

# Impact of different Environment parameters on the diversity of mudskipper in Goa Estuary

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## ABSTRACT

*Mudskippers are important for their biological and eco-toxicological studies and recognized as potential Bio-indicator in environmental monitoring and assessments of coastal waters and tropical or subtropical soft bottom intertidal systems. Mudskippers are very sensitive to ambient environment and this potential would be beneficial for new researches on this species especially its ecological importance in detecting pollution levels in coastal water ecosystems. Using these organisms as bio-indicator of pollution, environmental quality programme could be established. Regularly discharged pollutants have imminent detrimental effect on the flora and fauna of coastal ecosystems especially mangrove ecosystems and tropical mudflats. Abundance and distribution of mudskippers on land as well as in coastal waters could be considered as a direct indicator of habitat health.*

*Mudskipper is a species of fish that mostly found in the estuaries and coastal areas with mud substrates. This fish can adapt to wet conditions and change temperatures by hiding in the holes around the mangrove. The purpose of this study was to identify the diversity of mudskipper fish according to the environmental conditions of estuarine in Goa. The study was conducted in April-June 2018, with two observation stations. These stations were based on the characteristic differences in the estuary waters of Goa. This study used purposive sampling method. Data analysis used an ecological index (diversity index, uniformity, and dominance). The results showed that the diversity index was a moderate category (1.5858-1.5845). The distribution of species and individuals were spread evenly in each community while the environmental parameters were temperature (23-30°C), salinity (20- 30 ppt), pH (7.1-8.1), Do (1.55-2.16), BOD (0.42-0.89), BOT (11.14-29.39). The clay (muddy) substrates strongly supported mudskipper live in the estuary.*

*Mudskippers are members of the subfamily oxydercinae (tribe periophthalmi murdy (1989) within the family gobiidae (gobies). They are completely amphibious fish that can use their pectoral fins to walk on land. Being amphibious, they are unique adapted to intertidal habits, unlike most fish in such habitats, which survive the retreat of the tide by hiding under wet seaweed or in tidal pools. Mudskippers are quiet active when they are out of water, feeding and interacting with one another. Mudskipper constitute a group of 25 air-breathing species in four genera which contain periophthalmus, periophthalmodon, Boleophthalmus and Scartelaeos) that are the most derived and the most amphibious of the ten genera of the teleost subfamily oxudercinae (Gobiidae; Murdy, 1989, Clayton 1993, Graham 1997, Ayuilar 2000)*

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## INTRODUCTION

Diversity of organisms in water can be used as a benchmark of stability or balance of the organisms in a community. Species diversity is one of the characteristics of the level of a community based on its biological organisms so that one can be distinguished from one another. The mangrove ecosystem has a very high diversity in each biota that lives in it. Mudskipper is one of the biotas that can live in mangrove conditions which are wet and dry due to tidal influences.

Mudskipper habitats always change according to the wetness and temperature in the region, and in order to adapt, they spend time out of the water. The previous researches on mudskipper fish, namely about morphological studies of mudskipper fish (Gobiidae: Oxudercinae) studied the characteristics of the local biodiversity of Tarakan Island in 2016. Also, Murniati and Hasan researched the population of the godder fish (*Periophthalmus modestus*) in the mangrove forest area Kualo West West Ring Bengkulu and the fecundity of the mudskippers, *Boleophthalmus boddarti* (Pallas, 1770) on Brebes Beach.

According to who have conducted preliminary research, which found 6 types of mudskipper at the mouth of the

Mandovi River in Goa, Goa Province, India, namely *Boleophthalmus boddarti*, *B. pectinirostris*, *Oxudercus dentatus*, *Periophthalmus argentilineus*, *P. takita* and *Scartelaeos histophorus*, so this study needs to be done as a continuation of the previous research.

The species is usually cultured and studied ecologically because of their considerable tolerance to environmental stressors, organic and inorganic contaminants. If they are used as food source, it is highly recommended that they should be carefully and periodically monitored for contaminants to assess the health risk to consumers of this species. An urgent implementation to maintain the sustainability of natural resource is necessary and prompt environmental remediation measure and ecosystem rehabilitation is also urgently required. Basic researches at all organism levels are also needed to understand the ecotoxicology and biology of different fishes especially of mudskipper and their use as ecological indicators of pollution in coastal waters. In particular the toxic dynamics in different fish species and their effects at the community level are needed

**METHODS**

The study was conducted in April-June 2018 on the estuary coast of Goa. The research station consists of two stations based on differences in environmental characteristics in the two different waters. Tools and materials used include traps, Global Positioning System (GPS), plastic samples, sample bottles, stationery, label paper, tracing paper, rod thermometers, pH meters, hand refractometers, rulers and calipers, styrofoams, cold boxes, fish samples, 40% formalin, 70% alcohol, and H<sub>2</sub>O. Fishing was done at low tide using traps and caught using both hands. The fish caught were then analyzed at the laboratory.

**DATA ANALYSIS**

a. Species Diversity Index

$$H = - \sum_{k=1}^n p_i \ln p_i \quad \text{where } p_i = nk/N$$

Where:

H'; Diversity Index,

nK; Number of individual species k,

N; Total number of individuals,

ln; Natural logarithm.

Diversity index criteria  $H < 1$ , low diversity,  $1 < H' < 3$ , Medium diversity,  $H' > 3$ ; High diversity

b. The Uniformity Index of individuals caught between species

$$E = H / \ln S_k$$

Where:

E; Uniformity Index,

H'; Diversity Index,

S<sub>k</sub>; Total number of individuals at the k-th station.

