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Research Article

Bottom Gill Net Modification for Fish Catch Development and Coral Damage Prevention

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Abstract: One of the problems encountered in coastal areas and small islands in Indonesia is habitat degradation, especially the coral reef. Bottom gillnets have been commonly used by traditional fishermen, but it is not environmentally friendly. When lifting the net, coral rubbles are also taken up because the sinker line and sinker are in direct contact with the sea bottom. The use of bridle line on the sinker line can minimize damages of the bottom habitat. This research aimed at comparing the effect of using bottom gillnet with bridle line and strapping bands on fish catch and coral damages. The bridle line used was 100 cm long, while the strapping band distance intervals were different. This study revealed that addition of strapping bands between the bridle line could improve fish catch compared with the use of anly bridle line. Also, it did not affect the coral lifted.

Keywords: Bottom gillnet, bridle line, catch, coral cover, strapping band

1. INTRODUCTION

Fishing technology has been progressing, particularly in case of fishing gear, auxiliary gears, and fishing techniques. Gill net is one of the fishing gears widely used by traditional fishermen in Indonesia for self consumption. It is a passive fishing gear, but is very selective, since the size of the targetted fish can be predicted by adjusting the mesh size. It is designed to catch a specific size range of fish, but not species specific, and thus, this fishing gear often entangles many targeted fish. This gear is very common in use to catch reef fishe, since its construction is simple, relatively inexpensive and easy to handle.

Bottom gillnet is a type of gillnet used to capture demersal fish. In North Sulawesi, fishermen use smaller mesh size than 7.5 cm with no gap between sinker line and bottom waters. Thus, when hauling, not only fish, but also many corals and other biota, such as crabs, snails, shellfish and crustaceans are caught. Besides, fishermen assume that fishing operation can be successful if it is carried out over the reef.

Bottom gillnet commonly used in coral reef ecosystem like eastern Indonesian waters could have a negative impact on the coral existence and sustainability. There are three components of gillnet interacting with benthic habitats, *i.e*, weights or anchors, leaded rope or footgear, and the net itself. The weights can crush benthos or re-suspend sediment when retrieved. The leaded rope has some impact on bottom substrates while fishing, but impacts are greatest during retrieval or when gear is lost (i.e., due to dragging across the bottom, entanglement with biogenic habitat, or re-suspension of sediment). The mesh could become entangled on bottom features and cause damage upon retrieval [1, 2].

Artisanal fishing activity with gillnets has negative impact on the coastal reef systems

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analysing its associated fauna (by catch) and the stock of the target species *Panulirus echinatus* (Smith, 1869). The analysis of target species using nocturnal visual census demonstrated a significantly higher number of *P. echinatus* at the site where gillnet use was virtually absent within three sampled habitats, fringe, cave and soft bottom. The analysis of bycatch species from artisanal fishermen's gillnet landings recorded four lobster species and 10 crab species. These decapod species play an important ecological role as detritivores, herbivorous and first consumers within the reef ecosystem as well as being natural prey items for several reef fish [3]. The harvesting activity, such as leaving the net attached to the reef fringe over a nightly tidal cycle, to the next morning, can also directly affect the wild stocks and a significant impact on associated low-trophic level species, which are captured and discarded as bycatch [4].

Specific information on the extent of coral damages caused by gill net operation in Indonesia is not available, even though gill net fishing operation is well-known as one of coral-damaging causes. Based on studies in west Indonesia (435 stations), Central Indonesia (407 stations), and Eastern Indonesia (222 stations), in 2016 Indonesia coral reefs possesses 23.40 % good coral condition and only 6.39 % are in very good condition [5]. Looking at the impact of fishing operations practiced by traditional fishermen, the use of bottom gill net will have the largest impact on the bottom physical habitat damages, since the stone weights used are entangled on the corals [6]. Continuous bottom gill net operations in the same area could reduce the catch quality, and loss of the fishing gear in gill net fishing operation could lead to ghost fishing due to uncontrolled fishing operations [7].

Nevertheless, fisheries resources in the coral reef have traditionally been main food source of the coastal communities for family consumption or local sale and due to being near the sea, so that this area usually becomes the main target of fishing operations [8]. The use of small-meshed gillnet can be set to obtain sustained production by allowing a higher proportion of the spawning biomass (both ESS and MS) to remain in the stock. For this, gear selectivity should be known [9].

Previous study shows that the use of bridle line on the bottom gill net can prevents the sinker line to be in direct contact with the sea bottom, so that it can minimize the coral damage. However, the use of long bridle line is also potential to give escapement space for demersal fish, and makes lower catch [10]. It results from that the longer the bridle line is used, the bigger the space under the sinker line is opened and the easier the fish to escape.

In this study, increasing fish catch and reducing coral damage, strapping bands were installed between the bridle lines. Therefore, the purpose of this study is to compare the effect of strapping band addition to bottom gillnet with bridle line in relation with number of fish catches and coral damage.

