Aceh Journal of Animal Science (2021) 6 (1): 23-26

Aceh Journal of Animal Science

Journal homepage: www.jurnal.unsyiah.ac.id/AJAS

Gonad maturity and gonadal somatic index of blue swimming crab *Portunus pelagicus* harvested from Spermonde Archipelago, South Sulawesi, Indonesia

Muh. Saleh Nurdin[1*], Fauziah Azmi[2], Teuku Fadlon Haser[2]

[1] *Faculty of Animal Husbandry and Fisheries, Tadulako University, Palu, Indonesia.*
[2] *Faculty of Agriculture, Samudra University, Aceh, Indonesia.*

ARTICLE INFO

Keywords:
Biology
Blue Swimming Crab
Ecosystems Spermonde Archipelago

Received: 28 December 2020
Accepted: 12 February 2021
Available online: 28 February 2021

DOI: 10.13170/ajas.5.2.19187

ABSTRACT

Reproductive biology is one of the biological aspects that needed to formulate responsible management of blue swimming crab (BSC). The crab is one of the commercial fisheries commodities in South Sulawesi, Indonesia. Presently no information on the reproductive biology of this crab from Spermonde Archipelago, Sout Sulawesi. Therefore, the study aimed to analyze and compare gonad maturity stage (GMS) and gonadal somatic index (GSI) of the BSC caught on three ecosystems namely coral reef, seagrass, and mangrove in Salemo Island, Spermonde Archipelago. GMS and GSI were analyzed descriptively for five months from March to July 2015. Results indicate there was a difference in GMS of the BSC caught in mangroves, seagrass, and coral reef. Generally, mangrove was dominated by immature BSC with GMS I and GMS II, while the BSC caught in the seagrass and coral reef BSC were dominantly mature and spawn GMS III, IV, and V. GSI BSC caught in mangrove ecosystem are smaller than GSI BSC caught in seagrass and coral reef ecosystems. Seagrass and coral reef ecosystems suitable for development no-take zone of the BSC.

Introduction

Spermonde archipelago is located in the center of the Coral Triangle of which marine biota is highly diverse (Máñez *et al.,* 2012; Sawall *et al.,* 2013). These islands sit on the Makassar strait (Timm *et al.,* 2017). The highly valued commodity from this region is blue swimming crabs (*Portunus pelagicus*), which is mainly captured surrounding Salemo island, is an island in the archipelago (Nurdin *et al.,* 2016; Nurdin *et al.,* 2020).

Blue swimming crab (BSC) is an important commodity due to its high value in the global market fishery (Sahoo *et al.,* 2011; Mehanna *et al.,* 2013; Sabrah *et al.,* 2020). Increasing demand for BSC is mainly in the form of frozen and canned meats (Lai *et al.,* 2010), and freshly captured (Yusfiandayani and Sobari, 2011). The market demand triggers continuous exploitation of BSC in Salemo Island (Nurdin *et al.,* 2019a).

Presently, the BSC population in Salemo Island is facing multiple stressors. Over-exploitation has caused changes in reproductive biology patterns indicated by the shorter duration of spawning peak season (Ali *et al.,* 2004; Redjeki *et al.,* 2020). Apart from being heavily harvested, habitat degradation due to destructive fishing also contributes to factors that affect the BSC population (Kurnia *et al.,* 2014; Astuti *et al.,* 2020; Johnston and Yeoh, 2020).

Continuous and intensive exploitation without management intervention on BSC fishery in Salemo Island can lead to local extinction (Adam *et al.,* 2006). To retain sustainable production of BSC to contribute to the local economy, conservation efforts must be imposed. Conservation and management efforts must be supported by information from science to make the implementation more effective. Therefore, the objective of the present study was to assess the reproductive biology of blue swimming

* Corresponding author.
Email address: msalehnurdin@gmail.com

Printed ISSN 2502-9568; Electronic ISSN 2622-8734

crab especially on the aspects of gonad maturity stage (GMS) and gonadal somatic index (GSI) of BSCs in three ecosystems, namely seagrass meadows, coral reefs, and mangrove nearby the Salemo Island. This information is crucial to plan better conservation and management strategies of the BSC.

Materials and Methods

Site and time

The study area covers seagrass meadows, coral reefs, and mangroves in Salemo Island coastal waters, Pangkep Regency (Figure 1). Sampling was conducted from May to July 2015. Samples were collected using traps and gillnets. Samples obtained were put in the coolbox filled with ice and transported were transported to Aquatic Productivity Laboratory, Hasanuddin University for further analysis.

