The Diversity of Mudskipper Fish Family Gobiidae in Mangrove Area, Seberang District, Tanjung Jabung Regency, West Jambi

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Abstract:
Mudskipper fish (*Periopthalmus spp*) is a member of the order Periophthalmini, family Gobiidae and subfamily Oxudercinae. This fish is known by the names of gunshots, tempakul, timpakul and belacak. Mudskipper fish have a role as a bioindicator in mangrove ecosystems, so its existence and diversity needs to be known. This research is quantitative exploratory which aims to analyze the diversity of *mudskipper* fish in the mangrove area of Seberang District, Tanjung Jabung Barat Regency and determine environmental factors that affect their lives. The technique for determining the sampling station was purposive sampling. Sampling was carried out at 3 stations in two different villages, namely Kuala Baru Village and Seberang Village. The survey method was conducted at 2 different stations. Each sampling station area in Seberang Village is 50 x 20 m, while in Kuala Baru village it is carried out on 2 transect lines with a transect length of 35 meters and consists of 3 plots measuring 5 x 5 m and spaced 10 m between plots. The results showed that there were 2 species of 2 general of *mudskipper* fish, namely *Periophthalmodon schlosseri* and *Boleophthalmus boddarti*. The most abundant type of *Boleophthalmus boddarti* was obtained with 36 individuals out of a total of 45 individuals. The index of diversity of *mudskipper* fish species at the three stations was low ranging from 0.3-0.6 and the dominance index ranged from 0.6-0.8. Environmental conditions are water temperature 31-33°C, soil temperature 28-35°C, salinity 13-15 ppt, water pH 6.8 and soil pH 6.2-6.8. DO ranges from 5.9 to 6.8 mg/L, the soil texture is clay type, dusty loam, and clay. It can be concluded that the diversity of *mudskipper* fish in Seberang sub-district is low, with an abundant number found in the *Boleophthalmus boddarti* fish species.

Keywords: mudskipper fish; mangrove; diversity

INTRODUCTION

Mangroves are coastal ecosystems that provide the highest bioligatic productivity (poedjirahajoe and Matatula, 2019). Mangrove ecosystems in addition to having ecological functions (Wiryanto et al. 2017) Mangroves can also function as habitats in preserving the development and growth of aquatic fauna (Matatula et al 2019). One of the fauna that inhabit the mangrove forest is the *mudskipper* fish (Polgar and Lim, 2011). Mangroves have distinctive vegetation along the coast or river estuaries, with the ability to adapt to strong waves with high salinity levels and the land is always flooded with water (Serosero et al, 2020). According to the Directorate General of Social Forestry and Land Rehabilitation (Ditjen RLPS) of the Ministry of Forestry in 2007 in Kusmana (2011), the area of vegetation from mangroves in Indonesia is 7.7 million hectares with reports that the area is potential to be planted with mangroves (including areas with mangrove vegetation). estimated at 7.8 million hectares (30.7% in good condition, 27.4% moderately damaged, 41.9% heavily damaged). Jambi Province has a mangrove forest area of about 52,566 hectares (Kusmana, 2011), one of the areas is Tanjung Jabung Bara Regency.

Tanjung Jabung Barat Regency has a mangrove ecosystem area which is a habitat and spawning for fish including *mudskipper* fish and supports the life of other animals such as crabs, shrimp, hermit crabs, and snails. The body length of the *mudskipper* varies according to the habitat, the variety of species, and the age of the fish (Kumaraguru et al, 2020) ranging from 5 cm to close to 30 cm. *Mudskipper* fish are amphibian fish that are very strong in surviving in extreme environments. In fact, adaptations in morphological, physiological and behavioral traits allow them to move between aquatic and terrestrial habitats (Radkhah and Eagderi, 2019). The mudskipper amphibian lifestyle is aided by morphological and physiological adaptations such as aerial vision and smell, increased ammonia tolerance, locomotion of pectoral fins for walking on land, and increased immunological protection against pathogens (Aji and Arisuryanti, 2021). *Mudskipper* type *Periopthalmus waltoni* has the ability to absorb heavy metals and then degrade them into environmentally friendly materials (Thomas and Bu-Olayan, 2008). *Mudskipper* fish play an ecological role in the

mangrove ecosystem. The existence of *mudskipper* fish can act as an indicator for mangrove fertility, namely by preying on crustaceans (Al-Behbani and Ebrahim, 2010) and algae that grow in the mud (Ridho et al, 2019), so that in the mangrove ecosystem the number of crustaceans can be controlled.
Mudskipper fish has economic value, but its utilization in Indonesia is not optimal. Communities in the mangrove area of Seberang District, Tanjung Jabung Barat Regency have not considered *mudskipper* fish as cultivated fish and have economic value. *Mudskipper* fish are commonly consumed and used in traditional medicine in many countries such as Malaysia, Japan, China (Gadhavi et al, 2017; Looi et al, 2016; Yang et al, 2017). Coastal communities mostly consume *mudskipper* fish because the fish contains high protein, minerals and several vitamins (Mahadevan et al, 2021). *Mudskipper* fish contain corticosteroid compounds that function as anti-inflammatory (Panda and Mabalirajan, 2019), caratatoxin which functions as anticancer, carotenoids, and steroids, all of which are natural compounds that have diverse bioactivity (Ridho et al, 2020).

