SEA CUCUMBER FISHERIES, UTILIZATION AND TRADE IN INDONESIA

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1. Introduction

Indonesian waters contain high marine biodiversity including sea cucumbers which are used intensively in whole regions. Sea cucumbers constitute a group of animal having relatively no movement, so that it is easy to harvest these echinoderms organisms in large quantity to be commercialized. As trade commodity and an important export product of Indonesia, sea cucumbers might be exploited continuously by fishermen in large quantity to provide the market demand. In fact, this phenomenon has influenced the existence of sea cucumbers themselves. The actual condition shows that it is more and more difficult to find sea cucumbers in enough quantity, because their populations in the nature tend to decrease. Certain species seem suffer the depletion of its population or be vulnerable, for example: prickly redfish (*Theleonata ananas*) and sandfish (*Holotoria scabra*). A similar condition has occurred in some countries, so that it stimulates many countries to propose sea cucumbers entered to CITES (The Convention on International Trade of Endangered Species of Fauna and Flora).

As a country having potential sea cucumbers resource, Indonesia would need to provide accurate information on the existence of sea cucumbers stock in nature in order to find out necessary management measure. For that, it is needed scientific data and information of sea cucumbers on several aspects such as: species composition, stock size, distribution, production, utilization, trade, the effort of marine culture of sea cucumbers. To fulfill necessary data and information some scientific and technical reports published from publication from ten to fifty years ago are traced as follow: Yusron (1987, 1989, 1990, 1991); Andamari et al., (1989); Yusron and Pramudji (1995); Pralampita et al. (1992); Suprapto et al. (1992); Darsono and Djamali (1998) for biological and fisheries aspects; General Directorate of Capture Fisheries (2006) for production and trade; and Darsono et al (2002) and Yusron (2004a, 2004b) for marine culture aspects.

Sea cucumbers resource is known for years ago as delicious food for certain people, especially for Chinese ethnic. Actually the consumers of sea cucumbers have increased widely. Beside of China, Japan and Korea, export of sea cucumber product is also to United State of America (Hartati et al., 2002). As export commodity, sea cucumbers has played important role for foreign exchange earning and increases yearly both in volume and trade value (General Directorate of Capture Fisheries, 2006). In accordance with highly demand and price of sea cucumbers which reach to about US $ 65 per kg it stimulates the fishermen to exploit intensively sea cucumbers in Indonesian waters.

In Indonesia, sea cucumbers fishery has done by the people since Dutch colonization (Nuraini, et al., 1990). The areas of its harvest spread from west to eastern part of Indonesia. These benthic organisms inhabit usually coral reefs that are found potentially in Indonesian waters and its species composition includes those with high economic value such as Holoturia scabra and many others with having no economic value (Aziz, 1997).

The continuous exploitation of sea cucumbers by fishermen has influenced the current population status of sea cucumbers which tend to decrease in the waters (Darsono, 2002, Hartati et al., 2002, Andamari et al., 1989). In fact, the density of sea cucumbers population is relatively low also the size becoming small and the fishermen must harvest sea cucumbers in deeply waters. However, the awareness on sea cucumbers by stakeholders is still low (Darsono & Djamali, 1998) in conserving its stock populations. Therefore, management measure of sea cucumbers should be done before these important resources become vulnerable or endangered. Scientific knowledge on the condition of sea cucumbers would be needed to good manage these important resources.

Hence, studies and understanding related to the resources and fishery status including species

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composition, distribution, biological aspects as well as market, trade of sea cucumbers are all necessary to be scientific witness for orientation and solution to manage and maintain its resource in sustainable uses in Indonesia and as necessary information for CITES authority.

