BIOMA
p-ISSN: 0126-3552
e-ISSN: 2580-9032

DOI:10.21009/Bioma20(1).2 Research article

The analysis of natural forage of blue swimming crab (*Portunus pelagicus* Linnaeus, 1758) on the east coast of Pangandaran, West Java

Sofia Dorothy[1]* & Desak Made Malini[2]

[1]*Post Graduated Student of Forensic Science, Postgraduate School, Airlangga University, Jalan Airlangga 4-6, Surabaya 60286, Tel. +062 31 5041566*
[2]*Biology Department, Faculty of Mathematics and Natural Sciences, Padjadjaran University*
*corresponding author: sofia.dorothy-2022@pasca.unair.ac.id

ABSTRAK

*Pemanfaatan rajungan (*Portunus pelagicus*) tanpa adanya kendali dikhawatirkan menyebabkan penurunan populasi yang berujung pada rusaknya stabilitas ekosistem laut, khususnya di Pantai Timur Pangandaran, sehingga diperlukan adanya usaha budidaya. Dalam kegiatan budidaya perlu diberikan pakan yang tepat dengan mengetahui makanan alaminya. Penelitian ini bertujuan untuk mengetahui jenis makanan alami rajungan. Metode yang digunakan adalah analisis deskriptif. Parameter yang diamati yaitu lebar karapas, berat lambung dan komposisi jenis makanan rajungan. Hubungan antara lebar karapas dan berat lambung dianalisis dengan regresi sederhana sedangkan komposisi jenis makanan diketahui dengan menganalisis isi lambungnya. Hasil yang didapatkan yaitu terdapat hubungan yang positif antara lebar karapas dan berat lambung. Berdasarkan komposisi makanan dari isi lambung rajungan terdapat 5 jenis makanan alami yang terdiri atas krustasea (28,35%), daging (25,37%), moluska (18,65%), ikan (15,67%), dan Material Tidak Terdefinisi (MTT) (4,47%). Dari hasil penelitian ini dapat disimpulkan bahwa rajungan, merupakan karnivora dan scavenger, memiliki hubungan signifikan antara ukuran dengan berat isi perut. Ditemukan juga bahwa komposisi pakan rajungan betina secara umum lebih tinggi dibandingkan jantan.*

***Kata kunci: isi lambung, makanan alami, Pantai Timur Pangandaran,* Portunus pelagicus**

ABSTRACT

*Continuous use of blue swimming crab (*Portunus pelagicus*) without any control can cause population decline which leads to damage to the stability of the marine ecosystem, especially in East Coast Pangandaran, therefore cultivation is needed. In aquaculture, it is necessary to provide the right feed by knowing its natural diet. This study aimed to determine the natural diet of blue swimming crabs. The method used was descriptive analysis. The parameters observed were carapace width, gastric weight, the composition of natural diet. The relationship between the carapace width and gastric weight was analyzed by simple regression while the main type of natural diet was known by calculating the percentage of food composition. The relationship between carapace width and gastric weight was positive. Based on the composition found in crab gastric, there were 5 types of natural foods consisting of crustaceans (28.35%), meat (25.37%), mollusk (18.65%), fish (15.67%), and undefined material (UM) (4.47%). It is revealed that crabs are carnivores and scavengers, pose significant relationship between their size and gut content weight. It was also found that the composition of female crab feed was generally higher than that of males.*

Keywords**: **gut content, natural diet, East Coast Pangandaran,* Portunus pelagicus

INTRODUCTION

Pangandaran Beach is one of the coastal waters in the south of West Java with the potential for capture fisheries that make a major contribution to the regional economy and the surrounding community (Nurhayati, 2013). One of its important fishery commodities is blue swimming crab (*Portunus pelagicus*, locally *rajungan*) is a species of sea crab that is widely found in Indonesian waters. Crab plays an important role as a biota that maintains ecological balance in coastal waters and deep waters, and economically an important role in meeting consumption needs both domestically and abroad. In 2018, crab product exports reached USD 370.14 million or 10.50% of the total value of Indonesian fishery exports and ranked fourth as the leading export commodity of Indonesian fishery products (Sholeh, 2018).

