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Chemical oceanographic analysis of bills (*Portunus pelagicus*) habitat in coastal waters of Pangkep District

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Abstract
Blue swimming crab (*Portunus pelagicus*) is one of the crustaceans which is included in one of the world's fisheries commodities that has high economic value both at home and abroad. Environmental factors and the quality of the waters where the crabs live can affect the growth rate of the crabs. This study aims to examine the chemical quality of oceanography in the natural habitat of swimming crabs in the coastal waters of Pangkep Regency which was carried out from June to July 2023 in the coastal areas of Pangkep Regency. This study uses a descriptive survey method with random sampling. Research shows that water temperature, salinity, pH, Total Dissolved Solids (TDS), phosphate, and nitrate affect crab reproduction in the aquaculture area of Bulumanis Kidul Village. The water temperature range at the study site is 28.9°C to 33.5°C. Salinity ranged from 21.6 - 29.1 ppt, pH between 7.2 - 7.9, TDS between 19.7 - 28 mg/L, phosphate 0.0040 - 0.0289 mg/L, and nitrate 0.003 - 1.597 mg/L.

Keywords: Blue swimming crab, Chemical Parameters, Temperature, Salinity, pH, TDS, Phosphate, Nitrate

Introduction

Pangkajene and Islands Regency (Pangkep) has a characteristic with its territorial waters which are wider than its land, with a ratio of 1:17. In this region, there are 117 islands, and of these, 80 islands are inhabited by residents. These islands are divided into 3 districts, namely Liukang Tupabbiring, Liukang Kalmas, and Liukang Tangaya Districts. Marine wealth in Pangkep Regency is very abundant, and one of its potentials is the blue swimming crab (*Portunus pelagicus*).

Blue swimming crab (*Portunus pelagicus*) is included in the category of Class *Crustacea* and is a creature that lives on the seabed, but sometimes swims close to the surface of the sea in search of food. Because of this behavior, this animal is also known as the Blue Swimming Crab (Mawaluddin *et al*., 2016) [6]. Blue swimming crab is also a fishery commodity that has high economic value in Indonesia, where around 60% of the catch is exported abroad (Sidauruk, 2015) [10].

Blue swimming crabs can be found living in various types of habitats, including fish ponds in coastal waters that get an adequate supply of seawater. These animals can be found at varying water depths, around 0 to 60 meters. The basic substrate of the crab habitat is very diverse, ranging from coarse sand, fine sand, a mixture of sand and silt, to seagrass-covered waters.

Factors that influence the growth of an organism include the growing medium, water quality, and feed quality. In crab seeds, the growing media is a critical factor, especially the substrate, because when entering the seed phase, the crab seeds fully live in the rearing medium by immersing their bodies into the substrate. Therefore, the substrate has a significant impact on the survival rate and metabolic processes of the crab seeds. The bottom quality of waters, including their composition and structure, also plays an important role in determining the conditions in which organisms live.

Research purposes

Based on the description of the problem formulation, this study has several objectives as follows;

1. To be able to study the chemical factors of oceanography in the habitat of blue swimming crab (*Portunus pelagicus*) in the coastal waters of Pangkep Regency.

Research methods

This research was conducted in June - July 2023 in the coastal area of Pangkep Regency. (Figure 1).

