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Species diversity, distribution and status of fishes in Chitwan district and adjacent areas, Nepal

Dilip Kumar Jha

Department of Aquaculture and Fisheries, Faculty of Animal Science, Veterinary Science and Fisheries, Agriculture and Forestry University, Chitwan, Nepal
dkjha.ait@gmail.com

ABSTRACT

Chitwan district is endowed with varied aquatic resources which harbor diverse fish species in central Nepal. A total of 111 fish species were collected from different sampling sites of several tributaries of Trisuli, Rapti and Narayani river systems in Chitwan district and adjacent areas from August 2011 to July 2016. These species belong to 9 orders, 27 families and 72 genera. Among the orders, Cypriniformes had the highest number of species (49%) followed by Siluriformes (30%), Perciformes (12%), Synbranchiformes (3%), Osteoglossiformes (2%) while Anguiliformes, Beloniformes, Clupeiformes and Tetraodontiformes represented each by about 1%. Cyprinidae has the highest number of species (40%) among the families followed by Sisoridae (12%), Bagridae (7%), Cobitidae (5.4%), Schilbeidae(4.5%),Channidae (3.6%), Balitoridae (2.7%), Mastacembelidae (2.7%), Siluridae (2.7%), Notopteridae (1.8%), Ambassidae (1.8%), Nandidae (1.8%) and Mugilidae (1.8%). Other families accounted for about 1% were Anguillidae, Belonidae, Clupeidae, Psilorhynchidae, Anabantidae, Gobiidae, Belontidae, Synbranchidae, Amblycipitidae, Pangasidae, Clariidae, Heteropneustidae, Chacidae and Tetraodontidae. The *Botia geto* was reported for the first time from Rapti river of Chitwan and adjacent area. Different fish species are naturally maintained in aquatic systems and support livelihoods of the people. Catches of major food fishes are declining due to overexploitation of resources, therefore, appropriate measures are needed at once to maintain and conserve the indigenous stock.

Keywords: fish diversity, *Botia geto*, *Pseudolaguvia*, Trisuli, Rapti and Narayani Rivers, Chitwan

INTRODUCTION

Chitwan district lies in the Narayani zone of Central Development Region of Nepal between latitudes 27°20' to 27°52'N and longitudes 83°55' to 84°52'E, which covers an area of 2,238 $km^{2.}$ It is a part of Nepalese midlands with monsoon type sub-tropical climate offering huge potential for development of fisheries. It is bounded by Tanahu, Gorkha and Dhading districts in the north, the Parsa district and part of Bihar state of India in the south. It has Nawalparasi district in the west along the Narayani river and the Makwanpur district in the east (fig. 1). Its major portion is flooded during the rainy season which usually extends from June to September. The region is drained by the Gandaki/Narayani river system which ultimately discharges into the Ganga river in India.

Water resources in Chitwan and adjacent districts are drained by the Gandaki river system

which is one of the three major river systems of Nepal with seven tributaries. It is therefore, called Sapta Gandaki (fig.1) The Kaligandaki, antecedent to Himalayas, is regarded as one of the major tributaries and is joined by the Trisuli at Devghat where it attains the name of Narayani, drains approximately 35000 $km^{2,}$ which runs for approximately 332 km in Nepal before spilling into the Ganga river of India (Smith *et al.* 1996; Edds, 1986). In addition, Marsyangdi, Seti, Budhigandaki, Madi and Myagdi rivers are also considered as major tributaries of Gandaki river system. The Rapti river flows from the east to west direction dissecting the whole Chitwan valley in almost two parts and join the Narayani river at Golaghat in the Narayani municipality (Singh, 2013). Faunal composition on the natural system of the Narayani river is affected by interference of barrage in Nepal-India border at Tribenighat of Nawalparasi district (Smith *et al.,* 1996; Rajbanshi, 2002; Gubhaju, 2012; Gurung, 2012). The Kaligandaki/ Trisuli/Narayani systems sever through all of Nepal's varied geographical zones and thus present an excellent opportunity to examine the fish distribution along an impressive altitudinal gradient.

Considerable studies on the fish diversity and distribution of the Trisuli/Gandaki/Narayani river systems have been undertaken by many researchers (Shrestha, 1981, 1990, 1994, 2004, 2008, 2012; Jha, *et al.,* 1989, 2014; Dhital & Jha, 2002; Rajbanshi, 2002, 2012; Edds, 1986 a & b, 1993; Ng, 2003; Shrestha & Edds, 2012). Earlier, Shrestha (1981) reported 23 species fish from the Gandaki river system. Edds (1986a & b) recorded 107 and 111 species of fish from Chitwan National Park and the Kaligandaki-Narayani river system respectively. Jha *et al.* (1989, 2014) and Dhital & Jha (2002) collected 68, 108 and 69 species from the Narayani-Rapti river system in Chitwan respectively. Moreover, Shrestha (1990) and Rajbanshi (2002) reported 88 and 85 species from the Narayani river respectively.

