Some biological aspects of mud crab *Scylla serrata* (Forskal) Fisheries at Pelita Jaya Bay, Western Seram Regency, Indonesia

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Abstract

Research on some biological aspects of mud crab *Scylla serrata* of Pelita Jaya Bay was conducted between February to August 2012. Mud crab samples were obtained from local fisher from Pelita Jaya Village before sold. Majority of (53.20%) mud crab caught have the carapace width between 12-14 cm with 12.cm being the dominant one. There was a high relationship between carapace width-weight relationship with negative allometric growth pattern. The sex ratio showed monthly variation but not different statistically, with overall sex ratio of male to female was 1.04:0.96. Condition factor also also showed monthly variation but not statistically different. Estimation of 50% mean size at first maturity revealed that female mud crab reaches their first sexual maturity at the mean size of carapace width of approximately 12.00 cm with the smallest berried female caught of 9.60 cm carapace width.

Keywords: biological aspects, mud crab, Pelita Jaya Bay

1. Introduction

Coastal area of Pelita Jaya Bay of Western Seram District is a semi enclose coastal waters surrounded by three main tropical ecosystem *i.e.* mangrove, coral reefs, and sea grass bed. Among these three ecosystems, mangrove ecosystem is the dominant one and consequently contributes immensely to productivity of this area as shown by many fish resources found in this area like some pelagic fishes (skipjack tuna, anchovy, mackrel), some molluscs (blood clam, mangrove oyster, terebraila), mud crab, echinoderm, and macro algae, all of economic importance and non economic important \(^1, 2, 3\). Among many fish resources found in this area, mud crab of *Scylla* spp. is being one of particular fish sources with high price and demand, supporting the live of local mud crab fisher in this area. Harvested mud crab with weight of 1 kg ind.\(^{-1}\) and over (super one class) priced for IDR. 120,000.00. Main market for this super one class mud crab is mainly for regional market like Makassar of South Sulawesi and Batam of North Sumatra. High price, constant demand, economy dependency and poor fisheries management has lead to extensive exploitation of this commodity. Study by Makatita \(^4\) (2012), Tetelepta and Makatita \(^5\) (2012) shows that a sign of resource depletion has occured. According to local mud crab fisher, both number and size of mud crab harvested during the last ten years is decreasing. Estimated catch at 2005 was 20.479 kg yr\(^{-1}\) decreased to 17.202 kg yr\(^{-1}\) by 2010. Among female mud crab harvested, some were in their reproduction status and more than 95% was in mature status \(^6, 7\). Mangrove crab or mud crab or sometime called as black crab of *Scylla* spp. is one of fisheries resources lives in coastal area and in particular in the mangrove area. Ecological conditions play an important role on the sexual maturity of mud crab through the amount of available food and the environmental temperature. Reduction in mangrove swamp area may perturb the food chain in the mangrove swamp affecting crab sizes at sexual maturity while the spawning period may vary from year to year \(^6, 9\).

This crab has quite a high economic value both for the domestic market and international market \(^10, 11\). With hard exoskeleton body structure cause this animal to have less edible portion whilst mature female has more edible portion. This is why the mature female becomes a target in harvesting \(^10\). Local mud crab fisher from Pelita Jaya Village of Pelita Jaya Bay and some other villages nearby have harvested this crab for more than 25 years. Initial observation on institutional practices either formal or informal in these areas have revealed...
that there was no regulation on the management of this resources. With this situation followed by high price and demand as well as economic pressure experienced by local fishermen bring this mud crab fishery under serious threaten. This study was aimed to investigate some population parameters of mud crab *Scylla serrata* covering population structure, carapace width-weight relationship, sex ratio, condition factor, mean size at 50% first maturity of *S. serrata* and problems related to management practices in Pelita Jaya Village for future management purposes Mud crab fishery in Pelita Jaya Village of Jaya Bay started since 1980 an still continue up to the present time, conducted by local fisher form this area. Majority people from this village work as fishermen and most of them only have elementry education leve background. There are three species of mud crab commonly caught by the fisher i.e. *S. olivacea*, *S. paramamosain* and *S. serrata*. The later species was chosen from these three species caught since it dominated the harvested of mud crab fishery in this area. The study was conducted from February to August 2012.

