

## Fish Community Structure in The Coastal Mangrove Ecosystem of Cemara Kulon Village Indramayu Regency, Indonesia

Titin Herawati<sup>\*1</sup>, Muhamad Pauwwaz<sup>2</sup>, Zahidah<sup>3</sup>, Izza Mahdiana Apriliani<sup>4</sup>,  
Ayi Yustiati<sup>5</sup>, Atikah Nurhayati<sup>6</sup>

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<sup>1</sup>Master Program of Marine Conservation Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran. Jl. Soekarno KM 21, Sumedang, West Java, Indonesia, 45363. <sup>1,2,3,4,5,6</sup>Department Fisheries, Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran. Jl. Raya Soekarno KM 21, Sumedang, West Java, Indonesia, 45363.

e-mail:

<sup>1</sup>[titin.herawati@unpad.ac.id](mailto:titin.herawati@unpad.ac.id),

<sup>2</sup>[pauwwazm13@gmail.com](mailto:pauwwazm13@gmail.com),

<sup>3</sup>[zahidah@unpad.ac.id](mailto:zahidah@unpad.ac.id),

<sup>4</sup>[izza.mahdiana@unpad.ac.id](mailto:izza.mahdiana@unpad.ac.id),

<sup>5</sup>[yustiati@unpad.ac.id](mailto:yustiati@unpad.ac.id),

<sup>6</sup>[atikah.nurhayati@unpad.ac.id](mailto:atikah.nurhayati@unpad.ac.id)

**Abstract.** *The mangrove ecosystem of Cemara Kulon Village has the potential for fishery resources which has decreased in line with various anthropogenic activities. This study aims to determine the composition of fish and analyze the status of the fish community structure and its relation to the physical-chemical aspects of the waters in the mangrove ecosystem of Cemara Kulon Village. This research was conducted over a period of three months in the mangrove ecosystem of Cemara Kulon Village. The method used in this research was descriptive quantitative purposive and composite sampling at 3 research stations. Parameters observed in this study were relative abundance, diversity, uniformity, dominance, and the relationship between community structure and aquatic physico-chemical parameters. During the study, 508 fish were caught, consisting of 20 species from 16 families. The value of diversity was in the moderate category with a ranged of 1.87-2.50; the uniformity value was in the moderate category with a ranged of 0.41-0.46 and the dominance value was in the low category with a ranged of 0.11-0.22. Based on the results of the Canonical Correspondence Analysis (CCA) revealed that fish diversity was affected by light transparency and DO, the uniformity of fish was affected by temperature, and the dominance of fish was affected by ammonia. The fish community structure was categorized as unstable which was influenced by water quality.*

\*Corresponding author

**Keywords:** *analysis, canonical correspondence, diversity, uniformity*

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## INTRODUCTION

Cemara Kulon Village is included within the administrative area of Losarang District, Indramayu Regency, covering an area of 1,729 ha. Geographically, Cemara Kulon Village is located at coordinates 6°14' – 6°40' South Latitude and 107°52' – 108°36' East Longitude. Cemara Kulon Village is one of the areas in Indramayu Regency that has a mangrove ecosystem. The mangrove ecosystem has a functions as a habitat, feeding grounds, nursery grounds, and spawning grounds for various biotas (Martuti et al., 2018). The *Pomadasys argenteus* fish is a demersal fish that takes advantage of tidal conditions to visit mangrove areas as feeding grounds (Adiguna et al., 2018). Fortune et al. (2013) stated that gerot-gerot fish are marine fish that chooses mangrove areas as feeding ground by taking advantage of the tidal water phenomenon. The mangrove ecosystem is one of the supporting factors for the survival of aquatic biota which is specifically obtained through the release of nutrients from mangrove litter that falls into the waters and ultimately can determine fish stocks (Harahab, 2009).

Fishermen in Cemara Kulon Village generally rely on the mangrove ecosystem as the center of their fishing activities because this area is a productive fishing area. Utilization of mangrove ecosystems that is not followed by conservation efforts can result in damage in the form of abrasion, decreased water quality, and silting which can reduce the function of the ecosystem to support the life of the aquatic biota associated with it (Kawaroe, 2001).

According to Taha (2004), the mangrove ecosystem in Cemara Kulon Village experienced a reduction of 75,349 ha, from an area of 839.59 ha to 764,241 ha. This condition occurs due to land conversion and deforestation activities. Fishing activities and land

conversion have a huge impact on the ecosystem, causing changes in the abundance, productivity, and structure of fish communities, such as changes in species dominance, size spectra, and catches (Asriyana et al., 2009). Latuconsina et al. (2020) added that the density and diversity of mangrove vegetation influence the abundance and diversity of fish associated with it. The qualitative and quantitative degradation of the mangrove ecosystem can disrupt water conditions, which can determine the abundance and distribution of aquatic organisms. The occurrence of changes in conditions in a habitat will affect the life and reproduction of fish communities (Kartamihardja, 2008).

Based on the description above, conservation efforts are needed so that the potential of existing public waters can continue to be maintained (Kartamihardja et al., 2017). Efforts to conserve fisheries resources require the availability of basic information about fish species. Therefore, it is necessary to research the structure of fish communities in the mangrove ecosystem of Cemara Kulon Village which can be used as basic information in managing fisheries resources.

## MATERIAL AND METHODS

This research was carried out from 10 September 2021 to 31 June 2022. Research activities were divided into two, namely in-situ research and ex-situ research. In-situ research was carried out in the mangrove ecosystem of Cemara Kulon Village, Losarang District, Indramayu Regency West Java, Indonesia. Meanwhile, ex-situ research was carried out at the Aquatic Resources Management Laboratory (MSP) of the Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran.