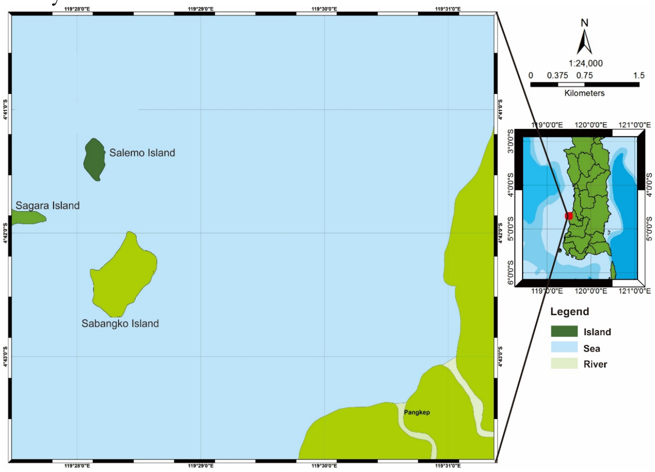

Figure 1. Salemo Island, Spermonde Archipelago.

Data collection

A total of 457 samples of blue swimming crab were obtained during the study. Of these, 92 BSC was captured in seagrasses, 250 samples were obtained from mangroves, and 115 samples from coral reef ecosystems. Parameters observed include body weight, gonadal weight, and GMS. The body weight was measured using an analytical balance with 0.001 g accuracy. The width of the carapace was measured using a digital caliper with 0.1 mm accuracy. GMS was classified descriptively based on Kumar *et al.* (2000), and Castiglioni and Fransozo (2006) which divides the maturity stage into (i) GMS I is indicated by the non-developed ovary and the color is pale yellow; (ii) GMS II is when the size of the ovary is extended with yellow golden color, eggs structure are yet been seen and the ovary is located above hepatopancreas; (iii) GMS III the size of ovary become larger and eggs granule becomes visible even though they are still covered by an oil membrane; (iv) GMS IV, eggs become larger and become visible with orange color, they can be easily segregated due to the decreasing the oil membrane that covers them, and; (v) GMS V ovary is contracted with some unleashed eggs during spawning remain on the abdomen. In this research, crabs with GMS I and II were classified as immature, crabs with GSI III and IV were classified as mature, and those with GSI V was classified as spawned.

Data analysis

Gonadal somatic index was computed based on the ratio between gonad weight and body weight with the formula following (Johnson, 1971; Muchlisin *et al.*, 2010):

$$GSI\ (\%) = \frac{GW}{BW} x100$$

GSI = Gonadal somatic index; GW = Gonad weight (g); BW = Body weight (g).

Results

Gonad maturity stage

The number of samples captured in five months interval is described in Figure 2. From the above figure, it can be seen that samples captured in mangroves were dominated by immature BSC with gonad maturity is in GMS I and GMS II. In the meantime, BSC captured in seagrass and coral reefs were dominated by mature and spawn (GMS III, IV, and V).

Gonadal somatic index

The gonadal somatic index in seagrass and coral reefs develops relatively faster during observations within this study. The GSI of females captured in the mangrove ecosystem is smaller compared to that of seagrasses and coral reefs. In general, the GSI in mangroves, seagrasses, and coral reefs ranged from 3.78-5.73%, 5.52-8.83%, 2.69-12.87% (Figure 3).

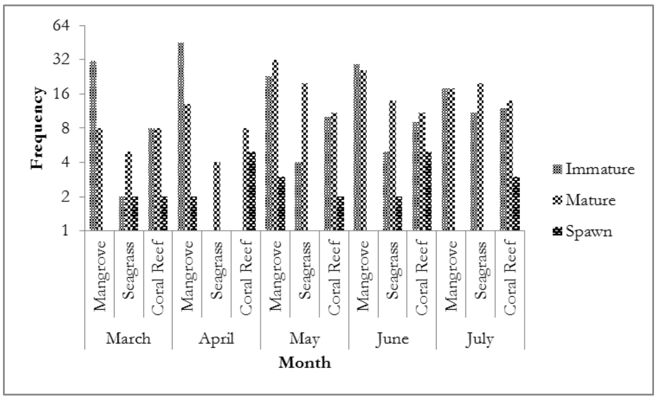

Figure 2. Frequency of immature, mature, and spawned BSC captured in mangrove, seagrass, and coral reef ecosystems

