E-ISSN: 2347-5129
P-ISSN: 2394-0506
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.549
IJFAS 2017; 5(5): 272-277

www.fisheriesjournal.com
Received: 17-07-2017
Accepted: 18-08-2017

Johannes MS Tetelpta
a) Department of Aquatic Resources Management, Faculty of Fisheries and Marine Science. Pattimura University, Ambon. Indonesia
b) Maritime and Marine Science Center of Excellence. Pattimura University. Ambon, Indonesia

AS Khouw
Department of Aquatic Resources Management, Faculty of Fisheries and Marine Science. Pattimura University, Ambon. Indonesia

Y Natan
a) Department of Aquatic Resources Management, Faculty of Fisheries and Marine Science. Pattimura University, Ambon. Indonesia
b) Maritime and Marine Science Center of Excellence. Pattimura University. Ambon, Indonesia

OTS Ongkers
a) Department of Aquatic Resources Management, Faculty of Fisheries and Marine Science. Pattimura University, Ambon. Indonesia
b) Maritime and Marine Science Center of Excellence. Pattimura University. Ambon, Indonesia

Correspondence
Johannes MS Tetelpta
a) Department of Aquatic Resources Management, Faculty of Fisheries and Marine Science. Pattimura University, Ambon. Indonesia
b) Maritime and Marine Science Center of Excellence. Pattimura University. Ambon, Indonesia

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

Johannes MS Tetelpta, AS Khouw, Y Natan and OTS Ongkers

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, terebralia), 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 fishier 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 [8, 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 [12]. 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 elemenrty 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 Siahainenia[13] (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].

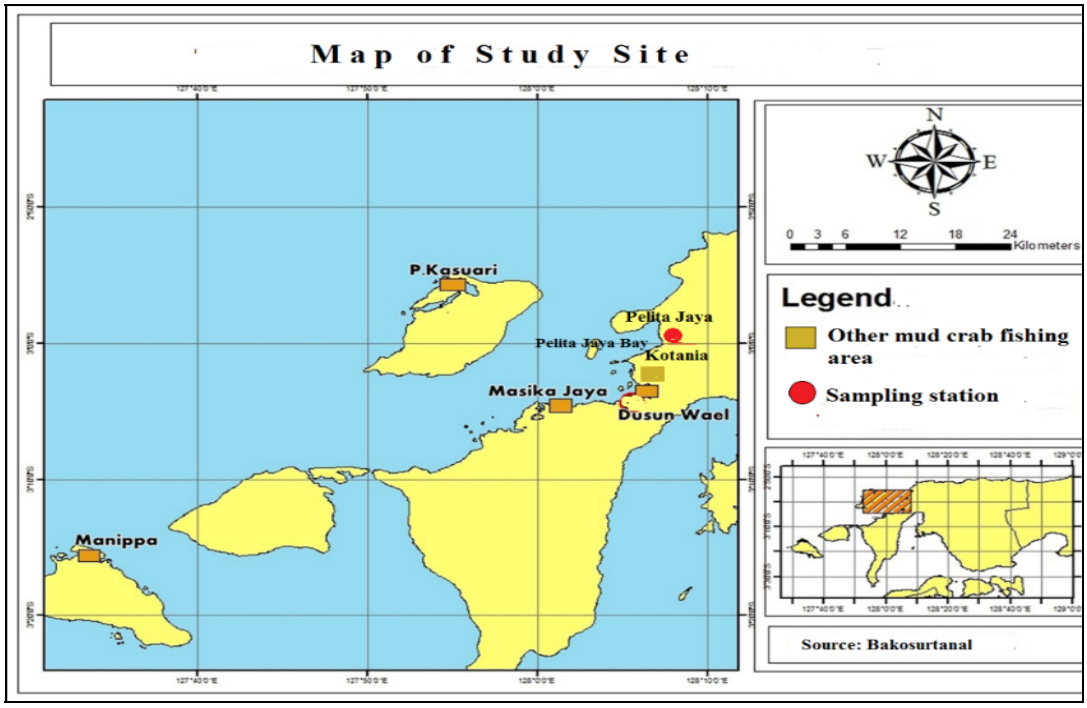

Fig 1: Map of Pelita Jaya Bay showing study site (Pelita Jaya), District of Western Seram.

