Analysis of diversity index, dominance and composition of beach seine in Masjid Raya, Aceh Besar District, Indonesia

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Abstract. Beach seine fishing gear is still widely used by Acehnese fishermen. Scientific information on the composition of the catch of beach seine in Lamnga and Ruyung waters is not yet available. This study aims to determine the composition of beach seine in Lamnga Village and Ruyung waters. Data collection is carried out by following the operation of the beach seine unit with ten days of data collection at each station. The research data were in the form of type and weight of fish caught and analyzed descriptively. The results of the measurement of the fishing gear of the beach seine obtained that the fishing gear at station I was smaller than station II. Analysis of the composition of the catch of beach seine at station 1 obtained 38 species consisting of 43,447 fish, which was dominated by shortfin scads fish of 529.98 kg. While at station II, 32 species were obtained with a total of 17,511 fish, which was dominated by shortfin scads fish of 648.90 kg. The results of the analysis showed that the catches of beach seine at station I were higher both in terms of the number of species and catch weights compared to station II.

1. Introduction
Aceh Besar District is one of the districts located on the coast of Aceh, this district administratively consists of 26 Districts, 8 of which are coastal districts. The traditional fishing gear that is still used by Aceh Besar fishermen today is the beach seine fishing gear or better known as the Acehnese seine net. This is because the construction of beach seine fishing gear is very simple, the operational costs and maintenance costs are also relatively small [1]. Districts that still operate beach seine’s are Lhoong, Leupung, Mesijd Raya, Peukan Bada and Baitussalam. The five sub-districts that operate a lot and
actively operate seashore trawlers are Masjid Raya District including Lamnga waters and Ruyung waters.

The Beach seine is a type of bag seine that is used to catch fish, both pelagic and demersal on the beach. Usually called edge trawl, because its operation is only limited to the beach [2]. The beach seine in question is nothing but a fishing gear that looks like a payang, which is pocket and has wings or legs [3]. The fishing gear of the beach seine is active, namely by circling the school of fish with a net after which it is pulled ashore and the fish gather into the bag [1].

The operation of beach seine by fishermen is aimed at getting fish that are the target of catching. Fishing time using this beach seine is from morning to evening or during periods where there is still sunlight. The distribution of fish in the waters is spatially different according to time in the morning and evening. The spatial distribution of the fish is the vertical and horizontal distribution in the waters.

There are various types of beach seine catches in Lamnga waters and Ruyung waters, but not many details are known about the types of fish that were caught. One of the causes is the lack of data and information available, so that it becomes the basis for research on diversity index analysis, dominance and composition of catches. The purpose of the study was to determine the general construction of beach seine and to identify the diversity, dominance and types of catches in Lamnga and Ruyung waters in Masjid Raya, Aceh Besar District.

2. Material and Methods

2.1. Time and Place of Research
This research was conducted in December 2019 in Masjid Raya, Aceh Besar District, covering two stations, namely Station I Lamnga waters and Station II Ruyung waters.

![Figure 1. Research Map.](image-url)
3 time, hauling time, number of fish and fish weight per species, length and weight measurements of fish, photos of caught fish species, measurements and observations of the general form of beach seine construction.

2.3. Data analysis
The data that has been obtained is recorded in daily data sheets then stored in Microsoft Excel, then the data is processed and presented in tables and diagrams.

2.3.1. General construction measurement of fishing gear
The data obtained from the results of measurements and observations of trawl fishing gear at the time of conducting the research will be tabulated in tabular form, then compiled in a descriptive description of the fishing gear as well as the discussion that is compared according to literature studies.

2.3.2. Composition of catch
The catch before analysis must be identified first to be able to find out the scientific name of the catch obtained. Identifying the catch must use a fish identification book [4]. After identifying the catch, then calculating the composition of the type of catch using the following equation [5].

Composition Type \((K_j)\)

\[
K_j = \frac{x_i}{X}
\]

Notes: \(x_i\) = Number of fish species \(i\) (fish); \(X\) = total number of fish species caught (tails)

Komposisi bobot \((K_b)\)

\[
K_b = \frac{y_i}{Y}
\]

Notes: \(x_i\) = Number of fish species \(i\) (kg); \(X\) = total number of fish species caught (kg)

2.3.3. Catch diversity analysis
Diversity data will be processed using Microsoft Excel, and analyzed descriptively. Diversity data is related to the selectivity of target fish. To determine the amount of diversity that exists in coastal trawl, it can be determined using the Shannon-Wiener diversity index formula [6] with the following formula:

\[
H' = -\sum Pi \ln Pi
\]

Notes: \(H'\): Shanon-wiener diversity index; \(n\): the number of the \(i^{th}\) individual; \(N\): Number of individuals of all species

2.3.4. Analysis of the dominance of catch results
Dominance data was processed using Microsoft Excel application and then analyzed by descriptive method. The catch dominance index is searched using the formula below [7]:

\[
c = \sum_{i=1}^{s} \left(\frac{n_i}{N}\right)^2
\]
Notes: > 1: High dominance, high tool selectivity; = 0: Low dominance, low tool selectivity

Information: S: Number of species; C: simpson dominance index; ni: the number of individuals of the ith species; N: the number of individuals of all species.