A review report conducted by Pormansyah et al (2019) on the distribution of *mudskipper* fish in Indonesia species *Boleophthalmus boddarti, Periophthalmodon schlosseri, Periophthalmus argentilineatus* Valenciennes, *Periophthalmus gracilis* Eggert, *Periophthalmus Kalolo, Scartelaos histophorus* are found in almost all islands in Indonesia, Kalimantan (Sumatra), Sulawesi and Papua). The existence of species and diversity of *mudskipper* fish species in Seberang Tanjung Jabung Barat District is not yet known, unlike what has been found in Palembang, Merauke, Brebes, Riau, Pangkal Babu and Tungkal Ilir Districts. Ridho et al (2019) reported that *mudskipper* fish in the waters of the Musi River in Palembang obtained 3 species based on the composition of their food, namely *Boleophthalamus boddarti, Periopthalmodon schlosseri,* and *Periophthalmus chrysospilos*. In the Merauke area, Papua, there are 6 species reported to be similar to *mudskipper*, including *Boleophthalmus boddarti, Boleophthalmus pectinirostis, Periophthalmus takita, Periophthalmus argentilineaus, Scartelaos histophorus,* and *Oxuderces dentatus* (Elviana et al, 2019). The province of Brebes, Central Java, has a slightly different distribution of *Mudskipper* fish from Papua with the species *Acentrogobius viridipunctatus, Oxuderces nexipinnis,* and *Parapocryptes serperaster*. *Mudskipper* fish and mangrove ecosystems have a correlation that shows a relationship that varies from low to very strong (Ramadhani et al., 2019).

This information on the diversity of *mudskipper* species is expected to be a source of learning that can be presented in various media in the form of handouts or books online and offline. The previous studies have reported by Susanti (2021) who made online learning of Mangrove Ecosystem Potential for Fauna as a learning resource for Biology, and Rosyid (2020) who made the development of mangrove eco-literacy stories as learning media for environmental education for Banten coastal children. Based on this, a study was conducted which aims to analyze the level of diversity of *mudskipper* species in Seberang Tungkal Ilir District, Tanjung Jabung Barat, Jambi and environmental factors that affect the life of *mudskipper* fish.

METHODS

Place and time of research

The research was conducted on the mangrove ecosystem of Seberang District, West Tanjung Jabung Regency, Jambi Province. The research was carried out from June to July 2021. The research stations were divided into 3 stations with different environmental conditions based on mangrove density and community presence. Stations I and II are located in the village of Muara Seberang, Seberang District, Tanjung Jabung Barat Regency which consists of 4 pick-up points with each pick-up point measuring 10 x 10 m. Station III is located in Kuala Baru Village, with sampling using a 35 m long transect, with 3 plots measuring 5 x 5 m and a distance between plots of 10 m.

Research design

This type of research is quantitative exploratory. Observations were made directly by observation and sampling in the field. The technique of determining the sampling station is purposive sampling based on certain characteristics that are considered to have a close relationship with previously known population characteristics. The locations determined in this study are: Station I in Muaro Seberang Village, a 1 hour drive from Kuala Baru village using a pompom (Figure 1), Station II in Muara Seberang village near a small stream near a bridge which is 500 meters away from station I (Figure 2), Station III in Kuala Baru village, is a 20-minute distance from the tungkal port using a pompom. (Figure 3).

Figure 1. Station I: a) Sampling point 1, b) Sampling point 2

Figure 2. Station II: a) Sampling point 1, b) Sampling point 2

Figure 3. Station III: a) Sampling point 1,2 and 3, b) Sampling point 4,5 and 6

Samples were caught using 4 fishing gear, namely: traps from peralon, sebetik fishing rods, nets and drains. Then the sample obtained is put into the container that has been provided. Prior to preservation, preliminary observations of the *mudskipper* fish were carried out in the form of color, pattern and body length as well as recording other characteristics of the fish. Furthermore, the abundance calculation for each type and research plot is carried out.