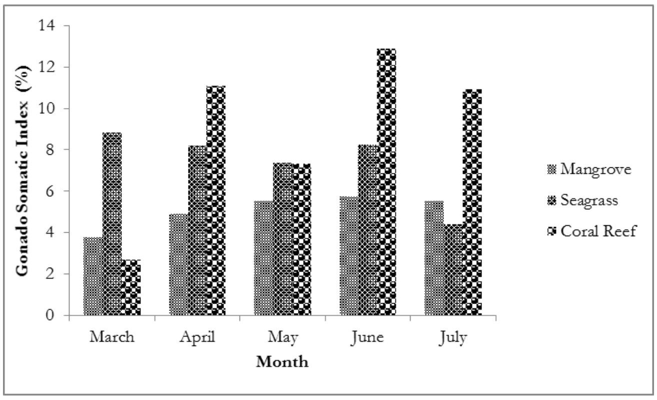

Figure 3. Gonadal somatic index development of female BSC captures mangrove, seagrass, and coral reef ecosystems during five months study period

Discussion

The GMS of female BSC captured in mangrove ecosystem (represent estuaries) with those captured in seagrasses and coral reefs which represent marine ecosystem are different. The GMS of BSC captured in estuaries is smaller compared to the other two ecotypes. Female BSC found in the estuary are those in the younger life stages (GMS I and II) and those which are found in marine habitats (seagrass and coral reefs) are those which are in the adult phase (mature and spawn).

The distinction of GSIs representing estuary and marine habitats support studies reported by (Potter and De Lestang, 2000; Safaie *et al.,* 2013) who stated that BSC are migrated to the sea to spawn from estuaries. This behavior is explained by the catadromous characteristic of BSCs (Sahoo *et al.,* 2011) who spend their juvenile and young adult phase in the estuary and moved to the sea for spawning (Kangas 2000; Adam *et al.,* 2006).

Based on a previous study by (Nurdin *et al.,* 2019b), from March to July there are always BSCs at the GMS V phase which are expected to release their eggs at any time. Recruitments of BSCs in Salemo Island occurs continuously in a year with recruitment percentages range between 1.9 – 22.11%). This phenomenon can also be used as an indicator that BSC spawn throughout the year (Dineshbabu *et al.,* 2008; Kamrani *et al.,* 2010; Dash *et al.,* 2013; Kunsook *et al.,* 2014). According to Bagenal (1978), aquatic animals with GSI below 20% can spawns more than one time in a year due they can have eggs more than once in a season depending upon their body size (Kumar *et al.,* 2003; Johnson *et al.,* 2010).

Seagrass and coral reef ecosystems are considered as a spawning ground for the BSC due to the high number of matured BSC captures within the two ecosystems (Nurdin and Haser, 2018). Therefore, the two ecosystems are expected to be preserved to become the "no-take zone". The larger the conservation area, the more BSCs will be protected. Apart from biological and scientific aspects, the social aspect of conservation preparation such as consulting fishery stakeholders including fishermen is crucial to avoid conflict (Nurdin *et al.,* 2019a).

Conclusions

There are some distinctions found in GMSs of BSC captured within the three ecotypes. Those which captured in estuaries comprise of immature that are still in GMS I and GMS II phases, whilst those who were captured in seagrasses and coral reefs are in the GMS phases III, IV, and V. The GSIs of BSC captured in mangrove are smaller than those captured in seagrasses and coral reefs. The latter two ecosystems are considered as the spawning ground of the BSC because of the larger number of mature females caught in the two marine ecosystems. Therefore, they can be proposed as the "no-take zone" area to protect the BSCs population.

Acknowledgements

The research was funded by BPPDN DIKTI. We also express our gratitude to Muh. Fuad Affany, Hermiyanti Herman, Junardiawan Sandi Ode, Nurwahidah, Nur Fadillah Rahim, and Nurmasita who have been helping the research team during sampling activity.

References

Adam., I. Jaya, M. Sondita. 2006. Diffusion numerical model for swimming crab fisheries in the Makassar Strait. Jurnal Ilmu-ilmu Perairan dan Perikanan Indonesia, 13(2): 83-88.

Ali, S. A., M.N. Nessa, M.I. Djawad, S.B.A. Omar. 2004. Analysis of the catch and maximum sustainable yield of the flying fish (Exocoetidae) in South Sulawesi. Torani, 14(2): 104-112.

Astuti, O., N. Alimina, S. Safilu, E. Emiyarti, L. Sara, W. Nurgayah, A. Rahmadani, I. Skel. 2020. Temporal sex ratio, growth patterns and condition factor of the blue swimming crab (*Portunus pelagicus*) in Northern of Tiworo Strait waters, Southeast Sulawesi, Indonesia. Aceh Journal of Animal Science, 5(2): 104-111. https://doi.org/10.13170/ajas.5.2.16809

Bagenal, T. B. 1978. Aspect of Fish Fecundity. In: Ecology of Freshwater Fish Production. S. D. Gerking (Ed) Third Edition, Blackwell, Oxford.

