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in collaboration with
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PREFACE

The International Conference on Medicinal Plants in occasion of the 38th Meeting of National Working Group on Medicinal Plant was held on the campus of Widya Mandala Catholic University in Surabaya during 21-22 July 2010. Over 300 participants had many fruitful discussions and exchanges that contributed to the success of conference. The present volume Proceedings (Volume 2) includes the papers presented at the conference and continues where Volume 1 leaves off.

The 192 abstracts that were presented on two days formed the heart of the conference and provided ample opportunity for discussion. Of the total number of presented abstracts, 63 of these are included in the Volume 1 and 58 in this proceedings volume. Both of the Conference Proceedings cover all aspects on key issues related to medicinal uses of plants, their active ingredients and pharmacological effects, production and cultivation of medicinal plants.

We appreciate the contribution of the participants and on behalf of all the conference participants we would like to express our sincere thanks to plenary speakers, Dr. Mona Tawab, Prof. Henk van Wilgenburg, Prof. Tohru Mitsunaga, Prof. De-An Guo, dr. Arijanto Jonosewojo, SpPD FINASIM, Dr. Bambang Prayogo, Mr. Jimmy Sidharta, Ir. Dwi Mayasari Tjahjono, S.Pd, Dipl. Cidesco, Dipl. Cibtac, and everybody who helped to make conference success and especially to our sponsors National Working Group on Indonesian Medicinal Plants (POKJANAS TOI) German Academic Exchange Service (DAAD) PT. Landson PT. Gujati 59 PT. Pasifik Sarana Cantik PT. Herbal Plus PT. Kaliroto May you all be richly rewarded by the LORD.

All in all, the Conference was very successful. The plenary lectures and the progress and special reports bridged the gap between the different fields of the development of medicinal plants, making it possible for non-experts in a given area to gain insight into new areas. Also, included among the speakers were several young scientists, namely, students, who brought new perspectives to their fields. I hope this proceedings will promote the interdisciplinary exchange of knowledge and ideas in medicinal plant and related industries.

Dr.phil.nat. Elisabeth Catherina Widjajakusuma
Conference Chairman
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SOFT CORAL (SINULARIA DURA, LOBOPHYTUM STRICTUM, SARCOPHYTON ROSEUM) FRAGMENTATION IN THOUSAND ISLAND AS POTENTIAL SOURCE OF NATURAL PRODUCT

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ABSTRACT: Research aim was to determine survival rate and growth rate of fragmented-soft coral (Sinularia dura, Lobophytum strictum, and Sarcophyton roseum). Fragmentation and transplantation of soft coral were carried out onshore and underwater. Well prepared research will support the success of transplantation. S. dura and L. strictum showed 100% survival rate. However S. roseum indicated low survival rate. This was caused by (a) soft morphological structure of S. roseum, hence it was vulnerable to swift away before attaching firmly to the sediment, (b) relatively strong current, (c) unsuccessful acclimatization, (d) predator. Growth rate of L. strictum was faster than that of S. dura. The result of the research revealed that S. dura and L. strictum were able to be as raw stock for further research on their bioactive substance content, due to the success of their transplantation.

Keywords: Transplantation, fragmentation, Sinularia dura, Lobophytum strictum, Sarcophyton roseum

INTRODUCTION

Background: Coral reef is a unique ecosystem of tropical waters with high level of productivity, high biotic diversity and high aesthetic value, but including one of the most sensitive to environmental changes. Biophysical role of coral reef ecosystems is diverse, such as shelter, feeding and breeding for diverse marine life. Besides acting as the retaining waves, coral reef functions as producer of the biological resources of high economic value. Reef area is one of important tropical waters producing natural resources has a great potential. Indonesia has the marine living resources with high diversity, but has not been used optimally.

There are a number of marine resources which have the potential to be harvested their bioactive compounds, such as: microalgae, macroalgae, soft corals, echinoderms, molluscs, crustaceans, fish and sponges. Soft corals are part of an important coral reef ecosystems (Benayahu, 1985; Sammarco and Coll, 1998), the second largest component after a hard coral (Manuputty, 1996), playing an important role in the ecology of coral reefs. In the Thousand Islands, the kind of soft corals found are 103 species from four families, and spread over 11 islands from south to north Thousand Islands (Manuputty, 1992). The biochemist gave the attention to soft corals as producer of bioactive compounds. Furthermore, new compounds are expected to be encountered for industry and pharmaceuticals (Weinheimer et al., 1977).

Research on marine natural products is a relatively new research field. Cultivation with transplant technique is a measure for providing soft corals stock instead of harvesting from the wild.


b. Analyzing the growth rate of soft coral S. dura, L. strictum and S. roseum.
METHODS
Soft coral transplantation research with artificial fragmentation was conducted eight months (June 2007 - October 2007), at Pramuka Island, Kepulauan Seribu (Figure 1).