Major rivers and their tributaries support a wide range of ichthyofaunal diversity and service to society (Gurung, 2016). The aquatic resources in Chitwan and the adjacent areas have vital fish stocks which are greatly affected by alteration of habitat and their overexploitation. There is a need to assess species distribution in different geographic locations for proper conservation. Therefore, an effort has been made to investigate the fish diversity of the Trisuli/ Gandaki/Rapti/Narayani river systems in Chitwan and adjacent areas.

MATERIALS AND METHODS

Study area

Chitwan district lies in the Central Development Region of Nepal. This district features a subtropical weather along with monsoon climate and is drained by the Trisuli, Gandaki/ Narayani river systems which ultimately discharge into the Ganga river in India. Its upper northern part is drained by Trisuli river which received Marsyangdi and Kaligandaki rivers at Muglin and Devghat respectively. From Devghat it named Narayani river which forms the western border with Nawalparasi district. The Narayani river extends widely and collects Rapti and Rew rivers along with a large number of tributaries of eastern Chitwan as Khageri, Kayar, Ladari, Pampa, Dhongre, Martal and Lothar (fig.1). These aquatic resources were studied in Chitwan along with adjacent areas in Makwanpur and Nawalparasi districts from August 2011 to July 2016.

Sampling sites

The study area (fig.1) was divided into ten sampling sites: I= Trishuli river at Kuringhat, II= Trishuli and Marsyangadi confluence at Muglin, III= Narayani river (Trishuli and Kaligandaki confluence) at Devghat and Narayanghat, IV= North – eastern bank of Narayani river at Shivaghat, Kabreghat and Kharkhareghat, V= Eastern and western bank of Narayani river at Koleghat of Chitwan and Nawalparasi, VI= Rapti river at Meghauli and Rapti -Narayani confluence at Golaghat of Narayani municipality, Chitwan, VII= Khageri river, Burhi Rapti, and Lothar river in eastern Chitwan, VIII= Manhari-Rapti confluence in Makwanpur district, IX= Rew river and its feeder streams at Madi in Chitwan National Park, and X= Western bank of Narayani River at Tribenighat of Nawalparasi district. Geographical coordinates of these sites are given in table 1.

TABLE 1. Geographical coordinates of different study sites.

Site	Location	Longitude	Latitude	Elevation (m)
I	Kuringhat (Trishuli river)	27°52’09” N	81°37’55” E	272
II	Muglin (Trishuli-Marsyangdi confluence)	27°51’26” N	84°33’35” E	252
III	Devghat (Narayani and Kaligandaki confluence)	27°44’28” N	84°25’24” E	191
IV	Shivaghat, north- eastern bank of Narayani river	27°40’46” N	84°22’38” E	183
V	Koleghat (eastern and western bank of Narayani river)	27°41’27” N	84°21’42” E	176
VI	Golaghat, Meghauli (Narayani and Rapti Confluence)	27°33’50” N	84°09’29” E	142
VII	Lothar (Lothar and Rapti confluence)	27°33’45” N	84°42’32” E	245
VIII	Manahari (Manahari and Rapti confluence)	27°31’38” N	84°46’46” E	278
IX	Madi (Reu river)	27°27’52” N	84°21’14” E	182
X	Trivenighat (Near India Border at dam site)	27°26’08” N	83°54’38” E	116

