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Growth of some of Transplanted Coral Genus and Fish Community Developed at Two Different Transplantation Sites in Kepulauan Seribu, DKI Jakarta, Indonesia

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Abstract

The research was conducted from September 2010 to May 2011 at two transplantation sites : waters of Karya and Harapan Islands in Kepulauan Seribu, Indonesia. Transplanted coral genus used for the research are Acropora spp, Pocillopora sp, Porites sp. Stylopora sp. and other genus The result shows that corals tranplanted at Harapan Island waters is higher in survival rate and growth compared to those of Karya Island.

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The length and height growth of Acropora spp at Karya Island are 4.1 cm and 2,8 cm, respectively, while at Harapan Island, are 5.7 cm and 3.5 cm, respectively. For Pocillopora sp., at Karya waters are 4.1 cm and 3.4 cm, while those of Harapan waters are 4.9 cm and 2.7 cm, respectively. For Porites sp., the length and height growth are 2.3 cm and 2.5 cm (Karya) and 4.8 cm and 1.4 cm (Harapan). Styllophora sp. length and height growth are 2.3 cm and 3.6 cm (Karya) and 1.2 cm and 1.6 cm (Harapan). Information on coral natural recruitment on transplantation media was also collected in September 2010.

It is recorded that 49 colonies of coral recruitment of hard coral (Acropora, Euphyllia, Heliofungia, Hydnopora, Pocillopora and Stylipora) and soft coral (Carijoa, Clavularia, Dendronepthea, Lobophytum, Melithaea, Nepthae, Sarcophyton and Sinularia) at Karya waters. While those of Harapan waters are 67 colonies consisted of hard corals (Acropora, Seritopora, Millepora, Anacropora, and Pocillopora) and soft coral (Dendronepthea, Melithaea and Nepthae). Number of genus of fish are 104, which belongs to 15 families found at both transplantation sites.

Keywords: coral; transplantation; growth; recruitment; Kepulauan Seribu.

1. Introduction

Coral reef ecosystem degradation in Indonesia is an enormous problem, which not only in ecological scale but it has already turns into socio-economical problems. The balance between coral exploitation and destruction rate and its conservation and rehabilitation seems to be the most critical issue urgently need to be solved. As many other coral reef area inhabited by people, Kepulauan Seribu faces degradation of its natural resources and biodiversity [1]. Kepulauan Seribu is coral reef islands consists of more than 100 islands which all of them are coral reef area. The area is a new administrative area, which was belongs to North Jakarta District. As a new administrative area, local government tends to do economic developments, by utilizing its natural resources, which includes towards coral ecosystem. Coral ecosystem in Kepulauan Seribu has been famous for its touristics area, as diving site for divers and other marine-related tourism activities. At the same time, as an area inhabited by people, which most of them are fishermen, pressure on coral ecosystems and its natural resources become crucial.

Coral reef rehabilitation program for coral reef area at Karya Island and Kelapa Island was started in 2008, by installing 800 desk-formed modules as media for transplanted corals[1]. Karya and Kelapa reef flats were chosen since these areas are among the most degraded coral reef in Kepulauan Seribu and close to inhabited islands of Pramuka, Panggang, Kelapa and Harapan.

Donors of coral were taken from Gosong Semak Daun reef both for Karya and Kelapa transplantation sites. The genus chosen were *Acropora* sp., *Caulastrea* sp., *echinophora* sp., *Stylophora sp., Clavularia* sp., *Hydnophora* sp., *Nepthea* sp., *Platygyra sp., Porites* sp., *Stylopora* sp., *Favia* sp., *Astreophora* sp., *Chyphastrea* sp., *Montipora* sp., *Pavona* sp., *Pocilopora* sp., *Stylocoeniella* sp., *Heliopora* sp.,and *Turbinaria* sp.

This research was conducted aim to analyse and evaluate the growth of those transplanted corals genus both in Karya and Kelapa reef areas. Parameters analysed are survival rate, growth, natural recruitment and fish

community.

Since the research done only for 2 years where the survey done 3 times and it was not consider the genetic aspects of each spesies, therefore the research may need to continue in longer time and shorther period of monitoring (e.g. done every 2 months) in order to have more accurate informations. This is preliminary information as a reference when setting up a plan for coral reef rehabilitation in this area. The reesearch may also done with other spesies.

2. Methods and Materials

The research was conducted in the waters of Karya and Kelapa Islands (Figure 1), Kepulauan Seribu, DKI Jakarta Province, from June 2010 to May 2011. Geographical position of Kelapa transplantation site is $05^0$39'31,5" S and $106^0$34'32,2" E, and Karya is at $106^0$36'19,7" BT dan $05^0$44'04,9" LS. Concrete-made table modules as media for transplanted corals had been deployed to the depth of 2 to 5 meter both in Karya and Kelapa waters.

Total of 800 modules have been installed, consists of 400 modules in Karya and 400 modules in Kelapa. Each module consists of 6 coral fragments, resulting in total 2400 coral fragments for each site. Distance between module is around 1 meter.

