



Impact of fishing methods on conservation of ichthyofauna of river Relli in Darjeeling Himalaya of West Bengal

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Abstract: Impact of fishing methods and gears used on fish faunal diversity in spring-fed torrential river Relli in Darjeeling hill area of West Bengal was investigated in the present study. The fish species available in the river provide nutrition and recreation (rarely income generating) for a large number of people residing along the river bank and nearby villages and towns. The fishing methods observed therein have been categorized as, i) Scientific fishing methods, that is, collection of required number and size of fish so that sufficient population of fish remains balanced in the nature. ii) Unscientific fishing methods, that is, indiscriminate killing of large number of fish which adversely affect the water quality of rivers. Ten types of fishing methods are practiced in this area, for example, diversion of river channel, cast netting, scoop netting, angling, fish spearing, rock striking or hammering, dynamiting, electric fishing, river poisoning and traps utilized. Over the years uncontrolled and often indiscriminate fishing in the unmanaged hill-stream has resulted in a sharp decline in fish resources. The study gives a clear picture on the anthropogenic pressure on the river Relli and provides baseline data which may be helpful for conservation and management of the fish species and also formulating new fishery policy.

Key words: Fishing methods, Fish conservation, Hill-stream, Darjeeling Himalaya
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Introduction

Darjeeling Himalaya is the hilly and Himalayan part of the northernmost Darjeeling district of West Bengal. The hill streams of Darjeeling Himalayan river system are known for their rich ichthyofaunal diversity and richness. There are more than 125 species of fishes in the Darjeeling district (Dash, 1947). Barat *et al.* (2005) mentioned only 21 species of fishes in Darjeeling Himalaya but, according to Rao (2006) there are more than 60 species of fishes. The ichthyodiversity of this region is unique from the zoogeographical point of view. The fish fauna represents mostly the Chinese, Malayan and Indian elements of fishes of the Oriental realm (Sen and Biswas, 2006). But, this region with rich biodiversity is under immediate threat of species extinction and habitat destruction due to tremendous pressure from demotechnic growth and natural environmental changes. All the rivers are more or less impacted because of high population growth, construction of highways, roads, bridges, dams, destruction of riparian vegetation and watershed forest cover, denudation causing high siltation, boulder and sand lifting, landslides, disposal of untreated sewages, indiscriminate use of pesticides and fertilizer in agricultural practices, altered land use pattern, rampant fishing and so on. Several workers like, Jhingran and Sehgal (1978), Uniyal *et al.* (2002) and Srivastava *et al.* (2002), have mentioned that illegal fishing methods used in the Himalayan rivers cause a decline in the fish population. In Darjeeling Himalaya, Mukherjee *et al.* (2002) and Sen and Biswas (2006), have pointed out that unfair practices used to catch fishes in this region cause wanton destruction of fish diversity.

There is no detailed study of the fishing method and implements used in Darjeeling Himalayan river system. This investigation was therefore undertaken in the Relli river, a spring-fed torrential left hand tributary of mighty river Teesta, to provide information on the anthropogenic pressure on the river, and useful baseline data for ichthyofaunal conservation, management and fishery policy formulation.

Materials and Methods

Study area: The river Relli has its origin in the Algarah-Lava ridge of Kalimpong subdivision (Lat. 26°51' to 27° 12' N and Long. 88° 28' to 88°53' E). in the Khampang reserve forest at an altitude of about 1800 m. The total length of the river Relli is about 32 km and joined to the river Teesta at an altitude of about 212 m. The point of joining is situated at 7 km. down from Teesta bazar. The average width of the river varies from 90-150 m. The longitudinal slope of the river is 11 m km⁻¹. The slope of the river bank varies from 20 to 90°. During the monsoon the river is quite swift but in dry season it dries down into a small stream. The catchment area of the river is hilly spreading to 165 km² and well managed. The soil of catchments is acidic (pH 5 to 6) and carbon content ranges from 0.5 to 1.5%. The soil ranges from sandy loam to clayey loam in texture.

