

# ECO-FRIENDLY LEVEL OF MUROAMI, ENCIRCLING NET, AND SPEARGUN FISHING GEARS IN RABBITFISH FISHERY ON SERIBU ISLAND, INDONESIA

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## ABSTRACT

*It is feared that the increasing exploitation of rabbitfish in the Seribu Islands waters will result in damage to the surrounding environment and changes in the population structure in the waters. Environmentally friendly fishing gear technology is one of the solutions for area management efforts so that existing resources and the environment are maintained. The results of the analysis of environmental friendliness for muroami fishing gear, encircling nets (tegur), and spearguns categorize spearguns as less environmentally friendly fishing gear, while muroami fishing gear and circle nets are categorized as damaging the environment fishing gear.*

**Keyword :** CCRF, exploitation, fishing technology, fisheries management.

## 1. INTRODUCTION

Rabbitfish is one of the many fish commodities found in shallow, rocky waters, coasts, to coral reefs [1]. There are 12 types of rabbitfish that have been found in Indonesia. Six of them are found in the waters of the Thousand Islands, namely *Siganus guttatus*, *S. canaliculatus*, *S. javus*, *S. punctatus*, *S. virgatus*, *S. fuscescens*, and *S. vermiculatus* [2]. The main locations for fishermen to catch the Thousand Islands are around Pramuka Island, Semak Daun, Karang Congkak, Karang Bongkok, and Beras Karang, because these areas are areas with seagrass ecosystems and the corals are still quite good for rabbitfish to live in. Several island groups are still actively used as diving or snorkeling sites so that the coral conditions are still good to become a habitat where rabbitfish live [3].

Among the various types of fishing gear used by fishermen in rabbitfish catching operations, three are muroami, encircling net (tegur), and speargun. Increasing market demand for rabbitfish causes fish prices to increase so that exploitation of rabbitfish increases [4]. Continuous exploitation of fishery resources will result in damage to fishing habitats [5]. Over-exploitation of rabbitfish resources causes changes in population structure seen from various sides, such as fish size, production of fishermen's catch, to the age of the fish caught [6].

Area management based on biological information needs to be done to maintain the sustainability of the rabbitfish population. One solution that can be applied is to use eco-friendly fishing technology in carrying out fishing operations. To achieve the sustainability of capture fisheries, the balance of fish resources must be maintained without affecting the quality of the environment. Analysis of the environmental friendliness of muroami fishing

gear, encircling net (reprimands), and spearguns are carried out as an effort to preserve rabbitfish resources and the surrounding environment.

## 2. RESEARCH METHODS

Data was collected in the Seribu Islands waters from February–March (east season) and November–December (west season) 2015. Research on environmentally friendly technologies for muroami fishing gear, encircling nets (reprimands), and spearguns were carried out using survey methods. The data used are primary and secondary. Primary data was obtained through direct interviews with fishermen. Respondents were selected using snowball sampling. Four fisherman respondents were obtained from each fishing gear. The selected respondents were boat owners from fishing gear located on Panggang Island and Pramuka Island. Observation and direct participation were carried out to obtain information regarding fishing locations, and types of rabbitfish caught, and to find out fishing methods. Secondary data was obtained from a literature study, the Department of Maritime Affairs and Fisheries of the Province of Jakarta, and the Livestock and Marine Services Office of Seribu. The data collected to analyze the friendliness of fishing gear are gear selectivity, catch quality, fishing methods, main and bycatch, and related social aspects.

Analysis of the ecofriendly level of fishing gear was carried out using nine criteria of environmental friendliness based on FAO (1995) referred to in Coning & Witbooi (2015) regarding the Code of Conduct for Responsible Fisheries (CCRF) [7]. The nine environmental friendliness criteria are attached in Table 1.

