

Fish Fauna of Narayani River, Nepal: Species diversity and Threats.

Gair P* and Regmi S

Nepal Academy of Science and Technology, Khumaltar, Lalitpur, Nepal.

Abstract

Aquatic biodiversity is in crisis due to several natural and anthropogenic factors. This study was conducted to find out the species diversity and to identify threats to the fish fauna in Narayani River system, Nepal. Both primary and secondary data collection methods were used in the study. Primary data was collected by reconnaissance survey and field monitoring and secondary data were collected from literature review from research reports, journal articles and books, records from Department of National Park and Wildlife Conservation (DNPWC), Chitwan National Park (CNP), National Trust for Nature Conservation (NTNC) and other stakeholders and from relevant websites. Various sampling sites were chosen based on availability of water resources, stakeholder consultation and the habitat preference of the fish species in that river system. Catch and release method was used in field to account the species diversity of fish. Ten orders of fish i.e. Clupeiformes, Cypriniformes, Siluriformes, Anguilliformes, Belontiiformes, Ophiocephaliformes, Synbranchiiformes, Perciformes, Mastacembeliformes, Tetraodontiformes were found in the area. Under these ten orders, 25 families and 86 species were identified. Among the orders, Cypriniformes had the highest number of species while in families; Cyprinidae had the highest number of species (41%) out of total 25 families. Both natural threats (silt deposition, flooding) and anthropogenic threats (illegal fishing, construction of dam/bridge, waste dumping and poisoning to fish) to fish were found in the study sites. It is suggested to construct appropriate ladder during dam construction, stop dumping in the river and further study on fish diversity and threats to fish.

Keywords: Narayani river system; Fish diversity; Anthropogenic threats

Introduction

Background

Nepal is located at the intersection of Palearctic and Oriental bio geographical realms, with varied topography that generates a wide variety of aquatic habitats, supports high diversity of fishes [1]. Being a landlocked country, Nepal consists of freshwater resources covering about 5% of the total area of the country which constitute about 2.27% of world's fresh water resources.

There are 185 fish species in Nepal belonging to 79 genera, 31 families and 11 orders. The indigenous and exotic fishes of Nepal in total were found to be 186 species. Out of these there were fifty-nine Coldwater indigenous and two exotic fish species in Nepal as investigated by Shrestha, but the latest data reveals about 200 fish species, of which 191 are indigenous and 9 exotic. They live in almost all conceivable aquatic habitats. The Sub-Himalayan or mountain region (2000 ft. to 16000 ft.) consist of basins, valleys and Duns among which Kathmandu valley and Pokhara valley supports (*Schizothorax spp*s) and Buduna (*Garra spp*s) but lower part between (9000 ft. and 2000 ft.) supports fishes like Shar (*Tor putitora*), (*Tor tor*), Catla (*Catla catla*), Rohu (*Labeo dero*), Sidre (*Puntius spp*s), Fageta (*Barilius spp*s) and Kabhre (*Glyptothorax spp*s) and the lower part of terai region (above 70m) support the fish species Rohu (*Labeo rohita*), Buhari (*Wallago attu*), Murrel (*Channa gachua*), (*Channa marulius*), sidre (*Puntius sophore*), (*Puntius sarana*), Bam (*Xenentodon cancila*) and Mahaseer (*Tor tor*) etc. However, freshwater ecosystems are most endangered ecosystem in the world because of declining as compared to terrestrial ecosystem [2]. The major threats to global freshwater including fish are overexploitation, water pollution, flow modification, destruction or degradation of habitat and invasion by exotic species. But due to absence of conservation and habitat management, poor knowledge, less priority in research of fish, disturbance in water quality and quantity and anthropogenic disturbance, the fish are reached near threat of extinction worldwide. The research carried out in Narayani River System, Bardiy National

Park of Bardiy district from Chepang to Parewa Odar with the help of experience staff of CNP, NTNC and local fisherman. The objective of the research was to account the various species of fish fauna, assess the threats to fish fauna in Narayani Valley River System. To find the potential site for survey of fish species, the reconnaissance survey was first carried out in the area and both primary and secondary data was collected in order to gather the required information.

