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A Review on Feeding and Reproductive Biology of *Ompok pabda* with an Emphasis on its Conservation

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Abstract

Ompok pabda commonly known as *pabda* or butter catfish is a freshwater species which is widely distributed in India, Afghanistan, Pakistan, Bangladesh and Myanmar. In India and Bangladesh, this fish species has high preference as a table fish due to its delicious taste and high nutritional value. Its acceptability as an ornamental fish has recently been reported. Due to number of reasons, its population has been declined abruptly and due to reduced abundance in nature it has already been enlisted as an endangered species both in India and Bangladesh. It has been placed under near threatened category as per IUCN Red List of Threatened Species. Earlier little research has been conducted on feeding and reproductive biology of this fish species; but so far no such consolidated report is available on these aspects. The present report thus aims to consolidate the earlier documented information with pointing out the knowledge gaps on these aspects along with suggesting some strategies which can be considered for the conservation of this fish species in near future.

Keywords: Feeding habit; Reproductive biology; Conservation; *Ompok pabda*

Species Introduction

Ompok pabda is a member of the family Siluridae under the order Siluriformes is a freshwater species which is commonly known as pabda or butter catfish. It has the native range in India, Afghanistan, Pakistan, Bangladesh and Myanmar [4]; and is commonly found in natural waterbodies like rivers, lakes and flood plains [1-3,5]. It has high preference as a table fish due to delicious taste and high nutritional value [6-12]; and its acceptability as an ornamental fish among the fish hobbyists has recently been reported [13,14]. Since last few years, a distinct fall in the natural catch of this fish species has been reported due to loss of its population which attributes to the indiscriminate fishing, destruction of habitat, extensive use of pesticides and insecticides in agricultural fields along with non-judicious land use pattern and planning which have resulted in subsequent decrease in habitat area and also the loss of breeding grounds of this fish species [5,7-9,12]. Lack of its domestication in culture system due to short of knowledge on breeding and farming technique of the fish species is also a reason behind this declination [7]. Due to reduced abundance in nature, it has already been enlisted as an endangered species both in India [15] and Bangladesh [16]. It has been included under the near threatened category of the IUCN Red List of Threatened Species [17]. Earlier few studies have been carried out on food, feeding habit and reproductive biology of *O. pabda*; but consolidated report on these aspects so far is not available. The present report aims to consolidate the already available information as well as to note down the knowledge gaps on its biology along with documentation of some possible strategies which can be considered for its conservation in coming days.

Morphological Characters

Day [1] first documented the morphological characters of *O. pabda*; Talwar and Jhingran [2] and Jayaram [4] further have added more information on this aspect. The documented morphological characters are as follows:

The body is elongated and compressed. Eyes are moderate in size; its lower border is below level of cleft of the mouth. The median longitudinal groove on the head is reaching the base of the occipital process. The occipital process is longer than wide at base and is not reaching basal bone of the dorsal fin. The mouth is large and oblique; width of the gape of the mouth equals half the length of the head. The lower jaw is very prominent. Teeth are villiform on jaws; depressible, sharp, velvet like and are present on the palate in two oval patches separated from each other. Barbels are two pairs in number; the maxillary pair extends usually as far as middle or end of the pectoral fin while the mandibular barbels extend to the hind end of the orbit. Rayed dorsal fin which is short and spineless is inserted above last half of the pectoral fin. The pectoral fin is surpassing the pelvic fin and its spine is moderately strong, serrated internally, sometimes rather strongly. The pelvic fins are reaching almost the anal fin. The anal fin is long, inserted usually opposite to the origin of the dorsal fin. The anal fin is not confluent with the caudal fin and is separated from the latter by a notch. The caudal fin is forked; both lobes are pointed or arching rather than tapering to a point. The upper lobe of the caudal fin is slightly longer than the lower lobe. The body colour varies considerably; usually it is silvery and glossed with gold. In fresh condition, silvery green with a tinge of yellow, dark on back fading to dull silver on the belly. Irregular light brown patches are concentrated close to the back and forming longitudinal lighter bands along the lateral line and just above the anal fin, with the space in between them light yellow. A dark oval shoulder spot is present on the lateral line, above middle of the pectoral fins and another one diffused black spot on the lateral line near the caudal fin base. The opercle is greenish yellow with fine black spots. The anal and caudal fins are golden yellow with fine black dots, and black lines are visible over their bases.