Castiglioni, D., M. Fransozo. 2006. Physiologic Sexual Maturity of the Fiddler Crab *Uca rapax* (Smith, 1870) (Crustacea, Ocypodidae) from Two Mangroves in Ubatuba, Brazil. Brazilian Archives of Biology and Technology an International Journal, 49(2): 239-248. http://dx.doi.org/10.1590/S1516-89132006000300009

Dash, G., S. Sen., K.M. Koya, K.R. Sreenath, S.K. Mojjada, M.S. Zala, S. Pradeep. 2013. Fishery and stock assessment of the three-spot swimming crab *Portunus sanguinolentus* (Herbst, 1783) off Veraval, Gujarat. Indian Journal Fisheries, 60(4): 17-25.

Dineshbabu, A.P., B. Shridhara, Y. Muniyappa. 2008. Biology and exploitation of the blue swimmer crab, *Portunus pelagicus* (Linnaeus, 1758), from south Karnataka coast, India. Indian Journal Fisheries, 55(3): 215-220.

Johnson, J.E. 1971. Maturity and fecundity of threadfin shad, *Dorosoma petenense* (Gunther), in Central Arizona reservoirs. Transaction of the American Fisheries Society, 100(1): 74-85.

Johnson, D.D., G.A. Charles, W.G. Macbeth. 2010. Reproductive biology of *Portunus pelagicus* in a South-East Australian estuary. Journal of Crustacean Biology, 30(2): 200-205. https://doi.org/10.1651/08-3076.1

Johnston, D.J., D.E. Yeoh. 2020. Carapace width-weight relationships of blue swimmer crab *Portunus armatus* (A. Milne-Edwards, 1861) (crustacea: brachyura: portunidae) in southwestern Australia: influences of sex, decadal change, environment, and season. Journal of Crustacean Biology, 1-8. https://doi.org/10.1093/jcbiol/ruaa046

Kamrani, E., A.B. Sabili, A. Yahyavi. 2010. stock assessment and reproductive biology of the blue swimming crab, *Portunus pelagicus* in Bandar Abbas Coastal Waters, Northern Persian Gulf. Journal of the Persian Gulf (Marine Science), 1(2): 11-22.

Kangas, M. 2000. Synopsis of the biology and exploitation of the blue swimmer crab, *Portunus pelagicus* Linnaeus, in Western Australia. Fisheries Research Report, 121: 1-22.

Kumar, M., G. Ferguson., Y. Xiao., G. Hooper, S. Venema. 2000. Studies on reproductive biology and distribution of the blue swimmer crab (*Portunus pelagicus*) in South Australia waters. SARDI Research Report Series No.47.

Kumar, M., X. Yongshun, V. Sonja, H. Graham. 2003. Reproductive cycle of the blue swimmer crab, *Portunus pelagicus*, off southern Australia. Journal of the Marine Biological Association of the United Kingdom, 83: 983-994. https://doi.org/10.1017/S0025315403008191h

Kunsook, C., G. Nantana, P. Nittharatana. 2014. A stock assessment of the blue swimming crab *Portunus pelagicus* (Linnaeus, 1758) for sustainable management in Kung Krabaen Bay, Gulf of Thailand. Tropical Life Sciences Research, 25(1): 41–59.

Kurnia, K., B. Mennofatria, Z. Zairion. 2014. Population biology of *Portunus pelagicus* and its essential habitat characteristics in order to propose nursery ground conservation in East Lampung. Jurnal Ilmu Pertanian Indonesia, 19(1): 22-28.

Lai, J., K. Peter, J. Peter. 2010. A revision of the *Portunus pelagicus* (Linnaeus, 1758) species complex (crustacea: brachyura: portunidae), with the recognition of four species. The Raffles Bulletin Of Zoology, 58(2): 199–237.

Máñez, K.S., S. Husain, S.C.A. Ferse, M.M. Costa. Water scarcity in the Spermonde Archipelago, Sulawesi, Indonesia: past, present and future. Environmental Science and Policy, 23: 74-84. https://doi.org/10.1016/j.envsci.2012.07.004

Mehanna, S., K. Sergey., A. Mansoor., S. Yehia, N. Mohamed. 2013. Stock assessment of the blue swimmer crab *Portunus pelagicus* (Linnaeus, 1766) from the Oman Coastal Waters. International Journal of Fisheries and Aquatic Sciences, 2(1): 1-8.

