



## Utilization of Processing Waste (Shrimp Heads/Shells and Crab Carapace) as Alternative Bait for Rajungan (Swimming Crab) Capture Fisheries in Jepara Waters

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### ABSTRACT

The bottom set gillnet is a fishing gear commonly used by fishermen in Jepara Regency, particularly by fishermen at the Ujungbatu Fish Landing Port (PPI Ujungbatu). One of the catches from this gillnet is the rajungan (swimming crab). Rajungan relies on its sense of smell to search for food, so an attractant in the form of bait is needed to lure the crabs towards the gillnet. In this study, processing waste, such as shrimp heads/skins and crab carapaces, was used as bait, considering that these processing by-products are commonly found in Jepara Regency. This research aimed to compare the catch rates of rajungan using traditional fish bait (Ponyfish) commonly used by fishermen, versus using bait made from crab carapace and shrimp heads/skins, as well as to determine the carapace width of the caught rajungan. The experimental fishing method used involved deploying 9 pieces of gillnets (3 nets for each type of bait). The results showed that using shrimp head/skin as bait caught 68 crabs, while Ponyfish bait caught 39 crabs, and crab carapace bait caught 53 crabs. The ANOVA test showed a p-value < 0.05, indicating a significant effect of the different types of bait on the catch rates in the gillnet operation in Jepara waters. This suggests that processing waste such as shrimp heads/skins and crab carapaces can be an effective alternative bait for catching rajungan in Jepara waters. The average carapace width of the caught rajungan was 101 mm (male) and 112 mm (female), with 76% of the crabs measuring  $\geq 100$  mm, in compliance with the Minister of Maritime Affairs and Fisheries Regulation (PERMEN KP) No.7 of 2024.

Keywords: *bottom set gillnet; Jepara waters; swimming crab; bait*

### 1. Introduction

Jepara Regency has a coastline approximately 72 km. The people of Jepara utilize its waters as a source of livelihood, including in activities such as fishing, recreation, transportation, and as a waste disposal area. This potential has already been exploited by the people of Jepara, particularly in the field of fisheries. Jepara Regency has a vast marine area of 317 ha with potential marine areas of 1,555.2 km<sup>2</sup> for pelagic fish and 1,360.8 km<sup>2</sup> for demersal fish. Some of the primary fish species caught in Jepara waters include *rajungan* (swimming crab), *tongkol* (mackerel tuna), *kembung* (mackerel), *teri* (anchovy), *manyung* (ray-finned fish), and *ekor kuning* (yellowtail) (Zubaidi et al., 2016).

The bottom set gillnet is a passive fishing gear that essentially waits for fish or shrimp (Chanafi et al., 2013). As a passive fishing gear, the bottom set gillnet is less effective for catching fish that are influenced by bait stimuli, such as groupers, crabs, shrimp, and others. Sudirman and Mallawa (2004) stated that fish species commonly caught by gillnets include those that swim near the surface (e.g., *cakalang* or mackerel tuna, various species of tuna, saury, flying fish, and others), demersal fish (e.g., flatfish, *katamba*, sea beam, and others), as well as shrimp, lobster, and crabs.

Bait serves as a tool to attract target species, guiding them to approach and become captured in the catch area. Using bait in bottom set gillnets aims to influence fish or other marine organisms at the sea floor, making them more likely to enter the catch area. According to a study by Fitri et al. (2008), the effectiveness of fishing using attractant baits was 60% higher than that without bait. The role of bait is not only to encourage the target organisms to feed, but also to stimulate them to enter the catchable area.

The most of traditional fishermen in Jepara operate bottom set gillnets, generally fish without using bait, although some use *Ponyfish* fish (a local term for a small fish species) as bait. This study aimed to investigate whether the use of crab carapace and shrimp head/skin as bait in bottom set gillnets results in different catch rates compared to the use of *Ponyfish* fish as a control. Passive fishing gear, such as gillnets, requires bait to attract crabs towards the gear (Martasuganda, 2008; Widowati et al., 2015). A good bait is characterized by its effectiveness in attracting the target species, its availability, and its low cost. The types of fish commonly used as bait by fishermen in Jepara are low-cost bycatch species, such as *Ponyfish* (*Leiognathus equulus*), *tembang* (*Sardinella gibbosa*), and *teri* (*Stoleporus indicus*).

