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Species diversity and catch per unit effort (CPUE) of *Portunidae* in Batubara, North Sumatera, Indonesia

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Abstract. Crabs from the family of Portunidae are distributed widely in Indonesian waters, including the blue swimming crabs which has been exploited as a target species to meet the export demand and economic needs of the capture fisheries sector. Crab catches from Portunidae family makes a major contribution to marine fisheries production in Batubara Regency, North Sumatra, Indonesia. The purpose of this study was to analyze the species diversity and catch per unit effort (CPUE) of crabs of Portunidae family in January–March 2023 in Tanjung Tiram Waters, Batu Bara Regency, North Sumatra, Indonesia. The fishing area was located right across the Malacca Strait, which is congested with international shipping traffic. Data were obtained through observations and community interview. Catch per unit effort (CPUE) of crabs was analyzed. The results showed about five species of crab from the Portunidae family were caught, including *Portunus pelagicus*, *Scylla serrata*, *Charybdis feriata*, *Charybdis affinis*, and *Charybdis natator*. The average CPUE value of target species *Portunus pelagicus* was 8,8 kg/trip.

Keywords: CPUE; *Portunidae*; *Portunus pelagicus*; species diversity

1. Introduction

Batubara Regency is one of the regencies located in the coastal area of North Sumatra Province, which is geographically directly adjacent to the Malacca Strait. With a strategic position and an open access fishing system, this area allows fishing freely throughout the year; therefore, the majority of the population are fishermen, with various commodities ranging from various types of fish, shellfish, and also crabs, especially *Portunidae*.

The Portunidae group has a diversity of more than 500 species globally. Species of Portunidae are targeted in many fisheries activities such as aquaculture, recreation, and commercial fishing [1]. The distribution of blue swimming crab (*Portunus pelagicus*) can be traced from the oceanographic factors of the waters that have been carried out [2] and the condition of the depth of the waters [3]. At the trophic level, temperature and salinity affect the crab migration pattern in the waters [4]. This family of Portunidae is spread in Indonesian waters, and especially the abundance of blue swimming crabs is exploited to meet demand and as a target species for increasing the value of the capture fisheries sector.



The production of this catch tends to increase continuously throughout the year [5]. Portunidae are one of the catches that contribute a lot to the production of marine fisheries in Batubara Regency, North Sumatra.

One type of Portunidae that is often caught is the crab. The blue swimming crab (*Portunus spp.*) is a member of the crustacean family and is a potential commodity to be developed considering the price is quite expensive and has high economic value. The blue swimming crab is known by its scientific name, namely *Portunus pelagicus*, which has a high nutritional content. Swimming crab is also much loved by the public because it tastes good and is tasty. This is what makes blue swimming crab an export commodity whose demand always increases every year, causing a decrease in both the quantity and quality of the population [6]. In this condition, it is necessary to have supervision in terms of catching so that the stock remains sustainable. The open-access nature of ocean resources often results in irresponsible use or ignoring the preservation of resources because people think that they are free to take existing resources without anyone's control [7].

Until now, the high level of utilization and trading of blue swimming crabs has not been matched by knowledge on how to conserve these resources. This can result in a decrease in the stock of crab resources. Knowledge about how to conserve crab resources can include knowledge about the recruitment rate, the mortality rate, the right time to catch, what size is appropriate for catching, the size of the first gonad at maturity, and the characteristics of the habitat. Through this knowledge, fishery management can be developed that is not only oriented to production but also to ecosystems.

The catch per unit of fishing effort (CPUE; Catch per Unit Effort) is the number of fish obtained (number or weight) from a number of fishing efforts (efforts) in a certain time span. CPUE is used as an index of the abundance of a fish species in water, which means that a change in CPUE will be followed by a change in fish stocks in water.

