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Taxonomic study of the Family Channidae, of Nepal

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Abstract
Fish survey were undertaken during August 2015 to March 2016 to predict the taxonomic study of the species beloning to the family Channide. Koshi Barrage, a part of Koshi River, lying in the district Sunsari and Saptari; of Nepal was choosen as a site, for the study. Fishes caught alive or in fresh condition, were collected, fixed with 40% formalin, photographed and preserved in 10% formalin, labeling them, giving serial numbers, the name of exact locality from where they have been collected; date of the collection and their local name on each jar and preserved. The fishes were identified using a website www.fishbase.com and other available resources. Five species of fishes belonging to the family Channidae were identified and taxonomic study was carried out at an international level. Further scientific reaearch is only possible after the correct identification. So, it is supposed to be the most important study; as fishes are the best alternative sources of protein and may carry many other values in the field of medicines against different challenging diseases. This is possible only when the fishes are identified correctly. Out of 5 species, 3 of them; Channa gachua, Channa marulius and Channa striatus; is investigated to be a new report in the context of Nepal, as it is not mentioned in the fishbase.

Keywords: taxonomy, koshi barrage, channidae, fishbase, koshi river

1. Introduction
Nepal covers an area of 147,181 square kilometres, that resides more than 6000 rivers and streams with three main river systems, viz., the Koshi, the Gandaki and the Karnali. The indigenous and exotic fishes of Nepal in total were found to be 186 species (Shrestha, J., 1995; Subba and Ghosh, 1996) [8, 7]. Out of these, there were fifty-nine Coldwater indigenous and two exotic fish species in Nepal as investigated by Shrestha. The latest data reveals about 239 fish species in the country according to the report of fish base.

1.1 Taxonomic study of the fishes in Nepal
As far as it is concerned with the taxonomic study of the fishes, in Nepal, it has been the least study ever, done in the Country. Fish constitutes almost half of the total number of vertebrates in the world. They live in almost all conceivable aquatic habitats. They exhibit enormous diversity of size, shape and biology, and in the habitats they occupy. Of the 39,900 species of vertebrates in the world, Nelson (1984) estimated 21,723 extant species of fish under 4,044 genera, 445 families and 50 Orders in the world, compared to 21,450 extant tetrapods. Of these, 8,411 are freshwater species and 11,650 are marine. Other researchers, have arrived at different estimates, most of which range between 17,000 and 30,000 for the numbers of currently recognized fish species. The eventual number of living fish species may be close to 28,000 in the world. Day (1889) [13] described 1418 species of fish under 342 genera from the British India.
Kankai, Kamala, Mechi, Rapti, Babai and Tinau are equally important rivers. There are 185 fish species in Nepal belonging to 79 genera, 31 families and 11orders (Shrestha, 1995) [9]. The indigenous and exotic fish of Nepal total 186 species (Shrestha, J., 1995; Subba and Ghosh, 1996) [9, 7]. They are distributed from the lowland plains (Terai), through the hills to the Himalayan Mountains up to an altitude of approximately 4000 m. Nepal is rich in water resources and fish diversity. The main sources of water of Nepalare Rivers originating from Himalayas and their tributaries. In addition to rivers, there are several lakes, ponds, reservoirs, etc. which provide shelter and feeding habitats to fresh water fishes. The initial taxonomic work of fishes of Nepal goes back towards eighteenth century when Hamilton (1822) [1], Hickel (1843), Gumther (1861, 1868) and Day (1869) [13] made expeditions to survey fish of India and its adjoining countries. They addressed the fishes of Nepal for the first time. Since then, the inception of taxonomic works on fish of Nepal took place so far the literature are concern, still a through survey of fishes of Himalayan waters of Nepal is incomplete. Among a good numbers of contributors to taxonomical works on fishes of Nepal, the works of Shrestha (1981) [9], Talwar and Jhingran (1991) [3], Tereshima (1984) and Subba (1995, 1996) [7] deserve special mention. The authors have made an attempt to collect and identify the fishes of eastern Terai of Nepal

