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# Size Distribution of Vermiculated spinefoot Fish and the Level of Environmental Friendliness of Traditional Sero Fishing Gear in Waters of Pangkep Regency, South Sulawesi Province

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## ABSTRACT

The waters of Pangkep Regency have large fisheries resource potential, including potential fish and non-fish resources. Utilization of fish resources uses several types of fishing gear, one of which is sero. The aim of this research is to determine the size distribution of Vermiculated spinefoot fish *Siganus javus* (Linennaeus, 1766) and the level of environmental friendliness of traditional sero fishing gear. The research was carried out in the waters of Pangkep Regency, May to August 2023. The types of data collected included primary and secondary data. Primary data was collected through surveys and field observations while secondary data came from related agencies. Measuring the total length and weight of Vermiculated spinefoot fish, carrying out fishing operations. The source of annual production data is obtained from the Pangkep District Fisheries Service, (2023). Identify types of fish using Market Fishes of Indonesia, (2013). Data analysis consisted of frequency distribution analysis and environmental friendliness level analysis using the CCRF approach (1995). The size distribution of the Vermiculated spinefoot fish *Siganus javus* (Linennaeus, 1766) caught using traditional sero fishing gear is in the weight range of 34.0 - 47.3 grams with a frequency of 115 out of 305 rabbitfish *Siganus javus* (Linennaeus, 1766). who took part in sampling during the research, and the size of the smallest fish was 7.2 - 20.5 grams and the size of the longest fish was 127.8 - 141.1 grams. The level of environmental friendliness and those caught in the waters of Pangkep Regency, using the Code of Conduct Responsible Fisheries (CCRF), are considered less environmentally friendly, although several assessment criteria are considered still better, including: a) Safe for the habitat (does not damage the habitat) and b ) The product does not harm consumer health.

## INTRODUCTION

Capture fisheries are fishing activities that aim to exploit existing fish resources in a waters for commercial purposes by using fishing gear in their operations. The capture fisheries business fluctuates every year. Production also tends to increase with the

development of fishing technology. The results of these efforts really support the economy and welfare of the community, especially the fishing community.

Pangkep Regency waters have quite large fisheries resource potential, including capture fisheries. The abundance of coastal fishing grounds is due to the fertile waters, with relatively good ecosystems of coral reefs, sea grasses and mangroves. Apart from that, there are many ponds covering thousands of hectares along the coast and waters of Pangkep Regency. Regarding the potential of fish resources which is quite large, it needs to be studied further to find out the characteristics of each type of fish so that it can be utilized optimally and maintain its sustainability.

Biologically, several fish species migrate to coral reef ecosystems, seagrass beds and mangrove ecosystems located in coastal or estuarine waters. In this ecosystem, basically these three ecosystems create abundant sources of nutrients so that fish migrate for the purpose of looking for food (feeding migration), doing nursery migration, and doing spawning *(spawning migration)*. By maintaining these three ecosystems, fish resources will be abundant and fishermen can utilize them without having to go to sea, one of them is the rabbitfish (*Siganus* spp.).

The rabbitfish (*Siganus canaliculatus* Park, 1797) is a herbivorous fish that is associated with seagrass habitats and is widely distributed in mangrove and coral reef habitats. This fish is one of the targets for catching fishermen in coastal waters.

To manage resources in coastal waters, a number of fishing techniques and tools are used, both modern and traditional operated by fishermen. Judging from the principles of fishing in Indonesia, fishermen make more use of the characteristics of fish and the environment **(Ihsan *et al*, (2023)**. One of the traditional fishing gears used by coastal fishermen in Pangkep Regency is Sero.

The process of operating sero fishing gear is to utilize tidal currents, where the high and low tide will affect the catch of sero. Tides are nothing but ocean currents, where tides move towards the coast, and receding ocean currents move away from the coast. These two things are closely related to each other because the determination of bathymetry is strongly influenced by the mean sea level (MSL) or the average sea level during high tides. In placing sero fishing gear, it is installed around the coast. Because the shallower and family the coastal waters are, the better the placement or installation of sero fishing gear **(Ihsan *et al*, 2019)**. One of the fish with the largest proportion caught using sero fishing gear is the Vermiculated spinefoot Fish.

