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Icthyofaunal Diversity and conservation strategies of River Siang, India

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Abstract

The unique topography of North-East India and its watershed pattern is an attractive field for fish fauna studies. This region has all been recognized as a global spot of freshwater fish diversity. Many species have been reported from most of the North-Eastern region states. River Siang is one of the major rivers of Arunachal Pradesh. The present study on Icthyofaunal diversity of River Siang in Arunachal Pradesh was carried out from June 2012 to July 2013. Fishes are very important from a biodiversity point of view. The present Studies on River Siang reveal the presence of 82 (Eighty-Two) species of fish belonging to 8 (Eight) orders, 24 (Twenty Four) families, and 53 (Fifty-Three) genera. Cypriniformesdominate the whole river and are found in higher numbers and Beloniformes and Tetradontiformes are found in fewer numbers.

Species richness in a region is governed by a number of factors that operate at different spatial and temporal scales*viz.*, speciation, dispersal, competition, disturbance, predation *etc*.Biotic as well as abiotic factors act together in regulating the local species richness.Stream fishes have been used extensively to examine the relative influences of local and regional factors on local species diversity.Regional diversity is said to be more influenced by biogeography processes.

Key words : Fish Diversity, Freshwater, River Siang, Species Richness, Arunachal Pradesh.

Fishes are variable living components of water bodies. These organisms are important food resources and good indicators of the ecological health of the waters they inhabit. However, the rich biodiversity of the freshwater fish of the Indian region has been rapidly dwindling because of the increasing degradation of inland water. Out of a total of 2500 species of fish in India, 930 are in freshwaters and belong to 326 genera, 99 families, and 20 orders[19]. India is one of the 12 mega biodiversity hot spots contributing 60-70% of the world's biological resources. India has about 11.72% of the total global fish biodiversity. A great number of fish species have been reported from the North-Easter region.

Various important studies have been conducted on fish diversity. Ghosh and Lipton[9] reported 172 species with reference to their economic importance from Assam. Talwar and Jhingran[19] represented 267 fish species belonging to 114 genera under 38 families 10 orders from the northeastern region. Sinha[18] compiled a list of 230 species from the northeastern region. Nath and Dey[15] recorded 131 species of fish from the drainages in Arunachal Pradesh. Sen[17] reported 806 ichnospecies inhabiting the freshwaters of India. Kar *et al.*[13] studied the fish diversity and conservation aspects in an aquatic ecosystem in northeastern India, this work is being done on the biggest freshwater tectonic lake Sone (area 3458.12 ha. at LSL) in Assam, India. Kar and Sen[14] worked on the systematic list and distribution of fish biodiversity in Mizoram, Tripura, and Barak Drainages in North-East India. Das *et al.*[3] studied Habitat Mapping, Spatial analysis of Fish diversity of River Subansiri during the winter season in Assam and Arunachal Pradesh (India); they reported 48 species of fish belonging to 15 families under 7 different orders. Acharjee *et al.*,[1] studied the Icthyofaunal diversity of Dhansiri River, Dimapur, Nagaland, India they found there 34 fish species belonging to 5 orders and 13 families, and 24 genera. Das *et al.*[4] studied the Ichthyofauna of the Subansiri River in Assam and Arunachal Pradesh, India, they reporteda total 87 number of different fishes were collected under 55 genera; they are classified into 9 orders and 22 families.