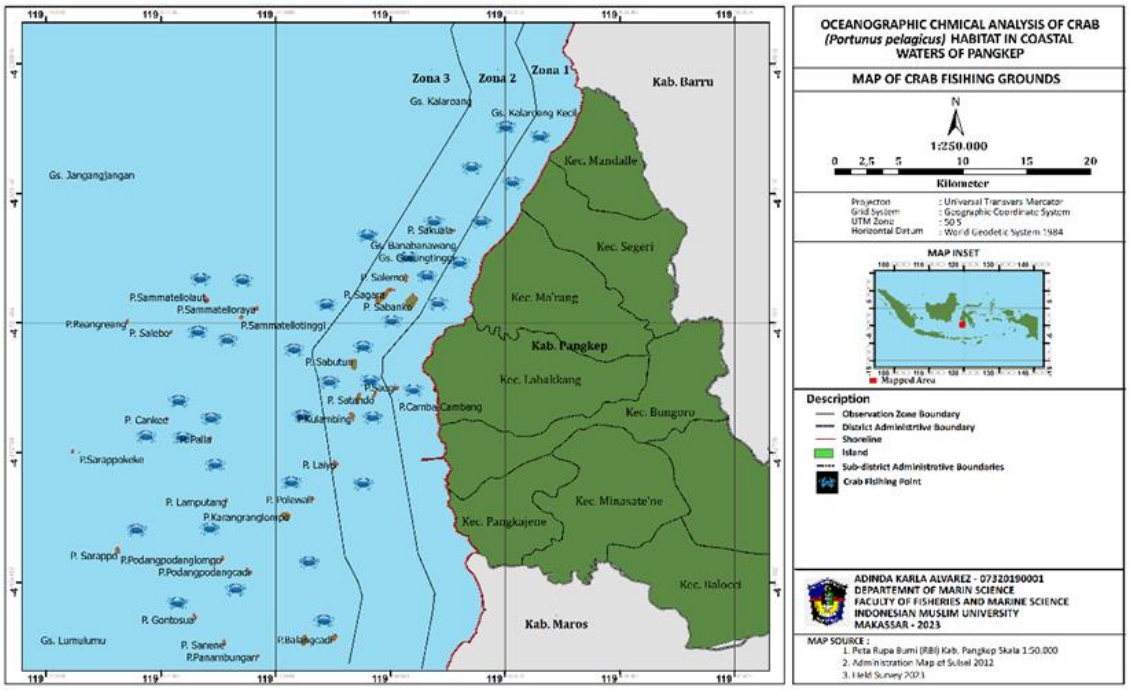

Fig 1: Observation Location Map

To observe the quality of Oceanographic Chemistry, water samples were taken which included measurements of salinity, temperature, pH, Total Dissolved Solids (TDS), Nitrate and Phosphate. Measurements of salinity, pH, temperature, and TDS were carried out on site (in situ). However, for Nitrate and Phosphate measurements, it is necessary to take water samples using a special container and then take them to the laboratory to get the desired analysis results. Determination of the location of the observation was carried out using the participatory fishing ground mapping method, which is based on information from fishermen who are experienced and have carried out fishing activities for quite a long time (Pratiwi *et al*. 2014) [12, 13].

Data analysis

The results of the data were then analyzed descriptively to then be compared using previous research data.

Table 1: Determination of Suitability Category for Chemical Parameters of Crab Habitat

Parameter	Conformity Category			References
	Perfect fit	In accordance	It is not in accordance with	
Temperature (°C)	28-31	26 – 28 and 31 -33	<26 and >33	Courtesy (2015)
Salinity (ppt)	31-36	29-31 and 36-38	<29->33	Courtesy (2015)
pH	6.78 – 8.0		<6 - >8.5	Courtesy (2015)
TDS (mg/L)	0 - 500	500 - 1000	>1000	Effendi (2003)
Nitrates (mg/L)	0.25 – 0.66	0.66 – 1.5	>1.5	Iskandar (2002) in Agus (2008)
Phosphate (mg/L)	0.01 – 0.16	0.06 – 1.2	>1,2	Winanto (2004) in Agus (2008)

***Source*:** Rahimah *et al*. – Suitability of Crab Catching Areas

Results and Discussion

Based on the results of measurements and observations of the chemical quality of oceanographic crab habitat carried out at 25 points, it appears that there is a significant difference between the three habitat zones that have been observed.

In-situ Observation of Water Quality

The data on the results of in-situ water quality measurements in the coastal waters of Pangkep district can be seen in Table 2.

