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OPTIMISING METHODS FOR COMMUNITY BASED SEA CUCUMBER RANCHING : A STUDY CASE OF *STICHOPUS HERMANNII* PRODUCTION IN KARIMUNJAWA ISLANDS

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ABSTRACT

Stichopus hermannii or gamat sea cucumber is an economically important species of sea cucumber, the demand is high, so the fishing effort becomes excessive. This condition will decrease their stock population. One good way to deal with the depleted stock is by sea ranching. The aim of this study was to conduct community-based sea ranching of *S. herrmanni* in the Nyamuk Island, in the Karimunjawa National Park, Jepara. Nine sea pens measuring 5x5x1.5 meters were installed and 30 individual sea cucumbers were stocked per sea pen with lengths ranging from 9.9-19.0 cm (average 14.95 cm) and weight ranged from 45.0 to 139.07 grams (with an average weight of 137.34 grams). Sea pens are installed at locations of 50, 100, and 150 meters from the beach. Length and weight measurements as well as the number of living individuals of ranched sea cucumber are carried out every month. Ranched for 3 months, the sea cucumbers showed a slight difference between sea pen locations. Sea cucumbers reared in sea pens located close to the mainland had a higher absolute growth (13.3 cm and 87.89 grams) and growth rate of 0.71 and 0.55%/day in length and weight compared to other locations. Sea cucumbers that are kept in an open location with the open sea have the lowest length and weight. It also showed that sea pens close to the coast have the highest survival (71%) compared to other sea pens. The water quality (temperature, salinity, dissolved oxygen is 28.5-29.5ºC, 30.2-30.6 ppt, and 7.2-8 ppm, respectively) during sea ranching is very good and supports the life of sea cucumbers. The impact of sea ranching *S. herrmanni* on the sediment was also observed, namely by measuring changes in nitrate and phosphate in the sediment. In sea pens 1, 2, and 3, the nitrate concentration increased from the beginning to the end of the study, as did the phosphate concentration. Nitrate and phosphate levels indirectly affect the growth of seagrass and microphytobenthic, which is the food for sea cucumbers. Sediment changes are also seen in the particle size character of the sediment, where the amount (%) of gravel decreases in the three sea pens, the coarse sand varies slightly in sea pens 2 and 3, but in general the levels decrease. There was an increase in fine sand in the three sea pens. Meanwhile, the silt content decreased. Chlorophyll-a concentration; Chlorophyll-b, chlorophyll-c, total carotene and phaeophytine in sediment (mg/g) of sea pen ranching *S. herrmanni* at the end of rearing were reduced compared to the beginning of stocking, while the control was not much different. This is related to the nature of sea cucumbers as bioturbators, which melt food by stirring the sediment around it. Through this community-based sea ranching activity, the fishermen group "Maju Lancar" and Karang Trauna "Bintang Muda" are able to cultivate sea cucumbers which can be a productive activity.

Key words : length, weight, sediment, sediment grain size, nutrient, Nyamuk Island.

1. Introduction

1.1. Background

In Indonesia, one increasingly harvested marine invertebrate species is sea cucumber which is wellknown as teripang, trepang, timun laut or gamat (Hartati *et al.*, 2015). Strong market demand, uncontrolled exploitation and inadequate fisheries management have led to many sea cucumber species stocks becoming heavily overfished (Conand, 2004). Before, only high price species such as *Holothuria scabra*, *Stichopus hermannii* etc were available in local and international market but now the demand is extended to many other species. *Stichopus hermannii*, teripang gamat provide good protein sources for human food especially for coastal community, produce high potency bioactive molecules for marine pharmaceutical, and they are ecologically important as their ability for sediment bioturbation and remineralization which enrich environment. Another advantage of this species that, through fission stimulation, they are able to do asexual reproduction through fission to increase their natural population when the environment are unfavourable for sexual reproduction.

One good effort suggested to overcome rapid depleting stock is sea ranching. Sea ranching is essentially a ‘put and take’ activity, where cultured or wild juveniles are released into an area of natural habitat and harvested when they reach a commercially optimal size (Bell *et al.*, 2008a;b). Some advantage of sea ranching are lower inputs, as the processes between release and harvest are largely left to nature and the level of care that can be offered to sea cucumber throughout the growth process is reduced, yet still able to produce matketable size of sea cucumber. Initial attempt of *H. atra* sea ranching in Indonesia has been done by Hartati *et al*. (2018; 2021a,b). Result of their study showed that *H. atra* grow well in bottom cage culture method and can be stocked in quite high density (3 individu/m^2). As bioturbation species, their high grazing rate on microphytobenthic organisms were proved enhanced nutrient availability while simultaneously thinned the microalgal overstory and allowing deeper penetration of light into the sediments (Hartati et al., 2019) that means that they provide their own food so they do not need to feed during their culture. It may be replicate for *S. hermannii* practices.

The keys to success of sea ranching of sea cucumbers are site selection and appropriate routine management (Qingxi *et al.,* 2016). The ranching farm sites have a series of requirements. The sites should be abundant in nutrients, with sandy mud sediment or substrate in the presence of Enhalus or Thalassia seagrass and Padina macroalgae (Hartati *et al.,* 2017). The sites should be open, with low current or tides and avoiding areas with input of freshwater from runnoff and strong currents. The depth should be 1-2 m. The physical and biological environment of the site maybe improved with additional shelter if required (Xie, 2004;Yu *et al.*,2010). Sea ranching ideally occupies a large area and has a low population density (3–15 individuals per square meter, Qingxi *etl al*., 2016). And for *S. hermannii* could be stocked for 3-5 individuals per square meter (Hartati *et al.,* 2019). Large juveniles are recommended for stocking in sea ranching as a higher survival rate can be obtained (Xie, 2004), for *S. hermannii* the size of stocked could be 8 cm . This aquaculture model has become increasingly popular due to its perceived eco-friendly sustainability (relative to coastal ponds) and significantly better profit and product quality (Xue, 2007). Sea ranching are ussulaly using low-technology methods (i.e. cultured juveniles are released into marine environments under traditional marine tenure in a ‘put, grow, and take’ operation) just like in Papua New Guinea (Hair *et al.,* 2016a,b), in Indonesia has potential as a sustainable livelihood opportunity. However, its successful development depends on resolving a number of technical and social constraints (Eriksson et al., 2012; Mills et al., 2012; Purcell *et al*., 2012; Robinson, 2013), not least of which is maximising the number of small juveniles that survive to commercial harvest size.

Trend of growing-out wild sea cucumbers in sea pens by Indonesian fishers actually provides a way to restore the damaged fisheries without having to formalise no-take zones or establish fishing rights for sea cucumbers. In the case of sandfish sea cucumber *H. scabra*, Bell *et al.* (2008) said that this simple way would involve just one additional activity by fishers: rearing sea cucumbers harvested from the wild in sea pens until marketable size. It is sure could be replicated for other species, such as *S. hermannii*. Therefore community based sea ranching is proposed in this research in which ranching of *H. atra* will be undertaken by community members as a part-time activity, devote effort to other subsistence activities and customary duties. Here we proposed community based sea ranching for *S. hermannii* to apply our previous result (Hartati *et al.*, 2019) in form of cooperation with coastal community of Nyamuk Island Village of Karimunjawa Islands-Jepara Regency.

Therefore, with the special objectives to produce consumption size, conservation and avoid overexploitation of natural populations of *S. hermannii*, it is needed a research on community based sea ranching of sea cucumber. This research will also be able to provide knowledge for a better understanding and application in marine conservation, population genetics and connectivity patterns

The result of the research will be published in international journal (Journal of BIOTROPIKA / BIODIVERSITY. In the end present work, simple applicable technology (Teknologi Tepat Guna) manual which could be applied to coastal community to enhance sea cucumber production and conservationwill be published.

1.2. Objectives

The longterm objectives of the reasearch is to better understanding of sea cucumber sea ranching and its application for marine biodiversity conservation.

Special Objectives of the research are

a. To replicated *H. atra* culture for sea ranching of *S. hermannii* using sea pen method

b. To measure the biological, physical, chemical characteristic of the habitat as impact of culture *S. hermannii*

c. To measure the performance (growth and survival rate) of *S. hermannii* in habitat of sea ranching

d. To engage and cooperate the sea cucumber culture with local community to perform community based sea cucumber ranching

e. To undertake capacity building for coastal community for sea cucumber culture

f. To raise their conservation awareness

1.3. Expected Outputs

The expected output and outcome as indicatopr performance of the project is presented in Table 1

Tabel 1. Expected Outputs and Outcomes of Research activity of 2020

Year	Activity	Output	Outcome indicator
2021	Performance of sea cucumber in sea ranching location	▪ New habitat for sea cucumber is established ▪ Performance of sea cucumber stocked in sea ranching location has been determined ▪ 1 paper presented in international seminar with tentative title : Stichopudidae (Holothuroidea: Echinodermata) from Nyamuk Island, Karimunjawa National Park, Central of Java, Indonesia ▪ Article submitted to 1 international journal BIOTROPIKA with tentative tittle : Sea ranching trial of *Stichopus* sp. in pens in the Nyamuk Island, Karimunjawa National Park	1 draft article has been submitted international journal 1 article published in Proceeding of International seminar

2. Benefit and Important of Reserach

Roadmap of the Research

This proposed research is on the track of previous research done by Hartati *et al* (2000-2002; 2003-2005; 2007-2009; 2009-2012; 20105-2016, 2018) as explained in Figure 1 below.

It is very limited data on sea cucucmber ranching in Indonesia. Restocking program for 4 species of sea cucumber in Karimunjawa Island (BTN Karimunjawa 2009) but there were no monitoring n evaluation program so there were no information on the result. Other works was sea ranching of 150 indv. *H. scabra* in Buleleng Waters, Bali (1 March 2018) do by Marine Science Dept-Univ. Ganesha, BBRBL, Gondol, KKP, NGO) but it is limited as seremonial release of animals and no other information yet.

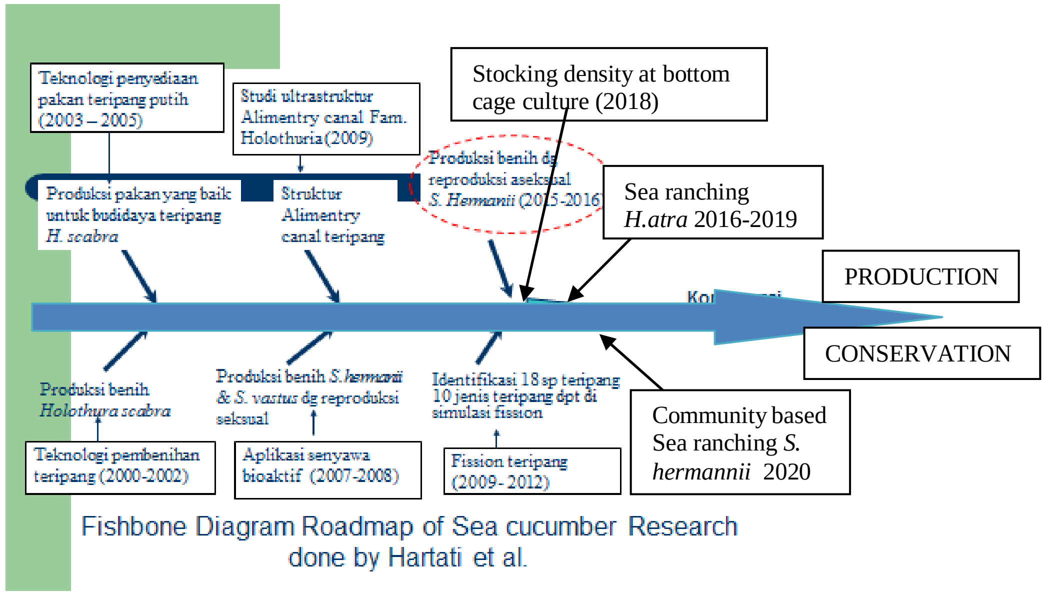


Figure 1. Fishbone diagram Roadmap of Sea cucumber Research

During 2016-2017 Hartati et al. did research on determining the location for sea ranching. Habitat characteristic of two selected locations for sea cucumber ranching purposes : compare and contrast of 2 purpose habitat (Teluk Awur and Bandengan waters of Jepara area) has been published (Hartati *et al*., 2017a) and the abundance of prospective natural food for sea cucumber *Holothuria atra* at Karimunjawa Island waters, Jepara, Indonesia (Hartati *et al*., 2017b). Funding by Dissertation grant of DIPA BIOTROP, the research on study on establishment of new ecosystem and its relation with their feeding ecology has been performed and information on stocking density for *H. atra* rearing in the bootom cage method has been available Hartati et al., 2018). The sea ranching research by Hartati *et al*. (2016; 2017, 2018, 2019 and 2020) complements several studies in the world Table 2.

Teripang, Timun Laut or Sea cucumbers are elongated tubular or flattened soft-bodied marine benthic invertebrates, typically with leathery skin, ranging in length from a few millimetres to a metre (Hartati *et al*., 2015) belong to belonging to the class Holothuroidea under the phylum Echinodermata, it is usually occur in the shallow benthic areas and deep seas. The major product in the sea cucumber is the boiled and dried body-wall, familiarly known as teripang/trepang, 'bêche-de-mer' or 'gamat', for which there is an increasing demand for food delicacy and folk medicine in the communities of Asia and Middle East (Tian *et al*., 2005).

Table 2. Some of sea cucumber sea ranching worldwide.

Country	Species cultured	Annual production of 1 g juveniles	Use of juveniles	Proponents	Start year to end year
Australia (Northern Territory)	*Holothuria scabra*	62,000+	Sea ranching; pond farming	Tasmanian Seafoods Pty. Ltd.	2004–ongoing
Australia (Queensland)	*H. scabra*	500,000	Sea ranching	Bluefin Seafoods	2003–2009
Australia (Queensland)	*H. lessoni*	330,000	Sea ranching	Bluefin Seafoods	2004–2009
Australia (Queensland)	*H. scabra*	1000	Experimental	QLD DPI&F	2004–2007
Canada	*Parastichopus californicus*	n/a	Pond farming	Sustainable Ecological Aquaculture (SEA)	2009–ongoing
China	*Apostichopus japonicus*	> 6 billion	Sea ranching; pond farming	Government and private hatcheries	1990–ongoing
Ecuador	*Isostichopus fuscus*	n/a	Experimental	n/a	2002–2008
Fiji	*H. scabra*	500	Experimental	Hunter Pearls, Fiji MAFF	2008–2010
FSM (Pohnpei)	*H. scabra*	10,000	Experimental	College of Micronesia, Land Grant Program	2009–ongoing
FSM (Yap)	*Actinopyga* sp.	n/a	Stock enhancement	n/a	2007
India (Tuticorn)	*H. scabra*	3000	Experimental	Central Marine Fisheries Research Institute	1988–2006
India (Tuticorn)	*H. spinifera*	na	Experimental	Central Marine Fisheries Research Institute	2001–2006
Iran (Bandar-e Lengeh)	*H. scabra*	na	Experimental	Persian Gulf Molluscs Research Station	2011
Japan	*A. japonicus*	> 3 million	Stock enhancement	n/a	1977–ongoing
Kiribati	*H. fuscogilva*	500–8000	Stock enhancement	Kiribati Ministry of Fisheries	1997–2009
Madagascar	*H. scabra*	200,000	Sea farming (pens)	Blue Ventures, TMD, MH.SA	2007–ongoing
Maldives	*H. scabra*	5 million	Sea ranching	Masmeeru Pty Ltd	1997–ongoing
Mexico	*I. fuscus*	300,000	Pond farming	Acuacultura Dos Mil	2008–ongoing
New Caledonia	*H. scabra*	18,000	Experimental	WorldFish Center	2000–2006
New Caledonia	*H. scabra*	450,000+	Sea ranching; pond farming	Société d'élevage aquacole de la Ouenghi	2011–ongoing
New Zealand	*Australostichopus mollis*	n/a	Experimental	National Institute of Water and Atmosphere	2007–ongoing
Palau	*Actinopyga mauritiana*	500,000	Stock enhancement	Government hatchery, Korean technicians	2009–2011
Palau	*Actinopyga miliaris*	50,000	Stock enhancement	Government hatchery, Korean technicians	2009–2011
Philippines (Bolinao)	*H. scabra*	32,000	Sea ranching	University of the Philippines MSI	2001–ongoing
Philippines (Mindanao)	*H. scabra*	15,000	Sea ranching; pond farming	University of the Philippines, DOST, PCARMD	2009–ongoing
Philippines (Bolinao)	*Stichopus horrens*	500	Experimental	University of the Philippines MSI	2009–ongoing
Philippines (Dagupan)	*H. scabra*	20,000	Experimental	NIFTDC-NFRDI	2009–2011
Philippines (Iloilo)	*H. scabra*	11,000	Experimental	SEAFDEC	2010–ongoing
Saudi Arabia	*H. scabra*	n/a	Sea ranching	National Prawn Company	n/a
Solomon Islands	*H. scabra*	n/a	Experimental	WorldFish Center	1996–2000
USA (Alaska)	*P. californicus*	n/a	Experimental	Alutiiq Pride Shellfish Hatchery	2010–ongoing
Vietnam	*H. scabra*	200,000+	Pond farming	RIA3	2001–ongoing

The total global catch of sea cucumbers is in the order of 100,000 tonnes of live animals annually (Purcell *et al*., 2010, 2012b). More than 66 species are now harvested around the world and exported to Asian markets (Choo, 2008; Conand, 2008; Kinch *et al*., 2008; Purcell *et al*., 2010; 2012a,b,c). In Indonesia, there have been more than 23 species come into market (Pradina *et al.*, 2012), such as teripang gamat (*S. hermannii*), teripang putih or teripang pasir (*Holothuria scabra*), teripang hitam (*H. edulis*), teripang getah or teripang keling (*H. vagabunda*), teripang merah (*H. vatiensis*), teripang coklat (*H. marmorata*) and teripang hitam (*H. Atra*). The area where sea cucumber exploited are Central Java, East Java, Bali, Nusa Tenggara Barat, Nusa Tenggara Timur, Iran, Sulawesi Tenggara, Sulawesi Selatan, West coast of Sumatera, Sumatera Utara dan Aceh (Wiadnyana *et al*., 2009).

As overfishing continues to diminish stocks of high-value sea cucumbers in the tropics such as in Indonesia (Anderson *et al*., 2010; Domínguez-Godino *et al*., 2015) and places more species in danger of extinction (Polidoro *et al*., 2011), it may need to close fishing of wild stocks. Sea ranching then faces a challenge of proving that harvests are from cultured animals or risk opening opportunities for black marketing of protected wild individuals and undermining conservation efforts (Eriksson *et al.*, 2012).

