

## Original Research Article

# Taxonomic Validation of the Assamese King Fish *Semiplotus semiplotus* (McClelland, 1839) (Cypriniformes: Cyprinidae) with Notes on its Biology and Habitat

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**Abstract:** The genus *Semiplotus* Bleeker 1860 was established to accommodate *Cyprinus semiplotus* McClelland 1839. Members of the genus are known from the Brahmaputra, Koladyne and Chindwin drainages, inhabiting the mountainous fast flowing streams with sediments consisting of pebble, cobble and boulder in. The generic placement of *Semiplotus semiplotus* has been confused since Howes synonymized the genus *Semiplotus* to *Cyprinion* Heckel in 1982, solely based on their similarities in the osteological structures of jaw and mouth shape. This study investigates the morphometric and meristics features of the *S. semiplotus*, and discussed the key characteristic differences between the two genera and considered *Semiplotus* as a valid cyprinid genus. This paper validated *Cyprinus semiplotus* under the genus *Semiplotus* and diagnosed it from congeners by its more branched dorsal-fin rays (23-25 vs. 20-23), single transverse row of 10-12 (vs. 5-6) open pores across the snout, and a fewer rows of scale (6 vs.7) above lateral line. The species is distributed only in the Brahmaputra drainage comprising: northeastern India, Bhutan and Nepal. The study also investigates the reproductive biology of the species and reveals that it breeds once in a year, after passing through a sequential gonadal maturity stages viz. immature phase, maturation phase and fully mature gonads. The fecundity of females ranged between 7510-23309 eggs with an average fecundity of  $12040.57 \pm 3574.62$  eggs. The findings on the physio-chemical characteristics of the *in situ* habitat of the species, its conservation status and prevailing threats are also presented and discussed in the paper.

**Key words:** Assamese king fish, *in situ* habitat, *Semiplotus semiplotus*, taxonomy

## Introduction

*Cyprinus semiplotus* McClelland 1839, was described from the Brahmaputra River in upper Assam, northeastern India. McClelland (1839) reported the species was plenty in the upper part of Brahmaputra basin, with size often reaching up to 2 feet in length; and further mentioned that the species refused all sorts of flies and baits, though a stone is cast into the water, all these fishes in the vicinity assemble surrounding the spot. The local name of this species is *Raja-mach* (*Raja*= King, *mach* =fish) in Assamese.

Bleeker (1860) established the genus *Semiplotus*, to accommodate *Cyprinus semiplotus*. Howes (1982) synonymized

*Semiplotus* under the genus *Cyprinion* Heckel. Menon (1999), Karmakar (2000), Shrestha (2008), Conway *et al*(2011). followed subsequently the same. However, Banarescu and Herzig (1995) recognized *Cyprinion* and *Semiplotus* are distinct genera and assigned *Cyprinus semiplotus* as a member of the genus *Semiplotus*. Sen (1985), Jayaram (1999), Peter (1999), Vishwanath and Kosygin (2000), Bagra *et al.* (2009a) and Gurung *et al.* (2013) placed the species under the genus *Semiplotus*.

In this study, we validate *Semiplotus semiplotus* and differentiate it from its congeners *S. modestus* Day and *S.*

*cirroshus* Chaudhuri. The distribution pattern, biology and *in situ* habitat of this species are also discussed.

### Material and methods

Measurements were made with a dial caliper to the nearest 0.1mm. Subunits of the head are presented as proportions of head length (HL). Head length and measurements of body parts are given as proportions of standard length (SL). Methods for measurements and meristic count follow Hubbs and Lagler (1964) and Armbruster (2012) respectively. Numbers in parentheses following a count are frequency of the specimens with that count. Morphometric and meristic data of *Semiplotus cirroshus* and *S. modestus* were taken from Vishwanath and Kosygin (2000).

