The effect of escape gap on the cube folding trap on fish catches composition and trap rate at the northern coast of Tuban regency

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Abstract. This study aims to determine the effect of escape gap on catch composition, CPUE, and trap rate at the northern coast of Tuban Regency. The research was conducted by ten trips of experimental fishing at different locations in November 2019. A total of 60 units of cube folding traps were installed long line, consisting of cube folding traps without escape gaps, cube folding traps with escape gaps 6x3 cm, cube folding traps escape gaps 7x4 cm, 20 units, respectively. The fish catch composition consists of 18 species of 6 groups, i.e., fish, swimmer crab, shrimp, hermit crab, and snail. Fish were the most dominant group captured by cube folding traps in the northern coast of Tuban Regency (59.7%), followed by swimmer crab, snail, crab, shrimp, and hermit crab. The highest catch per unit effort was found in cube folding traps with escape gaps 7x4 cm as much as 6.94 gr/traps/trip. The highest of the trap rate (18%) was obtained in the cube folding traps without escape gap. There was a significant difference (p=95%) in the weight of fish catches and CPUE between cube folding traps without escape gaps and the cube folding traps with escape gaps 7 x 4 cm.

1. Introduction

Marine fisheries are natural resources that can have an economic impact on the majority of the population around coastal areas. One of the activities to utilize marine fisheries resources is to capture fisheries. Capture fisheries production in the sea and inland public waters in Indonesia in 2017 reached 7,071,453 tons [1]. The northern coast of Tuban Regency with an ocean area of 22,608 km² located in the Java Sea (WPP-NRI 712) has abundant fishery potential. According to [2], the production of marine capture fisheries in Tuban Regency in 2016 and 2017 was 11,123.7 tons and 11,488.7 tons, respectively. Several types of fish landed, including fringe scale sardine, anchovies, indian mackerel, japanese threadfin bream, mackerel tuna, large head hairtail, and then scaled trevally.

Marine fishery resources in the northern coast of Tuban Regency which are included in WPP-NRI 712 need good fisheries management to maintain the availability of fish stocks because the water conditions have entered the overfishing category [3]. One of the fisheries management that can be done is to innovate technology on fishing gear. Bubu (Cube folding traps) is a type of simple passive trap fishing gear that allows fish to enter the trap and is difficult to escape, selective, has a variety of shapes and sizes, requires bait to stimulate catch targets in the waters [4]. Some fishermen in Indonesia have used fishing gear with different shapes and sizes that are adapted for certain types [5]. Research...
conducted by [6] regarding the modification of escape trap traps in the Rembang Waters showed that the catch on escape trap traps had a larger size than traps without escape gaps.

The research was conducted in the northern coast of Tuban Regency using a cube folding trap with escape gaps. This study has several objectives, including knowing the effect of the escape gap on the cube folding trap, knowing the difference in catch composition, catch per unit effort (CPUE), and trap rate on the cube folding trap without escape gap and escape gap. The benefits of developing fishing gear innovation are expected to provide information to readers about the effect of the escape gap on the cube folding trap and provide scientific contributions to the development of environmentally friendly fishing gear.

2. Materials and Methods
2.1. Materials
The folding trap used is in the form of a cube measuring 50x50x50 cm with an iron frame and net body (Mesh size 1.5 inches). The treatment of the cube folding trap that was given was without an escape gap and an escape gap. A total of 60 units of cube folding traps were installed in a long line, consisting of cube folding traps without escape gaps, cube folding traps with escape gaps 6x3 cm, cube folding traps escape gaps 7x4 cm, 20 units, respectively. The construction of the cube folding trap is provided in figure 1.

![Figure 1. The construction of the cube folding trap.](image1)

The installation of the cube folding trap is done by immersing it for 24 hours which goes through several stages, namely setting, immersing, and hauling. Installation of a series of cube folding traps in the waters is carried out alternately for each treatment. The design installation of the cube folding trap in the water is provided in Figure 2.

