



Regular Research Article

Reef-Associated Demersal Fishes Caught by Bottom Gillnets in The Coastal Waters of Kaleheng Beach, Kuma 1 Village, Sangihe Regency

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Abstract: Set bottom gillnets are a selective fishing gear widely used by traditional fishers in the coastal waters of the Sangihe Islands. This study aims to identify the species composition of Reef-associated demersal fishes caught by set bottom gillnets and to analyze the catching mechanisms based on fish morphology and behavioral characteristics. The study was conducted using an experimental fishing method by operating four units of set bottom gillnets locally known as *Soma Tataing* in the coastal waters of Kaleheng Beach, Kuma 1 Village, Tabukan Tengah District, from July to November 2025. A descriptive quantitative approach was applied through direct observation of fishing operation time, fishing ground location, water depth, species composition, abundance, and catching mechanisms of the fish. The results showed that the set bottom gillnets caught 59 individual fishes comprising 16 genera and 26 demersal fish species. The family *Holocentridae* dominated the catch, accounting for 26% of the total catch, while *Zebrasoma velifer* was the least captured species. Analysis of catching mechanisms revealed four main capture modes, namely snagged, gilled, wedged, and entangled. These mechanisms were strongly influenced by fish body shape, protruding body parts, and fish behavioral responses to the presence of the gillnet. The findings indicate that the effectiveness and selectivity of set bottom gillnets are closely related to the suitability of fishing ground characteristics with demersal fish habitats and their movement patterns. This study provides important insights into the development of environmentally friendly and sustainable fishing technologies in small island coastal waters.

Keywords: Bottom gillnet; Reef-associated demersal fishes; Fish behavior; Soma Tataing; Kaleheng coastal waters.

1. Introduction

Sudirman and Mallawa [1] define gillnets as rectangular nets with uniform mesh sizes throughout, where the number of meshes inward (mesh depth) is fewer than the number of meshes lengthwise (mesh size). Furthermore, Najamuddin [2] explains that the mesh size used is adjusted to the type and size of the target fish. Gillnet construction consists of the net body (webbing), upper riser rope, lower riser rope, floats, and weights. Gillnets are a selective

fishing gear, and the minimum size of the target fish can be regulated by adjusting the mesh size used. The mesh size and opening are largely determined by the target fish. In addition, Martasuganda [3] explains that the basic principle of gillnet fishing is to block the direction of the fish's swim. Fish that collide with the net will be caught. In general, the fish targeted for capture are those that migrate, either horizontally or vertically, and are not very active at certain depths. The width of the net is determined based on the depth of the

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migration.

According to Syahdan [4], in making a fishing gear, several things need to be considered, including the conditions of the fishing area and the characteristics of the target catch, both physically and biologically, known as fish behavior. Knowledge of fish behavior is important because various studies and experiences have shown that fish do not easily enter the fishing area, let alone get caught, because they can make efforts to avoid or escape from the coverage or snares/traps of fishing gear.

Hovgard and Lassen, as cited by Fahmi [5], state that fish are caught in gillnets in four ways, namely snagged, gilled, wedged, and entangled. Snagged is a condition where fish are caught by being snagged right behind the eye; gilled is where fish are caught by being snagged behind the gill cover; wedged is where fish are caught by being snagged in front of the dorsal fin; while entangled is where fish are caught by being entangled due to protruding body parts (teeth, jaws, fins) without having to break through the mesh. Furthermore, Sudirman and Mallawa [1] stated that for fish to be easily snagged (gilled) or entangled in the mesh, or so that the fish do not easily escape from the mesh, the mesh needs to be sufficiently shortened.

The bottom gillnet installed permanently in Sangihe Regency is known locally as *Soma Tataing* [6], which means a net that is permanently installed on the seabed. These gillnets are operated with the aim of intercepting schools of fish, either due to tidal movements or in search of food. The mesh size varies, with the horizontal length of the net (the width of the net) being longer than the vertical length (the depth of the net). As a fishing gear that is left in place or waits for fish to get caught in the mesh, technical factors such as the material of the net, the color of the net, the diameter of the net thread, the ratio of the mesh, etc., as well as the depth and condition of the seabed, fish migration, and so on, are determining factors in the success of fishing operations using bottom gillnets.