Fish sampling and water quality observations were carried out at 3 stations.

Determination of research stations was carried out based on differences in mangrove vegetation characteristics. The following are the locations of the research stations: (a). Station I is located at coordinates 06°18'29.77" South Latitude and 108°10'13.83" East Longitude with dense mangrove vegetation.

(b). Station II is located at coordinates 06°18'37.68" South Latitude and 108°10'20.43" East Longitude with moderate mangrove vegetation. (c). Station III is located at coordinates 06°18'59.04" South Latitude and 108°11'11.95" East Longitude with sparse mangrove vegetation.

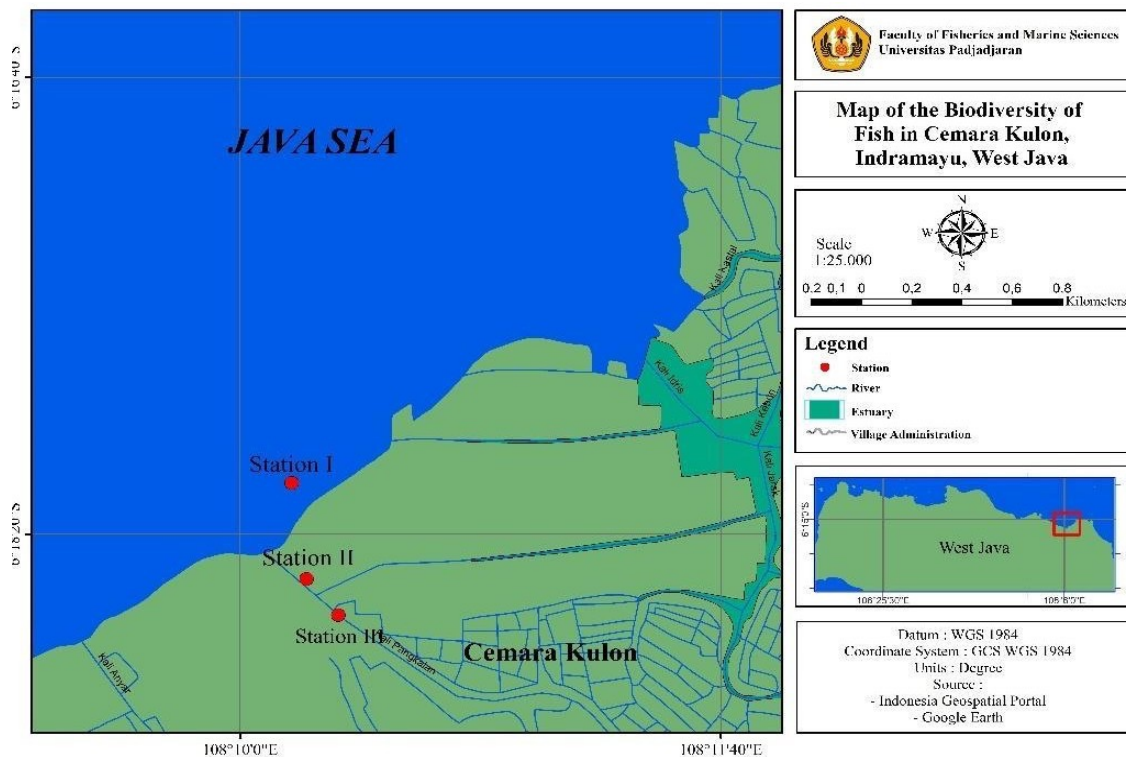


Figure 1. Research Location Map

### Research material and tools

The tools used in this research are fishing gear such as fishing rods and gill nets which are commonly employed by fishermen in Cemara Kulon Village, GPS (Global Positioning System) Garmin GPSMAP 64s made in United State of America, pH meter Lutron 207 made in Taiwan (accuracy 0.01), thermometer, DO meter Lutron 5510 made in Taiwan (accuracy 0.1 mgL<sup>-1</sup>), digital scales Acis AD-6001 made in Japan (accuracy of 0.01 g and 0.1 g), label paper, camera and stationery, cool box made in Indonesia, sechi disk,

refractometer Atago made in Japan, 1.5 L sample bottle, ruler and millimeter block and user manual identification of Freshwater Fish in Western Indonesia and Sulawesi (Kottelat et al. 1993). The materials used in this research activity are fish caught in the mangrove ecosystem of Cemara Kulon Village, water samples, ice cubes, and distilled water.

### Research Methods

The methodology used in this research is a survey method, determining research stations based on differences in mangrove

vegetation density, at three stations : station 1 with dense mangrove vegetation, station 2 with moderate mangrove vegetation, and station 3 with sparse mangrove vegetation. Water sampling was carried out using a purposive sampling method and data was analyzed descriptively and quantitatively. Fish sampling was carried out using composite sampling techniques and calculations based on the census. The fish caught were identified descriptively to find a complete description of each species refer to fish species identification guide (Kottelat et al. 1993). The amount of data on fish species that have been identified were calculated to estimate the relative abundance, diversity, uniformity, and dominance of fish at each station and analyzed using Canonical Correspondence Analysis (CCA) to determine the relationship between water quality and fish community structure.

