CHAPTER 1

INTRODUCTION

1.1 Historical Background

Bangladesh has diversified fisheries resources. Most are marine, but is not fully exploited due to lack of advanced scientific technology. St. Martin's Island locally called 'Narikel Jinjira' is residing on the southernmost tip of Bangladesh, roughly between 20˚34′ - 20˚39′ N and 92˚18′ - 92˚21′ E, segregated from the mainland by a channel that is almost 9 km wide (Hossain and Islam, 2006). The island is residing in the Northeastern part of Bay of Bengal. The island is a tiny island with the area of 8 km^2 in the northern part of the Bay of Bengal comprises a cluster of islands known as Chera Dip. Excess population and careless tourism has been pointed out as number one problem which is putting a lot of brunt on the resources of the island and on the fragile coral ecosystem which shelters a diverse variety of marine biodiversity which is not found anywhere else in Bangladesh (Dhaka Tribune, 2018). Environmentalist anticipate that the stock of biodiversity in the island has almost been exhausted. That's why it is necessary to assess biodiversity of Saint Martin's Island for the management of its resource.

Ornamental fishes are fascinating and colorful species which can be kept as pets in limited spaces like aquarium or garden pool with the intention of enjoying their beauty (Mukherjee et al., 2000). The ever- increasing demand for ornamental fishes has made them a significant element of global fish trade (Andrews, 1990; Singh and Ahmed, 2005; Tlusty et al., 2013). Some authors believe that indigenous ornamental fish is an important contributor to native economies. (Tlusty et al., 2008).

In Bangladesh there are only a few native fish species that are considered as ornamental fish species e.g. Rani Fish (*Botia* sp.). Ornamental fish trade is rapidly expanding and there is a growing recreational demand for aquarium fishes in the domestic and international market (Alam et al., 2016). 1400 Marine ornamental species are traded internationally. Only Australia imports 8 to 10 million fish each year (Whittington et al., 2007). Average annual growth rate 14% since 1985 (Wood, 2001). But our marine ornamental fishes could not be a part of this world wide marine ornamental fish marke though we have a vast marine resource. On the other hand there is no significant research done yet on marine ornamental fishes of Bangladesh. It was found that most

of the ornamental fishes being occupants of coral and rocky areas, their feeding manner and food are associated with the organisms combined with corals. (Gopinatha et al., 2020). And St. Martin Island has diversified coral reef area (Tomascik, 1997). That's why this research is focused on the diversity and the hotspots of the ornamental fishes available in the St. Martin's island. This study bears an importance in protecting the ornamental fishes from habitat degradation and overall management of their ecosystem.

So, it is important to expose and introduce indigenous ornamental fish resources available in Bangladesh, and to investigate their diversity status to make those species available in ornamental fish market. This research has been conducted to assess the diversity of the ornamental fishes of St. Martin's Island so that the actual ornamental fisheries resource can be determined.

1.2 Objectives:

The broad objective of the research was to study about the diversity of indigenous ornamental fishes of St. Martin's Island.

The specific objectives of the research were:

- To enlist indigenous ornamental fishes that exist in Saint Martin's Island, Bangladesh.
- To identify the present status of habitats & hotspots of indigenous ornamental fishes in the study area.

CHAPTER 2

LITERATURE REVIEW

St. Martin's Island is an important area for coral resource but the resource is decreasing/degrading day by day (Dhaka Tribune, 2018). An important study was done by Tomas Tomascik in 1997 on the coral resources of St. Martin's Island to establish a management plan for coral resources of Narikel Jinjira funded by Bangladesh Government. There are 86 species of reef associated fish under 34 families present in St. Martin Island (Tomascik, 1997). Most of those were colorful and lucrative. After Tomascik another study was done on the island by M. Maruf Hossain and Md. Hashibul Islam in 2005. They found a total of 234 species of fish of which 98 species are coral associated fish in the island (Hossain and Islam, 2006).

A study on fish biodiversity of Lohalia river of Bangladesh was done on 2016 by Md. Rabiul Islam Rubel. In the study biodiversity was measured through Shannon-Weaver diversity index, $H = -\Sigma Pi \ln Pi$ (Rubel et al., 2016). They found 30 species under 7 family in their studies. This biodiversity index also used in this study.

There is a conservational benefit have been found in a study titled "Opportunities for Public Aquariums to Increase the Sustainability of the Aquatic Animal Trade" (Tlusty et al., 2013) through introducing fish as aquarium fish. By Improving the sustainability and practices of the aquatic pet trade can bring a conservation benefit and protection of intact functioning ecosystems. This practice can also bring economic and educational benefits and impacts.

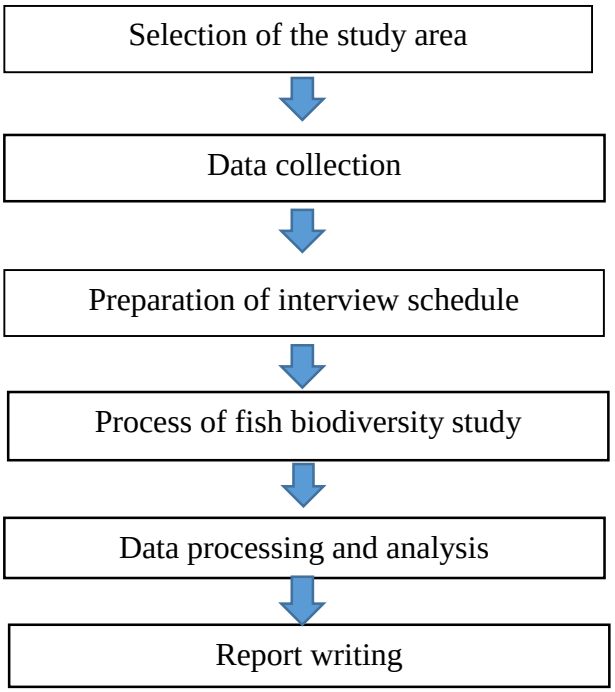
About 10 million ornamental marine fishes are imported global annually. Almost 400 species of marine ornamental fishes are indicated in the world under 175 genera in 50 families. The ornamental coral reef fishery is a multi-million dollar industry that clinches thousands of fishers in developing countries. (Renjithkumar and Madusoodana, 2010).