Study site :

The River Siang is the largest river of the Brahmaputra river system, originates from ChemaYungdung Glacier near Kubi at 5150 m in Tibet. In Tibet, it is popularly known as Tsang-Po, and flows in West–East direction. After traversing a distance of about 1625 km river in Tibet and then it takes a turn in a south direction, enters the territory of India near

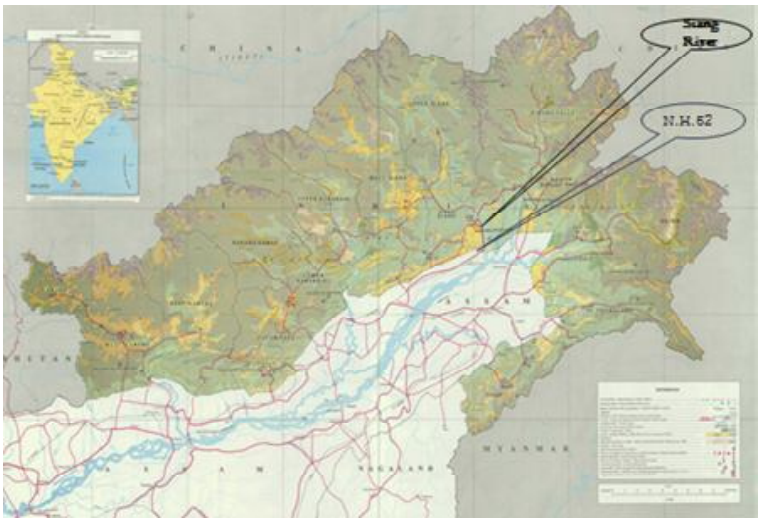

Figure 1. Showing the Location of the Siang River in Arunachal Pradesh

Tuting in the Upper Siang district of Arunachal Pradesh, and flows through North–South direction inthe East Siang district towards Assam and finally, it merges with Lohit and Dibang in Assam and it becomes the mighty River Brahmaputra.

A general survey of the fish biodiversity was done using standard procedures[2]. Fish samples were collected from Siang River from June 2012 to December 2013 through experimental fishing; using cast nets (dia.3.7 m and 1.0 m), gill nets (vertical height 1.0 m-1.5 m; length 100 m -150 m), drag nets (vertical height 2.0 m), triangular scoop nets (vertical height 1.0 m) and a variety of traps and also by hooks and lines. Local people were involved in the netting and also in the fish collection. Fish sample sites were chosen in the survey area based on micro-habitat types, substrate types, water quality, soil quality, and the depth of the river. Fish species have been preserved at first in concentrated (100%) formaldehyde in the field. After that, the fish are transferred into a 10% formaldehyde glass container for preservations purpose.In the laboratory, the fish species have been identified after standard literature by following Talwar and Jhingran[19], Jayaram[11], Kar[12], and Vishwanath[20].

The results of the present study pertaining to the aspects of fish diversity are given in the below-mentioned Table-1. The fish nomenclature is based on Fishbase.org. The present Studies on the Siang River reveal the presence of 82 (Eighty Two) species of fishes belonging to 8 (Eight) orders, 24 (Twenty Four) families, and 53 (Fifty Three) genera.

Cypriniformes dominates the whole river and are found in higher numbers and Beloniformes and Tetradontiformes are found in fewer numbers. Most of the fishes (65) that are recorded in Siang River are of Least Concern under the Conservation Status according to IUCN[10]; while only 9 (Nine) species are recorded as Near Threatened and only one is recorded as Not Evaluated fish species. Most of the species are recorded as harmless while only two species of fish are recorded as venomous.

The regular flow of water was diminished to a very minimum level which causes the lowering of the groundwater level resulting in loss of vegetation due to scarcity of soil water. The drying up of the river will initiate human activities on the river. The existing fish community comprising terrestrial as well as aquatic and other organisms will face the problems of loss of habitat, feeding sites, and breeding grounds as a result of the change of vegetation pattern due to the change of the normal water regime of the river.

Species richness in a region is governed by a number of factors that operate at different spatial and temporal scales. Biotic as well as abiotic factors act together in regulating the local species richness.Stream fishes have been used extensively to examine the relative influences of local and regional factors on local species diversity. Regional diversity is said to be more influenced by biogeography processes, thus more recent works seem to emphasize to the importance of scale in determining species diversity. It is a common fact that a hill stream with fast-flowing water over a rocky or a bed with boulders may not have large-sized carps.