### Results

#### *Semiplotus semiplotus* (McClelland 1839)

*Cyprinus semiplotus*: McClelland, 1839, Asiatic Researcher, 19(2): 274, 346, Pl 37, fig. 2 (type locality: Brahmaputra River, Upper Assam, India)

*Semiplotus maclellandi*: Day, 1887, Fishes of India: 550 (description)

*Cyprinion semiplotum*: Howes 1982, Bull. Brit. Mus. Nat. Hist. (Zoo). 42(4): 331, figs la-c (Jaw structure studied, status discussed); Talwar and Jhingran 1991, v. 1-2: i-xvii + 36 unnumbered + 1-1158, 1 pl, Menon, 1999:116; Karmakar, 2000:28; Shrestha, 2008: 62, text and figure; Conway *et al*, 2011: 1755.

*Semiplotus semiplotus*: Hora, 1937, Rec. Indian Mus. 39:45 (part); Shrestha 1978: 36, text; Vishwanath and Kosygin 2000: 98, text; Bagra *et al* 2009a: Gurung *et al*, 2013: 4882, text.

#### Material examined

RGUMF 058, 50.0-165.0 mm SL, 4 exs., India: Arunachal Pradesh: Dikrong river (Brahmaputra basin), 27°60' N latitude and 93°31' E longitude, elevation 126 msl., 3 March 2005, coll. Unknown. [Juvenile not measured]. RGUMF 304, 136.7-156.5 mm SL, 5 exs., India: Arunachal Pradesh: Singking river (Brahmaputra basin), 27° 54'26" N latitude and 95° 13'55" E longitude, elevation 175 msl., 24 Feb 2016, Coll. Rashmi Dutta

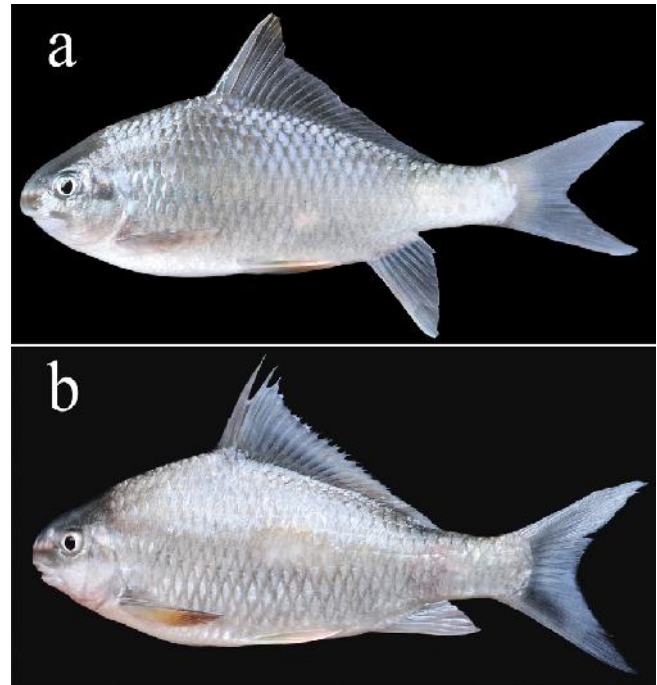


Fig. 1. Lateral view of *Semiplotus semiplotus* (unregistered) a. Female (218 mm TL) b. Male (200.6 mm TL).

and Party. RGUMF 305, 137.2-167.2 mm SL, 3 exs., India: Arunachal Pradesh: Sipu river (28°06'28" N latitude and 94°79'59" E longitude) (Brahmaputra basin), 5 April 2013, coll. A. Darshan and Party.

#### Diagnosis

*Semiplotus semiplotus* is distinct from congeners in having a unique combination of the following characters: last simple dorsal-fin ray posteriorly smooth; branched dorsal-fin rays 23-25, a transverse row of 10-12 open pores (5-6 on each side) across the snout (Fig. 2)