A Study on Coastal Marine Fish Biodiversity toward the Western Coast of India done by Robert D. Sluka, 2013. In the study, data was collected by one observer (RDS) on

SCUBA by recording observations on underwater paper and comparing to warrant fish identification books (Sluka, 2013).

CHAPTER 3

MATERIALS AND METHODS



3.1 Selection and description of the study area:

The study area was selected at 5 sites of the island (Figure 1). Site 1- 20˚ 38′7.51956′N, 92˚ 19′ 15.2642″ E, site 2- 20˚ 37′ 40.49314″ N, 92˚ 19′ 40.21767″ E, site 3- 20˚ 36′ 39.74267″ N, 92˚ 19′ 47.38239″ E, site 4- 20˚ 36′ 14.58174″ N, 92˚ 19′ 54.29605″ E, site 5- 20˚ 34′ 31.23705″ N, 92˚ 20′ 11.14569″ E. The primary criterion for the selection of the study area was identifying compatible geographical area for comprehensive variety of ornamental fish biodiversity according to fishermen. First primary information about available species and their habitat was collected from previous study. Then the colorful fish species was separated and made a separate list for colorful fish species with their picture collected from different website.

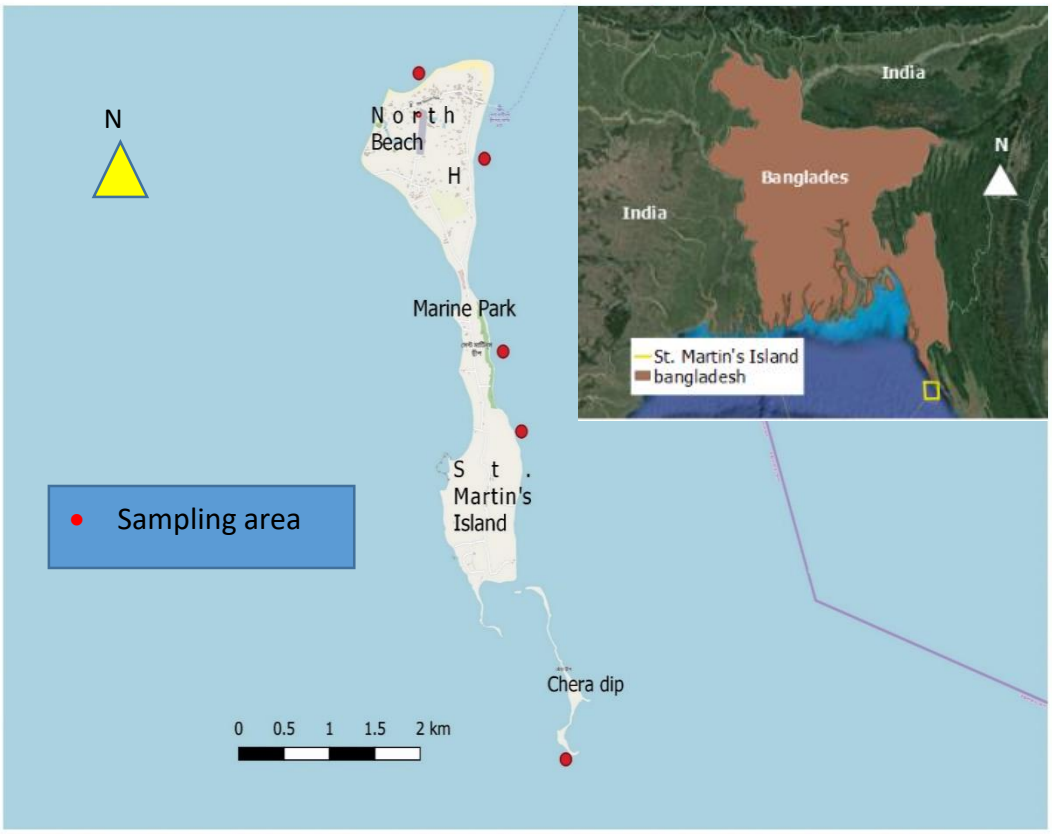


Figure 1: Sampling area

3.2 Preparation of interview schedule:

Interview schedule is very important for collecting data by survey method. In order to get a complete picture of fish biodiversity and habitat of fish, an interview schedule was made. The schedule included various questions related to fish abundance, factors affecting the level of fish production etc.

3.3 Data Collection:

During data collection, both primary and secondary sources were considered.

Primary data were collected from fisherman and by sampling through gill net and hook at 10 meter water depth and 50 meter far from coast line approximately. The fishing was done in coral reef region of the island as the ornamental fishes are abundant in this region. It was too tough to catch fishes at that region. Hook fishing was the successful way to catch the fishes. Four visits were made to the study area to collect accurate information related to objectives of the study. Collected sample was immediately

preserved with ice and in 70% Ethanol further in laboratory (AIHA, 1989; Gaston et al., 1996).

