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Review Paper

Review on feeding and reproductive biology of two spot barb (*Pethia ticto*) (Hamilton, 1822)

Sandipan Gupta
Department of Industrial Fish and Fisheries, Brahmananda Keshab Chandra College, Kolkata, India
sandipangupta2007@gmail.com

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Abstract

Pethia ticto, commonly known as two spot barb is a common cyprinid species of many Asian countries like Bangladesh, Bhutan, India, Myanmar, Nepal, Pakistan, Sri Lanka and Thailand. This fish species is euryhaline in nature and inhabits rivers, streams, pools, ponds, lakes, reservoirs etc. Due to the presence of high nutritional value, along with other important small indigenous fish species it has been considered as a source of nutrition for the poor people. It is popular as ornamental species too and its potential as mosquito bio-control agent has also been documented. Though this fish species has been recorded as Least Concerned species in IUCN Red List of Threatened Species, with increased pressure on its population due to over fishing and other anthropogenic factors, declined population of P. ticto has already been documented from India and Bangladesh. In Bangladesh, it has been enlisted as vulnerable while in India it has been documented as Lower Risk near Threatened species. Thus, considering this situation, population of P. ticto needs utmost measures for conservation. Conservation of any fish species needs proper knowledge on its feeding and reproductive biology. The present review has been aimed to consolidate the already documented information on feeding and reproductive biology of P. ticto and to point out the lacunae as well as the further scope of research to promote its in-situ conservation as well as fishery.

Keywords: *Pethia ticto,* feeding, breeding, biology, review.

Introduction

Pethia ticto (Hamilton 1822), which is commonly known as ticto barb or two spot barb belongs to the family cyrinidae under the order cypriniformes. It is a fresh and brackish water (euryhaline) species and naturally inhabits rivers, streams, reservoirs, canals, ponds, pools etc.[1,2]. It is a species of Indian sub-continent; available in countries like Bangladesh, Bhutan, India, Myanmar, Nepal, Pakistan, Sri Lanka and Thailand[2-5]. This small indigenous fish species has high protein, vitamin and micronutrient content[6,7]; that's why it has been considered as a cheap source of nutrient for the rural people[8-11].

It is very much popular in its dried form in north-eastern part of India and Bangladesh[12,13]. Its popularity and high demand among aquarium hobbyists has also been reported[14-17]. Apart from this, its mosquito bio-control efficiency has also been documented[18,19].

Though this fish species has been recorded as Least Concerned species in IUCN Red List of Threatened Species[20], rapid declination of its population has been reported due to degradation of habitat, pollution, over exploitation and other anthropogenic factors[21]. The species has been categorized as vulnerable in Bangladesh[22] and Lower Risk near Threatened in India[23]. Thus to conserve this fish species as well as to continue its fishery, culture of this fish species in captivity can be considered as the best solution.

Detail information on feeding and reproductive biology is mandatory to achieve success in captive culture of any fish species. This review report has been aimed to consolidate the already documented information on morphology, feeding and reproductive biology of *P. ticto* and to point out the lacunae as well as the further scope of research to support its conservation as well as fishery.

Morphological, morphometric and meristic characters

The body is short, elongated, deep and strongly compressed. The abdomen is rounded. Head short. Mouth is small and terminal, upper jaw slightly the longer. Eyes are moderate in size. Pharyngeal teeth present. Barbel absent. Scales are medium sized. Lateral line is incomplete. Dorsal fin is inserted onto the body nearer the head than the tail. Dorsal fin spine is strong and serrated. Caudal fin forked. Body color is silvery, often stained with red; a black spot is present on the side of the tail anterior to caudal peduncle and immediately behind anal fin and another smaller black spot (frequently absent) is present at the commencement of the lateral line. Fins are often black, sometimes orange in color[3-5,13,24,25]. The morphometric and meristic characters of *P. ticto* has been summarized in Table-1.

Growth pattern: Hossain *et al.*[26], Hossain[27], Hossain *et al.*[28], Saha[13] and Karna *et al.*[29] have documented isometric growth while Kaushik and Bordoloi[30] and Gupta and Tripathi[31] have reported positive and negative allometric growth respectively for *P. ticto*.

Table-1: Morphometric and meristic characters of *Pethia ticto* documented by earlier researchers.

