

Fish Fauna of Kankai River of Jhapa District, Eastern Nepal

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Highlights

- The primary purpose of the study was to investigate seasonal fish diversity in the Kankai River
- Fish diversity was investigated mainly from three sampling sites of Kankai river i.e. Domukha, Kotihom and Bengdada
- A total of 20 fish species belonging to 4 orders and eight families were recorded.
- The value of Shannon's diversity Index (H') was higher in winter (3.06; Domukha) than a rainy season (1.06; Bengdada).

Abstract

This study explored fish diversity in the Kankai River of the Jhapa district. Fishes were collected by cast net (mesh 0.5cm) from three sampling sites: Domukha, Kotihom and Bengdada in rainy and winter seasons. Water temperature, pH and water velocity were recorded at each site. A total of 20 fish species belonging to 4 orders and eight families were recorded. Cypriniformes has recorded as the dominant order with 16 species, followed by Siluriformes with two species and Perciformes, and Synbranchiformes with a single species each. The value of Shannon's diversity Index (H') was higher in winter (3.06; Domukha) than a rainy season (1.06; Bengdada), indicating higher diversity in winter than rainy season. Only a slight variation in pH was recorded during the study period, i.e. 7.9 (highest) and 7.8 (lowest). The highest and the lowest temperatures recorded in the rainy season were 28°C and 27°C, and that of winter were 17°C and 15°C. The highest and the lowest water current recorded in the rainy season were 0.75 m/s and 0.68 m/s, and that of winter were 0.55 m/s and 0.52 m/s. It should be noted that to have comprehensive fish diversity status, future investigation covering more seasons and more sampling sites is essential.

Keywords: Fish, Jhapa, Kankai River, Temperature, Water velocity

Introduction

Fish diversity that assesses species richness and other diversity indices play an essential role in developing appropriate conservation strategies. Aquatic research in Nepal is the least prioritized compared to terrestrial counterparts [3, 12], and fish research is not the exception. Fish diversity study in Nepal is not complete; many rivers are yet to be explored [16]. Also, rivers which are being surveyed before need periodic updating to appreciate current status of increasing or decreasing trends in fish diversity.

South Asian country, Nepal (1, 47,516 km²) is located between Oriental (Indo-Malayan) and Palearctic biogeographical realms. The altitudinal gradients of the country vary from 50 m asl (south) to 8,848. 68 m asl (north), and its climate ranges from tropical (south) to sub-alpine (north) [11]. Nepal is rich in inland water resources (e.g. rivers, lakes, ponds, reservoirs)

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and is blessed with dense networks of rivers, and rivers are primarily grouped into three categories: the first category includes the Koshi, the Gandaki and the Karnali (the Himalayan Rivers) whose origin is in the high Himalayas; the second category comprises Babai, West Rapti, Bagmati, Kamala, Kankai and Mechi whose origin is mostly the Mahabharat range, and the third category of rivers are mainly seasonal rivers originating from Siwalik hills [15].

The Kankai River (also known as Kankai Mai) is a perennial river (second category) that originated from the Mahabharat range [15, 10]. Apart from supporting aquatic animals, including fish, this river is also famous for its pilgrimage value. Local people worship this river as Kankai Mai (Goddess), especially at Domukha, where several temples were built nearby the river. Very few studies have been conducted in this river in fish diversity aspect. A total of 34 species have been reported [16] from this river, and since then, to our knowledge, no fish diversity study has been conducted so far. Our primary purpose of this study was to investigate seasonal fish diversity in the Kankai River.

Study area

The study area was the Kankai River of Jhapa District, which flows through the Siwalik region and reaches the plain area, Terai. The total drainage area of this river is about 1,165 km² [10], and the elevation range varies from 100 m (Terai) to 3,500 m (origin point) [10]. Jogmai, Puwamai and Deumai Rivers are three major tributaries of this river [10], and it eventually merges with the Ganges River system of India.

Materials and Methods

Sampling sites

The total stretch of sampling covers about 15 km. Three sampling sites were designated based on the presence or absence of human disturbances such as human settlement or religious disorders within that range. Domukha (the site I), Kotihom (the site II) and Bengdada (the site III) (Fig. 1) were three sampling sites fixed in the Kankai River for fish collection and water quality measurements during two seasons.

The Kankai River cuts a gorge of Churia hills at the first sampling site (Domukha), which is a famous tourist's destination. Domukha attracts many internal tourists, especially for religious purposes, and may have some negative impacts on aquatic lives due to human activities. Boulder, pebble and gravel was the main riverbed at the first site. The second site is located near the Kankai bridge, whose eastern and western regions are called Maidhar and Kotihom respectively. The Kankai cemetery is situated near the Kotihom and may have negative impacts on aquatic animals, including fishes. The sand was the chief riverbed at this site. The third sampling site, near Bengdada, does not have direct human impacts, unlike the two sampling sites (Domukha and Kotihom), so it is taken as an undisturbed site, and its river bed was also sandy.