For the study a combination of interview schedule, participatory rural appraisal (PRA) tools such as, focus group discussion (FGD), social mapping and cross interviews with key informants were used for fisherman.

The secondary data was collected from government office, research article and newspaper.

3.4 Process of fish biodiversity study:

The study was started from 1stJanuary 2019. The study was started with secondary data collection. It took four months to collect the secondary data and selection of the study area. For the study of ornamental fish biodiversity of St. Martin's Island sampling of catches and their assessment were carried out from 10thAugust to 20th December, 2019. A scuba diver was hired for the assessment of fish by using photograph as it was not possible to catch most of the species specially the species hides themselves under the coral or stone. So scuba diving became obligate for the assessment. Sampling was done in coral reef region and beyond coral reef region. Fishes are identified by observing morphometric and meristic characters. Local fishermen helped during sampling of fishes. Fishes which have no ornamental value were ignored. Only ornamental fishes were counted during sampling. Fishbase (Froese and Pauly, 2019) and Encyclopedia of Flora and Fauna of Bangladesh, Vol. 24. Marine Fishes (Ahmed et al., 2009) were used for the identification of fish species. Museum and Laboratory specimens of Faculty of Fisheries, Chattogram Veterinary and Animal Sciences University were also used to identify the species.

3.5 Data processing, analysis and presentation:

The collected data were summarized and processed for analysis. These data were verified to eliminate all possible errors and inconsistencies. To know the status of a particular fish species in the fish biodiversity of Saint Martin's island Shannon Diversity index

$H = - \Sigma Pi \ln Pi$ was used (Shannon and Weaver, 1949).

Where H is the diversity index, Pi is the relative abundance (s/N), s is the number of individual for each species, N is total number of individuals.

Shannon Diversity Index is a mathematical measure of species diversity in a community. It provides information about community composition beyond just species richness (how many different species are present). It also takes the relative abundance of each species into account. It provides important information about rarity and commonness of species in a community.

Shannon's Equitability can be calculated from Shannon Diversity Index. Shannon's Equitability (E_H) is a measure of species evenness or relative abundance. Equitability assumes a value between 0 and 1, with 1 being complete evenness (Equal numbers of every species in the sample).

Shannon's Equitability (E_H) = H/ ln S

Here, H= Shannon Diversity Index and S= Total number of species.

Tabular technique was used for the analysis of data by using simple statistical tools percentages and averages. Finally, the processed data were transferred to a master sheet from which classified tables were prepared revealing the finding of the study. For processing and analysis purpose, MS excel, MS word and QGIS tools are used.

CHAPTER 4

RESULT

There was 4802 individual ornamental fishes of 69 species recorded under 30 family according to fish market data and the summarized data collected from the fisherman (Table 1). Most of the ornamental fishes are inhabitants of coral and rocky areas. The species of Chaetodontida (17%), Terapontidae (10%), Serranidae (7%), Lutjanidae (6%), Pomacentridae (11%), Pomacanthidae (4%), Mullidae (4%), Labridae (8%), Tripterygiidae (4%), Ephippididae (3%) and Gobiidae (3%) family were abundant (Figure 2).