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with fast-flowing water over a rocky or a bed with boulders may not have large-sized carps. On the other hand, a slow meandering stream may not have any hill-stream fish at all, if it does not have a microhabitat in Table-1. Further, dim-lit, shallow, swampy pools may have catfishes, murrels, eels, and not many quality carps as rohu and mrigal, etc.[11].

Table-1. List of Fishes of Siang River

Sl. No	Fish common name	Scientific name of fish	Order	Family	Conser-vation Status (IUCN)
1	Reibo	*Aborichthys elongatus* Hora, 1921	Cypriniformes	Nemacheilidae	LC
2	Rebio	*Aborichthys kempi* Chaudhuri, 1913	Cypriniformes	Nemacheilidae	NT
3	Rebio	*Acanthocobitis botia* (Hamilton-Buchanan, 1822)	Cypriniformes	Nemacheilidae	LC
4	Batasi	*Ailia coila* (Hamilton-Buchanan, 1822)	Siluriformes	Schilbeidae	NT
5	Tayek	*Amblyceps mangois* (Hamilton-Buchanan, 1822)	Siluriformes	Amblycipitidae	LC
6	Morula	*Amblypharyngodon mola* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
7	Koi	*Anabas testudineus*(Bloch, 1792)	Perciformes	Anabantidae	DD
8	Boriwala	*Aspidoparia jaya* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
9	Rebio tapio	*Badis assamensis* Ahl, 1937	Perciformes	Badidae	DD
10	KhenNgoi	*Badis badis* (Hamilton-Buchanan, 1822)	Perciformes	Badidae	LC
11	Mein Lomen	*Bagarius bagarius* (Hamilton-Buchanan, 1822)	Siluriformes	Sisoridae	NT
12	Nepura	*Banganadero* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
13	Rebio tapio	*Barilius barna* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
14	Rebio tapio	*Barilius bendelisis* (Hamilton-Buchanan, 1807)	Cypriniformes	Cyprinidae	LC
15	Pan Ngoi	*Botia dario* (Hamilton-Buchanan, 1822)	Cypriniformes	Cobitidae	LC
16	Pan Ngoi	*Botia rostrata* Gunther, 1868	Cypriniformes	Cobitidae	VU
17	Boriwala	*Cabdio morar* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC

18	KeintahPuthi	*Chagunius chagunio* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
19	Chanda	*Chanda nama* (Hamilton-Buchanan, 1822)	Perciformes	Ambassidae	LC
20	Cheng	*Channa gachua* (Hamilton-Buchanan, 1822)	Perciformes	Channidae	LC
21	Gajar	*Channa marulius* (Hamilton-Buchanan, 1822)	Perciformes	Channidae	LC
22	Cheng	*Channa orientalis* Bloch and Schneider, 1801	Perciformes	Channidae	NE
23	Goroi	*Channa punctata* (Bloch, 1793)	Perciformes	Channidae	LC
24	Chengeli	*Channa stewartii* (Playfair, 1867)	Perciformes	Channidae	LC
25	Shoal	*Channa striata* (Bloch, 1793)	Perciformes	Channidae	LC
26	Mirika	*Cirrhinus mrigala* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
27	Lachim	*Cirrhinus reba* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
28	Magur	*Clarias magur* (Hamilton-Buchanan, 1822)	Siluriformes	Clariidae	EN
29	Ngoyou	*Crossocheilus latius* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
30	Sundori	*Cyprinion semiplotum* (McClelland, 1839)	Cypriniformes	Cyprinidae	VU
31	Tapo	*Danio dangila* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
32	Darikona	*Danio rerio* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
33	Tapo	*Devario aequipinnatus* (McClelland, 1839)	Cypriniformes	Cyprinidae	LC
34	Darikona	*Esomus danricus* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
35	Ngop	*Garra annandalei* Hora, 1921	Cypriniformes	Cyprinidae	LC
36	Ngoyou Totum	*Garra gotylagotyla* (Gray, 1830)	Cypriniformes	Cyprinidae	LC
37	Kemp	*Garra kempi* Hora, 1921	Cypriniformes	Cyprinidae	LC
38	Nunguga	*Garra lissorhynchus* (McClelland, 1842)	Cypriniformes	Cyprinidae	LC
39	Dohjei	*Garra mcclellandi* (Jerdon, 1849)	Cypriniformes	Cyprinidae	LC
40	Patimutura	*Glossogobius giuris* (Hamilton-Buchanan, 1822)	Perciformes	Gobiidae	LC