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 Venema[16] (1992) as follow:

$$W_{(i)} = qECW_{(i)}^{b}$$

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 Pauly[17] (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 Zar[14] (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]:

$$X^2 = \frac{\Sigma(O-E)^2}{E}$$

where O = observed frequency and E = expected frequency

The condition factor (*CF*) of the crab was calculated by the equation proposed by King[18] (2007):

$CF = \bar{W}/W$ where $\bar{W}$ = observed mean weight and W = predicted mean weight = aL^b

The mean size at 50% first sexual maturity for females was estimated by fitting size class (cm) against cumulative percentage of female. Size class fall below 50% of percent cumulative was considered as mean size at first maturity [19].

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 ($t_{(\alpha)2.0.05}$) 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.

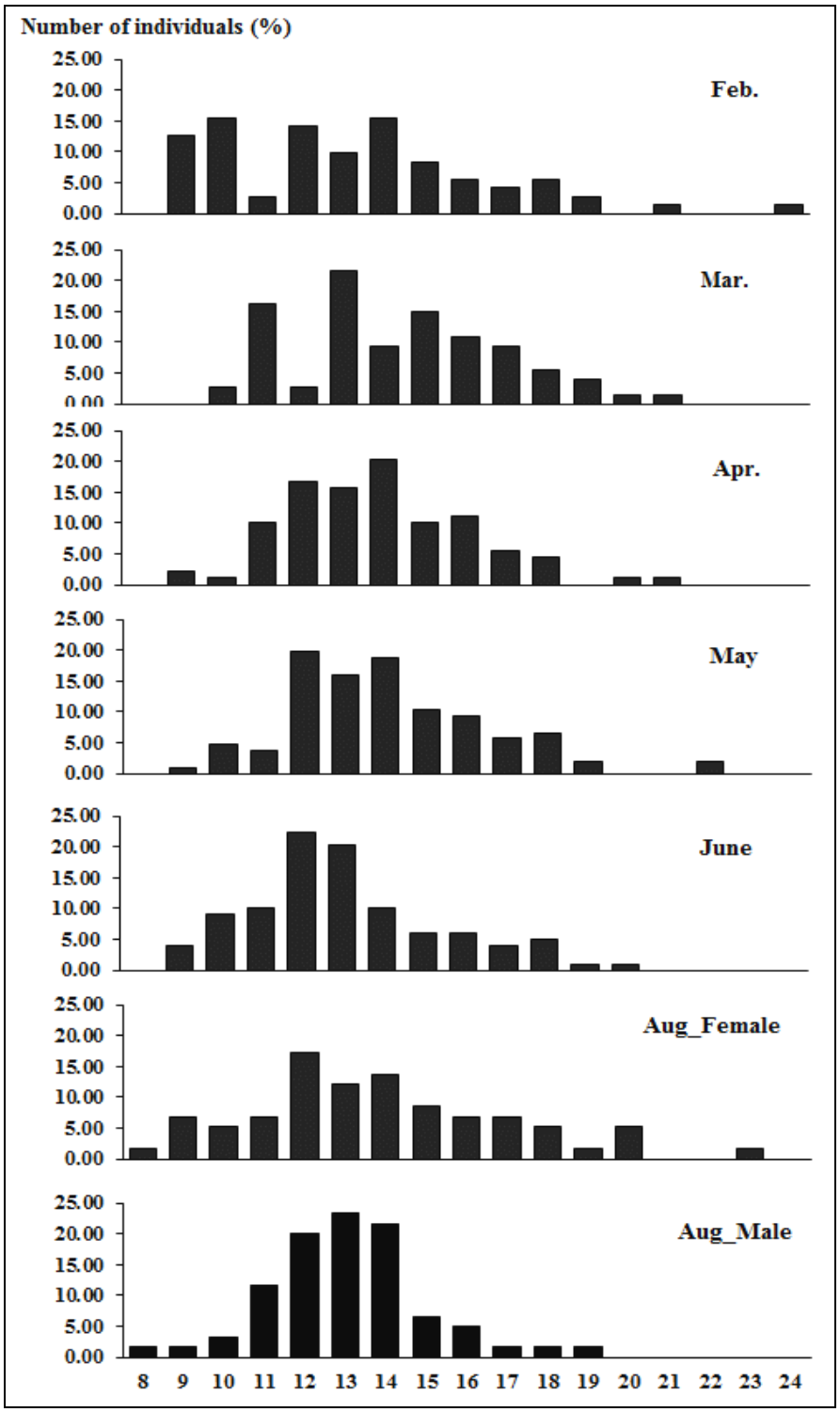