![Figure 2. Installation of cube folding traps in the water.](image2)
A. Marker Flag
B. Buoy (Styrofoam)
C. Buoy Rope
D. Float line
E. Bridle
F. Cube folding trap
G. Ballast rope
H. Ballast

2.2. Methods
The research method used is experimental fishing conducted in the northern coast of Tuban Regency at ten different sampling station locations. The cube folding traps were installed in a long line is near the FADs of fishermen or based on the experience of fishermen. The sampling location map is provided in Figure 3.

![Figure 3](image.png)

**Figure 3.** The research location of the cube folding trap at the northern coast of Tuban Regency.

The data collected is the type and size of the catch which is then used to determine the effect of the escape gap on the cube folding trap, calculate catch composition, CPUE, and trap rate. Composition analysis can be calculated using the following calculation formula:

\[ C = \frac{n}{N} \]  

\( C \) = Catch result composition, \( n \) = Number of catch result species, \( N \) = total number of catch result

The analysis of the catch per unit effort of the cube folding trap is calculated using the following calculation formula:

\[ \text{CPUE} = \frac{\text{Catch}}{\text{Effort}} \]  

\( \text{CPUE} \) = Catch per unit effort (g/bubu), \( \text{Catch} \) = Number of catches (g), \( \text{Effort} \) = number of fishing trap used

The trap rate analysis of the cube folding trap is calculated using the following calculation formula:

\[ \text{Trap rate (\%)} = \left( \frac{\text{Bubu filled}}{\text{Total}} \right) \times 100\% \]  

\( \text{Bubu filled} \) = Number of traps filled with catch, \( \text{Total} \) = Total traps used in the treatment
The statistical test used to determine the effect of the escape gap on the cube folding trap is the one-way ANOVA test. The hypothesis used in this study is that $H_0$ is a cube folding trap hypothesis with an escape gap that has no effect on the number of catches, catch weight, CPUE, and trap rate. $H_1$ is the hypothesis of a cube folding trap with an escape gap that affects the number of catches, catch weight, CPUE, and trap rate. The rule used in decision making in this study is the value of $F$-value $< F$-table, then $H_0$ is accepted, whereas if the value of $F$-value $> F$-table, then $H_0$ is rejected.

3. Results and Discussion

3.1. The catch composition

3.1.1. The total catch composition. The result of research shows that cube folding trap catch consisted of 6 catch groups, namely fish, swimmer crab, snail, crab, shrimp, and hermit crab. The catch was dominated by groups of fish as much as 59.75% of the total catch, while for the group swimmer crabs, snails, crabs, shrimp, and hermit crabs it was 40.25%. Research conducted by [7] shows the catching result of folded cube fish pots at the sea of Tuban Regency were divided into 5 groups dominated by fish as much as 48.97% of the total catch. The catch result of the cube folding trap in the northern coast of Tuban Regency is provided in Figure 4.

![Figure 4](image)

**Figure 4.** The catch composition of the cube folding trap at the northern coast of Tuban Regency.

3.1.2. The catch composition based on the group. The total number of catches of this cube folding trap is 159 individuals with a weight of 2746.7 grams. Determination of fishing ground using traps by fishermen in Socorejo Village is based on the experience of fishermen while at sea. Fishing grounds are often determined not far from the beach or around fish FADs owned by fishermen. The catch consisted of 18 species which were divided into 6 groups. Group of fish, swimmer crabs, crabs, and snails were caught in all three cube folding traps, shrimp groups were caught in both cube folding traps with escape gaps and hermit crab groups were only caught in 6 x 3 cm escape cube folding traps. The catch composition based on the group of the cube folding trap at the northern coast of Tuban Regency is provided in Table 1.

| Group of Catch   | Without Escape Gaps | Escape Gaps 6 x 3 cm | Escape Gaps 7 x 4 cm |
|------------------|---------------------|-----------------------|-----------------------|
|                  | Total | Weight (gr) | Total | Weight (gr) | Total | Weight (gr) |
| Fish             | 58%   | 128,6       | 59%   | 430,8       | 62%   | 567         |
| Swimmer Crab     | 19%   | 194,7       | 25%   | 313,6       | 9%    | 510,7       |
| Snail            | 16%   | 69,5        | 4%    | 62,2        | 15%   | 59,1        |

