Diversity of fish caught in Pangkalan Susu's Marine, Langkat District, North Sumatera Province

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Abstract. Pangkalan Susu is the second largest contributor of fishermen from nine sub-districts in Langkat Regency. The diversity of fish in Pangkalan Susu illustrates the wealth of fish in sea obtained from fishing efforts carried out by fishermen at the high demand of the community. This study aims to analyze the diversity of fish species caught in the Pangkalan Susu Sea, Langkat Regency. This study was conducted for 4 month with a sampling interval of one month once in June - August 2024 using the random purposive sampling method in Pangkalan Susu's sea. Data analysis used in this study is relative abundance (KR), Shannon-Wienner index (H'), uniformity index (E), and dominance index (C). The total fish catch during the study period was 697 individuals, which were divided into 52 fish species and 30 families. The number of catches in consisting of 30 families and 52 species. In June, 144 fish consisting of 25 species were obtained, in July 330 fish consisting of 25 species, and in August 223 fish consisting of 21 species. The value of the fish species diversity index in Pangkalan Susu sea is included in the moderate category the diversity index value in June was 1.011, July was 0.966 and August was 0.886. The small population uniformity and dominance index values show that fish species were evenly distributed during the study with no dominant species.

1 Introduction

Pangkalan Susu has quite large marine potential which is known as the second largest contributor of fishermen out of nine sub-districts in Langkat Regency [1]. One of the villages in Pangkalan Susu District is Alur Cempedak Village where the majority of the population

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works as fishermen. This village is located on the coastline which has distinctive characteristics, namely plant vegetation inhabited by mangrove plants [2].

Mangrove forests have important ecological functions for sea, one of which is as a nursery ground, feeding ground and spawning ground for various aquatic organisms such as fish, shrimp and shellfish [3]. This study aimed to observe diversity of fish species caught in the Pangkalan Susu sea, Langkat Regency.

The diversity of fish in one area represents the wealth of fish in that region. The high and low value of the index of variation depends on the variation of individual Numbers of each species of fish successfully caught. The greater the number of fish species and the variety within the number of individuals of each species, the greater the diversity of fish. If the diversity level is high, the better the quality of fisheries, it is also supported by the physical and chemical parameters that support fish's life in sea to determine sustainable fishing to be carried out. It would therefore be necessary to learn about the diversity of fish in the Pangkalan Susu so that sustainable fisheries and fishing communities could pass on to the Pangkalan Susu's marine for a long time.

2 Materials and Method

2.1 Research site

This research was conducted by taking fish samples in the Pangkalan Susu sea, Langkat Regency, North Sumatra Province for three months in June - August 2024. Analysis of sample fish was carried out at the Biology and Aquaculture Laboratory of the Aquatic Resources Management Study Program, Faculty of Agriculture, University of North Sumatra. The research location is presented in Figure 1.