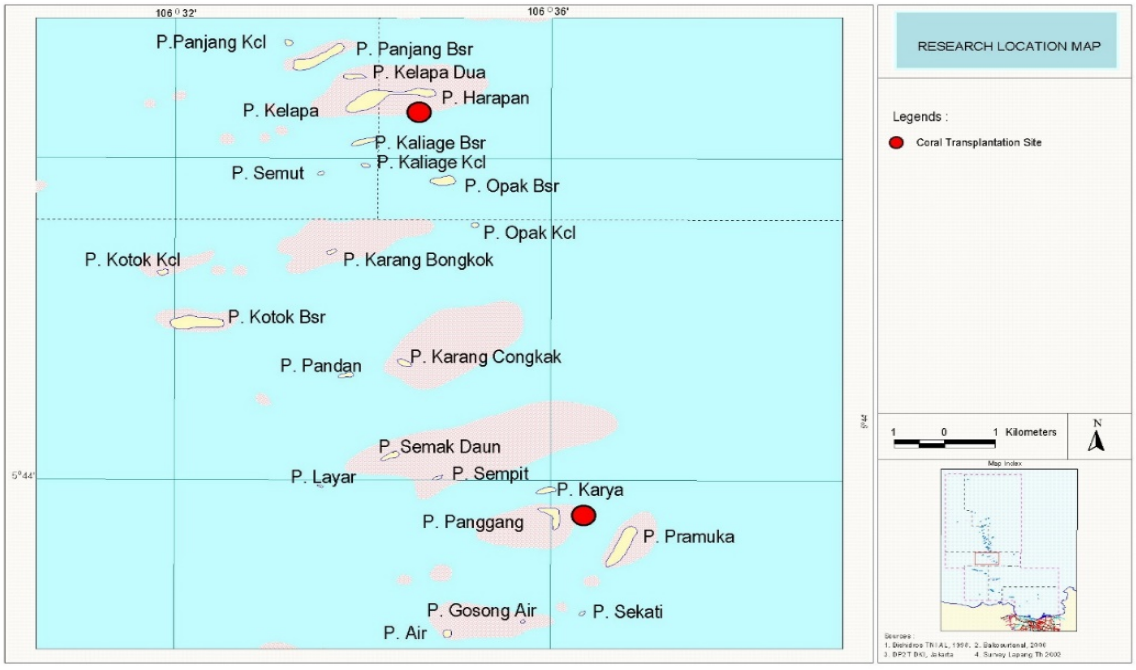


Figure 1: Research location at Karya Island and Kelapa Island Waters, Kepulauan Seribu, DKI Jakarta

Coral fragments were collected from Semak Daun Lagoon coral reef, which were then transported and transplanted in the transplantation areas, both in Karya and Kelapa. Coral fragments were attached to the modules by using cement. Selected genus were based on the natural occurement in the donor area, which is

assumed representing the dominant and originally genus in the area. The genus are *Acropora* sp., *Caulastrea* sp., *Echinophora* sp., *Stylophora sp., Clavularia* sp., *Hydnophora* sp., *Nepthea* sp., *Platygyra sp., Porites* sp., *Stylopora* sp., *Favia* sp., *Astreophora* sp., *Chyphastrea* sp., *Montipora* sp., *Pavona* sp., *Pocilopora* sp., *Stylocoeniella* sp., *and Heliopora* sp. Identification of transplanted corals were conducted according to [2]; [3] and [4]. Coral transplantation modulesare made of cement-concrete with dimension of length 60 cm, width 40 cm, and height 35 cm. The modules is constructed higher than the seaflooor,which is aimed to avoid settling of sediment which can cover the corals [5]. Each module has 6 holes, places for each transplanted coral fragment (Figure 2).

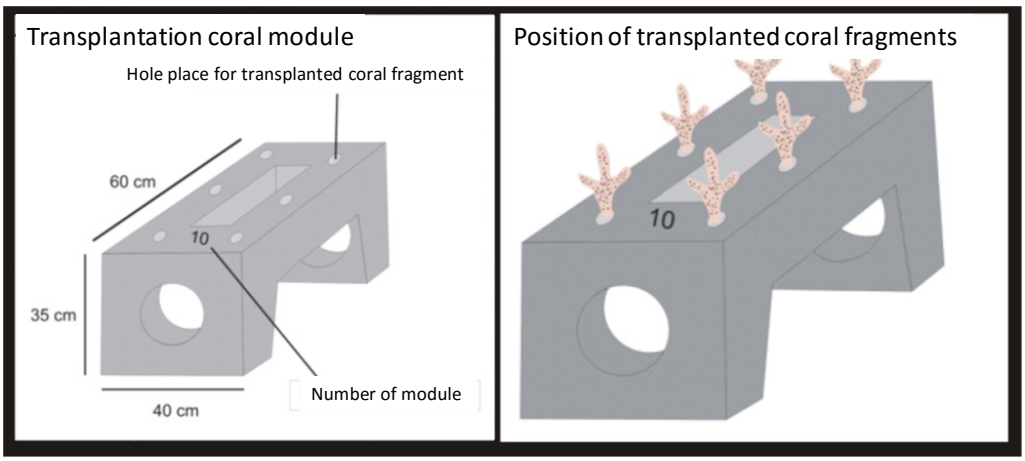


Figure 2: Contruction of transplanted coral module and position of transplanted coral fragments on the module

Survival rate was measured by calculating number of survivor divided by total transplanted corals and multiplied by 100%. Growth of transplanted coral was measured the length and height of the transplanted corals. Measurements were done by means of calliper and ruler with SCUBA technique. Growth is defined both for length and height as difference between length and height at time of measurement and time of transplantation starts.Measurement of growth for both transplantation sites was conducted three times : September 2010, December 2010 and May 2011.

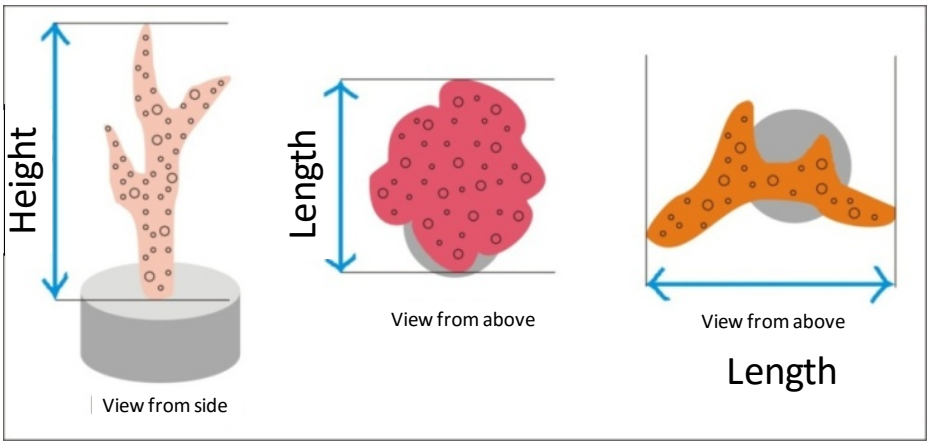


Figure 3: Definition of length and height of coral fragment

Data on coral fish community were collected by using *stationery visual sensus method* [6], by means of SCUBA technique. Fish observation was done in the transplantation area on each station, during December 2010 monitoring. The length of the station were 38.9 meter and 25 meter with the corridor of 5 meter left and right.

