

COMPARATIVE EFFECTIVENESS OF OCTOPUS HANDLINE (PANCING GURITA) AND OCTOPUS POTS (BUBU GURITA) IN BANYUWANGI WATERS, EAST JAVA: A PRELIMINARY STUDY

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ABSTRACT

The Center for Capture Fisheries (BBPI) has developed an octopus pots as an alternative to the conventional handline used in Banyuwangi, but its comparative effectiveness has never been evaluated. This study compared the catch performance and effectiveness of the two gears using data from seven fishing trips each in fishing zone IA, WPP NRI 573. A two-part statistical approach was employed: Fisher's exact test for trip success proportion and Mann-Whitney U test for positive catches. The handline caught octopus (11 individuals, 23.07 kg) exclusively, whereas the octopus pots captured a multi-species assemblage comprising octopus (4 individuals, 4.24 kg), spiny lobster, and swimming crab. No significant differences were found in trip success or catch magnitude between gears. Descriptively, the handline achieved higher effectiveness for octopus (73.33% versus 26.67%) and proved entirely selective for the target species. It is concluded that, although statistical parity exists, the handline is descriptively superior and more selective for octopus. The octopus pots offers income diversification by harvesting additional valuable crustaceans. The non-significant results likely reflect small sample size and high catch variability, warranting further research with greater replication.

Keywords: Octopus; Octopus Pot; Octopus Handline; Effectiveness

INTRODUCTION

Octopus (gurita) is a fishery resource of significant economic value in Indonesia (Dwiastuty *et al.*, 2023) and a potential commodity for generating income for fishermen (Mulyasari *et al.*, 2026). As a benthic organism, the octopus's natural habitat lies at the bottom of shallow waters with rocky and sandy substrates, ranging from the tidal zone to a depth of 1000 m (Hakim *et al.*, 2020; Linung *et al.*, 2024). Octopuses are known to take advantage of the holes and crevices of coral reefs, seagrass beds, and sandy or muddy bottoms to seek shelter and hunt (Taqwa, 2024; Bahtiar *et al.*, 2025).

Banyuwangi Regency, East Java, is one of the octopus production centers in Indonesia with a production volume of 2,169.03 tons and a production value of IDR 47,050,000,000 (KKP, 2023). The waters of Banyuwangi are dominated by sandy, coral, and rocky substrates, with sloping beaches and cliffs (Julianinda *et al.*, 2022). These conditions form a preferred habitat for octopuses, as rocky substrates and coral reefs provide many cracks, caves, and crevices for shelter and foraging (Tahir *et al.*, 2024).

Local fishermen in Banyuwangi catch octopuses with a handline called an octopus handline (Jessica *et al.*, 2024), while other alternative fishing gear is not yet available. The operation of hook and line, especially handline, has a weakness in the form of the risk of injury to fishermen due to the sharp and pointed tip of the hook (Wahyuni *et al.*, 2025). Octopus pots can be a safer alternative fishing tool, protecting fishermen from these risks. The Center for Capture Fisheries (BBPI) has developed an octopus pot innovation, but its performance and effectiveness in

octopus catching still need testing. To date, there has been no quantitative study comparing the effectiveness of BBPI-designed octopus pots with octopus handlines in Banyuwangi waters. Although the octopus is a potential commodity in the region, research on its capture methods is still limited. Local fishermen have never used the innovative octopus pots, so the effectiveness of these pots in catching octopuses is not yet known. Based on these problems, this initial study aims to analyze the difference in catch between octopus pots and octopus handlines, as well as examine the effectiveness of BBPI-designed octopus pots compared to octopus handlines in Banyuwangi waters. The results of the study are expected to provide an effective and safe alternative to octopus fishing gear for fishermen.

RESEARCH METHODS

Time and Location of the Study

This research was conducted in October 2025. Fishing gear operations are carried out in the waters of Pesanggaran District, Banyuwangi Regency, East Java Province. This study uses a quantitative descriptive method with an exploratory comparative field test design (Reken *et al.*, 2024). The primary data collected included the composition by type and the total number of catches, including the number of individuals and the weight of the target species, the octopus.

