Analysis of growth of sandfish *Holothuria scabra* cultured at different cultivated habitat

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Abstract. The problem in the sea cucumber culture development in Indonesia is the difficulty to find the culture area that could provide optimal production. This study analyzed the cultivated habitat that could provide optimal growth, proximate and total energy to sandfish *Holothuria scabra* cultivated in different habitats. The study was done from March to June 2011 in the Puteangin Island, Lasitae Village, District Tanete Rilau, Barru Regency, South Sulawesi. The cage size used was 2 m in length, 1 m in width, and 1.5 m in height. The net mesh-size was 0.5 inch. The cage placed at three different habitats, i.e. sandy overgrown with seagrass habitat, sandy covered with corals habitat, and sandy habitat. The study consisted of three treatments and three replications. Growth was observed by measuring the daily specific growth rate and absolute weight growth. Proximate and energy content of sandfish was analyzed at the beginning and the end of the study. The study reveals that the sand and seagrass habitat provide the best results with daily specific growth rate is 1.15% ± 0.03%. The absolute weight growth is 28.45 g ± 0.95 g. The proximate content is 0.24 g ± 0.492 g for protein, 0.07 g ± 0.395 g for fat, and 18.026 g ± 0.39 g for carbohydrate. The highest energy content is 176 997 calories.
Keywords: Sea cucumber, proximate, survival, macro benthos, Makassar

Introduction

In Indonesia, there are 23 species of sea cucumbers, which 5 species have important economic value. Sandfish *Holothuria scabra* is the species most widely traded (Hartati *et al*. 2004). Sea cucumbers could be found in the coastal waters, ranging from tidal areas to deep water. Sea cucumbers prefer clear waters in the sheltered area. Sandfish are frequently found in the sandy or muddy areas overgrown with seagrass (Radjab, 2002). The scientific classification of sandfish is : Kingdom : Animalia; Phylum : Echinodermata; Class : Holothuroidea; Order : Aspidochirotida; Family : Holothuriidae; Genus : *Holothuria*; subgenus *Metriatyla*; Species : *Holothuria scabra.* The synonyms is *Holothuria albida* Savigny, 1867; *Holothuria gallensis* Pearson, 1903; *Holothuria saecularis* Bell, 1887.

Sea cucumber is nutritious seafood with a high protein and low lipid content and is rich in gluten, nitrogen, iodine and other nutritional elements (Wang, 1997). Sea cucumbers used as a food contains high nutrient value, i.e. 43.1% protein, 2.2% fat, 27.1% moisture, 27.6% ash content (Rustam, 2006 dan Hendri *et al.* 2008). The amino acids of sandfish are generally the essential amino acids (Chen, 2004). Sandfish is a high economic value commodity and has a good prospect of domestic and international market. The domestic price could reach Rp.900.000 per kilogram (Hartati *et al*. 2005). Sandfish is the most expensive sea cucumber produced in tropical and sub tropical area. The price of dried product or trepang ranges from 25 to 63 US$ kg^{-1}, it depends on grade and quality. The grade is related to the thickness of the body wall and size. Generally, there are three grading size of sandfish dried product, i.e. grade A for 10 to 30 pc kg^{-1}; grade B for 15 to 40 pc kg^{-1}; and grade C for more than 40 pc kg^{-1}. The grade A price is range from 43 to 63.0 US$ kg^{-1}; grade B is range 35 to 40 US$ kg^{-1}; and grade C is range 25 to 37 US$ kg^{-1} (Anom. 2001a; Anom. 2001b Anom. 2002a; Anom. 2002b). The pularity of sea cucumber as a health food purportedly able to cure arthritis and some types of cancer, other forms of high value processed sea cucumbers are expected to receive good market acceptance and preference in local and international markets.

Sandfish yield is one of the largest sea cucumber catches worldwide; and it is an important source of income for marginal fishers in impoverished coastal villages in Southeast Asia countries. Sandfish are highly exploited so that it population continues to decline in the wild (Sudjiharno, 2003). To maintain the sustainability of sandfish production is needed. In Southeast Asian countries, cultivation has carried only on sandfish. Sandfish is better than another because of its high prices, also has a better environment adaptation than other sea cucumber species, such as more resistant to salinity fluctuation than other sea cucumbers species. Sandfish cultivation is generally located in shallow coastal areas; water depth should be 75 to 100 cm (Tuwo, 2004).

