

Gonad maturity level and
somatic index of sea cucumber
Acaudina sp. (caudinidae,
molpadida, holothuroidea) In
Delta Wulan Waters, Demak
Regency, Indonesia

by Widianingsih Widianingsih

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Gonad maturity level and somatic index of sea cucumber *Acaudina* sp. (caudinidae, molpadida, holothuroidea) In Delta Wulan Waters, Demak Regency, Indonesia

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Abstract. Sea cucumber *Acaudina* sp. belongs to the family Caudinidae, Order Molpadida, Class Holothuroidea. These animals have an important role in the benthic ecosystem. The purpose of this research was to determine the gonad maturity level and Gonad Somatic Index of *Acaudina* sp. in Delta Wulan Waters, Demak Regency. In total, 64 individuals of *Acaudina* sp. were taken in April 2021 and 148 individuals were taken in May 2021. In April observation, the highest gonad maturity level for females was at level 3, while the highest gonad maturity for male was at levels 1 and 2. Furthermore, in Mei observations, the highest gonad maturity level for females was at level 2 and for males, the highest gonad maturity level was at level 3. According to April observation, values GSI (Gonad Somatic Index) has a range 0.22 - 6.09 % and for May observation, value GSI has a range 0.04 - 2.24%. Hence, there is a positive correlation between gonad weight and GSI values in sea cucumber *Acaudina* sp.

1. Introduction

Sea cucumber *Acaudina* sp. belongs to Class Holothuria, Order Molpadidae and Family Caudinidae [1,2]. This animal has an important role in the benthic ecosystem for bioturbation to make the waters more fertile, stabilize sediment, and other ecological functions that indirectly lead to high fertility rates in benthic ecosystems as indicated by the large content of chlorophyll-a in the sediment[3]. Besides ecological functions, sea cucumbers also have a high economic value for the nutraceutical industry. Due to their nutritional content such as high protein, low lipids, vitamin A, B1 (thiamine), B2 (riboflavin), B3(niacin), and various types of minerals such as calcium, magnesium, zinc, and iron [4–6]. In addition, *Acaudina* sp. also contains a lot of collagen [7].

The high exploitation of sea cucumber *Acaudina* sp. is triggered by their collagen content, antioxidants, triterpene glycosides, antibiotics, antifungal, and antivirals [8–10]. The utilization of this biota has not been carried out optimally. Hence, it is necessary to conduct further studies on the bioecology and bioprospecting of the sea cucumber *Acaudina* sp.

Studies on gonad somatic index (GSI) and gonad maturity level (GML) on the sea cucumber *Acaudina* sp. are rarely done, but for some sea cucumber such as *Holothuria scabra* has been carried out in the Langgur Waters, Small Island Kei, Southeast Maluku [11]. Nonetheless, research on the growth pattern of *Acaudina* sp. [12] and the water quality of their habitat in Delta Wulan Waters, Demak has been carried out [13]. One of the important roles of sea cucumbers in their habitat are bioturbation



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and bioremediation in benthic ecosystems [14]. However, the study of gonad maturity level (GML) and gonad somatic index (GSI) of *Acaudina* sp. from Delta Wulan Waters, Demak Regency has never been done. Therefore, this research has purpose to determine the condition of gonad maturity level and gonad somatic index of *Acaudina* sp in the Delta Wulan Waters, Demak.

2. Material and Method

2.1. Location of Sampling

Samples of sea cucumber *Acaudina* sp. were taken from 11 stations in Delta Wulan Waters, Demak Regency (Figure 1) using a fishing gear namely *garid* (bottom comb). Measurement pH, DO, salinity, and temperature were conducted *in situ* using a Water quality checker. Grab Van Vien was used to take sediment for measurement of phosphate and nitrate in the sediment.

2.2. Determine Gonad Maturity Level and Gonad Somatic Index

Gonad maturity level is a value for the development of gonad maturity and indicated by the condition of the oocyte. Gonad maturity level is to determine with physical characteristic of sperm and ovum [15–17] with modification such as (a) level 1 (intermediate tubule); (b) level 2 (tubule start to grow); (c) level 3 (immature tubule); (d) level 4 (matured tubule); and, (e) level 5 (partly spawning tubule and late mature). The gonad somatic index (GSI) is a value that quantitatively describes the changes of gonads, when the gonad development occurs in the reproductive process, and when it will reach a maximum value at the time of spawning [18]