**Research Procedure**

Fish samples were obtained directly from fishermen who usually catch fish in the mangrove area in Cemara Kulon Village. The fish caught were documented using a cell-phone camera. Fish sampling was carried out twice with an interval of 14 days. The mapping procedure used the Geographic Information System. The distribution map of the fish community structure in the mangrove

ecosystem of Cemara Village was made in the following stages: analog map of the research location obtained from Google Earth was entered into ArcMap software GIS 10.3 and digitized to create a digital map that displays station positions and regional information and then a layout is created. Interpolation was performed on species data, including species abundance, diversity index, uniformity, and dominance index. The information displayed includes the title, map outline, scale, and legend, then the map is saved in image form. Community structure mapping were divided into three symbols based on the following categories: Red triangle is distressed community, yellow triangle is unstable community. Green triangle is stable community

**Observation Parameters**

In this study, the parameters observed include physical and chemical parameters of waters such as temperature, dissolved oxygen (DO), pH, salinity, and ammonia. Additionally, relative population abundance, diversity index, uniformity index, dominance index, and length-weight relationship were also assessed.

**Physical and Chemical Parameters of Waters**

The water quality parameters measured and the analytical tools used can be seen in Table 1.

**Table 1.** Water Quality Parameters

Parameter	Unit	Method	Analysis Tools	Observation Location
<b>Physical</b>				
Light_Transparency	cm	Visual	Secchi Disk	<i>In Situ</i>
Temperature	°C	Potensiometric	Thermometer	<i>In Situ</i>
<b>Chemical</b>				
pH	-	Potensiometric	pH Meter	<i>In Situ</i>
Salinity	ppt	Refractometric	Refractometer	<i>In Situ</i>
Disolved Oxygen (DO)	mg L-1	Potensiometric	DO Meter	<i>In Situ</i>
Amonia (NH <sub>3</sub> -N)	mg L-1	Spectrofotometric (SNI 06-6989.30-2005)	Spectrophotometer	<i>Ex Situ</i>

### Relative Abundance of Populations

The relative abundance of a population is the percentage of species abundance in one area which is obtained using the following equation (Michael 1994; Component I Coordinate Team of Biodiversity Experts 2013; Herawati et al., 2021)

$$KR = ni/N \times 100\%$$

In above formula, *KR* is the relative abundance, *ni* is number of individuals of each type, *N* is the number of individuals of all species

### Diversity Index

Fish diversity was calculated using the Shannon-Wiener diversity index (Krebs 1989; Component I Coordinate Team of Biodiversity Experts 2013; Herawati et al., 2021) with the following equation.

$$H' = - \sum_{i=1}^n pi \ln pi$$

Explanations:

$H'$  = Shannon-Wiener Diversity Index

$P_i$  = Comparison between the number of individuals of species *i* and the total number of individuals ( $ni/N$ )

$N_i$  = Number of individuals of the *i*-th species

$N$  = Number of individuals in all species

$i = 1, 2, 3, \dots, n$

Diversity index range:

$H' \leq 1$  = Small diversity

$1 \leq H' \leq 3$  = Medium diversity

$H' \geq 3$  = High diversity

### Uniformity Index

Balance in an ecosystem can be shown with a uniformity index through the following equation (Krebs 1989; Component I Coordinate Team of Biodiversity Experts 2013; Herawati et al., 2021).

$$E = \frac{H'}{H'maks} = \frac{H'}{\ln(s)}$$

Explanations:

$E$  = Uniformity Index

$H'$  = Shannon-Wiener Diversity Index

$H'max$  = Maximum Diversity Index =  $\ln(s)$

$S$  = Total Number of Species

The  $E$  value ranges from 0 - 1, if:

$0 < E \leq 0.4$  = Low population uniformity, depressed community structure

$0.4 < E \leq 0.6$  = Medium population uniformity, unstable community structure

$0.6 < E \leq 1.0$  = High population uniformity, stable community structure

### Dominance Index

The dominance index is calculated using Simpson's dominance index formula (Odum 1993; Component I Coordinate Team of Biodiversity Experts 2013; Herawati et al., 2021).

$$C = \sum_{i=1}^n pi^2$$

In above formula,  $C$  is the Simpson Dominance Index and  $pi$  is proportion of the number of individuals in a fish species. The dominance index has a range of 0-1, with the following categories:

$0 < C < 0.5$  = Low dominance

$0.5 < C \leq 0.75$  = Moderate dominance

$0.75 < C \leq 1.0$  = High dominance

### Data Analysis

The data were analyzed based on station and time using quantitative descriptive methods, by providing a systematic, factual, and accurate description of the physical and chemical factors of waters, types or species of fish, population abundance, uniformity index, diversity index, dominance index at all stations. The data were presented in

the polygon form on a map with the help of ArcMap GIS 10.3 and Microsoft Excel software. The relationship between fish community structure and water physical and chemical variables were analyzed using Canonical Correspondence Analysis (CCA) (Ter et al., 1995). The application used to support the data processing was Paleontological Statistics (PAST) software (Hammer et al., 2001).

## RESULTS AND DISCUSSION

### Composition and Abundance of Fish Species

The number of fish caught was 508 (Table 2) consisting of 20 species from 16 families : Ambassidae, Ariidae, Bagridae, Belonidae, Cynoglossidae, Echeneidae, Eleotridae, Engraulidae, Gobiidae, Lutjanidae, Mugilidae, Oxudercidae, Plotosidae, Sciaenidae, Serranidae, and Terapontidae. The number of fish caught were from the family Sciaenidae, Bagridae, Ambassidae, and Mugilidae, with the family Sciaenidae as much as 29.13%, followed by the family Bagridae 15.16%, Mugilidae 10.43%, and Ambassidae 9.45%. The most frequently caught species was leaftail croaker (*Johnius trachycephalus*) from the Sciaenidae family. This species is distributed in the waters of Sumatera, Java, and Kalimantan (Siagian, 2017).