Crab is widely favored due to taste and its nutritional value, so that the demand for this commodity continues to increase (Setiyowati, 2016), as this comodity has a high economic value compared to other fishery commodities, eventhough production of crabs both domestically and internationally are still come from sea catches (Susanto et al., 2004).

High economic value will have an impact on increasing demand and utilization. Continuous utilization of crabs from nature without any breeding efforts is feared to cause a decrease in population which will ultimately disrupt the stability of the marine ecosystem. The initial step in managing crabs for breeding enterprise is to understand their natural forage and the right water conditions to support crab growth. One component in supporting the growth of crab size is the availability of forage in the waters (Sara et al., 2007). Forage availability and crab growth can be influenced by water conditions (Ernawati et al., 2014). The condition of the aquatic environment can change due to various human activities and natural changes, the impact of declining environmental conditions will affect the growth rate of crabs (Tahmid et al., 2015). Research on natural crab forage has been conducted by Erlinda et al. (2016) in Lakara Waters, South Konawe Regency, Southeast Sulawesi, but in the waters of South Java, especially the East Coast of Pangandaran, it has never been done. This study aims to determine whether the body size is related to gut weight and to reveal the natural food of crabs based on sex.

METHODOLOGY

This research was conducted on March 10-16, 2019 in the waters of the East Coast of Pangandaran, West Java. The method used in this study is descriptive analysis. The variables observed include gut weight, carapace width, sex, and gut food composition. For this study we used dissection kit, dissection trays, sample bottles, petri dishes, 10ml measuring cups, calipers, slides and coverslips, cameras, coolers, labels, microscopes, dropper pipettes, gloves, and analytical scales. The materials used in this study were 70% alcohol, distilled water, ice cubes, and crab samples.

Crab sampling

The crab samples obtained came from net fishermen from the depth of 20-30 m on the East Coast of Pangandaran. Samples were separated according to sex (M/F), then classified into three size categories based on their carapace width (Budiaryani, 2007); juvenile size (carapace width <60 mm), young crab size (carapace width 60-120 mm), and adult size (carapace width> 120 mm). The crabs that had been classified were put into a cooler box containing crushed ice cubes to slow the gut digestion process. Sample measurements and forage composition analysis were carried out in a field laboratory set on the East Coast of Pangandaran, West Java.

Carapace width measurrements

Carapace width is measured using a ruler and caliper. Measurement of the width of the crab carapace starts from the tip of the left carapace to the tip of the right carapace. During carapace measurement, sex is of important consideration, as we measured female (rounded abdomen) and male (tapering acute abdomen) in seperate dataset (Cumberlidge, 1999; Ernawati et al., 2014; Nugraheni et al., 2015).

Forage Identification

Gut contents were identified by dissecting the carapace from the dorsal to the ventral, removing it from the rest of the body. Gut is weighed using an analytical scale and preserved in a sample bottle containing 70% alcohol. Gut contents were grouped based on forege types using the forage categorization according to Sara et al. (2007).

Data analysis

The relationship between carapace width and gut weight was analyzed using linear regression. The forage type preference of crabs was determined by calculating the percentage composition of each type of forage found in the gut based on Ingles formula (1992): Percentage of Forage Composition type – I = (ni N-1) x 100, where ni is the number of type – I forage in the gut and N is the total forage in the gut.

RESULTS AND DISCUSSION

We sampled 16 crab samples from net fishermen with a depth of 20-30 m on the East Coast of Pangandaran, 8 of which were males, while 8 were females. Sara et al. (2007), noted that to ensure that gut content of crab samples is not contaminated, net catching prosedure must be done instead of bait fishing, as the bait can contaminate gut content. The width of the carapace of male crabs obtained ranged from 12.6 - 15.7 cm, wider than the females, ranged from 11.6 - 15.2 cm (**Table 1**). The crabs sampled in this study were in the juvenile and adult stages, i.e. 8 males individuals were all in the adult phase, while 1 female in juvenile stage and 7 female in adult stage. According to Prasetyo et al. (2014), young crabs are more common at a depth of 5.5-10 m in Demak Waters, this is because their life cycle while juvenile to sub-adult is in coastal waters. Mustafa and Abdullah (2013) noted that crabs in Soropia District, Konawe Regency at a depth of more than 15 m have larger carapaces that are included in the adult category. Adult crabs can live in waters with a depth of up to 40 m (Kangas, 2000).