Table 1 Criteria for Eco-Friendly Fishing Gear

No	Criteria	Description	Score
1	High Selectivity	A. The tool catches more than three species with vastly different sizes	1
		B. A tool to catch three species with vastly different sizes	2
		C. Tools for capturing less than three species of approximately the same size	3
		D. A tool to catch only one species with approximately the same size	4
2	Does not damage the habitat, place to live and breed organisms	A. Causes habitat destruction over large areas	1
		B. Causes habitat destruction in narrow areas	2
		C. Causes some habitat in a narrow area	3
		D. Safe for habitat (do not destroy habitat)	4
3	No harm to fishermen (fishers)	A. Fishing gear and how to use it can cause death to fishermen	1
		B. Fishing gear and its use can result in permanent (permanent) disability	2
		C. Fishing gear and its use can result in temporary health problems	3
		D. Safe fishing gear for fishermen	4
4	Produce fish good quality	A. Dead and rotten fish	1
		B. Dead fish, fresh and physically disabled	2
		C. Fresh dead fish	3
		D. Live Fish	4
5	The product does not harm the health of consumers	A. Great chance of causing death	1
		B. Chance to cause consumer health problems	2
		C. Very small chance for consumer health problems	3
		D. Safe for consumers	4
6	Minimum by catch	A. By-catch consists of several types (species) that are not sold in the market	1
		B. By-catch consists of several types and some are sold in the market	2
		C. By-catch less than three types and sell well in the market	3
		D. By-catch less than three kinds and high price in the market	4
7	The fishing gear used must have a minimum impact on biodiversity	A. The fishing gear and its operations cause the death of all living things and damage the habitat	1

No	Criteria	Description	Score
		B. Fishing gear and its operations lead to the death of several species and damage to habitat	2
		C. Fishing gear and operations cause the death of some species but do not destroy habitat	3
		D. Safe for the diversity of biological resources	4
8	Does not catch protected species	A. Fish that are protected by law are often caught	1
		B. Protected fish caught several times	2
		C. Protected fish have been caught	3
		D. Protected fish are never caught	4
9	Socially accepted. A tool is socially accepted by the community if: (1) the investment costs are cheap, (2) it is economically profitable, (3) it does not conflict with local culture, (4) does not conflict with existing regulations.	A. Fishing gear fulfills one of the four statements above	1
		B. Fishing gear fulfills two of the four statements above	2
		C. Fishing gear fulfills three of the four statements above	3
		D. The fishing gear fulfills all of the above statements	4

Source: FAO (1995); Coning & Witbooi (2015) [7]

The nine eco-friendly criteria for fishing gear are then classified into four sub-criteria. The four sub-criteria are divided into four scores [8]: Sub-criterion A has a score of 1; Sub criterion B has a score of 2; Sub criterion C has a score of 3; and Sub criterion D has a score of 4. The score is calculated according to the number of respondents taken. The equation for the criteria calculation formula is as follows:

$$X = \frac{\sum_{i=0}^n a_i}{b}$$

with:





X = Total eco-friendly score

a<sub>i</sub> = Criteria score of the i respondent

b = number of respondents

The maximum score is the total score, which is 36. The eco-friendly category of fishing gear is divided into four groups with the range of scores listed in Table 2.

Table 2 The Category of Eco-friendly Fishing Units

Score	Flag	Category
1 – 9		Highly damaging the environment
10 – 18		Damaging the environment
19 – 27		Less environmentally friendly
28 – 36		Environmentally friendly (eco-friendly)

Source: Bubun and Mahmud 2015 [12]

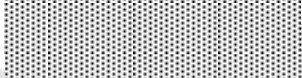


### 3. RESULTS AND DISCUSSION

Operations to catch rabbitfish are carried out using a variety of fishing gear due to the diversity of types of rabbitfish found in the waters of the Thousand Islands. Among the various fishing gears used, three of them are muroami, encircling net (rebuke), and speargun. The results of the ecofriendly analysis of fishing gear show that speargun fishing gear has the highest score compared to muroami and ring nets with a score of 24.75. The second highest score was achieved by the encircling net fishing gear at 17.75, while the lowest score was at the muroami fishing

gear at 16.25. The higher the score indicates the more ecofriendly the fishing gear is. The ecofriendly categories of muroami fishing gear, ring nets and spearguns are attached in Table 3.

The results of the ecofriendly analysis of muroami fishing gear, ring nets, and spearguns against nine criteria show that only speargun fishing gear is included in the less environmentally friendly category. The other two fishing gears, muroami and encircling nets, fall into the category of damaging the environment fishing gear.