2. Methods

2.1. Study Area

This research was conducted in January-June 2023 in the waters of Batubara Regency, North Sumatra, is one of the potential crab fishing areas in North Sumatra (Figure 1). The method used in this study was experimental fishing, where catch data were obtained from special crab fishermen using nets with a mesh size of 3.5 inches for 12 sets of fishermen, where each set was 100 m long by 1.5 m wide (Figure 2). These fishermen carry out their fishing activities only once a day, for a span of 5-7 hours. Fishermen mostly go to sea starting at midnight or sometimes following the high tide. If it's high tide, fishermen will go out to sea a little longer, around 02.00–04.00 WIB. Then, if the tide goes out, fishermen will go to sea sooner, around 00.00–03.00 WIB.

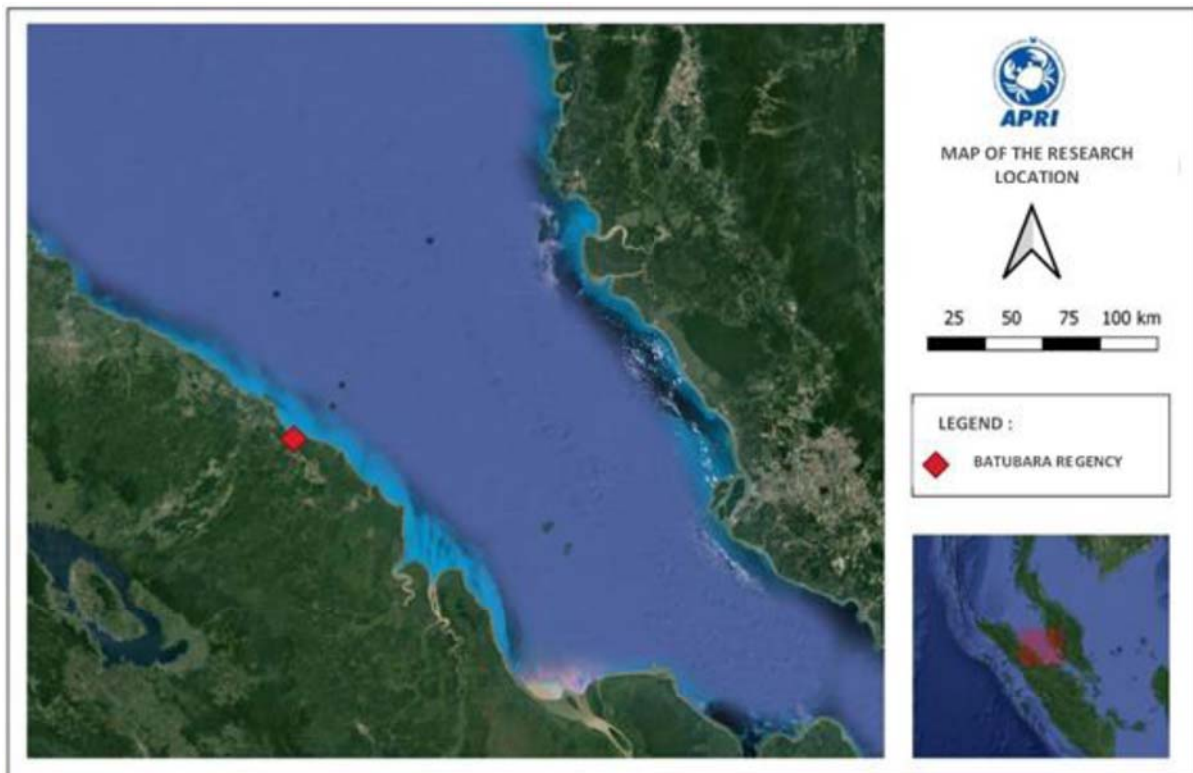


Figure 1. Map of research location in Batubara Regency, North Sumatra.

How to use the nets, usually these nets have been weighted or stoned so that the nets can sink and be stretched along the set of nets that each fisherman carries (Figure 2). The fishermen will wait at sea for 2-3 hours, then pull the nets back to the surface at a fishing distance. ground about 4–7 miles.