Table 1. Blue swimming crabs (*P. pelagicus*) sampled on the East Coast of Pangandaran

Sex and life stage	n	Measurements (cm)		
		x̄ ± SD	Min	Max
Male adults	8	14,22 ± 1,07	12,6	15,7
Female juveniles	1	11,6	-	-
Female adults	7	13,72 ± 1,15	12,3	15,2

The blue swimming crab is bright blue with white spots on males and greenish blue with white spots on females as shown in **Figure 1**. The color of the male swimming crab looks more striking and brighter than the female crab with longer carapace endspines. According to Setiyowati (2016) in a study in Jepara Regency, male swimming crabs have a blue base with bright white spots while females have a dirty green base with dirty white spots.



(a) (b) (c) (d)

FIGURE 1 Morphology of blue swimming crabs; (a) female ventral view, (b) female dorsal view, (c) male ventral view, and (d) male dorsal view.

The relationship between carapace width and gut weight

The coefficient of determination (R^2) of the linear regression analysis is 0.631 (Figure 2). This indicates that 63.1% proportion of variance in the gut weight that can be explained by the carapace width. A correlation coefficient value (r) of 0.794 was obtained, indicating a strong relationship between carapace width and gut weight (**Figure 2**). A positive r value according to Supranto (2008) indicates that the two variables have a unidirectional relationship, so that if there is an increase in carapace width, the gut weight will also increase. Therefore, it can be seen that one of the factors that affects the gut weight is the width of the crab carapace. According to Erlinda et al., (2016), crabs show a strong and positive coefficient of determination between gut weight and carapace width where the value of $R^2 = 0.764$ is obtained, which means that the gut weight will increase along with the increase in the width of the carapace. The increase in gut weight along with the width of the carapace shows that adult crabs require more forage than juveniles and young crabs, because more energy is needed for growth, survival and reproduction (Sara et al., 2007).

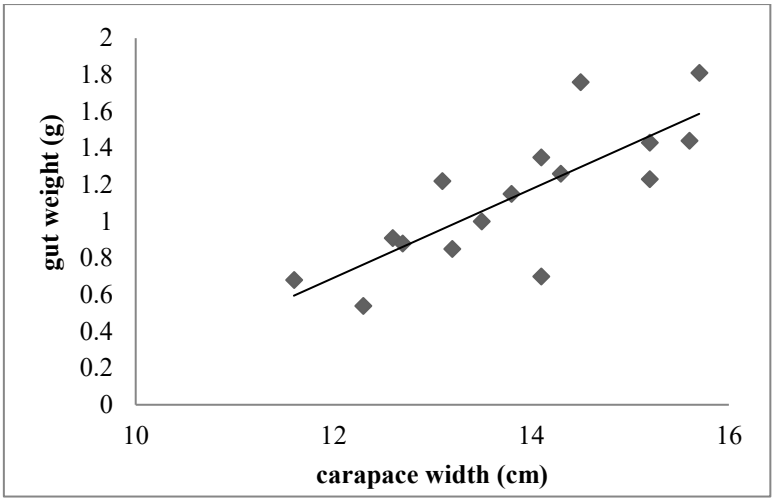


FIGURE 2. Relationship between carapace width (cm) and gut weight (g); y = 0,242x - 2,2116, R^2 = 0,6319, r=0,7949, n=16

Forage composition percentage

This study reveals 6 types of forage: inorganic components, meat, molluscs, crustaceans, fish and unidentified material (UM). **Figure 3** shows that the largest percentage of forage composition is crustaceans (28.35%), followed by flesh animal tissue (25.37%), molluscs at 18.65%, fish at 15.67%, inorganic components at 7.46%, and UM at 4.47%. This was also found by Josileen (2011) in the waters of Mandapam in India that the composition of crab food consists of 5 types of forage (crustaceans, fish, molluscs, unidentified materials and non-organic material/debris). Based on the this results, crabs consume slow-moving invertebrates such as crustaceans, molluscs, and also consume carcasses such as flesh animal tissue (meat). This shows that crabs are carnivores and scavengers (eating carcasses of living creatures) that consume forage based on the presence of their forage in waters. Our results are consistent with some existing research such as conducted by Zainal (2013) in the waters of Bahrain; William (1982) in the waters of Moreton Bay; and Chande & Mgaya (2004) in the waters of Dar es Salaam, all of which showed that based on the composition of its food, crabs are carnivores and scavengers and rarely consume fast moving organisms.

