# MACH

## Technical Paper 5

## Changes in Biodiversity with Wetland Restoration and Fish Reintroduction

***Management of Aquatic Ecosystems through Community Husbandry***

**July 2007**

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# Changes in Biodiversity with Wetland Restoration and Fish Reintroduction

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## Abstract

The MACH project worked to restore productivity of three major wetlands in Bangladesh between 1998 and 2007. The single largest contribution to local livelihoods from these wetlands is from wild fish catches, but communities identified declinging fish and other aquatic resources and wildlife as serious problems in these areas. The major interventions taken by local communities with project support have been habitat restoration (excavation of deeper spots to retain water and tree planning) and making fish sanctuaries. However, some species need a helping hand to re-establish having been lost or become very scarce in a wetland. MACH re-stocked 15 species of fish into the wetlands, 10 of which are considered to be nationally threatened. Regular catch monitoring gives an indication of whether these species have established self-sustaining populations and are now caught in greater numbers, and also any overall changes in fish diversity.

Piloting through MACH has shown that sustaining populations of some native carps can be re-established – populations of Goinna have been restored in all three sites, and Rui and Kalibaus appear to have increased where there are suitable conditions or connections for breeding. Habitat restoration and protection plus re-introduction appear to have been very successful in re-establishing Meni and Shol in the Kangsha-Malijhee floodplains of Sherpur. However, attempts to re-establish Deshi Sarputi appear not to have succeeded, and more time will be needed to determine the impact for other species. Overall species diversity increased in Hail Haor and Kangsha-Malijhee. However, although Turag-Bangshi had the lowest baseline fish catches they were more diverse and there has been no notable change in species diversity. In Hail Haor most of the gains have been from higher catches of small catfish and snakeheads which benefit from sanctuaries and excavation. In Turag-Bangshi miscellaneous small fishes, small catfish, snakeheads, large catfish and prawns have all recovered. In Kangsha-Malijhee most groups of fish have just increased in proportion to the increased catches. In addition catches of Common Carp in all three sites increased indicating that this introduced species is becoming established despite no assistance through the project.

Restoration of wetland habitats and their protection from exploitation have been demonstrated to be the key measures to restore other wetland biodiversity, for example water bird populations and diversity increased greatly in Hail Haor with protection and restoration of a large sanctuary. Restoration of populations of some locally rare fishes through re-introduction has been successfully demonstrated, but this requires careful assessment to see that suitable habitat is protected, collection of fish from wild sources where this will not affect the parent stock, and care and expertise in transporting and handling fry of native species during their release.

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# 1. Introduction

## 1.1 Declining wetland biodiversity

Out of Bangladesh's 260 freshwater fish species (Rahman 2005), more than 40% are now threatened with national extinction (IUCN Bangladesh 2000) and may soon follow the path of other wetland fauna and flora. Since 1985, natural carp spawn catches have declined by 75% (Ali 1997) and major carp and large catfish have declined by 50% in national catches. There have already been mass extinctions in the last 200 years in much of Bangladesh. In the mid-nineteenth century there were large areas of reed swamp, wet grassland and flooded forests, particularly in the haors of Greater Sylhet, where One-horned Rhinoceros, Tiger, Swamp Deer and Wild Buffalo all roamed (Sachse 1917). By 1967 large mammals had long since disappeared from the haors, but in Hail Haor "From horizon to horizon the sky was full of wheeling ducks and their clamorous voices could be clearly heard for half a mile" (Mountfort 1969). Yet monthly surveys of Hail Haor in 1992 revealed few ducks (FAP 6 1993); and in 2003 only a handful of wild ducks remained.

The wetlands that cover half of Bangladesh are a source of food and income for perhaps 70 million rural households. However, flood embankments and water control structures have blocked fish migration routes; irrigation has expanded winter rice cultivation and reduced the water available for aquatic life to survive in the six-month dry season; industrial development causes locally severe pollution; overexploitation has reduced wild fauna and flora; and loss of tree cover and poor slope cultivation practices in watersheds cause high rates of siltation in wetlands. The most critical problem is the loss of dry season surface water which is vital for all aquatic life including fish.

## 1.2 MACH

The Management of Aquatic Ecosystem through Community Husbandry (MACH) project (phases I and II) is a USAID supported project implemented in three large wetlands in conjunction with the Bangladesh Government and four NGOs. The project has been working since 1999 to enable and introduce sustainable wetland management and restore and protect wetland biodiversity. It follows a co-management approach based on community level participation and development which links socio economic benefits for fisher and other wetland dependent people in the project areas with wetland conservation.

**Hail Haor** in north-east Bangladesh is typical of deeply flooded basins in that region known as *haors*. Water from the hills to the east and west flows through 59 streams into the haor. Flood control works downstream limit its connection with the main river system The haor is located in five unions of Sreemongal Upazila and in two unions of Sadar Upazila of Moulvi Bazaar District. The watershed of Hail Haor covers about 600 $km^2$ (237 square miles) and 15% is in India. The average maximum wet season area of Hail Haor is about 13,000 ha, but the dry season area is typically just over 3,000 ha. Approximately 172,000 people live in 61 villages around the haor.

The **Turag-Bangshi** site is just north of Dhaka and is typical of low-lying floodplains in Bangladesh. It covers seven unions of Kaliakor Upazila in Gazipur District and one union of Mirzapur Upazila in Tangail District. The Turag-Bangshi River runs for approximately 30 km through the site with 26 beels (wetland depressions) and numerous canals on either side of the river. Water covers about 10,000 ha at full flood, but diminishes to less than 700 ha at the end of the dry season. Dry season water has been reduced for agriculture and irrigation. Approximately 225,000 people live in 226 villages that make use of the river and floodplains.

The **Kangsha-Malijhee** site is in north-central Bangladesh in Sherpur Sadar and Jhenaigathi Upazilas in Sherpur District. The area includes the catchments of the upper Kangsha and Malijhee river system. The hills here now have only remnants of natural forest. The area is prone to regular flash floods from these hills. The wetlands and floodplain have a water area of approximately 8,000 ha during the wet season, which falls to about 900 ha in the dry season. The floodplain area contains 47 beels, of which 18 are perennial. The population of the area is approximately 279,000 living in 163 villages.

### 1.3 Focus of this paper

This paper summarises evidence of changes in fish biodiversity and experiences in restoring locally scare fishes in the three MACH sites (Hail Haor (HH) in the north-east, Turag Bangshi (TB) just north of Dhaka, and Kangsha Malijhee (KM) in the north-central area based on catch monitoring data and key informants and their experience during the period from 1999 to mid-2005.

This paper should be read in conjunction with MACH Technical Report 4 to understand the links between fishery production and environment/water levels, and MACH Technical Report 3 on fish sanctuaries.

## 2. Biodiversity and Local Identification of Wetland Problems

In the baseline year of MACH without interventions (1999 in Hail Haor and Turag-Bangshi, and 2000 in Kangsha-Malijhee) the wetland habitats and fish biodiversity were degraded in all three sites. The wetland dependent people of the areas reported that fish catches and species diversity, along with other aquatic resources, had been declining, and people were not aware of any actions implemented either by Government or any other organizations to protect these wetlands.

To understand the issues and target appropriate measures to address local problems and restore aquatic biodiversity, identification of the critical problems was essential. Problems were identified by the local communities dependent on these wetlands through participatory planning processes. In Hail Haor and Turag-Bangshi, village level discussions were held that included problem censuses and rankings of priority problems. In Kangsha-Malijhee the Participatory Action Plan Development (PAPD) approach was used where workshops and discussion groups with separate stakeholder categories were held among people from several villages using each wetland (Table 1).

**Table 1 Priority problems identified by stakeholders in participatory planning**

| Problem | Hail Haor overall top problems | Kaliakoir (average score) * | Sherpur average score ** | Addressed by MACH |
|---|---|---|---|---|
| **Siltation** | **YES** | **9.2** | **4.5** | YES |
| **General decline in fish** | **YES** | **5.0** | **7.2** | YES |
| Loss/catching of fish spawn and brood fish | | **3.9** | **4.5** | YES |
| Pollution | **YES** | **3.9** | | YES |
| Use of destructive gear | | **3.5** | **5.1** | YES |
| Decline in aquatic resources plants/ animals | **YES** | 2.1 | 3.1 | YES |
| Low water in dry season/ irrigation problem | **YES** | 1.4 | 0.8 | YES |
| Some fish species lost | | 1.5 | **3.3** | YES |
| Lack of employment | | **2.5** | 2.2 | YES |
| Fish disease | | 2.4 | **3.7** | NO |
| Loss of water birds | **YES** | | 1.3 | YES |
| Flood damage | | | **3.5** | NO |
| Rice seed (HYV) quality | | **2.5** | | NO |
| Leasing system | **YES** | | | YES |

* Average of village based scores where: 1st priority problem = 10, 2nd = 9, etc.
** Average of stakeholder based scores where: 1st priority problem = 10, 2nd = 9, etc.
Bold = top seven problems by site, bold problem name = top problems common to all three sites
Only the problems that were in the top seven in each site are shown

Thus the main problems identified can be summarized as declining fisheries and aquatic resources/ biodiversity as a result of siltation, degradation and loss of habitat, and over-exploitation including the use of fishing gears and practices (such as dewatering) that are considered to be destructive. Moreover, biological and environmental specialists in the project assessed that catches were less than the potential for wetlands such as these. This was supported by baseline surveys (which then continued as monitoring throughout the project period), and information and opinions of related District and Upazila Fisheries Officers and the fisher communities.

# 3. Interventions

After identification of these problems, MACH helped the communities to organize and form wetland based Resource Management Organizations (RMO), and then helped them to take initiatives to restore and protect wetland habitat, and this was expected to restore fish diversity and populations. The main initiatives taken were:

- Re-excavation of beels and canals to keeping water in dry season.
- Establishment of fish sanctuaries complete with fish shelters of brushpiling or concrete pipes, tetrapods and hexapods.
- Collection of indigenous fish species from other places and reintroduction/re-stocking in the wetlands.
- Bans on fishing in the breeding season.
- Bans on hunting birds.

Because much of these wetlands dry up for half of the year, the focus has been on improving conservation of fish in the dry season so that they can spawn and repopulate the floodplains in the next wet season. The physical interventions that have had most impact on fish habitat are briefly discussed below, while the main focus of this technical paper is on restocking and its impacts.

## 3.1 Re-excavation of beels and connecting canals

To restore wetland habitat in the project water bodies, silted up beels and canals that had become seasonal were excavated so that they for retain more water throughout the dry season to support over-wintering adult fishes. These brood fishes play a key role in repopulating the wetland system in the following year. In addition to beel resident fish species, the first flood water in the early monsoon contains huge quantities of eggs of many fish species including those that are migratory and breed in the river system. The connecting canals (khals) play an important role alowing fish eggs, brood fish and fish hatchlings and fries to move from rivers to beels and floodplains, and vice versa. This of course is essential for completion of their biological cycle (spawning, nursing, feeding and taking refuge). By 2007 MACH had excavated 57 ha of beels and over 31 km of khals.

## 3.2 Establishment of fish sanctuaries

A fish sanctuary is a place where fish and other aquatic life are free from exploitation around the year. Fish sanctuaries have a critical role to protect brood fish in the dry season. Sanctuaries have been established by the RMOs with the help of the local wetland dependent communities, local Union Parisad (council), and local government officials. By 2007 a total of 57 sanctuaries had been established in the three MACH sites, covering 439 acres (178 ha), of these 11 (268 acres) were in Hail Haor, 23 (135 acres) in Turag–Bangshi, and 23 (36 acres) in Kangsha Malijhee. With the exception of one large wetland sanctuary (234 acres or about 100 ha) of national significance in Hail Haor, the others are of modest size. The largest of these sanctuaries – Baikka Beel – covers approximately 100 ha of permanent wetland in Hail Haor and has already been effective in providing breeding grounds for a number of beel resident fish species, larger fish are being caught in the neighboring areas, and migrant waterbirds, particularly ducks, have returned to the area in good numbers because they have a safe refuge and the RMO has successfully prevented hunting and other disturbance. With that exception a significant part of the no fishing area comprises improved fish habitats either through excavation or placing fish protection and shelter materials (in beels mostly concrete pipes and hexapods which the fish use as shelters and which provide surfaces for growing algae that the fishes feed on), and in the rivers brushpiles with bamboo and tree branches (which again act as a protector as well as food source for the fish). The RMOs protect the sanctuaries and prevent fishing year-round, and the areas are well demarcated and signed.

## 3.3 Restoration of swamp and riparian vegetation

Suitable wetlands have been planted with wet area tree species (Hijal *Barringtonia acutangula* and Koroch *Pongamia pinnata*) in each of the three sites. When fully established these wetland forests

will enhance the quality of habitats by providing additional niches for a range of wildlife to feed and when flooded as a refuge area for fish and other aquatic life. The communities (RMOs) also have rights to earn an income from these trees through selling of branches for making of brush piles and for use as fuel wood when they are sufficiently mature, but the agreements are not to fell these trees.