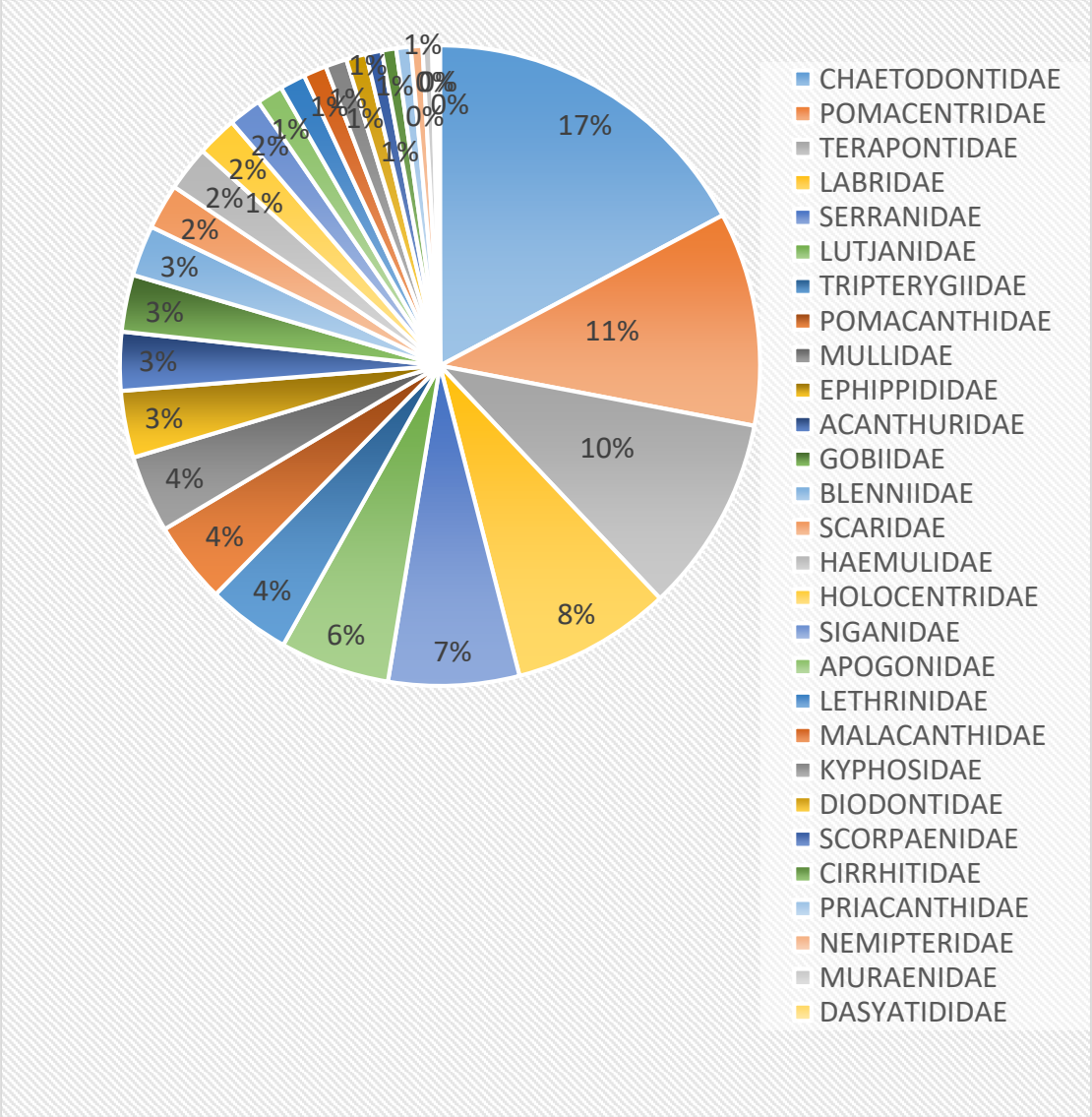


Figure 2: Percentage of different ornamental fish family

Table 1: Available fish species and their abundance status according to Fish market data and summarized data collected from fisherman

Family	Species	Species: Scientific name, Highest Length(cm), Common name	Status*(Very Low/ Low/ Moderate/ Abundant/ Highly Abundant)
DASYATIDIDAE	1	*Taeniura lymma* 70 cm (Bluespotted ribbontail ray)	Low
MURAENIDAE	2	*Gymnothorax favagineus* 90 cm (Laced moray)	Low
HOLOCENTRIDAE	3	*Myripristis vittata* 25cm, (White tip Soldier fish)	Low
	4	*Sargocentron rubrum* 32cm, (RedSoldier fish)	Moderate
SERRANIDAE	5	*Cephalopholis boenak* 30cm (Brownbarred grouper)	Abundant
	6	*Epinephelus hexagonatus* 27.5cm (Starspotted grouper)	Moderate
	7	*Epinephelus polyphekadion* 27.5cm (camouflage grouper)	Moderate
	8	*Cephalopholis formosa* 34cm (Blue line grouper)	Moderate
TERAPONTIDAE	9	*Terapon jarbua* 36cm (Tiger Bass)	Highly Abundant
	10	*Terapon Theraps* 32cm (Banded Grunter)	Highly Abundant
APOGONIDAE	11	*Apogon maculatus* 11.1cm (Flamefish)	Low
	12	*Apogon pillionatus* 6.5cm (Broadsaddle cardinalfish)	Low
MALACANTHIDAE	13	*Malacanthus latovittatus 45cm* (Blue Blanquillo)	Moderate

LUTJANIDAE	14	*Lutjanus fulviflamma* 35cm (Black spot sea perch)	Moderate
	15	*Lutjanus malabaricus* 100cm (Red Snapper)	Abundant
	16	*Lutjanus johnii* 97cm (John's Snapper)	Low
LUTJANIDAE	17	*Lutjanus lutjanus* 35cm (Big Eye Snapper)	Low
CAESIONIDAE	18	*Caesio xanthonota* 40cm (Yellowback Fusilier)	Very low
NEMIPTERIDAE	19	*Scolopsis vosmeri* 40cm (White Cheeked Monoclebream)	Low
	20	*Scolopsis bimaculatus* 31cm (Twospot Monocole Bream)	Very low
HAEMULIDAE	21	*Plectorhinchus orientalis* 86cm (Oriental Sweetlips)	Moderate
	22	*Plectorhinchus cinctus* 60cm (Three Band Sweetlips)	low
LETHRINIDAE	23	*Lethrinus nebulosus* 87cm (Spangled emperor)	Low
	24	*Lethrinus erythracanthus* 70cm (Orange-Spotted Empero)	Low
MULLIDAE	25	*Upeneus sulphureus* 20cm (Sulphur Goatfish)	Moderate
	26	*Parupeneus forsskali* 28cm (Red Sea Goatfish)	Abundant
KYPHOSIDAE	27	*Kyphosus cinerascens* 50.7cm (Blue Sea Chub)	Low
	28	*Kuphosus vaigiensis* 70cm (Brassy Chub)	Low
EPHIPPIDIDAE	29	*Platax teira* 70cm (Longfin batfish)	Abundant

CHAETODONTIDAE	30	*Chaetodon collare* 18cm (Redtail butterfly fish)	Abundant
	31	*Chaetodon decussatus* 20cm (Indian Vagabond Butterfly fish)	Abundent
	32	*Chaetodon octofasciatus* 12cm (Eightband Butterfly Fish)	Abundent
	33	*Heniochus acuminatus* 15cm (Pennat Coral Fish)	Abundent
	34	*Heniochus singularius* 30cm (Singular bannerfish)	Abundent
POMACANTHIDAE	35	*Pomacanthus annularis* 45cm (Blue Ring Angelfish)	Abundent
POMACENTRIDAE	36	*Abudefduf bengalensis* 17cm (Sergeant Major)	Moderate
	37	*Abudefduf sordidus* 24cm (Blackspot Sergeant)	Low
	38	*Abudefduf sexfasciatus* 19cm (Scissortail Sergeant)	Abundant
	39	*Neopomacentrus azysron* 7.5cm (Yellowtail Demoiselle)	Low
	40	*Chrysiptera unimaculata* 10cm (Onespot Demoiselle)	Low
	41	*Pomacentrus caeruleus* 10cm (Cerulean Damselfish)	Low
	42	*Pomacentrus coelestis* 9cm (Neon Damselfish)	Low
	43	*Pomacentrus vaiuli* 10cm (Ocellate Damselfish)	Moderate
	44	*Stegastes fasciolatus* 16.5cm (Pacific Gregory)	Moderate
CIRRHITIDAE	45	*Cirrhitichthys bleekeri* 10cm (Hawkfish)	Low