Small-scale fisheries for sea cucumbers have provided livelihoods for coastal communities in Indonesia for centuries (Pradina *et al*., 2012). However, increasing coastal populations, limited opportunities to earn income, and access to more effective fishing equipment have combined with three features of the biology of tropical sea cucumbers and the market place to cause chronic overfishing of these valuable resources. These three features are the ease with which sedentary sea cucumbers can be caught from shallow coastal waters (Lincoln-Smith *et al*, 2006), low and sporadic rates of recruitment (Uthicke, 2004; Uthicke *et al*., 2004; and intense demand for teripang or trepang or beˆche-de-mer (boiled and dried sea cucumbers) from exporteer country such as China (Lovatelli *et al*., 2004). In Indonesia, the sign of depleted sea cucumber stock showed by decreased production, reduced size of individual catch, farther and deeper fishing area, and more new species introduced in the market (Hartati *et al*., 2009a,b; Pradina *et al*., 2012).

Sea ranching is essentially a 'put and take' activity, where cultured or wild juveniles are released into an area of natural habitat and harvested when they reach a commercially optimal size (Bartney, 2007; Bell *et al.*, 2008a;b). Compared with intended sea cucumber culture, some advantage of sea ranching i.e. inputs are nominally lower, as the processes between release and harvest are largely left to nature and the level of care that can be offered to sea cucumber throughout the growth process is reduced, yet still able to produce matketable size of sea cucumber. Initial attempt on sea ranching for *H. atra* has been successfully conducted by Hartati et al. (2018). The sea cucumber are able to grow well in the bottom cage and sea cucumber give good feedback to the environment through their bioturbation and remineraliziation activity (Hartati et al., 2019).

Expanding current fishing practices into 'capture and culture' operations (concept of sea ranching) promises to create multiple, protected spawning aggregations to supply the recruits needed to replenish local fisheries. There are at least four advantages to this proposed way of restoring fisheries for sea cucumber. First, it does not require fishing patterns to be changed in open access fisheries, where sea cucumber of any size are often collected. Second, it provides incentives for fishers because they own the sea cucumber once they are placed in their sea pens. Third, it enables fishers to add great value to their catch because they can grow sea cucumber, at no or little cost for feed, to sizes where they obtain a premium price. Fourth, it changes the effects of the current harvesting regimes from damaging to improving the potential for replenishment by overcoming depensatory (‘Allee’) effects. (Bell *et al.*, 2008).

Grow-out in sea pens or in open sea-ranching will need to contend with risks of environmental perturbations, predation, poaching and social conflicts (Purcell et al., 2012). Sociological issues, such as governance, consultation and poaching, are significant and must be tackled at the outset. Therefore the concept of community based sea ranching where coastal community fully involved in rearing of the sea cucumber hopefully give succeed in sea cucumber production and conservation.

3. Methodology

Reseach Component

The research material were Teripang gamat (*Stichopus hermannii*) taken from Nyamuk Island Waters, Jepara, size of 45,0-139,07 grams as been used by Hartati, *et al*., (2005, 2018a); Xie, *et al.*, (2013) dan Zonghe *et al.*, (2014). The research was located in Nyamuk Island waters, Karimunjawa Islands-Jepara (Figure 2).

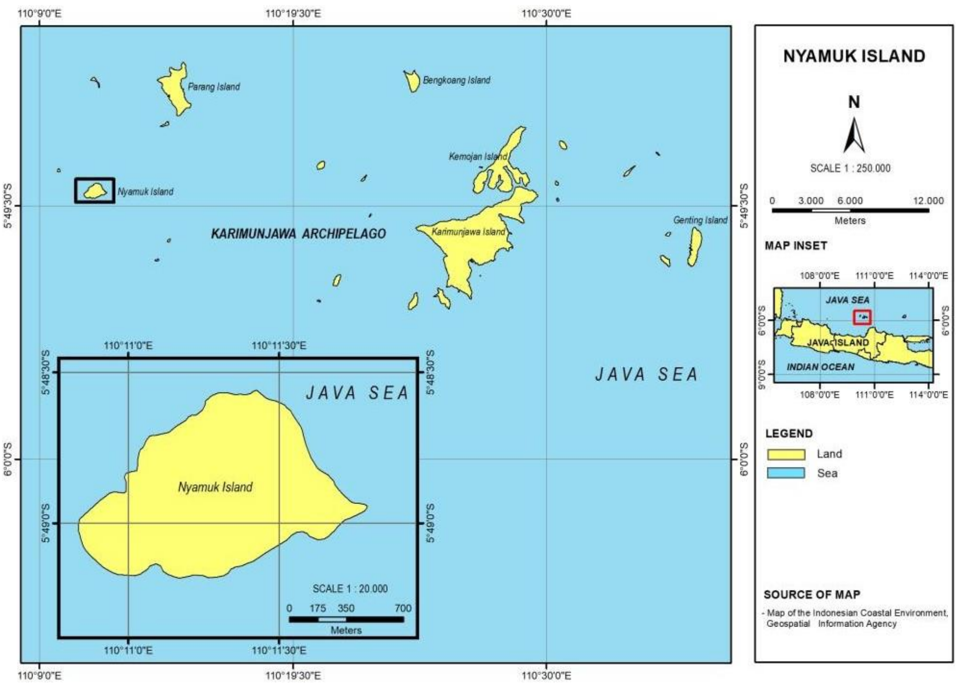


Figure 2. The research location of Nyamuk Island Waters, Karimunjawa Islands-Jepara

3.1. FGD with groups of fishering and processing sea cucumbers in P. Nyamuk

As community based sea ranching was conducted because it is important to involve and work closely with local communities and coastal communities will be involved from the start of the experiment. So Small Discussion Groups (FGDs) were held at the beginning to coordinate activities and increase their capacity and knowledge about sea cucumber cultivation.

3.2. Identification of sea cucumber species of Family Stichopudidae

Samples of gamet/gamat sea cucumbers were taken directly from fishermen, processors, traders and sea cucumber traders on Mosquito Island, Karimunjawa National Park. By fishermen, the collection relies on free diving (5-10 meters depth) (locations D, E, F) or compressor diving (10-25 meters depth) (locations A, B, C, G, and H) around The Island of Nyamuk, Krakalbesar dan Krakal Kecil. A map of where sea cucumber fishermen catch sea cucumbers is presented in Figure 3.

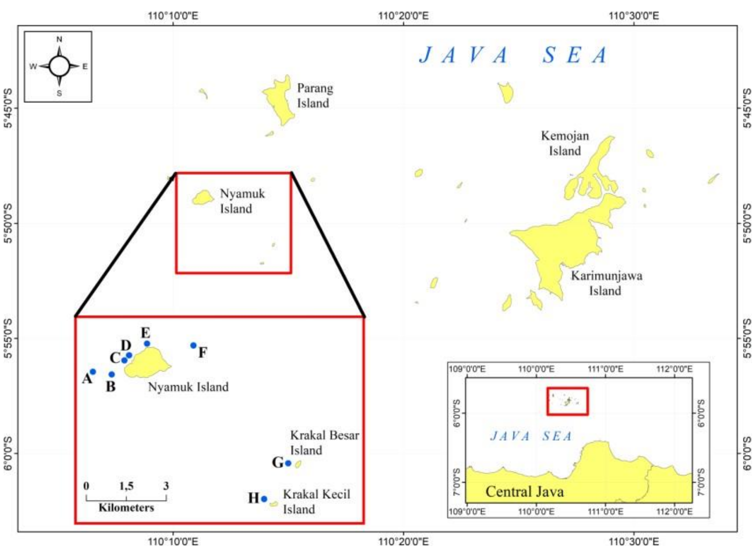


Figure 3. Sea cucumber fishing areas in Nyamuk Island and its surroundings (locations A, B, C, G, H = compressor diving; locations D, E, F = free diving)

All sea cucumbers are caught by hand. At the processing level, the samples taken are prior to processing, i.e. peeled, boiled, smoked or salted. Identification was carried out by means of fresh morphological characters, then the specimens were labeled, and fixed in 40% formalin overnight. The next day, the previous ethanol was removed and the specimen was preserved in 70% ethanol for longer preservation (Purwati *et al.*, 2010). Referred guides for species identification are Massin, (1996; 1999) and Samyn et al. (2006). The external morphology observed was the cross-sectional shape of the body, maximum body length, arrangement of papillae and tube feet, presence or absence of papillary protrusions, position of the mouth and rectum, no anal modifications, and the number of tentacles (Purcell *et al.*, 2012c; Wirawati and Purwati, 2004). 2016) (Figure 4).

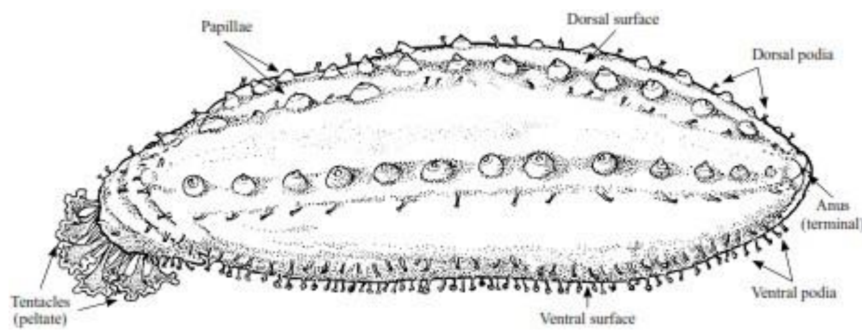


Figure 4. Main external anatomy of sea cucumbers (Purcell *et al*., 2012c)

***3.* 3. Build the Sea pens and their installation for Sea ranching *S. herrmanni*.**

As community based sea ranching will be performed during the experiment, it is important to engage and cooperate proposed activity with local community and the coastal community will be involved from the beginning of the experiment. So the Small Discussion group will be conducted as soon as this proposal funded to coordinate the activity as well as to increase their capacity and knowledge on sea cucumber culture.

Furthermore during present work we will determine the process of new habitat establishment in the sea raching location for *S. hermannii* and their performance. The best stocking density as result of previous experiment (Hartati *et al.*, 2018, 2021a) (Figure 5) will be applied in sea ranching, three unit of 5 X 5 meter^2 of sea pens will be set up in the coastal of Nyamuk Islands Waters of Karimunjawa Island-Jepara (Figure 6). Sea pens retain sea cucumbers in a defined area while allowing tidal, or current-driven, seawater exchange and access to naturally occurring sediments, seagrass and organic detritus. The position of the sea fence will be located accordingly so the effect of distance of the coastal to the sea fence will be determined. The sea cucumber will be stocked based on result of experiment by Hartati *et al.*, (2018). It will be no food addition for rearing of sea cucumber.

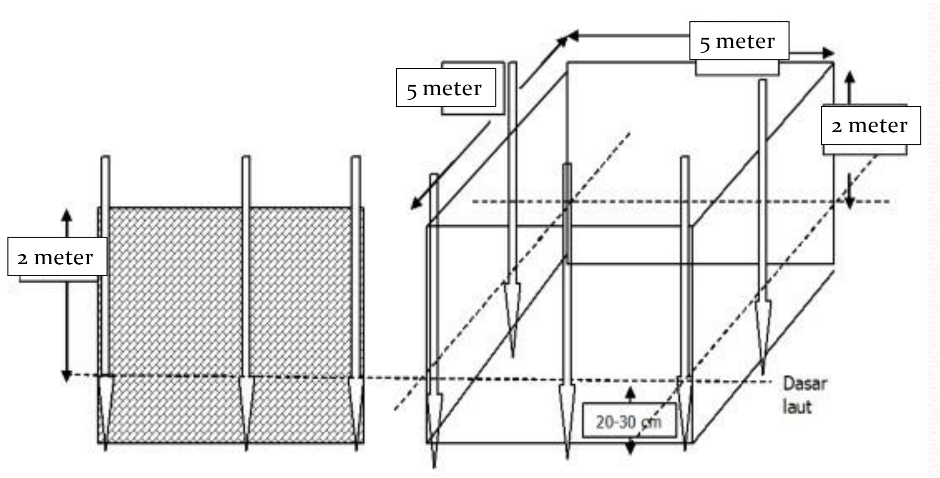


Figure 5. Sea pen design for sea cucumber ranching (Hartati *et al.*, 2018; 2021a)

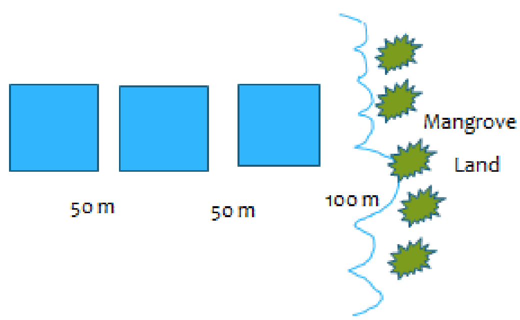


Figure 6. The position of sea pens for sea cucumber ranching

3.4. Stocking the sea cucumbers and research implementation

Sea cucumber species *S. herrmanni* collected by fishermen looking for sea cucumbers from the waters around the island of Nyamuk, Krakal Besar and Krakal Kecil were stocked with an initial stocking density of 0.8 individuals per m^2. The weight of the sea cucumbers at the beginning of stocking will be weighed. Base sediment and water samples will be taken monthly for biological, physical and chemical parameters. The biological parameters measured were shaped diatoms which were represented as chlorophyll-a, b, c, total carotene and phaeophytine. The physical parameters measured were temperature, salinity, organic matter, grain size, light penetration/turbidity. The chemical parameters measured were DO, pH, NO_3-N, PO_4-P. Sea cucumbers will be measured in length and weight to determine its growth.

3.5. Data Analises

During present work, chemical, physical, biologycal characteristic in more larger area will be analyses as the impact of sea susumber ranching. Process of habitat establishment in the location of sea raching for *S. hermannii* will be analysed. The behaviour of sea cucumber on new established habitat will be determined through their pattern of movement

The performance of sea cucumber (growth rate, Weight gain, specific growth rate and survival rate will be determined Weighing of sample will be done every month, and will be analys as growth rate (Weight gain) and specific growth rate as follows :

$$\text{Weight Gain} = W_2 - W_1$$

$$\text{SGR (\% d}^{-1}\text{)} = 100 \times (\ln W_2 - \ln W_1) / T$$

Noted : W_1 = Weight of esa cucumber at To, beginning of experiment (gram)

W2 = Weight of esa cucumber at Tn, end of experiment (gram)

Every 2 weeks, alive sample will be counted as survival rate as follows.

$$SR = (N_t / N_0) \times 100 \%$$

Noted : SR = Survival Rate (%)

Nt = Number sea cucumber alive at the end of experiment

No = Number sea cucumber stock at begining of experiment

To understand the effect of treatment , data will be analysed using two ways anova (Steel and Torrie, 1991).

4. Results and Discussions

4.1. Results

4.1.1. FGD with groups of fishermen catching and processing sea cucumbers in P. Nyamuk

The meeting was held on April 9, 2021 at the house of the group leader, Mr. Muntholib, which was attended by the village head P. Nyamuk and 12 members of the

“Maju Lancar” Sea Cucumber Catching and Processing Group (Figure 7). From the results of the FGD, information on the condition of sea cucumber stocks around the waters of P. Nyamuk often depends on the season. During hurricane season sea cucumbers are hard to come by. Group members know the importance of sea cucumber conservation. Group members welcomed the researcher's idea to initiate sea ranching for sea cucumbers in the waters of P. Nyamuk. The group members agreed with the Team to organize community-based sea cucumber activities, where sea ranching activities, starting from the establishment of cages, maintenance of sea cucumbers, monitoring the condition of sea cucumbers during sea ranching to harvesting will be carried out by the group under the guidance of the research team.

Figure 7. FGD of community-based sea ranching sea cucumbers in Nyamuk Island with the “Maju Lancar” Fishermen group

There were several obstacles during the implementation of this research, namely during the transition period, the ship did not always sail, so the schedule often changed according to the provisions of the harbormaster and paid attention to shipping safety. For this reason, it must adjust to the ship's schedule to Karimunjawa. The distance between P. Nyamuk and P. Karimunjawa is 2.5 hours sailing by motor boat, which also depends a lot on the season, weather and sea conditions. During the COVID-19 pandemic, the

Karimunjawa area is a green zone, so the requirements to enter the area are very strict. A Covid-19 free letter is required by doing an antigen-test.

In its implementation, according to the direction of the Head of the Nyamuk Village, the activity also involves the Youth Organization Group which can provide productive activities that can increase fishermen's income. In addition, it also raises awareness to do cultivation with the aim of supporting the conservation of sea cucumbers. The second and third monitoring of the growth of sea cucumbers was carried out by the team together with the Youth Organization Group “Bintang Muda” (Figure 8).

Figure 8. Community-based sea ranching activities with the Karang Taruna group “Bintang Muda”

In the process of implementing community-based sea ranching, all activities involve partner communities, starting with site selection, making and installing sea pens, selecting, spreading and maintaining sea cucumber seeds. Nine sea pens with designs have been made according to the designs of Hartati *et al.* (2018; 2021a) (Figure 4) measuring 5 x 5 x 2 meters3 and installed on the Beach near the P. Mosquito pier. Mounting location is 5°48'45.6"S 110°11'02.7"E. The material for the cage or sea pen is a net with a mesh of 1.5 cm, which will hold the sea cucumbers from leaving the cage. The sea pen is made of gelam wood and bamboo which is easily obtained from P. Mosquitoes. The bottom of the net will sink into the bottom, going 20-30 cm deep which will ensure the sea cucumbers do not escape from the cage. In order to prevent the nets from being lifted by the bottom current, a line of sand-filled sacks is placed which acts as a weight for the net.

4.1.2. Identification of sea cucumber species belong to Family Stichopudidae from Nyamuk Island

Sea cucumbers from the family Stichopodidae from the waters of Nyamuk island can be distinguished from the Family Holothuriidae, because the cross section of the body is as a whole trapezoidal in shape and the same diameter along the body. The body has a rough dorsal (dorsal) surface due to the presence of enlarged papillae or tubercular structures. Eleven species of the Stichopodidea family were found consisting of two genera (Stichopus and Thelenota), namely *Stichopus horrens, S. pseudohorrens, S. naso, S. vastus, S. chloronatus, S. hermannii, S. monotuberculatus, S. ocellatus, S. quadrifaciatus, Thelenota anax* and *T. ananas* (Figure 9).

The results of this research have been written in the form of an article entitled "Stichopudidae (Holothuroidea: Echinoderms) from Nyamuk Island, Karimunjawa National Park, Central of Java, Indonesia" which was received and presented at the International Seminar on Marine and Fisheries research UGM and presented on July 28-29 2021 via Webminar Online (Figure 10). Articles will be published in the Proceedings of the International Seminar indexed at SCOPUS according to the research outcome indicators (Table 1), namely Environment, Energy and Earth Science (E3S) Web of Conference Proceeding (Scopus Indexed). The letter of acceptance is presented in Figure 11.