Statement of problem

Because most of the research study in Nepal are concerned over mega species, only less priority given to reptiles, amphibian and pieces [3]. According to biological diversity conservation 1992, forest ecosystem, wildlife habitat and genetic resources were committed to be conserved through national protected area system covering about 19% area of country. And this strategy claimed to conserve all fauna and flora, however, fishes largely ignored, probably due to poor advocacy on fish conservation causing huge fish diversity loss. Fishes are decreasing in Nepal by alternation of aquatic habitats due to change in climate, snow caps, glacier and vegetation and also poisoning the water resources by mixed with pesticides, crude oil and other chemical from factories and fisherman using poison to kill more amount of fish. In Red Data book of IUCN, only 2 Endangered, 9 Vulnerable, 23 Rare and Threatened species of fish are kept in conservation status whereas Critically Endangered (CE) and Extinct (EX) are not identified because lacking further research with relate to fish diversity. Nearby wetlands

*Corresponding author: Derribew Hailu, Oromia Agricultural Research Institute, Batu Fish and Other Aquatic Life Research Center, Batu Ethiopia, E-mail: hailuderribew@yahoo.com

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in Chitwan National Park, Rapti River and Narayani River are one of the most suitable fresh water ecosystem and habitat of different varieties of fish species but very few study had been done yet for its proper conservation, protection and dissemination of knowledge and information among the local people about its threats. So, my study aimed to investigate the information about diversity of fishes in Narayani River System and threats by different causes and also solution to problem of declining fish fauna in study area.

Rationale of Study

Scientific conservation and management of wildlife and their research studies were emerged only after the establishment of National Park in late 18th century and after that many wildlife species had been explored but mostly focused on mega species, so that the conservation of small vertebrate like reptiles, amphibian and pieces were ignored [4]. Because of less priority given to them, they are declining and have faced severe threats of extinction. To control over destructive fishing (poisoning, use of dynamites and electro fishing, use of small mesh size net), increasing awareness, law enforcement have been challenging. Few years before initiatives of fish conservation by mobilizing local communities, especially women has been encouraged and prioritized. Since most of the fish species in this river system are threatened by change in water quality, habitat destruction, over fishing (electro fishing) and construction of diversion and dams had major effect on water resources in this river. This study had focused on fish diversity and its distribution and threats to fish by several causes in Narayani River system, so that the study would contribute to document different species of fishes distributed in this river system which helps to conserve and application of management effort to conserve fish species.

Objectives

The overall objective of this study is access the species diversity and to identify threats to fish fauna in Narayani River System (5).

And specific objectives is:

- To account the fish fauna and to study species diversity in Narayani River.
- To study the threats to fish fauna in the study area.
- To provide the recommendation to address the threats to fish fauna in Narayani river.

Literature Review

Fishes are well defined group of vertebrates, the primitive group of the cold blooded vertebrate with gills and fins. They can be distinguished from amphibian and other animals by several adaptation characteristics (habitat, locomotion, shape, size, morphology etc.). Fish are the pair of ecosystem and have ecological as well as cultural significance (some people have special profession to kill fish for their livelihood). Nepal being rich in diversity in species, ecosystem, habitats, altitudinal as well as climatic variation, the wide variety of fish fauna is found. But information and literature study about the fish species is very poor and scanty because less concerned about small vertebrates [6]. Among a good numbers of contributors to taxonomical works on fishes of Nepal the works of deserve special mention. The authors have made an attempt to collect and identify the fishes of eastern terai of Nepal provided a checklist of fish fauna of Trishuli River in which they reported 6 families, 16 genera and 28 species. Studied fishery ecology of the fishes in the flood plain of Koshi River. Biodiversity Profiles Project described the status of fish species in Nepal based on who enumerated the fish of Nepal. Rajbanshi gave a

report of a general bibliography on fish and fisheries of Nepal. Studied on the fishery resources of Karnali River describing the distribution, economic importance and taxonomy of 51 fish species. studied the relation of physio-chemical parameters with the fish fauna of the Sunkoshi River. Further recorded 182 indigenous fish species of Nepal prepared a checklist from the published literature and reported 187 species, while reported 199 species. Similarly, reported 217 indigenous fish species from Nepal. The present study was supported by Critical Ecosystem Partnership Fund (CEPE) according to which the aquatic biodiversity has been neglected in Eastern Himalayan Region of Nepal and hence inventory and research are needed on fishes (CEPE, 2005). However, documentation of the distribution of fish species across Nepal has limited in scope, consisting mostly of checklist of species by river drainage or remarks on general habitats or regions of occurrence. So much remains to be learned about the distribution and ecology of fishes in many Asian countries. Freshwater fish face a number of specific threats [7]. The foremost threats are habitat changes which are particularly threatening in river. Deforestation along river banks also affects fishes that feed in flooded wetland and pools near the forest. The best situation is seen in Koshi embankment of Nepal. Water represents one of the main resource opportunities for developing electric power generation for Nepal's future economic development. Many current loving species of fishes cannot migrate upstream because of physical barrier of the dam. Generally, discharge of water altering water volume influence composition of fish species especially migratory fishes. In the Ganga river basin, alterations in fish diversity and community structure are mainly due to hydrological alterations, dam constructions, over fishing, pollution, water diversions, changing land use pattern, exotic species invasion, rapid sedimentation, deforestation, climatic changes and land erosion etc. Assessing impacts and threats directly informs conservation strategies, management options and priorities for actions.