$$GSI = W_g / W_b \times 100\%$$

Note : GSI = Gonad Somatic Index (%); W_g = Gonad Weight; W_b = Body Weight

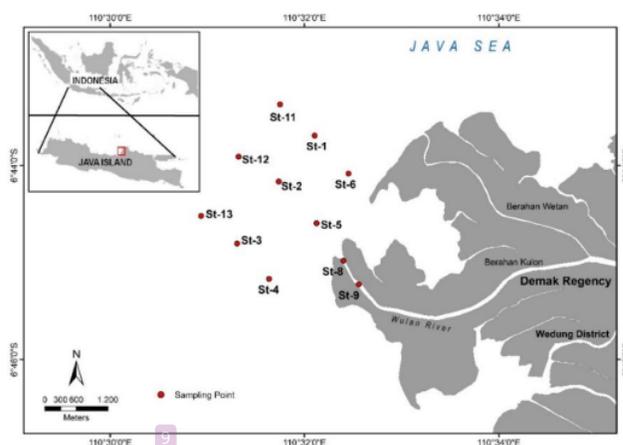


Figure 1. Location of sampling Sea Cucumber *Acaudina* sp on the Waters Delta Wulan, Demak, Central of Java, Indonesia

3. Result and Discussion

Based on the field observations, most of *Acaudina* sp. were found in a muddy and sandy habitats, with salinity range of 0-30 ppt, temperature range of 29.1 – 31.9 °C, pH value of 6.42 – 7.98, phosphate content range in sediment of 0.0003-0.0054 mg.g⁻¹ and nitrate range in sediment of 0.0057- 0.035 mg.g⁻¹ (Table 1). This is still in accordance with the conditions of the Delta Wulan Waters in the measurements

of May-August 2020, where salinity value was ranged from 29.25-33.50 ppt, water temperature value ranged from 29.4-29.9 °C, DO value ranged 5.04-8.13 ppm, and pH value range was 6.05-7.56 [13].

Sampling on April 1st 2021 indicated that among of 64 *Acaudina* sp., there were 19 individuals (29.69%) did not show any visible gonad, 19 individuals (29.69%) as female and 26 individuals (40.63%) as male. While the sampling in May 3rd 2021 showed that among 148 individuals, 42 individuals (28.38%) did not show any visible gonad, 48 individuals (32.43%) as male and 58 individuals (39.19%) as female.

Table 1. Water quality in April and May 2020 at the Delta Wulan Waters, Demak

Station	Salinity (ppt)	Temperature (°C)	pH	Phosphate in Sediment (mg.gr ⁻¹)	Nitrate in Sediment (mg.gr ⁻¹)	Depth (m)
1	16 - 30	29.9 - 30.3	7.92- 7.96	0.0035 - 0.0037	0.027 - 0.028	3.5 - 7
2	24 - 27	29.8- 30.3	6.44 - 6.75	0.0024 - 0.0026	0.0089 - 0.0091	4 - 6.5
3	25 - 28	29.9 - 30.4	7.33 -7.45	0.0054 - 0.0054	0.0046 - 0.0048	7.5 - 9
4	19 -30	29.8 - 30.3	6.86 - 6.88	0.0012 - 0.0013	0.0236 - 0.0256	5.5 - 5.8
5	16 - 30	29.9 - 30.2	6.42 - 6.67	0.0003 - 0.00035	0.0057 - 0.0058	2.5 - 9
6	13 -30	30.9	7.95 - 7.98	0.0003 - 0.0004	0.0057 - 0.0058	4.5 - 6
8	0 - 27	29.2 - 29.6	5.98 - 6.15	0.003 - 0.0035	0.016 - 0.017	1.5 - 4.0
9	0 - 28	29.1 - 29.7	6.51 - 6.76	0.006 - 0.005	0.031 - 0.035	2.5 - 2.0
11	22 - 30	30.7 - 31.9	7.63 - 7.67	0.004 - 0.005	0.0071 - 0.0076	9.5- 10
12	26 - 29.8	29.8 - 30.7	7.2 - 7.4	0.0004 - 0.0005	0.0198 - 0.0207	9.5 -11
13	25-29	29.9 - 30.3	7.39 - 7.41	0.0005 - 0.0006	0.024 - 0.026	9.5 - 12

The result of GML observations in April indicated that GML 2 and 3 occupied the largest number the samples (Figure 2). Further observations in May 2021, gave a similar result that most of the samples had GML 2 and 3 (Figure 3). This result indicates that *Acaudina* sp. in May, June, and July have a negative allometric growth pattern in Delta Wulan Waters [13]. Furthermore, when compared with the research in the Kenjeran Waters, Surabaya, the sea cucumber *Paracaudina australis*, which is one family with *Acaudina* sp, have large numbers in GML 1, 2, and 3 in August – November 2016[16].

