Composition of lost and discarded fishing gear (ghost fishing) in the blue swimming crab fishery in Rembang, Central Java

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Abstract. Ghost fishing is the ability of fishing gear to catch fish continuously for a certain period when the fishing gear has been lost. Some passive fishing gear will most likely be lost due to material degradation of gear components and other factors. Therefore, it is necessary to study the composition of fishing gear left in the sea to find out the cause of ghost fishing. The study aimed to determine the composition of materials from fishing gear left in the waters of the Rembang Sea. This is done by collecting fishing gear found by fishermen and then weighing per material to get the composition of the fishing gear. As many as 86% are metal, and 14% are plastic. This shows that metal and plastic materials are difficult to decompose in marine waters, so fishermen still find these fishing gear in Rembang waters. This also shows that metal is the dominant constituent of the fishing gear used by fishermen in Rembang waters. This research provides information about what fishing gear materials are likely to be a source of ghost fishing so that it can be a suggestion for using fishing gear.

Keywords: ghost fishing, fishery management, lost and discarded fishing gear

1. Introduction

Fishing on blue swimming crabs (BSC), carried out by fishers from Rembang District, Central Java, is one of the significant activities that may contribute to marine pollution in the form of lost and discarded fishing gear. The fisheries become more significant because of the high demand in domestic and overseas markets that promote the use of more fishing gear and fishing efforts [1]. Even the fisheries are categorized traditionally due to the involvement of small boats with folded or collapsible traps, gillnets, and trammel nets [2], [3]. Hundreds of collapsible traps are deployed underwater, and baits are provided inside the traps to attract the crabs. The traps, gillnets, and trammel nets can be accidentally lost because the connecting lines cannot stand excessive stress or are broken due to vital water currents and big waves, physical contacts with rigid substrates or obstacles, some fishing gear already abandoned by other anglers, etc. The fishing gear can also be deliberately abandoned by anglers in a particular condition when traps complicate fishing operations. When a fishing gear is out of the anglers' control, whether damaged or not, its construction still has the potential to capture fish for a certain period, known as the ghost fishing phenomenon [4]. The fish captured by the abandoned gear may attract more fish to approach the gear. Predatory fish likely approach the gear and get trapped or tangled when searching for prey. The process of uncontrolled fishing will continue until the gear loses its ability to retain the fish. In addition to the fishing effort made by the fishers, the lost or abandoned gear generates ghost

fishing that can significantly contribute to fish mortality. In the use of synthetic material, the potency of capture is prolonged because of the durability of the gear materials. This study aimed to determine the composition of materials from abandoned fishing gear off Rembang, Central Java.

2. Research methodology

This research takes advantage of an ongoing program called Ghost Fishing Clean Up that involves fishers collecting remains of abandoned fishing gear to minimize ghost fishing off Gedongmulyo Village, Lasem Sub-District, Rembang District, Central Java Province. The program was started by outreaching fishers to understand ghost fishing and its potential adverse impacts on fish resources and fishing operations. The outreach delivered some messages to stop cutting practices on other fishers' fishing gear, to avoid conflict among fishers, helping other fishers who lost their gear by recording the weight of the evacuated gear and taking it home. The outreach on the ghost fishing phenomenon was continued with posters in strategic locations and weekly/bi-weekly group meetings facilitated by community organizers from the Asosiasi Pengelolaan Rajungan Indonesia (APRI)/Indonesian Blue Swimming Crab Association. Anglers can report the findings of ghost fishing gear in the sea. The records made by the fishers include types of gear materials. The analysis is carried out by comparing the composition of materials of the evacuated lost gear. The materials are identified following categories made by [5]. Marine debris can be divided into plastics, metals, glasses, rubbers, wood, and cloth. Portions of each material are calculated using the following equation:

$$Material\ percentage = \frac{n}{N} x100\% \quad (1)$$

with, n: weight of material n and N: weight of all compositions

3. Results and discussion

3.1. Frequency of ghost gear found by fishers

From October 2020 to January 2022, five fishers reported ten findings of damaged and abandoned traps, or an average of two cases per month and two cases per reporting fisher (Table 1). The total weight of the evacuated traps was between 500-2500 grams per unit, while the ropes were between 50-550 grams per unit (Table 2).