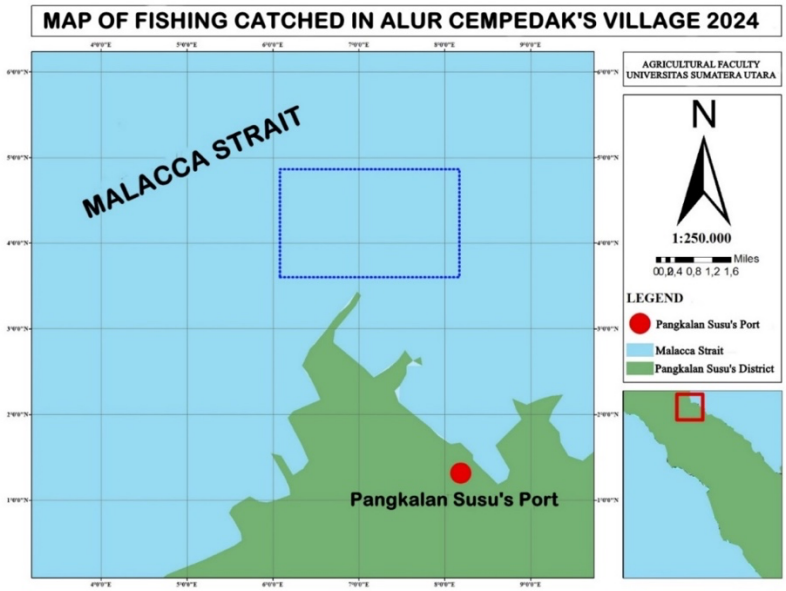

Fig. 1. Research location in Alur Cempaka Village, Pangkalan Susu

2.2 Procedures

The research's method uses random purposive sampling where the fishing area is determined based on the location of the fishing area belonging to the fishermen of Alur Cempedak Village who usually lower their fishing equipment. The fishing gear used was a gill net (mesh size 1 - 1 ½ inches), a hand line (size 18), a regular fishing line, and an ambai's trap. The net is 250 meters long, 100 eyes wide, with a mezh size of 1.5 inches. The fishing process begins with departure after arriving at the fishing ground, setting, immersing, and hauling are carried out.

The sampling method used is purposive random sampling. Determination of sampling locations is recommended in relatively different environmental conditions and fishing areas that are usually carried out by fishermen in Alur Cempedak Village. The fishing gear used is gill nets (mesh size 1 - 1 ½ inches), hand lines (size 18), regular fishing rods, and ambai's trap. The net is 250 meters long, 100 eyes wide, with a mesh size of 1.5 inches. The fishing process begins with departure after arriving at the fishing ground, setting, immersing, and hauling are carried out.

Measurements of temperature, salinity, brightness, pH, and DO were carried out in situ at each point during the retrieval process. Furthermore, the catch was sorted into zip plastic based on the fishing station and then put into a cool box to be taken to the laboratory. All fish caught in the one-day fishing catch were taken and identified first based on [4] in the book Market Fishes of Indonesia. The fish samples obtained were then documented, followed by identification of the type and a description of the type of sample caught. The Classification was carried out on samples to species. The data obtained from this study were analyzed using quantitative analysis, namely data managed from observed behavior then tabulated and depicted through graphs [5]. The data analysis used was Relative Abundance, Diversity Index, Uniformity Index, and Dominance Index.

2.3 Data analysis

2.3.1 Relative Abundance.

According to [6], The calculation of the fish relative abundance by calculating the percentage of the number of individuals with the total number of individuals is :

$$\textbf{Relative abundance} = \frac{ni}{N} \; X \; 100\% \qquad (1)$$

Where :
KR : Relative abundance (%)
Ni : Number of individuals spesies of i
N : Total number of individuals species

2.3.2 Frequency of presence

According to [6], The frequency of presence can indicate the extent of the distribution of a particular species as seen from the percentage frequency of fish caught, by :

$$\textbf{Fk} = \frac{Ti}{T} \; X \; 100\% \qquad (2)$$

Where:
Fk : The Caught frequency of i species presence (%)
Ti : The Caught number of stations where i species (%)

T : Total number of stations

Where:
FK 0 - 25% = Very rare presence
FK 25%-50% = Rare presence
FK 50%-75% = Moderate presence
FK > 75%= Frequent/absolute presence

2.3.3 The Diversity Index

Fish diversity can be calculated using the diversity index from Shannon and Wiener (1963) with the formula [7]:

$$\mathbf{H' = \sum Pi\ Ln\ Pi} \quad (3)$$

Where:
H′ : Diversity index ln : Logarithm of nature
Pi : Comparison of the number of individuals of a species to the total number of species (ni/N)

This category has a certain range of values [7], namely:
H′ < 1 = Low diversity
I< H′< 3 = Medium diversity
H′ > 3 = High diversity