Research was conducted on soft corals (Octocorallia: Alcyonacea) Lobophytum strictum, Sarcophyton roseum and Sinularia dura (Bayer, 1951; Manuputty, 2002; Mather and Bannet, 1993; Verseveldt, 1982) (Figure 2). Seedlings were taken from the soft coral around the Pramuka island waters at a depth of 3-7 m. High abundance of large soft coral colonies was selected as seed for transplant, placed on a rack of transplant (Figure 3). Stages of the research activities are:

- Determination of soft coral planting locations based on physical factors that support the success of transplantation.
- Search soft corals as the parent seed and the process of acclimatization to avoid stress from the cutting of soft coral (fragmentation).
- Planting seeds of coral transplants on an open system in Kepulauan Seribu.
• Monthly monitoring of survival rate and growth of softcorals and physical appearance of soft coral.

![Transplantation rack with net.](image)

**Figure 3.** Transplantation rack with net.

**Softcoral Survival Rate**

Softcoral growth was measured every month by using caliper. Survival rate of transplanted soft coral colonies are measured with the following formula:

\[ SR = \left( \frac{N_t}{N_0} \right) \times 100\% \]

- **SR** = Survival rate (%)
- **Nt** = Number of life soft coral colonies at the end of experiment
- **No** = Number of soft coral colonies at the onset of experiment

Calculation of survival rates is needed to determine the percentage success rate of transplants by knowing the number of living corals since the study began.

**Softcoral Growth**

Growth achievement of transplanted softcoral was measured by the following formula:

\[ \beta = L_t - L_o \]

- **\( \beta \)** = Growth achievement of transplanted softcoral
- **Lt** = Average size increment after month - \( t \)
- **Lo** = Average size of the initial research

To maintain data accuracy, measurements were done on the colonies that have been characterized and mapped previously. Increment of vertical was done by measuring the highest bud. Increment of horizontal was done by measuring the widest bud. Measurement of the transplanted coral growth rate is done by using the formula:
\[
\beta = \frac{L_{t+1} - L_t}{t_{i+1} + t_i}
\]

\(\beta\) = The rate of accretion of coral fragments transplanted
\(L_{t+1}\) = Average length or width of the fragment at time \(i + 1\)
\(L_t\) = Average fragment length or width of fragment at time \(i\)
\(t_{i+1}\) = Time \(i + 1\)
\(t_i\) = Time \(i\)

RESULT AND DISCUSSION
Preparation of materials and tools is one of the supporters of success in transplantation activity. Stages of preparation were carried out on land, and some in the bottom waters by SCUBA diving equipment. Preparation experiment rack assembly, preparation and installation of the substrate can be seen in Figure 5.

**Softcoral Aclimatitation**
Softcoral seed collection was conducted in the waters having a good bottom substrate. Soft coral usually appears in surrounding coral reefs, rocks, and dead coral, and adheres to the substrate (Benayahu and Loya, 1981; Sorokin, 1993). Cutting was performed in the bottom waters to reduce stress (Figure 6). Transportation affects the success of transplantation. Transportation on the deck of the ship which is protected for one hour, is not significantly different with water transportation. When soft corals exposed to air for two hours, the success rate between 50-90% and when exposed to air for three hours, the level of success will be 40-70% (Harrior and Fisk, 1988).
To reduce stress, soft corals to be transplanted were carefully removed and placed in perforated plastic containers and transportation process was carried out in water. This operation should only spend 30 minutes for each pile of rocks to be moved. Soft corals try to maintain the stability of their body metabolism by secreting mucus as consequence of cutting wounds. To reduce stress on the reef, an adjustment effort is necessary (Clark and Edwards, 199; Quinn and Sammarco, 1988).

**Survival Rate**

Survival rate depends on the accuracy of the method, especially in the treatment of fragments, biological factors such as physiology of transplanted corals and response to environmental conditions (Arvedlund, 2001; Clark and Maldive, 1995). Survival rate was calculated by the percentage of live soft corals from each treatment. Survival rate is calculated starting from the first month until the end of the study.

Soft coral survival rate is relatively high. *S. dura* and *L. strictum* had survival rate of 100% during four months of observation (Figure 7). *S. roseum* showed low survival rate (26.7%). This is because (a) very soft physical form, thus *S. roseum* was vulnerable to swift away before attaching firmly to the sediment, (b) the current was quite strong, (c) failure of acclimatization process, and (d) presence of predators (Figure 8) (Nybakken, 1992; Tursch and Tursch, 1982). Soft coral *S. dura* and *L. strictum* have strong spicule shape, compared with *S. roseum*.

![Figure 6. Softcoral strain selection](image)

![Figure 7. Softcoral survival rate (%).](image)
Generally expressed a successful transplant from a biological standpoint, if the survival rates of various treatments ranged between 50-100%, when transplanted to the similar habitats in which they were collected (Harriot and Fisk, 1988).

