Coalmines Degraded Ichthyofaunal Diversity of Simsang River, Meghalaya

(A report on climate change)

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Message

Upland fisheries resources of India is threatened by several external factors such as pollution, land-use transformation and competing aquatic resource uses upon which the impacts of climate changes could have an important compounding effect. The environmental impacts caused by mining activities impacting on spawning beds, create barriers to migration and hydrological changes and loss of habitat.

Again, the abundance and species diversity of Riverine fisheries in higher altitudes are predicted to be particularly sensitive to climatic disturbances. The impacts of global climate change on the physical and chemical characteristics will likely prove to be the driving factors in determining the well-being and composition of fish communities especially of higher altitude and thus cannot be discounted in discussions concerning global climate change.

North-East India is a global hotspot for fish faunal diversity not only for plain water fisheries but also for coldwater fisheries. In recent years, the physico-chemical parameters of the aquatic ecosystem of the region have reported rapid changes due to pollution, siltation and anthropogenic factors. Therefore, there is a critical need to analyse and predict processes and impacts at the level of species, assemblages of each and every ecosystem of the region to provide effective support for management.

Directorate of Coldwater Fisheries Research, Bhimtal has taken appreciable step in association with Goalpara College, Goalpara and Department of Zoology, Gauhati University, Assam for analyzing the impacts of coalmining, climate change and documentation of piscine diversity of Simsang River, Meghalaya. This document will be certainly beneficial for further works in management practices of the coldwater resources.

I extend my heartiest congratulation to the authors for the contribution and DCFR to take up right steps for timely publication of this bulletin.

Foreword

The resilience of many ecosystems is likely to be exceeded by an unprecedented combination of climate change and other global change drivers. Coal mining, pollution, fragmentation and loss of habitat (e.g. destructive fishing activities), invasive species infestations and over-harvesting from fisheries individually or collectively may have severe impacts on the production of the world's aquatic systems and the services they provide. The impacts on aquatic life from these stressors may be exacerbated by climatic change and the ability of ecosystems to cope (resilience) or recover will be impaired. Therefore, the combined effects of these may steadily and, in some cases, sharply increase the vulnerability of the aquatic resources, with important ecological, economic and social implications.

Garohills is a part of the Meghalaya plateau and the area is blessed with rich natural resources, both non-renewable and renewable including bio-resources. This region is also known as global hotspot for fish faunal diversity for plain water fisheries and cold-water fisheries as well. The ecology of the area has been threatened by large-scale environmental degradation caused by extensive deforestation, overexploitation of natural resources and other anthropogenic activities coupled with unprecedented climate change. In the recent years unscientific coal mining in the area has further aggravated the problem. The Simsang River of Garohills is the longest and one of the important habitats coldwater fisheries resources, which witnessed severe damage due to coal mining practices. In recent years, the hydrobiology of the River system have reported rapid changes as a result of which fishery resources of the River system reduced drastically.

Directorate of Coldwater Fisheries Research has taken several efforts for documenting hydro biological peculiarities and cold-water fishery resources in collaboration with various state fisheries Departments, Institutes, Colleges. This document prepared in association with Goalpara College and Gauhati University, Assam can be called as fruits. This document would serve as *first hand information* for academician, researcher and planner to carry out further works in respect to

The Simsang River

The Simsang river is the longest river and cultural icon of Garohills of Meghalaya, one of the important hill states of North-East India. The river is also known as **Someswari river** at Bangladesh. It originates on Nokrek Peak (now declared as Nokrek Biosphere Reserve) located about 1412 m MSL which lies 13 Km South-East of two faults and it is along the Northern faults, the river flows towards the East for about 45 Km. It drains the hills between Tura and Arbela ranges and the valley of the Rongdi. The river has a winding course. At first it flows in an Easterly direction for about 75 Km and then takes a turn towards the South and flows in a Southerly direction till it leaves the hills and enters the plains of Bangladesh. In Garohills the river flows between the altitudes of 1412m MSL (at Nokrek Biosphere Reserve) and 350 m MSL (at Baghmara, South Garohills) before entering into the plains of Bangladesh. The river from its origin to Baghmara flows through three district of Meghalaya, *i.e.* West Garohills (90⁰ 30/- 89⁰ 40/ E and 26⁰-25⁰ 20/ N), East Garohills (N 25°30/30//-E 90°37/) and South Garohills (N 25°11/30//-E 90°38/30//). The river as it passes along its courses springs up to beautiful waterfall of all shades, which has a unique tale of its origin. The river harbours a rich variety of coldwater species and famous for its endemic **Electric Fish** locally known as *Na-nil*. It is believed that the fish is able to generate electric

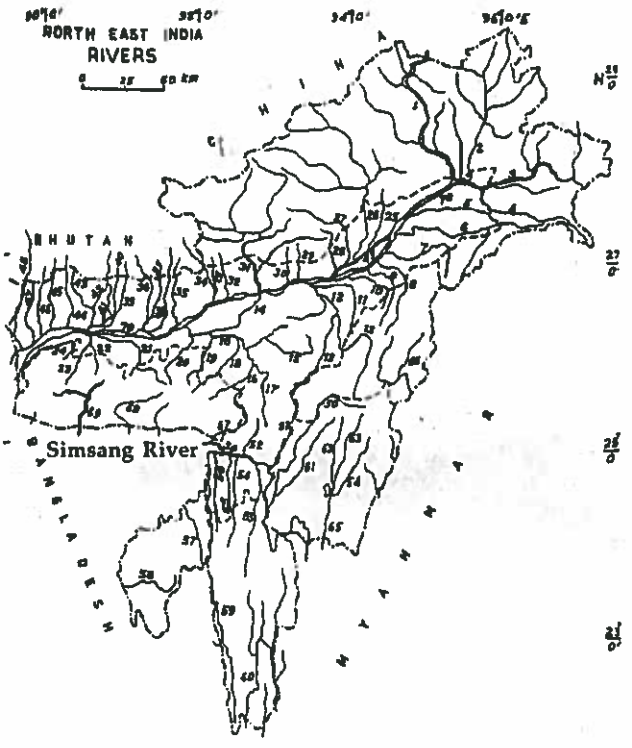
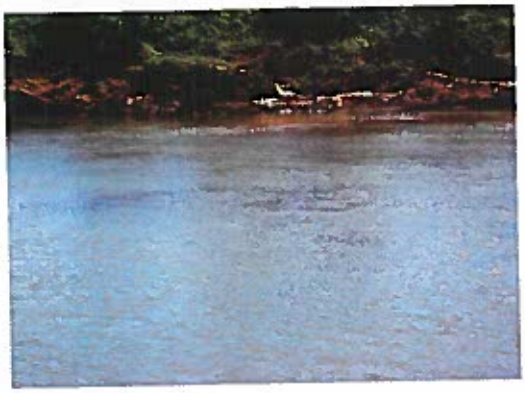


Fig: River Drainage of North East India (69-Simsang)



View of Simsang River

The bank of river is a part of Meghalaya plateau, which composed of rocks belonging to the age group of Archaen and Tertiary period, represented by granites, phyllite, gnessis, sandstone and limestone. The area is blessed with rich natural resources, both non-renewable and renewable including bio-resources. Minerals such as coal, limestone, fireclay, phosphorite etc. are found in abundance. The area also supports for growth of luxuriant forests rich in diverse flora and fauna.

