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An ecological study and its fishery potential of the mud crab, *Scylla serrata* (Forskål, 1775) in Segara Anakan mangrove waters, Cilacap, Indonesia

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Abstract. *Segara Anakan mangrove waters is a lagoon surrounded by mangrove forests and muddy land. Mangrove forests have an ecological function, such as spawning ground, nursery ground, and feeding ground for various biota. Mud crab is one of the fishery commodities which is important in Indonesia. Segara Anakan mangrove waters is one of the fishing villages which catch mud crabs because of the high demand. The high demand for mud crabs needs to be balanced with the right management strategy so that the population will not extinction. This study aims to determine the ecology of mud crab,* Scylla serrata *Forskål, 1775 and its fishery potential and explain the habitat population in the Segara Anakan mangrove forest. Many previous studies were conducted by previous researchers. Environmental parameters, i.e. temperature, salinity, oxygen, light penetration, and nature of the bottom were also studied. Crabs were caught by a traditional crab catch fishery called "Wadong" (fish pot). Around 6.487 crabs were caught by "wadong". The catch consisted of 2.920 male crabs (45,02%) and 3.567 female crabs (54,98%). The dominant size groups for males and females in terms of their carapace length (CL) were 35,00–40,00 mm and 43,00–106,00 mm, respectively. Females mature at a smaller size, i.e., at 42,70 mm CL. Breeding takes places from June–July. CL weight relationship showed that males were heavier than females. The regression equations for both sexes are as follows: WF = 10-3 5,871 L2.4443 (r = 0,999) and WM = 10-4 4,043 L3.1035 (r = 0,999).*

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INTRODUCTION

Segara Anakan is a mangrove-fringed shallow coastal lagoon in the Southern part of Central Java, Indonesia, which is of high ecological and economic value because of its richness and diversity in living natural resources (Yuwono *et al.* 2007; Asmara *et al.* 2011). Ecologically, the Segara Anakan mangrove waters represent an important mangrove forest function as a spawning ground, nursery, and feeding ground for various marine biota (Ardli 2007, Ardli and Wolft 2008; Asmara *et al.* 2011). Segara Anakan ecosystems consisting of brackish waters and mangrove forests accompanied by sediment originating from these rivers are waters where large and small rivers flow, so that they are rich in nutrients and rich in fishery resources such as

shellfish, fish, shrimp, and crabs (Yuwono *et al.* 2007; Asmara *et al.* 2011; Hilmi *et al.* 2017b; Ismail *et al.* 2019, 2021; Redjeki *et al.* 2020).

The type of biota from a very large class of crustaceans is the mangrove crab (*Scylla serrata*). The physical structure of mangrove vegetation, with its convoluted and dense root support and branches extending downward, makes the mangrove area a good habitat for crab life (Nagelkerken *et al.* 2008; Hilmi *et al.* 2017b; Redjeki *et al.* 2020; Indarjo *et al.* 2020; Saputra *et al.* 2020; Karniati *et al.* 2021; Sulistiono *et al.* 2021). The crab *S. serrata* is an important species to study because *Scylla* is very economical for fishermen. Catching *S. serrata* for fishermen in Segara Anakan is very easy. It does not require expensive fishing gear, the fishing season is not too long, it has high nutrition, and the selling price is also high in the market.

Therefore, market demand from outside the region is getting higher for both domestic and foreign consumption needs. The price of 1 kg of super crab is Rp 90.250,- (In year 2016, when the research was conducted), and currently (2022), the price of 1 kg is up to Rp 150.000,- (personal communication with fisherman). Usually, crabs and other fish are caught in the waters of Segara Anakan and done seasonally and sent to Java, Bali, and Sumatra areas. The potential for crab fisheries in the mangrove waters of Segara Anakan is estimated at around 11.972 tons per year, and for the entire Segara Anakan mangrove forest area, it is about 52.841 tons per year. This is what makes income increase and is very profitable for fishermen. *S. serrata* is the subject of ongoing research because it is the basis for the development of successful capture fisheries and aquaculture management programs (Tetelepta *et al.* 2019).

The purpose of this study is to determine the ecology of mud crab, *S. serrata* Forskal, and its fishery potential and also to explain the habitat population in the Segara Anakan mangrove forest for 1 year as additional information and as a complement to many previous research studies conducted by researchers.