2.3.4 The uniformity index

The uniformity index is used to determine the balance of a community by observing the number of individuals between species in a community. According to [8] the Uniformity Index E can be formulated as follows :

$$\mathbf{E} = \frac{H'}{Hmax} \quad (5)$$

Where:
E : Uniformity Index
H′ : Diversity Index
H max : Maximum species diversity. The following [7], criteria:
E < 0.4 = Small population uniformity
0.4 < E < 0.6 = Medium population uniformity
E > 0.6 = High population uniformity

2.3.5 The Dominance index

To calculate the dominance of a certain type in a community, the Simpson dominance index is used [7] using the following formula:

$$\mathbf{C} = \sum_{i=1}^{n} \left[\frac{ni}{N}\right]^2 \quad (6)$$

Where:
C : Dominance Index
Ni : Number of individuals of species i
N : Number of individuals

The information according to [7] states that there are dominance criteria as follows:
If the C value approaches 0 (<0.5), then there is no dominant species.
If the C value approaches 1 (>0.5), then there is a dominant species.

3 Result and Discussion

3.1 The number of fish

Based on the results of research conducted in Pangkalan Susu sea which was carried out in June - August. Sampling carried out every month consists of different sampling points depending on the location of the fishing ground used by fishermen. The number of fish during the study can be seen in Table 1.

Table 1. The number of fish during research

No	Family	Species	Month			Total
			June	July	August	
1	Ariidae	*Netuma talassina*	2	3	0	5
2	Butidae	*Butis humeralis*	1	0	0	1
3	Balitoridae	*Homaloptera ocellata*	0	0	1	1
4	Carangidae	*Alectis indica*	0	1	0	1
		Carangoides chrysophrys	1	2	0	3
		Alepes kleinii	0	0	6	6
		Atule mate	2	22	23	47
		Scomberoides tala	0	3	0	3
		Scomberoides tol	0	0	1	1
		Megalaspis cordyla	1	99	29	129
5	Chanidae	*Chanos chanos*	1	1	0	2
6	Clupeidae	*Sardinella gibbose*	6	3	0	9
		Sardinella fimbriata	1	0	0	1
7	Cynoglossidae	*Cynoglossus lida*	0	1	0	1
8	Engraulidae	*Setipinna tenuifilis*	4	0	0	4
		Encrasicholina punctifer	17	0	0	17
		Stolephorus indicus	1	0	0	1
		Stolephorus waitei	4	0	0	4
9	Gastromyzontidae	*Gastromyzon contractus*	0	0	1	1
10	Gerreidae	*Gerres filamentosus*	0	1	0	1
		Gerres oyena	1	0	0	1
		Gerres shima	2	0	0	2
11	Haemulidae	*Pomadasys kaakan*	0	3	0	3
12	Hemiramphidae	*Hyporhamphus dussumieri*	12	0	0	12
		Hyporhamphus quoyi	1	0	0	1
13	Leiognathidae	*Aurigequula fasciata*	4	0	0	4

No	Family	Species	Month			Total
			June	July	August	
		Eubleekeria jonesi	2	0	0	2
		Gazza dentex	1	0	0	1
		Secutor insidiator	0	4	0	4
14	Lutjanidae	*Lutjanus johnii*	0	1	0	1
15	Mugilidae	*Chelon subviridis*	22	37	71	130
16	Mullidae	*Upeneus sulphureus*	0	1	1	2
17	Muraenidae	*Echidna rhodochilus*	0	5	0	5
18	Nemipteridae	*Nemipterus japonicus*	0	0	2	2
19	Polynemidae	*Eleutheronema tetradactylum*	0	1	0	1
20	Priacanthidae	*Priacanthus tayenus*	0	18	0	18
21	Rachycentridae	*Rachycentron canadum*	0	0	3	3
22	Scatophagidae	*Scatophagus argus*	1	16	2	19
23	Sciaenidae	*Johnius carouna*	0	16	7	23
		Johnius borneensis	0	0	1	1
24	Scombridae	*Rastrelliger kanagurta*	0	6	0	6
		Scomberomorus commerson	0	0	1	1
25	Serranidae	*Epinephelus bleekeri*	0	1	3	4
		Epinephelus fuscoguttatus	0	0	1	1
		Epinephelus areolatus	0	0	1	1
26	Siganidae	*Siganus guttatus*	0	0	3	3
		Siganus javus	50	75	57	182
27	Sillaginidae	*Sillago sihama*	0	0	2	2
28	Sphyraenidae	*Sphyraena qenie*	0	1	5	6
29	Terapontidae	*Terapon jarbua*	2	9	2	13
30	Tetraodontidae	*Chelonodon patoca*	3	0	0	3
		Tetraodon nigroviridis	2	0	0	2
		Total individuals (N)	**144**	**330**	**223**	**697**