Data Collection and Analysis Techniques

The data collected was designed in the form of a field worksheet including the number of individuals found, where they were found, and the time of sampling. Data is also documented in the form of photographs and preserved. Supporting data in the form of temperature, degree of acidity (pH), salinity, and type of substrate. Data analysis is presented in quantitative descriptive form, the data taken include: Species Diversity Index (H') based on the Shannon-Wienner formula (Magurran, 1988), dominance index / Simpson index, and abundance and species composition in a community (Elviana et al, 2019). Identification of morphological characters of shape, size and color according to the book Freshwater Fishes of Western Indonesia and Sulawesi by Kottelat et al. (1993) and Fishbase (Froese and Pauly 2019). Morphometric measurements (PT, PB, PK, PM, PSP 1 & 2, PSD, PSA, PSE, PBE, LK, DM, KK and LB) and meristic measurements (dorsal fin/D, caudal fin/ C, anal fin/A , pelvic fins/V, and pectoral fins/P) from body length, mouth shape, tail, fins, scales, body color.

RESULTS

Description of Research Findings

The results of research that have been carried out in the mangrove ecosystem of Seberang District obtained as many as 45 individual *mudskipper* fish including 2 species from 2 genera namely Periopthalmodon and Boleophthalmus, the number and types of fish are presented in Table 1.

Table 1. The number and types of fish obtained at the research station in Seberang Tanjung Jabung Barat District, Jambi

Species name	Catching tool				Number of individuals found at the station		
	A	B	C	D	Station I	Station II	Station III
Periopthalmodon schlosseri	0	6	0	3	1	5	3
Boleophthalmus boddarti	9	0	27	0	9	14	13
Total Number	9	6	27	3	10	19	16

Description: Station I. M. Seberang Village (Rare mangrove area), Station II. M. Seberang Village (Tight and natural mangrove area), Station III. Kuala Baru Village (damaged mangrove area); A (peralon trap), B (sebetik fishing line), C (net), D (tankala)

Based on Table 1, the most abundant species found at all a station was *Boleophthalmus boddarti* with a total of 36 individuals, while the *Periopthalmodon schlosseri* species was the least with a total of 9 individuals at all stations. The research method uses 4 types of fishing gear, namely peralon traps, sebetik fishing rods, nets and tankalas (Figure 4). The net is a fishing gear that plays a role in catching *mudskipper* fish with the highest number of catches, namely 27 individuals, and the least catch using tankala as many as 3 individuals.

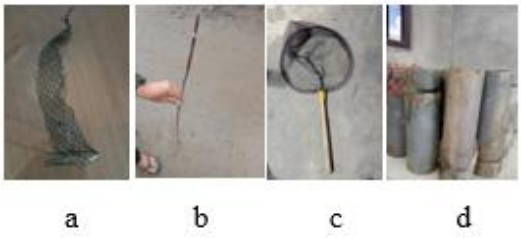

Figure 4. The fishing gear used (a) Tankala, (b) Sembetic fishing rods, (c) Folding nets, and (d) Paralon traps

The catch showed that 4 fishing gears were not effective for one species, such as *Periopthalmodon schlosseri* species were not effective using nets because these fish are very sensitive to the surrounding environment. In *Boleophthalmus boddarti* species, it is very effective to use net fishing gear and peralon traps. The descriptions of the two species of *mudskipper* found are as follows:

1. *Periopthalmodon schlosseri*

P. schlosseri (Figure 5), has a round head, protruding eyes, proctractile mouth, maxilla has 2 rows of teeth. The body is blackish brown, has a long dark line on the body from the top of the eyes to the base of the tail, the body is oval and tapers towards the tail. The pectoral, pelvic and anal fins are separate. Jugular pelvic fin and caudal fin rounded. Body size has a length of 11.2-28.5 cm with a weight of 107-150 g. D1 III-IV, 6-7, D2 I, 11-12, P.16-17, A.I, 11-12, C.12-16.

Figure 5. *Periopthalmodon schlosseri*

The samples identified were a total of 9 individuals, 1 individual was found at station I, 5 individuals were found at station II, and 3 individuals were found at station III. This species is mostly obtained using sembetic fishing gear as many as 6 individuals and Tankala as many as 3 individuals, where the mangrove conditions are too dense and there are too few nests in the scope of the research area so that the fishing method is more efficient, because this method uses bait for small fish, crabs and shrimp. This is in accordance with the type of feed *Periophthalmodon schloseri* which is a group of carnivorous animals with small fish that are preferred over crabs (Zulkifli et al, 2012). *Periophthalmodon schlosseri* as an adult can reach 30 cm, spread in every intertidal area starting from the muddy plains on the shores of seas and rivers, mangrove floors, to the muddy neighborhoods of people's homes.