View of Simsang River

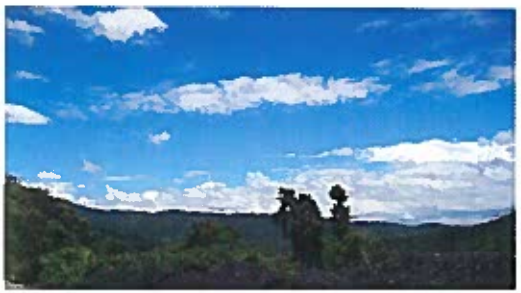
In the last few decades, the ecology of the river has been threatened by large scale environmental degradation caused by extensive deforestation, overexploitation of natural resources and other anthropogenic activities coupled with unprecedented rise in human population. During recent years unscientific coal mining in the area has further aggravated the problem which is a major concern for the scientific community. Therefore, habitat restoration, sustainable

In general it is observed that most climate models have global or regional resolution. So, it is difficult to predict the effects of climate change on individual fish populations, including those that support fisheries. Changes in hydrologic regimes will affect the species whose life histories require a larger scale (migratory species, big river fishes) in a different manner than those that are limited to a small scale (endemic species, headwater species). During recent year's unscientific coal mining in an area has been the major concern coupled with various natural and anthropogenic factors to protect the rich aquatic biodiversity of the Simsang river. As a result of it, the area has faced certain problems viz. soil erosion, scarcity of water, pollution of air, water and soil, reduced soil fertility and loss of biodiversity.

The extraction of coal creates a variety of impacts on the environment before, during and after the mining operations. The extent and nature of impacts can range from minimal to significant depending on a range of factors associated with the ongoing mining processes as well as the post-mining management of the affected landscapes. The sensitivity of the local environment also determines the magnitude of the problem. Usually, an ecologically fragile environment has been found highly vulnerable, attracting long term ecological impacts.

Impact of Acid Mine Drainage on Simsang River

In mining, the removal of vegetation and soil overburden is often necessary to gain access to metal or coal deposits. Topsoil and foliage can then wash into the river and blanket streambeds or obstruct stream courses. The term is referred to as **Acid Mine Drainage (AMD).** The water is badly affected by contamination



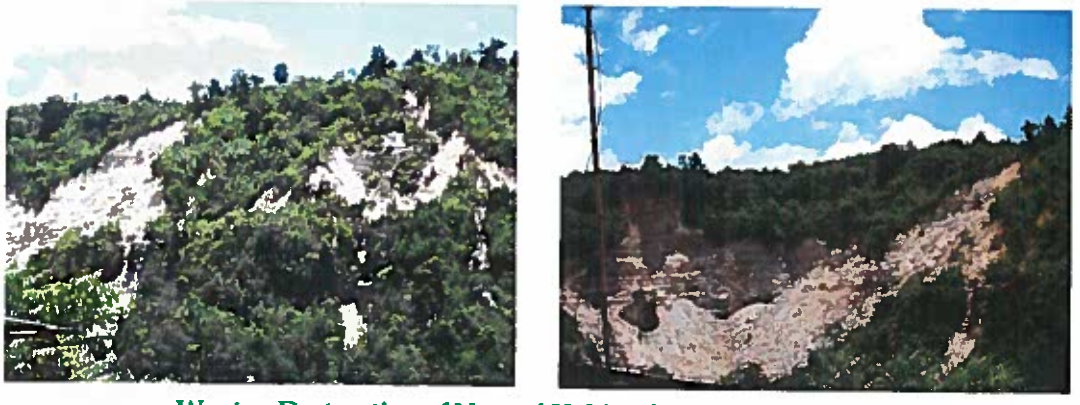
of Acid Mine Drainage (AMD) originating from mines, leaching of heavy metals, organic enrichment and silting by coal and sand particles. Pollution of the water is evident by the colour of the water and the colour of rivers and streams in the mining area changes to brownish to reddish orange. Low pH (between 2-3), high conductivity, high concentration of sulphates, iron and toxic heavy metals, low dissolved oxygen (DO) and high BOD are some of the physico-chemical changes which characterize the degradation of water quality.

The primary cause of degradation of water quality and the declining trend of biodiversity in the water bodies of the mining area of Simsang river is due to the effect of **Acid Mine Drainage** (AMD), which makes the water body highly acidic and rich in heavy metal concentration. It is formed by a series of complex geochemical and microbial reactions that occur when water comes in contact with pyrite (iron sulfide) found in coal and exposed rocks of overburden. Mine drainage is generated when pyrite reacts with air and water to produce sulphuric acid and dissolved iron. During the process of pyrite oxidation, dissolved Fe^{2+}, SO_4^{2-} and H^+, followed by the further oxidation of the Fe^{2+}, Fe^{3+} are formed. Some or all of this iron can precipitate to cause turbidity of water (in the form of red, orange, or yellowish colour) and sedimentation at the bottom of streams. The acid runoff or AMD aggravates the problem further by dissolving heavy metals such as aluminium, copper, lead, mercury etc. found in rocks and soil. As a result, the AMD contaminated surface water is not only acidic but also rich in different metals. The overall chemistry of AMD formation is summarized in reaction given below:

$$4\ FeS_2 + 15\ O_2 + 14\ H_2O = 4\ Fe(OH)_3 \downarrow + 8\ H_2SO_4$$

Pyrite + Oxygen + Water = "Yellow precipitate" ↓ + Sulphuric Acid

Aquatic communities of unaffected rivers and streams comprise of phytoplanktons, periphyton, macrophytes, zooplanktons, invertebrates and vertebrate species, play an important role in normal functioning of the aquatic ecosystem. Any physical, chemical or biological change in water bodies effects one or all species and disturbs the normal functioning of the aquatic ecosystem. The benthic (bottom-dwelling) communities of rivers and streams consist of those organisms which grow in or otherwise in association with various bottom



Wanton Destruction of Natural Habitat for Mining Activities

Fish in natural habitat often depends for their food on small aquatic organisms including macro-invertebrates. As a consequence of depletion of aquatic invertebrates, the fishes do not get adequate food and suffer indirectly from AMD contamination. AMD also has direct effect on fish by causing various physiological disturbances. The primary cause of fish death in acid water is loss of sodium ions from the blood. Less availability of oxygen to the cells and tissues leads to anoxia and death, as acid water increases the permeability of fish gills to water, adversely affecting the gill function.

Coal Mining Vs Hydrobiology of Simsang River

Meghalaya, one of the eight North-Eastern States of India possesses rich deposits of various minerals including coal. The coal deposits in the state occur along the Southern fringe of Shillong plateau distributed in Khasi Hills, Garo Hills and Jaintia Hills. The coal is one of the extensively utilized minerals in the state. East Garo hills district is a major producer of coal. Coal extraction is done by primitive mining method commonly known as ***'rat-hole'*** mining.

Most of the mining activities are small-scale ventures controlled by individuals who own the land. Mining operation, undoubtedly has brought wealth and employment opportunity in the area, but simultaneously has led to extensive environmental degradation and disruption of traditional values in the society

Entrance of A '*Rat-Hole*' Coalmining and Abandoned Pit

implications of coal mining. Besides, a vast area has become physically disfigured due to haphazard dumping of overburden, caving of the ground and subsidence of land.

The water bodies of the area are the greatest victims of the coal mining. The problems of water quality degradation and its adverse impacts on availability of potable and irrigation water, soil quality, agricultural productivity and biodiversity in the area have been attracting attention to the scientific community. Simsang river of Garo hills are an important habitat for coldwater fisheries that has witnessed severe damage due to coal mining practices couple with climate change. In recent years, the physico-chemical parameters of the river system have reported rapid changes especially in water temperature and dissolved oxygen. As a result of which fishery resources of the river system reduced drastically.