The abundance of fish obtained during the study were 697 consisting of 30 families and 52 species. In June, 144 fish consisting of 25 species were obtained, in July 330 fish consisting of 25 species, and in August 223 fish consisting of 21 species. The highest catch was in July because this month is included in the East Season which resulted in the catch in that month being very abundant. In addition, sampling was carried out in the dark moon with more sampling points compared to June and was caught using three different fishing gears. Meanwhile, the number of catches decreased in August due to the influence of the transition from the rainy season to the dry season.

3.2 Relative Frequency of fish

Relative density is the comparison between the abundance of individuals of each species with the total number of individuals caught in a community can be seen in Figure 2.

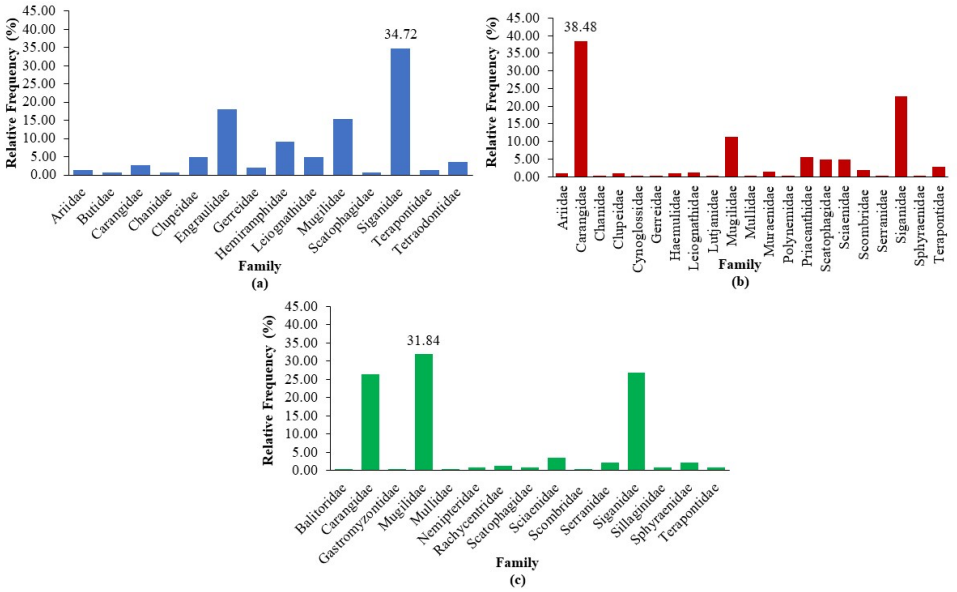

Fig. 2. Relative Frequency of fish during research a) June ; b) July ; c) August

The relative abundance of fish caught in Pangkalan Susu sea during the study was obtained as many as 697 consisting of 52 species and 30 families. The relative abundance of fish in June consisting of 14 families showed that the highest Siganidae family of 34.74% consisted of 2 species are *Siganus javus* and *Siganus guttatus*. The lowest relative abundance of the Butidae family, the Chanidae family, and the Scatophagidae family with each abundance of 0.69%. The relative abundance of fish in July consisting of 21 families showed that the highest Carangidae family of 38.48% consisted of 7 species are *Alectis indica*, *Carangoides Chrysophrys*, *Alepes kleinii*, *Atule mate*, *Scomberoides tala*, *Scomberoides tol*, and *Megalaspis cordyla*. The lowest relative abundance of the Chanidae family, Cynoglossidae family, Gerreidae family, Lutjanidae family, Mullidae family, Polynemidae family, Serranidae family and Sphyraenidae family with each abundance of 0.3%. The relative abundance of fish in August consisting of 15 families showed that