41	Ngop	*Glyptothorax annandalei* Hora, 1923	Siluriformes	Sisoridae	LC
42	Ngop	*Glyptothorax cavia* (Hamilton-Buchanan, 1822)	Siluriformes	Sisoridae	LC
43	Chapila	*Gudusia chapra* (Hamilton, 1822)	Clupeiformes	Clupeidae	LC
44	Singhi	*Heteropneustes fossilis* (Bloch, 1794)	Siluriformes	Heteropneustidae	LC
45	Bata	*Labeo bata* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
46	Kalbasu	*Labeo calbasu* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
47	Kuri	*Labeo gonius* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
48	Ghoria	*Labeo pangusia* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	NT
49	Rohu	*Labeo rohita* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
50	RemumPoda	*Lepidocephalichthys guntea* (Hamilton-Buchanan, 1822)	Cypriniformes	Cobitidae	LC
51	Tora	*Macrognathus aral* (Bloch and Schneider, 1801)	Synbranc-hiformes	Mastacembelidae	LC
52	Tora	*Macrognathus pancalus* Ham.-Buchanan, 1822	Synbranc-hiformes	Mastacembelidae	LC
53	Bami	*Mastacembelus armatus* (Lacepede, 1800)	Synbranc-hiformes	Mastacembelidae	LC
54	Elang	*Megarasbora elanga* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
55	Cuchia	*Monopterus cuchia* (Hamilton-Buchanan, 1822)	Synbranc-hiformes	Synbranchidae	LC
56	Tengra	*Mystus bleekeri* (Day, 1877)	Siluriformes	Bagridae	LC
57	Tengra	*Mystus cavasius* (Hamilton-Buchanan, 1822)	Siluriformes	Bagridae	LC
58	Tengra	*Mystus vittatus* (Bloch, 1794)	Siluriformes	Bagridae	LC
59	Gadgedi	*Nandus nandus* (Hamilton-Buchanan, 1822)	Perciformes	Nandidae	LC
60	Ngoge	*Neolissochilus hexagonolepis* (McClelland, 1839)	Cypriniformes	Cyprinidae	NT
61	Kanduli	*Notopterus notopterus* (Pallas, 1769)	Osteoglossi-formes	Notopteridae	LC
62	Pabo	*Ompok bimaculatus* (Bloch, 1794)	Siluriformes	Siluridae	NT
63	Pabo	*Ompok pabda* (Hamilton-	Siluriformes	Siluridae	NT