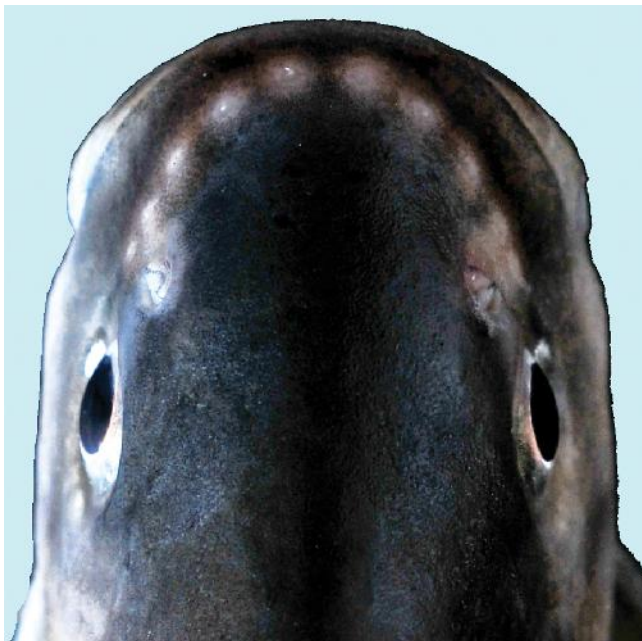
#### Description

Morphometric data are provided in Table 1. Head and body deep and laterally compressed. Dorsal profile convex from tip of snout to end of dorsal fin and gently slanting towards caudal peduncle. Ventral profile slightly convex up to end of anal-fin base and there after more or less straight up to base of caudal fin.

Snout blunt with single distinct transverse row of 10-12 open pores (5-6 in each side) across it. Posteriorly open pores directed towards middle of orbit. Eye moderate in size, placed almost on middle of head. Mouth wide, inferior, lower

**Table 1.** Morphometric data of *Semiplotus semiplotus* (n=10).

Morphometric measurement	Mean $\pm$ SD	Range
<b>% of standard length</b>		
Head length	22.659 $\pm$ 1.115	20.90-24.15
Body depth at dorsal origin	38.338 $\pm$ 2.581	34.50-42.35
Body width at dorsal origin	17.269 $\pm$ 0.953	15.50-18.65
Pre-dorsal length	45.376 $\pm$ 0.817	44.22-46.66
Pre-pectoral length	21.994 $\pm$ 1.287	20.34-24.6
Pre-pelvic length	46.902 $\pm$ 0.831	45.59-48.12
Pre-anal length	73.711 $\pm$ 0.793	72.67-74.55
Pre-anus	71.179 $\pm$ 2.217	68.00-73.87
Dorsal-fin base length	43.797 $\pm$ 0.975	42.72-45.52
Dorsal fin height	24.309 $\pm$ 0.916	22.46-25.40
Pectoral-fin length	21.889 $\pm$ 0.672	20.61-22.67
Anal -fin base length	12.194 $\pm$ 0.590	11.50-13.00
Anal fin length	22.31 $\pm$ 1.357	20.43-23.65
Caudal fin length(upper lobe)	34.191 $\pm$ 1.632	31.92-35.89
Caudal fin length(lower lobe)	33.375 $\pm$ 0.570	32.64-33.97
Caudal peduncle length	22.146 $\pm$ 0.599	22.10-23.33
Caudal-peduncle depth	11.831 $\pm$ 0.753	10.70-12.66
<b>% of head length</b>		
Head height at occiput	108.021 $\pm$ 4.519	99.83-14.25
Head width at occiput	70.043 $\pm$ 1.556	67.51-72.65
Snout length	34.595 $\pm$ 1.722	32.69-37.56
Eye diameter	25.94 $\pm$ 2.314	23.01-29.32
Inter-orbital distance	54.836 $\pm$ 2.337	52.35-59.67
Mouth width	61.966 $\pm$ 3.346	57.70-67.22

**Fig. 2.** Transverse row of open pores on snout of *Semiplotus semiplotus* (dorsal view). [Not to scale]

jaw with horny sheath, dentary with broad deflected labial surface. Maxillary barbel present, single pair, more prominent in juveniles, concealed in groove between maxilla and snout in larger specimens.