LABRIDAE	46	*Coris gaimard* 40 cm (Yellowtail Coris)	Low
	47	*Halichoeres Claudia* 8.9cm (Claudia's wrasse)	Low
	48	*Halichoeres wrasses* 8.9cm (Wrasses)	Abundant
	49	*Labroides dimidiatus* 14cm (Bluestreak Cleaner Wrasse)	Moderate
	50	*Thalassoma lunare* 45cm (Moon Wrasse)	Low
	51	*Bodianus dictynna* 14.4cm (Diana's hogfish)	Low
	52	*Bodianus scrofa* 30cm (Barred hogfish)	Low
	53	*Cheilinus lunulatus* 35cm (broomtail wrasse)	Moderate
SCARIDAE	54	*Bolbometopon muricatum* 70 cm (Green Humphead Parrot fish)	Moderate
	55	*Scarus psittacus* 30-50cm (Common parrotfish)	Low
TRIPTERYGIIDAE	56	*Helcogramma* sp. 4cm (Triplefin)	Highly abundant
BLENNIIDAE	57	*Cirripectes castaneus* 12.5 cm (Chestnut Eyelash-Blenny)	Moderate
	58	*Ecsenius bicolor* 11cm (Bicolor blenny)	Low
	59	*Salarias fasciatus* 14cm (Lawnmower Blenny)	Low
GOBIIDAE	60	*Cryptocentrus cinctus* 10cm (yellow prawn-goby)	Low
	61	*Amblyeleotris steinitzi* 13cm (Steinitz' prawn goby)	Moderate

ACANTHURIDAE	62	*Acanthurus xanthopteru* 50cm (yellowfin surgeonfish)	Moderate
	63	*Acanthurus lineatus* 38cm (Lined Surgeonfish)	Moderate
SYNGNATHIDAE	64	*Hippocampus kuda* 30cm (Spotted Seahorse)	Very Low
SIGANIDAE	65	*Siganus stellatus* 40cm (Brown-spotted spinefoot)	Low
	66	Siganus javus 53cm (Streaked spinefoot)	Low
DIODONTIDAE	67	*Diodon hystrix* 91cm (Spot-fin porcupinefish)	Moderate
PRIACANTHIDAE	68	*Priacanthus hamrur* 35cm (Purple-Spotted Bigeye)	Low
SCORPAENIDAE	69	*Pterois volitans* 45.7cm (Red LionFish)	Low

* Very low = 1 to 20 individual can be found in a year.
Low = 21 to 100 individual can be found in a year.
Moderate = 101 to 300 individual can be found in a year.
Abundant = 301 to 500 individual can be found in a year.
Highly abundant = More than 500 individual can be found in a year.

Shannon Index $H = -\sum Pi \ln Pi = 3.89308$ (Table 2, Appendix 2)

Here H is the diversity index, Pi is the relative abundance (s/N), s is the number of individual for each species and N is total number of individuals.

Shannon's Equitability (E_H) = H/ ln S = 3.89308/ ln 69 = 0.92

Here, H= Shannon Diversity Index and S= Total number of species.

Three species was not found in Tomascik's Study. They are

Siganus javus

Pterois volitans

Priacanthus hamrur

5 hotspots of ornamental fishes was identified according to the interview of fisherman during study (Figure 3). The north most side of the island is dominated by the family *Chaetodontidae*. The west side of the island was not exploited yet due to scarcity of enough facility.