3. Results and Discussion

3.1. Survival Rate

In general, survival rate percentage of transplanted corals in both locations (Karya and Kelapa) are above 90%, with some exceptional for *Acropora* sp., which the values of 72.4% and 75.2 % at Karya and Kelapa, respectively. Species with higher survival rate both at Karya and Kelapa is *Pavona*sp. (hard coral), with 98.2% and 97.2% at Karya and Kelapa, respectively. Other species with high survival rate percentage are *Clavuria*sp. (soft coral), *Nepthea*sp. (soft coral), *Favia*sp. (hard coral) at Karya, and *Helioporas*p. (hard coral), *Platigyra*sp. (hard coral), and *Caulastrea*sp. (hard coral) at Kelapa (Figure 4).

As much as 357 fragments at Karya and 256 fragments at Kelapa (from total of 1200 fragments at each site) died, which were commonly caused by algae invasion, bleaching and loss/broken of the coral body. The dominant cause of coral mortality is by macro algae invasion of *Padina jamaicensis* (*scroll algae*). Besides caused by algae, other cause for coral dead is fragment loss/broken, which is commonly observed for *Acropora* spp. The body branches structure of *Acropora* is fragile towards any physical disturbances (*waves*) and gravity. *Acropora*grows rapidly and very fragile in its base, causing break of this growing fragment because of its heavy biomassweight. Once it falled to the sea floor, it will then lead to mortality. This is the main case of *Acropora* mortality. It is seen that mortality in Karya is higher than that of Kelapa. This is mainly caused by rapid invasion of macro algae in Karya which is higher than in Kelapa.

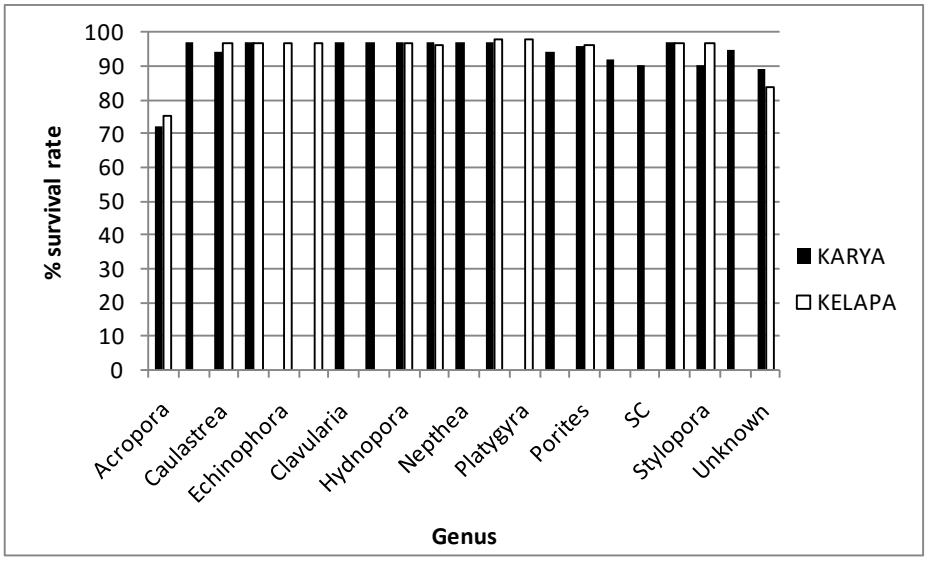


Figure 4: Survival rate of some major selected transplanted corals both in Karya and Kelapa

Mortality caused by macroalgae invasion is a common phenomena in transplantation and natural coral reef area. Sedimentation and high nutrient are also in the case of rapid growth of macroalgae in Karya and Kelapa waters as also commonly found in many other areas globally [7]. Other research such as [8] found that competition between coral and algae will be won by algae. Mechanism of competition is trough covering the coral by large biomass of algae, causing delimination of light for the corals [9]. Besides that, corals will then spend energy to clean the mucus which is disposed by algae, resulting in lower energy spend for growth [10].

[11] stated that in general, coral transplantation is considered to be good if the survival rate ranges between 50-100%. Other factor influencing the success of coral transplantation is predatory fish as been explored by [12] and [13], which stated that Chaetodontidae is the main coral predator in coral reef ecosystems. [14] that *Chaetodon octofaciatus*is the real *obligate coralivor* as shown by his research in East Petondan Island, Kepulauan Seribu, where shows that *Acropora*and *Pocillopora*are the most preffered food for *Chaetodon octofaciatus.*

3.2. Growth

Measurement of growth for both transplantation siteswas conducted three times : September 2010, December 2010 and May 2011. In Karya, in general, for the whole research period (June 2010 – May 2011), average transplanted corals grew more than 1 cm (length). The highest grow is observed for *Acropora*and *Pocillopora*with similarmean values of 4.1 cm. Second fastest growth is *Stylophora*which able to reach in average 3.6 cm (Figure 5).

