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A review on the biology of cyprinid fish, *Puntius sophore* (Hamilton-Buchanan) in India

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Abstract
The biology of freshwater cyprinid fish *Puntius sophore* in the fresh water bodies of India is reviewed based on published literature. *Puntius sophore* is a popular fish in India. This fish has beautiful undulating structure of dorsal and caudal fins during slow swimming activity The biological aspects of fish includes length-weight data, condition factor, food & feeding habits, fecundity, age and development, sexual category and biochemical constituents. The present review study is aimed at enhancing the knowledge regarding the biology of fishes and to enable the formulation of suitable management measures towards a rational exploitation and management in lotic and lentic water bodies.

Keywords: biological study, fresh water fishes, *Puntius sophore*, India

Introduction
Puntius sophore is a freshwater cyprinid of Indian sub-continent which has popularity as a food fish because of its high dietary benefit alongside presence of good quantify of protein, micronutrients and nutrient. As of late it has made its entrance in decorative fish exchange and has been accounted for to been sent out as native fancy fish from India. Because of heavy fishing and anthropogenic exercises this fish species is currently confronting danger in regular condition (Sandipan Gupta, 2015) [28].
Puntius sophore fish develops in a year and breeds normally in freshwater during rainstorm (FAO, 1996) [10]. The species has high nutritive status, fancy worth and market request both as new and prepared items (Talwar and Jhingran, 1991; Samad *et al*., 2009) [37, 27]. Be that as it may, the supplies of *P. sophore* are declining quickly because of robust fishing pressure and in ongoing investigations from the Indian waters, it is sorted as close compromised (Dua and Parkash, 2009; Sarkar *et al*., 2010) [9, 30]. Culture of these little fishes with significant carps may add to the job of the provincial poor (Debnath *et al*., 2014) [7].
Small indigenous fish species are exceptionally important wellspring of large scale and micronutrients. Since these Small native fish species are eaten in entire or without loss of supplements from cleaning or as plate waste (Roos *et al*, 2007) [26], their commitment on micronutrients in-take by human is higher than huge carps. Nutrients and minerals are additionally discovered to be substantially more in these fishes than major carps (Roos *et al*, 2007; Thilsted et.al., 1997) [26, 38]. For legitimate administration of the species, information on science is significant.
Yet, so far no such combined report is accessible on biological angles. Keeping this in see, the current review report has been arranged to summarize the lacunae of data which ought to be concentrated to help its future fishery.

Data collection
Secondary data was collected by referring monographs, journals, thesis, books and web references as worked out by the different researchers of India.

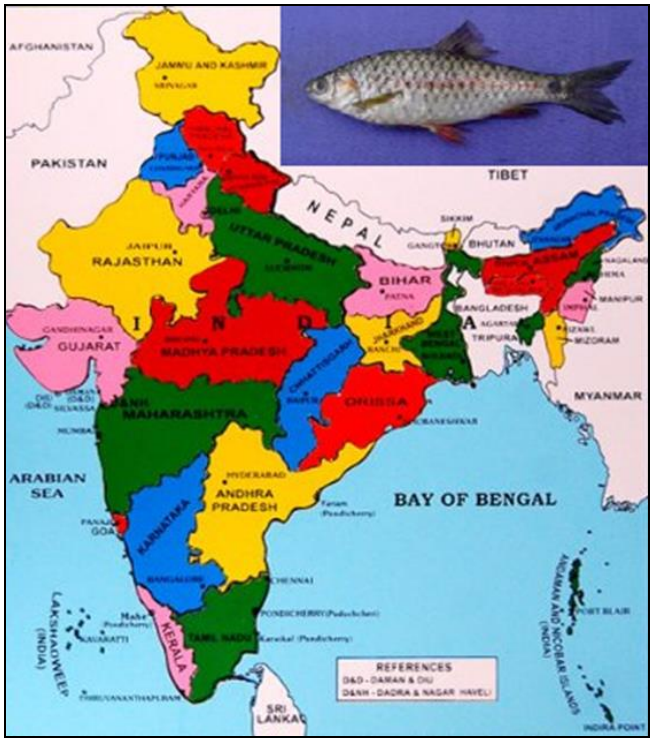

Fig 1: Biology of *Puntius sophore* fish as worked out by different researchers of India (mapsofindia.com; fishbase.in)