Information on fishing methods and gears were collected through intensive field survey and interaction with local fishermen of this region during the period of 2006-2008. Diversion of river channel, netting, angling, spearing, rock striking and hammering, dynamiting, electro-fishing, river poisoning, *Kur thunnu* traps are some of the methods used in this area (Table 1).

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Table - 1: Summary on information of fishing methods in river Relli of Darjeeling Himalaya

Fishing method	Description of method	Major species encountered by method	Impact of ichthyofaunal conservation
Division of river channel (<i>Dealipara</i> or <i>Duwalo thumre</i>)	Here stretches of river or side channel is made dry deflecting the flow of water to the side channel from the main channel or from other side channel by constructing a rough dam, using stones, logs, sand, clay and so on. At the distal end of diverted channel a bamboo-made fish trap (<i>Dhadiya</i>) is set to catch the fish escaping from the channel. Sometimes, lime, herbal or chemical poisons are used to paralyze fishes	Small sized bottom-dwelling fishes like, Budhuna (<i>Garra</i> spp.), Gadela (<i>Nemacheilus</i> spp.), Fageta (<i>Barilius</i> spp.), <i>Aborichthyes elongatus</i> and juvenile of Katli (<i>Neolissocheilus hexagonolepis</i>), Tor spp. and so on	This method causes wanton destruction of fish fauna of all ages and other aquatic organisms
Cast netting	Cast net is a stringed, bell-shaped, cotton or nylon net. It is thrown in the river to catch fishes. One of the most commonly used cast net in this region is <i>Bhurel/jal</i> which is small in size having a mesh ranging from 0.5 to 1.5 cm and covers an area of about 4.5 m ² when thrown in the water	Fageta (<i>Barilius</i> spp.), Gadela (<i>Nemacheilus</i> spp.), Katli (<i>Neolissocheilus hexagonolepis</i>), Asala (<i>Schizothorax</i> spp.), Budhuna (<i>Garra</i> spp.), <i>Danio</i> spp., <i>Cyprinion semiptotum</i> , <i>Euchiloglanis hodgarti</i>	Cast netting is generally not a destructive method but netting during breeding season with small mesh sized net causes loss of brood fishes
Scoop netting	Scoop net consists of a rectangular, triangular, round or ellipsoid wooden, metallic or bamboo frame which is supported by a short handle of wood or bamboo. The frame carries an oval mosquito net. Scoop net is generally used in muddy water or in diverted channel of river or during river poisoning, dynamiting, electro-fishing or even angling	Fageta (<i>Barilius</i> spp.), Budhuna (<i>Garra</i> spp.), Gadela (<i>Nemacheilus</i> spp.), <i>Schizothorax richardsonii</i> , <i>Danio</i> spp., <i>Cyprinion semiptotum</i> , Katli (<i>Neolissocheilus hexagonolepis</i>)	Scoop netting is not itself a destructive method of fishing but, when it is used with other destructive methods, namely, dynamiting, electro-fishing and river diversion it causes wanton killing
Angling	Angling is a popular sport fishing method to harvest cold water fishes with fishing rod. The rod is long, slender and has a slightly curved tip. Fine nylon or cotton thread (line) is tied to the curved tip or rod or sometimes a wheel and a hook is attached at the distal end of the line. Just above the hook there is a sinker made up of lead or stone. Bait usually consists of earthworms, small fishes, insect larvae, grasshopper, fleas and so on	<i>Schizothorax richardsonii</i> , <i>Schizothoracichthyes progastus</i> , Katli (<i>Neolissocheilus hexagonolepis</i>), Tor spp.	The method is not considered destructive
Spearing	A spear fixed at the tip of a bamboo or wooden handle is operated mostly by children at the crevices of stones and rocks when water level becomes low	<i>Aborichthyes elongatus</i> , Gadela (<i>Nemacheilus</i> spp.), Budhuna (<i>Garra</i> spp.), Kabre (<i>Pseudecheneis sulcatus</i>)	The method is not considered destructive
Rock-striking or Hammering	Large and flat rocks are selected in the shallow waters on which a weighty iron hammer is struck with full force. The intensive vibration and sound thus produced impairs the acoustico-lateralis system of the fish and results in both large and small fishes to float on the water surface. These paralyzed fishes are thus caught with bare hands or scoop nets	Juvenile fishes of mainly Gadela (<i>Nemacheilus</i> spp.), Budhuna (<i>Garra</i> spp.), Asala (<i>Schizothorax</i> spp.), Fageta (<i>Barilius</i> spp.), Tor spp. and Katli (<i>Neolissocheilus hexagonolepis</i>)	Destructive method causing indiscriminate killing of fishes of all ages hiding under the rocks
Electro-fishing	Fishes are caught by passing an electric current via electrodes (anode and cathode) from generator or 12V battery to the river water. Stunned fishes become disoriented and are easily captured by hand or scoop net	Fageta (<i>Barilius</i> spp.), Budhuna (<i>Garra</i> spp.), Gadela (<i>Nemacheilus</i> spp.), juvenile Katli (<i>Neolissocheilus hexagonolepis</i>) and juvenile Asala (<i>Schizothorax</i> spp.)	Mass killing of fishes of all ages