Dorsal fin with four osseous simple rays and 23-25 branched rays. Dorsal fin high reaching half of body depth at dorsal origin, its origin commencing at level through twice eye-diameter anterior to pelvic-fin origin and end at level through 4<sup>th</sup> branched ray of anal fin. Last dorsal simple ray strong, not serrated in adult but slightly serrated distally in juvenile specimens. Pectoral fin with one simple and 15-16 branched rays, its distal tip not reaching pelvic fin origin when adpressed, terminated one eye diameter anterior to pelvic origin, fin margin slightly concave. Pelvic fin with one simple and 9 branched rays, posterior fin margin concave, its distal tip not reaching origin of anal-fin when adpressed, terminated one and half eye diameter anterior to anal opening, auxillary scale prominently developed and terminate near distal tip of innermost branched ray. Anal fin with 2 simple 9 branched rays, fin margin straight, distal tip of anal fin reaching middle of caudal peduncle. Caudal fin deeply forked with 10+9 principal caudal-fin rays. Lateral scales large and smaller in chest and abdomen. Lateral line scale with 32-33, scales above lateral line to origin of dorsal fin with 6 rows of scales; scales below lateral line to origin of pelvic fin with 4 rows, 11-12 predorsal scales, 11+11 circumferential scales, 5+5 circumpeduncular scales, and 8 post anal scales. Lateral line complete.

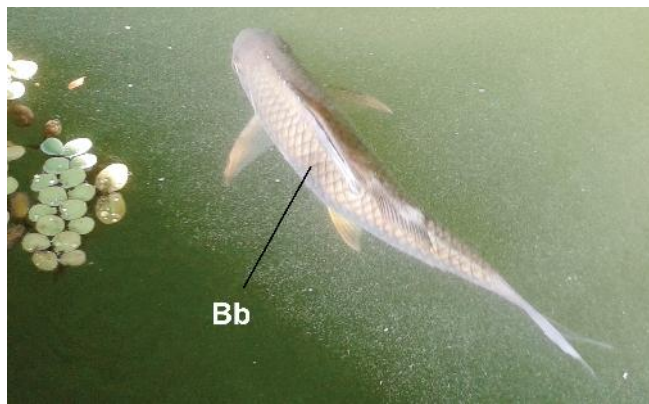
### Sexual dimorphism

Size of mature males usually smaller (150 mm TLd" male) than mature females (160 mm TLd" female). Anal and pair fins of males strongly reddish-orange (vs. very light orange in female) in colour. Anal fin longer in mature female than male (26.93  $\pm$  1.31 vs. 22.97  $\pm$  0.90 % SL). Male bears scattered tubercles on anal fin during breeding season (July to September) (Bagra *et al.*, 2009b).

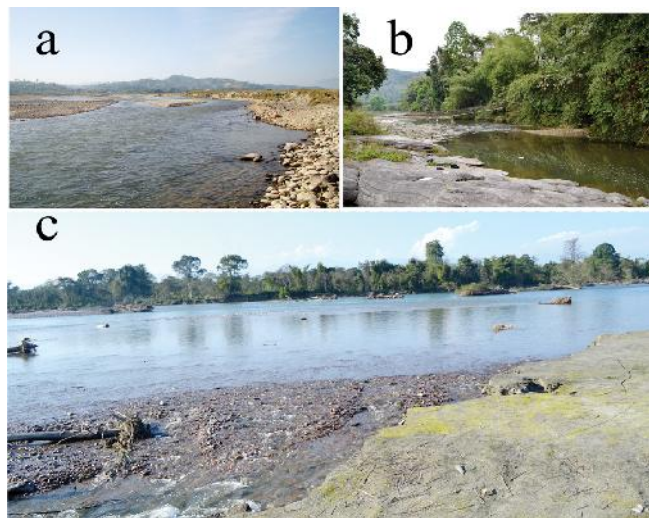
**Colouration:** Live specimen are silvery laterally and blackish on mid-dorsal. A prominent grayish bar reflects below dorsal fin (Fig. 3) when the fish is in water. A swarm of this species can be easily recognized in rivers by seeing its grayish bar.

This bar shaped grayish reflection turned indistinct when the fish are removed from the water. Pectoral, pelvic and anal fins orange. The degree of deepness of this orange colour differs seasonally and age of the fish. Fin colour is more prominent in smaller fishes. In 70% alcohol, dull silvery laterally and dorsally grayish. In 10% formalin, overall body appears brownish in colour.