2. Materials and Methods
Koshi is the biggest river of Nepal. Koshi is a river formed by merging 7 tributaries. So, also called as Saptakoshi River. As this river flows across 3 countries, namely China, Nepal and india, it is also called as an international river. Koshi falls in Ganga River from Kurshila of India, Bihar. The length of this river is 729 kilometer from Tibet to India Bihar. It covers 60420 square kilometer in three countries. Out of this area, Nepal bears 27883, India 11410 and Tibet bears 21127 square kilometer. After reaching it in Ganga River, it flows up Bangladesh and falls down in Indian Ocean (Khatiwada *et al*., 2014) [2].
Koshi flows from eastern Nepal. Different branches of koshi are originated from different mountains with different names and they are flowing towards southeast, southwest and direct south. After reaching near Triveni, Arun and Sunkoshi and

later on Tamor join each other and flow downward to the south with the name Saptakoshi. The water, east from Goshainkunda of central Nepal and to the west of Kanchangunjha of eastern Nepal collects to this river covering a large area of high mountains and hills. Out of its main seven branches, Arun and Bhotekoshi are originated from Tibet. Hence, Arun River enters Nepal from Kimathanka pass or boarder and the Bhotekoshi River enters Nepal from Tatopani pass. Latter on the Saptakoshi River enters towards India, Bihar from Bhimnagar. The field study was carried out in the koshi barrage area that encloses three districts namely saptari, sunsari and udayapur.

The field study was carried out in the koshi barrage of Koshi river, that encloses three districts namely saptari and sunsari. The study site lies within 86°55' - 87°05' E longitude and 26°24' - 26°45' N latitude. Fishes collected from this site were fixed with 40% formalin and photographed with lenovo mobile, S850 model with 13 mega pixel. 40% formalin through their mouth and vent were injected and finally preserved in 10% formalin. The fishes collected and fixed, were then labeled giving serial numbers, the name of exact locality from where they were collected; date of the collection and the local name on each jar. And finally brought in AUCST (Andhra University College of Science and Technology), Department of Zoology, in India for further identification and investigation. The fishes were identified and taxonomically classified using a website www.fishbase, articles and journals of Nepal and Talwar and Jhingran, 1991 and 1992 [3, 4].

List of the abbreviations used

TL – Total length of the body
SL – Standard length of the body
SN – Snout length
ED – Eye diameter
GM – Length of the gape of the mouth
CM – Length of the cleft of the mouth
IW – Interorbital width
PD – Predorsal length
Pd - Postdorsal length
LH – Length of the head
DH – Depth of the head
WH – Width of the head
DB – Depth of the body
LD – Length of the dorsal fin
LP – Length of the pectoral fin
LV – Length of the ventral fin
LA – Length of the anal fin
LC – Length of the caudal fin
lc – Length of the caudle peduncle
hc - Height of the caudle peduncle
VA – Distance between ventral fin and anal fin
va - Distance between vent and anal fin
LD – Length of the adhesive disk
WD – Width of the adhesive disk
LO – Length of the occipital process
DH – Depth of the head
Br. – Number of bracheostegal rays
D – Dorsal fin
C – Caudal fin
A – Anal fin
V – Ventral or pelvic fin
D_2 – Second dorsal fin
D_1 – First dorsal fin,
I, II, III….etc – Roman numbers represent the number of spines.
1, 2, 3….etc – Hindu Arabic numbers represent the number of rays
The morphometric measurements were taken in the unit (cm).

Fig 1: Study Area (Koshi Barrage)

3. Result

About 5 species of the genus, Channa were found. They were Channa striatus, Channa punctatus, Channa gachua, Channa marulius and Channa orientalis. The taxonomic and possible ecological study of these fishes are submarrized as under**:**

Family: Channidae (Snakeheads or Murrels)

Body elongate and cylindrical with long, entirely soft-rayed dorsal and anal fins. Mouth large with toothed jaws and palate. Eyes placed in anterior-half of head, dorsolateral in position. Gill openings wide; gill-membranes confluent with each other but free from isthmus; no pseudobranchiae. Branchiostegal rays five. Pelvic fins usually present (absent in some stocks of Channa orientalis), with six rays. Scales small, cycloid or

ctenoid; scales on head larger than those on body and provided with concentric rings towards their margin, a few arranged in form of a rosette. Airbladder elongated, extending almost too caudal peduncle. Colour pattern usually in shades of grey, brown and black, often with distinctive markings; possess a considerable range of colour change and speedily alter their hue according to their surroundings or mental condition. The shape of the head resembles that of a snake. The snakeheads inhabit mainly permanent shallow, lentic waters (ponds and lakes); the larger species (Channa marulius) also inhabit rivers and large lakes. These fishes are air breathers. They live for many hours out of water and can migrate across land from one fresh water pool to another. These fishes can be kept alive for days with the minimum quantity of water or even if the respiratory apparatus and the body are kept moist.