Specifications and Operation of Fishing Gear

The operation of octopus handlines and octopus pots is carried out using a local fishing boat measuring 3 GT with a 15

PK outboard motor. Data collection per trip involves the operation of 1 unit of octopus handline (cast 5–12 times per trip) and a longline system consisting of 15 units of octopus pots. The handline utilizes a crab imitation bait constructed from a mollusk shell filled with lead, while the octopus pots are operated collectively as a single set. The bait used in octopus pot operations is green mussels. The choice of this type of bait is because it is affordable and is one of the natural food

preferences of octopuses. The soaking time of octopus pots is ± 24 hours per trip. Data collection was carried out for 7 trips for each fishing gear. The design and construction of octopus pots and octopus handlines are presented in Figures 2 and 3. The octopus pot fishing ground is at a depth of $\pm 1\text{--}5$ m, while octopus handline fishing is operated at a depth of $\pm 5\text{--}95$ m. These two fishing grounds are on the IA fishing line at WPP NRI 573 (Figure 1).

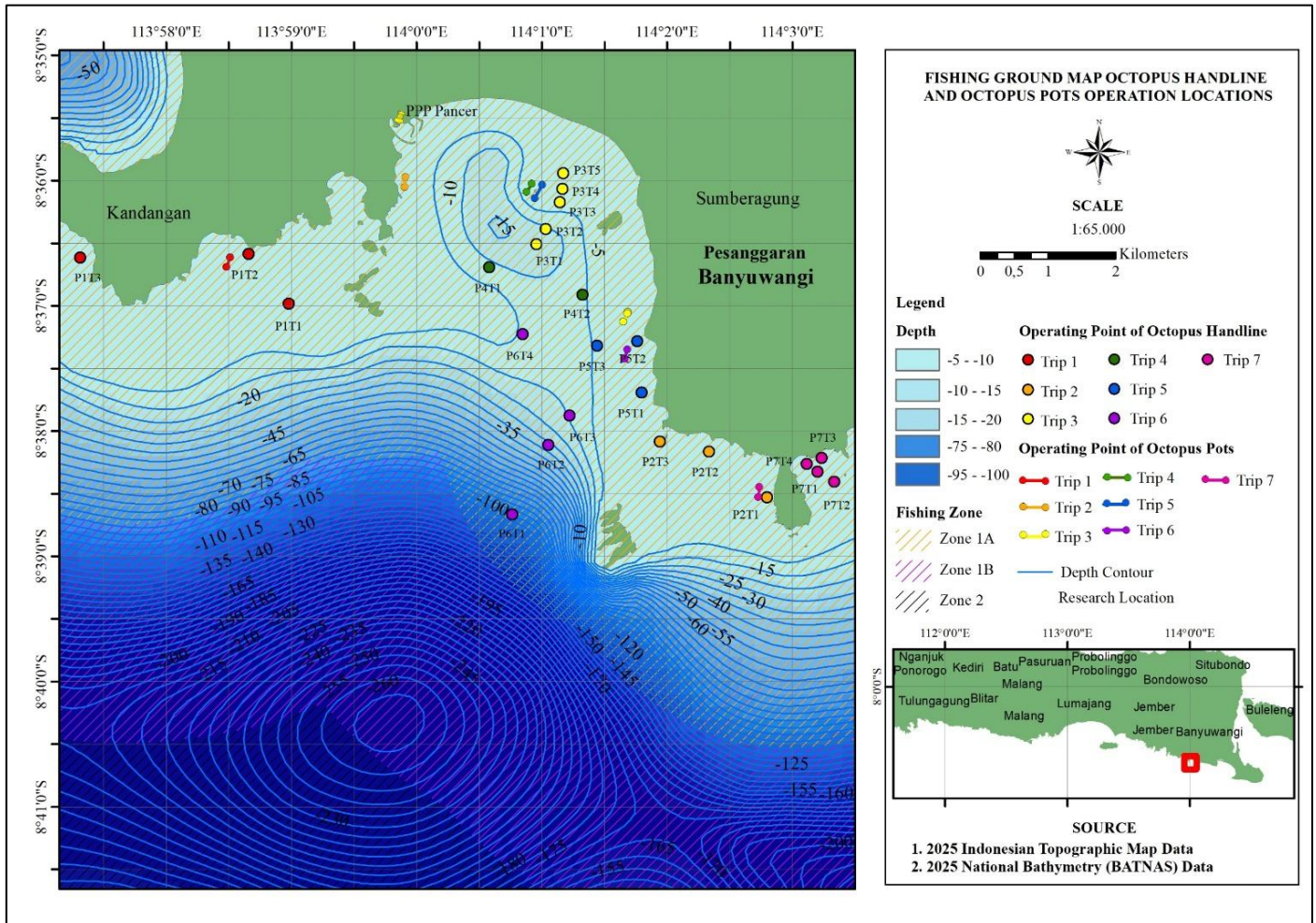


Figure 1. Map of Octopus Handline and Octopus Pots Fishing Ground Locations

Analysis of Catch Composition

The composition of the catch is calculated based on the type, number of individuals and weight of the catch with the following calculation formula (Kawarnidi *et al.*, 2018):

$$K_j = \frac{x_i}{x} \times 100\% \dots \dots \dots (1)$$

where K_j is the composition of the catch (%); x_i is the type of fish (individu); and x is the total number of types of fish caught (individual).

$$K_b = \frac{y_i}{y} \times 100\% \dots \dots \dots (2)$$

where K_b is the composition of the weight (%); y_i is the weight of the i fish (g); and y is the total weight of the fish caught (g).

Statistical Analysis and Effectiveness of Fishing Gear

The analysis of the difference in catch of the target octopus species between octopus pots and octopus handlines was conducted using a two-part test approach due to the number of trips that yielded zero catches. The variables tested were the number of individuals (individu) and the weight (g) of octopus per trip. The first part tested the difference in the frequency of trip success (trips that obtained octopus vs. trips that did not produce octopus) between the two fishing gears using the