**Distribution:** India: Ganga-Brahmaputra basin in Arunachal Pradesh, Assam, Sikkim, West Bengal (Talwar and Jhingram 1991; Nath and Dey, 2000; Vishwanath and Kosygin, 2000; Bagra *et al.*, 2009b; Tamang *et al.*, 2007). This species is also known from Nepal (Shrestha, 1997) and Bhutan (Peter, 1999;



**Fig. 3.** *Semiplotus semiplotus* showing the grayish bar below the dorsal fin. [Not to scale]



**Fig. 4.** Fast flowing river habitat of *Semiplotus semiplotus* a. Dikrong river at Papumpare. district, b. Sipu river at West Siang district, c. Singking river at Lower Dibang Valley district.

Gurung *et al.*, 2013). The report of this species from Myanmar (Day, 1877) is unlikely.

**Habitat and ecology:** *Semiplotus semiplotus* inhabits moderate to fast flowing mountain streams with rapids and rocky beds consisting of pebble, cobble and boulder (Fig. 4). The juveniles up to fingerling sizes are often encountered in rapids and ripple with bottom substrate consisting of pebble and cobbles while the matured larger fishes are in the deeper water with bottom substrate dominated with cobbles and boulder. Gut content analysis confirmed that, this species is a phytoplanktivorous fish. The phytoplankton (Bacillariophyceae) attached to the river bed substrate is the main source of food for this species. They are gregarious, and often found together with other species (*Barilius* spp., *Chagunius* sp. *Paraacanthocobitis* sp., *Labeo dero*, *Systemus sarana*, *Puntius* spp., *Pethia* spp. *Amblyceps arunachalensis*, *Mystus* spp., *Tor* spp., *Xenentodon cancila* etc) in their habitat. Water quality parameters of the *in situ* habitat of the fish species are given in Table 2.

**Biology:** *Semiplotus semiplotus* breeds once in a year. Gonad development, maturation and spawning phases are generally overlapping and cannot be demarcated accurately. Males achieve to maturity stage from 150 mm TL onwards whereas, females mature comparatively later, at larger body size (160 mm TL onwards). Gonad development starts from April onwards and fully mature by July-August till September, followed by spawning season which coincide with the warmer rainy season. The fecundity of females ranged between 7510-23309 eggs with an average fecundity of  $12040.57 \pm 3574.62$  eggs. The maturity of gonad can be classified as immature phase, maturation phase and fully mature gonads. The immature phase (resting phase) of gonad is observed during November to early March. Developing phase (maturation phase) of gonads starts from late March until early June. Mature or ripe phase (fully mature gonads) attained during late June to mid-September. Fully ripe ova of gravid females and fully ripe male fishes were observed during this period. Spent fishes were observed during the month from October till December.

**Table 2.** Physico-Chemical parameters of the sampling sites in Sipu river, Dikrong river and Singking river of Arunachal Pradesh, India

Parameter	Site1	Site2	Site3	Site4	Site5	Site6
Water temperature(°C)	20.94±2.03	20.3±2.82	19.8±2.17	19.9±3.76	17.77±2.44	21.84±2.33
DO(mg/l)	7.366±1.08	8.04±0.86	8.04±0.90	7.74±0.63	8.35±0.57	7.55±0.76
FCO <sub>2</sub> (mg/l)	2.82±0.56	2.38±0.48	2.54±0.37	2.9±0.67	2.64±0.53	2.76±0.47
Alkalinity(mg/l)	77.00±0.56	66.84±7.6	68.21±11.7	83.06±4.42	71.13±9.45	73.64±6.99
Hardness(mg/l)	6.44±0.93	6.8±0.83	6.12±0.73	6.16±0.77	5.58±0.42	6.46±0.85
Conductivity(1 mhos cm <sup>-2</sup> )	183.8±45.88	178.8±15.67	197.4±21.24	192.6±31.54	184.2±22.35	177.8±40.18
pH	7.06±0.36	7.3±0.78	7.25±0.50	7.06±0.64	6.58±0.42	7.34±0.56
Salinity(ppt)	0.01±0.06	0.10±0.04	0.06±0.05	0.07±0.05	0.07±0.06	0.09±0.05