Fish sampling and identification

The field visit was conducted from August 2017 to January 2018 for six months which covered two seasons (Rainy and winter). The cast net, which is mainly preferred by local fishers, was used for fish sampling. Sampling was performed in the daytime between 10 a.m. to 1 p.m. at each sampling site; uniformity in selection was maintained. We sampled for about 100-150 m river stretch from downstream to upstream with different fish habitats such as riffles, runs and pools. The collected fishes were enumerated, and some were preserved in 10% formalin for voucher specimens. Further lab analysis was carried out at Tri-Chandra Multiple Campus, Ghantaghar, Kathmandu. Fishes were identified to species level after [10, 13, 6]. The FishBase [14] was used for species authority and English common names used in this article.

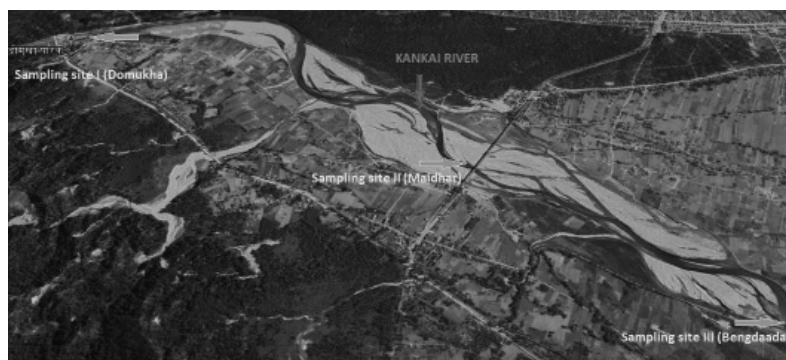


Fig1. Map showing Kankai River with sampling sites

Diversity index

Shannon - Weiner diversity Index (H') was used for estimating the diversity of fish species for each sampling sites [9]. Shannon - Weiner diversity Index (H') was calculated using the equation:

$$H' = -(\log_2 p_i)$$

H' = Shannon Weiner's index

S = Number of species

P_i = Proportion of total sample belonging to the i^{th} species.

Water quality parameters

The pH and water temperature of all sampling sites were measured by a pH meter (Model Hanna HI96107) and a thermometer. The tip of the pH meter was submerged into a beaker containing a water sample for about 30s and noted the readings. Similarly, the water temperature was recorded by immersing the tip of the thermometer into a beaker containing a water sample. At each site, the measurement was carried out for three different samples taken from three other locations, and the average value was determined. Water velocity was determined by the float method. Afloat (e.g. plastic bottle) was thrown upstream and time taken (in second) to reach that float at downstream was noted using a stopwatch. The distance between upstream and downstream points was already measured (meter). Hence, velocity was measured in m/s.

Results and Discussion

Twenty fish species were recorded from the Kankai River, which belongs to 4 orders, 8 families and 12 genera (Table 1). The Cypriniformes was the most dominant order with 16 species, 80% of total fish, followed by Siluriformes (2 species, 10%). A single species (5%) was recorded under each of Perciformes and Synbranchiformes. Cyprinidae was the most dominant family with 13 species, 65% of total fish fauna, followed by Psilorhynchidae (2 species, 10%). Each of Cobitidae, Bagridae, Sisoridae, Percidae and Synbranchidae had only one species (5%).

Table 1. Fish species recorded in the Kankai River, Jhapa (August 2017 to January 2018; NA: not applicable).

Order	Family	Species	Authority	English Common name
Cypriniformes	Cyprinidae	<i>Bangana dero</i>	(Hamilton 1822)	Kalabans
		<i>Barilius barila</i>	(Hamilton 1822)	NA
		<i>Barilius vagra</i>	(Hamilton 1822)	NA
		<i>Chagunius chagunio</i>	(Hamilton 1822)	Chaguni
		<i>Garra annandalei</i>	Hora 1921	NA
		<i>Garra mullya</i>	(Sykes 1839)	Sucker fish
		<i>Labeo boga</i>	(Hamilton 1822)	NA
		<i>Labeo caerulus</i>	Day 1877	NA
		<i>Labeo fimbriatus</i>	(Bloch 1795)	Fringed-lipped pen carp
		<i>Opsarius barna</i>	(Hamilton 1822)	NA
		<i>Pethia phutunio</i>	(Hamilton 1822)	Spotted-sail barb
		<i>Puntius sophore</i>	(Hamilton 1822)	Pool barb
		<i>Salmostoma acinaces</i>	(Valenciennes 1844)	Silver razorbelly minnow
	Cobitidae	<i>Botia dario</i>	(Hamilton 1822)	Bengal loach
	Psilorhynchidae	<i>Psilorhynchus balitora</i>	(Hamilton 1822)	Balitora minnow
<i>Psilorhynchus nudithoracicus</i>		Tilak and Hussain 1980	Rainbow minnow	