Figure 2. Ready-to-use nets by Fishermen (Source: Indonesian Blue Swimming Crab Association).

2.2. Data collection

A sampling of the catch was carried out by 30 fishermen who sold their catch to crab collectors in Mesjid Lama Village, Talawi District, Batubara Regency, North Sumatra. Sampling was carried out by special crab fishermen *Portunus pelagicus*, but there were also several species of Portunidae that were caught in the nets, which are then carried out for data analysis purposes.

2.3. Data Analysis

The research data obtained from the catches were then inputted and analyzed descriptive method data collection consists of primary data, where primary data is data obtained directly from the community through interviews and observations and the CPUE calculation aims to determine the abundance based on the division between the total catch and effort. According to Gulland in [8], the formula used is:

$$CPUE = \frac{Catch}{Effort}$$

CPUE was calculated using Microsoft Excel 2019. The diversity of the Portunidae will also be explained descriptively.

3. Results and Discussion

3.1. Species Diversity

The diversity of Portunidae species that have been found in the waters of Batubara Regency consists of *Portunus pelagicus* (Figure 3), *Scylla serrata* (Picture 4), *Charybdis feriata* (Figure 5), *Charybdis affinis* (Figure 6), and *Charybdis natator* (Figure 7). *Portunus pelagicus* is the main catch, and the others are bycatch or non-target catches that can be utilized, such as *Scylla serrata* and *Charybdis feriata*, while *Charybdis affinis* and *Charybdis natator* are catches that are not utilized.



Figure 3. *Portunus pelagicus*
(Source: Indonesian Blue Swimming Crab Association).



Figure 4. *Scylla serrata*
(Source: Indonesian Blue Swimming Crab Association).



Figure 5. *Charybdis feriata*
(Source: Indonesian Blue Swimming Crab Association).



Figure 6. *Charybdis affinis*
(Source: Indonesian Blue Swimming Crab Association).



Figure 7. *Charybdis natator*
(Source: Indonesian Blue Swimming Crab Association).

Table 1. Total sample dan average of CPUE in Portunidae species diversity.

Species	Total sample (ind.)						Average of CPUE (kg per trip)					
	Jan	Feb	Mar	Apr	May	Jun	Jan	Feb	Mar	Apr	May	Jun
<i>P. pelagicus</i>	2360	2514	2196	1892	2705	2155	23.96	22.03	14.88	22.81	33.87	31.65
<i>Scylla serrata</i>	24	17	20	15	14	18	0.28	0.19	0.23	0.17	0.17	0.21
<i>Charybdis feriata</i>	100	138	488	289	555	420	2.66	3.68	13.01	7.71	14.8	11.2
<i>Charybdis affinis</i>	899	1951	1609	1821	1712	1223	1.19	2.6	2.14	2.42	2.28	1.63
<i>Charybdis natator</i>	38	20	21	31	29	35	0.03	0.02	0.02	0.03	0.03	0.03

Table 1 and Figure 8 show that *Portunus pelagicus* is the catch with the highest total because it is the main type of catch by fishermen and because it has a fairly high selling value. In addition, *Charybdis*

affinis, although not the main catch, also has a fairly high total catch because it often gets caught in the nets of blue crab fishermen. This is what makes this species often regarded as "garbage" by fishermen because, besides having no economic value, it can also damage nets if caught in large quantities. Likewise, with *Charybdis natator*, this species does not get caught in fishermen's nets too much and is even classified as very rare. Species that are caught in fishermen's nets, are not the target of fishing, and have no economic value will be immediately returned by fishermen to the sea.

