Aseksual Reproduction of Black sea cucumber from Jepara Waters

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Abstract

Black sea cucumber or Lollyfish are trade name for Holothuria atra, one species of family Holothuriidae abundance in Jepara waters, especially in Panjang Island. They inhabit on the seabed, in shallow waters on reefs and sand flats or in Seagrass meadows. Beside reproduce sexually, H. atra also do fission (biology), i.e. able to reproduce asexually by transverse fission. Monthly survey has been conducted for three months to determine frequency of fission among H. atra population in Panjang Island waters. In total 891 individu of H. atra inhabit in seagrass meadow mixed with rubble were examimed. In fissiparous sea cucumber, transverse fission are followed by regeneration and in this research identified from external observations. The fission state was divided into three category, i.e. closed wound (Category 1), little regeneration either posterior or anterior part (category 2), moderate regeneration either posterior or anterior part (category 3). The result showed that the fission frequency was highest during end of rainy season in April (13,21%) and decreased during May (4,61%) and June (4,86%). Body regeneration seem happened fast, since the new individu sea cucumber at category 1 was low but high as category 3. The regeneration were related with the condition of environment.

***Keywords**: fission, Holothuria atra, population, regeneration.*

Introduction

Sea cucumber is one of the marine organisms that need to be considered for protection, due to high harvesting of its natural population (Toral-Granda *et al*., 2008; Conand *et al*., 2014). For this reason, proper management is needed which requires an understanding of various aspects including reproductive biology (Forero *et al*., 2013; Ambariyanto, 2017). It has been proposed that population management must reflect regional differences of these organisms (Ackiss *et al*., 2013; Jackson *et al*., 2014).

Black sea cucumber (*Holothuria atra*) is widely distributed in Indonesian waters. This species in Central of Java is called Teripang hitam or Lak Ling (in Karimunjawa islands) or Bantalan (in Jepara) based on the appearance of their black leathery skin. They are sold as dry product called lolyfish. Belong to Holothuroidea family, *H. atra* is able to reproduce sexual and asexually. According to Conand (1996) this particular life-history strategy by asexual reproduction offers a good example as a model for comparison with the general strategy of sexual reproduction in holothurians.

Asexual reproduction by fissiparity and regeneration is only displayed by some taxa but it can occur in populations that also reproduce sexually (Gouyon *et al*., 1993; Conand, 1996), among of them are aspidochirotid holothuroids (Mladenov, 1996; Uthicke, 2001). During fission, sea cucmber is capable of spontaneous transverse division and each part so formed producing a new individual. According to Chao *et al*. (1993). *H. atra* occurs in two phenotypes, a small form (ca. <250 g) that reproduces sexually and asexually and a large form (ca. >300 g) that appears to reproduce only by sexual means. The small form is abundant in intertidal and shallow water habitats and the large form is most common in deeper (>2 m depth) water (Chao *et al*., 1994).

In Panjang Island waters, *H. atra* present among seagrass meadows and sandy rubbles habitat. Previous study Hartati *et al*. (2019) indicated that the density of *H. atra* in the seagrass habitat were higher than in the sandy-rubble habitat but in contrary for their length data. They also found the evidence of fission among the samples. Therefore present work is aimed to determine the frequency of fission on *H. atra* population in Panjang Island waters.

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ijms.undip.ac.id
DOI: 10.14710/ik.ijms.24.3.121-126
Received : 22-07-2019
Accepted : 28-08-2019

Materials and Methods

Panjang Island was located at position of 06°34'32.8"S and 110°37'54.0"E which were used in previous ecological studies Hartati *et al*. (2019). Asexual reproduction of *Holothuria atra* was monitored in samples collected monthly from April-June 2018. The samples of *H. atra* inhabit in seagrass meadow mixed with rubble were collected at low tide. The length of each *H. atra* was measured with a ruler and weighed using BC-500 CIS digital balance to the nearest 0.1 g. Each specimen was examined externally for signs of fission. In fissiparous sea cucumber, transverse fission are followed by regeneration and in this research identified from external observations. The fission result state for each individu were divided into three category, i.e. closed wound (category 1), little regeneration either posterior or anterior part (category 2), moderate regeneration either posterior or anterior part (category 3) modified from Conand (1996) (Figure 1.).

Results and Discussions

There were 891 individu of *H. atra* observed (average 297 individu each month) for their fission. The result of present study showed that there were more sea cucumber fission happened during April and decrease sharply during May and slighlty increase in June (Table 1). April is the end of rainy season in Jepara and starting dry season during May and June. According to rainfall data from Semarang-Climatology Station, Meteorology and Geophysics Agency in Jepara watres during April, May and June were 100, 2, and 15 mm respectively.