Vermiculated spinefoot Fish from the *Siganidae* family has a diversity of species spread across various waters in Indonesia, Vermiculated spinefoot Fish are spread in almost all shallow waters or reefs. Fish from this family consist of one genus, namely Siganus, of which there are 12 species in Indonesia **(Iwatsuki *et al*., 2000**; **Carpenter, 2001; Ministry of Maritime Affairs and Fisheries, 2011**). **Yunus (2005)** found 13 species in spermonde waters, whereas **(Burhanuddin *et al*., 1979; Burhanuddin *et.al*., 2006)** obtained 16 species from the Siganidae family, and one of the Vermiculated

spinefoot Fish with the largest proportion caught with sero was the Vermiculated spinefoot fish *Siganus javus* (Linennaeus, 1766).

Based on the above, it is necessary to conduct research on the size distribution of the Vermiculated spinefoot Fish *Siganus javus* **(**Linennaeus, 1766**)** and the level of environmental friendliness of sero traditional fishing gear in the waters of Pangkep Regency, South Sulawesi Province.

## MATERIALS AND METHODS

### *Time and place of research*

This research was conducted in the coastal area of Pangkep Regency, from May to July 2023. The map of the research locations is presented as follows:

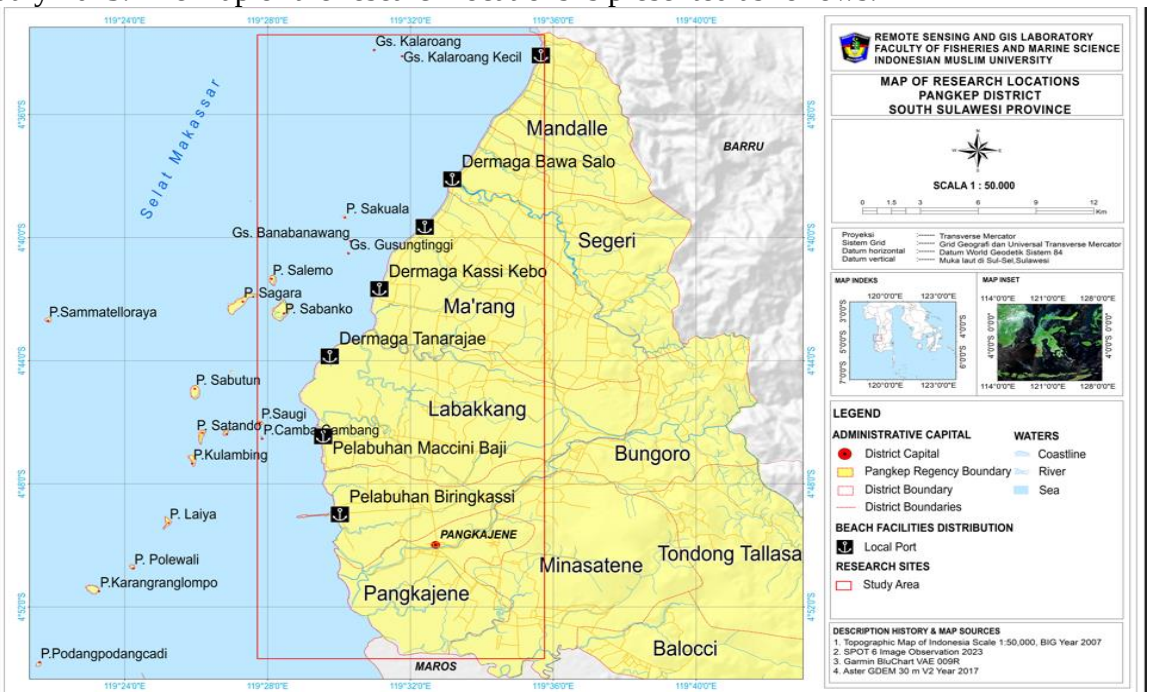


Figure 1. Map of the location of the research implementation

### *Materials and tools*

The materials used consist of earth maps, global positioning system (GPS), cameras and digital scales and measuring rulers as well as writing tools.