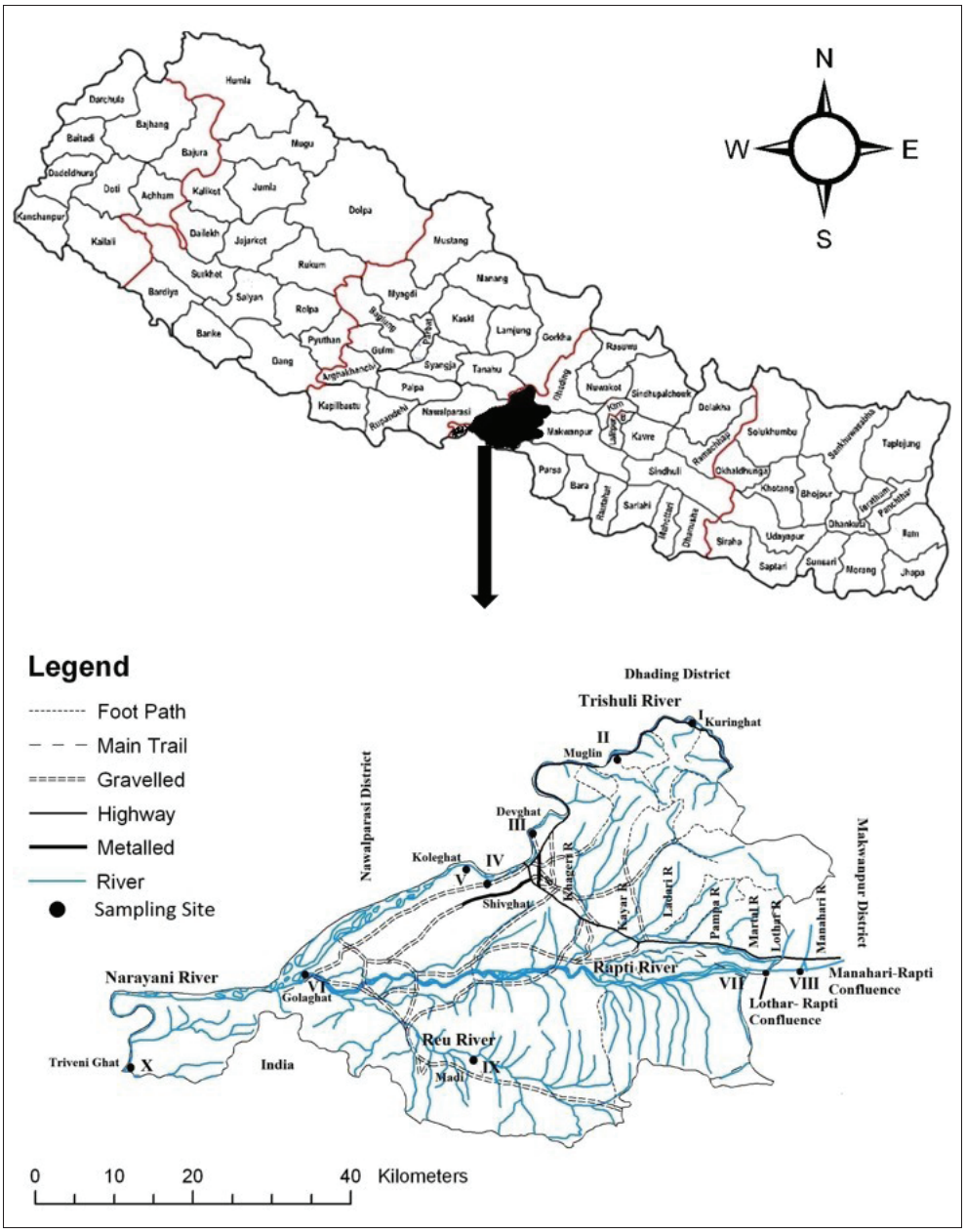

FIG. 1. Map of Nepal showing Chitwan district and adjacent areas along with the Narayani river and its tributaries. Black dots indicate sampling sites.

Sample collection, preservation and identification

Fish samples were collected from different selected sites with the help of local fishermen. Different types of fishing gears such as cast net, gill net, drag net and fish traps were used for the collection of fish specimens from these sites. Usually cast net was frequently applied. Sampling station was maintained within each study site to maximize fish collection. Ecological features of the fish habitat and color of fish species were recorded throughout collection. These specimens were preserved in 10% formalin. One milliliter pure glycerin per liter of 10% formalin was used to protect specimens from quick fading of their color. The large specimens were incised lengthwise along the abdomen while the smaller ones were directly put into the formalin. The fish were kept upside down to avoid any damage to caudal fin in the container.

For species identification, counts of lateral line scales and fin rays as well as measurement of body were made according to the system developed by Talwar & Jhingran (1991), Jayaram (1999) and Shrestha (1981, 2001, and 2008). Most of the identified preserved specimens are available from Department of Aquaculture and Fisheries, Rampur, Chitwan while some of the specimens are placed in Manahari Development Institute (MDI), Hetaunda, Nepal. The genera under their respective families and the species under their respective genera have been arranged alphabetically

RESULTS AND DISCUSSION

Fish diversity, composition, distribution and status

A total of 111 species belonging to 9 orders, 27 families, 71 genera were collected across all the major tributaries of river Narayani in Chiwan district and its adjacent areas in Nawalparasi and Makwanpur districts. Among the orders, Cypriniformes had the highest number of species (49%) followed by Siluriformes (30%), Perciformes (12%), Synbranchiformes (3%) and Osteoglossiformes (2%) while Anguilliformes, Beloniformes, Clupeiformes and Tetraodontiformes represented each by about 1% (fig. 2).

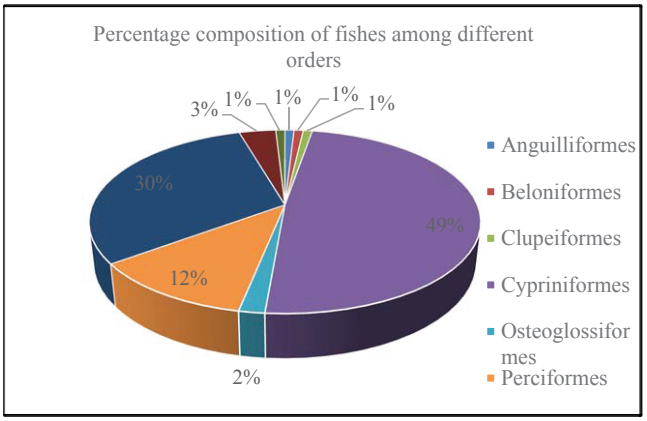

FIG. 2. Percentage composition of fishes among different orders.