		Buchanan, 1822)			
64	Chanda	*Parambassis baculis* (Hamilton-Buchanan, 1822)	Perciformes	Ambassidae	LC
65	Chanda	*Parambassis ranga* (Hamilton-Buchanan, 1822)	Perciformes	Ambassidae	LC
66	Ngopnogi	*Psilorhynchus balitora* (Hamilton-Buchanan, 1822)	Cypriniformes	Psilorhynchidae	LC
67	Puthi	*Pethia ticto* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
68	Puthi	*Puntius chola* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
69	Puthi	*Puntius sophore* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
70	Ngotabolm	*Raiamas bola* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
71	Darikona	*Rasbora rasbora* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
72	Ritha	*Rita rita* (Hamilton-Buchanan, 1822)	Siluriformes	Bagridae	LC
73	Chela	*Salmophasia bacaila* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
74	Adoi	*Schizothorax progastus* (McClelland, 1839)	Cypriniformes	Cyprinidae	LC
75	Kadong	*Schizothorax richardsonii* (Gray, 1832)	Cypriniformes	Cyprinidae	VU
76	Seni Puthi	*Systomus sarana* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	LC
77	Cutcutia	*Tetraodon cutcutia* (Hamilton-Buchanan, 1822)	Tetraodon-tiformes	Tetraodontidae	LC
78	Ngauch	*Tor putitora* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	EN
79	Ngorika	*Tor tor* (Hamilton-Buchanan, 1822)	Cypriniformes	Cyprinidae	NT
80	Kholisa	*Trichogaster labiosa* Day, 1877	Perciformes	Osphronemidae	LC
81	Borali	*Wallago attu* (Bloch and Schneider, 1801)	Siluriformes	Siluridae	NT
82	Chowki	*Xenentodon cancila* (Hamilton-Buchanan, 1822)	Beloniformes	Belonidae	LC