2. *Boleophthalmus boddarti*

B. boddarti (Figure 6) has a subcylindrical head and blue spots, and has eyelids. The torpedo-shaped body is blackish brown, with black oblique stripes and white spots. The lower body is white. The pectoral, dorsal and anal fins are separate. Jugular pelvic fin and caudal fin round. D1 IV-VI,5-6 D2 I, 24-25, P. 18 – 20, A. I. 25, C. 14, weight 0.5-10.40 g and body length 3.60-11.10 cm.

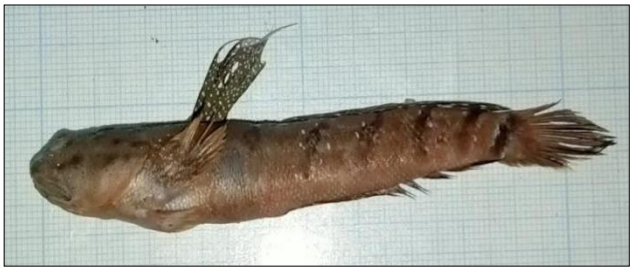

Figure 6. *Boleophthalmus boddarti*

The samples identified were 36 individuals, 9 individuals were found at station I, 14 individuals were found at station II, and 13 individuals were found at station III. This species was mostly obtained using nets as many as 27 individuals and 9 individuals using peralon traps. Based on field observations, the *Boleopthalmus boddarti* fish immediately fled to its

burrow/nest when an object approached at a distance of approximately 5 meters. This fish is more likely to swim to wet its body so it is very effective to use fishing nets when swimming in small streams.
Boleophthalmus boddarti, known locally as cempakul Layar, has a diurnal nature. This type of activity starts at low tide in the morning until the evening. This species lives in nests in soft mud with a nest depth of 40-100 m, and a regular distance between nests between 75-200 cm. This is in accordance with what was reported by Mahadevan et al (2021) that *B. boddarti* is a fish that is tied to its nest and wandering area with a radius of 220 cm. This area occurs because the *mudskipper* fish must carry out activities outside the nest, and at a certain time the *mudskipper* fish must return to the nest to wet their bodies.

Diversity Index and *Mudskipper* Fish Dominance Index
The index of diversity of *mudskipper* species at 3 research stations in the mangrove ecosystem of Seberang Tanjabbar District, Jambi ranged from 0.3 to 0.6 and the dominance index of *mudskipper* ranged from 0.6 to 0.8 as shown in Table 2.

Table 2. Diversity and dominance of *Mudskipper* fish in the mangrove ecosystem, Seberang Tanjung Jabung Barat District, Jambi

No.	Aspect	Research Station		
		I	II	III
1.	Species Diversity Index (H')	0,3	0,6	0,5
2.	Dominance Index (D)	0,8	0,6	0,7

Abundance of *Mudskipper* Fish
The abundance of *mudskipper* fish in the mangrove ecosystem of Seberang District is presented in Table 3. Based on Table 3 shows the highest relative abundance is found in the *Boleophthalmus boddarti* species, which reaches 80% of the total fish population in 3 research stations in the mangrove ecosystem of Seberang District. The same abundance was reported by Maturbongs et al (2017) where the abundance of *mudskipper* fish in Merauke Kambapi Beach had the highest relative abundance with a percentage of 63.24% found in *Boleophthalmus boddarti* species, followed by *Boleophthalmus pectinirostris* with a percentage of 36.45%. At station I in the Maro River estuary, the highest relative abundance was also of the *Boleophthalmus boddarti* species with a percentage of 32.95% and followed by the species of *Scartelaos histophorus* with a percentage of 24.26%. This concludes that *Boleophthalmus boddarti* is a common *mudskipper* fish found in Indonesia with great abundance.

Table 3. Individual Abundance and Relative Abundance of *Mudskipper* Fish at Research Stations

No	Species	Total/Station			Total Number of Individuals	K (ni/N)	Kr(%)
		I	II	III			
1	*Periopthalmodon schlosseri*	1	5	3	9	0,2	20
2	*Boleophthalmus boddarti*	9	14	13	36	0,8	80
Total Number		10	19	16	45	1	100

Description: (K = Species Abundance, Kr = Relative Abundance, ni = Number of Individuals of the ith Species, N = Total Number of All Individuals)

DISCUSSION
Analysis of Diversity Index and Dominance Index
The diversity index value at each research station is classified as very low, ranging from 0.3-0.6 (**Table 1**). Low species diversity is related to the physical factors that control an ecosystem (Odum, 1991). The highest diversity value from each research station was at station II with an index value of 0.6 and the lowest was at station I with an index value of 0.3.
Periaptholmodon schlosseri is more often found in mudflats and riverbanks than in mangrove forests (Rashid and Khoirunizam, 2000). This is in accordance with the conditions in the field where *P. schloseri* was found more at station II which has a lot of mud flats and riverbanks, in the middle of a mangrove forest than at station I and station III which only have small rivers that are only filled when high tides occur because it is far from the sea. In addition to environmental conditions that are less supportive of human factors, it also affects because it is often caught this type of fish to be used as bait for shrimp. *Boleophthalmus boddarti* species were more commonly found than *P. schlosseri*, this is because it has been supported from an environment that is very suitable for its habitat, where there is a small river and has a soft expanse of mud as a nest because this species lives in a nest in soft mud with a nest depth of 40 -100 m, and the regular distance between nests is between 75-200 cm.