Similarly, Cyprinidae was the highest number of species (40%) among the families followed by Sisoridae (12%), Bagridae (7%), and Cobitidae (5.4%). Other families accounted for about

1% with each of single species were Anguillidae, Belonidae,Clupeidae, Psilorhynchidae, Anabantidae, Gobiidae, Belontidae, Synbranchidae, Amblycipitidae, Pangasidae, Clariidae, Heteropneustidae, Chacidae and Tetraodontidae (table 2).

Number of fishes under different families is given in fig. 3. Taxonomic position, local name, distribution of fishes in different sites and status of fish species are listed in table 2.

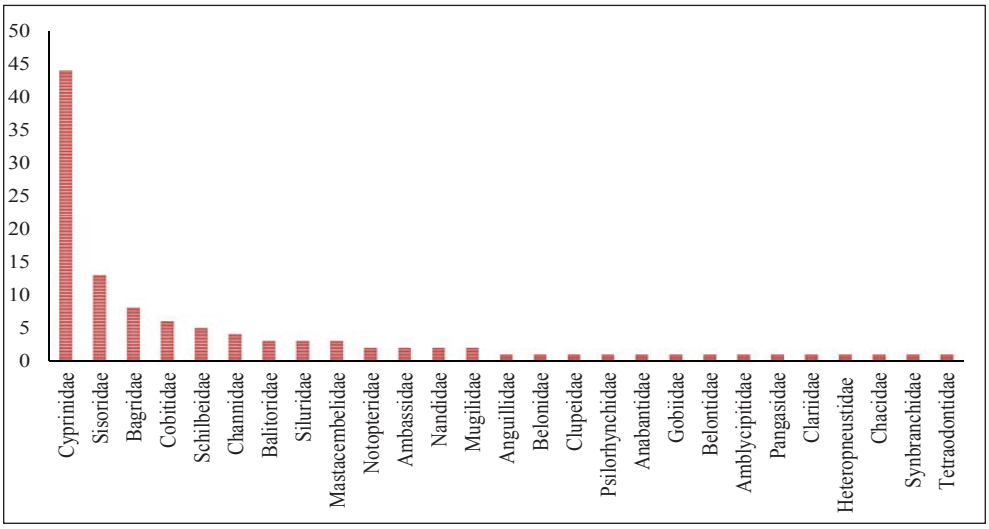

FIG. 3. Number of fish species under different families.

TABLE 2. Systematic position, distribution and status of fish species in the rivers of Chitwan and adjacent areas.

Order, sub-order, family, sub-family, genus and species	Local name	Distribution of fishes in different sites	Status
I. Order: Anguilliformes Suborder: Anguilloidei Family: Anguillidae			
1. *Anguilla bengalensis* (Gray)	Rajbam	I to X	R, M
II. Order: Beloniformes Suborder: Belonoidei Family: Belonidae			
1. *Xenentodon cancila* (Ham.)	Kauwamachha	I to X	C, LM
III. Order: Clupeiformes Suborder: Clupeioidei Family: Clupeidae			
1. *Gudusia chapra* (Ham.)	Suiya	X	R
IV. Order: Cypriniformes Family: Cyprinidae Subfamily:Cyprininae			
1. *Catla catla* (Ham.)	Vakura	VI & X	R
2. *Chagunius chagunio* (Ham.)	Chaurahi	II to IV	C
3. *Cirrhinus mrigala mrigala* (Ham.)	Naini	IV, VI & X	R
4. *Cirrhinus reba* (Ham.)	Rewa	IV to X	C
5. *Cyprinion semiplotus* (Mc-Clelland)	Chepti	IV to X	R, M
6. *Labeo angra* (Ham.)	Basarhi	III to X	C, LM
7. *Labeo bata* (Ham.)	Bata	VI to X	C, LM
8. *Labeo calbasu* (Ham.)	Karaunchh	III to X	C, LM
9. *Labeo dero* (Ham.)	Gardi	I to X	C
10. *Labeo gonius* (Ham.	Kursa	VI to X	UC
11. *Labeo rohita* (Ham.)	Rohu	IV to X	UC
12. *Labeo pangusia* (Ham.)	Kalaunchh	I to X	R
13. *Neolissochilus hexagonolepis* (Mc-Cl.)	Katle	I to X	R
14. *Osteobrama cotio cotio* (Ham.)	Gurda	X	C