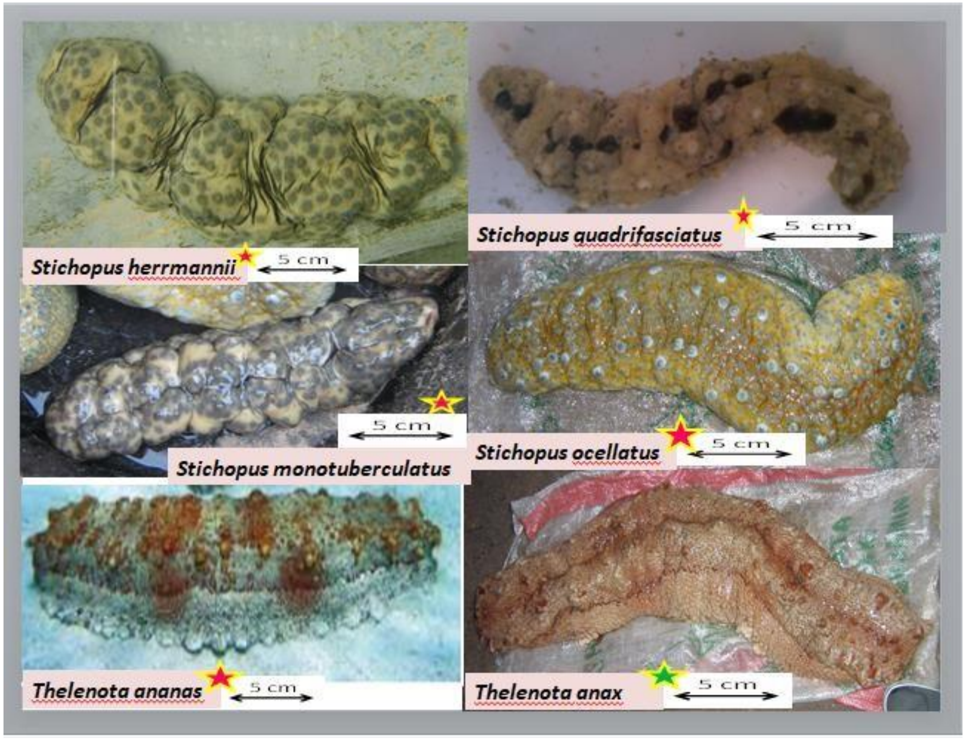
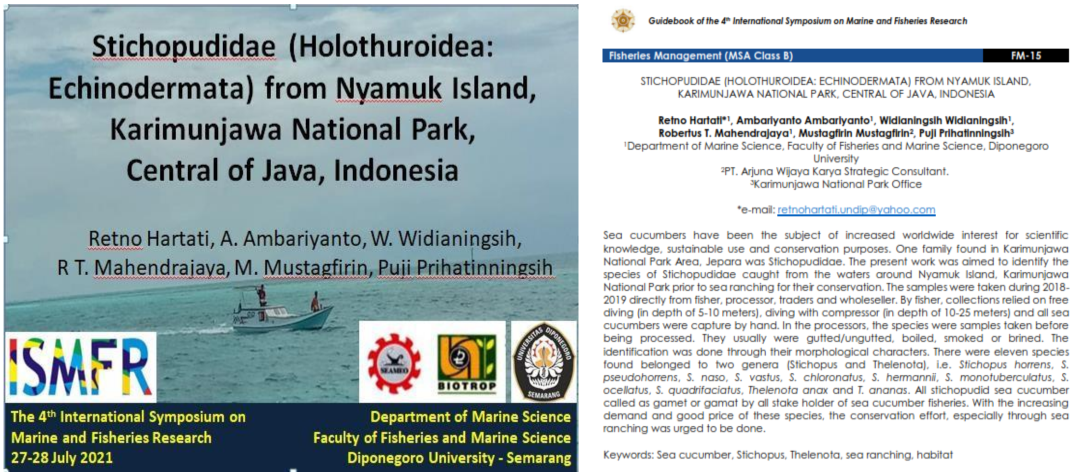


Figure 9. The sea cucumber species composition of Sthichopudidae from Nyamuk Island



Guidebook of the 4th International Symposium on Marine and Fisheries Research

Fisheries Management (MSA Class B) FM-15

STICHOPUDIDAE (HOLOTHUROIDEA: ECHINODERMATA) FROM NYAMUK ISLAND, KARIMUNJAWA NATIONAL PARK, CENTRAL OF JAVA, INDONESIA

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Sea cucumbers have been the subject of increased worldwide interest for scientific knowledge, sustainable use and conservation purposes. One family found in Karimunjawa National Park Area, Jepara was Stichopudidae. The present work was aimed to identify the species of Stichopudidae caught from the waters around Nyamuk Island, Karimunjawa National Park prior to sea ranching for their conservation. The samples were taken during 2018-2019 directly from fisher, processor, traders and wholeseller. By fisher, collections relied on free diving (in depth of 5-10 meters), diving with compressor (in depth of 10-25 meters) and all sea cucumbers were capture by hand. In the processors, the species were samples taken before being processed. They usually were gutted/ungutted, boiled, smoked or brined. The identification was done through their morphological characters. There were eleven species found belonged to two genera (Stichopus and Thelenota), i.e. *Stichopus horrens, S. pseudohorrens, S. naso, S. vastus, S. chloronatus, S. hermannii, S. monotuberculatus, S. ocellatus, S. quadrifaciatus, Thelenota anax* and *T. ananas*. All stichopudid sea cucumber called as gamet or gamat by all stake holder of sea cucumber fisheries. With the increasing demand and good price of these species, the conservation effort, especially through sea ranching was urged to be done.

Keywords: Sea cucumber, Stichopus, Thelenota, sea ranching, habitat

Figure 10. Seminar presentation slides and Seminar Article Abstracts

ISMFR

The 4th International Symposium on Marine and Fisheries Research

Yogyakarta, 23 August 2021

Dear Dr. Retno Hartati,

Thank you for submitting your manuscript to the Proceeding of the 4th International Symposium on Marine and Fisheries Research (ISMFR) by IOP. After a careful review process, we are pleased to inform you that your manuscript entitled: Stichopudidae (Holothuroidea: Echinodermata) FROM NYAMUK ISLAND, KARIMUNJAWA NATIONAL PARK, CENTRAL OF JAVA, INDONESIA with authors: Retno Hartati; Ambariyanto; Widianingsih; Robertus Triaji Mahendrajaya; Mustagfirin; and Puji Prihatinningsih is consider to be accepted and will be published in our proceeding.

In order to proceed to publish your submission, we will need you to submit the following:

1. The article files which have been revised according to the reviewer comments and formatted as suggested by IOP (only articles meet the format will be continued to the publication process) in the form of both .pdf and .doc/.docx (MS Word) formats.
2. The proof of the publication payment IDR. 1.500.000,00 to Bank Mandiri Account Number VA 8888812014111598 an. UGM PPN KAF LAT/SEM SEMNASKAN.

before September, 30 2021. The failure to meet the above requirements before the deadline will result in the cessation of the publication process.

Thank you for your attention and cooperation.

Sincerely,
ISMFR Chairperson

Dr. Indah Istiqomah

Figure 11. ISMFR 2021 participation certificate and article LOA

4.1.4. The growth and survival of the *Stichopus herrmannii*

The distribution of gamete sea cucumbers (**S. herrmannii**) as many as 30 individuals/sea pens has been carried out by fishermen who are members of the Maju Lancar Fishing Group" (Figure 12) with lengths ranging from 9.9-19 cm (average 14.95 cm) and weight ranging from 45.0-139.07 grams (with an average weight of 137.34

grams) (Table 3). At the time of implementation, water quality measurements and sediment sampling at the sea pen location were also carried out to find out initial data on the basic condition of the sea pen before sea ranching was carried out.

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Figure 12. Stocking of sea cucumber seeds in sea pens for sea ranching

Table 3. Morphometry of sea cucumber *Stichopus herrmanni* in sea pen during sea ranching

Paremeter	Month - 0		Month - 1		Month - 2		Month - 3	
	Length (cm)	Weight (gr)	Length (cm)	Weight (gr)	Length (cm)	Weight (gr)	Length (cm)	Weight (gr)
SEA PEN 1								
Average	14,87	137,57	17,32	162,19	22,66	188,80	28,17	225,46
±SD	1,96	25,41	2,51	21,95	2,22	20,24	1,64	17,50
Max	19,0	190,0	23,0	203,0	28,0	221,1	32,0	243,2
Min	11,0	100,0	13,0	123,0	19,0	141,8	25,0	182,3
SEA PEN 2								
Average	15,24	139,07	16,91	152,96	20,52	173,54	25,03	203,06
±SD	1,84	13,58	1,79	16,29	1,83	15,99	1,60	16,22
Max	18,0	166,0	19,9	187,0	24,2	203,2	28,6	234,0
Min	9,9	109,0	12,8	123,0	18,2	143,0	23,2	172,0
SEA PEN 3								
Average	14,73	136,38	15,69	145,96	19,29	167,17	23,00	188,27
±SD	1,71	26,85	1,49	22,10	1,58	19,49	1,39	16,51
Max	19,0	190,0	18,0	201,0	22,1	207,0	25,5	222,0
Min	11,0	45,0	13,0	122,0	16,1	149,2	21,2	170,1

The morphometric data in Table 3 represent the mean, maximum and minimum length and weight of sea cucumbers from the beginning to the end of the study. It appears that in general, sea cucumbers kept in sea pens installed near the coast have a length and weight greater than the two sea pen positions. Sea cucumbers kept in open locations with the open sea had the lowest length and weight (Figures 13 and 14).

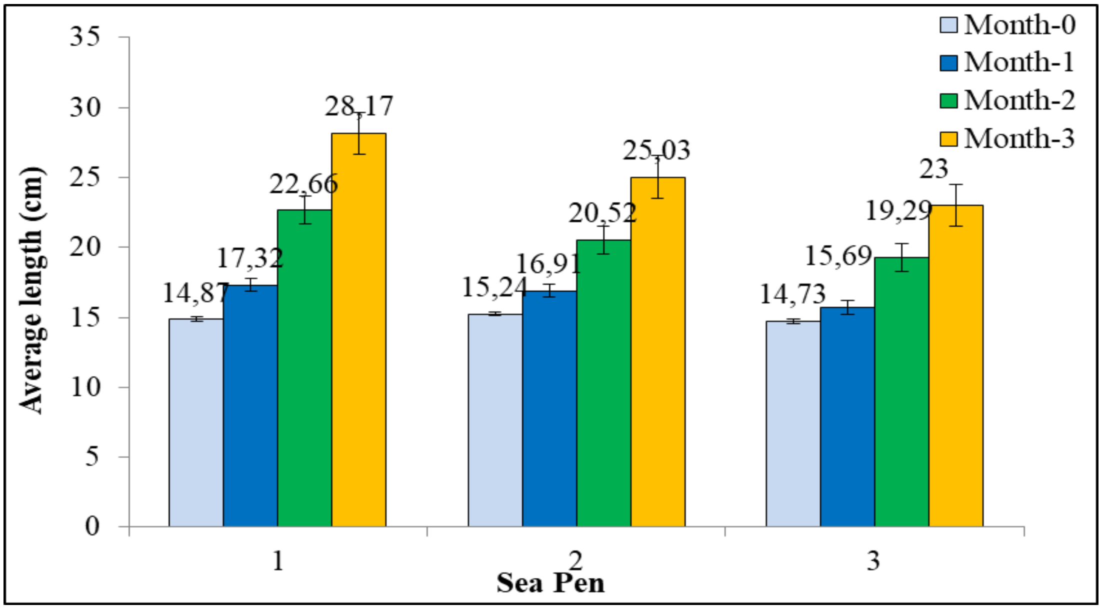

Figure 13. Average length (± SD) of sea cucumber (cm) *Stichopus herrmanni* at sea pen during sea ranching

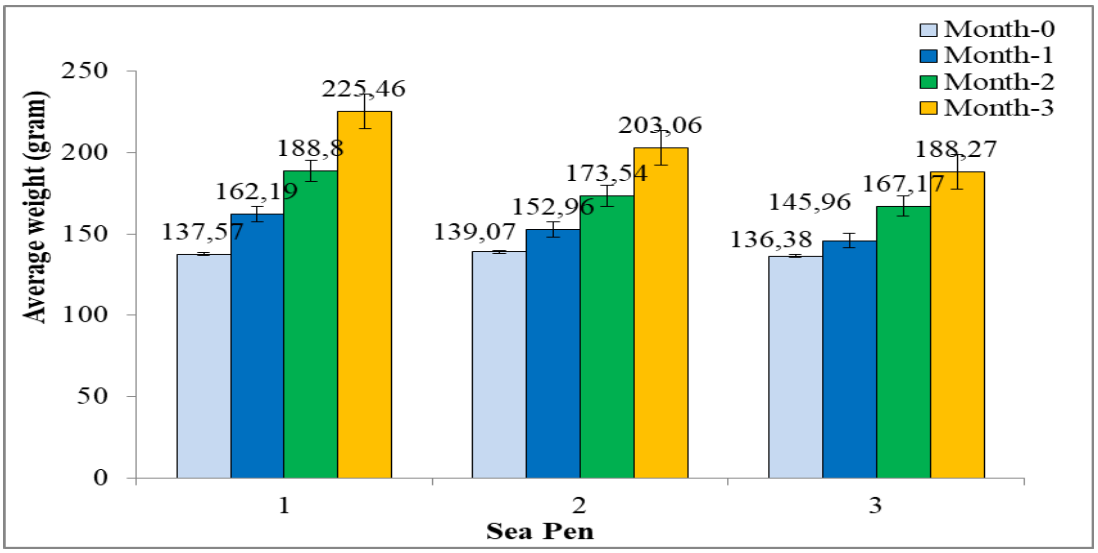

Figure 14. Average weight (± SD) of sea cucumber (gr) *Stichopus herrmanni* at sea pen during sea ranching

The absolute growth of sea cucumbers in the form of length and weight gain on sea pen 1 was higher than that of sea pen 2 and 3, namely 13.3 cm and 87.89 grams (Figure 15). The specific growth in length and weight of sea cucumbers was 0.71 and 0.55%/day (Figure 16).

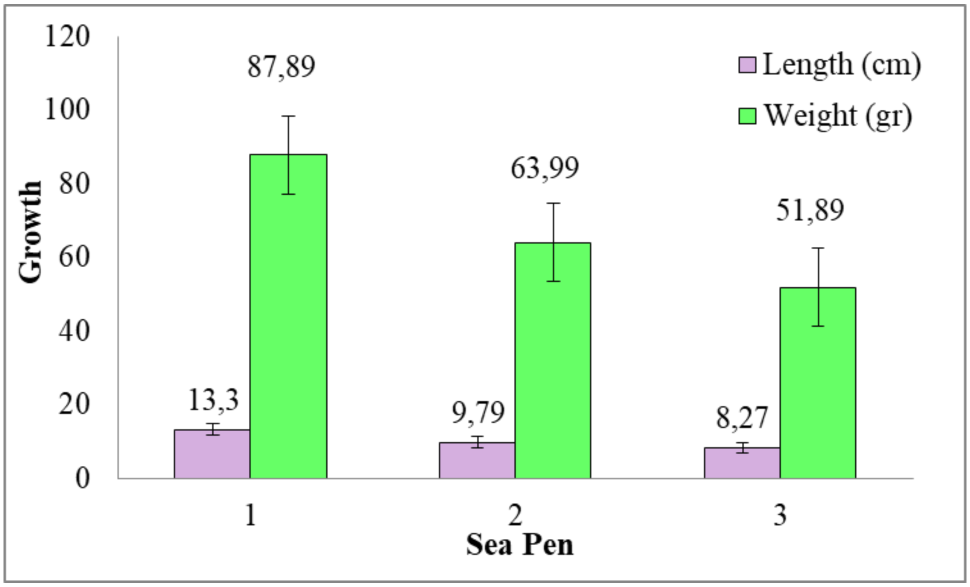

Figure 15. The absolute growth of length (cm) and weight (gr) of *Stichopus herrmanni* in the sea pen during sea ranching

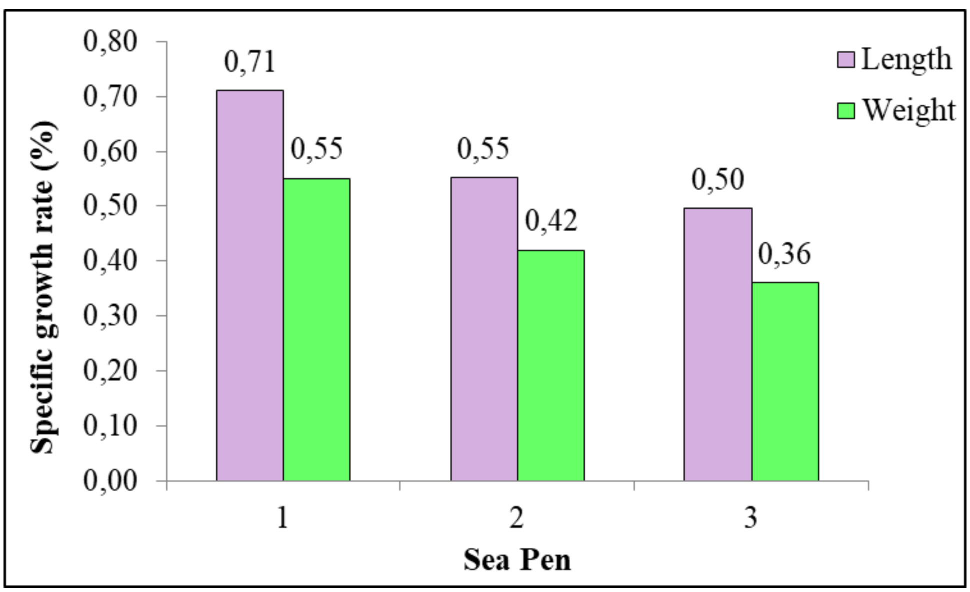

Figure 16. Specific growth of length and weight (%/day) of Stichopus herrmanni in sea pen during sea ranching

At the time of weighing the sea cucumbers, the number of sea cucumbers that are still alive in the sea pen is also counted every month and the results are presented in Figure 17. From this number, the survival rate is calculated. It appears that sea pen 1 has the highest survival (71%) compared to other sea pens (Figure 18).