2. Potency and Distribution of Sea Cucumbers

2.1 Species Composition

Inventory activities on sea cucumbers have conducted since in the end of 1970's in Indonesian waters. It was found about 53 species of sea cucumbers that are belonging from genera: *Holothuria, Actinopyga, Bohadschia, Labiodemas, Thelonota dan Stichopus* (Clark & Rowe, 1971). From all species identified, there are about 22 consumable species and only 8 species of these Echinoderms that constitute important fishery commodity with highly economic value (**Table 1**). The mostly species exploited is sandfish (*Holotoria scabra*), especially that collected in Bangka Belitung waters, Seribu Islands, Riau Islands, South Sulawesi, Buton, West Nusa Tenggara. The next species also strongly exploited is black fish (*A. miliaris*) that highly captured in Seribu Islands of Jakarta and West Nusa Tenggara. Other important species is prickly redfish (*T. ananas*), that especially collected in West Nusa Tenggara (Aziz, 1987).

The species presented in **Table 1** are systematically belonging to the family of Holothuridae and Stichopodidae. Furthermore, the systematic of sea cucumbers is done according to classification of University of Michigan Museum of Zoology (http://animaldiversity.ummz.umich.edu).

Phylum: Echinodermata
Class : Holothuroidea
SubClass : Aspidochirotacea
Ordo : Aspidochirotida
Family : Holothuriidae
Genus : Holothuria, Actinopyga, Bohadschia
Species : *Holothuria scraba, H. nobilis, H. fuscogiva Actinopyga miliaris, A. echinites, A.lecanora Bohadschia argus*
Family : Stichopodidae
Genus : Thelonota
Species : *Thelonota ananas*

Based on existing information, it was reported that the highest biodiversity of sea cucumbers is found in North Sulawesi (Kwandang Bay, Tiga Islands, and Sangir Islands) with number of 21 species. In Koloka District Sulawesi Tenggara Province it found about 20 species of sea cucumbers with dominant species of *Bohadschia marmorata* (87%), *Holothuria leucospilota* (6%) and *Synapta maculate* (7%) (Nuraini et al., 1990). The high biodiversity of sea cucumbers is found also in Alas waters of West Nusa Tenggara with number of 20 species and dominant species of *Synapta chloronothus*

The species inhabiting dominantly each location is different from one to other locations depending on water habitat condition. In North Sulawesi waters (Kwandang Bay, Tiga Islands and Sangir Island) the dominant species are *Holothuria pervicax, H. impatient, H. atra, H. coluber* and *Bohadshia marmorata* (Darsono, 2002). While in Seribu Islands of Jakarta Bay the dominant species are *H. impatiens, B. marmorata* and *Synapta maculate* (Hartati et al., 2002). In coastal waters of Waisisil, Saparua of Maluku Province the dominant species is sandfish (*Holotoria scabra*), reaching about 77 % of total number of the sea cucumbers production

Table 1. Sea cucumbers species with highly economic value

Scientific Name	Common Name	Local Name
Holothuria scraba	Sandfish	Teripang Pasir, Teripang putih
H. nobilis	Black teathfish	Teripang koro, teripang susuan
H. fuscogiva	White teatfish	Teripang susuan
Actinopyga echinites	Brown fish	Teripang batu
A. lecanora	Stone fish	Teripang bilabo, Teripang batu , Teripang tempulu
A. miliaris	Black fish	Teripang lotong
Bohadschia argus	Leopard (tiger) fish	Teripang mata kucing, Teripang kridou bintik
Theleonata ananas	Prickly redfish	Teripang pandan, Teripang nanas

Source: *Darsono (2005); (www.isoiblog.com), Hartati et al. (2002)*

(Andamari, 1989). At Batuampar of Lombok the species, *H. marmorata* is found in highest number, reaching about 68 % of total number of sea cucumbers collected (Prahoro & Suprapto, 1991).

The abundance of sea cucumbers in Indonesian waters is in general low, based on research results their abundance was less than 1 individual m^{-2}, excepted in Bunaken of North Sulawesi where the sea cucumbers abundance might reach to 3 individuals m^{-2} and in Southern Tanimbar (South-East Maluku) the abundance reached to 2.75 individuals m^{-2} (**Table 2**).