METHODS

Study Area

The study mud crab, *S. serrata* (Forskål, 1775), was studied in Segara Anakan mangrove waters (December 2015–November 2016). Segara Anakan Cilacap is a lagoon ecosystem consisting of a mangrove ecosystem an estuary ecosystem (Sara 2001; Ragavan *et al.* 2014; Hilmi *et al.* 2017a), and other distinctive ecosystems. The waters occur in a lagoon with a strong tidal influence (Figure 1).

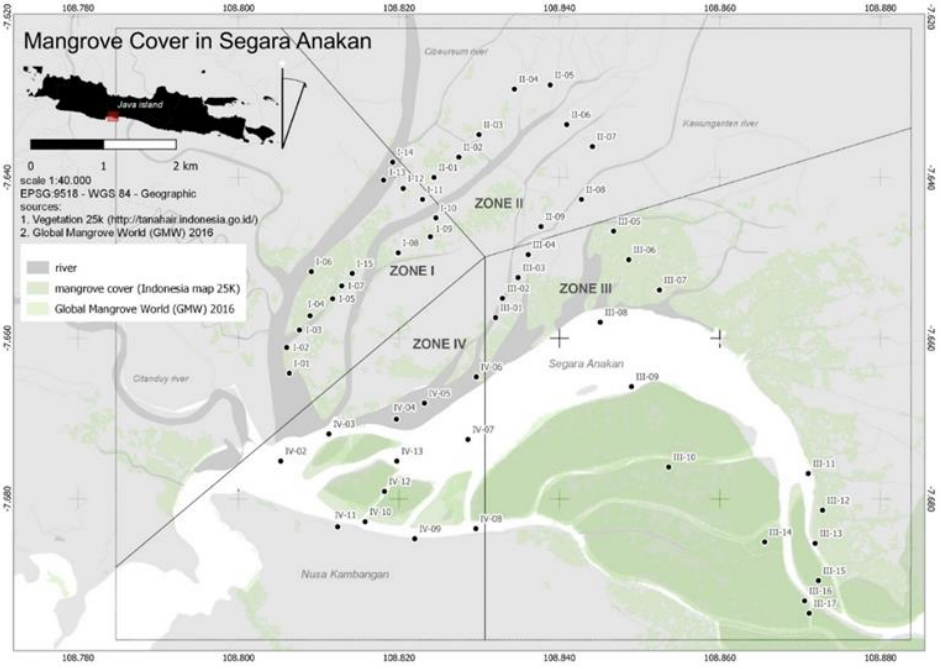

Figure 1 Map showing the Segara Anakan mangrove waters for the study area

Study locations were assigned to three zones which are Zone I (mesotrophic) which represent the area significantly affected by two main rivers, i.e., Cibereum and Citanduy, where low salinity and relatively high sedimentation are expected (sampling stations: approximately 0,6–0,9 km from Nusawere). Zone II (eutroph): representing the area located in the north-eastern part of the lagoon affected by the western channel, where the highest sedimentation and low salinity are expected due to freshwater inflow from two rivers, i.e., Kawunganten and Muara Dua (sampling stations: approximately 0,9–1,2 km from Nusawere). Zone III (eutroph): Representing the area located in the southeastern part of the lagoon, which is mainly affected by the eastern channel, inflow from the western channel might have a minor effect. High sedimentation is expected (sampling stations: approximately 1,2–1,5 km from Nusawere). Zone IV (mesotroph): Representing the area near the western channel, where the highest salinity (33‰) and relatively low sedimentation are expected due to prevailing strong tidal currents (sampling stations: approximately 0,4–0,7 km from Nusawere) (Figure 1).

Data Collection: Procedures

The number of *S. serrata* caught was 6.487 individu, 2.920 were males and 3.567 females. Random samples of crabs were collected from the Segara Anakan mangrove waters, which cover an area of about 615 ha. Samples were collected using "wadong", measuring 55 cm in length and 25 cm in diameter (10 wadongs were used to collect the samples at each collection per month). Before being installed, wadong is filled with bait in the form of a hermit crab chop. The obtained crabs were identified, and the number of individuals per species and sex counted. To find out the growth pattern of crabs, measurements were made to the length and width of the carapace. Morphometric characters of each crab were measured by using a stainless dial calliper to an accuracy of 0,05 mm and weighed to an accuracy of 0,10 g. The carapace width of the crabs was measured immediately after capture. The hydrological parameters (dissolved oxygen, temperature, salinity, and transparency) of the Segara Anakan waters were observed for a period of one year (four times per month by using portable Kits) (Table 1).

