

EXOTIC FISH AND THEIR IMPACT ON THE AQUATIC ENVIRONMENT: A CASE STUDY OF A WETLAND IN LOWER ASSAM

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ABSTRACT

The present study was carried out to find out the abundance of four exotic fish namely, common carp, grass carp, silver carp and bighead carp in the Ghorajan beel of Kamrup district of Assam. The Ghorajan beel has a rich ichthyofaunal diversity and having available almost all native fish species of Assam. During last few years the beel become habitat of some exotic fish species and their number has been increasing day by day, causing disturbances to the native fish species. The rate of exotic fish increase in the beel was determined through field investigation and catch record from January to December during the years 2013-2015 from three different sites of the beel. Abundance Index was calculated for the four exotic species from each catch data.. Among the four exotic species common carp recorded highest of total catch and bighead recorded lowest of total catch.

Key words: Abundance, Investigation, Diversity

INTRODUCTION

Exotic fish introduced into new habitat, established themselves as part of the habitat and disperse often causing negative impacts on the habitat and local aquatic ecosystems by affecting the endemic fish species, changing the ways the ecosystems work and carrying diseases detrimental to flora, fauna and humans. Exotic fish species have been receiving international attention in different forms including important ones like Convention on Biological Diversity and also in the FAO code of conduct for responsible fisheries. While much of the recent attention has been mainly focused on the adverse impacts of alien fish introduction, there is a realization that not all alien species perform badly under every circumstances

In India twenty six exotic food fishes have been introduced to freshwater aquaculture. Some of the introductions are deliberate while others are inadvertent. However, all these introductions have no prior sanction of the national committee on exotics which came in existence in 1984. Introduction of Common carp, Silver carp and Grass carp was intentional which is said to have increased production under polyculture. However, escape of these fishes into the wild has been reported to affect the indigenous fish species through competition for resources. Introduced species may alter habitat affecting human activities and those characteristics of the habitat on which all indigenous species depend. (Roy *et al.*, 1997). Exotic fish introduction for aquaculture have impacted on the fish biodiversity and have provided serious warnings of the various effects. According to Kottelat and Whitten (1996), the exotic or introduced species is accidentally or intentionally released or transported by man outside its present range. The term invasive has no standard definition, yet indicates that an exotic species spreads well beyond its place of introduction and is also often taken to indicate a species that poses a threat to ecosystems, habitats or native species.

A large number of exotic fishes have also been introduced in India for aquaculture like common carp (*Cyprinus carpio*), silver carp (*Hypthalmicthys molitrix*) and grass carp (*Ctenopharyngodon idella*) as an excellent combination of composite farming with exotic and

Indian Major Carps. But due to floods and accidents such fishes are available in natural water bodies such as rivers, lakes, beels and other water bodies. The exotic varieties of fish have been found to encroach the natural water bodies and adversely affect the indigenous fish species. The introduction of undesirable aquatic exotic species is an emerging threat to our native fish diversity and a challenge to the biodiversity of the country. Owing to extensive practice of composite culture, three fast growing exotic fishes are introduced along with the three Indian major carps gradually replacing indigenous fish group in natural waters.

Unregulated entry of exotic fish germplasm into Indian waters has been one of the greatest human interferences in the fisheries and aquaculture (Sarangi, 2007). Since 19th century there has been introduction of over 350 fish species into the country for game, sport, foods ornamental and public health purposes. Though some of the fishes have been found to be useful in confined management, their unregulated culture in some cases have led to escape into the open waters and caused major disaster to local fish genetic resources. Few instances to mention are establishment of population of Chinese carps in some reservoirs and river systems, entry of *Tilapia* sp . into open inland and coastal waters, unauthorized culture of African magur *Clarius gariepinus*, etc which are causing major damage to the locally important cultivable fish species in the Dal lake in Kashmir, Kumaon lake in Uttar Pradesh, Loktak lake in Manipur, Govind sagar and Pong reservoirs are some of the examples where rapid decline in native species due to the entry of Chinese carps such as silver carp and Common carp (Jhingran, 1975). Introduction or accidental entry of exotics has been depicted as the greatest ever ecological threat to the native fishery and such man made change in the delicately balanced species structure is likely to upset the whole process of community succession.

Findings of impact of exotic fishes were documented on types of ecosystem in India. The introduction of *Tilapia* in India seems to have caused surprising impact on both freshwater and brackish water fisheries (Trewavas, 1983). In India the introduction of *Cyprinus carpio* into Dal Lake and Loktak Lake has been reported to affect the population of indigenous *Schizothorax* & *Osteobrama belangeri* respectively. The populations of native Catla and Mahseer were depleted considerably in Govind Sagar Reservoir after the introduction of Silver carp.