The heterogeneity and diversity of vegetation are important determinants of the complexity of the overall ecosystem, including the diversity of animals and food energy flow networks (Dronova, 2017). The more heterogeneous a physical environment, the more complex the flora and fauna community, and the higher the diversity of species. In addition, competition also affects diversity if there is predation on population communities so that it can suppress other populations

(Smee, 2010), climate stability can also affect diversity because the more stable the climate also affects diversity because the more stable the climate will be more supportive for the survival of *mudskipper* fish.
Based on the dominance index in Table 2, there are types of *mudskipper* that dominate at 3 stations, because the dominance index exceeds 0.5 where the dominance index at station I is 0.8, station 2 is 0.6, and station 3 is 0.7. The results showed that the dominance index value was not close to zero (less than 0.5), which means that there are species that dominate at each station. The dominant type of *mudskipper* fish at the 3 research stations here is *B. boddarti*. Habitat suitability and relationship patterns that compete with other types of *mudskipper* fish are factors that support the presence of *B. boddarti* which is more abundant and dominates in all research stations. The dominance index is a parameter used to express the level of centralized control of species in a community (Thukral et al, 2019). The control of these species can be concentrated in one species, several species or many species which can be estimated from the high and low dominance index. If the value of the dominance index is higher, it describes a pattern of centralized control of a particular species and if the value of the dominance is lower, it describes the pattern of domination of species that spreads over each species. If the dominance index value is close to zero, it means that there is no dominant species, and from this dominance index value it can be seen that if the dominance index is high, a low diversity index value will be obtained or vice versa (Ulfah et al, 2019). According to data in the field, the abundance of *Boleophthalmus boddarti* was found compared to *Periaptholmodon schlosseri*, with a relative abundance reaching 80% of the total fish caught. This is due to habitat factors that are more supportive for *B. boddarti* species and overfishing of P. *schlosseri* species which have been used as bait for catching shrimp, which has caused at least this species to be found in the field.

Abundance of *Mudskipper* Fish

Species abundance is the number of the same species in an area. Abundance is influenced by several factors including the availability of food, reproductive power, number of predators, and adaptability. The abundance of *mudskipper* in the mangroves of Seberang District based on Table 3 is classified as moderate with a total of 45 individuals. According to Mahadevan and Ravi (2015) abundance is influenced by environmental factors, food availability, predators, competition, as well as chemical and physical conditions that are still within the tolerance range of a species, pressures and changes in community structure.

Environmental Factor Parameters

The physical condition of the environment is very important in determining whether or not the condition of an aquatic environment is good. The physical condition of the environment is also a supporting factor that can affect the survival of organisms in an ecosystem. Based on the data presented in Table 4, the temperature at the 3 stations, both water and soil temperatures, did not have much difference, which was still within the normal level for *mudskipper* fish, because according to Sunarni et al (2019) the temperature for *mudskipper* fish ranged from 23-30 ^{0}C. Even according to Polgar and Crosa (2007) the *mudskipper* can cope with extreme environmental temperatures, reaching temperatures of around 40°C..

The results of measurements of salinity in the Mangrove Ecosystem of Seberang District ranged from 12-15 ppt. The results of research by Elviana and Sunarni (2018) stated that the results of salinity measurements ranged from 20-30 ppt for *mudskipper* fish habitat. In brackish waters, salinity values range from 0.5 to 30 ppt, so it is still within the normal range for fauna life there. a report from Bucholtz et al (2009) showed that mudskippers persisted in salinity conditions of 5-50 ppt for more than 12 hours. Mudskippers will begin to die at a salinity of 60-65 ppt within 5 hours. The results of measurements of water pH and soil pH ranged from 6.2 to 6.8 values. According to Ghazy et al (2011) pH 6-9 is a tolerable range for marine life. This proves that the environment is still supportive for the life of *mudskipper* fish.