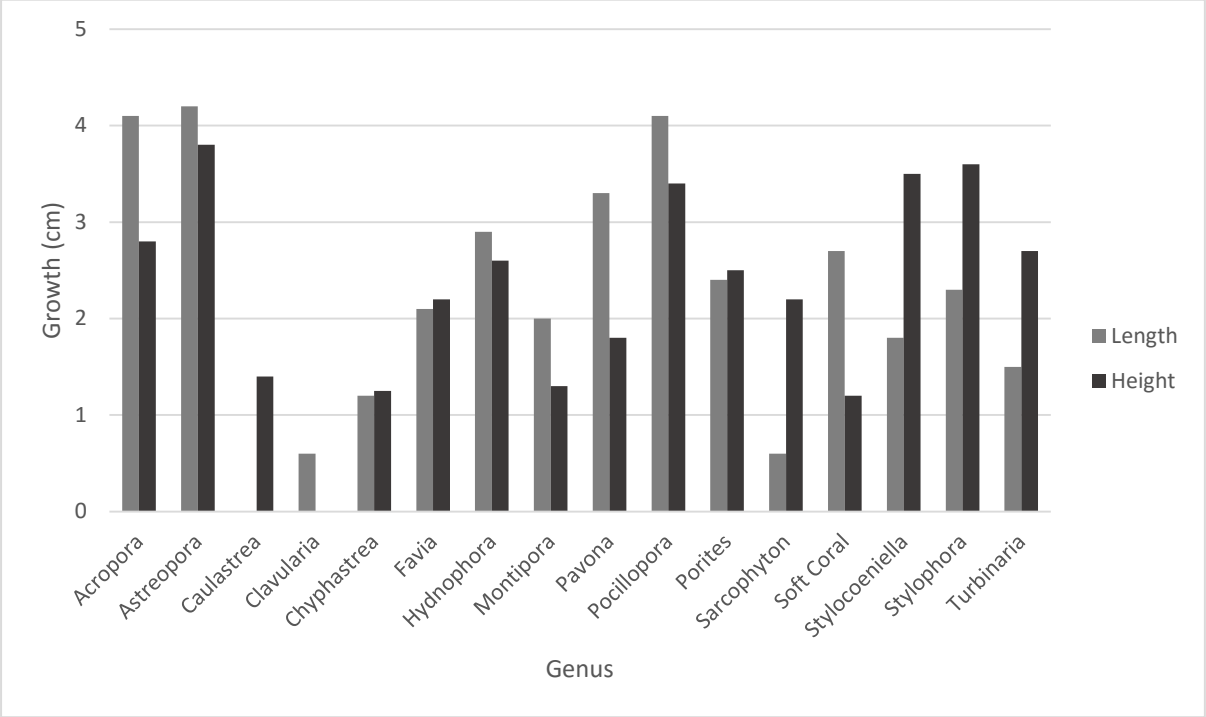


Figure 5: Length and height Growth of Transplanted Corals in Karya (June 2010 – May 2011).

However, some of the transplanted corals are degraded such as *Caulastrea*and *Clavularia*, which mostly caused by body breaks of the corals. In the case of *Clavularia,*which is soft coral, the body is shrunkdue to some environmental causes.

The growth for each genus were varied on each period of transplantation. For example, *Stylophora* grew 0.3 cm during the period ofSeptember – Desember 2010, while *Hydnopora*was 1.7 cm. But, in the next period (December 2010 – May 2011) *Stylophora*and *Hydnopora*reached 2 cm and 1.3 cm growth, respectively.

Differences in growth were also observed between hard and soft corals, which shows that soft coral growth is slower than that of hard coral. This might be related with high concentration of nutrient in the water and low movement of water mass in the study area which causes slower growth of soft coral.

In Kelapa,the fastest average growth of transplanted corals is *Acropora,*which reached 9.4 cm (length) and 5.7 cm (height) during June 2010 to May 2011. If it is compared to massive formed corals such as *Platigyra*, those of braching corals are faster in growth (Figure 7).