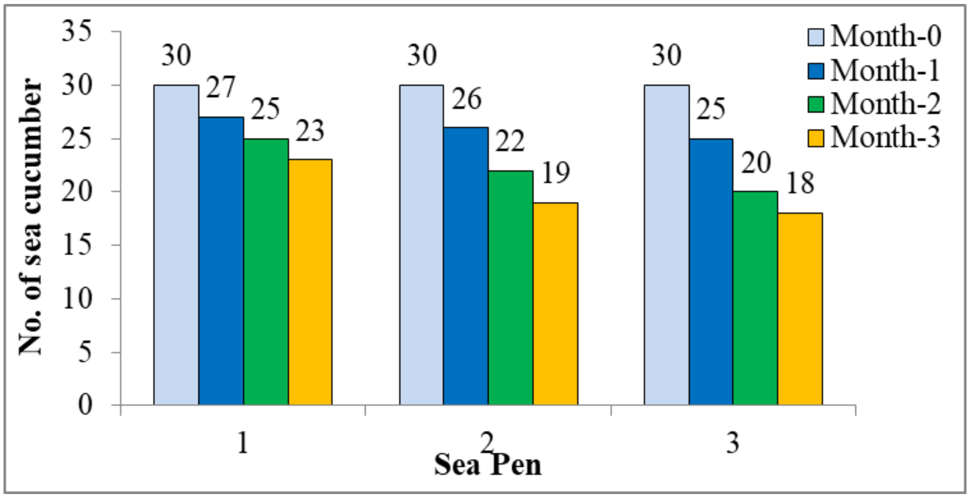

Figure 17. Number of sea cucumbers (individuals) *Stichopus herrmanni* in the sea pen during sea ranching

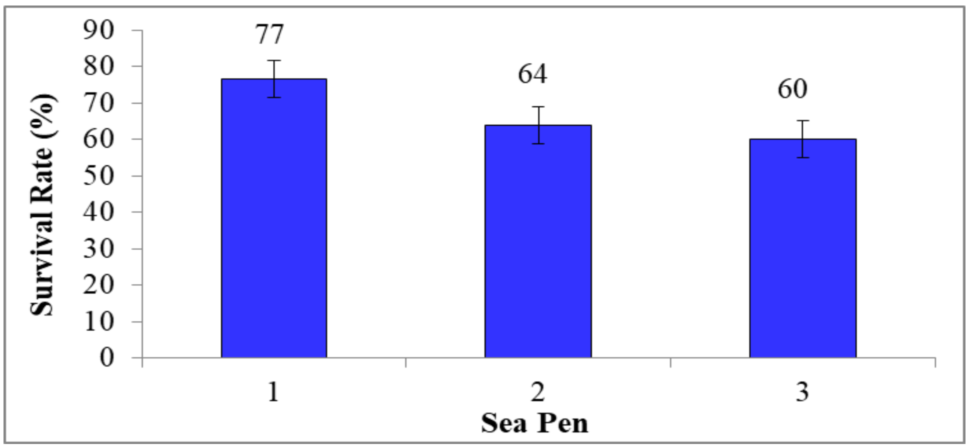

Figure 18. Survival rate (%) *Stichopus herrmanni* on sea pen during sea ranching

Water quality was also measured during the maintenance of sea cucumbers at sea ranching. It appears that the temperature, salinity and dissolved oxygen ranges are 28.5-29.5^{o}C, respectively; 30.2-30.6 ppt, and 7.2-8 (Figure 19).

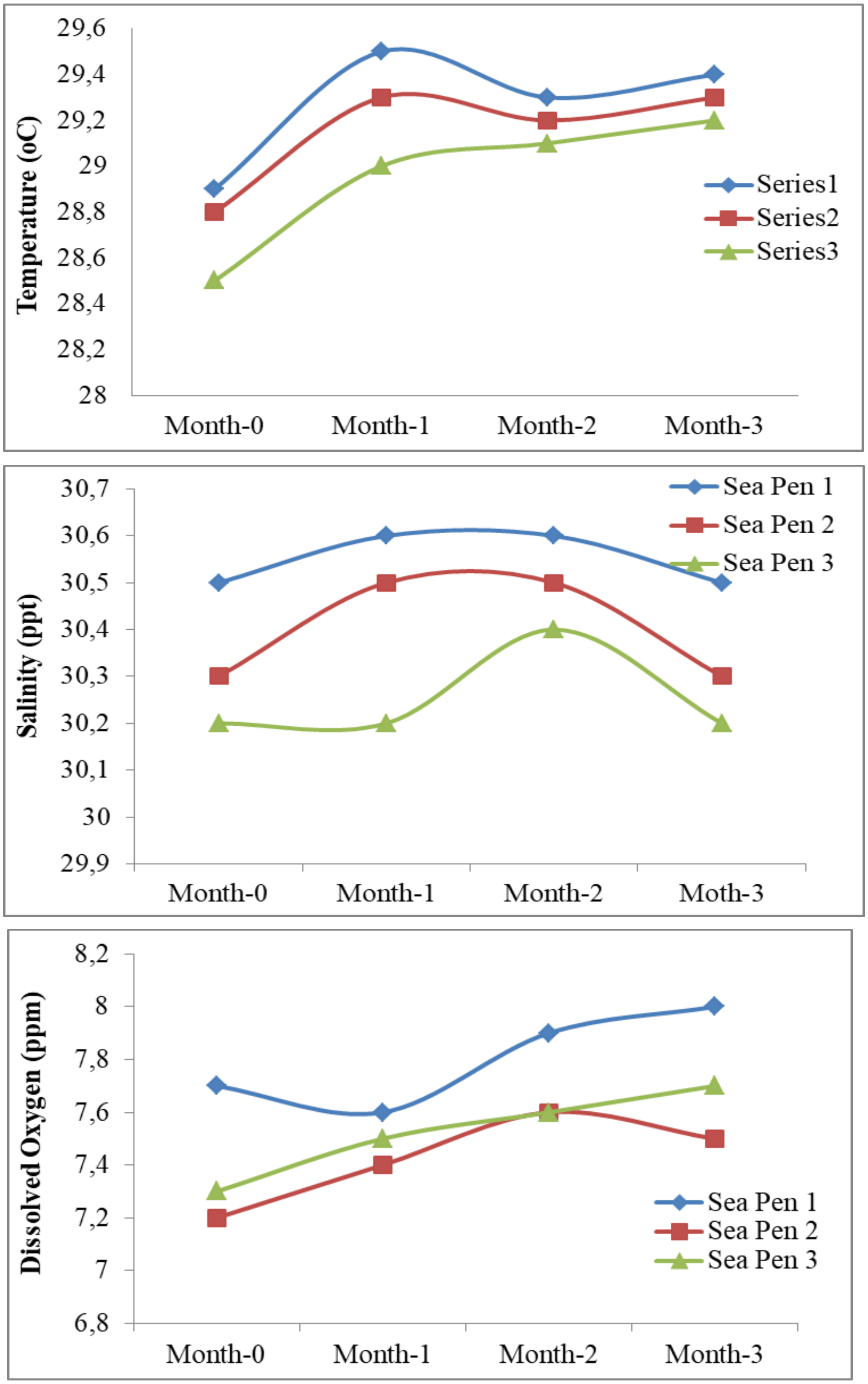

Figure 19. Seawater quality (temperature, salinity, and dissolved oxygen) at sea pen ranching *S. herrmanni*

The impact of sea ranching *S. herrmanni* on the sediment was also observed, namely by measuring changes in nitrate and phosphate in the sediment. In both sea pens 1, 2, and 3, the nitrate concentration increased from the beginning to the end of the study (Figure 20), as did the phosphate concentration. Sediment changes also appear in the character of the sediment particle size. Figure 21 shows that the amount (%) of gravel decreased in the three sea pens, coarse sand varied slightly in sea pens and 3, but generally decreased in levels. There was an increase in fine sand in the three sea pens. Meanwhile, the silt content decreased (Figure 21). Chlorophyll-a concentration; Chlorophyll-b, chlorophyll-c, total carotene and phaeophytine in the sediment (mg/g) of S. herrmanni sea pen ranching (Figure 22) at the end of rearing were reduced compared to the beginning of stocking, while the control was not much different

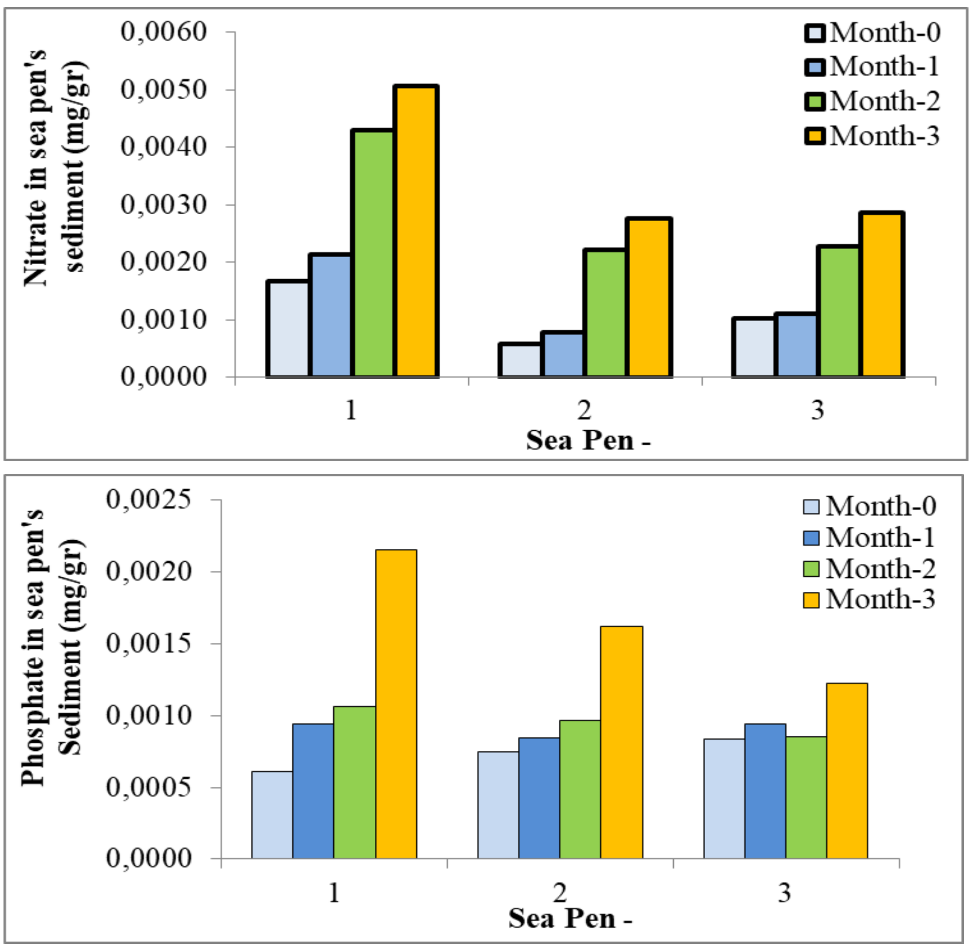

Figure 20. Concentration of nitrate dan phosphate (mg/gr) in the sediment of the sea pen sea ranching *S.herrmanni*

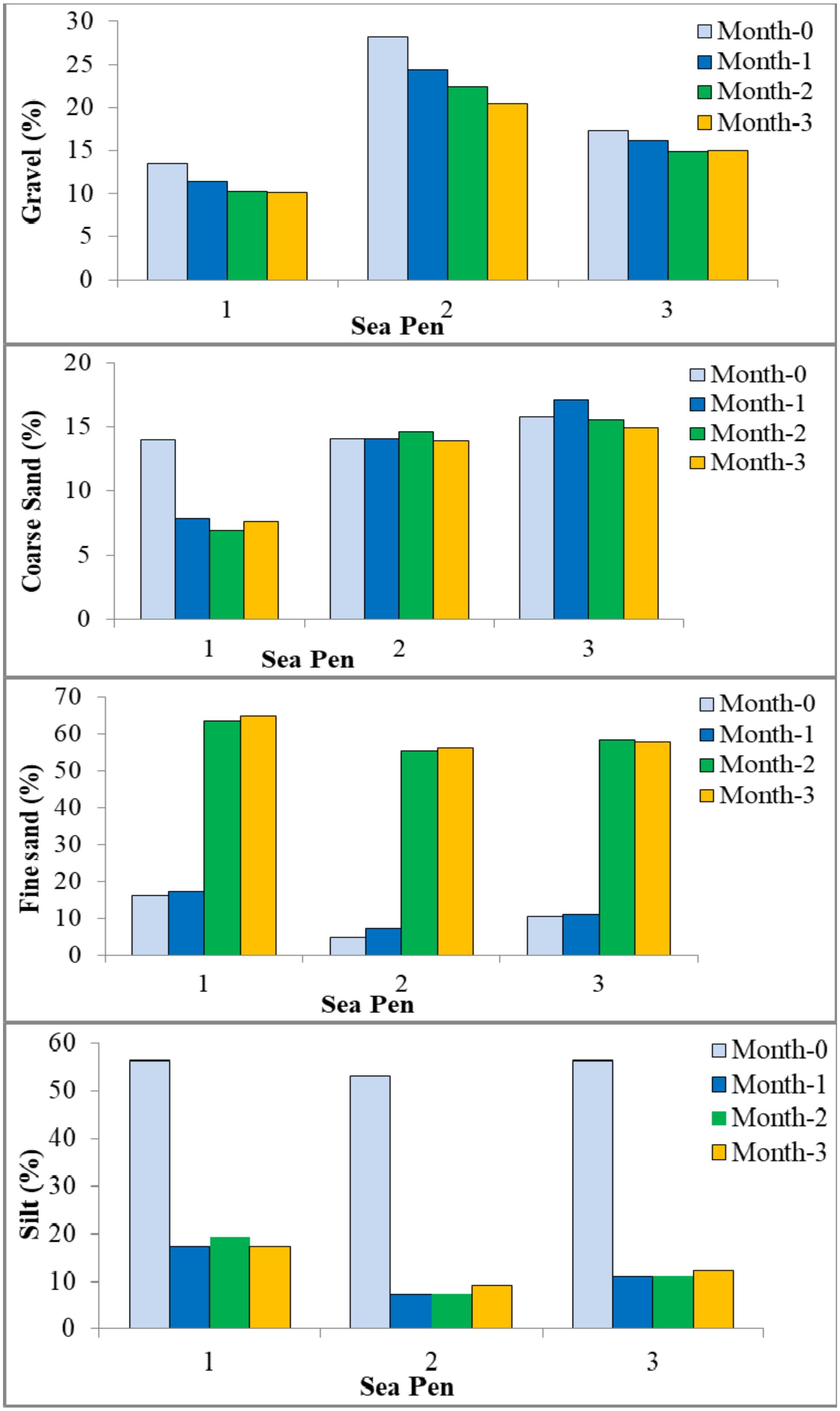

Figure 21. Grain size composition in the sedimen (%) on sea pen ranching *S. herrmanni*

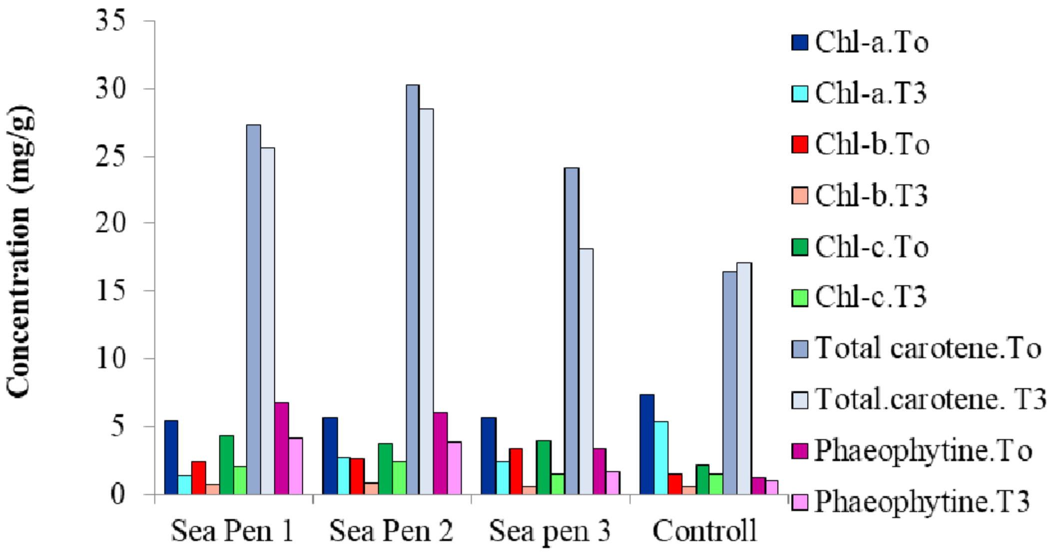

Figure 22. Chlorophyll-a concentration; Chlorophyll-b, chlorophyll-c, total carotene and phaeophytine in sediment (mg/g) on sea pen ranching *S. herrmanni*

4.2. Discusssions

4.2.1. Species composition of Stichopudid Sea cucumber from Nyamuk Island.

Sea cucumbers are now considered as an important marine invertebrate resource, not only important for marine ecosystems, but also for global trade and livelihoods (Toral-Granda *et al*., 2008). Therefore sea cucumbers have also become the subject of increasing worldwide interest for scientific knowledge, sustainable use and conservation purposes (Purcell *et al*., 2013). consists mainly of sea cucumbers which are commercially traded in Indonesia and have high commercial value because of their medicinal and edible properties. Species members of the family Stychopodidae are usually nocturnal; during the day, it remains hidden in crevices of coral, seagrass, rocks or other. Therefore, Nyamuk Island fishermen, both free and compressor diving, go fishing for sea cucumbers at night.

On Nyamuk Island, eleven species of the Stichopodae family were found which belong to two genera (Stichopus and Thelenota), namely *Stichopus horrens, S. pseudohorrens, S. naso, S. vastus, S. chloronatus, S. hermannii, S. monotuberculatus, S. ocellatus.* , *S. quadrifaciatus, Thelenota anax* and *T. ananas* (Fig. 7). Only two species, *T. ananas* and *S. herrmanni* are classified under the IUCN status as Endangered (high risk of extinction) and Vulnerable, and both populations are declining (Conand *et al.*, 2014).

Due to the absence of a sea cucumber management plan, it causes overfishing of sea cucumbers and a gradual decline in natural resources. It is recommended that a number of suitable protected areas be established around several islands, minimum catch sizes for different species are established, along with the establishment of legal fishing seasons for sea cucumbers. In addition, applied research has been carried out on asexual reproduction; economically valuable species of sea cucumbers (Hartati *et al*., 2013; 2016) and the results can be applied to the long-term sustainability of natural populations of sea cucumbers. Like other members of the Stichopodidae family, due to high demand and good economic value, *S. herrmanni* is very vulnerable to overexploitation. Therefore, urgent management efforts are needed (Purcell *et al*., 2013) and conservation efforts, such as sea ranching for sea cucumbers (Hartati *et al*., 2021a,b).

4.2.2. The Length and Weight Growth of *S. herrmanni* in the sea ranching using sea pen.

Sea ranching has been carried out on several species of sea cucumbers, including *H. scabra* (Juinio-Meñez *et al.*, 2012; Hair *et al*., 2016a; Rizqi and Supono. 2019); *H. atra* (Hartati *et al.,* 2018; 2021a,b), *H. argueensis* (Domínguez-Godino et al., 2015), and in this study *S. hermannii*. The selection of the location for the waters of Nyamuk Island for sea cucumber activities is based on research by Hartati *et al*., (2017; 2018). For species *H. atra* class Holothuroidea (Hartati *et al*., 2015) the determination of the location of sea ranching is carried out based on habitat characteristics (Hartati *et al*., 2017) and the abundance of natural food potential for sea cucumbers (Hartati *et al.,* 2017; 2020b) and use sea pen as a container for sea ranching (Hartati *et al.*, 2018). In this study, it was developed for different species, namely *S. hermannii* which has a high economic value (Purcell *et al*., 2012c).