2.2 Spatial Distribution

2.2.1 Habitat and Food Composition

Spatial distribution of sea cucumbers in Indonesian waters is widely significant, these Echinoderms spreading from west to east Indonesian region. They occur from Bangka – Belitung, Mentawai Island, Seribu Island, Karimun Jawa waters, Kangean, Sulawesi (along of southern coast, south-east, middle, northern part including Sangir Talaud waters), Maluku (middle, northern, south-eastern parts), West Nusa Tenggara covering some waters of Sumbawa Island (Saleh Bay, Waworada, Sape and Alas Waters) and East Nusa Tenggara covering the waters of Flores, Sumba, and Timor waters (Djamali *et al.*, 1998).

Sea cucumbers habitat is found in coral reef and seagrass ecosystems, from intertidal zone to the deep sea water of about 20 m. However some of them inhabit offshore deeper waters. Under their good adaptation capability, sea cucumbers are capable to inhabit in various substrates (Aziz, 1995). In general, sea cucumbers occur in clear waters, fine sandy bottom or mud mixed with sand with water plants such as seagrasses ((*Enhalus*) and seaweeds (*Sargasum* and *Laminaria*) that may protect directly sea cucumbers from sun shine and strong sea currents (Aziz 1999; Hartati *et al.*, 2002). The investigation conducted in Kolaka District waters of South-East Sulawesi by Nuraini et al.

Table 2. Species abundance, density/potnecy of sea cucumbers in some locations of Indonesia

Area	Location	Species Number	Density/Potency	Source
Maluku	Kulur, Saparua	3	Nd	Andamari et al. (1988)
	Waisisil, Saparua	4	0.88 ind. m^{-2}	Andamari et al. (1988)
	Yamdena, Tanimbar Selatan	12	2.75 ind. m^{-2}	Rumahpurute (1990)
	Kep. Kai Kecil	15	1.08 - 2.03 ind. m^{-2}	Yusron & Pramudji (1995)
Sulawesi	Sopura Kolaka	6	0.003 - 0.4 ind. m^{-2}	Mangawe & Daud (1988)
	Bunaken	8	2.98 ind .m^{-2}	Tamanampo et al. (1989)
	Pulau-pulau Tiga	21	Nd	Darsono (2002)
	P. Sembilan, Sinjai	13	15 ton $year^{-1}$	Nuraini et al. (1992)
	Kolaka	20	36 ton $year^{-1}$	Nuraini et al. (1990)
	Sulawesi Selatan	3	0.003 - 0.03 ind .m^{-2}	Darsono, & Djamali (1998)
	Sulawesi Tengah	4	0.002 - 0.06 ind .m^{-2}	Darsono & Djamali (1998)
	Sulawesi Utara	6	0.002 - 0.03 ind .m^{-2}	Darsono, & Djamali (1998)
Nusa Tenggara	Batunampar Lombok, NTB	5	0.19 ind m^{-2}	Prahoro & Suprapto (1991)
	Lombok, NTB	4	0.003 - 1.03 ind .m^{-2}	Darsono & Djamali (1998)
	Dompu, Bima, NTB	16	350 ton $year^{-1}$	Wahyuni (1992)
	Perairan Alas NTB	20	Nd	Prahoro & Wahyuni (1992)
	Lembata, Flores Timur, NTT	7	0.61 ind m^{-2}	Prahoro et al. (1994)
Jawa	Kep. Seribu	17	0.028 - 0.189 m^{-2}	Hartati et al. (2002)
	P. Pari Kep. Seribu	6	0.24 ind m^{-2}	Pralampita et al (1992)
	Sapeken, Kangean, Madura	10	30 ind Ha^{-1}	Suprapto et al. (1992)
	Karimun Jawa, Laut Jawa	14	20 ton $year^{-1}$	Nuraini & Wahyuni (1989)
Sumatera	Kepulauan Mentawai	9	0.003 - 0.09 ind m^{-2}	Darsono & Djamali (1998)

Note: nd = no data available.

