eJBio

Electronic Journal of Biology, 2007, Vol. 3(1): 13-17

Exotic Fish Biodiversity in Churni River of West Bengal, India

Jatindra Nath Bhakta*, Probir Kumar Bandyopadhyay

Parasitology Laboratory, Department of Zoology, University of Kalyani, Kalyani-741 235, West Bengal, India

*Corresponding author: Tel: +91 033-25820432; Fax: +91 033-2582 8282; E-mail: lsnjbhakta@rediffmail.com

Abstract

Study included survey and sampling carried out in ten sites of the Churni River to ascertain the qualitative and quantitative abundance of exotic fish species inhabiting the river. Extensive survey showed that eight exotic fish species under 3 orders, 4 families and 6 genera were listed from the Churni River. Results also demonstrated that 5–8% exotic fish of total catch was present in the Churni River where, both *Oreochromis mossambicus* (2.5–3.2%) and *Cyprinus carpio* (2–3%) have established highest populations and African catfish (*Clarias gariepinus)* showed lowest population among all exotic fish species. Therefore, it may be concluded that the reverine ecosystem consisting various natural foods in different niches of the river is an important exotic fish diversified zone. Moreover the exotic fishes, as an efficient consumer of these foods, reduce the river pollution and stabilize the riverine ecosystem and acts as an instrument for yield optimization in the river.

Keywords: Exotic fish; biodiversity; Survey; Churni River.

1. Introduction

West Bengal is called as a land of rivers because, large numbers of river forms a network just like blood vessels which present like harbour a rich and diversified fish fauna characterized by many rare and endemic fish species. Day, Pillai, Hora and Law, Easa and Shaji and Kurup and Ranjeet carried out various studies on the density of Indian freshwater fish fauna [1-5]. For centuries, all of the river systems of the country have provided a means of livelihood to thousands of fishers. The Ganga river system and its tributaries along with the numerous man-made canals are recognized as an important domain of freshwater fish biodiversity in West Bengal. The Ganga is also the original habitat of the prized Indian carps and a major source of various indigenous and exotic fish species, which meets 30% of the carp seed requirements of the aquaculture sector. More than 300 exotic species have been introduced into the country so far [6]. While a vast majority of them are ornamental fishes which remain, more or less, confined to the aquaria, some others have been introduced in aquaculture and open water systems with varying degrees of success. *Oreochromis mossambicus, Hypophthalmichthys molitrix, Ctenopharyngodon idella, Cyprinus carpio communis, C. carpio specularis* and *C. carpio nudus* have gained entry into the reverine ecosystem through accidental or deliberate introduction. Three larvicidal fishes *viz., Lebistes reticulatus, Nothobranchus* sp. and *Gambusia affinis* were introduced for containing the insect larvae in confined waters. In West Bengal, exotic species such as *Cyprinus carpio* have already established breeding populations and contribute more than 70 percent of the exploited stock. A recent series of reviews [7-13] has underscored the alarming condition of the region's rivers, which has been apparent for over a decade [14]. The major rivers of the Oriental Region, including the Indus, Ganges, and Yangtze (Chang Jiang), have experienced centuries of sustained human impact and are among the most degraded, densely settled, and human-modified river basins on Earth. Their waters are grossly polluted, and dams and impoundments influence their natural discharge to such an extent that the lower Ganges and the Indus virtually cease to flow during the dry season [15].

A database on fish biodiversity is essential as a decision making tool for conservation and management of fish germplasm, declaration of part of the rivers as aquatic sanctuaries, protection and preservation of endangered species and mitigation of anthropogenic activities so as to fulfil India's obligations under conventions on biological diversity with special reference to Articles 6 and 8 of UNEP [16]. In the present paper an attempt is made to prepare a consolidated list of exotic fishes and to assess their biodiversity status of Churni River. It is one of the many tributaries of the river Ganges and is a small and docile river of complete fresh water environment. It flows about 43km through the district of Nadia in West Bengal, India, which carrying water of about 1290km^2 drainage area to river Ganga. A sufficient amount of fish is harvested from this river by a number of fishermen through out the year (850–1265kg·fishermen^{-1}·yr^{-1}) which decreasing surprisingly year after year. This communication also deals with various management plans relevant to the conservation of fish biodiversity of Churni River for increasing the yields through better utilization of trophic niches.