Tabel 1 The Results of the Eco-friendly Analysis of Muroami, Encircling net, and Speargun

Alat Tangkap	Skor	Bendera	Kategori
Muroami	16,25		Damaging the environment
Encircling net	17,75		Damaging the environment
Speargun	24,75		Less environmentally friendly

### 3.1 Muroami

Muroami fishing gear is operated by herding fish into net bags, which are then lifted manually by 15–18 fishermen. Fishing equipment is used in the form of GPS, sonar, baskets, herds, compressors, and diving aids. Muroami is operated once a day at noon. Muroami has low selectivity because the mesh size is small so many types of fish of various sizes are caught [10]. The operation of muroami fishing gear is very dangerous for fishermen [11]. In addition to endangering fishermen, the operation process risks destroying coral habitats [12]. The operation of the fishing gear is shown in Figure 1. An improvement solution that can be applied to the operation of muroami fishing gear is the use of tools that meet safety standards [13]. Herding fish using rattles/slots is sufficient to use a float without diving equipment. The mesh size of the nets needs to be enlarged so that the selectivity of the muroami fishing gear increases [14]. The types of rabbitfish caught were *Siganus javus*, *S. vermiculatus*, *S. guttatus*.

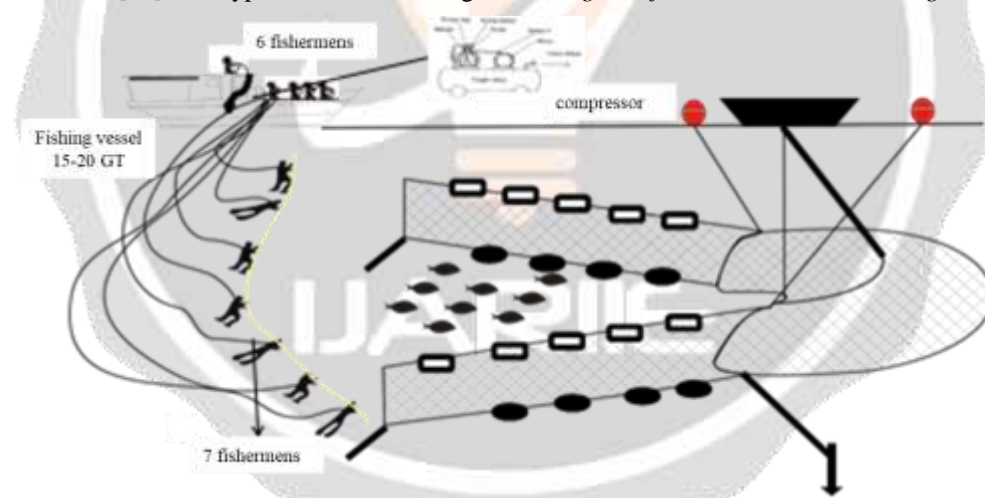


Figure 1 Muroami Operating Method

Muroami is included in the category of fishing gear that is damaging the environment and tends to be destructive, with a total score of 16.25. Of the nine categories, the low muroami score is in the category of having high selectivity, not destroying the habitat where fish and other organisms live and breed, the fishing process is not harmful to fishermen, the catch is of good quality, fishing gear has an impact on the diversity of biological resources, and socially acceptable fishing gear.

### 3.2 Encircling net

The ecofriendly score of the encircling net fishing gear based on nine criteria is 17.75, so the encircling net is categorized as damaging the environment fishing gear. The encircling net scores are low in various categories, namely having high selectivity, not destroying habitats, places to live, and breeding for fish and other organisms, the fishing process does not endanger fishermen, and fishing gear has an impact on the diversity of biological resources.