Characters	Ref.
Head Length (HL): 5mm; ratio of Body Depth (BD) to HL is 3-3.25; ratio of Eye Diameter (ED) to HL is 3; scales on lateral line 23-26; rows of scale between lateral line and pelvic fin 4-5; pre-dorsal scales 11; Dorsal Fin (D) 11 (iii/8), Pectoral Fin (P_1) 15, Pelvic Fin (P_2) 9, Anal Fin (A) 7 (ii/5), Caudal Fin (C) 19	3
Scales on lateral line 6-16; rows of scale between lateral line and pelvic fin 4-5; pre-dorsal scales 11.	24
D 11 (iii/8), P_1 13-15, P_2 9, A 7-8 (ii-iii/5)	34
D iii-iv 8, A ii-iii 5, P_1 i 12-14, P_2 i 8,	4
HL: 5-5.25 mm; ratio of BD to HL is 3-3.25; rows of scale between lateral line and pelvic fin 4-5; pre-dorsal scales 10-12; D iii-iv/8, P_1 12-14, P_2 i/8, A ii-iii/5	13
Scales on lateral line 25-29; rows of scale above the lateral line 4.5-6.5 and beneath the lateral line 6.5-7.5; pre-dorsal scales 9-10; D 10-11 (ii/8-9), P_1 12 (ii/10), P_2 8-9 (ii/6-7) A 7-8 (ii/5-6), C 20-24 (iv/16-20)	25

Feeding habit: *Pethia ticto* feeds on surface and sub-surface water body[7] and it is omnivore as per its feeding habit[13,32,33]. Most of the earlier workers[5,7,13,32-34] have reported this fish species as a plankton feeder. Rahman[34] has documented phytoplankton as major food item for *P. ticto* while Daniels[5] has reported maximum preference for zooplankton.

Saha[13] has reported the preference of adult individuals for zooplanktonic organisms of various sizes, supra-neuston, infra-neuston, small prawn, fish larvae or spawns and fry stages of other fishes. Hoque *et al.*[7] have documented the presence of five phytoplankton groups (chlorophyceae, cyanophyceae, bacillariophyceae, euglenophyceae and rhodophyceae as per abundance) and three zooplankton groups (rotifera, cladocera and crustacea) in its gut content.

The most dominant phytoplankton genera reported are *Ankistrodesmus*, *Aphanothece*, *Chlorella*, *Cyclotella*, *Microcystis*, *Oscilatoria*, *Spirogyra*, *Tetraedron* etc and *Asplanchna* is the dominant genus among zooplankton. Koundal *et al.*[33] have reported the dominance of phytoplankton (bacillariophyceae, chlorophyceae and cyanophyceae as per abundance) followed by insects in the gut content of *P. ticto*.

Ontogenic shift of feeding habit has been reported by Koundal *et al*.[32,33]. They have reported that young of *P. ticto* are carni-omnivorous in nature while adults are herbi-omnivore. They also have reported low feeding intensity in adults during the breeding season.

Sexual dimorphism: Talwar and Jhingran[4] and Bahuguna *et al*.[35] have reported sexual dimorphic characters in *P. ticto* which have been enlisted in Table-2.

Size at first maturity and sex ratio: Banik and Saha[36] have reported 8cm as length at first maturity for both the sexes while Hossain *et al.*[37] have documented early maturation of male (4.3 cm) than female (4.8cm) in *P. ticto*., Saha[13] has reported female dominance in her study at Tripura, India.

Gonad maturity stages and breeding season: The testes and ovary of *P. ticto* are paired structures. The testis is an elongated structure and remains suspended in the body cavity by mesorchium. Each testis is bean like in shape and composed of lobules which are arranged radially. Testes are attached on the coelomic surface and are with a thin visceral peritoneum covering. Based on histo-morphological study, Pundir and Saxena[38] have documented five maturity stages of testes (Table-3).

The two lobes of ovary are unequal in size; the right lobe is relatively larger than the left lobe. Saha[13] has documented seven maturity stages of ovary (Table-4).

April to August has been recorded as the breeding season for *P. ticto* in India[38] while April to September has been documented for the same in Gorai River, South-Western Bangladesh.[37].

Table-2: Sexual dimorphic characters in *Pethia ticto* as per Talwar and Jhingran[4] and Bahuguna *et al*.[35].

Characters	Male	Female
Black blotch on dorsal and pelvic fins	Present	Absent
Body color	Upper part of the body is shining light olive green; middle portion and lower portion are slight blue and dark pinkish respectively on both the sides.	Upper part of the body is shining light olive green; middle portion and lower portion are slight blue and slightly pinkish and dark yellow respectively on both the sides.
Fin color	Dorsal, pelvic and anal fins are dark pinkish and slight orange.	Dorsal, pelvic and anal fins are light pinkish.

Table-3: Maturity stages of male *P. ticto* as per Pundir and Saxena[38].

Maturity Stage	Characters
Spermatogonial proliferation	Testes whitish; the seminiferous lobules are small and contain few primary germ cells and spermatogonia. With progression, the lobules become packed up with spermatogonia and primary spermatocytes.
Early maturation stage	Testes dirty white; seminiferous lobules increase in number and with progression become filled up with spermatocytes and spermatids. The connective tissue septa which lie between lobules are prominent and interstitial cells are discrete in nature
Advanced maturation stage or stage of rapid spermatogenesis	Lobules with large number of spermatocytes and spermatids and the central part are occupied by small group of spermatozoa. Connective tissue septa are thin and interstitial cells are fully developed.
Functional maturity stage or stage of spermiation	The lobules are packed with spermatozoa and a layer of resting spermatogonia is also present. Connective tissue septa are thin and interstitial cells are less numbered.
Spent	Testes shrunken; most of the lobules are empty and with fibrous debris.