Materials and Method

Study Area

A survey was conducted to assess fish bio-diversity of the Narayani River along with its tributaries. Various sampling sites were taken in the Narayani River System from Trishuli River at Kuringhat, Trishuli and Marsyangadi confluence at Muglin, Chitwan to North western bank of Narayani River at Tribenighat, Nawalparasi (8). The Narayani River system is one of the three major river systems of Nepal with seven tributaries. It is, therefore, called Sapta Gandaki and drains central Nepal (Figures 1 and 2). The Kali Gandaki which originates from Tibetan plateau is regarded as one of the major tributaries and is joined by the Trishuli, another major tributary at Devghat where it attains the name of Narayani. Besides, Marsyangdi, Seti, Budhi Gandaki, Madi and Myagdi Rivers are also considered as major tributaries. These tributaries traverse through varied geographic zones, hence, represent diversified fish species. The river Narayani in Chitwan district extends widely and collects Rapti and Rew rivers along with a large number of streams. The Narayani River has an average flow of 283 m³/sec and the velocity of water changes from very fast in the higher altitudes to mild in the lower plains. The river receives sewage and wastes from the Bhrikuti Paper and Pulp Factory. It has a barrage to control water for irrigation and power generation without any fish way in Nepal-India border at Tribenighat, Nawalparasi. There is a great impact of barrages and irrigation systems on the aquatic life of upstream and downstream of the river. Faunal composition is affected by interference on the natural system of the river. The fishery resources of the Narayani River system is of great importance for the people of the area as it supports many whose livelihoods depend upon that tremendous fish diversity.



Figure 1: Map of Nepal showing catchment area of the Narayani River system.

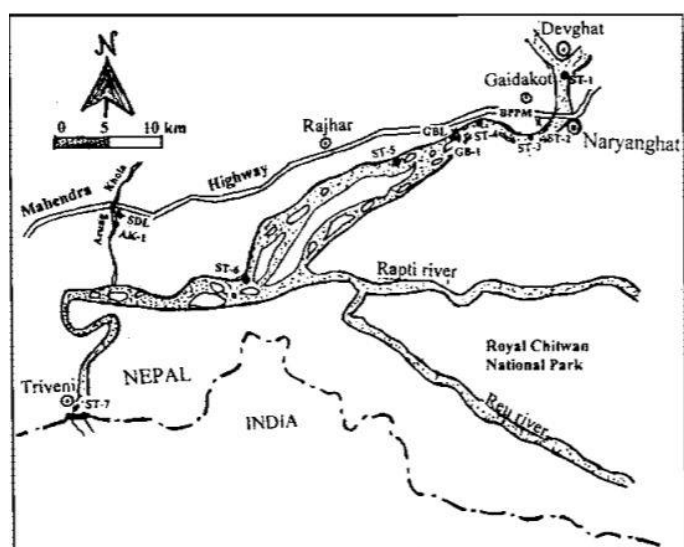


Figure 2: Map of study area.

Methodology

This research was prompted based on the data collected primarily in the field. Primary data constitutes reconnaissance survey and key stakeholder consultation [9]. Relevant secondary information was also collected through different approach.

Research design: This study basically relies on the primary data collected in the field. Primary data was collected through reconnaissance survey and field monitoring. Secondary information were collected through literature review from research reports, journal articles and books, records from DNPWC, CNP, NTNC and other stakeholders and from relevant websites. Secondary data were of immense importance for analyzing primary data and comparing the results with the previous findings [10]. Several phases of the project work is as shown in the schematic flow chart (Figure 3).

Data collection:

Primary data collection

a. Field visit for Reconnaissance survey: Before starting the actual survey, a prefeasibility survey was carried out. Reconnaissance field visit were made to find out potential areas for fish sampling.