The number of species and individual fish is determined by food availability, biotic and abiotic conditions (Effendie, 1997). The ability of fish species to reproduce, adapt to the environment and the ability to utilize the potential of existing resources will determine the number of fish present in nature (Nurudin et al., 2013).

The results of this study confirmed the research results of Kadarsah et al. (2020) which state that the fish species most commonly found in the mangrove ecosystem in

Pagatan Besar Village, Tanah Laut Regency, South Kalimantan Province was the Sciaenidae family, gulamah fish with a percentage of 31.31%. Fortune et al. (2013) stated that the fish most found in the mangrove ecosystem of Bedono Village, Sayung, and Demak, come from the Mugilidae and Ambassidae families. Tampubolon et al. (2018) stated that in the Cimanuk River Estuary, Indramayu Regency, the most abundant fish species were from the Ambassidae, Sciaenidae, leiognathidae, Ariidae, and Gobiidae Family. Thus, the Scianidae, Bagridae, Mugilidae, and Ambassidae are commonly found in coastal waters covered with mangroves.

Based on conservation status (Table 2), the fish that live in the coastal waters of the mangrove ecosystem area in Cemara Kulon Village, 70% of the twenty species found and identified were categorized as Least Concern (LC), which means these species have a low risk of extinction. Additionally, 10% were classified as Data Deficient (DD) conservation status, which means there was a lack of available data regarding these species and 20% were categorized as Not Evaluated (NE) conservation status, indicating that data from these species has never been evaluated so their conservation status cannot be determined.

### Relative abundance

Relative abundance is the percentage of species abundance in particular area (Michael, 1994). The relative abundance of fish varied at each research station was different (Figure 2). At station I amounted to 230 fish were caught consisting of 19 species: sin croaker, commerson's anchovy, blacktail snapper, gray eel catfish, amoy croaker, spearfish remora, singapore glassy perchlet, spotted catfish, long-whiskers catfish, long tongue sole, largescaled terapon, greasy grouper, leaftail croaker, boddart's google-eyed goby, hound needle fish, ambon gudgeon, small-eyed lot-

er, burrowing goby and flat-head grey mullet. The species with the highest relative abundance value was leaftail croaker at 24.78% of the total catch (Figure 2a). The number of fish caught at station II, amounted to 186 fish consisting of 16 species. The fish that with the highest relative abundance was leaftail croaker at 22.04% (Figure 2b). The high abundance of leaftail croaker at stations I and II is caused by several factors, including suitable water environmental conditions and the habit of living in groups of these fish. Leaftail croaker is a demersal fish that typically lives in groups and inhabits marine and brackish waters (Sasaki 1995). Boyd and Tucker (1998) stated that the optimal temperature for tropical fish ranges between 25°C - 32°C and salinity does not exceed 35 ppt. The results of water quality measurements at stations I and II were 31°C and 32°C, salinity 35 ppt and 34 ppt, with an average depth of 3 meters. The type of substrate was mud so it suitable as a habitat for leaftail croaker. This fish utilizes as natural food in the form of shrimp, small fish, and litter (Kottelat et al., 1993; Siagian et al., 2017). Apart from that, according to Saputra et al. (2008), the leaftail croaker population increases during the rainy season due to decreasing water temperatures. The mangrove vegetation at stations I and II also supports the leaftail croaker habitat because mangrove cover means the area it covers has low water temperatures (Siagian et al., 2017). This indicates that the coastal waters in the mangrove ecosystem area of Cemara Kulon Village were ideal as a habitat for leaftail croaker.

The measurements on the biological aspects, leaftail croaker has a length between 6.7- 15.9 cm and a weight of 2.9 - 45.4 grams, most of the fish were juvenile size. The mangrove ecosystem of Cemara Kulon Village most likely functions as a feeding and nursery ground by leaftail croaker. Previous studies stated that leaftail croaker were

a group of demersal fish that inhabit coastal areas and river estuaries that have mangrove vegetation (Kottelat et al., 1993; Herlan, 2015), leaftail croaker are bottom-feeding fish (Simanjuntak and Raharjo, 2001; Longhurst and Pauly, 1987). leaftail croaker use river estuaries to breeding and spawning.

The number of fish caught at station III amounted to 92 fish consisting of 10 species: flat-head grey mullet, small-eyed loter, boddart's goggle-eyed goby, leaftail croaker, largescaled terapon, sagor catfish, long-wiskers catfish, spotted catfish, singapore glossy perchlet, commerson's anchovy. The species with the highest relative abundance value was long-wiskers catfish at 41.30% (Figure 2c). The long-wiskers catfish is a demersal fish that lives in estuarine waters and has a high level of tolerance to changes in environmental salinity (Sjafei et al., 2004).

According to Talwar and Jhingran (1991), long-wiskers catfish are distributed in countries bordering the eastern Indian Ocean, from India to Indonesia and Vietnam. Simanjuntak and Sulistiono (2022) stated that long-wiskers catfish can be found in almost all Indonesian coastal waters. The characteristics of station III, which has a substrate in the form of sandy mud, calm currents, and a narrow river body, were thought to be the factors causing the abundance of long-wiskers catfish. According to Wahyuni and Zakaria (2018), long-whiskers catfish are generally often found in river waters that have muddy substrates with weak currents.