Fisher exact test in a 2×2 contingency table. The second part tested the difference in catch size only on trips that successfully caught octopuses (positive data). For the positive data, a normality test was carried out using the Shapiro-Wilk test. The results of the Shapiro-Wilk normality test showed that the data on the number of individuals in octopus pots were not normally distributed ($p < 0.001$). In contrast, the data on octopus handline were

normally distributed. The weight data for both groups met the assumption of normality. Although some variables met the assumption of normality, the Mann-Whitney U non-parametric test was chosen for the entire comparison on positive data. This decision was based on a very small sample size of positive data (octopus target species) ($n = 3$ and $n = 5$), which limited the reliability of the normality test and increased the risk of assumption violations in parametric tests. The consistency of the non-parametric approach also maintains uniformity of analysis across the response variables. All tests used a significance level of $\alpha = 0.05$. Statistical decisions were made based on the Exact Sig. 2-tailed significance value for both tests, with the criterion: if the p-value is < 0.05 , then there is a significant difference between octopus pots and octopus handline. Statistical testing was performed using SPSS software. The statistical hypotheses tested in this study are:

- H_0 : There is no significant difference between the catch of octopus pots and octopus handline.
- H_1 : There is a significant difference between the catch of

octopus pots and octopus handline.

To determine the level of effectiveness, the percentage of the contribution of the catch of each fishing gear to the total catch of all fishing gear during the study was calculated, referring to Julia *et al.* (2018) as follows:

$$\text{Effectiveness} = \frac{\text{catch per fishing gear}}{\text{total catch from all fishing gear}} \times 100\% \dots \dots \dots (3)$$

The percentage obtained was then categorized according to indicators (Syari *et al.*, 2016): values $< 30\%$ were categorized as less effective, $30-60\%$ as effective, and $> 60\%$ as very effective. Fishing gear is considered more effective if it has a higher effectiveness percentage and produces statistically significant differences in the variables of the number of individuals and the weight of the catch.