**Table 1.** The catch composition of the cube folding trap at the northern coast of Tuban Regency.
Cube folding trap (Bubu) is a type of trap fishing gear with various types and shapes. The operation of trap fishing gear uses bait as an attractor that triggers fish to enter the trap because some fish identify their prey using olfactory sensors [8]. Pots and traps are types of fishing gear that are widely used in commercial fishing to catch fish and crustaceans [9]. There is a difference between fishing traps and fishing pots. Fishing traps are traps with a larger structure and shape, are passive, making it easier for fish to enter the trap and difficult to get out, while fishing pots are passive traps with a smaller size, simpler shape, can be moved, and can be operated from on board [4].

Based on the one-way ANOVA statistical analysis, the escape gap in the cube folding trap has a significant difference effect on the weight of the catch with F-value 3.801 > F-table 3.354 (P-value 0.035 < 0.05 at 95% confidence level). One way ANOVA test analysis got significant difference results, then continued with the Post-hoc (LSD) follow-up test. This follow-up test aims to find treatments that are significant difference when compared. Based on the further test, there is a significant difference in the cube folding trap with an escape gap of 7 x 4 cm which is indicated by an asterisk (*) in the mean difference value which is significant at the 95% confidence level. Research conducted by [10] shows that the catch using dome traps without escape gaps is more than the two dome traps, which is 54.76% of the total catch. The amount of biomass caught in cube folding traps without escape gaps was more than traps with escape gaps because the caught species did not have the opportunity to escape from the trap. The successful use of traps is influenced by several factors, namely the length of immersion, the level of trap saturation (gear saturation), fish habitat, trap design, and the use of appropriate bait [11].

3.2. Catch per unit effort (CPUE)
The mean of Catch per unit effort (CPUE) value of the cube folding trap without escape gap is 2.24 g/bubu/trip, the cube folding trap with escape gaps 6 x 3 cm is 4.55 g/bubu/trip and the cube folding trap with escape gaps 7 x 4 cm is 6.94 g/bubu/trip. The catch per unit effort (CPUE) value is provided in Table 2.

| Trip | Without Escape Gaps | Escape Gaps 6x3 cm | Escape Gaps 7x4 cm |
|------|---------------------|-------------------|-------------------|
|      | Weight (g) | CPUE (g/bubu) | Weight (g) | CPUE (g/bubu) | Weight (g) | CPUE (g/bubu) |
| 1    | 69.6       | 3.48             | 34.7       | 1.74             | 87.6       | 4.38             |
| 2    | 148.1      | 7.41             | 278.7      | 13.94            | 151.0      | 7.55             |
| 3    | 16.8       | 0.84             | 116.6      | 5.83             | 75.9       | 3.80             |
| 4    | 3.7        | 0.19             | 2.0        | 0.10             | 250.7      | 12.54            |
| 5    | 19.0       | 0.95             | 27.0       | 1.35             | 35.1       | 1.76             |
| 6    | 69.4       | 3.47             | 124.0      | 6.20             | 124.0      | 6.20             |
| 7    | 19.1       | 0.96             | 91.0       | 4.55             | 139.5      | 6.98             |
| 8    | 20.0       | 1.00             | 103.4      | 5.17             | 361.0      | 18.05            |
| 9    | 34.0       | 1.70             | 53.7       | 2.69             | 73.0       | 3.65             |
| 10   | 48.9       | 2.45             | 79.4       | 3.97             | 89.8       | 4.49             |
| Total| 448.6      | 22.43            | 910.5      | 45.53            | 1387.6     | 69.38            |
| Mean | 44.86      | 2.24             | 91.05      | 4.55             | 138.76     | 6.94             |

