Diversity of non-targeted species on blue swimming crab *Portunus pelagicus* collapsible trap fishery in Pemalang, Central Java

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Diversity of non-targeted species on blue swimming crab *Portunus pelagicus* collapsible trap fishery in Pemalang, Central Java

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Abstract. A collapsible trap is one of the fishing gears commonly used by fishermen to catch blue swimming crabs. However, non-target species or by-catch are often caught by fishing gear. This study aimed to determine the diversity of non-target species caught by collapsible traps used in the blue swimming crab fishery. This study was conducted in Pemalang waters from January to June 2020. The Shannon-Wiener diversity, the evenness, and the Simpson dominance indices were analyzed. The results showed that the non-target species comprised seven crustaceans, six fish species, and four mollusks. The highest number of by-catches was observed in June from the mollusk group (5,762 ind of tiger snails), while the lowest catches were observed in Jan-March from the groups of fish, crustaceans, and mollusks. The predominated by-catch from collapsible traps in Pemalang was *Babylonia* sp. (87.64%), *Podophthalmus vigil* (9.74%), *Charybdis feriatus* (1.5%), and *Portunus sanguinolentus* (0.36%). The highest diversity index value was estimated in Jan at 1.73%, while the lowest was in June at 0.05%. The evenness index was highest in May and lowest in June. The by-catch biodiversity of blue swimming crab fishery in Pemalang was classified as low diversity category, low evenness, and moderate dominance.

Keywords: blue swimming crab, collapsible traps, crabs, non-target species

1. Introduction

A coastal area is an essential strategy and has the potential for abundant natural. The value of primary productivity in the coastal areas is higher than in offshore waters. The biological resource potential of the coastal areas is various, such as fish, shrimp, seaweed, mangroves, coral reefs, and seagrass beds [1]. It is estimated that there are 4000-6000 types of fish in all waters of Indonesia [2]. Fishing grounds are essential for the sustainability of capture fisheries activities, and each fishing area is not necessarily a potential fishing ground. A potential fishing area is a water area with the potential of abundant fish resources with excellent quantity and quality biologically. Criteria that can be used as fishing ground indicators include biological aspects and ecological aspects [3].

Pemalang District is one of the sub-districts in Pemalang Regency, which is a center for fishery activities. Consisting of 14 sub-districts and 222 villages, the Pemalang District area is divided into 20 villages with a population of 198,640 people. There are 172 fisheries households in Pemalang District, including 86 fishers, 22 cultivators, and 64 fish processors. Activities in the fishery product processing production system include the provision of raw materials, preparation of tools and materials, processing, and packaging [4]. The collapsible trap is one of the fishing gears commonly used by fishing

communities to catch bottom fish, reef fish, and another marine biota, including small crabs, because of its simple construction, relative cheapness, and ease of operation with small boats [5]. This fishing gear is shaped like a cage or a rectangular shape that is commonly used to catch blue swimming crabs. Although this tool is static and passive, it is not uncommon for several other biotas to be caught.

By-catch or non-target species are also often obtained by crab fishermen in Pemalang Regency, who use collapsible traps. The collapsible trap is one of the fishing tools commonly used by fishermen to catch small crabs. The crabs caught with traps are still alive and fresh, so the quality of the catch is guaranteed. Crab fishermen generally use a trap that is rectangular with two doors. The funnel (entrance) in the trap is one of the determinants of the success of the biota (crab) trapped in it [6]. Crab fishermen in various regions prefer collapsible traps for reasons other than being easy to use and clean, they are also practical to take to the sea in large quantities. The use of environmentally friendly fishing gear in fishing activities is a must for fishermen so that the sustainability of the marine ecosystem is well maintained. Fishing gear is environmentally friendly if the tool used in its operation does not damage or disturb the balance of the ecosystem. The collapsible trap is environmentally friendly fishing gear because, in its operation, it is passive and selective [7].

Collapsible trap fishers can get additional income from the sale of by-catch, which has significant economic value. However, it is not uncommon for fishermen to get by-catch that cannot be used for sale or personal consumption. The by-catch that crab fishermen often obtain in Pemalang is fish, shrimp, crabs, snails, and other mollusks such as octopus and cuttlefish. According to [8], the results of research on the fishing power of collapsible traps with the main target of mangrove crabs showed several other biotas caught in collapsible traps, including crabs (*P. pelagicus*), peci shrimp (*Penaeus indicus*), rock crabs (*Thalamita* sp.), bolem crabs (*Leptodius* sp.), and beloso (*Saurida tumbil*). The by-catch of collapsible traps in northern Pemalang waters is crabs (*Scylla* sp.), ronggeng shrimp (*Harspiosquilla* sp.), red snapper (*Lutjanus* sp.), and octopus (*Octopus* sp.). At the same time, starfish have no economic value [9]. This study aimed to determine the diversity of by-catch or non-target species that are likely to be caught by small crab fishermen using collapsible traps in Pemalang waters.