Table 1 Physical and chemical characteristics in the Segara Anakan mangrove waters (December 2015–November 2016)

Months	**DO* (mg/L)**	**Salinity* (‰)**	**Temperature* (˚C)**	**Transparency* (m)**
		West Monsoon		
December	5,15 ± 0,475	17,47 ± 0,531	27,45 ± 0,85	0,315 ± 0,071
January	6,67 ± 0,325	18,80 ± 0,843	28,26 ± 0,36	0,293 ± 0,097
February	4,05 ± 0,906	21,73 ± 0,529	30,57 ± 1,42	0,339 ± 0,167
Pre-Monsoon				
March	3,58 ± 0,325	23,99 ± 0,445	28,90 ± 0,95	0,279 ± 0,445
April	5,68 ± 0,472	22,32 ± 0,857	25,18 ± 1,22	0,299± 0,091
May	3,86 ± 0,132	24,08 ± 0,995	28,34 ± 1,05	0,312 ± 0,103
		East Monsoon		
June	3,65 ± 0,548	24,96 ± 0,422	29,00 ± 0,99	0,299 ± 0,575
July	3,84 ± 0,245	25,15 ± 0,242	29,06 ± 1,95	0,305 ± 0,095
August	7,46 ± 0,277	28,91 ± 0,025	26,53 ± 0,23	0,305 ± 0,109
		Post-Monsoon		
September	7,14 ± 0,614	26,85 ± 0,507	26,75 ± 0,30	0,328 ± 0,124
October	7,87 ± 0,619	25,32 ± 0,623	26,87 ± 0,57	0,308 ± 0,024
November	3,45 ± 0,225	23,02 ± 0,755	29,33 ± 0,45	0,288 ± 0,444

(* = average values ± standard deviation, Number of samples per site = 10, measured during high tide; Number of sites = 120)

Data Analysis: Carapace Width and Weight Relationship

Crab length (Carapace length, CL) and weight (W) values were Log10 transformed, and the regression equations (Log weight on Log CL) were computed by the method of least squares (Poole 1974; Snedecor and Cochran 1967; Sokal and Rohlf 1973). The equations were used to determine if these variables (W, CL) significantly influence the maturity of the mud crab. The carapace length and weight relationship can be expressed by the formula W = aLb (Cren 1951). The regression equations obtained for both sexes are given below:

$$t = \frac{(b_M - b_F)}{S_{y.x}\sqrt{\left(\frac{1}{SS_{X_M}}\right) + \left(\frac{1}{SS_{X_F}}\right)}}$$

Where bM and bF are slopes. WF = 10-3 5,871 L 2,4443 (r = 0,999) and WM = 10-4 4,043 L 3,1035 (r = 0,9999). The slopes of the regression equations were tested for the significance of differences using the following formula (Dhawan *et al.* 1976).

RESULTS AND DISCUSSION

Population and Size Frequency Distribution

Based on the results, Table 2 shows the population structure of the mud crab in the mangrove forest area of the Segara Anakan. The mud crab population is characterized by their carapace weight (CW, mm) and fresh weight (W, g) of 73,00–82,95 mm and 100,00–199,90 g, respectively. Since the size of the surveyed area, Segara Anakan mangrove waters was 615 ha. Therefore, the population density was 6.487/615 or 10,55 crabs/ha. In this study, crabs in the fresh weight class of 100,00–199,90 g dominated over 36% of the catch (Table 2.).