In order to protect stream banks and reduce soil erosion, selected stream banks within and adjacent to the project sites have been planted with trees (timber, fruit, and others) and shrubs to develop riparian forest along the river course. In addition to the ecological importance of riparian forest for birds and wildlife, as corridors connecting upland areas with the wetlands, and for stabilizing the banks of the streams and rivers, the local communities are also expected to earn income in the long term from felling (and replanting) the trees.

# 4. Re-stocking Program

Fingerlings and adult fish of 15 indigenous species were released in all three sites with the aim of restoring self supporting populations of indigenous fish species. The stages in this fish stocking program are discussed below. Appart from a small number of adult fish in the first year, most of the fish released were fry and fingerlings.

## 4.1 Identification of species to be stocked

Using baseline data, participatory planning, and opinions of local fishers, RMOs and Upazila Fisheries Officers, as well as the project team's assessment of biological needs and habitat conditions of the sites after MACH interventions, some fish species were identified (usually ones listed as nationally threatened with extinction, IUCN Bangladesh 2000) for stocking in each site, with the aim of restoring fish diversity (Table 2).

***Table 2 Fish species identified as rare in the project sites and suitable for restoration with national threat status***

| No. | Common name | Scientific name | National threat status |
|---|---|---|---|
| 1 | Shol | *Channa striatus* | |
| 2 | Gajar | *Channa marulius* | EN |
| 3 | Ghonia | *Labeo gonius* | EN |
| 4 | Kalibaus | *Labeo calbasu* | EN |
| 5 | Rui | *Labeo rohita* | |
| 6 | Bata | *Labeo bata* | EN |
| 7 | Deshi Sarputi | *Barbodes sarana* | CR |
| 8 | Pabda | *Ompok pabda* | EN |
| 9 | Shing | *Heteropneustes fossilis* | |
| 10 | Ayre | *Sperata aor* | VU |
| 11 | Gulsa | *Mystus cavasius* | |
| 12 | Chital | *Chitala chitala* | EN |
| 13 | Foli | *Notopterus notopterus* | VU |
| 14 | Chapila | *Gudusia chapra* | |
| 15 | Meni | *Nandus nandus* | VU |

Scientific names and order follow Rahman (2005); threat status is from IUCN (2001): CR = critically endangered; EN = endangered; VU = vulnerable.

## 4.2 Collection of fish

The fish used in re-introduction and enhancement were collected from several sources. Some came from the Bangladesh Fisheries Research Institute, Mymensing and others came from natural stocks in several rivers and beels in Pakundia and Gouripur Upazilas in Kishoregonj District, Adamdighi Upazila in Bogra District and Jessore Sadar Upazila in Jessore District. The carp fries (*Labeo* sp.) were hatchery raised fish collected from several nurserers in different parts of the country including Dhamrai Upazila in Dhaka District, Tangail Sadar Upazila in Tangail District, Sreemangal Upazila in Moulvibazar District, Gouripur and Pakundia Upazilas in Kishoregong District, and Sherpur Sadar Upazila in Sherpur District.

### 4.3 Transportation of fries

The fries were transported by trucks and microbus. The carp fries came from the supplier in bulk using steel drums and trucks. The other indigenous fishes (Pabda, Foli, Deshi Sarputi, Mani, Chapila, Gulsa, Gajor, Shol, Ayre, Chital and Shing) were transported in oxygenated poly bags (size 20" x 30") and aluminium pots (deksi). About 250-500 fry (the number depended on their size which was in the range 2.5 - 8.0 cm) could be carried in one poly bag. In the case of aluminium pots of medium size about 500 to 1,000 fry could be carried in one pot.

### 4.4 Mortality of fries during transportation

The rate of mortality depended on distance. When the fries were transported for 50 to100 km by truck the rate of mortality was within 5-7% for carps transported in steel drums. For longer distances the rate of mortality increased. In case of non-carp indigenous fishes the mortality rate was within 1-3% when poly bags were use. Overall oxygenated poly bags are more effective than aluminium pots for transportation of small fries. Note that this experience is based on experienced staff/workers handing the fries.

### 4.5 Fish release

The places for fish release were selected by the RMOs in consultation with the related Upazila Fisheries Officer, and MACH staff. After selection of the places, a stocking plan was made. Country boats, hapa, measuring scale, balance, and nets are required for fry release. It is better if fries are released either in the morning or afternoon. High temperatures (middle of the day), rainy days, and cloudy days should be avoided when releasing fries.

### 4.6 Stocking of fish

A total of about 1.2 million fish (almost all fry and fingerlings) of 15 species were released in the three wetlands between 2001 and 2005 (Table 3). At the time of fish release local government officials, chairmen and members of local Union Parisad, RMO members, local leaders, teachers, students and other opinion leaders attended to support and endorse the activity.

## 5. Impacts on Fish Diversity

### 5.1 Methods

Fish catches were monitored primarily with the aim of estimating changes in productivity (catch per unit area) in the wetlands as a whole, but were also monitored to assess diversity of fish catch. The baseline data collection year in Hail Haor was from April 1999 through March 2000, in Turag-Bangshi it was May 1999 through April 2000, and in Kangsha-Malijhee (Sherpur) site it was August 2000 to July 2001. Thereafter impact monitoring continued in all three sites up to 2006. The wetlands are far too large to attempt a complete enumeration of all fish catches, so monitoring was on a sample basis.

**Table 3 Fish re-introduction 2001-2005**

| Species | 2001 | 2002 | 2003 | 2004 | 2005 | **Total** |
|---|---|---|---|---|---|---|
| **Turag-Bangshi** | | | | | | |
| Kalibaush (*Labeo calbasu*) | 10 | 144 | | 13,622 | 4,717 | **18,493** |
| Rui (*Labeo rohita*) | | 26,434 | 109,510 | | | **135,944** |
| Gonia (*Labeo gonius*) | | 5,051 | 24,332 | | 19,754 | **49,137** |
| Deshi Sarputi (*Puntius sarana*) | 80 | | | | 2,000 | **2,080** |
| Meni (*Nandus nandus*) | 14 | | | | | **14** |
| Foli (*Notopterus notopoterus*) | 20 | | | | | **20** |
| Chital (*Notopterus chitala*) | | | | | 2,000 | **2,000** |
| Shing (*Heteropneustes fossilis*) | | | | | 2,000 | **2,000** |
| Pabda (*Ompok pabda*) | 12 | | | | 4,000 | **4,012** |
| **Carps sub-total** | **10** | **31,629** | **133,842** | **13,622** | **24,471** | **203,574** |
| **Total** | **136** | **31,629** | **133,842** | **13,622** | **34,471** | **213,700** |
| **Kangsha-Malijee** | | | | | | |
| Kalibaush (*Labeo calbasu*) | 16,940 | 175 | | 5,298 | | **22,413** |
| Rui (*Labeo rohita*) | | 320 | 27,939 | 20,344 | | **48,603** |
| Gonia (*Labeo gonius*) | 12,780 | 11,028 | 7,439 | 69,119 | 12,200 | **112,566** |
| Bata (*Labeo bata*) | | | 6,534 | | | **6,534** |
| Deshi Sarpunti (*Puntius sarana*) | | 2,090 | | | 1,000 | **3,090** |
| Meni (*Nandus nandus*) | | 372 | | | | **372** |
| Shol (*Channa striata*) | 11,180 | | 70 | | | **11,250** |
| Gojar (*Channa marulius*) | 1,390 | | | | | **1,390** |
| Chapila (*Gudusia chapra*) | | | 150 | | | **150** |
| Chital (*Notopterus chitala*) | | | | | 2,000 | **2,000** |
| Shing (*Heteropneustes fossilis*) | | | | | 4,000 | **4,000** |
| Pabda (*Ompok pabda*) | | 137 | | | 2,000 | **2,137** |
| Gulsha (*Mystus cavasius*) | | 30 | | | | **30** |
| **Carps sub-total** | **29,720** | **11,523** | **41,912** | **94,761** | **12,200** | **190,116** |
| **Total** | **42,290** | **14,152** | **42,132** | **94,761** | **21,200** | **214,535** |
| **Hail Haor** | | | | | | |
| Kalibaush (*Labeo calbasu*) | 2,108 | 15,213 | | 5,632 | 12,697 | **35,650** |
| Rui (*Labeo rohita*) | | | 117,253 | 52,468 | | **169,721** |
| Gonia (*Labeo gonius*) | 13,200 | 14,350 | 59,092 | 305,793 | 154,455 | **546,890** |
| Deshi Sarpunti (*Puntius sarana*) | 4,136 | 3,600 | | | 3,000 | **10,736** |
| Chital (*Notopterus chitala*) | | | | | 6,004 | **6,004** |
| Ayer (*Mystus aor*) | 384 | 2,934 | 500 | | | **3,818** |
| Gulsha (*Mystus cavasius*) | | | | | 650 | **650** |
| **Carps sub-total** | **15,308** | **29,563** | **176,345** | **363,893** | **167,152** | **752,261** |
| **Total** | **19,828** | **36,097** | **176,845** | **363,893** | **176,806** | **773,469** |

Biological productivity is a function of the ecological condition of the habitat, which is governed by the landscape, and hydrological regime of the area. The spatial and temporal variation in the project area is high, as it is over most of the floodplains of Bangladesh. Fishing method and gear techniques vary considerably by different habitat locations. In order to portray a fish catch that represents the project area, the habitats were stratified into rivers, canals, beels, and floodplains. The selection criteria also included the geographical distribution over the project site, water flow, inundation regime and biological zones of the area. Baseline conditions are used to measure parameter changes after appropriate interventions and implementation of fisheries management. The aim was to capture changes that were expected to be both local (in a specific habitat) and global (throughout the project site). Accordingly a number of locations and habitats were selected and have been monitored in the same way ever since.

The same monitoring sites (Table 4) were covered throught the study. The sites monitored were not selected to focus on locations where impacts from management improvements introduced through MACH (including fish releases) might be concentrated, but to represent the whole of the wetland system. For example, in Hail Haor some of the areas monitored were in areas that continued to be controlled by traditional leaseholders and are not directly managed by RMOs, but would be expected to be impacted to the extent that the whole haor is benefited by changes in management in a substantial part of it.

**Table 4 Monitoring locations, habitats and areas**

| Monitoring locations | Monitoring area (ha) | Habitat |
|---|---|---|
| ***Hail Haor Site*** | | |
| Jethua Beel | 67.95 | Beel, canal, floodplain |
| Gopla River | 41.23 | River |
| Boulashir floodplain | 234.38 | Floodplain |
| Cheruadubi Beel | 30.40 | Beel |
| 62-Beel Complex | 419.48. | Beel, floodplain |
| Rustompur Beel Complex | 221.73 | Beel, canal, floodplain |
| Balla Beel | 159.09 | Beel, floodplain |
| **Total** | **1174.26** | |
| ***Turag Bangshi Site*** | | |
| Mokash Beel South | 100 | Beel |
| Mokash Beel North | 100 | Floodplain |
| Kalidaha Beel | 50 | Beel |
| Mokash Khal | 0.70 | Canal |
| Turag River | 14 | River |
| Aowla Khal | 1.02 | Canal |
| Aowla Beel | 100 | Beel |
| Bangshi River | 17 | River |
| **Total** | **382.72** | |
| ***Kangsha-Malijhee site*** | | |
| Baila Beel | 44.10 | Beel, floodplain |
| Takimari Beel | 34.75 | Beel, floodplain |
| Kewta Beel | 33.07 | Beel |
| Nijla Beel | 63.92 | Beel, floodplain |
| Bagadubi Khal | 4.20 | Khal |
| Malijhi River (Baharalia kur) | 5.00 | River |
| Aowra Bowra Beel* | 69.33 | Beel |
| Bailasha Beel | 13.35 | Beel, floodplain |
| **Total** | **267.72** | |

* Not under an RMO, treated as a control and excluded from main analysis

Floodplain fisheries, with their spatial and temporal variations in fish and water abundance, are as complex and dynamic as the fishing practices. The type of fishing gear used affects a fisher's catch within a specific habitat. A sample unit was considered to be one set of gear used for a catch attempt. To offset any bias from the spatial distribution of fishing gear used, the field biologist collected data from different locations at the monitoring locations. For each gear type at least three fishing units were monitored on a survey day. If there were more than 30 fishing units of one particular gear type operating in a day, data was collected from not less than 10 percent of the operating fishing units. Irrespective of catch data from individual fishing, gear use by all types of fishing units in operation were counted during the catch monitoring day. This is the effort for that day. At the end of the day a list of fishing units by gear type was prepared. In order to accommodate for possible temporal variations in a single month the sampling intensity was set at a 10 days interval and accordingly data was collected three times a month from the selected locations.

Monitoring covered: fish catch (species by number and weight); fishing gear type and number, net area and mesh size; fishers type, sex, age, village and distance from fishing ground; time and duration of fishing.

## 5.2 Trends in catch of fish species stocked

The estimated catch (number of fish caught in sample areas on sample days iin sample gears, multiplied up to give a total estimate each year) was compared with the numbers of fish released (Table 5). This indicates that some species have been successfully re-established or reinforced

through stocking, but in other cases stocking had little impact or there has not been enough time to see any impact.