### *Methods and data collected*

In this research, the types of data collected include primary and secondary data. Primary data was collected through surveys and direct observation in the field, while secondary data was collected through several related institutions and agencies. Measuring the total length and weight of batik baronang fish, carrying out fishing operations, conducting interviews with fishermen using a questionnaire, with material describing fishing gear, fishing gear operating techniques, fishing areas, while the source of annual production data was obtained from the **Pangkep Regency Fisheries Service, (2023)** . Measurement of total length (cm) or total length (TL), namely the straight horizontal

measurement from the tip of the snout to the tip of the longest tail. Identify types of fish visually by using the **Market Fishes of Indonesia guidebook, (2013).**

***Data analysis***

To determine the size distribution of catches of Vermiculated spinefoot Fish *Siganus javus* Linennaeus, 1766) using traditional sero fishing gear, it can be determined based on the length and weight of the fish. Data on the length and weight of fish caught by the main target for each fishing gear are processed by calculating the frequency distribution. Length and weight data are processed in the form of a frequency distribution, making it easier to analyze catches from fishing gear and calculated using the formula below:

$$K = [\ 1+(3{,}3 \times [\ \log\ ]\ \ [\ n\ ]$$

$$\text{Class length interval (i)} = \text{Range}/K$$

Information:
K : Number of classes; N : Lots of data; Range : Largest data - smallest data.

According to **Sujana, (1991)** referred to by **Ihsan *et al*, (2016)**, the comparison of the size (kg) of catches caught used a frequency distribution approach to determine the size distribution of catches of Vermiculated spinefoot Fish *Siganus javus* Linennaeus, 1766).

To analyze the level of friendliness of traditional sero fishing gear, an analysis was carried out using the **FAO Code of Conduct Responsible Fisheries (CCRF) approach, (1995)** based on the following criteria: (1). has high selectivity (2). does not destroy the habitat; (3). produce high quality fish; (4). does not endanger fishermen; (5). production does not harm consumers; (6). low by-catch; (7). impact on biodiversity; (8). Does not harm protected fish; and (9). socially acceptable, with assessment sub-criteria of 1.0 - 1.50 (not environmentally friendly); 1.51 - 2.50 (not environmentally friendly; 2.51 - 3.50 (quite environmentally friendly) and > 3.51 environmentally friendly.

$$X = \sum X\, n : N$$

Information:
X = the value of the level of environmental friendliness of sero fishing gear
Xn = Total number of weighted values
N = Number of respondents

## RESULTS

***Vermiculated spinefoot Fish Size Distribution***

The results of the analysis carried out, it was found that the size distribution of the Vermiculated spinefoot fish *Siganus javus* (Linennaeus, 1766) caught by sero in the coastal waters of Pangkep Regency, is presented as follows:

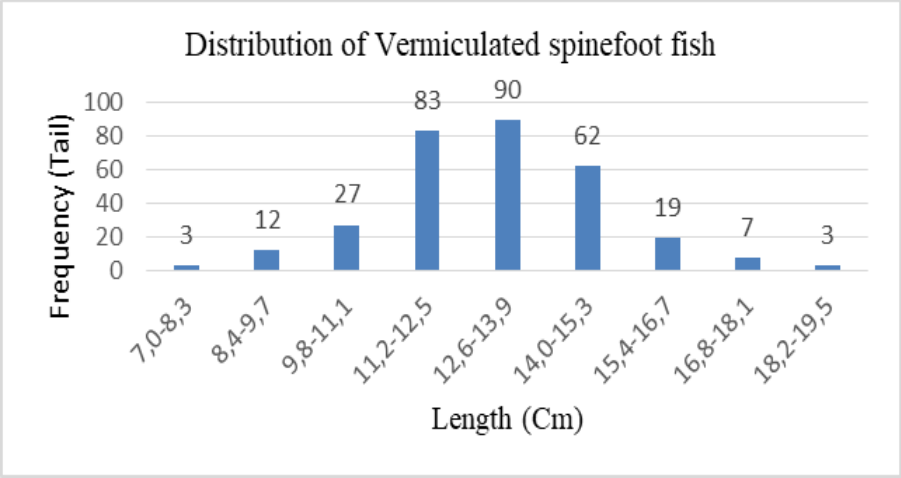


Figure 1. Diagram of length distribution (cm) and fish frequency

The results of the analysis and measurements showed that 3 size groups of the Vermiculated spinefoot fish *Siganus javus* Linennaeus, 1766) were caught using the traditional sero fishing gear with the highest proportion being in the length range of 11.2 - 12.5 cm; 12.6 - 13.9 cm; and 14.0 - 15.3 cm. While the size of the smallest sero caught fish is 7.0 – 8.3 cm and the longest fish size is 18.2 – 19.5 cm. For the size distribution of fish, the most commonly found is the length of 12.6 - 13.9 cm. Furthermore, in Figure 1, 3 groups of fish size were found, each group with a distribution size of 7.0 - 11.11 cm was caught 13%, a group with a size of 11.2 - 15.3 cm was caught 80.0% and a group with a size of 15.5 – 19.5 cm caught 9.4% during the study. The results of the analysis showed that the weight size of the fish obtained during the study caught with the traditional sero fishing gear was in the range of 34.0 – 47.3 grams with a frequency of 115 out of 305 Vermiculated spinefoot fish *Siganus javus* Linennaeus, 1766). who participated in the sampling during the study, and the size of the smallest fish weight was 7.2 – 20.5 grams and the largest fish size was 127.8 – 141.1 grams.

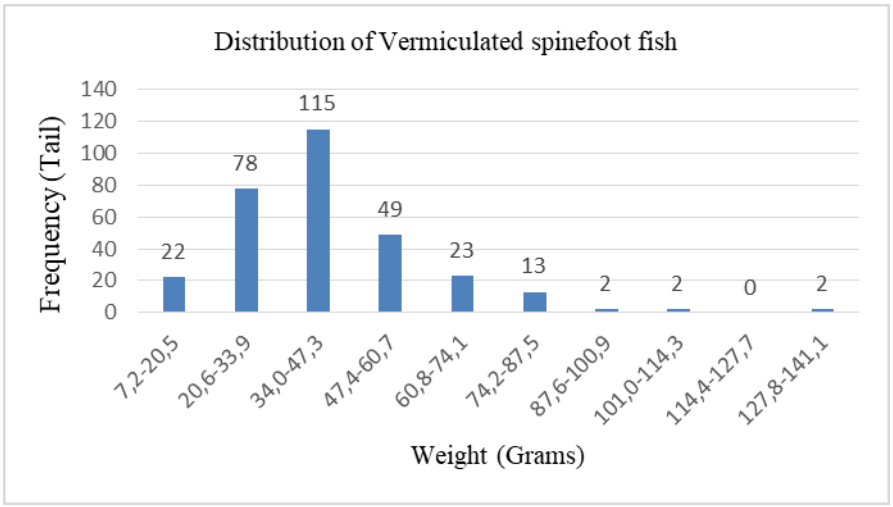


Figure 2. Diagram of distribution of weight (grams) against fish frequency

Meanwhile, the weight size distribution is divided into 3 weight size groups, namely the size distribution of 7.2 - 20.5 grams is 7.7%, the distribution of weight sizes is 20.6 - 60.7 grams is 79.4% and the size distribution is 60. 8 - 141.1 grams as much as 13.4%.

***Level of environmental friendliness***

The results of the analysis of the level of environmental friendliness, according to the weighting of the criteria, are determined based on things from low to high. Among the levels of environmental friendliness that are closely related, includes fishing gear that must have high selectivity, meaning that the fishing gear is intended to only be able to catch fish/other organisms that are the target of the catch. **FAO, (1995)**, said that its assessment sub-criteria for determining the level of environmental friendliness include: 1.0-1.50 (not environmentally friendly); 1.51-2.50 (not environmentally friendly; 2.51-3.50 (quite environmentally friendly) and >3.51 environmentally friendly. Complete results of the analysis of the level of environmental friendliness using the Code of Conduct Responsible Fisheries (CCRF) approach are presented in the following table:

Table 1. Results of analysis of the level of environmental friendliness using the Code of Conduct Responsible Fisheries (CCRF) approach, FAO (1995).