Fig 2: The percentage size frequency of mud crab *S. serrata* caught by local fisher of Pelita Jaya Village.

The mean size of carapace width distribution in this study was higher than what was found by Tongdee[20] (2001) and Jirapunpipat[9] (2008) in Thailand, Ali *et al*[21] (2004) in Bangladesh, Suryani[22] (2006) in Bengkulu (Indonesia) and Fondo *et al.*[19] (2010) in Kenya, whilst La Sara[23] (2010) found slightly higher in Lawele Bay of Southeast Sulawesi, Indonesia. A study by Bonine *et al.*[24] (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 alometric growth pattern meaning length increment was faster than weight increment.

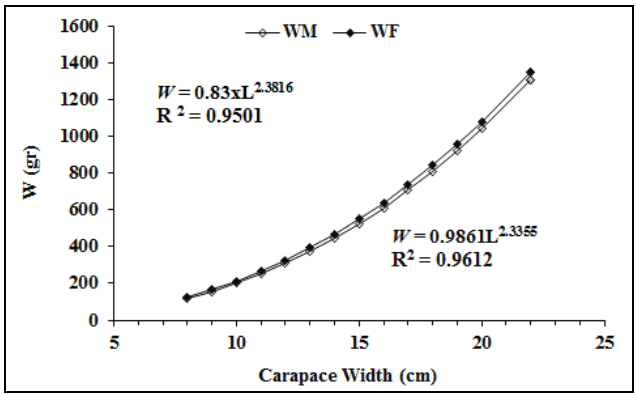

Fig 3: Carapace width-weight relationship of male and female mud crab *Scylla serrata* (n = 266 of male crab and n = 254 of female crab).

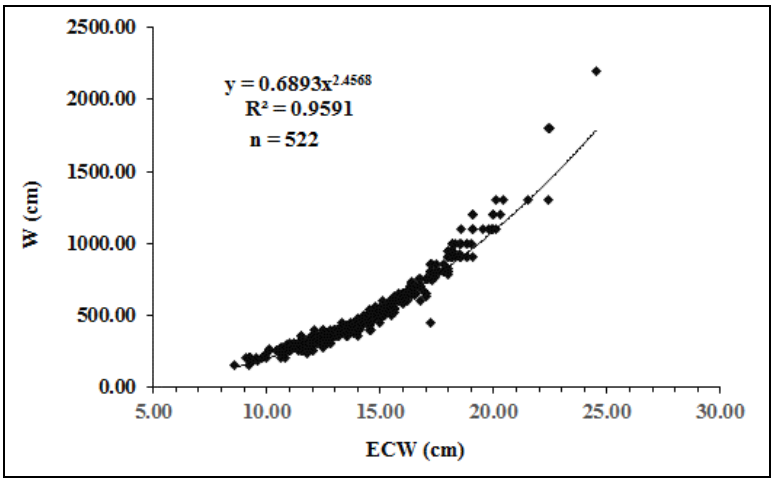

Fig 4: Carapace width-weight relationship of mud crab *Scylla serrate*

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 1: Sex ratio of male and female mud crab *S. serrata* of Pelita Jaya Village.