2. Materials and methods

Mud crab samples were taken from Pelita Jaya Village of Pelita Jaya Bay of the Sub district of Western Seram (Figure 1). During spring tides all mud crabs caught by local fishermen were sampled and measured for external carapace width and body weight before being sold by fishermen. Sampling was conducted from February to August 2012 with two weeks interval. A total number of 522 individu mud crab was sampled then classified into male and immature and mature female based on the morphology of the abdominal segment. For gonad maturity level of mud crab, identification was based on procedure proposed by Siahainenia13 (2008). Sex ratio was estimated per monthly sampling and for total observation, then chi-square test were used to determine if the proportion of males and females are significantly different from 1:1 expected ratio with the probability level was set to 0.05 [14, 15].

![Map of Pelita Jaya Bay showing study site (Pelita Jaya), District of Western Seram.](image)

The analysis of variance was applied to identify the relationship of sex on weight which will result in the estimation of carapace width-weight relationship. The result will determine whether it should be estimated separately by sex or whether both sexes should be combined. Then carapace width relationship was subsequently calculated using the equation proposed by Sparre and Venema16 (1992) as follow:

\[
W_{(b)} = qECW^{b} \]

The value of *b* is then used to determine growth pattern i.e. isometric growth (*b* = 3) or alometric growth (*b* ≠ 3) by using t-Student test based on Pauly17 (1984). The analysis was done in the computer software of Microsoft Excel Version 2010 with statistical difference were considered significant when *p*<0.05. Test of regression coefficient between male and female mud crab was conducted through *t-test* according to Zar14 (1999) using the following formula:

\[
t = \frac{b_1 - b_2}{S_{b_1 - b_2}} \]

Sex ratio was estimated per sampling date and as a whole. A chi-square test was used to determine if the proportion of males and females were significantly different from 1:1. The probability level was set at 0.05 [15].

\[
X^2 = \sum(O - E)^2/F 
\]

where *O* = observed frequency and *E* = expected frequency

The condition factor (*CF*) of the crab was calculated by the equation proposed by King18 (2007):

\[
CF = \frac{W}{L^a} 
\]
3. Results and Discussion

3.1 Size frequency distribution

The carapace width size distribution of male mud crab caught by local fisher during the study period ranged between 8.60 cm to 24.50 cm with the average size caught being about 13.91 cm (SD ± 2.25). For female mud crab, carapace width size distribution ranged between 8.60 cm to 22.40 cm with the mean size caught by the fisher was 14.40 cm (SD ± 2.56). The size distribution of both sexes was similar except the last period. The most size frequently caught mud crab for male and female was 12.60 cm and 12.50 cm respectively. Figure 2. Shows percentage size frequency of both sexes except for August period.

Fig 2: The percentage size frequency of mud crab S. serrata caught by local fisher of Pelita Jaya Village.
The mean size of carapace width distribution in this study was higher than what was found by Tongdee (2001) and Jirapunpipat (2008) in Thailand, Ali et al. (2004) in Bangladesh, Suryani (2006) in Bengkulu (Indonesia) and Fondo et al. (2010) in Kenya, whilst La Sara (2010) found slightly higher in Lawele Bay of Southeast Sulawesi, Indonesia. A study by Bonine et al. (2008) in Kosrae of Micronesia showed relatively similar results with this study as reported in the present study. This size frequency distribution differences could be due to site effect, habitat condition and harvest intensity. According to local mud crab fisher of Pelita Jaya Village, the size they harvested now is smaller than what they harvested 15 years back.

3.2 Carapace width-weight relationship
From test of regression coefficient differences between male and female mud crab, it was found that no significant difference in carapace width-weight relationship (P<0.05) as shown in Figure 3. The only slight differences start to occur at the carapace width of 17 cm where female *S. serrata* tend to have slightly higher body weight. Since there is no significant difference between male and female mud crab regression coefficient, regression on carapace width-weight relationship was then pooled and estimated for both sexes in single analysis and Figure 4. displays that relationship. The pooled regression analysis showed that there was a strong relationship between carapace width and weight of mud crab *S. serrata* as shown by high correlation coefficient (r = 0.9591). The same relationship pattern was also found in some other sites like in Thailand, Bangladesh, Southeast Sulawesi, India and Micronesia [20, 9, 24, 23, 29]. The b value for male and female and combine male and female were lower than 3 (Figure 3 and Figure 4) and from the t-student test at 95% confidence interval (p = 0.05) showed a negative allometric growth pattern meaning length increment was faster than weight increment.