River poisoning	A stretch of river is poisoned by using toxic plant extracts like Khirro (<i>Sapium</i> spp.), fruits of Maidal plant (<i>Erythrina arborescens</i>), bark of Kafal (<i>Myrica esculanta</i>), stem of Arare creepers (<i>Acacia</i> sp.), stem of Siudi (<i>Euphorbia</i> spp.), Powdered seed of <i>Xanthoxylon</i> sp., Derris root powder - rotenone being the active ingredient, and leaf extract of Tipati (<i>Artemesia</i> sp.)	Nearly all types of fishes and other aquatic organisms	Causes wanton destruction of aquatic life and pollutes the water
Kurthunnu	A big rock is selected at the side of river channel where water flows slowly. The rock is closed on all sides by making a rough dam with stones, sand, clay and plant materials leaving a small outlet in which <i>Dhadiya</i> is placed. The fishes are now caught by hammering the rock or using ichthyotoxic plant extracts	All major types of fishes are caught	A destructive method causing wanton destruction of fish fauna hiding under the rocks
Tip (a trap)	This is a large sized trap made up of bamboo splits, the mouth of which is broad and flat. The distal narrow end is covered with fine mosquito netting a bag-like appearance in which fishes are harvested. The length of the trap is about 3 to 3.5 m with an opening of diameter 2 to 2.5 m. The conical trap is placed in a suitable place in the river channel and all the water is forced to flow through the trap by constructing a rough dam, using stones, logs and sand. Fishes are mostly trapped at night	Fishes like Fageta (<i>Barilius</i> spp.), Budhuna (<i>Garra</i> spp.), Gadeia (<i>Nemacheilus</i> spp.), Kati (<i>Neolissocheilus hexagonolepis</i>), Asala (<i>Schizothorax</i> spp.), Kabre (<i>Pseudecheneis sulcatus</i>), Chepti (<i>Semiplotus semiplotus</i>) and others	A destructive method causing wanton destruction of fish fauna
Thokre (a trap)	A relatively small sized trap fabricated from splits of a single piece of bamboo having a node and internodes and splits are tied together giving a cone-shaped appearance. Several traps are placed side by side following the same principal as in the case of Tip. Several such rows of <i>Thokre</i> are placed in the river channel at about 50-100 m intervals	Fishes like Fageta (<i>Barilius</i> spp.), Budhuna (<i>Garra</i> spp.), Gadeia (<i>Nemacheilus</i> spp.), Kati (<i>Neolissocheilus hexagonolepis</i>), Asala (<i>Schizothorax</i> spp.), Kabre (<i>Pseudecheneis sulcatus</i>), Chepti (<i>Semiplotus semiplotus</i>) and others	The method causes wanton destruction of fishes
Thali (a trap)	A big metallic bowl or rice plate is covered with a thin cloth and tied. A small hole is made at the centre of the cloth. Some rice or flour is kept in the bowl or plate and the trap is placed in the river water. Fishes enter into the trap to eat rice or flour. After sometime the trap is taken out of water and trapped small fishes are collected	Fageta (<i>Barilius</i> spp.), Gadeia (<i>Nemacheilus</i> spp.) and juvenile forms of other fishes namely, Kati (<i>Neolissocheilus hexagonolepis</i>), Asala (<i>Schizothorax</i> spp.) and so on	A destructive method causing wanton destruction of fishes