Herawati et al. (2020), identified 26 fish species from 19 families in the lower reaches of the Cimanuk River. Among these species, 4 were also found in the mangrove ecosystem of Cemara Kulon Village, were small-eyed loter, sagor catfish, flat-head grey mullet, and largescaled terapon. Most of the fish caught from all stations were demersal fish. The high

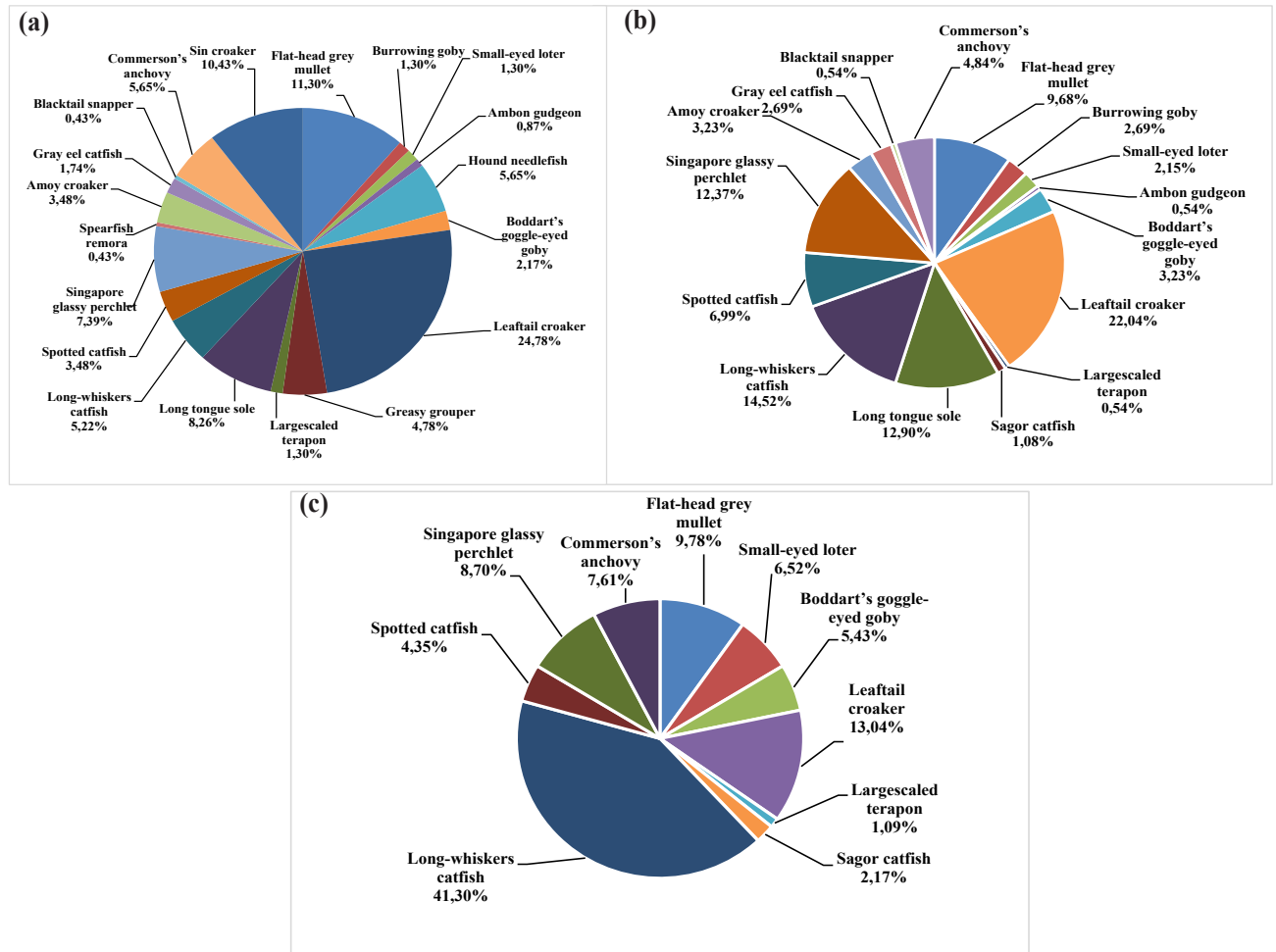


Figure 2. Relative Abundance of Fish in the Coastal Mangrove Area of Cemara Kulon Village During Research

abundance of demersal fish caught is related to the mangrove ecosystem where there is a detritus food chain (Hutchison et al., 2014). The decomposition of mangrove litter by bacteria and fungi produces detritus which serves as food for worms, crustaceans, and mollusca (Tampubolon et al., 2018). According to Froese et al. (2016) worms, crustaceans, and bottom mollusca are the main food for small fish which then become food for larger fish.

### Fish Diversity

Diversity is the relationship between the number of species and the number of individuals of each species in a community

(Kottelat et al., 1993). The fish diversity index from the research is shown in Figure 3.