ISSN 1860-3122

2. Materials and Methods

2.1. Location, origin and confluence of the Churni River

The Mathabhanga is one of the west Gangetic River. It originates in Bangladesh territory by leaving the main channel of the Ganges about 16km below the point where the Jalangi diverges. This river bifurcates into two after re-entering Krishnaganj of Nadia district, West Bengal and the eastern branch is known as the Ichamati river and the western branch called the Churni River flows (43km) west and ultimately falls into the Hugli river at Chakdaha in the district of Nadia (Latitude 23ºN and Longitude 88.5ºE), West Bengal, India (Figure 1a,b).

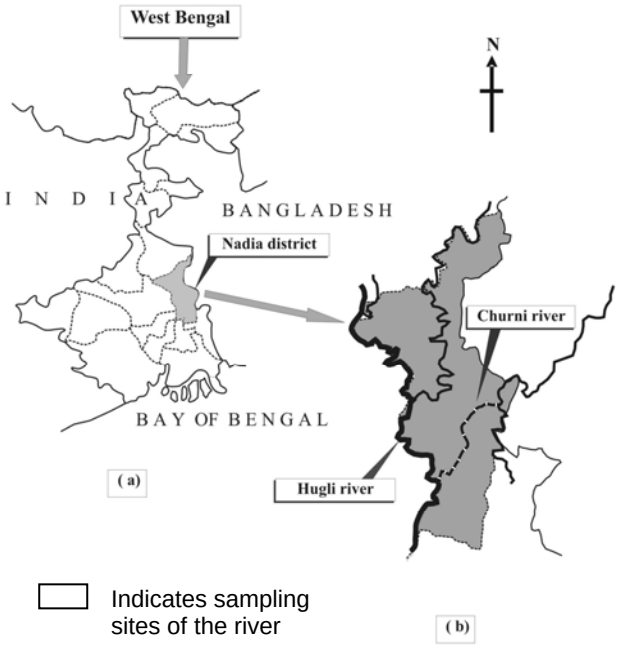

Figure 1. (a) The location of Nadia district in the state of West Bengal, India. (b) Showing the location of Churni River in the Nadia district of West Bengal and sampling sites.

2.2. Collection and identification of fish

Exotic fish species inhabiting the river were collected from ten sites of the river (Name of sites from origin are Krishnaganj, Majdia, Bhairabchandrapur, Hanskhali, Aranghata, Manjoan, Kalinarayanpur, Ranaghat I, Ranaghat II and Chakdah) during surveys and sampling carried out through out the year to assess the qualitative and quantitative abundance. The specimens were collected using various types of fishing methods such as cast nets (16mm, 18mm, 22mm in mesh), gill nets (32mm, 38mm, 64mm, 78mm, 110mm in mesh), drag nets (4mm, 15x3m in mesh), scoop nets and other local contrivances. Collections were made from all selected locations during 8:00-18:00 h. In addition, the catches of the exotic fishes were also collected from the fishermen of the river. Collected fish samples were preserved in 8 % formalin for detailed examination and identification following the methods described by Talwar and Jhingran [17] and Jayaram [18,19].

2.3. Population density of fish

Density of fish populations at each study site was estimated following the formula of abundance index:

$$AI = \frac{n(k)}{N} \times 100$$

Where, AI = Abundance index, n(k) = number of individuals of the species k caught at each study site and N = Number of individuals of all fish species caught at that site.

2.4. Food and feeding habits

Water and sediment samples were collected from ten selected sites of the river and examined to quantify the abundance of food available for fish in the river. Visual observations were carried out if the water was clear with a view and gut contents were also analyzed to assess the feeding habit of the fish.

2.5. Water quality

The water pH and dissolved oxygen levels at each survey location were measured using specific electrode and probe of a Multiline System (F/SET-3, Best-Nr. 400327, WTW Wissenschaftlich-technische Werkstatten 82362 Weilheim, Germany), respectively. Ammonium-N, orthophosphate and hardness were examined following the standard methods described by APHA [20].

3. Results

3.1. Biodiversity of exotic fish species & systematic position

Extensive survey showed that 48 fish species under 29 genera, 18 families and 8 orders were recorded and identified from freshwater body of Churni River whereas, exotic fish comprises 8 species under 3 orders, 4 families and 6 genera and remaining were native species of fishes. The common and scientific names, as well as systematic position of the exotic species are shown in Table 1.