(1990) showed that in the high density of seagrasses sea cucumbers occurred in higher number than those found in the waters with low density of seagrasses. The species, *H. leucospilota, H. atra, B. marmorata, B. similis, H. hilla, H. sucossa* and *H. scraba*, inhabit shallow waters such as seagrass bed and coral reefs with water depth under 2 m. While *H. nobilis, T. anax, T. ananas, S. variegates, A. achinetes, A. miliaris* and *Holothuria sp* inhabit deeper waters. The other sea cucumbers found in deep waters are *Actinopyga miliaris, Holothuria arenicola, H. difficilis, H. erinaceus, H. modesta, H. notabilis, H. moebi* and *H. kurti* (Aziz, 1995).

According to Pawson (1970), sea cucumbers prefer inhabit waters with normal salinity of about 30 – 33 ppt, and inversely in the low salinity. Bakus (1973) stated that sea cucumbers may tolerate waters condition with temperature of 26 – 31 °C. The proper dissolved oxygen for sea cucumbers is between 4 - 8 ppm (Panggabean, 1987) in range with dissolved oxygen in nature (Alwi, 1995).

Sea cucumbers obtain their food by sucking and filtering particles in the waters such as plankton and detritus attached on the substrates (Hyman, 1955; Hartati *et al.*, 2002). Results of their investigations showed that phytoplankton contributed as main food for sea cucumbers with preponderating index more than 50 %. Phytoplankton composition of sea cucumbers diet consists of diatom group such as *Chaetoceros* sp, *Pelagothix* sp, *Amphora* sp, and *Thallasiotrix* sp.

2.2.2 Reproductive Season

The spawning season of sea cucumbers is usualy going on the rainy season, because in this season the salinity decreases to the low level stimulating for the maturity of gonad and the spawning (Alwi, 1995). Some sea cucumbers species spawn two times per year on April and November (Misnawati, 1998). In Seribu Island waters, the spawning season of sea cucumbers probably occurs on the west monsoon period during December to February.

3. Sea Cucumbers Fisheries

3.1 Sea Cucumbers Fishery Activity

In Indonesia sea cucumbers fishery constitutes a traditional activity, on going since long time ago and mostly artisanal fishery (Darsono, 2002) or small scale fishery. Fishermen exploit sea cucumbers continuously without consider its ecological values this causes the impact of decreasing of sea cucumbers population in Indonesian waters (Aziz, 1997).

There are not all sea cucumbers being economically important. It is only some sea cucumbers having high economic value such as *H. scraba* and *H. nobilis*, while *T. ananas* and *H. atra* costs moderate price and low price, respectively (Aziz, 1997).

The harvest activity of sea cucumbers is usually along of year when the water is clear and calm sea. During west monsoon period in November to February the harvest is almost absent because the water condition is not accessible. The harvest of sea cucumbers is done traditionally only by using a lamp on the night, and sea cucumbers are collected by hand. To harvest in high scale fishermen usually use boat and compressor. The harvest using compressor is conducted in deep sea waters but the depth less than 30 m in the night as well as in day time (Hartati *et al.*, 2002; Nuraini *et al.*, 1990, Prahoro & Suprapto, 1991; Prahoro & Wahyuni, 1991; Suprapto *et al.*, 1992). In Alas (West Nusa Tengggara the harvest of sea cucumbers has done by using "ladung" of sea cucumbers that operates as similar to harpoon, and "cengkeraman" of sea cucumbers that operates as pincers (Prahoro & Wahyuni, 1991).

3.2 Production

Production of sea cucumbers fishery in the region is in correlation to the fishing effort. By using a boat and a compressor, the production of dray sea cucumbers in Seribu Island of Jakarta is around 8 – 10 kg per day, or about 30 – 60 kg of dray sea cucumbers per week (Hartati *et al.*, 2002). While based on result of research conducted in Kolaka of South-East Sulawesi in 1990, the production of sea cucumbers in this area reached to amount of 3 tons per month (Nuraini *et al.*, 1990).