3. Results and Discussion

3.1. General construction of trawl fishing gear
The measurement results obtained that the fishing gear for station I is smaller than that of station II. The results of these measurements can be seen in Table 1 below.

| No. | Construction Section         | Station I | Station II |
|-----|------------------------------|-----------|------------|
| 1   | Fishing gear length          | 158 m     | 230 m      |
| 2   |                              | 150 m     | 220 m      |
| 3   |                              | 150 m     | 220 m      |
| 4   | The length of the top rope   | Left = 150 m | Left = 200 m |
|     |                              | Right = 200 m | Right = 250 m |
| 5   | The length of the lower rope | 8 m       | 10 m       |
| 6   | The length of the strap      | 13 m      | 15 m       |
| 7   | Pouch length                 | 137 m     | 205 m      |
| 8   | Body length                  | 5 mm      | 5 mm       |
| 9   | Wing length                  | Part I = 7 mm | Part I = 7 mm |
|     |                              | Part II = 10 mm | Part II = 10 mm |
|     |                              | Part III = ½ inch | Part III = ½ inch |
| 10  | Pocket mesh                  | Part I = 1 inch | Part I = 1 inch |
|     |                              | Part II = 1.5 inch | Part II = 1.5 inch |
|     |                              | Part III = 2 inch | Part III = 2 inch |
|     |                              | Part IV = 3 inch | Part IV = 3 inch |

3.2. Identify the diversity, dominance and types of catches
The results of the measurements that have been made obtained that the fishing gear size of station I is smaller than station II, where at station I the overall length of the fishing gear is 158 meters and at station II is 230 meters. The seashore construction used consists of several parts, namely the wings, the body (shoulder), and the bag (bag), the wing consists of nets, ropes, buoys, and weights.

A total of 78,469 individual fish consisting of 37 species and 26 families identified during the study period (table 2) the number of fish species found in this study was more. However, from stations 1 and 2 where many fish samples were taken from 37 species of fish that were caught, Selar Bentong fish (Selar crumenophthalmus) as many as 12.83 fish and Talang fish (Scomberoides Commersonnianus) as many as 17.511, were the most common types of fish found in this location.

Caranidae is the dominant family with 9 species (25% and 27%) followed by Chacidae and Siganidae with 3 species (6%) (Figure 2 and 3). According to Konishi, the Order Perciformes (including Serranidae, Lutjanidae, and Carangidae) is the most widely distributed commercial fish group in Southeast Asia. The number of families of this order in Southeast Asia is estimated at 48 families.

3.3. Composition of the catch
The composition of the catch obtained during the study includes fish species, number of tails and total weight (kg). The total types of catch identified at station I were 38 species and station II were 32 species. The composition of the catch of beach trawlers at stations I and II can be seen in Figures 2 and 3.
Table 2. Composition and total family, species and individu of fisher.