Based on the one-way ANOVA statistical analysis, the escape gap in the cube folding trap has a significant difference effect on the catch per unit effort with F-value 3.800 > F-table 3.354 (P-value
The results were significant difference in the cube folding trap with an escape gap of 7 x 4 cm which is indicated by an asterisk (*) in the mean difference value which is significant at the 95% confidence level. The existence of an escape gap can serve as an entrance for small fish into the trap. The characteristics of environmentally friendly fishing gear or commonly known as [12] mentions several criteria for environmentally-friendly fishing gear, namely having high selectivity, producing high-quality fish, low by-catch, not destroys habitat, has little impact on the environment, does not endanger protected animals, does not endanger the safety of fishermen, and is socially acceptable.

### 3.3. Trap rate

The trap rate value captured using the cube folding trap without escape gap has the highest mean compared to cube folding trap with escape gap, which is 18%. The trap rate value of cube folding trap in the northern coast of Tuban Regency is provided in Table 3.

**Table 3.** Trap rate value of cube folding trap in the northern coast of Tuban Regency.

| Trip | Without Escape Gaps | Escape Gaps 6x3 cm | Escape Gaps 7x4 cm |
|------|---------------------|---------------------|---------------------|
|      | Bubu Filled | Trap Rate | Bubu Filled | Trap Rate | Bubu Filled | Trap Rate |
| 1    | 7          | 35%     | 2          | 10%      | 6          | 30%      |
| 2    | 7          | 35%     | 9          | 45%      | 6          | 30%      |
| 3    | 2          | 10%     | 1          | 5%       | 2          | 10%      |
| 4    | 3          | 15%     | 1          | 5%       | 1          | 5%       |
| 5    | 2          | 10%     | 2          | 10%      | 3          | 15%      |
| 6    | 1          | 5%      | 2          | 10%      | 1          | 5%       |
| 7    | 3          | 15%     | 1          | 5%       | 2          | 10%      |
| 8    | 1          | 5%      | 1          | 5%       | 1          | 5%       |
| 9    | 5          | 25%     | 2          | 10%      | 4          | 20%      |
| 10   | 5          | 25%     | 5          | 25%      | 4          | 20%      |
| Total| 36         | 180%    | 25         | 130%     | 30         | 150%     |
| Mean | 3,6        | 18%     | 2,5        | 13%      | 3          | 15%      |

The highest trap rate value is due to the fact that there is no escape gap in the cube folding trap so that the catches are more numerous and of various sizes. Based on the results of the one-way ANOVA statistical analysis, the escape gap in the cube folding trap has no significant difference (Asym. sig. 0.398 > 0.05) on the trap rate value at the 95% confidence level. Installation of escape gaps in trap fishing gear can minimize by-catch and reduce the death of individual species that are not yet fit to be caught so that they can escape naturally [13]. The escape gap in the trap fishing gear can increase the selectivity of the trap so that it can catch fish or other biomes with a size that is suitable for catching. According to [14] said that the installation of escape gaps has advantages such as reducing physical damage to fish due to fishing activities, reducing catch sorting time, reducing undersized and unfit catches, reducing the potential for illegal landings of certain commodities that are still below the catchable size, and can increase fishermen's income because the catch is large so that the selling price increases.

### 4. Conclusion

The escape gap on the cube folding trap showed significant difference results on the catch weight and CPUE on the cube folding trap with an escape gap of 7x4 cm. Cube folding traps consist of 18 species which are grouped into six groups, namely groups of fish (59.75%), swimmer crab (17.61%), snail...
(11.59%), crab (7.55%), shrimp (2.52%), and a hermit crab (0.63%). The weight of the catch on the cube folding trap without escape gap, the cube folding trap with an escape gap of 6 x 3 cm, and the cube folding trap with an escape gap of 7 x 4 cm, were 448.6 grams, 910.5 grams, and 1387.6 grams, respectively. The highest mean catch per unit effort (CPUE) was found in the 7 x 4 cm cube folding trap with an escape gap of 138.76 g/trip or 6.94 g/bubu/trip. The largest trap rate value is found in the cube folding trap without an escape gap of 18%.

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