ANNUAL REPORT

2018-19

Bangladesh Fisheries Research Institute
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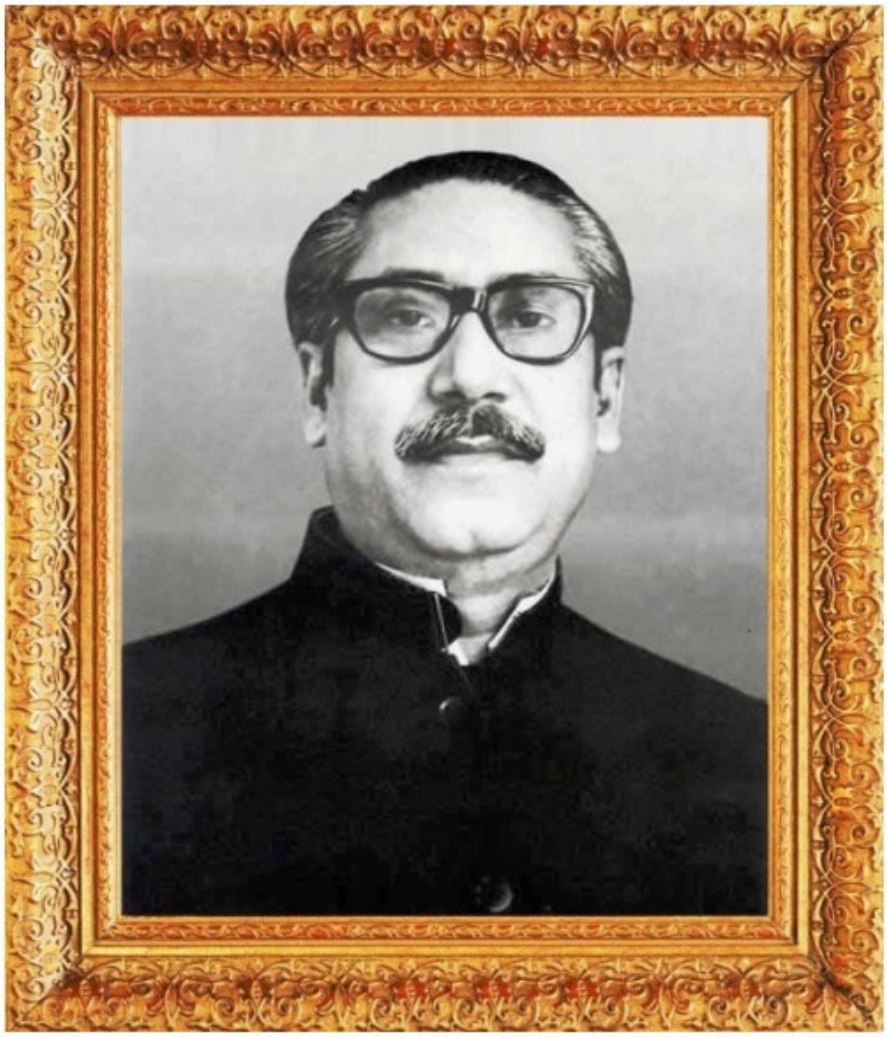

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BFRI Annual Progress Report 14

Annual Report
2018-19

Editorial Board

Published by
Director General
Bangladesh Fisheries Research Institute
Mymensing

Annual Report 2018-19. Bangladesh Fisheries Research Institute, Mymensingh. 2201. **120 p.**

Foreword

Fisheries sector plays an important role in the economy and livelihood of Bangladesh in terms of nutrition, employment and export earnings. Since inception, Bangladesh Fisheries Research Institute (BFRI) has been implementing research programmes reflecting the national developmental needs and policy. BFRI has so far innovated 57 improved aquaculture and management technologies through demand driven research. A good number of such technologies have been disseminated in the field in various degrees. During 1992-2017, fish production has increased by more than three folds from 1.2 million mt to 4.10 million mt due to dissemination of the developed technologies. As a consequence, Bangladesh attained 4th position in the globe in freshwater aquaculture production.

One of the important mandates of BFRI is to carry out and co-ordinate fisheries research in the country. The goal of the research is to develop improved aquaculture and management technologies for sustainable development of the fisheries sector. The Institute prioritizes annual research programmes incorporating suggestions and recommendations of different stakeholders like farmers, entrepreneurs, academicians & policy makers.

The research programmes and the activities implemented by the Institute during 2018-2019 for development of the sector have been presented in this report. A total of 51 research projects were implemented in different stations and sub-stations of the Institute during the reporting period. The BFRI scientists succeeded in developing technology of seed production and culture of endangered fish species, tengra (*Mystus vittatus*) in its Freshwater Sub-station at Saidpur. Other activities included here are technology innovation, training, publication, finance etc. of the Institute.

The main outputs of BFRI in terms of technology generation for increasing fish production and policy guidelines formulation for fisheries development of the country forwarded in line with the Govt. 7th Five Year Plan and Sustaionable Development Goals (SDG). While aquaculture has been progressing very well due to development of various technologies, some of the new and emerging issues have cropped up in the process, which need to be seriously dealt with to maintain the current growth of the aquaculture industry. Besides, new intervention in marine sector is a thurst area of research to be undertaken on priority basis.

We hope this report will be useful to researchers and planners of different national and international organizations for the formulation of project proposal and policy guidelines for fisheries development.

Dr. Yahia Mahmud
Director General

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Bangladesh Fisheries Research Institute: An Overview

The fish and fisheries are integral part of the culture and heritage of Bangladesh. The sector plays a significant role in nutrition, employment generation and foreign exchange earnings. Keeping in view of the immense potentials of the sector in providing better nutrition and job opportunities, particularly to the poorest of the poor, and the urgency for optimum scientific utilization of the aquatic heritage, the President of the People's Republic of Bangladesh was pleased to promulgate an Ordinance entitled "The Fisheries Research Institute Ordinance 1984" on 11 July 1984. In pursuance of this Ordinance, the Fisheries Research Institute (FRI) was established in July 1984. In 1997, the FRI has been renamed as Bangladesh Fisheries Research Institute (BFRI) through the amendment of the 1984 Ordinance.

Though the Institute was established in 1984, it actually started functioning in 1986 with the recruitment of required manpower and creation of initial research facilities. Since then, the institute has been playing a key role in assisting the nation to achieve the goal of fisheries development as set out in successive development plans.

Vision of the Institute

Development of need based technology leading to increasing fisheries production of the country.

Mission of the Institute

To conduct research for the development of need based technology on aquaculture and fisheries resource management of the country.

Mandate of the Institute

- ✓ To carry out basic and adaptive research for development and optimum utilization of all living aquatic resources and coordinate fisheries research activities in Bangladesh;
- ✓ To conduct experiment and standardize techniques for maximizing productions and better management of living aquatic resources;
- ✓ To identify new production opportunities and develop them to usable levels;
- ✓ To develop skilled research manpower through training;
- ✓ To transfer developed technologies to users through training of extension workers, planners, fish farmers and other stakeholders;
- ✓ To advise the Government in all matters relating to research and management of living aquatic resources.

Management of the Institute

The Institute (BFRI) is an autonomous research organization and linked up administratively with the Ministry of Fisheries and Livestock, Government of the Peoples' Republic of Bangladesh. The general direction, administration and supervision of the affairs of the institute is vested in the Board of Governors consisting as follows:

Board of Governors

Chairman	: Hon'ble Minister, Ministry of Fisheries and Livestock
Vice-chairman	: Secretary, Ministry of Fisheries and Livestock
Members	: Executive Chairman, Bangladesh Agricultural Research Council
	: Vice-chancellor, Bangladesh Agricultural University, Mymensingh
	: Member (Agriculture), Planning Commission
	: Director General, Department of Fisheries
	: Two Members of the Parliament to be appointed by the Govt.
	: Two persons to be appointed by the Govt. among the persons having interest in fisheries development
	: Two persons to be appointed by the Govt. engaged in research in BFRI
Member-Secretary	: Director General, BFRI

Board of Governors may exercise all powers and doing all acts and things that may be performed or done by the Institute. The Board may appoint such committees, as it may consider necessary to assist it in the performance of its functions. As the Chief Executive of the Institute, the Director General takes appropriate steps in implementing its programs in the light of the policies and directives formulated by the Board of Governors.

BFRI Organogram

The Headquarters of the Institute is located at Mymensingh. The Institute has five research stations and five sub-stations based on different aquatic ecosystems. The organogram of the institute is shown in next page.

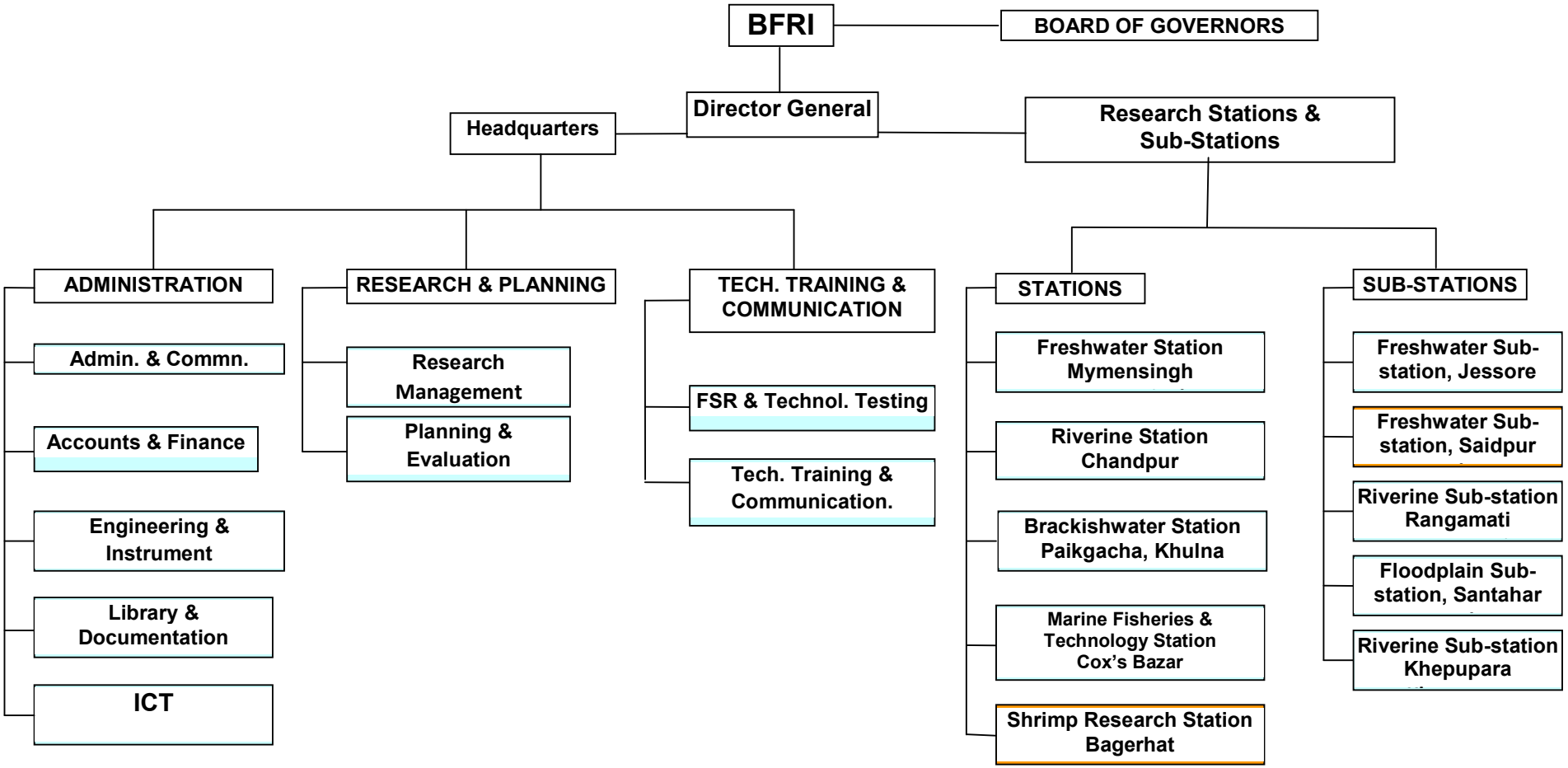
Stations and Sub-stations

Headquarters, Mymensingh

The Headquarters of the Institute is located at the south-west corner of the Bangladesh Agricultural University, Mymensingh, which is about 120 km north of the capital city, Dhaka. The Headquarter functions through its various divisions in respect of administrative development, coordination and operation of its research programs. The divisions are:

- Research Management
- Planning & Evaluation
- Technology Testing, Training & Communication
- Administration & Common Service
- Engineering & Instrument
- Library, Documentation & Public Relations
- ICT and
- Accounts & Finance

ORGANOGRAME
Bangladesh Fisheries Research Institute
Mymensingh 2201



Freshwater Station (FS), Mymensingh

The largest station of the Institute, with an area of 40 ha is located at Mymensingh attaching to the BFRI Headquarters. The station has well established and sophisticated carp and prawn hatcheries. The station has as many as 118 drainable ponds consisting of 20 mini ponds; 52 nursery ponds (0.1 ha each), 47 rearing ponds (0.25 ha each) and 16 grow-out/brood stock ponds (1.6-2.6 ha each). Other physical facilities include a feed store, office buildings, residential quarters, a 35 bed constructed dormitory, a community center and a 5-bed guesthouse. The station is actively involved in conducting research on hatchery management, fish genetics and reproduction, carp polyculture, integrated fish farming, fish feed and nutrition, pearl culture, fish disease, health management and socio-economic aspects. The various research activities of the station are implemented by the following divisions:

- Reproductive Physiology & Genetics,
- Aquaculture & Farming System,
- Nutrition, Food & Feed Technology,
- Fish Disease Diagnosis & Health Management;
- Soil, Water & Productivity Management;
- Fisheries Socio-economics.

Three sub-stations are attached to the Freshwater station. These are:

Floodplain Sub-Station, Santahar: To support the floodplain fisheries development program taken up by the Government, studies on the ecology, limnology and gear selectivity of floodplains are being undertaken at the Santahar Sub-station.

Freshwater Sub-Station, Jessore: To support freshwater aquaculture farmers and hatchery operators of greater Jessore region, the Freshwater Sub-Station has been conducting research on breeding and culture of BFRI super Tilapia, carp disease diagnostic services and also farming system research and development.

Freshwater Sub-Station, Saidpur: To support the fisheries development program in northern region of Bangladesh, a freshwater sub-station is established in Saidpur Upzilla under Nilphamari. The prime objective of the sub-station is to conduct need based research to suit with the ecosystem of northern Bangladesh and to transfer technology to the farmers through effective training and demonstration.

Riverine Station (RS), Chandpur

The station is situated in the riverine port city of Chandpur, with an area of 17.2 ha and has 36 non-drainable ponds ranging in size from 0.12 to 0.37 ha each and with a total of 8.6 ha. water area. In addition, the station has one carp, one catfish and one prawn hatchery, two deep tube-wells, specialized laboratories, library, office buildings, residential quarters and a 8-bed guest house. One research vessel, one mechanized wooden boat equipped with research facilities, and three speed boats are available for undertaking riverine survey and studies relating research and management to hilsa and other riverine fisheries resources. The Riverine Station consists of 6 research divisions, which are as follows:

- Stock Assessment & Resource Dynamics;
- Fisheries Resource Management & Conservation;
- Culture-based Fisheries Management;
- Reproductive Biology of Riverine Species;
- Environment & Aquatic Pollution.

Two Sub-Stations are attached with the Riverine Station, and these are:

Riverine Sub-Station, Rangamati: To devise sustainable management and development strategies for the Kaptai lake fishery, Riverine Sub-Station (RSS) undertakes various adaptive research programs. Priorities are given on continuous monitoring of biological productivity, stock assessment, natural spawning, and population dynamics of various commercially important fishes and major carps, in particular. Recently, RSS has been introducing pen and cage aquaculture programs in the creeks and lagoons of Kaptai lake to culture fingerlings of major carp and thus to support artificial stocking of the lakes by Bangladesh Fisheries Development Corporation (BFDC), Kaptai lake project. Extension works are being carried out through adaptation of pen and cage aquaculture, installation of pens and cages in the creeks/coves in Kaptai lake on participatory basis.

Riverine Sub-Station, Khepupara, Patuakhali: The fish landing and wholesale center of BFDC at Khepupara Upazilla has been handed over to BFRI to develop as a Sub-Station and carry out research mainly on hilsa fishery. The old infrastructure has now been renovated by BFRI. Due to manpower, funds and logistic constraints, research is being conducted on hilsa in a limited scale. In addition to this, technical advice to the fish farmers are being provided and improved fish seeds are distributed to the local farmers time to time.

Brackishwater Station (BS), Paikgacha, Khulna

The station was established in 1987 with a view to undertake research and development activities on various aspects of coastal aquaculture and fisheries management. The station is located at Paikgacha Upazilla under Khulna and has an area of 30.56 ha. The station has got 53 drainable experimental bracksihwater ponds of different sizes ranging from 0.05 to 1.0 ha, an experimental hatchery for the production of prawn and commercially important brackishwater fin-fish seeds and a number of laboratories. The station has 5 research divisions, such as:

- Nutrition & Feed Technology;
- Disease Diagnostic & Health Management;
- Brackishwater Aquaculture;
- Estuarine Ecology & Environment;
- Soil, Water & Productivity Management.

This station is involved in conducting research on increasing productivity of coastal *ghers*, environment friendly shrimp culture development, crab seed production and fattening, seed production and culture of commercial finfishes, diseases management, aquatic environment monitoring etc. The research work undertaken so far by this station includes socio-economic studies on shrimp farming, survey and assessment of shrimp fry resources and its breeding ground, production potential of *gher* fishery (with improved management practices), polyculture of shrimp and mullet, culture and fattening of mud crab *(Scylla* spp.), breeding and nursing of *Macrobrachium rosenbergii*, improved method of shrimp farming etc.

Marine Fisheries & Technology Station (MFTS), Cox's Bazar

This station, with an area of 4 ha, was established at Cox's Bazar in 1991. The station is being equipped with five specialized laboratories, and one outdoor complex with 39 cisterns (200 m^2 each), a two-storied office building including laboratory, eight residential buildings for officers and staff accommodation, one seminar room, one library, one service building and a 8-bed guest house. The laboratories of the station are:

- Water quality;
- Fish technology;
- Biology;
- Marine museum;
- Live Feed Lab.

The mandate of the station includes research on marine fish and shrimp seed production, marine ecology, environmental studies, production systems for marine shrimp, fin-fish and shell-fish, stock assessment and population dynamics of commercially important species, oceanographic studies, diseases diagnosis and control, development of processing and preservation technologies, socio-economic studies of marine and coastal fishers and quality control of marine products.

Shrimp Research Station (SRS), Bagerhat

The station was established on 2010 at Sadar Upazilla under Bagerhat with an area of 8.0 ha. The mandate of the station is to conduct research on enhancing shrimp production, shrimp health management, shrimp feed & nutrition, post harvest handling & quality control of shrimp and shrimp products. The station consist of a 2-storied Office-cum-Laboratory building, 3-storied Staff dormitory, and 4-storied Training dormitory of the station. Moreover, a pond complex composing 9 experimental ponds of different sizes are being used for experimental purposes. The laboratories of the station are:

- Shrimp Health Management;
- Quality Control;
- Shrimp Feed & Nutrition;
- Water & Soil Quality Management.

Manpower

The manpower status of the Institute is highlighted in the following table:

Head	Approved posts			Filled up posts		Vacant posts	
	Officer	Staff	Total	Officer	Staff	Officer	Staff
Revenue	162	295	457	116	228	46	67
Development	27	30	57	22	26	05	04

During 2018-2019 period, 1 staff was appointed.

Development of Technologies

Regular research activities of the institute lead to generate various aquaculture and management technologies for better management of the resources and increase the fish production. Till 2017-18, the Institute has evolved more than 61 aquaculture, biotechnological and fisheries management technologies. Among them, 2 package technologies have been developed during 2017-18 and these are as follows :

- ✓ Breeding and seed production of mud crab (*Scylla sereta*)

Technology transfer: Subsequent to development of technologies or management practices, the generated research results were transferred through various mechanisms. Different government agencies including Dept. of Fisheries, NGOs, farmers and entrepreneurs were offered training on research-evolved technologies. After successful maturation of technologies, printing materials like manuals, booklets, leaflets, posters etc. were published and distributed among the users.

On-Farm trials: Field trials of the on-station research findings were conducted for adaptation of technologies in on-farm conditions through government and non-government extension agencies, private entrepreneurs and NGOs.

Farmer's Advisory Services: The Institute through its different Stations and Sub-Stations provided advisory services to the farmers on improved fish farming technologies, water quality monitoring, feed quality, diseases control etc. Scientists of the institute also provided service on national crises related to fisheries and environmental issues as and when deemed necessary.

Annual Performance Agreement (APA) Implementation

Under four strategic objectives and nine functions in Annual Performance Agreement (APA), BFRI achieved 100% in all activities. BFRI headquarters signed APA with its five station for the year in 2018-19 FY on July 2018 and accordingly signed agreement with MoFL on 11 June 2018.

SDG Implementation

To achieve sustainable development goals (SDG), Institute is being conducting research accordingly. Action plan has been set up for the Institute to achieve SDG targets. Five development projects are being implementing by the institute are: Strengthening of Hilsa research, Development and dissemination of pearl culture technology, Conservation, propagation and culture of mussels and snail in Bangladesh and Marine fisheries research strengthening and infrastructural development.

Future plan of the institute includes genetically improved variety development for fish disease combat adverse effects of climate changes, integrated sea fish farming, breeding and fry production of commercial sea fish etc

Development Projects Implemented during 2018-19

Project Title	Cost (In Lakh Taka)	Project Period	Objectives of the Project
Development and Dissemination of Pearl Culture Technology	1845.00	July 2012-June 2019	• To carry out research for development of sustainable pearl culture technology • To conduct research for propagation of pearly mussels through development of breeding technology • To provide training to the fishermen, rural women and entrepreneurs to disseminate pearl culture technology.
Culture of *Cuchia* (Mud Eel) and Crab in the Selected Areas of Bangladesh and Research Project (Component-B, BFRI Part)	1386.35	July 2015-June 2018	• To assess existing population and stock of mud crab for the conservation and management of natural stock and to conduct survey on the existing status of *cuchia.* • To develop breeding, seed production and culture technology of mud crab and *cuchia*. • To optimize the developed technologies on mud crab fattening and *cuchia* production through demonstration in the farmers' field.

			• To provide technology based training on mud crab and *cuchia* seed production and culture to the GO and NGO extension workers, farmers and entrepreneurs. • To establish a laboratory cum hatchery buildings for BS, MFTS and strengthening of the existing laboratory facilities for BS, FS, FSS and MFTS. • To strengthen some necessary infrastructures of FS, Mymensingh BS, Paikgacha, MFTS, Cox's Bazar and FSS, Santahar.
Strengthening of Hilsa Research in Riverine Station, Chandpur	3353.90	January 2017-June 2021	• To establish office cum hilsa laboratory building and other infrastructures for strengthening hilsa research in the Riverine Station. • To carry out demand driven research for development of appropriate technologies for increasing production and conservation of hilsa fisheries resources. • To provide technology based training to different stakeholders on production and conservation of hilsa fisheries.
সামুদ্রিক মৎস্য গবেষণা জোরদারকরণ ও অবকাঠামো উন্নয়ন	৪৯৩০.৭২	জুলাই ২০১৭-জুন ২০২১	• বাংলাদেশে সামুদ্রিক মৎস্য গবেষণার সক্ষমতা জোরদারকরণ। • বাংলাদেশে বঙ্গোপসাগরের মৎস্য সম্পদের ব্যবস্থাপনা কৌশল উদ্ভাবন। • বাণিজ্যিকভাবে গুরুত্বপূর্ণ সামুদ্রিক মৎস্য প্রজাতির প্রজনন ও চাষ প্রযুক্তি উদ্ভাবন। • বাংলাদেশে সামুদ্রিক মৎস্য সম্পদের সঠিক ব্যবহারের লক্ষ্যে আহরণোত্তর পরিচর্যা কৌশল উদ্ভাবন।
বাংলাদেশে ঝিনুক ও শামুক সংরক্ষণ, পোনা উৎপাদন এবং চাষ প্রকল্প	১১৩০.০০	জুলাই ২০১৭-জুন ২০২১	• বাংলাদেশে ঝিনুক ও শামুকের পপুলেশন ডিনাইমক্স এর উপর বেইজ-লাইন তৈরীকরণ। • অর্থনৈতিকভাবে গুরুত্বপূর্ণ ঝিনুক ও শামুকের পোনা উৎপাদন ও চাষ প্রযুক্তির উন্নয়ন। • ঝিনুক ও শামুকের প্রাকৃতিক মজুদ সংরক্ষণ। • ঝিনুক ও শামুক প্রাণিকূলের সংরক্ষণের জন্য সচেতনতা তৈরী এবং সরকারী বেসরকারী সম্প্রসারণ কর্মকর্তা, চাষী ও উদ্যোক্তাদের ঝিনুক ও শামুকের পোনা উৎপাদন ও চাষ বিষয়ে হাতে কলমে শিক্ষা প্রদান।

Training Programs

Training on different aspects of fisheries is utmost important for boosting -up of fish production and to ensure better management of aquatic resources. A series of well structured training programs are organized by the Institute every year to disseminate the research evolved technologies to the end users. Moreover, effective transfer and dissemination of the technologies and management procedures such as training of extension workers both of Government and NGOs, teachers, students and Journalists are also organized by Institute. The training programs organized on different aspects are as follows:

- Improved fish culture and management
- Production & culture of GIFT and Monosex Tilapia
- Fish disease and health management
- Seed production and culture techniques of endangered fish species
- Pearl culture techniques in freshwater ponds
- Shrimp nursery, culture and management
- Crab fattening techniques
- Pen and cage culture techniques
- Fisheries and aquaculture research management
- Mud eel culture technique

The Institute also conducts training on research methodology, financial management, office management, e-filing, e-GP and other research oriented programs for researchers of the Institute to shine up their capability.

Training Programs conducted: For boosting-up fish production and to ensure better utilization of aquatic resources, BFRI organizes series of training programs every year for farmers, entrepreneurs, unemployed youth, rural women and university students, extension workers both of Government and NGOs, teachers, journalists and LGED fisheries facilitators. The main objective of offering such type of need and opportunity based training is to transfer and disseminate technologies among various stakeholders and end users. During July 2017-18 a total of 92 training batches were completed and 1,500 nos. of people were trained up by the Institute.

Institutional Manpower Development: For strengthening the capabilities of scientists, administrative and management personnel, the Institute organizes different in-country and overseas short-term and long-term training programs, study tour and experience-sharing visits. During 2017-2018, a total of 30 scientist achieved overseas short-term and long-term training in 12 programs, Besides, 10 different in-country training programs have been organized for the scientists and officers. A number of 8 scientists have been awarded with abroad higher studies mostly PhD and 7 scientists have been awarded with in-country PhD studies.

Workshop/Seminar organized: The Institute organized 8 numbers of National workshops and seminars in different disciplines to identify the problems and sharing and exchanging knowledge generated through research in this year. The Institute and its Stations and Sub Stations organize Regional and National workshops every year to review the research projects and to present the research progress of the Institute.

Public Relation & Publications

Public Relations (PR) division of BFRI provides information among different stakeholder of fisheries sector and so on. PR divn. also give information as well as latest research success to the Press. During 2018-19 a total of 71 news and report have been published in different print and electronic media including the daily Ittefaq, the daily Prothom Alo, the daily Jugantor, the daily Kaler Kantho, the daily Star, The daily Financial Express, the daily Bangladesh Pratidin & so on. Besides, some well circulated agri news magazines also publish BFRI news for example: Monthly Krishi Surakkha, Krishi Projukti, Monthly Khamar etc. In addition, BTV, ATN Bangla, Ekushey TV, Jamuna TV, Channel i, Channel 24 also broadcast BFRI news.

The Institute publishes research findings, annual reports, newsletters, journals, workshop proceedings, training manuals, extension materials in the form of booklets, leaflets and posters. The publications are available at the Library and Documentation Center as well as at different regional stations and sub-stations of the Institute. The following publications were published during the reporting period:

কুচিয়া মাছের পোনা উৎপাদন কৌশল চাষ ও খাদ্য ব্যবস্থাপনা (সম্প্রসারণ পুস্তিকা নং-৪৪)
নরম খোলসের কাঁকড়া উন্নত চাষ কৌশল (সম্প্রসারণ প্রচার পত্র নং-৬০)
উপকূলীয় অঞ্চলে ঘের/পুকুর ও খাঁচায় যুগপৎ কাঁকড়ার (*Scylla* sp) ফ্যাটেনিং (সম্প্রসারণ প্রচার পত্র নং-৬১)
গিফট তেলাপিয়ার সাথে মাগুর ও গুলশা মাছের মিশ্র চাষ (সম্প্রসারণ প্রচার পত্র নং-৬২)
খাঁচায় মাগুর মাছের চাষাবাদ কৌশল (সম্প্রসারণ প্রচার পত্র নং-৬৩)
কুচিয়া মাছের পুষ্টি চাহিদা এবং খাদ্য ব্যবস্থাপনা (সম্প্রসারণ প্রচার পত্র নং-৬৪)
হ্যাচারিতে শীলা কাঁকড়ার প্রজনন লার্ভি প্রতিপালন ও পোনা উৎপাদন কৌশল (সম্প্রসারণ প্রচার পত্র নং-৬৫)
কাঁকড়ার সুষম খাদ্য তৈরীতে অ্যাট্রাকটেন্টস এর ব্যবহার (সম্প্রসারণ প্রচার পত্র নং-৬৬)
প্রযুক্তি নির্দেশিকা ২০১৭ : বিপন্ন প্রজাতির মাছের প্রজনন ও চাষ কৌশল (মৎস্য সপ্তাহ প্রকাশনা- ৯)
At a glance :Bangladesh Fisheries Research Institute
তথ্য অবমুক্তকরণ নির্দেশিকা-২০১৭
Bangladesh Journal of Fisheries Research. Vol. 17(2018), 2018
Fisheries Newsletter. Vol. 17(1-4), 2017; 18(1), 2018

Institute gives special value to publication and documentation of aquaculture and management technologies for their wider adoption. For this reason, extension manuals, leaflets, posters, handouts etc. were well circulated to govt. and non-govt. extension agencies, farmers, entrepreneurs etc.

Library and Documentation

Bangladesh Fisheries Research Institute Library and Documentation Centre (FRILDOC) act as a repository of literature and technical information and provides latest information on scientific research and experimental development in all branches of fish and fisheries. The most of the FRILDOC collection backup on the subjects: aquaculture, brackish water aquaculture, mari culture, marine science, biology,

ecology, environmental science, agriculture, life sciences, sea weeds, plankton, food processing, feeds, zoology, botany, geography, economics, marketing, geology, socioeconomics, rural development etc.

The Library has 7,888 technical and general books 183 titles of scientific periodicals 2,819 miscellaneous publications. In addition to above collection, the library has kinds of reference books, academic dissertations, government and others departmental publications.

The FRILDOC is operating in fully automated environment. The various activities of the centre have been computerized using Library Management Information System (LMIS) software.
The FRILDOC provides the following documentation services:

- Document Delivery Service
- Current Awareness Service
  i) Current Content Service
  ii) Monthly Accession list
  iii) Monthly News paper Articles
- Reference service
- Bibliographical service
- Abstracting service
- SDI (Selective Dissemination Information) Service
- Internet Service
- Photocopy Service
- ASFA (Aquatic Sciences and Fisheries Abstract) DVD Service
- TEEAL (The Essential Electronic Agricultural Library) Service
- Digital Library Service (BFRI in Aquatic Commons digital repository(http://aquaticcommons.org/view/issuing_agency/Bangladesh_Fisheries_Research_Institute.html).

During the reporting period of July 2018 to June 2019, a number of books, journals, periodicals etc. procured for the library. The library has also received a noticeable number of books journals, periodicals, proceedings, research reports, annual report, newsletters and magazines on complimentary and exchange basis. The library maintained exchange programme with more than 75 leading national and International organizations. The category wise list are shown below:

Items	2018-2019
Books	250
Journals	12
Reports/Proceeding of seminars and workshops/papers	16
Newsletters/Bulletins/Reprints/Off prints	79
ASFA (Aquatic Sciences and Fisheries Abstract) DVD	up to 2017
TEEAL (The Essential Electronic Agricultural Library)	up to 2013

During the reporting period about 120 scientists and research support personnel of the institute used the library. Moreover, about 190 users from outside BFRI consulted FRILDOC. The library maintained free mailing of institutional publications to various research organizations, Universities, NGOs, entrepreneurs and farmers to keep the aware with the latest development in fisheries research.

Working Linkage

The overall research, training and management activities of the institute were carried out in close cooperation and linkages with various national and international organizations/agencies. The institute also maintained close contact with public extension organizations, different NGOs working in the country, for dissemination of technologies and obtaining feed-back from them. BFRI collaborated with national universities and maintained close liaison for fisheries research and development (R & D). Among the

national collaborators, definitely the main focus implies to the Department of Fisheries (DOF) followed by NARS Institutions and joint research and development programs with different NOGs.

Infrastructure Development

Engineering section of BFRI is directly involved in repair, renovation & constructing of various structure under the development and revenue budget. During financial year 2018-19 the section has repair the residential building, cistern complex at Freshwater Station, Mymensingh. The major works under Engineering Division are highlighted below:

Head Quarters/ Station/ Sub-Stations	Name of work	Remarks
Rivering Station, Chandpur.	Construction work of A-type building	Funded by Development Budget form Hillsa Research Project
Rivering Station, Chandpur.	Construction work of Dormitory building.	Funded by Development Budget form Hillsa Research Project

Finance and Accounts

The sources of funds of the institute comprise grants from the government, and grants from different donor agencies. Government grant from the revenue budget is usually provided to meet only salaries and allowances of staff small protein of operational costs. The cost of development, maintenance and research is also borne by the government from its development budget provided in the form of development project. The budget provided from its revenue head is quite insufficient to meet the recurring expenditures and research as well. Again, processing and flow of fund through development project is not continuous.

Receipts and expenditure: The institute received an amount of Tk. 3027.00 lakh during the year 2018-19 from the government revenue budget and the expenditure incurred was Tk. 2854.00 lakh.

Income: During reporting period, the institute earned Tk. 24.00 lakh from the sale of by-products obtained from various ongoing research projects. These include sale of spawn, fish, short tender schedules, conveyances and other miscellaneous items.

Research Progress 2018-19

Studies on the Human Health Benefit of Fish Peptides Producedfrom Low Valued Marine fish species of Bangladesh

Researchers: Dr. Md. Kamal, Professor, Dept. of Fish. Technology, BAU, Mymensingh

The development of fish protein hydrolysates (FPH) and peptides as functional food ingredients is a relatively recent technology gaining popularity due to array of potential bioactive properties associated with them, including antioxidant, antihypertensive, immunomodulatory, nueroactive, antimicrobial, and mineral or hormone regulating properties.Proteins are made from a chain of amino acids. When broken down in smaller units of several amino acids they are named peptides.In Bangladesh, proteins from marine artisanal low valued fishes might be potential sources of raw materials for producing peptides that might be also be used to develop valuable products and nutraceuticals. First of all it is important to identify the suitable low cost species those are available round the year.

Objectives

- Identification of suitable low cost marine fish species for production of fish peptides;
- Production of fish peptides from suitable species;
- Test of the products against various health activities in lowering blood pressure, diabetes and body fitness.
- Train up of marginal processors, particularly women on production technology;
- Organize the national and multinational pharmaceutical companies in production of fish peptides.

Achievements

Nutritional composition of fish peptides

Chemical composition of fish peptides were analysed according to the standard methods. Moisture, protein, lipid and ash content were 1.3%, 95%, 3.2% and 1.7%, respectively. Sodium content was 112 mg/100g of peptides.

Trials of fish peptides: 10 (Ten) people participated in testing peptides for one or more problems. 9 (nine) tablets (3g protein) was prescribed for each person day. Different aspects (blood pressure and sugar level) were checked every seven days interval. It was taken care of not drop out of any people during the study period. They were asked about their feelings of health benefit/ any changes in health, willingness in taking peptide tablets through phone call The study conducted for three months. Category of target group are: (i) high blood pressure; (ii) diabetes (sugar level); (iii) body muscle pain; (iv) weakness; (v) suffering from sound sleep; (vi) stool problem and (vii) gastric problem. The mechanism of product testing is given below in the Fig. 1

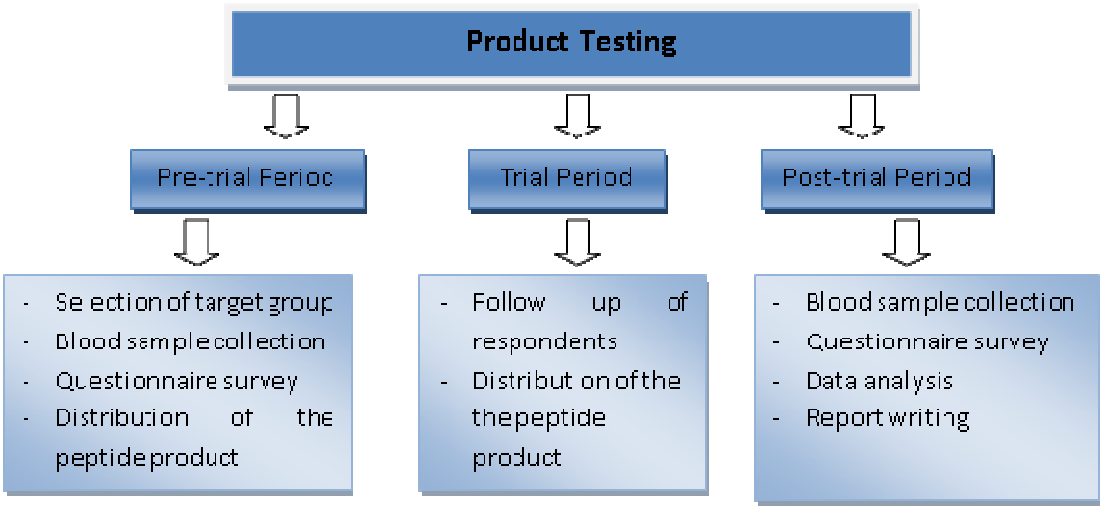
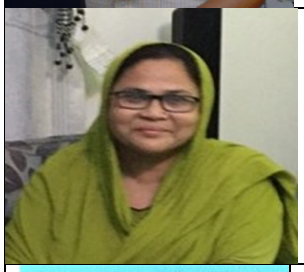
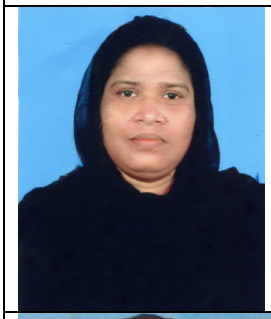
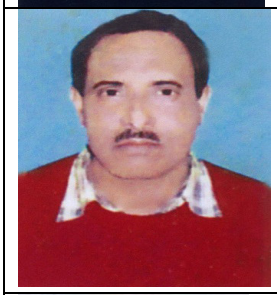


Fig. 1. Product testing procedure

Picture	Name with ID No.	Address	Problems facing
	Dr. Md. Kamal Age:68Y Weight:100kg NID.NO..6125221270592 Profession:Teaching	Dept. of Fisheries Technology, BAU, Mymensingh	High Blood pressure, Pain in joint, feeling weakness & tiredness.
	Nazma Begum Age:58Y Weight:83kg NID.NO.6125221270430. Profession: Housewife	Wife of Dr. Md. Kamal, Presently living in Teknaf Cox,s Bazar	Pain in the joint of right arm, high pressure and diabetics
	MD. Bazrul Rahman khan Age:58Y Weight:53kg NID.NO.6115223359316 Profession: Service	Village:Moddho barera, P.O:Chor barera Mymenshingh Sadar Mymensingh.	Pain in the leg, feeling tiredness &weakness, sleeping problem

	Momtaz Begume Age:53Y Weight:45kg NID.NO.6115223359309 Profession: Housewife	Village:Moddho barera, P.O:Chor barera Mymenshingh Sadar Mymensingh	High blood pressure , pain in the body, weakness & feeling tiredness during work.
	Saleha Begume Age:50Y Weight:55kg NID.NO.2394055970 . Profession: Housewife	Village:Dokkhin chorer bari P.O:Barishal,8200 Barishal sador, Barishal	High blood pressure, diabetes, gastric problem, sleeping problem.
	Morsheda Begume Age:40Y Weight:55kg NID.NO.4218454459694 Profession: Housewife	Village;Porbo fulhar, P.O:Rola-8510 Rajapur,Jhalokati	High blood pressure, diabetes, gastric problem ,feeling weakness.
	Abdur Rahman Mollik Age:55Y Weight:69kg NID.NO.4194022333 Profession: Service holder	Basa/Holding: Aonni vila, Village: B.I.P sorok, chorer bari P.O: Barishal -8200 Barishal Sadar,Barishal.	High blood pressure, constipation, gastric, sound sleeping problem and feeling weakness also.
	Khairun Nessa Housewife Age: 65 year Weight: 54 kg 1954798526317459	.North Khal, Bank road, Post- Khulna-9100 Sonadangha Khulna city corporation, Khulna	High Blood pressure, Pain in joint, feeling weakness & tiredness

	Rabeya Begum 2219079556339 Housewife 70 years Weight 46 kag	Kangor Para Teknaf Cox's Bazar	feeling pain whole body joint, fleeling weakness .
	Kazi Masud Ahmed: Age:50Y Weight:73kg NID.NO.3294038322 Profession: Service holder	Basa/holding:0566 Village:Dokkhin chorer bari P.O:Barishal,8200 Barishal	He has high blood pressure, Diabetes Gastric problem, feeling tiredness & weakness during walking & working.