| No | Assessment Criteria | Assessment Weight |
|---|---|---|
| 1 | Fishing gear must have high selectivity. *Assessment criteria:* (Tools catch more than three species with very different sizes) | 1 |
| 2 | The fishing gear used does not damage the habitat, habitat and breeding of fish and other organisms. *Assessment criteria*: (Safe for habitat (does not damage habitat) | 4 |
| 3 | Does not harm fishermen (fish catchers). *Assessment criteria:* (Fishing gear and how to use it can result in permanent (permanent) disability to fishermen) | 3 |
| 4 | Producing catches (fish) of good quality or freshness. *Assessment criteria*: (Dead fish, fresh, and physically disabled) | 3 |
| 5 | The product does not harm consumer health. *Assessment criteria:* (Safe for consumers) | 4 |
| 6 | Minimum wasted by-catch. *Assessment criteria:* (By-catch consists of several species that cannot be sold in the market) | 1 |
| 7 | The fishing gear used must have a minimum impact on biodiversity. *Assessment criteria:* (Gear and operation causes death of all living creatures and destroys habitat) | 1 |
| 8 | Do not catch species that are protected by law or endangered. *Assessment criteria:* (Protected fish are often caught by gear) | 1 |
| 9 | Socially acceptable. *Assessment criteria:* (Fishing gear meets one of the four requirements above) | 1 |
| Total | | 19 |
| Conclusion: Not environmentally friendly | | 2,1 |

## DISCUSSION

The results of the analysis carried out on sero catches, found that the highest proportion of fish caught was Vermiculated spinefoot Fish, one of which was the Vermiculated spinefoot fish *Siganus javus* (Linennaeus, 1766). According to **Kordik & Gufran, (2003)**, the meristic calculation results for Vermiculated spinefoot Fish yielded 13 hard fingers and 10 soft fingers. Calculation of the number of meristic in the anal area has about 7 hard fingers, 9 soft fingers. *S. javus* is usually known as the writing Vermiculated spinefoot Fish. The writing baronang has the characteristics of a rather dark back, there is a small blue circle that is located from the head to the individual, on the top of the Vermiculated spinefoot fish's body. The lower part of the fish's body has a curved line in the belly of the baronang writes. S. javus has a yellow color on the fins and under the eyes. *S. javus* has fine teeth and has a slender body. The habitat of the S. javus type Vermiculated spinefoot Fish lives in shallow waters.

The results of the analysis and measurements showed that 3 size groups of the Vermiculated spinefoot fish *Siganus javus* (Linennaeus, 1766) were caught using the traditional sero fishing gear, with the highest proportion being in the length range of 11.2 - 12.5 cm; 12.6 - 13.9 cm; 14.0 - 15.3 cm.

While the size of the smallest sero caught fish is 7.0 – 8.3 cm and the longest fish size is 18.2 – 19.5 cm. For the size distribution of fish, the most commonly found is the length of 12.6 - 13.9 cm. The longest size of fish and the largest proportion of fish caught, including the size of fish that are still small, and it is very worrying that if the fishing is carried out optimally, it will endanger the sustainability of the rabbitfish resource. This species reaches a maximum total length of 45 cm (18 in), although 30 cm (12 in) is more typical **Froese *et al,* (2021),** The body is covered with a complex gray and whitish labyrinth-like or reticulate pattern with yellow patches on the head and spots on the caudal fin, **Bray *et al,* (2018).**

When compared with the results of **Suherman's research, (2021)** that the *Siganus javus* type Vermiculated spinefoot Fish obtained during the study had the smallest total length of 14 cm, and had an average total length of 26.3 cm. The standard length obtained from measurement results of 15-30 cm. The standard length has an average value of around 20.34 cm. The head length is found to be four to 7 cm.

Based on this comparison, the rabbitfish caught at the research location are a group of fish that are still in the size category of small fish that are not yet worth catching. Descriptively, the proportion of small fish caught during the research was caused by several things, including:

1. In locations where traditional sero fishing equipment is caught, many seagrass ecosystems are found which are good habitats for rabbitfish, where the seagrass ecosystem is a place for nurturing and rearing several types of rabbitfish and other fish.
2. The location for the operation of traditional sero fishing gear is in an estuary area that is still fertile because along the coastline a mangrove ecosystem grows.
3. Rabbitfish migrate during low tide
4. The traditional sero fishing gear is a fishing gear that is a trap, so that when the rabbit fish make their daily migration they are led by the penaju into the serambi, until they are trapped in the sero bag.

5. The location of the sero operation is in a grass cultivation area which is a place to find food for several types of rabbitfish.