Biological aspects
Talwar and Jhingran (1991) [37] and Gupta (2015) [12] predicted the morphological features of *Puntius sophore*. The differences in colour as observed during their study might be due to diverse ecological conditions of the habitat of this fish. Further it was already has been established that the body colour varies with the habitat and the surrounding environments (Das 1992).
Geetha *et al* (1990) reported that many of the smaller fishes *viz*., *P. vittatus, P. sophore* were herbivorous. Herbivorous

nature of *P. sophore* has also reported by Mitra *et al*., (2006) [18] and Kiran (2015) [13]. However, Mitra *et a1* (2006) [18] opined that *P. sophore* was herbivorous in feeding habit and consumed diatoms followed by chlorophycean algae. Banik and Saha (2013) [3] recorded pico plankton, zooplankton, fishes and shrimps in the gut of *P. sophore*. Nazneen and Bari (1982) [22] observed phytoplankton in the gut of *P. sophore*.

Singh and Rajshree Srivastava (2008) [33] studied the age and growth of *Puntius sophore* from the Ganga River using its scales. The cycloid scales has distinct larval mark under the SEM. The age of this fish was 4 years. The fish should be harvested after second year of life when it attained 62 mm length.

Length-weight relationship and condition factor of *P. sophore* were estimated by Monalisa Pal *et al* (2013) [20] from Kolkata and sub-urban fish markets. They reported r value of 0.934. The logarithmic equation of the species was established as Log W=-2.130+3.242 Log L. The coefficient of determination value was r^2=0.871. The mean condition factor was 1.10.

Saon Das *et al* (2013) [29] have studied the morphometric relationship and phytoplankton and zooplankton in the gut content of *Puntius sophore*. It feeds maximum of zooplankton at a later stage. Chabungbam Bijayalakshmi *et al* (2014) [4] reported the proximate composition of small indigenous fishes and estimated the moisture and lipid content of some selected small indigenous fishes of Manipur. They reported 78.95 % moisture and 2.34 % of lipid in *Puntius sophore* respectively.

Kiran (2015) [13] reported that this fish was a column feeder in the Mudagodu tank of Karnataka. Seema Lanager *et al* (2013) [31] worked on the reproductive Cycle and Oogensis of *Puntius Sophore* from Gho-Manhasan Stream of Jammu, India. 07 stages of oocytes were recognized by them and oogonia were present throughout the reproductive cycle. The breeding period was from July to August.

Choudhury *et al* (2015) [5] have determined the length-weight relationship, fecundity, GSI, ovarian development and sex ratio of *P. sophore* in the rivers of Tripura, India as it has commercial value as a food fish as well as an ornamental fish. Pooled length-weight data of *P. sophore* was pooled into a single equation which was calculated as: Log W= -2.182 + 3.322 log L. The parabolic equation derived was $W = 0.0066L^{3.322}$. The value of 'b' was 3.322 suggesting that the length-weight relationship followed the cubic law for isometric growth. K value is less than 1, except for male the general well being of fish is poor. The GSI indicates the state of gonadal development which reflects the maturity stages in fishes (Parween *et al*., 1993) [23]. The average GSI in male and female fishes was highest during July. Fecundity was peak in spawning season The sex ratio observed for the *P. sophore* was different from the expected ratio of 1:1 (female: male). The breeding season of *P. sophore* was observed during July to August which was observed in other *Puntius* species by Arunachalam & Sankaranarayanan (1998) [2] and Mannan *et al*. (2010) [16]. The raise in GSI indicates advanced ovarian developmental stages and this fish shed its eggs once within a short spawning phase as reported in other three barbus species by De Silva *et al*. (1985) [6].