2. Research methodology

The research was conducted from January to June 2020 in Pemalang waters. Pemalang is one of the centers of blue swimming crab fishing activities on Central Java's north coast, using collapsible traps. The collapsible trap used is rectangular with 2 funnels (entrances) installed in Pemalang waters at a depth of 15-20 m for 24 hours. The bait used is half-dried fish in the middle of the collapsible trap. The size of the collapsible trap used by fishermen to catch blue swimming crabs is 45 cm x 30 cm x 15 cm. The number of traps used is 600–700 traps per boat. The boat size is 3–4 GT with 2 machines with a power of 23 PK. The machine is used as boat propulsion and to tow the trap rope during the trap lifting.

The method used to collect the by-catch data was a direct trial of the operation of collapsible traps in Pemalang waters. This location operates collapsible trap fishing gear to catch blue swimming crabs as its primary target. The by-catch obtained by fishermen is collected by type (fish, crustaceans, and mollusks) and then categorized as non-target that is utilized or retained and not utilized or discarded. The number of individuals per species is then calculated and weighed with the accuracy of a digital scale of 0.1 gram. The by-catch sample was obtained from 9 boats with 27 fishermen, whose number per group can be seen in Table 1.

Figure 1. Fishing boat (Source : Indonesian Blue Swimming Crab Association).

Figure 2. Collapsible trap (Source : Indonesian Blue Swimming Crab Association).

Figure 3. Bait (Source : Indonesian Blue Swimming Crab Association).

Figure 4. By catch weighing tool (Source : Indonesian Blue Swimming Crab Association).

Table 1. By-catch species from BSC trap fisheries in Pemalang Waters.

No	Group	Number of Species					
		January	February	March	April	May	June
1	Fish	5	4	2	3	0	2
2	Crustaceans	2	3	3	4	3	3
3	Molluscs	1	1	1	1	1	2
	Total	8	8	6	8	4	8

The method of analysis used to determine the ecological condition of by-catch is based on the Shannon-Wiener diversity index, the homogeneity index, and the Simpson dominance index [10] and [11],

The equation for the Shannon-Wiener species diversity index (H'):

$$H' = -\sum pi \log pi \quad (1)$$

which is pi = the proportion of the number of by-catch*es* i-th to the total number of by-catch (ni/N)

Uniformity index equation (E):

$$E = \frac{H'}{H_{max}} \quad (2)$$

which is Hmax = Log number of fish species by-catch
Simpson's Dominance Index:

$$C = \frac{\sum ni(ni-1)}{N(N-1)} \quad (3)$$

which is ni = Number of NTS type to I and N = Total NTS.

3. Results and discussion

Based on the results of the study, it was determined that there was a diversity of types of by-catch from collapsible trap fishing gear operated in Pemalang waters. The by-catch obtained during the study was from groups of fish, crustaceans, and mollusks with 6,588 individuals. The most common species found were as many as 7 species from the fish group. The types of by-catch obtained during the study can be seen in Table 2.

The results showed that there was a diversity of by-catch types from collapsible trap fishing gear operated in Pemalang waters. The highest number of by-catch species was found in January, February, April, and June, which was 8 species. The lowest total number of by-catch species was in May, when there were as many as 4 species. The side catches found during the study were 7 fish species. The group of fish that caught the most was Blama fish (*Johnius belangeri*) as many as 11 fish. The crustacean group found mostly was the wind crab (*P. vigil*) as many as 642 individuals. The most common group of mollusks found was the tiger snail (*Babylonia* sp.) as many as 5,762 individuals.

Species that fishing trap fishermen often find during research are from the crustacean group, namely *C. feriatus* or a local name in Pemalang, namely Gerbah, which was found every month during the study with an average catch of 16 fish per month and wind crabs (*P. vigil*) found in four months with an average catch of 160 fish per month. This type of species is very often caught in collapsible traps, as is the case with the results of research conducted by [12], which show that the composition of the type of catch on collapsible traps includes coral crab (*C. feriatus*) and small crab wind (*P. vigil*).

The crustacean group is a type of marine biota that dominates by-catch in the operation of collapsible traps, with the main target of catching being crabs. The wind crab (*P. vigil*) is one of the crustacean species that dominated by-catch during the study, but this species was not found throughout the year in

large numbers. The currents are mostly found at the beginning of the year, namely February, March, and April, where in those months fishermen operate collapsible traps in shallow waters (edges) close to the river mouth with a depth of less than 5 m. According to [11], based on the study's results, it was shown that in Lasongko Bay, at water depths ranging from 2.85 to 14,66 m, the bottom substrate of loamy sand waters was found as the habitat of wind crabs.

Table 2. By-catch in Pemalang Waters.