Mangrove and seagrass habitats are generally used as habitat in the juvenile stage before migrating to coral reefs in the adult phase **(Amin *et al*., 2016).** Furthermore, **Campbell *et al.* (2011)** stated that the number of adult fish was lower in seagrass ecosystems than in coral reef ecosystems. Seagrass influences the conservation and survival of rabbitfish. Rabbitfish use seagrass plants to live in the juvenile phase, when the rabbitfish spawn, and make seagrass as food for the rabbitfish. However, in the adult phase, rabbitfish will leave the seagrass area and will find coral reef areas to live in **(Kordik & Gufran, 2003).**

**Munira *et al*, (2016)** said that the broad habitat of the rabbitfish is caused by the search for food and reproduction, the rabbitfish move from one habitat to another. This fish can adapt from one habitat to another with different environmental conditions. These milk rabbitfish also often gather in coastal areas at high tide and start spawning after midnight when the tide is low. Specifically for the type *Siganus lineatus* according to **Lam (1974); Widodo *et al*, (2006)** stated that the habitat of this species is in coral waters, along harbor docks and vegetated areas (grass flats). Juveniles like places with mangroves. An area of marine waters can be said to be a fishing area if there is an interaction between the fish resources that are the target of fishing and the fishing technology used to catch fish. Furthermore, **Kordik & Gufran, (2003),** the length of the rabbitfish species *S. javus* has a maximum length of 45 cm. The body size of this fish is also quite large, this type of fish can grow to a size of 40 cm/head. The results of the analysis showed that the weight size of the fish obtained during the study caught with the traditional sero fishing gear was in the range of 34.0 – 47.3 grams with a frequency of 115 out of 305 *Siganus javus* Vermiculated spinefoot fish Linennaeus, 1766). who took part in sampling during the research, and the size of the smallest fish was 7.2 – 20.5 grams and the size of the longest fish was 127.8 – 141.1 grams. **Kordik & Gufran, (2003)** the body size of this fish is also quite large, this type of fish can grow to a weight of 1 kg per fish. Another characteristic of the Vermiculated spinefoot fish, it has 13 soft rays on the dorsal fin, 7 hard rays and 9 soft rays on the anal / anal fin. The width of the body is 1.9 - 2.2 shorter than the standard length.

Based on the length and weight of the caught Vermiculated spinefoot fish *Siganus javus* Linennaeus, 1766), the larger the total length and weight of the fish, the less caught. This was because the Vermiculated spinefoot fish *S. javus* (Linennaeus, 1766) before it reached the optimal size, the fish had been caught by fishermen, so it did not have time to grow to its maximum size. **Suardi *et al.* (2016)** found that the number of rabbitfish S. canaliculatus was higher in seagrasses than coral reefs, while *S. javus* and *S. guttatus* were found in seagrasses but not found in coral reefs. According to **Amalyah *et al.* (2019)** that the rabbitfish *S. guttatus* is a fish that is a pest to seaweed. Furthermore, it is said that the large number of Vermiculated spinefoot fish caught is associated with the presence of vegetation which indicates that seaweed is a place to live and or food for fish. The results of the analysis of the level of environmental friendliness, according to the weighting of the criteria, are determined based on things from low to high. Among the levels of environmental friendliness that are closely related, includes fishing gear that must have high selectivity, meaning that the fishing gear is intended to only be able to catch fish/other organisms that are the target of the catch. There are two types of

selectivity which are sub-criteria, namely fish size selectivity and type selectivity. This sub-criteria consists of (lowest to highest).

According to the first criterion with a criterion weight of 1. it can be said that sero fishing gear does not have high selectivity. Biologically, this fishing gear does not have high selectivity for fish length. This condition needs to be a concern considering that the volume of fish caught is dominated by the size of fish that are not yet suitable for catching or are not yet mature. The fish caught are dominated by immature fish, so the fish recruitment process will not occur, because no fish will grow into adults, spawn and reproduce to improve stocks in the waters. Sero traditional fishing gear uses net material, the results of the analysis of the criteria. The fishing gear must have high selectivity, placing the sero with an assessment weight of 1. This is because the sero fishing gear catches 27 types of fish.

Criteria 2 rating weight, safe for the habitat (does not damage the habitat). Sero traditional fishing gear can cause damage to some habitats in narrow areas. Because the process of operating sero fishing gear is done by installing bamboo stakes and nets as a place for fish to be caught. The use of bamboo stakes has the potential to damage coral, especially when the stakes are installed in fishing locations where there is coral so that the stakes hit the coral which is a fish habitat.