The Northeastern part of India is considered as one of the hot spots of freshwater fish biodiversity in the world (Kottelat and Whitten, 1996). The exotic fishes are prolific breeders and easily adaptable to the environment of Assam. The rapid growth of such exotic fish species may affect the indigenous fish population through competition for food, shelter and breeding sites. The four exotic fish species viz. *Cyprinus carpio*, *Ctenopharyngodon idella*, *Hypophthalmichthys molitrix*, *Aristichthys nobilis* are now available in all rivers, tributaries and wetlands in Assam. The fish catch reports shows that their numbers have been increasing in all rivers and wetlands. Considering this, the present study was aimed to find out the increase in abundance of these four exotic species in Gorajan beel of Kamrup district of Assam.

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MATERIALS AND METHODS:

The study was conducted at Ghorajan beel of Kamrup district of Assam to investigate the abundance of four exotic fish *Cyprinus carpio*, *Ctenopharyngodon idella*, *Hypophthalmichthys molitrix* and *Aristichthys nobilis* in the beel.

STUDY SITE:

Ghorajan beel, a floodplain lake of the river Brahmaputra is situated near North Guwahati at about a distance of 25 km from Guwahati (Fig. 3). It is located within 91°42'E longitude and 26°13'N latitude in Kamrup district of Assam. The beel is a lake-like perennial water body and its water spread area at full storage and dead storage level are 117 ha and 86 ha respectively. It is connected with the river Brahmaputra through a channel which works both as inlet and outlet. An earthen embankment with a sluice to control flow of water forms the southern boundary of Ghorajan beel. On the northern side also, there is an embankment. The National Highway 31 is the western boundary of the beel. The catchment area of the beel is the foothill of the Silla-Sundari range. Small streamlet, traversing through the adjoining land brings water during monsoon, but the main source of water for the beel is the river Brahmaputra. The beel is an oblong body in shape. Highly irregular shoreline with a number of pockets is the salient morphometric feature of the beel. Maximum water depth at full and dead storage levels are 5 m and 2 m respectively.

The abundance of four exotic fishes in the Ghorajan beel was examined by two methods. Firstly the total commercially caught fishes in Kg was recorded and percentage was calculated thereof. Secondly, calculation of Abundance Index (Density of fish populations at each study site) of four exotic fishes and also the other fish species was done from total catch. In order to collect data on fish field investigation was conducted from January to December during 2013 - 2015 in Ghorajan beel on weekly basis and data were compiled on monthly basis and finally year wise. Data collections were done from all the three sites of the beel during 6:00AM to 9.00 PM. Fish species were identified by using the taxonomic keys (Jhingran, 1975; Fisher and Bianchi, 1984). The abundance index of exotic fish was calculated by using the following formula (Singh *et al.*, 2010 a).

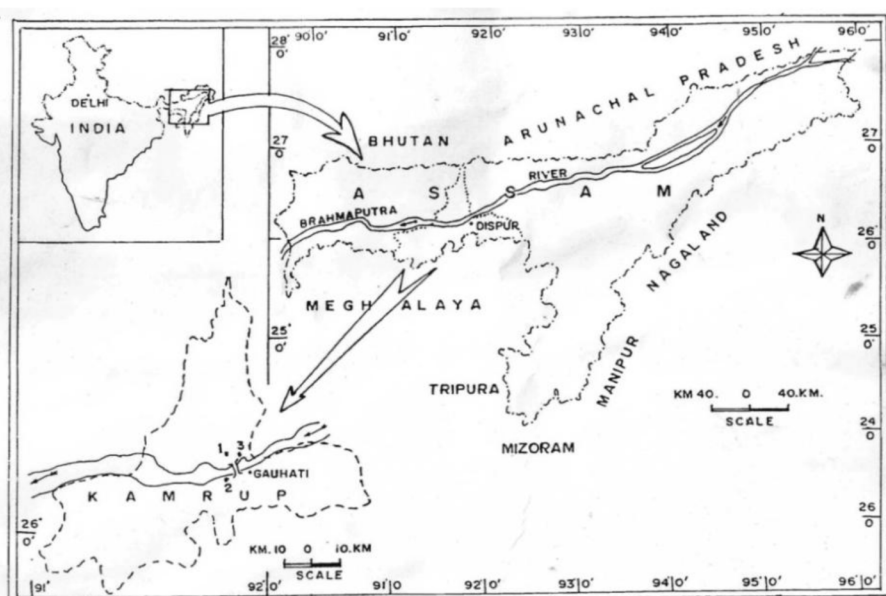


FIGURE 1. LOCATION OF GHORAJAN BEEL IN KAMRUP DISTRICT, ASSAM.