2. MATERIALS AND METHODS

This research was conducted in the Manado Bay, Indonesia at the geographical position of 1°28'08,28" N and 124°49'41.41" E. Bottom gillnets were made of PA Cf 210D × 21 with the length of 18.20 m and the width of 4.56 m, the mesh size is 10 cm. The amount of 1 m bridle lines were installed on the sinker line, and strapping bands were also placed between the bridle lines with different distance intervals, 25 cm (A), 50 cm (B), and 100 cm (C), respectively. The bottom gill net without bridle line was used as control treatment. Fishing operations were done for 12 trips at the depth range of 0 m to 40 m. Measurements were done for number of fish caught and number of coral rubbles taken. The uplifted coral was expressed as squared meter of cover area.

The hypotheses were set as follows: H_0 : uplifted corals and total fish catches taken were not significantly different between treatments of different strapping band distance intervals, and H_1: uplifted corals and total catches taken were significantly different between treatments of different. Data of fish catch and corals lifted were

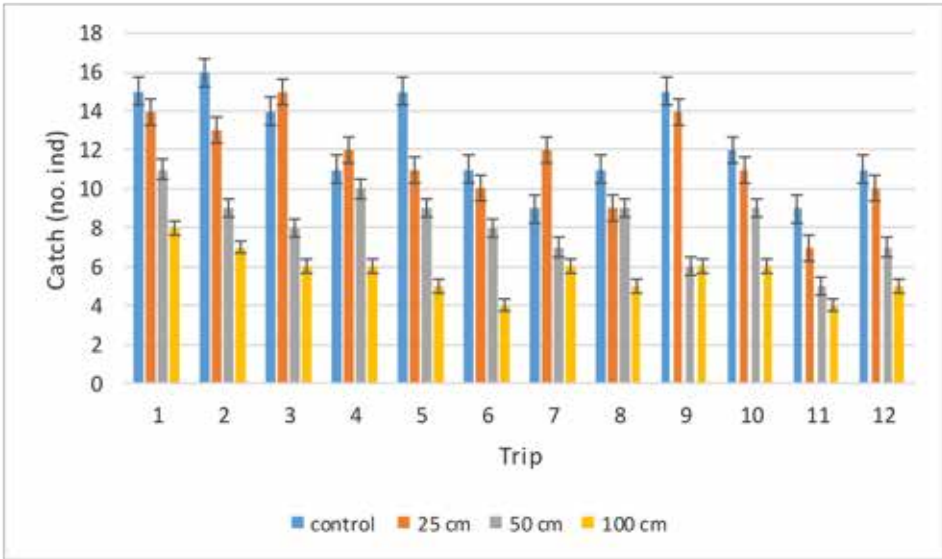

Fig. 1. Fish catches taken in the bottom gill nets using different strapping band distance intervals.

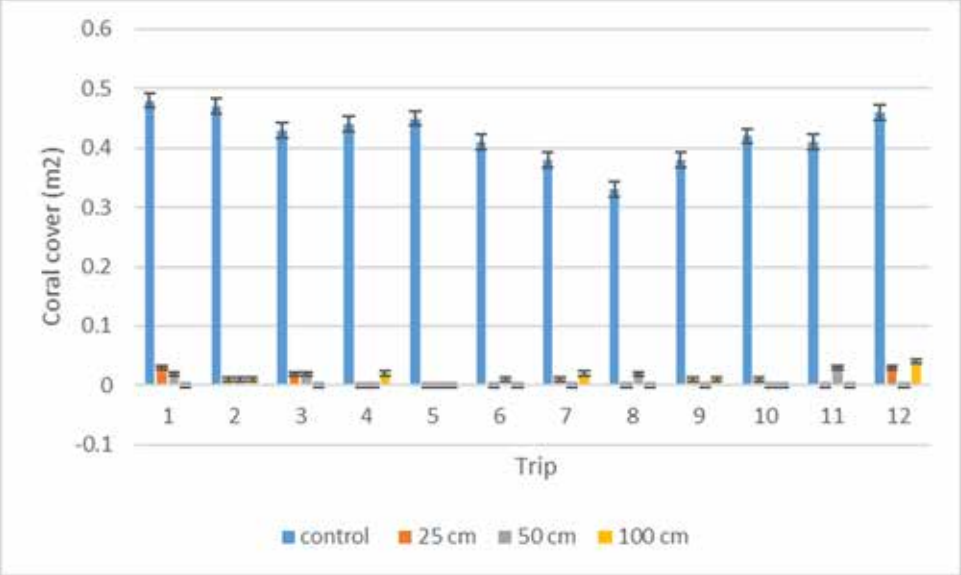

Fig. 2 Coral cover taken in the bottom gill nets using different strapping band distance intervals.

descriptively analyzed and presented as histograms. Treatment effects on number of fish catches and lifted corals were analyzed using t-test in Excel Program Software.