Genus: Channa

Body very elongate, almost cylindrical anteriorly and somewhat compressed posteriorly. Head large; mouth fairly large. Anterior nostrils tubular. Dorsal and anal fins long-based; pelvic fins sub abdominal. It is found in almost every part of India, in lowland streams and canals, and upland and mountain streams, and lakes, ponds and swamps.

Species 1.

Channa striatus (Bloch, 1793), Plate A.1.

Ophiocephalus striatus (Bloch, 1793)

Taxonomic position:

Kingdom - Animalia
Phylum - Chordate
Class - Actinopterygii
Order - Perciformes
Family - Channidae
Genus - Channa
Species – striatus

Distribution: Pakistan to Thailand, south China and Nepal (Sunsari and Saptari).

Diagnosis:

Table 1: Fin formula

Br.	D	D_1	D_2	P	V	A	C
-	40	-	-	16	6	26	17

Table 2: Morphometric measurement

TL	SL	SN	ED	GM	CM	IW	PD	pd	LH	WH	DH	DB	LD	LP	LV	LA	LC	lc	hc	VA	va	LD	WD	LO
19.5	16.6	1.2	0.8	1.6	2.5	1.2	6.9	1.1	5.6	2.6	3.2	3	1.6	2.8	2	1.7	2.9	1.6	1.6	3.5	0.4	-	-	-

Description: Body sub-cylindrical; head depressed with viliform teeth in the mouth; dark vertical bands are present on the ventro-lateral side of the body below the lateral line; caudal fin rounded. The dorsal surface and sides, dark; a large head reminiscent of a snake's head; predorsal scales 18 to 20; lateral line scales 50. Eyes placed above the cleft. Dorsal, caudal and anal fins black in colour. The pectoral fin is brown and the head is pale yellow laterally. Large scales on the head. Anal fin rays 23 to 29. The pectoral fin is 2 times in head length.

Ecology: Eyes moderate, its diameter is 6 to 7 times in head length. Very common in freshwater plains; survive dry season by burrowing in bottom mud of lakes, canals and swamps as long as skin and berating apparatus remain moist. Feeds on fishes and crustaceans.

Common name: Striped snakehead.

Colour: Adults grey green to black-green on upper side; from middle of side upwards very pale, yellow to slivery; belly usually pure white. In young fishes the upper side paler, with dark blotches on flanks which may form angular bands; a dark band runs obliquely upwards from snout to edge of gill-cover. Dorsal and anal fins slightly darker in colour than body, with dark patches on membranes between rays; caudal fin dark, with two distinct pale vertical bands on its base; pectoral and pelvic fins pale; dorsal fin in young with a black blotch at hind end.

Distribution: Pakistan to Thailand, south China and Nepal (Sunsari and Saptari).

IUCN red list status: Least concern.

CTTES: Not evaluated.

Threat to human: Potential pest.

Species 2.

Channa gachua (Hamilton, 1822) [1]**, Plate A.2.**

Taxonomic position:
Kingdom - Animalia
Phylum – Chordata
Class – Actinopterygii
Order – Perciformes
Family –Channidae
Genus – Channa
Species – gachua

Distribution: Afghanistan in the west to Indonesia through South and Central Asia and Nepal (Sunsari and saptari).