Increasing sandfish production could not be done by only relying on wild capture. Sandfish production needs to be done both wild capture and cultivation. Actually, sandfish cultivation faces many problems, i.e. sandfish adaptation to the cultivation area. One problem often encountered sandfish cultivation area is the lower growth rate and lower nutritional value of sandfish from cultivation compare to sandfish from the wild. To overcome this problem is needed to find out the cultivation area that has environment condition to sandfish natural habitat. Until present, there has been no previous research on the sandfish habitat condition that favorable to sandfish cultivated growth. This study aims to analyzed the habitat condition that could potentially provide better growth rate and.

Materials and Methods

The study was conducted from March to June 2011 in the island Puteangin, Lasitae Village, District Tanate Rilau, Barru regency, South Sulawesi. There are 100 individuals used in this study. The sandfish weight is 28 to 29 g of as many as 100 individuals. Cultivation media used in this study were the nets that have length, width and height of each of the 2 x 1 x 1.5 m. the nets size is of 0.5.

The study consisted of three treatments and each treatment consisted of three replications. Thus, this study consists of nine units of the experiment. The treatments tested were the bottom waters are: (1) sandy overgrown with seagrass habitat, (2) sandy covered with corals habitat, (3) sandy habitat. Parameters measured were survival rate, growth, proximate (proteins, fats, carbohydrates) and total energy. The survival rate (SR, %) is calculated using the formula Effendie (1979): SR = Nt / No x 100; wherein SR is the survival rate (%), N_t is the number of sandfish at the end of the study, N_o is the number of sandfish at the beginning of the study.

The daily specific body growth rate (SGR) was calculated using the formula Effendie (1979): SGR = {(lnWt - lnWo) / t} x 100, wherein the W_t is the average weight of the end of the study (g), W_o is the average weight at the beginning of the study (g), t is the duration of the study (days).

The absolute weight growth was calculated using the formula Effendie (1979): W = Wt - Wo; wherein W_t is the average weight at the end of the study, and W_o is the average weight at the beginning of the study.

Results and Discussion

Survival Rate

The survival rate of sandfish was 40% to 70%. Highest survival rate was found at Sandy overgrown with seagrass habitat, which was 70% (average 66.67%). The lowest survival rate was found at habitat sandy, which was 40% (average 50.00%). Sandfish survival rates were significantly different two types of habitat, the sandy overgrown with seagrass habitat and sandy covered with corals habitat (Table 1). The sandfish survival rates obtained in this study is higher than the results of other studies. Hair (2011) reveals that the survival rate of sandfish after six months rearing was around 28%; and the highest survival rate was 41%, recorded from a pen of large sandfish.

Growth Rate

The highest daily specific body growth rate (1.15) and absolute weight growth (28.45) of sandfish were found at sandy overgrown with seagrass habitat. The two growth parameters of sandfish were significantly different in the three types of habitats. Both growth parameters is greater than the second. The soil fraction was same at three cultivation habitats. The texture type was sandy (Table 6). This sediment texture is suitable for sandfish cultivation habitat. Gultom (2004) revealed that soil fraction suitable for sandfish is 83.62% - 93.40% of sand fraction, 0.57% - 2.17% of dust and 3.20% - 5.68% of clay. Naturally, sea cucumbers live in sandy areas mixed with rubble and overgrown grass (Gultom, 2004). Chen (2004) and Agudo (2006) reveal that sandfish suitable reared at substratum muddy or sandy bottom, preferably with seagrass; and depth range from 3 to 10 meters (Chen, 2004; Agudo, 2006). The content of nitrogen, phosphorus, pH, organic matter and sediment were relatively same for the three cultivation habitats. The pH was around 8. The ideal conditions for a desirable cultivation site of sandfish should be pH range from 7.9 to 8.4 (Chen, 2004). Soil organic matter content was slightly higher in the sandy overgrown with seagrass habitat and sandy

covered with corals habitat (Table 3). Mercier *et al*, (1999) and Pitt and Duy (2004) found that sandy muddy substrates were rich in organic matter. The content of nitrogen, phosphorus, pH, organic matter at the three cultivation habitats was feasible for sandfish.

Table 1. Survival rate of sandfish (*Holothuria scabra*) cultivated at three different types of habitats.