Despite broad research on bottom gillnets, data on reef-linked bottom-dwelling fish taken by fixed-bottom nets known as *Soma Tataing* in

small island seas stay sparse. Earlier work looked mostly at what was caught and how well fishing worked - yet links between fish shape, their actions, and how they get captured drew scant notice. What unfolds here centers on naming which kinds of reef-related seabed fish *Soma Tataing* captures while probing how body form and habits influence entrapment. Outcomes may sharpen insight into net preference patterns, lending weight to wiser stewardship of shoreline fish populations.

2. Materials and Methods

2.1 Study Area and Experimental Design

The study was conducted by operating four bottom gillnets simultaneously in the waters off Kaleheng Beach, Kuma 1 Village, Tabukan Tengah District, Sangihe Islands Regency, from July to November 2025. The fish caught were then analyzed to determine how they were caught. This study used a quantitative descriptive approach through direct observation (experimental fishing), where participants operated bottom gillnets to obtain data on fishing time, fishing ground, net length and water depth, as well as the type and number of fish caught.

Running at once, four *Soma Tataing* units kept consistent settings during the entire observation window. Nets went into place each day from 16:00 to 17:00 h, then came out later that night between 23:00 and 24:00; after redeployment, a last pull occurred from 05:00 to 06:00 h. Once brought ashore, every fish was tallied, named by species, while noting how it had been caught - either gilled, snagged, wedged, or tangled. Instead of treating hauls separately, results merged into one set examined through descriptive methods focusing on makeup across types, frequency patterns, along with ways individuals got held.

2.2 Fishing Gear and Study Site

In the Sangihe Islands Regency, bottom gillnets are known by various names, all of which depend on how they are operated and the purpose of fishing, so they are known by the local names *Soma Bawuluse*, *Soma Tataing*, *Soma Anting-anting*, and *Soma Gorango* [6].

Thus, the construction of the bottom gillnet fishing gear is also adapted to the fishing method and the target fish. The bottom gillnet used is the *Soma Tataing* type, which is operated at a depth of 7-10 meters in sandy and small rocky seabeds. The gillnet is installed along the coastline. The purpose of installing the net along the coastline is to block the direction of fish swimming towards the coast when the tide rises, taking advantage of the fish's behavior when searching for food. An anchor is attached

to the bottom of the net to make it sink deeper and stand upright on the seabed. These bottom gillnets are operated in the waters of Kaleheng Beach, Kuma 1 Village, Tabukan Tengah District, Sangihe Regency, which has a topographical profile of coral reefs along the coastline, a drop-off approximately 30 m from the coastline, and seagrass beds at a depth of 2-5 m. There are no rivers or mangroves, resulting in minimal sedimentation and no significant impact.

Table 1. Specifications of 1 unit of *Soma Tataing*

No	Specifications	Quantity (units, pieces)	Size/No	Material
1	Main net	1	P: 32 m, L: 46 m Ø 0.08 mm, # 2" E'=0.40%	PA. Monofilament
2	Upper riser rope	1	Dia. 2 mm	PE
3	Lower rope	1	Dia. 2 mm	PE
4	Floats	32	Sandals	Sandals
5	Floating marker	1	-	Plastic
6	Weight	64	-	Lead
7	Anchor	2	-	Stone 2 kg

The gillnet is set in the afternoon at 4:00 p.m. or 5:00 p.m. when the tide begins to rise. The bottom gillnet is left for 5-6 hours and then lifted at 11:00 p.m. or midnight to check the catch. After the catch is identified, the net is re-installed and will be lifted again in the morning at 5:00 AM or 6:00 AM.

2.3 Catch Identification and Data Analysis

After the gillnet is operated, the catch is grouped according to family and species using fish identification guides developed by Allen [7] and Bergbauer and Kirschner [8]. For more specific and detailed results, the catch is also identified based on local names.

3. Results and Discussion

3.1 Catch Composition and Relative Abundance

The catch composition of the *Soma Tataing* bottom gillnet showed a clear variation in abundance among fish families. A total of 59 individuals representing 14 families were recorded during the fishing operations. Holocentridae was the most abundant family, contributing 15 individuals (25.43% of the total catch), followed by Lutjanidae with 8 individuals (13.56%) and Siganidae with 6 individuals (10.17%). Acanthuridae accounted for 5 individuals (8.47%), while Chaetodontidae, Labridae, and Lethrinidae each contributed 4 individuals (6.78%). The remaining families occurred in relatively lower proportions, indicating that the catch was dominated by reef-associated fish groups commonly inhabiting coral reef, seagrass, and adjacent coastal habitats. The detailed composition and relative abundance of each fish family are presented in Table 2.