Physico-chemical and biological characteristics of the river were studied for a couple of years to observe the impact of coalmines on the characteristic changes of the river in terms of ichthyofaunal biodiversity in five different

William Nagar (District head quarter of East Garohills) ■ S-III

Nangalbibra (Maximum coal mining activities are practicised) ■ S-IV

Near Siju (South Garo hills) ■ S-V

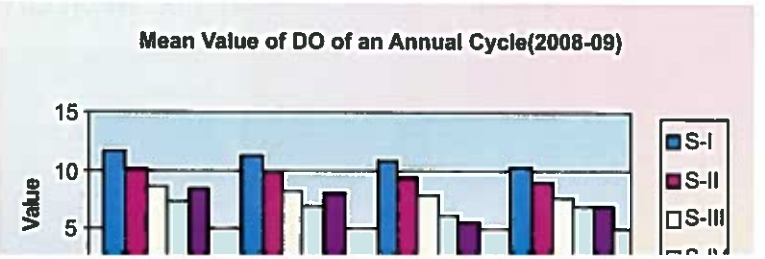
Colour

The colour of the river is found to be transparent to turbid in Nokrek Biosphere Reserve. However, in Nangalbibra and Siju the water is found to be slightly brownish to orange in colour. This might have resulted due to siltation of coal, sand, and soil particles. In addition to these contamination of AMD and formation of iron hydroxide are some of the major causes of change in water colour. According to the local inhabitants, the taste of water is also different in upstream in comparison to the downstream of the river where coal excavation are taking place *i.e.* in Nangalbibra.

Dissolved Oxygen

Adequate dissolved oxygen (DO) concentrations are essential for most fishes, aquatic insects, algae and macrophytes. Oxygen enters the water column through diffusion from the atmosphere, introduction by turbulence and by photosynthetic production. Plant, animal and microbial aerobic respiration all require DO, lowering its concentration in the water column. Dissolved oxygen concentrations of 5.0 mg/L or more are acceptable for most aquatic organisms.

Generally DO level of high altitude torrential rivers are higher than that of the flood plain rivers. However, in case of Simsang river in Nangalbibra and Near Siju area (maximum coal mining activities are practicised), the level of DO



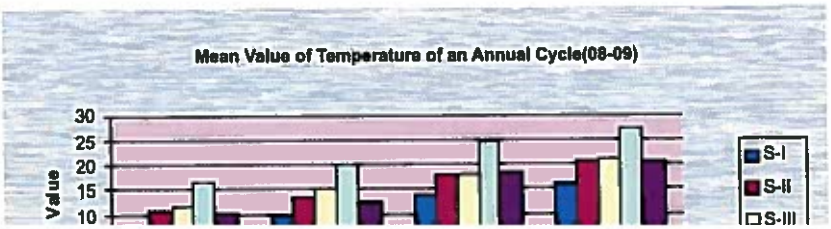
estimated found to be low. The level of dissolve oxygen were found ranging from 5.7-11.6 mg/L. Maximum level of DO was estimated in Nokrek Biosphere Reserve (near the origin of river) and lowest level of DO was estimated in Nangalbibra and Siju (South Garohills) which shows orthograde profile.

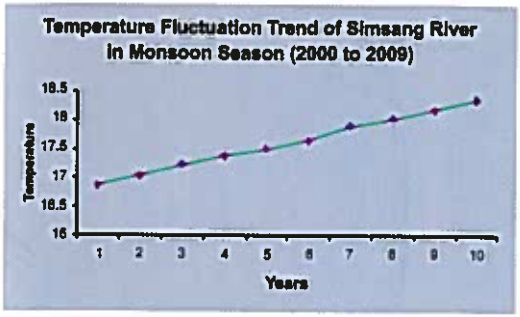
Sand and Pebbles are excavated regularly from the Riverbed of Simsang near, William Nagar

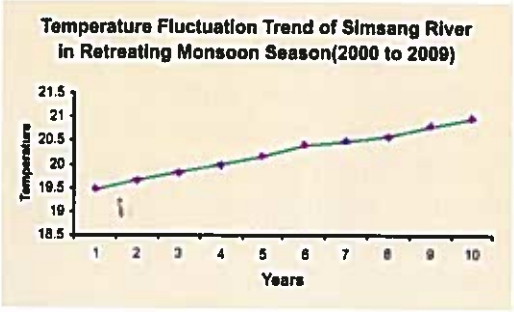
The aerobic metabolic rates of most cold-blooded aquatic organisms increase with temperature and an increase in temperature reduces the metabolisms and increases the biological oxygen demand (BOD). Fishes exposed to elevated water temperatures can face an *oxygen squeeze* where the decreased supply of oxygen cannot meet the increasing demand. Decreasing level of DO in Simsang river might have resulted due to debris of coal mining couple with climate change. It is noteworthy that in Nangalbibra, the bank of river is used as the dumping ground of coal.

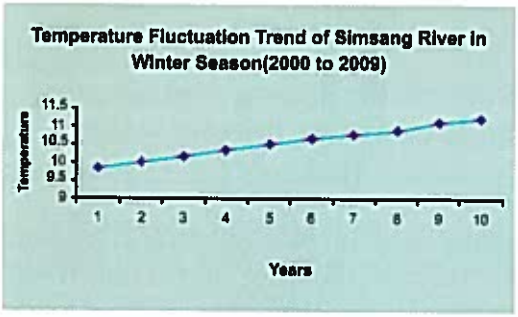
Temperature

It has been observed from the study that the temperature profile of the Simsang river system is rapidly changing from the last decade. According to the observation, fragmented ice were regular phenomenon in winter season in the river especially in the area of Nokrek Biosphere Reserve before 10 years. The temperature profile of the river are showing (temperature profile of the river system are projected herewith with the help of primary and secondary data, as per





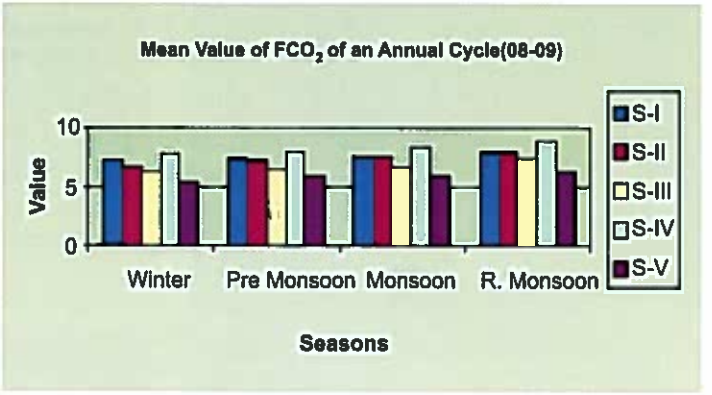




information gathered from local inhabitants and through personal observation) increasing trend due to global climate change coupled with pollution and other anthropogenic activities.

Free Carbondioxide

Free CO_2 level of a high altitude river is generally very low. However, Free CO_2 level of Simsang river was found to be extremely high at Nangalbibra. This might have resulted due to deposition of coal debris as well as the rivulets arises from the *Rat hole*



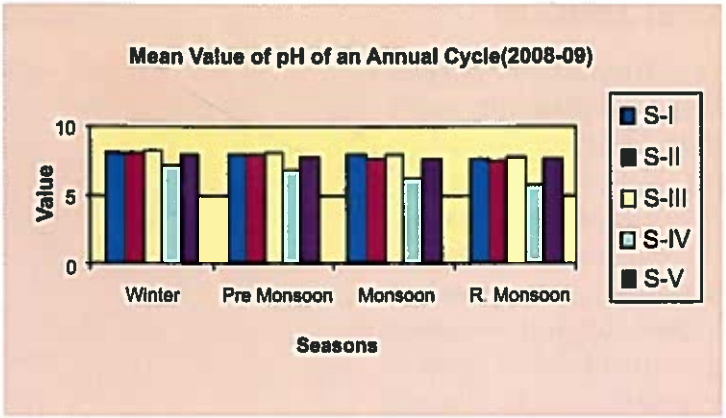
Generally higher level of CO_2 in lotic water body is liberated due to rapid decomposition of organic matter. However, during the study at Simsang river it has been found that the deposition was only from coal debris, not from other organic matters. The process of human intervention and release of carbon rich materials into the Simsang river exacerbates as well as also restrict the quality and extent of cold-water fisheries habitat.

pH

The level of pH of the river is found slightly acidic at Nangalbibra. However, in other sites the level of pH conducive for fish are showing decreasing trend from higher altitude (in origin) to lower altitude. Contamination of Acid Mine Drainage (AMD) leads to acidity or low pH of the affected water bodies. Acidic water is a matter of primary concern since it can directly be injurious to aquatic organisms. It also facilitates leaching of toxic metals into the water that could be hazardous to aquatic life directly or can disturb the habitat after precipitation.