Table-4: Maturity stages of female *P. ticto* as per Saha[13].

Maturity Stage	Characters
Immature	Ovaries are transparent and occupy about 1/4 to 1/5 area of body cavity. Ova are not visible to naked eyes. The ova diameter range 0.12-0.22mm.
Maturing	Ovaries occupy about 1/2 area of body cavity. The ova look transparent and yolk formation starts in few eggs. The ova diameter range 0.37-0.42mm.
Maturing	Ovaries occupy about 2/3 area of body cavity. Large numbers of mature ova which are opaque and spherical with yolk are visible to naked eyes. The ova diameter range 0.94-1.08mm.
Mature I	Ovaries occupy about 2/3 area of body cavity and extend laterally. Ovaries granular in appearance and deep yellowish in color. The ova diameter range 1.1-1.8mm.
Mature II	Ovaries occupy most part of body cavity and extend laterally. Blood vessels are visible. Ova contains high amount of yolk. The ova diameter range 1.07-1.21mm.
Ripe	Ovaries occupy entire part of body cavity. Ova are off-white. The ova diameter range 1.22-1.28mm.
Spent	Ovaries shrunken, occupying about 1/2 of body cavity. The ovary with a number of small ova 0.66-0.78mm and only a few large eggs 1.11-1.14mm.

Fecundity: Hossain *et al.*[1] have documented fecundity range of 1,611-4,130 in their study in Ganges River, North-Western Bangladesh; later in their study at Gorai River, South-Western Bangladesh, Hossain et al.[37] have reported fecundity range of 2,230-8,450 with an average fecundity of 4,779±1,578. Comparatively high fecundity range of 4,374-10,804 has been documented by Banik and Saha[36] from Dhalai River, India.

Significant relationship of fecundity with body weight, total length, standard length, fork length, ovary weight and ovary length has been reported[1,13,37] in *P. ticto*.

Captive breeding: Saha[13] first tried the captive breeding of *P. ticto* and achieved fertilization rate of about 60-70%. After 32-36 hours of spawning, hatching occurs and yolk-sac absorption of hatchlings occurs after 4-6 days of hatching. Supply of mass cultured zooplankton with tubifex has been reported to assure high survival and growth rate of the larvae.

Conclusion

The present review shows that little research has been done so far on feeding and reproductive biology of *P. ticto* in comparison to its allied species and also other fish species available in Indian subcontinent[39-46]. The less commercial importance of this fish species may be a reason behind this. So far, there is no standardized culture technique for this fish species; small scale fishermen used to catch this species along with other small indigenous fish species and sell them in heap.

Regarding growth pattern of this fish species, contradictory views are available. This may be due to combination of different factors like sample size, differences in sampling or different in length ranges of the samples, difference in number of specimens studied, seasonal effect, variation in habitat, age and maturity stages, sex, degree of stomach fullness, health status of the studied specimens, difference in catch techniques, preservation methods etc[47-50].

Most of the researchers have confirmed omnivorous feeding habit along with plankton as the main food for this fish species. All of them have concluded on its feeding habit based on gut content analysis except Saha[13] who carried out enzymatic analysis further and reported the presence of amylase and pepsin in the alimentary canal. Gut content analysis is a primitive technique to ascertain on feeding habit; some modern techniques like enzymatic analysis and histo-morphological study should be done to affirm the already established conclusion of its feeding habit. Furthermore, age wise and sex wise variation in feeding habit and food preference should also be studied as these information will be helpful to provide proper care to brood stock and early life stages during captive culture which not only will enhance the fecundity and fertility rate but also will increase the growth and survivability rate of the early life stages.

Sex ratio and length at first maturity are two important parameters, information on which is needed to assure success in captive culture as well as for in-situ conservation of any fish species. For *P. ticto*, just a single report is available on sex ratio and on length at first maturity, two contradictory results are available. Thus enough scope is there for further research to explore proper information on these two aspects. Scope of further research is also there to study the maturity stages and breeding season, as scarce information is available on these two aspects too. Pundir and Saxena[38] and Saha[13] have documented the different maturity stages of testes and ovary respectively. On the other hand, only Pundir and Saxena[38] and Hossain *et al.*[37] have documented information on its breeding periodicity in India and Bangladesh respectively, but considering its wide distribution in other Asian countries, elaborate data on breeding biology in other parts is really missing.

The captive culture of this fish species has been tried first by Saha[13], though she has not mentioned any specific inducing dose in her report. Though she has reported 60-70% of fertilization rate in her experiment but rate of hatching or hatchling survivability has not been mentioned anywhere. Supply of mass cultured zooplankton with tubifex has been reported to support high survivability and growth rate of the larvae; though the amount to be supplied, the frequency of feed supply etc has not been documented. Thus, scope of research is there to standardize the inducing dose, method of brood stock maintenance and larval rearing to ensure success in captive culture of *P. ticto*.

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