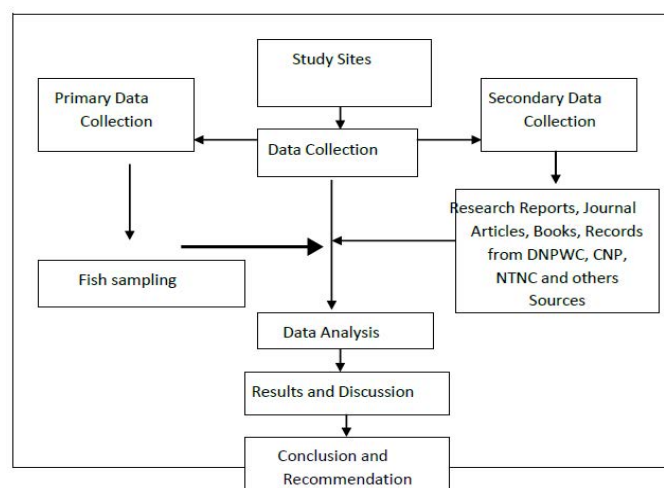


Figure 3: Schematic flow of research design.

This study included discussion with key stakeholders, concerned and knowledgeable people, local people and direct field observation [11]. General information about study sites were obtained during field visit.

b. Focus group discussion: Focus group discussion with local leader, users' committee members, teachers, innovative farmers and local institutions environmentalist, ecologist will be asked about the threats to fishes due to different causes and its declining or increasing trends will be discussed respectively.

c. Field observation based on previous recorded data: For the present investigation the fieldwork was conducted during January-February, 2017. To achieve spelled out aims and objectives, the following materials and methods were used. A direct field observation was conducted to assess the existing threat and potential habitat. Previous recorded data from Park were used to identify the potential habitat of fishes. The photos of observed fishes were taken and GPS points were recorded along with other parameters.

d. Fish sampling and identification: It was difficult to survey of these small vertebrate groups because of impossible to observe significant number of any individual species. They are under water so cannot visualize properly and depends upon the appropriate methods, time and season for data collection during field visit in study site. So the study was based on literature review, Key informant interview, field observation. This study applies both qualitative and quantitative

approaches to achieve the research objectives [12].

The fishes were collected by employing local fishermen. Cast net was mostly used to collect the fish during field visit from each site. However, gill net and other local techniques were also used. Information on local name and behavior pattern was obtained from fishermen. The color pattern and size were noted as soon as the fishes were netted out in fishing sites. All fish -collected during survey were identified and enumerated by species. Fish species were photographed. They were properly identified using standard methods.

Secondary data collection

The secondary data sources were collected through literature review from research reports, journal articles and books, records from DNPWC, CNP, NTNC and other stakeholders and from relevant websites [13]. Consultation with CNP’s staff and NTNC-BCC’s staff was done in order to make the better intend in the field before commencing the field work.

Data analysis

Qualitative and quantitative analysis methods were applied to analyze the data. After each discussion, major points raised related to the research problems were recorded as bullet points and elaboration of those points were made. Those interviews and group discussions were later compiled and categorized in each of the questions. Compilation, categorization and tabulation were the basic steps taken prior to analyze the data collected from reconnaissance survey, consultations and discussion. Information received through different methods were compiled and tabulated accordingly and analyzed according to the nature of the information with context to its representation.

Results and Discussion

Distribution of fish fauna

Various sampling sites were taken in the Narayani River System from Trishuli River at Kuringhat, Trishuli and Marsyangadi confluence at Muglin, Chitwan to North western bank of Narayani River at Tribenighat, Nawalparasi [14]. The Narayani river system provides a habitat for fresh water fishes of diverse type’s viz. Mahaseers, carps, barbs, minnows, loach, cat fish etc. Chart show the order-wise fish species which were reported in Narayani River during this research project from April 2019 to February 2020. The present study revealed that the river had diversified fishes belonging to 10 orders,

25 families and 86 species. Among the orders, Cypriniformes had the highest number of species (51%) followed by Siluriformes (24%), Perciformes (7%), Mastacembeliformes (5%), Osteoglossiformes (5%), Clupeiformes (3%), Synbranchiformes (2%) and Interestingly, the orders Anguilliformes, Beloniformes, and Tetraodontiformes each were represented by single species; *Anguilla bengalensis*, *Xenentodon cancula*, and *Tetraodon cutcutia* respectively. The percentage composition of the fishes of different orders is given in (Figure 4) below.