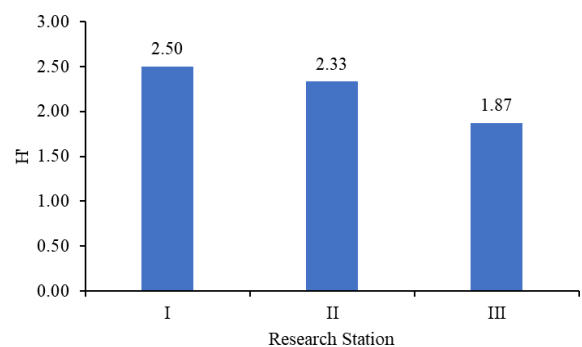


Figure 3. Fish Diversity Index (H') in the Coastal Mangrove Area of Cemara Kulon Village During Research



**Table 2.** Fish Species Caught in the Coastal Mangrove Area of Cemara Kulon Village During Research

Familia	Local Name	Common Name	Scientific Name	Total (tail)	Composi-tion (%)	Status Conserva-tion IUCN
Ambassidae	Pepetek	Singapore glassy perchlet	<i>Ambassis kopsii</i> (Bleeker, 1858)	48	9.45	Not Evaluated
Ariidae	Kedukang	Sagor catfish	<i>Hexanematchthys sagor</i> (Hamilton, 1822)	4	0.79	Not Evaluated
	Manyung	Spotted catfish	<i>Arius maculatus</i> (Thunberg, 1752)	25	4.92	Data Deficient (Kaymaram et al. 2015)
Bagridae	Lundu	Long-whiskers catfish	<i>Mystus gulio</i> (Hamilton, 1822)	77	15.16	Least Concern (Goonatilake et al. 2019)
Belonidae	Cendro	Hound needlefish	<i>Tylosurus crocodilus</i> (Péron & Lesueur, 1821)	13	2.56	Least Concern (Collette et al. 2015)
Cynoglossidae	Lidah Pasir	Long tonguesole	<i>Cynoglossus lingua</i> (Hamilton, 1822)	43	8.46	Least Concern (Munroe et al. 2020)
Echeneidae	Ramora	Spearfish remora	<i>Remora brachyptera</i> (Lowe, 1839)	1	0.20	Least Concern (Collette 2010)
Eleotridae	Boboso	Small-eyed loter	<i>Prionobutis microps</i> (Weber, 1907)	13	2.56	Least Concern (Larson 2021)
Engraulidae	Teri	Commerson's anchovy	<i>Stolephorus commersoni</i> (Lacepède, 1803)	29	5.71	Least Concern (Munroe 2018)
Gobiidae	Belut Gobi	Burrowing goby	<i>Trypauchen vagina</i> (Bloch & Schneider 1801)	8	1.57	Least Concern (Larson 2018)
	Butuh keleng	Ambon gudgeon	<i>Butis amboinensis</i> (Bleeker, 1853)	3	0.59	Least Concern (Larson 2018)
Lutjanidae	Tambangan	Blacktail snapper	<i>Lutjanus fulvus</i> (Forster 1801)	2	0.39	Least Concern (Russell et al. 2016)
Mugilidae	Belanak	Flat-head grey mullet	<i>Mugil cephalus</i> (Linnaeus 1758)	53	10.43	Least Concern (Camara et al. 2019)
Oxudercidae	Tembakul Total	Boddart's goggle-eyed goby	<i>Boleophthalmus boddarti</i> (Pallas, 1770)	16	3.15	Least Concern (Allen et al. 2021)
Plotosidae	Sembilang	Gray eel catfish	<i>Plotosus canius</i> (Hamilton, 1822)	9	1.77	Not Evaluated
Sciaenidae	Gulamah	Leaftail croaker	<i>Johnius trachycephalus</i> (Bleeker, 1853)	110	21.65	Least Concern (Seah et al. 2020)
	Samge	Amoy croaker	<i>Argyrosomus amoyensis</i> (Bleeker 1863)	14	2.76	Not Evaluated
	Tigawaja	Sin croaker	<i>Johnius dussumieri</i> (Cuvier, 1830)	24	4.72	Least Concern (Thantun et al. 2020)
Serranidae	Kerapu	Greasy grouper	<i>Epinephelus tauvina</i> (Frosskål, 1775)	11	2.17	Data Deficient (Samoilys 2018)
Terapontidae	Kerong kerong	Largescaled terapon	<i>Terapon theraps</i> (Cuvier, 1829)	5	0.98	Least Concern (Allen 2011)
16	20	508	100			

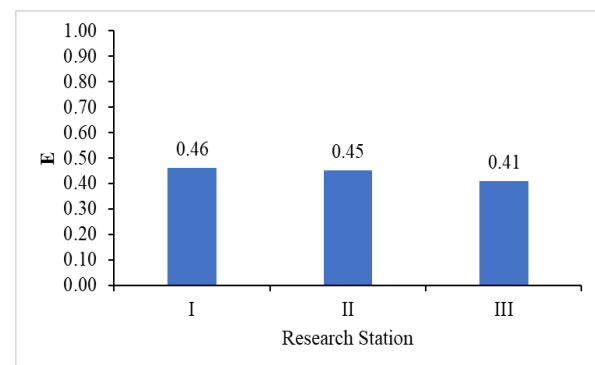
The fish diversity index in the mangrove ecosystem of Cemara Kulon Village ranges between 1.87 and 2.50. Based on the Shannon-Wiener diversity index criteria, if  $1 \leq H' \leq 3$  then fish diversity at all research stations was included in the medium category. The diversity value classified as moderate is probably influenced by the water conditions of all research stations which meet the standard criteria for seawater quality according to Indonesia Government Regulation No. 22 of 2021 that many fish inhabit the area. At station I, the diversity index value was higher because it is influenced by the number of fish species found, which was greater than at other stations. This result was consistent with Gunarto (2004) statement that a community has high species diversity when a large number of species are present, with the number of individuals of each species is relatively even.

The diversity index does not significantly different from the previous findings of Descasari et al. (2016) which found that the fish diversity index in the river estuary and coastal areas of Pabean Ilir Village and Pagirikan Village, Indramayu Regency had a value of 2.12 – 2.29 and was classified as moderate. This is caused by the dense mangrove vegetation which can enhance the density and diversity of fish.