## Discussion

Howes (1982) synonymized *Semiplotus* under the genus *Cyprinion* Heckel 1843 (type species: *Cyprinion macrostomus* Heckel 1843) based on the similarity observed in the osteological features of the jaw as well as on the shape and size of the mouth. However, Howes (1982) overlooked the following characteristics which can distinguished the genus *Semiplotus* from *Cyprinion* viz. 23-25 branched dorsal-fin rays (vs. 9-17), 27-33 scales on lateral line (vs. 33-45), 8-9 anal-fin rays (vs.7) and more deeper body (35.4-41.3 % SL vs. 35.3), and more pelvic fin rays (8-9 vs.7) (Banarescu and Herzig 1995; Vishawanath and Kosygin 2000). A report of lacking maxillary barbel in *S. semiplotus* (Banarescu and Herzig, 1995) is rejected here as we observed a pair of maxillary barbel in both the juvenile and mature specimens (Fig. 1). A recent study based on mitochondrial DNA sequence also support the existence and validity of the genera *Cyprinion* and *Semiplotus* as two distinct taxon under the Barbini tribe (Yang 2015).

Three species are consider here as valid under the genus *Semiplotus* viz. *S. semiplotus* from the Brahmaputra River drainage, *S. cirrosus* Chaudhuri from the Chindwin-Irrawaddy River basin and *S. modestus* Day from the Koladyne River basin. *Semiplotus manipurensis* Vishwanath and Kosygin is treated here as synonym of *S. cirrosus* following Kottelat (2013). *S. semiplotus* differs from *S. cirrosus* by its wider head (67.5-72.6 vs. 58.8% HL), wider body (width at dorsal fin origin: 15.5-18.6 vs. 11.1% SL), smaller eye (23.0-29.3 vs. 36.2% HL), shorter predorsal (44.2-46.6 vs.47.6 % SL), more branched pelvic-fin rays (9 vs. 8), and

more number (10-12 vs. 4) of open pores on snout, fewer branched anal rays (7 vs. 9), and shorter head (20.9-24.1 vs. 26.9).

*S. semiplotus* is also distinct from *S. modestus* by its fewer predorsal scales (11-12 vs.14-15), narrower body (width at dorsal fin origin: 15.5-18.6 vs. 9.9), more branched pelvic fin rays (9 vs.8), last dorsal spine posteriorly smooth (vs. serrated), a transverse row of open pores with 10-12 pores on the snout (vs. 4 scattered pores on each side of snout), and a fewer rows of scale above lateral line (6 vs.7).

Menon (1989) included *S. semiplotus* in the list of endangered freshwater fishes of India. The hill stream fishes of Nepal includes *S. semiplotus* and suggested the possibility of developing recreational fishery of these fishes in the country (Shrestha, 1997). The present population structure of *S. semiplotus* is fragmented, and some restricted populations were encountered during our survey in the Brahmaputra river system of Arunachal Pradesh.

We observed the Catch Per Unit Effort index (CPUE index) of the species in three sites each of the three river drainages of Arunachal Pradesh state viz. the Dikrong river in Papum Pare district (site 1: 0.053, site 2: 0.273, site 3: 0.060); the Sipu river in West Siang district (site 1: 0.023, site 2: 0.063, site 3: 0.0534); and the Singking river at Lower Debang valley district (site 1: 2.533, site 2: 2.311, site 3: 1.020). The CPUE indices are relatively low in all the sites under this investigation except in the Singking River. Mature individuals were rarely encountered in all the studied sites. Sen (1985) reported that the species is restricted to the upper-Assam and its population has been declining. According to IUCN (2010), population of

this species is decreasing due to over fishing, habitat loss and other anthropogenic activities and further states that during the past 10 years the population structure of the species declined at the rate of more than 30% (Singh 2010).

Our observation conclude that, the declining of the population of this species specially in Arunachal Pradesh is due to over fishing by using numerous nontraditional methods of fishing like dynamiting, electric fishing (using generators, domestic electricity supply, etc.) poisoning, fishing during breeding period; habitat loss due to removal of substrate from the river bed for quarry work, damming, pollution and other anthropogenic factors related to urbanization.

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