Snigdha Dey *et al*. (2015) [34] analyzed the major lipids and fatty acids in a small sized Indian minor carp *Puntius sophore*, by thin layer and gas liquid chromatography. The muscle lipid is <1%, for which fish can be regard as very low fat fish. Among the lipid classes, Phospholipids (PL) is maximum and the fatty acid (FA) symphony consists of altogether 36 members which are quantified by open gas liquid chromatography. In *P. sophore* the DHA is 2.5 times higher than EPA and ω3/ω6 ratio is ranging from 3.69 to 5.57 in the major lipid fractions.

The length-weight relationship, relative condition factor of two fish species *Puntius sophore* and *Systomus sarana* of Deepar Beel of Assam was studied by Madhubanti *et al* (2015) [15]. The length-weight relationship data shows negative allometric correlation. The negative allometric growth may be due to lower feeding proficiencies and/or may be due to environmental or seasonal incompatibility for proper growth of fishes. The KN value of sub adult *Puntius sophore* and adult *Puntius sophore* are 0.93 - 1.07 and 0.85 - 1.19, respectively which are more or less similar.

Sibani Saha (2015) [32] studied the biology of two fish species *Puntius sophore* and *Puntius ticto* in Gomoti River and Feni River in Tripura. *Puntius sophore* and *Puntius ticto* fingerling consumes small zooplankton. Adults consumes zooplankton, insects, broken small prawn etc. During fingerling stage certain quantity of alpha-amylase and pepsin were recorded. During adult stage both the alpha-amylase and pepsin were increased quantitatively. Based on relative length of gut the two fish species were identified as omnivorous. The length-weight relationship in these species followed cube law signifying isometric growth. In *Puntius sophore* and *Puntius ticto* the variations in the condition factor may be due to the result of different nature of effect. Those effect might be because of some fluctuation in the environmental character, variability in abundance of food and the gonad maturity etc. The fertilized eggs hatch in about 72-96 hrs. The size of the mature eggs were ranging from 0.96-1.02 mm. In *Puntius sophore* fecundity was studied in fish population ranging from 108-116 mm in total length and 41-52 g in total weight respectively. The ratio of male and female in *Puntius sophore* was about 1:3. In *Puntius sophore* the gonado-somatic index was 64.87 for female and 62.88 for male. Length at first maturity in *Puntius sophore* was 74 mm. In *Puntius sophore* the rate of fertilization was varied from 75-80%.

Krishan Raj Kant *et al* (2016) [14] have reported the fecundity of *Puntius sophore* from Jammu water bodies. They recorded fecundity of 1560 to 2314 eggs.The relative fecundity ranged from 390.85 to 480.18 and absolute fecundity from 6106.73 to 6942.35 eggs.

Rehena Akhtara Begum and Saibal Sengupta (2016) [24] revealed that *Puntius sophore* is an herbivore fish and occasionally feeds on zooplankton in Brahmaputra valley of Assam. The food item were found to be diatoms, desmids, blue green algae, chlorophyceae and zooplankton in its gut. They reported that the fish has a narrow niche width.

Talukdar *et al* (2016) [36] investigated the karyotypes of *Puntius sophore* from the Brahmaputra river of Assam, India. Chromosome preparations were used in the anterior parts of the kidney cells. The karyotype of the population consisted of 48 diploid chromosomes with fundamental arm number of 54.

Monalisa Pal and Mahapatra (2017) [19] reported the d*evelopment* stages of the embryo and larval period of Indian ornamental barb, *Puntius sophore* under captive conditions. The newly deposited fertilized eggs were demersal, slightly sticky in nature, translucent,

unpigmented, light yellowish in colour and almost spherical in shape with dimension of 909.200µm to 871.609µm. The hatchlings were transparent with 3.0±1mm in length with a large oval head, large yolk sac and short tail.

Supratim Pal *et al* (2018) [35] studied the length-weight relationship of *Puntius sophore* rom river Ghargharia at Cooch Behar in West Bengal. The parabolic equation was $W = 0.007524L^{3.3204}$. The "b" value was 3.3204. They opined that equilibrium constant does not follow the cube law.

Manoj Kumar Das *et al* (2018) [17] reported native fishes with larvivorous habit against mosquito larvae control in endemic malarious region of Ranchi district, Jharkhand, India Their analysis revealed that *Puntius sophore* and other nine fishes possess high level of larvivorous potentiality to control malaria.