| No | Family          | No | Species                  | Local Name      | Station I | Station II |
|----|-----------------|----|--------------------------|-----------------|-----------|------------|
| 1  | Belonidae       | 1  | Tylosurus crocodilus     | Caroang         | 166       | 0          |
| 2  | Chacidae        | 2  | Chanos chanos            | Bandeng         | 6         | 20         |
| 3  | Carangidae      | 3  | Gerres shima             | Kapas-kapas     | 51        | 35         |
| 4  | Carangidae      | 4  | Charax ignobilis         | Kwee Gerong    | 273       | 179        |
| 5  | Carangidae      | 5  | Gnathanadon speciosus    | Kwee Macan      | 20        | 72         |
| 6  | Alectis ciliaris| 6  | Alectis ciliaris         | Kwee Rambut    | 17        | 5          |
| 7  | Carangidae      | 7  | Carangoides bajad        | Kwee Tutul     | 20        | 10,960     |
| 8  | Decapterus      | 8  | Decapterus macrosoma     | Layang Deles    | 12523     | 70         |
| 9  | Selar crumenophthalmus | 9 | Selar crumenophthalmus | Selar Bentong  | 12831     | 78         |
| 10 | Selaroides      | 10 | Selaroides leptolepis    | Selar Kuning    | 3190      | 277        |
| 11 | Eleutherronema  | 11 | Eleutherronema Tetradactylum | Senangin   | 10       | 49         |
| 12 | Scomberoides    | 12 | Scomberoides             | Commersonianus | 30       | 17,511     |
| 13 | Clupeidae       | 13 | Sardinella gibbosa       | Tembang        | 441       | 0          |
| 14 | Caesionidae     | 14 | Caesionidae              | Kuniran        | 813       | 30         |
| 15 | Dasyatidae      | 15 | Pastinachus sephen       | Pari           | 0         | 672        |
| 16 | Engraulidae     | 16 | Telephorus indicus       | Teri Gelagar   | 1232      | 0          |
| 17 | Fistularidae    | 17 | Fistularia petimba       | Terompet       | 30        | 0          |
| 18 | Gobiidae        | 18 | Trachino cepalus         | Beloso         | 97        | 63         |
| 19 | Haemulidae      | 19 | Pomadasys maculatus      | Gerot-gerot    | 10        | 30         |
| 20 | Hemiramphidae   | 20 | Hemiramphus lutkei       | Julung-julung  | 40        | 30         |
| 21 | Loliginidae     | 21 | Loligo sp                | Cumi           | 286       | 285        |
| 22 | Lethrinidae     | 22 | Lethrinus nebulosus      | Lencam         | 20        | 12         |
| 23 | Leiognathidae   | 23 | Leiognathus equalus      | Peperek        | 1882      | 480        |
| 24 | Mugilidae       | 24 | Mugil sp                 | Belanak        | 12        | 4          |
| 25 | Nemipteridae    | 25 | Nemiterus furcosus       | Kurisi         | 278       | 30         |
| 26 | Nemipteridae    | 26 | Upeneus vittatus         | Ciko-ciko      | 83        | 2          |
| 27 | Octopodidae     | 27 | Octopus sp               | Gurita         | 2         | 50         |
| 28 | Parastromateusda| 28 | Platix boersii           | Bawal hitam    | 1         | 12         |
| 29 | Portunidae      | 29 | Portunus sp              | Kepiting       | 35        | 20         |
| 30 | Pleuronectidae  | 30 | Pseudothomus dupliocellatus | Sebelah   | 15        | 36         |
| 31 | Siganidae       | 31 | Siganus javus            | Baronang       | 2         | 43         |
| 32 | Siganidae       | 32 | Siganus sp               | Cabe           | 8458      | 3,500      |
| 33 | Sepiidae        | 33 | Sepia sp                 | Sotong         | 6         | 314        |
| 34 | Scombridae      | 34 | Rastrelingger faughni    | Kembung Lelaki | 414       | 137        |
| 35 | Sphyraenidae    | 35 | Sphyraena putnamea       | Barakuda       | 150       | 5          |
| 36 | Terapontidae    | 36 | Terapan jarbua           | Kerong-kerong  | 2         | 7          |
| 37 | Tetraodontidae  | 37 | Diodon hystrix           | Buntal         | 1         | 4          |
Figure 2. Composition of families based on number of species station I.

Figure 3. Composition of families based on number of species Station II.

The highest catch based on the number of fish at station I was carangidae with 25% and the lowest were puffer fish (Diodon hystrix), black pomfret (Platax boersii), stingray (Pastinachus sephen) with 1 fish each (0.00%), while at station II the highest catch was carangidae with 27% and the lowest was ciko-ciko fish (Upeneus vittatus) with 2 fish (0.01%).
3.4. Diversity Index
The catch diversity index of station 1 and station 2 trawl fishing gears is shown in Figure 4.

![Figure 4. Diversity Index at station 1 and station 2.](image)

Based on Figure 4 the fishing gear at stations 1 and 2 shows negative results, namely -1.9 and -1.3, this means that the trawl nets in Lamnga and Ruyong Villages have a low level of diversity.

3.5. Dominance Index
The value of the dominance index of the catch of coastal trawl nets is presented in Figure 4. The index in Figure 4 shows the level of dominance of a species in the beach trawl. The dominance index value shown in Figure 5 is above the value of 0, which is 0.08 at station 1 and 0.39 at station 2, this indicates that the dominance level of the trawl species in Lamnga and Ruyong Villages is high, meaning that both the trawl the station has a selectivity that is not low.