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

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. 9J, 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 (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 (Westerm Java), Indonesia, the value range from 0.82 to 1.5 for male and 0.84 to 2.2 for female [29]. Study on orange mud crab *S. olivaceae* 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.

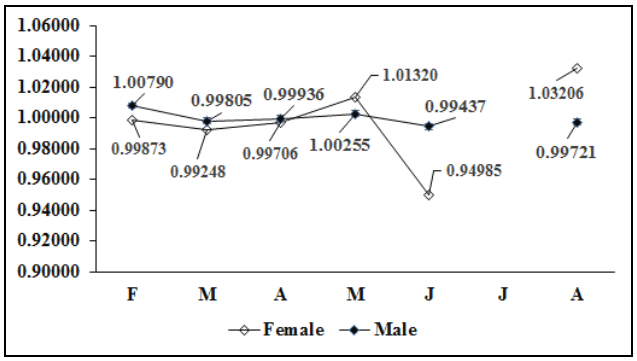

Fig 5: Monthly variation in condition factor of male and female mud crab *Scylla serrata.*

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 81.5 mm carapace width but first sexual maturity was at 90.00 mm [31, 19]. A. study at Klong Ngao mangrove swap, Ranong Province, Thailand [9,32] showed mean size at first maturity of *S. olivacea* was 9.55 cm external carapace width with the minimum size of being 8.3 cm. These studies mentioned revealed that size at first maturity of mud crab might varies between species and between region,

This present study shows slightly higher carapace width at first sexual maturity of *S. serrata* compared to what was found in Kenya [31, 19] and at New South Wales Australia [33]. Some factors that could trigger off this differences are mangrove condition, local environmental factors, fishing activity [8, 9, 34].

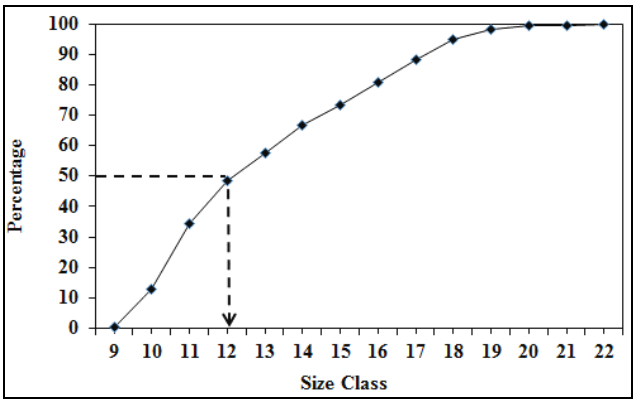

Fig 6: Mean size of carapace width at first maturity of *S. serrata* of Pelita Jaya Bay

4. Conclusion

The most common technique applies by mud crab fishermen for harvesting the mud crab is crab plot employed within the mangrove forest. For fishermen at Pelita Jaya Village have harvested this crab for more than 25 years with almost no management regulation either formal or informal. The plot mesh size use is approximately 4.5 cm, slightly bigger than what was used in some parts in the Philippine, Thailand, and Viet Nam. With this plot mesh sizes and fishing period that has been carried out for more 20 years, not surprisingly that the size and number were inevitable decrease.

The smallest mud crab caught was 8.4 cm and majority (53.20%) of mud crab caught was at size between 12.00-14.90 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 alometric. 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.