Table 2 The carapace width (CW, mm) and fresh weight (W, g) of *Scylla serrata* were sampled in the mangrove waters of Segara Anakan

CW class (mm)	Weight class (g)													Total Number of Individual
	0-99,90	100-199,90	200-299,90	300-399,90	400-499,90	500-599,90	600-699,90	700-799,90	800-899,90	900-999,90	1.000-1.099,90	1.100-1.199,90	1200-1.299,90	
23-32,95	3	2	-	-	-	-	-	-	-	-	-	-	-	5
33-42,95	39	19	10	-	-	-	-	-	-	-	-	-	-	68
43-52,95	22	10	6	-	-	-	-	-	-	-	-	-	-	38
53-62,95	141	77	46	10	-	-	-	-	-	-	-	-	-	274
63-72,95	17	626	628	10	2	-	-	-	-	-	-	-	-	1.506
73-82,95	-	1.262	654	279	64	34	2	-	-	-	-	-	-	2.319
83-92,95	-	317	450	233	188	100	56	44	-	-	-	-	-	13.388
93-102,95	-	21	150	104	136	57	34	30	20	-	-	-	-	552
103-112,95	-	-	21	49	35	29	25	20	18	12	6	2	-	207
113-122,95	-	1	3	27	14	15	14	6	5	4	3	2	1	95
123-132,95	-	-	-	2	6	2	1	1	2	2	2	2	3	23
133-142,95	-	-	-	-	-	-	-	3	2	1	1	1	1	9
Total	462	2.335	1.968	714	445	237	132	101	47	15	12	7	5	6.487

In connection with the tidal pattern recorded in the Segara Anakan mangrove area, we found that the tides appeared to influence the catch (Y_{Lt} = 105,246 + 0,112 X; r = 0,984; n = 12; Y_{Ht} = 26,032 = 0,276 X, r = 0,883, n = 12; Y = catch per month during low tide = L_t, and high tide = H_t; X = frequency of low or high tides per

month. Out of the 6.487 crabs, 80.20% were caught during low tide and 19.80% during high tide (Table 3), and the ratio of sex was studied monthly we can see in Table 4. The monthly variation in the mode size of the crabs was positively correlated significantly with the salinity at the 1% level (Figure 2).

In the Segara Anakan area, crab fishing is seasonal from June to August (East Monsoon); the total catch in this season during the study period amounted to 638,76 kg per 15 days. The density of crabs was 10,55 crabs per ha, weighing 3,657 kg per ha. The fishery potential of crabs in the Segara Anakan mangrove waters can be estimated at about 11,972 tons per year, and for the whole Segara Anakan mangrove forest area, about 52,84 tons per year (Table 5). Morphometric analysis showed in (Figure 3).

Table 3 Substrate conditions during the different seasons in Segara Anakan mangrove waters study area (615 ha)

CL class (mm)	Mean CL (mm)	D	J	F	M	A	M	J	J	A	S	O	N	Total	Grand Total
		M/F	M/F	M/F	M/F	M/F	M/F	M/F	M/F	M/F	M/F	M/F	M/F		
15-19,95	17,475	-/-	-/-	-/-	3/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/3	3/3	6
20-24,95	22,475	-/-	1/-	-/1	1/3	3/1	-/-	-/-	-/-	-/-	-/-	-/1	2/5	7/11	18
25-29,95	27,475	2/-	-/-	1/-	7/-	7/4	-/-	1/1	-/-	2/-	-/-	9/3	2/4	31/12	43
30-34,95	32,475	4/1	1/1	-/1	12/4	4/6	3/7	2/4	-/-	6/-	-/-	-/4	6/11	38/39	77
35-39,95	37,475	2/5	1/2	3/-	9/4	-/2	1/4	2/3	3/2	1/-	-/-	20/12	4/6	46/40	86
40-44,95	42,475	15/17	3/2	1/3	10/7	3/3	1/2	10/11	-/1	9/3	-/-	7/13	12/24	71/86	157
45-54,95	47,475	23/17	8/8	6/5	17/5	8/6	4/2	6/11	10/5	12/8	11/20	42/22	8/66	155/175	330
50-54,95	52,475	36/23	28/31	49/35	40/23	14/8	53/18	18/32	28/18	47/28	6/10	49/32	41/93	409/347	756
55-59,95	57,475	6/37	15/28	5/40	31/28	38/31	70/68	15/65	55/52	74/39	49/33	51/28	27/61	436/510	946
60-64,95	62,475	73/71	73/50	58/55	4/6	28/27	66/90	48/60	73/75	70/61	42/40	28/55	21/72	585/664	1249
65-64,95	67,475	40/62	43/52	42/49	8/5	11/17	46/86	48/69	5/58	54/66	32/26	16/43	24/52	379/600	979
70-74,95	72,475	3/17	10/27	13/19	7/14	16/19	55/26	22/83	32/47	20/53	53/17	21/17	7/45	238/393	631
75-79,95	77,475	15/23	20/50	14/40	4/8	12/11	21/38	16/54	20/25	11/27	33/17	17/6	6/33	209/332	541
80-84,95	82,475	-/7	7/14	12/10	3/2	8/9	9/52	12/10	18/12	-/12	15/4	10/1	-/7	112/153	265
85-89,95	87,475	6/6	8/17	9/18	7/3	6/8	6/13	4/5	2/10	10/5	5/1	3/-	1/3	77/92	169
90-94,95	92,475	3/-	1/6	8/10	13/2	2/4	3/4	1/7	4/2	2/2	-/-	1/-	-/2	43/40	83
95-99,95	97,475	4/4	-/8	4/8	3/1	3/5	6/2	4/2	-/5	3/3	-/-	-/-	5/-	32/38	70
100-104,95	102,475	-/1	5/2	1/2	6/1	2/-	1/-	6/1	4/5	4/3	-/1	3/-	-/1	32/16	48
105-109,95	107,475	3/2	-/2	1/4	-/-	-/-	2/-	3/2	-/-	-/-	-/-	1/-	-/-	10/11	21
110-114,95	112,475	1/3	-/-	1/-	-/-	-/1	-/-	2/-	-/-	-/-	-/-	-/-	-/-	4/4	8
115-119,95	117,475	-/-	-/-	1/1	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	1/1	2
120-124,95	122,475	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/1	-/-	-/-	-/-	-/1	1
125-129,95	127,475	-/-	-/-	1/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	1/-	1
Total by male & female		236/296	224/301	230/301	185/116	165/162	348/411	220/420	254/317	325/307	289/211	278/237	166/488	2.920/3.567	6.487
Grand total		532	525	531	301	327	759	640	571	632	500	515	654	6.487	6.487