Table 2: In-situ oceanographic chemical measurement results

	Station	Observation Point		Temperature (°C)	Salinity (ppt)	pH	TDS (mg/L)
		Latitude	Longitude				
zone 1	1	04°37′14.26″ S	119°32′54.23″ E	30	27.5	7,5	24
	2	04°37′15.30″ S	119°32′37.38″ E	29.5	27,9	7,9	22,9
	3	04°37′55.05″ S	119°32′30.05″ E	29	28	7,8	27,8
	4	04°38′07.74″ S	119°32′48.32″ E	30	27,7	7,7	27,7
	5	04°38′25.76″ S	119°32′39.07″ E	31	27	7,2	28
	6	04°38′23.88″ S	119°32′52.48″ E	30	27,9	7,8	27,7
	7	04°44′45.29″ S	119°28′23.07″ E	30	22.5	7,2	19,7
	8	04°47′00.77″ S	119°28′50.44″ E	33.5	28,2	7,6	23.5
Zone 2	1	04°39′43.31″ S	119°29′39.64″ E	29	29	7,9	23.5
	2	04°40′18.11″ S	119°29′57.90″ E	29,4	29	7,9	23,8
	3	04°40′16.18″ S	119°29′10.17″ E	29,2	28,1	7,7	22,7
	4	04°41′08.91″ S	119°29′31.28″ E	30	28,9	7,9	23.5
	5	04°42′07.21″ S	119°27′51.83″ E	30.5	29,1	7,8	23,7
	6	04°43′18.30″ S	119°28′32.35″ E	29.5	21,6	7,8	18,2
	7	04°43′56.05″ S	119°27′24.31″ E	29,8	29.5	7,9	23,7
	8	04°44′11.94″ S	119°25′34.69″ E	30	28,6	7,8	23
	9	04°44′55.13″ S	119°26′49.27″ E	31	28.5	7,9	22,8
	10	04°45′49.99″ S	119°27′25.79″ E	30	29.3	7,8	23,9
	11	04°46′01.38″ S	119°28′26.91″ E	29,6	23,3	7,2	18,6
	12	04°46′47.00″S	119°28′03.08″ E	29,6	29,1	7,7	23,6
	13	04°47′30.54″ S	119°28′24.43″ E	29,8	28,9	7,8	23,6
zone 3	1	04°43′07.64″ S	119°24′26.34″ E	29,8	26,7	7,9	22.5
	2	04°46′18.26″ S	119°23′05.47″ E	29	28.5	7,8	23,8
	3	04°46′33.64″ S	119°21′21.68″ E	28,9	29	7,8	22,8
	4	04°48′06.10″ S	119°20′33.59″ E	29	28,8	7,8	23.5

Temperature

According to research conducted by Nugraheni *et al*. in water temperature was the main environmental factor affecting blue swimming crab (*Portunus pelagicus*) reproduction. This study shows that water temperature plays an important role in regulating the reproductive process of blue swimming crab species. Changes in water temperature can affect the reproductive cycle, egg development, and growth of crabs. Therefore, suitable water temperature conditions strongly support the continuity of reproduction and the successful development of blue swimming crab populations. The water temperature obtained at the research location can be seen in table 1.

Based on the data contained in Table 1, it is known that the temperature range in each crab habitat zone ranges from 28.9°C to 33.5°C. The highest water temperature was recorded at station 8 Zone 1, while the lowest temperature was recorded at station 3 Zone 3.

According to research by Rahimah *et al* in high water temperatures can be caused by runoff of river water which tends to be warmer than the parts affected by water masses from deeper open waters. Therefore, the temperature range in zone 1 tends to be higher than that in zones 2 and 3, because zone 1 is located closer to the river flow which affects the water temperature in the region. Based on the suitability category for the crab catching area made by Rahimah *et al* the temperature in Zone 1 with a range of 29.0°C – 33.5°C is still in the appropriate category, for zone 2 with a temperature range of 29.0°C – 31.0°C it is included in the very suitable category, as well as zone 3 with a temperature range of 28.9°C-29.

Salinity

Salinity is one of the environmental parameters that has a significant impact on biological processes, and directly affects living organisms. Salinity affects many aspects, including growth rate, amount of food consumed, feed conversion rate and survival of aquatic organisms. Changes in salinity also affect the physiological characteristics and body structure of organisms, the activities of organisms, and can affect the frequency of molting and growth in crustacean size (Jumaisa *et al*).