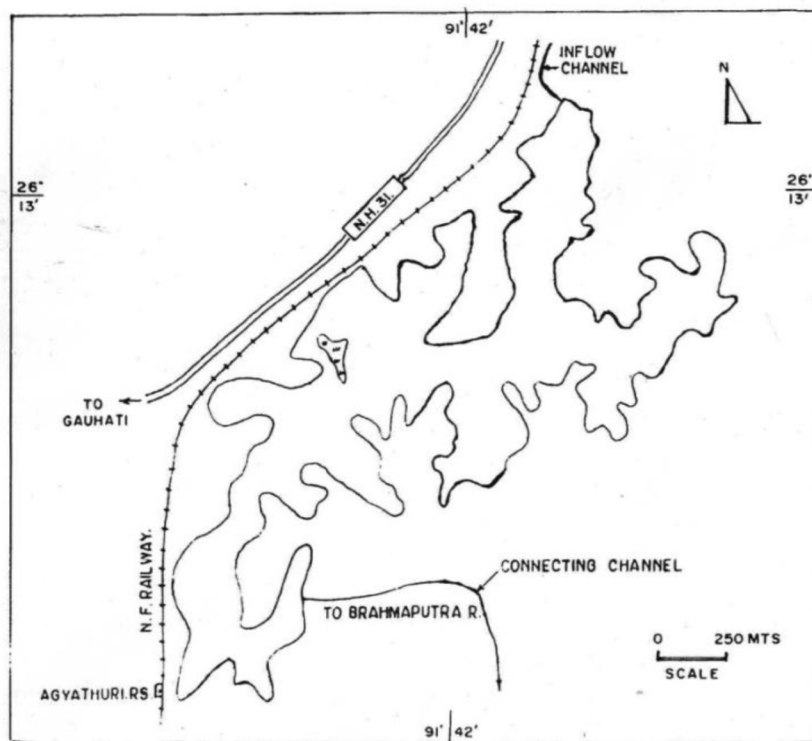
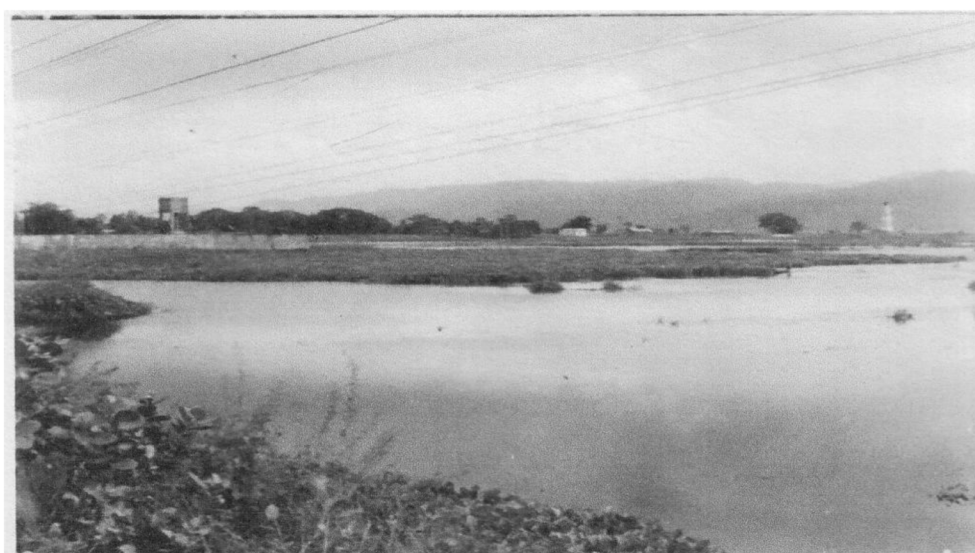


FIGURE 2. GHORAJAN BEEL

Photo : Ghorajan beel (2014)