Table 4. Environmental Factors at Research Stations in the Mangrove Ecosystem, Seberang District, Tanjung Jabung Barat Jambi

No.	Parameter	Location		
		Station I	**Station II**	**Station III**
1.	Water Temperature (^{0}C)	33	31	33
2.	Soil Temperature (^{0}C)	28-30	32	32-35
3.	pH of Water	6,8	6,8	6,8
4.	pH of Soil	6,8	6,2-6,6	6,8
5.	Salinity	15	15	12
6.	DO (mg/L)	6,8	6,8	5,9-6,0
7.	Substrate type	Dusty clay	Loam	clay

The results of soil texture analysis using millar triangles on samples taken from 3 stations, showed 3 types of soil texture, namely dusty clay at station I, clayey loam at station II and clay at station III. This is in accordance with the habitat of *mudskipper* fish that live in areas with soft textures, because *mudskipper* fish live by digging soft-textured soil and using the burrow as a nest. Mangrove areas have a typical basic substrate that is muddy. The muddy bottom substrate is used by *mudskipper* fish to build nests, hiding places when the mangrove waters are high tide and as a place when the breeding

season arrives (Polgar and Crosa, 2007). DO at the research site at each station ranged from 5.9 - 6.8 mg/L, which indicated that oxygen levels were still maintained for living things, including *mudskipper* fish.

Al-Behbehani and Ebrahim (2010) stated that the activity pattern and zoning of *mudskipper* fish can be influenced by tides and environmental factors such as temperature, salinity, acidity and type of substrate. Temperature is one of the important parameters for the survival of marine life. Temperature can affect processes such as photosynthesis and respiration. In addition, temperature can also be a limiting factor for certain biota, with the ideal temperature for mangrove biota being 28-32 ^{0}C. All types of fish have a low tolerance for temperature changes, especially drastic changes (Akpovwovwo, 2020). Soils in mangrove forests have a salt content in the range of 0-5%. (Zaky et al, 2012).

CONCLUSION

Based on the results of research on the types of *mudskipper* fish (Gobiidae) in the mangrove ecosystem, Seberang District, Tanjung Jabung Barat Regency, it can be concluded that the types of *mudskipper* fish found were 2 species from 2 genera, namely *Periophthalmodon schlosseri* and *Boleophthalmus boddarti* with the most *Boleophthalmus boddarti* species obtained with a total of 36 individuals out of a total of 45 individuals. The index of diversity of *mudskipper* fish species at the three stations in Seberang Tanjung Jabung Barat sub-district is low because it ranges from 0.3-0.6 and the dominance index is classified as high, which is between 0.6-0.8. The environmental conditions at the 3 observation stations had a water temperature range of 31-33°C, soil temperature 28-35°C, salinity 13-15 ppt, water pH 6.8 and soil pH 6.2-6.8. DO ranges from 5.9 to 6.8 mg/L. The substrate for each station is suitable for the life of *mudskipper* fish with a soil texture of clay type, dusty loam, and loam.