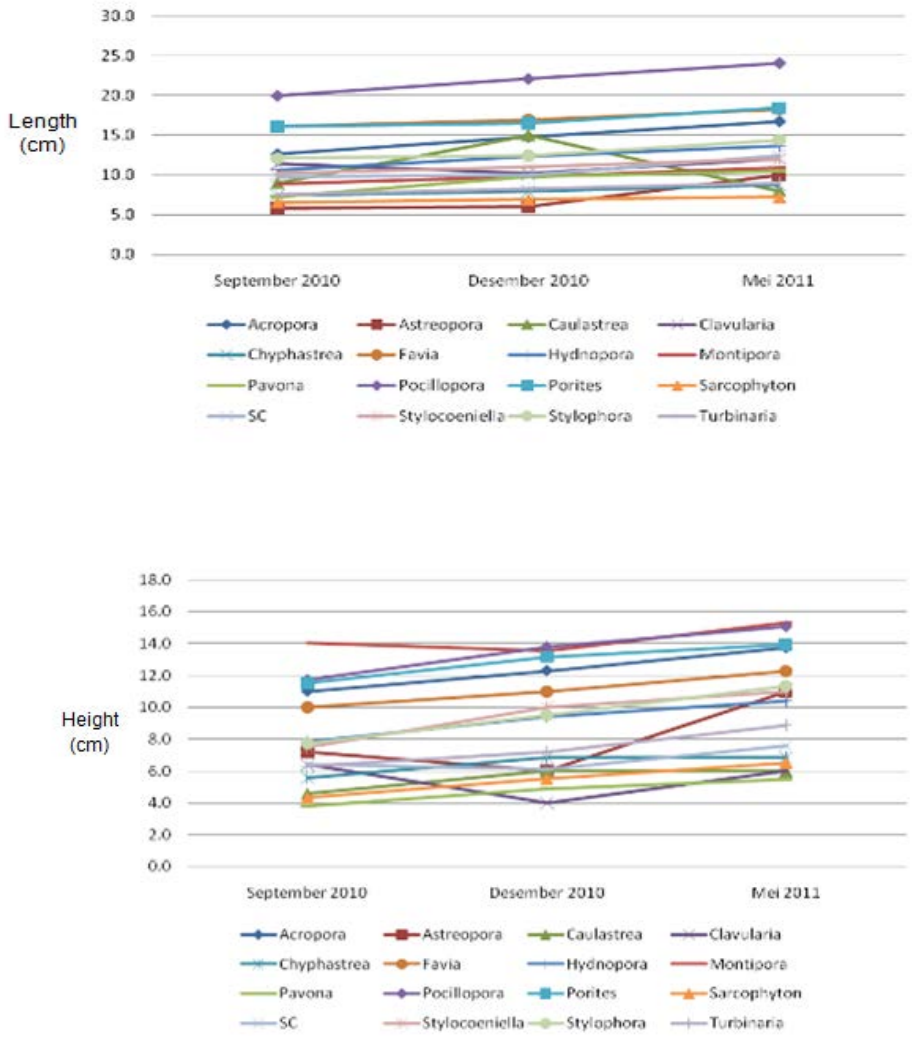


Figure 6: Length and height of transplanted corals in Karya

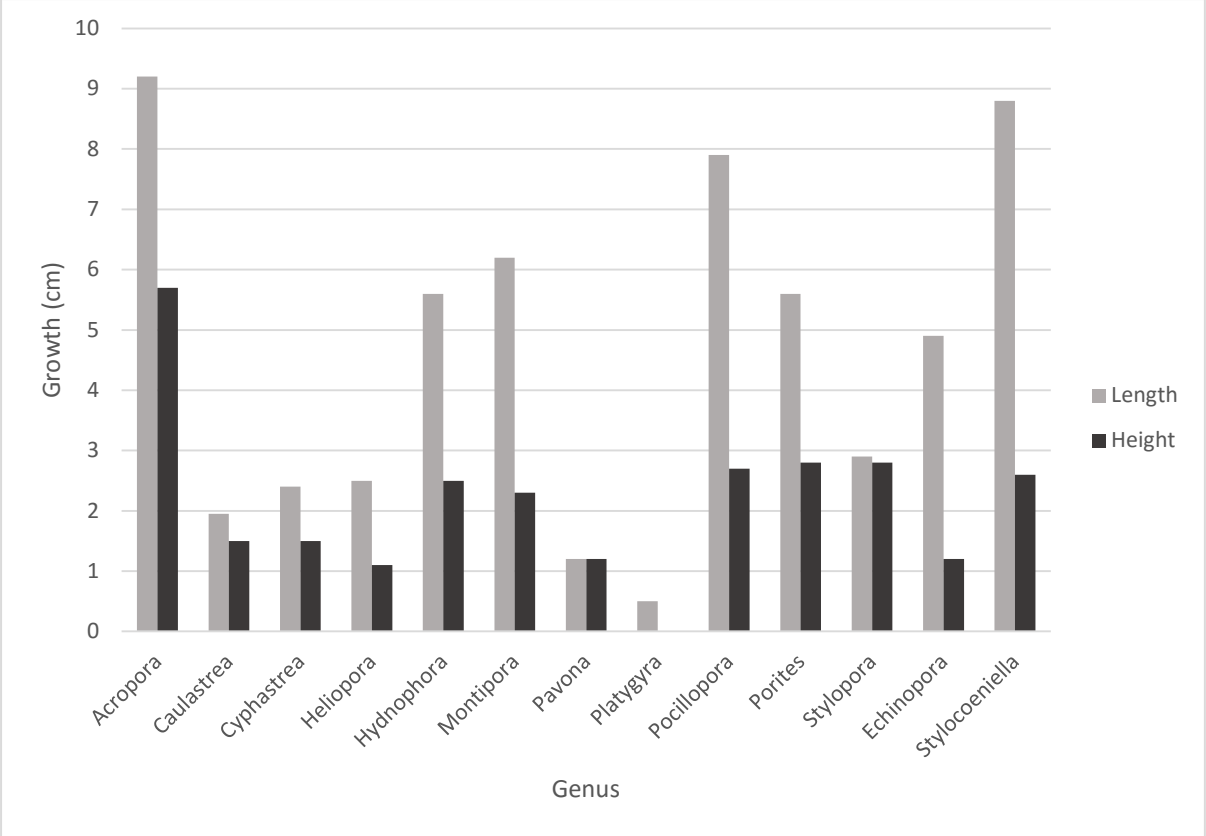
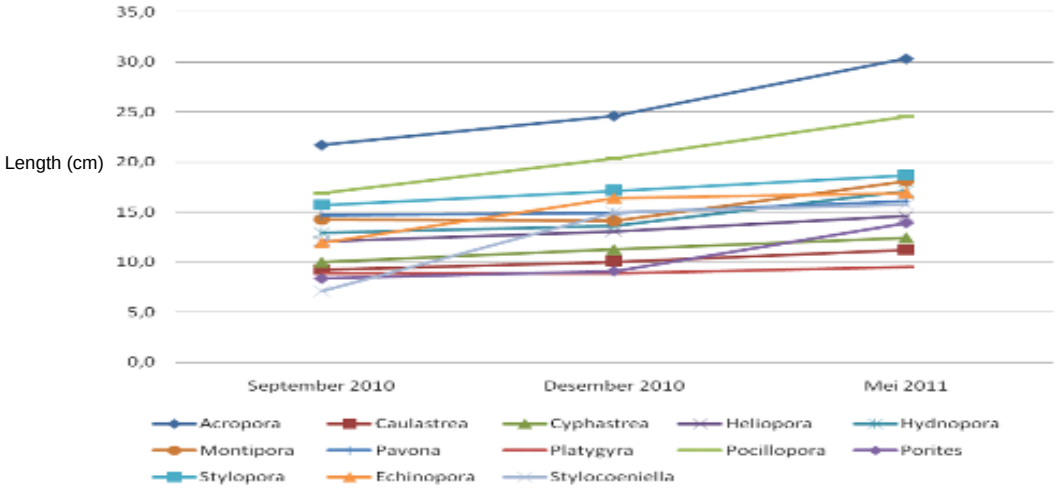


Figure 7: Length and height Growth of Transplanted Corals in Kelapa (June 2010 – May 2011).

In the period between September 2010 to December 2010, *Acropora* grew 3.8 cm, while between December 2010 to May 2011, it reached 5.7 cm (Figure 8). Similar trend was also observed for genus of *Caulastrea*, *Heliopora*, *Hydnopora*, *Montipora*, *Pavona*, *Platigyra* and *Porites.* However, opposite trend was observed for *Cyphasthrea* and *Echinopora*.