Muchlisin, Z.A., M. Musman, M.N. Siti-Azizah. 2010. Spawning seasons of *Rasbora tawarensis* (Pisces: Cyprinidae) in Lake Laut Tawar, Aceh Province, Indonesia. Reproductive Biology and Endocrinology, 8:49.

Nurdin, M.S., S.A. Ali, D.Y. Satari. 2016. Sex ratio and size at first maturity of blue swimming crab (*Portunus pelagicus*) at Salemo Island, South Sulawesi. Ilmu Kelautan, 21(1):17-22. https://doi.org/10.14710/ik.ijms.21.1.17-22

Nurdin, M.S., T.F. Haser. 2018. Condition coefficient of blue swimming crab (*Portunus pelagicus*) catched in Mangrove, seagrass and coral reef ecosystem in Salemo Island, South Sulawesi. Jurnal Ilmiah Samudra Akuatika, 2(1): 9-13.

Nurdin, M.S., T.F. Haser, F. Azmi, N. Hasanah. 2019a. Fishery management strategy based on spatial and temporal distribution study of berried female size in blue swimming crabs. Jurnal Ilmiah Samudra Akuatika, 3(2): 14-20.

Nurdin, M.S., N. Hasanah, A.E. Putra. 2019b. Recruitment pattern of blue swimming crab *Portunus pelagicus* in Salemo Island Waters, South Sulawesi Province. AgriSains, 20(1): 6-11.

Nurdin, M.S., E. Eniwati., T.F. Haser, N. Hasanah. 2020. The relationship between blue swimming crab (*Portunus pelagicus*) abundance and environmental paramaters in Spermonde Archipelago. Tomini Journal of Aquatic Science, 1(1): 8–15. http://dx.doi.org/10.37905/tjas.v1i1.5917

Potter, I. C., S. De Lestang. 2000. Biology of the blue swimmer crab *Portunus pelagicus* in Leschenault Estuary and Koombana Bay, south-western Australia. Journal of the Royal Society of Western Australia, 83: 443-458.

Redjeki, S., M. Zainuri, I. Widowati, A. Ghofar, E.L. Agus, M. Mustagpirin, P. Ayodya. 2020. Biology reproduction and dynamic of gonads maturity blue swimming crabs (*Portunus pelagicus*) in Betahwalang Waters, Demak. Jurnal Kelautan Tropis, 23(3): 357-361. https://doi.org/10.14710/jkt.v23i3.8977

Sabrah, M.M., A. El-Refaii, T.G. Ali. 2020. Reproductive characteristics of the blue swimming crab, *Portunus pelagicus* (Decapoda, Brachyura: Portunidae) from the Bitter Lakes, Suez Canal, Egypt. African Journal of Biological Sciences, 16(1): 79-91. https://doi.org/10.21608/ajbs.2020.121901

Safaie M., J. Pazooki., B. Kiabi, M. Shokri. 2013. Reproductive biology of blue swimming crab, *Portunus segnis* (Forskal, 1775) in coastal waters of Persian Gulf and Oman Sea, Iran. Iranian Journal of Fisheries Sciences, 12(2): 430-444.

Sahoo, D., S. Panda., B. Guru. 2011. Studies on reproductive biology and ecology of blue swimming crab *Portunus pelagicus* from Chilika Lagoon, Orissa, India. Journal of the Marine Biological Association of the United Kingdom, 91(1): 257–264. https://doi.org/10.1017/S0025315410000354

Sawall, Y., J. Jompa, M. Litaay, A. Maddusila, C. Richter. 2013. Coral recruitment and potential recovery of eutrophied and blast fishing impacted reefs in Spermonde Archipelago, Indonesia. Marine Pollution Bulletin, 74(1): 374-382. https://doi.org/10.1016/j.marpolbul.2013.06.022

Soundarapandian, P., D. Varadharajan, T. Anand. 2013. Male Reproductive System of Blue Swimming Crab, *Portunus pelagicus* (Linnaeus, 1758). Cytology and Histology, 5(1): 1-8. http://dx.doi.org/10.4172/2157-7099.1000206

Timm, J., M. Kochzius, H.H. Madduppa, A.I. Neuhaus, T. Dohna. 2017. Small scale genetic population structure of coral reef organisms in Spermonde Archipelago, Indonesia. Frontiers in Marine Science, 4: 1-14. https://doi.org/10.3389/fmars.2017.00294

Yusfiandayani, R., M. Sobari. 2011. Bio-technique aspect of blue swimming crab resources utilization in Banten Bay Water. Jurnal Teknologi Perikanan dan Kelautan, 2(1): 71-80. https://doi.org/10.24319/jtpk.2.71-80