Table 2. Relative Abundance of Fish Families

No.	Family	Fish name	Local name	Number (individuals)	Family total	Relative abundance (%)
1	Holocentridae	Lolong coral (<i>Myripristis berndti</i>)	Memeha	4	15	25.43
		Soldierfish (<i>Myripristis murdjan</i>)	Memeha	4		
		Rengginan (<i>Myripristis chryseres</i>)	Memeha tahang	2		

No.	Family	Fish name	Local name	Number (individuals)	Family total	Relative abundance (%)
2	Lutjanidae	Stonefish (<i>Myripristis violacea</i>)	Memeha	2	8	13.56
		Rengginang (<i>Sargocentron melanospilos</i>)	Memeha mahoro	3		
		Boxfish (<i>Lutjanus decussatus</i>)	Mananung	2		
		Tambakan (<i>Lutjanus sp</i>)	Humbawi	2		
		Tambakan (<i>Lutjanus fulvus</i>)	Dendapa	2		
		Red snapper (<i>Lutjanus gibbus</i>)	Mananung	2		
		Kea-kea, semadar cicit (<i>Siganus vulpinus</i>)	Behang	2		
		Canaliculatus rabbitfish (<i>Siganus canaliculatus</i>)	Koloiang	2		
		Ringtail rabbitfish (<i>Siganus doliatus</i>)	Behang	2		
		Butana (<i>Acanthurus mata</i>)	Sembele	4		
4	Acanthuridae	Bali basketfish (<i>Zebrasoma velifer</i>)	Kaliwembang	1	5	8.47
5	Chaetodontidae	Yellow-spotted butterflyfish (<i>Haniochus varius</i>)	Pareduaheng	2	4	6.78
		Native butterflyfish (<i>Haniochus chrysostomus</i>)	Pareduaheng	2		
6	Labridae	Keling (<i>Halichoeres sp</i>)	Kalenggihang	2	4	6.78
		Kilu, bayeman (<i>Cheilinus trilobatus</i>)	Dedapele	2		
		Ambangan (<i>Monotaxis grandoculis</i>)	Batungkapese	2		
7	Lethrinidae	Sand pond (<i>Gymnocranius microdon</i>)	Batungkapese	2	4	6.78
8	Balistidae	Pogot (<i>Balistoides viridescens</i>)	Sunga	2	2	3.39
9	Carangidae	Bluefin trevally (<i>Caranx melampygus</i>)	Bira	2	2	3.39
10	Mullidae	Jackfruit seeds (<i>Parupeneus barberinus</i>)	Tintingbungang	2	2	3.39
11	Nemipteridae	Cucumber crab (<i>Scolopsis ciliata</i>)	Tingang	2	2	3.39
12	Scaridae	Ember parrotfish (<i>Scarus rubroviolaceus</i>)	Elong	2	2	3.39
13	Belonidae	Cendro (<i>Tylosurus crocodilus</i>)	Solong	2	2	3.39
14	Scorpaenidae	Chicken scorpionfish (<i>Scorpaenopsis oxycephalus</i>)	Nepo	1	1	1.69
Total				59	59	100.00

The catch composition was dominated by the family Holocentridae, which accounted for 25.43% of the total catch, followed by Lutjanidae (13.56%) and Siganidae (10.17%). This distribution indicates that several reef-associated fish families contributed substantially to the catches obtained using Soma Tataing bottom gillnets.

The predominance of Holocentridae suggests that the fishing ground was closely associated with coral reef habitats, where squirrelfishes and soldierfish are commonly distributed. The relatively high abundance of Lutjanidae and Siganidae also indicates ecological connectivity between coral reef and

seagrass habitats within the study area. Because the bottom gillnets were positioned within or adjacent to these habitats, fish moving through the area during feeding activities were more likely to encounter the nets.

Tidal conditions may also have influenced the capture process, particularly when rising tides increased fish movement toward shallow feeding grounds. During these periods, reef-associated and demersal fishes moving between coral reefs, seagrass beds, and adjacent coastal habitats could become gilled, wedged, snagged, or entangled in the stationary nets. The proportional contribution of each fish family to the total catch is illustrated in Figure 2.