The uniformity index criteria (E) is close to 1, so the distribution of individuals between species is relatively evenly distributed. But if the value (E) is close to 0, then there are certain species which are relatively abundant in number from other types.

c. Dominance index was used to determine whether there was dominance, then Simpson dominance index

$$C = \sum [nk/N]^2$$

Where: C; Simpson Dominance Index,

nk; Number of individual species k,

N; The number of individuals of all specie,

Dominance index criteria if C approaches 0, it can be said that there is no dominant type and a high level of uniformity.

**RESULTS AND DISCUSSIONS**

Type of diversity According to the results of research of 3 months in the estuary waters of Goa, the study found 4 mudskipper types in the station I while in the station II there were 6 mudskipper types (table 1).

**Table1. Type of diversity found in the estuary waters of Goa**

NO.	SPECIES NAME	STATION I	STATION2
1	Boleophthalmus boddarti	√	√
2	Boleophthalmus pectinirostris	-	√
3	Periophthalmus takita	√	√
4	Periophthalmus argentilineaus	-	√
5	Scartelaos histophorus	√	√
6	Oxuderces dentatus	√	√

At station II more mudskipper types found because at that station there are a lot of mangroves along the coast.

Meanwhile, the station I is a river estuary where saltwater and freshwater converge so that water flow occurs. Different habitat conditions will affect the adaptation patterns and structure of different fins in the Mudskipper. Water areas are affected by the presence of water pressure while in the mainland areas are affected by gravity. Mangrove is utilized by mudskipper as a place to find food, breed, and other activities by using the roots of mangroves. The existence of mangroves as breeding grounds supports a large number of species found in the area. Genisa (2003) and Nontji (1987) in Endrawati H (2012), carnivorous fishes have swift movements in shallow water and utilize mangroves as a place to look for food.

**DIVERSITY, HOMOGENEITY, AND DOMINANCE**

**Table2: The index value of mudskipper diversity, uniformity, and dominance**

INDEX CATEGORIES	STATION1	STATION2
DIVERSITY	1.5845	1.5858
HOMOGENEITY	0.2124	0.1986
DIVERGENCE	0.3736	0.3689

Based on the results of the analysis, the diversity index of the mudskippers at the two stations gained slightly different an average value of diversity index, namely at the station I with a percentage of 1.5845 while at station II a percentage of 1.5858. if H 'that is less than one has a low diversity index, if the value of H' is more than one and less than three has a moderate diversity index and if the value H 'is more than three have a high diversity index. This is because of the similarity in the substrate of the two stations, namely clay (mud).

The homogeneity index of the fish species at the station I obtained a percentage of 0.2124 while at the station II a percentage of 0.1986, it means the level of uniformity of the fish at the station I and the station II is in the high criteria. This is probably caused by the general condition of the two stations is same so that they are homogeny. The dominance index of the mudskippers at the station I was 0.3736 while at the station II it was 0.3689. From these results, it appears that no type of mudskippers dominated at the two stations. If the dominance index value is close to 0, then it is categorized as low so that it can be said that there is no one type that dominates.

**ENVIRONMENTAL PARAMETERS**

According to the results of measurements of environmental parameters in the estuary waters of Goa, it can be seen in the following table.

**Table3: Value of environmental parameters**

ENVIRONMENTAL PARAMETERS	STATION1	STATION2
TEMPERATURE	26.5	27.5
SALINITY	24	28
WATER Ph	7.6	7.6
Do	1.85	1.82
BOD	1.02	0.59
BOT	17.76	21.01
SUBSTRATE	CLAY(MUD)	CLAY(MUD)

**Mudskipper Diversity According to Environmental Conditions in the Estuary Waters of Goa.**

Environmental parameters can influence the diversity of an organism as support of aquatic biota life. Mudskipper is an organism that has an overall tolerance level so that it can survive on fickle conditions.

The mudskipper diversity index in the estuary waters of Goa was in the medium category. Moderate diversity indicates

that the aquatic environment in the area is in good condition. In general, the condition of the aquatic environment based on observations in the estuarine waters of Goa was in good condition. Environmental parameters become one of the supporting factors that can affect the survival of organisms that exist in seawater ecosystems is environmental quality.

Generally, environmental parameters of the estuarine waters of Goa waters still support mudskipper life. Panjaitan (2013) stated that the temperature of the waters suitable for mudskipper is 29°C, so it can be said the temperature at both stations is still ideal for mudskipper life. Animals that live in the tidal zone, such as the shoddy fish at certain times experiences drought have an enormous tolerance to temperature changes. Also (Kordi. et al. 2007) argued that temperature is very influential on the life and growth of aquatic biota. The appropriate pH value for mudskipper is 8.2. While the ideal pH value is 7. The perfect salinity for mudskipper life is 8 ppt. While the perfect salinity for 30 ppt mudskipper. Brackish waters have very diverse salinity values

because they are influenced by the presence or absence of freshwater and seawater.

The mudskippers prefer clear water environment with a muddy sand base which is used as a spawning ground and other activities. Mudskipper can survive in the tidal area with muddy substrate because it has adapted to breathe through the skin of the body and mucous membranes in the mouth and esophagus.

## DISCUSSION

Based on the results of the study, it can be concluded that there are various species diversity of mudskippers found in the estuarine waters of Goa. The study also indicates that species diversity can be varied according to the type of habitat. The perfect habitat for mudskippers here is determined by the particular temperature, salinity, water pH, Do, BOD, BOT and land substrate.

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