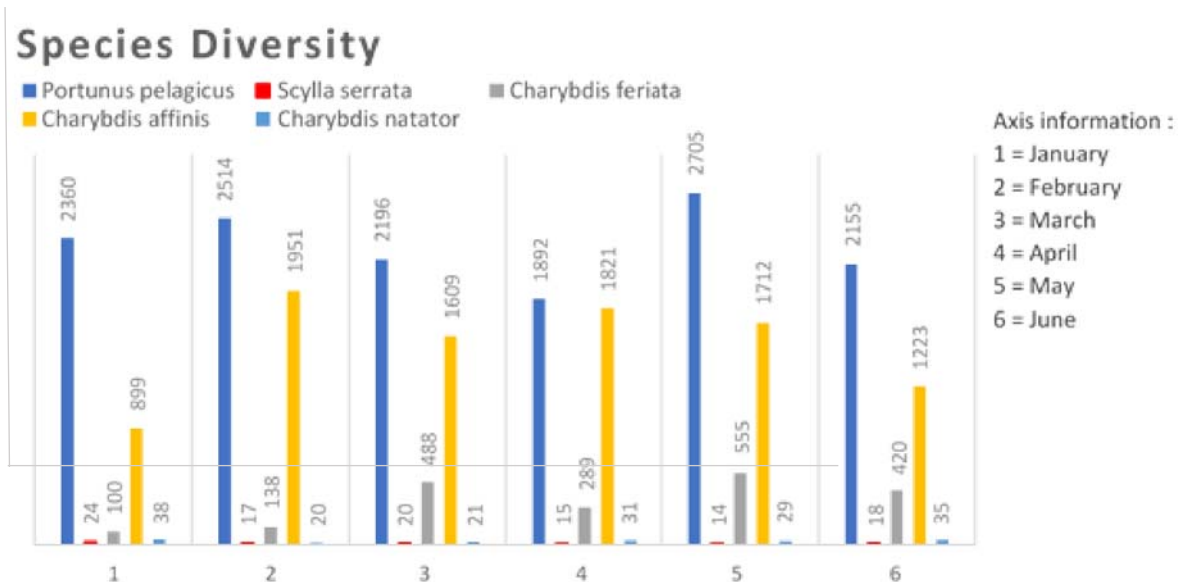


Figure 8. Graph total catches of Portunidae species during January–June 2023.

Scylla serrata and *Charybdis feriata* are also often caught in fishermen's nets, but not too many *Scylla serrata* species are found (Figure 8). The natural habitat of *Scylla serrata* is an area of brackish waters with a muddy bottom along the shoreline with lots of mangrove trees. This type of mud crab is only caught in the edge area, while the dominant crab fishermen have a fishing ground that is slightly more towards the center.

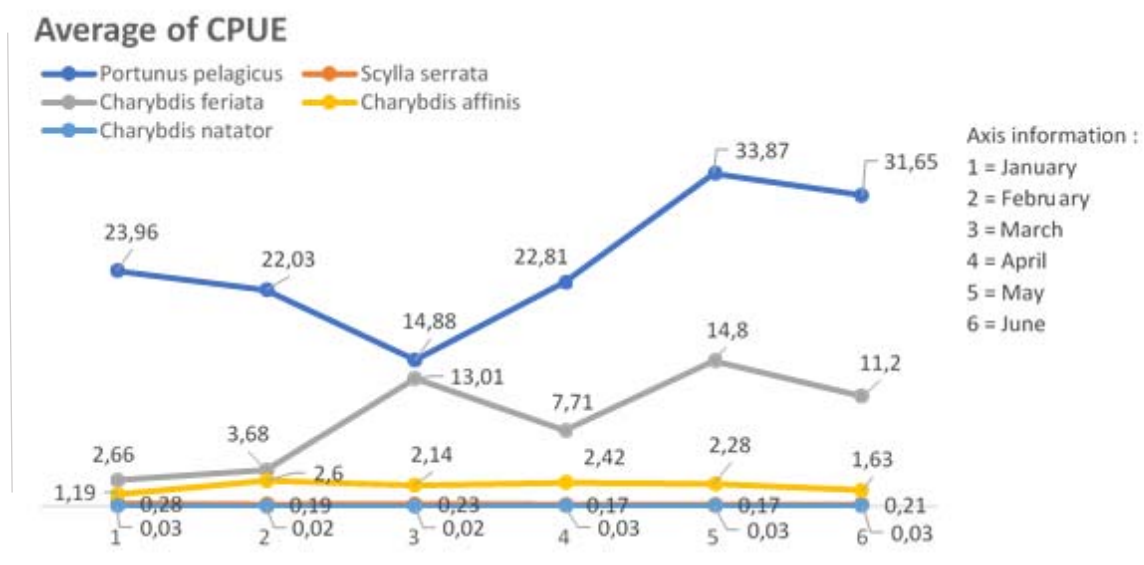


Figure 9. Graph of CPUE in Tanjung Tiram waters, Batubara.