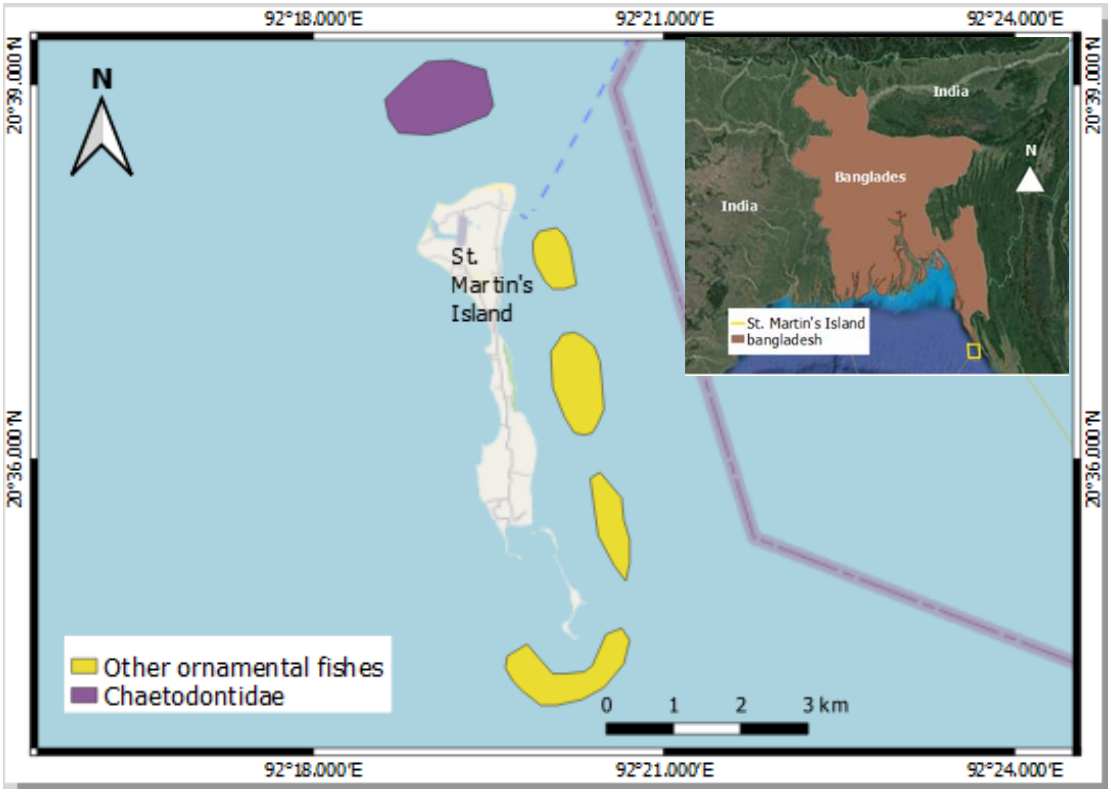


Figure 3: Ornamental fish hotspot

CHAPTER 5
DISCUSSION

Although the ornamental fish biodiversity of the island is very rich, but due to some natural and manmade negative intervention on the environment of the island has been considered responsible for fish reduction. The reasons of biodiversity reduction are excess fishing pressure, excess tourism pressure, catching brood fish, by catch (unwanted fish catch), ghost fishing (fishing by abandoned net), and destruction of natural habitats by other activities (Dhaka Tribune, 2018). Except some ornamental fishes most of the fishes are inedible to the local people. The species are caught as by catch and abandoned by sorting. Though some luxurious hotels of the island give shelter to some species in aquarium to increase the aesthetic view of the hotel, most of the people don't know the actual value of those species. Some species have high economic value as aquarium fish. For example *Pterois volitans* is an outstanding aquarium fish, *Plectorhinchus orientalis* has both aquarium and food value (Ahmed et al., 2009), *Platax teira, Chaetodon collar, Heniochus acuminatus, Pomacanthus annularis and Abudefduf sp.* have great merit as aquarium fish worldwide (Ahmed et al., 2009).

There were 69 species found under 30 family and the Shannon index was 3.89308. Typical values of Shannon index are usually between 1.5 to 3.5 in most ecological studies, and the index is seldom greater than 4 (Kerkhoff, 2010). So the biodiversity of ornamental fishes of Saint Martin's Island is very sound. But some species are vulnerable due to some environmental causes and human interruption. Most of the ornamental fishes was found in coral reef region. This outcome has matched with Gopinatha's study. He found that most of the ornamental fishes being inhabitants of coral and rocky areas (Gopinatha et al., 2020). So conserving coral resource is very important to conserve the ornamental fishes of St. Martin's Island.

The study found Shannon's Equitability (E_H) = 0.92. Equitability assumes a value between 0 and 1, with 1 being complete evenness (Equal numbers of every species in the sample). It indicates that this sample has pretty high equitability.

Tomas Tomascik included 86 species in his study (Tomascik, 1997). Most of the fishes found in his study was ornamental fish. All the ornamental fishes found in Tomascik study are also found in this study. But there are some species found in this study was not found in Tomascik's study. The species are *Siganus javus*, *Priacanthus tayenus* & *Pterois volitans*. This is happened for seasonal succession of those species or due to change of migration route. But the common thing of both studies is the island is an outstanding source of ornamental fishes. And the island is very much potential for ornamental fish production. There are lot of things to know about the island. The island is very important for the biodiversity researcher. More studies should be conducted in the island.

M. Maruf Hossain and Md. Hashibul Islam showed the threats to the biodiversity of the Island. And the threats are water pollution, over exploitation, excess tourism pressure, poor management of agricultural lands etc. (Hossain and Islam, 2006).

There are some region on the island where most of the coral become bleached. There are excess plastic found on the beach. There are lot of abandoned fishing net found which are continuously trapping fishes and other aquatic animals. A proper management system must be implemented as soon as possible to save the biodiversity of the island.

Some species of fishes are abundant in the island and the fish groups includes damselfish, parrotfish, surgeonfish, dogfishes, groupers, snappers, emperors, and butterfly fish (Hossain and Islam, 2006). This study also mentioned some fish family which are abundant in the island such as Chaetodontida, Terapontidae, Serranidae, Lutjanidae, Pomacentridae, Pomacanthidae, Mullidae, Labridae, Tripterygiidae, Ephippididae and Gobiidae. This study indicates that species of the Chaetodontida family covers major proportion of ornamental fish resource of the island. Damselfish, parrotfish, surgeonfish, groupers, snappers, emperors, and butterfly fish are the abundant fish species of those families. Butterfly fishes are the most common and available ornamental fishes of the island. The fish groups which are mentioned as abundant at Hossains' study, also mentioned in this study.