Diagnosis:

Table 3: Fin formula

Br.	D	D_1	D_2	P	V	A	C
-	37	-	-	13	6	22	13

Table 4: Morphometric measurement

TL	SL	SN	ED	GM	CM	IW	PD	pd	LH	WH	DH`	DB	LD	LP	LV	LA	LC	lc	hc	VA	va	LD	WD	LO
13.4	11.1	0.8	0.64	1.1	1.4	0.8	4.2	0.9	3.8	2.2	1.8	2.2	1.4	2.2	1.4	1.1	2.3	1	1.2	1.9	0.4	-	-	-

Description

The head is distinctly dorsoventrally flattened with large broad irregular scales on the summit of head. Scales on the head roughened by circular lines, which is externally parallel with outer edge. 4 or 5 rows of scales between the orbit and the angle of the pre-opercle,12 number of scales in between the snout and base of the dorsal fin. Lateral line bend downwards after proceeding 12 scales. Colour changes according to the habitat. laterally placed eyes. Pectoral fin reach beyond the pelvic fin. Pectoral fin is with a black base transversely barred. White dorsal, anal and caudal margins. The tail is rounded. Opercula touches the pectoral fin. The body colour is dark grey and the ventral part is light grey except the pectoral and ventral fins. The lateral line scales 40. Scales 3, between the anterior dorsal rays and the lateral line. L. tr. sc is 3/7. Greatest width of the head equals its length behind the eyes. The body depth is 6 in total length, the eye diameter is 1/6 of the head length and the ventral fin is 2/5 of the length of the pectoral fin.

Ecology: Predatory in habit, its diet comprises terrestrial insects and smaller fish prey.

Common name

Colour: Body dark grey in colour with white margin in dorsal, caudal and anal fin.

Distribution: Afghanistan in the west to Indonesia through South and Central Asia and Nepal (Sunsari and saptari).

IUCN red list status: Least concern.

CTTES: Not evaluated.

Threat to human: Harmless.

Species 3

Channa punctatus (Bloch, 1793), Plate A.3.

Ophiocephalus punctatus (Bloch, 1793)

Taxonomic position:

Kingdom - Animalia

Phylum – Chordata

Class – Actinopterygii

Order – Perciformes

Family –Channidae

Genus – Channa

Species – punctatus

Distribution: Afghanistan, Pakistan, India, Sri Lanka, Nepal (Sunsari and Saptari), Bangladesh, Myanmar and Yunnan in China.

Diagnosis:

Table 5: Fin formula

Br.	D	D_1	D_2	P	V	A	C
-	30	-	-	13	6	21	20

Table 6: Morphometric measurement

TL	SL	SN	ED	GM	CM	IW	PD	pd	LH	WH	DH	DB	LD	LP	LV	LA	LC	lc	hc	VA	va	LD	WD	LO
12.9.	10.9	0.9	0.5	1	1.3	0.9	4.4	0.9	4	1.9	1.9	2.5	1.5	2	1.4	1.6	2	0.9	1.2	2	0.1	-	-	-

Description:

The head is dorsally flattened and contains large scales. The mouth is superior and the snout contain pores. Villiform teeth in the upper and lower jaw. Dorsal fin has 30 rays longer than the anal fin with 21 rays. The pectoral fin is longer than pelvic fin and plain without any vertical bands. The length of pelvic fin is more than 50% of the pectoral fin. . The pectoral fin is laterally originated and the ventral fin is ventrally originated. Grey spots and blotches are present in the body. Prodromal scales 11, lateral line scales 37 and lateral transverse scales 6 and 8 above and below the lateral line respectively. Dorsal, anal and caudal fins are grey while pectoral and ventral fins are creamish white. Eyes moderate, its diameter 7 to 8.5 times in head length.

Ecology**:** This fish species carry heavy infection of helminthes parasites and serve as the host of different helminthes parasites. Infection of these parasites may be result in poor growth, postpone sexual maturity and mortality of fishes, and cause human and animal diseases. Digenean trematodes are important helminth parasites of Channa punctatus (Yadav *et al*., 2010) [16].

Common name: Spotted snakehead

Colour: In life varies from black to light green on dorsal side and flanks; ventral side white to pale yellow, sometimes with a reddish tinge; several dark blotches on flanks; some specimens with numerous black spots on body, and also on dorsal, anal and caudal fins. Dorsal, anal and caudal fins dark grey, sometimes with a reddish tinge; paired fins pale orange.

Distribution: Afghanistan, Pakistan, India, Sri Lanka, Nepal (Sunsari and Saptari), Bangladesh, Myanmar and Yunnan in China.