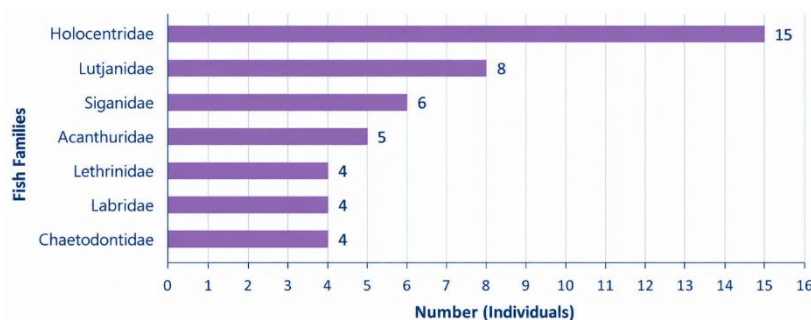


Figure 1. Dominant Family Ranking

The dominance ranking indicates that reef-associated families accounted for most of the catch. The predominance of *Holocentridae* reflects the suitability of the fishing ground for nocturnal reef fishes. The presence of *Lutjanidae*, *Siganidae*, and *Acanthuridae* in relatively high numbers suggests that the stationary bottom gillnet effectively intercepted fishes moving between reef, drop-off, and seagrass habitats during feeding activities associated with tidal movements.

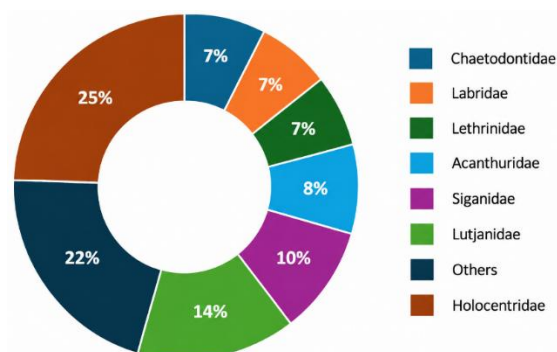


Figure 2. Percentage Composition of Catch Based on Family

To examine the retention characteristics of the Soma Tataing bottom gillnet, each captured fish was classified according to its mode of capture. Four capture mechanisms were identified, namely wedged, snagged, entangled, and gilled. This classification was based on the position of the fish relative to the net mesh and the body part involved in retention.

Differences in capture mechanisms reflect the interaction between mesh size and fish morphology. Species with deeper or compressed bodies tended to be retained by wedging or snagging, whereas fishes with prominent anatomical structures, such as dorsal spines, elongated snouts, or other protruding body parts, were more likely to become entangled. In contrast, fishes with body dimensions that closely matched the mesh opening could be retained by the gills.

The distribution of captured individuals according to these four mechanisms provides an indication of how fish morphology influences the selectivity of the bottom gillnet. The number of individuals, percentage contribution, capture method, and corresponding description for each group are presented in Table 3.

3.2 Capture Mechanisms and Fish Morphology

Table 3. How the Caught Fish Were Caught

No.	Species	Number of Species	Percent. (%)	Method of Capture	Description
1.	<i>Siganus canaliculatus</i> , <i>Siganus vulpinus</i> , <i>Siganus doliatus</i> , <i>Acanthurus mata</i> , <i>Caranx melampygus</i> , <i>Lutjanus gibbus</i> , <i>Lutjanus fulvus</i> , <i>Lutjanus decussatus</i> , <i>Parupeneus barberinus</i>	18	30,51	Wedged	Entangled in front of the dorsal fin
2.	<i>Monotaxis grandoculis</i> , <i>Lutjanus</i> sp, <i>Myripristis murdjan</i> , <i>Sargocentron melanospilos</i> , <i>Halichoeres</i> sp, <i>Gymnocranius microdon</i> , <i>Cheilinus</i>	17	28,81	Snagged	Caught behind the eye

No.	Species	Number of Species	Percent. (%)	Method of Capture	Description
<i>trilobatus</i>					
3.	<i>Zebrasoma velifer</i> , <i>Balistoides viridescens</i> , <i>Tylosurus crocodilus</i> , <i>Haniochus chrysostomus</i> , <i>Haniochus varius</i> , <i>Scarus rubroviolaceus</i> , <i>Scorpaenopsis oxycephalus</i>	14	23,73	Entangled	Entangled on the protruding part of the body
3.	<i>Myripristis berndti</i> , <i>Myripristis violacea</i> , <i>Myripristis chryseres</i> , <i>Scolopsis ciliata</i> ,	10	16,95	Gilled	Entangled behind the gill cover

