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# DIVERSITY INDEX OF DANISH SEINE'S CATCHES IN PANGANDARAN REGENCY

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KeyWords

Biodiversity, demersal fish, danish seine, Pangandaran, swept area

## ABSTRACT

Danish seine is one of fishing gear operating in Pangandaran which is banned from operation based on PERMEN KP/2 2015 because it contributes to the decline of fisheries resources in Pangandaran, especially demersal fish. Biodiversity index is one important element in the effort of sustainable fisheries management. The purpose of this research is to analyze the diversity of demersal fish based on swept area of danish seine operated in Pangandaran Regency, West Java. The research is conducted from August 2018 to July 2019 in the eastern region of Pangandaran Water. Sampling was carried out in 3 stations (Sagara Anakan, Bagolo, and Babakan Villages) with 8 repetitions each. The analysis used was the Shannon Wienner diversity index and Pielou's evenness index to determine the demersal fish community structure and oceanographic parameter analysis in the research area. The method used is a survey method, the samples taken directly with swept area method using danish seine. The main catch of danish seine in Pangandaran consists of danish seine shrimp (Metapenaeus ensis) with a percentage of 2%, rebon shrimp (Acetes indicus) with a percentage of 81%, and krosok shrimp (Parapenaopsis sp.) with a percentage of 14%. Oceanographic conditions in the research area have sandy mud and mud substrates with depths ranging from 8-120 meters. The results of the research show that the demersal fish resources caught by danish seine in Pangandaran are at a low to moderate level of diversity and have a low level of species evenness with the most dominant family is Penaeidae.

## INTRODUCTION

Pangandaran is one of the potential areas for marine tourism and capture fisheries. Both of these sectors make a major contribution to the regional economy and the people in the region. Fishing gear operated by Pangandaran fishermen consist of longline fishing, beach seine, gillnet, trammel net, and danish seine[1].

Danish seines are operated at the bottom water to catch demersal fish and shrimp. Based on Ministry of Maritime and Fisheries Affairs Regulation number 2 2015, danish seine is prohibited because it is one of trawl nets type. Danish seines have low selectivity and potentially damage the area they sweep. Those are the reason on why operating ban on fishing gear is implemented which is considered declining in fish resources and can damage the ecosystem as an effort to manifest the responsible, optimal and sustainable fisheries /resources.

Demersal fish usually caught by danish seine. Generally, demersal fish live in area with mud or sandy mud substrates. One of the reasons for the prohibition of danish seine is that it is considered declining in fish resources, so that the demersal fish resources in Pangandaran water require a rational management for sustainable capture fisheries. One important element needed to support these efforts is the availability of data and information about the fish biodiversity index. The purpose of this research is to analyze the diversity of demersal fish based on the swept area of danish seine operated in Pangandaran Regency, West Java as a basis for the responsible, optimal, and sustainable fisheries management.

## MATERIALS AND METHODS

Research was conducted from August 2018-January 2019 located in Pangandaran Regency, West Java. Samples were obtained from 3 different stations with 8 repetitions at each station. The station location is determined to represent the entire east coast region (west, center and east) with the following details (Figure 1):

- Station 1: 07°42'30.73"-07°43'29.37"S and 108°44'27.39"-108°45'9.93 "E (Sagara Anakan Village, Kalipucang District)
- Station 2: 07°41'55.90"-07°41'18.78"S and 108°41'44.00"-108°42'46.69 "E (Bagolo Village, Kalipucang District)
- Station 3: 07°43'38.46"-07°44'43.09"S and 108°41'19.41"-108°41'19.58"E (Babakan Village, Pangandaran District)