The result of fission was observed visually in situ i.e. closed wound, little and moderate regeneration either posterior or anterior part of the body. *H. atra* that have undergone fission are easily distinguished because the regenerating region of the body is lighter in colour and smaller in diameter than the original body. The observation on the result of fission revealed that body regeneration seem happened fast, since the new individu sea cucumber at category 1 (closed wound) was low but high as category 3 (moderate regeneration) (Figure 2.). The weight range of *H. atra* fission individu (g) per category result of fission were different. Category 1 in which the new individu had wound closed had lower weight (23.7-41.8 g), as they recover and regenerate they increase their weight (Table 2.).

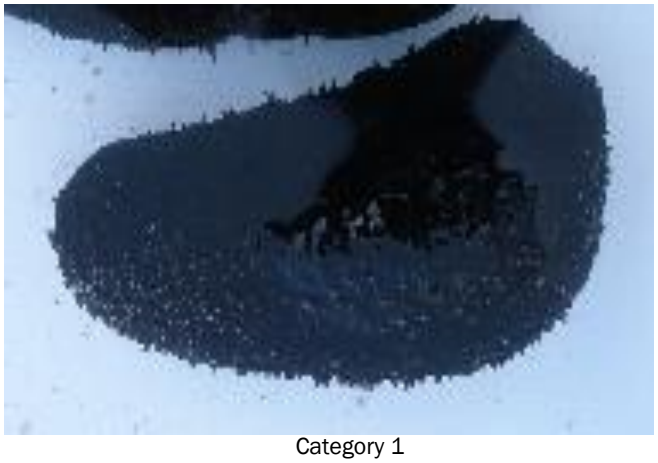
Naturally sea cucumbers has great potential of regeneration following evisceration. Because of physiological change or in response to varied external factors, during evisceration, the sea cucumbers expulse most of their internal organs and within a certain period of time the eviscerated sea cucumbers regrow new internal organs and live normally Purwati *et al*. (2009). The regeneration also happen after process of asexual reproduction by fission. Asexual reproduction through self-division results in posterior and anterior parts. Each fissiparous population tends to have their own fission plane located in various places of the, e.g. one third of the body length, anteriorly, in *Holothuria leucospilota* (Purwati, 2004); 44% of the body length, anteriorly, in *H. atra* (Chao *et al.*, 1993); or at the mid-body in *H. parvula* and *H. surinamensis* (Crozier, 1917; Kille, 1942). Although found only in very small number of sample, during fission, fission plane *H. atra* in Panjang Waters were happened at

Table 1. Number of *H. atra* observed and fission in seagrass meadows of Panjang Island waters

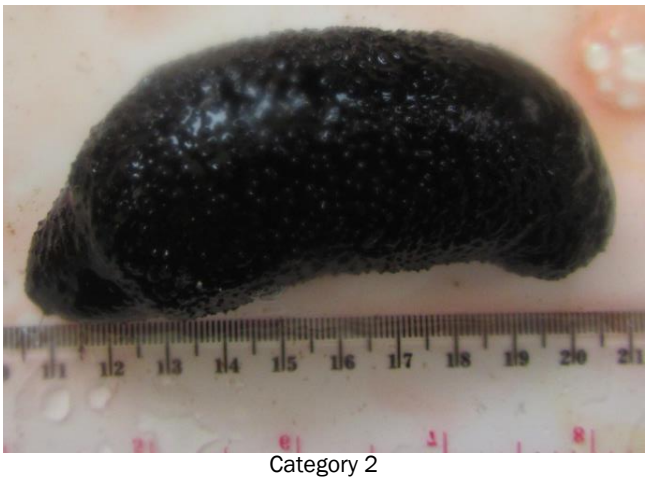
Month	No. Samples (ind.)	No. Individu Fission	Fission (%)
April	386	51	13,21
May	217	10	4,61
June	288	14	4,86

Table 2. The range of length (cm), weight (gr) and their average of *H. atra* fission individu per category result of fission regeneration

Category	April		May		June	
	Length (cm)	Weight (gr)	Length (cm)	Weight (gr)	Length (cm)	Weight (gr)
1	7.89-21.01 (13.52)	23.7-181.7 (89.23)	-	-	-	-
2	7.16-21.43 (13.33)	16.7-148.2 (66,19)	10.96-13.64 (12.30)	34.2- 68.3 (51.25)	11.17-12.34 (11.35)	61.0- 78.5 (74.35)
3	8.27-18.92 (13.94)	24.6- 93.6 (80.51)	11.33-22.99 (16.72)	32.5-193.5 (90.09)	10.52-16.63 (12.62)	43.9-143.0 (95.15)



Category 1



Category 2

Category 3

Figure 1. The fission result state for each individual

anteriorly part of body. Each part resulting from fission develops into new individu.