Out of the 15 species released, Chital, Foli, Gulsha, Pabda, and Shing were either only released in numbers in 2005, or were never released in sufficient numbers to have expected any real impact. The catch surveys from 2005-06 cover the period up to early 2006 and show these species being caught, but data from 2006-07 and later would be needed to see the trend in catch of subsequent generations of these species, so no conclusion is possible on an impact from re-stocking of these species.

Considering the native carps (*Labeo* sp.), in general these move from floodplains and beels into the main river system to breed (Ali 1997; Rahman 2005), so it was not sure if re-stocking would help establish self-sustaining populations. Kalibaush existed in the catches of all three wetlands before any were released or any habitat restoration work. Releases appear to have augmented populations and catches of this species since these have been higher in each site since the baseline. However, only in Turag-Bangshi has the trend been consistently up, and with catches in 2005-06 much higher than in the baseline, it would appear that this fish has been restored to the site.

**Table 5 Re-introduced fish species - numbers of fish introduced and estimated numbers of fish caught**

| Fishing year -> | | 1999-00 | 2000-01 | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 | | Interpretation |
|---|---|---|---|---|---|---|---|---|---|---|
| Stocking year -> | | | | 2001 | 2002 | 2003 | 2004 | 2005 | **Total** | |
| **Turag-Bangshi** | | | | | | | | | | |
| Kalibaush (*Labeo calbasu*) | released | | | 10 | 144 | | 13,622 | 4,717 | **18,493** | Natural fishery, releases may have augmented and helped to establish self sustaining populations |
| | estimated catch | 8,508 | 14,184 | 10,815 | 21,927 | 36,237 | 69,504 | 188,710 | **349,886** | |
| Rui (*Labeo rohita*) | released | | | | 26,434 | 109,510 | | | **135,944** | Natural fishery, releases may have augmented |
| | estimated catch | 21,345 | 26,758 | 5,002 | 78,892 | 244,864 | 507,053 | 488,883 | **1,372,796** | |
| Gonia (*Labeo gonius*) | released | | | | 5,051 | 24,332 | | 19,754 | **49,137** | Releases probably helped establish self sustaining populations |
| | estimated catch | 0 | 0 | 0 | 628 | 25,011 | 15,201 | 117,801 | **158,640** | |
| Deshi Sarputi (*Puntius sarana*) | released | | | 80 | | | | 2,000 | **2,080** | |
| | estimated catch | 0 | 0 | 0 | 183 | 183 | 0 | 343 | **708** | no impact yet |
| Meni (*Nandus nandus*) | released | | | 14 | | | | | **14** | Re-established naturally, but habitat improvements of MACH likely to have helped by increasing aquatic vegetation |
| | estimated catch | 0 | 14,504 | 28,962 | 60,151 | 169,798 | 205,555 | 210,683 | **689,653** | |
| Foli (*Notopterus notopoterus*) | released | | | 20 | | | | | **20** | Fluctuates, but naturally increasing |
| | estimated catch | 5,550 | 278,760 | 37,961 | 76,334 | 83,289 | 145,416 | 47,417 | **674,727** | |
| Chital (*Notopterus chitala*) | released | | | | | | | 2,000 | **2,000** | Small population, too early to see any impact |
| | estimated catch | 0 | 0 | 0 | 343 | 0 | 514 | 1,062 | **1,919** | |
| Shing (*Heteropneustes fossilis*) | released | | | | | | | 2,000 | **2,000** | Fluctuating population |
| | estimated catch | 302,114 | 207,223 | 44,951 | 77,225 | 274,089 | 414,091 | 213,367 | **1,533,058** | |
| Pabda (*Ompok pabda*) | released | | | 12 | | | | 4,000 | **4,012** | Fluctuates no evidence of change |
| | estimated catch | 62,549 | 234,574 | 16,377 | 32,228 | 492,880 | 14,869 | 74,621 | **928,099** | |
| **Carps sub-total** | released | | | **10** | **31,629** | **133,842** | **13,622** | **24,471** | **203,574** | |
| **Total** | released | | | **136** | **31,629** | **133,842** | **13,622** | **34,471** | **213,700** | |
| **Hail Haor** | | | | | | | | | | |
| Kalibaush (*Labeo calbasu*) | released | | | 2,108 | 15,213 | | 5,632 | 12,697 | **35,650** | Natural fishery, releases may have augmented |
| | estimated catch | 22,778 | 5,139 | 7,043 | 26,448 | 13,033 | 145,710 | 23,810 | **243,959** | |
| Rui (*Labeo rohita*) | released | | | | | 117,253 | 52,468 | | **169,721** | Natural fishery, releases may have augmented |
| | estimated catch | 13,501 | 45,651 | 48,609 | 105,803 | 65,259 | 585,679 | 174,413 | **1,038,915** | |
| Gonia (*Labeo gonius*) | released | | | 13,200 | 14,350 | 59,092 | 305,793 | 154,455 | **546,890** | Natural fishery, releases may have augmented and possibly established self sustaining populations |
| | estimated catch | 18,895 | 15,980 | 216,096 | 402,733 | 56,333 | 273,461 | 212,330 | **1,195,827** | |
| Deshi Sarpunti (*Puntius sarana*) | released | | | 4,136 | 3,600 | | | 3,000 | **10,736** | Releases appear not to have established self sustaining population |
| | estimated catch | 0 | 0 | 41,513 | 28,938 | 0 | 2,447 | 2,298 | **75,195** | |
| Chital (*Notopterus chitala*) | released | | | | | | | 6,004 | **6,004** | Too early to see any impact |
| | estimated catch | 0 | 0 | 0 | 904 | 149 | 0 | 5,394 | **6,447** | |
| Ayer (*Mystus aor*) | released | | | 384 | 2,934 | 500 | | | **3,818** | Fluctuates no evidence of change |
| | estimated catch | 3,298 | 106 | 0 | 39,513 | 500 | 5,458 | 2,553 | **51,428** | |
| Gulsha (*Mystus cavasius*) | released | | | | | | | 650 | **650** | Common with fluctuating population, too early to see any impact |
| | estimated catch | 366,497 | 930,069 | 4,657,993 | 862,097 | 285,876 | 514,984 | 115,548 | **7,733,065** | |

| Fishing year -> | | 1999-00 | 2000-01 | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 | | Interpretation |
|---|---|---|---|---|---|---|---|---|---|---|
| Stocking year -> | | | | 2001 | 2002 | 2003 | 2004 | 2005 | **Total** | |
| **Carps sub-total** | released | | | **15,308** | **29,563** | **176,345** | **363,893** | **167,152** | **752,261** | |
| **Total** | released | | | **19,828** | **36,097** | **176,845** | **363,893** | **176,806** | **773,469** | |
| **Kangsha-Malijee** | | | | | | | | | | |
| Kalibaush (*Labeo calbasu*) | released | | | 16,940 | 175 | | 5,298 | | **22,413** | Natural fishery, releases may have augmented |
| | estimated catch | | 13,695 | 27,023 | 63,788 | 87,043 | 251,477 | 47,183 | **490,209** | |
| Rui (*Labeo rohita*) | released | | | | 320 | 27,939 | 20,344 | | **48,603** | Natural fishery, releases may have augmented |
| | estimated catch | | 45,375 | 23,683 | 68,200 | 553,936 | 296,822 | 70,161 | **1,058,177** | |
| Gonia (*Labeo gonius*) | released | | | 12,780 | 11,028 | 7,439 | 69,119 | 12,200 | **112,566** | Probably re-established through releases |
| | estimated catch | | 0 | 22,703 | 103,066 | 12,960 | 90,444 | 40,166 | **269,339** | |
| Bata (*Labeo bata*) | released | | | | | 6,534 | | | **6,534** | Fluctuates no evidence of change, may have benefitted from releases |
| | estimated catch | | 18,842 | 29,014 | 46,723 | 301,509 | 282,268 | 13,695 | **692,052** | |
| Deshi Sarpunti (*Puntius sarana*) | released | | | | 2,090 | | | 1,000 | **3,090** | Declining natual fishery, releases may not have helped |
| | estimated catch | | 54,903 | 39,921 | 46,049 | 35,938 | 36,950 | 27,053 | **240,815** | |
| Meni (*Nandus nandus*) | released | | | | 372 | | | | **372** | Releases in 2002 were adult (brood) fish which appear to have helped re-establish, taking advantage of more suitable habitat created through MACH |
| | estimated catch | | 0 | 0 | 433,957 | 1,097,210 | 1,589,349 | 1,531,168 | **4,651,685** | |
| Shol (*Channa striata*) | released | | | 11,180 | | 70 | | | **11,250** | Probably re-established through releases |
| | estimated catch | | 0 | 4,106 | 7,445 | 11,673 | 25,307 | 127,056 | **175,587** | |
| Gojar (*Channa marulius*) | released | | | 1,390 | | | | | **1,390** | Unclear, does not appear to sustain from releases |
| | estimated catch | | 0 | 7,690 | 61 | 0 | 0 | 9,804 | **17,556** | |
| Chapila (*Gudusia chapra*) | released | | | | | 150 | | | **150** | Fluctuates no evidence of change |
| | estimated catch | | 3,677 | 17,127 | 288,059 | 0 | 7,874 | 84,163 | **400,899** | |
| Chital (*Notopterus chitala*) | released | | | | | | | 2,000 | **2,000** | Too early to see any impact |
| | estimated catch | | 0 | 0 | 0 | 0 | 31 | 1,256 | **1,287** | |
| Shing (*Heteropneustes fossilis*) | released | | | | | | | 4,000 | **4,000** | Too early to see any impact |
| | estimated catch | | 484,357 | 698,241 | 476,299 | 586,167 | 1,424,271 | 9,892,264 | **13,561,600** | |
| Pabda (*Ompok pabda*) | released | | | | 137 | | | 2,000 | **2,137** | Fluctuates no evidence of change |
| | estimated catch | | 103,250 | 7,016 | 345,536 | 13,481 | 31,864 | 11,305 | **512,452** | |
| Gulsha (*Mystus cavasius*) | released | | | | 30 | | | | **30** | Fluctuates no evidence of change |
| | estimated catch | | 147,522 | 52,023 | 151,352 | 85,266 | 373,294 | 26,686 | **836,143** | |
| **Carps sub-total** | released | | | **29,720** | **11,523** | **41,912** | **94,761** | **12,200** | **190,116** | |
| **Total** | released | | | **42,290** | **14,152** | **42,132** | **94,761** | **21,200** | **214,535** | |

Rui likewise was caught in all three sites in the baseline year, and releases appear to have augmented catches, but catches have fallen in years after releases in Hail Haor and Kangsha-Malijhee, whereas in Turag-Bangshi there were high catches of Rui also in 2004-05 and 2005-06 suggesting that this fish may be sustaining here, but also in Hail Haor in 2007 Rui and Mrigal fry were seen in the early monsoon indicating that they are now breeding in the area. Despite problems of poor water quality due to industrial pollution, this is the most likely of the sites to succeed in re-establishing more halthy populations of migratory major carps since the site includes a sizeable river which remains distantly connected to the main Jamuna-Padma system as well as to the floodplains in Kaliakoir.

A major effort was made to re-establish Goinna/Gonia in all three sites. In both Turag-Bangshi and Kangsha-Malijee it was absent in the baseline year, substantial estimated catches (much higher than the numbers released) since re-stocking started suggest that it has re-established in these sites. In Hail Haor the catch has increased very substantially since re-stocking started, but the estimated catches are similar to the numbers released so more time is needed to be sure if it now has a more healthy self-sustaining population (although many fry were seen in 2007). Another "minor carp" Bata was only stocked in Kangsha-Malijhee where it was already caught in the baseline, the catch increased when releases were made, but fell back to the baseline level in 2005-06 indicating a lack of long-lasting impact.

Deshi Sharputi was absent in Turag-Bangshi and Hail Haor, modest numbers were released but appear not to have sustained. However, in Kangsha-Malijee there was already a population with a reasonable catch in the baseline year, and despite releases it appears to have declined. As will be seen in the next section this is the one site that reported an increasing catch of the exotic but very similar Thai Shar puti. Assuming that there were no misidentifications by the monitoring teams, this raises an important question: whether Thai Shar puti may be reproducing in Kangsha-Malijhee and displacing the native species or even hybridising with it.

The beel resident Meni *(Nandus nandus*) appears to be one of the success stories largely due to restoration of habitat for it to overwinter in. It was absent in Kangsha-Malijhee in 2000-2002, but after the release of a modest number of brood fish in 2003 it quickly became common in fish catches and has continued to increase. It has also increased in Turag-Bangshi due to natural repopulation, while it was already common in Hail Haor before MACH.

Another successful re-introduction has been Shol in Kangsha-Malijhee, which was absent in the baseline catch, and after release of a good number of fry in 2002 has steadily increased in fishers catches suggesting that it has a sustainable and growing population. However, an attempt to reintroduce its close relative Gozar in the same year does not appear to have been successful. Similarly, Ayer was already present at a low level in Hail Haor catches, after releases the catches increased, but have since fallen to the baseline level, indicating that stocking has probably not helped to establish a population yielding a larger sustainable catch than before.

Re-stocking of fishes is not the only factor affecting changes in fish biodiversity and catches. It is unlikely to succeed without interventions such as sanctuaries, an end to dewatering, excavation of dry season water habitat, and closed seasons when fish are spawning since these restore previous environmental conditions. In addition success is affected by hydrological factors, in particular: connectivity of wetlands for fish migration routes, the timing of onset and extent of monsoon flooding, and water quality.