IUCN red list status: Least concern.

CTTES: Not evaluated.

Threat to human: Harmless.

Species 4

Channa orientalis (Bloch and Schneider, 1801), Plate A.4.

Ophiocephalus gachua (Hamilton-Buchanan, 1822) [1]

Ophiocephalus apus (Canestrini, 1861)

Ophiocephalus harcourt-butleri (Annandale, 1918)

Channa burmenica (Chaudhuri, 1919)

Ophiocephalus gachua kelaarti (Gunther: Munro, 1955)

Taxonomic position:

Kingdom - Animalia

Phylum – Chordata

Class – Actinopterygii

Order – Perciformes

Family –Channidae

Genus – Channa

Species – orientalis

Diagnosis:

Table 7: Fin formula

Br.	D	D_1	D_2	P	V	A	C
-	33	-	-	15	6	21	19

Table 8: Morphometric measurement

TL	SL	SN	ED	GM	CM	IW	PD	pd	LH	WH	`	DB	LD	LP	LV	LA	LC	lc	hc	VA	va	LD	WD	LO
13.4	11.1	0.8	0.64	1.1	1.4	0.8	4.2	0.9	3.8	2.2	1.8	2.2	1.4	2.2	1.4	1.1	2.3	1	1.2	1.9	0.4	-	-	-

Description: The body is laterally compressed with dorsoventrally flattened head. The head contains a rosette of large scales behind the orbits touching the frontal head scale and the mouth bears teeth, both in its upper and lower jaw. The eyes are laterally placed and its diameter is 6 times in head length. The anal, caudal and dorsal fins are black with orange tipped ventral fin. The ventral fin originates ventrally and are fused. The pectoral fin is barred and distinctly large than the ventral fin. About 9 to 10 vertical bands are present behind the operculum upto the caudal finbase. The predorsal scales are 6 and the lateral transverse scales 5/8. The lateral line scales 41. The dorsal fin has 33 rays and the anal fin has 21 rays. Caudal fin is roundly pointed only in this species out of 37 species reported in fishbase in 2016. The HL is 34.23%SL and 28.35% TL. The height is 19.81%SL and 16.41%TL. The eye is 13.15%HL
Common name: Asiatic snakehead/Walking snakehead.
Colour: In life dorsal side and flanks green, ventral side pale with a faint bluish or reddish tinge; a row each of dark oblique bands run above and below the lateral line. Pectoral fins with a series of distinct alternating blue and pale orange vertical bands; outer margin of caudal fin bright orange and barred in the fishes of India.
Distribution: Afghanistan, Baluchistan southward to Sri Lanka and eastward to Indonesia and Nepal (Sunsari and Saptari).
IUCN red list status: Not evaluated.
CTTES: Not evaluated.
Threat to human: Harmless.

Species 5
Channa marulius (Hamilton- Buchanan), Plate A.5.
Ophiocephalus marulius (Hamilton- Buchanan, 1822) [1]
Ophiocephalus leucopunctatus (Day, 1876) [13]
Ophiocephalus pseudomarulius (Gunther: Day, 1876) [13]
Channa marulius are (Deraniyagala, 1945)

Taxonomic position
Kingdom - Animalia
Phylum - Chordate
Class - Actinopterygii
Oder – Perciformes
Family - Channidae
Genus – Channa
Species – marulius
Distribution: India to China, south to Thailand, Cambodia, Pakistan and Nepal (Sunsari and Saptari)

Diagnosis:

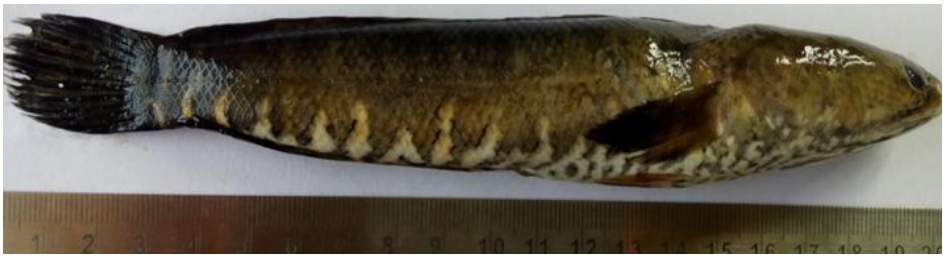
Table 9: Fin formula

Br.	D	D_1	D_2	P	V	A	C
-	54	-	-	19	6	34	17

Description: Body elongate and fairly rounded in cross-section. There are 3 to 4 ocelli on the lateral sides of the body and a black white edged ocellus at the tip of the caudal finbase. Numerous white spots on body and fins. The dorsal, anal and caudal fins are brown and the pectoral fins are yellow in colour. The caudal fin is rounded and the body is covered with moderate scales. The mouth is large and the eyes moderate. Lateral line scales 62. Caudal fin rounded. Pelvic fin about 75% of pelvic fin. Pectoral fins about half head length. Lower jaw with 7 to 18 canines behind a single row of villiform teeth. Scales on summit of head of moderate size, rosette of head-scales lies between orbits, frontal head scale occupying central portion of rosette; two scales between rosette and basal head-scale; predorsal scales 16; scales 60 t0 70 in lateral line series.
Ecology: As Channa marulius constructs nests of vegetation for spawning and rearing of young, the species is often found in association with flooded forests and submerged vegetation (Talwar and Jhingran, 1992) [4].Channa marulius is aggressive and highly predatory and is known to prey upon fishes (including conspecifics), crustaceans and insects (Dasgupta, 2000) [15]. They are highly sought after as a game species in Thailand and are known from both the aquarium and live food fish industries (Courtenay and Williams, 2004) [14].
Common name: Great snakehead
Colour: In life, above lateral line greyish-green, with five or six dark oval blotches on flank which terminate below lateral line; below lateral line between blotches pale yellow with reddish tinge; distinct white spots scattered on body. Dorsal and anal fins with white spots, more distinct towards posterior end of fins; paired fins pale with a reddish tinge; caudal fin dark with white spots arranged in form of discontinuous vertical bands; a distinct pale-edged ocellus at base of caudal fintowards upper side. Juveniles with an orange band running from eye to middle of caudal fin.
Distribution: India to China, south to Thailand, Cambodia, Pakistan and Nepal (Sunsari and Saptari)
IUCN red list status: Not evaluated
CTTES: Least concern.
Threat to human: Traumatogenic

Table 10: Differences among the species of the genus, Channa

Characters	Channa striatus	Channa punctatus	Channa gachuwa	Channa orientalis	Channa marulius
Grey Blotches	absent	present	absent	absent	absent
Lateral line scales	50-57	37-40	40	40-50	60-70
Bands in the pectoral fin	absent	absent	Alternating black and white bands present	Alternating blue and light orange bands present	absent
Dorsal fin	40	30	37	33	54
Anal fin	26	21	22	21	34



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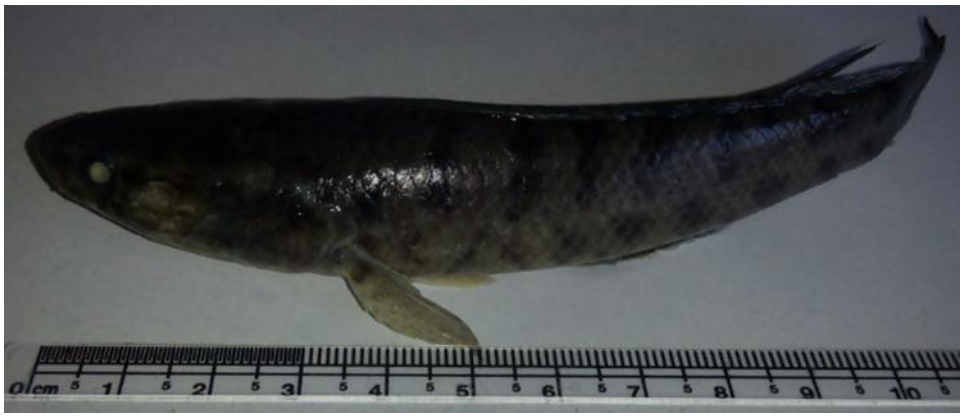