In this study, sea ranching with a stocking density of 30 individuals of sea cucumber *S. herrmanni* per sea pen with an initial length ranging from 9.9-19 cm (mean 14.95 cm) and weight ranging from 45.0-139.07 grams (with an average weight of 137.34 grams) (Table 3) has progressed quite well. Large size stockings of sea cucumbers were also carried out for *Apostichopus japonicus* (Chen, 2004) and *H. scabra* (Rougier *et al*., 2013). Because according to Dumalan *et al*. (2019) the increase in survival with increasing size at the time of stocking is due to a decrease in susceptibility to predation. As the sea cucumber gets bigger, its body wall thickens and becomes harder. This is considered the main line of defense against predators which can increase with increasing body size and swelling or stiffness of the sea cucumber's body in the presence of predators.

In the last measurement after sea ranching for 3 months, the length and weight of sea cucumbers ranged from 23-28.17 cm and 188.27-225.46 grams (Figures 13 and 14). The absolute length and weight growth of sea cucumber gametes in this sea ranching experiment ranged from 8.27-13.3 cm and 51.89-87.89 grams in 3 months (Figure 15) or 0.50-0.71 and 0.36- 0.55% per month (Figure 16). Optimum growth of sea cucumbers depends on a good environment and the carrying capacity of the sea ranching system (Juinio-Meñez *et al.,* 2013). The estimated carrying capacity of the sea pen in this study is lower than that in tank-based aquaculture, according to Battaglene *et al.* (1999) is possible in part because environmental conditions in marine-based cultural systems are more dynamic. For example, high water movement during strong storms during the rainy season can decrease sediment quality. Coupled with very high rainfall and lower seawater temperatures (Dumalan *et al.,* 2019), the growth rate decreased and thus resulted in lower biomass at the end of rearing. Thus, a better understanding of the environmental conditions of a particular sea ranching location and the interaction between water quality parameters is very important in site selection for increasing the scale of sea cucumber cultivation through sea ranching efforts.

During rearing *S. hermannii* experienced a decrease in the number of survivors (Figure 17), but Sea pen 1 produced the highest life (77%; Figure 18). This survival rate is quite high compared to maintenance on other species, for example on *H. scabra* (Hair *et al*., 2011; James, 2012; Juinio-Me˜nez and Dumalan, 2012; Juinio-Me˜nez *et al*., 2013; Purcell *et al.,* 2012a; Robinson and Pascal, 2012; Rougier *et al.,* 2013), this is possible because the stocked size is quite large and there are no predators in the sea pen, as was the case in Hartati *et al*. (2021a), in *H. atra*. Small stockings will result in low survival rates due to predation, stress during transport to sea ranching locations, freshwater input, being swept away by strong currents, escaping from sea pens, and extreme weather (Purcell, 2004; Robinson and Pascal, 2012). And predation is the main cause (Robinson and Pascal, 2012). Predators of sea cucumbers are fish, crustaceans, starfish, and gastropods (Knopp, 1982; Francour, 1997; Dance et al., 2003; Zamora and Jeffs, 2013). To minimize predation, Hair *et al.* (2016a) suggested 4 things, namely maximizing the size of stocked sea cucumbers, improving stocking techniques to reduce stress, removing predators, and protecting against predators. However, for sea ranching with an open system (without a sea pen), controlling predators will be more difficult.

Water quality conditions and habitat characteristics also affect the success of *S. hermannii* sea ranching. During rearing in the sea pens, water quality (temperature, salinity, and dissolved oxygen were still within the normal range for sea cucumbers (Dissanayake and Stefansson, 2012; Zamora and Jeffs, 2012; Günay *et al.*, 2015). The characteristics of nitrate and phosphate are more closely related. to the density of seagrass which serves as a shelter for sea cucumbers, especially small ones (Hartati et al., 2020a). Grainsize sediments in sea pens which tend to be sandy mud become good habitats for sea cucumbers (Tolon *et al.,* 2015). will hide and immerse themselves in the substrate during the day (Altamirano *et al*., 2015) or when water quality conditions are not good, such as low salinity or high temperature (Hamel *et al*., 2001), and appear at night. foraging (Hair *et al*., 2016). Shi *et al.* (2015) found that for sea cucumbers, mud and sand, as feed ingredients, may regulate the residence time of feed in the digestive tract of sea cucumbers. n sand contains nutrients that serve as feed, and provide a better growth performance impact.

Benthic microalgae have an important role as a food source for higher trophic levels in shallow water and play an important role in food webs in estuaries (Hartati *et al.,* 2019; 2020a,b). Algae biomass in seawater and sediments was assessed by measuring chlorophyll-a, -b, -c and the results are presented in Figure 22. Chlorophyll-a in sediments is a representation of the pigments of benthic microphytobenthos or microalgae (Kuczynska *et al.,* 2015) which is feed from sea cucumbers (Hartati et al., 2017; 2020b). The content of chlorophyll-a, b, c, total carotene and phaeophytine decreased during maintenance (Figure 22). According to Viyakarn *et al.* (2020) sea cucumbers significantly reduced the chlorophyll-a content of the sediments associated with the bioturbation activity of this species.

Aquaculture or sea ranching to produce high value sea cucumber species through this activity has been proposed as an option to increase market supply and help reduce fishing pressure on sea cucumbers on their natural stocks (Eriksson *et al.,* 2012; Purcell *et al.*, 2012a). Apart from socio-economic considerations, depletion of sea cucumbers affects the integrity of benthic ecosystems as they are important macrofauna consumers and the biotribulation ability of ecosystems due to their ability to process sea surface sediments (Purcell *et al.*, 2016).

4.2.3. Community based sea cucumber ranching

Data on sea cucumbers in Indonesia are very limited. Program restocking 4 types of sea cucumbers in Karimunjawa Island (BTN Karimunjawa 2009) but there is no monitoring and evaluation program so there is no information about the results. Another job is marine farm 150 indv. *H. scabra* in Buleleng Waters, Bali (1 March 2018) conducted by the Department of Marine Science-Univ. Ganesha, BBRBL, Gondol, KKP, NGO) but only limited to the ceremonial release of animals and there is no other information.

The initial community-based sea ranching activity for *S. herrmanni* was carried out by conducting FGDs to involve the community involved in catching sea cucumbers to preserve the existing stock in the waters of Nyamuk Island and its surroundings. Community-based sea ranching activities have also been carried out for the sea cucumber species H. scabra which has high economic value (Rizqi and Supono, 2019), as well as for *H. atra* which has low economic value (Hartati *et al.,* 2021a;b), with satisfactory results. good.

Small-scale fisheries for sea cucumbers have provided livelihoods for coastal communities in Indonesia for centuries (Pradina *et al.*, 2012). However, increasing coastal populations, limited income-generating opportunities, and access to more effective fishing gear have combined with the three biological characteristics of tropical sea cucumbers and markets leading to chronic overfishing of this valuable resource. These three characteristics are the ease with which settled sea cucumbers can be caught from shallow coastal waters (Lincoln-Smith *et al,* 2006), low and sporadic recruitment rates (Uthicke, 2004; Uthicke *et al.*, 2004) and strong demand for sea cucumbers or sea cucumbers. beˆche-de-mer (boiled and dried sea cucumbers) from exporting countries such as China (Lovatelli *et al*., 2004). In Indonesia, signs of depleting sea cucumber stocks are indicated by decreased production, reduced individual catch sizes, fishing areas that are getting farther and deeper, and more new species being introduced to the market (Hartati *et al*., 2009a, b; Pradina *et al*., 2012).

Sea ranching is essentially a 'put and take' activity, where farmed or wild seeds are released into areas of natural habitat and harvested when they reach commercially optimal size (Bartney, 2007; Bell *et al*., 2008a; b). There are several advantages of sea ranching of sea cucumbers, namely nominally lower inputs, because the process between release and harvest is largely left to nature and the level of care that can be offered to sea cucumbers during the growth process is reduced, but still able to produce marketable size sea cucumbers. Early attempts at marine aquaculture for H. atra were successfully carried out by Hartati *et al.* (2018). Sea cucumbers are able to grow well at the bottom of cages and sea cucumbers provide good feedback for the environment through bioturbation and remineralization activities (Hartati *et al.*, 2019).

Extending current fishing practices into 'catch and aquaculture' operations (the concept of sea ranching) promises to create many protected spawning aggregations to supply the recruits needed to replenish local fisheries. There are at least four advantages of this proposed way of restoring fisheries for sea cucumbers. First, there is no need to change fishing patterns in open access fisheries, where sea cucumbers of any size are often collected. Second, providing incentives for fishermen because they already have sea cucumbers after being placed in cages. Third, it allows fishermen to add high value to their catch because they can grow sea cucumbers, with no or little cost for feed, to a size where they get a premium price. Fourth, changing the effect of the current harvesting regime from damaging to increasing the filling potential by overcoming the depensatory effect ('Allee'). (Bell *et al.,* 2008).

Growing in sea pens or in open sea ranching may be at risk of environmental disturbance, predation, hunting, and social conflict (Purcell **et al**., 2012b). Sociological issues, such as governance, consultation, and poaching, are critical and must be addressed from the outset. This study involved more groups, namely the “Maju Lancar” fisherman group and the “Bintang Muda” youth group, which showed good results. Therefore, the concept of community-based sea farming or sea ranching where coastal communities are fully involved in the maintenance of sea cucumbers is expected to provide success in the production and conservation of sea cucumbers.

5. Consclusions and Recommendations

5.1. Consclusions

1. On Nyamuk Island, there are eleven species of the family Stichopodidae consisting of two genera (Stichopus and Thelenota), namely *Stichopus horrens*, *S. pseudohorrens*, *S. naso*, *S. vastus*, *S. chloronatus*, *S. hermannii*, *S. monotuberculatus*, *S. ocellatus*, *S. quadrifaciatus*, *Thelenota anax* and *T. ananas*. This sea cucumber is referred to be Gamat or gamete sea cucumber.
2. *S. hermannii* has been successfully reared in sea ranching using a sea pen. The absolute growth of length and weight were in the ranged from 8.27 to 13.3 cm and 51.89 to 87.89 grams with the best specific growth of length and weight of sea cucumbers being 0.71 and 0.55% per day. The survival rate of sea cucumbers reared for 3 months ranges from 60-77%.

5.2. Recommendations

1. Of the eleven species found in the waters of Pulau Nyamuko, only two species, *T. ananas* and *S. herrmanni* are classified under the IUCN status as Endangered (high risk of extinction) and Vulnerable, and both stock populations are declining. With increasing demand and good prices for this species, conservation efforts, especially through aquaculture or sea ranching, are urgently needed.
2. Community-based sea cucumber cultivation or sea ranching can be recommended to be replicated in other areas in collaboration with coastal communities.

6. Personal Investigator and other researcher

No.	Name	NIDN	Speciali-zation	Time alocation (Hours/week)	Job description
1.	Prof. Dr. Ir. Ambariyanto, MSc.	0013046102	Marine Biology	4	To coordinate all research activity and responsible for

					publications
2	Dr.Ir. Retno Hartati, MSc.	0011076209	Marine Biology	4	Sea cucumber rearing and community service
3.	Dr. Ir. Widianingsih, MSc.	0025066706	Marine Science	3	Water quality measurement & Data analyses

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Appendix 1. Article presented in InternationaL Seminar Fisheries and Marine Research UGM 2021

Stichopudidae (Holothuroidea: Echinodermata) from Nyamuk Island, Karimunjawa National Park, Central of Java, Indonesia

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Abstract. Sea cucumbers have been the subject of increased worldwide interest for scientific knowledge, sustainable use and conservation purposes. One family found in Karimunjawa National Park Area, Jepara was Stichopudidae. The present work was aimed to identify the species of Stichopudidae caught from the waters around Nyamuk Island, Karimunjawa National Park prior to sea ranching for their conservation. The samples were taken during 2018-2019 directly from fisher, processor, traders and wholeseller. By fisher, collections relied on free diving (in depth of 5-10 meters), diving with compressor (in depth of 10-25 meters) and all sea cucumbers were capture by hand. In the processors, the species were samples taken before being processed. They usually were gutted/ungutted, boiled, smoked or brined. The identification were done through their morphological characters. There were eleven species found belonged to two genera (Stichopus and Thelenota), i.e. *Stichopus horrens, S. pseudohorrens, S. naso, S. vastus, S. chloronatus, S. hermannii, S. monotuberculatus, S. ocellatus, S. quadrifaciatus, Thelenota anax* and *T. ananas.* All stichopudid sea cucumber called as gamet or gamat by all stake holder of sea cucumber fisheries. With the increasing demand and good price of these species, the conservation effort, especially through sea ranching was urged to be done.

Keywords: sea cucumber, Stichopus, Thelenota, sea ranching, habitat.

1. Introduction

The Karimunjawa islands lie in semi-closed waters, located in the Java Sea (110°07.2' - 110° 37.2' BT and 5°43.2' - 5°54.6' LS), east of Seribu Islands and west of Madura-Bali waters. The islands of Karimunjawa is a small district belong to Jepara Regency, Central of Java Province of Indonesia. The coastal community are only inhabited at six islands (out of 27 islands) i.e. Parang, Nyamuk, Kemujan, Karimunjawa, Sambangan dan Genting Island, distributed in four villages, namely Nyamuk, Parang, Karimunjawa and Kemojan Villages. Most of area of Karimunjawa archipelago is under authority of Karimunjawa National Park. In this area, the west (December–March) and east (July-September) monsoonal seasons are the dominant climatic forces influencing both human activity and also likely to affect the marine resources by physical forces (e.g. wave action, currents, turbidity) and recruitment and migration of species (e.g. currents). Karimunjawa waters experience two calm seasons (April-June and October-November) [1]. The Karimunjawa archipelago were characterized by their special environment and extensive habitats, these fishing grounds are valuable for the growth and reproduction of many species of marine taxa, including fish, corals, molluscs, crustaceans, seaweeds, and echinoderms, especially sea cucumber. Sea cucumber have been longtime fished and processed in Karimunjawa and Kemojan Islands [2]. There were a total of 15 species of sea cucumbers found according to study done by Balai Taman Nasional Karimunjawa, in 2008 carried out at Karimunjawa archipelago, i.e. Geleang, Ujung Gelam, Karang Wangkang, Alang-alang and Menjangan Besar Island. More recent studies, stated that 18 out of 26 sea cucumber species processed as teripang in Indonesia were found from Karimunjawa archipelago[3]. These species belong to the family of Holothuriidae and Stichopodidae. The family Stichopodidae (Echinodermata: Holothuroidea) consists of diverse and commercially important species[4], especially those in the Indo-Pacific region[5].

Nyamuk Island is located in the west part of Karimunjawa National Park. These area is surrounding by a very good coral and seagrass ecosystem as habitats of sea cucumber. There are several processors and only two sea cucumber traders and whole seller in Nyamuk Island, but there are more than fifteen sea cucumber fisher who joined in sea cucumber fisher community group "Maju Lancar". During their preliminary survey in several island around Nyamuk Island, *H. coluber, H. edulis, Personothuria graeffei*, *Stichopus vastus, S. horrens,* dan *Theleonata anax were processed as teripang*[6]. As demand of this products is increased yearly, the catch were more profound for Stichopupid family sea cucumber. The product has higher price than holothurid family. Therefore it is urgent need to do their conservation. One good effort of sea cucumber conservation is sea ranching, in which cultured or wild juveniles/youth are released into an area of natural habitat and harvested when they reach a commercially optimal size [7][8]. Lower inputs throughout their growth process in sea ranching will give advantage for coastal community since it is still able to produce matketable size of sea cucumber[9]. Stichopudid sea cucumber in Nyamuk Island were called as gamat or gamet. They provide good protein sources for human food especially for coastal community and produce high potency bioactive molecules for marine pharmaceutical[10]. Another advantage of this family that, through they are able to do asexual reproduction. The sea cucumber with ability to reproduce asexually by fission naturally are included as fissiparous holothuria, one of this is Stichopudid sea cucumber[11]. In asexual reproduction, sea cucumbers do divide its body or fission. After fission, anterior part of body complete with mouth and tentacles and some internal organs will regenerate and grow as well as the posterior part with anus, some intestinal and respiratory tree, become a new individual[12]. Therefore the present work was aimed to identify the species of Stichopudidae caught from the waters around Nyamuk Island, Karimunjawa National Park prior to their community based sea ranching for their conservation.

2. Materials and Methods

The samples were taken during 2018-2020 directly from sea cucumber fisher, processor, traders and wholeseller in Nyamuk Island of Karimunjawa National Park. By fisher, collections were relied on their free diving (in depth of 5-10 meters) (locations of D, E, F) or compressor diving (in depth of 10-25 meters) (locations of A, B, C, G, and H) around Nyamuk, Krakal Besar and Krakal Kecil Island.. The map where the sea cucumber fisher fished the sea cucumber is presented in Figure 1. All sea cucumbers were capture by hand. In the processors, the species were samples taken before being processed, i.e. gutted/ungutted, boiled, smoked or brined. The identification were done through their fresh morphological characters, afterwards, the pecimens were labelled, and fixed in 95% ethanol overnight. The following day, the previous ethanol was removed and the specimen was preserved in 70% ethanol for longer preservation[13]. The referred guides to species identification were used guidene book by [14 – 16]. The outer morphology observed is the shape of body cross section, maximum body length, the arrangement of the papillae and tube feet, whether or not protrusion of the papillae, position of the mouth and rectum, there the absence of anal modification, and the number of tentacles [17].

3. Results and Discussion

Sea cucumbers are now considered as important invertebrate marine resources, not only to be significant to marine ecosystem, but also to global trade and livelihoods [18]. Therefore they also have been the subject of increased worldwide interest for scientific knowledge, sustainable use and conservation purposes [19]. One of this sea cucumber is family Stichopodidae, belonged to Ordo Aspidochirotida Class Holothuroidea (Echinodermata), in which consisted mostly the commercially trade sea cucumber in Indonesia and high commercial value due to its medicinal and edible properties [20]. The species member of Stychopodidae family is usually active nocturnally; during the day, it remains hidden in reef crevices, seagrass, rock or others. Therefore fisher of Nyamuk Island, both free and compressor diving, go for sea cucumber fishing during the night.