Siluriformes	Bagridae	<i>Rita rita</i>	(Hamilton 1822)	Rita
	Sisoridae	<i>Glyptothorax pectinopterus</i>	(McClelland 1842)	River cat
Perciformes	Percidae	<i>Channa punctata</i>	(Bloch 1793)	Spotted snakehead
Synbranchiformes	Synbranchidae	<i>Mastacembelus armatus</i>	(Lacepède 1800)	Zig-zag eel

The contributions made by Cypriniformes, Siluriformes, Perciformes and Synbranchiformes to overall fish diversity in this study in the Kankai River were 80%, 10%, 5% and 5%, respectively (Fig. 2).

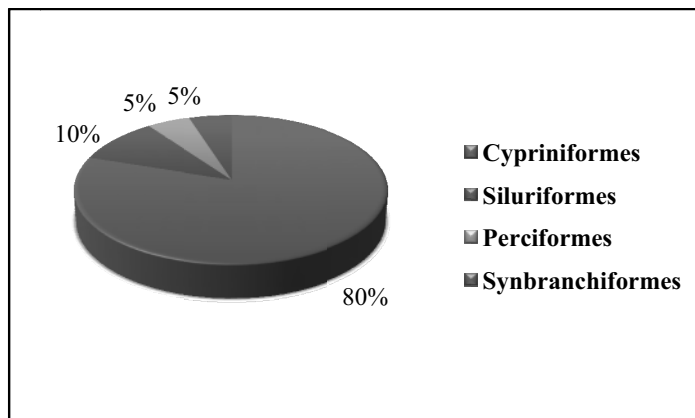


Fig. 2 Order-wise composition of fishes of Kankai River, Jhapa.

The Shannon diversity index (H') was highest at Domukha in both seasons (rainy and winter), while it was lowest at Bengdada (Fig. 3).

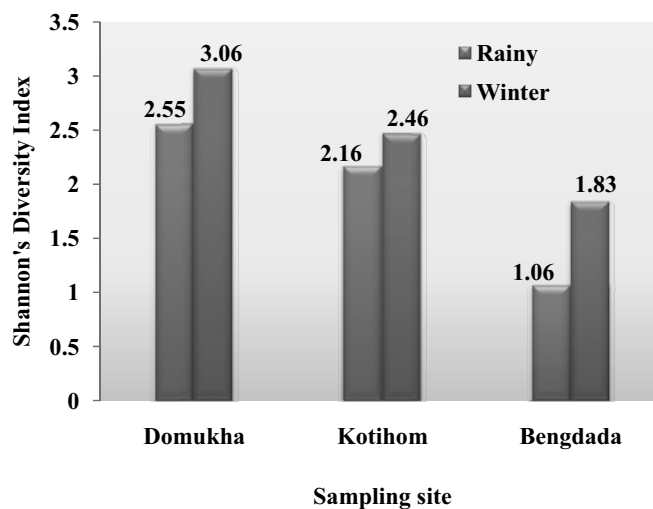


Fig. 3 Shannon's Diversity Index calculated at three sampling sites (Domukha, Kotihom and Bengdada) in two seasons in Kankai River, Jhapa.

The maximum pH (7.9) was measured at Domukha, while the minimum (7.8) was measured at Kotihom and Bengdada in the rainy season of 2017. Likewise, the maximum pH (7.9) was recorded at two sites, Domukha and Kotihom, but the minimum (7.8) was recorded at Bengdada in the winter of 2018.

Table 2 Water quality parameters (pH, temp.) and river morphology (water current) recorded at three sampling sites in rainy season and winter in Kankai River, Jhapa.

Sampling sites	Season					
	Rainy season (2017)			Winter (2018)		
	pH	Temp. (°C)	Water current (m/s)	pH	Temp. (°C)	Water current (m/s)
Domukha	7.9	27	0.75	7.9	17	0.55
Kotihom	7.8	28	0.70	7.9	15	0.53
Bengdada	7.8	27	0.68	7.8	15	0.52
Average	7.83	27.33	0.71	7.86	15.66	0.53

In the rainy season, the maximum temperature (28°C) was recorded at Kotihom while the minimum (27°C) was recorded at Domukha and Bengdada. In winter, the recorded temperature was ranged from 17°C (Domukha) to 15°C (Kotihom and Bengdada). Water current measured in the rainy season ranged from 0.75 to 0.68 m/s while 0.55 to 0.52 m/s were measured in winter.