The measured water salinity in this study was in the range of 21.6 – 29.1 ppt, Juwana *et al* showed that blue swimming crab can live at a salinity of 11 - 53 ppt. Nicholas Romano and Chaoshu Zeng (2006) [9] said that salt content significantly affects the survival and early growth of young crabs. Mortality was significantly higher ($p < 0.01$) for juvenile crabs reared at salinity ≤ 15 ppt and at 45 ppt.

pH (Degrees of Acidity)

The pH concentration has an influence on the distribution of fertility in the waters because it has an impact on the life of micro-organisms. Waters with high acidity tend to cause fish death. This phenomenon is caused by the low concentration of oxygen in the water, which results in high respiratory activity and reduced appetite.

The results of pH measurements carried out at 25 observation points showed that the lowest pH value recorded was 7.2, while the highest pH value was 7.9. So that it can be said that the pH of crab habitat on the coast of the Pangkep area is in the appropriate category for crab growth, this is based on Ihsan's research (2015) [3] that the pH value supports the growth and development of marine organisms, especially crabs for all phases, namely the range of 6.0 to 8.0.

Total Dissolved Solids (TDS)

TDS in waters is overflow from agriculture, household and industrial waste. Changes in Total Dissolved Solid (TDS) concentrations can be dangerous because they will cause changes in salinity, changes in ionic composition, changes in turbidity and clarity of seawater, and the toxicity of each ion.

(Weber-Scannel and Duffy, 2007) [15]. According to Herna (2014) [7] high concentrations of TDS can also reduce water clarity or in other words increase water turbidity which will further inhibit the penetration of sunlight into the water column and ultimately affect the process of photosynthesis in the waters. Based on observations, the TDS values in Zone 1 ranged from 19.7 – 28mg/L for zone 2, ranging from 18.2 – 23.9mg/L while those for zone 3 tended to be more stable with a range of TDS values of 22.5 – 23.8mg/L.

From the Environmental Protection Agency (EPA) USA in (Tanto *et al*, 2018) [14], suggests that the maximum level of TDS contaminants is 500 mg/liter (500 ppm), while the ideal value of a water reaches 50 mg/L (Tanto *et al*, 2018) [14]. So that the TDS value obtained in the coastal area of Pangkep Regency is in the very suitable category for the sustainability of the blue swimming crab.

Laboratory Result Data

DO, Nitrate and Phosphate measurements were carried out by taking water samples to be observed in the laboratory, while the results of the observations can be seen in Table 3.

Table 3: Observations on Nitrate and Phosphate

	Station	Observation Point		Phosphate (mg/L)	Nitrate (mg/L)
		Latitude	Longitude		
zone 1	1	04°37′14.26″ S	119°32′54.23″ E	0.029	1.115
	2	04°37′15.30″ S	119°32′37.38″ E	0.023	0.04
	3	04°37′55.05″ S	119°32′30.05″ E	0.016	0.044
	4	04°38′07.74″ S	119°32′48.32″ E	0.008	0.133
	5	04°38′25.76″ S	119°32′39.07″ E	0.014	0.378
	6	04°38′23.88″ S	119°32′52.48″ E	0.016	0.009
	7	04°44′45.29″ S	119°28′23.07″ E	0.017	0.453
	8	04°47′00.77″ S	119°28′50.44″ E	0.008	0.007
Zone 2	1	04°39′43.31″ S	119°29′39.64″ E	0.027	1,597
	2	04°40′18.11″ S	119°29′57.90″ E	0.004	0.009
	3	04°40′16.18″ S	119°29′10.17″ E	0.007	0.01
	4	04°41′08.91″ S	119°29′31.28″ E	0.004	0.016
	5	04°42′07.21″ S	119°27′51.83″ E	0.008	0.08
	6	04°43′18.30″ S	119°28′32.35″ E	0.004	0.005
	7	04°43′56.05″ S	119°27′24.31″ E	0.007	0.024
	8	04°44′11.94″ S	119°25′34.69″ E	0.01	0.053
	9	04°44′55.13″ S	119°26′49.27″ E	0.005	0.003
	10	04°45′49.99″ S	119°27′25.79″ E	0.007	0.005
	11	04°46′01.38″ S	119°28′26.91″ E	0.007	0.012
	12	04°46′47.00″S	119°28′03.08″ E	0.028	0.014
	13	04°47′30.54″ S	119°28′24.43″ E	0.004	0.255
zone 3	1	04°43′07.64″ S	119°24′26.34″ E	0.026	0.026
	2	04°46′18.26″ S	119°23′05.47″ E	0.023	0.023
	3	04°46′33.64″ S	119°21′21.68″ E	0.016	0.016
	4	04°48′06.10″ S	119°20′33.59″ E	0.021	0.021