5. Acknowledgement

The authors would like to thank Ayhuan Vanny and Qomariah Bugis students from Faculty of Fisheries and Marine Science of the Pattimura University, Ambon and to the local mud crab fishers of Pelita Jaya Village of Western Seram District which made this study possible through their support and friendship. This study was funded by Research Fund provided by The Directorate of Research and Community Service of The Department of Education and Cultural of the Republic of Indonesia under MP3EI Research Scheme, 2012

6. References

1. Wouthuyzen S, Sapulete D. A review on condition of coastal area of Western Seram at past and present time. Perairan Maluku dan Sekitarnya. 1994, 7.
2. MFBWS. Annual year report of fisheries product of Western Seram Districr, Maluku Province. Marine and Fisheries Board of Western Seram District. 2010 (In Indonesia).

3. BP-KAPET SERAM. Fisheries Potency. (In Indonesia), 2012. http://www.kapetseram.com/potensi_perikanan.html.
4. Makatita M. Gonad maturity index and social, economy and institutional status as a basis for management of mud crab *Scylla serrata* at Pelita Jaya Waters. B.Sc. Script. Department of Aquatic Resources Management. Faculty of Fisheries and Marine Scince. Pattimura University. (In Indonesia), 2012.
5. Tetelepta JMS, Makatita M. Status and problems of Mud Crab *Scylla serrata* Fisheries and Pelita Jaya Village of Western Seram District TRITON Jurnal Manajemen Sumberdaya Perairan. 2012; 8:1-11.
6. Ayhuwan SM. Study of some biological aspects of mud crab and sustainability identification for mud crab fisheries management at Pelita Jaya Village of Western Seram District. B.Sc. script of Fisheries and Marine Science, Pattimura University (In Indonesian), 2013.
7. Natan Y, Khouw AS, Tetelepta JMS, Siaila S. Mud crab *Scylla* spp. fishery and local community economy empowerment of Pelita Jaya Village, Western Seram District: Potency, utilization and development. 2nd year Report of MP3EI Project. Pattimura University Board of Research, 2013 (In Indonesia).
8. Blaxter JHS, Gamble JC, Westernhagen HV. The early life history of fish. The third ICES symposium, Bergen, 3-5 October 1988. 1989, 497.
9. Jirapunpipat K. Population Structure at Size of Maturity of the Orange Mud Crab *Scylla olivacea* in Klong NgaoMangrove Swamp, Ranong Province, Thailand. 2008; Kasetsart Journal. (Natural. Science). 2008; 42**:**31-40.
10. Shelley C. Capture-based Aquaculture of Mud Crab *Scyla* spp. Lovatelli, A. and Holthuis, P.F. Capture-Based Aquaculture. Global Overview. FAO Fisheries Technical Paper. No. 508. FAO, Rome, 2008.
11. Gaillard J. Development of the mud crab sectors in three provinces of the Philippines. Constraints and Prospects. CEARCA in Collaboration with Cirad and World Fish Center. 2009, 54.
12. Paterson BD, Mann DL. Mud Crab Aquaculture. Fotedar, R.K. and B.F. Philips. Recent Advances and New Species In Aquaculture. Blackwell, Oxford. UK. 2011, 22.
13. Siahainenia L. Bioecology aspect of mud crab (*Scylla* spp.) at mangrove ecosystem of Subang Regency, West Java. Ph.D. disertation. Posctgraduate School. Bogor Agriculture University (In Indonesia), 2008.
14. Zar JH. Biostatistocal Analysis. 4th Edition. Prentice Hall International, Inc. New Jersey, USA. 1999, 663.
15. Fowler J, Cohen L. Practical statistic for field biology. John Willey & Sons, New York. 1990, 227.