The water bodies of the mining area are attributed mainly to the AMD, which makes water highly acidic and rich in heavy metal concentration. Low pH is directly injurious to many freshwater animals and has diverse biological effects including changes in abundance, biomass and diversity of invertebrates. Also higher concentration of heavy metal in water impairs the moral physiological functioning of the aquatic organisms and leads to toxicity. The effects of AMD are the result of a combination of factors which are

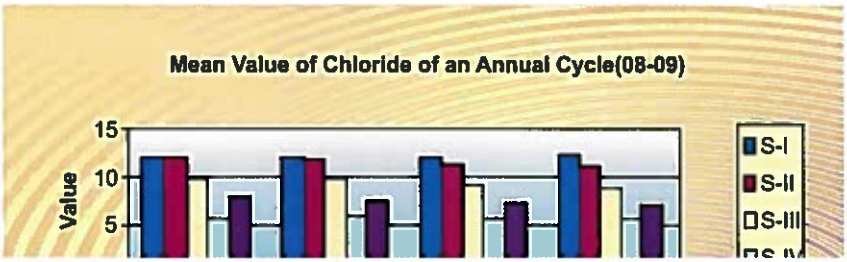
plant species. Acidic pH in the river at Nangalbibra area has resulted from AMD. The area is threatened for the habitat of aquatic organisms including fishes due to combination of all the adverse effect of water quality parameters. According to the observations as well as evidence from the local inhabitants, it was found that the fishes from the site are disappearing gradually as mining activities are increasing day by day.



However, Simsang river harbours a diverse range of fishes and other aquatic organisms in many other places, where water bodies are not affected by Acid Mine Drainage. There is high diversity of insects. In the places like Nokrek Biosphere Reserve, Rombagre, William Nagar, Nangalbibra and Siju Mayflies were also seen indicating presence of microhabitat for cold water species. However, gradual increase in the level of pH in these places occurs as a result of climate change couple with anthropogenic activities, since air temperature is called as ***master variable*** of pH of stream water.

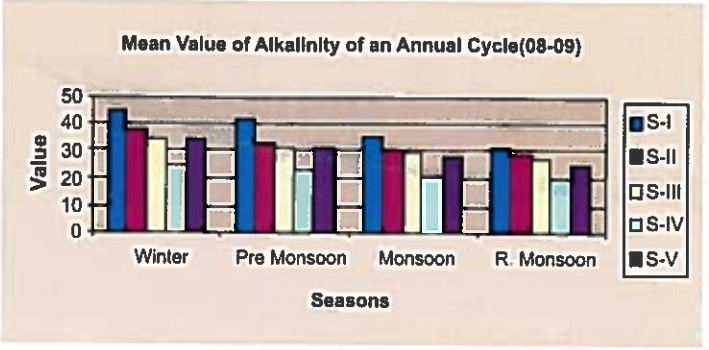
Chloride

The values of chloride were found between 5.6-12.14 mg/L.



Total Alkalinity

The mean estimated values of alkalinity were found between the ranges of 21.0 - 45.0 mg/L throughout the annual cycle. Though the level of alkalinity was found in higher side but luxuriant growth of some aquatic vegetation at Rombagre (where effect of coal mining was not found) indicating increasing trend of alkalinity. This may be due to impact of increase in temperature, which might enhance eutrophic conditions by stimulating explosive macrophytes growth.



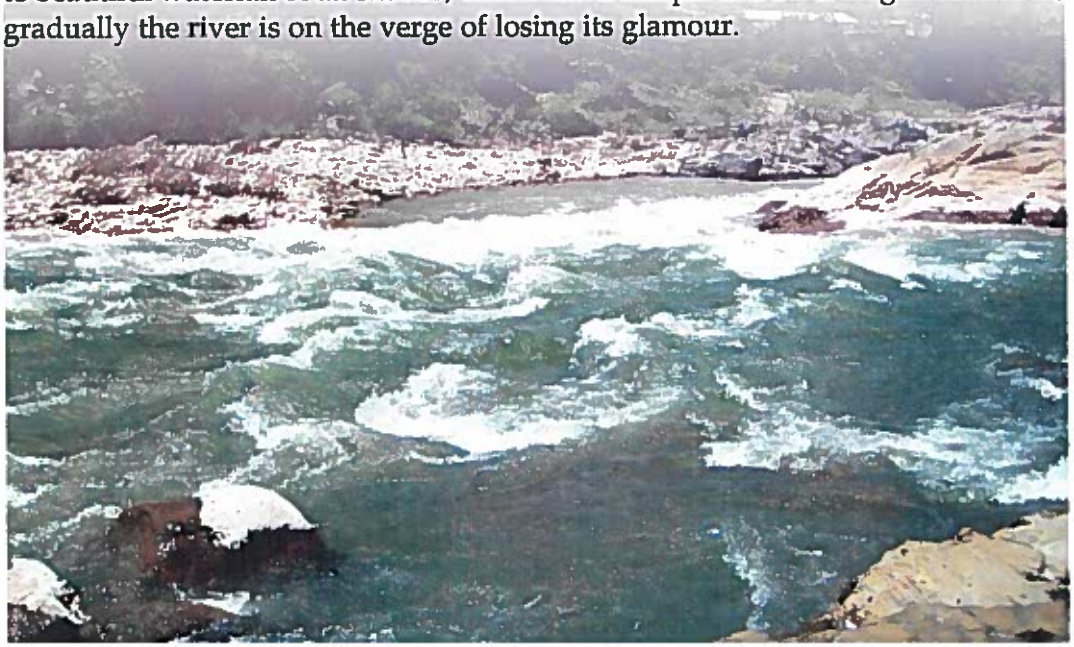
A study conducted found that an increase of 2- 3^{0}C temperature could cause a 300-500% increase in shoot biomass of the aquatic macrophytes, *Elodea canadensis*. A biomass increase of this magnitude would effect the system in various ways. Because macrophytes take up the phosphorus sequestered in the sediment, the amount of phosphorus immediately available for other primary producers would decline. However, when the macrophytes die and decompose, they release nutrients such as nitrogen and phosphorus into the water column. This influx of nutrients can stimulate algal blooms and help perpetuate high macrophytes production. According to local inhabitant, the growth of aquatic vegetation was observed since last few years, which may be a

Diversity of Aquatic Insect

Aquatic insect belonging to five orders viz. Ephemeroptera (Mayflies), Plecoptera (Stoneflies), Tricoptera (Caddisflies), Coleoptera (Water spider) and Odonata were recorded in all the sampling sites during the study. However in Nangalbibra, the diversity of aquatic insect was found to be very less. It is recorded that Mayflies are one of the most sensitive groups of aquatic insect to low pH. Acid Mine Drainage causes a reduction in the abundance and diversity of aquatic insect. Since this area is affected by coal mining, reduction in the level of aquatic insect might have been the result of above mentioned factors.

Diversity of Fish Fauna

Simsang, which eventually enters into the Bangladesh, is a threshold of unique fishes indigenous to this region. Earlier it was also popularly known as **Buffer Zone** for coldwater fish species The river as it passes along its courses springs up to beautiful waterfall of all shades, which has a unique tale of its origin. However, gradually the river is on the verge of losing its glamour.



In our study, a total of **43** species belonging to **31** genera of **16** families were collected from the river along with two new species (communicated). In addition to that, two species of prawn were also recorded from the river, which are indigenous to the river system. Amongst the recorded species, 20 species were identified as inhabitants of high altitude streams and rivers along with some species endemic to the river (*Chaudhuria khajurial, Macrobrachium assamense peninsulare* etc.) and the rest are warm water species.