Crustaceans are the main forage for crabs (28.25%), in accordance with Sukumaran and Neelakantan (1997) who found that crabs in Mangalore waters consume a lot of crustaceans and Josileen (2011) in the Mandapam Region, Tamil Nadu, along the east coast of India. William (1982) stated that crustaceans are foods rich in calcium, usually consisting of a large number of hermit crabs, and a small number of amphipods, tanaids, small brachyurans and barnacles. The second forage composition is fleshy animal tissue in the form of unidentified white fiber clumps most probably from fish, crustaceans or molluscs (25.37%). According to Tuda (2005), adult crabs eat flesh by crushing their prey using their claws and putting the flesh directly into their mouths. Furthermore, molluscs were also found in the gut of the crab (18.65%).

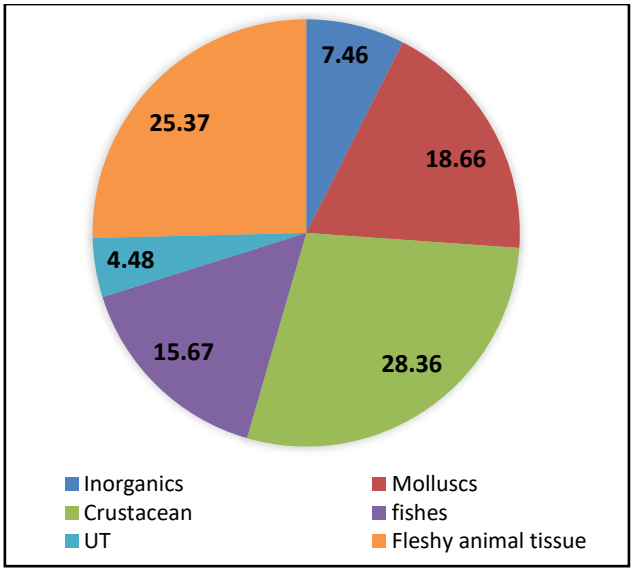


FIGURE 3. Blue swimming crab forage composition percentage (%)

Molluscs are important forage in every crab habitat, both in the juvenile and adult categories besides crustaceans and fish (William, 1982; Josileen, 2011). This was also noted by Ikhwanuddin et al. (2014) that crabs consume a lot of marine animals such as decapods, gastropods, and bivalves based on the analysis of fatty acid concentrations in the crab's foregut. Another type of forage found in the crab's gut is fish. The pieces of spines and scales found were identified as fish remains. Most crabs are feeder of benthic invertebrates, usually sessile or slow-moving animals, so that sometimes fish component in gut content are usually few. The presence of fish in gut content is likely due to the crab's scavanging acivity toward dead fishes or other large animals, instead of as predatory activities (Chande and Mgaya, 2004). Inorganic components were also found in the crab's gut with the smallest percentage (7.46%). In some species of crabs, synthetic fibers were found in their guts, which are thought to have come from fishing nets. According to Zainal (2013), broken glass, plastic, and nylon can indicate the presence of pollutants originating from the bottom sediment where the crabs were caught while feeding. Crab feeding activities usually occur at night, especially when the light intensity on the surface is low, but sometimes when they are not active, crabs tend to bury themselves in the sediment so that several inorganic components are found in the crab gut (Puspito, 2011). In addition, the discovery of inorganic components can also indicate that crabs have non-selective eating habits (Haputhantri et al., 2022). In this study these components are represented in inorganic (7.46%) and UM (4.77%).