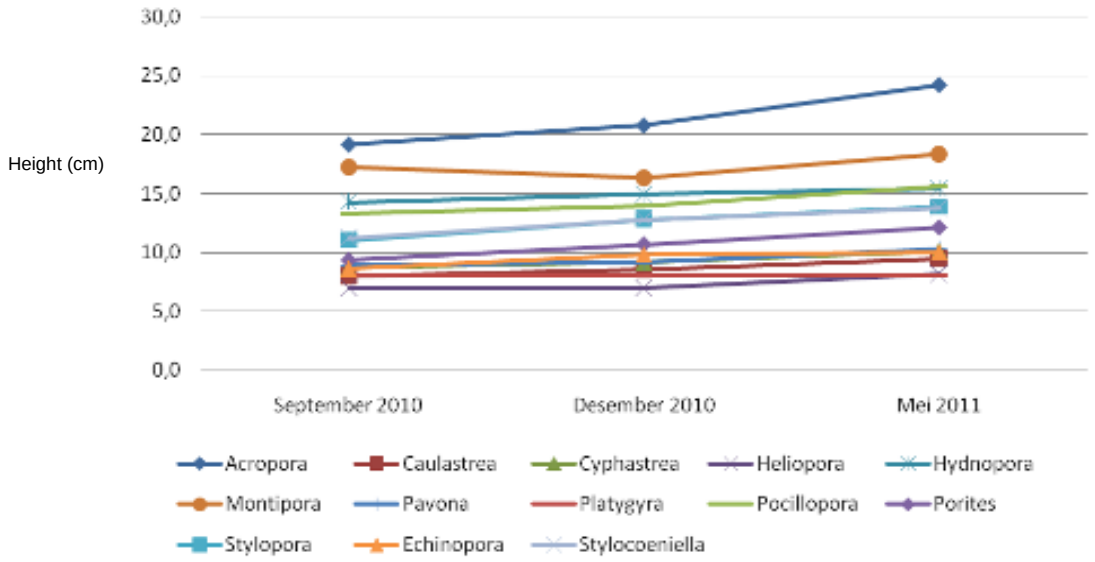


Figure 8: Length and height of transplanted corals in Kelapa

It is recorded that some of *Acropora* grew very fast above the average, reaching 25 - 37 cm (length) between June 2010 to May 2011 or equal to 2.27 – 3.37 cm per month (Figure 7). This is much faster than *Acropora* growth as observed by Boli (1994) in [15] in Pari Island waters which showed 19 mm per 28 days. [15] and [16] observed that in the depth of 3 meter in Pari Island, Seribu Islands, the growth of length reach 18.8 mm/monthand height was 11.4 mm/month.

Figure 9: Acropora grew very fast in Kelapa which cover the transplantation table.

Growth of corals is species specific and depends on the environmental factors and genetics of the coral.

Research on *Acropora* growth in the same area done by [15] resulted that *Acropora formosa* in the depth of 3 m and 10 m, shows different growth rate. Acropora planted at 3 m depth shows faster growth than that of 10 m depth, showing 18,8 mm/month and 11,5 mm/month, respectively. Research done by [17] in the same area and [18,19,20] shows that *Acropora is* the fastest in growth compared to *Hydnoporarigida* and *Pocilloporaverrucosa*.It seems that environment in the transplantation site which is high in turbidity and nutrient give positive effect on *Acropora* than to other transplanted species.

3.3. Recruitment

Informationon natural coral recruitment attached in the transplantation modules is also gathered in this research. In September 2010, it is recorded that as much as 49 and 67 coral colonies naturally live in transplantation modules, in Karya and Kelapa, respectively, consisted of 26 hard corals and 23 soft corals (Karya) and 64 hard corals and 3 soft corals. Hard corals in Karya are *Acropora, Euphyllia, Heliofungia, Hydnopora, Pocillopora* and *Stylipora* whilesoft corals are *Carijoa, Clavularia, Dendronepthea, Lobophytum, Melithaea, Nepthae, Sarcophyton* and *Sinularia* (Figure 10). In Kelapa, hard corals colonies found are *Acropora, Seritopora, Millepora, Anacropora, andPocillopora,* whilethose of soft corals are *Dendronepthea, Melithaea* and*Nepthae*). *Acropora* and *Nepthea* are the most abundant corals found in Karya while in Kelapa are *Pocillopora* and *Acropora*.

