival of this sponge at a depth of 15 meters is higher than at a depth of 7 meters. In addition, differences in water quality such as brightness, phosphate, nitrate, TOM, salinity and TSS greatly influence the growth and survival of *Petrosia nigricans.*

3.4.2 Aaptos suberitoides

The difference in colour of the injured body part of the *Aaptos suberitoides* sponge is very easy to recognize. The wound on this sponge is bright yellow, while the pinacoderm or uninjured body part is dark brown. Based on research data for 12 weeks, the average value of wound closure length was around 2.81±0.50 cm/week, while the average value of wound closure width was around 1.92±0.35 cm/week (Figure 13).

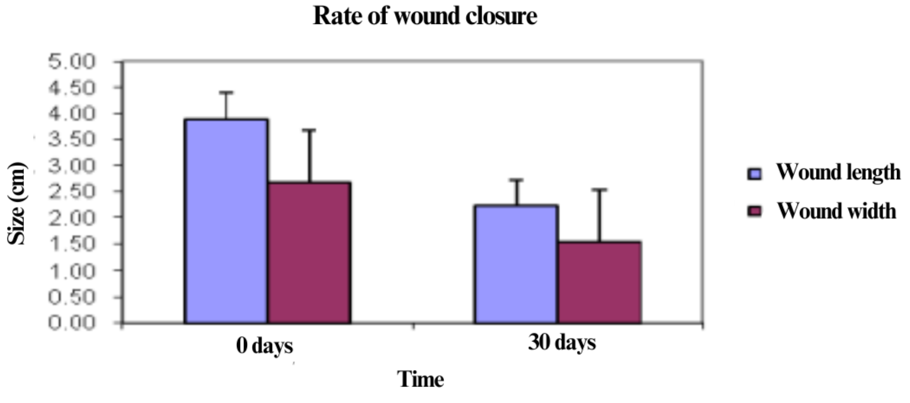

Fig.13. Mean and standard deviation of wound closure *Aaptos suberitoides*

The average wound length closure rate was 0.15±0.18 cm/week and the average wound width closure rate was 0.10±0.28 cm/week. Sponge experienced a reduced wound area during 12 weeks of observation, but the average difference in wound closure each week fluctuated. This is caused by changes in the body size of the sponge. Changes in wound size are also influenced by changes in sponge size. The enlarged size of the wound does not mean that the sponge has an enlarged wound, but the size of the wound is affected by changes in the size of the sponge's body. The reduced size of the wound occurs due to the restoration of the sponge body. This can be seen from the research results that the size of the sponge wound is getting smaller than the size of the wound at the beginning of the observation (Figures 14 and 15). The decreasing size of the wound can also be indicated by the difference in the average size of the wound being below zero (minus).

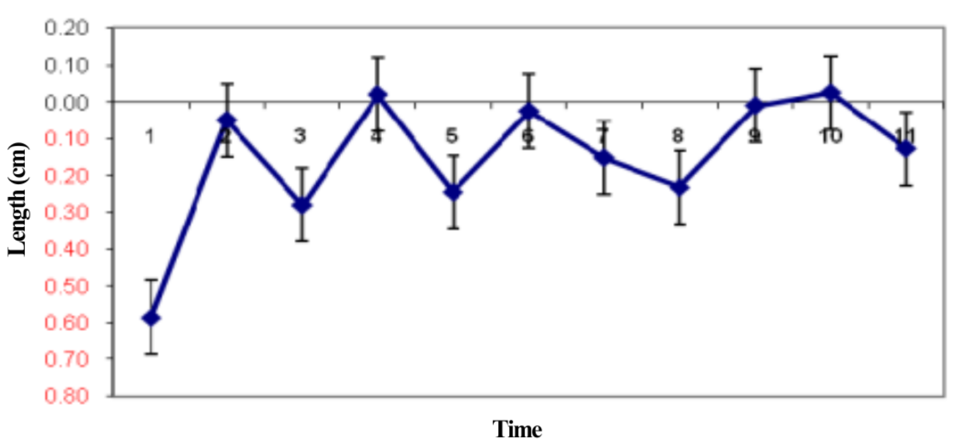

Fig. 14. Mean and standard deviation of wound length closure rates *Aaptos suberitoides*