Males and females are observed to have the same type of forage composition (Figure 4); consisting of crustaceans, fleshy animal tissue, molluscs, fish and UM. However, in females, no type of forage in the form of inorganic components was found. According to Zainal (2013), there is no significant difference between males and females

in forage selection, this indicates that the availability of forage for these organisms is always available in the waters.

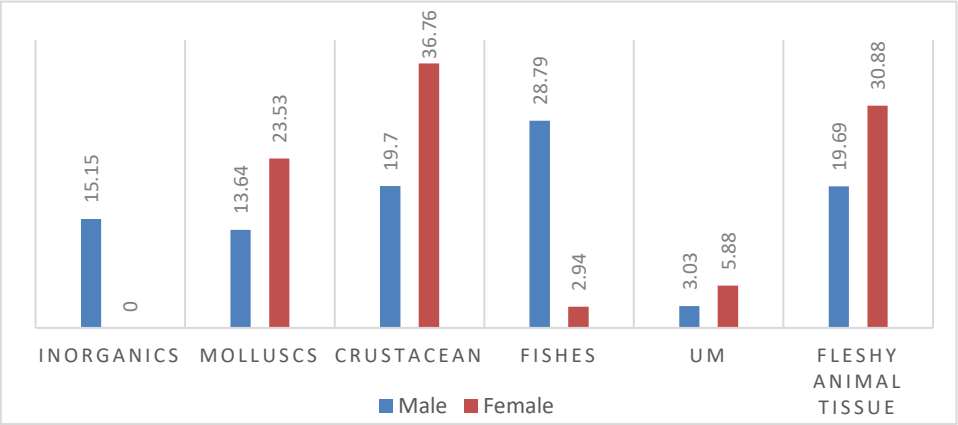


FIGURE 4. Forage composition percentage based of crab sexes.

However, there is a difference in the percentage of forage composition between males and females. In males, the composition of forage includes molluscs, crustaceans, fleshy animal tissue and UM is lower than in females, while fish is the only higher in males. This indicates that females consume more forage in almost every forage category. Kunsook et al. (2014) stated that there was no difference between the types of forage for male and female, but in the female gut, more food was found than in the male gut. This may be due to the higher energy requirement, as females need to produce eggs.

CONCLUSIONS

There is a relationship between the carapace width and gut weight, signifying gut contents is related to body size. The blue swimming crabs are carnivorous-scavenger with natural forage consisted of crustacean (28,35%), fleshy animal tissue (25,37%), molluscs (18,65%), fishes (15,67%), dan unidentified matters (4,47%). Gut content in females are mostly higher than in male, probably due to higher energy requirement.

AUTHOR CONTRIBUTIONS

SD, DMM: project conception; SD, DMM: methodology; SD, DMM: data analyses; SD: original manuscript draft; SD: manuscript review and editing.

ACKNOWLEDGEMENT

Thank you to the Balai Besar Konservasi Sumber Daya Alam (BBKSDA) Jawa Barat for giving us permission to carry out research at East Coast of Pangandaran Beach, our field study team, KKL 2019, and fishers of East Coast of Pangandaran Beach and many others who assisted and facilitated us in this research.

CONFLICTS OF INTEREST STATEMENT

There are no conflicts to declare.

DISCLOSURES AND ETHICS

As a requirement of publication author(s) have provided to the publisher signed confirmation of compliance with legal and ethical obligations including but not limited to the following: authorship and contributorship, conflicts of interest, privacy and confidentiality and (where applicable) protection of human and animal research subjects.

REFERENCES

Budiaryani, N. R. (2007). *Kajian Perikanan Rajungan Di Perairan Semarang.* Semarang: Balai Besar Pengembangan Penangkapan Ikan.

Chande, A. I. & Mgaya, Y. D. (2004). Food Habits of the Blue Swimming Crab Portunus pelagicus along the Coast of Dar es Salaam, Tanzania. *West Indian Ocean J. Mar. Sci*, 3(1), 37-42. https://www.ajol.info/index.php/wiojms/article/view/28443/22090

Cumberlidge, N. (1999). *The Freshwater Crabs of West Africa (Family Potamounautidae)*. Paris: Institut de Recherche Pour le Development.