15. *Puntius chola* (Ham.)	Sidhare	IV to X	C
16. *Puntius conchonius* (Ham.),	Sidhare	IV to X	UC
17. *Puntius phutunio* (Ham.)	Sidhare	X	R
18. *Puntius sarana sarana* (Ham.)	Sidhare	IV to X	UC
19. *Puntius sophore* (Ham.)	Sidhare	IV to X	C
20. *Puntius ticto* (Ham.)	Tikuliasidhare	IV to X	C
21. *Tor Putitora* (Ham.)	Sahar	I to VIII	R, M
22. *Tor Tor* (Ham.)	Sahar	I to VIII	R, M
Subfamily: Cultrinae			
23. *Salmostoma acinaces* (Val.)	Chelha	VI to X	C
24. *Salmostoma bacaila* (Ham.)	Chelha	X	UC
25. *Securicula gora* (Ham.)	Chelha	X	UC
Subfamily: Rasborinae			
26. *Amblypharyngodon mola* (Ham.)	Dhawai	X	R
27. *Aspidoparia morar* (Ham.)	Chepua	III to X	C
28. *Barilius barna* (Ham.)	Faketa	I, II & V	C
29. *Barilius barila* (Ham.)	Faketa	I ,II to V	R
30. *Barilius bendelisis* (Ham.)	Khasre	I to VIII	C
31. *Barilius tileo* (Ham.)	Faketa	IV & VI	C
32. *Barilius vagra* (Ham.)	Faketa	V & X	RS
33. *Brachydanio rerio* (Ham.)	Dedhwa	IV & X	RS
34. *Danio aequipinnatus* (Ham.)	Pataki	IV to VIII	RS
35. *Danio devario* (Ham.)	Pataki	IV to VIII	RS
36. *Esomus danricus* (Ham.)	Dedhwa	IV to X	C
37. *Parluciosoma daniconius* (Ham.)	Dedhwa	IV to X	C
38. *Raiamas bola* (Ham.)	Galara	IV to X	C
39. *Raiamas guttatus* (Ham.)	Hasta	IV to X	C
40. *Schizothorichthys progastus* (McCl.)	Asla	I to IV	R
41. *Schizothorichthys richardsonii* (Gray)	Asla	I to IV	R
Subfamily:Garrinae			
42. *Crossocheilus latius latius* (Ham.)	Budhuna	IV to VI	C
43. *Garra annandalei* (Hora)	Budhuna	III to VIII	U
44. *Garra gotyla* (Gray)	Nakurobudhuna	III to VIII	C
Family: Psilorhynchidae			

45. *Psilorhynchus pseudecheneis* (Menon & Datta)	Tite	I to IV	R
Family: Balitoridae Subfamily: Nemacheilinae			
46. *Acanthocobitis botia* (Ham.)	Goira	IV to V	C
47. *Nemacheilus corica* (Ham.)	Gadela	I to IV	UC
48. *Schistura beavani* (Gunther)	Goira	IV to V	C
Family: Cobitidae Subfamily: Cobitinae			
49. *Lepidocephalus guntea* (Ham.)	Nakati	IV to X	C
50. *Somileptus gongota* (Ham.)	Goira	IV to X	R
Subfamily: Botiinae			
51. *Botia almorhae* (Gray)	Baghe	III to X	R
52. *B.dario* (Ham.)	Baghe	III to X	R
53. *B. geto* (Ham.)	Baghe	VII to VIII	R
54. *B. lohachata* (Chauduri)	Baghe	III to X	UC
V. Order: Osteoglossiformes Suborder: Notopteroidei Family: Notopteridae			
1. *Notopterus notopterus* (Pallas)	Patra	IV to X	C
2. *Chitala chitala* (Ham.)	Moi	IV to X	R
VI. Order: Perciformes Suborder: Percoidei Family: Ambassidae		IV to X	
1. C*handa nama* (Ham.)	Chuna	IV to X	C
2. *Parambassis ranga* (Ham.)	Chanarbiju	IV to X	C
Family: Nandidae Subfamily:Nandinae			
3. *Nandus nandus* (Ham.)	Dhedhari	IV to X	C
Subfamily:Badinae			
4. *Badis badis* (Ham.)	Khesaki	X	R
Suborder: Anabantoidei Family: Anabantidae			
5. *Anabas testudineus* (Bloch)	Kabai	X	R

Suborder:Gobioidei Family: Gobiidae Subfamily: Gobiinae			
6. *Glossogobius giuris* (Ham.)	Bulla	IV to X	C
Suborder: Mugiloidei Family: Mugilidae			
7. *Rhinomugil corsula* (Ham.)	Thadiya	X	R
8. *Sicamugil cascasia* (Ham.)	Hurra	X	R
Family: Belontidae Subfamily:Trichogasterinae			
9. *Colisa fasciatus* (Bloch & Schneider)	Kotari	IV to X	C
Sub-order: Channoidae Family: Channidae			
10. *Channa marulius* (Ham.)	Saura	IV to X	C
11. *Channa orientalis* (Bl. & Schn.)	Bhoti	IV to X	C
12. *Channa punctatus* (Bloch)	Hile	IV to X	C
13. *Channa striatus* (Bloch)	Saura	IV to X	C
VII. Order: Siluriformes Family: Amblycipitidae			
1. *Amblyceps mangois* (Ham.)	Paharisinghi	IV to X	C
Family: Bagridae		IV to X	
2. *Aorichthys aor* (Ham.)	Kubratengar	IV to X	C
3. *Aorichthys seenghala* (Sykes)	Kanti	IV to X	C
4. *Mystus bleekeri* (Day)	Tengasi	IV to X	RS
5. *Mystus cavasius* (Ham.)	Tengara	IV to X	RS
6. *Mystus menoda* (Ham.)	Tengara	X	R
7. *Mystus tengara* (Ham.)	Tengara	IV to X	C
8. *Mystus vittatus* (Bloch)	Tengana	IV to X	C
9. *Rita rita* (Ham.)	Tengar	IV to X	UC
Family: Siluridae		IV to X	
10.*Ompok bimaculatus* (Bloch)	Lodara	IV to X	C
11. *Ompok pabda* (Ham.)	Nanaria	IV to X	R
12. *Wallago attu* (Bl. & Schn.)	Barari	IV to X	C