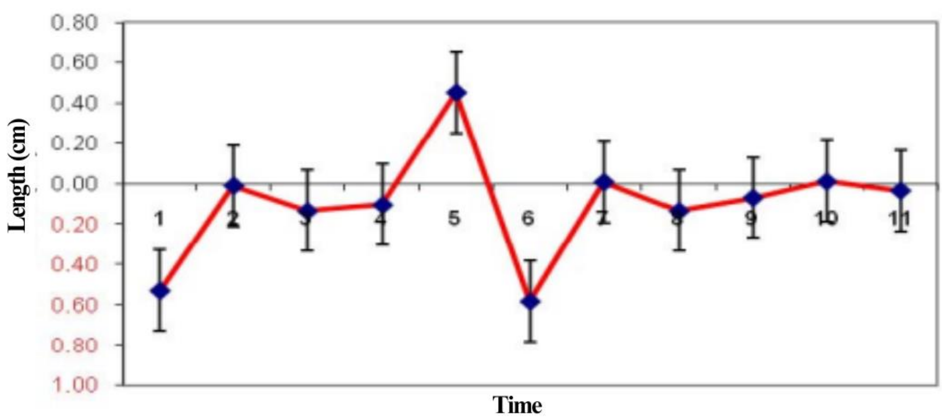

Fig. 15. Mean and standard deviation of wound wideth closure rates *Aaptos suberitoides*

The speed of regeneration and growth of spongy tissue after injury depends on the size of the wound [15]. Several studies show that the rate of regeneration and growth generally decreases with increasing wound area. Within one month, the pigmentation on the sponge fills the surface of its body, the sponge has finished reconstructing its body into a slightly round shape and re-forming its waterways.

Results of previous research in natural habitats for 177 days [12]. The sponge *Aaptos suberitoides* experienced an average growth rate of 0.012 cm/day in wound fragment 1. The difference in the average value of wound closure could be caused by the size of the wound at the initial measurement and the aquatic environment. Previous research was in open locations so that the sponge's need for nutrients was increasingly met and supported the regeneration process.

Research in the waters of Barang Lompo island and Samalona island showed that entering the second to fourth day after transplantation, some wounds had been covered by pinacoderm [15]. The wound healing process on the *Aaptos suberitoides* sponge is different from the wound healing process on the Petrosia nigricans sponge. The wound healing process on the *Aaptos suberitoides* sponge can be characterized by the color of the wound, starting with a bright yellow color then dark brown, the wound healing process is also different, the pinacoderm that appears in the wound has a random pattern and there is a pattern through the edge of the wound (Figure 16).

Fig. 16. The healing pattern tracks and follows the edge of *Aaptos suberitoides*

3.5 *Water quality*

Ammonia is a parameter of the aquatic environment whose content in the water must be taken into account. High levels of ammonia in water will be toxic or cause pollution. The ammonia contained in pool water comes from the metabolism of sponges and other biota that live in pools such as: algae, Aiptasia sp. and organisms from the isopod class. Nitrate is the final product of nitrogen oxides in seawater. Nitrate is a micronutrient compound that controls primary productivity in the surface layer of eutrophic areas [20]. Nitrates can used to classify the level of fertility of water.

The value of water quality of ponds where sponges are reared has values that are much different from the quality standards for seawater quality (Ministerial Decree 51/MENLH/IIV/2004). The nitrite content in the pool is 0.0060 mg/L with a quality standard of 0.06-0.20 mg/L, nitrate in the pool is 0.3544 mg/L with a quality standard of 0.008 mg/L and ammonia in the pool is 0.9541 mg/L with a quality standard of 0.3 mg/L (Table 1). Water conditions greatly influence the growth rate and survival of sponges. Sponge rearing ponds have high brightness so there is no sedimentation as an obstacle to sponge growth. Temperature and salinity measurements are carried out every week with measurement times from midday to evening. Figure 17 shows changes in temperature and salinity of pond waters over 12 weeks.