*Rajungan* (*Portunidae*) is one of the marine fisheries commodities that has been extensively studied due to its high economic value. Its market is not only domestic but also extends to countries in the Americas and Europe. The *rajungan* catch for export still largely depends on wild-caught crabs (Hamid, 2015; Jayanto et al., 2023).

*Rajungan* is a scavenger and exhibits cannibalistic behavior, which is generally linked to its genetic traits and living habits (Susanto et al., 2005; Suharyanto et al., 2008; Jayanto et al., 2023). This scavenger and cannibalistic nature is a key consideration in this study, which aims to test the use of shrimp heads/skins and crab carapaces as alternative bait. Research by Putri et al. (2013) and Widowati et al. (2015) indicated that fresh *Ponyfish* fish bait resulted in higher catch rates for *rajungan* compared to dried *Ponyfish* fish or salted pufferfish. The use of shrimp heads as an alternative bait is also justified due to the abundance of shrimp head waste in Jepara, while crab carapaces are by-products of crab processing.

Research on the effectiveness of different bait types for catching *rajungan* is important for finding alternative solutions, especially when fresh fish bait is scarce due to seasonal fluctuations. Therefore, using processing waste like shrimp heads/skins and crab carapaces as bait is a practical solution, as both materials are rich in protein. The objective of this research is to compare the catch rates of *rajungan* using gillnets with three types of bait: *Ponyfish* fish (control), shrimp heads/skins, and crab carapaces, and to determine the average carapace width of the caught *rajungan*.

## 2. Methodology

This study was conducted in March 2024 in the waters of Jepara. The selected fishing area for this study had a travel time of more than 400 minutes, or more than 10 km from the river mouth. Data collection was carried out by accompanying the *rajungan* fishermen of Group B on 9 fishing trips, with the soaking time of the bottom set gillnets from 5 p.m until 6 a.m. The method used in this study was experimental fishing. A total of 9 pieces of bottom set gillnets were used, with three different bait treatments (*Ponyfish* fish, shrimp heads/skins, and crab carapaces), with 3 pieces of gillnets for each bait type. The weight of each bait was 50 grams, and the number of repetitions was 9 (nine) fishing operations or settings (Figure 1). The control treatment in this study was *Ponyfish* fish bait, as this is the type of bait commonly used by fishermen in Jepara.

In this study, the bait was placed on the net body at a distance of 10 mesh from the bottom rope, with a spacing of one fathom (1.5 meters) between each bait (Figure 1). In total, each net setting (piece) used 20 baits. For each treatment, 3 pieces of bottom set gillnets were set, alternating between the *Ponyfish* fish bait (control), shrimp head/skin bait, and crab carapace bait. The placement of the bait, starting from the tenth mesh from the bottom rope, was chosen because *rajungan* (swimming crabs) occupy a swimming layer ranging from the seabed to the surface (Figure 2).



Fig 1 - Placement of Bait on the Bottom Set Gill Net

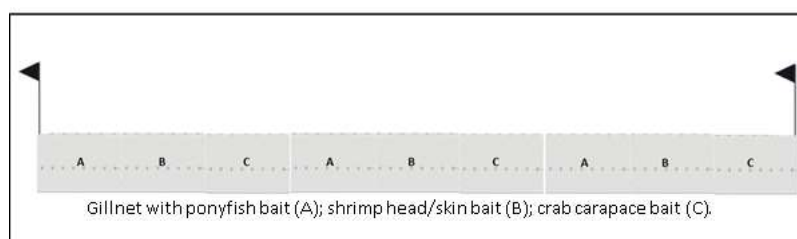


Fig 2 - Illustration of the Operation of Bottom Set Gillnet with Different Treatments (A, B, C)

## 3. Results and Discussion

Observations at 9 fishing sites for *rajungan* (swimming crabs) showed that the water depth ranged from 15 to 23 meters, with the seafloor substrate consisting of sandy mud. *Rajungan* were generally more frequently caught in sandy mud substrates compared to clayey mud substrates (Ernawati et al., 2014). Overall, a total of 160 *rajungan* were caught during the study using bottom gillnets, with 39 crabs caught with petek fish bait, 68 crabs with shrimp head/skin bait, and 53 crabs with crab carapace bait (Figure 3).