Stichopodidae from Nyamuk Island could be distinguished from Holothuriidae, that their overall body shape were trapezium in transverse section and similar diameter along the length of the body and their body shape have rough dorsal surface due the presence of enlarged papillae or tubercular structures. There were eleven species of Family Stichopodidae found consisted of two genera (Stichopus and Thelenota), i.e. *Stichopus horrens, S. pseudohorrens, S. naso, S. vastus, S. chloronatus, S. hermannii, S. monotuberculatus, S. ocellatus, S. quadrifaciatus, Thelenota anax* and *T. ananas.*

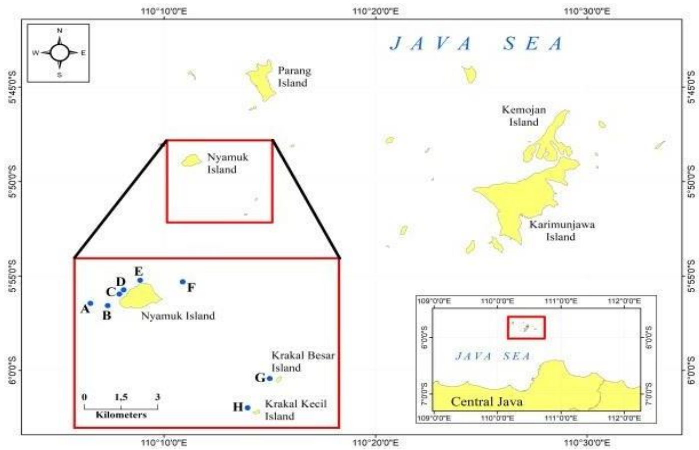

Figure 1. Sea cucumber fishing in the area of Nyamuk Island (locations of A, B, C, G, H = compressor diving; locatios of D, E, F = free diving)

S. horrens Selenka, 1867 is commersially called dragonfish and locally named as *Gamet kacang goreng* or *Gamet rengget*. The mouth is ventral with 20 tentacles. The body is solid, thick, folded and soft flesh. The body color is yellowish green with a small patch with blackish brown stripes. Papillae are white, long and small with a large protrusion at the base. The protrusions are greenish-white and somewhat transparent, scattered on the dorsal surface. The tube feet are arranged in three longitudinal rows on the ventral surface. Coloration of *S. horrens* is highly variable, from grey to beige to dark red, dark brown or black with different coloured blotches dorsally[21]. Dorsal surface lightly arched with long and conical, or wart-like, papillae mostly in two rows along the upper dorsal surface and a row of larger papillae along the lateral margins of the flattened ventral surface. Numerous, large podia occur on the ventral surface. Because of similar appearance, it can be mistaken for *S. monotuberculatus*, *S. naso* or *S. quadrifasciatus*, therefore, further identification through the spicules has to be done[22]. *S. horrens* from Nyamuk Island is relatively small. Average fresh weight were 100-250 g with average fresh length 12-22 cm. *Gamet rengget* is caught by free diving fisher in rocky bottoms with sandy patches in the depth of 2-10 meter and the compressor diving caught them from rocky shore, reef flats and upper slopes in depth of more than 10 meter.

S. pseudohorrens Cherbonnier, 1967 is a large species and locally named as *Gamet duri.* Its mouth is ventral, with 20 long dark brown tentacles, and surrounded by large papillae. The anus is terminal. It has solid, thick and hard flesh. Body color reddish brown with yellowish spots. Papillae are very large and tightly packed covering the dorsal surface. Tube feet are arranged in three long bars lengthwise. Identification *S. pseudohorrens* coloration is brownish-yellow to rosy red with darker mottling[16]. The body is highly arched dorsally and flattened ventrally, making it squarish to trapezoidal in cross-section. It has very long, slender, conical papillae dorsally, especially on the upper surface of the body; the dorsal papillae are generally darker in colour than the body wall [5]. Long papillae also occur on the lateral margins of the ventral surface. *Gamet duri* from Nyamuk Island is quite big size with average body length more than 20 cm and more than 700 grams in weight. Mostly caught by compressor diver from over coral sand up to 20 m depth.

S. naso Semper, 1868 found from Nyamuk island are usually relatively small, trapezoidal to rectangular in cross-section. The mouth is ventral with 18–20 tentacles. Anus terminal, unguarded by papillae. Its coloration is yellowish-tan dorsally and mottled with brown, or uniformly light brown[23]. Laterally, somewhat lighter. Ventral surface with a brown central longitudinal band running between the rows of podia. Tips of podia and dorsal papillae are dark brown. Small specimens nearly uniformly grey, sometimes with a pair of reddish dorsolateral papillae. Dorsal surface lightly arched with squat, conical dorsolateral papillae. Numerous, large podia arranged in longitudinal rows occur on the ventral surface[24]. The sample of this Teripang gamet's fresh length from Nyamuk Island was from 10 to 20 cm and approximately from 100 g to 200 g fresh weight. Its intestine and/or gonads are eaten in traditional diets; local consumption is the same as for *S. horrens*. *S. naso* is often mistaken for *S. horrens*, *S. monotuberculatus* or *S. quadrifasciatus*. This gamet species from Nyamuk Island has fresh length from 10 to 25 cm, with average weight of 250 g.

In Nyamuk Island, Gamet kacang goreng or gamet pace is also found in the subtidal area. *S. vastus* Sluiter, 1887, commercially named as Curry fish, has vetral mouth with 18–20 tentacles, surrounded by a collar of papillae. The anus is terminal, without teeth. This species has a highly arched dorsally and flattened ventrally body, and may be squarish in cross-section. Body wall folded. Body color is grey-green with numerous dark brown stripes on the dorsal surface and lighter color on the ventral surface. Dorsal papillae are enlarged at the base with dark brown stripes, and tube feet are arranged in the ambulacral area.

S. vastus coloration is variable from goldish-yellow, to brownish-yellow, or reddish, olive green or greyish-green[25]. The base of large papillae is surrounded by fine, dark, discontinuous lines on the dorsal surface. The large, wart-like papillae are present in 5–6 rows on the upper dorsal surface and along the lateral margins of the ventral surface. There are smaller wart-like papillae on all over the dorsal surface. Deep transverse wrinkles may be present dorsally. Ventral surface is brown and the interambulacral areas are yellow-orange. Large podia are numerous along the ambulacra of the ventral surface.

Gamet kacang goreng or gamet pace is fished by free diver fisher on inshore reefs edges on sand, coral rubble or muddy sand in shallow waters and at the base of semi-sheltered reefs, generally to about 8 m depth. It also could be found on sandy or coral rubble substrates. This is big size species, with fresh weight of 100-1500 g with average length of 30 cm. The body wall of the animals may disintegrate when handled and held out of water for a long time.

Gamat jepun is a very distict sea cucumber species from Nyamuk Island as their entire body colour is green or blue-black with orange papillae. *S. chloronatus* Brandt, 1835 is commercially named as Greenfish/squarefish. Body moderately firm and squarish in cross-section. Mouth is ventral with 19 or 20, white to greyish, stout tentacles. Anus is terminal bordered by five large papillae. This species has a solid, thick and hard flesh body. The papilla is small and short with a large, long bulge in the conscious. The ridges are arranged along both sides of the dorsal part of the body in longitudinal rows. Ventral podia are long and green, in four rows. The tube feet are arranged in three longitudinal rows on the ventral surface.Other research indicated that the body colour of *S. chloronatus* is dark green to near black dorsally with dark green ventrally[25]. Rows of long, conical papillae on both sides of the dorsal surface and along both lower lateral margins of the body. Papillae tips are usually, but not always, orange to yellow.

Gamet jepun was caught by free diver fisher of Nyamuk island from coral reefs, in shallow waters from the intertidal to depths of 10 m and also can be found on reef-flats and upper reef slopes. The mximum size of *S. chloronatus* from Nyamuk Island was 38 cm. Before being processed, this species has to be handled with care, since this body-wall may disintegrate if the animal is held out of the water for a long time.

S. ocellatus is called as Gamet mas or gamet kasur by Nyamuk Island community[26]. This Curry fish species was found in the subtidal area. Mouth is in ventral position and anus is in the terminal body with no teeth. Dorsal surface rounded. Ventral surface is flattened and whitish yellow. Body color is yellow with small orange spots on the dorsal surface and darker yellow on the ventral surface. Dorsal papillae color is white on the base and dark green-grey color on the tip. Tube feet are dark green-grey and arrange in the ambulacral area.

Identified *S. ocellatus* as yellow or yellowish-orange dorsal surface with prominent, large, circular, greenish-grey,wart-like papillae that are white around the base[5,27]. There are four row of large papillae in a zig-zag pattern arrangement. Podia on the ventral surface are numerous and greenish-brown, only on the ambulacral areas, and terminating with large suckers (up to 1.5 mm diameter) [22]. Gamet mas caught by sea cucumber fisher of Nyamuk island from seagrass beds on sandy or muddy-sand substrata on nearshore reef flats and sandflats with average size length of 34 cm. This species is often found associated with *S. herrmanni* which showed have some similar habitat preferences to that species[26].

S. quadrifasciatus Massin, 1999 was found in Nyamuk Island and named as Gamat. Solid body, thick flesh and soft. Light brown in color with four dark brown areas running across the dorsal part of the body. Papillae with large protrusions at the base that are tightly packed together on the dorsal surface. On the lateral side there is a papilla with a very large protrusion at the base and shaped like a wing [14]. The tube feet are arranged in three longitudinal rows on the ventral surface. This spepies was caught by fisher from rocky and seagrass bed shore.

S. herrmanni Semper 1868 or Curryfih is named as Gamat emas in Nyamuk Island. Body relatively firm, moderately elongate and squarish in cross-section. Mouth is ventral with 8–16 stout green tentacles. Anus is terminal, with no teeth nor surrounding papillae. The body was solid, thick flesh, hard, and folded like a mattress. The whole body is bright yellow or greenish yellow. The small papillae are black or dark brown in color with large protrusions at the base scattered on the dorsal and lateral surfaces. The tube feet are arranged in three longitudinal rows on the ventral surface. Body colour of *S. herrmanni* varies from light mustard-yellow to orangey-brown or brown or olive green[5]. Colour tends to be lighter ventrally. Numerous dark brown to black spots scattered over the entire body; two double-rows of larger wart-like papillae, bordered by fine dark rings. Podia are numerous ventrally. This species is previously known as *S. variegatus*[25] and sometimes mistaken as *S. monotuberculatus*. From Nyamuk Island, *S. herrmanni* have size of 25-45 cm and sea cucumber fisher found them in seagrass beds, rubble and sandy-muddy bottoms between 2 and 25 m. Sometimes they found smaller size from shallower waters. As other stichopodid species, its body wall disintegrates easily when it is held out of water for a long time.

S. monotuberculatus Quoy & Gaimard, 1834 found from Nyamuk island is called *Gamet pace*. The mouth of this species is ventral with 20 tentacles. It has a solid, thick flesh and soft body and a trapezoidal to rectangular in cross-section. Body color yellowish green with black dotted lines. Long papilla with white tip and red base. The base of the papilla is a very large protrusion covering the dorsal surface. The bulge is darker in color than the body color and there is a circular dotted line. The tube feet are arranged in three longitudinal rows on the ventral surface. It was widely distributed in the Indo-Pacific Ocean as well as in Indonesia and had synonym name of *Holothuria monotuberculata* Quoy and Gaimard, 1833[15].

The coloration of this species is highly variable, often indistinguishable from *S. horrens*: a grey to beige to yellowish background color dorsally overlaid with darker brown, grey to black spots and blotches, which can appear to form two indistinct transverse bands[5]. Large pointed dorsolateral and ventrolateral papillae are retracted during the day. Ventral surface mottled similar to dorsal surface, with three longitudinal rows of large podia. *S. monotuberculatus* from tropical northeast Australia have low wart-like pap illae and prominent lateral papillae and that specimens from the central Pacific had longer dorsal papillae[4]. In Nyamuk Island, this *Gamet pace* is often mistaken for *S. horrens*, *S. naso* or *S. quadrifasciatus*. It has average fresh weight 250 g and fresh length of 15-25 cm. Sea cucumber fisher found this species emerged from crevices and under rubble at night on the reef flat, lagoons and reef slope from 3 m to 25 m depth.

S. monotuberculatus, Quoy & Gaimard, 1834 of Parang Island, which is the next of Nyamuk Island[28]. Morphologically they were grey-green colour with numerous small dark patches ventrally and grey green to orange-brown with dark green to black patches dorsally with square thick integument/body wall. Calcareous ring radial pieces had a posterior notch and four short anterior points whereas the interradial pieces had a long anterior tooth. Their ossicles showed numerous tables-shaped ossicles in the anterior and dorsal tissue of the bodywall, but no rossete-shape in dorsal body wall which is the characteristic of *S. monotuberculatus*. DNA sequencing of nine samples showed that all samples had got 93-99% similarity with *S. monotuberculatus* haplotype4, 5, 9, and 13. This result confirmed the identification through morphology and ossicles characters. It is approved the presence of *S. monotuberculatus,* Quoy and Gaimard, 1833 in Parang Island, Karimunjawa Archipelago, Jepara.

There are two species of Thelenota found from Nyamuk Island of Karimunjawa National Park, i.e. *T. ananas* and *T. anax*. *Thelenota ananas* Jaeger 1833, commercially named as Princkly redfish/Plum flower trepan and locally named as Teripang nenas/nanas. This species can reach size of 80 cm. Body is firm and rigid; arched dorsally and flattened ventrally. Body wall is thick. Mouth ventral with 20 large, brown tentacles, surrounded by conical papillae. Anus is terminal, and often hidden by large papillae. Body reddish brown with very large papillae and branching like leaves on the dorsal to lateral surface of the body. The color of the papilla is relatively brighter than the color of the body. Tube feet are densely distributed on the ventral surface. This species has varied dorsal colour from reddish-orange to brown or burgundy[29]. Dorsal surface is covered in very large papillae, which may be long and conical or star-shaped on a short stalk or somewhat branched. Ventral surface is light pink to red, with brown to pink podia more abundant on the radii. From Nyamuk Island Teripang nenas could be as long as 80 cm and could be found in reef slopes and passes, hard bottoms with large coral rubble and coral patches in waters between 1 and 25 m. sometimes sea cucumber fisher caught them in coral slopes over hard substratum between 4 and 30 m.

Thelenota anax Clark 1921 is named as *Gamet Babi/donga* in Nyamuk Island or *Amberfish* are relatively large body size that can reach 100 cm. . It has a thick body wall. Body is rather quadrangular in cross-section. The flat ventral surface is densely covered with fine, long podia. The mouth is ventral with 18–20 peltate tentacles. The anus is terminal to subdorsal. Its body is thick and has a hard flesh [30]. Cream body color with bright reddish hues, sometimes there is a light brown. Along the lateral side there are very large protrusions and coalesce to form a love. Papillae are large, slightly protruding and yellowish-brown in color scattered on the dorsal and lateral surfaces[31]. The tube feet are densely distributed on the ventral surface. Lamberson (1978) and Lane (1992) stated that *T. anax*'s colour varies from creamy white beige to grey or light brown with dark brown and/or reddish spots and blotches dorsally[32,33]. Numerous, light coloured, wart-like bumps occur mostly in rows along either side of the dorsal surface. Large, white papillae are located along the ventro-lateral margins. In Nyamuk Island, *T. anax* could be found inhabits reef slopes and outer lagoons on sandy bottoms between 10 and 30 m. The free diver sometimes found it in shallower waters to about 4–5 m depth, and on hard bottoms or on coral rubble. Generally *T. anax* has low density population, the populations are usually sparse[34].

Other research found 18 sea cucumber species which is processed as teripang in Karimunjawa archipelago, there are *Actinopyga banwarthy, A. miliaris, A. lecanora, Bohadschia vitiensis, B. Subrubra, B. similis Holothuria atra, H. edulis, H. leucospilota, H. fuscocinerea, H. scabra, Pearsonothuria graeffei* which is belong to Holothuriidae family and *S. hermanni, S. horrens, S. vastus, S. ocellatus, S. chloronotus,* and *T. anax* belong to the family of Stichopodidae[13]. During their preliminary survey in several island around Nyamuk Island, found *H. coluber, H. edulis, Personothuria graeffei, Stichopus vastus, S. horrens, Theleonata anax*[6] and population growth analysis of *S. quadrifasciatus* of Karimunjawa Island[35]. Among the sea cucumber exploited in Lampung that out of eight species[27], only 2 species belong to Stichopodid family, i.e. *S. ocellatus* and *S. vastus* while *S. variegatus* revealed in the most previous study in same area by [36]. Other studies in Biakaheuni water found *S. horrens* and *S. vastus by* Fahmi et al. (2015) which were commercially important species in those area[37].

That holothurians have been harvested commercially for at least a thousand years, occasionally for the raw body wall or viscera[5], but mostly in order to be processed into a dry product called bêche-de-mer, trepang, or hai-san, which is considered a delicacy and a medicinal food by Chinese and other Asian peoples. Harvesting in the tropics is usually done by hand, while wading in shallow waters, or gleaning, at low tide or by free-diving from small boats, although SCUBA have increasingly been used, but not in Nyamuk island. There are 15 boat fishing in around Nyamuk Island, generally 10-15 GT fitted with a 20 hp engine and have 3-4 people onboard, 3 of them are divers. Fishers go for sea cucumber in the afternoon (aroud 17.00pm) and come back early in the morning. Fishermen engaged in the collection of sea cucumber are very often fished for other species such as demersal fish, sharks, molluscs, as well as collect a variety of seaweed species.

In Nyamuk Island, sea cucumber are processed and become salted/non-salted smoked dried product called teripang (be-chede-mer). The processing of sea cucumbers involves three steps: removal of the viscera, cooking and drying. Prior to the evisceration process the sea cucumbers are sorted by species and then incision is made on the ventral side. Following the removal of the internal organs the sea cucumbers are rinsed with seawater and then placed in a suitable boiler with moderate boiled water. The sea cucumber then are cooked for two to three hours depend on the amount of sea cucumber in the boiler. During this phase the sea cucumbers become stiff and lose 50-70 % of their body fluids, assuming blackish colorations in most species. After allowing water to cool down, the sea cucumber placed in the bucket. Some sea cucumber were salted for six hours according the demand of trader. The sea cucumbers are then further smoked over hot wood or oven for an additional 30 minutes. The cooked product is then sun dried (small bamboo sections are used to keep the incision wide open in large individuals) while ensuring that each sea cucumber is regularly turned over every few hours. Up to 2 days may be required to dry the products completely. Proper cooking and drying of sea cucumbers is essential. If not cooked completely the sea cucumber will soon start to rot and acquire an undesirable smell. Overcooking may also damage the product as a very soft sea cucumber may not be processed into a high quality product. The sea cucumber processor in Nyamuk Island is able to process 300 kg of fresh holothurians per day, which were harvested by local fishers. The sea cucumber were divided into three categories based on their price, i.e. low value (*T. anax*), medium (*S. naso, S. horrens* and *S. chloronatus*) and expensive (*S. pseudohorrens S. vastus S. ocellatus S. quadrifasciatus S. herrmanni S. monotuberculatus and T ananas mahal*. It has been estimated that there are about 4-10 tonnes (dry weight) of exploitable of sea cucumbers in these Karimunjawa Archipelago (Pringgenies *et al.,* 2008) sold out to Surabaya-East Java. Like in other areas of Indonesia, in Karimunjawa islands processed trepang has never been kept for long periods of time. Most species of all sizes are sold immediately, demonstrating their high market demand. This encourages them to collect[3] as many as they can, so they can compensate for expenses they incur while they are sailing.