The numbers of crabs collected during the seasons are also indicated (* = average values ± standard deviation; Number of sites = 120; Number of samples per site = 10; the soil analyses were performed by the Chemistry Section of the Department of Natural Sciences, Bogor Agricultural University, Bogor)

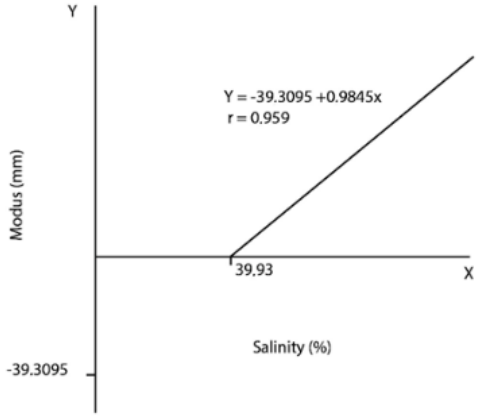

Figure 2 Correlation of modus size (Y, mm) crab population and salinity gradient (x, ‰) during the one-year study

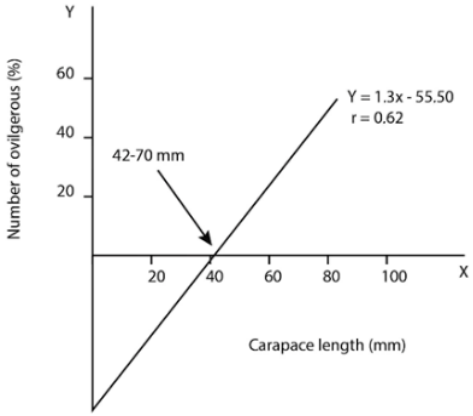

Figure 3 The relationship between carapace length (CL) and number of ovigerous female crabs (%) during the study period

Table 4 Size composition from December 2015 to November 2016 and sex of *Scylla serrata* sampled in Segara Anakan mangrove waters (615 ha)