Criterion 3, fishing gear is safe for fishermen and understands standard operating procedures (SOP) when setting up fishing gear, especially installing bamboo stakes which can injure legs if you are not careful. Next, operating fishing gear is categorized as fishing gear and how to use it. result in temporary health problems. Therefore, this fishing gear is classified as unsafe for fishermen because while they are using the fishing gear, they experience temporary injuries when installing the fishing gear. After finishing installing the sero fishing gear, you have to remove hundreds of bamboo stakes so that they don't pollute the aquatic environment, dangerous for people who carry out activities in coastal waters and hinder the movement of fishermen sailing from one place to another in coastal waters. **Bubun *et al*, (2015)** said that sero fishing gear can cause damage to some habitats in small areas. Because the process of operating the sero fishing gear is done by installing wooden stakes and nets as a place for the fish to be caught. The use of wooden stakes has the potential to damage coral, especially when the stakes are installed in fishing areas where there is coral so that the stakes hit coral which is a fish habitat.

Criterion 4, the assessment produces catches (fish) that are of good quality or freshness, according to the results of the analysis carried out, criteria 1 are obtained, this happens because the hauling process for fishing gear takes a long time, causing the fish caught to no longer be fresh, especially since there are no fishermen cold chain process as long as they carry out sero fishing activities.

Criterion 5, The product does not endanger the health of consumers, during the research there has never been an incident of consumers being poisoned due to eating sero-caught, and Criterion 6: Too much by-catch is wasted, the assessment weight is only 1 because there are too many catches from sero-fishing gear. The results of observations carried out on serocatches found several types of fish that were not possible to eat except as discarded catches.

Criterion 7, the fishing gear used must have a minimum impact on biodiversity. Meanwhile, sero fishing gear has a negative impact by reducing the recruitment of small

fish into the waters because most of the fish caught are still small, as explained in the analysis of the distribution of the size of the fish caught.

Furthermore, criterion 8, the assessment of not catching species that are protected by law or endangered, is also quite worrying because the equipment operated by fishermen can cause the fishermen's catch to have the opportunity to catch protected animals.

Criterion 9, assessment of the performance of traditional fishing equipment is socially acceptable, with the requirements: (a) investment costs are cheap and affordable for fishermen, (b) provide economic benefits, (c) do not damage the local community's planting and culture, (d) do not conflict with with existing local and national regulations. According to the research results, sero fishing gear fulfills two of the four requirements above so that sero fishing gear is categorized as fishing gear that is socially acceptable to the community. Economically, operating sero fishing gear provides financial benefits, this is known based on the large investment costs incurred for making sero fishing gear, around 3-5 million rupiah, the depreciation costs are very low.

**Bubun *et al*, (2015)** said that according to the research results, sero fishing gear meets two of the four requirements above so that sero fishing gear is categorized as fishing gear that is socially acceptable to the community at the research location. Economically, operating sero fishing gear provides financial benefits, this is known based on the large investment costs incurred for making sero fishing gear, where fishermen change the sero material from bamboo to nylon nets. Specifically, Vermiculated spinefoot fish *S. javus* that were caught during the research were very dependent on traditional sero fishing gear, the size of the fish caught was dominated by the size of small fish, one of the reasons was because sero, according to the results of the analysis carried out, the level of environmental friendliness was found to be in the poor category. environmentally friendly.

## CONCLUSION

Based on the results of the discussions carried out, the conclusions are formulated:

1. The size distribution of the Vermiculated spinefoot fish *Siganus javus* (Linennaeus, 1766) caught using traditional sero fishing gear is in the size range and weight of 34.0 - 47.3 grams with a frequency of 115 out of 305 Vermiculated spinefoot fish *Siganus javus* (Linennaeus, 1766 ). who took part in sampling during the research, and the size of the smallest fish was 7.2 - 20.5 grams and the size of the longest fish was 127.8 - 141.1 grams.
2. The level of environmental friendliness and those caught in the waters of Pangkep Regency, South Sulawesi Province, using the Code of Conduct Responsible Fisheries (CCRF), are considered less environmentally friendly, although several assessment criteria are considered still better, including: a) Safe for the habitat (not damage the habitat) and b) The product does not endanger the health of consumers.

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