RESULTS AND DISCUSSION

In the present investigation, it has been observed that the beel contain a rich fish diversity. Four exotic species (*Cyprinus carpio*, *Hypophthalmichthys molitrix*, *Ctenopharyngodon idella* and *Airichthys nobilis*) had been observed in the beel during the study period. Bhattacharjya (2011) reported five exotic fish species including the three carps recorded from the beels of Assam. Apparently the three exotic carps found their way to the open beel due to inclusion of the flood waters from the river Brahmaputra during the south-west monsoon season. The fish-catching intensity is higher in winter. But during monsoon season catching of two exotic fish namely grass carp and silver carp is frequent in comparison to winter season. The commercially important indigenous fish species of the beel are *Labeo rohita*, *Labeo calbasu*, *Labeo gonius*, *Catla catla*, *Cirrhinus mrigala*, *Labeo gonius*, *Notopterus chitala*, *Aorichthys aor*, *Wallago attu*, *Channa marulius*, *C. punctatus*, *Heteropneustes fossilis*, *Clarias batrachus*, *Notopterus notopterus* etc and exotic species are *Cyprinus carpio*, *Ctenopharyngodon idella*, and *Hypothalmichthys molitrix*, *Aristichthys nobilis*. The exotic species are available throughout the year and there has been a considerable increase of catch percent of exotic fish in the beel was recorded. Among the four exotic species common carp recorded 1.66 %, 2.17%, and 10.98 % of total catch during the three consecutive years and bighead recorded lowest 0.83%, 0.06 % and 2.48 % of the of total catch during the three consecutive years. The common carp have established breeding populations in the beel. The fish catch record showed that common carp and silver carp are more abundant than bighead carp.. Thus the common carp is most abundant and bighead carp is less abundant fish among the four exotic fish in the beel.

The overall total catch in Ghorajan beel depicted a declining trend during the study period with 3595 (Kg) , 3312 (Kg) and 1820 (Kg) during the three consecutive years (Table 1) may be interpreted as a result of accidental introduction of exotic species due to incursion of flood waters in the beel along with other anthropogenic factors. On the other hand, the abundance index of exotic carps depicted an increasing trend during the three consecutive years.

Table 1 : Specieswise Catch in Ghorajan beel

SL. NO	SPECIES	2013	%	2014	%	2015	%
		Total catch (Kg)		Total catch (Kg)		Total Catch (Kg)	
1.	<i>Catla catla</i>	155	4.31	140	4.23	17	0.93
2	<i>Cirrhinus mrigala</i>	25	0.70	20	0.60	48	2.64
3	<i>Labeo rohita</i>	240	6.68	210	6.34	109	5.99
4	<i>Cirrhinus reba</i>	20	0.56	21	0.63	17	0.93
5	<i>Labeo bata</i>	46	1.28	40	1.20	18	0.99
6	<i>Mystus seenghala</i>	15	0.42	12	0.36	10	0.55
7	<i>Mystus tengara</i>	98	2.73	84	2.54	22	1.20
8	<i>Wallago attu</i>	710	19.7	790	23.85	265	14.56
9	<i>Mystus aor</i>	6	0.17	4	0.12	10	0.55
10	<i>Chitala chitala</i>	45	1.25	62	1.87	32	1.76
11	<i>Notopterus notopterus</i>	225	6.26	130	3.93	63	3.46
12	<i>Live fishes</i>	810	22.53	840	25.36	238	13.08
13	<i>Prawns</i>	60	1.67	42	1.27	70	3.85
14	<i>Miscellaneous group</i>	955	26.56	700	21.14	366	20.1
15 #	<i>Cyprinus carpio</i>	60	1.66	72	2.17	200	10.98
16 #	<i>Hypothalmichthys molitrix</i>	50	1.39	60	1.81	190	10.43
17 #	<i>Ctenopharyngodon idella</i>	45	1.25	50	1.51	100	5.49
18 #	<i>Airichthys nobilis</i>	30	0.83	35	0.06	45	2.48
	TOTAL	3595		3312		1820	

Indicates Exotic fish species.

While the abundance index all other exotic carps shows an increasing trend, in the same consecutive years, the abundance index of all other fish species showed a decreasing trend (Table 3). Year wise individual abundance index of the four exotic species shows an increasing trend for all the exotic species individually with *Cyprinus carpio* recording the highest mean abundance index (4.94) followed by *Hypothalmichthys molitrix* (4.54). It may be interpreted that with the increasing AI (Abundance index) of exotic carps an impact can be felt in the wetland ecosystem, that other fish population showed a decreasing trend. Similarly, while observing the total catch, the increase of more exotics during the three consecutive years impact was depicted in the total catch while for other species showed a declining trend.