Based on the observations for all gonad maturity level in April 2021, the GML value was greater than in May with the highest GSI value of 5.56 (Figure 3) that increases gradually. Meanwhile, for the month of May 2021, the GSI value increased from GML 1 to 4 and in GML 5 the GSI value decreased slightly. It suggested that in GML 5 a lot of ovum and sperms have been released into the waters. As for the male sex observations, the GSI value was higher in April rather than in May (Figure 4). This is contrary to the observation of the value of the sea cucumber *Holothuria scabra* which has a higher GSI value in May compared to observations in other months in the waters of Linggur Waters, Small Kei Island, Southeast Maluku [11]

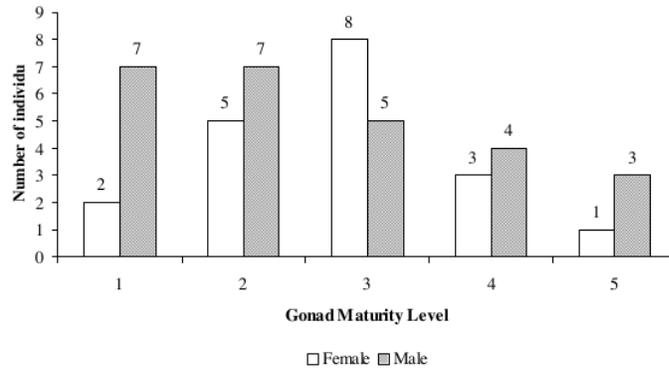


Figure 2. The number of individual females and males on April 2021 at different GML Level.

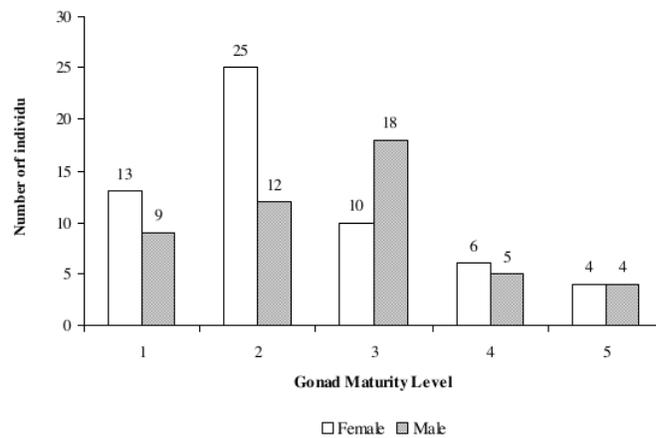


Figure 3. The number of individual females and males on May 2021 at different GML Levels.

Furthermore, the GSI value for both male and female has a GSI value that increases with the higher value of the Gonad Maturity Level (Figure 4 and 5). This is also shown by the results of research on sea cucumber *Bohadschia vittensis* in the Red Sea Waters in Egypt showed that the higher Gonad Somatic Index (Gonad Index) value, so indicated the higher the gonad maturity level. Gonad index analysis is one of the methods for tracking reproductive maturity [19,20].

Based on observations, the GSI value of female *Acaudina* sp. in April 2021 (0.78–5.56%) was higher than in May 2021 (0.53–2.32%). Furthermore, the observation of the GSI value of male *Acaudina* sp. on April 2021 (0.6–3.12%) is greater than the GSI value of May 2021 (0.35–0.98%).

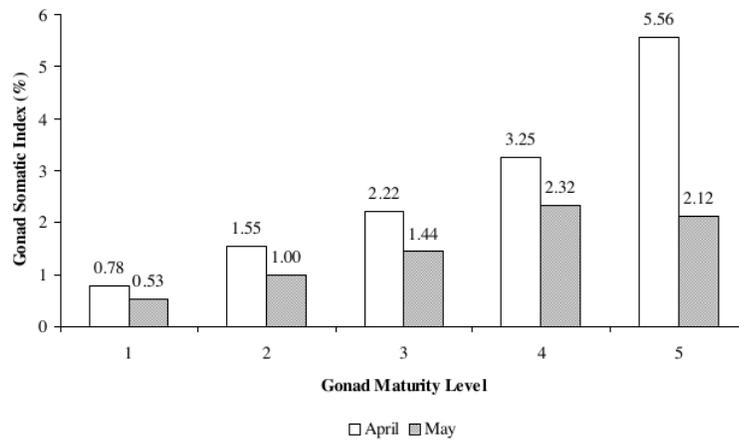


Figure 4. The GSI value of female *Acaudina* sp for each GML on observation April and May 2021.