Results and Discussion

The above observations based on critical study of different fishing methods used in the river Relli and their impacts revealed, that the observed fishing methods can be classified into two categories, namely, (a) Scientific fishing method, that is, collection of required number and size of fish so that sufficient population of fish remain balanced in the nature, examples being, cast netting and angling (Table 1) (b) Unscientific fishing method, involves indiscriminate killing of large number of fish (juvenile, as well as, brood fish) which adversely affects the water quality of rivers, for example, (1) Dynamiting, (2) Electro-fishing, (3) Hammering, (4) River poisoning and (5) Diversion of river channel (Table 1).

The different fishing methods used in river Relli in different seasons show the patterns of fish migration. Upward spawning migration of some cold water brood fish like, Katli (*Neolissocheilus hexagonolepis*), commences from the last week of February and continues through the months of March, April and May. The spawning and breeding season lasts from June to September (Barat *et al.*, 2005). The monsoon begins to recede from September and most of the fishes begin their downward migration to return to their winter habitat in the deep pools of either river Relli or Teesta. This downward migration of juveniles and adults continues through the month of September to first week of November. During the winter months namely, November, December and January most of the fishes lie in the deep pools (Sen and Biswas, 2006).

Cast net is used almost throughout the year but the catch is maximum (10-12 fishes/effort) during rainy season, when the river bed is flooded and fishes show horizontal migration to breeding sites. Fishing with small nets in torrential hill-stream is a laborious process with very poor catches. During upward and downward migration and also during monsoon, angling is mostly done by the people as a sport fishery (Sen and Biswas, 2006). Traps, like Tip and Thokre, are used during downward migration of fishes (September to November) thus, most of the juvenile and adult fishes are killed. Hammering, dynamiting, river channel diverting, river poisoning, and electro-fishing are used mainly during winter months in the pools of the river causing indiscriminate killing of fishes. Electro-fishing and dynamiting are adopted mainly by picnickers (Sen and Biswas, 2006).

The use of dynamites and poisoning of water by toxic plants have been considered else-where, too, to be very destructive methods of catching fish. Bombs consisting of a detonator, match-head and safety fuse inserted in an explosive (usually Amatol) tied up in a polythene bag with rock are made into a package and then used for fish bombing in Hong Kong (O'Brien, 1997).

Use of five local fish plants have been listed as fish poisons in China and Taiwan (Ho, 1981). The fish poison is derived from rotenone, an active ingredient, of the Derris root that affects the ability of the fish to take up oxygen, causing them to become narcotized and easy to collect (UNEP, 1994).

Over the years uncontrolled and often indiscriminate fishing in the largely unmanaged Relli river has resulted in a sharp decline in catches of the important sport and subsistence fish.

It may be concluded, that gene pool of unique ichthyofauna in Darjeeling Himalaya is a valuable endowment of nature. The aquatic resources and fish germplasm are our national wealth which has co-evolved during the course of evolution. Any species getting extinct would upset the ecological balance resulting in dangerous imbalance of the system. Thus, the use of destructive methods of fishing calls for formation of task force, strict vigilance, stopping illegal fishing and effective enforcement of legislative measures such as, closed season, mesh size regulation and awareness of the local people residing along the river bank. The involvement of voluntary organizations, local clubs, self-help groups, is urgently needed in an effort to maintain fish stocks at a healthy level. Cornish and McKellar (1998) opined, educating the local communities on the destructive effects of the practices and making them more vigilant and responsible for controlling them would be more effective. The stocks should be enhanced through regular release of hatchery produced fingerling.

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