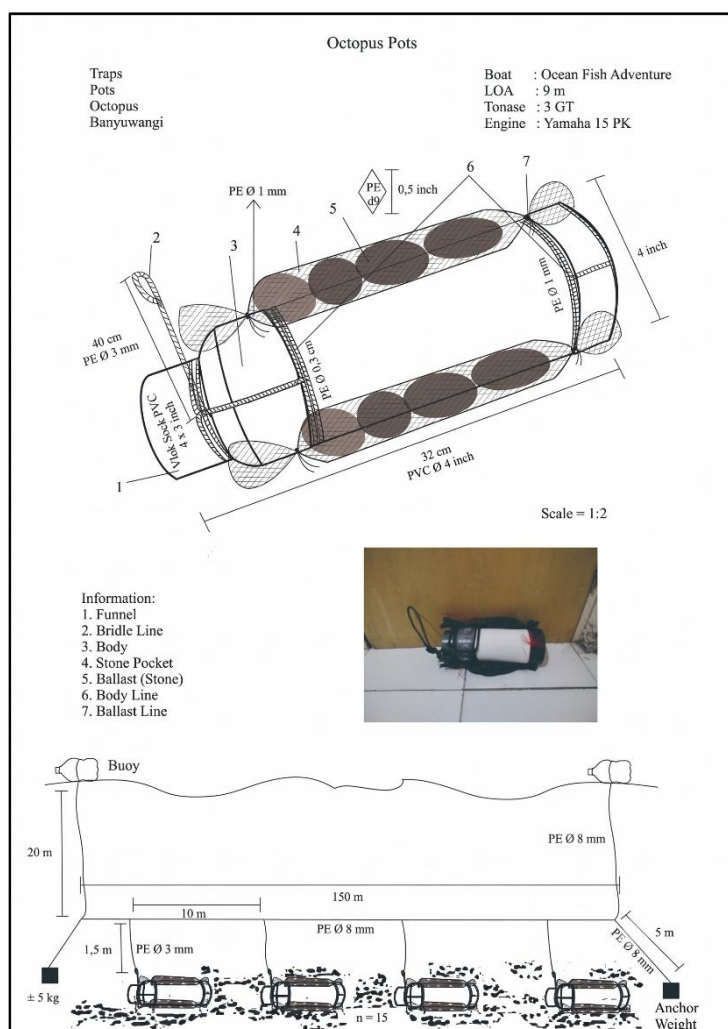


Figure 2. Octopus Pots Design and Construction

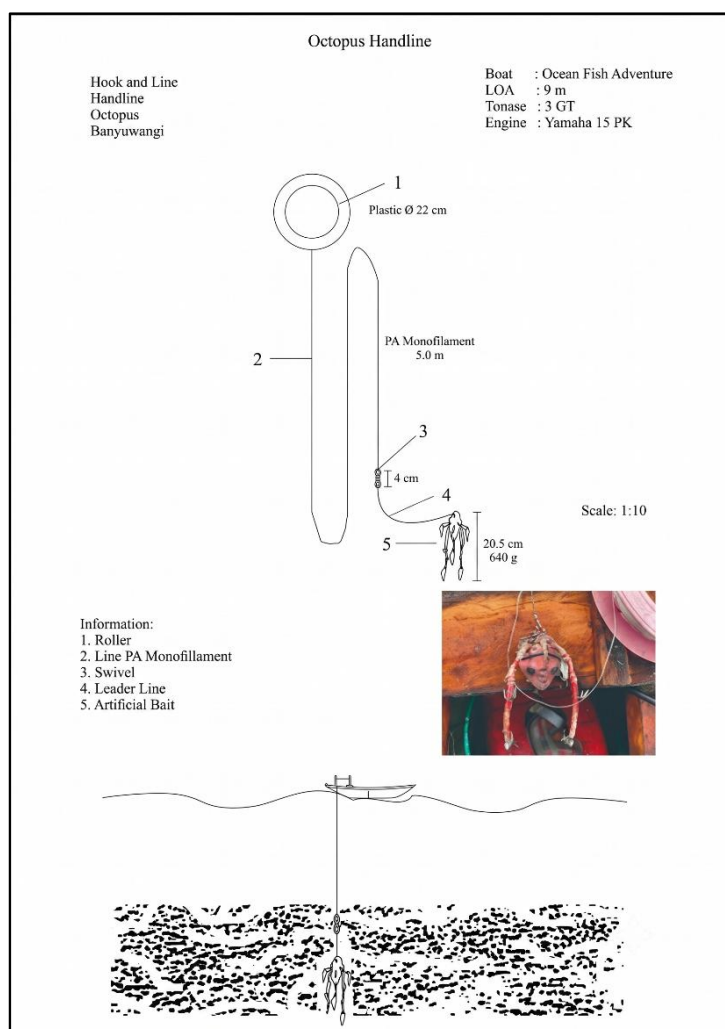


Figure 3. Octopus Handline Design and Construction

RESULT AND DISCUSSION

Composition of Catch

The operation of the octopus handline during the study resulted in the capture of 100% of the target species of octopus, without the discovery of any other species. The composition of

octopus fishing catch by sex is shown in Figure 4, which shows the number of individuals and weight. Female octopuses dominate the catch, both in terms of number and weight, with 7 individu (total weight 14.73 kg), while male octopuses have 4 individu (total weight 8.34 kg).

The operation of octopus pots succeeded in catching three species, namely octopus (*Octopus cyanea*), crab (*Portunus pelagicus*), and lobster (*Panulirus homarus*). The composition of the octopus pot catch is presented in Figure 5. Based on the number of individuals, the catch consisted of 7 lobsters (41.18%), 6 crabs (35.29%), and 4 octopuses (23.53%). Based on total weight, octopus contributed 4.24 kg (83.37%), crab 0.596 kg (11.72%), and lobster 0.25 kg (4.92%). Based on the perspective of the number of individuals, octopus pots dominantly caught lobsters (41.18%), while in terms of catch weight, it was dominated by octopus (83.36%).