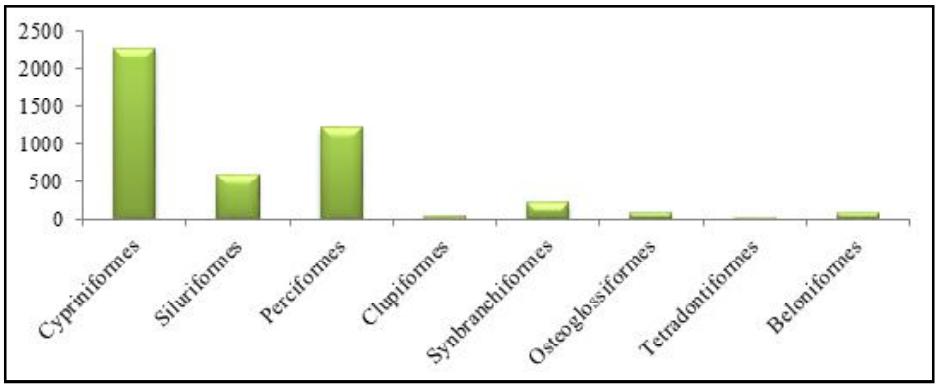

Figure 2. Total Fish Collected in Order wise of Siang River

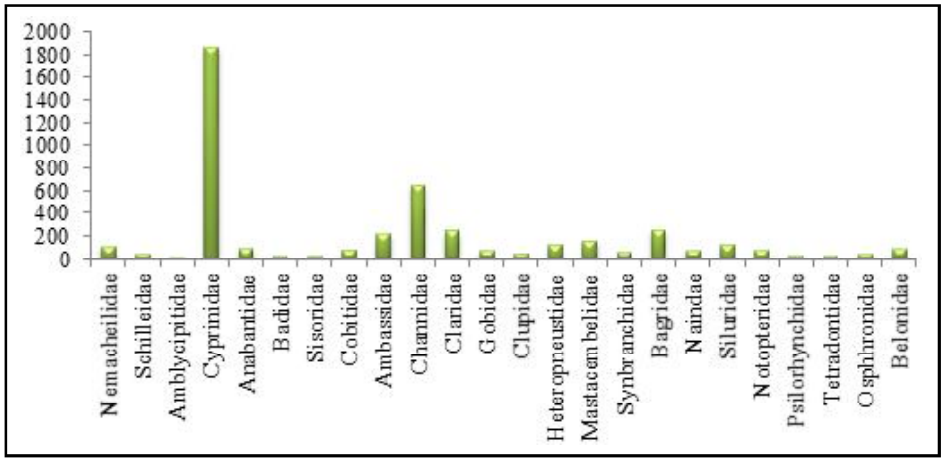

Figure 3. Total Fish Collected in Family wise of Siang River

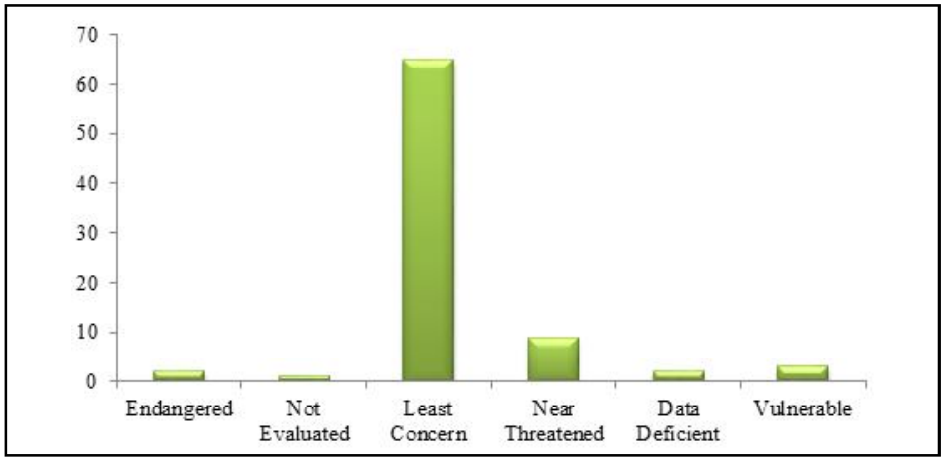

Figure 4. Conservation Status of Fishes of Siang River

Conservation strategies :

Challenges in fish community ecology :

The spatial dynamics of populations and communities arean important aspect, which is generally ignored within thecontext of aquatic systems, in particular, by resource managers.Althoughterrestrial and theoretical ecologists have done extensive work related to the spatial dynamics of singlespecies or communities, there is limited work examining such aspects in rivers and streams. Human activities are modifyinghabitats in stream systems and groups of lakes tovarying degrees. Changes in the connectivity due to dammingor alterations to flow patterns, coupled with habitat modification, may threaten the long-term viability of existing fish populations and communities.

Habitat destruction :

The form of sustained unscientific and profit-making approaches in human activity leads to the modification of the natural environment, which successively affect the relative abundance of species.If this continues, this could lead to the extinction of species and loss of biodiversity. The forest from which mankind had derived all his basic requirements is now being cleared to make way for human settlement and or fuel in the form of firewood. The forests are also the sites of origin of many water bodies, particularly, the River Siang. The River Siang, in turn, is the site of the progress of many human civilizations since time immemorial. As such, the conservation of the water bodies is of utmost importance for the sustenance of life on the earth including fish. However, random deforestation coupled with soil erosion has been severely disrupting the ecosystem.

Construction of dams and barrages :

Drawbacks in general planning and developmental policies, like the construction of dams, barrages, river valley projects, and roads along the river course are as follows:

A. Reduced discharge in downstream.
B. Habitat destruction due to impoundments.
C. Obstruction in the migratory pathways, particularly of the fishes.
D. Reduced the available areas of rapid gorges, the natural habitat of fishes.
E. Further, the blasting done during the construction work makes the hills weak, and loose landslides during heavy rains become an easy process.

Pollution :

Water pollution has been widely cited as a cause of habitat deterioration which has resulted from the discharge of waste from the human population, industrial activities, from unscientific mining. These often lead to the disappearance of fish from the water bodies.

Extraction of sand and stone from the river bed :

The side waters of the River Siang are generally the nursery and spawning grounds of the fishes. In some places, stone structures at the bank of the River Siang have been raised to check land erosion. Construction materials *viz*., sand, gravel, and stones are generally collected from the Siang basin. These activities, which were most prevalent in the

North Eastern Rivers, not only disturb the spawning ground but also cause scarcity of pebbly bottom and shallow pockets of side waters for the growth of planktonic fish food.Removal of gravel and pebbles from the breeding grounds and silting has also reduced the spawning success of fishes.