Blood pressure: A total of seven people who were suffering from high blood pressure took 9 peptide tablets daily. All the blood pressure patients were taking medicine for reducing blood pressure before taking peptides. Initial blood pressure range among the respondents was in the range of 152/90mm/Hg to 178/108mm/Hg. After taking peptides, their blood pressure started to decline within 2 weeks. After 90 days of taking peptides, blood pressure of the most of the patients were reduced to normal range of 120/80mm/Hg. Among the users, Mrs. Nazma Begum and Momtaz Begum are controlling blood pressure using peptide tablets without taking any blood pressure medicine.

Diabetics (blood sugar): Ten people participated in testing peptides for one or more problems. Among them, some people were also suffering from diabetics (blood sugar) for a long time and most of them were taking medicine for reducing diabetics. After taking insulin and medicine, diabetics were also not controlled among some patients. For an example, Mrs. Nazma Begum, her sugar level was 16 mmol/L in random sampling after taking insulin and medicine. After taking peptides along with insulin and medicine, the sugar level reduced to 9 mmol/L in 90 days. Dr. Md. Kamal who was also experiencing diabetic's problem but not taking any medicine. After taking peptides his sugar level reduced from 8.6mmol/L to 5.8 mmol/L in 90 days. Blood sugar levels in all other patients were also reduced considerably in 90 days after taking peptides.

Other effects: As mentioned before, the functional properties of peptides were tested among the people for one or more problems. Among the users, most of them were elderly people of above 60 years of age. They were also suffering from some sorts of pain somewhere in different parts of the body and feeling weakness. All the users reported that after taking peptides even within a week time, body pains started to reduce, whereas, in 90 days of taking peptides, body pains reduced considerable. They all were feeling very good and they also getting strength in walking and doing works. The other effects of taking peptides reported by the users were good and sound sleep, good digestion and relief from gastric and constipation problem. All the peptide tablet users are asking for continued supplying of more peptides.

Stock improvement and dissemination of commercially important Tilapia and climbing perch Koi through genetic selection

Researchers: Dr. A. H. M. Kohinoor, Senior Scientific Officer
Md. Moshiur Rahman, Scientific Officer

Objectives

- To improve the stock of BFRI-GIFT strain using family selection protocol
- To improve the stock of Vietnamese Koi through brood stock replacement technique
- To produce the cross bred Koi through breeding of native and Vietnamese koi *(A. testudineus)*

Achievements

Family selection program of BFRI-GIFT using family selection protocol

Stocking of Breeder in Hapa: On the basis of breeding values of F-10 generation, the best 50 males have been crossed with 50 females. The range of breeding values of selected males and females were 92.79 to 117.20 and 76.49 to 129.90. The body weight along with tag number of selected males and females are shown in table 1. After that, pair of selected female and male breeder (1:1) was stocked in each breeding hapa in 22, July 2017.

Table 1. Body weight of male and female of selected breeders

Male ID	Wt	EBV	Rank		Female ID	Wt	EBV	Rank
A4B4	325	93.84	1		A641	250	104.7	1
A564	305	91.67	2		416E	290	111.2	2
A3B8	324	93.73	3		3A68	252	95.09	3
A4F3	322	93.51	4		3BCB	262	96.17	4
6720	320	105.4	5		A30F	239	91.38	5
B7A2	348	108.1	6		42BF	214	86.12	6
B250	384	103.12	7		E944	236	88.5	7
996A	330	96.68	9		18D3	302	129.9	9
05A0	358	109.3	10		A48A	282	96.04	10
3FF9	340	107.3	11		B835	262	91.32	11
D809	320	105.1	12		B5F7	219	86.66	12
D348	385	112.2	13		3F57	232	94.08	13
C5D5	365	99.1	14		29DC	214	92.13	14
99D1	347	114.6	15		A18D	300	126.2	15
386B	342	118.8	16		2F1C	235	89.39	16
CFE9	352	119.9	17		9A71	240	96.62	17
33A8	378	122.7	18		18D2	240	98.34	18
31A8	370	101.21	19		2C61	298	112.4	19
8352	304	98.41	20		A5F1	220	89.32	20
BBCO	309	98.95	21		61F5	244	98.03	21
6EE8	392	116.7	22		B071	302	104.3	22
7A63	357	112.9	23		573E	220	83.12	23
4B6B	380	115.4	24		389E	285	114.9	24
22A0	310	90.66	25		464E	209	76.49	25
37A3	320	91.74	26		547E	225	82.72	26

2A47	352	95.21	27		417F	290	110.8	27
F135	362	105.7	28		2A78	255	104.2	28
2F1C	375	107.1	29		3BC8	232	101.8	29
310A	370	117.2	30		98F8	244	98.77	30

Male ID	Wt	EBV	Rank		Female ID	Wt	EBV	Rank
8CB4	302	98.42	31		DD1B	203	72.41	31
2AA5	340	97.14	32		3DC9	284	119.4	32
32ED	302	94.8	33		22D1	266	106.2	33
463C	322	96.97	34		DF6E	208	87.97	34
4577	360	101.1	35		5057	266	94.26	35
16FB	350	114.5	36		A424	290	120.5	36
B20A	350	113.5	37		0CA7	252	104.6	37
47D9	372	102.4	38		A642	284	108.4	38
4223	372	99.48	39		A654	255	105.2	39
30BE	320	93.85	40		3832	206	76.16	40
2E4D	375	99.8	41		40DB	232	92.08	41
DC8C	342	96.23	43		A372	242	103.8	43
5872	320	95.66	44		2B16	232	92.81	44
47D0	340	97.83	45		407C	240	102.6	45
4429	322	95.88	46		32D9	294	99.53	46
3C9D	300	86.11	47		A3D9	233	90.73	47
3265	325	98.97	48		9890	270	117.9	48
23F6	305	96.8	49		8035	302	116.6	49
E6EE	362	95.03	50		B6AO	285	114.7	50
5F1A	340	96.04	51		6A71	284	98.44	51
4C41	310	92.79	52		6361	254	104.1	52

Nursing in hapa: After 30 days of stocking i.e. 22 August 2017, tiny fry from each progeny group were shifted to a series of nursery hapas in a pond. The progeny were fed with nursery feed containing 30% protein at the rate of 20% of estimated body weight. The progeny of each family were again transferred to secondary nursery hapas after one months of primary nursing (23 September, 2017). Each progeny group, 150 fry were transferred to 50 rearing hapas (2.0 m^3 size). Supplementary feed (Nursery feed) are being applied in all the hapas at the rate of 15% of estimated biomass.

Tagging and communal rearing: In the second week of November 2017, each progeny group 10 male and 10 female fish were selected and tagged them by using Passive Integrated Transponder (PIT). Tagged fishes were stocked in a pond (1000m^2) for communal rearing. During tagging, tag number, body weight and total length were recorded. Supplementary feed (Floating feed) containing 28% crude protein are being applied 6 days in a week for the tagged fishes at the rate of 8% of estimated body weight.

Harvesting of tagged fish: After five months of rearing, all fishes were recaptured by seine netting followed by dry out the pond. Total bulk weight, individual weight and number of fish from each treatment were recorded.

Data analysis for estimating ebv: All recorded data were analyzed for estimating breeding values. On the basis of breeding value, breeding line will be produced for the production of F-12 generation.

Evaluation of F- 11 Generation with founder population of GIFT strain in pond ecology

For evaluating the growth performances of upgraded GIFT (T-1) and founder population of GIFT (T-2), an experiment were conducted during July to October 2017 in a pond having an area of 1000m^2.

Stocking of fingerling: After pond preparation with lime (250 kg/ha) and inorganic fertilizer (37.50 kg/ha), in each treatment 500 fry were stocked for rearing for four months. The initial mean weight of upgraded BFRI-GIFT (F-11) and fry of non selected GIFT strain are 2.15±0.49 and 2.22±0.51g, respectively. Fry of non selected GIFT strain were marked through cauterization of pelvic fin.

Post stocking management: Fry were fed with supplementary feed (Floating feed) containing 28% crude protein. Supplementary feed were applied six days in a week at the rate of 8% of estimated biomass at twice daily. Pond was limed at the rate of 125 kg ha $^{-1}$ at monthly interval during the culture period.

Fish sampling : Fish were sampled at fortnightly intervals through seine netting and weighing 50 fish in each treatment to measure the growth, assess the health status and feed adjustment.

Harvesting and data analysis: All fishes were recaptured after harvesting of four months rearing. Total bulk weight, individual weight and number of fish from each treatment were recorded. Month wise sampling data showed that growth rate of the selected GIFT was always higher than the non selected GIFT. After four months rearing, the mean weight of treatmnet-1 and treatment-2 were 206±5.21 and 130±7.88g, respectively. Data analysis was done through statistical programme (SAAS). Preliminary analysis showed that the upgraded fish had 58.46% greater harvest weight than that of the non selected GIFT strain (Fig.1).

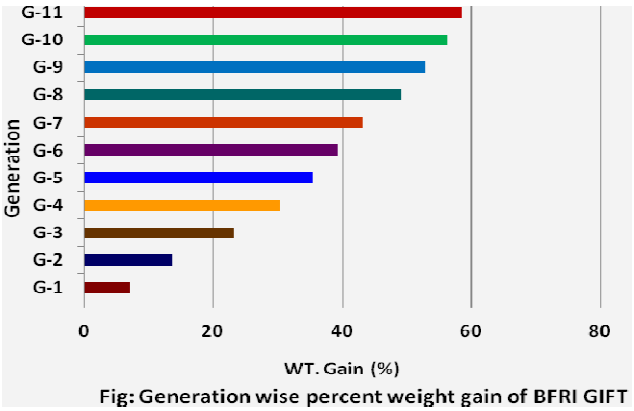


Fig: Generation wise percent weight gain of BFRI GIFT

Validation trial of GIFT tilapia with Shing (H. fossilis) & Magur (C. batrachus) in semi-intensive culture management

Validation trial of GIFT with Magur (*C. batrachus*) and Shing (*H. fossilis*) was carried out for five months during February to June 2018 in six farmers pond at Dohakhola, under Gouripur upazila, Mymensingh. Three stocking densities of Magur and Shing were tested keeping the monosex GIFT Tilapia stocking density similar. Each stocking density of Magur and Shing was considered as treatment and replicated thrice. Fingerlings of Magur and Shing were stocked at the rate of 25000 & 50000; 17500 & 57500 and 10000 & 65000 in treatments-I, II and III, respectively. In all the treatments mono sex GIFT tilapia were stocked at the rate of 50,000/ha. The same regime of pelleted feed (28% crude

protein) was applied in all the treatments. The results showed that monosex GIFT tilapia reached an average weight of 238±13.21g in T-1, 242 ±11.4g in T-2 and 250 ±9.76g in T-3, respectively (Table 1). The average final weights of magur were 137 ±8.72g, 157±9.17 and 167±9.62g in treatment-1, treatment-2 and treatment-3, respectively. The poor harvesting weight was observed in treatment-1 where as, comparatively higher harvesting mean weight was observed in treatment-3. However, the harvesting weight of Shing of treatment-1, treatment-2 and treatment-3 was 42.0 ±3.11, 37.0 ±3.29 and 31.0 ±3.09g, respectively. After five months rearing, the production obtained were 14952, 14235 and 13977 kg/ha from treatment-1, treatment-2 and treatment-3, respectively. The highest production was obtained from treatment-1, where monosex were stocked with Magur and Shing at the stocking density 25000 & 50000/ha. The lowest production was obtained in treatment-3 where magur and Shing were stocked at 10000 & 65000/ha. The production level of treatment-1 showed significant difference ($p > 0.05$) with treatment- 2 and 3. The contribution of Magur and Shing in total production was 25.98% in treatment-1, while in T-2 and T-3 were 24.36 and 18.62%, respectively.

Table 2. Harvesting weight and production of fish under different treatments

Treat	Fish sp.	Stock. den./dec	Harvesting wt. (g)	Survival (%)	Sp. wise Prod./dec.	Production (Kg/ha)
T-1	GIFT	200	238±13.21	93	44.27	14952[a]
	Magur	100	137±8.72	68	9.32	
	Shing	200	42±3.11	74	6.22	
T-2	GIFT	200	242±11.40	89	43.07	14235[b]
	Magur	70	157±9.17	72	7.91	
	Shing	230	37.0±3.29	70	5.96	
T-3	GIFT	200	250±9.76	91	45.50	13977[b]
	Magur	40	167±9.62	75	5.01	
	Shing	260	31.0±309	67	5.40	

*Figures in the same row having the same superscripts are not significantly different ($p > 0.05$)

Stock improvement of Vietnamese koi (A. testudineus) through brood stock replacement techniques (F_2)

Stock improvements of Vietnamese Koi (*A. testudineus*) through Brood Stock Replacement techniques, the following methodologies are being followed for the production of F-2 generation:

Stocking of selected fry: Vietnamese Koi spawn were nursed in four nursery ponds during May to June 2017. After nursing, 500 selected fry from each nursery pond were stocked in two prepared rearing pond during August 2017. The initial mean weight Thai Koi was 4.61±0.72g. As such 2000 fry of Thai Koi are being reared in four nursery ponds.

Post stocking management: The fry of Koi are being fed with supplementary feed (containing 30% protein) at 8-10% of estimated body weight. Lime and table salt are being applied in all the rearing ponds at the rate of 50 and 125 kg/ha, respectively. Freshwater from deep tube well are being supplied to the ponds at three days interval to maintain average water depth upto 1.0 meter. The fish are being sampled at fortnightly interval to adjust the feeding rate. The sampling weights of Koi in rearing ponds are shown in Table 2. After four months of rearing, the sampling weight of fish in Ponds-1, 2, 3 and 4 are 104±4.72, 99±4.55, 111±5.20 and 106±5.71, respectively.

Table 2. Sampling weight of Vietnamese Koi in different rearing ponds

Month	Sampling Weight (g)			
	Pond-1	Pond-2	Pond-3	Pond-4

September	36±1.95	31±2.1	26±2.62	37±2.10
October	54±2.1	60±2.3	58±2.3	61±2.55
November	68±3.60	77±3.84	85±4.20	88±3.92
December	104±4.72	99±4.55	111±5.20	106±5.71
January	106±6.14	103±5.47	103±6.10	108±5.92
February	108±5.49	105±6.11	106±6.77	109±6.21
March	112±6.10	109±6.74	110±5.79	113±6.78

For the production of F-2 generation, the following protocols were followed during breeding season (April-May 2018):

- Fourty breeding hapas (size 2 x 2 x 1 m) were required for this purpose.
- The fishes mated in 5 pair cross in a single hapa to ensure equal numbers of male and female fish.
- These activities were completed in four batch breeding.
- After breeding, about 20 gm of hatchlings from each hapa was mixed together and reared in a single nursery pond for 4 weeks.
- As such four nursery ponds were maintained where each nursery pond contained 200g larvae (from 10 hapas out of a total of 40 hapas).
- After nursing, 500-600 fry randomly selected from each batch (each nursery pond) and put into the brood stock replacement pond in which 200 pairs of fish contribute fingerlings in this desired stock.

For evaluating the growth performance of non selected group of Vietnamese Koi and improved F-2 generation of Vietnamese Koi, an experiment was conducted for a period of three months. The fry of Koi were stocked in May 2018 at the stocking density of 75,000/ha at on-station, Mymensingh. Treatment-I was designed with F-2 generation of Vietnamese Koi, while treatment-II with non selected group of Vietnamese Koi. After stocking, the fry were fed 30% crude protein enriched feed at the rate of 5-15% of estimated body weight. The harvesting means weight of T-1 and T-2 were 72±5.81 and 66±6.12g, respectively and results were statistically significant ($P > 0.05$).

Production of cross bred Koi through cross breeding native and Vietnamese koi (A. testudineus)

Cross bred Koi were produced through induced breeding between native Koi and Vietnamese Koi. For the production of cross bred Koi, native Koi and Vietnamese koi were reared in two separate ponds up to maturation. During breeding season (April-May), three groups of fry were produced through induced breeding of following crosses which are as follows:

Group I: Female native Koi (♀) × Male Vietnamese Koi (♂)
Group II: Male native Koi (♂) × Female native Koi (♀)
Group III: Male Vietnamese Koi (♂) × Female Vietnamese Koi (♀)

During trial period, observation was made on ova diameter, fertilization and hatching. At day 3 after hatching, when yolk sac was completely absorbed in all the groups, then larvae transferred to nursery ponds for nursing.

Overall mean values of ova diameter, fertilization rate, hatching rate and survival rate of cross bred, native and Vietnamese Koi is presented in table 1. During the observation period, the ova diameter of Treatment-1, 2, 3 and 4 were 0.40±0.06, 0.35±0.06, 0.35±0.04 and 0.40±0.05 mm. The highest ova diameter was observed in Treatment-1 and 3, while the smallest diameter was observed in

Treatment-1 and 4. Mean diameter of ova in Treatment-1 and 4 was observed same size. On the other hand, similar size of ova diameter was found in Treatment-2 and 3.

Table 3. Mean values of ova diameter, fertilization, hatching and survival rate of different treatments

Treatments	Ova diameter (mm)	Fertilization (%)	Hatching (%)	Wt. of fry (mg)	Survival (%)
T-1	0.40±0.05	70 ±6.00^{b}	58 ±5.37^{c}	390±25^{b}	55± 6
T-2	0.40±0.07	72±5.88^{b}	62±5.63^{b}	150±32^{c}	48±9
T-3	0.38±0.04	84±7.25^{a}	75±4.90a	470±30^{a}	62±7

*Figures in the same row having the same superscripts are not significantly different (P>0.05)

During observation period maximum fertilization rate was observed in T- 3 (82-88%) while T-1 and 2 showed comparatively less fertilization rate. The mean fertilization rates were found 70±6, 72±5.88 and 84±7.25 in Treatment- 1, 2 and 3, respectively. The result of ANOVA indicated that different Treatments significantly (P<0.05) effected on fertilization rate. According to ANOVA results the Treatment-3 fertilization rate was found significantly (P<0.05) different from other Treatments.

Among the Treatments remarkable variation was not recorded in hatching rate of eggs. In observation period maximum hatching rate 75% was observed in Treatment 3 and minimum 58% in Treatment-1. While mean hatching rates were achieved 58±5.37, 62±5.63 and 75±4.90% in Treatment 1, 2 and 3, respectively. Hatching rate of Treatment- 3 showed significant difference (P<0.05) than those of other Treatments.

Mean survival rate were 55, 48 and 62% with mean final weight 390±25, 150±32 and 470±30mg in Treatment-1, 2 and 3, respectively. Among the treatments, highest final weight was attained by treatment-3 which was significantly higher (P<0.05) than those of other treatments. Growth of cross bred was intermediate between that of Vietnamese Koi and native Koi stocks.

Genetic improvement of BFRI Rohu (*Labeo rohita*) through selective breeding techniques

Researcher: Dr. Selina Yeasmine

Objectives

- To continue genetic stock improvement of BFRI Rohu (*Labeo rohita*) through selection
- To compare the growth performance of BFRI F*4* Rohu generation with non-selected group
- To distribute of improved germplasms of Rohu to the fish farmer/hatchery owners

Achievements

Communal grow-out trials of BFRI F_3 improved rohu

Following protocols were maintained for the production of F_4 generation of Rohu (*Labeo rohita*). BFRI F_3 improved stock of Rohu (*L. rohita*) are used as the experimental fish. A 30 advanced fingerlings to a total of 900 of F_3 Rohu (*L. rohita*) from each of the selected 30 families were stocked in communal grow out experimental pond for communal rearing. Before stocking the pond were filled up with water from a deep tubewell. Ura and TSP were applied @ of 100 and 50 g/dec. Then, the pond was left for 7 days for the production of plankton. Then, 900 fingerlings of F_3 Rohu (*L. rohita*) were stocked. Fish were fed with locally available commercial feed containing about 35% protein @ of 3-5% body weight daily. Thus, an average of 900 fish (#30 from 30 families) were reared communally in rearing pond to raise as brood fishes following all scientific management measures. In the F_3 generation, evaluation of growth and other performances were carried out through communal rearing. So, during communal rearing, the fish were sampled for growth and sex along with configuration, color, maturity-age etc. and the number of the fish.

After communal rearing, the growth performances of F_3 Rohu (*L rohita*) generation were recorded for conducting the breeding program on the basis of mass selection using best selected individuals to proceed further stock improvement. The results of the present study on growth performances in terms of mean length and mean weight gain of F_3 Rohu (*L rohita*) are 45.44 ± 5.43(cm) and 2259.74 ± 52.42(g) respectively (table 1). From the result of growth performances and other characteristics such as body color, size, maturity, age, appearance it was observed that the fishes were ready for selective breeding. So, the breeding program was conducted for selective breeding on mass selection using best selected individuals to produce next generation of Rohu (*L. rohita*).in the month of May-July in this year (2018).

Table 1. Growth performance of BFRI F_3 improved generation of Rohu (*L. rohita*).in communal grow out pond

Parameters	Initial status	Present status
Length (cm)	16.74 ± 1.71	45.44 ± 5.43
Weight (g)	54.02 ± 15.20	2259.74 ± 52.42

Selection breeding protocol: One of the main objectives in a selection breeding program is to maximize the genetic gain per generation of selection. Sixty families of improved F_4 progeny group were produced from F_3 generation of Rohu (*L. rohita*) in the month of May-July in 2018 through a series of pair mating between selected pair of female and male fish according to the plan and design.

The selection .breeding program was performed in FS hatchery complex. The matured males and females were selected on the basis of their morphological criteria i.e, size, colour and weight attainment of the F_3 generation.. The female broods were average 45 cm in total length and 2120 g in weight while the males are average 45 cm and 2150 g. After selection the fishes were kept in cistern in the FS hatchery complex for conditioning. Therefore, considering mass selection, the F_4 improved generation of Rohu, (*L. rohita*) was produced in the breeding season through a series of pair mating between selected pair of female and male brood fish (1:1) of the F_3 generation. A total of 60 families of F_4 progeny groups were produced in the breeding trial. Equal volume of fertilized eggs of about 200 g from each pair of fish were incubated in hapas which ware set up before in the hatchery and maintained as a separate family groups. Thus a total of 60 families of F_4 progeny family groups were incubated, hatched and nursed separately in 60 hapas in the hatchery.

Primary nursing in hapa: After 5 days of nursing in hapa in the cistern the F_4 progeny families were transferred in another hapas separately that were set up in a pond for primary nursing. An approximately 1500 spawn from each family were transferred to a primary nursery units of hapas in the

pond for 8 weeks. Now the F_4 progeny families are being nursed separately with nursery feed containing 30% protein @ 15-20% body weight. After two months primary nursing the individual progeny families will be transferred in another hapas for secondary nursing system in a pond.

Secondary nursing in hapa: After primary nursing the individual progeny families will be transferred in another hapas for secondary nursing system in a pond. During secondary nursing the number of fry will be 200 from each progeny families to secondary nursery units in hapas (2.5 m3 size). They will be reared with supplementary feed (nursery feed) @ 10-15% body weight in all hapas for two months. During the nursing period the growth performances of all progenies families will be recorded, compared and evaluated.

After secondary nursing the produced fry of F_4 generation of Rohu (*Labeo rohita*) will be stocked in grow-out pond for rearing to carry out further genetic improvement of BFRI Rohu (*L rohita)* through selection breeding technique.

Development of induced breeding and culture techniques for Mekong giant catfish, *Pangasianodon gigas*

Researchers: Dr. Md. Khalilur Rahman, CSO
Dr. Jubaida Nasreen Akhter, PSO
Rubia Akter, SSO
Rumana Yeasmin, SO

Objectives

- To develop induced breeding technique for *Pangasianodon gigas*
- To develop rearing technique for *Pangasianodon gigas*

Development of induced breeding technique of Mekong giant catfish, Pangasianodon gigas

Management of pond environment: Two ponds having area of 40 and 150 dec, respectively were prepared for rearing of *P,gigas*. The pond having 40 dec area has been prepared by repairing dykes and increasing depth by removing bottom clay. The pond was disinfected by applying stone lime at the rate of 1kg/dec. The pond was filled up with water from a deep tube well. Water level was maintained at 1.8 to 2.0 m. Arrangement was made by clipping tree branches for adequate sunlight on the pond. Abundance of benthic fauna i.e. chironnmids, annelids, snail and mussels was low in the bottom soil in comparison to the larger pond.

Other pond having an area of 150 dec was netted to remove previously stocked major carps and other fishes. Floating and spreading weeds were removed. The pond was prepared by applying stone lime at the rate of 1kg/dec. Water from a deep tube well was supplied to maintain adequate depth of 2.5 to 3.0 m. Abundance of benthic fauna i.e. chironomids, annelids, snail and mussels is high in the bottom soil in comparison to the smaller pond.

Stocking and feeding management in pond: A total 10 of fish was stocked and reared in the pond having an area of 40 decimal. The other pond having an area of 150 decimal was harboring 40 fishes. Stocked fishes were fed with home-made feed containing about 28% protein at the rate of 1-3% body

weight twice daily (Table-1). Locally and commercially available feed ingredients were used to formulate the feed. Feeding rate was 2-3% body weight in summer and 1% in winter.

Table 1. Ingredients, % composition, protein% of non-pelleted Home-made feed for *P. gigas*

Feed Ingredients	% composition	Protein (%)
FM	20	12.30
MOC	15	6.36
RB	35	3.36
WB	10	2.96
MP	20	2.52
Total	100	28.00
Vitamin Premix	1g/10 kg	
Tamarind (Tetul)	200g/10 kg	
Rate:	1-3 BWD	
Frequency:	2 times	

Water management in experimental pond: Water shower was provided daily in each pond for 2-3 hours. Moreover, fresh water from a deep tube well was provided once a week to maintain required water depth. Colour of water of the experimental ponds was light greenish having no scum and off odour. The water quality parameters (Table-2) are suitable for culturing *Pangasianodon gigas*.

Table 2. Water Quality parameters of the experimental pond

Parameter	Pond area 40 acre	Pond area 150 acre
Temperature (^{0}c)	27.70±2.72	27.81±2.71
Transparency (cm)	22.87±2.90	23.31±3.44
pH range	7.80±0.52	7.70±0.40
Dissolved oxygen (mg/L)	5.60±0.61	5.90±0.56
Total alkalinity (mg/L)	135±12.15	132±13.05
Ammonia-nitrogen (mg/L)	0.00	0.00

Maturity assessment: Stocked fishes were checked to assess the maturity from March 2018 and on word. In March weight of two individual fish was taken during sampling. One female having size of 96 kg and 1.78 m while the other was male having size of 72 kg and 1.68 m, respectively were weighted. It was tremendously difficult to take weight of such huge live fishes. Moreover, there is a change of getting severe injury by both of fishermen and fishes. That is why weight of only two fishes was taken. For assessing gonadal development, female fishes were checked by examining their secondary sexual character like shape, size and colour of genital opening, softness and bulginess of the belly. In case of male, generally milt come out with gentle pressure on the abdomen. In 22 June 2018, no promising male and female were found during sampling (Table-3).

Table 3. Assessing gonadal maturity of *Pangasianodon gigas* (22 June 2018)

SL	Sex	Length (m)	Weight (kg)	Physical Condition	Maturity Assessment
1	Female	1.74	94	Active, Strong & Moving	Oval reddish genital opening with hard belly
2	Female	1.75	95	Active, Strong & Moving	Oval reddish genital opening with hard belly
3	Female	1.78	96	Active, Strong & Moving	Oval reddish genital opening with hard belly
4	Male	1.62	75	Active, Strong & Moving	Distinguish reddish genital papilla, no milt was observed
5	Male	1.60	64	Active, Strong & Moving	Distinguish reddish genital papilla, no milt was observed
6	Female	1.70	84	Active, Strong & Moving	Oval reddish genital opening with hard belly
7	Female	1.74	90	Active, Strong & Moving	Oval reddish genital opening with hard belly
8	Female	1.76	95	Active, Strong & Moving	Oval reddish genital opening with hard belly
9	Female	1.74	88	Active, Strong & Moving	Oval reddish genital opening with hard belly
10	Male	1.68	72	Active, Strong & Moving	Distinguish reddish genital papilla, no milt was observed

Induced breeding experiment by HCG and cPGE: Age and size of fish are important factors for getting success in induced breeding. Age of this fish was 13 years and size ranges from 75 to 90 kg. Available literature indicated that *P. gigas* breeds between 12 and 15 years with corresponding weight of 90 to 120 kg. With this view in mind, a trial on induced breeding of *P. gigas* was conducted on 03 August 2018. Both the ponds were netted at 07:00 hours and 03 gravid females and 02 males were selected primarily. Selected fishes were housed in two net hapas in the pond having a dimension of 8 m x 4 m. Water shower was provided by a submersible pump. At 09:00 hours on 4 August 2018, primarily selected fishes were checked for induced breeding trial. The female, having comparatively soft and bulging belly was selected as brood while the male counterpart was identified by observing elongated protrude genital papilla. Human Corionic Gonadotropin (HCG) was applied at the rate of 200, 500 and 300 IU at preparatory, 2nd and final dose to female spawners. Female spawners also got Carp Pituitary Gland Extract (cPGE) at the rate of 7 and 8 mg/kg BWt during 2nd and final injection of HCG. The male spawners received 200 IU HCG and 7 mg/kg BWt of PG at preparatory and 2nd dose. Preparatory dose was administered at 09:00 hours on 04/08/2018. After 07 hours interval 2nd dose was applied at 16:00 hours while the final dose was applied at 23:00 hours after 8 hours of 2nd injection. The male received two doses while the female received three injections (Table 4).

Table 4. Details of induced breeding trials on *P. gigas* on 04 August 2018

Item	Criteria
Examination	Gonadal development Secondary sexual characters
Male ♂	01 Wt: 80 kg Double Dose: HCG 200 IU and PG 7 mg/kg BWt
	01 Wt: 80 kg Double Dose: HCG 200 IU and PG 7 mg/kg BWt
Female ♀	01 Wt: 80 kg, Triple dose: HCG: 200, 500 and 300 IU & PG: 7 and 8 mg/kg BWt
	01 Wt: 80 kg, Triple dose: HCG: 200, 500 and 300 IU & PG: 7 and 8 mg/kg BWt
	01 Wt: 80 kg, Triple dose: HCG: 200, 500 and 300 IU & PG: 7 and 8 mg/kg BWt
Interval	7 & 8 hours

At 09:00 hours on the following day (05 August 2018), the injected fish was checked for stripping. However, no sign of ovulation was observed although the belly became more soft and bulging than the uninjected conditions. In case of male no milt was found when gentle pressure was applied on the abdomen. Then the fishes were treated with $KMnO_4$ to prevent secondary infection on body skin, lip of mouth and fins. Finally, the injected fishes were released in the pond.

Mass seed production and conservation of endangered important fish species in Bangladesh

Researchers: Md. Moshiur Rahman, SSO
Parvez Chowdhury, SO

Objectives

- To develop fry rearing technique of Foli, *Notopterus notopterus*
- To optimize the hormone doses of Shal Baim, *Mastacebelus armatus* for mass seed production
- To know the production performance of Sharputi, *Systomus sarana* at different stocking densities at on farm condition.

Fry rearing technique of Foli, Notopterus notopterus using different feed ingredients

The newly hatched larvae of *Notopterus notopterus* were cultured in pond nursery conditions for 30 days where suitable physico-chemical characteristics of freshwater were provided for their smooth survival besides supply of qualitative feed. The stocking density of the larvae was maintained at the rate of rate of $100/m^2$ in all treatments. Under this ratio the stock was maintained in the studied experimental condition. Under the suitable physico-chemical characteristics of freshwater in experimental conditions the water level was maintained at 1meter during rearing period. Periodical water exchange was done. Some arrangement has also been made in order to maintain feeble water current in the experimented pond for enhancing growth and survival rate of the larvae. Specific quantity of freshwater weeds such as *Hydrilla* was introduced in the experimental water for providing a suitable shelter to the larvae. During study period it was observed that the larvae during food shortage conditions develop fast swimming activity followed by some unusual behavior such as violent attitude towards other larvae and subsequently development of cannibalistic habit. Three treatment groups were fed with three different feeds viz.T_1 (Poultry eggs and zooplankton), T_2 (live fish spawn and zooplankton), and T_3 (only zooplankton).

During the experiment, the larvae were found to be very active almost in all food conditions provided in the experiment. However, the larvae fed live mass cultured zooplankton along with live fish spawn showing relatively greater survival and growth rate which achieve relatively higher length and weight in comparison to the other types of feed (Table 1). Therefore, it was observed that for enhancing survival potential of the studied larvae efficient quality as well as sufficient quantity of feed is prerequisite. So, the present experimental studies showing that due to providing better quality of feed substance cannibalism as well as mass mortality can be prevented in various stages of life cycle such as spawn, fry and fingerling conditions. Hence, significantly greater survival rate in their life cycle stages is achieved only when mass cultured zooplankton with live fish spawn is supplied in form of efficient feed type.

Table 1. Length-weight data of the larvae of the studied fish species of *N. notopterus*

Biological parameters	T1 (Poultry eggs and zooplankton)	T2 (live fish spawn and zooplankton)	T3 (only zooplankton)
Initial length (cm)	0.82±0.07	1.06±0.03	1.35±0.05
Initial weight (g)	0.63±0.09	0.68±0.05	0.66±0.08
Final length (cm)	4.50±0.06	5.36±0.18	4.95±0.10
Final weight (g)	2.99±0.40	3.44±0.36	3.04±0.32

Table 2. Water quality features in larval experiment of *N. notopterus.*

Parameter	Range
Water temperature (°C)	24-29.5
pH	6.8-8.6
Dissolve Oxygen (mg/l)	5.62-7.46
Total ammonia (mg/l)	0.00-0.02
PO_4-P (ppm)	0.064 – 0.098 ppm
NO_3-N (ppm)	0.013 - 0.046 ppm

Development of induce breeding technique of Shal Baim, Mastacembelus armatus

Mature *Mastacembelus armatus*, (average 250-320g weight) were collected from natural habitat during March, 2018 to optimize seed production technique of this fish. Brood fishes of both sexes were stocked in ponds. Ponds were provided with all facilities including continuous water supply through porous plastic pipes for aeration. The fishes were fed with pellet feed and trash fish (3-5% body wt). As the fish has hiding tendency, pieces of PVC pipe were used as shelter in pond. Water quality parameters (DO, pH, temperature and Total ammonia etc) of the ponds were monitored at fortnightly intervals. The values of temperature, dissolved oxygen; pH and total ammonia were 20.5– 29.61°C, 5.62-7.58 mg/l, 7.6-8.90 and 0.0-0.03 mg/l, respectively. A regular exchange of underground water was facilitated to attain sexual maturity. Breeding trials were carried out during June–July. Corresponding data representing the effects of PG doses on ovulation rate, fertilization rate, hatching rate and survival rate are shown in Table 3. Fish did not show any response in 1st two doses but in the 3rd dose precipitated ovulation and successful striping of ovulated eggs observed.

Table 3. Observation of induced breeding trials of *M. armatus*

Treatment	Mean body weight (g)		Dose of 1st injection (mg/kg^{-1})		Interval of 2nd injection (hr)	Dose of 2nd Injection (mg/kg^{-1})		Ovulation period (hr)	Fertilization rate (%)	Hatching period (hr)	Remarks
	Male	Female	Male	Female		Male	Female				
T_1 Ovaprim (ml/kg)	288.3 ±12.3	287.8 ±14.6	-	0.25	06	0.5	0.5	-	-	-	Complete Ovulation. Successful fertilization & hatching
T_2 HCG (IU/kg)	254.3 ±16.7	284.9 ±10.89	-	200	06	400	400	-	-	-	Partial Ovulation took place
T_3 PG (ml/kg)	275.6 ±17.2	245.6 ±16.38	-	30	06	30	60	-	-	-	No Ovulation

Production performance of Olive Barb (Systomus sarana) at different stocking densities

The experiment was carried out for a period of 08 months from November 2017 to June 2018. Experiment was conducted at different famer's pond and each pond was 20 decimal with an average water depth of 1.5 meter at Tarakanda, Muktagacha and Fulpur Upazila under Mymensingh district in nine rectangular earthen ponds of identical size. Corresponding data representing the stocking density/ha, initial weight and final weight are shown in Table 4.

Table 4. Species combination used in different treatments

Treatment	Species	Stocking density/ha	Initial weight (g)	Final weight (g)
T_1 (Control)	Sharpunti (*Systomus sarana*)	62500	3.02 ± 1.56	65.29 ± 9.27
T_2	Silver Carp (*H. Molitrix*)	1250	23.21 ± 4.56	1102.36± 18.36
	Rohu (*Labeo rohita*)	2500	17.52 ± 5.62	685.28± 16.78
	Sharpunti (*Systomus sarana*)	58750	3.02 ± 1.56	75.39 ± 11.58
T_3	Silver Carp (*H. Molitrix*)	1250	23.21 ± 4.56	987.96 ± 17.89
	Monosex GIFT (*O. niloticus*)	5000	5.09 ± 1.69	247.85 ± 10.52
	Sharpunti (*Systomus sarana*)	56250	3.02 ± 1.56	61.71 ± 8.93

In case of Sharpunti, the average initial weight of 3.02 ± 1.56g reached to a final weight of 65.29 ± 9.27g, 75.39 ± 11.58g and 61.71 ± 8.93g in treatments 1, 2 and 3 respectively. In case of Silver carp, the average initial weight of 23.21 ± 4.56g reached to a final weight of 1102.36± 18.36g and 987.96 ± 17.89g in treatments 2 and 3 respectively. In case of rohu, the average final weight of 685.28± 16.78g treatments 2. In case of Monosex Tilapia, the average initial weight of 5.09 ± 1.69g reached to a final weight of 247.85 ± 10.52g under treatment 3.