Although sea cucumber is a nutritious seafood with a high protein and low lipid content, the coastal community almost never eat them. The fisher always sell the sea cucumber to sea cucumber processor. Extract of *Stichopus* sp. have good effect on high cholesterol and triglyceride in the human blood by reducing them[38]. Although sea cucumbers have not been classified as a protected group by Indonesian government, the Diponegoro University are promoting the development of aquaculture activities by giving demplot of sea cage for sea cucumber culture and now with initial sea cucumber ranching. Among stichopudid species, *T. ananas* is classified in IUCN status as Endangered (at a high risk of extinction) and *S. herrmanni* as Vulnerable both populations are decreasing[39].

Since there are no sea cucumber management plan, it has caused excessive fishing and a gradual decline of the natural resources. It is suggested that a suitable number of protected areas are established around some of the islands, a minimum catch size for the different species is set, along with the establishment of authorized fishing seasons. Moreover, applied research has been done on the fission reproduction of economically important species of sea cucumbers[12,40] and the result may be applied the long term sustainability of the sea cucumber natural population. As other member of Family Stichopodidae, because of high demand and good economy value, *S. herrmanni* was very prone to overexploitation. Therefore, it is need urgent management intention[19] and effort to conservation, such as sea cucumber ranching[9].

4. Conclusions

In Nyamuk island there were eleven species Stichopodid family found belonged to two genera (Stichopus and Thelenota), i.e. *Stichopus horrens, S. pseudohorrens, S. naso, S. vastus, S. chloronatus, S. hermannii, S. monotuberculatus, S. ocellatus, S. quadrifaciatus, Thelenota anax and T. ananas*. Only two species, *T. ananas* and *S. herrmanni* are classified in IUCN status as Endangered (at a high risk of extinction) and Vulnerable respectively, and both populations are decreasing. With the increasing demand and good price of these species, the conservation effort, especially through sea ranching was urged to be done**.**

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Appendix 2. Curriculum Vitae

Biodata Ketua Tim Peneliti

1. Nama Lengkap		**Prof. Dr. Ir. Ambariyanto, MSc**
2. NIP/NIDN/Pendidik		131771275 / 196104131988031002 / 0013046102 / 08100803767
3. Pangkat/ Gol./Jab.		Pembina Utama Madya/ IVD / Guru Besar
4. Tanggal lahir		13 April 1961
5. Tempat lahir		Klaten
6. Fakultas/Jurusan		Fakultas Perikanan dan Ilmu Kelautan / Ilmu Kelautan
7. Alamat Kantor		Jl Prof Sudarto SH. Kampus FPIK UNDIP Tembalang Semarang
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9 .Alamat		Cempedak Selatan No 2, Semarang 50249
9. Alamat	a. Jalan	
	b. Desa	Lamper Kidul
	c. Kec.	Semarang Selatan
	d. Kab/kota	Semarang 50249
	e. Propinsi	Jawa Tengah
10. Telp	a. Rumah	024 8311 543
	b. HP	081 5656 5278
	c. e-mail	ambariyanto@undip.ac.id; ambariyanto.undip@gmail.com

PENDIDIKAN

Program	Bidang	Institusi	Tempat	Tahun Kelulusan
Postdoct	BioEcology	Univ. of Sydney	Sydney, Australia	1997
S3 (PhD)	Marine Biology	Univ. of Sydney	Sydney, Australia	1996
S2 (MSc)	Marine Biology / Akuakultur	Univ. of Wales	Bangor, North Wales, U.K.	1990
S1 (Ir)	Akuakultur	UNDIP	Semarang, Indonesia	1986

PUBLIKASI :

A. Jurnal 3 tahun terakhir:

1. Nanlohy, H., Bambang, A.N., Ambariyanto and Hutabarat, S. 2015. Coastal Communities Knowledge Level on Climate Change As a Consideration in Mangrove Ecosystems Management in the Kotania Bay, West Seram Regency. Procedia Environmental Sciences 23:157–163. doi:10.1016/j.proenv.2015.01.024 ISSN: 1878-0296 http://www.sciencedirect.com/science/article/pii/S1878029615000250
2. *Diah Permata Wijayanti, Elis Indrayanti, Wandi Febrian Asri, **Ambariyanto**. 2015. Growth of Favia and Favites Coral Transplants Based on Polyps Number. Ilmu Kelautan. 20(1):23-32* http://ejournal.undip.ac.id/index.php/ijms/article/view/8828 *DOI: 10.14710/ik.ijms.20.1.23-32*
3. *Pra Luber Agung Wibowo, Agus Hartoko, **Ambariyanto** Ambariyanto. 2015.* Land Subsidence Affects Coastal Zone Vulnerability. Ilmu Kelautan. 20(3):127-134. http://ejournal.undip.ac.id/index.php/ijms/article/view/9705 DOI: 10.14710/ik.ijms.20.3.127-134
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6. Siwat V., Ambariyanto A., Widowati I., 2016 Biometrics of bigeye scad, Selar crumenophthalmus and shrimp scad, Alepes djedaba from Semarang waters, Indonesia. AACL Bioflux 9(4):915-922. http://www.bioflux.com.ro/home/volume-9-4-2016/
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8. Pusparini, N., Prasetyo, B., Ambariyanto and Widowati, I., 2017, February. The Thermocline Layer and Chlorophyll-a Concentration Variability during Southeast Monsoon in the Banda Sea. In IOP Conference Series: Earth and Environmental Science (Vol. 55, No. 1, p. 012039). IOP Publishing. http://iopscience.iop.org/article/10.1088/1755-1315/55/1/012039
9. Ambariyanto., 2017, Conserving endangered marine organisms: causes, trends and challenges. In IOP Conference Series: Earth and Environmental Science (Vol. 55, No. 1, p. 012002). IOP Publishing. http://iopscience.iop.org/article/10.1088/1755-1315/55/1/012002
10. Ulmursida A., Ambariyanto A., Trianto A., 2017 Antibacterial activity o mangrove Avicennia marina leaves extract against Virgibacillus marismortui and Micrococcus luteus bacteria. AACL Bioflux 10(2):372-380. http://www.bioflux.com.ro/home/volume-10-2-2017/
11. Prasetya, J.D. Supriharyono, Ambariyanto, and Purwanti, F., 2017. Diversity Based Sustainable Management for Seagrass Ecosystem: Assessing Distribution and Diversity of Seagrass in Marine Protected Area. Advanced Science Letters, 23(3), pp.2413-2415. **http://www.ingentaconnect.com/content/asp/asl/2017/00000023/00000003/art00224 https://doi.org/10.1166/asl.2017.8665**
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14. Hartati, R., Widianingsih, Trianto, A., Zainuri, M. & Ambariyanto. 2017. The abundance of prospective natural food for sea cucumber Holothuria atra at Karimunjawa Island waters, Jepara, Indonesia . Biodiversitas. 18(3): 947-953. doi: 10.13057/biodiv/d180311
15. Haryono, F.E., **Ambariyanto**. 2017. Genetic Diversity Approach to Fishery Management Spiny Lobster Southern Waters of Java Based on SWOT Analysis and AHP. Omni-Akuatika, 13(1): 26-33.
16. Handhani A. R., **Ambariyanto** A., Supriyantini E., 2017 Reduction of Pb concentration in seawater by seaweed Gracilaria verrucosa. AACL Bioflux 10(4):703-709.
17. Pertiwi, N.P.D., Nugraha, B., Sulistyaningsih, R.K., Jatmiko, I., Sembiring, A., Mahardini, A., Cahyani, N.K.D., Anggoro, A.W., Madduppa, H.H., Ambariyanto, A. and Barber, P.H. 2017. Lack of differentiation within the bigeye tuna population of Indonesia. Biodiversitas, 18(4): 1406-1413. DOI: 10.13057/biodiv/d180416 http://biodiversitas.mipa.uns.ac.id/D/D1804.htm
18. Hartati, R., Widianingsih, Agus Trianto, Muhammad Zainuri, Ambariyanto. 2017. The abundance of prospective natural food for sea cucumber *Holothuria atra* at Karimunjawa Island waters, Jepara, Indonesia. *BIODIVERSITAS* 18(3): 947-953. DOI: 10.13057/biodiv/d180311.

19. Hartati , R., M Zainuri, A Ambariyanto, Widianingsih, A Trianto, and R T. Mahendrajaya. 2018. Similarity microalgal epiphyte composition on seagrass of Enhalus acoroides and Thalasia hemprichii from different waters. IOP Conf. Series: Earth and Environmental Science 139 (2018) 012011 doi :10.1088/1755-1315/139/1/012011. https://iopscience.iop.org/article/10.1088/1755-1315/139/1/012011
20. Hartati, R., A. Ambariyanto, M. Zainuri., W. Widianingsih, E. Supriyo, A. Trianto. 2019. The Concentration of Chlorophyll-C in The Bottom Sediment of Sea Cucumber Rearing Cage. IOP Conf. Series: Earth and Environmental Science 246 (2019) 012078. doi:10.1088/1755-1315/246/1/012078
21. Hartati, R. Zainuri, M., Ambariyanto, A., Ayodya, F.P., Widianingsih, W., Mustagpirin, M., Soegianto, A. 2019. Initial assessment of *Holothuria atra* in Panjang Island, Jepara, Indonesia. *Eco. Env. & Cons. 25 (Suppl. Issue) : S1-S6)*
22. Hartati, R., Zainuri, M., Ambariyanto, A., Redjeki, S., Riniatsih, I., Azizah, R., Endrawati, H. 2019. Aseksual Reproduction of Black sea cucumber from Jepara Waters. *ILMU KELAUTAN: Indonesian Journal of Marine Sciences 24(3):121-126.* DOI: 10.14710/ik.ijms.24.3.121-126

B. Buku (3 tahun terakhir):

1. Agus Dermawan, Ngurah Wiadnyana, Syafrudin Yusuf, Ambariyanto. 2015. Pedoman Pengkayaan Populasi Kima. Direktorat Konervasi dan Keanekaragaman Hasil Laut. Kementerian Kelautan dan Perikanan. 72 hal.
2. Winarno, F.G, dan Hariyadi, P (Eds). 2017. The Indonesian Sago Palm. Unraveling its Potential for National development. Team of Writers: Ambariyanto, B.P. Widyobrooto, B. Arifin, E. Handayanto, F.M. Dwivany, P. Haryadi, W. Lukito, and W.T. Koesoemo. PT. Gramedia Pustaka Utama. 92 pp
3. Winarno, F.G., Handayanto, E., dan B. Arifin (Eds). 2017. Cabai. Potensi Pengembangan Agrobisnis dan Agroindustri. Tim Penulis: B. Arifin, W.T. Koesoemo, Ambariyanto, E. Handayanto, dan F.M. Dwivany. PT. Gramedia Pustaka Utama. 199 pp.

Semua data yang saya isikan dan tercantum dalam biodata ini adalah benar dan dapat dipertanggungjawabkan secara hukum. Apabila di kemudian hari ternyata dijumpai ketidaksesuaian dengan kenyataan, saya sanggup menerima sanksi.

Semarang, 30 November 2021

Prof.Dr.Ir. Ambariyanto, MSc.

Biodata Anggota Tim Peneliti 1

A. Identitas Diri

1	Nama Lengkap (dengan gelar)	Dr. Ir. Retno Hartati, MSc.
2	Jenis Kelamin	P
3	Jabatan Fungsional	Lektor Kepala
4	NIP/NIK/Identitas lainnya	19620711 198703 2 001
5	NIDN	0011066209
6	Tempat dan Tanggal Lahir	Semarang, 11 Juli 1962
7	E-mail	Retnohartati.undip@yahoo.com
9	Nomer Telepon/HP	0248314945/081325862512
10	Alamat Kantor	Jl. Prof. Soedharto, SH Kampus tembalang Semarang
11	Nomor Telepon/Faks	0247474698/0247474698
12	Lulusan yang telah dihasilkan	S1 = 30 orang; S2=…orang; S3=…orang
13	Mata Kuliah yang Diampu	1 Avertebrata Laut
		2 Fisiologi Biota laut
		3 Penangkaran dan Restocking Biota Laut
		4 Zoologi Laut

B. Riwayat Pendidikan

	S1	**S2**	**S3**
Nama perguruan Tinggi	IPB	Institute of Aquaculture, Stirling University, Scotland	Universitas Diponegoro
Bidang Ilmu	Budidaya Perairan	Aquaculture	Ilmu Kelautan
Tahun Masuk-Lulus	1981-1986	1990-1991	2017-2020
Judul Skripsi/Thesis/Disertasi	Pengaruh Pemberian Makanan Dengan Sumber Protein Berbeda Terhadap Pertumbuhan Udang Galah *Macrobrachium* rosenbergii de Mann	The Effect of Feeding Attractants on Behaviour and Performance of Juvenile *Penaeus Monodon* Fab	Sea ranching of *Holothuria atra*: study on establishment of new ecosystem and its relation with their feeding ecology
Nama Pembimbing/Promotor	Dr.Ir. Ing Mokoginta, MSi.	Dr. Matthew Briggs	Pr.Dr.Ir. M. Zainuri, DEA Prof.Dr.Ir. Ambariyanto, MSc.

C. Pengalaman Penelitian Dalam 5 Tahun Terakhir

(Bukan Skripsi, Tesis, maupun Disertasi)

No.	Tahun	Judul Penelitian	Pendanaan	
			Sumber	Jumlah (Juta Rp.)
1.	2011-2015	Pemantauan Kualitas lingkungan, Biologi :	PII (Menristek)	250/tahun

		makrobenthos (Anggota).		
2.	2012-2013.	Optimasi Pemanfaatan Tambak Tidak Produktif dan Diseminasi Konservasi Mangrove. (Ketua).	Mangrove For future – UNDP	250
3.	2013	Kajian Pendugaan Stok Data Terbatas serta pemodelan Ekosistem Ikan Karang. (Anggota).	WWF	250
4.	2015	Kajian Fenotip dan genotip Teripang Famili Stychopodidae dan Famili Holothuroidae dari Kepulauan Karimunjawa (Anggota).	Penelitian Fundamental DP4M (Dikti)	75
5.	2015-2016.	Teknologi Produksi benih Teripang Tril *Stichopus hermanii* Melalui Reproduksi Aseksual (Ketua)	Penelitian Hibah Bersaing DP4M (Dikti)	90
6.	2016-2019	Sea ranching of Indonesian Sea cucumber. (Ketua).	Riset Publikasi Internasional. PNBP. Universitas Diponengoro.	227.5
7.	2017	Keberhasilan trasplantasi lamun dengan metode ramah lingkungan sebagai upaya rehabilitasi kondisi ekosistem lamun di perairan Jepara (Anggota)	Riset berbasis Output, Selain APBN, FPIK, Undip	15
8.	2018	Study on Establishment of New Ecosystem and Its Relation with Their Feeding Ecology: An Attempt of Sea Ranching for *Holothuria atra* (Ketua)	Hibah Disertasi Doktor - DIPA Biotrop 2018 - SEAMEO BIOTROP	50
9.	2018	Asesmen populasi dan bioekologi jenis teripang target baru *Holothuria atra* di Pulau Panjang, Jepara (Ketua).	Riset berbasis Output, Selain APBN, FPIK, Undip	50
10.	2018	Cephalopoda Di Taman Nasional Laut Karimunjawa: Keragaman Genetik Dan Interkoneksi Antar Pulau. (Anggota)	Penelitian Dasar Unggulan Perguruan Tinggi Kemenristek-Dikti.	90

** Tuliskan sumber pendanaan baik dari skema penelitian DIKTI maupun dari sumber lainnya.*

D. Pengalaman Pengabdian Kepada Masyarakat dalam 5 Tahun Terakhir

No.	Tahun	Judul Pengabdian Kepada Masyarakat	Pendanaan	
			Sumber*	Jumlah (juta Rp.)
1	2012	Optimasi Pemanfaatan Tambak Tidak Produktif dan Diseminasi Konservasi Mangrove	MFF	225
2	2012	Aplikasi Pewarnaan Alam Mangrove dan Indigo untuk Bahan Batik Sebagai Diversifikasi Usaha di Desa Binaan Kabupaten Semarang.	BOPTN-FPIK UNDIP	7,5
3	2013	IbM Kelompok Usaha Garam Rakyat di Pati.	DP2M-DIKTI-	40
4	2013	IbM Kelompok Usaha Carica di Wonosobo	DP2M-DIKTI-	50
5	2013.	IbM Kelompok Nelayan Pembudidaya Teripang di Kepulauan Karimunjawa Jepara..	DP2M-DIKTI-	50
6	2013-2014	Collaborative Blue Swimming Crab Fishery Management in Demak..	APRI-Crab Council	200
7	2014	IbM Kelompok Petani Garam Rakyat di Rembang	DP2M-DIKTI-	45
8	2015-2016	IbPE Manisan Carica di Wonosobo Jawa Tengah	DP2M-DIKTI-	100

** Tuliskan sumber pendanaan baik dari skema pengabdian kepada masyarakat DIKTI maupun dari sumber lainnya.*

E. Publikasi Artikel Ilmiah Dalam Jurnal dalam 5 Tahun Terakhir

No.	Judul artikel ilmiah	Nama Jurnal	Volume/Nomor /Tahun
1.	Eighteen Sea Cucumber Species Fishes in Karimunjawa Island, Java Sea.	*Mar. Res. Indonesia*	35/2/2012
2.	Stimulasi fission pada reproduksi aseksual teripang *Holothuria atra*..	J. Mar. Res	2/1/2013
3.	Fission Reproduction of Two Stichopudidae Species (Holothuria:Echinodermata)	*Ilmu Kelautan : Indonesian Journal of Marine Science*	18/2/2013
4.	Fatty acid composition of marine microalgae in Indonesia.	*Journal of Tropical Biology and Conservation*	10/-/2013
5	Yodisasi garam rakyat dengan *system screw injection*	GEMA TEKNOLOGI	17/4/2014
6	Penerapan Teknologi Fission pada Budidaya Teripang	INFO	XVII/2/2014
7	Re-deskripsi teripang *Stichopus hermanii* dari Kepulauan Karimunjawa melalui analisa morfologi, anatomi dan spikula (ossicle)	*Jurnal Kelautan Tropis*	X/2/2015
8	Ultrastruktur alimentari canal teripang *Holothuria scabra* dan *Holothuria atra* (Echinodermata : Holothuroidea).	Buletin Oseanografi Marina	6/1/2016
9	The Growth of Sea cucumber *Stichopus*	*Indonesian*	21/2/2016

	herrmanni After Transverse Induced Fission in Two and Three Fission Plane.	*Journal of Marine Science (IJMS)/ Ilmu Kelautan*	
10	Komposisi fitoplankton di tambak kerang. *Jurnal Kelautan Tropis*	*Jurnal Kelautan Tropis*	20/1/2017
11	Biomassa dan estimasi simpanan karbon pada ekosistem padang lamun di Pulau Menjangan kecil dan Pulau Sintok Kepulauan Karimunjawa.	Buletin Oseanografi Marina	6/1/2017
12	Komposisi echinodermata di rataan litoral terumbu karang Pantai Krakal, Gunung Kidul, Yogyakarta.	Buletin Oseanografi Marina	9/1/2017
13	The abundance of prospective natural food for sea cucumber *Holothuria atra* at Karimunjawa Island waters, Jepara, Indonesia.	*BIODIVERSITAS*	18/3/2017
14	Habitat characteristic of two selected locations for sea cucumber ranching purposes.	*IOP Conference Series: Earth and Environmental Science*	55/1/2017
15	The Evidence of Imposex in *Turbo* sp. from Ujungpiring Waters of Jepara.	*IOP Conference Series: Earth and Environmental Science*	116/-/2018
16	The application of Environmental Friendly Technique for Seagrass Transplantation	*IOP Conference Series: Earth and Environmental Science*	116/-/2018
17	Preliminary Study on Gonad Maturity Stages of the Sea Cucumber *Paracaudina australis* from Kenjeran Water, Surabaya, Indonesia.	*IOP Conference Series: Earth and Environmental Science*	116/-/2018
18	Similarity microalgal epiphyte composition on seagrass of *Enhalus acoroides* and *Thalasia hemprichii* from different waters	*IOP Conference Series: Earth and Environmental Science*	126/-/2018
19	The Concentration of Chlorophyll-C in The Bottom Sediment of Sea Cucumber Rearing Cage	*IOP Conference Series: Earth and Environmental Science*	246 (2019)
20	Initial assessment of *Holothuria atra* in Panjang Island, Jepara, Indonesia.	*Eco. Env. & Cons.*	*25 (Suppl. Issue) : S1-S6)*/2019
21	Aseksual Reproduction of Black sea cucumber from Jepara	*ILMU KELAUTAN: Indonesian Journal of Marine Sciences*	*24(3):121-126/2019*