## 5.3 Changes in fish diversity

This section provides evidence of the changes in biodiversity recorded in the three wetlands. Table 6 summarizes the numbers of fish species recorded each year, while Fig. 1 summarizes changes in the composition of catch in terms of categories of fish.

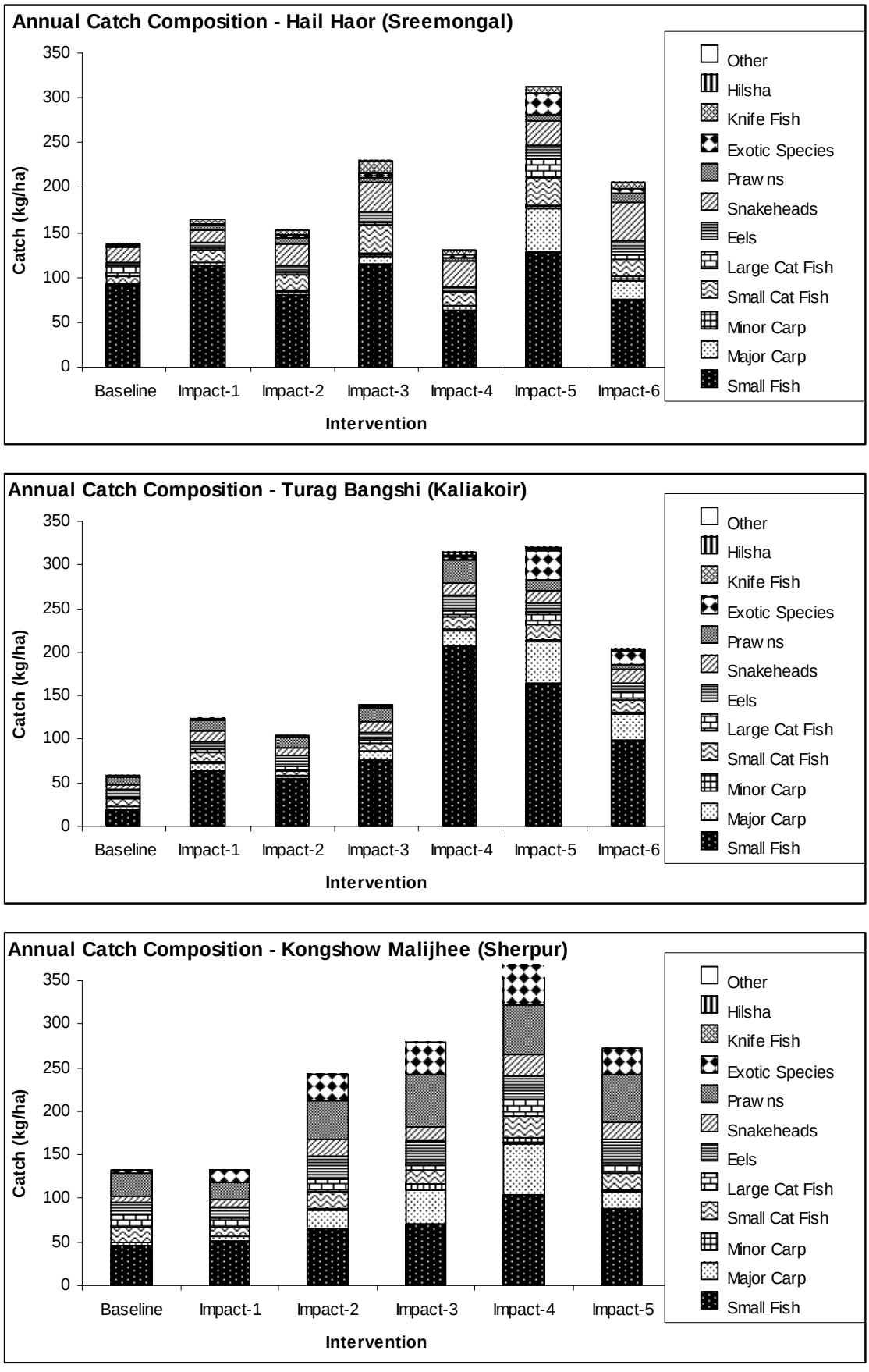



**Fig. 1 Catch composition by types of fish**

**Table 6 Number of fish species recorded in sample catches in monitoring areas**

| Year | Hail Haor | Turag Bangshi | Kangsha Malijhee |
|---|---|---|---|
| Baseline | 71 | 82 | 64 |
| Impact-1 | 71 | 81 | 67 |
| Impact-2 | 69 | 86 | 71 |
| Impact-3 | 76 | 91 | 73 |
| Impact-4 | 67 | 85 | 84 |
| Impact-5 | 81 | 85 | 68 |
| Impact-6 | 75 | 83 | |

Years defined as: Hail Haor - April to March; Turag-Bangshi - May to April; Kansha-Malijhee - August to July.
Baseline: 1999-00, Impact-1: 2000-01; Impact-2: 2001-02; Impact-3: 2002-03; Impact-4: 2003-04; Impact-5: 2004-05; Impact-6: 2005-06.

Fish biodiversity was assessed as a simple count of species recorded from the sampling program, which was a constant effort between years in each site. There has been a modest increase in the number of species recorded per year between the baseline years and subsequent years in Hail Haor and Kangsha-Malijhee sites – up to 10 more species in Hail Haor and up to 20 more species in Kangsha-Malijee. But there has been no notable change in numbers in Turag-Bangshi (Table 6).

Biodiversity does not relate only to the number of species recorded, but also the proportions of species present and how numerous each is. As can be seen from Fig. 1, in all three sites in the baseline year miscellaneous small fish of a number of species comprised a high proportion of the catch. In the less degraded fisheries (Hail Haor and Kangsha-Malijhee) the recovery has mainly been of other fish such as snakeheads, eels and small catfish able to over winter in the sanctuaries.

As Figure 1 shows, in the 2004 floods more major carp and exotic fish were caught due to escapes from over flooded ponds, which is unrelated with restoration of these fisheries, although there is some general increase in major carps and some of these have been released by the RMOs. The pattern of changing fish catch composition differs between the three sites – in Hail Haor most of the gains have been from higher catches of small catfish and snakeheads which benefit from sanctuaries and excavation. In Turag-Bangshi the baseline catches were very low indicating a highly degraded fishery and small fishes have increased rapidly with improved management and comprise over 50% of the total catch in each impact year. In Turag-Bangshi other species groups such as small catfish, snakeheads, large catfish and prawns have also recovered. By comparison in Kangsha-Malijhee site catches of small fishes as a guild of fish have hardly changed and most groups of fish have increased in proportion to the increased catches.

**Table 7 Biodiversity indices for fish catch (Shannon indices)**

| Year | Hail Haor | | Turag-Bangshi | | Kangsha-Malijee | |
|---|---|---|---|---|---|---|
| | native fin fish | all fish | native fin fish | all fish | native fin fish | all fish |
| Baseline | 2.759 | 2.801 | 3.221 | 3.242 | 2.643 | 2.696 |
| Impact 1 | 2.884 | 2.969 | 3.279 | 3.350 | 2.786 | 2.967 |
| Impact 2 | 3.303 | 3.419 | 3.275 | 3.310 | 2.826 | 2.919 |
| Impact 3 | 3.290 | 3.405 | 3.346 | 3.427 | 2.953 | 2.965 |
| Impact 4 | 3.242 | 3.357 | 3.097 | 3.184 | 2.968 | 3.082 |
| Impact 5 | 3.430 | 3.599 | 3.146 | 3.351 | 2.974 | 2.987 |
| Impact 6 | 3.294 | 3.428 | 3.239 | 3.415 | - | - |

The dominant species by weight caught in all three sites included jat puti which is typical of floodplains and open waters in Bangladesh. Small shrimps were the highest percentage of catch (10-19%) in baseline and subsequent years in Turag-Bangshi and Kangsha-Malijhee sites. This is a concern, as de Graff et al. (2001) have argued, that a high proportion of shrimps in floodplain catches indicates a fishery that has been severely damaged as it lacks appropriate conditions for breeding and recruitment of larger and beel resident fishes.

Considering the quantities of fish caught by species, the diversity of native fish species caught has increased from the baseline. The indices calculated and reported in Table 7 are based on the weight of fish reported for each species in the catch from monitoring areas in each year and are a measure of the diversity – the higher the number of species and the more even the amount of fish spread across species, the higher the index. It appears that overall diversity of fish in Hail Haor has increased since MACH started, but despite the greatest gains in productivity being in Turag-Bangshi site there has been no change in the diversity of catch there, while increases in diversity of catch in Kansha-Malijee site have been very small because a few species dominate a relatively high proportion of the total catch.

## 5.4 Trends in main fish species caught

Tables 8 to 10 summarize the contributions of the most commonly caught fish species in each wetland towards total catch, and the trend over 5-7 years. Species are listed in order of overall percentage contribution to catch, those initalics were re-stocked, while exotic species names are in bold. Those species that have increased as a percentage of catch are highlighted. However, it must be remembered that catch per hectare has increased considerably during this period compared with the baseline, for example catches in Hail Haor were on average 88% higher in impact years 5 and 6 compared with the baseline, this means that the total catch of species such as Jat Puti increased even though the percentage contribution declined.

**Table 8 Fish species contributing 1% or more of catch, with % of catch by year and trend - Hail Haor (Sreemongal)**

| Species | Baseline | Impact-1 | Impact-2 | Impact-3 | Impact-4 | Impact-5 | Impact-6 | Total | Trend in proportion |
|---|---|---|---|---|---|---|---|---|---|
| Jat Puti | 14.3 | 16.6 | 11.8 | 11.8 | 8.0 | 9.5 | 8.0 | 11.2 | decline |
| Meni/Bheda | 12.8 | 6.7 | 8.6 | 7.5 | 8.7 | 5.3 | 6.5 | 7.5 | decline |
| Khalisha | 13.6 | 3.5 | 6.0 | 6.9 | 9.8 | 3.9 | 4.5 | 6.3 | decline |
| Taki | 8.2 | 5.0 | 8.8 | 7.1 | 6.5 | 3.2 | 6.2 | 6.1 | stable |
| Mola | 7.7 | 23.4 | 3.2 | 2.5 | 0.7 | 1.8 | 0.9 | 5.1 | increase then decline |
| Shol | 3.1 | 1.8 | 4.1 | 4.4 | 7.7 | 2.8 | 6.9 | 4.3 | **increase** |
| Tengra | 3.3 | 4.3 | 2.7 | 6.6 | 3.5 | 3.0 | 2.8 | 3.8 | increase then decline |
| Gojar | 0.7 | 1.3 | 2.4 | 2.5 | 7.1 | 2.9 | 7.9 | 3.5 | **increase** |
| *Rui* | 0.2 | 1.4 | 1.6 | 2.2 | 2.2 | 5.7 | 7.9 | 3.5 | **increase** |
| Foli | 1.0 | 3.4 | 4.0 | 6.1 | 3.8 | 2.2 | 3.2 | 3.4 | **increase** |
| Boal | 8.6 | 1.3 | 2.4 | 1.5 | 0.6 | 6.0 | 2.5 | 3.4 | decline |
| Kaikla | 1.4 | 3.1 | 2.9 | 4.3 | 3.5 | 3.1 | 2.1 | 3.0 | **increase** |
| Guchi Baim | 1.5 | 2.5 | 3.1 | 3.2 | 2.6 | 2.2 | 4.6 | 2.8 | **increase** |
| Koi | 8.6 | 0.6 | 2.0 | 1.9 | 2.4 | 0.8 | 1.8 | 2.2 | decline |
| Catla | 0.0 | 0.0 | 0.1 | 0.6 | 0.5 | 7.8 | 0.9 | 2.1 | increase then decline |
| Shing | 2.4 | 1.5 | 2.9 | 1.9 | 2.4 | 1.0 | 2.0 | 1.9 | stable |
| Bele | 0.1 | 1.2 | 2.4 | 1.3 | 1.2 | 2.6 | 2.8 | 1.8 | **increase** |
| Magur | 0.6 | 1.4 | 2.5 | 2.6 | 2.6 | 1.0 | 1.8 | 1.7 | **increase** |
| Thengua Echa | 0.1 | 2.3 | 2.2 | 1.3 | 2.0 | 1.5 | 2.6 | 1.7 | **increase** |
| Kanchan Puti | 0.2 | 1.7 | 2.4 | 2.2 | 2.4 | 1.6 | 1.0 | 1.6 | increase then decline |
| Gol Chanda | 0.5 | 1.0 | 1.6 | 1.8 | 2.3 | 1.9 | 1.4 | 1.5 | **increase** |
| Gura Echa | 1.2 | 1.1 | 2.0 | 1.0 | 1.2 | 1.0 | 2.3 | 1.4 | stable |
| Dankina | 0.9 | 1.6 | 1.4 | 1.7 | 1.4 | 1.4 | 0.6 | 1.3 | stable |
| **Common Carp** | 0.0 | 0.2 | 0.8 | 1.0 | 0.9 | 2.7 | 1.3 | 1.2 | **increae** |
| *Goinna* | 0.1 | 0.2 | 1.1 | 1.6 | 0.6 | 1.2 | 2.5 | 1.2 | **increase** |
| Chuna Khalisha | 1.8 | 1.5 | 1.8 | 1.2 | 1.4 | 0.8 | 0.9 | 1.2 | decline |
| Tit Puti | 0.6 | 0.9 | 1.4 | 1.0 | 2.0 | 1.3 | 0.8 | 1.1 | increase then decline |
| Tepa/Futkora | 0.3 | 1.0 | 1.2 | 1.1 | 0.9 | 1.5 | 1.5 | 1.1 | **increase** |
| Kani Pabda | 0.1 | 0.3 | 1.3 | 1.2 | 1.1 | 2.0 | 1.1 | 1.1 | **increase** |
| Tara Baim | 1.3 | 0.7 | 0.3 | 1.0 | 0.8 | 1.4 | 0.9 | 1.0 | stable |

30 species 1% or more of total catch
Italic = restocked in substantial numbers, Bold = exotic

It would appear that carps including exotic species have increased considerably in catches in all three sites. Common Carp is know to reproduce in Bangladesh and presumably has established self-sustaining populations in these wetlands which are still increasing, whereas Silver Carp are presumably escapes from ponds. However, the growing Thai Sharputi catch in Kangsha-Malijhee, is of note, since the catch of the native Deshi Sharputi is falling despite re-stocking. This raises a question whether the closely related exotic species is reproducing and displacing the native species. Other species that have gained are diverse including snakeheads, eels and other bottom feeders in Hail Haor, and in Turag-Bangshi surface filter feeding Chapila and other small fishes.