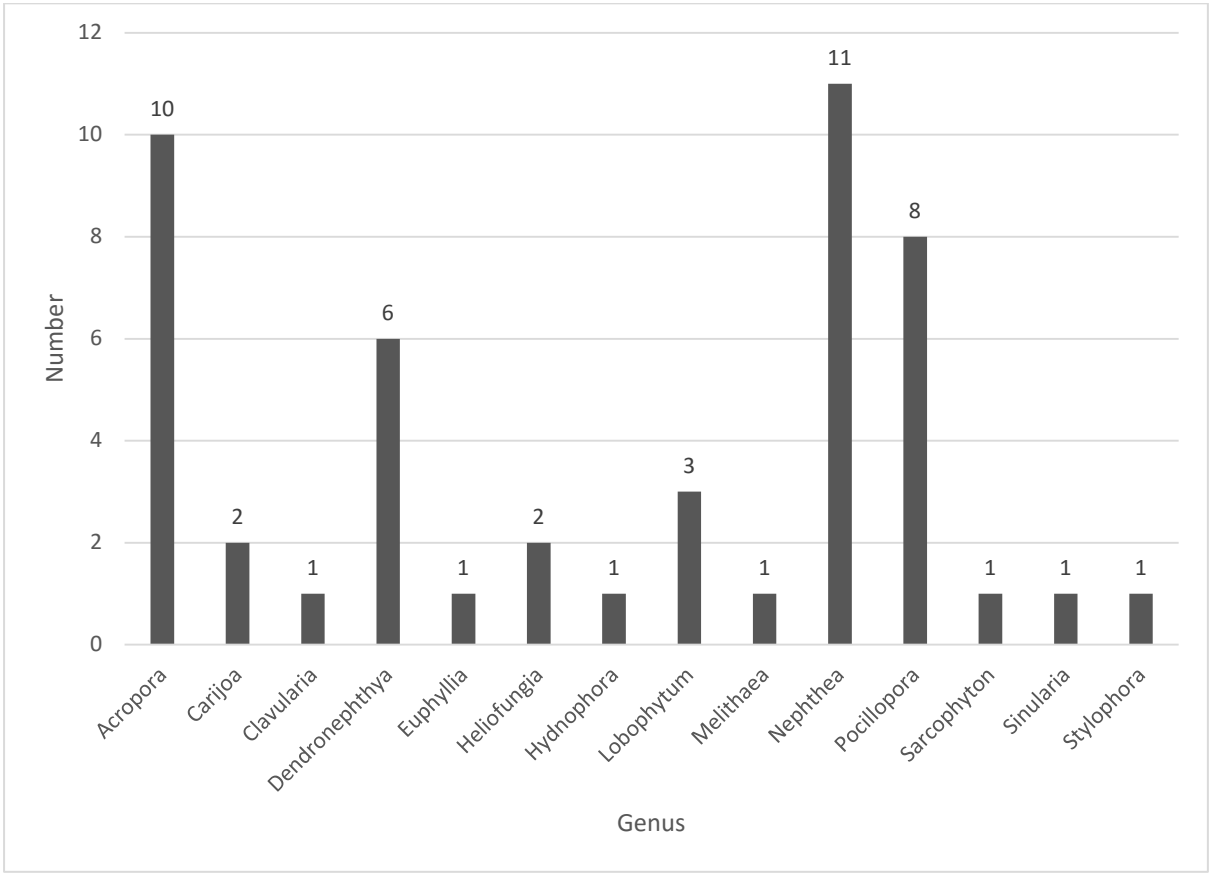


Figure 10: Number of coral naturally grow in transplantation modules in Karya

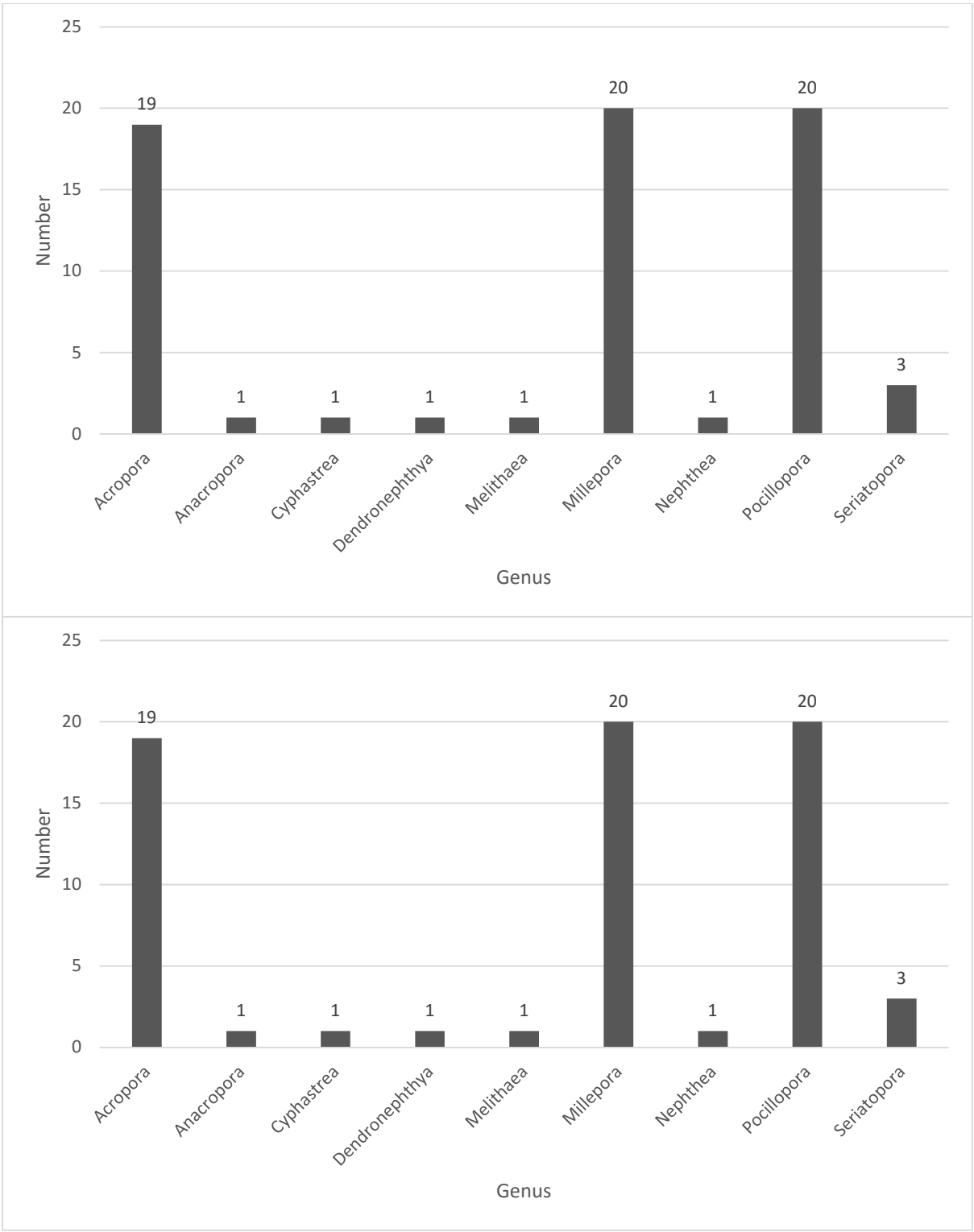


Figure 11: Number of coral naturally grow in transplantation modules in Kelapa

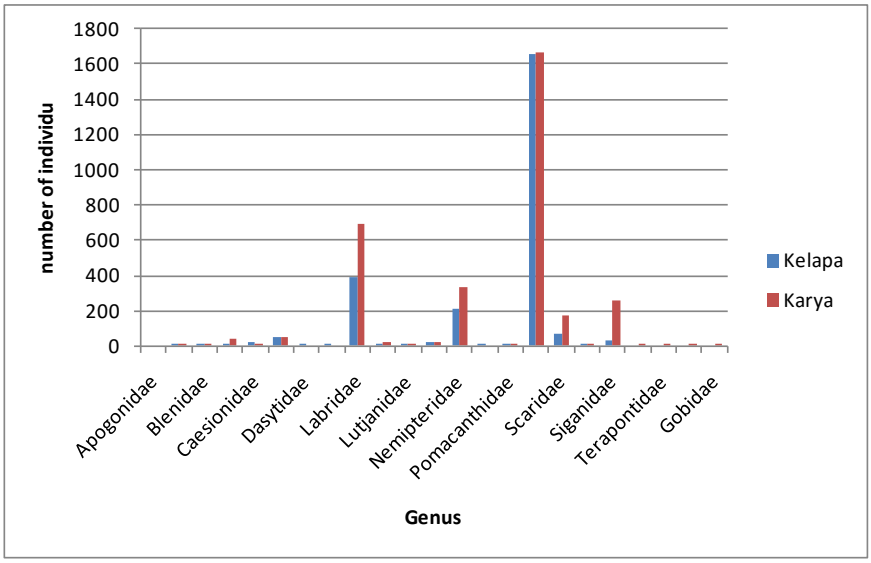
3.4. Fish

In Karya, the highest number of fish families was observed in May 2011 as much as 14 families, while the lowest was observed during December 2010 monitoring as much as 7 families. Maximum number of coral fish