F. Pemakalah Seminar Ilmiah (Oral presentation) dalam 5 Tahun terakhir

No.	Nama Temu	Judul artikel ilmiah	Waktu dan Tempat

	Ilmiah/Seminar		
1.	Indian Ocean and Pacific Conference (IOPAC) 2013	Intergrated Conservation for Food Security and Environment Resilience : Case study of two coastal village of Semarang.	Nusa Dua Bali, on June 18th – 20th, 2013.
2.	Seminar Nasional Tahunan Ke XII Hasil Penelitian Perikanan dan Kelautan. UGM.	Recovery Perfomance Teripang Trill, *Stichopus hermanii*, (Stichopodidae: Holothuroidea: Echinodermata) Setelah fission	Yogyakarta, 8 Agustus 2015
3.	The 2nd International Symposium on Aquatic Products Processing and Health	Fission as a prosperous attempt for Seacucumber *Pearsonothuria graeffei* and *Bohadschia similis* (Holothuria : Echinoderm) Conservation.	September 13-15, 2015 Diponegoro University, Semarang,
4.	Workshop Pengumpulan Data jenis Ikan Dilindungi Dan/Atau Terancam Punah di wilayah ADB,	Jenis-jenis teripang dari Kepulauan Karimunjawa dan Perairan Jepara (2009-2015)	Hotel Padjadjaran Suite Bogor, 23-25 November 2015.
5	Seminar Nasional Tahunan Hasil Penelitian Perikanan dan Kelautan XIII UGM	Pertumbuhan Teripang trill, *Stichopus herrmannii* (Stichopodidae: Holothuroidea: Echinodermata) Pasca fission.	Jogjakarta, 13 Agustus 2016.
6	The 2nd International Conference on Tropical and Coastal Region Eco Development 2016.	Habitat characteristic of two selected locations for sea cucumber ranching purposes.	Bali, 25-27 October 2016
7	Seminar Nasional Hasil-Hasil Penelitian Perikanan dan Kelautan Ke VI Tahun 2016 UNDIP	Peningkatan Peran Wanitas Pesisir pada Industri Garam rebus.	Semarang, 12 November 2016.
8	Seminar Nasional Hasil-Hasil Penelitian Perikanan dan Kelautan Ke VI Tahun 2016 UNDIP,	Komposisi alga perifiton pada akar vegetasi mangrove di Desa Pantai Harapan Jaya dan Desa Pantai mekar, Kabupaten Bekasi.	Semarang, 12 November 2016.
9	Seminar Nasional Hasil-Hasil Penelitian Perikanan dan Kelautan Ke VI Tahun 2016 UNDIP	Keanekaragaman Sumberdaya teripang di perairan Pulau Nyamuk, Kepulauan Karimunjawa	Semarang, 12 November 2016.
10	Seminar Nasional Hasil-Hasil Penelitian Perikanan dan Kelautan	Middle Portion of Sea Cucumber After Fission Stimulation.	Semarang, 12 November 2016.

	Ke VI Tahun 2016 UNDIP		
11	Seminar Nasional Tahunan Hasil Penelitian Perikanan dan Kelautan XIV UGM	Komposisi mikroalga epifit pada beberapa jenis lamun Dari perairan Teluk Awur jepara	FPIK, UGM, 22 Juli 2017
12	The 2nd International Symposium for Marine and Fisheries Research (ISMFR 2017), FPIK UGM	Similarity microalgal epiphyte composition on seagrass of *Enhalus acoroides* and *Thalasia hemprichii* from different waters	24-25 July, 2017 at Eastparc Hotel, Yogyakarta, Indonesia.
13	The 3nd International Conference on Tropical and Coastal Region Eco Development 2017.	Feeding selectivity of *Holothuria atra* in the different micro habitat	Eastparc Hotel, Jogjakarta, 2-4 October 2017
14	The 1st International Conference on Fisheries and Marine Science, Universitas Airlangga	Aseksual reproduction of Black sea cucumber from Jepara Waters	Surabaya, 5-6 October 2018
15	The 1st International Conference on Fisheries and Marine Science, Universitas Airlangga	Initial assesment of *Holothuria atra* population in Panjang Island	Surabaya, 5-6 October 2018
16	The 4nd International Conference on Tropical and Coastal Region Eco Development 2018.	The concentration of chlorophyll-c in the bottom sediment of sea cucumber rearing cage	Semarang, 30-31 October 2018.

G. Karya Buku dalam 5 Tahun terakhir

No.	Judul Buku	Tahun	Jumlah Halaman	Penerbit
1	Pembenihan dan pembesaran Teripang Pasir (Echinodermata: Holothuroidea).	2009	128	Badan penerbit Universitas Diponegoro. Semarang
2	Teripang (Holothuroidea : Echinodermata) di Indonesia : Biologi, Budidaya dan Konservasinya.	2009	72	Navila Idea Yogyakarta.
3	Mikroalga Laut	2009	141	Badan penerbit Universitas Diponegoro Press.

4	Field Guide Timun Laut di Kepulauan Karimunjawa	2011	37	Universitas Diponegoro.

H. Perolehan HKI dalam 5-10 Tahun terakhir

No.	Judul/tema HKI	Tahun	Jenis	Nomor P/ID
-	-	-	-	-

I. Pengalaman Merumuskan Kebijakan Publik/Rekayasa Sosial Lainnya dalam 5 Tahun Terakhir

No.	Judul/tema/jenis Rekayasa Sosial Lainnya yang telah diterapkan	Tahun	Tempat Penerapan	Respon masyarakat
-	-	-	-	-

J. Penghargaan dalam 10 tahun Terakhir (dari pemerintah, asosiasi atau institusi lainnya)

No.	Jenis Penghargaan	Institusi Pemberi Penghargaan	Tahun
1	Dosen Teladan II FPK	UNDIP	1998
2	Satyalencana Karya Satya 10 Tahun	Presiden RI	2002
3	Satyalancana Karya Satya XX Tahun	Presiden RI	2 Mei 2008
4	Sertifikat Pendidik	Depdiknas	25 Nopember 2008
5	Penyaji Poster terbaik Hasil pengabdian kepada Masyarakat	Depdiknas	18 Oktober 2014
6	Satyalancana Karya Satya XXX Tahun	Presiden RI	17 Agustus 2018

Semua data yang saya isikan dan tercantum dalam biodata ini adalah benar dan dapat dipertanggungjawabkan secara hukum. Apabila di kemudian hari ternyata dijumpai ketidaksesuaian dengan kenyataan, saya sanggup menerima sanksi.

Semarang, 30 November 2021
Anggota Peneliti,

(Dr.Ir. Retno Hartati, MSc.)
NIP 19620711 198703 2 001

Biodata Anggota Tim Peneliti 2

1.	Nama Lengkap	Ir. Widianingsih, M.Sc.
2.	Jenis Kelamin	Perempuan
3.	Jabatan Fungsional	Lektor Kepala
4.	NIP	19670625199403 2 002
5.	NIDN	0025066706
6.	Tempat & Tgl Lahir	Semarang, 25 Juni 1967
7.	E-mail	Widia2506@yahoo.com
9.	Nomor Telepon/ HP	024 76482550/ 081325581564
10..	Alamat Kantor	Jurusan Ilmu Kelautan, Kampus Ilmu Kelauatan Undip, Tembalang Semarang
11.	No Telepon/ Fax	024 7474698
12.	Lulusan yg telah dihasilkan	S1 = 48 orang
13.	Mata Kuliah yg Diampu	1. Planktonologi
		2. Zoologi Laut
		3. Oseanografi Biologi
		4. Oseanografi Kimia

B. Riwayat Pendidikan

	S1	S2	S3
Nama Perguruan Tinggi	Institut Pertanian Bogor	Institute of Marine Ecology University of Aarhus, Denmark	Universitas Diponegoro
Bidang Ilmu	Ilmu dan Teknolologi Kelautan	Marine Sciences	Manajemen Sumber Daya Pesisir
Tahun Masuk-Lulus	1986 - 1991	1999 - 2001	2016-2018
Judul Skripsi/Thesis	Kelimpahan dan Struktur komunitas Fitoplankton di Perairan Selatan P. Jawa - Sumbawa	The effect of crustacea Amphipod (*Corophium volutator* Pallas) and Microphytobenthos on sediment stability	Domestikasi dan Bioekologi Teripang Paracaudina australis dari Pantai Kenjeran, Surabaya
Nama Pembimbing	Dr. Dedi Soedarma	Prof. Lars Lund Hasen, PhD	Prof.Dr.Ir. Muhammad zainuri DEA. Prof.Dr. Sutrisno Anggoro, MSc.

C. Pengalaman Penelitian Dalam 5 Tahun Terakhir

No	Tahun	Judul Penelitian	Pendanaan	
			Sumber	Jml (Juta Rp)
1	2016	Aplikasi Tepung Klekap dan *Spirulina platensis* sebagai pakan kaya nutrisi bagi teripang *Paracaudina* sp Tahun Pertama	Kemenristek dikti	36,5
2	2015	Kajian Fenotip dan Genotip Teripang Famili Stichopodidae dan Famili	Dikti	61,5

		Holothuriidae dari Kep. Karimunjawa, Jepara		
3	2014	Pengaruh Lama Waktu Pemaparan Gelombang Ultrasonik terhadap Kandungan Klorofil Pada Berbagai Mikroalga	BOPTN FPIK UNDIP	15
4	2013	Karakteristik Pigmen pada Mikroalga *Porphyridium cruentum*	BOPTN FPIK UNDIP	15
5.	2012-2013	Pengkajian Ekosistem Sumberdaya Ikan di Kawasan Konservasi Perairan Kepulauan Karimunjawa, Jawa Tengah	BPKSI	200
6	2011	Eksplorasi Mikroalga Laut Yang Berpotensi Sebagai Biofuel Dalam Upaya Pencaharian Energi Alternatif yang Terbarukan. (Tahun Ketiga)	Hibah Kompetensi Ditjen Dikti	85
7	2010	Eksplorasi Mikroalga Laut Yang Berpotensi Sebagai Biofuel Dalam Upaya Pencaharian Energi Alternatif yang Terbarukan. (Tahun Kedua)	Hibah Kompetensi Ditjen Dikti	100

D. Pengalaman Pengabdian Kepada Masyarakat dalam 5 tahun Terakhir

No	Tahun	Judul Pengabdian Masyarakat	Pendanaan	
			Sumber	Jml (Juta Rp)
1.	2013	IbM Kelompok Nelayan Teripang di Karimunjawa	Ditjen Dikti	47
2	2012	Optimasi Pemanfaatan Tambak Tidak Produktif dan Diseminasi Konservasi Mangrove	MFF	225
3.	2011	IbM Kelompok Usaha Kerupuk Ikan dan Udang	Ditjen Dikti	45
4.	2010	IbM Petani Pembudidayaan Artemia di Tambak Garam Kec. Trangkil.	Ditjen Dikti	45

E. Publikasi Artikel Ilmiah Dalam Jurnal 5 Tahun Terakhir

No	Tahun	Judul Artikel	Volume/ Nomor	Nama Jurnal/ Prosiding
1	2016	Nutritional Value of Sea Cucumber [*Paracaudina australis* (Semper, 1868)	Vol. 7 Tahun 2016	Aqua Precedia
2	2016	The Study of Ossicles Family Stichopodidae (sea Cucumber) From Karimunjawa Island, Central of Java.	Tahun 2016	Prosiding ISMFR (International Symposium for Marine and Fisheries Research

				UGM
3	2015	Kajian morfologi Ossicle teripang *Actinopyga milliaris* dari Karimunjawa, Jepara, Jawa Tengah	Tahun 2016	Prosiding Semnaskan ke XII UGM
4	2014	Penerapan Teknologi Fission pada Budidaya Teripang	Volume XVII (2) : 59-71	INFO LPPM UNDIP
5.	2013	Fatty Acid Composition of Marine Microalgae in Indonesia	Vol 10 : 75-82 tahun 2012	Journal of Biological and Conservation , Malaysia
6.	2012	Kandungan Lipid *Total Nannochloropsis oculata* Pada Kultur Dengan Berbagai Fotoperiod	Vol. 17 No. 3 September 2012 hal:	Ilmu Kelautan
7.	2011	Fauna Echinodermata di Indonoor Wreck, Pulau Kemujan, Kepulauan Karimunjawa	Vol. 16 No. 4 Desember 2011 hal: 236-242	Ilmu Kelautan
8.	2011	Komunitas cacing laut dalam (Polychaeta) di Selat Flores, Lamakera dan Alor, Nusa Tenggara Timur	Vol. 16 No. 4 Desember 2011 hal: 219-228	Ilmu Kelautan
9.	2011	Komposisi jenis dan kelimpahan Diatom bentik di Muara sungai Comal Baru Pemalang	Vol. 16 No. 1 Maret 2011 17-24	Ilmu Kelautan
10.	2011	Kajian Pengurangan Konsentrasi Nutrien Terhadap Kandungan Total Lipid Mikroalga *Nannochloropsis oculata*	Vol. 16 No. 1 Maret 2011 25-30	Ilmu Kelautan
11	2010	Eighteen Sea Cucumber Species Fishes in KarimunJawa Island, Java Sea. Mar. Res. Indonesia 35 (2) 23-30.	35 (2) 23-30	Mar. Res. Indonesia

E. Pemakalah Seminar Ilmiah (Oral Presentation) dalam 5 Tahun Terakhir

No.	**Nama pertemuan Ilmiah/Seminar**	**Judul Artikel Ilmiah**	**Waktu dan Tempat**
1	Seminar Nasional Tahunan IX Hasil penelitian Perikanan dan Kelautan	Kajian Kadar Total Lipid dan Kepadatan *Nitzschia* sp. Yang Dikultur Dengan Salinitas Yang Berbeda.	14 Juli 2012 Jur. Perikanan, Faperta UGM,
2.	Seminar Nasional Tahunan IX Hasil penelitian Perikanan dan Kelautan	Komposisi Makrozoobentos Di Perairan Morosari dan Pandansari, Desa Bedono, Kecamatan Sayung, Kabupaten Demak.	14 Juli 2012 Jur. Perikanan, Faperta UGM,
3.	Seminar Nasional Kimia	Karakteristik Spesifikasi Biodiesel	31-3-2012. FKIP

	dan Pendidikan Kimia IV (SN-KPK IV),	Berbahan Baku Mikroalga Laut *Nitzschia* sp	UNS, Surakarta,
4.	Seminar Nasional Ke II Hasil-hasil penelitian Perikanan & Ilmu Kelautan Undip	Kajian Kadar Total Lipid Dan Kepadatan *Nitzschia* Sp Yang Dikultur Dengan Salinitas Yang Berbeda.	4 Oktober 2012, Undip, Semarang
5.	Seminar Nasional Ke II Hasil-hasil penelitian Perikanan & Ilmu Kelautan Undip	Pemanfaatan Air Limbah Hatchery Sebagai Media Kultur Mikroalgae *Chaetoceros calcitrans*.	4 Oktober 2012, Undip, Semarang
6.	Seminar Nasional Tahunan X Hasil Penelitian Perikanan dan Kelautan	Optimalisasi Total Lipid Mikroalga *Nannochloropsis oculata* Melalui Media Kultur degan Intensitas Cahaya Yang Berbeda**.**	23-8-2013, Jur. Perikanan, Faperta, UGM
7	Semnaskan XII Hasil penelitian Perikanan dan Kelautan	Kajian morfologi Ossicle teripang *Actinopyga milliaris* dari Karimunjawa, Jepara, Jawa Tengah	8 Agustus 2015 Jur. Perikanan, Faperta, UGM
8.	1st ISMFR (International Symposium for Marine and Fisheries Research)	The Study of Ossicles Family Stichopodidae (sea Cucumber) From Karimunjawa Island, Central	7 Agustus 2015 Jur. Perikanan Faperta, UGM
9	2nd International Symposium on Aquatic Products Processing and Health, ISAPPROSH 2015	Nutritional Value of Sea Cucumber *Paracaudina australis* (Semper, 1868)	Semarang, 13-15 September 2015
10	Semnaskan ke XIII UGM	Kajian Tingkat Kematangan Gonad teripang *Paracaudina australis* dari Perairan Kenjeran, Surabaya, Jawa Timur	13 Agustus 2016
11	The 2nd International Conference on Tropical and Coastal Region Eco-Development , Bali	Proximate Content of “klekap” (Microphytobenthos and Their Associated Meiofauna) From Milk-Fish Pond	25-27 Oktober 2016, Bali

F. Karya Buku dalam 5 Tahun terakhir

No.	Judul Buku	Tahun	Jumlah Halaman	Penerbit
1	Pembenihan dan pembesaran Teripang Pasir (Echinodermata: Holothuroidea).	2009	128	Badan penerbit Universitas Diponegoro. Semarang
2	Teripang (Holothuroidea : Echinodermata) di Indonesia : Biologi, Budidaya dan Konservasinya.	2009	72	Navila Idea Yogyakarta.

3	Mikroalga Laut	2009	141	Badan penerbit Universitas Diponegoro Press.

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Semarang, 30 November 2021
Anggota Peneliti

Dr. Ir. Widianingsih, MSc.
NIP. 19670625 199403 2 002