Total Catch During 7 trips, Octopus pots produced a total of 4 octopuses with a total weight of 4,240 g (4.24 kg), while Octopus handline produced a total of 11 octopuses with a total weight of 23,070 g (23.07 kg). Based on the total quantity of catch, octopus handline produces almost three times the number of octopus individuals and more than five times the weight of octopus pots.

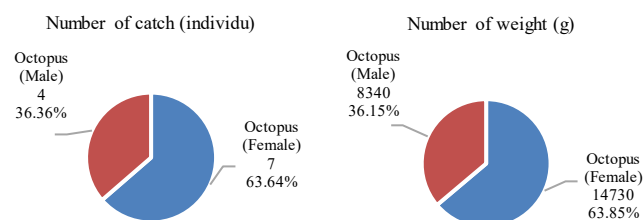


Figure 4. Composition of Octopus Handline Catch

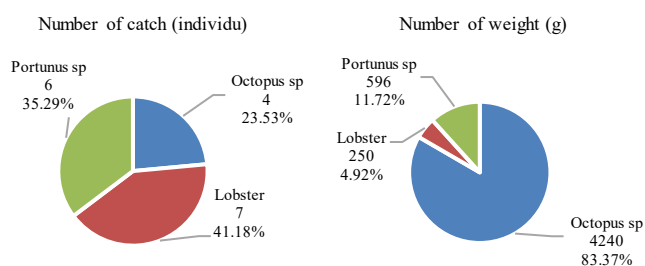


Figure 5. Composition of Octopus Pots Catch

Various studies confirm that the octopus hook and line is a very selective fishing gear against target species. Bubun & Mahmud (2019), Rahmatang *et al.* (2023), and Tupen *et al.* (2024) report that the catch of octopus handline is completely dominated by octopus. Nonetheless, Wahyuni *et al.* (2025) reported that handline for octopus can also catch non-target species such as giant trevally (14.74%) and skipjack (5.26%), with the proportion of octopus remaining dominant (80.00%). This high selectivity has to do with the method of operation and the type of bait used, which is specifically tailored to the behavioral characteristics of the octopus (Kurniawan *et al.*, 2019).