Effect of different types of feed ingredients in formulated diets on muscle color and growth performance of *Pangasianodon hypophthalmus*

Researchers: Momtaz Begum, Principal Scientific Officer
Rumana Yasmin, Scientific Officer

Objectives

- To evaluate the effect of various sources of feed ingredients and additives on growth of *Pangasianodon hypophthalmus*
- To evaluate the muscle color of *Pangasianodon hypophthalmus*
- To optimize the inclusion level of feed ingredients and additives in the formulated diets

Achievements

The water quality parameters recorded during the feeding trail, such as temperature (18.0-28.7^{0}C), pH (7.0-8.3) and dissolve oxygen (4.5-8.85 mg/L) were within tolerance limits for Thai Pangas (Table 1). There was no major variation in water quality parameters, which could be attributed to observed growth differences.

Growth performances in terms of weight gain, % weight gain, SGR, FCR, survival and production of fish fed diet 4 was apparently higher than fish fed diets 1, 2 and 3 but not significant($P < 0.05$) (Table 2).

Table 1. Formulation and proximate composition of the experimental diets for *Pangasianodon hypophthalmus*

Diet no.	Diets number Diet -1	Diet-2	Diet-3	Diet-4
	Ingredients:			
Fishmeal	08.00	14.00	08.00	14.00
Meat and Bone meal	15.00	_	15.00	_
Mustard Oil Cake	15.00	15.00	15.00	15.00
Rich bran (auto)	29.25	29.25	44.25	43.00
Soybean meal	12.00	21.00	12.00	22.25
Maize	15.00	15.00	_	_
Atta	05.00	05.00	05.00	05.00
Salt	0.50	0.50	0.50	0.50
Vitamin and Minerals Premix	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
	Proximate composition:			
Crude Protein	28.28	28.30	28.35	28.38
Crude Fat	08.80	08.36	09.83	09.72
Ash	09.48	07.68	10.33	08.51
Fiber	06.30	06.27	06.81	06.76
NFE	37.67	39.35	34.93	36.35

Table 2. Ranges of water quality parameters observed in the treatments during feeding trail

Parameters	Diet number Diet -1	Diet -2	Diet -3	Diet -4
Temperature (^{0}C)	18.00-28.70	17.60-28.01	18.50-28.20	18.5-28.52
pH	7.0-8.24	7.5-8.2	7.1-8.3	7.9-8.25
Dissolved oxygen (mg/L)	5.2-6.95	4.5-6.64	6.10-8.85	5.7-6.64
NH_3 (mg/L)	0.03-0.09	0.04-0.09	0.07-0.17	0.02-0.06
Alkalinity (mg/L)	170-200	150-210	166-220	170-190

Table3. Growth performance and production of *Pangasianodon hypophthalmus* fed in different formulated diet

	Diets number			
Diet no.:	Diet 1	Diet 2 (Without MBM)	Diet 3 (without maize)	Diet 4 (without MBM and maize)
Initial body wt. (Kg)	0.75±0.03	0.75±0.02	0.75±0.04	0.75±0.01
Final body wt. (Kg)	1.37±0.06	1.60±0.05	1.54±0.01	1.83±0.04
Weight gain (Kg)	0.61±0.09	0.67±0.03	0.97±0.04	1.12±0.02
% Wt. Gain	79.89±15.07	77.95±2.09	153.71±15.96	157.04±0.14
(SGR) (% day)	0.24±0.03	0.24±0.00	0.39±0.03	0.39±0.00
FCR	1.8± 0.03	1.7 ± 0.05	1.6 ± 0.06	1.9 ± 0.12
Length (cm)	25.5±4.0	25.0±2.0	24.0±3.0	27.1±5.0
Survival (%)	93 ±3.0	92 ±5.0	89 ±2.0	94 ±5.0
Production (kg/ha)	40606.80±315.45	47424.00 ±300.50	45645.60±253.80	54241.20±337.20

Table 4. Colour profile of *Pangasianodon hypophthalmus* fish fillets.

Parameters	Diet 1	Diet 2 (Without MBM)	Diet 3 (without maize)	Diet 4 (without MBM and maize)
L (Lightness)	40.50	55.01	47.89	57.9
a (Red/Green)	1.85	0.65	-0.60	-1.01
b (Yellow/blue)	3.30	5.25	2.60	1.57
RI (Redness Index)	0.307309	-0.13636	0.12037	-0.25377

Colour profile: Colour profile of this study showed that lightness factor was highest for Diet 4 indicating the degree of lightness or darkness of fish fillets and red (+) /green (-) and yellow (+) /blue (-) colour attributes and redness index were lowest for Diet 4 indicating less redness of fish fillets (Table 4) due to the absence of meat and bone meal and maize as feed ingredients and possible reason behind this is absence of myoglobin of meat and bone meal which is responsible for red colour and absence of carrotinoids of maize which is responsible for yellow colour in fish fillets.

In conclusion, the results of the feeding trial (diet 4) of *Pangasianodon hypophthalmus* without meat and bone meal and maize showed higher growth performance, feed and protein utilization, survival and production, more lightness and less redness than in fish fed with these two ingredients. From the results of this feeding trial, it is logical to conclude that feed incorporated without meat and bone meal and maize can be used as a fish feed in *Pangasianodon hypophthalmus* culture, to enhance fish health, better feed efficiency and growth performance and to produce whitish fish fillets.

Investigation and identification of emerging fish diseases and development of their control strategies

Researcher: Dr. Nazneen Bagum, Senior Scientific Officer
Md. Shirajum Monir, Senior Scientific Officer
Md. Ashikur Raham, Scientific Officer

Objectives

- To isolate and adapt Shing virus using different cell lines
- To isolate and identify the causal agents of emerging diseases of fish with special reference to Tilapia Lake Virus (TiLV)
- To develop effective Koi vaccine with the isolated *Streptococcus agalactiae*
- To validate the efficacy of experimentally developed Koi vaccine at the laboratory and farm level

Isolation and adaptation of Shing virus using different cell lines

Apparently juvenile healthy Shing (*Heteropneustes fossilis*) were collected from different areas of Mymensingh district and those juvenile Shing were kept in aquariums for preliminary observation of pathogens (virus and bacteria) free. Before dissecting out the tissues for primary culture, the healthy Shing were starved for four days and maintained overnight in sterile, aerated water containing 1000 IU ml^{-1} penicillin and 1000 μg ml^{-1} streptomycin. Prior to sacrifice, the fishes were tranquilized by plunging in iced water for 5 min, then disinfected in sodium hypochlorite (500 ppm available chlorine) for 5 min, washed in sterile water and swabbed with 70 % ethyl alcohol. The liver, heart and brain tissues were aseptically excised from the fishes and collected in sterile vials containing phosphate buffered saline (PBS, pH 7.2) having 500 IU ml^{-1} Penicillin, 500 μg ml^{-1} Streptomycin and 1.25 μg ml^{-1} Amphotericin B. Subsequently, the tissues were washed thrice in the same medium prior to trypsinisation.

Isolate and identify the causal agents of emerging diseases of fish with special reference to Tilapia Lake Virus (TiLV)

Collection, transportation and preservation of diseased Tilapia: A total of 100 diseased Tilapia were collected from four infected fish farms at Trishal and Bhaluka upazillas under Mymensingh, and Kaliakair upazilla under Gazipur districts in the period of July to November 2017. The collected freshly-dead Tilapia samples were transported in sterile plastic bags (one fish per bag) using ice packs, whereas, infected live fish were transported in clean plastic water gallons containing freshwater (to ensure oxygenation) in different groups to avoid cross-contamination. The collected Tilapia were processed within 4 hours of collection in the Fish Disease and Health Management Laboratory at BFRI, Mymensingh. The infected organs of the infected Tilapia such as brain, kidney, spleen and liver sterile swabs were streaked on Trypto Soya Agar (TSA) supplemented with 1.5% NaCl. The isolated bacteria were identified according to their biochemical characteristics (Sabur, 2006; Ahammed *et al.*, 2016). The infected Tilapia (brain, liver, spleen and kidney) were also preserved at -80 ^{o}C for viral study.

Clinical signs of the infected Tilapia: Most of the collected samples were observed gross signs include multifocal to coalescing dermal hemorrhage with erosions and ulcers, ocular alterations including opacity of the lens and shrinkage of the eyes (Figs. 1 & 2). In the infected farms, most of the Tilapia exhibited loss of appetite, pale color, gathering in the bottom, slow movement, and stopped schooling

prior to death. Mass mortality (60-90%) of the cultured Tilapia in the infected farms was noticed within 12-15 days.

Fig. 1. Moribund or freshly death Tilapia at infected cultured ponds

Fig. 2 Haemorrhage and erosions on body

Post mortem findings: After post mortem of the collected samples showed severe haemorrhages, pale and enlarged liver, gall bladder distended and enlarged 20 times than normal, destruction of kidney, thin and watery blood in the body cavity (Figs. 3 & 4).

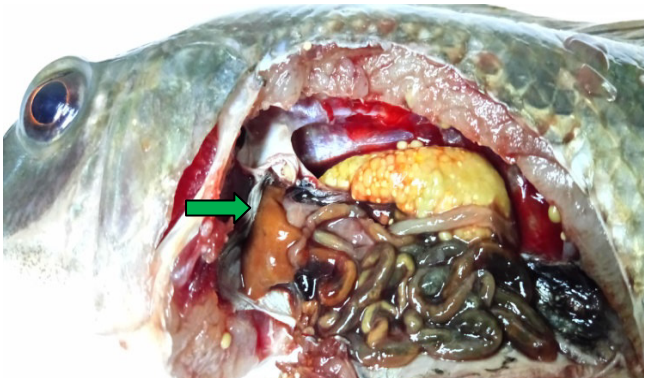


Fig. 3 Healthy Tilapia (normal liver and gall bladder

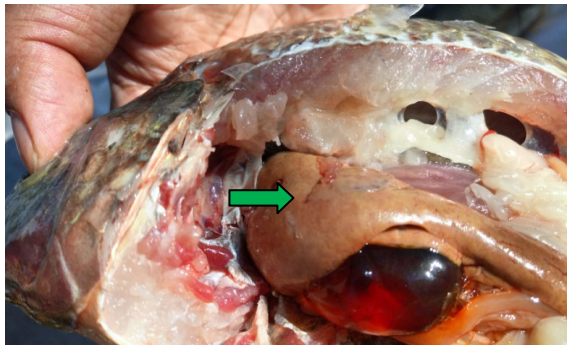


Fig. 4 Infected Tilapia (pale and enlarged liver and gall bladder)

Isolation and identification of bacteria from infected Tilapia: Fish sampling and primary isolation of bacteria were done under complete aseptic condition from the body, kidney, liver, spleen and ascitic fluid and inoculated on Tryptic Soy Broth (TSB) that incubated at 28-37 ^{o}C for 24-48 h. Characterization of the pure isolates was performed and involved colonial characteristics, bacterial cell morphology, motility test and biochemical tests of gram reaction, catalase test, glucose, sucrose and lactose utilization, citrate test, motility test, indole test, urease test, hydrogen sulfide production, TSI (gas production), methyl red (MR) test, voges praskaure (VP) test, coagulase test. The biochemical tests were carried out to identify the pathogens following Bergey's manual of Bacteriological classification (John *et al.,* 1998). However, among the isolated bacteria only *Aeromonas* sp. was identified. This isolated Aeromonas sp. is not responsible for mass mortality of Tilapia in cultured farms but might be due to secondary infection.

Isolation of Tilapia Lake Virus (TiLV): Target tissues (muscle, kidney, liver, spleen and brain) from moribund and freshly dead Tilapia were homogenized using sterile mortar-pestle and sea sand for the

preparation of 20% suspension of inoculum to isolate viruses. Ether, chloroform, RNase sensitive and direct hemagglutination properties (can agglutinate goose and human O type blood) virus was isolated from the liver, kidney homogenate of naturally infected and dead Tilapia from recent outbreak using special technique (biological and molecular techniques). The isolated virus was found highly fragile and species specific, means fail to infect other species of fishes at the pond during natural outbreak (carps and pangas species) and at the aquarium during experimental infection (Pangas and Vietnamese koi). The isolated virus was used for the reproduction of similar disease in TiLV free healthy Tilapia those collected from the pond of BFRI, Mymensingh. The experimentally infected (through intra-peritoneal and intra-muscular route of infection) fishes revealed similar characteristic signs and symptoms with 36-60 hours of pi (post infection) of naturally infected TiLV fishes at aquarium based infection. From the experimentally infected fishes similar RNA hemagglutinating viruses had been isolated using special techniques of fish virus isolation (both in-vivo and in-vitro system of propagation).

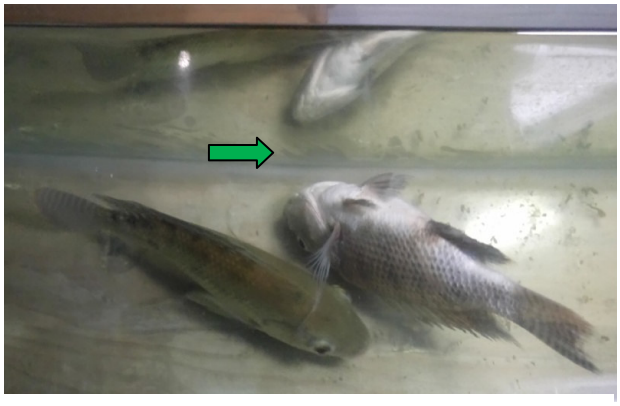


Fig. 5. Challenge test with TiLV in aquarium condition

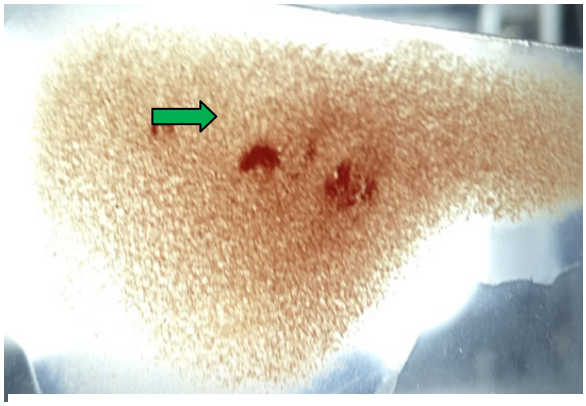


Fig. 6. Hemagglutination positive TiLV.

Validation the efficacy of experimentally developed Koi vaccine at the laboratory and farm level

Field trials of the vaccinated Vietnamese Koi at farmers level: An experiment is being carried out at three Vietnamese Koi farms at Tarakanda and Muktagacha upazila under Mymensingh district to observe the efficacy of the developed Streptococcus killed vaccine for the period of 5 months at least. In a private hatchery at Tarakanda upazila, both male and female brood Koi were fed initially with IgG present in the egg yolk and serum of immunized hen through orally and then inactivated vaccine was injected intra-muscularly through dorsal fin of the healthy brood fishes. After 25 days of active immunization the brood fish were used for artificial breeding. The spawn derived from the immunized brood Koi were fed with half boiled egg yolk of immunized hen for a period of 3 consecutive days. The immunized fries were nursing for 30 days at the farmers nursing ponds and then immunized fries were transferred into farmer's ponds at Tarakanda and Muktagacha. After 4 months cultured of the active and passive immunized Koi at farms level, at least 25 Koi were collected from each culture ponds for challenge test at laboratory condition. The immunized (vaccinated) and no-immunized (control group) Koi were challenged with 3.23 x 10^6 cfu/ml of the virulent isolate of *Streptococcus agalatice* bacteria. After 6 days of post- infection, hemorrhage in brain, bilateral exophthalmia, enlarge kidney, liver and spleen were developed and 100% mortality was found within 12 days in control group but there were no clinical sign and symptoms and mortality observed up to 14 days in immunized (vaccinated) Koi group those were collected from field (Table. 1).

Table 1. Cumulative progression of mortality rate in experimental Koi infected with *Streptococcus agalactiae*

Group	Replication	Bacteria	Bacterial dose	Number of healthy	Mortality (%)

(Treatment)				Koi used each group at aquarium	after 14 days
Vaccinated Koi (Tarakanda farm)	Two (R-2) each group	*Streptococcus agalactiae*	3.23 x 10^6 cfu/ml	10	0
Vaccinated Koi (Muktagacha farm)				10	0
Control (Non-vaccinated)				10	100

However, it is clear from these challenge tests that field vaccinated Koi are carrying specific antibody up to protective level against *Streptococcus agalactiae* bacteria. This challenge test will be continued up to harvesting period.

Harvesting of vaccinated Koi: An experiment is being carried out at three Vietnamese Koi farms at Tarakanda and Muktagacha upazila under Mymensingh district to observe the efficacy of the developed Streptococcus killed vaccine for the period of 5 months at least. A good number of healthy koi was harvested from those field under the presence of Upazila Fisheries Officer.

Development of Fish Museum and Live Gene Bank at Freshwater Station

Researchers: Muhammod Mominuzzaman Khan, Scientific Officer
Dr. Md. Khalilur Rahman, Chief Scientific Officer
Md. Ashikur Rahman, Scientific Officer

Objectives

The main objective of this project is to develop a fish museum by collecting all available fish species of the country. Moreover, a live gene bank will be established at Freshwater Station in earthen pond. Within this main objective, the specific objectives are as follows:

- To collect and identify available fish species from different habitats and to know their distribution pattern.
- To preserve the collected and identified fish species.
- To categorize the collected fish species according to ecological status (Abundant, Rare, Threatened / Endangered etc.), feeding habit (Planktivore, Omnivore, Carnivore, etc) and spawning requirements (Peleagophils, Phytophils, Lithophils etc.).
- To establish a live gene bank at Freshwater Station.
- To prepare booklet/ Identification Field Handbook on the collected samples.

Achievements

Specimen and Data collection: A total number of 735 fish species are found to inhabit in different aquatic habitats of Bangladesh like pond, beel, baor, haor, canal, lake, river, estuary and the Bay of Bengal. Among the 735 fish, a total of 167 fish species have been collected from different corners of the country and housed in the museum. Of the total of 167 fish species, 98 species (Table 1) are from Freshwater habitat and 69 species are from Marine and Brackishwater habitats (Table 2). Collected freshwater fish species of 98 are from 27 families while 69 fish species are from marine and brackishwater habitats under 31 families. The highest number of fish species was collected from the

family Cyprinidae which counted for 22. Number of vulnerable, critically endanger and endanger species were 07, 02 and 07 respectively (Table 1).

Table 1. Collected Freshwater species housed in the Museum

Order	Family	Local Name	English Name	Scientific Name	Status BD
Beloniformes	Belonidae	Kaikka, Kakila	Freshwater Gar	*Xenentodon cancila* (L.)	LC
	Hemiraphidae	Akthuta	Congaturi Haflback	*Hyporhamphus limbatus* (Valenciennes)	LC
Channiformes	Channidae	Taki	Spotted snakehead	*Channa punctata* (Bloch)	LC
		Gozar	Great snakehead	*Channa marulius* (Hamilton)	EN
		Shol	Striped snakehead	*Channa striatus* (Bloch)	LC
		Cheng	Walking snakehead	*Channa orientalis* (Bloch and Schneider)	LC
Clupieformes	Clupidae	Chapila	River shads	*Gudusia chapra* (Hamilton)	VU
		Kechki	Ganges river sprat	*Corica soborna* (Hamilton)	LC
Cypriniformes	Cyprinidae	Catla	Catla	*Gibelion catla* (Hamilton)	LC
		Mrigal, Mirka	Mrigel	*Cirrhinus cirrhosis* (Bloch)	NT
		Kalibaus, Baus	Orange-fin labeo	*Labeo calbasu* (Hamilton)	LC
		Rui	Rohu	*Labeo rohita* (Hamilton)	LC
		Mohashol	Putitor Mohasheer	*Tor putitora* (Hamilton)	NT
		Ghainna, Goni	Boggut labeo	*Labeo gonius* (Hamilton)	NE
		Mirror Carp	Mirror Carp	*Cyprinus carpio* var. *specularis* (L.)	NE
		Common Carp	Common Carp	*Cyprinus carpio*var. *communis* (L.)	LC
		Silver Carp	Silver Carp	*Hypophthalmichthys molitrix* (Hamilton)	LC
		Bighead Carp	Bighead Carp	*Aristichthys nobilis* (Richardson)	LC
		Grass Carp	Grass Carp	*Ctenopharyngodon idella* (Hamilton)	LC
		Mola	Mola Carplet	*Amblypharyngodon mola* (Hamilton)	VU
		Dhela	Cotio	*Osteo bramacotio* (Hamilton)	NT
		Darkina	Flying Barb	*Esomus danricus* (Hamilton)	LC
		Bata, Bhagna	Reba Carp	*Cirrhinus reba* (Hamilton)	NT
		Chela	Silver Hatchlet Chela	*Chela cachius* (Hamilton)	NT
		Sar Punti	Olive Barb	*Barbodes sarana* (Hamilton)	LC
		Chala Punti	Swamp Barb	*Puntius chola* (Hamilton)	LC
		Phutani Punti	Spotted sail Barb	*Puntius phutunio* (Hamilton)	VU
		Kanchan Punti	Rosy Barb	*Puntius conchonius* (Hamilton)	VU
		Tit Punti	Ticto Barb	*Puntius ticto* (Hamilton)	LC
		Punti, Jat Punti	Spot fin Swamp Barb	*Puntius sophore* (Hamilton)	LC
		Teri Punti	One spot Barb	*Puntius terio* (Hamilton)	NT
		Java Puti	Java Barb	*Barbonymus gonionotus* (Bleeker)	NT
	Engraulidae	Faysha	Gangetic Hairfin Anchovy	*Setipinna phasa* (Hamilton)	LC
	Cobitidae	Gutum	Guntea Loach	*Lepidocephalichthys guntea* (Hamilton)	LC
		Puiya	Bangla Loach	*Botia dario* (Hamilton)	EN
Osteoglossiformes	Notopteridae	Foli	Bronze Featherback	*Notopterus notopterus* (Pallas)	VU
		Chital	Clown Knifefish	*Notopterus chitala* (Hamilton)	EN
	Ophichthidae	Kharu	Rice Paddy eel	*Pisodonophis boro* (Hamilton)	LC
Perciformes	Gobiidae	Baila	Tank Goby	*Glossogobius giuris* (Hamilton)	LC

	Anabantidae	Koi	Climbing Perch	*Anabas testudineus* (Bloch)	LC
	Badiidae	Napit Koi	Badis	*Badis badis* (Hamilton)	NT
	Nandidae	Meni, Bheda	Gangetic Leaffish	*Nandus nandus* (Hamilton)	NT
	Osphronemidae	Cholisa	Branded Gourami	*Colisa fasciata* (Bloch and Schneider)	NT
		Lal Kholisha	Dwarf Gourami	*Colisa laila* (Hamilton)	NT
		Chuna	Honey Gouram	*Trichogaster chuna* (Schneider)	NT
	Cichlidae	Tilapia	Tilapia	*Oreochromis mossambicus* (Peters)	DD
		Nilotica	Nile Tilapia /Nilotica	*Oreochromis niloticus* (L.)	DD
	Mugilidae	Parch Bata	Gold spot Mullet	*Liza parsia* (Hamilton)	LC
		Bata	Green back Mullet	*Liza subviridiase* (Hamilton)	
		Khorsula	Corsula Mullet	*Rhinomugil corsula* (Hamilton)	LC
		Khorolla Bata	Stripped Mullet	*Mugil cephalus* (L.)	LC
	Ambassiade	Chanda	River Glass Perch	*Chanda nama* (Hamilton)	LC
Siluriformes	Siluridae	Boal	Freshwater Shark	*Wallago attu* (Bloch)	VU
		Boali Pabda	Butter Catfish	*Ompok bimaculatus* (Bloch)	CR
		Madhu Pabda	Pabda Catfish	*Ompok pabda* (Hamilton)	EN
	Schilbeidae	Kajoli, Bashpata	Gangetic Ailia	*Ailia coila* (Hamilton)	LC
		Batashi	Indian Potasi	*Pseudeutropius atherinoides* (Bloch)	LC
		Bacha	Batcha bacha	*Eutropiichthys vacha* (Hamilton)	LC
		Ghaura	Gaura Bacha	*Clupisoma garua* (Hamilton)	LC
	Chacidae	Cheka	Square head Catfish	*Chaca chaca* (Hamilton)	EN
	Pangasidae	Thai Pangas	Sutchi Catfish	*Pangasianodon hypopthalamus* (Sauvage)	DD
	Heteropneustidae	Shing	Sting Catfish	*Heteropneustus fossilis* (Bloch)	LC
		Magur	Walking Catfish	*Clarias batrachus* (L.)	LC
	Bagridae	Rita	Rita	*Rita rita* (Hamilton)	EN
		Ayre	Gaint-River Catfish	*Sperata aor* (Hamilton)	VU
		Guizza Ayre	Long-whiskered Catfish	*Sperata seenghala* (Sykes)	VU
		Golsha, Golsha tengra	Gangetic Mystus	*Mystus bleekeri* (Hamilton)	LC
		Bhajari-tengra, Ghuitta tengra	Bagrid Catfish	*Mystus tengara* (Hamilton)	LC
		Tengra	Striped dwarf Catfish	*Mystus vittatus* (Bloch)	LC
	Sisoridae	Baghair	Dwarf Goonch	*Bagarius bagharius* (Hamilton)	CR
		Hara	Sisorid Catfish	*Hara hara* (Hamilton)	LC
	Amblycipitidae	Catfish	Indian Torrent Catfish	*Amblyceps mangois* (Hamilton)	LC
Synbranchiformes	Mastacembelidae	Tara baim	Lesser Spiny Eel	*Macrognathus aculatus* (Bloch)	NT
		Baim, Bam, Salbaim	Zig-zag Eel	*Mastacembelus armatus* (Lacèpéde)	EN
		Guchi, Baim, Chirka	Barred Spiny Eel	*Macrognathus pancalus* (Hamilton)	LC
	Synbranchidae	Chucia	Mud Eel	*Monopterus cuchia* (Hamilton)	VU

Table 2. Collected Freshwater Brackish water & Marine water species housed in the Museum

Order	Family	Local Name	English Name	Scientific Name

Anguilliformes	Congridae	Kamila	Indian Pike Conger	*Congresox telabonoides*
Aulopiformes	Harpadontidae	Loitta	Bombay Duck, Bummalo, Lizard Fish	*Herpodon nehereus*
	Synodontidae	Achila	Greater Lizardfish, Dog-stick	*Saurida tumbil*
Beloniformes	Belonidae	Kakiya	Banded Needle Fish, Square-tail Alligator Gar	*Strongylura leiura*
Carcharhiniformes	Sphyrnidae	Haturi Hagor	Hammer Headed Shark, Winghead Shark	*Eusphyra blochii*
Characiformes	Serrasalmidae	Piranha	Pirapitinga, Red-bellied Pacu	*Piaractus brachypomus*
Clupeiformes	Clupeidae	Ilish	River Shad, Hisha Shad	*Tanualosa ilisha*
		Chouka	Bigeye Ilisha	*Ilisha megaloptera*
		Chondona Ilish	Toli Shad, Shad	*Tanualosa toli*
	Engraulidae	Oluya	Tapper Tail Anchovy, Neglected Grenadier Anchovy	*Coilia neglecta*
		Teli pasa	Scaly Hairfin Anchovy	*Setipinna taty*
Cypriniformes	Nemacheilidae	Bil Churi	Mottled loach, Zipper Loach, Sand loach	*Acanthocobitis botia*
		Tular Dandi	Gangetic Sillago, Flathead Sillago	*Sillagenopsis panijus*
Decapoda	Portunidae	Shila Kakra	Giant Mud Crab, Mangrove Crab	*Scylla serrata*
		Boro Kakra	Mud Crab, Mangrove Crab	*Scylla olivacea*
	Penaeidae	Loilla Chingri	Speckled Shrimp	*Metapenaeus monoceros*
	Scyllaridae	Boal Sanansa	Flathead Lobster, Sand Lobster, Sand Cray Fish, Bay Lobster	*Thenus orientalis*
Myliobatiformes	Dasyatidae	Haus pata	Bennett`s Stingray, Frilltailed Stingray	*Dasyatis bennetti*
		Sapla Pata	Gangetic Stingray	*Himantura fluviatilis*
		Shonkhochil	Javanese Cowray	*Rhinoptera javonica*
Perciformes	Carangidae	Kala Chanda	Black Pomfret, Brown Pomfret	*Parastromateus niger*
		Chapri	Malavar Trevally, Hunchback Trevally, Horse Mackerel, Kingfish, Malabar Crevalle	*Carangoides malabaricus*
	Gobiidae	Chiring	Pointed-tailed Goby	*Pseudapocryptes elongatus*
	Lobotidae	Somudro Koi	Triple Tail, Rockfish, Buoyfish, Black Perch	*Lobotes surinamensis*
	Lutjanidae	Vetki	Sea Bass, Barramundi, Sea Perch	*Lates calcarifer*
	Menidae	Chan Chanda	Moon-Fish	*Mene maculata*
	Polynemidae	Tailla	Fourfinger Threadfin	*Eleutheronema tetradactylum*
	Scatophagidae	Bishtara	Spotted Scat, Spotted Butterfish, Spade fish, Argus Fish	*Scatophagus argus*
	Sciaenidae	Poa	Tiger Toothed Croaker	*Otolithes rubber*
	Serranidae	Bol Koral	Commet Grouper, Bended Cheek Reef Cod	*Epinephelus morrhua*
		Chitra Bol	Bluelined Coralcod, Brown Banded Seabass, Brown-barred Rockcord, Brown-barred Grouper	*Cephalopholis boenak*
	Sciaenidae	Lombu Poa	Tiger Toothed Croaker	*Panna microdon*
		Koitor Poa	Poa	*Pama pama*
	Stromatidae	Rup Chanda	Chinese Pomfret, White Pomfret	*Pampus chinensis*

	Toxotidae	Archer fish	Seven Spot Archer Fish	*Toxotes chatareus*
Pleuronectiformes	Cynoglossidae	Kukur Jib	Bengal Tongue Sole, Gangetic Tongue Sole	*Cynoglossus cynoglossus*
		Kukur Jib	Fourlined Tonguesole	*Cynoglossus bilineatus*
Scombriformes	Scombridae	Tuna	Yellowfin Tuna	*Tunnus albacares*
		Maytta	Big Eye Tuna	*Tunnus obesus*
Scorpaeniformes	Platycephalidae	Sagor Baila	Papillose Flathead	*Eurocephalus carbunculus*
Siluriformes	Ariidae	Sagor Guzza	Sagor Catfish	*Arias gagora*
		Kata Mach	Flatmouth Sea Catfish	*Arias platistomus*
	Schilbeidae	Muri Bhacha	Murius Vacha	*Eutrophicthys murius*

Natural propagation of freshwater mussel in Bangladesh

Researcher(s): Sonia Sku, Scientific Officer
Dr. Mohosena Begum Tanu, Principal Scientific Officer
Arun Chandra Barman, Senior Scientific Officer
Mohammad Ferdous Siddique, Senior Scientific Officer
Abu Rayhan, Scientific Officer
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Md. Saiful Islam, Scientific Officer

Objectives

- To know the gonadal histology of freshwater mussels of *Lamellidens marginalis* and *L. corrianus*
- To know the Condition Factor (CF) of freshwater mussels of *Lamellidens marginalis* and *L. corrianus*
- To know the reproductive behavior of freshwater mussels of *Lamellidens marginalis* and *L. corrianus*
- To environment control breeding of freshwater mussels of *Lamellidens marginalis* and *L. corrianus*

Achievements (2017-18):

Observation of breeding behavior of freshwater mussel Lamellidens marginalis and L. corrianus

Prenuptial behavior of *Lamellidens marginalis* observed in aquarium. Four transparent aquarium ($1.2\times0.5\times0.8$) m^3 were used for this experiment. White transparent aquarium used to observe the pre-marital activities of mussels from the outside of the aquarium. Mussels from the research pond reared in the aquarium at a density of 10 mussel/ m^3. Different carp species and Tilapia also reared at a density of 10 fish/ m^3in the same aquarium. Pond and ground water were used for the experiment. Two aquarium and two containers arranged with 7.62cm mud in the bottom, rest of them kept without mud. *Lamellidens marginalis* were used for the study.

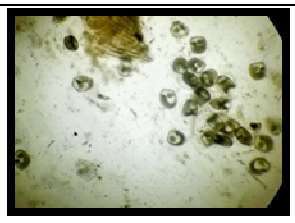
The mussel reared in aquarium was found stable condition both day and night. No chasing and nuzing reproductive behavior were observed during rearing period. No aggressive or attacking behavior was also recorded. No glochidia were found in fish and mussel body during checking.

Control breeding of fresh Lamellidens marginalis and L. corrianusin natural environment

A pond of 30 decimal was selected at BFRI pond complex. After preparation of the pond mussels were released. Water level was maintained at 1-1.5 m. The Stocking density of mussel in pond was 80 mussel/decimal. Stocking density of fish was 50 fish /decimal (*Catlacatla* 6, *Labeorohita* 6, *Cirrhinus cirrhosus* 7, *Heteropneustes fossilis* 7, *Channa punctata*7, *Cyprinus carpio* 7, *Puntius sarana* 4 *Oreochromis niloticus* 6). Fish were fed with commercial feed @5% of the body weight. The pond was separated by two fence (bana). Organic and inorganic fertilizers were applied fortnightly to the pond @ 3kg compost 0.1 kg T.S.P and 0.1 kg urea per decimal. Lime was applied fortnightly @ 0.5 kg/decimal. Survival of the mussel was monitored once in a month. Water temperature, pH, and NH_4-Nand DO were monitored fortnightly.

Fig 1. Checking of different fish organs for glochidium

On the basis of gonad histology, condition factor and life cycle of mussel, a study had been conducted to observe the glochidium in fish body. Gill, fin and slime of the host fish and mussel were checked under microscope to observe glochidia. Glochidia were found in gills of *Ompok pabda, Puntius sarana, Oreochromis niloticus* and fins of *Heteropneustes fossilis.* After breeding season juvenile mussel were found in control pond.

	
Glochidia in *Oreochromis niloticus* gill	Glochidia in *Puntius sarana* gill

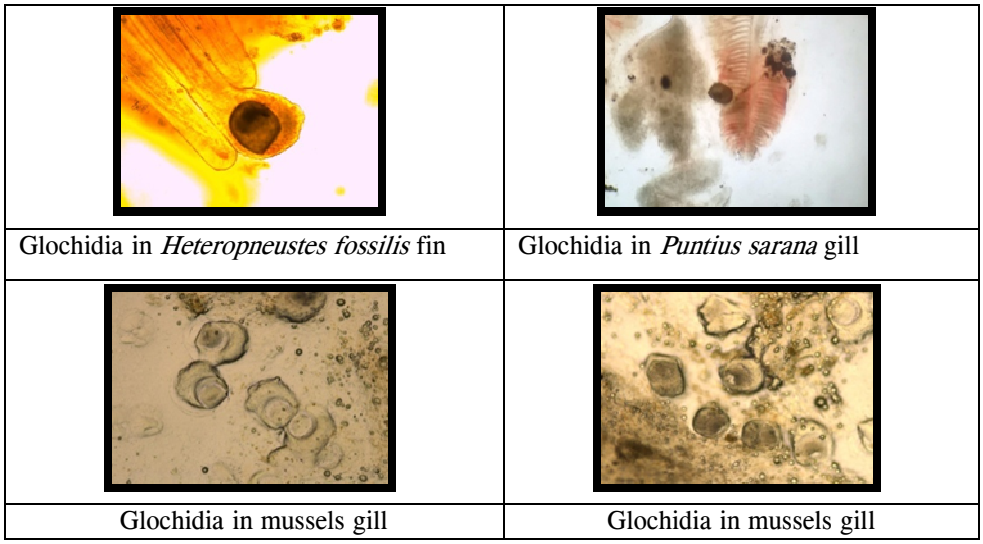


Fig 2. Presence of glochidia in mussel and different fish species

Table 1. Monthly variations of water quality factors in the experimental pond no 28

Months	Temp. (℃)	(DO) mg/L	pH	Ammonia (mg/l)	Alkalinity
July	26.60 ± 0.7	6.19 ± 1.30	7.10± 0.21	0.003±0.06	180±17.32
August	27.60 ± 0.6	5.79± 0.04	7.33 ± 0.21	0.002±0.03	170±15.28
September	26.3 ± 0.4	5.31± 0.42	8.61 ± 0.49	0.03±0.02	180±26.46
October	28.40 ± 0.6	3.37± 0.84	7.73 ± 0.64	0.004±0.04	190±26.46
November	26.10 ± 0.7	3.73± 0.78	8.04 ± 0.37	0.002±0.07	180±10.00
December	24.40 ± 0.6	5.80± 0.26	8.06 ± 0.52	0.002±0.03	200±10.00
January	18.20 ± 0.5	6.7 ± 0.12	8.24 ± 0.31	0.01±0.02	190.34±15.28
February	25.80 ± 0.4	6.8 ± 0.42	7.98 ± 0.55	0.01±0.03	140±10.00
March	27.05 ± 0.6	4.6 ± 0.57	8.09 ± 0.42	0.04±0.02	110±15.3
April	26.05 ± 0.4	5.5 ± 0.51	8.02 ± 0.22	0.006±0.007	120±15.3
May	25.03 ± 0.5	6.0 ± 0.42	7.88 ± 0.49	0.007±0.006	150±11.5
June	24.10 ± 0.6	5.1 ± 0.27	8.25 ± 0.40	0.03±0.02	210±10.0

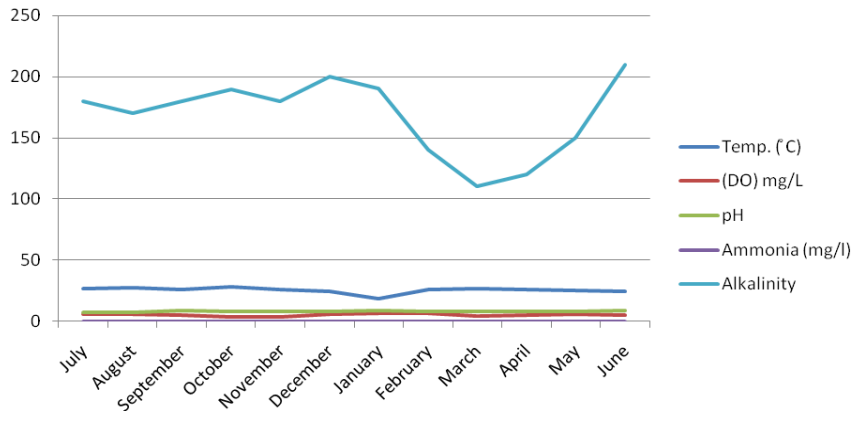


Fig 3. Monthly variations of water quality parameters in the experimental pond
Water quality parameters of experimental pond were found in optimum range.

Refinement of freshwater pearl culture techniques in Bangladesh

Researchers: Dr Mohosena Begum Tanu, Principal Scientific Officer
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Objectives

- To determine suitable nucleus size for nuclei pearl production in freshwater indigenous mussel
- To determine suitable techniques for maximum non nuclei pearl production in freshwater mussel
- To refine image pearl culture technology
- To disseminate the pearl culture technology through training

Achievements

Determination of suitable nucleus size for nuclei pearl production in indigenous mussel

A pond having 30 decimal area and 1-1.5 m depth were used for rearing of operated mussels. For the growth of natural plankton, organic and inorganic fertilizers were applied fortnightly to the pond at the rate of 5 kg cow dung, 0.125kg T. S. P. and 0.1kg urea per decimal respectively. Lime was applied at 0.5kg/decimal fortnightly. Water temperature, pH, plankton growth, NH4-N and DO parameters were recorded fortnightly. Then the reared mussels were kept in cistern without food for one week as pre-operative treatment. Mussels were operated by following operation procedure.

Nuclei pearl operation method: Young and healthy mussels were selected for operation. Mussels were set on baskets keeping the posterior ends downwards to eject water. One mussel was sacrificed for mantle tissue collection. This mussel was opened by cutting the abductor tissue and mantle tissue taken to make mantle tissue blocks (2mm×2mm). Another live mussel was used for inoculating that tissue block. During transplantation the mussel was opened only in 8mm and made a pocket in the mantle tissue and inoculated by putting one tissue block attached on nuclei.