family found in Kelapa which is 13 families (April 2010), while the lowest was found as much as 5 families (June 2010) (Figure 10). The most frequent fish families observed are pomacentridae, labridae, chaetodontidae, scaridae, and serranidae. Some of the families were observed only once such as scorpinidae in September 2010, and dasytidae and tetrapodontidae in December 2010. Pomacentridae is family with the higest density found both in Karya and Kelapa (Figure 12). Similar results was observed by Utami (2010) in [10] where she found that Pomacetridae was the dominant family found in this area. However, Pomacentridae is coral fish family with the highest number of species accounted around 300 species belongs to this family (Choat, 1991) in [12]. Some of Pomacentridae are planktivore such as *Chromis*and *Dascyllus*or omnivoresuch as *Pomacentrus*and *Chrysiptera* [14]. Choat (1991) in [12] stated that Pomacentrus is dominated by herbivore eating algae. While [21,22] states that Pomacentridae eats algae and zooplankton. Thus this family is dominant in an algae-influenced coral reef area such as in Kepulauan Seribu area. Second dominant species was Labriidae, is commonly found in coral lagoon waters eats small crustacean[23][24]. Labriidae was the second-most abundant fish family both in Karya and Kelapa. However, this family is relativelly more abundant in Karya than in Kelapa. It is seen that Karya has higher in number of fish family than that of Kelapa and it might be related to the availability of food and influence of surrounding environment.

In general, number of fish individu is fluctuated on each period of monitoring, which might be related to the dynamics of environment. Highest fish density was observed in May 2011 which was 25.300 ind/ha and 8756 ind/ha in Karya and Kelapa, respectively. Coral transplantation modules itself is functioned as *fish aggregrating devices* (FAD) that creates new habitat and home for fish ([25,14]) that provide place to hide from predators, place for stay and foods such as algae, crustaceans and other small fishes [14].

Fish density in two coral transplantation sites shows fluctuated pattern, showing maximum density in May 2011 for Karya (25,300 ind/ha) and in April 2010 in Kelapa (17,100 ind/ha). Minimum density was observed in June 2010 for both sites, showing values below 10,000 ind/ha. It is seen that there is no specific pattern for temporal variation of fish density, both for Karya and Kelapa. Temporal fluctuation of fish density might be regulated by several environmental factors such as water quality, temperature and availability of food [14]



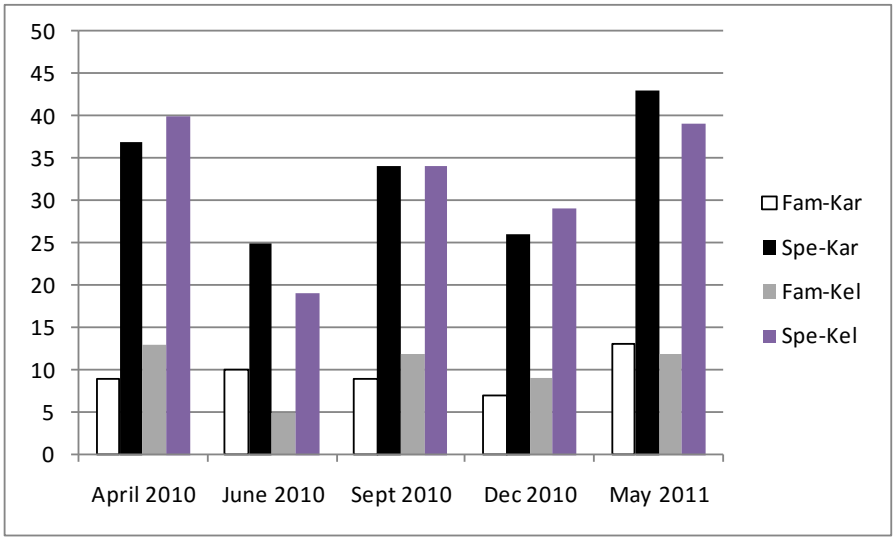


Figure 12: Number of fish individu per family (upper graph) and number of fish family and species (lower graph) observed in coral transplantation area of Karya and Kelapa in the period between April 2010 – May 2011.

However, it is seen that Karya is more in fish density than Kelapa, which might be related to the more trophic of Karya waters than that of Kelapa. In Karya, algae is more abundant, covering the area than observed in Kelapa. It is caused by the trophic status of Karya waters is relativelly higher than that of Kelapa. Nutrient concentration measurement (not shown in this paper), resulted that Karya waters is higher in nutrient concentration than in Kelapa waters. Domination of herbivore in Karya is concomitant with this condition.

4. Conclusion

Transplantation program conducted both at Karya and Kelapa waters Kepulauan Seribu seems to be succeded, especially if it is seen from its survival rate, growth and supporting fish live. Coral transplantation is not only to grow the corals but also to serve a new place for other marine biota such as fish, echinoderms, molluscs and other marine biota. Comparison between Karya and Kelapa seems to be similar, where both of them are highly influenced by domestic activities from the nearby settlements as indicated by high nutrient concentration in its waters. High nutrients leads to rapid invasion of macro algae which then turns to domination of omnivore and herbivore fishes. Hard corals such as Acropora, Pocillopora and Styllopora are able to survive in this area, thus recommended to be the suitable genus for coral transplantation in the area with adjustment in the construction of the modules (media).

5. Reccomendations

More comprehenship research should be done in order to have more acurrate and complete information regarding the coral reef transplantation in this area. The ability of the species to grow may be limited where the growth may be faster in first and second year and then stop or die due to disease or ageing or due to something else. Therefore further research need to be done. The coral reef transplantation is one of the method to conserve

coral reef in certain area and also to rehabilitate the damage coral reef should be done in Kelapa island waters and in Karya islands waters.

Acknowledgement

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