**Table 9 Fish species contributing 1% or more of catch, with % of catch by year and trend - Turag Bangshi (Kaliakoir)**

| Species | Baseline | Impact-1 | Impact-2 | Impact-3 | Impact-4 | Impact-5 | Impact-6 | Total | Trend in proportion |
|---|---|---|---|---|---|---|---|---|---|
| Chapila | 6.4 | 7.3 | 8.1 | 8.3 | 16.2 | 18.9 | 14.9 | 13.8 | **increase** |
| Jat Puti | 8.6 | 12.5 | 10.6 | 10.1 | 13.3 | 9.1 | 10.4 | 10.9 | stable |
| Gura Echa | 13.6 | 8.7 | 11.2 | 9.5 | 7.7 | 3.1 | 2.4 | 6.5 | decline |
| Bele | 3.8 | 5.2 | 5.7 | 5.2 | 7.1 | 3.8 | 4.3 | 5.2 | **increase** |
| Tit Puti | 2.4 | 6.0 | 7.5 | 6.0 | 5.7 | 3.0 | 4.3 | 4.9 | **increase** |
| Taki | 7.5 | 7.1 | 6.8 | 6.1 | 3.1 | 2.9 | 5.3 | 4.6 | decline |
| Guchi Baim | 4.5 | 4.0 | 4.8 | 3.8 | 4.4 | 2.6 | 4.2 | 3.9 | stable |
| Mrigel | 2.1 | 2.4 | 1.6 | 2.9 | 2.0 | 6.7 | 5.1 | 3.8 | **increase** |
| *Rui* | 0.7 | 3.0 | 0.7 | 4.3 | 3.3 | 5.2 | 4.7 | 3.7 | **increase** |
| Tengra | 8.7 | 6.0 | 3.7 | 3.6 | 2.5 | 2.4 | 2.8 | 3.4 | decline |
| Gol Chanda | 0.7 | 1.8 | 2.5 | 2.6 | 3.9 | 2.0 | 1.5 | 2.4 | **increase** |
| Lamba Chanda | 3.2 | 1.4 | 2.0 | 2.3 | 2.1 | 1.5 | 1.4 | 1.8 | stable |
| Chela | 1.4 | 1.3 | 1.9 | 1.4 | 2.4 | 1.5 | 1.3 | 1.7 | stable |
| Guzi air/ Guzkata | 0.0 | 0.0 | 2.5 | 2.4 | 1.5 | 1.9 | 2.2 | 1.7 | **increase** |
| Boro Baim | 6.9 | 2.8 | 5.3 | 1.3 | 0.8 | 0.6 | 1.3 | 1.7 | decline |
| **Silver Carp** | 0.1 | 0.1 | 0.0 | 0.8 | 0.6 | 4.7 | 0.9 | 1.6 | **increase** |
| **Common Carp** | 0.4 | 0.1 | 0.1 | 0.3 | 0.1 | 3.3 | 3.8 | 1.5 | **increase** |
| Shol | 1.5 | 1.9 | 1.8 | 2.0 | 1.1 | 1.3 | 1.7 | 1.5 | stable |
| Kaikla | 1.3 | 2.3 | 1.0 | 1.8 | 1.9 | 1.1 | 0.6 | 1.4 | stable |
| Chuna Khalisha | 0.5 | 0.9 | 0.9 | 1.4 | 2.0 | 1.2 | 0.9 | 1.3 | **increase** |
| Chola Puti | 2.2 | 2.2 | 0.9 | 2.9 | 0.3 | 1.1 | 0.7 | 1.2 | decline |
| Bagha Puti | 0.0 | 2.8 | 1.0 | 2.1 | 0.7 | 1.0 | 1.0 | 1.2 | **increase** |
| Catla | 2.2 | 0.3 | 0.0 | 0.1 | 0.1 | 2.4 | 2.7 | 1.2 | fluctuates |
| Ranga Chanda | 0.7 | 0.7 | 2.1 | 1.5 | 1.6 | 0.8 | 0.4 | 1.1 | stable |
| Mola | 0.3 | 0.9 | 1.0 | 1.0 | 1.1 | 0.9 | 1.0 | 1.0 | stable |
| Khalisha | 0.1 | 0.6 | 0.8 | 0.9 | 1.4 | 1.0 | 1.3 | 1.0 | **increase** |
| Lal Khalisha | 0.2 | 0.4 | 0.9 | 1.1 | 1.2 | 0.8 | 1.3 | 1.0 | **increase** |
| Satka Chingri | 1.6 | 2.1 | 1.1 | 1.5 | 0.7 | 0.8 | 0.7 | 1.0 | decline |

28 species 1% or more of total catch
Italic = restocked in substantial numbers, Bold = exotic

Besides this some native fishes appear to have disappeared from these wetlands since the baseline year: Gharua *Clupisoms garua,* Boiragi Icha (a type of prawn), and Kecho Baim *Ophichthys boro* in Hail Haor; Mola Puti *Puntius guganio and* Potka *Tetradon potaca* in Turag-Bangshi; and Putani Puti *Puntius phutunio,* Narkeli Chela *Oxygaster bacaila,* Naftani *Osphronemus nobilis,* and Putul *Botia lohachata* in Kangsha-Malijhee. Although they have not been recorded from comparable monitoring involving higher catches in the impact years it is difficult to say if they have disappeared from the entire area of these wetlands, but at best they must be very scarce there and none were common in the baseline year catches. However, it is not possible to identify any reasons for apparent loss of these species.

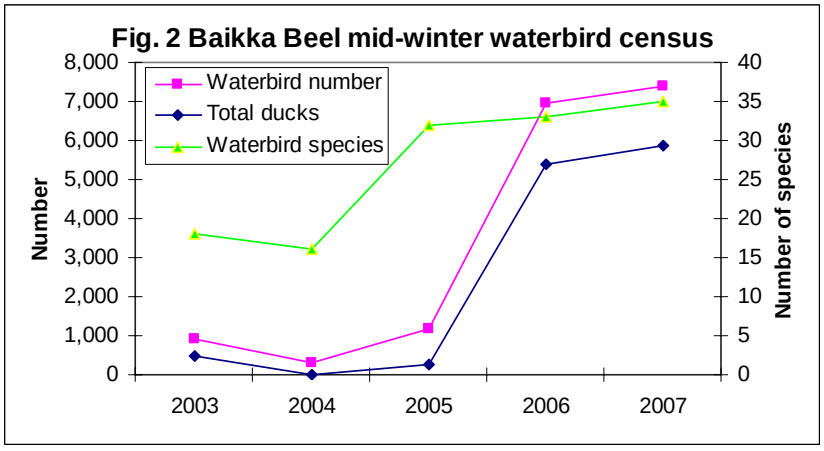
**Table 10 Fish species contributing 1% or more of catch, with % of catch by year and trend – Kongsha-Malijhee (Sherpur)**

| Species | Baseline | Impact-1 | Impact-2 | Impact-3 | Impact-4 | Impact-5 | Total | Trend in proportion |
|---|---|---|---|---|---|---|---|---|
| Gura Echa | 19.2 | 14.1 | 18.2 | 21.3 | 15.4 | 20.0 | 18.1 | stable |
| Jat Puti | 16.1 | 13.7 | 11.8 | 8.4 | 12.0 | 11.5 | 11.7 | fluctuates |
| Taki | 5.9 | 7.4 | 7.9 | 5.8 | 6.0 | 7.2 | 6.6 | stable |
| Mrigel | 0.3 | 3.0 | 6.0 | 7.9 | 10.4 | 4.8 | 6.5 | **increase** |
| Tengra | 11.0 | 6.2 | 7.4 | 4.6 | 5.2 | 5.8 | 6.2 | decline |
| Boal | 11.6 | 7.9 | 5.5 | 2.9 | 5.2 | 3.8 | 5.4 | decline |
| **Common Carp** | 2.5 | 4.9 | 7.0 | 5.9 | 5.0 | 5.9 | 5.4 | **increase** |
| Bele | 4.8 | 8.4 | 5.2 | 5.3 | 4.3 | 5.5 | 5.3 | stable |
| Guchi Baim | 5.4 | 3.3 | 6.0 | 4.6 | 4.3 | 5.4 | 4.9 | stable |
| **Thai Shor Puti** | 0.4 | 2.5 | 3.1 | 3.8 | 4.7 | 3.8 | 3.5 | **increase** |
| Tara Baim | 3.1 | 4.7 | 3.4 | 3.6 | 2.1 | 3.5 | 3.2 | stable |
| *Rui* | 1.4 | 0.4 | 1.1 | 4.6 | 2.6 | 0.7 | 2.1 | fluctuates |
| Tit Puti | 3.5 | 4.6 | 1.3 | 2.4 | 1.3 | 1.9 | 2.1 | decline |
| Gutum | 3.2 | 3.3 | 1.8 | 1.6 | 1.6 | 2.0 | 2.0 | decline |
| **Silver Carp** | 0.0 | 1.7 | 0.5 | 3.1 | 2.0 | 0.6 | 1.5 | **increase** |
| Gol Chanda | 1.7 | 1.7 | 1.2 | 1.4 | 1.2 | 1.5 | 1.4 | stable |
| Boro Baim | 1.7 | 1.3 | 2.0 | 1.0 | 0.8 | 1.1 | 1.2 | stable |
| Kaikla | 0.8 | 0.9 | 0.4 | 0.5 | 1.5 | 1.8 | 1.1 | **increase** |
| Bata | 0.2 | 0.2 | 0.5 | 2.8 | 1.4 | 0.1 | 1.0 | fluctuates |
| Chela | 1.0 | 1.0 | 0.4 | 1.1 | 1.1 | 1.5 | 1.0 | stable |

20 species 1% or more of overall catch
Italic = restocked in substantial numbers, Bold = exotic

## 5.5 Other wildlife

Although surveys of plants, birds and other wildlife were conducted at the start of MACH in Hail Haor and Turag-Bangshi sites, few changes in plant diversity were expected as a result of MACH interventions, apart from tree planting which for example has seen the restoration of patches of swamp and riparian forest in the sites. Of the sites, Hail Haor has historically been regarded as an important site for wetland biodiversity in Bangladesh, with relatively more information available on, for example, birds recorded there. However, wintering waterfowl numbers had disappeared from tens of thousands reported in the late 1960s to a handful at the start of MACH. With the creation of a permanent wetland sanctuary covering about 100 ha in Baikka Beel in late 2003, the RMO has banned fishing, hunting, and collection of aquatic plants, except for limited grazing in part of the area.




Between 2004 and April 2007, 113 species of birds were recorded within the 100 ha sanctuary. Both numbers and diversity have increased, reaching 7,200 birds of 35 water bird species in January 2007 (Fig. 2). These include large flocks of Fulvous and Lesser Whistling-duck; Northern Pintail, Common

Teal, Garganey and Purple Swamphen. Rare globally threatened species have also returned to the area: several Pallas's Fish Eagle and Greater Spotted Eagle (both Vulnerable) now spend the winter here, as do the near-threatened Black-headed Ibis and Ferruginous Pochard. Overall 147 species of bird had been recorded in Hail Haor up to February 2000, but by April 2007 an additional 22 species had been added, the total includes five threatened and seven near-threatened species (P. Thompson personal records; Thompson et al. 1993; Thompson and Johnson 2003).