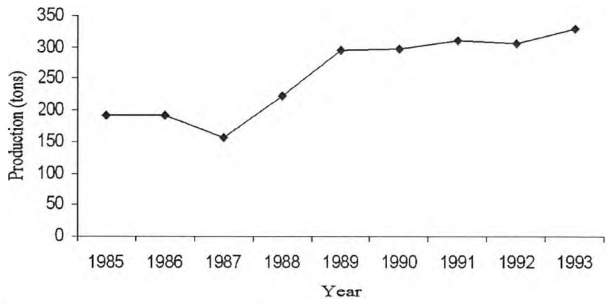
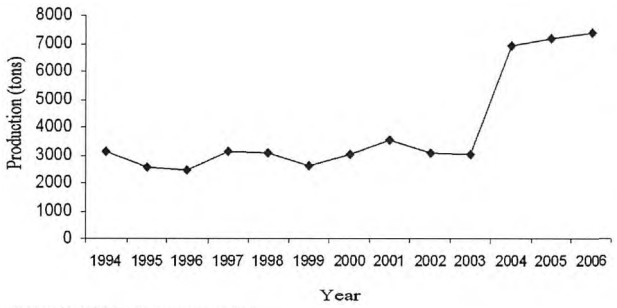


Figure 1. Fluctuation of sea cucumber production in South-East Maluccas District.



Note: In 2006 - temporary data

Figure 2. Trend of dray sea cucumbers production in Indonesia during 1994 to 2006.

In Maluccas, as the main production place of sea cucumbers in Indonesia, the production value increases from year to year (Yusron, 2001). According to export production data of South-East Maluccas District, the production value has always increased during 1985 to 1993 (**Figure 1**).

According to Indonesian capture fisheries statistic data, the harvest production of sea cucumbers from 1994 to 2003 was between 2,000 to 3,000 tons per year. The production increased significantly since 2004 when the production became twice than that in 2003 (**Figure 2**). The production during 2005 to 2006 has also increased significantly, reaching to about 7,000 tons per year. This increase of production might be related to the better data system application in whole regions of Indonesia. Beside of this condition, this high production was due to more intensively harvest of sea cucumbers. This situation is stimulated by high price and demand of sea cucumbers in the market.

As the impact of highly exploitation of sea cucumbers, it caused the depletion of sea cucumbers stock in the waters. Research result reported by Darsono (2002) who stated that in North Sulawesi the suplay of sea cucumbers decreased a half quantity in 2002 than the suply in 2001.

4. Trade

Almost there is no local utilization of sea cucumbers in Indonesia. Most part of catches is exported to foreign countries (Hartati *et al.*, 2002; Prahoro & Wahyuni, 1991, Darsono, 2002) through three steps trade mechanism. Firstly, the catch is bought by a collector as first buyer ("Penampung") who keeps sea cucumbers till a large quantity before selling them to second collector as second buyer ("Pengumpul"). The latter then sell sea cucumbers to exporter.

The price of sea cucumbers varies widely with sea cucumbers species. **Table 3** shows market price of certain species of dray sea cucumbers sold in Seribu Island of Jakarta in 2002.

The actual price of dray sea cucumbers more and more increases in the market, because the stock available in the nature tends to decrease, for example dray sea cucumbers black teathfish and white teatfish (*Holothuria fuscogiva* and *H. nobilis*) cost up to 70.00 US $ per kg.

Table 3. Composition and dray sea cucumber price in Seribu Island of Jakarta

Species	Price in fishermen per kg (US $)	Price in buyer 2 per kg (Rp)
Holothuria scraba	30.30	60.60
Stichopus variegatus		
Super (size 20 cm)	12.20	15.50
Moderate (size 15 cm)	10.00	11.75
Small (size 10 cm)	5.00	6.75
Theleonota ananas	12.20	15.75
Bohadschia marmorata	1.00	1.40
Achtinopyga echinites	12.00	15.75

Source: Hartati et al. (2002)

Those highly price and export demand of sea cucumbers might cause more intensively the exploitation of this commodity by fishermen in Indonesian waters. This high exploitation may directly cause the dramatically depletion of sea cucumbers stock in whole Indonesia waters (Aziz, 1997). Therefore, to maintain the market supply it needs to develop sea cucumbers culture. For the time being, there is just only one species i.e sandfish (*H. scabra*) which has taken place successfully in marine culture.