CHAPTER 6
CONCLUSIONS

After the study it can be concluded that most of the ornamental fishes are inhabited in the reef area. They are dominant where there is less pollution and abundant in pigmented plankton especially in the coral reef region. Saint Martin's Island is very much diversified in ornamental fishes. But due to excess tourism pressure, fishing activities, dumping of damaged net, ocean acidification, coral reef as well as ornamental fishes have been hampered. Some fishes are going to be extinct in near future. On the other hand their biodiversity status is not conducted in the IUCN red list yet. There are so many potential ornamental fishes are found in the island which can be excellent species in the ornamental fish market. Such as *Cirripectes castaneus, Ecsenius bicolor, Amblyeleotris steinitzi, Acanthurus lineatus, Pterois volitans, Sargocentron rubrum, Cephalopholis boenak, Epinephelus hexagonatus, Cephalopholis formosa, Parupeneus forsskali, Platax teira, Chaetodon collare, Chaetodon decussatus, Chaetodon octofasciatus, Heniochus acuminatus, Heniochus singularius, Pomacanthus annularis, Abudefduf sexfasciatus, Neopomacentrus azysron, Chrysiptera unimaculata, Pomacentrus caeruleus, Pomacentrus coelestis, Coris gaimard, Thalassoma lunare, Siganus javus, Terapon jarbua*. So it is high time to conserve the species. Further study can be run on their breeding biology and artificial breeding. If artificial breeding can be developed of those species, they will contribute a huge in our economy. One the other hand, if breeding technique of a species can be developed it will no longer vulnerable.

CHAPTER 7

RECOMMENDATIONS AND FUTURE PERSPECTIVES

As St. Martin's Island is a diversified area and its diversity is facing great threat due to human interruption, necessary steps should be taken to conserve the biodiversity of the island. Especially the coral reef of the island has to take under consideration. Because coral reef is very sensitive to pollution and it has great impact on ornamental fishes of the island. Fish sanctuary can be established where fish can take shelter. By protecting these ornamental fish species we can boost our tourism sector which can contribute our economy. Further study can be done on reproductive cycle, seasonal variation and breeding in captive condition of these ornamental fishes to make contribution in ornamental fish market. Breeding and culture of these ornamental fishes can contribute in our economy and create employment opportunity.

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PHOTO GALLERY

Focus group discussion:


Personal Interview:



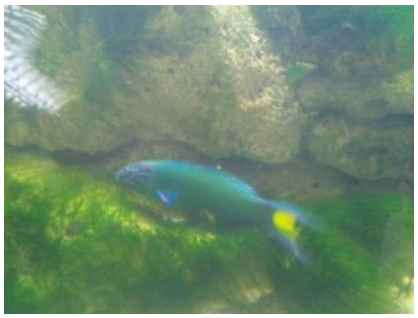



Sampling & Sample:







APPENDICES

APPENDIX 1

Questionnaire

Interview schedule for biodiversity assessment of ornamental fish of Saint Martin's Island

Date of Interview:

Sample no:

A. Personal information:

1. Name:
2. Address:
3. Age:
4. Sex:
5. Contact no:
6. Occupation:

_____

Signature of the interviewee

B. Information about fish biodiversity:

1. Which colorful fishes are available in the island?
   Ans:

2. Which areas are abundant in colorful fishes?
   Ans:

3. Which fishes were previously available?
   Ans:

4. What are the causes of fish extinction?
   Ans:

5. What is the impact of tourist on Fish biodiversity?
   Ans:

6. What is your recommendations to protect biodiversity?
   Ans:

SL	Local Name	Scientific Name	Status*(Very Low/ Low/ Moderate/ Abundant/ Highly Abundant)
01			
02			
03			
04			
05			
06			
07			
08			
09			
10			
11			

* Very low = 1 to 20 individual can be found in a year.
  Low = 21 to 100 individual can be found in a year.
  Moderate = 101 to 300 individual can be found in a year.
  Abundant = 301 to 500 individual can be found in a year.
  Highly abundant = More than 500 individual can be found in a year.

Appendix 2

Table 2: Shannon Diversity Index

Sl	Species name	No. of Individuals (s)	Total number (N)	s/N = Pi	lnPi	Pi lnPi
1	*Taeniura lymma*	10	4802	0.002082	-6.1742	-0.01286
2	*Gymnothorax favagineus*	23	4802	0.00479	-5.34129	-0.02558
3	*Myripristis vittata*	46	4802	0.009579	-4.64815	-0.04453
4	*Sargocentron rubrum*	52	4802	0.010829	-4.52554	-0.04901
5	*Cephalopholis boenak*	112	4802	0.023324	-3.75829	-0.08766
6	*Epinephelus hexagonatus*	82	4802	0.017076	-4.07007	-0.0695
7	*Epinephelus polyphekadion*	76	4802	0.015827	-4.14605	-0.06562
8	*Cephalopholis formosa*	47	4802	0.009788	-4.62664	-0.04528
9	*Terapon jarbua*	234	4802	0.04873	-3.02147	-0.14724
10	*Terapon theraps*	243	4802	0.050604	-2.98373	-0.15099
11	*Apogon maculatus*	16	4802	0.003332	-5.7042	-0.01901
12	*Apogon pillionatus*	48	4802	0.009996	-4.60559	-0.04604
13	*Malacanthus latovittatus*	56	4802	0.011662	-4.45144	-0.05191
14	*Lutjanus fulviflamma*	97	4802	0.0202	-3.90208	-0.07882
15	*Lutjanus malabaricus*	118	4802	0.024573	-3.7061	-0.09107
16	*Lutjanus johnii*	42	4802	0.008746	-4.73912	-0.04145
17	*Lutjanus lutjanus*	9	4802	0.001874	-6.27956	-0.01177
18	*Caesio xanthonota*	7	4802	0.001458	-6.53088	-0.00952
19	*Scolopsis vosmeri*	25	4802	0.005206	-5.25791	-0.02737
20	*Scolopsis bimaculatus*	3	4802	0.000625	-7.37818	-0.00461
21	*Plectorhinchus orientalis*	93	4802	0.019367	-3.94419	-0.07639
22	*Plectorhinchus cinctus*	16	4802	0.003332	-5.7042	-0.01901
23	*Lethrinus nebulosus*	30	4802	0.006247	-5.07559	-0.03171