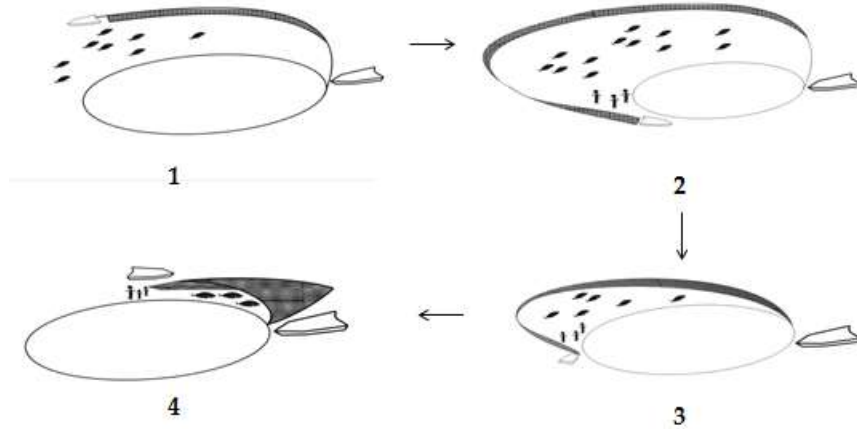


Figure 2 Encircling net Operating Method

Encircling net selectivity can be increased by increasing the mesh size of the net. As many as 7–10 fishermen spend the night and operate the encircling net by spreading nets from the coast towards the sea, to then be herded into shallow waters in the surrounding area. The operation of encircling net fishing gear is very dangerous for fishermen, so fishermen should use safety gear such as rubber boots, life jackets, masks, and wet suits. The types of rabbitfish caught were *Siganus javus*, *S. virgatus*, *S. punctatus*, *S. canaliculatus*, and *S. guttatus*.

**3.3 Speargun**

Spearguns are made of a shaft of wood, metal, or some other material with one or more pointed points [15]. Fishing gear works by gripping, pinching, injuring, or killing the fishing target and is operated by 5–6 fishermen at night around 19.00–20.00 at a depth of 3–18 m. Fishing operations are carried out at night because reef fish tend to sleep and are passive [16]. Some of the tools used are compressors, waterproof flashlights, and diving masks. Compressor aids make speargun fishing gear dangerous to operate because it can cause decompression to the death of fishermen [10]. To reduce the risk of accidents, the compressor should be replaced with a piece of safe diving equipment. The types of rabbitfish caught were *Siganus javus*, *S. vermiculatus*, *S. punctatus*, *S. canaliculatus*, and *S. guttatus*.

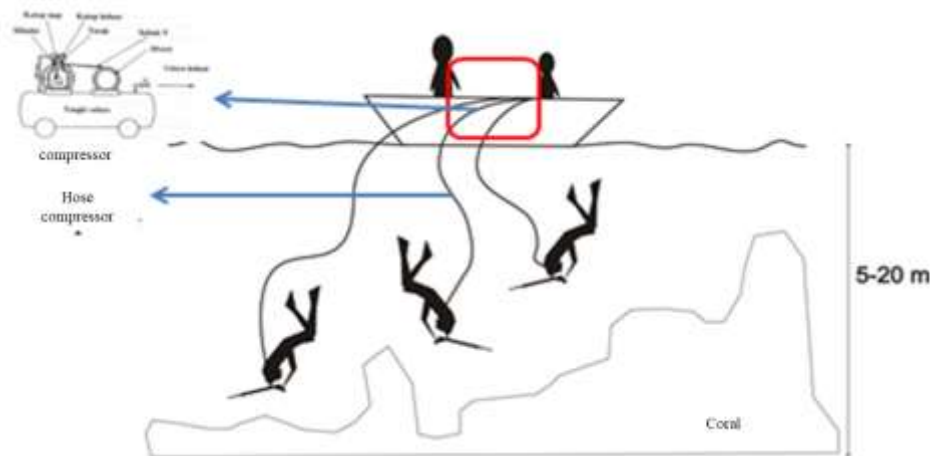


Figure 2 Speargun Operating Method

The speargun achieved the highest score among the three fishing gears, which was 24.75, so the speargun was categorized as a less environmentally friendly fishing gear. Speargun fishing gear is categorized as environmentally friendly on the criteria of having high selectivity, does not damage habitats, places to live, and breeds fish and other organisms, small catches with a score of 3. This fishing gear is considered less environmentally friendly because it does not include the criteria for a non-hazardous fishing process fishermen, and socially acceptable fishing gear.

#### 4. CONCLUSIONS

Three of the various types of fishing gear used in rabbitfish fishing operations in the Seribu Islands waters are muroami, encircling net, and speargun. The results of the analysis of the level of ecofriendly fishing gear for nine categories show that speargun fishing gear gets the highest score and belongs to the less environmentally friendly fishing gear category, while muroami and encircling net fishing gear fall into the damaging the environment fishing gear category.

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