Post operation culture: Operated mussels were hanged in net bags in cistern for one week without feed. Then these mussels were nourished with feed for 2-3 weeks and water was changed daily. Then the treated mussels were cultured for 3 months in ponds under hanging method. Then operated mussels were reared under grazing method for 18 month. Stocking density of mussels was 80/decimal and fish 30/decimal (*Catla catla* 6, *Labeo rohita* 10, *Cirrhinus cirrhosus* 10, *Labeo calbasu* 4).

Table 1. Design of the experiment

Culture method	Different size nuclei (mm)	Mussel used for transplantation
Hanging and grazing in cistern and pond	2, 3, 4	*Lamellidens marginalis* and *L. corrianus*

A total of 2400 mussels were operated with nuclei of different size. Eight hundred mussels were operated with nuclei of size 2 mm. Another 800 were operated with 3mm size nuclei and again another 800 musssels were operated with nuclei of 4mm size.

Table 2. Nuclei pearl production

Size of nuclei (mm)	No of operated mussel	No of stocked mussel in pond	Survival of mussel	Nuclei containing mussel	Nuclei keeping rate	Comments
2	800	664	624	203	21%	Experiment on going
3	800	584	510	155	15%	
4	800	456	334	31	7%	

Among 2400 operated mussel 1468 were survived and nuclei contained mussel were 389 and nuclei keeping rate in 2 mm size was 21 %, in 3mm size was 15% and 4mm size was 7% found till now. Final harvest will be done after 18 month on December 2018.

Table 3. Water quality parameter of pond 27 during experimental period

Parameters	Pond no. 27
Temperature (^{o}C)	26.14
DO(mg/ l)	5.07
pH	7.10
Ammonia(mg/ l)	0.024
Alkalinity (mg/ l)	154.16

Determination of suitable size of shell image for better quality image pearl through inoculation in indigenous mussel

Operated mussels were reared in ponds of 5 decimal area with water depth ranged between 1.0 and 1.5m. Organic and inorganic fertilizers were applied fortnightly to the pond at the rate of 5 kg cow dung, 0.125kg T. S. P. and 0.1kg urea per decimal respectively for natural growth of plankton. Lime was applied at 0.5kg/decimal fortnightly. Physicochemical parameters such as water temperature, pH, NH4-Nand DO were recorded fortnightly. Then the reared mussels were kept in cistern without food for one week pre-operative treatment. Mussels were operated following the procedure.

Shell image operation: Aged mussels were collected from different freshwater habitats of the country. Collected mussels were reared separately in stocking pond and rearing pond. Then the reared mussels were kept in cistern without food for one week to maintain pre-operative procedure. Shell image were prepared. Different size and shape of shell images were inserted into the mussel. After operation mussels were kept in cistern without food for one week to follow post-operative procedure. Then the operated mussel was transferred to another cistern for three weeks under post-operative care. After one month of post-operative care the operated mussels were cultured by hanging and grazing methods in pond.

Stocking density of mussels were80/decimal and fish 30/decimal (*Catla catla* 6, *Labeo rohita* 10, *Cirrhinus cirrhosus* 10, *Labeo calbasu* 4).These fishes were stocked with mussels to ensure the maximum use of pond. After 8 months culture, the shell image pearls were harvested.

Table 4. Design of the experiment

Name of culture technique	Length of mussel (cm)	Size of Image (cm^2)	Mussel used for transplantation
Hanging and grazing in cistern and pond	9-12	(3.0 × 1.5) (2.5 × 1.5) (2.0 × 1.5)	*Lamellidens marginalis* and *L. corrianus*

Four hundred and fifty mussels were operated and cultured by hanging and grazing in cistern and pond technique.

Table 5. Shell Image pearl production

Culture Techniques	Operated mussel	Length of mussel (cm)	Width of mussel (cm)	Length of image (cm)	Width of image (mm)	Sur-vival rate (%)	Mussel containing Image (%)	No of image	Nacre (mm)	Luste r
Hanging and grazing in cistern and pond	150	9-10	4-5	3.0	1.5	25	60	22	<0.15	low
	150	9-10	4-5	2.5	1.5	33	42	20	<0.25	medi um
	150	9-10	4-5	2.0	1.5	44	34	22	<0.50	High

From this experiment a total of 64 image pearls were produced from 450 operated mussels from a pond of 5 decimal within a culture period of 8 months.

Comparison between shell and paraffin made image pearl through observing physical properties

Pond size, area, depth and operation methods were same as experiment no 2. Mussels were operated by following operation procedure.

Operation Method: Shell and paraffin image were prepared and inserted in different mussels. Different size and shape of shell and paraffin images were inserted into the mussels and cultured by hanging methods in cistern and then hanging method in pond.

Culture Method

Hanging and grazing in cistern and pond: Operated mussels were kept in cistern for one week without food and then kept in another cistern for three weeks with food. Operated mussels were kept in pond for two months by using net bag hanging method. Then it was cultured in pond again for four months in grazing method. After six months mussels were cultured for one month in net bag hanging method. Finally, after 8 months culture, the image pearls were harvested. The survival rate and mussels having image were recorded.

Table 7. Design of the experiment

Name of image	Length of mussel (cm)	Size of Image (cm^2)	Sp. of mussel used for transplantation
Shell image	9-12	(3.0 × 1.5) (2.5 × 1.5) (2.0 × 1.5)	*Lamellidens marginalis,* *L. corrianus*
Paraffin image	9-12	(3.0 × 1.5 (2.5 × 1.5) (2.0 × 1.5)	*Lamellidens marginalis,* *L. corrianus*

Comparison was made between shell and paraffin made image pearls by observing physical properties.

Table 8. Comparison between shell and paraffin image

Name of image	Culture Technique	Length of mussel (cm)	Width of mussel (cm)	Length of image (cm)	Width of image (cm)	Survival rate (%)	Mussel containing Image (%)	No of prodecedi mage	Nacre (mm)	Luster
Shell image	Hanging and grazing in cistern and pond	9-11	4-6	2-3	1.5	20	45	18	0.15-0.5	Medium, high
Paraffin image	Hanging and grazing in cistern and pond	9-11	4-6	2-3	1.5	42.5%	100	85	0.98-1.6	Low, medium, high

A total of 103 pearls were produced from 400 mussel from a pond of 5 decimal within a culture period of 8 months. Water quality parameters were found suitable for mussel culture.

Early development of brood of Thai Pangas, *Pangasianodon hypophthalmus* using Green House concept

Researchers: Dr. David Rintu Das, Senior Scientific Officer
Mst. Sonia Sharmin, Scientific Officer

Objectives

- To accelerate maturation of broods of Thai Pangas, *Pangasianodon hypophthalmus*
- To improve quality of broods of Thai Pangas, *P. hypophthalmus* between January to February

Achievements

Enhancement of development of ovary of Pangasianodon hypophthalmus using 'green house' concept

In this study, early development of brood of Thai Pangas, *Pangasianodon hypophthalmus* was conducted during the period from July 2017 to June 2018 at Floodplain Sub-Station, Santahar, Bogra. Four ponds were selected with an area of 0.08 ha each. Among the ponds, two ponds were fully covered with transparent polyethylene sheet fastened in frame, made of bamboo that was treated as "green house pond" (GP) (Fig. 1).The other two ponds were kept open and were treated as open pond (OP) as control. All the ponds were prepared by drying, bottom soil was excavated to increase depth and the dykes were repaired properly, cleaning aquatic vegetation and stone lime (CaO) at the rate of 250 kg/ha followed by cow dung at the rate of 750 kg/ha as organic fertilizer and waited for a week. After then ponds were filled up with water up to a depth of more than 1.0 meter. To promote algal growth ponds were fertilized with inorganic fertilizers i.e. Urea and TSP were applied at the rate of 63kgand 63kg/ha and waited for another week to allow the water become suitable for stocking.

Fig. 1. Fully covered by transparent polyethylene sheet of a green house pond

After growing sufficient plankton, all the ponds were stocked with adult and healthy ThaiPangasat the rate of 990 nos/ha (density 12 kg/decimal) in October. The brood fish were acclimatized 3 days before stocked. Commercial pellets feed were fed to stocked brood (28% crude protein) supplemented with vitamin premix daily at a rate of 10 % for the first month, 8% for the second month, 5% for the third

month and 3% for rest of the brood development period (Fig. 2). Half of the daily feed was applied in the morning and rest half in the evening. Cod liver oil were added at 1-2 ml/kg feed for augment maturation of eggs. Duration of brood development period was 5 months (Table 1). The ratio of stocked broods (female: male) were 2:1. The size of male Pangas was 3-3.5 kg and that of female was 4-4.5 kg. Water quality parameters were routinely monitored. To keep the pH and others water quality parameters in suitable range, water of ponds were treated with stone lime @ 63 kg/ha fortnightly. After stocking ponds were fertilized with organic (cow manure) and inorganic fertilizer (Urea and TSP) fortnightly. Water depth was maintained at 1.0 m. Water quality parameters such as Temperature (^{0}C), pH, total alkalinity, dissolved oxygen (mg/l) and hardness of water were recorded weekly using a commercial kit box (Model: FF-3, USA).Partial water of the ponds were exchanged in every 7 days intervals after stocking of fish but it was not more than 10% at a time. Water Temperature (^{0}C), pH and dissolved oxygen (mg/l) were maintained with 25-27 (^{0}C), 7 and 6 (mg/l). Paddle wheel was used in the pond to maintained dissolved oxygen.

After stocking of fish, development of gonad of brood Pangas were checked monthly observation by external features of secondary sexual maturity. Gravid females were identified by their swollen, distended, soft abdomen with reddish and swollen vent. Mature males were identified by their reddish genital opening and oozing of milt with gentle pressure on the abdomen (Table 2). For this study, about 5-6 fishes were examined randomly, particularly during the winter season (October- February).

Confirmation of the gonadal maturity of brood depends upon the size of the gonad in length and weight and fecundity. Fecundity was estimated by gravimetric method. Induced breeding that's with the early matured was conducted in the month of the 1st week of March (Fig. 2).

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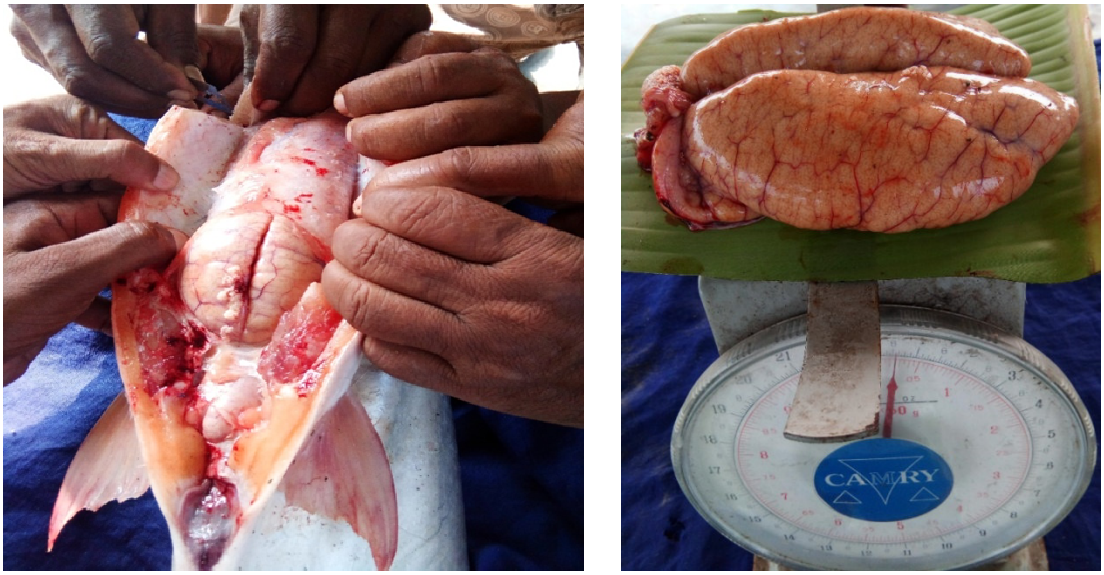

Fig. 3. Observe the gonad development of brood Pangas

Table 1. Design of the experiment

Treatments	Replications	Stocking ratio	Stocking density	Brood development period

		(Female: Male)	(no./decimal)	(Month)
T_1 (GP)	2	2:1	(2+1) = 3	5
T_2 (OP)	2	2:1	(2+1) = 3	5

❖ GP= Green house pond, OP= Open pond

In the green house ponds the stocked male and female Pangas started to be matured after stocking and they were found at the end of culture period. All females & males become matured in the 1st week of March. However, 80% females &90%males become ready for induced breeding. However, no Pangas become matured in the open ponds throughout the culture period. Matured females were identified by their swollen, distended, soft abdomen with reddish, swollen vent as well as dissecting gonad. Matured males were identified by their reddish genital opening and oozing of milt with gentle pressure on the abdomen. For this study, total 3 fishes were examined randomly during the experimental period (October-February). It was evident from the results (Table 2) that gonad weight increased slowly from October to February with the gonadal development of greenhouse reared broods.

Table 2. Total body length, weight and gonad weight at successive months of greenhouse reared female, *Pangasianodon hypophthalmus*

Month	No. of fish examined	Total length (cm)	Total weight (kg)	Gonad weight (g)
October	3	64.2 ±2.12 (Initial)	4.0±3.22 (Initial)	154±0.42 (Initial)
November	3	67.5±1.45	4.4±0.39	233±0.18
December	3	69.3±2.32	4.7±1.23	340±1.22
January	3	71.2±3.45	5.1±1.54	354±1.07
February	3	73.8±2.78	5.6±1.23	398±1.34

Induced breeding was started on 7th March, 2018in the hatchery complex of the Sub-Station, Santahar. The average weight of females broods were 4.8-5.7 kg and males were 3.9-4.3kg during hormone injection. After hormone administration eggs were released by stripping method(Fig. 5).About 80% eggs were come out easily from female brood when stripped. The average number of ova per gram body weight was 79.38 and the number of ova present per gram of ovary weight was 973.64. Early maturation of Thai Pangas, was considered in terms of gonadosomatic index, length-weight relationship of gonad, ovadia meter and fecundity. Thai Pangas was also injected with different doses of different inducing agents like pituitary gland (PG), human chorionic gonadotropin (HCG), Gonadotropin releasing hormone (GnRH) and Ovuline-a synthetic hormone in different environmental conditions. However, it was observed that the artificial breeding of Thai Pangas was not yet succeeded through inducing agents in captive conditions, rather the inducing agent and doses showed negative impacts on fecundity and ovarian tissues. Whereas, augment maturation of eggs used hormon injection for female was applied for 1st dose: 1.5 mg cPG + 200 IU HCG/kg BW, 2nd dose: 12 mg cPG /kg BW and in the same time for male 2 mg cPG /kg BW showed positive result in 1st week of March. However, in open ponds female and males were became fully matured within late April.

In greenhouse, it was observed that 80% female and 100 %males werebecame fully matured in the 1st week of March. Ambient water temperature of bottle hatchery was26.1^0 C wherehatching rate was found70%. At the first time 60,000-70,000 fries have been produced from greenhouse reared broods (Fig. 5).It is indicated from the primary finding that it will be possible to produce matured Pangas within the 1st week of March if proper matured Pangas fish stocking can be done with in October using greenhouse technique.

Demonstration and dissemination of Cuchia (*Monopterus cuchia*) farming in earthen ponds at Adamdighi Upazila

Researcher: Dr. David Rintu Das, Senior Scientific Officer
Mst. Sonia Sharmin, Scientific Officer

Objectives

- To demonstrate/validate the culture technique of Cuchia
- To analyze the cost-benefit ratio

Achievements

Adoption on culture of M. cuchia in farmer's pond

A preliminary study entitled culture of Cuchia (*Monopteruscuchia)*was validated in Adamdighiupazilla during July 2017 to June 2018. The above study was conducted round the year on growth, survival, production and the cost-benefit ratio of freshwater mud eel in earthen ponds.

Fig. 1. Pictorial view of Cuchia (*Monopteruscuchia)*

Pond selection and preparation: Nine earthen ponds were selected throughout at Adamdighi Upazila. All together 9 ponds were chosen for this validation trial. The size of the ponds were 5dec. each. For the preparation of pond, at least two feet bottom soil were removed from all ponds and then filter net was placed in the bottom due to avoid the burrowing habit of Cuchia. After setting the filter net, removed soil was further used on the filter net (Fig. 2). After that, water of the ponds were fertilized with Urea and TSP @ 25 ppm and 30 ppm to enhance the production of plankton. Water hyacinth were provided to the ponds for suitable and safe shelter of Cuchia. The depth of water was maintained at 20.0 cm. for all the ponds.

Fig. 2. Photograph of pond preparation for Cuchia culture (*Monopterus cuchia)*

Fish stocking and management: Live specimens of Cuchia (45.65±2.50g) were collected from local fisherman. The collected baby fishes were acclimatized for 15 days in a cemented cistern with water hyacinth as a shelter. After acclimatization collected baby eels were stocked in 1st week of February/2018 at different stocking density (Fig. 3).

Fig. 3. Stocking of Cuchia for culture (*Monopterus cuchia)*

There are three different treatment on stocking density namely T_1 ($10/m^2$),T_2($15/m^2$) and T_3($20/m^2$)respectively. Each treatment was replicate thrice. The stocked Cuchia was fed with Fish spawn (*Channa punctatus, Cyprinus carpio* and *Lepidocephalichthys berdmorei*), Vermi (Earthworm) and Tadpole @ 20-5% body weight two times in a day (Table 1). Cuchia was reared up to six months. Sampling was done at an interval of one month to measuring weight of fish and to observe the health condition of fish.

For conducting the experiment in pond conditions the following design and methods were followed:

Table 1. Design of the experiment

Treatments	Replications	Stocking density (nos /m^2)	Size of the ponds (Dec.)	Feed
T_1	3	10	5	Tadpole/ Fish spawn/ Vermi (Earthworm)
T_2		15		
T_3		20		

Water quality parameters such as water temperature, pH, dissolved oxygen and alkalinity were recorded monthly throughout the study period. The results of the water quality parameters are shown in Table 2. The water quality parameters are important for growth, survival and production of Cuchia culture. The water quality parameters were found within the suitable range, however, no significant variation was observed in all treatments.

Table 2. Monthly water quality parameters recorded from the ponds of Cuchia cultured with different treatments

Months	Parameters			
	Temperature (^{0} C)	dissolved oxygen (mg/L)	pH	Alkalinity (mg/L)
February	19.7	4.60	7.52	47
March	25.3	4.75	7.45	49
April	28.3	5.0	7.50	53
May	29.5	5.5	7.6	55
June	30.4	5.6	7.7	58
July	31.5	5.5	7.5	60

At the end of the experiment, all Cuchia was harvested. Final weight and survivability was recorded. Significantly highest survival rate, specific growth rate and production (78 %, 0.508 ± 0.08 and 1.64 ± 0.88 Kg/m^2/6 months) was observed in treatment I and lowest (53 %, and 0.405 ± 0.03 and 1.52 ± 0.33 Kg/m^2/6 months) was treatment III respectively. FCR value were 1:1.52, 1:1:43 and 1:1.18 with gross margin estimated Tk. 656.00, 636.00 and 608.00/ m^2. The calculated BCR were 1:1.42,1:1.22 and 1:1.11 for treatments I, II and III respectively (Table 3). Results revealed that, treatment I appeared to be promising in Adamdighi upazila.

Table 3. Growth, survival and production of Cuchia cultured under different stocking densities in different treatments

Parameters	T_1	T_2	T_3
Initial weight (g)	45.65 ± 2.50	45.65 ± 2.50	45.65 ± 2.50
Final weight (g)	210.32 ± 3.21	171.54 ± 1.85	143.32 ± 2.65
% weight gain	360.72 ± 12.31	275.78 ± 7.67	213.95 ± 5.56
SGR (%)	0.508 ± 0.08	0.456 ± 0.06	0.405 ± 0.03
Survival rate (%)	78.0 ± 8.0	62.0 ± 4.0	53.0 ± 2.0
Production (Kg/m^2/6 months)	1.64 ± 0.88	1.59 ± 0.67	1.52 ± 0.33
FCR	1:1.52	1:1:43	1:1.18
BCR	1:1.42	1:1.22	1:1.11

Farmgate price- Cuchia: Tk. 400/Kg, TVC= Total variable cost, BCR= Benefit cost ratio

Adaptation of BFRI evolved cage culture technology of high valued fishes in Baor environment

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Objectives

- Study the production performance of Gulsha (*Mystus cavasius*) in net cages at different stocking densities to estimate the suitable stocking density
- Study the production performance of Pabda (*Ompok pabda*) in net cages at different stocking densities to estimate the suitable stocking density

Growth performance of Gulsha (Mystus cavasius) in net cages

Expt. I. To study the production performance of Gulsha (*M. cavasius*) in net cages at differ stocking densities, the experimental design was as follow:

Treatments	Species	Stocking density (m^{-3})	Experimental Site	Feed	Duration (Days)
T_1	Gulsha	200	Jhapa baor, Mosshimnagar Rajbari, Rajganj, Monirampur, Jessore	Locally available commercial 10-5% body weight (floating feed)	120
T_2		300			
T_3		400			

Expt. II. To study the production performance of Pabda (*Ompok pabda*) in net cages at different stocking densities, the experimental design was as follow:

Treatments	Species	Stocking density (m^{-3})	Experimental Site	Feed	Duration (Days)
T_1	Pabda	200	Jhapa baor, Mosshimnagar Rajbari, Rajganj, Monirampur, Jessore	Locally available commer-cial 10-5% body weight (floating feed)	120
T_2		300			
T_3		400			

Stocking, feeding and sampling: Fingerlings of Gulsha and Pabda were stocked in net cages according to the experimental design during last week of March, 2018 for the period of 120 days. Feeding was done with locally available commercial feed containing 30% crude protein @ 10～5 % of body weight for Gulsha and Pabda twice daily. Fishes of each cage were sampled at fortnightly interval to monitor their growth as well as feed adjustment. Water quality parameters such as water temperature (°C), dissolved oxygen (mg/L), pH, total alkalinity and transparency (cm) were monitored at 15 days intervals.

Harvesting and analysis: Fishes were harvested after 120 days of culture period. Then total number and length-weight data of fishes were recorded and survival, production etc. were calculated. Statistical analysis were done to find-out the correlation and impact of different stocking densities on growth and production following the standard statistical methods.

Water quality parameters: Water quality parameters like air temperature, water temperature, water pH, soil pH, dissolved oxygen, ammonia, transparency and total alkalinity were observed at 15 days interval throughout the experimental period (Table 3 and 4).

Table 1. Water quality parameters of Gulsha in different treatments in cages

Water quality Parameters	Treatments		
	T_1	T_2	T_3
Air temperature (^{0}C)	31.42±0.47	31.42±0.47	31.42±0.47
Water temperature (^{0}C)	30.28±0.81	30.28±0.81	30.28±0.81
pH	7.37±0.04	7.35±0.04	7.32±0.04
DO (mgl^{-1})	4.45±0.35	4.39±0.38	4.37±0.37
Ammonia (mgl^{-1})	0.00	0.00	0.00
Total alkalinity (mgl^{-1})	146.57±0.57	138.28±0.81	139.14±0.47
Hardness (mgl^{-1})	186.28±0.47	195.28±0.81	195.42±0.47
Transparency (cm)	93.28±1.24	93.00±1.41	93.00±1.41

Analyzing the water quality parameters, we observed that water quality was in suitable range for gulsha in net cages.

Table 2. Water quality parameters of Pabda in different treatments in cages.

Water Quality Parameters	Treatments		
	T_1	T_2	T_3
Air temperature (^{0}C)	31.42±0.47	31.42±0.47	31.42±0.47
Water temperature (^{0}C)	30.28±0.81	30.28±0.81	30.28±0.81
pH	7.37±0.05	7.42±0.00	7.20±0.04
DO (mgl^{-1})	4.41±0.50	4.32±0.49	4.27±0.46
Ammonia (mgl^{-1})	0.00	0.00	0.00
Total alkalinity (mgl^{-1})	137.85±0.85	138.00±0.81	137.28±0.00
Hardness (mgl^{-1})	195.14±0.0	196.28±2.49	196.42±2.49
Transparency (cm)	93.42±1.69	94.28±3.29	93.00±1.83

Table 5. Growth performance of Gulsha in different treatments in cages.

Parameters	T_1	T_2	T_3
Stocking densities (no./m^3)	200	300	400
Initial length (cm)	4.5±0.60	4.5±0.60	4.5±0.60
Initial weight (g)	0.86±0.15	0.86±0.15	0.86±0.15
Culture Duration (Days)	120	120	120
Length (cm)	11.90±0.73	11.84±0.98	11.60±0.83
Weight (g)	15.05±1.13	14.10±1.61	13.86±1.43
FCR	2.15	2.18	2.37
Survival Rate (%)	85.80	75.86	73.32
SGR (%)	2.38	2.33	2.31
Production (kg/m^3)	2.58	3.21	4.06

From the above data, final weight were 15.05±1.13, 14.10±1.61 and 13.86±1.43 in T_1, T_2 and T_3 respectively and survival was higher (85.80%) in T_1 than T_2 and T_3.

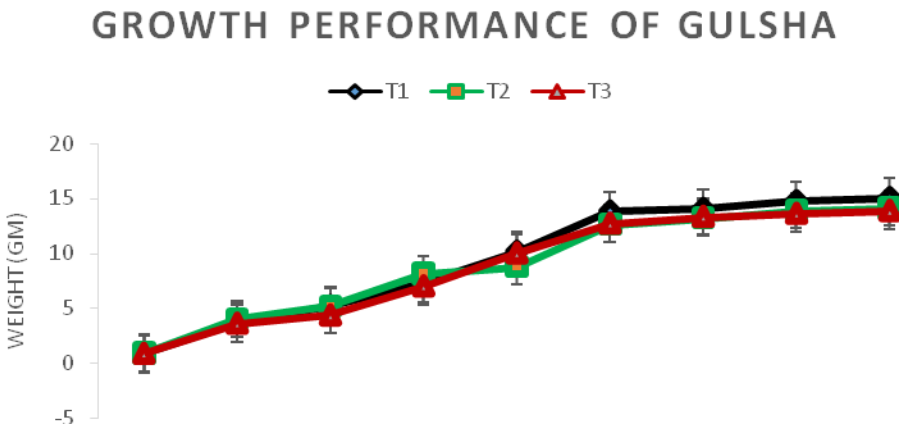


Fig. 1. Growth performance of Gulsha (*Mystus cavasius*)

It was observed that the final weight 15.05±1.13 g, 14.10±1.61 g and 13.86±1.43 g were found in T_1, T_2 and T_3, respectively. SGR (%) was estimated as 2.38, 2.33 and 2.31; survival rate (%) was estimated as 85.80, 75.86 and 73.32 and FCR was estimated 2.15, 2.18 and 2.37 in T_1, T_2 and T_3, respectively.

Table 6. Growth performance of Pabda (*Ompok pabda*) in different treatments in cages.

Parameters	Treatments		
	T_1	T_2	T_3
Stocking densities (no./m^3)	200	300	400
Initial length (cm)	10.05±1.38	10.05±1.38	10.05±1.38
Initial weight (g)	5.6±2.15	5.6±2.15	5.6±2.15
Culture Duration (Days)	120	120	120
Length (cm)	19.15±1.06	18.56±1.12	18.05±1.05
Weight (g)	39.57±5.92	37.81±7.22	34.76±6.70
FCR	2.83	3.32	3.41
Survival Rate (%)	90.30±5.70	85.43±2.65	80.00±11.00
SGR (%)	1.84	1.81	1.76
Production (kg/m^3)	7.16	9.64	11.12

From the above data, final weight were 39.57±5.92, 37.81±7.22 and 34.76±6.70 in T_1, T_2 and T_3 respectively and survival was higher (90.30%) in T_1 than T_2 and T_3.

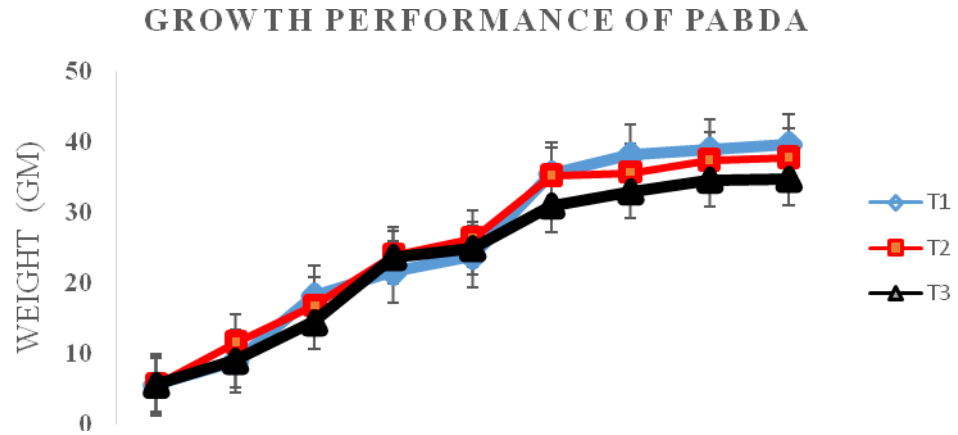


Fig. 2. Growth performance of Pabda (*Ompok pabda*)

It was observed that the final weight 39.57±5.92 g, 37.81±7.22 g and 34.76±6.70 g in T_1, T_2 and T_3, respectively (Table 4). SGR (%) was estimated as 1.84, 1.81 and 1.76; survival rate (%) was estimated as 90.30±5.70, 85.43±2.65 and 80.00±11.00 and FCR was estimated as 2.83, 3.32 and 3.41 in treatments T_1, T_2 and T_3, respectively.

Field validation of selected high valued fish culture technologies for maximizing production (Component - B)

Researchers: Maliha Hossain Mou, SSO
Md. Shariful Islam, SO
Md. Abdul Halim, SO

Objective

- To validate the BFRI evolved production technologies of high valued fishes in Jashore region

Achievements

Adoption of polyculture of Gulsha (Mystus cavasius), Pabda (Ompok pabda) and Catla (Catla catla) in small water bodies in Jashore region

BFRI evolved polyculture technology of Gulsha (*M. cavasius*), Pabda (*O. pabda*) and Catla (*C. catla*) was validated in small water bodies of two farmer's pond (one is 5 decimal and another is 10 decimal) in Ichali and Bhaturia of sadar upazilla under the Jashore district and four ponds in BFRI Jahore FSS (two ponds were 0.04 ha and two ponds were 0.04 ha) during April to July 2018.

Pabda and Gulsha fries were collected from Mymensingh and Calta fingerlings from Jashore. Then those fry and fingerlings were released in the nursing pond of BFRI FSS, Jashore. The fingerlings of Gulsha, Pabda and Catla were stocked at the stocking density of 49,400/ha, 49,400/ha and 2,964/ha, respectively.

For validating the stocking density of BFRI evolved polyculture technology of Gulsha (*M. cavasius*), Pabda (*O. pabda*) and Catla (*C. catla*) in Jashore region, the experimental design was as follows (Table 1):

Table 1. Experimental design

Treatments	Average Pond size (ha)	Replications	Species	Stocking density (ha^{-1})	Invariables
T_1	0.04	3	Gulsha	49,400	Average Stocking size: ➢ Gulsha 2-3 g ➢ Pabda3-4 g ➢ Catla 200 g
T_2	0.02		Pabda	49,400	Feed – Commercial floating feed @ 10-5% body weight
			Catla	2,964	Culture Period – 120 days

Water quality parameters like air temperature, water temperature, water pH, soil pH, dissolved oxygen, ammonia, transparency and total alkalinity were observed at 15 days interval throughout the study period (Table 2).

Table 2. Water quality parameters observed during the experimental period

Parameters	Treatments	
	T_1	T_2
Air temperature (^{0}C)	30±.50	30.66±1.00
Water temperature (^{0}C)	28±1.50	28.5±1.00
Water pH	7.50±0.25	7.40±0.35
DO (Dissolve oxygen) (ml/L)	4.00±0.50	3.75±0.38
Ammonia (ml/L)	00	0.25
Total alkalinity(ml/L)	197.5±1.35	206.5±1.41

After stocking, fishes were fed at a rate of 5-10% of body weight with supplementary feed (30% crude protein) twice daily. The commercially ready floating feeds were supplied by the FSS, BFRI Jashore. Fish health and water quality parameters were monitored after 15 days intervals. Length and weight of the fishes were measured and recorded bi-weekly. Feed adjustment was done through fish sampling at 15 days interval. Fishes were harvested after 120 days of culture period. Then total number and weight of fishes were recorded and survival, production etc. were calculated (Table 3 and Figure 1, 2, 3, 4 and 5).

Table 3. Growth performance of Gulsha, Pabda and Catla in different treatments

Parameters	Species		
	Pabda (*O. pabda*)	Gulsha (*M. cavasius*)	Catla (*C. catla*)
Stocking densities (no./ha)	49,400	49,400	2,964
Initial length (cm) [04.04.18]	10.18	7.06	27.8
Initial weight (g) [04.04.18]	3.7	1.6	219
Culture period (days)	120	120	120
Final length (cm) T1	16.75±0.02	16.25±0.41	38.25±0.50
Final weight (g) T1	32.83±1.02	19.70±.75	686.92±10.50
Final length (cm) T2	18.30±0.04	17.08±0.25	37.50±0.10
Final weight (g) T2	39.03±0.50	21.46±.40	668.25±20.00
SGR (%) T1	1.83	3.45	0.95
SGR (%) T2	1.97	2.16	0.92

After successful completion of trial, the mean harvesting weight of Gulsha, Pabda and Catla were 19.70±.75, 32.83±1.02 and 668.25±20.00g, respectively in T_1, whereas 21.46±.40, 39.03±0.50 and 686.92±10.50g, respectively in T_2. It was observed that growth performance of Gulsha, Pabda and Catla were higher in larger pond than smaller pond. At the end of experimental the growth was estimated and seems to be potential but survival of Gulsha and Pabda were poor due to mortality throughout the experimental periods.

Adoption of suitable culture technologies of some commercially important fish species in the Northern Region of Bangladesh

Researchers: Saokat Ahamed, Scientific Officer
Dr. Khondaker Rashidul Hasan, Senior Scientific Officer

Objectives

- To adopt the polyculture techniques of short-cycle species in the seasonal water bodies;
- To assess the water quality parameters of cultural water bodies;
- Estimation of cost benefit analysis of culture technologies; and
- To disseminate these polyculture techniques in different aqua-ecological zones in the northern part of the country

Achievements

Polyculture of Shing and polyculture of Vietnamese koi were tested under different treatments in seasonal farmer's mini ponds at the adjacent areas of FSS, Saidpur during 2015-17. Of them, 600 Shing+50 Magur+10 GIFT+5 Shorputi combination from shing polyculture and 400 Vietnamese koi+10 GIFT+ 5 shorpunti combination from koi polyculture have already been selected due to technically sound, socially acceptable and economically viable polyculture patterns. These two patterns have been disseminated in different aqua-ecological zones of northern region of Bangladesh

Multi location testing (MLT) program: Multi location testing program have been conducted in different aqua-ecological zones viz., Niphamari, Dinjpur and Lalmonirhat to verify the research results of previously tested suitable culture patterns and exchange of views among the researcher, extension people (DoF). Six (06) seasonal ponds were selected for this experiment. Six ponds divided into two groups. Each group will be considered as one pattern e.g. pattern-I, pattern-II and each pond considered as one replication. The area of ponds ranges between 10 and 15 decimal each. The on-farm ponds were selected with the concerning of relevant Senior Upazilla Fishery Officer (SUFO/UFO). The selected ponds were prepared by drained and drying. Aquatic weeds were removed from the ponds manually and harmful and unwanted fish species removed by using rotenone 25-35 g dec^{-1} ft^{-1} if necessary and ponds were liming @1 kg dec^{-1}. After 5 days of liming, cow-dung 6 kg dec^{-1}, urea 100 g dec^{-1} and TSP 75 g dec^{-1} were applied at initial stage during pond preparation. About 7-10 cm fingerlings of those fishes were stocked as per experimental design (Table 1). Fish are being fed commercially available fish feed 10-5% BW day^{-1} (containing 30- 35% protein). Length, weight data and water quality parameters *viz.*, temperature, pH, DO, CO_2, NH_3 etc. are being collected fortnightly. The experimental design is presented in Table 1.

Table 1. Experimental design of pattern-1 and pattern-2

Culture pattern	Replication	Species combination	Stock. density (no. dec^{-1})
Pattern-1	3	Shing+Magur+GIFT+Shorputi	600+50+10+5
Pattern-2	3	Vietnami koi+ GIFT+ shorpunti	400+10+5

After 120 days, the growth parameters of *H. fossillis* have been observed in different places (Table 2). The maximum sampling weight of *H. fossilis* was recorded as 47 g in R_1 and minimum weight were observed 41.5 g in R_3. The weight gain of *H. fossilis* varied in different places and the higher value (44.2 g) was found in R_1 followed by R_2 (41.2 g) and R_3 (28.2 g). Subsequently the higher SGR, ADG

and HC were found in R_1 followed by R_2 and R_3. The recorded water temperature, Transparency, pH, DO and NH_3 were varied between 32.0 °C and 33.0 °C, 26.5 cm and 27.1 cm, 7.6 and 7.8, 5.4 mg l^{-1} and 6.0 mg l^{-1} and 0.13 mg l^{-1} and 0.16 mg l^{-1} respectively among the three places (Table 3). The values were within the acceptable range for the fish culture

Table 2. Growth performances of *H. fossillis* under polyculture of pattern-1 (after 120 days culture)

Parameters	Multication Testing		
	R_1	R_2	R_3
Stock. dens of shing (indi. dec^{-1})	600	600	600
8^{th} sampling weight (g)	47	44.3	41.5
Weight gain (g)	44.2	41.2	28.2
SGR (% day^{-1})	3.18	3.13	3.08
ADG(g day^{-1})	0.36	0.34	0.32
HC(g cm^{-1})	2.35	2.27	2.12

Table 3. Physiochemical parameters of the experimental ponds under polyculture of *H. fossillis*

Water quality parameters	R_1	R_2	R_3
Temperature (^oC)	32.0±2.5	32.8±3.0	33±2.0
Transparency (cm)	26.5±1.5	26.6±2.0	27.1±1.0
Water pH	7.8±1.0	7.7±1.5	7.6±1.0
DO (mg l^{-1})	6.0±0.5	5.5±0.6	5.4±0.5
NH_3 (mg l^{-1})	0.13±0.01	0.14±0.02	0.16±0.01

After 105 days, the growth parameters of Vietnami koi under polyculture in different places are presented in Table 4. The higher weight was found in R_2 (112 g) rather than R_1 (105 g) and R_3 (100.5 g). Average weight gain was also higher in R_2 (110.8 g) followed by R_1 and R_3. The specific growth rate (SGR) of Vietnamese koi was 4.43, 4.49 and 4.38 respectively in R_1, R_2 and R_3. The value of ADG and HC were higher in R_2 followed by R_1 and R_3. The water quality parameters are presented in Table 5 and the values were within the acceptable range for the fish culture.