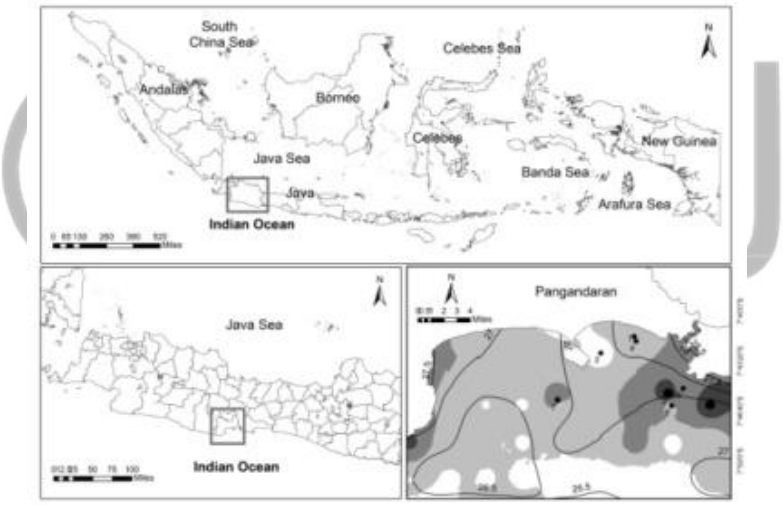


**Figure 1.** Research location

The danish seine used to catch demersal fish during the research consisted of 3 ships, namely Rizki Ilahi, Sentosa Jaya, and Tirta Baskoro with different net size specifications (Table 1). The difference in the size of the net influences the swept area of the fishing gear when operated so that it also affects to the catch. The mesh size in the bag is too small so it has a high bycatch and captures targets with a size that is not worth catching.

**Table 1**. Characteristics of danish seine

| Station | Name of Ships | Main Line Length (m) | Head Rope Length (m) | Mesh Size of Bag (inch) | Wings Opening (m) | Material |
|---|---|---|---|---|---|---|
| 1 | Rizki Ilahi | 200 | 37,5 | 0,5 | 18,75 | Polyethylene |
| 2 | Sentosa Jaya | 200 | 40,5 | 0,5 | 30,37 | Polyethylene |
| 3 | Tirta Baskoro | 200 | 45 | 0,5 | 33,7 | Polyethylene |

Data used in this research includes primary and secondary data. Primary data consists of demersal fish caught by danish seine and its characteristics, while secondary data consists of satellite images of depth sea, substrates characteristics, and statistical data on capture fisheries in Pangandaran Regency. Fish identification was carried out at the Pangandaran Fish Auction Place (Jongor Batu) by observing the morphological characteristics of the fish. Identification of danish seine fishing gear includes the name of ship and the owner, main line

length, head rope length, mesh size, wings opening, net materials, hauling time, and the average of vessel velocity when pulling the net. Oceanographic parameters observed identified by remote sensing method, and the characteristics of the substrate identified by the literature study method. Demersal fish data were collected then analyzed using fish diversity index and evenness index.

**Index of diversity**

Fish species diversity index values are used Shannon Wienner diversity index[2], namely:

$$H' = -\sum \mathrm{Pi} \ln \mathrm{Pi}$$

$$Pi = \frac{\mathrm{ni}}{\mathrm{N}}$$

Description:

H' = Shannon-Wienner diversity index
Pi = proportion of individuals found in the $i_{th}$ species
ni = Total fish in the $i_{th}$ species
N = Total fish

Criteria:

H'< 1 = Low diversity
1<H'< 3 = Medium diversity
H'> 3 = High diversity

**Index of Evenness**

Evenness of individuals distribution in the community is used Pielou's evenness index. The index is calculated using the following formula[3].

$$E = \frac{\mathrm{H}'}{\mathrm{H}'Max}$$

Description:

E = Index of evenness (0-1)
H' = Shannon-Wienner diversity index
H'Max = ln S
S = Number of species

Range values are as follows

E< 0,4 = Low population evenness
0,4< E< 0,6 = Medium population evenness
E> 0,6 = High population evenness

**Swept Area**

The swept area of danish seine is calculated by[4]:

$$A = \frac{\left(\frac{2}{3}\right) \mathrm{L.v}(1.85\mathrm{x}0.001)}{\mathrm{t}}$$

Description:

A = Swept area ($km^2$)
t = Hauling time (hour)
v = Average speed of vessel (knot)
L = Head rope length (meter)
1,852 = Conversion of miles to km
0,001 = Conversion of m to km

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**Catch Rate**

Catch rate results of danish seine are calculated by:

$$Catch\ rate = \frac{\text{Weight of catch}}{\text{Hauling time}}$$

**Stock Density**

The stock density calculation using swept area method based on area passed, the average velocity of the vessel when pulling the net, the width opening of the net, and catch is as follows[5]:

$$\mathrm{D} = \left(\frac{1}{A}\right) x \left(\frac{e}{f}\right)$$

Description:

D = Stock density
A = Swept area
e = Catch (kg/hour)
f = *escapment factor* (0,5)

**Data Analysis**

The diversity index, species evenness index, catch rate, demersal fish stock density in Pangandaran Regency, and oceanographic profiles in research area were analyzed descriptively quantitatively presented in the form of tables and graphs.