Wahengbam Sarjubala *et al* (2018) [39] have estimated the total free amino acid, polyunsaturated fatty acid, minerals and antioxidant properties of 06 fresh water fishes and *Puntius sophore* was one among them and were collected from different sites of Manipur. The high moisture, protein and ash contents were recorded in *Puntius sophore*. The total amino acid content was lowest in *Puntius sophore*. The high Mg, K, Ca and antioxidant activity were recorded in *Puntius sophore*.

Anju Rani *et al* (2019) [1] studied the morphometrics of *P.sophore* from the Yamunanagar and Faridabad fish markets in Haryana, India. Their t-test revealed no significant difference between the otolith length and width of both the right and left otoliths ($p > 0.05$).

Dhananjaya (2021) [8] studied the biochemical and mineral composition of freshwater cyprinid fish *Puntius sophore* from Mudagodu tank of Chikmagalur district, Karnataka. Protein level deviated 18.5 to 23.7%. While, moisture content fluctuated from 69.8 to 75.3%. However, fat, ash and carbohydrate levels ranged in between 1.0 and 2.3%. Potassium content ranged from 650 to 698 mg/100gm. Calcium and magnesium levels varied from 120-155 and 110-139mg/100gm respectively. Phosphorus in the fish deviated from 242 to 248 mg/100gm. Trace metals like zinc and copper ranged between 18-24 mg/100gm and 3.9-4.2 mg/100 gm respectively.

Table 1: Biology of Cyprinid fish, *Puntius sophore* worked by different researchers in India

Sl. No	Area of Research	Habitat	References
1.	Food habits	Wetlands of West Bengal	Mitra *et al*., 2006 [18]
2.	Reproductive biology	Gho-Manhasan stream,Jammu	Seema Lanager *et al*., 2013 [31]
3.	Food and feeding habits	-	Saon Das *et al*., 2013 [29]
4.	Biological aspects	Gomti and Feni river	Sibani Saha, 2015 [32]
5.	Lipid and fatty acid profile	-	Snigdha Dey *et al*., 2015 [34]
6.	Biological aspects	Rivers of Tripura	Choudhury *et al*., 2015 [5]
7.	Length-weight relationship & Food and feeding habits	Mudagodu tank, Karnataka	Kiran, 2015 [13]
8.	Fecundity	Jammu water bodies	Krishan Raj Kant *et al*., 2016 [14]
9.	Biochemical & mineral composition	Mudagodu tank, Karnataka	Dhananjaya, 2012 [8]
10.	Diet composition	Brahmaputra valley, Assam	Rehena Akhtara Begum and Saibal Sengupta
11.	Feeding and Breeding biology	-	Gupta, 2015 [12]
12.	Length-weight relationship & Condition factor	Kolkata and sub urban fish markets	Monalis pal *et al*., 2013 [20]
13.	Reproductive biology	-	Monalisa Pal and B. K. Mahapatra, 2017 [19]
14.	Length-weight relationship	River Ghargharia at Cooch Behar, West Bengal	Supratim Pal *et al*., 2018 [35]
15.	Age and growth	Ganga river	Singh and Rajshree Srivastava, 2008 [33]
16.	Length-weight relationship & Relative Condition factor	Deepar Beel,assam	Madhubanti Das *et al*., 2005 [15]
17.	Moisture and total lipid	Manipur	Chabungbam Bijayalakshmi *et al*., 2014 [4]
18.	Nutritional properties	Manipur	Wahengbam Sarjubala *et al*., 2018 [39]

Conclusion

There is an increasing demand for small indigenous fresh water fish fauna facing several threats, such as over fishing, human interference, habitat loss, overexploitation, pollution, siltation, trade, and diseases. Therefore, regular survey and monitoring of diversity, differentiation of breeding spots, field research study on the efficacy of this fish, and public awareness on establishment of fish habitat should be adopted as a part of the fisheries management approach in the regions of different states of India to conserve this small cyprinid fish.

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