3.2. Population dynamics & seasonal variation

The total caught 48 species of fish population ranged from 165 to 186kg·site^{-1} during the period of investigation. Native fish species ranged from 150 to 171kg·site^{-1} whereas, exotic fish species (i.e. alien fish species) varied from 10 to 17kg·site^{-1} among the total catch of fish which, exhibiting 108±5 mean number in each site of collection.

Percentage contribution of exotic fish (5–8% of total catch) showed clear cut difference among the total catch fish species by weight and number

(ANOVA, P<0.05) in different site. *Oreochromis mossambicus* (2.5–3.2%) and *Cyprinus carpio* (2–3%) have established highest populations, whereas African catfish (*Clarias gariepinus)* showed lowest population among remaining (0.6–2%) exotic fish species through out the year.

Seasonal variation in the abundance of exotic fish (ranged from 100–122 in numbers) was also apparent and exhibiting highest population (8% of total catch) in the rainy months (June to August) than that of the other study period of the year showing the value of 5 to 6.5%.

Table 1. List of exotic fish species reported from the Churni river of West Bengal, India

Sl.No.	Scientific name	Common name	Systematic position	Feeding habit
1	*Oreochromis mossambicus*	Tilapia	Ord. - Perciformes Fam. - Cichlidae	Omnivorous- opportunistic feeder, feeding predominantly on detritus and plankton but also on macrophytes.
2	*Oreochromis niloticus*	Nilotica	Ord. - Perciformes Fam. - Cichlidae	Omnivorous grazer- phytoplankton, periphyton, aquatic plants, small invertebrates, benthic fauna and detritus.
3	*Cyprinus carpio*	Common carp	Ord. - Cypriniformes Fam. - Cyprinidae	Omnivorous- Algae, Macro-vegetation, insects, rotifers, crustaceans.
4	*Hypopthalmicthys molitrix*	Silver carp	Ord. - Cypriniformes Fam. - Cyprinidae	Plankton feeder- Zooplankton, Phytoplankton, unicellular algae, rotifers, decaying macro-vegetation and detritus.
5	*Hypopthalmicthys nobilis*	Bighead carp	Ord. - Cypriniformes Fam. - Cyprinidae	Plankton feeder- Zooplankton, Phytoplankton, unicellular algae, rotifers, decaying macro-vegetation and detritus.
6	*Ctenopharyngodon idellus*	Grass carp	Ord. - Cypriniformes Fam. - Cyprinidae	Herbivorous- Aquatic vegetation and voracious feed on aquatic weeds
7	*Clarias gariepinus*	Thai magur	Ord. - Siluriformes Fam. - Pangasiidae	Omnivorous- Insects, worms, copepods ostracods, debris and algae
8	*Pangasius sutchi*	African pangus	Ord. - Siluriformes Fam. – Clariidae	Carnivorous- Insect, fish fry and fingerlings, frogs and tadepoles.

3.3. Abundance of food & feeding habit

The best estimates of the quality and quantity of food available to fishes in the river are populated with littoral, planktonic and benthic communities consisting of plants and animals. The water of the river is rich in both phytoplankton and zooplankton.

The phytoplanktonic communities are usually represented by major groups of algae, like green algae, blue-green algae, desmids, diatoms. The major known genera of phytoplankton are *Eudorino, Pleodorina, Volvox, Pediastrum, Oocystis, Scenedesmus, Coelastrum, Ulothrix, Gloeotila, Oedogonium, Cladophora, Stigeoclorium, Mougeotia, Zygenma, Spirogyra, Microcystis, Aphanothece, Syechococcus, Merismopedia, Dactylococcopsis, Spirulina, Oscillatoria, Lynabya, Schizothrix, Symploca, Microcoleus, Wollea, Nostoc, Aradaera, Raphidiopsis, Scytorema, Nitella, Anabaena, Oscillatoria, Chlorella, Eudoria* and *Gloeotrichia.* The zooplanktonic communities are represented by invertebrate organisms like- protozoans, rotifers, cladocerans, copepods, and ostracods. Moreover, some immature stages of fishes, various animal larvae and worms are also found as occasional plankter. The major genera of zooplanktonic organisms are *Diaptomus, Heliodiaptomus, Neodiaptomus, Cyclops, Mesocyclops, Macrocyclops, Microcyclops, Cypris, Stenocypris, Cyclestheria, Pleuretra, Rotaria, Embata, Anuraeossia, Brachionus, Platyias, Keratella, Euchlanis, Dipleuchlanis, Triplechilanis, Macrochaetus, Mytilina, Epiphane, Diplois*, and *Monostyla*, *Chironomids.* The benthic food communities available to fish are small water insects, various worms, nematodes etc. Few aquatic vegetation are also available to some fishes as a food like- Lemna, Pistia, Trapa, Chlorelle, Valisneria, Azolla, Anabaena, Eichonea, ,Najas, Hydrilla and Wolfia.