## 6. Conclusion

Healthy floodplains are rich in floral and faunal diversity, including insects, mollusks, crustaceans, frogs, turtles, fish, birds, and many aquatic plants. Surveys in Bangladesh under Flood Action Plan (FAP 6 1993) in floodplains in the northeast of the country recorded 154 species of fish and prawn, and 104 species have been recorded in the country's only freshwater Ramsar site and ecologically most diverse freshwater wetland - Tanguar Haor in Sunamgong District. FAP 17 (1995) recorded 79 to 89 species of fish and prawn in different heavily used and partly embanked floodplains. The three MACH wetlands compare favorably with these standards by the end of the project period.

The evidence presented shows that fish diversity has increased. It seems that this is the product mainly of sanctuaries and habitat restoration. Re-stocking of indigenous fishes has also played a part and there is evidence that this has helped to re-establish sustaining populations of some fish species. Although stocking of native carps such as Rui, has mostly likely only resulted in those fish gaining weight in the floodplains and producing higher catches, there is some evidence that in the Turag-Bangshi may be able to migrate to spawn in the main river system, and that some carps have spawned in Hail Haor where fry were seen in the early monsoon in 2007 before any cultured fish could have escaped from ponds.

Based on this experience, some lessons and recommendations for re-stocking fish are drawn:

- Identify wild sources for indigenous fishes /fries where they can be collected by the community/ project's own initiative and where collection will not adversely affect the parent stock (except major carp).
- The fry of indigenous carps can be collect from government or private hatcheries and nurseries.
- Visit the hatcheries / nurseries before stocking to ensure the quality of fry.
- Use oxygenated poly bags for carying small fry instead of aluminium pots or drums to reduce mortality.
- Carry the optimum quantity of fries - 250 to 500 (depending on size) - in each poly bag.
- Maintain the stocking time within June to August each year for better results.
- Use a sunny day, either morning or afternoon, for stocking, but not in mid day.
- To save the fries avoid rainy days, cloudy situation or high temperature when releasing.
- Use experienced persons to handle the fries.
- Ensure optimum water in sanctuary in the dry season to support the re-stocked brood fish.
- Ensure there are sufficient materials such as bamboo and branches in sanctuaries around the year to provide good habitat and safety for fish.

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# Annex 1: Fish Species Diversity – lists of species by year and site

Family sequence follows IUCN Bangladesh (2000)
Sequence within a family is alphabetical
Scientific names follow FishBase (November 2006 download) where available, and otherwise IUCN Bangladesh (2000)
Bangla name follows local usage
√ = present in sample catches
X = absent in sample catches

**Fish Species Diversity of Hail Haor by year (based on sample of fishers' catches in monitored areas)**

| Species (Bengali Name) | *Species (Scientific Name)* | Baseline | Impact1 | Impact2 | Impact3 | Impact4 | Impact5 | Impact6 |
|---|---|---|---|---|---|---|---|---|
| | | 1999-00 | 2000-01 | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 |
| **Feather backs** | **Notopteridae** | | | | | | | |
| Chital | *Chitala chitala* | X | X | X | √ | √ | X | √ |
| Foli | *Notopterus notopoterus* | √ | √ | √ | √ | √ | √ | √ |
| **Snake eels** | **Ophichthidae** | | | | | | | |
| Kecho Bime | *Pisodonophis boro* | √ | X | X | X | X | X | X |
| **Shads, herrings etc.** | **Clupeidae** | | | | | | | |
| Kachki | *Corica soborna* | √ | X | X | X | X | √ | X |
| Chapila | *Gudusia chapra* | √ | √ | √ | √ | √ | √ | √ |
| Afila | *Gudusia varigata* | X | X | X | X | X | √ | √ |
| Hilsha (Jatka) | *Tenualosa ilisha* | X | X | X | X | X | √ | X |
| **Carps, minnows and barbs** | **Cyprinidae** | | | | | | | |
| Dhela | *Amblypharyngodon microlepis* | X | X | X | X | √ | X | X |
| Mola | *Amblypharyngodon mola* | √ | √ | √ | √ | √ | √ | √ |
| Bighead Carp | *Aristechthys nobilis* | X | X | X | √ | X | √ | √ |
| Nayan Bali | *Asidoparia jaya* | X | X | X | X | X | X | √ |
| Thai Shor Puti | *Barbonymus gonionotus* | √ | √ | √ | √ | √ | √ | √ |
| Catla | *Catla catla* | √ | X | √ | √ | √ | √ | √ |
| Chep Chela | *Chela laubuca* | √ | √ | √ | √ | √ | √ | √ |
| Mrigel | *Cirrhinus cirrhosus* | √ | √ | √ | √ | √ | √ | √ |
| Raek | *Cirrhinus reba* | X | X | X | √ | X | √ | X |
| Tatkini | *Crossocheilus latius* | X | √ | X | X | X | √ | X |
| Grass Carp | *Ctenopharyngodon idellus* | √ | √ | √ | √ | √ | √ | √ |
| Comon Carp/Karfu | *Cyprinus carpio* | √ | √ | √ | √ | √ | √ | √ |
| Silver Carp | *Hypophthalmichthys molitrix* | X | √ | X | √ | √ | √ | √ |
| Vangra | *Labeo boga* | √ | X | √ | X | X | X | X |
| Kalibaush | *Labeo calbasu* | √ | √ | √ | √ | √ | √ | √ |
| Goinna | *Labeo gonius* | √ | √ | √ | √ | √ | √ | √ |
| Rui | *Labeo rohita* | √ | √ | √ | √ | √ | √ | √ |
| Moa | *Osteobrama cotio* | X | √ | √ | √ | X | √ | X |
| Chola Puti | *Puntius chola* | √ | √ | X | √ | √ | √ | √ |
| Kanchan Puti | *Puntius conchonius* | √ | √ | √ | √ | √ | √ | √ |
| Jhili Puti | *Puntius gelius* | √ | √ | √ | √ | √ | √ | √ |
| Mola Puti | *Puntius guganio* | X | X | √ | √ | X | √ | √ |
| Futani Puti | *Puntius phutunio* | √ | √ | √ | √ | X | X | X |
| Shar Puti | *Puntius sarana* | X | X | √ | √ | X | √ | √ |
| Jat Puti | *Puntius sophore* | √ | √ | √ | √ | √ | √ | √ |
| Teri Puti | *Puntius terio* | √ | X | X | √ | √ | X | √ |
| Tit Puti | *Puntius ticto* | √ | √ | √ | √ | √ | √ | √ |
| Dankina | *Rasbora daniconius* | √ | √ | √ | √ | √ | √ | √ |
| Elong | *Rasbora elanga* | √ | X | X | X | X | √ | X |
| Narkeli Chela | *Salmostoma bacalia* | √ | √ | √ | √ | X | √ | X |
| Chela | *Salmostoma pholo* | √ | √ | √ | √ | √ | √ | √ |
| **Loaches** | **Balitoridae** | | | | | | | |
| Buth Koi/Bali Chata /Balitora | *Acanthocobitis botia* | X | √ | √ | X | X | √ | X |
| **Loaches** | **Cobitidae** | | | | | | | |
| Rani | *Botia dario* | √ | √ | √ | √ | √ | √ | √ |
| Gutum | *Lepidocephalichthys guntea* | √ | √ | √ | √ | √ | √ | √ |
| Gora Gutum/Ganga Shagor | *Somileptes gongota* | √ | √ | √ | X | √ | √ | √ |
| **Bagrid catfish** | **Bagridae** | | | | | | | |
| Bajri Tengra | *Mystus tengara* | √ | √ | √ | √ | √ | √ | √ |

| Species (Bengali Name) | *Species (Scientific Name)* | Baseline | Impact1 | Impact2 | Impact3 | Impact4 | Impact5 | Impact6 |
|---|---|---|---|---|---|---|---|---|
| | | 1999-00 | 2000-01 | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 |
| Golsa | *Mystus bleekeri* | √ | √ | √ | √ | √ | √ | √ |
| Tengra | *Mystus vittatus* | √ | √ | √ | √ | √ | √ | √ |
| Kabasi Tengra | *Mystus cavasius* | X | X | X | √ | √ | √ | √ |
| Rita | *Rita rita* | X | X | X | X | X | √ | X |
| Air | *Sperata aor* | √ | √ | X | √ | √ | √ | √ |
| Guzi air/Guzkata | *Sperata seenghala* | X | X | X | X | √ | X | X |
| **Butter cat fishes etc** | **Siluridae** | | | | | | | |
| Kani Pabda | *Ompok bimaculatus* | √ | √ | √ | √ | √ | √ | √ |
| Pabda/Madhu Pabda | *Ompok pabda* | √ | √ | √ | √ | √ | √ | √ |
| Boal | *Wallago attu* | √ | √ | √ | √ | √ | √ | √ |
| **Schilbeid catfish** | **Schilbeidae** | | | | | | | |
| Baspata/Kazuli | *Ailia coila* | X | X | X | √ | X | X | X |
| Ghaura | *Clupisoma garua* | √ | X | X | X | X | X | X |
| Bacha | *Eutropiichthys vacha* | √ | √ | √ | √ | √ | √ | X |
| Batasi | *Pseudeutropius atherinoides* | X | X | X | X | X | √ | X |
| **Pangas** | **Pangasiidae** | | | | | | | |
| Thai Pangas | *Pangasius hypophthalmus* | X | X | X | √ | X | √ | X |
| **Catfish** | **Sisoridae** | | | | | | | |
| Bagair* | *Bagarius bagarius* | | | | | | | |
| Senia (Eusufi) | *Gagata cenia* | X | √ | √ | X | X | X | X |
| **Air breathing catfish** | **Clariidae** | | | | | | | |
| Magur | *Clarius batrachus* | √ | √ | √ | √ | √ | √ | √ |
| African Magur | *Clarias gariepinus* | X | √ | X | X | X | X | X |
| **Stinging catfish** | **Heteropneustidae** | | | | | | | |
| Shing | *Heteropneustes fossilis* | √ | √ | √ | √ | √ | √ | √ |
| **Square head catfishes** | **Chacidae** | | | | | | | |
| Chaka/Gangina/Kowakata | *Chaca chaca* | √ | √ | √ | √ | √ | √ | √ |
| **Gars** | **Belonidae** | | | | | | | |
| Kaikla | *Xenentodon cancila* | √ | √ | √ | √ | √ | √ | √ |
| **Top minnows** | **Aplocheilidae** | | | | | | | |
| Tin Chokha | *Aplocheilus panchax* | √ | √ | √ | √ | √ | √ | √ |
| **Mud eels** | **Synbranchidae** | | | | | | | |
| Kuicha | *Monopterus cuchia* | √ | √ | √ | √ | √ | √ | √ |
| **Glass perch** | **Ambassidae** | | | | | | | |
| Lamba Chanda | *Chanda nama* | √ | √ | √ | √ | √ | √ | √ |
| Ranga Chanda | *Parambassis ranga* | √ | √ | √ | √ | √ | √ | √ |
| Gol Chanda | *Pseudambassis baculis* | √ | √ | √ | √ | √ | √ | √ |
| **Jew fish, croakers** | **Sciaenidae** | | | | | | | |
| Poa | *Otolithoides pama* | X | √ | X | √ | √ | X | X |
| **Mud perch** | **Nandidae** | | | | | | | |
| Meni/Bheda | *Nandus nandus* | √ | √ | √ | √ | √ | √ | √ |
| **Badis** | **Badidae** | | | | | | | |
| Kali/Napti Koi | *Badis badis* | √ | √ | √ | √ | √ | √ | √ |
| **Mullets** | **Mugilidae** | | | | | | | |
| Khalla/Kharshulla | *Rhinomugil corsula* | X | X | √ | X | X | X | X |
| **Gobies** | **Gobiidae** | | | | | | | |
| Bele | *Glossogobius giuris* | √ | √ | √ | √ | √ | √ | √ |
| **Climbing perch** | **Anabantidae** | | | | | | | |
| Koi | *Anabas testudineus* | √ | √ | √ | √ | √ | √ | √ |
| **Gouramies** | **Osphronemidae** | | | | | | | |
| Khalisha | *Colisa fasciata* | √ | √ | √ | √ | √ | √ | √ |
| Boicha Chuchra/Chuna Khalisha | *Colisa labiosa* | √ | √ | √ | √ | √ | √ | √ |
| Lal Khalisha | *Colisa lalia* | √ | √ | √ | √ | √ | √ | √ |
| Naftani/Berkul | *Ctenops nobilis* | √ | √ | √ | √ | √ | √ | √ |
| Reckha Kholisha; Madha Boicha; Sheel Boicha | *Trichogaster chuna* | √ | √ | √ | √ | √ | √ | √ |
| **Tilapia** | **Cichlidae** | | | | | | | |
| Telapia | *Oreochromis mossambicus* | √ | √ | √ | √ | X | √ | √ |
| Nailotika | *Oreochromis niloticus* | X | X | X | X | X | √ | √ |
| **Snakeheads** | **Channidae** | | | | | | | |

| Species (Bengali Name) | *Species (Scientific Name)* | Baseline | Impact1 | Impact2 | Impact3 | Impact4 | Impact5 | Impact6 |
|---|---|---|---|---|---|---|---|---|
| | | 1999-00 | 2000-01 | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 |
| Cheng | *Channa gachua* | √ | √ | √ | √ | √ | √ | √ |
| Gojar | *Channa marulius* | √ | √ | √ | √ | √ | √ | √ |
| Taki | *Channa punctata* | √ | √ | √ | √ | √ | √ | √ |
| Shol | *Channa striata* | √ | √ | √ | √ | √ | √ | √ |
| **Spiny eels** | **Mastacembelidae** | | | | | | | |
| Tara Baim | *Macrognathus aculeatus* | √ | √ | √ | √ | √ | √ | √ |
| Guchi Baim | *Macrognathus pancalus* | √ | √ | √ | √ | √ | √ | √ |
| Boro Baim | *Mastacembelus armatus* | √ | √ | √ | √ | √ | √ | √ |
| **Puffer fish** | **Tetraodontidae** | | | | | | | |
| Potka | *Chelonodon patoca* | √ | √ | √ | √ | X | X | √ |
| Tepa/Futkora | *Tetraodon cutcutia* | √ | √ | √ | √ | √ | √ | √ |
| | | | | | | | | |
| **Fresh water prawn** | **Palaemonidae** | | | | | | | |
| Thengua Echa | *Macrobrachium birmanicus* | √ | √ | √ | √ | √ | √ | √ |
| Gura Echa | *Macrobrachium lamarrei* | √ | √ | √ | √ | √ | √ | √ |
| Satka Chingri | *Macrobrachium malcolmsonii* | X | X | √ | √ | √ | X | √ |
| Golda Echa | *Macrobrachium rosenbergii* | X | X | X | X | X | √ | √ |
| Dimua/Kathalia Echa | *Macrobrachium villosimanus* | √ | √ | X | √ | √ | √ | √ |
| Boiragi Echa | *Prawn Sp.* | √ | X | X | X | X | X | X |