Some countries noted as main importers for Indonesian sea cucumbers are South Korea, Singapore, Taiwan, Hongkong, Malaysia, China, Vietnam, and USA. According to data available of sea cucumbers mixed with other marine product ("exotic marine product) from January to April 2007 (Central Statistic Board, 2007), the highest export value is Hongkong with trade value of about 497,682 $US and three other countries play an important importer of sea cucumbers from Indonesia are South Korea, Vietnam and Singapore (**Figure 3**).

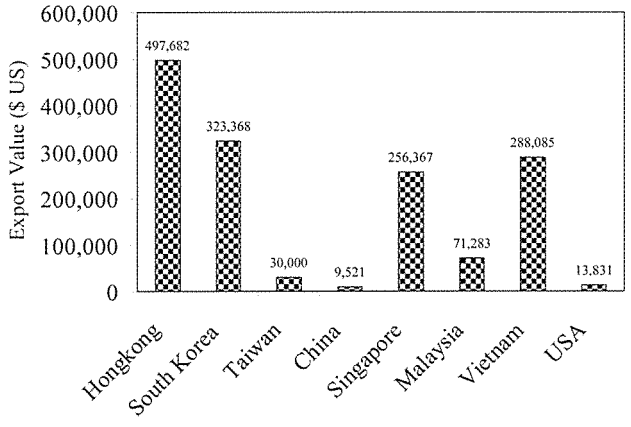


Figure 3. The variation of export trade value of sea cucumbers and the other marine products to eight principal countries.

5. Sea Cucumbers Resource Management

5.1 Management Policy

As mentioned previously that sea cucumbers catches increased significantly with increasing the price and demand of this marine commodity. The intensively harvest had resulted high production of sea cucumbers in some regions. This finally caused the depletion of sea cucumbers stock, for example two species of sea cucumbers: *H. scabra* and *T. ananas* are more and more difficult to collect them in the waters. Moreover, since the regulation is not yet available to manage the exploitation of sea cucumbers, this marine product would become vulnerable or endangered.

In their life, sea cucumbers are generally associated with coral reefs as their habitat. Therefore, the management of sea cucumbers would be a part of coral reefs management. The management policy of coral reefs is through the Ministry of Marine Affairs and Fisheries Decree No.KEP 38/ MEN/2004 on General Guideline for Coral Reefs Management. However, the specific regulation for sea cucumbers management that should include seasonal harvest, minimum size and fishing ground is actually not yet available. At the time being the sea cucumbers fishery is open for all people. Beside of that, applying the regulation would be difficult since the sea cucumbers fishery is traditional and not an industrial fisheries scale activity.

5.2 Research Status on Sea Cucumbers Resource

Research activity on sea cucumbers has been developed since 10 to 15 years ago with focus on biological aspect, ecology, marine culture, and processing. Many research activities were deal with Inventory Program on Sea Cucumbers Resource. Results of this program identified species composition, distribution, habitat condition, and standing stock of sea cucumbers. The methods used include direct observation in the field and census at the fishermen level and the collector 2 ("Pengumpul") to know the species composition. Some research activities on sea cucumbers condition have been conducted in several Indonesian waters as presented in **Table 4**.