Table 1. The content of nitrite, nitrate, and ammonia in maintenance ponds

No	Parameter	Pond		Quality standards*
		Maintenance	Control	
1	Nitrit (mg/L)	0.0060	0.0049	0.003-0.002
2	Nitrat (mg/L)	0.3544	0.2731	0.008
3	Ammonia (mg/L)	0.9541	0.1869	0.03

*) Water sea quality standard of Ministerial Decree 51/MENLH/IV/2004

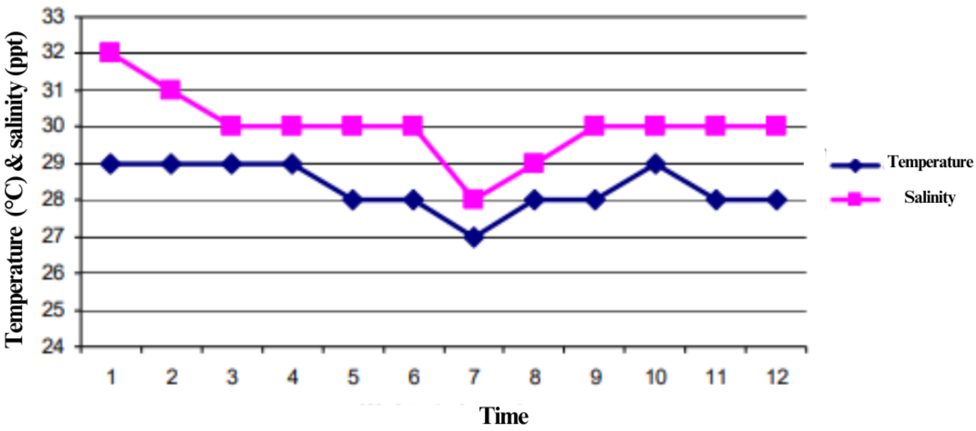

Fig. 17. The changes of temperature and salinity

Changes in temperature in pool waters can be caused by changes in time and weather at the time of measurement, the pool temperature in the first month of maintenance reaches 29 °C then the temperature decreases in the following month due to high rainfall, water enters the maintenance pool and the temperature decreases. Pool temperature in the seventh week decreased to 27 °C and looked different from other times, because when the temperature was measured it decreased due to cold weather which affected the pool water, at that time it also rained at the research location. Salinity in maintenance ponds is very fluctuating and is strongly influenced by the amount of rainfall and evaporation that occurs in maintenance ponds. The salinity of the waters ranges from 28-32 $^{0}/_{00}$. In the 5^{th} to 12^{th} weeks, rainfall is predicted to be higher than the previous week. The results of salinity measurements in the seventh week were 28 $^{0}/_{00}$, this is not in accordance with sea water quality standards, however, it is still within the range of tolerance values for sponge life (Table 2). As a result of the reduction in salinity of 28 $^{0}/_{00}$, at that time the water was released at half the original water level and then replaced with sea water.

As a result of the reduction in salinity 28 $^{0}/_{00}$, at that time the water was released to half the original water level and then replaced with new sea water 41, so that the salinity of the pool water increased gradually every week until it reached 30 $^{0}/_{00}$. In this research, apart from observing temperature and salinity, the presence of other organisms in the rearing pond was also observed, such as Algae and organisms from the cnidaria phylum, namely *Aiptasia* sp. These organisms began to appear during the one month rearing period. Algae is often found stuck around aeration hoses, pool walls, pool substrates, sponge substrates (Polyethylene rope) and foam filters in pools. *Aiptasia* sp. often found on pool substrates or pool walls by occupying holes in hard surfaces.

Fig.18. Algae and *Aiptasia sp.*

These organisms are thought to interfere with the growth of sponges because they can increase ammonia levels in waters and act as competitors for food availability and nutrients. Limited organic material in maintenance ponds.