Difference Catch of Octopus Handline and Octopus Pots

The proportion of successful trips (trips with >0 catches) in Octopus pots shows that only 3 out of 7 trips (42.9%) managed to catch octopus. The successful trips were the 2nd, 5th, and 7th trips. Meanwhile, in the octopus handline, it showed that 5 out of 7 trips (71.4%) managed to catch octopus. Only the 3rd and 6th trips are empty. These data show that Octopus

handline more often managed to get octopus in a single capture operation (Table 1).

Table 1. The Frequency of Successful Trips to Catch Octopus On Octopus Pots And Octopus Handline.

Fishing Gear	Successful Trip	Failed Trip	Total
Octopus Pots	3	4	7
Octopus Handline	5	2	7
Total	8	6	14

Based on the average catch per trip, Octopus handline excels in all averages, both when all trips are counted (1.57 individu/trip, 3,295.7 g/trip) and when only successful trips (2.20 individu/trip; 4,614.0 g/trip) are considered. Based on variability and distribution, it is known that Octopus pots have many trips with no results (4 zero trips), but one trip produces 2 (2,520 g). This pattern shows sporadic and unstable catches. While Octopus handline shows wide fluctuations, it is in a higher range: the 5th trip reaches 8.040 g, while the 3rd and 6th trips are empty. Variability remains high, but at a greater level of productivity. Descriptively, Octopus handline is consistently more productive in catching octopus, both in terms of individual numbers and total weight. Octopus pots are only able to catch octopus on certain trips, with much lower yields. Differences in operating principles or capture mechanisms can cause this.

To test the effectiveness of octopus catching, octopus catch data from both fishing gear (octopus handline and octopus pots) were analyzed using a two-part approach. The first part carried out Fisher's exact test to compare the proportion of trips that managed to catch octopuses between octopus pots (3 out of 7 trips) and octopus handline (5 out of 7 trips). The second part analyzed only the trips that managed to catch octopuses (positive data).

In the first part, Fisher's exact test on the frequency of trip success (trips with catches >0) showed no significant difference between octopus pots (3 out of 7 successful trips) and octopus handline (5 out of 7 successful trips) ($p = 0.592$). There was no significant difference in the frequency of successful trips between the two fishing gears (Fisher's exact test, $p = 0.592$, 2-sided). Thus, the chances of both fishing gear getting an octopus in one fishing trip are statistically equivalent.

The second part was analyzed only on trips that managed to catch octopuses (positive data). The Shapiro-Wilk normality test showed that the number and weight data were not normally distributed, so the Mann-Whitney U test was used. However, the Mann-Whitney U test showed this difference was not statistically significant ($U = 3.00$, $p = 0.250$, 2-sided exact). Similarly, the catch weight on the trip was successfully higher in octopus handline (median = 4480 g, range 1760-8040) than in octopus pots (median = 1400 g, range 320-2520 g). However, the difference was not significant (Mann-Whitney $U = 2.00$, $p = 0.143$, 2-sided exact). Due to the very limited number of samples ($n=3$ and 5), the confidence interval for the mean was not precise, and the Mann-Whitney U test found no statistically significant difference.

The results showed no statistically significant difference between the octopus pots and octopus handline in catching octopus, both in terms of trip success frequency and the

magnitude of catch when successful. This finding indicates that both gears have comparable ability in extracting octopus resources under the conditions of this study. However, the lack of statistical significance should be interpreted with caution, given the very small sample size (14 trips, only 8 positive trips), which results in low statistical power. Descriptively, the octopus handline showed a tendency for higher catches, with a median weight 3.2 times that of the octopus pots, which might become significant if the number of replications were increased.

Fishing Effectiveness of Octopus Handline and Octopus Pots

Based on the percentage of contribution to the total octopus catch of all fishing gear, octopus handlines have an effectiveness of 73.33% (very effective category), while octopus pots are only 26.67% (less effective category) referring to the criteria from Syari *et al.* (2016). On the other hand, when considering the total multispecies catch, octopus pots achieved an effectiveness of 60.71% (very effective) thanks to the additional catch of lobster and crab. In comparison, octopus handline was 39.29% (effective).