Table 4. Growth performances of Vietnami koi under polyculture of pattern-2 (after 105 days culture)

Parameters	Multication Testing		
	R_1	R_2	R_3
Stock. dens. (indi. dec^{-1})	400	400	400
Culture period (months)	04	04	04
Initial length (cm)	3.5	3.5	3.5
Initial weight (g)	1.20	1.20	1.20
7^{th} sampling length (cm)	15.3	16.0	15.0
7^{th} sampling weight (g)	105	112	100.5
Weight gain (g)	103.8	110.8	99.3
SGR (% day^{-1})	4.43	4.49	4.38
ADG(g day^{-1})	0.98	1.05	0.94
HC(g cm^{-1})	6.86	7.0	6.7

Table 5. Physiochemical parameters of the experimental ponds under polyculture of Vietnamese koi

Water quality parameters	R_1	R_2	R_3
Temperature (°C)	30.6±3.0	29.0±3.5	30.5±3.2
Transparency (cm)	27.0±1.0	26.5±2.5	28.0±1.0
Water pH	7.8±0.2	8.0±0.2	7.6±0.1
DO (mg l^{-1})	6.7±0.2	6.8±0.1	6.0 ±0.2
NH_3 (mg l^{-1})	0.16±0.01	0.18±0.02	0.19±0.03

Optimization of breeding and development of culture technology of striped dwarf catfish, *Mystus vittatus*

Researchers: Mrs. Maliha Hossian Mou, Scientific Officer
Dr. Kh. Rashidul Hasan, Senior Scientific Officer
Saokat Ahamed, Scientific Officer

Objectives

- To study brood rearing techniques of *M. vittatus* in captive condition
- To study reproductive parameters of *M. vittatus*
- To determine the reproductive response of *M. vittatus* to different doses of natural and synthetic hormone in captive condition
- To study the effect of stocking density and feeds on the growth and survival of the nursery rearing of *M. vittatus* in pond condition; and
- To assess the growth and yield performance under mono and polyculture system of *M. vittatus*

Achievements

Development of mass seed production technique of M. vittatus in captive condition

The experiment was conducted in hapa (5m×2m×1m) which will set in earthen ponds located at the Bangladesh Fisheries Research Institute, Freshwater Sub-Station, Saidpur. The broods (2♂:1♀) were injected with Ovupin at the rate of 1.5 ml kg^{-1}. After ovulation, broods were transferred and egg release rate, fertilization rate, hatching rate and survivability of hatchling were observed. We found good result in terms of 80% Ovulation rate, 90% eggs release, 75% fertilization and 70% hatching. After absorption of yolk sac, the spawn were fed on boiled egg and live feed up to one week of rearing condition of larvae.

Table 1. Development of mass seed production technique of *M. vittatus* in captive condition

System	Doses ml kg^{-1}	Ovulation rate	% of eggs release	Fertilization rate (%)	Hatching rate (%)	First Feeding
Hapa in earthern pond	Ovupin: 1.5	80%	90	75	70	72 hours after hatching

Growth and yield performance under polyculture system of M. vittatus

The experiment were conducted in six earthen ponds located at the Bangladesh Fisheries Research Institute, Freshwater Sub-Station, Saidpur, Nilphamari for a period of 6 (six) months to observe the growth and yield perfomanes of *M. vittatus* under polyculture system in captive condition. Nine ponds were selected for this experiment. Nine ponds divided into three groups. Each group was considered as one treatment e.g. treatment-I (T_1), treatment-II (T_2), treatment-III (T_3) and each pond considered as one replication. The ponds were 5-6 decimal in size. The experimental ponds were prepared by dewatering and liming (1 kg dec^{-1}). After 7 days of liming, the ponds were filled with water and then organic (5-6 kg dec^{-1}) and inorganic (100 g dec^{-1} urea & 75 g dec^{-1} TSP) fertilizer applied to grow phytoplankton and zooplankton. The fingerling of tengra, GIFT and sharputi were stocked as per experimental design (Table 02). Length and weight data have been collected fortnightly and average daily growth (ADG), specific growth rate (SGR), health condition (HC) are being calculated. Water quality parameters *viz.*, Temperature, pH, DO, CO_2, NH_3 etc. are also been collected fortnightly.

Table 2. Experimental design of polyculture of *M. vittatus*

Treatments	Species combination	Stocking size (cm)	Stocking density (individual dec^{-1})	Feeding/culture period
T_1	Tengra+GIFT+Sharputi	5, 5-6, 7-10	500+25+15	Commercially available cat fish Feed (containing 30-35% protein) Application:-10-5%, twice daily
T_2			600+25+15	
T_3			700+25+15	

Table 3. The growth and yield performance of tengra under polyculture system

Parameters	T_1	T_2	T_3
Initial length (cm)	5.4	5.4	5.4
8^{th} sampling length (cm)	10	9.7	9.5
Initial weight (g)	2.0	2.0	2.0
8^{th} sampling weight (g)	12.0	11.2	10.4
Weight gain (g)	10	9.2	8.4
ADG (g day^{-1})	0.08	0.07	0.07
SGR (% day^{-1})	2.02	1.96	1.89
HC (g cm^{-1})	1.2	1.15	1.09

After 120 days, the growth parameters viz., ADG, SGR and HC are presented in Table 3. The higher growth was found in T_1 (12 g) followed by T_2 (11.2 g) and T_3 (10.4 g). The average weight gain was also higher in T_1 (10 g) than that of T_2 and T_3. The SGR of *M. vittatus* was 2.02, 1.96 and 1.89 in T_1, T_2 and T_3 respectively. The ADG was found higher in T_1 than other treatments. The HC was found higher in T_1 than T_2 and T_3.

Population Dynamics and Stock Assessment of Hilsa, *Tenualosa ilisha* in Bangladesh

Researchers: Dr. Mohammad Ashraful Alam, Senior Scientific Officer
Tayfa Ahmed, Senior Scientific Officer
Flura, Senior Scientific Officer
Md. Mehedi Hasan Pramanik, Scientific Officer
Md. Monjurul Hasan, Scientific Officer

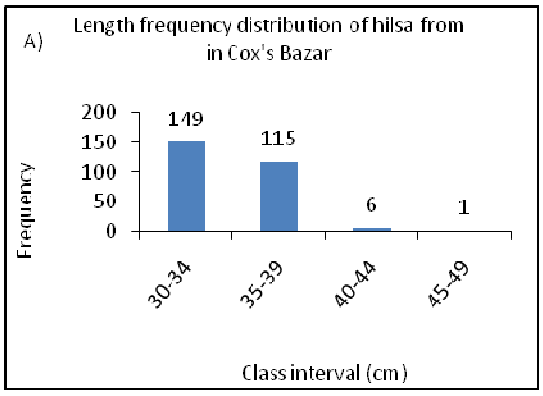
Objectives

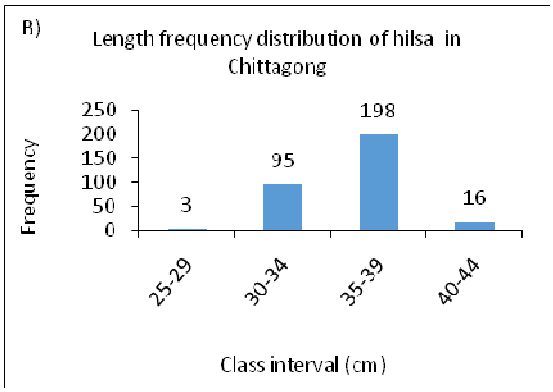
- To assess the population parameters of hilsa at different regions of Bangladesh.
- Study on the Virtual Population Analysis (VPA) of hilsa and
- To estimate the MSY and Biomass of hilsa

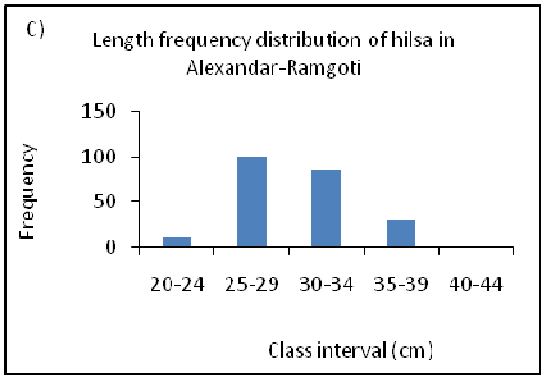
Achievements

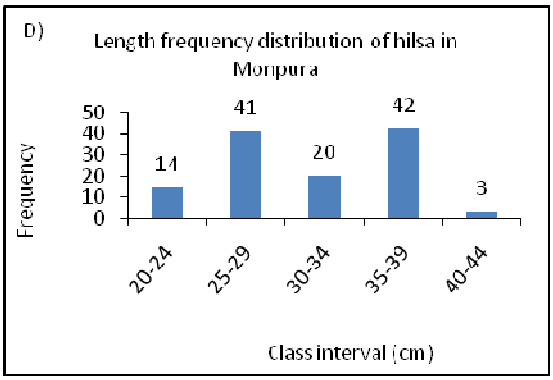
Population parameters of Hilsa

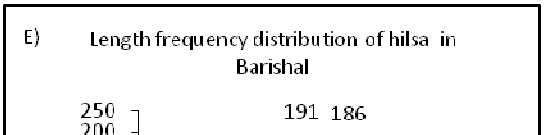
Length frequency distribution: Monthly length-weight data of Hilsa, *T. ilisha* has been collected from the selected sampling locations. Till to date a total of 7836 specimen's data have collected. Collected data were pooled together in Microsoft Excel Spread Sheet to analyze through Microsoft Excel Analytical Toolpak. Length frequency distributions (LFDs) of Hilsa were constructed using 5 cm intervals of TL. The LFDs exhibits considerable regional variations. In most of the places, (25-40 cm) sized Hilsa were more predominant than the other sized classes except Godagari and Chandpur (Fig 1 A-K).

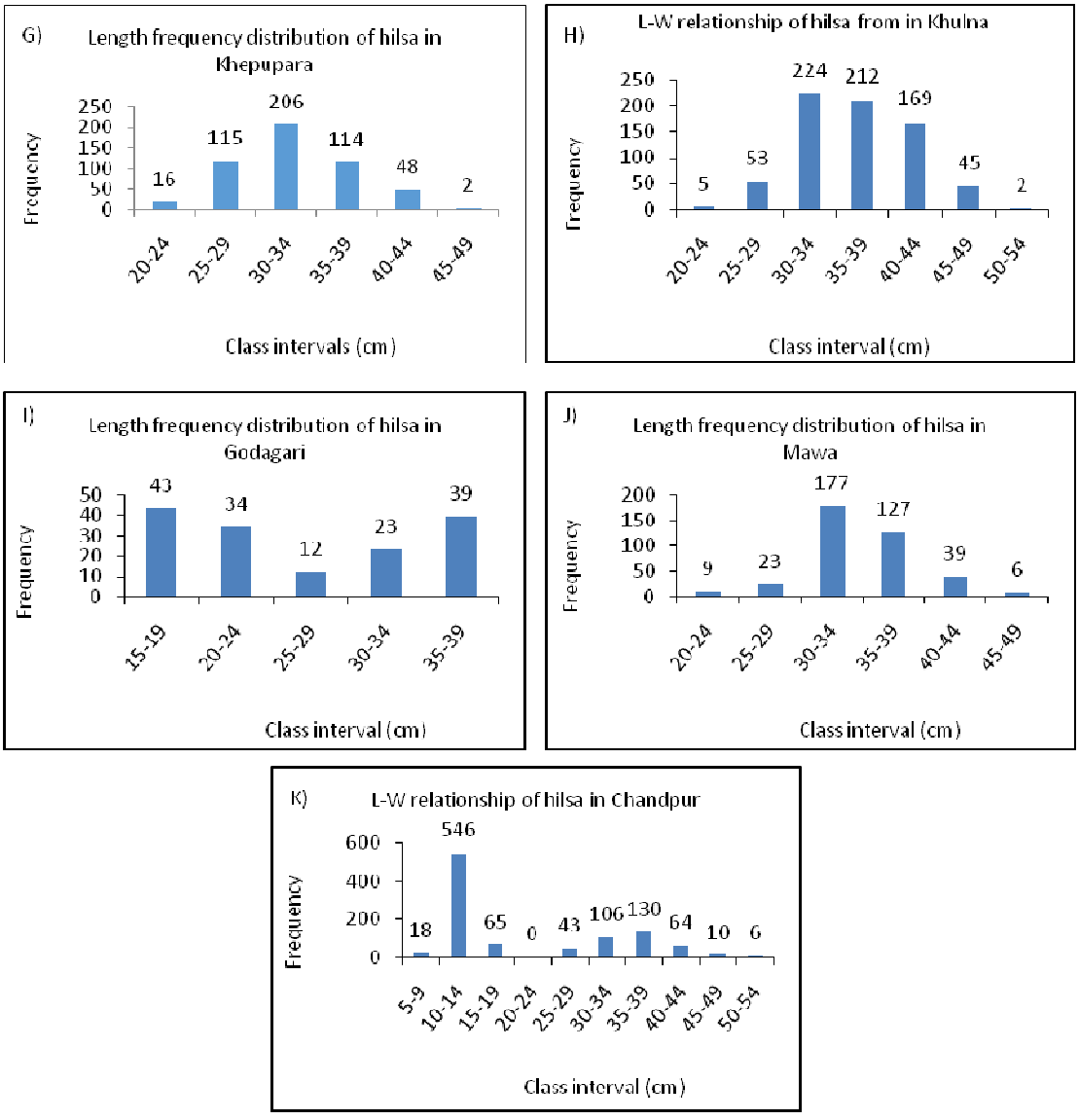












Figs. 1 (A-K). Length frequency distribution of Hilsa in different sampling locations.

Length-Weight relationship: For each individual, total length (TL) and total body weight (BW) were taken using measuring tape and an electronic balance. The length-weight relationship (LWR) was calculated using the equation: $BW = a \times TL^b$, where BW is the total body weight (g) and TL is the total length (cm). The parameters "a" and "b" were estimated by linear regression analyses based on natural logarithms: $\ln (W) = \ln (a) + b \ln (L)$. Additionally, 95% confidence intervals of "a" and "b" and the co-efficient of determination (r^2) were estimated. In general, the b values in LWRs should

remain within a range of 2.5–3.5 (Froese 2006). In the present study, all b values fell within this expected range (Table 1).

Table 1. Length–weight relationship parameters (y = a + b * x) of *T. ilisha* from the selected sampling locations

Locations	n	Equation	Regression parameters		95% CI of a	95% CI of b	r^2
			a	b			
Cox's Bazar	750	$W = 0.01TL^{3.17}$	0.01	3.17	-886.69 to-789.85	34.97 to 37.75	0.78
Chittagong	681	$W= 0.03TL^{2.72}$	0.03	2.72	-621.23 to -552.62	27.99 to 30.00	0.82
Alexander-Ramgoti	467	$W = 0.02TL^{2.83}$	0.02	2.83	-626.45 to -546.40	28.00 to 30.61	0.81
Monpura	419	$W = 0.01TL^{3.12}$	0.01	3.12	-721.56 to -662.72	32.28 to 34.13	0.92
Barishal	959	$W = 0.01TL^{3.16}$	0.01	3.16	-813.63 to -765.10	35.35 to 36.77	0.913
Pathargata	930	$W = 0.01TL^{3.13}$	0.01	3.13	-1013.31 to -958.86	40.65 to 42.17	0.93
Mohipur-Khepupara	780	$W = 0.01TL^{3.03}$	0.01	3.03	-738.48 to -689.73	32.41 to 33.92	0.91
Khulna	826	$W=0.01TL^{3.12}$	0.01	3.12	-1016.82 to -964.50	41.61 to 43.10	0.94
Godagari	255	$W = 0.01TL^{3.12}$	0.01	3.12	-405.27 to -361.64	22.31 to 23.91	0.93
Mawa	720	$W = 0.01TL^{3.12}$	0.01	3.12	-1038.35 to -943.45	40.87 to 43.66	0.83
Chandpur	1049	$W = 0.01TL^{3.04}$	0.01	3.04	-283.76 to -261.38	21.66 to 22.57	0.90

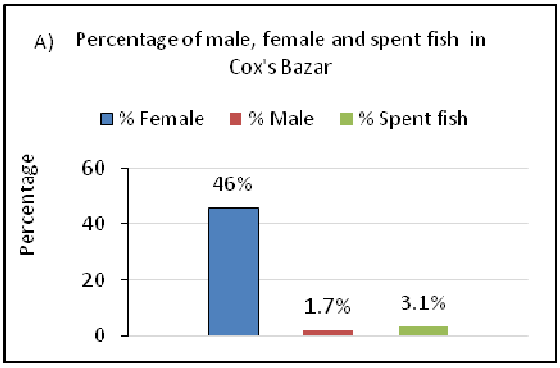
Condition factors: Four different types of condition factors were calculated from the collected data. The allometric condition factor (K_A) was calculated as BW/TL^b (Tesch 1968). Fulton's condition factor (K_F) was calculated using Fulton's equation (1904): $K_F = 100 \times (BW/TL^3)$. Furthermore, the relative condition factor (K_R) was calculated following Le Cren (1951): $K_R = BW/ (a \times TL^b)$. The relative weight ($W_R$) was calculated according to the formula: $WR = (W/Ws) \times 100$, where W is the BW of a specific specimen and Ws is the predicted standard weight of that specimen calculated by the formula $Ws = a \times L^b$ (Froese 2006). In all the cases, a and b are parameters of LWRs. Based on the data collected till to date, negative to positive allometric growth of hilsa was observed with regional discrepancies (Table 2). However, this indication may be changed if data are collected all the year round.

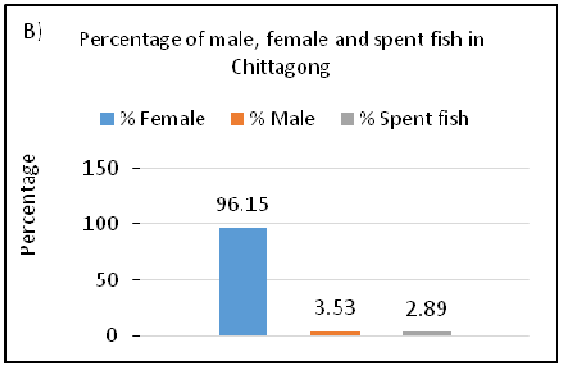
Table 2. Condition factors of *T. ilisha* in different regions of Bangladesh

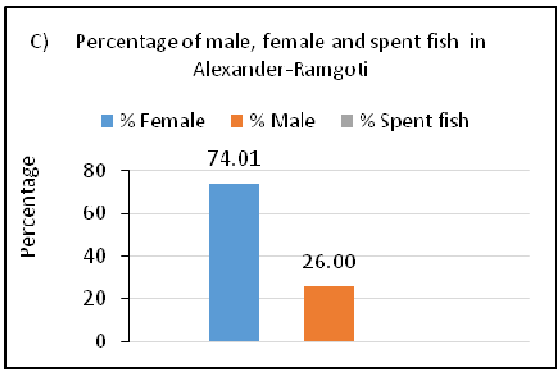
Place	K_A (Mean±SD)	K_F (Mean±SD)	K_R (Mean±SD)	W_R (Mean±SD)
Cox's Bazar	0.01±0.00	0.99±0.14	1.08±0.15	107.64±15.35
Chittagong	0.03±0.00	0.98±0.14	1.03±0.15	103.11±14.56
Alexander-Ramgoti	0.02±0.00	1.03±0.18	1.01±0.18	101.28±17.86
Monpura	0.01±0.00	1.02±0.14	0.98±0.13	97.63±12.90
Barishal	0.01±0.00	1.02±0.10	0.96±0.09	96.17±9.28
Pathargata	0.01±0.00	1.03±0.10	0.93±0.09	93.40±9.44
Mohipur-Khepupara	0.01±0.00	0.99±0.11	0.99±0.11	99.07±10.87
Khulna	0.01±0.00	0.70±0.07	1.01±0.11	100.58±10.63
Godagari	0.01±0.00	0.99±0.13	0.95±0.12	94.74±12.16
Mawa	0.01±0.00	1.02±0.17	1.10±0.18	109.66±17.92
Chandpur	0.01±0.00	0.90±0.14	1.00±0.16	99.56±15.74

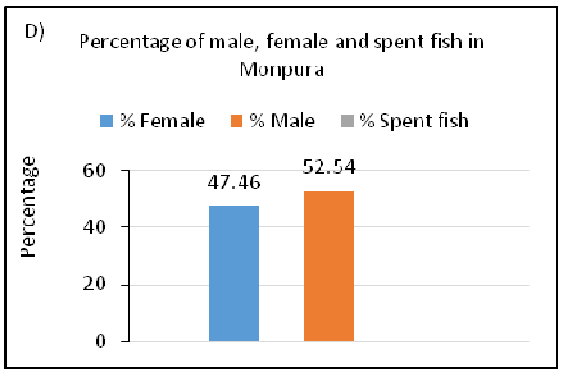
Sex Ratio and Percentage of Spent Fish: The percentage of female, male and spent fish also exhibited considerable variations in different sampling locations. In all locations, the percentage of female was

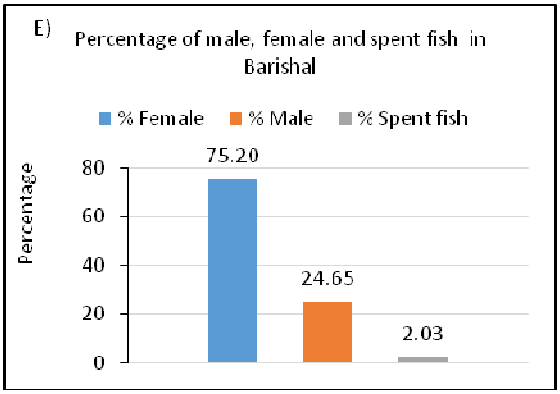
higher than the male except in Monpura. The percentage of spent Hilsa was lower than 5% in all sampling stations (Fig. 2 A-K).

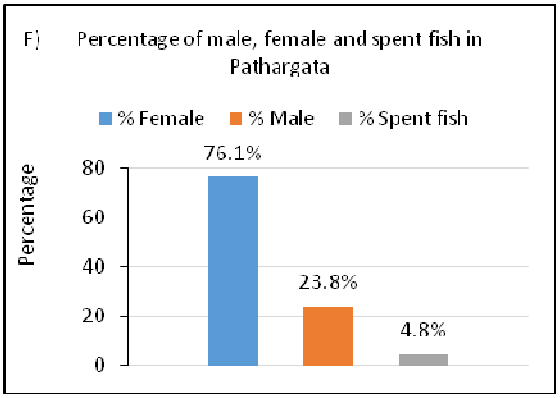


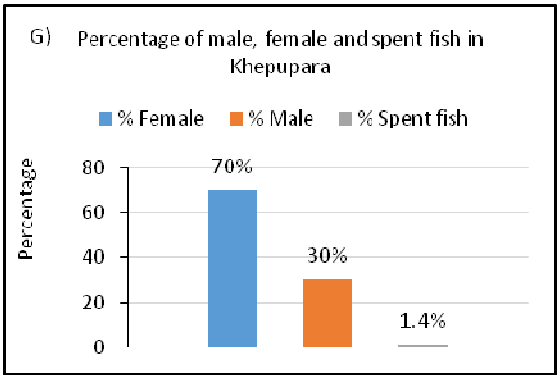


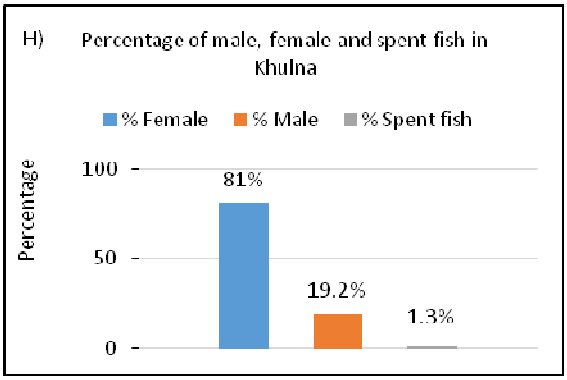












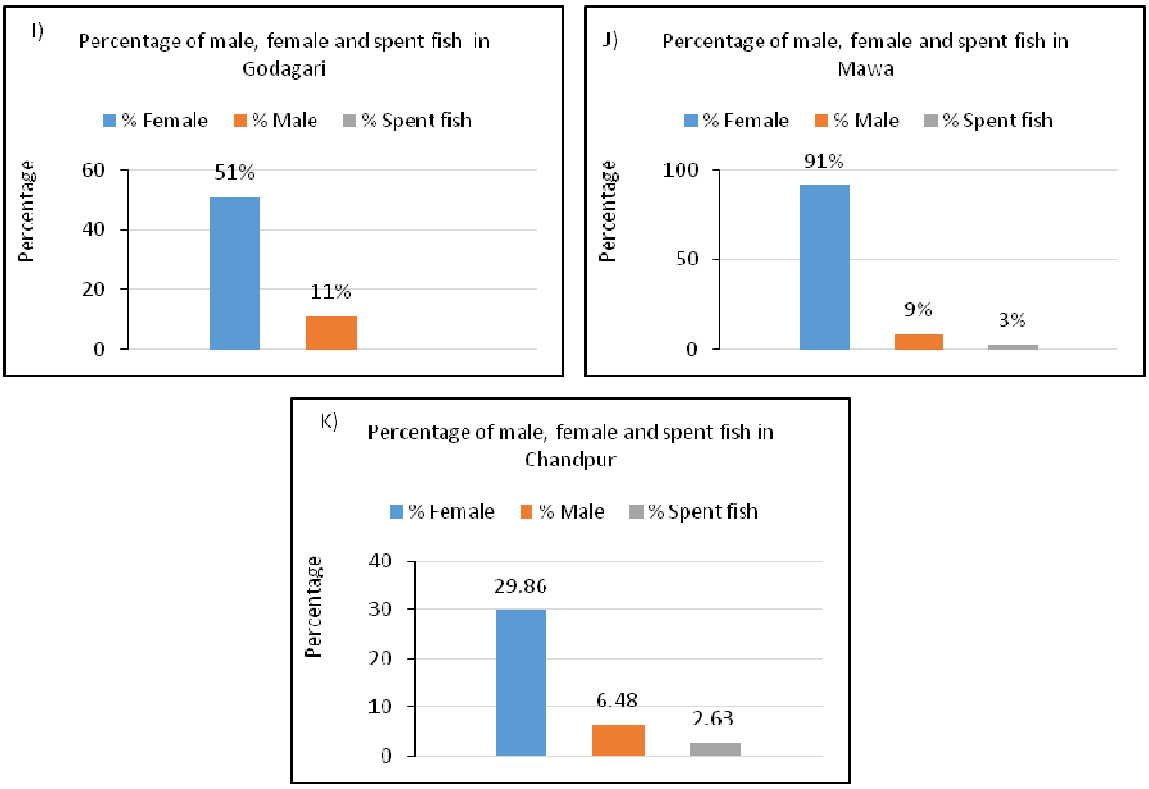


Fig. 2 (A-K). Percentage of female, male and spent Hilsa in different sampling locations

Effect of Climate Change on the Ecology and Biodiversity of Inland Open Water Fishes

Researchers: Tayfa Ahmed, SSO
Md. Mehedi Hasan Pramanik, SO
Md. Istiaque Haidar, SO
Aovijite Bosu, SO

Objectives

- To study the effects of climatic factors and their associated events on the riverine ecology and biodiversity of fish
- To develop a salinity intrusion map for the river Meghna, lower Meghna, Tentulia, and Agunmukha describing the potential impacts on riverine ecology and fish biodiversity

Achievements

Physico-Chemical Parameters: Parameters such as temperature (air & water), transparency, dissolved oxygen, free carbon dioxide, pH, total alkalinity, total hardness, salinity and availability of fish species were recorded from market survey on a monthly basis. The maximum, minimum and average values of water quality parameters are shown in the following tables (Tables 1-3) respectively.

Table 1. Water temperature (^{0}C) in different sampling sites of 2017-2018

Sampling sites	Water Temp (^{0}C)		
	Max	Min	Avg
Shatnol	31	15	24.20
Chandpur	32	14	23.23
Haimchar	30	16	23.45
Char Bhoirobi	31	17.6	24.54
Char Lodhua	32	18	24.78
Char Alexzander	31	18	23.63
Ramgoti	33	19	25.25
Hijla	31	18	24.18
Kaligonj	33	19	25.13
Ilisha Ghat	29	19	23.54
Dhulia	33	17	24.72
Kaliya	31	18	24.26
Charipara	32	23.5	27.20
Mohipur	31	22.9	26.75

Table 2. Dissolved Oxygen (mg/l) in different sampling sites of 2017-2018

Sampling sites	Dissolved Oxygen (mg/l)		
	Max	Min	Avg
Shatnol	6	4.8	5.35
Chandpur	6.5	4.5	5.61
Haimchar	7	4.7	5.71
Char Bhoirobi	6.5	4.9	5.71
Char Lodhua	6.5	4.6	5.69
Char Alexzander	7	4.9	5.79
Ramgoti	7	5.5	6.40
Hijla	7	5	5.89
Kaligonj	6.5	4.8	5.69
Ilisha Ghat	6.5	5	5.56
Dhulia	5.5	4.5	5.18
Kaliya	7	4.9	5.52
Charipara	6.8	5.1	5.70
Mohipur	6	4.5	5.41

Table 3. pH in different sampling sites of 2017-2018

Sampling sites	pH		
	Max	Min	Avg
Shatnol	8	7	7.58
Chandpur	8	7.5	7.83
Haimchar	8	7.5	7.83
Char Bhoirobi	8	7.5	7.71
Char Lodhua	8.5	7	7.80
Char Alexzander	8	7.5	7.65
Ramgoti	8	7.5	7.80
Hijla	8	7.75	7.88
Kaligonj	8.5	7.5	7.91
Ilisha Ghat	8	7.5	7.80
Dhulia	8	7.5	7.77
Kaliya	8	7	7.66
Charipara	9	7.5	8.07
Mohipur	8	7.5	7.89

Relatively highest average air temperature was recorded at Ramgoti (27.79^{O}C) and the lowest in Chandpur (25.76)^{O}C whereas the highest average water temperature was in Chariparar (27.20)^{O}C and lowest in Chandpur (23.23)^{O}C among the sampling points compared to others (Table 1). High humidity and distance from sea considered to be the main reason for higher temperature. During the sampling period the range of average dissolved oxygen was recorded from 5.18- 6.40 mg/l was also suitable for fishes (Table 2). The average pH value was found in congenial level (7.58-8.07) for fishes almost all the sampling sites of the rivers (Table 3).

Salinity intrusion in fresh water: During the study period, the highest range of salinity was recorded at Ramgoti (1-12.5 ppt.) followed by Char Alexzander (1-11 ppt.) and Char Ludhua (0.5-8 ppt.) in dry season (December-May) of each sampling year (Fig.1) in River Meghna. However, the salinity (0.1 ppt) was also found to intrude up to Harina Ghat point of Chandpur in 2016. The salinity intrusion was observed which covering gradually from the lower reaches to upper reaches of River Meghna and stayed around half of the year during dry season from December to April which might create unfavorable environment for fresh water fishes in course of time. On the other hand the highest salinity was observed at Mohipur (15 ppt.) in the River Agunmukha in April, 2018 and it was very high comparison to other sampling points. It might be mainly due to strong tidal action and nearer to the sea.

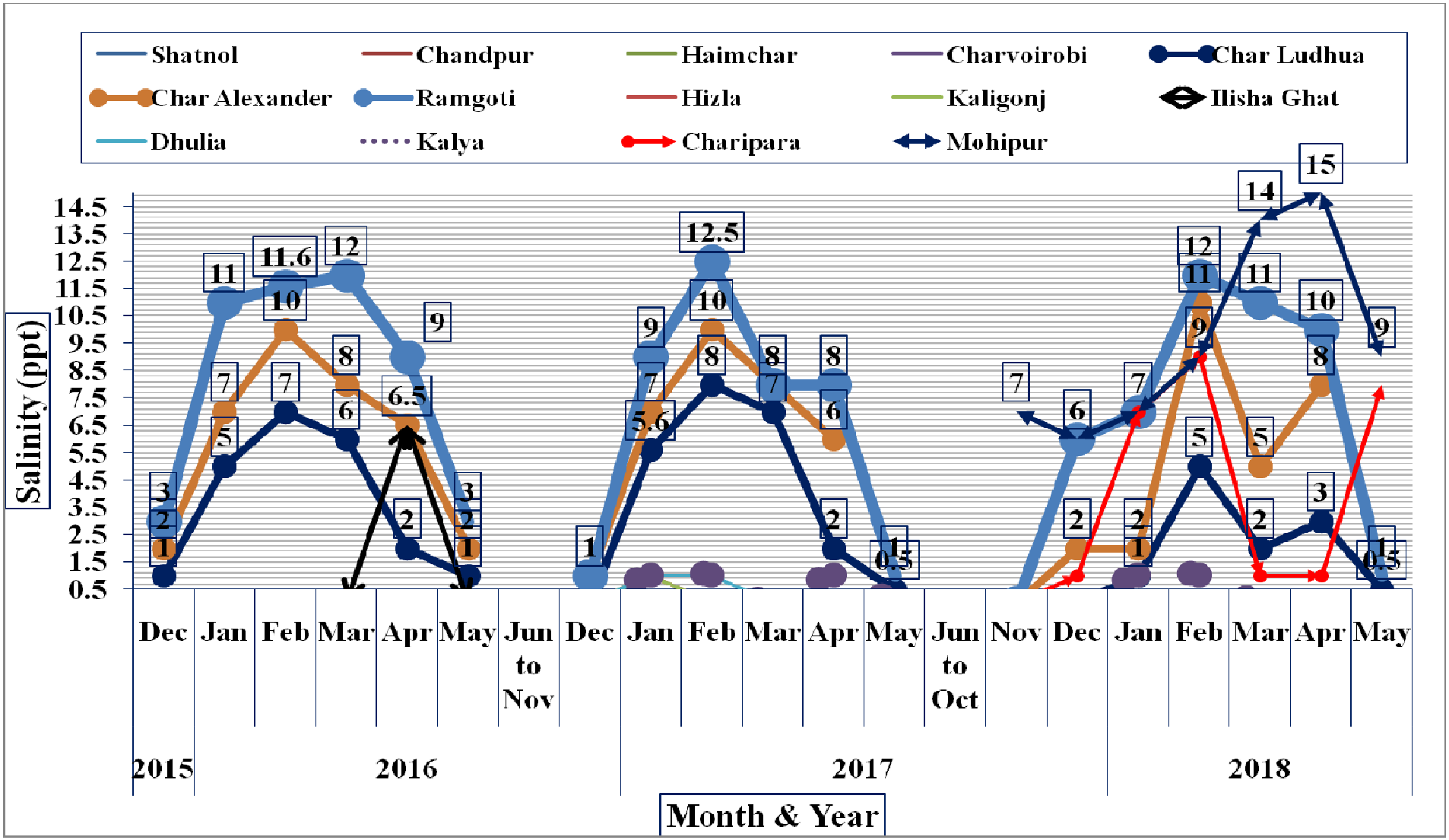


Fig. 1. Location wise year round Salinity (ppt) from December 2015-May 2018

Table 4. Year wise salinity level in sampling sites of river Meghna, Tentulia and Agunukh

River	Sampling sites	Nov			Dec			Jan			Feb			Mar			Apr			May		
		2015	2016	2017	2015	2016	2017	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018	2016	2017	2018
Meghna	Shatnol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chandpur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Harina ghat	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0
	Char Bhoirobi	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0
	Char ludhua	0	0	0	1	0	0	5	5.6	1	7	8	5	6	7	2	2	2	3	1	.5	.5
	Char Alexzander				2	1	2	7	7	2	10	10	11	8	8	5	6.5	6	8	2	0	0
	Ramgoti				3	1	6	11	9	7	11.6	12.5	12	12	8	11	9	8	10	3	1	1
	Hizla	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Kaligang	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Illisha ghat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tentulia	Dhulia																					
	Kaliya																					
Agunmukha	Charipara			0			1			1			1			1			1			8
	Mohipur			7			6			7			9			14			15			9

Fish diversity: Data on availability of fish species were collected by interviewing and visiting fisher and fish markets. Based on observation there is no fish species which is extinct from the river but amount of catch is decreasing day by day.