Habitat	Survival Rate (%)
Sandy and seagrass	66.67 ± 5.77a
Sandy and coral	56.67 ± 5.77b
Sandy	50.00 ± 10.00b
t_{count}	$t_{A\&B}$=2.123; $t_{A\&C}$=2.501; $t_{B\&C}$=1.001
t_{table}	0.134

Table 2. Daily specific body growth rate and absolute weight growth of sandfish (*Holothuria scabra*) cultivated at three different types of habitats.

Habitats	Daily Specific Growth Rate (%)	Absolute Weight Growth (g)
Sandy and seagrass	1.15 ± 0.03[a]	28.45 ± 0.95[a]
Sandy and coral	0.83 ± 0.01[b]	18.51 ± 0.28[b]
Sandy	0.62 ± 0.04[c]	12.97 ± 1.03[c]
t_{count}	$t_{A\&B}$=17.270; $t_{A\&C}$=18.358; $t_{B\&C}$=8.823	$t_{A\&B}$=17.308; $t_{A\&C}$=19.093; $t_{B\&C}$=8.986
t_{table}	0.134	0.134

Table 3. Chemical and physical parameters of three habitats cultivated by sandfish (*Holothuria scabra*)

No.	Contents		Sandy and seagrass		Sandy and coral		Sandy	
			Average	Std	Average	Std	Average	Std
1.	N (%)	Beginning	0.067	0.003	0.062	0.006	0.026	0.004
		End	0.072	0.003	0.069	0.004	0.032	0.004
2.	P (ppm)	Beginning	6.521	0.004	7.525	0.234	6.388	0.005
		End	6.521	0.004	7.525	0.234	6.388	0.005
3.	pH	Beginning	8.180	0.020	8.267	0.124	8.493	0.025
		End	8.197	0.015	8.293	0.093	8.493	0.012
4.	BO (%)	Beginning	0.886	0.003	0.894	0.010	0.440	0.145
		End	0.958	0.014	0.955	0.016	0.430	0.102
5.	Sediment							
	Sand (%)		92.00	-	96.00	-	93.00	-
	Dust (%)		5.00	-	3.00	-	4.00	-
	Clay (%)		3.00	-	1.00	-	3.00	-
	Texture types		Sandy	-	Sandy	-	Sandy	-

Salinity is one of important factors for the sandfish growth. Salinity waters during this study ranged from 27 to 31 ppt (Table 4). This range is feasible for the cultivation of sandfish. Rusyani *et al*. (2003) found that the ideal seawater salinity range for sandfish was 28 to 33 ppt. The ideal conditions for a desirable site are salinity range from 28 to 31 (Chen, 2004; Agudo, 2006). Sandfish tended to burrow when salinity decreased, whereas increased water temperatures reduced normal burrowing behavior (Mercier *et al*, 2000a, 2000b). Temperature has an important role for the sandfish growth. Water temperature during this study ranged from 28 to 32 ^{o}C. Optimum temperature for the sea cucumber is 24 to 30^{o}C (Martoyo *et al*, 2006; Chen, 2004; Agudo, 2006). Dissolved oxygen concentration during this study was 3.5 to 8.5. The optimum dissolved oxygen concentration for the cucumbers ranged from 4 to 8 ppm (Martoyo *et al*, 2006). The content of nitrate (NO_3) obtained during the study ranged from 0.02 to 0.08 ppm. This concentration is still suitable for the survival and growth of the sea cucumber.

Table 4. Water quality parameters at three types of habitat cultivated by sandfish (*Holothuria scabra*)

	Water Quality			
Habitat	Salinity (ppt)	Tempe-rature (^{o}C)	DO (ppm)	Nitrate (ppm)
Sandy and seagrass	27 - 31	28 - 32	3.667±0.006 - 8.527±0.031	0.040±0.000 - 0.07±0.006
Sandy and coral	27 - 31	28 - 32	3.750±0.044 - 8.157±0.040	0.040±0.000 - 0.067±0.006
Sandy	27 - 31	28 - 32	3.473±0.025 - 8.660±0.017	0.033±0.006 - 0.067±0.006

Conclusions

The study reveal that survival rate, growth, proximate and total body energy content of sandfish found in sandy habitats overgrown grass is better that the two other cultivation habitat. The lowest levels found in sandy habitats.

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