The damaged traps were discovered by the anglers when they hauled or lifted their traps. The shape of the damaged traps is irregular, e.g., bending or broken frames. The abandoned traps were tangled on the ropes or their traps. Abandoned traps were commonly reported because folding traps are prevalent among fishers targeting BSC [6], [7], [8].

Table 1. Frequency of reporting fishing gear left in the sea found by fishermen.

No	Date	Fisherman	Type of Fishing Gear	Weight (g)
1	18/10/2020	Suparwis	Pot/Trap/Bubu	800
2	18/10/2020	Suparwis	Rope	76
3	30/11/2020	Munadi	Pot/Trap/Bubu	2201
4	30/11/2020	Munadi	Rope	516
5	11/12/2020	Munadi	Pot/Trap/Bubu	590
6	22/12/2020	Suparwis	Pot/Trap/Bubu	2489
7	22/12/2020	Khairul Hadi	Pot/Trap/Bubu	1741
8	20/05/2021	Suparwis	Pot/Trap/Bubu	1556
9	02/01/2022	Indra Priyana	Pot/Trap/Bubu	1400
10	29/01/2022	Suleka	Pot/Trap/Bubu	590

Table 2. The composition of the found ghost fishing gear.

Type of Fishing Gear	Part	Compositions	Weight (g)
Pots/Traps/Bubu 1	Framework	Metal	728
	Net	Plastic	72
Rope 1		Plastic	76
Pots/Traps/Bubu 2	Framework	Metal	2002.91
	Net	Plastic	198.09
Rope 2		Plastic	516
Pots/Traps/Bubu 3	Framework	Metal	536.9
	Net	Plastic	53.1
Pots/Traps/Bubu 4	Framework	Metal	2264.99
	Net	Plastic	224.01
Pots/Traps/Bubu 5	Framework	Metal	1584.31
	Net	Plastic	156.69
Pots/Traps/Bubu 6	Framework	Metal	1415.96
	Net	Plastic	140.04
Pots/Traps/Bubu 7	Framework	Metal	1274
	Net	Plastic	126
Pots/Traps/Bubu 8	Framework	Metal	536.9
	Net	Plastic	53.1

The lost traps are likely due to strong water currents [9], [10]. The strong water currents coincide with lousy weather. In addition, the second reason for lost gear is the overlapping of the fixed and mobile fishing gear, which sometimes conflicts among fishers. The third reason is the entanglement of fishing gear with obstacles at the sea bottom.

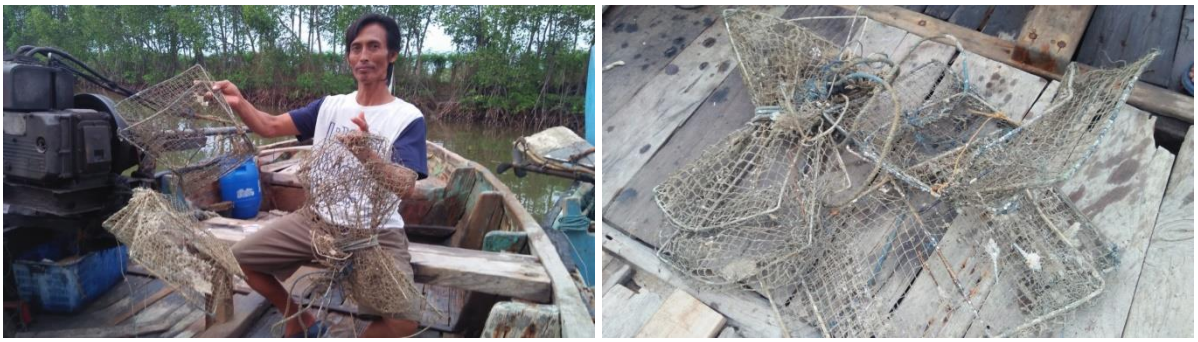

Figure 1. Finding a ghost fishing gear in the form of a trap by fishermen in Gedongmulyo Village, Rembang (Source: Research Documentation/APRI).