Though some fishes remain plankton feeders throughout their life and most of the carps are

mainly plankton feeders, but maximum exotic fishes have diversified feeding habits (i.e. plankton feeder, herbivore, carnivore and omnivore) which has been shown in Table 1.

3.4. Water quality

pH, dissolved oxygen and hardness of water ranged from 7.1 to 8.9, 7.6 to 13.5mg·l^{-1} and 76 to 180mg·l^{-1} during the period of experimentation, respectively. The ammonium-N and orthophosphate of water varied from 0.081 to 0.326mg·l^{-1} and 0.037 to 0.111mg·l^{-1}, respectively in different periods and different sites of the river. Nutrient concentrations showed gradually increasing trend from the site of origin towards the sites of confluence of the river.

4. Discussion

Extensive study of the present survey demonstrated that 5 - 8% exotic fish was present in the Churni river where, both *Oreochromis mossambicus* and *Cyprinus carpio* contributed 2.5–3.2% and 2–3%, respectively than that of the remaining fish species. This data implied that exotic species, *Oreochromis mossambicus* and *Cyprinus carpio* have already established breeding populations and contribute a large percent of the exploited stock in the river. The present important database of the study can be compared against past and future data to determine the degree of depletion of fish of river over time. Although, the introduction of exotic fish to the natural waters of river has resulted in competition for food and space showing a percentage of diet overlap exists between native fish species and exotic species like Tilapia *(Oreochromis mossambicus)* and Common carp *(Cyprinus carpio)* were ultimately resulting in the decline of indigenous species but the varieties of exotic fish with broadening species spectrum increasing the yields in aquaculture through better utilization of trophic niches. From this, it may be indicated that different planktonic, benthic and vegetative food present in the different niches of the river are efficiently consume by this exotic fish species which ultimately reduce the river pollution and stabilize the riverine ecosystem and acts as an instrument for yield optimisation in the river. Therefore, it may be concluded that the reverine ecosystem consisting various natural foods in different niches of the river is an important exotic fish diversified zone.

Seasonal dynamics of the fish population showed that remarkably high value of fish density during rainy months which implied that river carries large volume of less polluted and high oxygenated water which favouring the increment of fish growth and population whereas, in the other period of the year river carries water adverse to fish which is caused by anthropogenic activities are the main cause for alarming decline of fish populations in the rivers. Unethical over fishing, using of chemicals and poisons, dynamiting, a wide array of prohibited fishing methods and habitat destruction of natural spawning and breeding grounds of the fishes through various human activities in the river has contributed to the population decline of the freshwater fishes. The increasing rate of nutrient concentrations (pH 25%, dissolved oxygen 77%, hardness 136%, ammonium-N 302% and orthophosphate 200%) towards the sites of confluence of the river indicating the increment of various pollutants only due to carrying of agricultural runoff from the drainage area ultimately affecting the population of the freshwater fishes in the river. Ghosh proposed that river Churni drains a heavy load of dye factory effluent rich in chromium which is hazardous and carcinogenic heavy metal [21].

From this study, the following management plans have been considered for the conservation of fish biodiversity and for increasing the fish yield in the river, which should be inserted into the fishery policies of the Government. Identification and listing of threatened and endangered fish species in the river should be the important conservation strategies of the fishes in river. The information on population size and distribution on the basis of trophic niches should be essential measurement plan. Micro-geographical characteristics with food availability of the habitats of ecologically sensitive fishes should be strengthened by undertaking extensive micro geographical surveys. Information regarding migration, feeding, breeding behaviour and spawning grounds of threatened fish species should be collected through extensive surveys and analysis which is essential for both *ex situ* and *in situ* conservation of the species. The techniques of captive breeding and broodstock maintenance of fishes of potential economic importance should be developed as conservation strategies. Hatcheries for brood stock maintenance should be established exclusively for indigenous endangered fishes for their *in situ* conservation and aqua ranching as a substitute for their natural recruitment. Finally, over fishing should be important factor for the depletion of fish biodiversity in the river, therefore over exploitation of fishes should be restricted. The database of this information would be important for conservation of freshwater fishes in river. Various Government and Non Government Organizations should be involved to implement various measures for conservation of the fish biodiversity of the state.