![Fig 3: Carapace width-weight relationship of male and female mud crab *Scylla serrata*](image)

![Fig 4: Carapace width-weight relationship of mud crab *Scylla serrata*](image)

3.3 Sex ratio
There were 522 individuals of mud crab used in this study comprise of 266 male mud crab and 256 female mud crab. The largest size male and female mud crab was 22.40 and 24.5 cm for external carapace width respectively. The overall sex ratio of male to female found in this present study was 1.04:1. Result of chi-square test showed that there was no significant difference between male and female in which \( \chi^2 \) calc. = 0.66 < \( \chi^2 \) table = 3.84 (p = 0.05; df = 1). This also explains that the sex ratio found from this study was not significantly different from hypothetical distribution sex ratio 1:1. This result suggests that proportion of male and female mud crab in the area are equal or both sex have an equal probability to be captured. Table 1. showed sex ratio for monthly period which statistically do different through all the period.

<table>
<thead>
<tr>
<th>Period</th>
<th>Male</th>
<th>Female</th>
<th>M/F</th>
<th>X^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>February</td>
<td>38</td>
<td>35</td>
<td>1.09:1.00</td>
<td>0.7255</td>
</tr>
<tr>
<td>March</td>
<td>47</td>
<td>43</td>
<td>1.09:1.00</td>
<td>0.6732</td>
</tr>
<tr>
<td>April</td>
<td>48</td>
<td>51</td>
<td>0.94:1.00</td>
<td>0.7630</td>
</tr>
<tr>
<td>May</td>
<td>40</td>
<td>42</td>
<td>0.95:1.00</td>
<td>0.8251</td>
</tr>
<tr>
<td>June</td>
<td>43</td>
<td>38</td>
<td>1.13:1.00</td>
<td>0.5785</td>
</tr>
<tr>
<td>August</td>
<td>50</td>
<td>47</td>
<td>1.06:1.00</td>
<td>0.7606</td>
</tr>
<tr>
<td>Total</td>
<td>266</td>
<td>256</td>
<td>1.04:1.00</td>
<td>0.6616</td>
</tr>
</tbody>
</table>

Table 1: Sex ratio of male and female mud crab *S. serrata* of Pelita Jaya Village.
The deviance of equal sex ratio could appear and this could be due to male and females movement during their reproductive activity. Mature female mud crab usually move off shore to spawn whilst male female remain in mangrove swamp [25, 9, 26, 27]. Study in Bangladesh [21] gave similar pattern with this present study, but slightly different from what was found in Kenya [19].

3.4 Condition factor
The condition factor of male and female mud crab for each month observation was shown on Figure 5. This figure shows almost the same pattern throughout the observation period with male having the highest value (1.00790) on February and female mud crab having the highest value (1.03206) on August. Even the value varies between male and female but not statistically significant (F < 0.05). Condition factor can be used as an indicator to describe a fatness or wellbeing condition of a particular organism [27]. A study on the same species in Bangladesh shows condition factor range from 0.41 to 1.53 for male and 1.0074 to 1.0374 for female [21], whilst in coastal area of Mayangan (Western Java), Indonesia, the value range from 0.82 to 1.5 for male and 0.84 to 2.2 for female [20]. Study on orange mud crab S. olivacea in Thailand [9] showed lower condition factor which ranged from 0.27 to 0.39 for female and 0.10 to 0.1421 for male orange mud crab. Toward.

3.5 Size at first maturity
Estimation of 50% mean size at first maturity from this present study has revealed that female mud crab reaches their first sexual maturity at the mean size of carapace width of approximately 12.00 cm (Figure 6.). Sexual maturity in S. serrata is believed to occur at a smaller size in many tropical populations compared to subtropical populations. Higher water temperatures in the tropics are suspected to increase the crab’s growth rate and decrease time to maturity [30, 19]. A smallest female mud crab S. serrata found to sexual mature in Malindi, Kenya was 8.4 cm and majority [31] of mud crab caught was at size between 12.00-13.90 cm carapace width. There was a high relationship between carapace width-weight for both male, female and pooled sexes and the growth pattern was negative allometric. Monthly sex ratio for male and female mud crab gave lower variation with overall sex ratio of 1.04:0.96. The condition factor of male and female mud crab was varies between month but statistically not different. Observation on the 50% mean size at first maturity revealed that female mud crab reaches their first sexual maturity at the mean size of 12.00 cm carapace width with approximately 36.65% of female mud crab caught having carapace width range between 12.00-13.00 cm which is quite high and can lead to recruitment over fishing.

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