the highest Mugilidae family of 31.84% consisted of 1 species is *Chelon subviridis*. The lowest relative abundance of the Balitoridae family, Gastromyzontidae family, Mullidae family, and Scombridae family with each abundance of 0.45%. factors that cause species abundance such as habitat so that certain species can be found in one location but not in other locations [9]. In addition, species abundance is also influenced by substrate, salinity, ability to withstand currents and waves, food source availability factors, and self-protection factors from surrounding conditions [10].

3.3 The Diversity index

The calculation results, the diversity index value in June was 1.011, July was 0.966 and August was 0.886. According to the data displayed, it is known that the highest diversity index value is in June, then it will decrease in July and decrease again in August. The diversity index is categorized as high if H'>3, is said to be moderate if 1<H'>3, and low if H'<1 [11] can be seen in Figure 3.

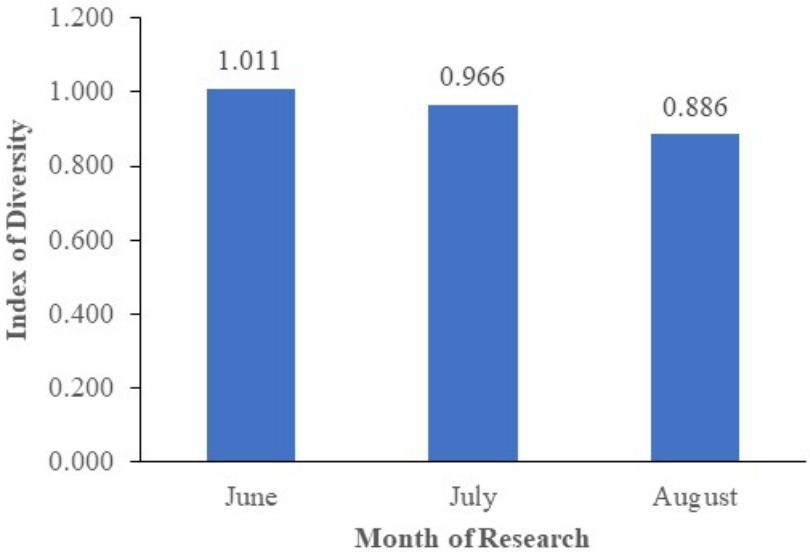

Fig. 3. The diversity index of fish during research

Based on the calculation results and compared with the diversity index value category, it can be said that in June it has a moderate diversity index while in July and August it is included in the low criteria. This is because the number of species per individual in each sampling is uneven and uneven. The diversity index has a large value if all individuals come from different genera or species. While the smallest value if all individuals come from one genus or one species only with the number of each individual relatively even, and vice versa. A community if its distribution is uneven, then its diversity is low [12].

3.4 The Uniformity Index

Fish Uniformity Index in Pangkalan Susu sea describes the number of individual sizes between species in a fish community, the more evenly distributed the individuals between species, the more balanced the ecosystem will be. The uniformity index value ranges from 0-1 will be presented in Figure 4.