16. Sparre P, Venema SC. Introduction to tropical fish stock assessment. Part I: Manual. FAO Fish. Tech. Pap. No. 306/1 (Rev.1. Rome, FAO. 1992, 376.
17. Pauly D. Fish population dynamic in tropical waters: a manual for use with programmable calculators. ICLARM Studies and Reviews 8, Manila, Philippines. 1984. 325 p
18. King, M. Fisheries biology, assessment and management. Wiley-Blackwell, UK. 2007. 400.
19. Fondo EN, Kimani EN, Odongo DO. The status of mud crab fishery in Kenia, East Africa. International Journal of Fisheries and Aquaculture. 2010; 2(3): 79-86.
20. Tongdee N. Size distributions, sex ratio and size at maturity of mud crab *(Scylla* spp.) in Ranong province Thailand. Asian Fisheries Science. 2001; 14:113-120.
21. Ali MY, Kamal D, Hossain SMM, Azam MA, Sabbir W, Murshida A, *et al.* Biological studies of the mud crab *Scylla serrata* (Forskal) of the Sundarbans mangrove ecosystem in Khulna Region of Bangladesh. Pakistan Journal of Biological Sciences. 2004; 7(11):1981-1987.
22. Suryani M. Ecology of mud crab (*Scylla serrata* Forskal) in mangrove ecosystem at Enggano Island, Bengkulu Province. Indonesia. M.Sc. Thesis. Postgraduate School, Diponegoro University (In Indonesia), 2006.
23. La Sara. Study on the size structure and population parameters of mud crab *Scylla serrata* in Lawele Bay, Southeast Sulawesi, Indonesia. Journal of Coastal Development. 2010; 13(2):133-147.
24. Bonine KM, Bjorksted T, EP Ewel KC, Palik M. Population characteristic of the mangrove crab *Scylla serrata* (Decapoda: Portunidae) I Kosrae Federated States of Micronesia: effects of harvests and implications of management. Pacific Science. 2008; 62(1):1-19.
25. Ryan DA, Heap AD, Radke L, Heggie DT. Conceptual Models of Australia's Estuaries and Coastal Waterways. Application for Coastal Resources Management. GeoscienceAustralia Record. 2003, 55.
26. FAO. Cultured aquatic species information. Programme. *Scylla serrata* (Forskal, 1755). Fisheries and Aquaculture Department. 2011, 12.
27. Fisheries Fact Sheet. Mud Crab. Fish for the future. Government of Western Australia. Department of Fisheries. 2013, 4.
28. Bagenal T, Tesch FW. Age and growth: Method for assessment of fish production in freshwater. Bagenal T. (eds), IBP Handbook, Blackwell Scientific Press, Oxford, 1978, 101-136.
29. Sentosa A, Syam AR. Temporal distribution of condition factor of mud crab (*Scylla serrata*) in the coastal area of Mayangan, Subang Regency, West Java. Journal of Fisheries Science. 2011; 13(1):35-43.
30. Quinn NJ, Kojis BL. Reproduction biology of *Scylla* spp. (Crustacea: Portunidae) in the Labu estuary in Papua New Guinea. Bulletine of Marine Science. 1987; 42(2):234-241
31. Fondo EN. Effect of mangrove deforestation on mangrove mud crab fishery. Western Indian Ocean Marine Science Association. Technical Report WIOMSA-MARG I. 2007-
32. Choano P, Ajjimangkul S, Meksumpun S, Netharn U. Mud crab fisheries in Kapapor Bay, Ranong Province. Kasetsart Journal (Natural Science). 2010; 40:31-40.
33. Wild Fisheries Research Program. Giant mud crab (*Scylla serrata*). Status of fisheries resources in New South Wales, 2008/9. 2010, 147-150.
34. Paital B, Chainy GBN. Biology and conservation of genus *Scylla* spp. in India subcontinent. Journal of Environmental Biology. 2012; 3:871-879.
35. Shelley C. Capture-based Aquaculture of Mud Crab *Scylla* spp. Lovatelli, A. and P.F. Holthuis. Capture-Based Aquaculture. Global Overview. FAO Fisheries Technical Paper. No. 508. FAO, Rome. 2008, 255-269.