The **Electric Eel** locally known as "Na-nil" prefer to live in hiding themselves underneath the big boulders as well as their microhabitat which lies in the shady area of the river. The fishes are nocturnal in habit, came out in search of food from the hole during night. It is believed that fishing can only be possible during night. In full moon night, catching of the fish is significantly reduced. The fishes are found in pairs in a single hole and their spawning takes place within the hole. Schooling behaviour is also characteristic feature of the fish during parental care. The intensity of electric current increases as size of the fish increases. The fishes are grown up to 4- 5 feet in length and weigh up to 10 kg.

The species diversity of this river is more peculiar than the other cold water river system of India but it has been observed that the number of plain water species increasing day by day because of rapid changes of physico-chemical properties of the river due to rise in temperature. When the increase in temperature is not sufficient to prove acutely or even chronically lethal, the sub-lethal impacts on fish physiology, particularly on growth and reproduction may be sufficient to cause significant changes in the structure and composition of fish fauna. The impact of global climate change on the critical physical and chemical characteristics will likely prove to be the driving factors in determining the well being and composition of fish communities.

Out of the five sampling sites, the diversity of fishes were found more in Nokrek Biosphere Rserve and Rambagra sampling sites, however, nothing have been recorded from the Nangalbibra site. According to the local inhabitants, fishes are disappearing from the area very rapidly with the increased level of coal mining activities. However, the abundance of hills stream variety of fishes is also dwindling

species size ranging from 3-4 kg were caught from the area very near to the Nokrek Biosphere reserve (altitude about 1300m MSL) as reported by the local fishermen.

According to the local fishers, Mahseers and Electric fish weighing about 10 to 25 kg were regularly caught from the area earlier but at present the size of the fish species as well as catch per unit effort has been reducing very rapidly. Fishing through **herbal poison** is also one of the causes for depletion of fish diversity besides the above mentioned factors.

From the survey, it has been observed that numbers of plain water species including ***Clarius gariepinus*** are occupying the higher altitude in spite of having heavy current shows the clear indication of rising in the level of temperature.

Major significant feature of the Simsang river is that no traditional fisher is found in the fishing practices. Only the Garo people of the fringe villages are engaged in fishing practices with indigenous fishing gears in the river.

Name of the species	Status of the species as per CAMP report	Status at Simsang River (As per annual catching %)
Sisor rabdophorus	Endangered	1.2
Chagunius chagunio	Not evaluated	5
Mastacembelus armatus	Not evaluated	4
Channa orientalis	Vulnerable	3
Schistura sikmaiensis	Endangered	1.5
Barilius barna	Lower risk near threatened	3
Badis badis	Not evaluated	4
Danio aequipinnatus	Lower risk near threatened	4
Puntius conchonius	Vulnerable	4
Glyptothorax cavia	Endangered	2.5
Schistura species	-	1.5
Barilius bandelisis	Not evaluated	3
Garra annandalei	Not evaluated	3
Tor tor	Endangered	2
Chaudhuria khajurial	Endangered	6
Puntius gelius	Not included	3
Monopterus cuchia	Lower risk near threatened	2
Tor putitora	Endangered	2
Barilius species	-	7
Botia dario	Not evaluated	4
Lepidocephalus guntea	Not evaluated	1.5
Ailia coila	Vulnerable	1.5
Puntius sophore	Lower risk near threatened	2
		2

Aspidoparia morar	Lower risk near threatened	1.3
Glossogobius gutum	Not included	2
Glossogobius giuris	Not included	1.5
Chanda nama	Not evaluated	2
Chanda ranga	Not evaluated	1.5
Colisa lalia	Not included	1
Colisa fasciata	Lower risk near threatened	1.5
Clupisoma garua	Vulnerable	1.5
Puntius terio	Lower risk near threatened	0.5
Tetradon cutcutia	Lower risk near threatened	1
Anabas testudineus	Vulnerable	1.5
Channa striatus	Lower risk near threatened	0.5
Macrognathus pancalus	Not evaluated	1.5
Chela cachius	Not included	2
Salmostoma bacaila	Lower risk least concern	1.2
Clarius gariepinus	Not evaluated	0.8
Macrobrachium assamense peninsulare	Not evaluated	1
Macrobrachium assamense	Not evaluated	2

List of the species recorded from Simsang river along with their status as per CAMP report and status in the river (as per annual catching percentage)

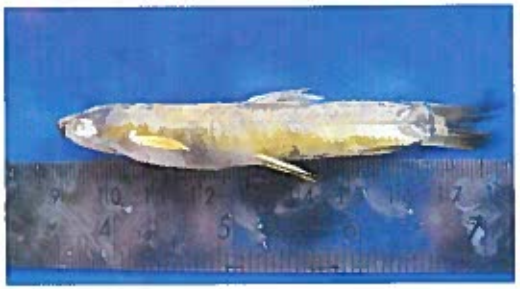
Chaudhuria khajurial (Talwar)

Channa orientalis (Bloch-Schneider)

Sisor rhabdophorus (Hamilton-Buchanan)

Tor tor (Ham.)

Glyptothorax cavia (Hamilton-Buchanan)



Schistura sikmaiensis (Hora)

Chagunius chagunio (Hamilton-Buchanan)

Barilius species

Botia dario (Hamilton-Buchanan)

Salmostoma bacaila (Hamilton-Buchanan)

Mastacembelus armatus (Lacepede)

Chela cachius (Hamilton-Buchanan)

Barilius barna (Hamilton-Buchanan)

Gagata gagata (Hamilton-Buchanan)

Salmostoma horai (Silas)

Puntius conchonius (Hamilton-Buchanan)

Aspidoparia morar (Hamilton-Buchanan)

Monopterus cuchia (Hamilton-Buchanan)

Macrognathus pancalus (Hamilton-Buchanan)

Puntius sophore (Hamilton-Buchanan)

Puntius gelius (Hamilton-Buchanan)

Lepidocephalichthys guntea (Hamilton-Buchanan)

Puntius terio (Hamilton-Buchanan)

Xenentodon cancila (Hamilton-Buchanan)

Chanda nama (Hamilton-Buchanan)

Clupisoma garua (Hamilton-Buchanan)

Nandus nandus (Hamilton-Buchanan)

Chanda ranga (Hamilton-Buchanan)

Anabas testudineus (Bloch)

Channa striatus (Bloch)

Colisa fasciatus (Schneider)

Macrobrachium assamense peninsulare

Macrobrachium assamense

Schistura species (Communicated)

Species communicated

Photographs of Fish and Prawn Species Collected from Simsang River

Other Coldwater Fish Species Reported from Simsang River

Schizothorax progastus, *Schizothorax molesworthii*, *Schizothorax richardsonii*,

Species Information Recorded From Simsang River

Chaudhuria khajurial (Talwar, Yazdani and Kundu)

Species character: Body elongated eel like without scales. Head conical, compressed. Lower jaw slightly longer. Dorsal fin with 34-40 rays. Pectoral fin with 19-20 rays, caudal fin with 12 rays. Colour deep brownish with black dots on head, body and fins.

Geographical distribution: India: Garo Hills (Meghalaya) and upper Assam.

Remarks: This fish is endemic to Simsang River commonly known as electric Eel.

Sisor rhabdophorus (Hamilton-Buchanan)

Species character: Body is very elongated with caudal filament 1.5 times long than the length of the body. Eyes are small. Barbels are 6 pairs, 1 of maxillary and 5 of mandibular. There are five plates on either side of the base of the dorsal fin. The lateral line has also a series of smaller rough bony plates. First undivided dorsal fin ray weak and serrated anteriorly. Pectoral spine serrated on both edges. Caudal fin is truncated and its upper ray with a long prolongation. Colour of the body is blackish above, dirty yellowish below.