Season	Rainfall (mm)	Percentage 0f *			Texture class	Number of crabs caught in 615 ha	Number of crabs caught in	
		Sand Silt Clay	Sand Silt Clay	Sand Silt Clay			Low tide High tide	Low tide High tide
West Mooson	1.001	5,45 ± 1,21	54,15 ± 1,38	40,40 ± 1,06	Silty clay	1.608	1.290	318
Pre-Mooson	910	9,25 ± 3,27	40,35 ± 1,67	50,40 ± 1,44	Silty clay	1.405	1.127	278
East Moonson	663	2,55 ± 0,16	42,25 ± 1,77	55,20 ± 0,39	Silty clay	1.866	1.497	369
Post Mooson	964	8,25 ± 0,30	45,45 ± 0,33	46,39 ± 0,94	Silty clay	1.608	1.290	318
West Mooson	1.001	5,45 ± 1,21	54,15 ± 1,38	40,40 ± 1,06	Silty clay	1.608	1.290	318
Pre-Mooson	910	9,25 ± 3,27	40,35 ± 1,67	50,40 ± 1,44	Silty clay	1.405	1.127	278
East Moonson	663	2,55 ± 0,16	42,25 ± 1,77	55,20 ± 0,39	Silty clay	1.866	1.497	369
Post Mooson	964	8,25 ± 0,30	45,45 ± 0,33	46,39 ± 0,94	Silty clay	1.608	1.290	318

Note: Month (D, J, F, M, A, M, J, J, A, S, O, N); M = Male; F = Female

Table 5 The fishery potential of mud crab, *Scylla serrata* in the mangrove forest and lagoon of Segara Anakan

Area	Size (ha)	Fishery Potential Number of crabs/year Weight (ton/year)	Value in Rp. (in a million rupiahs) for the period 2015–2016
Segara Anakan Lagoon	3.225	34,017–11,792	Rp 90,25
Mangrove forest	11.227	118,44–41,049	Rp 135,00
Mangrove forest + lagoon in Segara Anakan	14.452	152,439–52.841	Rp 225,35

Length – Weight Relationship

The carapace length was correlated with weight to determine the average weight of the crabs in the Segara Anakan mangrove waters (Tirtadanu and Chodrijah 2018; Yunus and Suwarni 2019). It was found that the average weight of crabs during the study period was 346,635 g (± 16,704). The value obtained was 2,596 (p>0,01), which indicated that the regression of weight on CL was not significantly different between the sexes. The males weight at 161,40 g (± 29,00) was heavier than the females at 151,20 g (± 21,40), and the difference between the sexes persisted throughout the range of length observed. The seasonal changes of the environmental factor (Table 1) contributed significantly to the movement of each crab with different CW, resulting in the CW variation along with the number of crabs (Table 2). The present study on the population structure can see at Appendix Tables 2 and 4. Figure 4 shows the relative growth rate of *S. serrata* in the Segara Anakan mangrove waters is correlated significantly with their CL at the 1% level. It can be concluded that Segara Anakan supports the growth and development of the *S. serrata* throughout their breeding season (June to July), thus representing the fisheries ground of mud crabs in the lagoon.

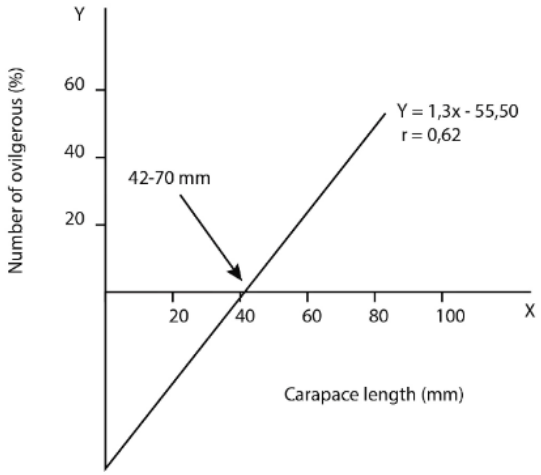

Figure 4 The relationship between carapace length (CL) and the number of ovigerous female crabs (%) during the study period

Substratum

Analysis of the substratum's particle size for one year clearly indicated continuous changes in the substratum (120 sites and 10 samples per site) throughout the seasons (Table 3). Tables 3 shows that the sand fraction during the West Monsoon was higher than during the other seasons. This was probably caused by the heavy rainfall of 1.001 mm per 3 months. Seasonal changes in the substratum and the hydrography are important and bring about changes in the size composition (CW or CL) and the availability of *S. serrata* (Table 2) and other marine life, such as prawns, *Penaeus monodon* (Pratiwi and Sukardjo 2018; 2021). There are seasonal changes in the transparency, temperature, and salinity, and the DO value of surface and bottom waters vary seasonally (Dewi *et al.*, 2016) (Table 1).