Phosphate

Phosphates in waters have a vital role in determining the fertility of these waters. When phosphate levels are maintained within normal limits, Jakarta Bay can be said to have good conditions to support marine life (Simanjuntak 2007) [11]. However, like any other nutrient, phosphate can cause problems if taken in excess. Therefore, regular monitoring of phosphate levels and prudent management are necessary to maintain ecosystem harmony and prevent negative impacts such as eutrophication.

Based on the results of observations at water crab habitat locations, phosphate concentrations were found in the range of 0.0040 – 0.0289mg/L. With this it can be said that the observation site has a fairly good fertility rate, this is evidenced by data sourced from Hakanson and Brayann (2008) [2] which says that phosphate with tilapia <0.015 is low, 0.015 - 0.040 is sufficient, 0.40 - 0.13 is good and >0.15 is hypertrophic.

Nitrate

Nitrate concentrations at the study sites were in the range of 0.003 to 1.597 mg/L. In zone 1, nitrate concentrations tend to be higher than those in zones 2 and 3, because zone 1 still receives the influence of organic matter inputs from the mainland. Nutrients or nutrients have a very important role in maintaining the fertility of waters, especially related to the primary productivity of waters. Primarily, nutrients in marine waters come from the influx of fresh water through streams, which carry with them various organic matter. In addition, nutrients also come from the processes of secretion and degradation of marine organisms.

The availability of nutrient concentrations in waters can have a positive or negative impact on marine organisms. If the richness of nutrients in accordance with the needs of organisms, it can provide benefits for their growth and reproduction. However, if nutrient levels are excessive, this can lead to problems such as algae blooms, which can lead to reduced oxygen levels in the water (eutrophication) and be detrimental to the marine ecosystem as a whole. Therefore, monitoring and managing nutrient levels in the waters is very important to maintain the balance of the marine ecosystem.

Substrate Type

Blue swimming crab is an organism that has a tendency to dive its body into the bottom substrate of the waters. Blue swimming crabs can be found in various types of substrate fractions. For example, Foka *et al*. (2004) [1] found that blue swimming crabs are more likely to be found in sandy mud

substrates, while a study by Yokes *et al* found the presence of blue swimming crab on a beach with a rocky substrate (gravel beach).

Most of the substrates found in Zone 1 consist of muddy sand while in Zone 2 it has a substrate with a predominance of silt and in zone 3 it has a sand type substrate. The high silt in zone 1 is caused by silt carried by the river flow.

Conclusion

Research shows that water temperature, salinity, pH, Total Dissolved Solids (TDS), phosphate, and nitrate affect crab reproduction in the aquaculture area of Bulumanis Kidul Village. The water temperature range at the study site is 28.9°C to 33.5°C. Salinity ranged from 21.6 - 29.1 ppt, pH between 7.2 - 7.9, TDS between 19.7 - 28 mg/L, phosphate 0.0040 - 0.0289 mg/L, and nitrate 0.003 - 1.597 mg/L. The results showed that the environmental conditions were suitable for the growth and survival of blue swimming crabs in the region. Blue swimming crabs tend to be found in sandy mud substrates in Zone 1 and on rocky beaches in Zone 3. So it can be concluded that the oceanographic chemical quality of crab habitat in Pangkep Regency tends to be suitable for crab growth.

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