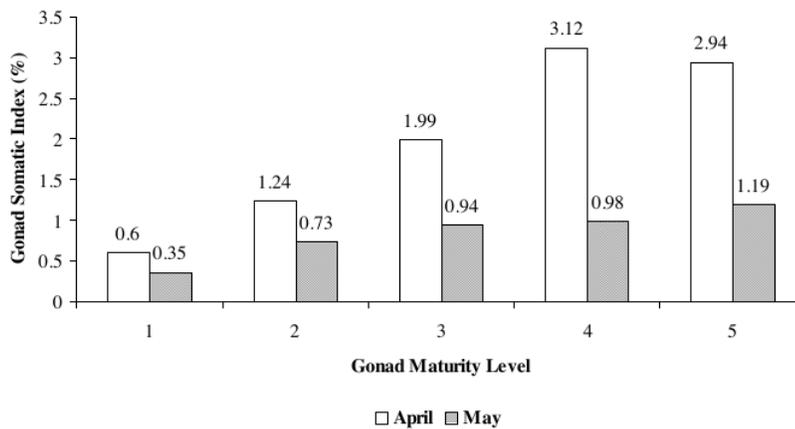


Figure 5. The GSI value of male *Acaudina* sp for each GML on observation April and May 2021

Based on the analysis results, there is a very a positive correlation between the value of the gonad maturity level and the GSI values for both male and female *Acaudina* sp. (Figure 6 and 7). The correlation value of GSI and GML for female *Acaudina* sp. in April and May had a positive correlation value $r = 0.96$ and $r = 0.95$. Likewise for male *Acaudina* sp., the observations of April and May have a positive correlation value with a value of $r = 0.96$ (Figure 7)

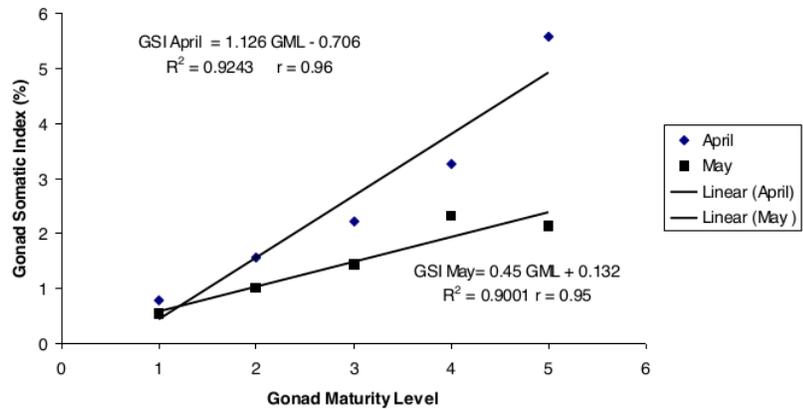


Figure 6. The correlation between GML value with GSI value of female *Acaudina* sp. on April, and May 2021.

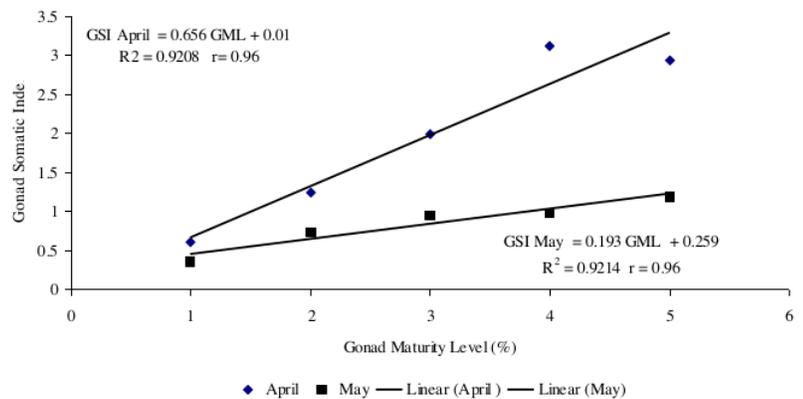


Figure 7. The correlation between GML value with GSI value of male *Acaudina* sp. on April, and May 2021.

4. Conclusions

Based on this research, there is a relationship between the gonad maturity level and the gonad somatic index. The greater the value of Gonad maturity level, so the greater the value of gonad somatic index. The correlation value of GSI and GML for female *Acaudina* sp. in April and May observations has a positive correlation with values of $r = 0.96$ and $r = 0.95$. Likewise, for the male *Acaudina* sp., the observation in April and May 2021 have a positive correlation with a value of $r = 0.96$.

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