Table 4. Some research activities on the sea cucumbers condition in Indonesia

Location	Research Aspect	Researcher
Maluccas	Utilization and Management of Sea Cucumbers	Yusron (1987)
Maluccas	Status of Sea Cucumbers Resource	Yusron (1990)
Maluccas	Habitat Condition	Yusron (1991)
Maluccas	Community Structure	Yusron & Pramudji (1995)
Maluccas	Food Analysis	Yusron & Sjafei (1997)
Maluccas	Status of Sea Cucumbers Resource	Yusron (2000)
Maluccas	Status of Sea Cucumbers Resource	Yusron (2001)
Maluccas	Community Structure	Yusron (2001)
Maluccas	Status of Sea Cucumbers Resource	Yusron (2003)
Maluccas	Community Structure	Yusron & Pita (2004)
Maluccas	Status of Sea Cucumbers Resource	Andamari et al. (1989)
West Nusa Tenggara	Status of Sea Cucumbers Resource	Yusron (2003)
West Nusa Tenggara	Status of Sea Cucumbers Resource	Yusron (2003)
West Nusa Tenggara	Status of Sea Cucumbers Resource	Yusron (2003)
West Nusa Tenggara	Sea Cucumbers Stock	Prahoro & Indar ()
Sulawesi	Status of Sea Cucumbers Resource	Prahoro & Suprapto (1991)
Sulawesi	Status of Sea Cucumbers Resource	Darsono (2002)
Seribu Islands	Biological Aspect	Hartati (2002)
Seribu Islands	Sea Cucumbers Stock	Hartati (2002)
Seribu Islands	Potency	Pralampita (1992)
Madura	Status of Sea Cucumbers Resource	Suprapto (1992)
Indonesia waters	Potency and Distribution	Subani et al. (1989)
Indonesia waters	Biological Aspect	Aziz (1995)
Indonesia waters	Status of Sea Cucumbers Resource	Darsono & Djamali (1998)
Indonesia waters	Status of Sea Cucumbers Resource	Djamali et al. (1998)

Research on marine culture of sea cucumbers has been developed since several times ago, especially for sandfish (*H. scabra*). The main aspects investigated in some occasion of studies includes: spawning, breeding, and experiments on the growth of sea cucumbers in the laboratory. **Table 5** presents some research activities on marine culture of sea cucumbers in Indonesia.

Table 5. Research on sea cucumbers culture in Indonesia.

Research Aspect	Reference
Growht aspect in laboratory	Yusron (1989)
Breeding	Darsono et al. (2002)
Larva rearing	Yusron (2001)
Spawning	Yusron (2004)

In developing marine culture of sea cucumbers, breeding aspect plays an important role in providing seeds stock. Therefore, in 2004 the Research Centre for Aquaculture, the Agency for Marine and Fisheries Research published a technical book as guideline of breeding technology of sandfish (*H. scabra*).

Research on processing aspect has been not developed with reason that in general Indonesia does export sea cucumbers with simple processing for which sea cucumbers are just sold in dry product, and there is not any local consumption of sea cucumbers.

5.3 Conservation Aspect

The depletion of sea cucumbers stock may be seen from the low density of these organisms found in most research locations. From 23 research activities conducted in some locations of Indonesian waters, most of results show that the density of sea cucumbers in the waters are less than 1 individual m^{-2}. This condition may not meet with the highly harvest activities of sea cucumbers. Therefore, it needs to develop the conservation effort or appropriate management to enhance the sea cucumbers stock in the waters, for instant the development of stock enhancement program of sea cucumbers. Hence, providing of sea cucumbers seeds seems to be crucial to implement this program.

For the conservation effort, there are some measures necessary which might be implemented such as:

a. Regulation on the size of sea cucumbers allowed to be harvested for trading purpose. Giving low price for small size of sea cucumbers does not decrease the harvest of sea cucumbers with small size.
b. Applying of marine protected area (MPA) where sea cucumbers do not be allowed to harvest by fishermen, except for research purpose.
c. Improving control and law enforcement.

In term of restocking program as part of sea cucumbers stock enhancement, stakeholders such as fishermen, collectors and exporters must be involved in the program. While in term of ecological aspect, restocking activity needs a water condition with good environment as well: clean, clear protected waters condition. Wahyuni et al. (2004) reported for their sea cucumbers stock enhancement activity in Seribu Island that sea cucumbers seeds with size of 67,0 g per individual and 78,0 g per individual might be life and grew well with growth rate of 0.95 to 6.37 % per day.