3. RESULTS AND DISCUSSION

Construction modification of bridle line-having bottom gill net by adding strapping bands between bridle lines showed that strapping bands could function as instrument of preventing fish to go through under the net and therefore, could drive the fish school to swim slightly higher over the sea bottom. This makes the fish unable to avoid the net body and increases the number of fish catches. Fig. 1 demonstrates that wider strapping band distance interval catches lower number of fish than that of shorter strapping band intervals. It reflects that the addition of strapping bands could help increase the number of catches.

The present study also found similar condition as previous study [10] that the use of bridle line

reduced lifted corals, since bridle line made the sinker line do not touch the corals. Fig. 2 shows that only control treatment takes the highest number of corals, while those with bridle line and strapping bands collect very low number of coral rubbles. This study verifies results of a previous study that this bottom gill net modification could support the effort to create environmental friendly type of bottom gill net, and thus, contribute to coral reef conservation efforts.

Moreover, Table 1 demonstrates that mean number of fish catch declines with increase in size of different distance interval of strapping band application. The wider the strapping band distance interval is the lower the number of fish is obtained. It could result from that wide distance interval of the strapping band placement gives larger escapement space. However, the lifted corals are much lower in the bottom gill net with bridle line and strapping bands than that in the control treatment (Table 1).

Statistical analysis using t-test shows that distance interval of strapping ban significantly affects the number of catch, and only the shortest distance interval reveals no significant difference. It means that the shortest distance gives better barrier image that drives the fish to swim to the upper layer and makes them entangled on the net. Table 2 demonstrates that application of bridle net with strapping band distance interval does not give significantly different effect on the lifted coral rubbles. Only control treatment takes the highest number of corals in fishing operation experiments of bottom gill net.

Application of bridle line with strapping band also took much lower number of coral rubbles than the control treatment. Comparisons between treatment A, B, and C do not show any significant difference. It means that application of strapping bands between bridle line does not harm the coral

Table 1. Mean and standard error of fish catch and coral lifted.

Mean ± SE	Control	25 cm	50 cm	100 cm
Fish catch	12.416 67 ± 0.712	11.5 ± 0.669	8.166 667 ± 0.489	5.666 667 ± 0.333
Coral lifted	0.422 ± 0.1249	0.01 ± 0.0032	0.009 167 ± 0.0031	0.008 333 ± 0.0036

Table 2. t-test on treatment effects on fish catch and coral lifted.

Treatment comparison	N	Df	$t_{calc.}$	$t_{tab.}$	*P*
Fish Catch					
Control vs A	12	11	1.688 2	2.200 9	$P > 0.05$
Treatment A vs B	12	11	5		$P < 0.001$
Treatment B vs C	12	11	6.267 832		$P < 0.001$
Control vs 50 cm	12	11	6.290 7		$P < 0.001$
Control vs C	12	11	11.658 3		$P < 0.001$
Coral Cover					
Control vs A	12	11	36.746 4	2.00 9	$P < 0.001$
Treatment A vs B	12	11	1.018 45		$P > 0.05$
Treatment B vs C	12	11	0.139 7		$P > 0.05$
Control vs B	12	11	31.369 35		$P < 0.001$
Control vs C	12	11	33.523 53		$P < 0.001$

reefs. The demersal fish caught consist of *Caranx* sp., *Gymnosarda* sp., *Pampus* sp. and *Lujanus* sp. These belong to economically important fish [11] with mean body circumference of 20 cm and standard length of 40 cm. The catches could be influenced by fish behavior, surface currents, tide and construction of the bottom gillnet. However, untargeted species, such as sea turtles, dugong, sharks, and other possibly endangered or threatened marine animals that feed in the coastal areas could also be entangled on the net. In fact, large ocean animals are also entangled, such as whales, seals, sea turtles, seabirds, and sharks – many of which are threatened or endangered with extinction [12], so that technological development of bottom gillnet is needed. Previous study shows that the use of pinger fitted to bottom gillnets could influence fish catch efficiency and damage to bottom gill nets related to bottlenose dolphins, about 28 % of fish biomass of the catch 31 % of damage inflicted by dolphins on the nets [13], so that it reduces the economic loss suffered by fishermen. Therefore, fishing gear development needs to consider the gear selectivity, target fish, sufficient spawning stock availability, minimum legal size, and negative impact of the fishing operation on habitat destruction and biological damages.

4. CONCLUSIONS

Modification of bottom gill net by adding bridle line and strapping bands could increase the number of fish catches and prevent coral damage. The use of strapping bands under the sinker line could drive the fish upward, and the net's function as fish barrier net could be optimal in the fishing operations. In spite of that, bottom gill development needs better modification to produce both more catches and an environmentally friendly effect.

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