Family: Schilbeidae Subfamily:Ailiinae			
13. *Ailia coila* (Ham.)	Jalkapoor	V to X	R
Subfamily:Schilbeinae			
14. *Clupisoma garua* (Ham.)	Jalkapoor	V to X	C
15. *Eutropiichthys vacha* (Ham.)	Suha	IV to X	R
16. *Eutropiichthys murius*(Ham.)	Jalkapoor	IV to X	R
17. *Pseudeutropius atherinoides* (Bloch)	Jalkapoor	IV to VII	C
Family: Pangasidae			
18. *Pangasius pangasius* (Ham.)	Jalkapoor	X	R
Family: Sisoridae			
19. *Bagarius bagarius* (Ham.)	Gonch	I to X	UC
20. *Bagarius yarrellii* (Sykes)	Gonch	I to X	UC
21. *Gagata cenia* (Ham.)	Datkitari	V to X	UC
22. *Glyptothorax cavia* (Ham.)	Kapre	II to IV	R
23. *Glyptothorax indicus* (Talwar)	Kursimlo	III to V	R
24. *Glyptothorax pectinopterus* (McCl.)	Kapre	IV to X	R
25. *Glyptothorax telchitta* (Ham.)	Chepti	IV to X	C
26. *Hara hara* (Ham.)	Datkitari	VI to VIII	R
27. *Nangra viridescens* (Ham.)	Katenga	VIII & X	R
28. *Pseudecheneis sulcatus* (McCl.)	Vedra	I to V	UC
29. *Pseudolaguvia kapuri* (Tilak & Husain)	Kapre	VI to VII	R
30. *Pseudolaguvia ribeiroi* (Hora)	Patekapre	VI to VII	R
31. *Sisor rhabdophorus* (Ham)	Chheparomachha	X	R
Family: Clariidae			
32.*Clarias batrachus* (Linnaeus)	Mangur	IV to X	C
Family: Heteropneustidae			
33. *Heteropneustes fossilis* (Bloch)	Singhi	IV to X	C
Family: Chacidae			
34. *Chaca chaca* (Ham.)	Kirkire	X	R
VIII. Order: Synbranchiformes Suborder:Synbranchoidei Family: Synbranchidae			
1. *Monopterus cuchia* (Ham.)	Andhwabam	IV to X	C

Suborder: Mastacembeloidei Family: Mastacembelidae Subfamily:Mastacembelinae		IV to X	
2. *Macrognathus aral* (Bl. & Schn.)	Chuchebam	IV to X	C
3. *Macrognathus pancalus* (Ham.)	Dharebam	IV to X	RS
4. *Mastacembelus armatus* (Lacepede)	Bam	IV to X	RS
IX. Order: Tetraodontiformes Suborder:Tetraodontoidei Family:Tetraodontidae Subfamily:Tetraodontinae			
1. *Tetraodon cutcutia* (Ham.)	Kitkitia	VI, VII & X	R

The status of each species is given as: common (C), uncommon (UC), rare (R), resident (RS), migratory (M) and local migrant (LM). Localities I to VIII are given as mentioned in the 'Materials and Methods'. Common: Frequently noted during sampling period; Uncommon: Very few represent in the sample; Resident: Never migrate according to local fishermen; Rare: Very few, sometimes absent; only repeated sampling reveal the presence of the species.

The Trisuli/Rapti/Narayani river ecosystem supports diverse stock of carps, catfishes, perches, featherbacks, eels, gobies, puffers, yellowtails, loaches, mullets and so on. Upper parts of these aquatic resources are dominated by important coldwater fishes such as *Schizothorax* sp.*, Schizothoraichthys* spp., *Neolissocheilus hexagonolepis*, *Tor* spp. and *Bagarius* spp. The middle and lower parts are chiefly inhabited by mixed group of fishes like carps, catfishes, perches, snakeheads, featherbacks and eels (table 2). Out of 111 species, common (49), uncommon (14) rare (40) and resident (8) were observed (fig. 4). Among these, *Barilius bendelisis, Puntius* spp.*, Esomus* sp.*, Mystus* spp.*, Glossogobius* sp.*, Monopterus cuchia, Macrognathus* sp.*, Notopterus notopterus, Aorichthys* spp. and *Channa* spp. were frequently observed while some species of carps, loaches and catfishes were seen uncommonly and rare also (table 2). Further, *Amblypharyngodon mola*, *Chaca chaca*, *Rhinomugil corsula* and *Anabas testudineus* were also very rare and collected from canals in Nawalparasi district only. Though *Amblypharyngodon mola* was available in some farmer's ponds of Chitwan, the *Anabas testudineus* was not seen in the Chitwan district. The Status of fish species of the Narayani river system is given in fig. 4. Most of these species have high market value and preferred by the people. However, they are caught only from the wild and have not yet been cultured with some exception.