### Fish Uniformity

Fish uniformity is a description of the distribution of fish populations which is used to determine the balance of an ecosystem (Rejeki et al., 2013). The fish uniformity index resulting from the research can be seen in Figure 4. The fish uniformity index in the mangrove ecosystem of Cemara Kulon Village according to the calculation results ranges from 0.41 – 0.46, which means that based on the Shannon-Wiener uniformity index criteria, if  $0.4 < E \leq 0.6$  then the uniformity value is in the medium category. The distribution of fish species throughout the research station was relatively

even and no single species dominating. This results aligns with Gunarto's (2004) statement, that a community exhibits high species uniformity when there are many species, and the number of individuals is relatively even so that no species dominating in the ecosystem.



**Figure 4.** Fish uniformity index (E) in the coastal mangrove area of Cemara Kulon Village during research

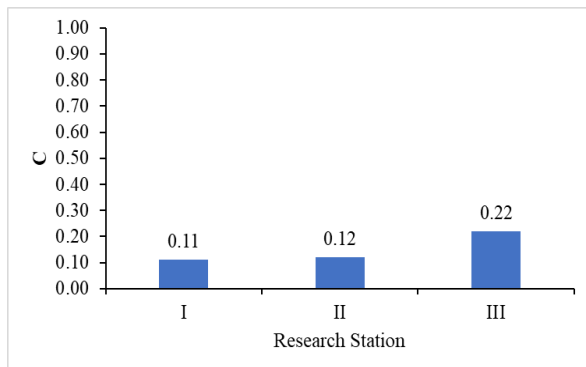
Compared with the research results of Nolan et al. (2019) the fish uniformity index in the mangrove ecosystem in Basule Village, North Konawe Regency is in the range of 0.130 - 0.252 and is included in the low category. The low uniformity value may be attributed to certain species dominating the area, thereby disrupting the balance with other species. According to Gunarto (2004), low uniformity occurs when a community consists of a few species and the number of individuals per species is uneven.

### Fish Dominance

Dominance is defined as the ratio between the number of individuals in a species and the total number of individuals throughout the species. If a community has high diversity, then one species should not be more dominant than the others. Meanwhile, if there are species whose density is greater than others, then the community is considered less diverse (Mandolang et al., 2021). The fish dom-

inance index from the research can be seen in Figure 5.

The fish dominance index in the mangrove ecosystem of Cemara Kulon Village, based on Simpson's calculations was in the ranged 0.11 – 0.22. The dominance index at all research stations were in the low category. This result follow Odum (1994) statement that if the dominance index value is  $0 < C \leq 0.5$  then it is included in the low category or no species dominates. Based on Figure 5, it is known that the highest dominance index value was at station III with a value of 0.22. The *Mystus gulio* has the highest abundance at station III with a uniformity index value that smaller. However, based on the dominance index criteria, the *M. gulio* cannot dominate the waters of the Mangrove ecosystem in Cemara Kulon Village.



**Figure 5.** Fish dominance index in the coastal mangrove area of Cemara Kulon Village during research.

The dominance index value at all research stations is included in the low category. The species in the research location can adapt to environmental changes and utilize resources evenly (Sumarto and Koneri 2016). A low dominance index value indicates undisturbed community, as dominant species can indicate ecological pressure (Nolan et al., 2019). Wizurai et al. (2012) stated that the removal of dominant species in a community generally occurs due

to human influence. Dhahiyat et al. (2003) reported that if in a biota community, there were species that dominate, the condition of the community structure is in a state of stress, or ecological pressure was occurred. The results of the dominance index in the mangrove ecosystem of Cemara Kulon Village are not much different from the research of Adiguna et al. (2018) who examined the structure of fish communities in the Badung River Estuary in the mangrove area of Ngurah Rai Forest Park, Bali, which obtained dominance index results between 0.16 – 0.40, including the low category with the *M. gulio* species having the highest abundance but not dominating enough, but there are differences with the research results of Rejeki et al. (2013), in the mangrove ecosystem of Bedono Village, where the dominance index value ranged from 0.60 – 0.83 was in the medium to high category, the fish community structure in this ecosystem is experiencing ecological pressure.

### Fish Community Structure

Based on data on the diversity index, uniformity index, and dominance index, the structure of the fish community in the mangrove ecosystem of Cemara Kulon Village was in an unstable condition, marked by a yellow triangle symbol on the map (Figure 6). Figure 6 shows the structure of fish communities in three research locations that fall into the unstable category, with moderate population uniformity, moderate diversity, and low dominance. The results of this research were same as those conducted by Setiawan et al. (2019) in the mangrove ecosystem of Karangsong Village, Indramayu Regency, which stated that the fish community structure in the area was in the unstable category, with the diversity index value in the medium category and dominance in the low category. According to Basmi (2000) if in a biota

community structure that is observed, there are species that dominate or are evenly distributed, then this indicates that the condition of the

community structure is in an unstable state or that ecological pressure is occurring.



Figure 6. Map of Fish Community Status in the Mangrove Ecosystem of Cemara Kulon Village

### Relationship between Fish Community Structure and Water Quality

The results of the CCA (Canonical Correspondence Analysis) analysis in Figure 7 show the two main axes (CCA1 and CCA2) of the relationship between fish community structure in the mangrove ecosystem of Cemara Kulon Village and water quality parameters (ammonia, DO, pH, salinity, temperature and light transparency) which explain the data distribution in CCA 1 was 99.81% and CCA 2 was 0.19%. Based on the results of the CCA analysis, it is known that fish diversity in Cemara Kulon Village is influenced by three water quality parameters, were light transparency, DO, and salinity.