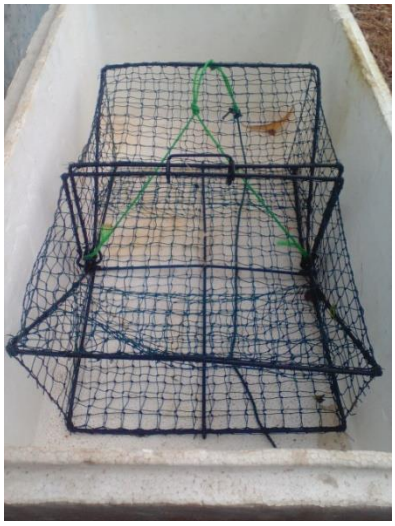

Figure 2. Example of the folding trough in good condition (Source: Research Documentation/APRI).

3.2. Material composition

The materials found in the discovered traps are metals (86%) and plastics (14%) (Table 3). Metal is the primary material of the frames of the traps; the frames were either coated with plastics or without coating. Fishing gear, mainly operated at sea, generally consists of fishing gear frames and nets, including traps. [7] in their research state that fishing gear is made of iron and nets.

The skeletons that make up the ghost fishing gear have a weight that ranges from 500-2,300 grams, while the nets that make up the fishing gear have a weight that ranges from 50-225 grams. The ropes found were made of plastic, so the weight of the material was the same as the weight of the fishing gear found. [6] stated that traps made of metal, namely mild steel rods and meshes of welded steel wire and fully protected by a plastic layer, have provided efficient performance and more extended durability. Fishermen themselves tend to prefer traps that are light, easy to make, using durable materials.

Table 3. Total and percentage of each composition.

Composition	Total Weight (g)
Metal	10,343.97
Plastic	1,615.03
Total	11,959

Metal, which is the building block of the fishing gear frame, will, of course, dominate the findings of the weight of the material, plus the fact that what is found is folding trap fishing gear. The folding trap fishing gear found uses a metal frame, which is common in small-scale fisheries. Metals and plastics are difficult to degrade by the sea, which is quite dangerous for the environment, especially the biota in these waters. Although metal is corrosive, using plastic that coats the metal makes it degrade longer. In addition to ghost fishing gear that can entangle aquatic biota without the control of fishermen, the composition of metal and plastic materials can allow them to enter the body of aquatic biota while eating.

Furthermore, [11] stated that abandoned fishing gear would damage tourist attractions, become an obstacle for commercial and recreational fishing, can reduce fishermen's opportunities to get fish because the presence of such fishing gear will make marine animals avoid so that the fish will not be found again where it should be. He also stated that plastics in the form of fishing tools, such as fishing lines or nets thrown into the sea, will be carried by ocean currents and can even reach coral reefs or algae, making these organisms entangled and difficult to reproduce. In addition, coral reefs and algae are trapped by the ocean currents (in entanglement nets) in shallow waters, where they cannot survive

there. The disruption of the proliferation of coral reefs and plankton will reduce the heterogeneity of the organisms that comprise the primary marine habitat.

Efforts to collect data and clean up ghost fishing gear, especially in crab fisheries, have been carried out by Asosiasi Pengelolaan Rajungan Indonesia (APRI)/Indonesian Blue Swimming Crab Association, with initial locations in Rembang and Pamekasan. APRI itself is trying to continue developing this program to be more comprehensive and reach other locations. Fisheries management in general, particularly crab fisheries, needs to be carried out collaboratively between all stakeholders. Ghost fishing is a problem in capture fisheries that must be addressed to realize sustainable fisheries [12].

4. Conclusion

The ghost fishing gear found in the waters of Rembang from October 2020 to January 2021 was dominated by folding traps in as many as 8 of the ten finds, with the rest being ropes. The composition of the fishing gear found consisted of two materials, namely metal, and plastic. Metal is generally found in the framework of fishing gear, while plastic is a constituent of nets and ropes. The ghost fishing gear comprised 86% metal and 14% plastic. Fishing gear lost and dumped in the sea can become ghost fishing gear that triggers ghost fishing, where it catches and ensnares fish and other marine biota without human control. In addition, the composition of materials in the form of metal and plastic also endangers the sustainability of fisheries due to environmental pollution due to metal and plastic waste. Ghost fishing needs to be minimized with collaboration by all stakeholders.

Recommendation

The research carried out still has many limitations. Further research needs to present more comprehensive data, including recording the dimensions of the lost and discarded fishing gear, then collecting data on the specific location of the fishing gear found. In addition, it is also necessary to involve more fishermen so that the scope of research can be more comprehensive and the results obtained can be better.

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