The environmental friendliness level of the trammel net in Kuala Langsa, Langsa City, Aceh Province

A Rahmah1*, E Miswar1, A Ramadhan1, R M Aprilla1

1Department of Fisheries Resources Utilization, Faculty of Marine and Fisheries, Syiah Kuala University, Banda Aceh, 23111, Indonesia
Corresponding author: alvi_rahmah@unsyiah.ac.id

Abstract. The development of fishing activities in Kuala Langsa water can continually increase the number of trammel net. Statistical data showed that the number of trammel net in Langsa in 2013 was 84 units and the number increased to 152 units in 2016. The main target of trammel net is shrimp. Whereas in reality the most catches are fish, with different species, small sizes of fish and not sellable. The objective of the present study was to assess the environmental friendliness level of trammel net to the environment. Data collection was carried out by experimental fishing, with 3 samples of purse seine ships and 3 catching trips each. The data collected were number of fishes, species and size of the length and weight of the fishes. Data were analyzed using Shannon diversity index, Simpson dominance index, and scoring analysis (based on the 9 criteria of CCRF (Code of Conduct for Responsible Fisheries) about the environmental friendliness level of fishing gear). The results showed that the catch species diversity index was average 0.80 (high diversity index; low fishing gear selectivity) and average of dominance index was 0.27 categorized as low dominance (no dominance of certain species). The total score of the environmental friendliness level was 27 which means trammel net categorized as less friendly to the environment.

1. Introduction
Langsa City is one of the fishery exporters areas i.e fishes, shrimps and crabs which have very good quality. Kuala Langsa water as one of the priorities for the development of the fisheries and marine sector was expected to be the main driver of the economic growth [1]. The development of fishing activities in Kuala Langsa water also continues to increase.

The selectivity of fishing gear is very important as an effort to conserve and recruit the process of existing resources for example the young fish can survive and reproduce continuously with use selectivity of fishing gear [2]. Trammel net is one type of fishing gears that is commonly used by fishermen in Kuala Langsa, with the catch target is shrimps. Whereas in reality the most catches are fishes, and the number of bycatches were abundant. Result of bycatch of trammel net in Cilacap was more than 50% of the total catch [3]. Based on this fact, it is necessary to assess the environmental friendliness level of trammel net in Kuala Langsa water. Therefore the aim of this study is to assess the environmental friendliness level of trammel net to the environment.

2. Material and Methods
The method used in this study was an experimental fishing method. Data retrieval was carried out on 3 samples of ships with 3 replications (based on trip/ship), which has different mesh sizes, it was 6 inch
for outer net and 1.5 inch for inner net. Data collected in the form of position of fishing ground, species caught, number of catching species, method of capture, weight and length of fishes. Comparison of the environmental friendliness level was analyzed by using the descriptive method. The researcher measured the impact of trammel net operation in the environment by measuring the proportion of the main target of the catches and by-catches. Moreover the data already collected were used to measure the diversity index, dominance index, and environmental friendliness level assessment based on 9 CCRF criteria. The Shannon-Wiener diversity index \[ H' = -\sum_{i=1}^{S} P_i \times \ln(P_i) \] where \[ P_i = \frac{n_i}{N} \]

Where:
\( H' \): Diversity index
\( P_i \): Proportion of each species in the sample
\( n_i \): The number of fishes of particular species
\( N \): The total number of fishes of all species
\( S \): The total number of species

The criteria of Shannon diversity index [5]
\( H' = 0 \): Low diversity; selectivity of the high gear
\( H' > 0.1 \): High diversity; low catching selectivity

Simpson dominance index [6] was calculated by the formula:

\[ C = \sum_{i=1}^{S} \left( \frac{n_i}{N} \right)^2 \]

Where:
\( C \): Dominance index
\( n_i \): The total number of fishes of particular species
\( N \): The total number of fishes of all species
\( S \): The total number of species

Criteria for the Simpson Dominance index value:
\( C < 0.5 \): Dominance of species caught low
\( C > 0.5 \): Dominance of high catch species

Scoring analysis was used to evaluate the environmental friendliness level of fishing gear based on 9 CCRF criteria [7]. Category of the environmental friendliness score:

Table 1. Category of environmental friendliness level of fishing gear

| No. | Category of environmental friendliness level | Score (X)     |
|-----|---------------------------------------------|---------------|
| 1.  | Environmental friendly                      | \( X > 31.5 \) |
| 2.  | Less environmental friendly                 | \( 22.5 < X \leq 31.5 \) |
| 3.  | Non-environmental friendly                  | \( 13.5 < X \leq 22.5 \) |
| 4.  | Damage the environment                      | \( X \leq 13.5 \) |
3. Results and Discussion
The results of the diversity index (H') ranged from 0.66 to 0.93 or an average was 0.80 (Figure 1). The value explained that trammel net as fishing gear showed high species diversity or has a low level of selectivity (H’ > 0.1). The other study showed that the diversity index value of trammel net in Cilacap were high, namely more than 1[3].