■ Ponyfish Bait ■ Shrimp Head/Shell Bait ■ Crab Carapace Bait

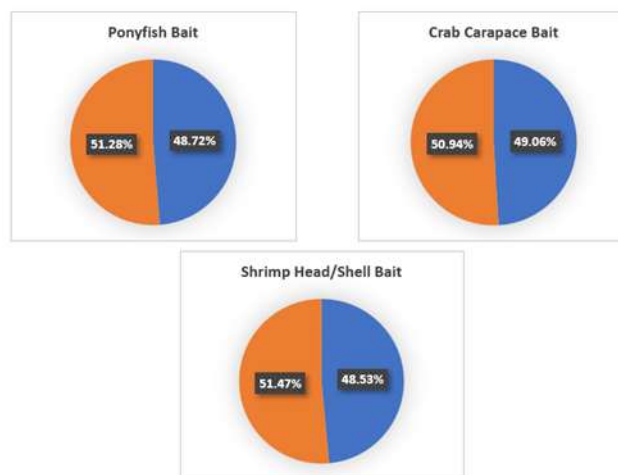
Fig 3 - Percentage of *Rajungan* Caught Using Different Baits

The results indicated that using different baits (ponyfish, shrimp head/skin, and crab carapace) led to varying catch numbers, with shrimp head/skin bait yielding the highest number of *rajungan* (68 crabs). Bait is a crucial component in catching *rajungan* with fishing gear such as gillnets. The chemical stimuli contained in the bait can influence the catch rate. Subagio (2004) reported that ponyfish contains 90% water, 10% protein, and 0.14% oil. In contrast, the proximate composition of shrimp heads/skins is 80.15% water, 14.67% protein, 0.93% fat, and 2.64% ash (Saleh et al., 2017). The chemical composition of crab carapace waste, with remnants of meat still attached to the shell, is 8.10% water, 15% protein, and 0.19% fat (Fawzya, 2004). Based on the chemical compositions of these three baits, the shrimp head/skin and crab carapace baits are more likely to attract *rajungan* than ponyfish bait, as they contain higher protein levels.

One factor influencing *rajungan* attraction to the bait is the specific odor produced by the bait. When bait is submerged in seawater, it undergoes fermentation, which breaks down proteins into peptides, amino acids, and flavor components (Sainuddin, 2012; Jayanto et al., 2024). Amino acids resulting from protein degradation, such as alanine, arginine, proline, glutamate, cysteine, and methionine, are able to stimulate the olfactory sense of *rajungan* (Purwanto et al., 2013).

Based on the ANOVA test results for the total catch of *rajungan*, it was found that  $F_{t} > F_{\text{tabel}}$  ( $22.34 > 3.40$ ), meaning that the type of bait used significantly affected the number of *rajungan* caught at  $\alpha = 0.05$ . The post-hoc Bonferroni test at a 95% confidence level showed significant differences between the baits of shrimp head/skin, ponyfish, and crab carapace.