24	*Lethrinus erythracanthus*	32	4802	0.006664	-5.01105	-0.03339
25	*Upeneus sulphureus*	63	4802	0.01312	-4.33365	-0.05686
26	*Parupeneus forsskali*	124	4802	0.025823	-3.65651	-0.09442
27	*Kyphosus cinerascens*	28	4802	0.005831	-5.14458	-0.03
28	*Kuphosus vaigiensis*	24	4802	0.004998	-5.29873	-0.02648
29	*Platax teira*	162	4802	0.033736	-3.38919	-0.11434
30	*Chaetodon collar*	186	4802	0.038734	-3.25104	-0.12593
31	*Chaetodon decussatus*	152	4802	0.031653	-3.45291	-0.1093
32	*Chaetodon octofasciatus*	159	4802	0.033111	-3.40788	-0.11284
33	*Heniochus acuminatus*	173	4802	0.036027	-3.3235	-0.11973
34	*Heniochus singularius*	157	4802	0.032695	-3.42054	-0.11183
35	*Pomacanthus annularis*	198	4802	0.041233	-3.18852	-0.13147
36	*Abudefduf bengalensis*	78	4802	0.016243	-4.12008	-0.06692
37	*Abudefduf sordidus*	27	4802	0.005623	-5.18095	-0.02913
38	*Abudefduf sexfasciatus*	137	4802	0.02853	-3.55681	-0.10147
39	*Neopomacentrus azysron*	22	4802	0.004581	-5.38575	-0.02467
40	*Chrysiptera unimaculata*	18	4802	0.003748	-5.58642	-0.02094
41	*Pomacentrus caeruleus*	38	4802	0.007913	-4.8392	-0.03829
42	*Pomacentrus coelestis*	45	4802	0.009371	-4.67013	-0.04376
43	*Pomacentrus vaiuli*	97	4802	0.0202	-3.90208	-0.07882
44	*Stegastes fasciolatus*	56	4802	0.011662	-4.45144	-0.05191
45	*Cirrhitichthys bleekeri*	35	4802	0.007289	-4.92144	-0.03587
46	*Coris gaimard*	16	4802	0.003332	-5.7042	-0.01901
47	*Halichoeres Claudia*	19	4802	0.003957	-5.53235	-0.02189
48	*Halichoeres wrasses*	136	4802	0.028322	-3.56413	-0.10094

49	*Labroides dimidiatus*	84	4802	0.017493	-4.04597	-0.07078
50	*Thalassoma lunare*	23	4802	0.00479	-5.34129	-0.02558
51	*Bodianus dictynna*	12	4802	0.002499	-5.99188	-0.01497
52	*Bodianus scrofa*	10	4802	0.002082	-6.1742	-0.01286
53	*Cheilinus sp lunulatus*	87	4802	0.018117	-4.01088	-0.07267
54	*Bolbometopon muricatum*	92	4802	0.019159	-3.955	-0.07577
55	*Scarus psittacus*	18	4802	0.003748	-5.58642	-0.02094
56	*Helcogramma* sp.	202	4802	0.042066	-3.16852	-0.13329
57	*Cirripectes castaneus*	95	4802	0.019783	-3.92291	-0.07761
58	*Ecsenius bicolor*	16	4802	0.003332	-5.7042	-0.01901
59	*Salarias fasciatus*	12	4802	0.002499	-5.99188	-0.01497
60	*Cryptocentrus cinctus*	44	4802	0.009163	-4.6926	-0.043
61	*Amblyeleotris steinitzi*	94	4802	0.019575	-3.93349	-0.077
62	*Acanthurus xanthopteru*	89	4802	0.018534	-3.98815	-0.07392
63	*Acanthurus lineatuss*	53	4802	0.011037	-4.5065	-0.04974
64	*Hippocampus kuda*	2	4802	0.000416	-7.78364	-0.00324
65	*Siganus stellatus*	45	4802	0.009371	-4.67013	-0.04376
66	Siganus javus	35	4802	0.007289	-4.92144	-0.03587
67	*Diodon hystrix*	49	4802	0.010204	-4.58497	-0.04679
68	*Priacanthus hamrur*	35	4802	0.007289	-4.92144	-0.03587
69	*Pterois volitans*	38	4802	0.007913	-4.8392	-0.03829
∑s=		4802			∑Pi ln Pi =	-3.89308

Shannon Index H = - ∑Pi ln Pi = 3.89308

H is the diversity index, Pi is the relative abundance (s/N), s is the number of individual for each species, and N is total number of individuals.

BRIEF BIOGRAPHY OF THE AUTHOR

The author Md. Maksudur Rahman; son of Md. Abu Taher and Ismoth Jahan from Mirsarai thana under Chattogram district of Bangladesh. He pursued the Secondary School Certificate Examination in 2012 from Dhaka Collegiate School, Dhaka and Higher Secondary Certificate Examination in 2014 from University Laboratory College, Dhaka. He obtained his B.Sc. in Fisheries (Hons.) Degree in 2018 from Faculty of Fisheries, Chattogram Veterinary and Animal Sciences University (CVASU), Chattogram, Bangladesh. Now, he is a candidate for the degree of M.Sc. in Marine Bioresource Science under the Department of Marine Bioresource Science, Faculty of Fisheries, Chattogram Veterinary and Animal Sciences University, Chattogram, Bangladesh.