**RESULTS**

**Danish Seine Fisheries in Pangandaran Regency**

Pangandaran is one of the areas that included to the zone of Fisheries Management Area (WPP) 573 which covers the Indian Ocean, south of Java to the south of Nusakambangan Island. This geographic profile makes Pangandaran besides of being a mainstay area for the marine tourism sector, it is also a potential area for capture fisheries. These two sectors make a major contribution to the regional economy and the people in the region[1].

Based on data from the Department of Marine Fisheries and Food Security of Pangandaran Regency in 2019, fishing gear operating in Pangandaran consists of 3 types of operating methods, namely static gear which includes gillnet and fishing rods with a total of 1.728 units (90%), encircling gear which includes mini purse seine with a total of 31 units (2%), and towed/dragged gear which includes danish seine and beach seine with a total of 160 units (8%) (Figure 2).

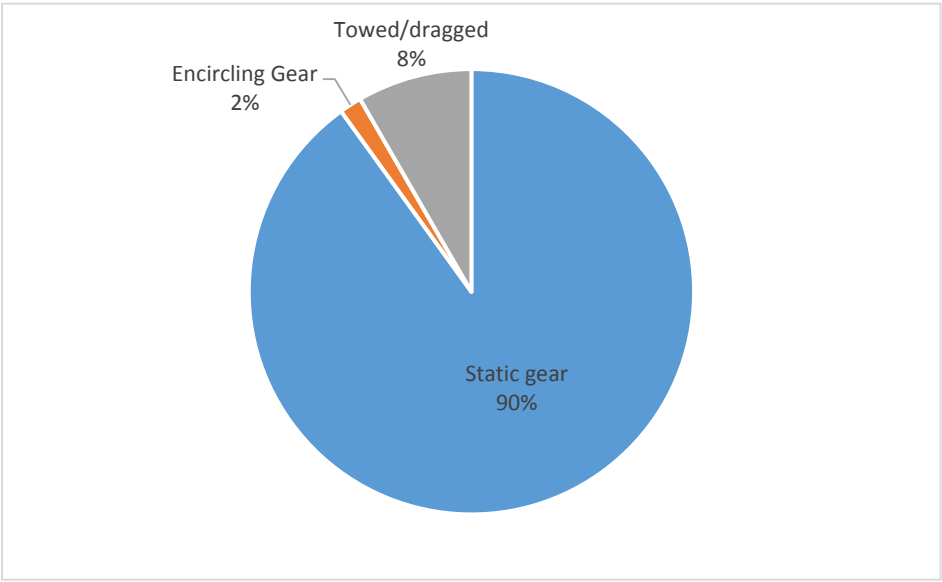


**Figure 2**. Percentage of fishing gear based on the method of operation in Pangandaran
(Source: DKPKP 2019)

One of the fishing devices operated in Pangandaran Regency is a danish seine. The Ministry of Maritime and Fisheries Affairs Regulation No. 2 2015 concerning the prohibition on the trawls and seine nets operation in the fisheries management area of Indonesia is an effort by the government to anticipate the destructive fishing[6]. Danish seine is a fishing device operated at the bottom water made from