4 Conclusion

Transplanted *Petrosia nigricans* sponges had low survival rates and reduced growth in length and width. Meanwhile, the *Aaptos suberitoides* sponge also had a high survival rate and reduced growth in length and width. Pond water quality conditions showed that temperature and salinity can still be tolerated by the sponge.

References

1. A. Haris, S. Werorilangi, S. Gosalam, A. Mas'ud, Jurnal Ilmiah Ilmu-Ilmu Hayati **19**, 1 (2014)
2. T. Murniasih, Oseana **30**, 1 (2005)
3. N. S. Sarma, M. S. R. Krishna, S. R. Ran, Marine Drugs **3** (2005)
4. M. Kawaroe. *Fragmentasi buatan dan reproduksi seksual spons Aaptos aaptos dalam upaya perbanyakan stok koloni di alam*, Dissertations (IPB University, Bogor, 2009) (in Indonesian)
5. N. J. De Voogd, Indonesia sponges: biodiversity and marincultured potential (Geborente Dodrecht, Netherland, 2009)
6. B. Subhan, *Tingkat kelangsungan hidup dan pertumbuhan spons jenis Petrosia (Petrosia) nigricans Lindgren, 1897 and Aaptos aaptos (Schmidt, 1864) yang ditransplantasikan di Perairan Pulau Pari, Kepulauan Seribu, Jakarta*, Master Theses (IPB University, Bogor, 2009) (in Indonesian)
7. N. E. Fitrianto, *Laju pertumbuhan dan sintasan spons Aaptos aaptos di kolam buatan terkontrol*, Undergraduate Theses (IPB University, Bogor, 2009) (in Indonesian)
8. R. Osinga, T. Johannes, R. H. Wijffels, Marine Biotechnology **1** (1999)
9. Suparno, D. Soedharma, N. P. Zamani, R. Rachmat. ILMU KELAUTAN: Indonesian Journal of Marine Sciences **14**, 4 (2012)
10. C. D. R. Astuti. *Kelangsungan hidup dan pertumbuhan spons Petrosia sp. yang ditransplantasikan pada rak horizontal dan vertikal di Perairan Pulau Pari, Kepulauan Seribu, Jakarta*, Undergraduate Theses (IPB University, Bogor, 2007) (in Indonesian)
11. W. A. Setiawan. *Analisis kecepatan pertumbuhan dan tingkat keberhasilan transplantasi karang Stylophora pistillata dan Pocillopora verrucosa di Perairan Pulau Karya, Kepulauan Seribu*, Undergraduate Theses (IPB University, Bogor, 2009) (in Indonesian)
12. Mursalin, *Pertumbuhan dan perkembangan spons aaptos yang difragmentasikan pada dua kondisi yang berbeda*, Undergraduate Theses (IPB University, Bogor, 2007) (in Indonesian)
13. Susanna, *Kajian kualitas perairan terhadap kelimpahan dan senyawa bioaktif antibakteri spons Demospongiae di Kepulauan Seribu DKI Jakarta*, Master Theses (IPB University, Bogor, 2007) (in Indonesian)
14. A. R. Duckworth, C. N. Battershill, D. R. Schiel, P. R. Bergquist. *Farming sponges for the production of bioactive metabolites*, in Proceedings of the International Sponges Symposium, 30 June 1999, Queensland, Australia (1999)
15. Haris, Undergraduate Theses (IPB University, Bogor, 2005) (in Indonesian)
16. K. Romimohtarto, S. Juwana, Biologi Laut (LIPI, Jakarta, 1999) (in Indonesian)
17. K. M. Faulkner, S. I. Liochev, I. Fridovich, Journal of Biological Chemistry **269** (1994)

18. E. Carpenter. *Marine cyanobacterial symbiosies,* in Proceeding of the Royal Irish Academy (2002)
19. P. R. Pong-Mask, Maritek **3** (2003)
20. A. V. Putrisia, C. Ain, A. Rahman, Jurnal Manajemen Sumberdaya Perairan **18**, 1 (2022)