* reported by fishers in Gopla River within the haor but not recorded in catch monitoring

**Fish Species Diversity of Turag-Bangshi site by year (based on sample of fishers' catches in monitored areas)**

| Species (Bengali Name) | *Species (Scientific Name)* | Baseline | Impact1 | Impact2 | Impact3 | Impact4 | Impact5 | Impact6 |
|---|---|---|---|---|---|---|---|---|
| | | 1999-00 | 2000-01 | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 |
| **Feather backs** | **Notopteridae** | | | | | | | |
| Chital | *Notopterus chitala* | X | X | X | √ | X | √ | √ |
| Foli | *Notopterus notopoterus* | √ | √ | √ | √ | √ | √ | √ |
| **Shads, herrings etc.** | **Clupeidae** | | | | | | | |
| Kachki | *Corica soborna* | √ | √ | √ | √ | √ | √ | √ |
| Mamoli Chapila | *Gonialosa manminna* | X | √ | √ | √ | √ | X | X |
| Chapila | *Gudusia chapra* | √ | √ | √ | √ | √ | √ | √ |
| Hilsha (Jatka) | *Tenualosa ilisha* | √ | √ | √ | √ | √ | √ | √ |
| **Carps, minnows and barbs** | **Cyprinidae** | | | | | | | |
| Dhela | *Amblypharyngodon microlepis* | √ | √ | √ | √ | √ | √ | √ |
| Mola | *Amblypharyngodon mola* | √ | √ | √ | √ | √ | √ | √ |
| Bighead Carp | *Aristechthys nobilis* | X | X | X | √ | X | √ | X |
| Nayan bali | *Aspidoparia jaya* | √ | √ | √ | √ | √ | √ | √ |
| Peali | *Aspidoparia morar* | √ | √ | √ | √ | √ | √ | √ |
| Thai Shor Puti | *Barbonymus gonionotus* | √ | √ | √ | √ | √ | √ | √ |
| Catla | *Catla catla* | √ | √ | √ | √ | √ | √ | √ |
| Chep Chela | *Chela laubuca* | √ | X | X | X | √ | √ | √ |
| Mrigel | *Cirrhinus mrigala* | √ | √ | √ | √ | √ | √ | √ |
| Tatkini | *Crossocheilus latius* | √ | √ | √ | √ | √ | √ | √ |
| Grass Carp | *Ctenopharyngodon idellus* | X | √ | √ | √ | √ | √ | √ |
| Common Carp/Karfu | *Cyprinus carpio* | √ | √ | √ | √ | √ | √ | √ |
| Baspata/Kazuli | *Danio devario* | √ | √ | √ | √ | √ | √ | √ |
| Silver Carp | *Hypophthalmichthys molitrix* | √ | √ | √ | √ | √ | √ | √ |
| Vangra | *Labeo boga* | √ | √ | √ | X | X | √ | √ |
| Kalibaush | *Labeo calbasu* | √ | √ | √ | √ | √ | √ | √ |
| Goinna | *Labeo gonius* | X | X | X | √ | √ | √ | √ |
| Rui | *Labeo rohita* | √ | √ | √ | √ | √ | √ | √ |
| Chola Puti | *Puntius chola* | √ | √ | √ | √ | √ | √ | √ |
| Kanchan Puti | *Puntius conchonius* | √ | √ | √ | √ | √ | √ | X |
| Jhili Puti | *Puntius gelius* | √ | √ | √ | √ | √ | √ | √ |
| Mola Puti | *Puntius guganio* | X | X | √ | √ | X | X | X |
| Futani Puti | *Puntius phutunio* | √ | X | X | X | X | X | X |
| Shar Puti | *Puntius sarana* | X | X | X | √ | √ | X | √ |
| Jat Puti | *Puntius sophore* | √ | √ | √ | √ | √ | √ | √ |
| Bagha Puti | *Puntius stigma* | √ | √ | √ | √ | √ | √ | √ |

| Species (Bengali Name) | *Species (Scientific Name)* | Baseline | Impact1 | Impact2 | Impact3 | Impact4 | Impact5 | Impact6 |
|---|---|---|---|---|---|---|---|---|
| | | 1999-00 | 2000-01 | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 |
| Teri Puti | *Puntius terio* | X | X | X | X | √ | √ | √ |
| Tit Puti | *Puntius ticto* | √ | √ | √ | √ | √ | √ | √ |
| Fesha | *Raconda russeliana* | √ | X | X | √ | X | X | X |
| Dankina | *Rasbora daniconius* | √ | √ | √ | √ | √ | √ | √ |
| Narkeli Chela | *Salmostoma bacalia* | √ | X | X | X | X | X | X |
| GangChela/Ghora Chel | *Salmostoma (Oxygaster) gora* | √ | X | √ | √ | √ | √ | √ |
| Chela | *Salmostoma (Oxygaster) pholo* | √ | √ | √ | √ | √ | √ | √ |
| **Loaches** | **Balitoridae** | | | | | | | |
| Buth Koi/Bali Chata/Balitora | *Nemacheilus batia* | √ | √ | √ | √ | √ | √ | X |
| **Loaches** | **Cobitidae** | | | | | | | |
| Rani | *Botia dario* | √ | √ | √ | √ | √ | √ | √ |
| Putul | *Botia lohachata* | √ | X | X | X | X | X | X |
| Gutum | *Lepiodocephalus guntea* | √ | √ | √ | √ | √ | √ | √ |
| Gora Gutum/Ganga Shagor | *Someleptes gongota* | √ | √ | √ | √ | √ | √ | √ |
| **Bagrid catfish** | **Bagridae** | | | | | | | |
| Tengra (Batasio) | *Batasio batasio* | X | √ | X | √ | X | X | X |
| Golsa | *Mystus bleekeri* | √ | √ | √ | √ | √ | √ | √ |
| Kabasi Tengra | *Mystus cavasius* | X | X | √ | √ | X | √ | X |
| Bajri Tengra | *Mystus tengara* | X | X | √ | √ | √ | √ | √ |
| Tengra | *Mystus vittatus* | √ | √ | √ | √ | √ | √ | √ |
| Rita | *Rita rita* | √ | √ | √ | √ | √ | √ | √ |
| Air | *Sperata aor* | √ | √ | √ | √ | √ | √ | √ |
| Guzi air/Guzkata | *Sperata seenghala* | √ | X | √ | √ | √ | √ | √ |
| **Butter catfish, etc** | **Siluridae** | | | | | | | |
| Kani Pabda | *Ompok bimaculatus* | √ | √ | √ | √ | √ | X | X |
| Pabda/Madhu Pabda/ Kowakata/Ghorakata | *Ompok pabda* | √ | √ | √ | √ | √ | √ | √ |
| Boal | *Wallago attu* | √ | √ | √ | √ | √ | √ | √ |
| **Schilbeid catfish** | **Schilbeidae** | | | | | | | |
| Ghaura | *Clupisoma garua* | √ | √ | √ | √ | √ | √ | √ |
| Bacha | *Eutropiichthys vacha* | √ | √ | √ | √ | √ | √ | √ |
| Batasi | *Pseudentropious (Clupisoma) atherrinoides* | √ | √ | √ | √ | √ | X | √ |
| Silong | *Silonia silondia* | √ | √ | √ | √ | X | X | √ |
| **Pangas** | **Pangasiidae** | | | | | | | |
| Thai Pangas | *Pangasius sutchi* | X | X | √ | X | X | √ | X |
| **Catfish** | **Sisoridae** | | | | | | | |
| Bagha Air | *Bagarius bagarius* | √ | √ | √ | √ | √ | √ | √ |
| Peashi | *Conta conta* | √ | √ | √ | √ | √ | √ | √ |
| Senia (Eusufi) | *Gagata cenia* | X | X | √ | √ | √ | √ | √ |
| Gang Tengra | *Nangra (Gagata) viridescens* | X | X | √ | X | X | X | X |
| Chenua | *Sisor rhabdophorus* | X | X | X | √ | √ | X | X |
| **Air breathing catfish** | **Clariidae** | | | | | | | |
| African Magur | *Clarias gariepinus* | X | √ | X | √ | X | X | X |
| Magur | *Clarius batrachus* | √ | √ | √ | √ | √ | √ | √ |
| **Stinging catfish** | **Heteropneustidae** | | | | | | | |
| Shing | *Heteropneustes fossilis* | √ | √ | √ | √ | √ | √ | √ |
| **Square-headed catfish** | **Chacidae** | | | | | | | |
| Chaka/Gangina/Kowakata | *Chaka chaka* | √ | √ | √ | √ | √ | X | √ |
| **Gars** | **Belonidae** | | | | | | | |
| Kaikla | *Xenentodon cancila* | √ | √ | √ | √ | √ | √ | √ |
| **Top minnows** | **Aplocheilidae** | | | | | | | |
| Tin Chokha | *Aplocheilus panchax* | √ | √ | √ | √ | √ | √ | √ |
| **Mud eels** | **Sybranchidae** | | | | | | | |
| Kuicha | *Monopterus (Cuchia) cuchia* | √ | √ | X | √ | √ | √ | √ |
| **Glass perch** | **Ambassidae** | | | | | | | |
| Lamba Chanda | *Chanda nama* | √ | √ | √ | √ | √ | √ | √ |
| Ranga Chanda | *Chanda ranga* | √ | √ | √ | √ | √ | √ | √ |
| Gol Chanda | *Chanda baculis* | √ | √ | √ | √ | √ | √ | √ |
| **Jew fish, croakers** | **Sciaenidae** | | | | | | | |
| Poa | *Otolithoides (Pama) pama* | √ | √ | √ | √ | √ | √ | √ |

| Species (Bengali Name) | *Species (Scientific Name)* | Baseline | Impact1 | Impact2 | Impact3 | Impact4 | Impact5 | Impact6 |
|---|---|---|---|---|---|---|---|---|
| | | 1999-00 | 2000-01 | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 |
| **Mud perch** | **Nandidae** | | | | | | | |
| Meni/Bheda | *Nandus nandus* | X | √ | √ | √ | √ | √ | √ |
| **Badis** | **Badidae** | | | | | | | |
| Kali/Napti Koi | *Badis badis* | √ | √ | √ | √ | √ | √ | √ |
| **Mullets** | **Mugilidae** | | | | | | | |
| Khalla/Kharshulla | *Rhinomugil (Mugil) corsula* | √ | √ | √ | √ | √ | √ | √ |
| **Gobies** | **Gobiidae** | | | | | | | |
| Gugri Bila | *Brachygobius nunus* | √ | √ | √ | √ | √ | √ | X |
| Bele | *Glossogobius giurius* | √ | √ | √ | √ | √ | √ | √ |
| **Climbing perch** | **Anabantidae** | | | | | | | |
| Koi | *Anabas testudineus* | √ | √ | √ | √ | √ | √ | √ |
| **Gouramies** | **Osphronemidae** | | | | | | | |
| Khalisha | *Colisa fasciatus* | √ | √ | √ | √ | √ | √ | √ |
| Chuna Khalisha | *Colisa laboisa* | √ | √ | √ | √ | √ | √ | √ |
| Lal Khalisha | *Colisa lalia* | √ | √ | √ | √ | √ | √ | √ |
| Naftani/Berkul | *Ctenops (Osphronemus) nobilis* | √ | X | X | X | X | X | X |
| **Tilapia** | **Cichlidae** | | | | | | | |
| Telapia | *Oreochromis (Telapia) mossambicus* | √ | √ | √ | √ | √ | √ | √ |
| **Snakeheads** | **Channidae** | | | | | | | |
| Cheng | *Channa gachua* | √ | √ | √ | √ | √ | √ | √ |
| Gojar | *Channa marulius* | X | √ | √ | √ | X | √ | √ |
| Taki | *Channa punctata* | √ | √ | √ | √ | √ | √ | √ |
| Shol | *Channa striata* | √ | √ | √ | √ | √ | √ | √ |
| **Spiny eels** | **Mastacembelidae** | | | | | | | |
| Tara Baim | *Macrognathus aculeatus* | √ | √ | √ | √ | √ | √ | √ |
| Guchi Baim | *Macrognathus pancalus* | √ | √ | √ | √ | √ | √ | √ |
| Boro Baim | *Mastacembelus armatus* | √ | √ | √ | √ | √ | √ | √ |
| **Puffer fish** | **Tetraodontidae** | | | | | | | |
| Potka | *Chelonodon patoca* | √ | √ | √ | X | √ | √ | √ |
| Tepa/Futkora | *Tetraodon cutcutia* | √ | √ | √ | √ | √ | √ | √ |
| | | | | | | | | |
| **Freshwater prawn** | **Palaemonidae** | | | | | | | |
| Gura Echa | *Macrobrachium lamrrei* | √ | √ | √ | √ | √ | √ | √ |
| Satka Chingri | *Macrobrachium malcolmsonii* | √ | √ | √ | √ | √ | √ | √ |
| Golda Echa | *Macrobrachium rosenbergii* | √ | √ | √ | √ | √ | √ | √ |
| Dimua/Kathalia Echa | *Macrobrachium villosimanus* | √ | √ | √ | √ | √ | √ | √ |
| **Total** | | **82** | **81** | **86** | **91** | **85** | **85** | **83** |