pocketed net to collect the catch with the construction of a long rope and wings. Danish seines are operated at the bottom of the waters by circling the hordes of fish and then pulled using human power. Construction of danish seine nets consists of bags (cod end), body, and wings. The danish seine has a different mesh size in each part, wing parts have mesh size of 5 inches, body parts have mesh size of 1.5, and parts of the bag have mesh size of less than 1 inch so that it has high bycatch and captures targets with a size that is not worth catching so this fishing gear is considered to have low selectivity. Danish seine fishing gear belongs to vessel seines and prohibited from operating because in addition of having a low selectivity it also potentially damages the area that they sweep. In fact, the danish seine is still wide spread used by fishermen in Indonesia. Based on the KKP data in 2016, the number of trawlers (including danish seine) in Indonesia amounted to 79,018 units. The wide spread use of danish seine is because it has been operating in Indonesia for a long time and is a source of life for fishermen so this prohibition policy cannot be accepted by fishermen[7]. Based on the capture fisheries statistics data in West Java Province in 2009-2017, the number of danish seine in Pangandaran Regency in the past 9 years has tended to decline. Based on these data, the number of danish seine fishing units in Pangandaran tends to remain unchanged until 2013, which amounted to 201 units and increased in 2014 to 225 units. The number of danish seine catching units subsequently decreased in 2015 to 80 units and in the following year respectively amounted to 109 and 27 units (Figure 3). Since 2015 the number of danish seine fishing equipment in Pangandaran has declined due to the enactment of Ministry of Marine and Fisheries Affairs regulation numbers 2 2015 concerning the prohibition of trawl fishing gear in Indonesian fisheries management area, so that re-capture of fishing gear in Pangandaran is conducted. When data collection is carried out, danish seine fishermen register their other fishing gear so that the number of registered danish seine fishing gear decreases.

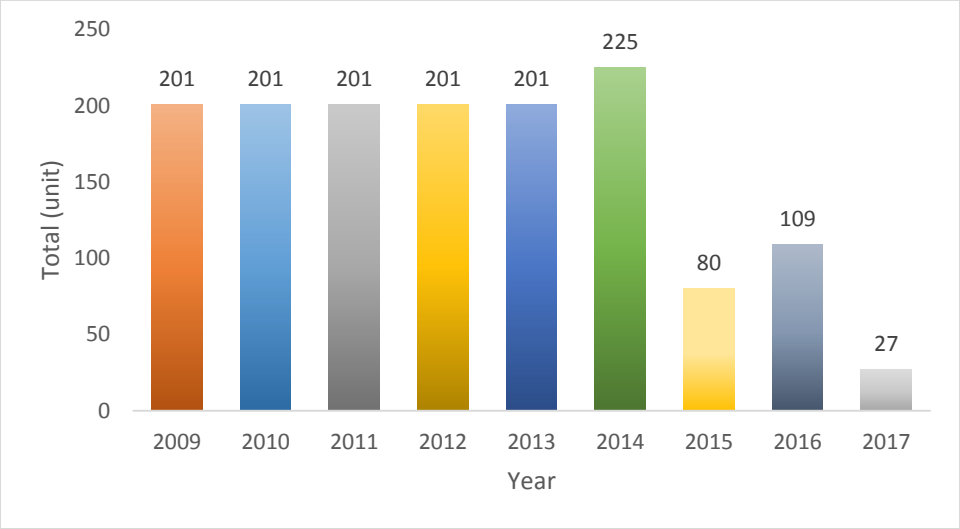


**Figure 3.**Number of units of danish seine fishing gear in Pangandaran Regency
(Source: Fisheries statistical data capture West Java Province)

**Sea Depth Profile**

The depth of the sea provides important information about what can be utilized from the sea.The sea depth profile is usually used in connection with the navigation system and can also provide information about the distribution of living things inside[8]. Pangandaran marine water face directly to the Indian Ocean, so it is very influential on the depth of the sea. Danish seine fishermen carry out fishing activities with outboard motor vessel measuring <5 GT so the fishing area is limited and not too far from the port. This shows that the danish seine fishing gear operation area in Pangandaran has about 10-40 meters of depth and categorized as shallow water. Shallow waters are places for spawning and nursery, so many young fish (small size) are caught[9]. This is evidenced by the many types of young fish caught by danish seine in Pangandaran which certainly can threaten the sustainability of demersal fish resources in Pangandaran. Based on the depth data obtained from topex.ucsd.edu and processed using Microsoft Excel and Surfer, the water depth of the research area ranged from 8 - 120 meters (Figure 4).