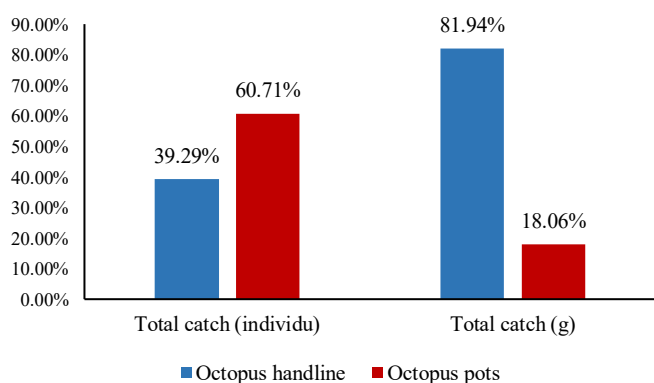


Figure 6. Fishing Effectiveness of Octopus Handline and Octopus Pots Based on Total Catch

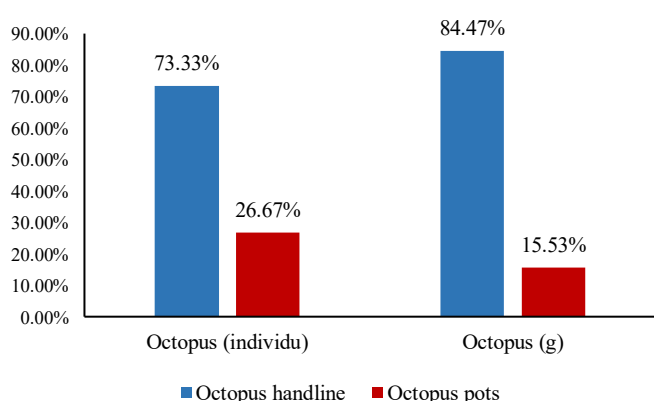


Figure 7. Fishing Effectiveness of Octopus Handline and Octopus Pots Based on Species Target Octopus

The octopus handline belongs to the hooks and lines fishing gear group (He *et al.*, 2021) or handline (Widodo & Sasmita, 2013). The fishing principle of hooks and lines is to lure the target fish so that the fish is caught by a hook attached to a line, with or without bait (Widodo & Sasmita, 2013). In this study, the octopus handline was operated using an artificial bait (Figure 3) resembling a crab. This type of artificial bait was also

reported in octopus handline fisheries at Barrang Lompo Island (Idrus *et al.*, 2023) and in Sendang Biru, Malang, known locally as pancing gurita or pocong-poongan (Astari *et al.*, 2023; Hanafiah *et al.*, 2022; Suciati *et al.*, 2024). The crab-shaped artificial bait proved more effective (70.8%) than the shrimp-shaped one (29.2%) in attracting octopus (Idrus *et al.*, 2023).

Technically, octopus handlines are operated using artificial baits designed to resemble crabs, which are the main natural prey of octopuses (Yuniarsih *et al.*, 2025). The operation is carried out by a periodic jerking technique (jigging), which produces two main types of stimulus for the octopus, namely visual stimulus and movement stimulus. From the perspective of fish behavior, octopuses are visual predators with excellent visual abilities. The strikingly colored artificial bait serves as a static visual stimulus that octopuses can recognize from a distance, even in relatively murky waters. When the bait is jigging, the movement of jumping up and down on the substrate mimics the natural behavior of a creeping or fleeing crab. This dynamic movement acts as the main trigger that manipulates the octopus's predatory instincts, stimulating it to immediately approach, pounce, and wrap around the bait with its tentacles. In addition, periodic jolts also produce a vibrational stimulus when the feed ballast hits the substrate, although its main attraction remains from a combination of visuals and movement.