Table 5. Fish Species Recorded from the Sampling Sites in the River Meghna, Tetulia and Agunmukha

Sampling Sites	Fish Species (Fishbase Name and Local Name)	
	Major Species	Minor Species
Shatnol	Ilish (*Tenualosa ilisha*), Bele (*Glossogobius giuris*), Tengra (*Mystus tengara*), Sada Cheuya (*Trypauchen vagina*), Lal Cheuya (*Odontamblyopus rubicundus*), Ayre (*Mystus aor),* Guizza Ayre (*Mystus seenghala*), Jatka (*Tenualosa ilisha*), Shilong (*Silonia silondia*), Bacha (*Eutropiichthys vacha*), Garua (*Clupisoma garua*), Boal (*Wallago attu*) = (12)	Keski (*Corica soborna*), Chapila (*Gudusia chapra*) = (2)
Chandpur	Ilish (*Tenualosa ilisha*), Sal Baim (*Mastacembelus armatus*), Tara Baim (*Macrognathus aculeatus*), Guchi (*Mastacembelus pancalus*), Sada Cheuya (*Trypauchen vagina*), Lal Cheuya (*Odontamblyopus rubicundus*), Ayre (*Mystus aor)*, Guizza Ayre (*Mystus seenghala*), Boal (*Wallago attu*), Shilong (*Silonia silondia*), Bacha (*Eutropiichthys vacha*), Garua (*Clupisoma garua*), Jatka (*Tenualosa ilisha*), Bele (*Glossogobius giuris*), Pangas (*Pangasius pangasius*), Rita (*Rita rita*), Poa (*Otolithoides pama)* = (17)	Keski (*Corica soborna*), Chapila (*Gudusia chapra*), Tengra (*Mystus tengara*), Gutum (*Lepidocephalus guntea*), Topshi (*Polynemus paradiseus)* = (6)
Horina Ghat	Ilish (*Tenualosa ilisha*), Sal Baim (*Mastacembelus armatus*), Tara Baim (*Macrognathus aculeatus*), Guchi (*Mastacembelus pancalus*), Sada Cheuya (*Trypauchen vagina*), Lal Cheuya (*Odontamblyopus rubicundus*), Ayre (*Mystus aor*), Guizza Ayre (*Mystus seenghala*), Boal (*Wallago attu*), Shilong (*Silonia silondia*), Bacha (*Eutropiichthys vacha*), Garua (*Clupisoma garua*), Jatka (*Tenualosa ilisha*), Bele (*Glossogobius giuris*), Pangas (*Pangasius pangasius*), Rita (*Rita rita*), Poa (*Otolithoides pama*) = (17)	Keski (*Corica soborna*), Chapila (*Gudusia chapra*), Tengra (*Mystus tengara*), Gutum (*Lepidocephalus guntea*), Topshi (*Polynemus paradiseus*) = (5)
Char Bhoirobi	Ilish (*Tenualosa ilisha*), Sal Baim (*Mastacembelus armatus*), Tara Baim (*Macrognathus aculeatus*), Guchi (*Mastacembelus pancalus*), Sada Cheuya (*Trypauchen vagina*), Lal Cheuya (*Odontamblyopus rubicundus*), Ayre (*Mystus aor*), Guizza Ayre (*Mystus seenghala*), Boal (*Wallago attu*), Shilong (*Silonia silondia*), Bacha (*Eutropiichthys vacha*), Garua (*Clupisoma garua*), Jatka (*Tenualosa ilisha*), Bele (*Glossogobius giuris*), Pangas (*Pangasius pangasius*), Rita (*Rita rita*), Poa (*Otolithoides pama*), Khorolla (*Rhinomugil corsula*) = (18)	Chapila (*Gudusia chapra*), Tengra (*Mystus tengara*), Gutum (*Lepidocephalus guntea*), Topshi (*Polynemus paradiseus*) = (4)
Char Ludhua	Ilish (*Tenualosa ilisha*), Sal Baim (*Mastacembelus armatus*), Tara Baim (*Macrognathus aculeatus*), Guchi (*Mastacembelus pancalus*), Sada Cheuya (*Trypauchen vagina*), Lal Cheuya (*Odontamblyopus rubicundus*), Ayre (*Mystus aor*), Guizza Ayre (*Mystus seenghala*), Boal (*Wallago attu*), Shilong (*Silonia silondia*), Bacha (*Eutropiichthys vacha*), Garua (*Clupisoma garua*), Jatka (*Tenualosa ilisha*), Bele (*Glossogobius giuris*), Pangas (*Pangasius pangasius*), Keski (*Corica soborna*), Chapila (*Gudusia chapra*), Topshi (*Polynemus paradiseus*), Poa (*Otolithoides pama)*, Khorolla (*Rhinomugil corsula*). PL of Golda (*Macrobrachium rosenbergii*), Golda (*Macrobrachium rosenbergii*), Rita (*Rita rita*) = (23)	Sada Cheuya (Trypauc*hen v*agina), Lal Cheuya (*Odontamblyopus rubicun*dus), Tular Dandi (*Sillaginopsis panijus*), Kukur jib (*Cynoglossus cynoglos*sus), Tengra (*Mystus tengara*) = (6)

Char Alexander	Ilish (*Tenualosa ilisha*), Bele (*Glossogobius giuris*), Shilong (*Silonia silondia*), Bacha (*Eutropiichthys vacha*), Garua (*Clupisoma garua*),, Keski (*Corica soborna*), Jatka (*Tenualosa ilisha*), Kukur jib (*Cynoglossus cynoglossus*), Topshi (*Polynemus paradiseus*), Poa (*Otolithoides pama*), PL of Golda (*Macrobrachium rosenbergii*), Golda (*Macrobrachium rosenbergii*), Khorolla (*Rhinomugil corsula*), Ayre (*Mystus aor*), Guizza Ayre (*Mystus seenghala*), Pangas (*Pangasius pangasius*), Rita (*Rita rita*) = (17)	Chapila (*Gudusia chapra*), Tengra (*Mystus tengara*), Sada Cheuya (*Trypauchen vagina*), Lal Cheuya (*Odontamblyopus rubicundus*) = (4)
Ramgoti	Ilish (*Tenualosa ilisha*), Bele (*Glossogobius giuris*), Shilong (*Silonia silondia*), Bacha (*Eutropiichthys vacha*), Garua (*Clupisoma garua*), Jatka (*Tenualosa ilisha*), Poa (*Otolithoides pama*), PL of Golda (*Macrobrachium rosenbergii*), Golda (*Macrobrachium rosenbergii*), Khorolla (*Rhinomugil corsula*), Ayre (*Mystus aor*), Guizza Ayre (*Mystus seenghala*), Pangas (*Pangasius pangasius*), Rita Rita (*Rita rita*), Vetki (*Lates calcarifer*),Gang magur (*Plotosus canius*) Tular Dandi (*Sillaginopsis panijus*) = (17)	Choto Bele (*Eleotris fusca*), Keski (*Corica soborna*), Chapila (*Gudusia chapra*), Kukur jib (*Cynoglossus cynoglossus*), Topshi (*Polynemus paradiseus*) = (5)
Ilisha Ghat	Ilish (*Tenualosa ilisha*), Bele (*Glossogobius giuris*), Shilong (*Silonia silondia*), Bacha (*Eutropiichthys vacha*), Garua (*Clupisoma garua*), Jatka (*Tenualosa ilisha*), Poa (*Otolithoides pama*), Khorolla (*Rhinomugil corsula*), Ayre (*Mystus aor*), Guizza Ayre (*Mystus seenghala*), Boal (*Wallago attu*), Pangas (*Pangasius pangasius*), Rita (*Rita rita*), Vetki (*Lates calcarifer*), Poa (*Otolithoides pama*), Tular Dandi (*Sillaginopsis panijus*) = (16)	Choto Bele (*Eleotris fusca*), Keski (*Corica soborna*), Chapila (*Gudusia chapra*), Kukur jib (*Cynoglossus cynoglossus*), Topshi (*Polynemus paradiseus*), Tengra (*Mystus tengara*), Sada Cheuya (*Trypauchen vagina*), Lal Cheuya (*Odontamblyopus rubicundus*) = (8)
Hijla	Ilish (*Tenualosa ilisha*), Bele (*Glossogobius giuris*), Shilong (*Silonia silondia*), Bacha (*Eutropiichthys vacha*), Garua (*Clupisoma garua*), Jatka (*Tenualosa ilisha*), Poa (*Otolithoides pama*), Khorolla (*Rhinomugil corsula*), Ayre (*Mystus aor*), Guizza Ayre (*Mystus seenghala*), Boal (*Wallago attu*), Pangas (*Pangasius pangasius*), Rita (*Rita rita*), Vetki (*Lates calcarifer*), Poa (*Otolithoides pama*), Tular Dandi (*Sillaginopsis panijus*), Topshi (*Polynemus paradiseus*), Sada Cheuya (*Trypauchen vagina*), Lal Cheuya (*Odontamblyopus rubicundus*) , Golda (*Macrobrachium rosenbergii*), Kukur jib (*Cynoglossus cynoglossus*) = (21)	Tengra (*Mystus tengara*), Chapila (*Gudusia chapra*) = (2)
Kaligonj	Ilish (*Tenualosa ilisha*), Bele (*Glossogobius giuris*), Shilong (*Silonia silondia*), Bacha (*Eutropiichthys vacha*), Garua (*Clupisoma garua*), Jatka (*Tenualosa ilisha*), Poa (*Otolithoides pama*), Khorolla (*Rhinomugil corsula*), Ayre (*Mystus aor*), Guizza Ayre (*Mystus seenghala*), Boal (*Wallago attu*), Pangas (*Pangasius pangasius*), Rita (*Rita rita*), Vetki (*Lates calcarifer*), Poa (*Otolithoides pama*), Tular Dandi (*Sillaginopsis panijus*), Topshi (*Polynemus paradiseus*), Golda (*Macrobrachium rosenbergii*), Kukur jib (*Cynoglossus cynoglossus*), Chapila (*Gudusia chapra*) = (20)	Chota Baila (*Eleotris fusca*), Tengra (*Mystus tengara*), Sada Cheuya (*Trypauchen vagina*), Lal Cheuya (*Odontamblyopus rubicundus*) = (4)
Dhulia	Ilish (*Tenualosa ilisha*), Shilong (*Silonia silondia*), Chapila (*Gudusia chapra*), Tular Dandi (*Sillaginopsis panijus*), Vetki (*Lates calcarifer*), Boal (*Wallago attu*), Pangas (*Pangasius pangasius*), Rita (*Rita rita*), Poa (*Otolithoides pama*) Khorolla (*Rhinomugil corsula*), Ayre (*Mystus aor*), Kukur jib (*Cynoglossus cynoglossus*) = 12	Tengra (*Mystus tengara*), Chapila (*Gudusia chapra*) = (2)

Kaliya	Ilish (*Tenualosa ilisha*), Shilong (*Silonia silondia*), Chapila (*Gudusia chapra*), Tular Dandi (*Sillaginopsis panijus*), Vetki (*Lates calcarifer*) , Boal (*Wallago attu*), Pangas (*Pangasius pangas*ius), Rita (*Rita rita*), Poa (*Otolithoides pama*) Khorolla (*Rhinomugil corsula*), Ayre (*Mystus aor*), Kukur jib (*Cynoglossus cynoglossus*) = 12	Choto Bele (*Eleotris fusca*), Keski (*Corica soborna*), Chapila (*Gudusia chapra*), Topshi (*Polynemus paradiseus*) = (4)
Charipara	Ilish (*Tenualosa ilisha*), Jatka (*Tenualosa ilisha*), Poa (*Otolithoides p*ama), Phasa (*Setipinna phasa*), Olua (*Colia dussumier*i), Khorolla (*Rhinomugil corsula*), Topsh (*Polynemus paradiseus*), Vetki (*Lates calcarifer*), Ayre (*Mystus aor*), Boal (*Wallago attu*), Pangas (*Pangasius pangasius*), Kukur jib (*Cynoglossus cynoglossus*), Gang tengra (*Gagata gagata*), Potka (*Tetraodon cutcutia*)	
Mohipur	Ilish (*Tenualosa ilisha*), Jatka (*Tenualosa ilisha*), Poa (*Otolithoides pama*), Phasa (*Setipinna phasa*), Olua (*Colia dussumier*i), Khorolla (*Rhinomugi corsula*), Topsh (*Polynemus paradiseus*), Kukur jib (*Cynoglossus cynoglos*sus), Gang tengra (*Gagata gagata*), Potka (*Tetraodon cutcutia*),	

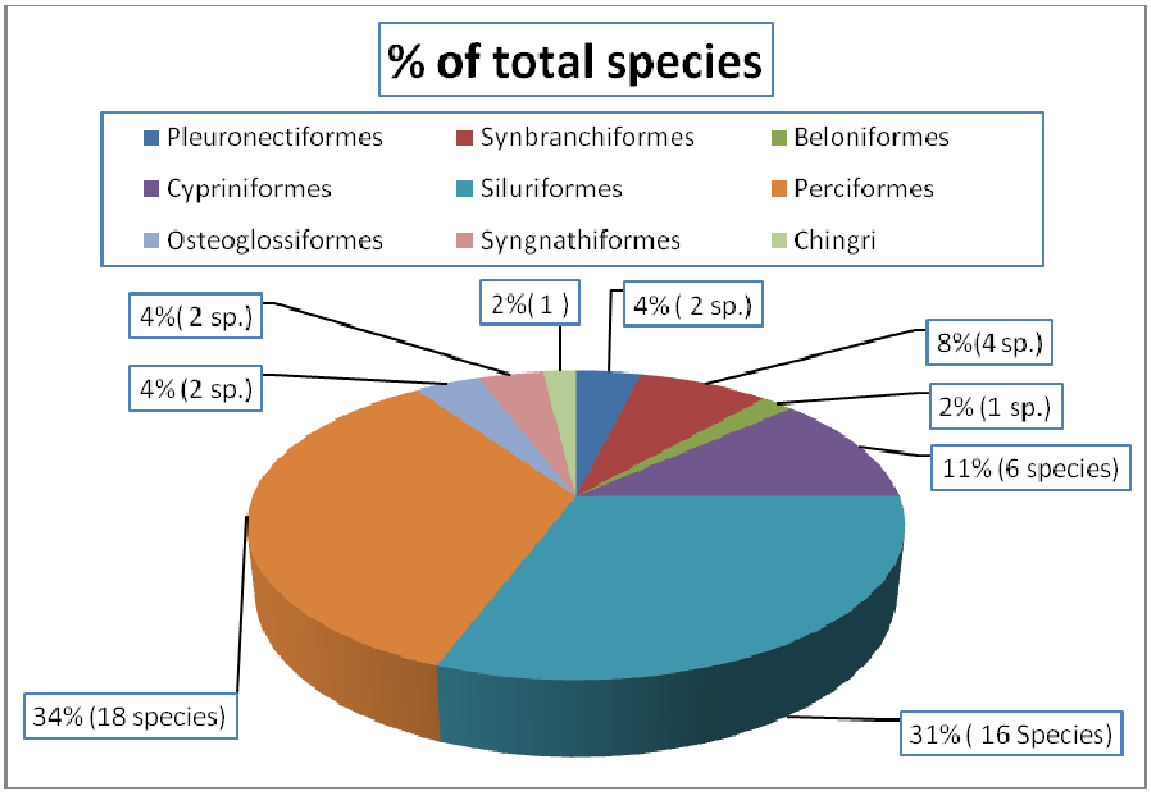


Fig. 2. Percentage (%) of fish species in River Meghna

Fishes of Perciformes (34%) were the larger group followed by Siluriformes (31%), Cypriniformes (11%), Synbranchiformes (8%), Pleuronectiformes (4%), Osteoglossiformes (4%), Syngnathiformes (4%), Beloniformes (2%) and Arthopoda/Chingri (2%) during the observation period in the sampling sites of the River Meghna in the year 2017-2018. No remarkable differences in terms of fish species were evident among three consecutive years.

Optimization of Breeding and Seed Production Techniques of *Pangasius pangasius*

Researchers: Mrs. Akhery Nima, Senior Scientific Officer
Md. Mehedi Hasan Pramanik, Scientific Officer
Aovijite Bosu, Scientific Officer
Md. Monjurul Hasan, Scientific Officer

Objectives

- To optimize the induced breeding technique of *P. pangasius*
- To develop nursery technique of *P. pangasius* depending on successful breeding

Achievements

Brood management and selection

A total of 30 hatchery-produced brood Pangas (*Pangasius pangasius*), ranges from 5 to 8 kg, were reared in a pond having an area of 30 decimal. Water depth was maintained at 1.5 to 2.0 m. For sufficient dissolved oxygen in water, aeration was provided to the pond through a paddle wheel aerator for a period of 4 hours daily. Aeration was provided 2 hours at day time and 2 hours at night time. Water quality parameters were found suitable for raising broods in ponds (Tables 1 & 2). In the brood pond ratio of male and female was maintained at 1:1.5. Ground water was supplied regularly to the rearing ponds to maintain water quality and water depth at optimum level. In a separate pond of 25 decimal, a total of 30 wild broods, ranging from 5-7 kg in weight, were reared with commercially available supplementary feed at the rate of 3% body weight once daily. These broods were collected from the River Meghna near Chandpur from the commercial catch. From February to August, health of the brood fishes was checked regularly to assess gonadal maturity by examining the colour and shape of genital opening and softness of the belly. Ten pairs of brood Pangas were selected from the RS produced stock on the basis of secondary sex characters. For augmenting and proper gonadal development two priming doses of PG were applied intramuscularly in each pair of fish. Both the 1st and 2nd doses of PG were applied 1 mg /kg and 2 mg/kg of body weight for male and female respectively. 1st priming dose was applied at the end of February while the 2nd one was applied at the end of March.

Table 1. Water quality of Pangas brood pond No. 09

Pond 9	Water temp (°C)	Total alkalinity (mg/l)	Total hardness (mg/l)	DO (mg/l)	Free CO_2 (mg/l)	P^H	Ammonia (NH_3) (mg/l)
November	25.0	65.0	40.0	4.5	10.0	7.5	0
December	18.0	60.0	65.0	4.8	9.0	8.0	0
January	19.5	75.0	61.0	5.8	11.0	7.8	0
February	22.0	66.0	61.0	5.0	10.0	7.5	0
March	26.0	67.0	62.0	5.5	10.0	7.5	0
Average	22.1	66.6	57.8	5.1	10.0	7.6	0

Table 2. Water quality of Pangas brood pond No. 10

Pond 10	Water temp (°C)	Total alkalinity (mg/l)	Total hardness (mg/l)	DO (mg/l)	CO_2 (mg/l)	P^H	Ammonia (NH_3) (mg/l)
November	25.0	65.0	60.0	5.0	11.0	7.5	0
December	18.0	65.0	55.0	5.8	10.0	7.5	0
January	21.0	72.0	56.0	6.0	10.5	7.5	0
February	24.0	66.0	49.0	5.0	12.0	7.5	0
March	26.0	64.0	54.0	5.0	13.0	7.5	0
Average	22.8	66.4	54.8	5.4	11.3	7.5	0

Induced breeding trials

Maturity assessment: Maturity of Pangas was assessed through rigorous examination of the secondary sexual characters such as softness of abdomen, shape of belly and colour of vent. Female spawners were selected by observing the softness and bulgingness of abdomen and reddish colour of the genital opening while male spawners were selected by observing milt on gentle pressure on the abdomen.

Selection and conditioning: From the rearing ponds two pairs of hatchery-produced brood Pangas were selected at 9:30 hours and kept into a tank for conditioning with continuous water shower for 6 hours.

Hormone Injection: cPGE was prepared by grinding of cPG and mixing of distilled water to obtain the desired concentration of PG. The average weight of each cPG was measured as 3.0 mg. After 6 hours of conditioning (15:30 hours) 1st dose (Stimulatory dose) of cPGE was applied intramuscularly at the rate of 3.0 mg/kg body weight to the female Pangas (Table 3) and then kept into the conditioning tank under continuous water shower.

Table 3. PG dose calculation for female brood Pangas (First dose)

cPGE per kg body weight	Calculated dose
3.0×6.0	18.00 mg
3.0×4.5	13.50 mg

After 6 hours of 1st injection, (21:30), female brood received a 2nd dose (resolving dose) of cPG at the rate of 9 mg/kg body (Table 4) while at that time the male brood received a single dose of cPG at the rate of 3 mg/kg body weight (Table 5). After 2nd injection, both the male and female broods were kept into the conditioning tank under continuous water shower and their breeding behavior was observed. After 8 hours of 2nd injection (05.30 hours on following day), female brood Pangas were checked for stripping but no symptom of ovulation was recorded. Vent was not found to be protruded and no change was observed at that time. Vent color was not found to be changed. Little amount of milt appeared following gentle pressure on the abdominal region of male brood Pangas and milt were found motile enough under microscopic examination. It seemed that the female Pangas were not mature enough to be used for the breeding purpose.

Table 4. PG dose calculation for female brood Pangas (Second dose)

cPGE per kg body weight	Calculated dose
9.0×6.0	54.00 mg
9.0×4.5	40.5 mg

Table 5. PG dose calculation for male brood Pangas

cPGE per kg body weight	Calculated dose
3.0×5.5	16.50 mg
3.0×6.0	18.00 mg

Development of breeding and culture techniques of *Wallago attu*

Researchers: Dr. Masud Hossain Khan, Chief Scientific Officer
Md. Istiaque Haidar, Scientific Officer
Aovijite Bosu, Scientific Officer
Md. Monjurul Hasan, Scientific Officer

Objectives

- To develop culture technique of *W. attu* in pond condition
- To collect and rearing of mature fish for adaptation
- To develop induced breeding techniques for *W. attu*
- To develop nursing /early rearing techniques for newly hatched fry

Achievements

Pond Preparation: Pond selection is one of the most important criteria for fish culture and breeding. Two Ponds were selected for stocking and rearing of *W. attu*. Pond no 18 (40 decimal) and pond no 19 (42 decimal) were selected for stocking of Boal. Ponds bank were repaired and cleaned. Aquatic weeds were removed from those ponds manually. Undesirable fish and animal species were removed by netting but small fish were left undisturbed in order to grow as live feed for feeding Boal. Lime was applied in both the ponds at the rate of 500g/dec. during pond preparation. Urea and TSP were applied in each of the pond at the rate of 150 g/dec. and 75 g/dec. respectively on a monthly basis.

Water quality parameters were tested on the spot using a HACH kit. Parameters ranges are as follows:

Table 1. Ranges of water quality parameters during the study period

Water parameters	Pond no-18	Pond no-19
Water Temperature (^{0}C)	21-35	21-35
pH	6.7-7.3	6.9-7.3
Dissolved oxygen (mg/l)	4.5-6.7	5.0-7.2
Free carbon di oxide (mg/l)	3.4-6.0	3.0-6.0
Total Hardness (mg/l)	39-59	36-53
Total Alkalinity (mg/l)	51-62	35-84
Total Ammonia (mg/l)	.02	.02

Collection ad stocking of Boal: In the Rivers Meghna and Dakatia of Chandpur area, *W. attu* are harvested from brush shelters (Jak Fishery). Accordingly, live healthy Boal were collected from different brush shelters of the Rivers Meghna and Dakatia in different times during the winter season.

After collection, Boal were transported from river to BFRI, RS campus by using plastic drums through speed boat and pick-up van of Riverine Station. During transportation, physiological saline and oxygen tablets were applied in fish containers in order to ensure electrolytic balance and sufficient oxygen supply for fish.

After conditioning, the collected Boal were stocked in the experimental pond no.18 and pond no.19 of Riverine Station. A total of 105 Boals were stocked having an average weight of 915 g.

Nursing of carp fry for feeding Boal: Two nursery ponds were prepared and fenced using glass nylon net. Live carp fry were collected from different hatcheries and stocked in the nursery ponds for feeding the Boal.

Length-weight measurement of Boal: A total of 105 Boals were collected from the Rivers Meghna and Dakatia in different times and places during December 2017 to January 2018. Initially, length and weight of fish were recorded using a measuring tape and a digital weighing machine. Length of fish ranged between 40 and 78 cm (avg. 56 cm) while weight ranged from 507 to 2300 g (avg. 915 g) respectively. Collected fishes were conditioned under a water shower in cistern for a period of 8 hours.

Culture of Boal: Boals were fed with live carp fingerlings [Rohu (*Labeo rohita*), Catla (*Catla catla*), Mrigal (*Cirrhinus mrigala*)] and Taki fish (Walking snakehead: *Channa punctatus*) of size 7.5-10 cm the rate of 10-15 individuals per fish concurrently on every alternative day. In addition supplemental feed containing fish meal 30%, wheat brain 20%, rice brain 20% and 30% chicken offal were supplied at the rate of 2% body weight once daily by placing suspended feeding tray under the water at opposite corners of the ponds. Feeding trays were examined daily to understand whether Boals were accepting the supplementary feed or not. Based on the observation it was evident that some of the Boals might attempted to take a very small amount of supplementary feed. Further intensive investigations are required on this issue to confirm the feeding behavior of Boal towards commercially available supplemental feeds.

Out of 105 fish 10-15% fish might be died due to stress during collection and transportation. Initial and present average length and weight were recorded as 56 & 61cm and 915 & 1016 g after 5 months of raring.

Breeding and seed production of brackish water fin fishes (*Scatophagus argus* and *Pomadasys hasta*)

Researchers: Syed Lutfor Rahman, Chief Scientific Officer
Nilufa Begum, Senior Scientific Officer
A.K.M.Shafiqul Alam Rubel, Senior Scientific Officer
Debashis Kumar Mondal, Senior Scientific Officer

Objectives

- To investigate the food and feeding habits and reproductive characteristics (GSI, fecundity etc) of *Scatophagus argus* and *Pomadasys hasta.*
- To develop induced breeding technique of *Scatophagus argus* and *Pomadasys hasta.*

Achievements

Domestication of wild S. argus and P. hasta under controlled condition for brood development

Fry (0.1g) and Sub-adult (40 g) of *S. argus* and *P. hasta* were collected from river and is rearing in 0.1 ha on-station ponds. Stocking density was @ 10 fish/decimal. Growth performance is being monitored fortnightly and maturity/gonadal development are being monitored monthly. Both *S. argus* and *P. hasta* accepted commercial feed. Quality feed is being applied for rearing of both *S. argus* and *P. hasta* @ 25%-5% of BW. After 240 days of rearing average weight of *S. argus* was 113.75±2.1 g whereas average body weight of *P. hasta* was 42.83±0.5 g after 156 days of rearing. Water quality parameters were monitored weekly and all the parameters were congenial for brackish water aquaculture (Table-1).

Table 1. Water quality parameters of the rearing water during study period

Parameters	Chitra-pond	Datina-pond
Temperature (^{o}C)	31.0-33.5	31.0-33.5
Salinity (ppt)	12-13	12-13
Depth (cm)	85-101	81-94
Transparency (cm)	30-83	24-63
pH	8.6-9.0	8.4-9.2
Alkalinity (mg/l)	102-116	104-120
Dissolved oxygen (mg/l)	7.25-9.47	7.08-8.85
Free CO_2 (mg/l)	0-0.0	0-0.0

Food and feeding habits of S. argus and P. hasta

The fishes of different size and maturity and sex groups were collected from the natural sources in Paikgacha region. The stomach content was measured qualitatively and quantitatively.

Fig.1. Different food fractions (mostly appendages of crustaceans) in the diet of *P. hasta*

The different food fractions were measured by the counting method. The food items composed of microscopic organisms was counted in aliquot samples on a Sedgewick Rafter chamber then total food items converted into 100. Percentages of different food materials of *S. argus* and *P. hasta* are given in Fig. 2.

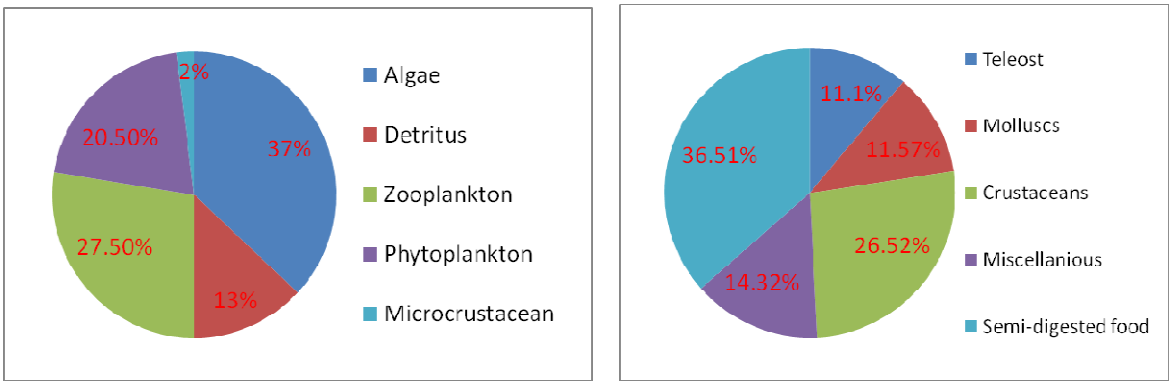


Fig. 2. Percentage of different food materials of *S. argus and P. hasta*

Maturity and spawning cycle of P. hasta.

Male-female Identification: The head profile of the female ascends at a relatively constant slope, whereas in the male, there is an obvious curvature of the head above the eye which is absent in females. Besides, male are darker in color while female are light green.

Gonado-somatic index (GSI): Fish samples both male and female (M:F:: 50:50) was collected fortnightly from the local market, fishermen and brackish water aquaculture farms. The collected specimens were brought to the laboratory and they were firstly cleaned, measured and weighed. In order to determine the sexual maturity and reproduction time, the male and female fishes were separated and data were recorded after dissecting out the gonad of the individual fish. Then the gonads of fish were taken out very carefully and preserved in well labeled vials containing bouin's fixative for histological studies. Gonad somatic index (GSI) of the male and female fish of the collected samples was determined separately following the equation:

$$GSI = (\text{Weight of gonad} / \text{Weight of fish}) \times 100$$

Estimation of fecundity: Gravimetric method was followed to determine the fecundity of fish. By using this method, the external connective tissues will be removed from the surface of the ovaries. Moisture of the ovaries was removed with the help of blotting paper. Weight of ovaries was recorded in gram with the help of a fine electric weighing balance. Then 0.01 g of each ovary was taken separately from anterior, middle and posterior regions of each lobe.

Fig. 4. Estimation of GSI and fecundity of *S. argus*

The number of matured and immature eggs for each portion were sorted out and counted with the help of a needle and magnifying glass. The mean number of eggs in 0.01 g was determined and then multiplied by the total weight of the ovary, which gave the total number of eggs, *i.e.*, the fecundity of the respective fish according to the following formula:
Fecundity = (WOV/WSs) x NOV in Ss;

Where, WOV = weight of the ovary; WSs= weight of the sub-samples; and NOV= number of mature ova in samples.

GSI and fecundity of both male and female *S. argus* were studied. Both GSI and fecundity showed gradual increase from November and reached its peak at June which indicates its peak spawning season. Highest GSI and fecundity of female in June were 7.01±0.90 and 372126±3970 (Table 2).

Table 2. Month wise GSI and fecundity of male and female *S. argus*

Month	Mean GSI of male	Mean GSI of female	Mean fecundity
November	1.84±0.2	3.2±1.3	129480±1394
December	1.89±0.27	5.17±1.23	255604±2165
January	2.02±0.25	6.14±1.4	299463±3029
February	2.03±0.28	6.31±1.2	377505±3847
March	2.05±0.24	6.60±1.3	386050±3670
April	2.1±0.2	6.85±1.7	368107±3826
May	2.12±0.22	7.01±0.90	372126±3970
June	2.15±0.26	7.09±0.85	392841±3784

Assessment of Mud crab, *Scylla* spp Resources in the Coastal Areas of Bangladesh

Researchers: Dr. Md. Latiful Islam, Senior Scientfic Officer
Mollah N.S. Mamun Siddiky
Md. Mizanur Rahman Washim

Objectives

- To assess the qualitative and quantitative production in major crab harvest areas.
- To assess the stock status of mud crab through estimating the catch per unit efforts (CPUE).
- To identify the breeding biology and spawning seasons of the mud crab in Bangladesh environment.
- To estimate the genetic diversity (composition) of mud crab species in Bangladesh coastal areas.
- To find out occurrence of available disease out breaks in mud crab.

Achievements

Estimation of genetic diversity (composition) of mud crab in Bangladesh coastal areas

Genetic diversity of mud crab in Bangladesh was estimated through the morphological features of species identification keys as stated by Keenan (1999). Samples was collected from different sampling sites, live sample was carried to the laboratory and identified therefore. According to the morphological characteristics, 99% of the sample was *S. olivacea* and only 1% belonged to *S. serrata* (Fig. 1). Whereas, *S. paramamosain* and *S. tranquebarica* were not found in the samples. Some of the samples seemed confused to identify from the keys available on morphological features; needs mitochondrial analysis for confirmation.

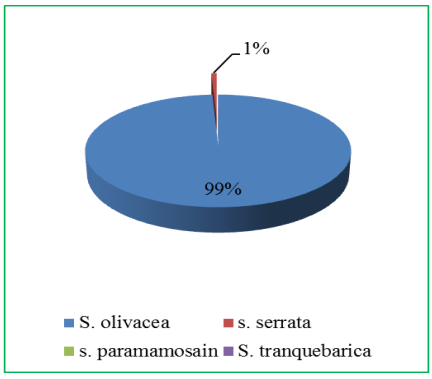


Fig. 1. Status of genetic composition of mud crab species in the samples collected from different sampling sites.

Assessment of qualitative and quantitative production of mud crab in major harvest areas

Qualitative and quantitative production of mud crab was assessed through direct visiting of the *depots* of the sampling sites by a pretested questionnaire. The production or landing of mud crab in 2017-18 revealed highest production in Khulna (3588 ton) followed by Satkhira (2089 ton) and Bagerhat (1970 ton) district (Fig. 2). Lowest production was recorded in Patuakhali (560 ton) and Barguna (240 ton) district.

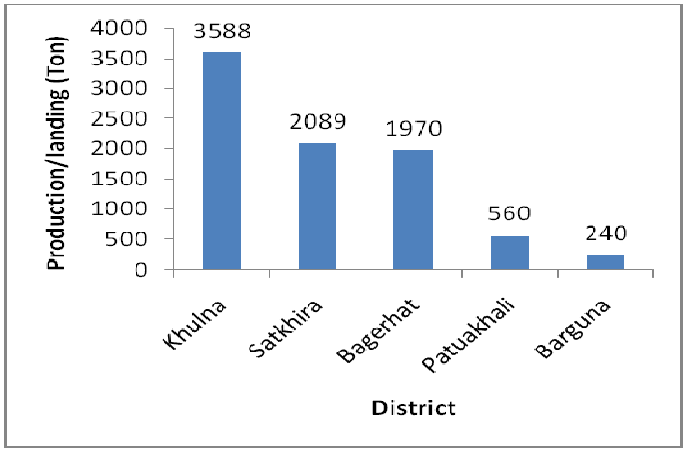


Fig. 2. Landing status of mud crab in different sampling sites

A total of 632 crab sample was sexually segregated during sampling. The sex ratio of sampled crab was 1:1.40 for male and female (Fig. 3-A). Huge amount of small sized (juvenile and sub-adult) crabs was found in the market/*depot* and that was 12 to 46% of total landing (Fig. 3-B).

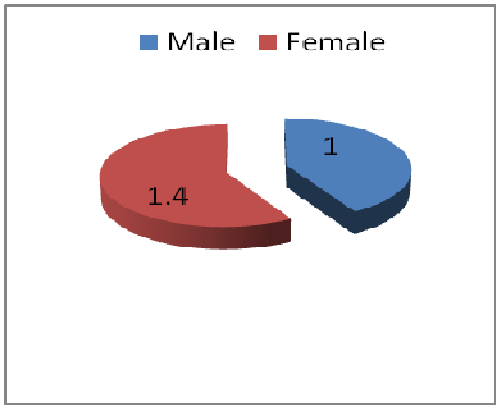


Fig. 3-A. Status of male-female ratio in landed mud crab

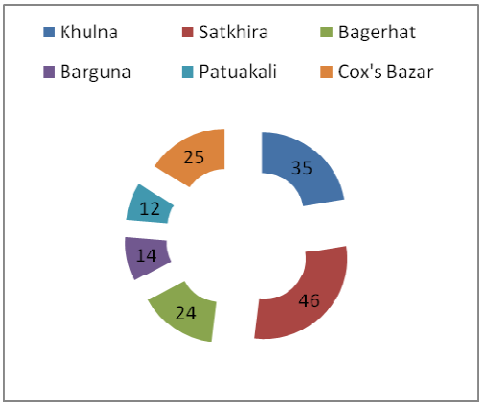


Fig. 3-B. Status of juveniles in landed crabs

Assessment of the stock status of mud crab through estimating the catch per unit efforts (CPUE)

Assessment of the mud crab stock status was performed on monthly collected samples during the full moon period by using long line bait and crab traps. Finally, catch per unit effort (CPUE) was calculated as follows:

CPUE (crab/hour/trap or bait)= (NC/ST)/NT
Where, NC= number of crabs caught; ST= soak time in hours; NT= number of traps/*charu*/bait.

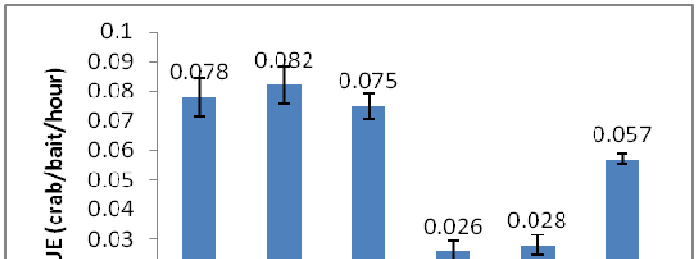


Fig. 4: Catch per unit effort (CPUE) of mud crab in coastal areas

The catch per unit effort (CPUE) was higher in Satkhira (0.082 crab/hour/trap or bait) followed by Khulna (0.078 crab/hour/trap or bait) and Bagerhat (0.075 crab/hour/trap or bait) district. Lowest is for Patuakhali (0.026 crab/hour/trap or bait) and Barguna (0.028 crab/hour/trap or bait).

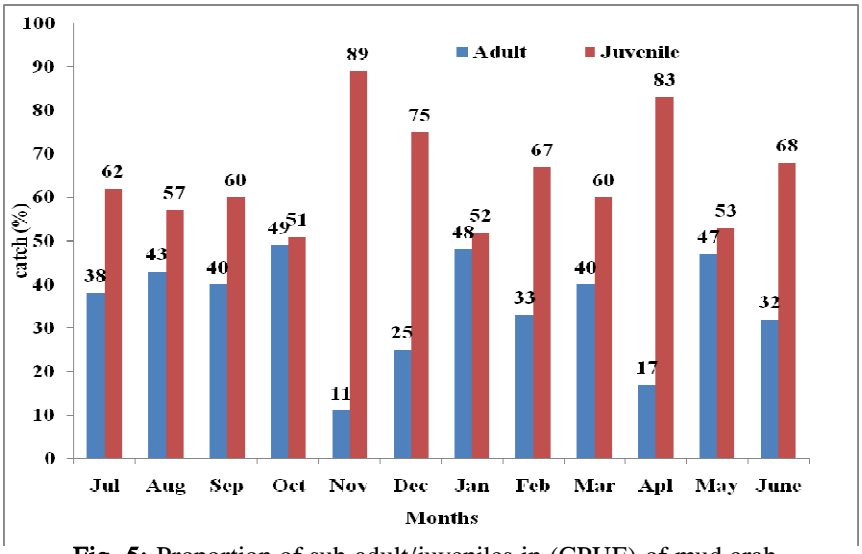


Fig. 5: Proportion of sub-adult/juveniles in (CPUE) of mud crab

Figure 5 demonstrates the proportion of sub-adult/juveniles in CPUE of mud crab in the Sundarbans region. Highest proportion (89%) of sub-adult/juveniles was noticed in November followed by Aril (83%) and lowest was in the month of October (51%). Indiscriminate harvest of sub-adults and juveniles might reduce the stock and regular recruitment.

Gonad status: Crab samples were collected from different sampling sites, carried in the laboratory, graded and the sexually matures females were dissected. Gonad samples were picked out and categorized following Islam et.al. (2010) and Islam and Yahya (2017). Mud crab attained gonad maturation following five distinct stages of immature, developing, early maturing, late maturing and mature. Among the samples, 23% crabs was in the mature stage. The immature stage augmented the highest proportion (36%). Mature crab was noticed in each month indicated year round breeder. The highest proportion of mature stage was noticed in the month of March, April followed by January, February and July, indicated the peak spawning season (Fig. 6-B).

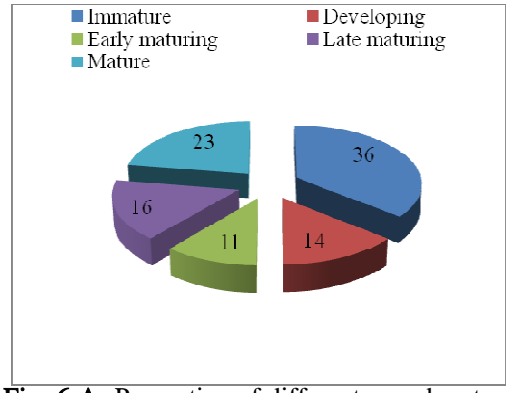


Fig. 6-A: Proportion of different gonad maturation stages of mud crab in the sample

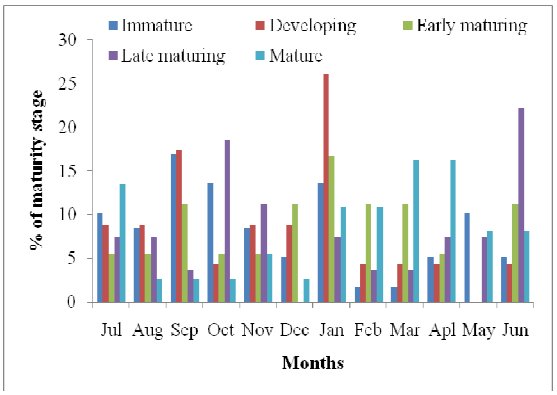


Fig. 6-B: Monthly availability of different gonad development stages

Larva sampling: A 50 meter distance of river near to mangrove of all the sampling sites were sampled with a 1 meter mouth opening push/drag net. Sampling was done in each full moon period. Whole sample was preserved in 10% formalin and carried in laboratory/hatchery. Megalopa, crab instars and crablets were separated and counted. As presented in Fig. 7-A, highest mud crab larvae was available in the month of April, May June and July, indicated the respective previous month might be a peaks of spawning/breeding.

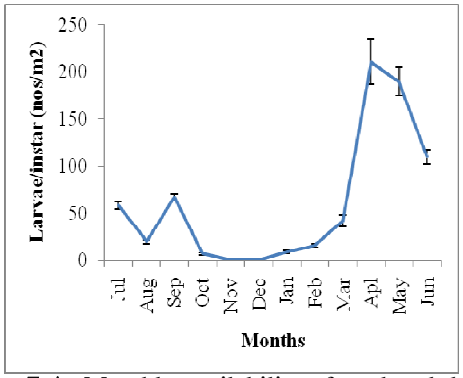


Fig. 7-A: Monthly availability of mud crab larvae in coastal rivers

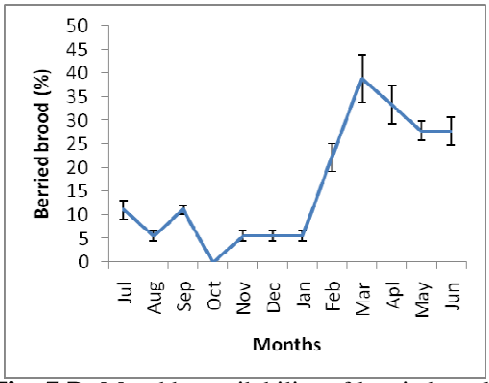


Fig. 7-B: Monthly availability of berried mud crab in the hatchery

Berried broods sampling: A total of 20 gravid broods were reared in sand bed concrete tanks with sea water. Once a crab turned into berried was picked out and noted down for respective months. A similar sized gravid broods was introduced to maintain the number and density. The process was carried out for year round. Fig. 7-B denotes the availability of berried broods in hatchery condition and highest proportion (39%) of berried brood was available in March, followed by April, May and June 33%, 28% and 28%, respectively. A second narrow peak was in September (11%).