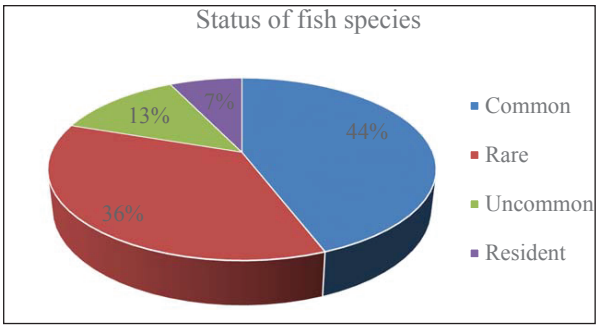

FIG. 4. Status of fish species in the aquatic resources of Chitwan and adjacent areas.

In Nepal, 230 indigenous fishes have been reported from major rivers along with their feeder streams and scores of lakes and reservoirs (Rajbansi, 2012). They belong to 11 orders, 34 families and 104 genera. Similarly, Shrestha (2012) reported 228 indigenous fishes which belong to 11 orders, 32 families, 24 sub-families, and 99 genera including 15 endemic species. Earlier, Shrestha (2008) described a total of 232 fish species belong to 114 genera under 37 families and 11 orders. Out of 232 species 217 are native to different aquatic systems and remaining 15 species are exotics. Karki (2016) stated that Nepal is rich in fish biodiversity and its aquatic systems support nearly 200 fish species which are commercially and economically important (Gautam, 2015).

Various researchers have reported different numbers of fish species from the Gandaki/ Narayani river system. Amongst them, Shrestha (1981) reported 23 fish species from the Gandaki river system. Edds (1986) recorded 111 species of fish through longitudinal survey of the Kaligandaki-Narayani river system from 100m to 3000masl. Further, Smith *et al.,* (1996) reported the presence of 135 fish species from the Narayani river basin below and within the Himalayan foothills. Jha *et al.* (1989), Dhital & Jha (2002) collected 68 and 69 species fish from the Narayani-Rapti river system in Chitwan respectively. Furthermore, Shreshta (1990) and Rajbanshi (2002) reported 88 and 85 species from the Narayani River. Similarly, Shrestha (2008) and Rajbanshi (2012) reported the presence of 170 and 195 species respectively from the sapta Gandaki river system and their tributaries from different altitudinal gradient. Jha & Bhujel (2014) recorded 108 species of fishes from the aquatic resources in Chitwan and adjacent areas in Nawalparasi and Makwanpur districts. In the present collection number of fish species was in increasing trend towards downstream. Edds (1993) reported that longitudinal succession was evident in the Gandaki river. Fish species showed close resemblances with fishes of the different districts of Nepal (Sharma, 2008; Shrestha & Edds, 2012; Kumar *et al.,* 2015) and also the Ganga river of India (Sarkar *et al.,* 2012).

The carps are dominated group having major food fishes including *Labeo* spp. Eleven species of *Labeo* were reported from the Gandaki/Narayani river Shrestha (2008, 2012). Only 7 species of *Labeo* represented in my collection and need further verification. Though fingerlings of different species of *Labeo* released regularly by Fisheries Research Centre of Nepal Agricultural Research Council in the tributaries of Narayani river to maintain the existing

stock, only *Labeo dero* was found abundantly in lower stretches.

The loach *Botia lohachata* showed its unusual occurrence during sampling, the other three species of this genus were very rare. The *Botia geto* was collected for the first time from Rapti river (fig. 5). Earlier, Jha & Bhujel (2014) not reported this species from the Narayani river system. Shrestha (2004, 2008) reported 2 and 4 species of the genus *Botia* respectively from the Gandaki river system. Shrestha (2008) reported the occurrence of *Botia geto* from the Seti river only. Rajbanshi (2012) also reported *B. geto* from the Gadaki/Narayani river, but not from the Rapti river in Chitwan and adjacent areas.