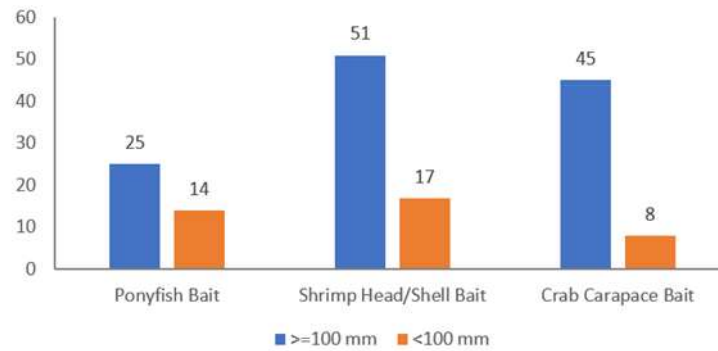
Regarding the gender of the *rajungan* caught during the 9 repetitions of the study, a total of 78 male crabs and 82 female crabs were caught. Female *rajungan* were more numerous than males (Figure 4). This condition is likely influenced by water depth. As water depth increases, female *rajungan* tend to be more dominant, while in shallower waters, male *rajungan* are more commonly caught (Prasetyo et al., 2014).



**Fig 4 - Percentage of *Rajungan* Caught Based on Gender**

Male *rajungan* were only found at depths <10 m and between 10 – 20 m, while female *rajungan* were found at all depths, with the highest number at depths >20 m (Rahman and Fuad, 2020). The fishing areas in this study had water depths ranging from 15 to 23 m, which is why more female *rajungan* were caught compared to males. Similar results were reported by Adam et al. (2006), who found that male *rajungan* were predominantly caught in waters up to 1.4 nautical miles from the shore, while female *rajungan* dominated catches in offshore waters. Both male and female *rajungan* spawn in nearshore waters. Once the eggs mature and appear on the abdomen, gravid females (*berried eggs female*) migrate to offshore waters where salinity levels are higher (King, 2007).

The carapace width of the *rajungan* caught in this study was mostly above 10 cm. *Rajungan* with a carapace width greater than 10 cm were found in every sampling repetition (Figure 5). Compared to the Indonesian Ministry of Marine Affairs and Fisheries (PERMEN KP) Regulation No. 7 of 2024, which states that the minimum legal carapace width for *rajungan* to be caught and sold is >10 cm, this indicates that the fishermen can legally capture *rajungan* in the study area. Among the *rajungan* caught, 39 individuals (24%) had a carapace width less than 10 cm, as the study location was approximately 10 km from the shore. According to Hamid et al. (2016) and Prasetyo et al. (2014), the farther the fishing area is from the shore, the fewer small *rajungan* are caught.



**Fig 5 - Number of *Rajungan* Based on Size Distribution and Gender**

The bottom gillnet fishing with various baits in this study can be considered environmentally friendly, as the average carapace width of the caught *rajungan* was 106.8 mm, with the average width for male *rajungan* being 101 mm and for female *rajungan* 112 mm. The average carapace width at first gonadal maturity (Lm) for *rajungan* is reported to be 107 mm (Ernawati et al., 2014). Munthe and Dimenta (2022) reported that the average size of male *rajungan* at first gonadal maturity is 87.20 mm, while females mature at an average size of 103.55 mm. Mature female *rajungan* are predominantly found in the northern coastal waters of Central Java, particularly during January, April, and August, with carapace widths ranging from 110–119 mm. The smallest carapace width class is found in July, with widths of 70–79 mm. These smaller females (<100 mm) are believed to experience pressure from fishing activities, leading to earlier gonadal maturation and earlier spawning (Tharieq et al., 2020).

#### 4. Conclusion

The total number of *rajungan* caught using bottom gillnets with different baits was 39 crabs with petek fish bait, 68 crabs with shrimp head/skin bait, and 53 crabs with crab carapace bait. The total catch of male *rajungan* was 78 individuals with an average carapace width of 101 mm, while the total catch of female *rajungan* was 82 individuals with an average carapace width of 112 mm. Statistical analysis showed that the use of shrimp head/skin and crab carapace baits resulted in significantly higher catches compared to petek fish bait. This indicates that shrimp head/skin and crab carapace can serve as alternative baits for catching *rajungan*. The carapace width of the *rajungan* caught ranged from 88 to 122 mm, with 76% of the individuals being  $\geq 100$  mm, which complies with the Indonesian Ministry of Marine Affairs and Fisheries (PERMEN KP) Regulation No. 7 of 2024.

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