Erlinda, S., Sara, L., & Irawati, N. (2016). Makanan Rajungan (Portunus pelagicus) di Perairan Lakara Kabupaten Konawe Selatan, Sulawesi Tenggara. *Jurnal Manajemen Sumber Daya Perairan*, 1(2), 131-140. http://ojs.uho.ac.id/index.php/JMSP/article/view/2462/1815

Ernawati, T., M. Boer, dan Yonvitner. 2014. Biologi populasi rajungan (Portunus pelagicus Linnaeus) di perairan sekitar wilayah Pati, Jawa Tengah. *Bawal*, 6(1):31-40. http://dx.doi.org/10.15578/bawal.6.1.2014.31-40

Haputhantri, S., Bandaranayake, K., Rathnasuriya, M., Nirbadha, K., Weerasekera, S., Athukoorala, A., Jayathilaka, R., Perera, H., Creech, S. (2022). Reproductive Biology and Feeding Ecology of The Blue Swimming Crab (*Portunus pelagicus*) in Northern Coastal Waters, Sri Lanka. *Trop Life Sci Res.* 33(2):155-178. https://doi.org/10.21315%2Ftlsr2022.33.2.8

Ikhwanuddin, M., Liyana, A. N., Azra, N., Bachok, Z., & Abol-Munafi, A. B. (2014). Natural Diet of Blue Swimming Crab, Portunus pelagicus at Strait of Tebrau, Johor, Malaysia. *Sains Malaysia*, 43(1), 37-44. http://www.ukm.edu.my/jsm/pdf_files/SM-PDF-43-1-2014/05%20M.%20Ikhwanuddin.pdf

Ingles, J.A. (1992). Natural diet of the commercial blue swimming crab Portunus pelagicus, in Ragay Gulf, Philippines. In: Alcala AC, McManus LT, editors. *Proceedings of the First National Symposium in Marine Science*. Quezon City: Marine Science Institute, University of the Philippines

Josileen, J. (2011). Food and feeding of the blue swimmer crab Portunus pelagicus (Linnaeus, 1758) (Decapoda, Branchyura) along the coast of Mandapam, Tamil Nadu, India. *Crustacean.* 84(10), 1169-1180. http://dx.doi.org/10.1163/001121611X590111

Kangas, M. I. (2000). Synopsis of the biology and exploitation of the blue swimmer crab, Portunus pelagicus Linnaeus, in Western Australia. Fisheries Western Australia, Perth, Western Australia. *Fisheries Research Report.* 121. https://www.fish.wa.gov.au/Documents/research_reports/frr121.pdf

Kunsook, C., Gajaseni, N., & Paphavasit, N. (2014). The fedding ecology of the blue swimming crab Portunus pelagicus (Linnaeus, 1758) at Kung Krabaen Bay, Chanthaburi Province, Thailand. *Trop. Life. Sci. Res*. 25(1), 13-27. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4156471/pdf/tlsr-25-1-13.pdf

Mustafa, A. dan Abdullah. (2013). Strategi Pengaturan Penangkapan Berbasis Populasi dengan Alat Tangkap Bubu Rangkai pada Perikanan Rajungan: Studi Kasus di Perairan Kabupaten Konawe Sulawesi Tenggara. *Aquasains*. 45-52. https://jurnal.fp.unila.ac.id/index.php/JPBP/article/view/195/197

Nugraheni, D.I., Fahrudin, A., dan Yonvitner. 2015. Variasi Ukuran Lebar Karapas dan Kelimpahan Rajungan (*Portunus pelagicus* Linnaeus) di Perairan Kabupaten Pati. *Jurnal Ilmu dan Teknologi Kelautan Tropis* 7(2):493-510. https://journal.ipb.ac.id/index.php/jurnalikt/article/view/10996/8763

Nurhayati, A. (2013). Analisis Potensi Lestari Perikanan Tangkap di Kawasan Pangandaran. *Jurnal Akuatika*. 4(2), 195-209. https://jurnal.unpad.ac.id/akuatika/article/view/3143/2404

Puspito, G. 2011. Jenis Umpan dan Bentuk Perangkap Platik yang Efektif Untuk Menangkap Rajungan. *Marine Fisheries.* 2(2): 111-119. https://doi.org/10.29244/jmf.2.2.111-119