The wedged capture mode was the most dominant mechanism, accounting for 30.51% of all captured fishes. This indicates that many fish species were able to partially pass through the mesh before becoming trapped around the anterior dorsal region. Snagged capture was the second most common mechanism (28.81%), reflecting the suitability of the mesh size for retaining fishes with body depths slightly larger than the mesh opening. Entangled capture contributed 23.73% of the catch and was mainly associated with species possessing protruding structures such as dorsal spines, elongated snouts, or caudal spines. Gilled capture represented the smallest proportion (16.95%), suggesting that relatively few species had body dimensions that perfectly matched the mesh size for classical gillnet retention.

Fish that are snagged or entangled behind the eyes are relatively deep-water fish with a compressed body shape, such as the Ambangan fish (*Monotaxis grandoculis*). This body shape allows the fish to become snagged behind the eyes, and if the fish struggles, it may become entangled in the gills or directly behind the gill cover. Fish that get caught by the gills are slender and small, allowing them to enter the net. Examples include the slender Jangkik fish (*Scolopsis ciliata*) and small fish from the *Myripristis* genus.

Fish that get caught by being wedged or snagged in front of their dorsal fins include the Kea-kea or Semadar Cicit (*Siganus vulpinus*), the Beronang Kalung (*Siganus doliatus*), the Butana (*Acanthurus mata*), Bluefin Trevally (*Caranx melampygus*), Red Snapper (*Lutjanus gibbus*), Tambakan (*Lutjanus fulvus*), Checkered Snapper (*Lutjanus decussatus*), and Biji Nangka (*Parupeneus barberinus*). These fish species are

entangled in the front part of their dorsal fins and, in some species, even through their dorsal fins. The rabbitfish or Semadar Cicit (*Siganus vulpinus*) has an elongated and slightly flattened body shape and can also be described as slender with a distinctive fox-like snout. These fish get caught by becoming wedged. It is believed that when caught, the fish struggles, forcing it to break through the net until the net is caught on the dorsal fin, preventing the fish from escaping the net.

Pogot (*Balistoides viridescens*), Cendro (*Tylosurus crocodilus*), Lepu Ayam (*Scorpaenopsis oxycephalus*), Kranjang Bali (*Zebrasoma velifer*), Lencang Kuning (*Haniochus varius*), Kambingan Asli (*Haniochus chrysostomus*) are fish that are entangled. The Kranjang Bali (*Zebrasoma velifer*) or Botana sirip layar (*Zebrasoma velifer*) has a flat (compressed) body with high dorsal fins and spines at the base of its tail. The spines at the base of the tail are the most prominent feature of this fish. The Pogot fish (*Balistoides viridescens*) has spines at the base of its tail, the Cendro fish (*Tylosurus crocodilus*) has a long snout and sharp teeth, while the Lepu Ayam fish (*Scorpaenopsis oxycephalus*) has spines along its entire body. These prominent body parts allow them to become entangled. Meanwhile, the Lencang Kuning fish (*Haniochus varius*) and the Kambingan Asli fish (*Haniochus chrysostomus*) get entangled in the spines of their dorsal fins.

Martasuganda [3] explains that there are several factors that cause fish to be caught in gillnets, including 1). It is suspected that fish become entangled in gillnets because at that moment the fish are in a state of "sleeping swimming" so that they are unaware of the presence of the net; 2). Fish become entangled

because they want to investigate foreign objects around them by looking, approaching, touching, and eventually becoming entangled; 3). Fish that always travel in schools and groups will follow one or more fish that have become entangled in the net; 4). In a state of panic, fish that are already in front of the net and find it difficult to escape will also become entangled in the net. Similarly, Baskoro and Taurusman [9] explain that fish behavior is defined as the movement and response of fish to their environmental conditions, which are greatly influenced by changes in the water and the habits of the fish.

Fish will panic when confronted with a net, causing them to move away from the net, but the rising tide can hinder their escape. As a result, fish that do not respond quickly to the presence of the net will collide with the net and become entangled.