Geographical distribution: Ganga, Yamuna and Brahmaputra river system of Northern India, Bengal and Bihar, Bangladesh and Pakistan.

Remarks: It is occasionally found in Simsang River. The fish has no food value.

Chagunius chagunio (Hamilton-Buchanan)

Species character: Body elongated, abdomen rounded. Head is having flat sided. Sub orbital region cheeks and anterior upper margin of the orbit covered with many pores. 2 pairs of barbels. Dorsal fin inserted ahead of pelvic fin. Its last undivided ray is osseous, strong and serrated posteriorly. Colour is silvery with a

Mastacembelus armatus (Lacepede)

Species character: Body eel like and pointed. Eyes are small and superior. Dorsal fin inserted above middle of pectoral fin with posteriorly serrated spines. Body dark brown with lighter on the abdomen, 21-23 rounded dark spots present along base of dorsal fin.

Geographical distribution: India, Throughout Bangladesh, Myanmar, Malay, Sumatra, Nepal, Pakistan, Sri Lanka, Thailand, Vietnam, Southern China and Java.

Remarks: The colour of the fish at Simsang River was slightly different from that found in plain.

Channa orientalis (Bloch-Schneider)

Species character: Body elongated, cylindrical anteriorly. Head covered with plate like scales. Mouth opening is wide. Dorsal and anal fin long, without spines. Colour dark greenish to blackish on sides. Pectoral fin is having alternating blue and orange bands.

Geographical distribution: India, Afghanistan, Iran, Pakistan, Bangladesh, Nepal, Sri Lanka, Thailand, Malaysia and Borneo.

Remarks: Most abundant fish of Simsang River.

Schistura sikmaiensis (Hora)

Species character: Body elongated, eye small. Nostrils close to each other. Mouth semicircular, lips thick and poorly furrowed. Barbels well developed. Caudal fin deeply forked. Body with 13 black broad bands separated by narrow white ones.

Geographical distribution: Manipur, Meghalaya, Nagaland, Myanmar,

***Barilius barna* (Hamilton-Buchanan)**

Species character: Body rather deep. Mouth moderate and jaw short. Dorsal fin inserted in advance of anal fin. Lateral line with 39-42 scales. Colour silvery, greenish dorsally. Body with 7-10 blue-black transverse bars.

Geographical distribution: Ganga and Brahmaputra river system, Mahanadi, Nepal, Bangladesh and Myanmar.

Remarks: Mostly found in Simsang River.

***Barilius bendelisis* ((Hamilton-Buchanan)**

Species character: Body shallow. Mouth moderate, jaws long. Barbels two pairs (rostral and maxillary). Colour silvery with a greyish black. Body with 8-9 blue black transverse bars descending towards the lateral line. Scales with black Spots.

Geographical distribution: India, Pakistan, Nepal, Bangladesh and Sri Lanka.

Remarks: Most abundant fish of Simsang River.

***Barilius tileo* (Hamilton-Buchanan)**

Species character: Back bluish brown with silvery belly and flanks. 2-3 rows of blue blotches and spots having vertical character on the lateral sides. Dark grey pinkish edged caudal and dorsal fins. The remaining fins yellow. Attains a length of about 150 mm.

***Badis badis* (Hamilton-Buchanan)**

Species character: Body moderately elongated and compressed. Mouth small, terminal, slightly upturned. Operculum with one sharp spine. Colours dirty blackish with green and red transverse bands. Fins dark blue.

Geographical distribution: India, Pakistan, Nepal, Bangladesh and Myanmar.

Remarks: It is commonly found in Simsang River.

***Danio aequipinnatus* (McClelland)**

Species character: Body elongated and compressed. Barbels two short pairs, rostral half as long as the orbit, maxillary minute. Lateral line with 35-37 scales. Colour yellowish white. A dark blue longitudinal band extending from base of caudal fin to the head in the middle of the body on sides. Faint lines of yellowish golden colour on either side of central blue band.

Geographical distribution: Himalayas at Darjeeling, Assam, Naga and Garo Hills, Bangladesh, Myanmar, Nepal and Sri Lanka.

Remarks: Commonly found in Simsang River.

***Puntius conchonius* (Hamilton-Buchanan)**

Species character: Body deep and compressed. Dorsal fin inserted equidistant between lip of snout and base of caudal fin. Last un-branched ray osseous, moderately strong and serrated. Body silvery, a large round black spot on the middle of the side above the posterior portion of the anal fin.

Glyptothorax cavia (Hamilton-Buchanan)

Species character: It is flattened before, conical behind. Head very large and blunt. Chest with adhesive apparatus formed by longitudinal fold of skin with central pit. Pectoral spine serrated on both edges. Colour olivaceous brown dorsally, dirty yellowish ventrally. Body mooted with dark spots, narrow longitudinal bands on sides.

Geographical distribution: India, Pakistan, Nepal, Bangladesh, Iraq, Myanmar, Thailand.

Remarks: Most frequently found in Simsang River.

Garra annandalei (Hora)

Species character: Body almost sub cylindrical, slightly depressed. Mental disc well developed. Barbels two pairs. Pectoral fin shorter than head. Lateral line with 33-34 scales. Colour dorsally dark grey, belly pale.

Geographical distribution: India: Assam, North Bengal and Bihar. Eastern Nepal: Kosi drainage. Bangladesh.

Remarks: Occasionally found in the Market of the Region.

Tor tor (Hamilton-Buchanan)

Species character: Body stout and fairly deep. Head relatively small. Mouth small, lip fleshy. Barbels two pairs, maxillary barbells equal to eye diameter. Scales large. Colour of dorsal side greyish green, the flanks pinkish with greenish gold above. Dorsal fin reddish, others deep orange.

Tor putitora (Hamilton-Buchanan)

Species character: Body streamlined, oblong and moderately compressed. Head broadly pointed, its length more then depth of body. Mouth small, lips fleshy and continuous at corner of mouth. Barbell two pairs of equal length. Colour greenish dorsally, light pink laterally, silvery white ventrally. Fins are yellowish.

Geographical distribution: Manipur, Nagaland and along the Himalayan foot hills, Pakistan, Afghanistan, Nepal and Bangladesh.

Remarks: Found occasionally in Simsang River, Meghalaya.

Botia dario (Hamilton-Buchanan)

Species character: Its head long and pointed. Eyes placed almost in the posterior part of the head. Barbels 4 pairs. Caudal peduncle tapers posteriorly. 7-8 oblique bands descend from the back to the abdomen.

Geographical distribution: Ganga and Brahmaputra drainages and Bangladesh.

Remarks: This species is found moderately in Simsang River.

Salmostoma horai (Silas)

Species character: Body compressed. Abdomen keeled, not hardened. Scales small. Lateral line complete. Colour yellowish brown. A bluish black longitudinal band.

Geographical distribution: India, Pakistan, Bangladesh and Myanmar.

Nandus nandus (Hamilton-Buchanan)

Species character: Body moderately elongated. Cleft of mouth wide. Lower jaw longer. Opercle with a spine. Anal fin with 3 spines. Colour greenish brown with yellowish tinge. 3 dark transverse bands on body.

Geographical distribution: India. Bangladesh. Pakistan. Myanmar. Thailand.

Remarks: Rarely found in Simsang River.

Gagata gagata (Hamilton-Buchanan)

Species character: Body compressed head short and with a distinct median groove. Barbells 4 pairs. Rayed dorsal fin with a smooth spine. Pectoral spine serrated internally. Colour yellowish grey, darker dorsally. Four dark saddles extending up to lateral line.

Geographical distribution: Uttar Pradesh, West Bengal, Chindwin drainage of Manipur, Bangladesh and Myanmar.

Remarks: Rarely found in Simsang River.

Aspidoparia morar (Hamilton-Buchanan)

Species character: Body elongated and sub cylindrical. Mouth inferior, jaws short. Lateral line with 38-42 scales. Body colour silvery and belly yellowish-silvery. Fins dark yellow.