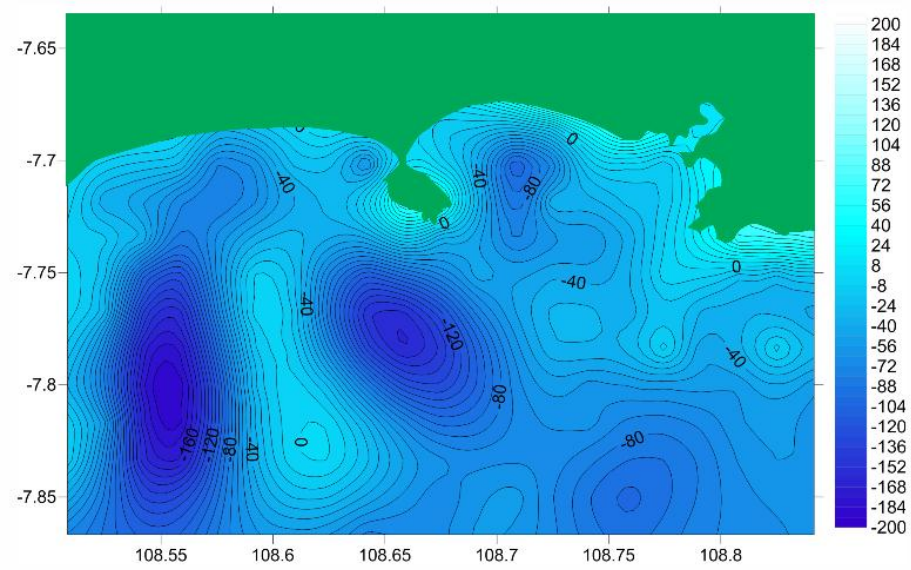


**Figure 4.** Profile depth of research area
(Source:topex.ucsd.edu)

Each data collection station has a different depth profile. Station 3 has the deepest area which ranges from 24 - 120 meters, while stations 1 and 2 have the same depth, ranging from 8 - 40 meters (Table 2). The depth profile of the research area shows that demersal fish in Pangandaran inhabit areas with a depth of 8 - 120 meters. This is consistent with research that states demersal is found in depths of 20-40 m[9]. Biota inhabiting the bottom of the waters with a profile depth of less than 100 meters are dominated by various types of benthos, especially crustaceans and fish from sciaenidae family (tigawaja fish) and trichiuridae (hairtail fish) which are the demersal fish groups[11].

**Table 2**. Depth profile of each station

| Station | Depth (m) |
|---|---|
| 1 | 8 – 40 |
| 2 | 8 – 40 |
| 3 | 24 – 120 |

**Substrate Characteristics**

Demersal fish live on the bottom of the sea and inhabit several regions with different substrate characteristics. Substrate characteristics have a role as a store of nutrients derived from the sea and from the land through various processes. Nutrients that are in the substrate are used by microfauna as decomposers into organic materials which are then used as food for other organisms. Demersal fish are very dependent on the substrate, it's because demersal fish take a lot of food on the substrate.

The characteristics of research area have relatively sloping bottom waters because it is a continental exposure area and has a muddy substrate. The type of substrate is a habitat for various types of demersal fish[9]. The type of substrate can affect the life of organisms that live at the bottom of the water. Demersal fish generally live well in muddy or sandy mud substrates. Generally, demersal fish group in waters with mud or sandy mud substrates[12]. The southern waters of Java has a flat bottom water and tend to be muddy.

**Catch Composition**

The catch composition of danish seine is dominated by several types of shrimp, such as *Acetes indicus*, *Parapenaopsis* sp., and *Metapenaeus ensis*. The bycatch of danish seine consists of several types of demersal fish, such as hairtail fish, flounder fish, and tigawaja fish. Broadly speaking, the catch of the danish seine catch consists of 18 species from 15 families (Table 3).