Light transparency and DO strongly influence on fish diversity. The brightness of a body of water is related to the distribution of phytoplankton and the level of water fertility. Increasing the intensity of light entering water bodies will enhance plankton productivity in those waters. The penetration of sunlight needed by phytoplankton for photosynthesis depends on the water brightness conditions. The better the brightness, the higher the rate of pho-

tosynthesis which can increase the dissolved oxygen content in the waters. Apart from their role in producing oxygen in the water, phytoplankton can be used as a food source for aquatic biota including fish (Azis et al., 2020).

The light transparency values obtained during the research ranged from 63.7 to 114.7 cm. According to Suparjo (2009), marine waters with a transparency value of more than 45 cm are considered good. The high value of light transparency is attributed to the low amount of suspended solid these waters. The high light transparency value is also influenced by the sampling time, typically during in sunny weather conditions. According to Mallela et al. (2007), the brightness value is directly proportional to the abundance of individuals in a body of water. In line with research by Ridho et al. (2019) which states that fish diversity in Lebak Jungkal Waters, Ogan Komering Ilir Regency in the dry season has a higher value compared to the rainy season which is caused by differences in light transparency in the two seasons.

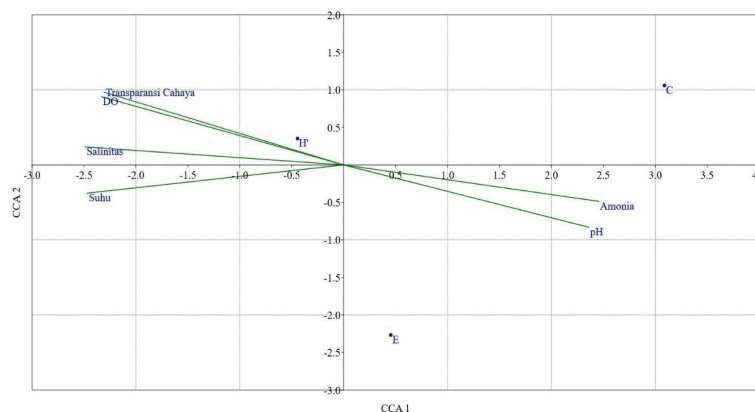
Putra et al. (2018) stated that DO is positively correlated with fish abundance,

which means that an increase in DO will be followed by an increase in fish abundance. Apart from that, Siagian (2009) also stated that the dissolved oxygen content greatly influences the survival of fish in a body of water. The dissolved oxygen content in the mangrove ecosystem of Cemara Kulon Village during the research ranged between 4.5 and 6.4 mg L<sup>-1</sup>. According to Indonesia Government Regulation Number 22 of 2021 concerning the Implementation of Environmental Protection and Management, the threshold for dissolved oxygen content for organisms in marine waters is  $\geq 4$  mg L<sup>-1</sup>, so it can be concluded that the dissolved oxygen content in the mangrove ecosystem of Cemara Kulon Village supporting fish life.

Water temperature weakly influences fish uniformity of fish in the mangrove ecosystem of Cemara Kulon Village. Water temperature affects the metabolic activity of fish, causing the distribution of fish in a body of water to be limited by the level of tolerance to changes in temperature. Water temperature is influenced by tree cover (canopy) from surrounding vegetation, light penetration, and measurement time (Maturbongs et al., 2019). Based on the results of temperature measurements at the research location, it ranges from 25°C to 32.2°C. According to Government Regulation Number 22 of 2021

concerning the Implementation of Environmental Protection and Management, the water temperature threshold in the mangrove area is in the range of 28°C to 32°C  $\pm 3$ , So it can be concluded that the water temperature in the mangrove ecosystem of Cemara Kulon Village supports the survival of fish.

The dominance of fish in the mangrove ecosystem of Cemara Kulon Village is influenced by ammonia. The ammonia content in a body of water is best proportional to the dissolved oxygen content, so the higher the ammonia content, the lower the dissolved oxygen content in the water, and can cause physiological and metabolic damage to the fish's body (Zhang et al., 2012). Based on the results of ammonia measurements at the research location, it ranged from 0.022 to 0.027 mg L<sup>-1</sup>. According to Government Regulation Number 22 of 2021 concerning the Implementation of Environmental Protection and Management, the threshold for aquatic ammonia in mangrove areas is  $\leq 0.2$  mg L<sup>-1</sup>. The ammonia content in the mangrove ecosystem of Cemara Kulon Village areas indicating support for fish survival. The fish community structure in the mangrove ecosystem of Cemara Kulon Village was unstable condition, this requires further research over a longer period of time and the fishing gear used varies.



**Figure 7.** CCA Plot Graphic Map of Fish Community and Physical-Chemical Parameters of Water

## CONCLUSION

Fish species in the mangrove ecosystem consisted of 20 species from 16 families, The most frequently caught fish species at stations I and II was leaftail croaker (*Johnius trachycephalus*) and at station III was long-whiskers catfish (*Mystus gulio*). The fish community structure exhibited an unstable condition, with diversity and uniformity were in the medium category and dominance was low at all stations. Fish community structure was influenced by water quality.

## AUTHOR CONTRIBUTION

T.H. study concept, design, and intellectual content; acquisition of data discussion and critical revision of the manuscript, M.P. collected and analyzed the data; wrote the manuscript, Z. discussion and critical revision of the manuscript, I.M. critical revision of the manuscript.

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## CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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