6. Conclusion and Recommendation

In Indonesian waters it is found about 53 species of sea cucumbers belonging to Genera *Holothuria, Actinopyga, Bohadschia, Labiodemas, Thelonota* and *Stichopus*. Among those species, there are about 22 species which are consumable and only 8 species of those sea cucumbers constituting marine product with highly commercial value. These eight species are belonging to family Holothuriidae such as: *Holothuria scraba, H. nobilis, H. fuscogiva, Actinopyga echinites, A. lecanora, A. miliaris, Bohadschia argus*, and family Stichopodidae with single species, *Theleonata ananas*.

Sea cucumbers fishery in Indonesia constitutes as traditional fishery activity done by small fishermen since several years ago. This marine product is processed with simple way by draying the animals before selling to market. The market mechanism includes three steps: from fishermen to collector 1 as first buyer, collector 1 to collector 2 as second buyer, and collector 2 to exporter. Almost there is no local utilization of sea cucumbers. Most part of this marine product is exported with mainly direction to: Hongkong, South Korea, Vietnam and Singapore Taiwan, Malaysia, China, and USA. Due to highly price and market demand, the exploitation of sea cucumbers increased significantly, this produced a large quantity of sea cucumbers. For last two years the production reached to about 7,000 tons per year.

The impact of highly exploitation of sea cucumbers has caused the depletion of sea cucumbers stock in the waters. In fact, in the most locations the density of sea cucumbers was fairly low with density of less than 1 individual m^{-2}. Some studies on sea cucumbers have been conducted since more than 10 years including marine culture. Research on marine culture might provide seeds of sea cucumber in order to support and develop its marine culture.

In respect to maintain the sustainability use of sea cucumbers in the nature, it is recommended to take measure in managing of sea cucumbers resource including size catch regulation, establishment of marine protected area, controlling of harvest by low enforcement, development of sea cucumbers stock enhancement program, and developing sea cucumbers culture. Establishing and developing of good data record and statistic on sea cucumbers production are also recommended in order to better manage sea cucumbers fishery as important resource for small fishermen in Indonesia.

Photography of eight most important sea cucumbers species of Indonesian waters

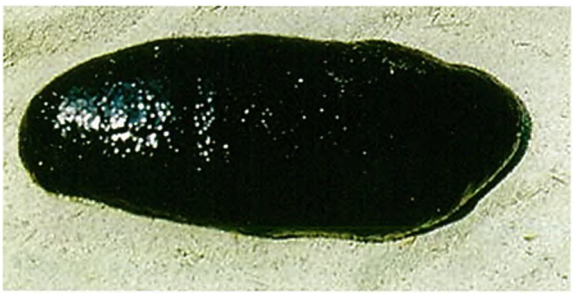
Holothuria scabra (sandfish)
TL: 400 mm; W: 1.5 kg
Local name: Teripang pasir

Holothuria nobilis (black teatfish)
TL: 400 mm; W: 1.5 kg
Local name: Teripang susuan

Holothuria fuscogilva (white teatfish)
TL : 300 mm ; W : 1 kg
Local name: Teripang susuan

Actinopyga echinites (Deep water redfish)
TL : 400 mm; W: 3 kg
Local name : Teripang bilalo

Actinopyga lecanora (stoneffish)
TL: 400 mm; W: 3 kg
Local name: Teripang batu



Actinopyga miliaris (blackfish)
TL: 300 mm; W: 2 kg
Local name: Teripang lotong

Bohadschia argus (leopard/tiger fish)
TL: 500 mm; W: 2 kg
Local name: Teripang kridou bintik

Thelenota ananas (prickly redfish)
TL: 700 mm; W: 6 kg
Local name: Teripang nanas, Teripang pandan

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