3.3 Fish Behavior and Fishing-Ground Conditions

Some fish species choose their own habitat according to the availability of food, such as seagrass beds, coral reefs, sandy areas, or muddy substrates. Fish from the Siganidae family (goatfish), Cendro (*Tylosurus crocodilus*), and Labridae family are commonly associated with seagrass beds as their habitat to search for food. Latuconsina et al. [10] noted that several species of *Siganus canaliculatus* were found to be quite dominant in mangroves and coral reefs adjacent to seagrass beds. Similarly, Fakhri et al. [11] found a strong correlation between the fish species *Siganus canaliculatus* and seagrass beds.

The Soma Tataing is installed in the drop-off area, resulting in catches of fish that migrate between the drop-off area, coral reefs, and seagrass beds, such as fish from the Acanthuridae family or butana fish. Several types of Butana fish are caught in groups, such as *Acanthurus mata*, of which five were caught in a single net operation. Meanwhile, fish from the Holocentridae family (*Myripristis* sp), Mullidae family (*Parupeneus barberinus*), Chaetodontidae family, Scaridae family, and Lutjanidae family are types of fish that are commonly associated with coral reefs and can be found in groups, either in large or small

numbers. Muandri et al. [12] reported that red snapper caught with bottom longlines were found at a depth of 40-50 meters with a substrate of sparse coral. Meanwhile, Red Snapper (*Lutjanus gibbus*) were caught on a Soma Tataing operated at a water depth of 10 meters at 4:00 p.m. This is possible because these fish are active in the afternoon when the tide rises to search for food. The coral lionfish (*Myripristis berndti*), soldierfish (*Myripristis murdjan*), and rengginang (*Myripristis chryseres*) from the *Myripristis* family are often caught every time the Soma Tataing is operated, with more than one fish caught each time.

3.4 Gear Selectivity Implications

Wedge and snagged capture modes accounted for 59.32% of the total catch, indicating that the selectivity of the Soma Tataing bottom gillnet is influenced not only by fish size but also by body depth and morphological characteristics. Species possessing compressed bodies, prominent dorsal spines, elongated snouts, or other protruding structures exhibited a higher probability of capture. These findings demonstrate that capture selectivity in stationary bottom gillnets results from interactions among mesh size, fish morphology, and behavioral responses to the net. Understanding these interactions is important for improving environmentally responsible fishing practices and supporting the sustainable management of reef-associated demersal fish resources in small-island coastal waters.

3.5. Study Limitations

This study has several limitations that should be considered when interpreting the results. Sampling was conducted only in a single fishing area in the coastal waters of Kaleheng Beach, which may limit the generalization of the findings to other locations. In addition, only one type of fishing gear, namely Soma Tataing with a mesh size of 2 inches, was evaluated. Therefore, the observed species composition and capture mechanisms may reflect the selectivity characteristics of this gear configuration. Environmental variables such as coral cover, seagrass density, water temperature, salinity,

and current velocity were not measured during the study. Future studies should include multiple fishing locations, different mesh sizes, and environmental habitat assessments to provide a more comprehensive understanding of fish distribution patterns and gear selectivity.

4. Conclusions

The catch from fixed bottom gillnets (Soma Tataing) consisted of 59 individual fishes representing 26 species from 16 genera and 14 families. The family Holocentridae dominated the catch with 25.43% with 5 fish species, and the Butana fish (*Acanthurus mata*) from the Acanthuridae family dominated the catch per species with a total catch of 4 fish or 7% of the catch per species. The Ambangan fish (*Monotaxis grandoculis*) was snagged in the net, while the Beronang Lingkis (*Siganus canaliculatus*), Butana (*Acanthurus mata*) and Lolong Karang (*Myripristis berndti*) were gilled. The Rabbitfish (*Siganus vulpinus*) were caught by wedging, while the Bali Basketfish (*Zebrasoma velifer*), Pogot (*Balistoides viridescens*), and Cendro (*Tylosurus crocodilus*) were caught by entanglement. The findings indicate that the selectivity of Soma Tataing is strongly influenced by fish morphology and behavioral characteristics. Fish body shape, body depth, and protruding anatomical structures affect the probability of capture through different mechanisms. These results provide valuable information for the development of environmentally friendly fishing practices and support the sustainable management of reef-associated demersal fish resources in small island coastal waters.

Author contributions: Designing the study, data collection, and data analysis: JT; Correction of data analysis and correction of writing language: IB; Data collection, Conceptualization and correction of data analysis: HJP

Competing interests: The authors declare that they have no competing interests.

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