**Table 3**. Catch composition

| Station | Total of family | Total of species | Total of individuals | Total of weight (kg) | Catch rate (kg/h) |
|---|---|---|---|---|---|
| 1 | 15 | 18 | 4,582 | 25.36 | 10.57 |
| 2 | 14 | 17 | 6,761 | 33.86 | 10.16 |
| 3 | 13 | 17 | 20,517 | 50.6 | 21.08 |

The composition of demersal fish catches at the sampling location during the research was not much different from each station. This proves that Pangandaran Water is a community that is supported by the behavior of demersal fish that have migration activities not too

far from the coastline with not much different of sea depth profiles. The main sample of the research was taken using a danish seine with the swept area method. Danish seine in Pangandaran is a fishing gear specifically used to capture various types of shrimp, such as *Acetes indicus*, *Parapenaopsis* sp., and *Metapenaeus ensis* and so on so that the main catch of this fishing gear are several types of shrimp. Based on the composition, the catch of this fishing gear is dominated by some types of crustaceans. Data on the composition of demersal fish species are taken in August 2018 (east season) and January 2019 (west season). Based on the data obtained, the catch caught by danish seine in August 2018 is more than the catch caught in January 2019 (Table 4). This shows that the season affects the fishing activities in Pangandaran Regency.

**Table 4**. Catch comparison

| Station | Catch average (kg) | |
|---|---|---|
| | August | January |
| 1 | 31,95 | 18,77 |
| 2 | 39,67 | 28,05 |
| 3 | 81,75 | 19,45 |

Fishing activities are mostly carried out in the east season, while in the west season fishermen only carry out fishing activities in less intensity because of the large ocean waves and the least catch. Catches in the west season tend to be smaller when compared to the catch in the east season which occurs from June to August. The difference in the amount of these catches shows that there is a significant difference in fish growth between the west and east seasons.

**Community Structure**

Understanding of the demersal fish diversity is very important because of the biological organizations characteristics that have genetic diversity, species, or ecosystems that play a very important role in maintaining life. Loss or reduction in biodiversity can reduce the ability of the population to adapt to environmental changes[13]. Therefore, the fish resources in Pangandaran must be rationally manage so that it can be used sustainably and remain sustainable. One important element in the management effort is the availability of data and information about the fish biodiversity index. The indexes analyzed to support the availability of this information are the species diversity index, and the species evenness index.

Diversity of species (H ') and evenness of species (E) are index that are often used to evaluate the state of an environment including the aquatic environment based on biological conditions. Good ecosystems can be seen from the high species diversity and high population evenness, but on the contrary, relatively low species richness and the dominance of certain species show poor ecosystem conditions. This is consistent with the statement that good ecosystems have high species diversity characteristics and the spread of individual species that are almost evenly distributed in each waters[3].

The highest diversity index of demersal fish in Pangandaran is found at station 1 with a value of 1.24 and the lowest at station 3 with a value of 0.45, while at station 2 the diversity index value is 1.05. Based on these values, stations 1 and 2 are categorized as medium diversity areas, while station 3 is categorized as low diversity area (Table 5). This refers to the determination of criteria for species diversity according to Odum (1971), namely as follows:

- H '<1 = Low diversity
- 1 <H' <3 = Medium diversity
- H '> 3 = High diversity

Station 2 and 3 categorized as low population evenness region, while station 1 is categorized as a moderate population evenness region (Table 5). This is based on criteria according to Gonawi (2009).

- E <0.4 = Low population evenness
- 0.4 <E <0.6 = Medium population evenness
- E> 0.6 = High population evenness

**Table 5**. Demersal fish community structure

| Station | H’ | E |
|---|---|---|
| 1 | 1.24 | 0.43 |
| 2 | 1.05 | 0.37 |
| 3 | 0.45 | 0.16 |

The same thing happened in the results of the research stating that the results of analysis of several parameters of demersal fish community structures in southern Java showed Shanon Wienner diversity index values (H ') amounting to 2.5 (medium) and evenness index types from Pielou (E) of 0.30 (low)[11]. The evenness index value depends on the value of the diversity index. The smaller the diversity index value, the smaller the species evenness index. This indicates the dominance of a species of another type. As already mentioned, the type of crustaceans dominates the composition of the catch of danish seine, especially the types of *Acetes indicus*, *Parapenaopsis* sp., and *Metapenaeus ensis*, thus causing low population evenness. Generally, habitat that is preferred by shrimp is soft substrate seabed and

usually consists of a mixture of mud and sand[12]. Therefore, the catch of danish seine fishing equipment in Pangandaran is dominated by shrimps because the catching area of the danish seine has a mud substrate and is not far from the coast so that it is shallow water.