Among families, Cyprinidae had the highest number of species (41%) among the families followed by Sisoridae (7%), Bagridae (7%), Cobitidae (6%), Mastacembelidae (5%), Ophiocephalidae (5%), Schilbeidae (2%), Balitoridae (2%), Siluridae (2%), Nandidae (2%), Notopteridae (2%) & Ambassidae (2%). Other families accounted for about 1% were Anguillidae, Belonidae, Clupeidae, Psilorhynchidae, Gobiidae, Belontidae, Synbranchidae, Amblycipitidae, Amphipnoidae, Clariidae, Centropomidae, Chacidae and Tetraodontidae.

Threats

Narayani River being one of the important rivers is also important for the ecological and fishery point of view. The management intervention is particularly needed at many sites where there is always a chance of anthropogenic impact [15]. It will help in maintaining undisturbed aquatic habitat thus reducing anthropogenic threats in the area.

The villagers near the buffer zone of Chitwan National Park areas are poor and the source of income for their livelihood is very limited due to which they are unable to provide their basic needs. The marketing system is also poor in the nearby areas which compel them to attract illegal fishing in the area. Although, the area was used for fishing and hunting before the declaration of protected area, the illegal fishing is in control now. The use of gears, poisoning and dynamiting in the past too were the cause of over exploitation of fish stocks but it is not in practice now [16].

Conclusion and Recommendation

Conclusion

The fishes of the Narayani River are biologically diverse. Fish species diversity and threats were studied and the nearby local people were consulted along with Chitwan National Park authority [17]. The sampling methods used can be generally be considered effective as a wide diversity of species were caught in a short period of time,

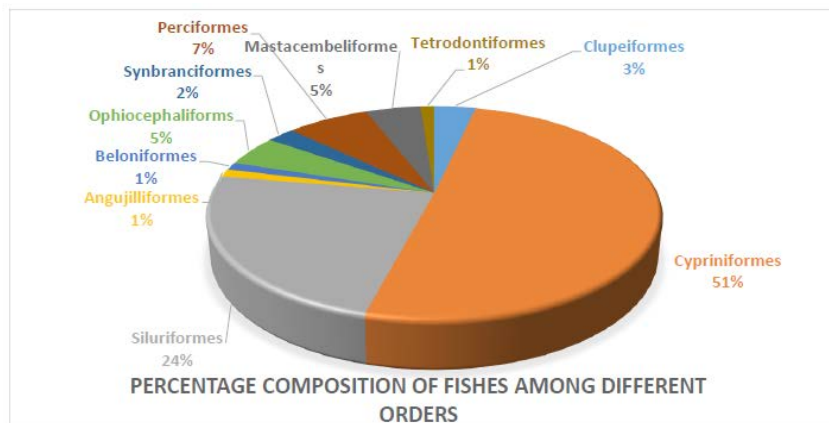


Figure 4: Percentage composition of fishes among different Orders.

however, the limitation of one time sampling season is not sufficient to explain the overall diversity. Comprehensive sampling of deeper water is always challenging but during the present sampling season it was not considered as the major one. Generally, the species composition at different sites differed with zones that are dominated by particular species or families. Longitudinal zonation of fish populations has been reported in other river systems in Nepal though there is variation in the number and composition of these zones. In the present study, among the collected fish fauna family Cyprinidae predominated throughout the study period and alone constituted 41.53% of the total, Bagridae and Sisoridae were found as second and third 17 dominant families respectively and constituted combine 14.4 percent of the total collected fish fauna [18]. Cyprinids were the dominant families reported, reflecting the dominant fish family in Nepalese rivers that also supports the other reviewed literature. A more detailed investigation would be of interest, particularly as the indicator species in each zone could be used as the basis of aquatic biodiversity management plans.

The knowledge regarding the existing threats and management practices were also gathered which indicated the effectiveness of protected area management showing the reduced number of illegal activities despite having some issues and cases. The core areas are totally safe whereas buffer zone and fringe areas need special attention.

Recommendation

Further studies are needed to understand the fish diversity in other season also.

Appropriate fish ladder or fish lifts or any other by pass facilities should be constructed according to migratory patterns of fish species while constructing dams or initiating other developmental activities based on the EIA's recommendation [19].

Wastes should not be dumped in the river.

To fulfil gap of knowledge on fish diversity, it is advisable to have government plan, school syllabus, so the knowledge on fish taxonomy and conservation could be prioritized giving special focus on raising awareness on the conservation of riverine fishes.

To give focus on the conservation of aquatic biodiversity, buffer zone community and other stakeholders should be mobilized for reducing illegal activities particularly in fringe areas [20].

To establish community or cooperative based conservation groups that have similar interest, expertise, and ability to collect, review and disseminate information to those individual or agencies that could develop and drive natural resource policy of fish conservation.

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