Disease occurrences in mud crab

Whole crab samples harvested by a crab fisher was purchased and carried to the laboratory. Firstly the crabs were observed with naked eye for external fouling on shell or appendages. Later on, crabs were dissected and internal organs (gill, ovary, hepatopancreas) were monitored. The naked eye observation as well as observation under dissection of crab showed that no major disease outbreak was noticed. Among the samples 79% was disease free, 9% was infested with gill parasites (*Zoothamnium*), 6% was black shell disease and affected with *Barnacles* each (Fig. 8).

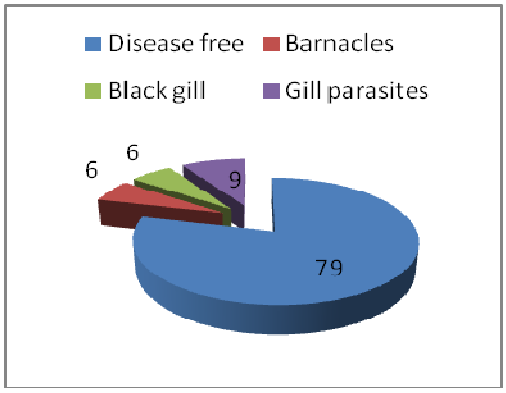


Fig. 8: Outbreak of different diseases of mud crab

Development of technique for breeding and larval rearing of mud crab, *Scylla olivacea*

Researchers: Dr. Md. Latiful Islam, Senior Scientfic Officer
Mollah N.S. Mamun Siddiky

Objectives

- To develop culture protocols and scaling up of live feed for mud crab larvae rearing.
- ii. To develop brood of mud crab, *Scylla olivacea* in captivity.
- iii. To develop larval rearing techniques of mud crab, *Scylla olivacea*.

Achievement:

Production of berried brood stock under captive condition

Berried broods of mud crab was developed using salinity levels of 25 ppt (T1) and 30 ppt (T2). Cemented cisterns were prepared through drying, cleaning and providing a sand bed (10-12 cm thickness). Gravid female crabs (250-300g) were purchased from different sources acclimatized with salinity and temperature; eyestalk was ablated and stocked @ 2 crabs/m^2. The crabs were fed with chopped tilapia up to satiation twice daily. About 75% of the water was changed with same salinity water after one month of intervals. Water temperature (24.0 °C – 31.0 °C), pH (7.7 – 8.5), dissolved

oxygen (4.5 mg/l – 6.0 mg/l) and ammonia (0.5 mg/l – 1.0 mg/l) was similar in both the salinity level treatments (Table 1).

Table 1. Water quality parameters of different salinity levels of brood stock tanks

Parameters	25 ppt salinity (T1)	30 ppt salinity (T2)
Temperature (°C)	24-31	22-31
pH	7.8-8.5	7.7-8.4
Dissolved oxygen (mg/l)	4.5-6.0	4.6-6.0
Ammonia (mg/l)	0.5-1.O	0.5-1.0

Spawning success was 66% and 56% in salinity level of 30 ppt and 25 ppt, respectively. Fertilization rate of 86.60% and 84.40% was similar in 30 ppt and 25 ppt salinity levels (Table 2). Considering the performance and availability of salinity water, both of the salinity levels might be used for berried brood production of mud crab.

Table 2. Performance of berried female production under different salinity levels

Parameters	Treatments	
	25 ppt	30 ppt
Ave. body weight (g)	254± 8.30	262±12.80
Ave Carapace width (cm)	11.2±0.45	11.3±0.52
Total Number of brood reared	18	18
Total No. spawned	10	12
Spawning success (%)	56	66
Incubation (days)	12	12
Fertilization rate (%)	84.40	86.60

Evaluation of some commercial crustacean larvae rearing liquid diets for mud crab larvae rearing

To observe the effect of different forms of produced and commercial (crustacean larvae feed) live feeds on growth, survival and metamorphosis of mud crab larvae, experiment was conducted with two step larvae rearing protocol. The initial larvae stages (Z1 to Z2) and the late larvae rearing stages (Z3-M). The stocking density for Z1-Z2 was 100 larvae/L, and for Z3 to M stage the density was 50 larvae/L. The experimental was designed with three treatment viz, T1: larvae reared with live feed (Z1-Z2: rotifer; Z3-M: Artemia); T2: with liquid diet (Z1-Z2: liquid rotifer; Z3-M: liquid Artemia); and T3: reared with live feed + liquid diet (Z1-Z2: rotifer+liquid rotifer; Z3-M: Artemia+liquid Artemia). The larvae were reared following standard protocols and the trial was repeated for second time.

In case of Z1 to Z2 larvae rearing, T3 (Z1-Z2: rotifer+liquid rotifer) provided highest survival rate of 79% and better growth of (Larval Stage Index, LSI) 4.50 at 7 days of culture (Table 3). In terms of survival (70%) and LSI (4.3), T1 stood second and lowest survival of 67% and LSI of 4.2 was achieved for T2. For Z3 to M stage larvae rearing, T3 also provided higher survival of 11% and LSI of 4.6 followed by T1 (survival 9%, LSI 4.3) and T2 (survival 6%, LSI 4.2). Result of this study indicated that rotifer+liquid rotifer for Z1 to Z2 stage and Artemia+liquid artemia for Z3-M stage provided better performance (Table 3).

Table 3. Growth (LSI) and survival of larvae under different treatments

Parameters	Z1 to Z2 stage			Z3 to M stage			Megalopa to C1 stage
	T1	T2	T3	T1	T2	T3	
Stocking density (Nos/l)	100	100	100	50	50	50	Survival rate was 1.05%
Survival (%)	70	67	79	9	6	11	
Growth (LSI)	4.3	4.2	4.5	4.30	4.20	4.60	
Day of Culture	7	7	7	11	12	11	

Effect of different nursery protocols on growth and survival of mud crab larvae (megalopa to crab instars, C1)

To observe the effect of different nursery protocols on growth and survival of mud crab larvae (M to C1) an experiment was conducted with a stocking density of 100 megalopa for each. Combined nursery was set up with two different systems, viz, T1- substrate with hanging net and T2- substrate with hanging net along with sand bed. Stocking density was 25 Megalop/m^2. Larvae/megalopa was fed with 5-7 days old Artemia for first 3 days. Later on, chopped trash fish (tilapia) at satiation level was served as feed.

In the nursery, survival was 50% and 75% for T1 and T2, respectively. Weight gain of 1.4 g was similar in both the treatments. Intactness of crablet was 60% and 75% in T1 and T2, respectively.

Table 4. Survival of mud crab larvae at M & C1 stage under different nursery protocols

Parameters	T1-Nursery with hanging net substrate	T2- Nursery with hanging net and sand bed substrate
Number stocked	100 (25/m^2)	100 (25/m^2)
Number harvested	50	150
Survival rate (%)	50	75
Wt (g) CW (cm)	1.4 (g) 1.6 (cm)	1.4 (g) 1.5 (cm)
Stage	Instar (C1)	Instar (C1)
Proportion of intactness	60%	75%

Growth comparison of three live feed (microalgae) species under indoor and outdoor culture condition

Nannochloropsis, *Nannochlorum* and *Tetraselmis* microalgae was cultured under indoor and outdoor condition. The culture was initiated in 2 L conical flask for indoor and 300 L fiber glass tank for outdoor with an inoculation density of 0.05 $\times 10^6$ cells/ml. For indoor F2 media and for outdoor N, P and K was added as nutrient appropriate doses. Temperature for indoor culture was adjusted at 25 °C with automated air conditioner and 24 hour photoperiod was maintained. Whereas, for outdoor the culture was exposed in day-night photoperiod with ambient temperature Under indoor culture, all 3 species started cell division immediate after inoculation, reached to the peak on 9th day of culture (Fig. 1). The stationary phase was observed for 9-15 days and then started to collapse. Highest density of 1.46, 1.44 and 1.42 cells/ml $\times 10^6$ was observed for *Nannochloropsis, Nannoclhorum* and *Tetraselmis,* respectively at 14th DoC then collapsed (Fig. 1).

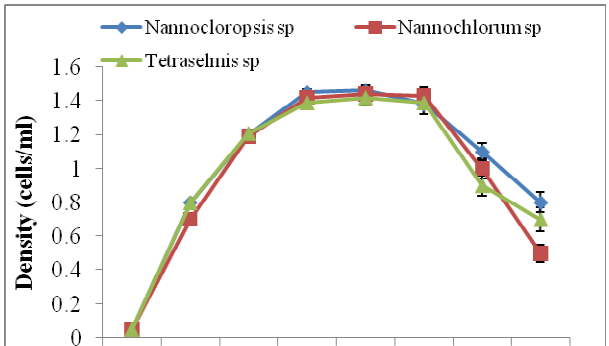


Fig 1. Growth (cells/ml $\times 10^6$) of microalgae under indoor culture condition

Under outdoor system, all 3 species also started cell division immediate after inoculation and reached to the peak on 9th day of culture (Fig. 2). The stationary phase was observed only for 3 (12-15) days and then started to collapse. Highest density was 1.65, 1.60 and 1.58 (cells/ml $\times 10^7$) for *Nannochloropsis, Nannochlorum* and *Tetraselmis,* respectively on 12th day of culture (Fig. 2). The density was higher under outdoor culture condition than indoor.

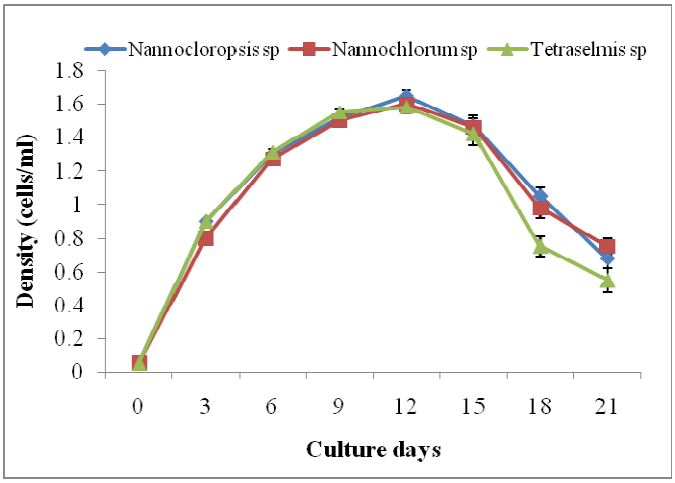


Fig 2. Growth (cells/ml $\times 10^7$) of microalgae under outdoor culture

Growth performance of live feed, rotifer (Brachionus plicatilis) under different medium/ feedings.

Rotifer, *Brachionus plicatilis* was scaled up under outdoor condition in 400 L fiber glass tanks. Four types of media, viz, only yeast, only microalgae, yeast+microalgae and yeast+commercial diet was used for scaling up of rotifer production. Growth of rotifer (*Brachionus plicatilis*) was higher (400ind/ml) in yeast+microalgae media. Yeast + commercial diet media yielded 370 ind/ml. The lowest growth (260 ind/ml) was noticed with baker's yeast media for 5th day of culture (Fig. 3). Rotifer scaled up with microalgae provided a moderate growth (320 ind/ml), but it was clean and uncontaminated. Whereas, rotifers scaled up with other 3 media was found contaminated with ciliate protozoan.

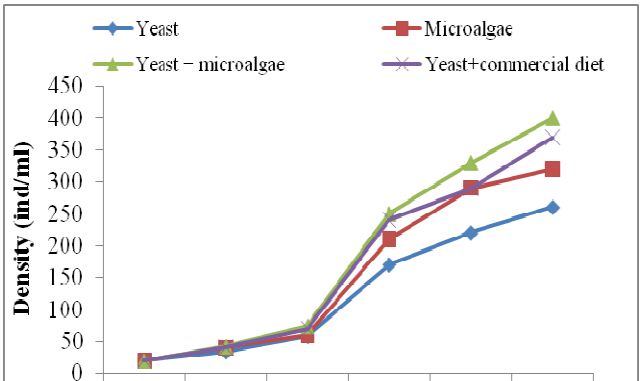


Fig 3. Growth performance of rotifer (*Brachionus plicatilis*) under different feedings.

On-station and on-farm research of environment friendly Mud Crab (*Scylla olivacea*) culture technology

Researchers: Syed Lutfor Rahman, Chief Scientific Officer
AKM Shafiqul Alam Rubel, Senior Scientific Officer
Md. Mizanur Rahman Washim, Scientific Officer

Objectives

- To optimize the stocking density of mud crab in pond/pen culture system.
- To initiate an innovative and environment friendly mud crab aquaculture approach in south-west coastal region.

Achievements

Water Quality Parameters: Salinity was observed in all the experimental treatment among 4 to 15‰, temperature ranged from 28.2 to 35.2°C, dissolved oxygen level varied among 4.53 to 6.45 mg /l, pH level varied among 7.9 to 8.64 and transparency ranged was from 31.55 to 83 cm and alkalinity varied from 121.98 to 270mg /l. water quality parameters in all the experimental treatments were within the normal range for mud crab culture (Table 1).

Table 1. Mean water quality parameters in all treatments during experimental period

Parameters	Temperature (°C)	pH	Salinity (ppt)	DO (mg/l)	Transparency (cm)	Alkalinity (mg/l)
0th day	28.2 ±0.12	7.9 ±0.14	4.5 ±0	6.41 ±1.21	83 ±8.78	235.27 ±6.98
15th day s	28.8 ±0.25	8.25 ±0.12	7 .0±0	5.59 ±1.29	65.23±7.23	249.31 ±4.98
30th days	30.01 ±.01	8.5 ±0.197	10 ±0	4.53 ±1.25	45.83±6.93	270 ±1.10.96
45th days	32.00 ±0.21	8.51 ±0.45	12 ±0	6.79 ±1.32	33.9 ±7.13	265.33 ±8.99
60th days	32.5 ±0.5	8.6 ±0.121	12.5 ±0.51	6.45 ±1.91	35.90 ±4.34	159.33 ±7.45
75th days	32.5 ±0.56	8.64 ±0.81	14 ±0	6.39 ±1.11	32.74 ±7.32	134.88±8.32
90th days	33.4 ±0.25	8.3 ±0.01	15 ±0	5.45 ±1.29	31.55 ±6.93	132 ±8.45
105th days	34.1 ±0.23	8.25 ±0.51	13.45 ±0.25	5.79 ±1.16	34.83 ±6.21	124.5 ±6.73
120th days	35.2±0.521	8.1 ±1.01	14 ±0	5.95 ±1.34	33.5 ±8.3	121.98 ±6.43

Growth, Feed Utilization and Production of Fish: The growth and production of young crabs in term of gain in number and weight under two treatments were investigated and monitored fortnightly. The

results obtained are presented in Table 2, and Figure 1, 2 and 3; which indicated that the growth in terms of number and weight showed much variation in different treatment and continued till final harvesting. During the investigation, final weight of crab was recorded 276.37± 3.41g and 247.41±2.57g in treatment T1 and T2, respectively. The increase in weight mud crab was the highest in T1 followed by T2 respectively. The crab in treatment T1 showed the highest gain in carapace length, carapace width and weight (67.35±2.74cm, 99.41±1.39cm, 276.37 ± 3.41g) compared to the treatments T2. However, the mean final weight of mud crab in different treatments were significantly different ($P<0.05$). SGR in treatment T1 was significantly higher than in T2 ($P<0.05$). Food conversion ratio was significantly lower in T2 than T1. Therefore, best SGR (1.69±0.013) and FCR (2.975±0.754) were recorded in treatment T1 where lowest number of juvenile of crab was reared. The feed for the crabs were used mainly trash fish and tilapia meat due to the low cost and availability near the Kata, Paikgacha and fed with 6-8% body weight to the crabs during the culture period. However, the survival rate (SR) shows significantly low and having only 40 -50% survival at the end of the culture period.

The highest survival rate (55.97±1.98) was also observed in T1 and the lowest (40.31±1.23) in T2. There was a significant variation ($P<0.05$) in the survival rate of crabs among different treatments. The net production of crab was (1546.84±6.54 ^{a}) kg and (1994.12± 7.245 ^{b}) kg /ha-^{1}/days^{-120} in treatment T1 and T2, respectively. Total production of mud crab was recorded to be higher in treatment T2 and lowest in treatment T1. On the other hand, highest number of juveniles was stocked in treatments T2, where lowest production was recorded and differed significantly ($P<0.05$) from T1 and T2 (Table 2).

Table 2. Survival, feed conversion ratio (FCR), Growth performance and production of *S. olivacea* after 120 days of rearing; mean ± S.D. with ranges in parentheses

Parameters	Tratments	
	T1	T2
Initial carapace length (cm)	39.1±2.05 (35-44)	38.66±2.61 (35-58)
Final carapace length (cm)	67.35±2.74(65-75)	61.41±3.49 (62-69)
Initial carapace width (cm)	55.73±2.47 (50-62	55.1±2.07 (50-60)
Final carapace width (cm)	99.41±1.39 (87-102)	88±2.25 (85-97)
Initial body weight (g)	36.17±3.56 (28-42)	36.06±3.01 (28-42)
Final body weight (g)	276.37 ± 3.41 ^{a} (265-292)	247.41±2.57 ^{a} (261.5-288.45)
Net weight gain (g)	240.2±3.98 ^{a} (231.9-244.6)	211.35±2.08 ^{b} (207.19-214.36)
Average daily gain(g)	2.001±0.98 ^{a} (1.93-2.08)	1.765±0.53 ^{a} (1.58-1.77)
Specific growth rate (SGR)	1.69±0.013(1.54-1.75)	1.60±0.0145 (1.57-163.2)
Survival rate (%)	55.97±1.98 ^{a} (50.75-61.25)	40.31±1.23 ^{b} (35.89-42.41)
FCR	2.975±0.754 ^{a} (2.65-2.99)	4.695±0.56 ^{b} (4.67-4.71)
Production (kg/ha^{-1})	1546.84±6.54 ^{a} (1535.6-1554.32)	1994.12± 7.245 ^{b}(1901.089-2054.7)

Figure in the same row having the same superscript are not significantly different (P>0.05). Values in the parenthesis indicate the range. # Total crop of crabs harvested after 120 days. Average daily gain (g) = (mean final weight - mean initial weight) / time interval (days). Specific growth rate (SGR) = Ln mean final weight - Ln mean initial weight) /time interval (days) × 100. FCR (Food conversion ratio) = Total diet fed (kg) / total wet weight gain (kg).

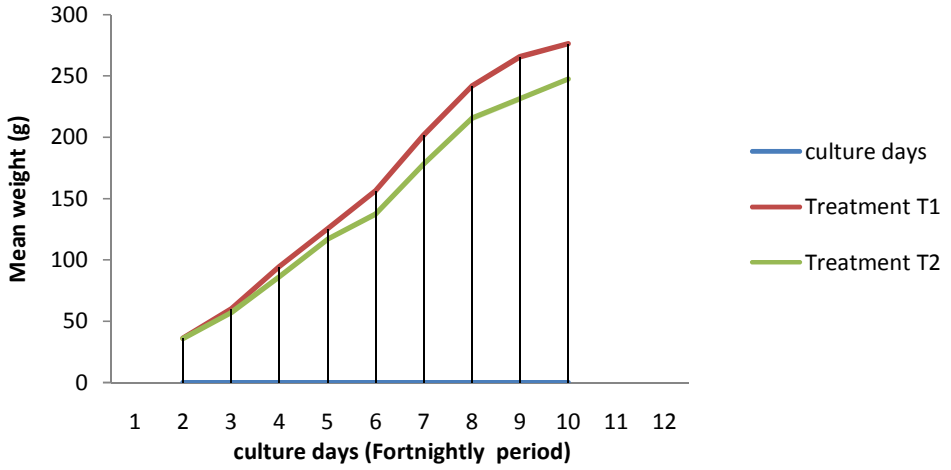


Fig. 1. About 15 day's interval means weight gain (g) of mud crab juvenile genera Scylla under different density.

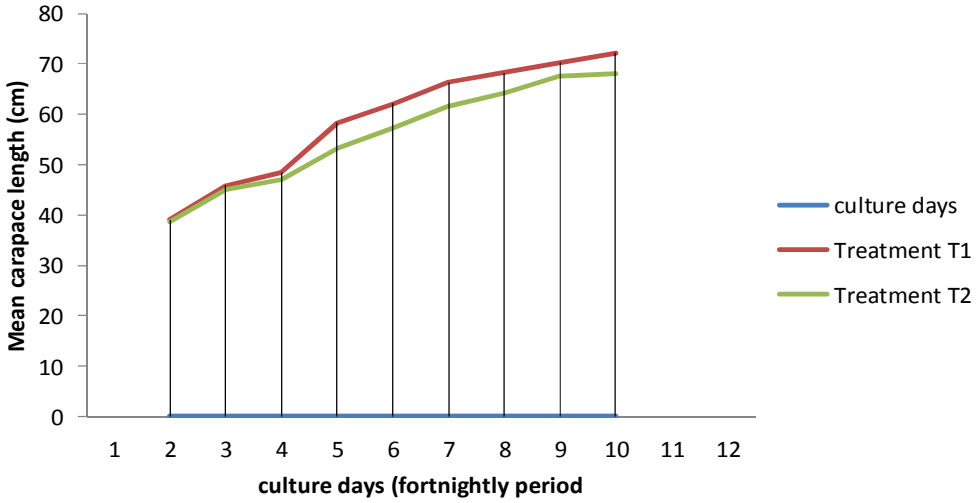


Fig. 2. 15 day's interval means Carapace length (cm) of mud crab juvenile genera Scylla under different density.

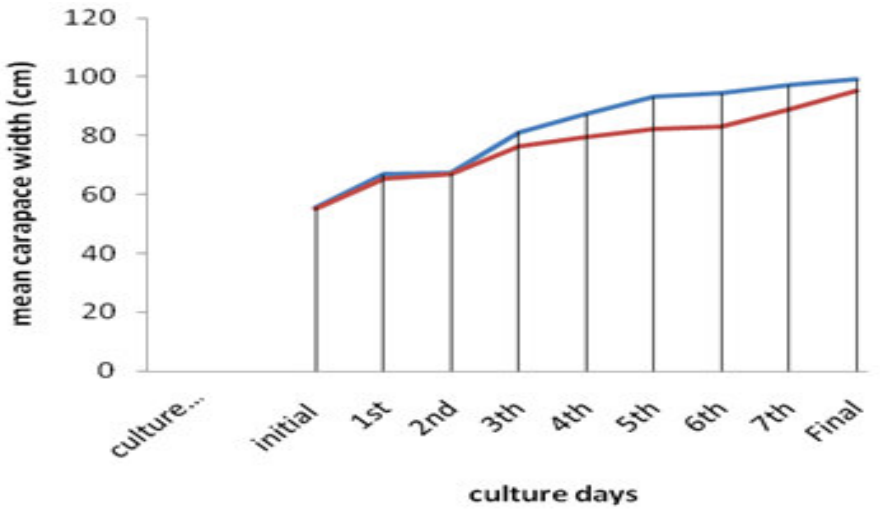


Fig. 3. 15 day's interval means Carapace width (cm) of mud crab *S. olivacea* under different density.

Cost and Net Benefit Trends: Total cost production in treatment T1 and T2 was recorded BDT. 27272.72 and 42545.45 respectively. On the other hand, cost of production in treatment T2 was consistently higher than those treatments T1 (Table 3). Highest net return (in term of BDT/ha^{-1} and one US$ = BDT. 83) was obtained in treatment T2 (BDT. 57160.55) followed by T1 (BDT. 50069.28) in that order.

Table 3. Cost and benefits from the culture of *S. olivacea* in 1ha earthen ponds for a period of 120 days.

Item	T1	T2
Total return (TR)	77342 TK	99706 TK
a. Variable cost:		
1. Price of juvenile	7272.72	14545.45
2. Feed (Tk. 30.00/kg)	6000	12000
3. Fertilizer, lime etc.	2000	4000
4. Human labour cost (Tk.400.00/day)	12000	12000
5. Chemicals	Not applicable	Not applicable
6. Miscellaneous	Not applicable	Not applicable
Total Variable cost (TVC)	27272.72	42545.45
b. Fixed cost :		
1.Pond rental value	Not applicable	Not applicable
2.Interest of operating capital	Not applicable	Not applicable
Total fixed cost (TFC)	Not applicable	Not applicable
Total cost (TC=TVC+TFC)	27272.72	42545.45
Gross margin (GM= TR-TVC)	50069.28	57160.55
Net Return (TR-TC)	50069.28	57160.55

Development of domesticated quality broods for better breeding performance of Prawn (*Macrobrachium rosenbergii)*

Researchers: H M Rakibul Islam, Senior Scientific Officer
Md. Motiur Rahman , Scientific Officer
Md. Shariful Islam, Scientific Officer

Objectives

- To develop suitable technique for brood stock management
- To develop improved stock of prawn through selection programme
- To identify the optimum maturation age for better breeding performance
- To compare the breeding performance of wild and domesticated brood stock of prawn

Achievements

Post Larvae obtained from the previous year are being reared in six compartments in one pond with same management and inputs. Table 1& 2 revealed size variation in terms of body length & weight of the reared groups but no significance difference found among the six groups.

Table 1. Average body weight (gm) of brood reared.

Source	1st	2nd	3rd	4th	5th	6th
BP	10±8.69	13.2±5.98	13.4±11.30	16.4±14.67	20.5±13.14	21±11.1
PG	9.8±13.66	10.5±15.04	13.8±17.78	13.8±15.10	18.2±19.58	25±20.44
BG	8±6.29	11±11.14	12.4±6.85	13±11.93	16±5.91	17±8.27
PB	11.15±5.12	12.8±5.18	14.2±7.77	15.5±7.14	20.8±13.96	24.1±13.49
GB	7.5±3.98	11.9±6.19	12.2±5.94	14.4±8.97	18.9±11	19.8±10.42
GP	9.2±6.10	11.2±9.20	11.6±7	12.3±9.15	16±15.97	20±10.06
7th	8th	9th	10th	11th	12th	13th
21.5±11.28	22.6±13.48	26.5±11.83	27.2±17.2	27.7±17.47	32.4±18.61	35.8±22.06
24.8±21.54	22.9±8.09	23.3±7.95	30±16.33	36.8±24.06	32.2±24.22	35.3±27.91
18±7.41	25±9.37	24.6±9.50	31.5±6.75	33.1±21.51	36.5±36.48	36.9±36.77
26±16.31	27.7±6.63	28±10.31	29.8±8.67	30.3.5±8.42	32.2±21.58	37.4±31.82
22.4±14.63	22.8±15.80	23.8±12.05	30.4±20.86	29.8±18	33.6±38.41	36.4±22.30
19.5±10.24	24±12.07	26±14.98	26.1±9.38	34.6±18.66	33.4±25.17	36.6±34.19

Where, BG=Balaswar (Male) x Gher (Female); GB=Gher (Male) x Balaswar (Female); GP= Gher (Male) x Payra (Female); PG=Payra (Male) x Gher (Female); BP=Balaswar (Male) x Paira (Female); PG=Payra(Male) X Gher (Female)

During breeding season berried female prawn was not available from the reared group. So, comparative study of larval development, survivability & disease susceptibility experiment will be carried out in the coming year.

Besides, limited hatchery operation was performed using SRS produced brood but no sign of disease was observed as experienced in the previous years (EED). Usually in the other hatcheries, PL mortality started at stage III~IV and VI~IX with visible bluish and filamentous red spots. Neither such symptoms nor any parasitic infestation like *Zoothamnium* or *Epistilis* infection were observed in the SRS hatchery. Unfortunately, the ammonia toxicity raised (1.6 mg/l) significantly in LRT prior to final molting resulted in poor conversion to PL. Similar toxicity also observed in the ready water (12 ppt).

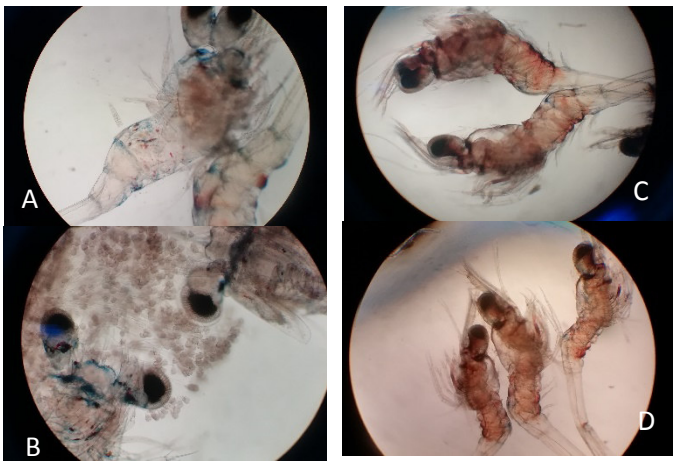


Fig. 1.A- Infected Larvae from other hatchery with bluish and reddish spot. B- *Zoothamnium* infestation of larvae in other hatchery. C & D- Healthy Larvae from SRS hatchery

To overcome the problem second cycle of hatchery operation has been carried out using mechanical recirculation system to reduce ammonia load in the LRT (Fig.2).

Fig. 2. Installation of mechanical recirculation system

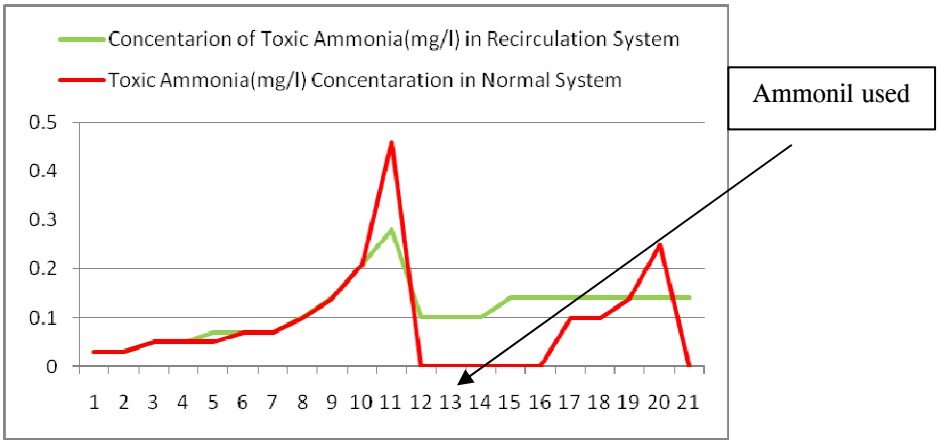


Fig. 3. Comparative study of toxic ammonia in normal and recirculation LRT.

Mechanical recirculation system is found to be quite efficient in controlling ammonia toxicity compared to the non-recirculation system (Fig. 3) because of accumulation of denitrifying bacteria on the shells used in bio-filters. Moreover, using of different mesh size of filtration gateway allowed unfed artemia and custard to cutting out from the LRT ensuring better water quality. Directional water circulation also facilitate the larvae to move fast and increase the opportunity of grabbing both artemia and custard particle efficiently and thereby, resulted in better growth rate and lower size variation. It can be hypothesized that this system would be helpful to overcome the poor molting rate of larvae into PL at completion of the rearing cycle of 35 days.

Efficacy of Locally Isolated *Bacillus* and *Lactobacillus* spp. as Probiotic Candidate in Shrimp Aquaculture

Researchers: Dr. Khan Kamal Uddin Ahmed, Chief Scientific Officer
Md. Amirul Islam, Senior Scientific Officer
H M Rakibul Islam, Senior Scientific Officer
Mst. Subrina Khatun, Scientific Officer
Md. Shariful Islam, Scientific Officer

Objectives

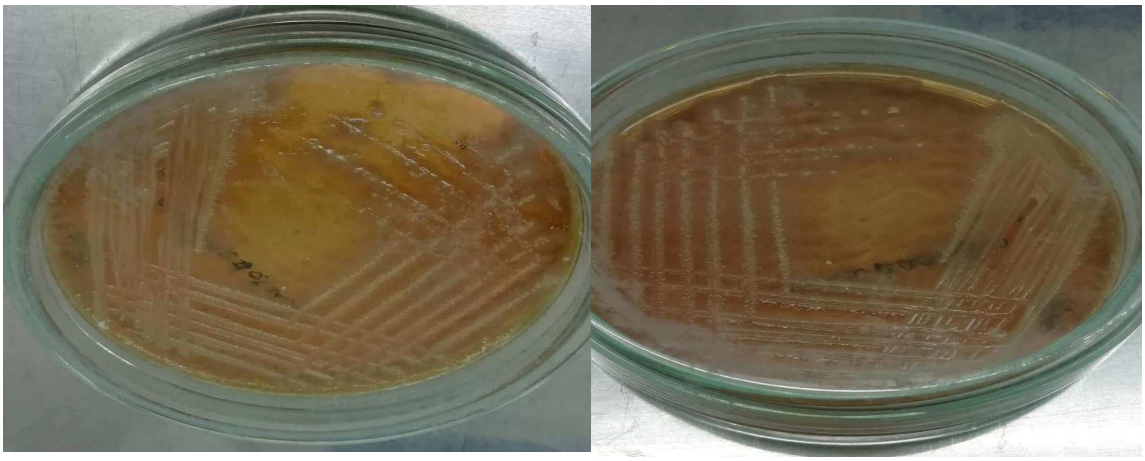
- To isolate *Bacillus* and *Lactobacillus* spp. from healthy individual and water body
- To evaluate the effectiveness of isolated *Bacillus*, *Lactobacillus* spp. as probiotic candidate
- Backyard production of probiotics

Achievements

Bacillus spp. was isolated from the environment (soil and water) using Nutrient Agar at pH 6.0 with 0.8% NaCl and incubated at 37^0C for 24 h. Colony morphology was large opaque, raised, irregular surfaced and margined, non-pigmented, 2-3 mm grayish-white opaque in color. Isolated bacteria were enriched in nutrient broth and stored at -80°C in glycerol for further experiment. Confirmation of bacterial strains by PCR (using specific primers) is going on.

Pics. 1 & 2. Isolated *Bacillus* bacterial colony from shrimp ghers soil and water

Lactobacillus spp. was also isolated from the intestines of healthy shrimp and tilapia using MRS (selective) Agar Media with pH 5.4 and incubated at 37 °C for 72 h. Colony morphology was raised, circular shape with1-5 mm diameter and margined, non-pigmented creamy-white in appearance. Isolated bacteria were enriched in nutrient broth. Bacterial sample was stored at -80°C in glycerol for further experiment. Confirmation by PCR (using specific primers) is going on.



Picture 3 & 4: Isolated *Lactoacillus* bacterial colony from shrimp ghers soil and water

Surveillance and Distribution of Pathogenic Agents (Virus/Bacteria) of Shrimp/Prawn Disease in Bangladesh

Researchers: M Rakibul Islam, Senior Scientific Officer
Mst. Subrina Khatun, Scientific Officer
Md. Shariful Islam, Scientific Officer

Objectives

- To Investigate the emerging diseases of shrimp and prawn
- To identify the pathogenic agent of NHP, E MS /AHPND and EHP using PCR
- To identify the Risk-factors of the disease invasion
- To identify the available strains of White Spot Syndrome Virus (WSSV) causing shrimp (*P. monodon*) mortality

Achievements

In the year of 2017-18, 42 samples were tested to identify pathogens causing four diseases namely, White Spot Syndrome Virus (WSSV), Acute Hepatopancreatic Necrosis Disease (AHPND), Necrotizing Hepatopancreatitis (NHP) and Enterocytozoon Hepatopenaei (EHP). Shrimp samples were collected from different areas of Khulna, Satkhira and Bagerhat districts. All the samples were tested using self-developed gene specific primer covering 1st step and Nested PCR protocol. The percentages of infected samples and percentages of sampling among the study area are shown in Figure 1. Figure 3 showing the distribution and prevalence of the pathogen.

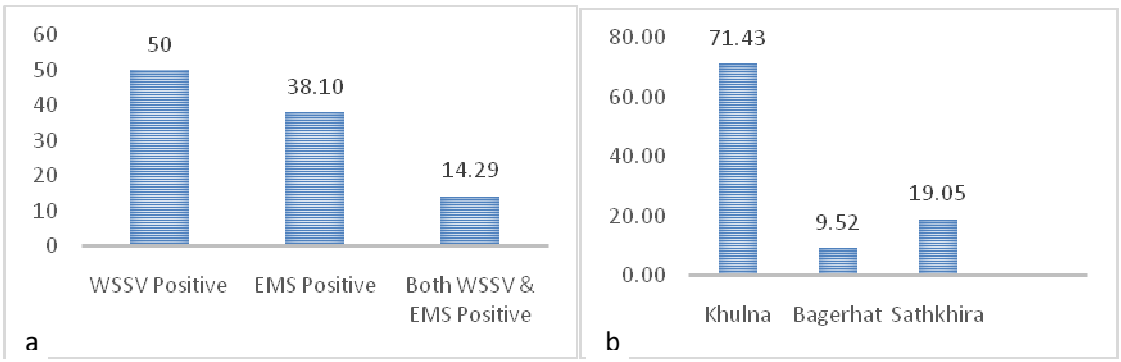


Fig. 1. a. Percentages (%) of infected samples **b.** Percentages (%) of sampling among the study area

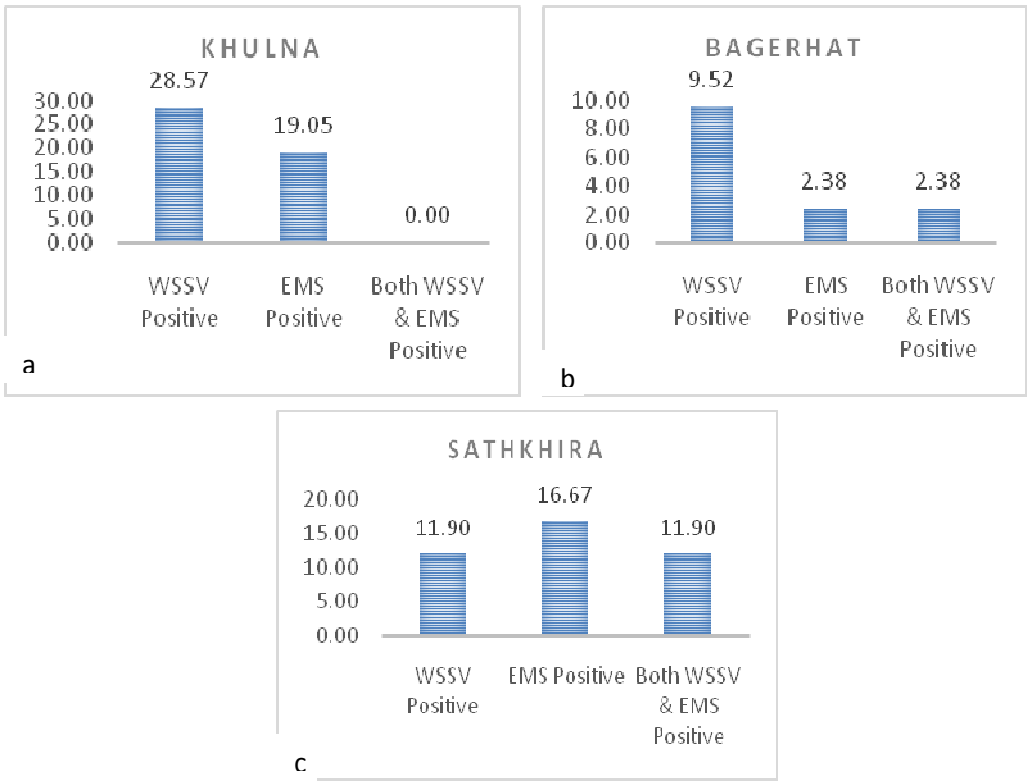


Fig. 2. Percentages of pathogenic infection in **a.** Khulna **b.** Bagerhat and **c.** Satkhira district

Among the collected samples 50% were WSSV positive and 38.1% was EMS/AHPND positive while 14.29% samples were found positive for the both pathogens (Fig. 1. a.). Within the districts, prevalence of AHPND was higher in Satkhira but higher infestation was observed in Khulna district (71.43%). WSSV infection was also found higher (28.52%) in Khulna district followed by Satkhira (11.90%) and Bagerhat (9.52%) Districts (Fig. 2).