Based on the community structure, the diversity of demersal fish in Pangandaran Regency is in the low to moderate category with the dominance of several types of crustaceans. This shows that the ecosystem is not good so it is necessary to manage responsible, optimal and sustainable fisheries resources. The main objectives of sustainable fisheries resource management can be achieved by maintaining biodiversity which affects the characteristics, properties, and forms of life[14]. Based on these principles, fisheries resource management must have the following strategies:

1) Maintain a productive and efficient structure of fish species in order to harmonize with the process of changing habitat components with dynamics between populations.
2) Reducing the rate of fishing intensity to suit the production capacity and recoverability of fish resources, so that optimal and sustainable capacity can be guaranteed.
3) Control and prevent any fishing operation that can cause damage or pollution of the aquatic environment directly or indirectly.

## Conclusion

Based on the results obtained, then some things that the author can conclude such as:

1) Demersal fish resources captured by danish seine in Pangandaran are at a low to moderate level of diversity with a low level of population evenness.

2) The density of demersal fish stocks in Pangandaran waters at the time of the research consisting of 15 families and 18 species, with the most dominant family is Penaeidae.

## References

[1] Nurhayati A. 2013. Analysis of Sustainable Potential of Fishing Fish in Region Pangandaran. Journal of Aquatics, 4 (2): 195-209.

[2] Magurran, AE (1988). Ecological diversity and its measurement (p. 179). Princeton University Press, New Jersey.

[3] Krebs, CJ (1989). Ecological methodology (63 p). Harper Collins Publisher, New York

[4] Pauly, D. 1980. A new methodology for rapidly acquiring information on tropical fish stocks: growth, mortality and stock recruitment relationships, P. Roedel and S. Saila (eds.) Stock assessment for tropical small-scale fisheries. International Center for Marine Resources Development, Uni-versity of Rhode Island, Kingston. 154-172pp.

[5] Sparre, P., & Venema, SC (1998). Introduction to tropical fish stock assessment. Part 1. Manual. FAO Fisheries Technical Paper. No. 306.1, Rev. 2. Rome, FAO, 407 pp.

[6] Suprapti, Yuyun, Rudianto Syamsu Dhuha, and Miftachul Munir. 2017. Perception of Cantrang Fishermen to the Minister of Marine AffairsRegulation Number 2 2015. and FisheriesJournal of Economic and Social of Fisheries and Marine 5 (1): 104-115.

[7] Dewanti, LP, Mahdiana, I., Zidni, I., & Herawati, H. 2018. Evaluation of the Selectivity and Friendliness of Danish seine Fishing Equipment in Pangandaran Regency, West Java Province. Airaha Journal, Vol. 7 (1): 030-037.

[8] Pambuko, DM., Jondri, and Umbara, RF. 2013. Identification of Sea Depth (Bathymetry) based on Sea Surface Color on Satellite Images using the ANFIS Method. JMI. 9 (2): 167-178.

[9] Purbayanti, Ari, and Riyanto. 2005. Operation of Shrimp Trawlers on Day and Night Impacts on Side Capture in the Arafura Sea. Maritek 5 (1): 29-41.

[10] Cahya, CN, Dadmuk, S, Dewi, S. 2016. Effect of Oceanographic Parameters on Fish Distribution. Oseana, 41 (4): 1-14.

[11] Hidayat, T & Nurulludin. 2017. Biodiversity Index of Demersal Fish Resources in the Waters of the South Indian Ocean of Java. Journal of Indonesian Fisheries Research, 23 (2).

[12] Akbar, H. 2013. Relation of Basic Waters Type to Distribution of Demersal Fish in Pangkajene Waters of South Sulawesi. Journal of Fisheries and Marine Technology, 4 (1): 31-39.

[13] Badrudin, Sasanti, Suharti, R., Yahmantoro., & Imam, S. (2003). Biodiversity index of Kepe-kepe (fishChaetodontidae)in Wakatobi waters, Southeast Sulawesi, J. Lit. Perik. Ind., Resource Edition and Arrest, 9 (7), 67-73.

[14] Purwanto. 2003. Fisheries Resource Management. Jakarta. Directorate General of Capture Fisheries, Ministry of Maritime Affairs and Fisheries.