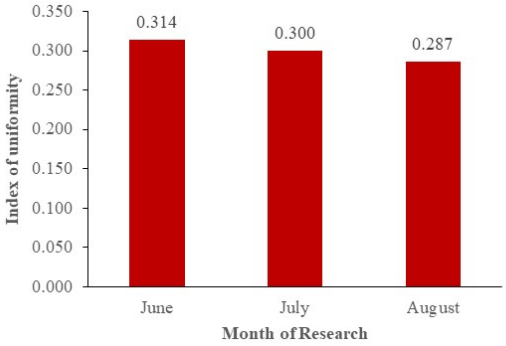

Fig. 4 The Uniformity Index of fish during research

The diversity index value in June can be seen as 0.314, in July as 0.3, and in August as 0.287. The calculation results from the three months of research in Pangkalan Susu sea show a small population uniformity index value. The low value of the uniformity index means that there is a type of fish that dominates during the study. In addition, it is also said that the distribution of the number of individuals in the Pangkalan Susu Sea is relatively uneven, especially in June which has the highest uniformity index value. This is in accordance with the statement of [4] who said that if the uniformity value approaches 0, it means that in the ecosystem there is a tendency for certain species. Meanwhile, if the diversity index value approaches 1, it indicates that the ecosystem is stable and the number of individuals is evenly distributed in each species. This condition is also influenced by environmental conditions that determine the distribution of fish at that location. In addition to environmental factors, the presence of predators from various types of fish in that location causes fish species to not be able to spread evenly [13].

3.5 The Dominance index

The dominance index describes the pattern of concentration and distribution of species dominance in an ecosystem [14]. The dominance index of fish species during the study had different values, based on the calculation of the highest dominance index in August with a value of 0.197. The dominance index value in June was 0.171 and July had the lowest dominance index value of 0.168. The highest dominance index value is 0.197, if the C value was close to 0 (<0.5), then there was no dominant species and if the C value was close to 1 (>0.5), then there is no dominant species [12]. It shows that the smaller the value of the dominance index, the more widespread the dominance pattern of the species, and *vice versa*. The results during the study in Pangkalan Susu Sea showed that there were types of fish that dominated during the study. This is because the value of the dominance index achieved did not exceed 0.5. The following are the results of the dominance index in Figure 5.

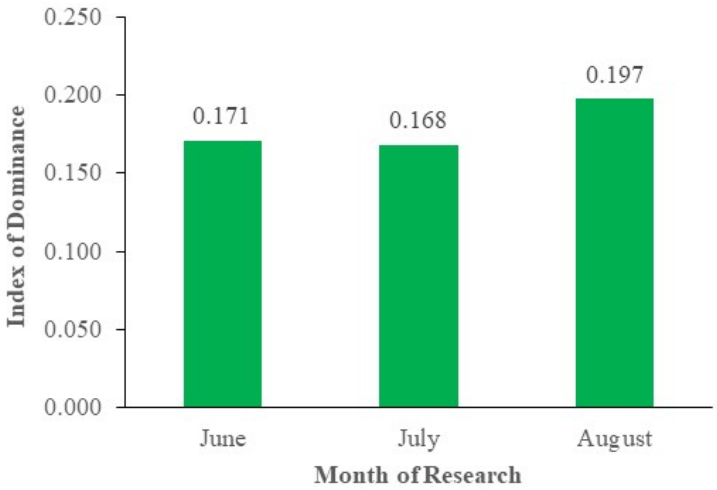

Fig. 5 The Dominance Index of fish during research

Based on the results of the analysis of the diversity index and diversity index, it shows that the distribution of fish in Pangkalan Susu Sea was, while based on the dominance index, there are fish that dominate during the study. The large number of individuals and groups

affects the high abundance [15]. This condition is also influenced by environmental conditions that determine the distribution of fish at that location [16]. In addition to environmental factors, the absence of predators from various types of fish in the months of the study could be caused fish species to spread evenly [17].

4 Conclusions

The highest relative abundance during the study were 3 Families as Family Siganidae, Carangidae, and Mugilidae The value of the fish species diversity index in Pangkalan Susu Sea is 0.954 with low diversity category, The uniformity index is 0.242 as small population uniformity, and the dominance index is 0.179 as no dominant species category.

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