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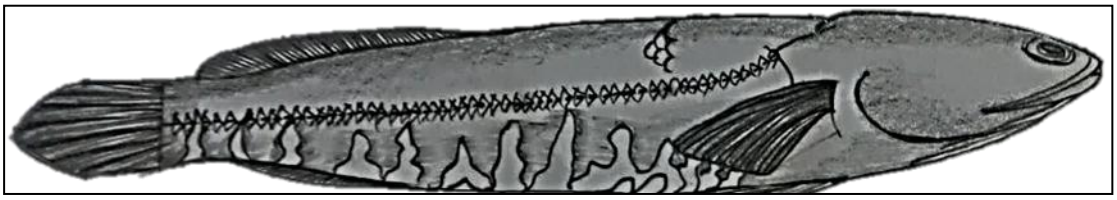
Fig 1: A. I.Channa striatus, 2.Channa gachua, 3.Channa punctatus, 4.Channa orientalis and 5.Channa marulius



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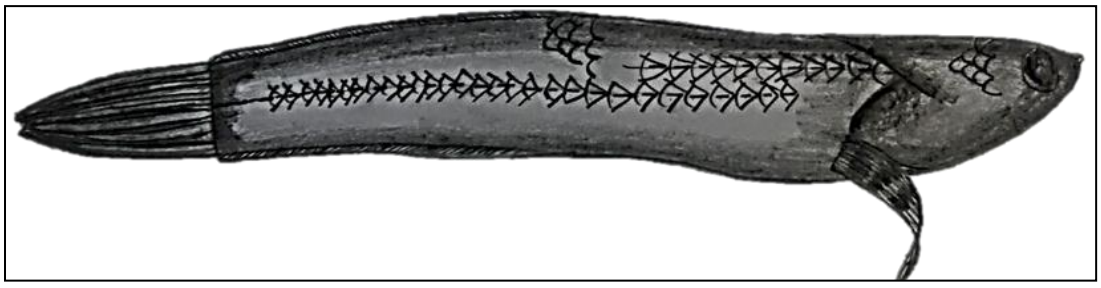

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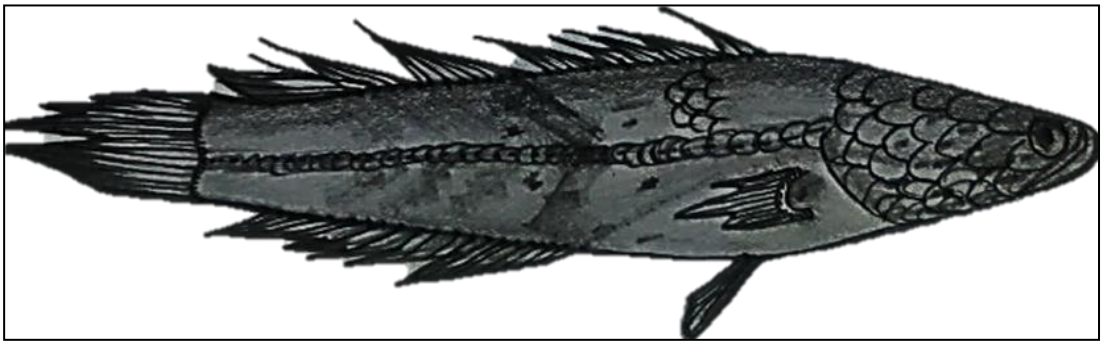

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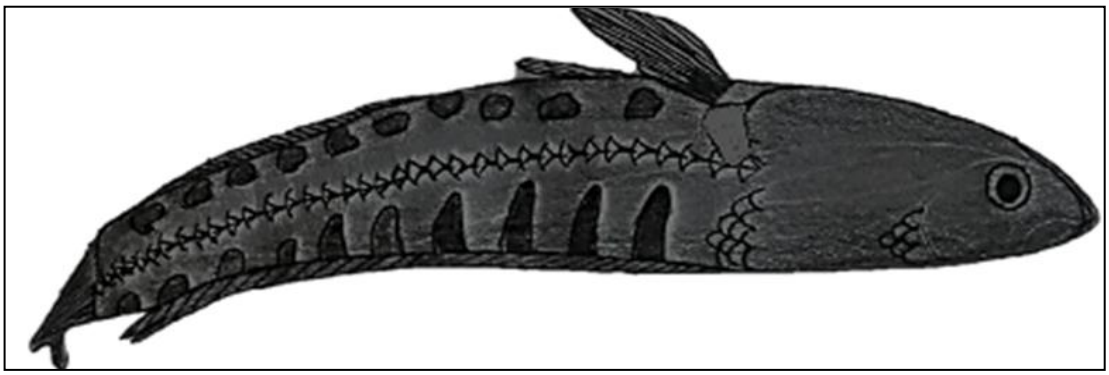