Indiscriminate fishing and dynamiting :

In the absence of a uniform policy for regulating fishing in the River Siang drainage system, indiscriminate fishing is restored in large stretches of the river, especially in the upstream tribal dwelling regions of River Siang in Arunachal Pradesh. Different types of fishing gear, nets, and tackles are used in the River Siang drainage system for catching fish. The application of these gears varies with the current and depth of water as also with the fishermen. In the absence of a regulated fishing policy, over-exploitation is resorted to, with the result; of even the juveniles caught, resulting in a consequential decrease in the size and quantity of fish. Dynamiting in certain stretches of River Siang, particularly in the hilly upstream regionsis another cause of alarm as this led to the total destruction of life, and the entire food chain is also disturbed. The attraction of dynamite in these upland river conditions is that, amongst other things, it can be used even in deep, fast-flowing waters which are unsuitable for other methods. Typically, a stick is broken in half with one section being tied to a medium-sized stone with strips of cloth.

Point and non-point pollution :

Discharge of untreated industrial, municipal, and agricultural effluents and domestic sewage in the drainage system of the Siang basin are the main sources of pollution. The effluents from these are said to cause fish mortality, habitat destruction, and toxicity to organisms. The pollutants are also said to cause oxygen depletion and high BOD load. Certain zooplankton totally disappears near the outfall of sewage. Agricultural wastes are believed to increase the silt load and alkali status of the soil and water. Due to the leaching effect, biotic community like plankton, which is an important link in the food chain, is depleted. Salinity also directly affects the fish population which attempts to migrate away from such areas and causes decline due to breeding failure.

Over-exploitation of water :

The discharge rate of water plays a significant role in the dilution of contaminants and also affects the temperature, transport of organic materials, etc. The communities which are adapted to fast flow steadily give way to the fishes adapted to low velocities and may, thus, disturb the physiological rhythm of the fishes. Abstractions of river water for agriculture, domestic and industrial use, etc., may also serve as threats to the fishery in certain stretches of the River Siang.

Forest denudation and erosion of banks:

Deforestation, construction activities, and agricultural development on the hill slopes have caused excessive water run-off and soil erosion, leading to the siltation of the RiverSiang. This has adversely affected the natural habitat of the hill-stream fishes. There are frequent landslides in the hills with loose soils. The silt chokes the gills of fishes and their fingerlings, particularly during monsoon

floods. Excess silting during monsoon destroys the nursery and spawning grounds of fishes; and is also said to cover- up the bottom organisms of the channel of River Siang, thereby reducing the food supply of the fishes. High fish mortality occurs during monsoon months when torrential rain washes down the silt, debris, and allochthonous materials from devastated and overgrazed hillsides.

Further, a substantial number of morphometric transformations is said to have occurred in the fish habitat, due to landslides, slumps, and other construction activities, which are said to obstruct the movement of the fish from the foothills to the upper reaches of the River Siang.

Poaching :

Even though fishing is prohibited in the stream, particularly in the shelter areas; but, there are instances of secret fishing taking place. These further add pressure to the existing population. Therefore, concerted efforts are needed to sensitize the local stakeholders about the importance of these vital resources which are considered to be endangered.

Use of electric shocks :

Where ever electricity is available, electric currents; otherwise, high voltage battery currents are also of very common use. Persons engaged in fishing introduce electric wires into the water body and later on they pass the current into the water through wires. The water of the stream becomes electrically charged. The groups of fish reaching the electrically charged areas are shocked to death. This method also causes heavy mortality of the fish in different stages of their maturity. In addition to the fishes, several other flora and fauna are said to be destroyed which serve as food and shelter for them.

Indiscriminate leasing :

Another problem is the change of habitat or the ecological condition of the riverine system is the indiscriminate leasing of River Siang for the collection of boulders, cobbles, and gravels. These have, possibly, resulted in the loss of breeding grounds and suitable habitats of theprimary hill stream fishes. Similarly, leasing of surrounding forest lands on the river banks, mainly to the agriculturists, is supposed to have also resulted in the destruction of habitats.

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