**Fish Species Diversity of Kangsha-Malijhee site by year (based on sample of fishers' catches in monitored areas)**

| Species (Bengali Name) | *Species (Scientific Name)* | Baseline | Impact1 | Impact2 | Impact3 | Impact4 | Impact5 |
|---|---|---|---|---|---|---|---|
| | | 2000-01 | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 |
| **Feather backs** | **Notopteridae** | | | | | | |
| Chital | *Notopterus chitala* | X | X | X | X | √ | √ |
| Foli | *Notopterus notopoterus* | √ | √ | √ | √ | √ | √ |
| **Shads, herrings etc.** | **Clupeidae** | | | | | | |
| Chapila | *Gudusia chapra* | √ | √ | √ | X | √ | √ |
| Hilsha (Jatka) | *Tenualosa ilisha* | X | √ | √ | √ | √ | X |
| **Carps, minnows and barbs** | **Cyprinidae** | | | | | | |
| Dhela | *Amblypharyngodon microlepis* | √ | √ | √ | X | √ | √ |
| Mola | *Amblypharyngodon mola* | √ | √ | √ | √ | √ | √ |
| Bighead Carp | *Aristechthys nobilis* | X | X | √ | X | X | √ |
| Thai Shor Puti | *Barbonymus gonionotus* | √ | √ | √ | √ | √ | √ |
| Catla | *Catla catla* | √ | √ | √ | √ | √ | √ |
| Chep Chela | *Chela laubuca* | √ | √ | √ | √ | √ | √ |
| Mrigel | *Cirrhinus mrigala* | √ | √ | √ | √ | √ | √ |
| Raek | *Cirrhinus reba* | X | √ | √ | X | X | X |
| Tatkini | *Crossocheilus latius* | √ | √ | √ | √ | √ | √ |

| Species (Bengali Name) | *Species (Scientific Name)* | Baseline | Impact1 | Impact2 | Impact3 | Impact4 | Impact5 |
|---|---|---|---|---|---|---|---|
| | | 2000-01 | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 |
| Grass Carp | *Ctenopharyngodon idellus* | √ | √ | √ | √ | √ | √ |
| Common Carp/Karfu | *Cyprinus carpio* | √ | √ | √ | √ | √ | √ |
| Silver Carp | *Hypophthalmichthys molitrix* | √ | √ | √ | √ | √ | √ |
| Baspata/Kazuli | *Danio devario* | X | X | X | √ | √ | X |
| Bata | *Labeo bata* | √ | √ | √ | √ | √ | √ |
| Vangra | *Labeo boga* | √ | X | √ | √ | √ | √ |
| Kalibaush | *Labeo calbasu* | √ | √ | √ | √ | √ | √ |
| Goinna | *Labeo gonius* | X | √ | √ | √ | √ | √ |
| Nandil | *Labeo nandina* | √ | √ | √ | √ | √ | √ |
| Rui | *Labeo rohita* | √ | √ | √ | √ | √ | √ |
| Chola Puti | *Puntius chola* | √ | X | √ | X | X | X |
| Kanchan Puti | *Puntius conchonius* | √ | √ | √ | √ | √ | √ |
| Jhili Puti | *Puntius gelius* | √ | X | X | √ | √ | X |
| Mola Puti | *Puntius guganio* | √ | X | X | X | X | X |
| Futani Puti | *Puntius phutunio* | X | X | √ | X | X | X |
| Shar Puti | *Puntius sarana* | √ | √ | √ | √ | √ | √ |
| Jat Puti | *Puntius sophore* | √ | √ | √ | √ | √ | √ |
| Bagha Puti | *Puntius stigma* | X | √ | √ | √ | √ | √ |
| Teri Puti | *Puntius terio* | X | X | X | √ | √ | X |
| Tit Puti | *Puntius ticto* | √ | √ | √ | √ | √ | √ |
| Dankina | *Rasbora daniconius* | √ | √ | √ | √ | √ | √ |
| Elong | *Rasbora elanga* | X | X | X | X | √ | X |
| Gang Chela/Ghora Chel | *Salmostoma (Oxygaster) gora* | √ | X | √ | √ | √ | √ |
| Chela | *Salmostoma (Oxygaster) pholo* | √ | √ | √ | √ | √ | √ |
| Narkeli Chela | *Salmostoma bacalia* | X | X | X | X | X | √ |
| **Loaches** | **Cobitidae** | | | | | | |
| Rani | *Botia dario* | √ | √ | √ | √ | √ | X |
| Gutum | *Lepiodocephalus guntea* | √ | √ | √ | √ | √ | √ |
| Gora Gutum/Ganga Shagor | *Someleptes gongota* | √ | √ | √ | √ | √ | √ |
| **Bagrid catfish** | **Bagridae** | | | | | | |
| Tengra (Batasio) | *Batasio batasio* | X | X | X | X | √ | X |
| Golsa | *Mystus bleekeri* | √ | √ | √ | √ | √ | √ |
| Kabasi Tengra | *Mystus cavasius* | X | √ | X | X | X | X |
| Bajri Tengra | *Mystus tengara* | X | X | √ | √ | √ | √ |
| Tengra | *Mystus vittatus* | √ | √ | √ | √ | √ | √ |
| Rita | *Rita rita* | X | X | X | X | √ | X |
| Air | *Sperata aor* | √ | X | X | X | √ | X |
| Guzi air/Guzkata | *Sperata seenghala* | X | X | √ | √ | √ | √ |
| **Butter catfish, etc** | **Siluridae** | | | | | | |
| Kani Pabda | *Ompok bimaculatus* | √ | X | X | √ | √ | √ |
| Pabda/Madhu Pabda/ Kowakata/Ghorakata | *Ompok pabda* | √ | √ | √ | √ | √ | √ |
| Boal | *Wallago attu* | √ | √ | √ | √ | √ | √ |
| **Schilbeid catfish** | **Schilbeidae** | | | | | | |
| Ghaura | *Clupisoma garua* | √ | √ | X | X | √ | √ |
| Bacha | *Eutropiichthys vacha* | X | X | X | √ | √ | √ |
| Batasi | *Pseudentropious (Clupisoma) atherrinoides* | √ | √ | √ | √ | √ | √ |
| Silong | *Silonia silondia* | X | X | √ | X | X | X |
| **Pangas** | **Pangasiidae** | | | | | | |
| Thai Pangas | *Pangasius sutchi* | X | √ | √ | √ | √ | X |
| **Catfish** | **Sisoridae** | | | | | | |
| Bagha Air | *Bagarius bagarius* | √ | X | X | X | √ | √ |
| Senia (Eusufi) | *Gagata cenia* | X | √ | X | X | X | X |
| **Air breathing catfish** | **Clariidae** | | | | | | |
| African Magur | *Clarias gariepinus* | X | √ | X | X | √ | X |
| Magur | *Clarius batrachus* | √ | √ | √ | √ | √ | √ |
| **Stinging catfish** | **Heteropneustidae** | | | | | | |
| Shing | *Heteropneustes fossilis* | √ | √ | √ | √ | √ | √ |
| **Square-headed catfish** | **Chacidae** | | | | | | |
| Chaka/Gangina/Kowakata | *Chaka chaka* | X | X | X | √ | √ | X |

| Species (Bengali Name) | *Species (Scientific Name)* | Baseline | Impact1 | Impact2 | Impact3 | Impact4 | Impact5 |
|---|---|---|---|---|---|---|---|
| | | 2000-01 | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 |
| **Catfish-eel** | **Plotosidae** | | | | | | |
| Gang Magur | *Plotosus canius* | X | X | X | √ | √ | X |
| **Gars** | **Belonidae** | | | | | | |
| Kaikla | *Xenentodon cancila* | √ | √ | √ | √ | √ | √ |
| **Top minnows** | **Aplocheilidae** | | | | | | |
| Tin Chokha | *Aplocheilus panchax* | √ | X | √ | √ | √ | X |
| **Mud eels** | **Synbranchidae** | | | | | | |
| Kuicha | *Monopterus (Cuchia) cuchia* | √ | √ | √ | √ | √ | √ |
| **Glass perch** | **Ambassidae** | | | | | | |
| Lamba Chanda | *Chanda nama* | √ | √ | √ | √ | √ | √ |
| Ranga Chanda | *Parambassis ranga* | √ | √ | √ | √ | √ | √ |
| Gol Chanda | *Pseudambassis baculis* | √ | √ | √ | √ | √ | √ |
| **Jew fish, croakers** | **Sciaenidae** | | | | | | |
| Poa | *Otolithoides (Pama) pama* | X | √ | √ | X | X | √ |
| **Mud perch** | **Nandidae** | | | | | | |
| Meni/Bheda | *Nandus nandus* | X | X | √ | √ | √ | √ |
| **Badis** | **Badidae** | | | | | | |
| Kali/Napti Koi | *Badis badis* | √ | √ | √ | √ | √ | √ |
| **Mullets** | **Mugilidae** | | | | | | |
| Khalla/Kharshulla | *Rhinomugil (Mugil) corsula* | X | X | X | √ | √ | X |
| **Gobies** | **Gobiidae** | | | | | | |
| Gugri Bila | *Brachygobius nunus* | X | X | √ | X | √ | X |
| Bele | *Glossogobius giurius* | √ | √ | √ | √ | √ | √ |
| **Climbing perch** | **Anabantidae** | | | | | | |
| Koi | *Anabas testudineus* | √ | √ | √ | √ | √ | √ |
| **Gouramies** | **Osphronemidae** | | | | | | |
| Khalisha | *Colisa fasciatus* | √ | √ | √ | √ | √ | √ |
| Chuna Khalisha | *Colisa laboisa* | √ | √ | √ | √ | √ | √ |
| Lal Khalisha | *Colisa lalia* | √ | √ | √ | √ | √ | √ |
| Naftani/Berkul | *Osphronemus(Ctenops) nobilis* | X | √ | X | √ | √ | X |
| **Tilapia** | **Cichlidae** | | | | | | |
| Telapia | *Oreochromis (Telapia) mossambicus* | X | √ | √ | √ | √ | X |
| Nailotika | *Oreochromis niloticus* | X | X | X | √ | √ | √ |
| **Snakeheads** | **Channidae** | | | | | | |
| Cheng | *Channa gachua* | √ | √ | √ | √ | √ | √ |
| Gojar | *Channa marulius* | X | √ | √ | X | X | √ |
| Taki | *Channa punctatus* | √ | √ | √ | √ | √ | √ |
| Shol | *Channa striata* | X | √ | √ | √ | √ | √ |
| **Spiny eels** | **Mastacembelidae** | | | | | | |
| Tara Baim | *Macrognathus aculeatus* | √ | √ | √ | √ | √ | √ |
| Guchi Baim | *Macrognathus pancalus* | √ | √ | √ | √ | √ | √ |
| Boro Baim | *Mastacembelus armatus* | √ | √ | √ | √ | √ | √ |
| **Puffer fish** | **Tetraodontidae** | | | | | | |
| Potka | *Chelonodon (Tetraodon) patoca* | √ | X | X | X | X | X |
| Tepa/Futkora | *Tetraodon cutcutia* | √ | √ | √ | √ | √ | √ |
| | | | | | | | |
| **Freshwater prawn** | **Palaemonidae** | | | | | | |
| Gura Echa | *Macrobrachium lamrrei* | √ | √ | √ | √ | √ | √ |
| Golda Echa | *Macrobrachium rosenbergii* | √ | √ | X | √ | √ | √ |
| Dimua/Kathalia Echa | *Macrobrachium villosimanus* | X | X | X | √ | X | X |
| **Total** | | **64** | **67** | **71** | **73** | **84** | **68** |

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