Present work proposed that study is needed to prepare a database of various information, which should be inserted into the fishery policies of the Government through various Government and Non Government Organizations for the conservation of fish biodiversity and for increasing the fish yield in the riverine ecosystem.

Acknowledgements

I am thankful to people especially fishermen who extend their kind cooperation during survey work and collection of data of this river.

References

[1] Day F. (1889) *The Fauna of British India, Including Ceylon and Burma. Vol. 1. Fishes*, Taylor and Francis, London, pp. 1-548.

[2] Pillai R.S.N. (1929) A list of fishes taken in Travancore from 1901-1915. *Journal of Bombay Natural Historical Society*, **XXX**: 111-126.

[3] Hora S.L., Law N.C. (1941) The freshwater fishes of Travancore. *Rec. Ind. Mus*., **43**: 233-256.

[4] Easa P.S., Shaji C.P. (1995) *Freshwater fish diversity in Kerala part of the Nilgiri Biosphere Reserve. Research Report. Peechi*, Kerala Forest Research Institute, Kerala, India.

[5] Kurup B.M., Ranjeet K. (2002) Invasion of exotic fish population in Periyar lake, Kerala: Ahotspot of fish biodiversity. In: *Proc. Life History Traits of Freshwater Fish Population for its Utilization in Conservation*, Lucknow; India, NBFGRNATP, AC-15, pp.1-4.

[6] Jhingran A.G. (1989) Role of exotic fishes in capture fishery waters of India. In: *Conservation and management of inland capture fisheries resources of India* (Jhingran AG, Sugunan VV ed.), Inland Fisheries Society of India, CIFRI, Barrackpore, India, pp.275.

[7] Dudgeon D. (1999) *Tropical Asian streams: zoobenthos, ecology, and conservation*. Hong Kong University Press, Aberdeen, Hong Kong.

[8] Dudgeon D. (2000) Large-scale hydrological alterations in tropical Asia: prospects for riverine biodiversity. *Bioscience*, **50**: 793-806.

[9] Dudgeon D. (2000) The ecology of tropical Asian streams in relation to biodiversity conservation. *Annual Review of Ecology and Syst*., **31**: 239-263.

[10] Dudgeon D. (2000) Riverine wetlands and biodiversity conservation in tropical Asia. In: *Biodiversity in wetlands: assessment, function, and conservation*. (Gopal B., et al. ed.), Backhuys Publishers, The Hague, The Netherlands, pp. 35-60.

[11] Dudgeon D. (2000) Riverine biodiversity in Asia: a challenge for conservation biology. *Hydrobiologia*, **418**: 1-13.

[12] Dudgeon D. (2002) Fisheries: pollution and habitat degradation in tropical Asian rivers. In: *Encyclopaedia of global environmental change* (Douglas I.), John Wiley, Chichester, UK, **3**: 316-323.

[13] Dudgeon D. (2002) The most endangered ecosystems in the world? Conservation of riverine biodiversity in Asia. *Verhandlungen Internationale Vereinigung Limnologie*, **28**: 59-68.

[14] Dudgeon D. (1992) Endangered ecosystems: a review of the conservation status of tropical Asian rivers. *Hydrobiologia*, **248**: 167-191.

[15] Postel S., Richter B. (2003) *Rivers for life: managing water for people and nature*. Island Press, Washington, DC, USA.

[16] UNEP (1992) *Global Biodiversity Strategy: Guidelines for Action to Save, Study, and Use Earth's Biotic Wealth Sustainably and Equitably*. World Research Institute, Washington, DC, USA.

[17] Talwar P.K., Jhingran A.G. (1991) *Inland fishes of India and adjacent countries*. Oxford & IBH Publishing Co., New Delhi, India.

[18] Jayaram K.C. (1981) *Fresh water fishes of India handbook*. Zoological Survey of India, Calcutta, India.

[19] Jayaram K.C. (1999) *The freshwater fishes of the Indian region*. Narendra Publishing House, New Delhi, India, pp. 509.

[20] APHA (1995) *Standard Methods for the Examination of Water and Wastewater* (19th ed.). American Public Health Association, Washington, DC, pp. 1038.

[21] Ghosh T.K. (2002) Effects of chromic nitrate on fish and fish food organisms with special reference to river Churni. *J Nature Conservator*, **14**(2): 171-176.