The dominance index analysis (C) Shimpson showed that the dominance index ranged from 0.23 to 0.31 or an average was 0.27 (Figure 2). Based on this figure it can be seen that the dominance value was categorized as low dominance because the value of C’ < 0.5. Low Dominance indicated that the number of individuals in the species was similar and no certain species dominated in study sites. The other study showed the same result, the dominance value of trammel net in Cilacap ranged from 0.36 to 0.50. Its indicated that the selectivity of trammel net was low [3]. Table 2 presented the description of the enviromentl friendliness score. It showed that trammel net used by fishermen in Kuala Langsa catched more than 3 species of fishes, causes damage to some habitat, produce dead fish, fresh, physically disable, safe for fishermen and consumer, have more species of by-catch, causes dead for some species (but not threatened the habitat), never caught protected fish and doesn’t conflict with existing regulations.

![Figure 1. Diversity index value of trammel net in Kuala Langsa.](image1)

![Figure 2. Dominance index value of trammel net in Kuala Langsa.](image2)
### Table 2. Score of the environmental friendliness level of trammel net in Kuala Langsa

| No. | Criteria                  | Description of Sub criteria                                                                 | Score (Ship/Trip) | Total | Average |
|-----|---------------------------|---------------------------------------------------------------------------------------------|-------------------|-------|---------|
|     |                           |                                              | Ship 1 | Ship 2 | Ship 3 |       |
| 1   | High selectivity          | Capture more than three species of fishes with varying sizes                               | 1     | 1     | 1     | 1  1  | 9     | 1     |
| 2   | Not threatened the habitat| Causes damage to some habitat in a narrow area.                                             | 3     | 3     | 3     | 3  3  | 27    | 3     |
| 3   | Produce high quality of fish | Dead fish, fresh, physically disabled.                                                        | 2     | 2     | 2     | 2  2  | 18    | 2     |
| 4   | Do not endanger the fishermen | Safe for fishermen.                                                                          | 4     | 4     | 4     | 4  4  | 36    | 4     |
| 5   | The product do not endanger consumer | Safe for consumers.                                                                          | 4     | 4     | 4     | 4  4  | 36    | 4     |
| 6   | Low by-catch              | Have more species of by-catch and few of them sellable in the market.                       | 2     | 2     | 2     | 2  2  | 18    | 2     |
| 7   | Impact for biodiversity   | Causes dead for some species but not threatened the habitat                                  | 3     | 3     | 3     | 3  3  | 27    | 3     |
| 8   | Do not harm for protected fish | Protected fish are never caught.                                                            | 4     | 4     | 4     | 4  4  | 36    | 4     |
| 9   | Socially accepted         | Does not conflict with existing regulations                                                  | 4     | 4     | 4     | 4  4  | 32    | 4     |
|     | Total                     |                                                                                             | 27    | 27    | 27    |       |       |       |
Based on Table 2, score of environmental friendliness level of trammel net was 27. The value of diversity index and dominance index was suppotng this result. This score was based on the classification of environmental friendliness categories included in the category of less environmentally friendly fishing gear. The same results were also shown that conducted in Lampulo [8]. This shows that trammel net has low selectivity in fishing operations so that the catches is not dominated by certain species. However, the species caught are very diverse and mostly small in size (not sellable). This indicates that most of the catch is in the juvenile stage, or teenagers. The lack of catches of economic value triggers fishermen to catch as much as possible fish to cover the highly operational costs of fishing [5].

4. Conclusion
The diversity index value (H) in Kuala Langsa waters showed that species richness in these water was high, with an average value of was 0.80. In addition, the value of the dominance indicated that there was no certain species that dominate in the present study, with an average value of C was 0.27. This is related to the environmental friendliness level that trammel net caught more than three species of different types and sizes. Based on 9 criteria of CCRF for the environmental friendliness level of fishing gear, trammel net was included in less environmentally friendly catagory of fishing gear, with a scoring value was 27.

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