Geographical distribution: North India. Bangladesh. Iran. Nepal. Pakistan.

Glossogobius giuris (Hamilton-Buchanan)

Species character: Body rounded anteriorly and compressed posteriorly. Cheek and operculum naked. Mouth small, oblique. Pelvic fin oblong, united midventrally. Scales ctenoid on body. Colour yellowish brown. Five faint dark blotch on flank.

Geographical distribution: India, Bangladesh, Nepal, Pakistan, Myanmar, Sri Lanka, Thailand, East coast of Africa, Japan, Australia and South pacific.

Remarks: Most frequently found in Simsang River.

Glossogobius gutum (Hamilton-Buchanan)

Species character: Body elongated, head depressed. Eyes large in the middle of the head. Lips thick. Gill opening extend in advance of orbit below. Colour greyish and without any dark blotch.

Geographical distribution: India, Bangladesh, Nepal, Pakistan, Myanmar, Sri Lanka and Thailand.

Remarks: Rarely found in Simsang River.

Chanda nama (Hamilton-Buchanan)

Species character: Body ovate, highly compressed and transparent. Lower jaw strongly projected. Lower limb of pre-opercle with double serrated edge. Lateral line complete. Body with scattered minute black dots. Fins bright orange.

Geographical distribution: India, Bangladesh, Nepal, Pakistan and Myanmar.

Chanda ranga (Hamilton-Buchanan)

Species character: Mouth large, gap oblique, extending to anterior border of the orbit. Pre-orbital serrated on both ridge and edge. Colour olive with a dark mark on the shoulder. Body with 4-5 dark vertical bands.

Geographical distribution: India, Bangladesh, Pakistan, Myanmar and Malaysia.

Remarks: Most frequently found in Simsang River.

Salmostoma bacaila (Hamilton-Buchanan)

Species character: Body strongly compressed. Dorsal fin inserted well in advance of anal fin. Scales very small, lateral line slightly curved. Colour silvery, greyish green above.

Geographical distribution: Ganga, Brahmaputra and Mahanadi river systems, Bangladesh, Nepal and Pakistan.

Remarks: Occasionally found in the tributaries of Simsang river.

Colisa fasciata (Hamilton-Buchanan)

Species character: Body short, mouth upturned. Jaws with fixed conical teeth. Dorsal fin with spines and soft rays. Colour greenish brown with orange and bluish bars descending downwards.

Colisa lalia (Hamilton-Buchanan)

Species character: Mouth small and highly protractile. Pelvic fin in the form of single elongated filliform rays. Lateral line interrupted. Bright green and orange band on body. Fins with red margin.

Distribution: India, Bangladesh, Nepal, Pakistan, Myanmar and Thailand.

Remarks: Most frequently found in Simsang River.

Monopterus cuchia (Hamilton-Buchanan)

Species character: Body eel like. Head conspicuous, mouth terminal. Eyes reduced covered with skin. Gill membrane triangular. Colour dark red to yellowish. Many black spots over the body.

Geographical distribution: India, Northern parts of Bangladesh, Nepal, Pakistan and Myanmar.

Remarks: Frequently found in Simsang River.

Clupisoma garua (Hamilton-Buchanan)

Species character: Body elongated, abdomen edge partly keeled. Barbells 4 pairs. Rayed dorsal fin with a spine. Pectoral fin with a spine serrated internally. Body silvery in colour. Fins are greyish.

Geographical distribution: North India, Bangladesh, Nepal and Pakistan

Puntius terio (Hamilton-Buchanan)

Species character: Body fairly deep. Mouth moderate. No barbells. Last unbranched dorsal ray osseous and smooth. Lateral line incomplete. Colour silvery. A large round golden edged black blotch over anal fin.

Geographical distribution: Ganga and Brahmaputra basins, Bangladesh and Pakistan.

Remarks: Frequently found in Simsang River.

Puntius gelius (Hamilton-Buchanan)

Species character: Body elongated. Last dorsal unbranched ray osseous, strong and serrated. Lateral line ceases after 5-6 scales. Colour silvery white. A broad red golden longitudinal band which become coppery posteriorly.

Geographical distribution: Bihar, West Bengal, Assam and Orissa, Bangladesh and Pakistan.

Remarks: Found in Simsang River only in the monsoon season.

Tetradon cutcutia (Hamilton-Buchanan)

Species character: Body short, head oval, snout blunt. Dorsal fin short. Pelvic fin absent. Body with dermal spine. Colour dirty yellowish, olivaceous green dorsally. A dark ocellus on sides in front of dorsal and anal fin.

Anabas testudineus (Bloch)

Species character: Body oblong, compressed. Dorsal fin with 16-18 spines. Caudal fin rounded. Lateral line in two rows, the upper and lower. Colour greenish to dark grey, yellowish ventrally. A distinct dark spot at the base of caudal fin.

Geographical distribution: India, Pakistan, Bangladesh, Sri Lanka, Myanmar, Malay Archipelago and Singapore.

Remarks: Frequently found in Simsang River.

Channa striatus (Bloch)

Species character: Body cylindrical anteriorly. Head depressed and large. Mouth opening wide. Pre-dorsal scales 18-20. Colour black green and yellowish white ventrally. Dark and light bands on dorso-ventrally.

Geographical distribution: India, Pakistan, Bangladesh, Sri Lanka, Myanmar, Malay, China and Thailand.

Remarks: Occasionally found in Simsang River.

Macrognathus pancalus (Hamilton-Buchanan)

Species character: Body eel like. Snout long, fleshy. Dorsal fin spines depressible. Anal fin with 3 spines. Colour greenish olive on dorsal side, ventrally yellowish with dark brown vertical stripes.

Chela cachius (Hamilton-Buchanan)

Species character: Body greatly compressed. Outer ray of pelvic fin strongly produced and filamentous. Colour translucent, bright silvery, black light olive. A shiny green longitudinal band on dorsal fin.

Geographical distribution: India, Pakistan, Bangladesh, Myanmar and Nepal.

Remarks: Rarely found in Simsang River.

Xenentodon cancila (Hamilton-Buchanan)

Species character: Body sub cylindrical, compressed. Head and snout sharply pointed. A deep longitudinal groove along the upper surface of the head. Caudal fin truncated. Colour is greenish grey above, whitish along the abdomen. A dark band extending from caudal fin base to middle of the body.

Geographical Distribution: India, Bangladesh, Nepal, Pakistan, Myanmar, Sri Lanka and Thailand.

Remarks: Found in Monsoon Season only.

Lepidocephalus guntea (Hamilton-Buchanan)

Species character: Body is low, slightly compressed anteriorly and strong posteriorly. Barbells 3 pairs, mental lobe well developed. Caudal fin convex with rounded corners. A series of 10-12 dark grey spots on the side fused to form a continuous band extending almost to the base of the caudal fin.

Ailia coilia (Hamilton-Buchanan)

Species character: Body compressed. Head short. Eyes small. Barbells 4 pairs. Adipose fin short. Pectoral spine slender. Caudal fin forked. Colour silvery. Fins greyish at their margins.

Geographical distribution: India: Bangladesh. Nepal. Pakistan.

Remarks: Found occasionally in Simsang River.

Puntius sophore

Species character: Body relatively deep, dorsal side more convex than ventral. Head short, mouth terminal. Last dorsal unbranched, ray osseous and smooth. Colour silvery, white towards inside. A deep round blotch at base of caudal fin and on central part of dorsal fin.