Prasetyo, G.D., A.D.P. Fitri, dan T. Yulianto. 2014. Analisis daerah penangkapan rajungan (Portunus pelagicus) berdasarkan perbedaan kedalaman perairan dengan jaring arad (mini trawl) di Perairan Demak. *J. Fisheries Resources Utilization Management and Technology*, 3(3):257-266. https://ejournal3.undip.ac.id/index.php/jfrumt/article/view/5607

Sara, L. Aguilar, R. O., Laureta, L. V., Baldevarona, R. B., & Ingles, J. A. (2007). The Natural Diet of the Mud Crab (Scylla serrata) in Lawele Bay, Southeast Sulawesi, Indonesia. *The Philippine Agricultural Scientist*, 90(1):6-14. https://www.researchgate.net/publication/288469346_The_natural_diet_of_the_mud_crab_Scylla_serrata_in_Lawele_bay_Southeast_Sulawesi_Indonesia

Setiyowati, D. (2016). Kajian Stok Rajungan (Portunus pelagicus) di Perairan Laut Jawa, Kabupaten Jepara. *Jurnal Disprotek*. 7(1), 84-97. https://doi.org/10.34001/jdpt.v7i1.363

Sholeh, K. 2018. *Kinerja Ekspor Produk Perikanan Indonesia Tahun 2018* [Online]. Tersedia di: https://kkp.go.id/djpdspkp/artikel/7947-kinerja-ekspor-produk-perikanan-indonesia-tahun-2018 (Diakses pada tanggal 15 Oktober 2019).

Suharyanto. (2008). Polikultur Rajungan (Portunus pelagicus) dan Ikan Baronang (Siganus siganus) di Tambak. *Jurnal Perikanan (J. Fish. Sci.).* 10(2), 167-177. https://jurnal.ugm.ac.id/jfs/article/viewFile/8883/6731

Sukumaran, K. K. & Neelakantan, B. (1997). Food and feeding of Portunus (Portunus) sanguinolentus (Herbst) and Portunus (Portunus) pelagicus (Linnaeus) along the Karnataka coast. *Indian Journal of Marine Science*. 26(1), 35-38. https://core.ac.uk/download/pdf/33018349.pdf

Supranto, J. 2008. *Statistika Teori dan Aplikasi*, 7th ed.. Jakarta: Erlangga.

Susanto B., M. Marzuqi, I. Setyadi, D. Syahidah, G. N. Permana & Haryanti. (2004). Pengamatan aspek biologi rajungan (Portunus pelagicus), dalam menunjang teknik perbenihannya. *Warta Penelitian Perikanan Indonesia*. 10(1), 6-11.

Tahmid, M., Fahrudin, A., dan Wardiatno, Y. 2015. Kualitas Habitat Kepiting Bakau (Scylla Serrata) pada Ekosistem Mangrove Teluk Bintan, Kabupaten Bintan, Kepulauan Riau. *Jurnal Ilmu dan Teknologi Kelautan Tropis*, 7(2), 535-551. https://media.neliti.com/media/publications/98904-ID-none.pdf

Tuda, M. D. (2005). *Teknik Pemeliharaan Induk Rajungan (Portunus pelagicus) Matang Gonad.* Balai Budidaya Air Payau Desa Bontoloe Kecamatan Galesong Selatan Kabupaten Takalar Sulawesi Selatan.

William, M. J. (1982). Natural Food and Feeding in the Commercial Sand Crab Portunus pelagicus (Linnaeus, 1766) in Moreton Bay, Queensland. *J. Exp. Mar. Biol. Ecol.* 59, 165-176. https://doi.org/10.1016/0022-0981(82)90113-7

Zainal, K. A. Y. (2013). Natural Food and Feeding of the Commercial Blue Swimmer Crab, Portunus pelagicus (Linnaeus, 1758) along the coastal waters of the Kingdom of Bahrain. *Journal of the Association of Arab Universities for Basic and Applied Sciences.* 13, 1-7. https://doi.org/10.1016/j.jaubas.2012.09.002