![Figure 5. Dominance Index at station 1 and station 2.](image)

Judging from the measurement results of fishing gear in table 1 above, the results of fishing gear in Masjid Raya Aceh Besar District have an overall length ranging from 158-230 meters. However, when compared with the size of the fishing gear on the beach trawl on the coast of Article ban, Bungus Selatan Village, Bungus Bay Kabung District, Padang City, West Sumatra Province, the overall length of the fishing gear is 400 meters with a wing length of 387 meters and the size of the mesh used is 6-5.5 cm,
body part 7.5 meters with mesh sizes ranging from 2.5 to 1.5 cm and pockets 5.3 meters with mesh sizes 0.7 cm. The length of the rope used is between 130-180 meters. From the results of this comparison, it can be concluded that the fishing gear used in each region is different and adapted to the needs [8].

Analysis of the composition of the catches of coastal trawlers at station I obtained the total number of catches, namely 1,419 kg and 43,447 fish, while at station II, 957 kg and 17,511 fish were obtained. The catch obtained from the two stations showed that the species caught the most was scad (Decapterus sp), this was due to the nature of the scad that lived in groups (Schooling). The results of the study according to explained that the tendency of schooling pelagic fish to be in the area around the coastal plain is thought to be the activity of pelagic fish to look for areas rich in food or for spawning [9]. Every aquatic organism, one of which is the flyfish, will move according to the distribution of conditions according to the needs of its body, besides that it is also a factor in finding food sources in the waters [10].

The difference in the number of catches from the two stations can be influenced by several factors, namely environmental conditions, construction, number of crew members and speed of net pulling. Environmental conditions in the research location there is a river flow that is directly related to the sea. the highest abundance of zooplankton is found around the coast, this is because there are many phytoplankton in the estuary of the river [11]. That in the mouth of the river there are many nutrients that are carried by currents towards the sea so that they can be utilized by plankton [12]. This condition causes fish to be found in coastal waters because there are sources of food. The number of crew members and the speed of netting can also affect the number of catches where at station I the number of crew members is 12 more than station II. Because the greater the number of crew members, the faster the net withdrawal process, so that there are fewer opportunities for fish to escape. That the slinging rope has an effect on towing, where the longer the slingshot used, the longer the towing process will take [13]. If the towing process is faster than swimming fish, it can affect the catch. In addition, the condition of the fishing gear also affects the catch. Station I of the fishing gear used still looks good, while station II the condition of the fishing gear used is not good because there are parts of the net that have been damaged and have holes so that the trapped fish can escape from the hole.

The catches obtained are several types of fish that are not consumed by fishermen because they taste bad and have a low selling value. The types of fish that are not consumed are beloso fish (Trachino cepalus), caroang (Tylosurus crocodilus), trumpet (Fistularia petimba), buntal (Diodon hystrix) and chili. Some of the catch is given to animal feed and part is disposed of by planting it in the sand so as not to emit a bad smell.

The results of the diversity index analysis can be seen in Figure 4. The fish diversity index values at all stations ranged between -1.9 and -1.3. Based on the criteria for the diversity index at observation stations 1 to 2, it is low. The low diversity of fish in the sea is caused by human activities around the observation station, namely the dominance by certain species (the dominance index value is close to number 1). The diversity index between 0.43-1.06 indicates that the marine environment cannot support high species richness [14].

The highest dominance index values occurred at stations 1 and 2 with values of 0.08 and 0.39. The high dominance index value which is close to 1 is because there are two fish species that are caught the most (stations 1 and 2 are dominated by Crumenopthalmus, station 2 is dominated by Scombroides cameroonian). The dominance of the two fish is due to the characteristics of these fish prefer habitats with weak ocean currents [15,16]. This is in accordance with the characteristics of the two stations, namely weak current. A community with low species diversity is influenced by a low uniformity index and also the dominance by one or a few species [17]. Fish species richness, abundance and community structure of fish in the sea depend on habitat conditions, increasing volume of water in the sea, presence of predators and competition for food [18,19].

4. Conclusion
The result is that the overall length of the fishing gear at station I is 158 meters and station II the overall length is 230 meters. Analysis of the composition of the catches of beach seine at Station I obtained 38
species with a total number of 1,419 kg and 43,447 fish which were dominated by deles flying fish of 529.98 kg (37.35%) and station II 32 species were obtained with a total number of 957 kg and 17,511 fish which were dominated by the deles flying fish of 648.90 kg (67.84%).

Acknowledgement
Thank you, we say to the Aceh of Panglima Laot, Krueng Raya of Panglima Laot, Fishing Masters of Beach seine, and friends who have helped.

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