For identification of the causative agent of AHPND, a total of 101 bacterial colonies (Fig. 3) were isolated from the samples of study area and stored at -85^{0}C in 50% glycerol solution for further analysis.

Fig. 3. Isolated bacterial colony from the study area

Investigation of Shrimp/Prawn Farming Status in South-West Region of Bangladesh in Context with its Quality Control and Food Safety Issues

Researchers: Md. Ariful Islam, Scientific Officer
Mst. Subrina Khatun, Scientific Officer
Rakhi Das, Scientific Officer

Objectives

- To survey the existing shrimp farms for exploration of its present farming status based on GAqP
- To assess the hazardous antibiotics/chemicals and pesticides residues for determination of shrimp/prawn quality of GAqP and non GAqP farms
- To explore the post-harvest management techniques of shrimp/ prawn for ensuring its food safety issues

Achievements

Survey of the existing shrimp farms for exploration of its present farming status based on GAqP

A comprehensive survey was conducted randomly among two hundred (200) shrimp farms of Rampal Upazila covering 10 Unions of Bagerhat district. Shrimp farms were grouped into 03 categories on the basis of surveyed data. The farms which comply 90-100% GAqP criteria denoted Category-A, the farms which comply 70-< 90% GAqP criteria Category-B and the farms which comply 50-<70% GAP criteria Category-C respectively. It was found that only 2% farms were under Category-A, 43% farms were under Category-B and the highest (49%) number of farms were under Category-C. Rest of the farms were not following the criteria of GAqP (Table 1). From the result it was found that only 04 semi-intensive farms were fully complying the 100% GAqP criteria at Rampal Upazilla of Bagerhat district.

Assessment of the hazardous antibiotics/chemicals and pesticides residues for determination of shrimp/prawn quality of GAqP and non GAqP farms

Assessment of antibiotic residues in shrimp/prawn farms: For determination of banned antibiotic Nitrofuran, a total of 20 Shrimp/Prawn samples were collected from 10 Unions of Rampal Upazila of Bagerhat district. 15 samples were analyzed in Quality Control Laboratory of Shrimp Research Station, BFRI, Bagerhat by LC-MS Machine following standard analysis protocol and no hazardous Nitrofuran metabolites were found in the samples. Some samples have been sent to Fish Inspection and Quality Control (FIQC) laboratory of DoF, Savar, Dhaka to test the presence of Nitro-furan Metabolites. Further sample collection and analysis are going on.

Assessment of pesticide residues in shrimp/prawn farms: Shrimp/Prawn samples were collected from 10 Unions of Rampal Upazila of Bagerhat district for determination of pesticide residues. A total of 20 shrimp and prawn samples were collected from the sampling site and were analyzed by GC-MS Machine following standard analysis protocol for detection of DDT, Dieldrin, Endrin and Heptachlore residues in samples. Some pesticides residues were detected in the three samples of non-GAqP farms that were much lower than the acceptable limit (Table 1). Some samples have been sent to the Pesticides Laboratory of Bangladesh Agricultural Research Institute (BARI) to test the presence of pesticides residues. Further sample collection and analysis are going on.

Table 1. Hazardous pesticides residues in Prawn/ Shrimp of Rampal Upazila of Bagerhat district

Sampling Area	Pesticides Residues (ppm)			
	Heptachlor	Dieldrin	Endrin	DDT
Gurumba	0.000304	00	00	00
Rajanagar	0.000141	00	00	00
Rampal Sadar	0.000119	00	00	0.000215
Acceptable limit	0.01	0.02	0.01	0.05

Exploration of the post-harvest management techniques of shrimp/prawn for ensuring its food safety issues

A few numbers of samples of shrimp and prawn have been collected because harvesting of shrimp/prawn has not started yet. Required amount of samples will be collected when the harvesting of shrimp and prawn will be started in full swing. Samples will be collected and brought to the laboratory and analyzed to know the post-harvest management techniques of shrimp/prawn for ensuring its food safety issues.

Cataloging Marine Fisheries Resources of Bangladesh

Researchers: Dr. Md. Zulfikar Ali, Chief Scientific Officer
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Dr. Sayedur Rahman Chowdhury, Prof., IMSF, CU
Dr. SM Sharifuzzaman, Prof., IMSF, CU
Mohammed Ashraful Haque, Senior Scientific Officer
Jakia Hasan, Scientific Officer
Md. Mohidul Islam, Scientific Officer

Objectives

- To create an up-to-date and complete species catalog of the fisheries resources with photographs, illustrations, taxonomic and relevant information.
- To assess the temporal and spatial fisheries diversity in the marine ecosystem of Bangladesh.
- To facilitate continued research and assessment at MFTS and IMSF through creating/improving fisheries museum and geo-informatics laboratory.

Achievements

Collection of fish specimen for systematic analysis

Fish samples from the selected locations have been collected following the protocol. Photography, morphometric and meristics database development are underway.

Taxonomic identification and updating species catalog

Taxonomic studies were made on the basis of prescribed morphological characters of the collected specimens. Identification and other information about the species were done with the help of different literatures. Attempts were made to provide valid scientific name of all the genera, and species listed in accordance with the rules and principles as set forth in the international code, known vernacular names werementioned.

Identification of fish species

A total of 237fish species under 84 families and 22 orders were identified.

Table 1. Identified marine fish species of Bangladesh

Class	Order	Family	Species
Elasmobranchii	Carcharhiniformes	2	10
	Lamniformes	1	1
	Myliobatiformes	3	25
	Orectolobiformes	1	1
	Rajiformes	1	2
	Rhinopristiformes	1	2
	Torpediniformes	1	1
Sub-total	7	10	42
Actinopterygii	Anguilliformes	3	5

	Aulopiformes	2	2
	Beloniformes	3	5
	Beryciformes	1	1
	Clupeiformes	4	21
	Elopiformes	2	2
	Gadiformes	1	1
	Lophiiformes	1	1
	Mugiliformes	1	5
	Perciformes	40	124
	Pleuronectiformes	4	7
	Scorpaeniformes	3	6
	Siluriformes	3	6
	Syngnathiformes	2	2
	Tetraodontiformes	4	7
Sub-Total	15	74	195
Grand Total	22	84	237

Photographic processing of each collected marine fish specimen with digital scale so that understand about fish size from the view of fish photo.

Order: *Anguilliformes* Family: *Muraenesocidae* Species: *Muraenesoxbagio*

A survey has been conducting to analyze seasonal and geographical distribution of species to publish a Marine Fishes of Bangladesh: Reference book.

Eleutheronema tetradactylum (Shaw, 1804)

Classification:

Order : Perciformes Family : Polynemidae Genus : *Eleutheronema*

English / Bangla name: Fourfinger threadfin / তাইল্লা

Frequent synonyms: *Polynemus tetradactylus* (Shaw, 1804)

Salient features: D1. VIII; D2. I-II, 13-15; P. 16-17+4; V. I, 5; A. II, 15-17

Body elongated, inferior mouth (on the underside of the head with the snout projecting in front), eye covered with adipose tissue. Back and head silvery blue, becoming yellowish white on the sides and abdomen. A dark spot on the upper portion of the opercle. Pectoral fin not branched but 4 free filaments reach nearly to the end of ventral. Caudal fin darkened edge.

Habitat and biology: Adults occur over shallow muddy bottoms in coastal waters, also enter rivers. Feed on prawns and fishes of Mugilidae, Engraulidae, and Sciaenidae. Two peak spawning appears during January-April and July-September in tidal swamps. Newly hatched larvae passage to lower estuaries and shallow foreshore zone for feeding and growing.

Size and weight: Common length 60-80 cm, maximum 100 cm (TL); common weight 3-4 kg, maximum weight 6 kg. Fished by gill net, trawl net, seine net and set bag net.

Distribution: Zone 4 in the map of the Bay of Bengal.

Investigation on the spawning season of commercially Important marine fishes of the Bay of Bengal, Bangladesh coast

Researchers: Dr. Shafiqur Rahman, Senior Scientific Officer
Md. Shahzad Kuli Khan, Scientific Officer
Md. Mozammel Hoque, Scientific Officer

Objectives

- To identify the spawning season of commercially important marine fishes through reproductive biology
- To determine justification of existing imposed banning period through assessing catch of marine fishes of bay of Bengal

Achievements

Interview based survey for local knowledge and sample collection from different locations

Seventeen commercially/most consumable fish were found under the four groups such as Eel, Tuna, Cat fish & Red snapper. Local Name, English name, Scientific Name and breeding seasons are given bellow. Verification of recorded fish spawning/breeding season related information (under the sardine, croaker, pomfrets, ribbon, hilsa, scads & mackerels group of fish) was done which were mainly gathered from the aged fishermen, fishermen, oarsman, businessmen and entrepreneurs in last year.

Local Name	English Name	Scientific Name	Breeding season
Baim	Short fin eel	*Anguilla bicolor*	Peaks: Nov. - March
Kamila	Yellow pike conger	*Congresox talabon*	Peaks: April - May; Sept. – Oct.
Kamila	Indian pike conger	*Congresox talabonoides*	Peaks: April -May ; Sept. – Oct.
Kamila	Common pike conger	*Muraenesox bagio*	Peaks: July; September – Oct.
ey‡jU gvBU^{a}v bullet myitta	Bullet Tuna	*Auxis rochei*	Peak: June-July; May to August
ফ্রিগেট মাইট্রা frigate myitta	Frigate tuna	*Auxis thazard*	Peak: June-July; May to August
বম মাইট্রা bom myitta	Kwakawa	*Eutynnus affinis*	Peak: June-July; May to August
মাইট্রা myitta	Skipjack tuna	*Katsuwonus pelamis*	Peak: June-July; May to August
হলুদ ফিন মাইট্র্যা yellow fin myitta	Yellowfin tuna	*Thunnus albacares*	Peak: June-July; May to August
বড় চোখ্যমাইট্র্যা big eye myitta	Bigeye tuna	*Thunnus obesus*	spawn throughout the year
লম্বা লেজ মাইট্র্যা/টুনা long tail myitta	Long tail tuna	*Thunnus tonggol*	unknown
Snapper			
Ranga Chowkha	Yellow fin red snapper	*Lutjanus guilcheri*	April to October
Ranga Chowkha	John ‘s snapper	*Lutjanus johni*	April to October
kata fish	Threadfin sea Catfish	*Arius arius*	April to August
kata fish	Sagor Catfish	*Hexanematichthys sagor*	April to August
Apia Kata Fish	Solidier catfish	*Osteogeneiosus militaris*	April to August
Kata sona	Sona sea catfish	*Sciades sona*	April to August

Reproductive biology study (based on histological analysis)

Fish histological analysis data of revealed, the pattern of oogenesis or egg growth was asynchronous during the month of January to April in case of rupchanda, folichanda & lalpoa however, in May, June and July which was observed in almost ovulated which indicate May, June and July months may be the peak spawning season of *P. chinensis* (rupchanda), folichanda (*P. argeteaus*) and *J. argentatus* (lalpoa). But asynchronous pattern of oogenesis or egg growth during January to April reflects a lean breeding seasons may exist for both of fish *P. chinensis* and *J. argentatus* during February March and October-November.

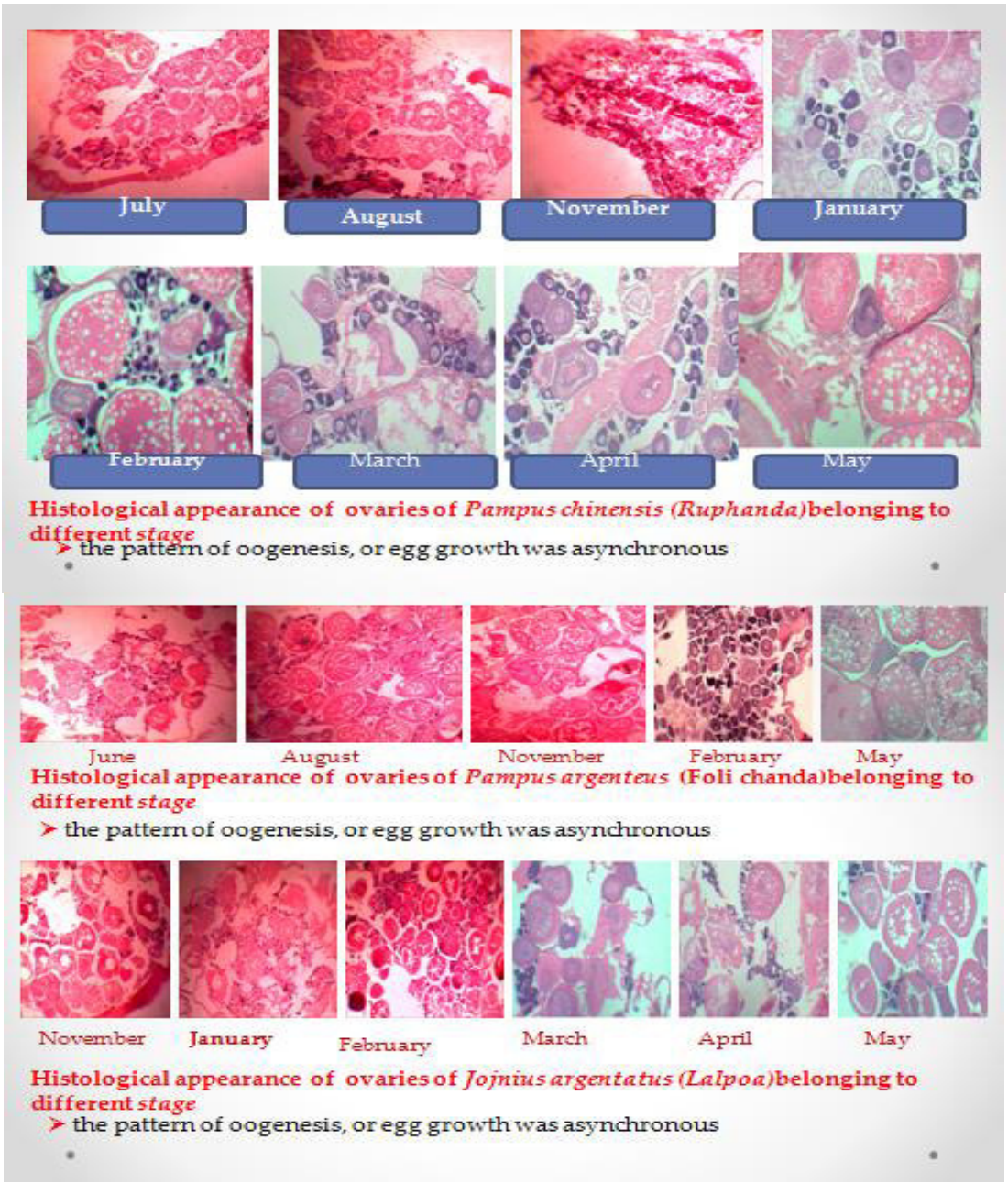


Fig. 1. Monthly variations of ovarian maturation stages for *Pampus chinensis, P. argentatus* and *Jojnius argentatus* in the Bay of Bengal from Bangladesh Part.

Estimation of Spawning- and peak-spawning season for Pampus chinensis through GSI:

A total 222 (male= 106 and female=116) individuals of Chinese Pomfret, *Pampus chinensis* were examined in the present study. Monthly changes of GSI for males and females *P. chinensis* are shown in Figure 1. The lower values of GSI (<0.20% for males and <2.0% for females) were during the October to March for both sexes. However, the higher GSI (>0.20% for males and >2.0% for females) were found during the month of March to September, which indicated the spawning season of *P. chinensis* in the Bay of Bengal. In addition, peak values of GSI were found in the month of June-July, which was the peak spawning season for this species.

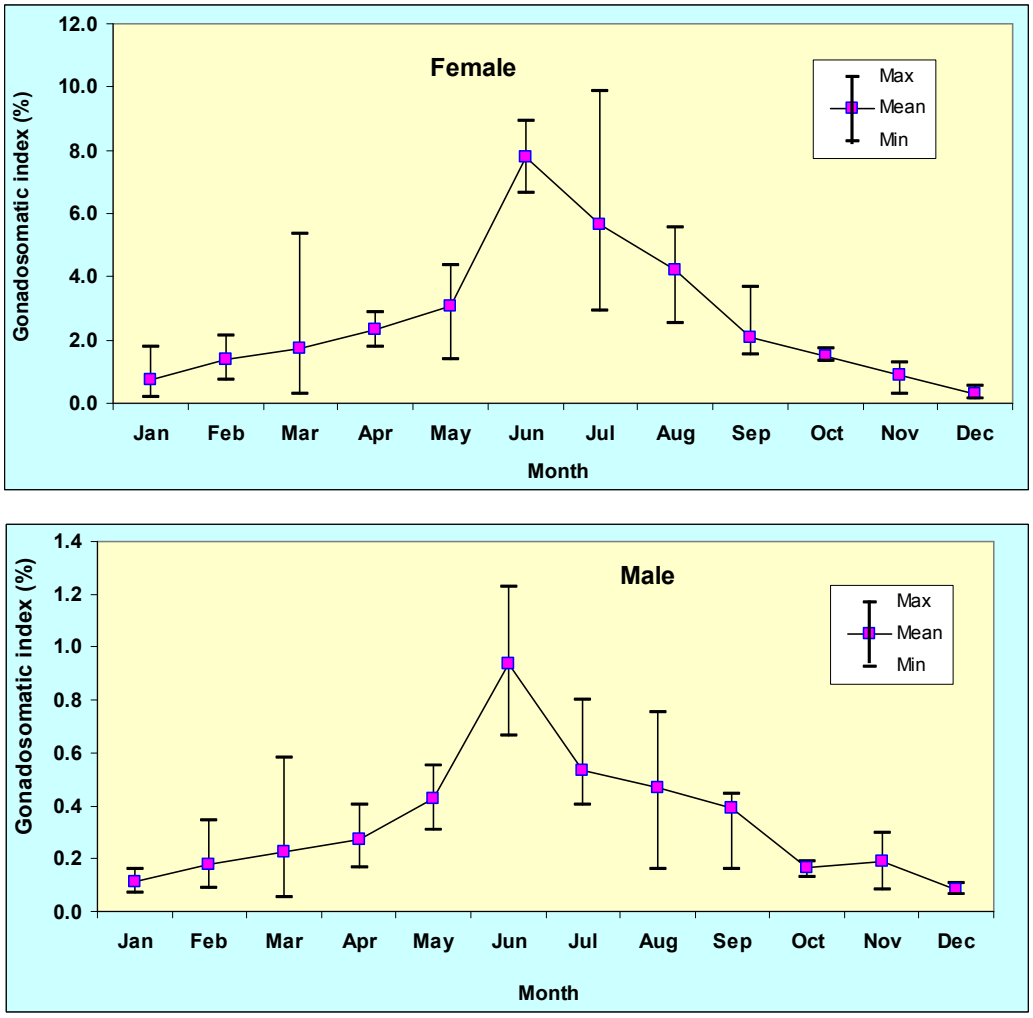


Fig. 2. Monthly variations of gonadosomatic index (GSI %) for *Pampus chinensis* in the Bay of Bengal from Bangladesh Part. The rectangles indicate monthly mean value, whereas vertical lines indicate minimum-maximum values of GSI (%).

Estimation of Spawning and peak-spawning season for Johnius argentatus through GSI:

A total 226 (male= 102 and female=114) individuals of Lal poa; *J. argentatus* were examined in the present study. Monthly changes of GSI for males and females *J. argentatus* are shown in Figure 2. The lower values of GSI (<0.40% for males and <3.0% for females) were during the October to March

for both sexes. However, the higher GSI (>0.40% for males and >3.0% for females) were found during the month of March to September, which indicated the spawning season of *J. argentatus* in the Bay of Bengal. In addition, peak values of GSI were found in the month of June, which was the peak spawning season for this species.

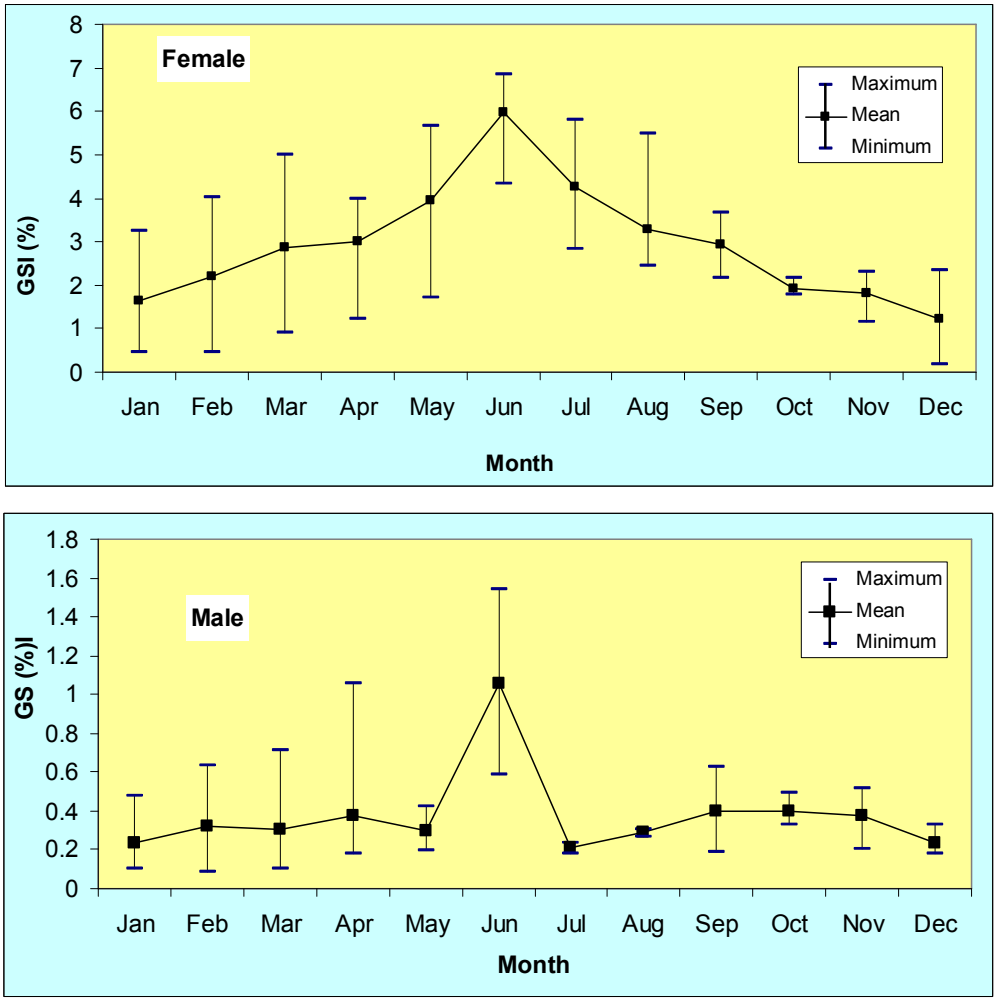


Fig. 3. Monthly variations of gonadosomatic index (GSI %) for *Johnius argentatus* in the Bay of Bengal from Bangladesh Part. The rectangles indicate monthly mean value, whereas vertical lines indicate minimum-maximum values of GSI (%).

Study on migratory aggregation patterns through catch assessment

Maximum length based size at sexual maturity: The size at sexual maturity was calculated through maximum length based formula as male= 22.25 cm TL (95% CL= 15.30 to 32.40 cm TL) and female = 24.50 cm TL (95% CL= 16.70 to 35.80 cm TL) for *Pampus chinensis.* Also the size at sexual maturity was male= 22.75 cm TL (95% CL= 15.78 to 33.20 cm TL) and female= 25.0 cm TL (95% CL= 17.00 to 36.5 cm TL) for *Johnius argentatus.*

Development of culture of seaweeds in south-eastern coast of Bangladesh

Researchers: Dr. Md. Zulfikar Ali, CSO, MFTS, BFRI
Md. Mohidul Islam, SO
Jakia Hasan, SO

Objectives

- To make a detailed inventory of available seaweed species in Bangladesh coast
- To develop culture technique of selected seaweeds in St. Martin and other suitable areas
- To develop culture technique of selected seaweeds at shrimp farm or crab farm in Cox's Bazar as integrated farming
- To investigate the nutritious value of seaweeds

Achievements

Inventory of available seaweed

Survey was conducted in and around Cox's Bazar (St. Martin Island, Teknaf, Inani, Bakkhali, Patowartek and Moheshkhali) during October 2017 to April 2018, different species of seaweed i.e. *Rosenvingea intricata, Dictyota atomaria*, *Asparagopsis taxiformis, Padina fraseri, Caulerpa taxifolia, Caularpa racemosa, Codium fragile, Enteromorpha intestinalis, Galaxaura obtusata, Gracilaria* sp., *Hypnea musciformis, Hypnea* sp., *Analipus japonicas, Padina tetrastromatica, Ulva prolifera, Gelidium pusillum* (Table1) were collected randomly by hand-picking from the study area at the time of low-tide. Sixteen newly seaweed identified during this study period and the total ninety one number of seaweed species recorded from study sites. Fresh samples were taken into plastic jars and then kept into icebox for laboratory work. In the laboratory, samples were gently brushed under running seawater, rinsed with distilled water, dried with paper tissue and finally preserve by open air drying.

Table 1. Availability and distribution of seaweed

Table-1: Seaweed species availability in different months								
Scientific name	Type	Area	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
Actinotrichia fragilis	RSW	St.Martin		+	++	+		
Asparagopsis taxiformis	RSW	St.Martin			+	+++	++	
Caulerpa (3 sp).	GSW	St.Martin	+	+	++	+++	+++	+
Chrysymenia sp.	RSW	St.Martin			+	++	+	
Codium fragile	GSW	St.Martin				+	++	+
Colpomenia (2 sp).	BSW	St.Martin		+	+++	++	+	+
Dermonema pulvinatum	RSW	Inani				+	+	
Dictyota (2 sp).	BSW	St.Martin		+	++	++	++	+
Enteromorpha (3 sp).	GSW	St.Martin,Inani Moheshkhali,	+	+	+++	+++	++	+
Eucheuma cottonii	RSW	St.Martin			+	++	+	
Galauxara sp.	RSW	St.Martin		+	++	++	+	+
Gracilaria sp.	RSW	St.Martin			+	++		
Helimeda (2 sp).	GSW	St.Martin		+	+	++	+	+
Hydroclathrus sp.	BSW	St.Martin		+	+++	+++	+	+
Hypnea (4 sp).	RSW	St.Martin,Inani Moheshkhali,	+	+++	+++	+++	++	+

Jania sp.	RSW	St.Martin			++	+	+	+
Liagora viscida	RSW	St.Martin				+	++	+
Padina (2 sp).	BSW	St.Martin, Inani		+	+++	+++	+	+
Peyssonellia sp.	RSW	St.Martin			+	+	+	+
Porphyra sp.	RSW	St.Martin		+	+	+	++	
Sargassum(3 sp).	BSW	St.Martin			++	+++	+++	+
Tricleocarpa cylindrica	RSW	St.Martin				+	++	+
Ulva sp.	GSW	St.Martin,Inani Moheshkhali,		+	++	+	+	

RSW = Red Seaweeds + Normally available
BSW = Brown Seaweeds ++ Moderately available
GSW = Green Seaweeds +++ Highly available

Seaweed culture

Experimental culture sites of seaweeds were setup sheltered intertidal zones of Bakkhali river estuary (N21°28.482, E091°57.867), Inani (N21°28.241, E091°55.226), Saint Martin (N20°36.971, E092°19.459) and Chowfoldondi (N21°30.761, E092°0.772). Date of culture experiment set up was 01 December, 03 December, 05 December and 07 December 2017 respectively. Coir rope was used as net material for substrate with horizontal net size of square (4m×4m). Four corners of the nets were tied with rocks or bamboo with plastics floats placed 25 cm above from the bottom. Micronutrients enriched seaweed species *Enteromorpha intestinalis* were selected for culture experiment in study sites. Seeding was done by inserting the young fragments of *Enteromorpha intestinalis* with an average of 4±0.5kg fw (fresh weight) and 5cm length in the twists of the coir ropes with short length of string at a density of seaweed seed were 35-40 seed/m^2. Besides this in Saint Martin (N20°36.971, E092°19.459) another species of seaweed *Hypnea musciformis* was cultured as like *Enteromorpha intestinalis.* Partial harvesting was done after15 days culture period. Seaweed mean biomass was recorded at the end of 90 days of experiment and expressed as wet weight of seaweed per unit culture area (Kgm^{-2}) and computed with the following formula:

$$Y = (W_t - W_0)/A$$

Where: Y = biomass production; W_t = wet weight at day t; W_0 = initial wet weight; A = area of 4 m^2 net.

Daily growth rate (DGR) % was calculated every 15 days of culture using a formula Hung *et al.* (2009).

$$DGR = [(W_t/W_0)^{1/t} - 1] \times 100 \ \% \ day^{-1}$$

Where: W_0 is the initial wet weight, W_t is the final wet weight, and t is days of culture

Three (03) replications were trialed for each culture area of the species. The hydrological data are shown in Table 2.

Table 2. Hydrological data of the culture sites

Experimental Sites	Mean values of hydrological data						
	Temperature (°C)	Salinity (‰)	DO (mg/l)	pH	Alkanity (ppm)	Transparency (cm)	Depth (cm)
Bakkhali	20.1	25.8	6.1	7.4	115	62.2	105
Inani	22.8	29.8	7.5	8.4	125	69.3	120
Saint Martin	24.5	31.8	7.2	7.8	132	90	140
Chowfoldondi	18.7	21.5	5.5	7.2	120	52.5	62.7

Between December 2017 to March 2018, a total of 18 partial harvests were made of *Enteromorpha intestinalis* in three sites (Saint Martin, Bakkhali and Inani), 6 partial harvests in each site. In Chowfoldondi (Polyculture with soft shell farm) only 3 partial harvest were made due to pond drying problem. In Saint Martin, the maximum partial harvesting was recorded as 25.10±0.36 kg fresh wt at 60th day; the minimum 11.54±0.28 kg fresh wt.occurred at 15th day. In Bakkhali, a maximum 21.73±0.40 kg fresh wt. was partially harvested at 60th day; the minimum was 10.10±0.40 kg fresh wt. at 15th day. In Inani, the partial harvesting peaked at 12.77±0.25 kg fresh wt. at 45th day and the lowest was 7.21±0.10 kg fresh wt. at 90th day. In Chowfoldondi (Polyculture with soft shell farm) the partial harvesting peaked at 10.80±0.50 kg fresh wt. at 30th day and the lowest was 8.57±0.21 kg fresh wt. at 45th day (Table.3)

Table 3. Shows the partial harvesting (Kg) of *Enteromorpha intestinalis* on 90 days of culture period in four sites

Culture sites	Partial harvesting *Enteromorpha intestinalis* (Mean±SD) Kg					
	15th day	30th day	45th day	60th day	75th day	90th day
St. Martin	11.54±0.28	15.68±0.38	19.88±0.32	25.10±0.36	17.40±0.40	12.38±0.24
Bakkhali	10.10±0.40	16.24±0.03	17.82±0.33	21.73±0.40	19.43±0.35	13.63±0.32
Inani	8.63±0.42	11.92±1.12	12.77±0.25	10.57±0.50	7.46±0.06	7.21±0.10
Chowfoldondi	7.40±0.10	10.80±0.50	8.57±0.21	-	-	-

Maximum daily growth rate 6.55±0.15 % day^{-1} at 15th day and minimum daily growth rate 1.1±0.05 % day^{-1} was observed at 90th day in Saint Martin. In Bakkhali, the DGR value peaked at 5.71±0.26 % day^{-1} at 15th day and the lowest was 1.23 ±0.03% day^{-1} at 90th day. In Inani, the DGR was at a maximum 4.71±0.30 % day^{-1} at 15th day and minimum daily growth rate 0.65±0.03 % day^{-1} was observed at 90th day harvest. Maximum daily growth rate 4.61±0.30 % day^{-1} at 15th day and minimum daily growth rate 1.53±0.05 % day^{-1} was observed at 45th day in Chowfoldondi (Table 4)

Table 4. Shows the daily growth rate % day^{-1} of *Enteromorpha intestinalis* on 90 days of culture period in four sites

Culture sites	*Enteromorpha intestinalis* DGR % day^{-1} (Mean±SD)					
	15th day	30th day	45th day	60th day	75th day	90th day
St. Martin	6.55±0.15	4.18±0.05	3.25±0.04	1.85±0.01	1.48±0.03	1.1±0.05
Bakkhali	5.71±0.26	4.29±0.06	3.04±0.02	1.70±0.02	1.59±0.02	1.23±0.03
Inani	4.71±0.30	3.21±0.31	2.34±0.02	0.97±0.05	0.78±0.03	0.65±0.03
Chowfoldondi	4.61±0.39	3.02±0.16	1.53±0.05	-	-	-

Harvest at the end of 90-day duration of culture period in four sites resulted in the absolute maximum biomass yields (24.50±0.08 kg fresh wt.m^{-2}) yielded in Saint Martin and the lowest biomass (5.61±0.66 kg fresh wt.m^{-2}) in Chowfoldondi due to short duration (Table 5)

Table 5. Shows the biomass production (Kg m^{-2}) of *Enteromorpha intestinalis* on 90 days of culture period

Culture sites	Biomass production (Mean±SD) Kg m^{-2}
St. Martin	24.50±0.08
Bakkhali	23.74±0.87
Inani	13.84±1.06
Chowfoldondi	5.61±0.66

In Saint Martin, the maximum partial harvesting of *Hypnea musciformis* was recorded as 30.23±0.40 kg fresh wt at 60th day; the minimum 14.53±0.45 kg fresh wt.occurred at 90th day (Table 6)

Table 6. Shows the partial harvesting (Kg) of *Hypnea musciformis* on 90 days of culture period in Saint Martin

Culture sites	Partial harvesting *Hypnea musciformis* (Mean±SD) Kg					
	15th day	30th day	45th day	60th day	75th day	90th day
St. Martin	16.53±0.25	21.50±0.20	25.35±0.22	30.23±0.40	18.30±0.44	14.53±0.45

Maximum daily growth rate 8.88±0.10 % day^{-1} at 15th day and minimum daily growth rate 1.15±0.02 % day^{-1} was observed at 90th day in Saint Martin (Table 7).

Table 7. Shows the daily growth rate % day^{-1}of *Hypnea musciformis* on 90 days of culture period in Saint Martin

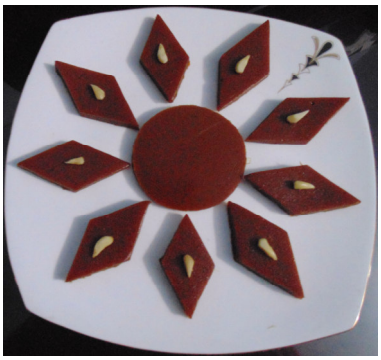
Culture sites	*Hypnea musciformis* DGR % day^{-1} (Mean±SD)					
	15th day	30th day	45th day	60th day	75th day	90th day
St. Martin	8.88±0.10	2.56±0.08	2.36±0.05	1.36±0.01	1.37±0.01	1.15±0.02

Harvest at the end of 90-day duration of culture period resulted in the absolute maximum biomass yields (30.61± 0.23 kg fresh wt.m^{-2}) yielded in Saint Martin

Seaweed product development: After washing by clear sea water then cultured seaweeds (*Enteromorpha intestinalis* & *Hypnea musciformis)* washed by running tap water and finally washed by clean freshwater for used as an ingredient in various foods item to enrichment of food product and stored after air drying at room temperature for further use. Seaweed soup, seaweed barfi, squid-seaweed masala was prepared.

Squid-seaweed masala

Seaweed Soup



Seaweed barfi

Though, cultured seaweed *Hypnea musciformis* shows better biomass yield and daily growth rate than *Enteromorpha intestinalis* but we can successfully culture these two species along our south-eastern coast of Bangladesh. However, successful development of seaweed culture not only requires appropriate natural environmental conditions and the availability of workable technical methods but also receptive and supportive social and economic conditions.

Development of Seed Production and Larval Rearing Technique of Mud Crab (*Scylla* sp)

Researchers: Md. Shahzad Kuli Khan, SO
Dr. Abdur Razzaque, DD
Md. Mozzammel Hoque, SO
Jakia Hasan, SO

Objectives

- To domesticate the mud crab (*Scylla sp.*) broodstock under captive/hatchery conditions
- To develop breeding technology of mud crab (*Scylla sp.)* in captivity
- To develop larval rearing and nursery management technique of mud crab (*Scylla sp.*)

Achievements

The experimental side was Marine Fisheries & Technology Station, Bangladesh Fisheries Research Institute, Cox's Bazar. Gravid brood crabs were collected from Chakaria crab market under Cox's Bazar district. Total off 80 crabs were collected from market. After sorting 60 crabs were select for reared.



Among them only 10 crabs were finally survived. Chlorinated sea water was used for the experiment. During the experiment collected crabs were subjected to a bath of 100μL/L of a 40% formalin solution for disinfected. After the formalin bath in each 500 L fibre glass tank were used for 04 crabs and in this way 15 tank were used for 60 crabs. Water temperature was maintained to 26-28^{o} C, water salinity was 30ppt, and daily feeding ratio was @ 10-15% of body weight of fresh marine squid, bivalve or fish meat alternately. Water quality parameters were monitored daily following standard methods and A daily management schedule were maintain for siphoning out waste material from the tank. Eyestalk ablation was applied for selected 10 broods to spawning by a blunt scissor.



After eye ablation, berried crabs were again subject to a 100μL/L formalin bath and then transfer to a 300 L fibre glass tank. In this time individual tank were used for individual species. Water temperature was maintained to 28-30^{o} C, water salinity was 30 ppt with continuous aeration. After eye ablation 04 crabs were response with eggs. Among them 02 crabs were died at 4th and 6th day respectively. At 7th day another 01 crab released the unfertilized eggs. After the 14 days last one released the fertilized eggs with some of zoea.

Table 1. Number of counted eggs

No.	No. of eggs (in millions)	Status
Crab-1	2.6	--
Crab-2	1.8	--
Crab-3	1.6	Unfertilized eggs released
Crab-4	2.1	Spawning (with poor condition)

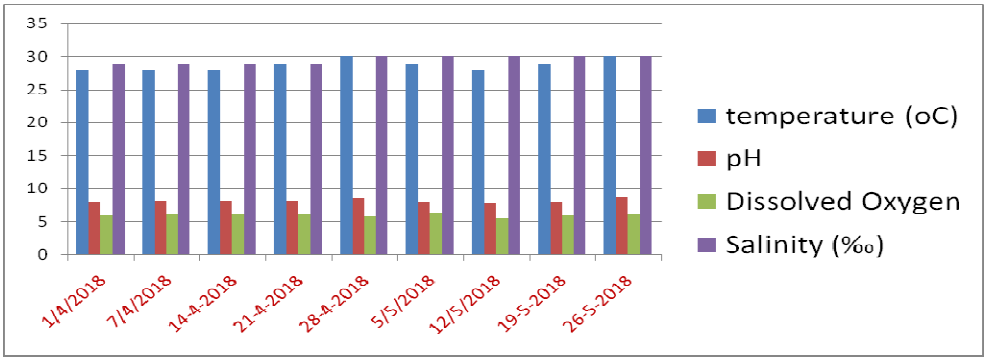


Fig. 1. Water quality analysis

Water quality parameters were monitored daily following standard methods. The temperature, pH, salinity and dissolved oxygen was <0.05 & was statistically significant.

The results reveals that crab seed production showed 2 berried crabs were died and another one released unfertilized and another one fertilized eggs. The fertilized eggs with some of zoea were completely died within 5 hours.