No	Species	Number of Individuals						Total
		January	February	March	April	May	June	
	Fish							
1	*Epinephelus sexfasciatus*	1		1	3			5
2	*Platycephalus indicus*		1	1	1			3
3	*Nemipterus hexodon*	1	1					2
4	*Selaroides leptolepis*	2						2
5	*Epinephelus coioides*	1	1					2
6	*Johnius belangeri*	4	1		1		5	11
7	*Sihama silago*						1	1
	Crustaceans							
1	*Scylla serrata*				2	6		8
2	*Harpiosquilla harpax*		1					1
3	*Thenus orientalis*				1			1
4	*Podophthalmus vigil*		38	537	62		5	642
5	*Portunus sanguinolentus*	7		5		10	2	24
6	*Charybdis Feriatus*	10	8	21	41	12	7	99
	Molluscs							
1	*Babylonia* sp.						5762	5762
2	*Sepia recurvirostra*	2						2
3	*Octopus vulgaris*		3	1	1		1	6
4	*Sulcospira thochels*					3	14	17
Total Individuals (N)		28	54	566	112	31	5797	6588
Total Species (S)		8	8	6	8	4	8	
Diversity Index (H')		1.73	1.06	0.25	1.03	1.28	0.05	
Evenness Index (E)		0.83	0.51	0.14	0.50	0.92	0.02	
Dominance Index (Di)		0.45	1.04	1.80	0.88	0.60	1.98	

The highest by-catch diversity index value was obtained in January, which was 1.73, and the lowest was in May, which was 0.05. The calculation results show differences in the value of the by-catch diversity index every month. However, the average value of the species diversity index obtained is less than 3. This shows that the level of by-catch diversity in Pemalang waters is low. According to [13], the level of species diversity index value (H') of a species can be seen from the number of species found and their abundance in nature and can be grouped into low, medium, and high levels. If the H' value is less than 3.32, then the diversity is low. For moderate diversity, the H' value is between 3.32 and 9.97, and the diversity value is said to be high if H' reaches more than 9.97. The unequal number of species

in an ecosystem determines the size of its diversity. Several species are found in large numbers, contributing to the diversity of a small ecosystem. The adaptation pattern of each species and the availability of supporting habitats such as tides, food, and environmental conditions can affect the evenness of the number of individuals in each species.

The by-catch obtained by this collapsible trap fisherman can be categorized based on its benefits: discarded or utilized. Some by-catches that are often used for sale or consumption are usually from the fish and mollusk groups, while the by-products that are often discarded are usually from the crustacean group. One of the by-catch that fishermen often sell is the tiger snail. This tiger snail is a marine biota with economic importance, but the species cannot be found all year round. In addition to the tiger snail, other species found in large quantities that are also of economic value are the octopus and the cuttlefish/blekutak. According to [12], cuttlefish (*Sepia* spp.) and octopus (*Octopodidae*) are by-catches of collapsible trap fishing gear that have substantial economic value.

The most fish species found in January were 5 species including *Epinephelus sexfasciatus, Nemipterus hexodon, Selaroides leptolepis, Epinephelus coioides*, and *J. belangeri*. The species found and caught almost monthly are blama fish (*J. belangeri*). Blama fish live in shallow waters, usually found in river mouths. Blama fish is a fish that has economic value, so if fishermen get it in large quantities, they can sell it, besides that, they can also use it for consumption. According to [14], blama fish has the characteristics of soft and thick meat, so it is in great demand by the public. The price of blama fish in general is around Rp 25,000/kg. According to [15], the habitat of gulama/blama fish is found in waters with a muddy substrate and calm currents.

The highest evenness index value (E) was in May (0.92), and the lowest was in June (0.02). The evenness index (E) shows that the average evenness value for the by-catch of collapsible trap fishing gears is 0.49. This value shows that the diversity of the by-catch is low to high. According to [16], among the overabundant variety of evenness indices, each is typically derived by rescaling a diversity measure to the interval from 0 to 1 so that the evenness index value (E) varies between 0 and 1—the closer to 1, the more evenly distributed the fish populations that make up the community.

The results of the calculation of the dominance index show that the highest value was obtained in June (1.98) and the lowest in January (0.45). Based on the results, the average value of the dominance index is 1.13. Based on the results, it shows that each month, no by-catch species dominate. Similar results were found in [17] study in Lasongko Bay, Southeast Sulawesi, where the dominance index value was 0.242–0.534, which was in the low to moderate status category.

4. Conclusion

The results showed that the number of non-target species caught was seven crustaceans, six fish species, and four mollusks. The available range of the three indices is 0,05–1,73 for the Shannon-Wiener diversity index, 0.02-0.92 for the evenness index, and 0.45–1,98 for the Simpson dominance index. The by-catch that is often found is from the crustacean group. The diversity index of by-catch on collapsible trap fishing gear in Pemalang is low (1.73). Generally, these results determined that the by-catch biodiversity of blue swimming crab fishery in Pemalang was classified as low diversity category, low evenness, and moderate dominance. These results provide information for fishermen to know the types of by-catch that are good for sale or consumption. The recommendation for this research is the need for further research using different baits to determine the types of by-catch in collapsible traps.

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