The catfishes are important group of fishes represented its dominance after carps. Thirty four species of catfishes were collected from different sampling sites. Shrestha (2008) reported 53 species of catfishes from the Gandaki/Narayani river system out of 70 species from Nepal. About 50% of total catfishes of Nepal represent in the present collection. Jha (2012) reviewed the Nepalese catfishes and their diversification of aquaculture. Mandal & Jha (2013) reported the presence of *Glyptothorax pectinopterus* and *Pseudecheneis sulcatus* from the Marsyangdi river, a tributary of the Narayani river, in Lamjung district with a total of 26 species. Jha & Bhujel (2014) not reported the occurrence of *Pseudolaguvia ribeiroi* (fig. 6) and *P. kapuri* (fig. 7) from the Narayani river system. These species were collected from different parts of the Rapti river (fig. 8, 9, 10). Shrestha (2008) reported both species of the genus *Pseudolaguvia* from the Gandaki/Narayani river.

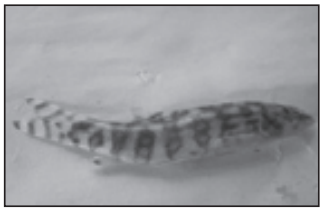

FIG. 5. *Botia geto.*

FIG. 6 *Pseudolaguvia ribeiroi.*

FIG. 7. *Pseudolaguvia kapuri*

Courtesy: MDI

Edds (2007) reported *Glyptothorax Garhwali*, *Psilorhynchus gracilis*, *Nangra assamensis*, and *Sisor rheophilus* from the Gandaki/Narayani river. These species were not represented in the collection as *Glyptothorax Garhwali* and *Psilorhynchus gracilis*, re ported to occur in the upper reaches of the Kali Gandaki river. Similarly, *Nangra assamensis*, and *Sisor rheophilus* reported to occur in the lower most reaches of the Narayani river. Though *Sisor rhabdophorus* was of rare occurrence in upper reaches of the Narayani river in Chitwan, it was uncommonly seen down from the Gandak barrage. Shrestha (2008, 2012) reported both of these species from the Gandaki/Narayani river. Also, Ng (2003) reported the rare occurrence of *Sisor rheophilus* from the upper stretches of the Narayani river. Further, 4 and 3 species of *Pseudecheneis* were reported by Shrestha (2008, 2012). The single species of *Pseudecheneis sulcatus* was represented the collection obtained during this study. On the paper of Ng and Edds (2005), Shrestha (2012) opined that *P. sulcatus* has been divided in to three different species as *P. crassicauda*, *P. eddsi*, and *P. serracula* from Nepal. Also, Ng and Edds (2005) reported that

P. sulcatus is restricted to Brahmaputra drainage only, while Shrestha (2008) reported the occurrence of all 4 species from Nepal including *P. sulcatus*. The river shad *Gudusia chapra* reported earlier from the middle part of Chitwan was collected from lower part only. The distribution of different species of fishes in Chitwan and adjacent areas showed similarities with those of earlier reports (Edds, 1993; Sharma, 2008; Shrestha, 2008; Shrestha & Edds, 2012; Jha & Bhujel, 2014).

The Narayani River has a barrage to control water for irrigation and power generation without any fish way has great impact on the ichthyofauna of upstream and downstream of the river. Faunal composition is affected by interference on the natural system of the river, thus development of suitable technology for conservation of indigenous fishes would be challenging (Rajbanshi, 2002, 2012; Gubhaju, 2012, Gurung, 2012). Specially, during spring and summer, downstream near barrage is completely dry, which effect the migration of important migratory fishes. Fishing community of Tribenighat reported declining catches due to degradation of fish habitats and barrage without fish-way which obstruct spawning migration also. Regulation of water flow by damming or irrigation has pronounced effect on fishery resources of major rivers (Shrestha, 2008; Gubhaju, 2012; Mandal & Jha, 2013).

Though restocking of some important fishes are regularly carried on by Nepal Agricultural Research Council for conservation and maintaining population, more research is needed on whether there are any significant anthropogenic effects on the fish population through habitat alterations, poisoning and other illegal fishing, overexploitation and new species introduction in the river system. Maximum presence of 195 species of indigenous fishes reported from the Sapta Gandaki/ Narayani river system on the basis of literature reviewed, which are either based on the previous works or on short studies by various authors, there is an urgent need of year round studies on the diversity and distribution of different fishes from all tributaries of the Narayani/ Rapti river systems in Chitwan and adjacent areas. The species collected should be preserved and deposited in proper places for further study to avoid confusion.

The study revealed that ichthyofauna in the Trisuli, Rapti and Narayani river systems in Chitwan district and adjacent areas is represented by 111 species which belonged to 9 orders, 27 families, and 72 genera. Among the collected species, order, Cypriniformes had the highest number of species while Anguiliformes, Beloniformes, Clupeiformes and Tetraodontiformes represented the lowest in number. Findings of this study will be useful to ichthyologist and others studying Asian/ South-Asian fishes as well as managers/planners responsible for conserving the existing fauna through aquaculture diversification. Fish diversity of the major tributaries of Narayani river system in Chitwan and adjacent areas was found to be affected by overexploitation of fishery resources and loss of habitat. Therefore, appropriate measures should be applied for species conservation.

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