In contrast, the octopus pots is static and relies solely on stationary bait in the form of green mussels. Without motion stimuli, octopuses, which are known to leave their dens without a trigger rarely (Vrandich *et al.*, 2024), tend not to be attracted to enter the trap. This is confirmed by the low number of octopuses caught. Conversely, spiny lobsters and swimming crabs, which are opportunistic and have limited mobility, are more easily stimulated by stationary bait and enter the trap. As a result, the octopus pots effectiveness against the target species was only 26.67% (in the less-effective category). However, its overall effectiveness reached 60.71% (in the highly effective category) due to the accumulation of mixed biomass. A similar phenomenon was also reported for folding traps in Lamongan that caught various demersal species (Mahiswara *et al.*, 2018). The superiority of the octopus handline in selectivity and effectiveness for the target species is consistent with research in Sendang Biru, South Malang, which showed that handlines with artificial bait caught octopus exclusively (Astari *et al.*, 2023). Thus, the difference in operating principles between the semi-active gear (handline) and passive gear (trap) is the main determining factor explaining the differences in catch composition and effectiveness.

The main limitation of this study is the small number of trips, which limits the ability to detect actual differences (Type II error). In addition, the high catch variability between trips, with coefficients of variation in total weight of 163% for the octopus pots and 99% for the octopus handline, indicates that other factors, such as environmental conditions and the fishing season, also influence fishing success. Furthermore, the two gears were operated at different depth ranges (the octopus handline at 5–95 m and the octopus pots at 1–5 m), meaning that habitat variability cannot be fully separated from gear effect, which may have contributed to the observed differences in catch composition and magnitude. The use of different bait types, an artificial crab-shaped lure for the octopus handline and a green mussel for the octopus pots, represents an additional confounding factor, as bait type is known to influence the attraction and selectivity for octopus. Local fishers in

Banyuwangi are known to be highly dependent on seasonal and sea-wave conditions (Tupen *et al.*, 2024), and this applies to both gears. These limitations reflect the exploratory nature of the study, in which fishing operations followed the natural practices of local fishers without experimental intervention. Therefore, further research with more replications, control of depth zones, standardized bait, and accounting for seasonal variations is needed to validate these findings and to provide a more rigorous comparison of gear effectiveness.

In practice, the octopus handline can remain the primary choice for fishers targeting octopus as their primary species. This is due to its high species selectivity and its ability to produce a higher total octopus catch weight than the octopus pots. On the other hand, the octopus pots can serve as an alternative gear to diversify octopus-targeting fishing methods, although the contribution of octopus catch in this study remained low. Furthermore, the success of the octopus pots in catching spiny lobsters and swimming crabs can also offer an alternative source of income diversification, as both species are economically valuable.

Improvements in the design and the use of alternative bait attractants in the octopus pots are recommended to enhance its specific effectiveness for octopus. Integrating both fishing gears into an adaptive fishing strategy that considers seasonal and water conditions could be an optimal solution for the octopus fishery in Banyuwangi.

CONCLUSION

Based on the results of the study, it can be concluded that there is no significant difference between octopus pots and octopus handlines in the effectiveness of catching octopus in Banyuwangi waters. Fisher's exact test showed that the proportion of trips that managed to catch octopuses did not differ significantly ($p = 0.592$). Similarly, on successful trips, the Mann-Whitney U test found no significant difference in the number of individuals ($p = 0.250$) or the weight of the octopus ($p = 0.143$). Descriptively, octopus handline produced higher catches (median 2 individu and 4,480 g) than octopus pots (median 1 individu and 1,400 g) and achieved a descriptive effectiveness of 73.33% (very effective) compared to 26.67% (less effective). Octopus handlines is also very selective with the catch of 100% of the target species, while octopus pots is multi-species with the dominance of lobster and crab by-products. The absence of statistical significance is suspected to be influenced by the small sample size (only 7 trips per fishing gear) and the very high variability of catch between trips. Therefore, although statistically the two tools have equivalent capabilities, octopus handline are superior descriptively and more selective to the target species. Future research with a greater number of repeats and seasonal variations is strongly recommended to validate these findings. The development of octopus pot designs and the use of other alternative types of bait attractants are recommended to increase their effectiveness in catching octopuses.

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