According to Chao *et al*. (1994) and Uthicke (1997) reproductive mode in *H. atra* either sexual or asexual is influenced by environmental conditions. Asexual reproduction or fission is more prevalent in intertidal and shallow water populations, indicating that the physiologically stressful conditions characteristic of these habitats (e.g., temperature and salinity fluctuations, hydrodynamics) may promote fission (Chao *et al*., 1994; Conand, 1996; Uthicke, 2001). In present works in Panjang Island waters fission seem happened more during April and

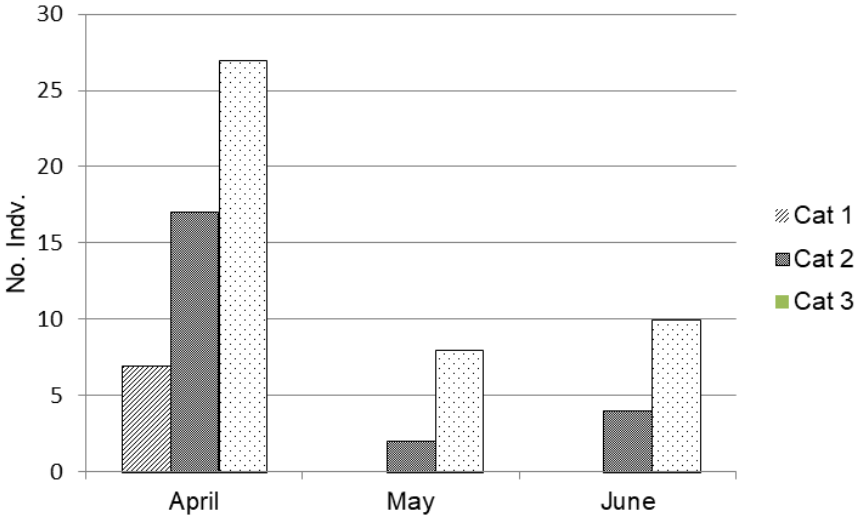


Figure 2. The regeneration of individu after fission (Cat/category 1: closed wound; Cat/category 2, little regeneration either posterior or anterior part; Cat/category 3: moderate regeneration either posterior or anterior part)

decrease during May and June. In other place such as in Taiwan fission in *H. atra* peaks in summer (Chao *et al*., 1993). While on the Great Barrier Reef (GBR), the two reproductive modes (sexual and asexual) of *H. atra* tend to be seasonally distinct with fission being most prevalent in winter and spring and sexual reproduction occurring in summer (Harriott, 1982; Conand, 1996; Uthicke, 1997) and cooler months in Tuticorin, India (Asha and Diwakar, 2015). Same as in *H. atra* in this study, fission appears to be suppressed in *H. hilla* in at One Tree Island, Great Barrier Reef, Australia in the warmer months (Lee *et al*., 2008a). Environmental factors especially sea water temperature also may have a role in triggering the process of autotomy. Whilst (Lee *et al*., 2008a) stated that solar radiation is a particularly important factor causing fission in *H. atra*. During present study, the average water temperature were 26, 28, 30^{0}C in April, June and July, respectively.

Natural autotomy is a population density dependent phenomenon among sea cucumbers as can bee seen that product of fission were noticed in densely populated *H.atra* location and hardly noticed in locations with sparse populatios (Asha and Diwakar, 2015), although Lee *et al*. (2008b) showed there was no fission rate significant different between low and high density population.

From length and weight data per category result of fission regeneration revealed that generally they increase in lenght and weight size among category in the same month and between month (Table 2). *H. atra* have been proposed to regenerate two months after fission (Uthicke, 1997; 1998). Based on Lee *et al*. (2008a) they approximate doubling in size as *H. atra* regenerate and grow post fission is similar to that seen for *H. difficilis* and *H. hilla* at OTI, GBR.

Fission is considered to play a role in maintaining populations of several IndoPacific holothuroids by compensating for mortality and migration (Gouyon *et al*., 1993; Chao *et al*., 1994). Although there is disadvantage of this type of reproduction is the lack of genetic variation, and being genetically identical the progeny cannot withstand big changes in environment. In order to determine the impact of fission on *H. atra*'s population dynamics it will be necessary to conduct further research in longer time observation and more parameters such as recruitment by sexual and asexual means and their growth and mortality of recruits as well as impact of both natural and anthropogenic disturbances on their fission.

Conclusions

In seagrass meadow habitat of Panjang Island, Jepara, fission in *Holothuria atra* population happened more frequent during cooler month (April) end of rainy season than warmer month (May and June). Body regeneration as mean growth among individu seem happened fast by increasing size among the stage of fission product and during time observation.

Acknowledgment

Thank you to Dean of Faculty Fisheries and Marine Science for funding the research through scheme of other than APBN SUKMA FPIK

Diponegoro University 2018 No 1501-20/UN.7.5. 10/LT/2018

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