Based on the research results, there are several types of Portunidae that are used. Like *Portunus pelagicus* which is the highest and most caught species because this species is the main target of fishing. Based on the landing data, which was then converted into graphical form above, it shows that the lowest catch occurred in March 2023 with a total of 14.88 kg/trip and then slowly increased in the following months. Then the highest catch occurred in May 2023, with a total of 33.87 kg per trip. This happens because of the change in season from the west (rain) to the east (dry). Apart from *Portunus pelagicus*, the type of Portunidae used is *Scylla serrata* with a relatively small number of catches, with the lowest yields occurring in April and May 2023 with a value of 0.17 kg/trip, while the highest yields occurred in January with a value of 0.28 kg/trip, and *Charybdis feriata* as the second highest type of response after blue swimming crab, with the highest catch occurring in May 2023 with a value of 14.8 kg/trip and the lowest in January 2023 with a value of 2.66 kg/trip.

According to Juwana *et al.* [9], blue swimming crabs (*Portunus spp.*) and mud crabs (*Scylla spp.*) are marine products that are very popular with the community and are quite expensive. The general public called blue swimming crab from the spot shape and the blue color, the crab legs are longer and slender, and the other one is called a mud crab or mangrove crab with shell, or carapace, is wider on the sides and more rounded. And the crab legs are short and fat.

Charybdis feriata (*Crucifix Crab*), commonly known as coral crab or cruciferous crab, is a type of crab that can be found in the tropical waters of the Indo-West Pacific, Japan, Korea, China, Australia, and the Atlantic. This blue swimming crab has a combination of orange-brown body color with a cross-shaped pattern on the front carapace. This type of crab can reach a maximum carapace width of 20 cm with a widened sideways shape. The anterolateral side has 6 teeth; the first tooth (on the outside of the eye) is wide and has a truncated end (hash or indentation). The upper or dorsal side of the propodus (end segment) on the claw has four spines. This type of crab has a sandy-muddy habitat [10].

While the catches that are not utilized include *Charybdis affinis*, the highest catch value occurred in February 2023 with a value of 2.6 kg/trip, while the lowest catch occurred in January 2023 with a value of 1.19 kg/trip and continued to increase in the next *Charybdis natator* is also one of the Portunidae family, which is not used but gets caught in fishermen's nets. With very few and relatively stable catches each month, with values ranging from 0.02 to 0.03 kg/trip.

4. Conclusion

The conclusion drawn from this research is that there is 5 species diversity for the Portunidae family, namely *Portunus pelagicus*, *Scylla serrata*, *Charybdis feriata*, *Charybdis affinis*, and *Charybdis natator*, with *Portunus pelagicus* as the main catch. The highest average catch for *Portunus pelagicus* occurred in May 2023 with a value of 33.87 kg/trip, while the least caught species was *Charybdis natator*, with a stable value each month ranging from 0.02 to 0.03 kg/trip. 3 out of 5 species that are caught are used by fishermen because they have economic value that can support fishermen's lives, while 2 other types are not used and tend to be considered "garbage" by fishermen because they will damage nets if caught in large quantities. Further research is needed on the diversity of Portunidae species because there may be other unidentified species. Based on the results of the research above, *Portunus pelagicus* is the highest catch, if it is continuously caught without control it can cause a decrease in catch, reduced defense of the sustainable fishing system and a decline in the community's economy.

Acknowledgments

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