**Softcoral Growth**

In general, growth is defined as the change in the length, width, and weight versus time. Measurements were performed on the growth of *S. dura* and *L. strictum*, since it has a high survival rate. For *S. roseum* only survival was analyzed. It should be further studied the method of good binding of *S. roseum*. Softcorals can grow from each section of fragments.

Growth observations were performed four months (June - October 2007). Growth in the early phase of maintenance was slow, but then growth faster (Effendie, 1997). This is because in the first and second weeks underwent physiological disorders. This physiological disorder was due to wounds caused by cutting. *L. strictum* is soft leather coral, which has skin and a lot of spicules (Fossa and Nilsen, 1998). This is evidenced by the straight and solid fragments after attaching to the substrate.

**Sinularia dura**

Observations of softcoral growth for four months, starting from the soft coral fragments were bound to the substrate. Planting transplants were performed at the depth of 3 m and 10 m.

Length of soft coral growth rate varied from 0.77 cm/month, 0.34 cm/month, and 0.32 cm/month, width growths were 0.80 cm/month, 0.32 cm/month, and 0.61 cm/month, for three softcoral (Figure 9). Decrease the rate of growth (July-August) can be expected is an implication of the acclimatization and stress from the cutting (fragmentation).
Stress is a condition caused by a change in the ecosystem or factors that cause decline in productivity. Stress period fragments of *S. dura* at a depth of 3 m lasted for two weeks, after which this species again showed their colors. Stress causes the color of *S. dura* pale and shrunken. When soft corals began to bloom and color, they have passed phase of acclimatization.

When the cuts were made on soft corals, artificial fragments react by producing lots of mucus. This mucus will isolate the fragment from the water, thus preventing gas exchange, which in turn disrupt the process of photosynthesis (Benayahu and Loya, 1981; Clark and Edwards, 1995).

At the depth of 10 m, growth rate of length and width in the first month was less than those at the depth of 3 m. Length growth rate during the first month was 0.64 cm/month, second month of 0.23 cm/month, and the third month of 0.39 cm/month (Figure 10).

*S. dura* adaptation processes in the depth of 10 m lasted 14-25 days, this proves the existence of a less supportive environment pressure during acclimatization process.

Environmental pressure caused by fish and other predators biota, and physical factors caused several *S. dura* stress and shrink in the second month of observation. To reduce stress it is needed adjustment effort. If successful, the acclimatization process will bring soft corals back in homeostatic conditions, but if not successful then the biota will stress again with the possibility of even greater stress. Most likely *S. dura* at a depth of 10 m experienced longer stress.
**Lobophytum Strictum**

The growth rate of *L. strictum* at the beginning of the study was 0.67 cm/month and 0.88 cm/month. Length growth rate has increased over the next month and then decreased to 0.50 cm/month. Width growth has increased again in three months (0.65 cm/month) (Figure 11). In general, the growth rate of *L. strictum* was better than *S. dura*. This shows that survival of *L. strictum* was better used as animal transplants.

![Growth rate graph](image)

**Figure 11.** Growth rate of *Lobophytum strictum* at the depth of 3 m.

Differences in growth rate were made possible by the existence of differences characteristics among species. There are polyps that can be withdrawn or outstretched. This is a morphological characteristic that can distinguish between genera (types) with each other. Another difference is anatomically, ie the content of spiculation/sklerit which is a proponent and shaper of the body texture (Manuputty, 1996; Fossa and Nilsen, 1998).

From four months observation the length and width growth of *L. strictum* at the depth of 10 m was not much different (Figure 12). At the beginning of the study length growth rate of 1.09 cm/month and width of 0.76 cm/month. Then at the end of the study length growth rate of 0.76 cm/month and width of 0.81 cm/month.

![Growth rate graph](image)

**Figure 12.** Growth rate of *Lobophytum strictum* at the depth of 10 m.

Based on Figure 12, in the second month, the growth rate of coral declined. After going through the phase of acclimatization to the environment, soft corals were back to normal condition. It can be seen from the shape and color of coral fragments were returned to normal. Octocorallia colonies generally have a beautiful color. These colors are produced by a number of zooxanthellae that live inside coral tissue, which produces the brown pigment, yellow, green and so forth (Manuputty, 1996). *S. dura* and *L. strictum* stock can

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be used as preparation for bioactive substance research, because of the success of their transplantation process (Manuputty, 1991; Weinheimer et al., 1977).

CONCLUSION

Transplantation activities with artificial fragmentation of soft corals were made up of various activities on land and at sea. Proper preparation will support the success of the soft coral transplantation. 

*S. dura* and *L. strictum* showed 100% survival rate. However, *S. roseum* showed low survival rate. Growth rate of *S. dura* and *L. strictum* on first and second weeks declined, this is the period of tissue repair on the soft coral fragments. Growth of *L. strictum* was faster than *S. dura*.

*S. dura* and *L. strictum* stock can be used as preparation for bioactive substance research, because of their success of transplantation process.

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