Based on the data, which appear in Tables 1 and 3, it can be stated that the crabs are able to withstand considerable variations in temperature and salinity. The mud crab population in the study area is structurally characterized by a total of 2.319 individuals of a CL class of 73–82,95 mm and a total of 2.335 individuals with a weight class of 100–199,99 g (Table 2). Mud crabs are burrowing and mobile animal and they have a specific behavior for the activity during low tide to a terrestrial substrate in the mangrove as their homering for food preference. The movement of mud crabs follows the rhythm of low tide during the East Monsoon season with rainfall of 663 mm (1.497 individuals, in silty clay substrate) (Table 3).

If we look at fisheries, The spawning of *S. serrata* in the Segara Anakan mangrove waters occurs throughout the year, with a peak number of ovigerous females found during the last part of the West Monsoon,

i.e. February (139 crabs). The spawning habit of the mud crabs was found in the Segara Anakan mangrove waters. Furthermore, our data indicated that female crabs with ripe ovaries were found in the study area throughout the year, but berried females were never found. This is an interesting finding from mangrove areas, and they presumable will move out to the open sea. Morphometric analysis showed that the minimum size of female crabs having ovaries was 42,79 mm CL or 64,60 mm CW, and the maximum size was 97,475 mm CL or 150,30 mm CW. Hence, it can be concluded that the maximum size of mature female crabs should be 42,70 mm CL too. Meanwhile in the Substratum, the DO value of surface and bottom waters varied seasonally.

They occur in shallow lagoons in the Segara Anakan area (615 ha), where during the latter part of the Pre-Monsoon, the temperature rises to 30,57°C (± 1,42) and salinity reaches 21,73‰ (± 7,529). With a density of 10,55 crabs per ha, the crab occurrence is appreciable in Segara Anakan waters throughout the year. A high number of crabs was found during the East Monsoon (1.866 crabs), when the substratum was classified as silty clay with a lower sand content (2,55 ± 0,16%). Meanwhile, the low number of crabs (1.405 crabs) starts during Pre-Monsoon (March-May) when the substratum was silty clay with high sand content (9,25 ± 3,27%). Thus, crabs in the Segara Anakan mangrove waters tend to prefer a silty clay substratum with lower sand content (Ycrab = 1.988,0189–57,5951 X sand; r = -0,919).

CONCLUSION

The conclusion of this study is Segara Anakan mangrove waters in general has substratum is silty clay. *S. serrata* is abundant in the area with silty clay substratum, supporting a good crab fishery. The distribution of *S. serrata* on the Segara Anakan mangrove closely follows the salinity gradient. Meanwhile, *S. serrata* occupies a trophic level; thus, it is an essential organism in the energy flow of the mangrove ecosystem.

To support the long-term survival and productivity of the Segara Anakan crab resources, a number of management options have been identified viz: 1) Protection of mangrove forest: Mangrove Forest area constitutes the principal habitat of the crab and should be designated as fish habitat reserves or fish sanctuaries. 2) Protection of the breeding stock and young crabs: All female and male crabs, which are less than 64,00 mm CW, should be protected because we found that the minimum size of the ovigerous female crabs in the Segara Anakan waters was 64,60 mm CW or 42,79 mm CL. 3) Unlike many other commercial fish species, which are migratory, the mud crab population is firmly bound to particular mangrove estuarine in the Segara Anakan Lagoon. 4) The localized occurrence of mud crabs to particular estuaries begins with the settlement and metamorphosis of the last stage larvae (megalopa) to the first crab stage (post larvae).

The peak in the recruitment (CW, 83,00) of the first stage post-larvae occurs in the dry season or months, in conjunction with the retardation of growth in the wet months, effectively separating the mud crab population into three definable year groups in the Segara Anakan mangrove waters. This should allow the progressive development of successive year groups to be monitored so that the size of the commercial yield (more than 200,20 mm CW or 129,00 mm CL, three-year-old male crabs). This could be predicted at least one and possibly up to three years in advance. Obviously, this optimistic prediction is preferable to the earlier and rather pessimistic prediction. Hopefully, enough research efforts will be conducted to enable more optimistic goals to be reached in the not-too-distant future. We appreciate that mud crabs in the Segara Anakan Lagoon will be developed continuously without damaging local biological interests.

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