A total of 20 fish species (4 orders, 7 families and 12 genera) in the Kankai River in two seasons: rainy season and winter. Cypriniformes and Cyprinidae were found as the most dominant order and family in this river, and our result was in line with [3, 1, 5]. Cypriniformes is usually the dominant order in Nepalese Rivers [7]. The least study has been carried out concerning fish diversity in the Kankai River. There is a vast gap of research concerning fish diversity in the Kankai River after [8], who reported a total of 34 species belonging to 3 orders, 8 families and 26 genera. Comparatively, more species, families and genera were reported [8] than in this study. Limited field sampling might have caused low species diversity in the current study. A study like this is crucial because it fulfilled the current gap in research about fish diversity. It also recorded a species *Mastacembelus armatus* (order Synbranchiformes) that was not reported earlier [see 8], however.

Shannon's Diversity Index (H') was higher during winter than the rainy season in all sampling sites in the Kankai River. The high water flow and turbid water in the rainy season were not appropriate for fishing might have contributed to the low diversity index. Site-wise, the highest value of Shannon diversity index was recorded at Domukha in both seasons (rainy and winter), which may be attributed to types of the river bed (e.g. boulder, cobble and gravel) having autotrophs (e.g. algae, phytoplanktons). Unlike our expectation of finding more species at the undisturbed site, Bengdada, the results showed the opposite tendency, i.e. low diversity index was recorded. This may be due to unproductive habitat associated with sandy bottom, which is unsuitable for macroinvertebrates and autotrophs on which fishes usually depend. Detail data on such habitat-related parameters and fish diversity indices need to be analyzed before making such a generalization.

Local people believe that fishes of the Kankai River are decreasing these days and stressed the need for the implementation of strict rules and regulations from concerned authorities. They pointed out indiscriminate fishing was the leading cause of fish declination. Overall, the result of this study also showed that the species had been decreased in comparison to [8]. However, factors like duration of the study, sampling gears used etc., can significantly affect in the species collection, so those factors also need to be considered before making any generalization regarding decreasing trend of species diversity. For this more systematic and detail study in this river should be conducted.

Nepal is a home for 236 indigenous and 16 exotic species [17]. Previous studies show that country's total number of fish species is increasingly reported and expected to discover more new species in future through extensive research [11] in virgin rivers. Lack of uniformity among authors on the country's total fish species is confusing to a great extent because the total species reported varies from author to author [7]. Fish diversity study is principally essential for a country like Nepal, where several unconventional fishing practices such as fish poisoning, dynamiting etc., are common, and it is very likely that such activities adversely impacts the fish population. Also, regular and systematic investigation about the country's fish fauna is scarce, so the need for updating fish fauna (e.g. species richness, population status, distribution etc.) becomes crucial. Knowledge of fish population status and distribution ecology [2] is essential for effective conservation plan.

It was observed that pH values of all sampling sites in rainy and winter did not vary much indicating no drastic changes in water chemistry among the sites. The average pH values were recorded as 7.83 (rainy season) and 7.86 (winter), which shows that pH in winter is slightly greater than that of the rainy season. The average temperature of rainy and winter was recorded as

27.33°C and 15.66°C, respectively. Only a slight temperature variation was found among sites in the rainy season as well as in the winter. The temperature at Domukha and Bengdada in the rainy season and Kotihom and Bengdanda in winter season were recorded the same. This may be due to similar topography among the sampling sites. The average water currents recorded in the rainy season and winter were 0.71 m/s and 0.53 m/s, respectively. The high volume of water in the rainy season contributed to higher water current than in winter. In the rainy season, the highest water current (0.75 m/s) was recorded at Domukha, and the lowest was recorded at Bengdada (0.68 m/s). Similarly, the highest current was recorded at Domukha (0.55 m/s), and the lowest (0.52 m/s) was recorded at Bengdada in winter. As Domukha is the site having boulders, pebble, and gravel as dominant substrates, this condition may have attributed to high water current in both seasons in comparison to the remaining two sites (Kotihom and Bengdada) where the riverbed was sandily resulting in low water current.

Conclusions

The fish diversity in the Kankai River was higher in winter than the rainy season. In comparison to the previous study, fewer species have been recorded in this study. However, it should be noted that the current investigation was conducted in two seasons and limited sites being sampled for fishes. Further research covering more seasons and more sampling area is needed to have a more reliable picture about the status of fish diversity in this river. Moreover, fish species composition and analysis based on dominant riverbed types (e.g. boulder, cobble, and gravel vs sand) could be a future research area in the Kankai River.

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