From the data cited above (Table 1) it is evident that there is a decline in fish catch of the indigenous fish species and increase in abundance of exotic carps. It may be interpreted that food competition among exotic and indigenous fish species may also be one of the factors for decline in fish catch of the indigenous fish species. This has been supported by the work of Khan (2003) and Khan *et al.* (2003).

Table 2: Year wise Individual Abundance Index of the four exotic species in Ghorajan Beel (2013 – 2015)

SL NO:	Species	2013	2014	2015	Mean
1.	<i>Cyprinus carpio</i>	1.67	2.17	10.99	4.94
2.	<i>Ctenopharyngodon idella</i>	1.25	1.5	5.49	2.74
3.	<i>Hypothalmichthys molitrix</i>	1.39	1.81	10.43	4.54
4.	<i>Airichthys nobilis</i>	0.83	1.05	2.47	1.45

Table 3: Abundance index (AI) of the four Exotic and other fish species during the year 2013 - 2015

SL NO :	AI	YEAR			MEAN
		2013	2014	2015	
	Year of Survey				
1.	AI of exotic carps	5.14	6.55	29.3	13.6
2.	AI of other fish species	94	93.4	70.6	76

Introduction of exotic Common carp (*Cyprinus carpio*) had a significant impact on diversity of the indigenous fish species of Sone beel of Assam. A serious effect of this single species introduction led to the inability to maintain genetic diversity inherent in naturally reproducing population (Kar *et al.*, 1996).

Introduction of exotic fast growing species is causing a threat to indigenous fish biodiversity of Garjan beel of Assam. (Dehadrai and Ponniah, 1997) reported that *Osteobrama belangari* in the Loktak lake of Manipur is fast disappearing due to the introduction of Common carp. Simultaneously, the population of *Chitala chitala* and *Wallago attu*, the two commercially important fish species have been declining perennially.

The introduction of a non-indigenous species may work synergistically with other factors, such as water diversions or pollution, to alter the population and distribution of indigenous species (Nyman, 1991). The breeding population of common carp can negatively impact native species both directly and indirectly by competing for food (Arthington, 1991) and habitat. Exotic fish may cause changes in the existing aquatic community through competition with native species or

predation on them, as well as through overcrowding or aggressive behavior. Despite possessing some attractive culture characteristics, exotic fish species generally becoming invasive and reduce the availability of local species in natural water bodies and consequently adversely affecting fish biodiversity and aquatic ecosystems (Lakra *et al.*, 2008). The grass carp consume a variety of aquatic plant that may cause damage or imbalance in the beel ecosystem. In Donghu Lake of China, after introduction of grass carp complete elimination of aquatic macrophytes was resulted (Kumar, 2000). The common carp has found to deteriorate the water quality of culture pond and grass carp has found to destroy paddy field during monsoon (Choudhury *et al.*, 2012). Invasion of exotic species is the second most important threat to biodiversity after habitat loss. Alien species after established in new habitat threatens native biodiversity in that habitat by causing changes in ecosystem. The native fish species has been declining in alarming rates due to invasiveness of exotic fish species. A number of exotic fishes are now available in all major rivers, reservoir and wetland of India. The Yamuna River and Ganges River system harbored several exotic fish species including common carp and Nile tilapia (Singh *et al.*, 2010b). The exotics compete with the indigenous species for food, habitat and even prey upon them, introduce new parasites and diseases, result in the production of hybrids.

CONCLUSION

India is one the mega diversity countries with respect to freshwater fish species. There are a variety of culturable fish species and introduction of exotic species is not an acute necessity. The need of the hour is to protect the indigenous species and to take steps to for enhancing the quality of culturable indigenous fish species rather than go in for indiscriminate introduction of exotic species .The indigenous fish species should be incorporated into some valuable aspects society like sport, biological control aesthetic value such as eco-tourism etc. Indian fishes such *Gambusia affinis* a representative of exotic fish species can be used for mosquito control. There are also attractive beautiful fishes. The need of the hour is to develop a baseline data on the natural population of indigenous fish species. The diversity of freshwater wetlands are at serious threat. Checking entry of exotic fish species would go a long way in preserving the aquatic diversity of wetlands without allowing exotic species to affect the ecosystem The results of the study indicate that Assam is still very rich in terms of fish species diversity. Though the wetlands are subjected to varied pressures (anthropogenic and natural) they are still rich in fish diversity. It is also noted that most of the endemic and native species are replaced with some exotic species. So, for conservation of these fish species various strategies is the need of the hour which may be halting of siltation, promoting controlled harvest, exploring checks of the growth of exotic species and control of water pollution.

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