REFERENCES

1. Aji K W and Arisuryanti T. (2021). Molecular Identification of Mudskipper Fish (Periophthalmus spp.) from Baros Beach, Bantul, Yogyakarta. *Journal of Tropical Biodiversity and Biotechnology* 6(3): 1-13. Doi: 10.22146/jtbb.66391.
2. Akpovwovwoa U E. (2020). Mangrove growth dynamics and sediment relations in South Western Nigeria. *Journal of Natural Resources and Environmental Management* 10(4): 688-698. Doi:10.29244/jpsl.10.4.688-698.
3. Al-Behbehani, B.E. and Ebrahim, H.M.A. 2010. Environmental Studies On The Mudskippers In The Intertidal Zone Of Kuwait Bay. *Nature and Science*. 8(5): 80-89. (ISSN: 1545- 0740).
4. Bucholtz R H, Meilvang A S , Cedhagen T, and Christensen J T. (2009). Biological Observations on the Mudskipper *Pseudapocryptes elongatus* in the Mekong Delta, Vietnam. *Journal Of The World Aquaculture Society* 40(6): 711-723 Doi:10.1111/j.1749-7345.2009.00291.x
5. Dronova I. (2017). Environmental heterogeneity as a bridge between ecosystem service and visual quality objectives in management, planning and design. *Landscape and Urban Planning*. 163(2017): 90–106.
6. Doi:10.1016/j.landurbplan.2017.03.005
7. Elviana S and Sunarni S. (2018). The Compositian and Abudance of Mudskipper Species Relationship with Organic Materials in Estuary Aquatic, Merauke Districts. *AGRIKAN*. 11(2): 38-43
8. Elviana S, Sunarni S, Maturbongs M R, Sajriawati S, and Fakhriyyah S. (2019). Mudskipper diversity and its relationship to an environmental condition in estuary. *IOP Conf. Series: Earth and Environmental Science* 343(2019): 1-5. doi:10.1088/1755-1315/343/1/012191
9. Froese R and Pauly D. (2022). *FishBase:World Wide Web electronic publication*. www.fishbase.org, (02/2022)
10. Gadhavi M K, Kukadia D, Dar S, Gokulakannan N, Talukdar G, Sivakumar K, and Gopi G V. (2017). Indigenous techniques of catching mudskipper in Bhavnagar and Bharuch districts, Gujarat. *Indian Journal of Traditional Knowledge* 16(3), pp. 533–538. Corpus ID: 135253887
11. Ghazy M M E, Habashy M M, and Mohammady E Y. (2011). Effects of pH on Survival, Growth and Reproduction Rates of The Crustacean, *Daphnia magna*. *Australian Journal of Basic and Applied Sciences* 5(11): 1-10. Corpus ID: 41489803
12. Kottelat M, Whitten A J, Kartikasari S N and Wirjoatmodjo S. (1993). *Freshwater fishes of Western Indonesia and Sulawesi*. Jakarta : Jakarta (Indonesia) Periplus Ed.
13. Kumaraguru A, Mary R C and Saisaraswathi V. (2020). A review about fish walking on land. *Journal of Threatened Taxa* 12(17): 17276–17286. Doi: 10.11609/jott.6243.12.17.17276-17286
14. Kusmana C. (2011). Management Of Mangrove Ecosystem In Indonesia. *JPSL*. Vol. (1) 2 : 152- 157. 10.29244/jpsl.1.2.152
15. Looi L J, Aris A Z, Haris H, Yusoff F M, and Hasim Z. (2016). The levels of mercury, methylmercury and selenium and the selenium health benefit value in grey-eel catfish (*Plotosus canius*) and giant mudskipper (*Periophthalmodon schlosseri*) from the Strait of Malacca. *Journal of Chemospere* 152: 265–273. Doi: 10.1016/j.chemosphere.2016.02.126.
16. Magurran A E. (1988). *Ecological Diversity and Measurement*. New Jersey: Princetown University Press.
17. Mahadevan G and Ravi V. (2015). Distribution of mudskippers in the mudflats of Muthupet, Southeast coast of India. *International Journal of Fisheries and Aquatic Studies* 3(2): 268-272. Corpus ID: 133613502.
18. Mahadevan G, Pouladi M, Stara A, and Faggio C. (2021). Nutritional evaluation of elongate mudskipper *Pseudapocryptes elongatus* (Cuvier, 1816) from Diamond Harbor, West Bengal, India. *Natural Product Research*, (35): 2715-2721. Doi: 10.1080/14786419.2019.1666388.