Geographical distribution: India, Bangladesh, Nepal, Pakistan, Burma and Yunnan (China)

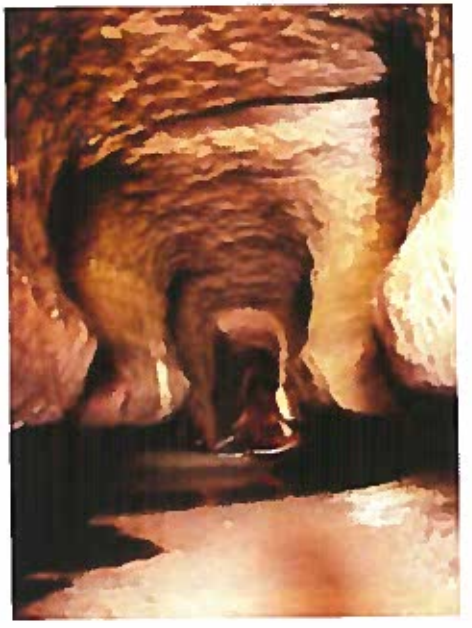
Remarks: Found frequently in Simsang River.

Simsang Aquatic Sanctuary

Keeping in mind the importance of the river system as well as dwindling fish diversity of the river, local people from 10 villages of the area called Rombagre (35 km from Tura and very near to the Williamnagar -Tura Road) protected certain area of the river from fishing as well as other activities by declaring it as an Aquatic Sanctuary where schools of fishes are found swimming in the clear waters, turning the place virtually into a tourist spot, as many tourists are often found enjoying with the fish in the protected water pool. Watching tower is also constructed for the tourists. Undoubtedly, it is a noble venture for conserving the fish diversity of the river. However, protection of microhabitat of the river from various factors like pollution, climate change and exotic fishes is the need of the hour to save the Ichthyofaunal diversity from extinction. The steps taken by the local people must be encouraged so that, similar type of protected areas can be established for conserving

Watching Tower At Rombagre

Fish Fauna of Siju Cave



Located at the right bank of the Simsang River in south Garo hills district, the cave is locally known as **Dobakhol** or **The Cave of Bats**. The cave consists of innumerable internal chambers and labyrinths, which have not yet been fully explored. The depth of the cave is yet to be fathomed. The cave is totally dark with a perennial stream flowing out of it and drains into river Simsang, which abounds with different forms of aquatic life including ***Nemachelius sijuensis*** reported by Menon in 1987. The species is also occasionally found in the Simsang River. Other fish species of the stream flowing out through the cave are not yet confirmed.

Nemachelius sijuensis (Menon)

Species character: Body fairly stout. Body depth is 5 to 6.6 times in standard length. Eyes are small and not visible from underside of head. Nostrils close to each other, anterior nostril tubular. Mouth is semicircular. Lips fleshy and poorly furrowed. Dorsal fin inserted slightly near to the base of caudal fin than to snout tip. Caudal fin forked. Scale small and imbricate, more prominent in posterior part of the body.

Colour: Body marked with 8 to 10 short light grey bands across back. The bands break up into secondary bands below lateral line, upper surface of head marked with a few spots.

Remarks: The species attains a length of 5.1 cm in standard length and hardly used as food. The species is considered as threatened species.

Future R & D

It has been felt that following are critical need for mitigation of climate change threat, restoration of habitat and to define the factors and process that maintain and manage the cold-water fisheries resources of the Simsang River.

- Detailed morphometry of the river to find out distribution of fish species using historical baseline.
- Seasonal distribution, abundance and microhabitat of endemic and exotic hill stream fish species along with the limnology and productivity of the river in correlation with the fish catch in a particular pocket of water body.
- To prepare action plan for eradication of ***Clarius gariepinus*** and other exotic species from the River.
- To build up institutional and legal frameworks that considers and responds to climate change threats and uncertainties along with other pressures such as overfishing, illegal fishing, pollution and changing hydrological conditions. This requires effective public, private and NGO partnerships, integrating research and management across the sectors and ensuring that regulations limiting access to resources are appropriate to respond to both the threats and benefits of future climate variability.
- To prepare action plan for prioritization of certain area of the river as ***aquatic sanctuary*** as well as to adopt strategy for mitigation of climate change and other threats.

Suggested Reading

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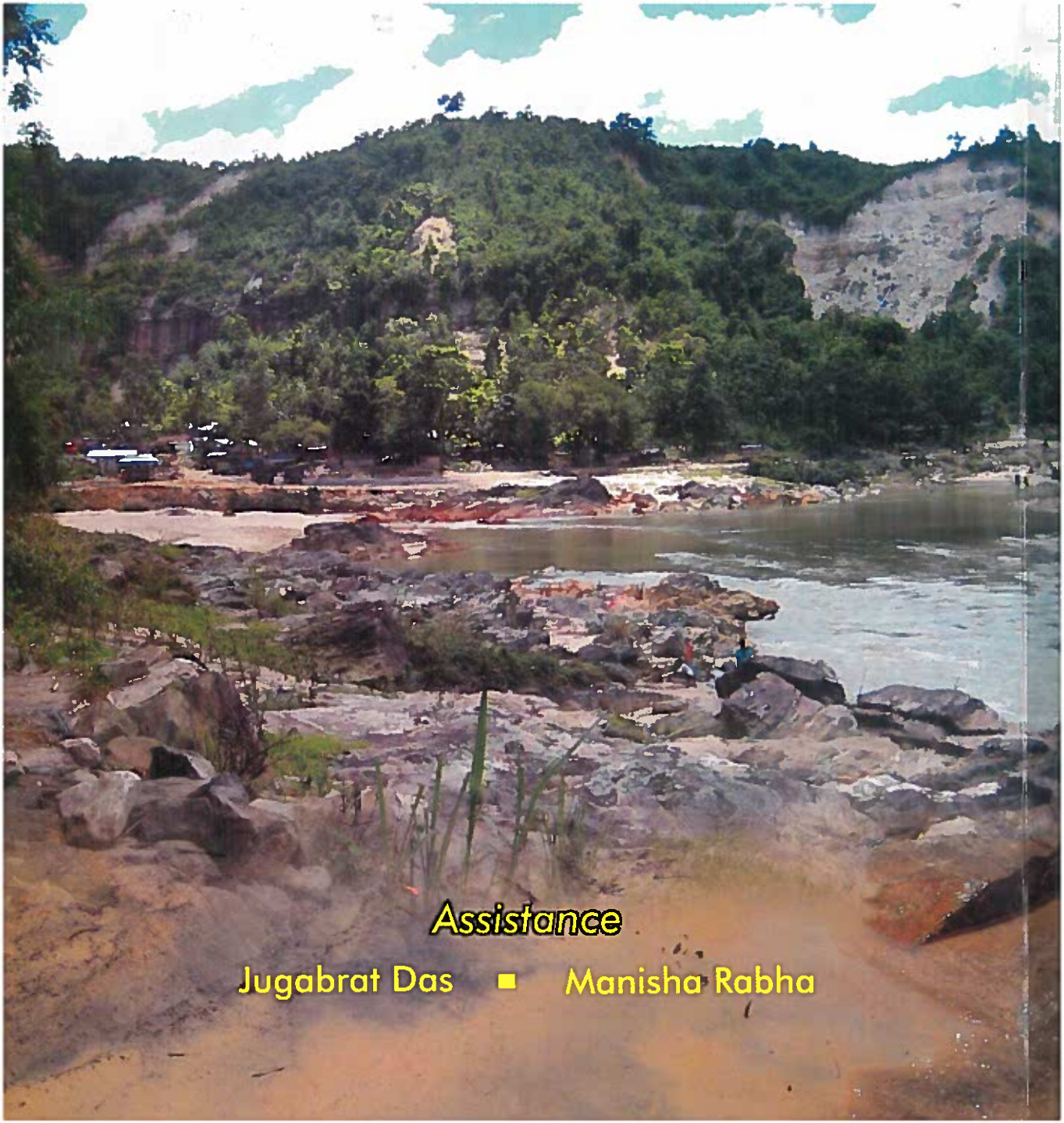
Assistance
Jugabrat Das ■ Manisha Rabha