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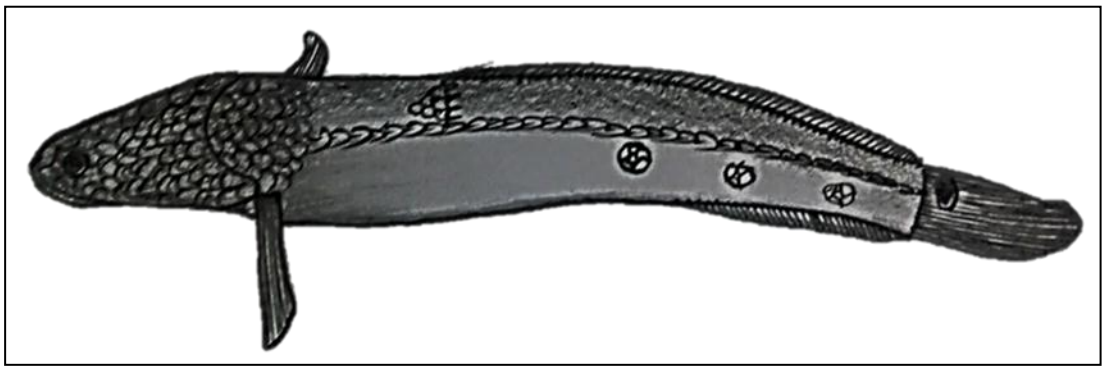

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Fig 2: B. I.Channa striatus, 2.Channa gachua, 3.Channa punctatus, 4. Channa orientalis and 5.Channa marulius

4. Discussion and conclusion

The water in Koshi barrage flows from eastern Nepal. It inhabits non flowing water in it except at the time of flood.The bottom of the water is gravelly sandy with some rocks and boulders in certain places. The algal growth and aquatic weeds in downstream regions of the river are fairly high. One of the feeder stream Arun supports the largest concentration of game and rare ornamental fish species than any other river in Nepal. The pH of the Koshi river at lower reaches varies from 6.0 to 7.5, water temperature 13^0C to 28.5^{o}C, DO from 6.0 to 12 ppm during March and April (1990-1991), as reported by (Shrestha, 1990a) [9]. In this water the agriculture lands and aquatic environment interact, which results in a complex ecological network with a substantial impact on the fish fauna of the river. The large number of cows and buffaloes interacts with the river water by supplying nitrogenous waste. Likewise the forest ecology enriches water with organic matter and products of its decomposition (by S. Yadav).

In the above study, finally 5 species of Channa were sort out, out of which Channa gachua, Channa marulius and Channa striatus are reported to be the new species. In the latest report revealed by fishbase and since 2012 onwards and yet now, these 3 fishes have not been reported. These all 3 species are also found to be absent in the report as investigated by (Shah, 2016) [5]. All of these 5 species, differ from each other in different morphological and biametric characters, as mentioned in table 10. They also differ ecologically from each other. Channa gachuwa is supposed to be predatory in habit, its diet comprises terrestrial insects and smaller fish prey. Channa marulius is found to be aggressive and highly predatory and is known to prey upon fishes (including conspecifics), crustaceans and insects (Courtenay and Williams, 2004) [14]. Channa punctatus carry heavy infection of helminth parasites and serve as the host of different helminth parasites. Infection of these parasites may result in poor growth, postpone sexual maturity and mortality of fishes and cause human and animal diseases. Digenean trematodes are important helminth parasites of Channa punctatus (Yadav et al., 2010) [16]. Channa striatus is supposed to be a potential pest.

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