19. Matatula J, Poedjirahajoe E, Pudyatmoko P, and Sadono R. (2019). Spatial distribution of salinity, mud thickness and slope along mangrove ecosystem of the coast of Kupang District, East Nusa Tenggara, Indonesia. *Biodiversitas*. 20(6): 1624-1632. DOI: 10.13057/biodiv/d200619
20. Maturbongs M R, Elviana S, Sunarni S, and deFretes D. (2017). Mudskipper (Gobiidae) diversity study on estuary of Maro River and mangrove area in Kembapi Beach, Merauke. *Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan*. 7(2): 177-186. DOI: 10.13170/depik.7.2.9012
21. Odum E P. 1991. *Fundamentals of ecology (Third eddition ed.)*. Philadelphia: W. B. Saunders Co.
22. Panda L and Mabalirajan U. (2018). Recent updates on corticosteroid resistance in asthma. *European Medical Journal*. 3(3), 49–57.
23. Poedjirahajoe E and Matatula J. (2019). The Physiochemical Condition of Mangrove Ecosystems in The Coastal District of Sulamo, Kupang, East Nusa Tenggara, Indonesia. *Jurnal Manajemen Hutan Tropika*. 25(3): 173-184. DOI: 10.7226/jtfm. 5.
24. Polgar P and Lim L. (2011). *Mangroves: Ecology, Biology and Taxonomy*. Publisher: Nova Science Publishers, Hauppage Editors: Metras J.N
25. Polgar G And Crossa G. (2007). Multivariate Characterisation Of The Habitats Of Seven Species Of Malayan Mudskippers (Gobiidae: Oxudercinae). *Marine Biology.* 156:1475–1486. Doi:10.1007/s00227-009-1187-0
26. Pormansyah P, Iqbal M, Setiawan A, Yustian I, and Zulkifli H. (2019). A Review of Recent Status on Mudskippers (Oxudercine Gobies) in Indonesian Waters. *Oceanography and fisheries* 9(4): 1-4. DOI: 10.19080/OFOAJ.2019.09.555769.
27. Radkhah A R and Eagderi S. (2019). Study on biological and ecological characteristics of mudskippers. *Journal of Threatened*. 11(7): 13948–13950. Doi: 10.11609/jott.4984.11.7.13948-13950.
28. Ramadhani S F, Setyobudiandi I and Haryadi S. (2019). Inventory and Ecology of Mudskipper (Family: Gobidae) in Brebes District, Central Java Province. *Journal of Tropical Fisheries Management*. https://doi.org/10.29244/jppt.v2i1.25320.
29. Ramadhani S F, Setyobudiandi I and Haryadi S. 2018. Inventory and Ecology of Mudskipper (Family: Gobidae) in Brebes District, Central Java Province. *Journal of tropical fisheries management*. 2(1): 42-51. ISSN-e : 2614 – 8641
30. Rashid N Y and Khoirunizam M Z. (2000). Distribution of Mudskipper (Gobiidae: Oxudercinae) on the Selangor Coast. Mangrove and Coastal Enviroment of Selangor.Malaysia: Institute of Biological Sciences Univ. of Malaya.
31. Ridho M R, Patriono E and Sholikah M. (2019). Food habits of three species of mudskippers in the Musi River Estuary, South Sumatra, Indonesia. *Biodiversitas*. 20(8): 2368-2374. DOI: 10.13057/biodiv/d2008xx.
32. Ridho M R, Setiawan A, Sarno S, Arwinsyah A, Patriono E, and Sulistiono S. (2020). Bioactive Compounds Evaluation of the Mudskippers in the Estuarine Area of Musi River, South Sumatera, Indonesia. *Journal of Ecological Engineering*. 21(3): 70-80. Doi:10.12911/22998993/118296.
33. Rosyid N U. (2020). Development Of Mangrove Eco-Literacy Storytelling As Environmental Education Learning Media For Coastal Children In Banten. *GeoEco Journal*. 6(2): 162-176. ISSN: 2460-0768.
34. Serosero R H, Abubakar S and Hasan S. (2020). Distribution And Community Structure Of Mangrove In Donrotu, Guratu And Manomadehe Islands, West Halmahera District, North Maluku. *Jurnal Ilmu dan Teknologi Kelautan Tropis*. 12(1): 151-166. DOI:10.29244/jitkt.v12i1.26929
35. Smee D. (2010) Species with a Large Impact on Community Structure. *Nature Education Knowledge.* 3(10): 40.
36. Sunarni S, Melmambessy E H P, Mote N, and Rahmatia R. (2019). Baigo Hamuna. Length-Weight Relationship and Condition Factor of Mudskipper *Boleophthalmus pectinirostris* from Maro Estuary, Merauke Regency, Papua. *Journal of Ecological Engineering.*20(8):199-204. DOI:10.12911/22998993/110841.
37. Susanti F D. (2021). Potential of mangrove ecosystem as learning sources of Biology through online learning. *AMCA Journal Of Science & Technology* 1(1): 12-16. DOI 10.51773/ajst.v1i1.28.
38. Thomas B V and Bu-Olayan A H. (2008). Trace Metals Toxicity and Bioaccumulation in Mudskipper *Periophthalmus waltoni* Koumans 1941 (Gobiidae: Perciformes). *Turkish Journal of Fisheries and Aquatic Sciences*. 8: 215-218.
39. Ulfah M, Fajri S N, Nasir M, Hamsah K, and Purnawan S. (2019). Diversity, evenness and dominance index reef fish in Krueng Raya Water, Aceh Besar. *IOP Conf. Series: Earth and Environmental Science*. 348(012074): 1-5. doi:10.1088/1755-1315/348/1/012074
40. Wiryanto W, Sunarto S and Rahayu S M. (2017). Biodiversity of mangrove aquatic fauna in Purworejo, Central Java, Indonesia. *Biodiversitas* 18(4): 1344-1352. DOI: 10.13057/biodiv/d180309
41. Yang X, Gu W, Liang L, Yan H L, Wang Y F, Bi Q, Zhang T, Yu J, and Rao G X. (2017). Screening for the bioactive constituents of traditional Chinese medicines-progress and chalenges. *Royal society of chemistry*. 7: 3089–3100. DOI: 10.1039/C6RA25765H
42. Zaky A R, Suryono C A and Pribadi R. (2012). Study of Mangrove Land Conditions in Bedono Village, Sayung District, Demak Regency and Mangunharjo Village, Tugu District, Semarang City. *Journal of Marine Research*. 1(2): 88-97.
43. Zulkifli S Z, Mohamat-Yusuff F, Ismail A, and Miyazaki N. (2012). Food preference of the giant mudskipper *Periophthalmodon schlosseri* (Teleostei: Gobiidae). *Knowledge and Management of Aquatic Ecosystems*. 405(7): 1-10. DOI: 10.1051/kmae/2012013