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Food and Feeding Habit

Not much considerable research has been carried out so far on food and feeding habit of *O. pabda*. Some studies [5,18] have reported it as a carnivorous species while in contradiction some others [19-21] have documented its omnivorous feeding habit. Bhuiyan [19] has documented algae, roots of some higher plants, protozoa, crustacean, little quantity of mud and sand in the gut content of *O. pabda* in his study in Bangladesh while Taleb et al. [20] have reported the presence of small fishes, crustaceans, protozoan, algae, insects, parts of higher plants and debris in its gut content. Chakrabarti et al. [5] have studied the stage wise variation in food preference of *O. pabda*; fry (up to about 40 mm in length) has been reported to feed exclusively on zooplankton specifically on cladocerans, copepods, rotifers and protozoan with preference for soft and smaller insect larvae while fishes above 70 mm in length have been reported to feed on insect larvae, small insects, nematode worms, annelids, small minnows, shrimps and detritus. Cannibalistic behaviour has also been reported by them for the fry stage mainly during the 2nd to 5th day of post hatching period which gradually diminish after this period. Parameswaran et al. [18] earlier have also reported cannibalistic tendencies in the fry and juveniles of *O. pabda*.

Discussion on Reproductive Biology

Sexual dimorphism

Male and female of *O. pabda* can be easily identified observing the secondary sexual characters which develop during the breeding season. In mature male, the genital papilla is elongated and pointed or somewhat conical in shape while in female it is somewhat fleshy, round and large in size with reddish vent. The pectoral fin spines are relatively larger and thicker in male than those in female where the spines are very feeble or absent. Male is slender, usually smaller in size, more translucent and less pigmented than female which is with soft, round and with bulged abdomen during the breeding season [5,8,9,12]. Apart from these already documented characters, Hussain [3] has included another sexual dimorphic character for this fish species; he has reported that maxillary barbels in male are used to extend beyond the pectoral fins whereas in female they don't.

Sex ratio

Not much research so far has been done to study the sex ratio in the population of *O. pabda* except by Banik et al. [10,11] who have reported female dominance in the population of this fish species.

Length and age at first maturity

Banik et al. [11] have reported 16.3 cm and 17 cm as length at first maturity for male and female of *O. pabda* respectively. Parameswaran et al. [18], Chakrabarty and Chakrabarti [22], Chakrabarty et al. [8] and Chakrabarti et al. [5,9] have reported that *O. pabda* used to attain maturity at the end of first year of its life. Early maturation of males than females has been reported by all these researchers.

Fecundity

Qasim and Qayyum [23] have reported absolute fecundity range of 2,500-40,000 for *O. pabda* while Banik et al. [11] have reported the range of 2,190-41,552 for the same. Chakrabarti et al. [5] have documented relative fecundity range of 2,00,000-2,50,000/kg of body weight for *O. pabda*.

Breeding periodicity

Considerable research so far has been done to gather information on breeding periodicity of *O. pabda*. Parameswaran et al. [18] have reported May to August as its breeding season with spawning peak in June and July. Chakrabarty and Chakrabarti [22] have documented early June to late July as the breeding season in West Bengal. Later Chakrabarty et al. [8] have reported May to August and Chakrabarti et al. [5,9] have documented June to August as breeding season for this fish species in West Bengal. Banik et al. [11] have reported May to August as the breeding season for *O. pabda* in Tripura. Just like in India, little variation in the breeding season of *O. pabda* has also been documented from Bangladesh. Siddique and Choudhury [23,24] have reported May to July as its breeding season while Akhteruzzaman et al. [25] have reported May to August and Datta et al. [6] have reported May to September for the same. Later Chakraborty et al. [26] have also supported the observation of Akhteruzzaman et al. [25].

Possible conservation strategies

The natural population of *O. pabda* is already in dwindling condition and thus proper measures are really needed to conserve this valuable fish species. The following strategies can be considered on serious note to conserve this fish species

Population restoration in nature

Population restoration in nature is the first and foremost step to conserve any fish species. So, this should be done first to conserve the existing population of *O. pabda*. For this purpose, information on native distribution range of this fish species is to be gathered so as to put protection to the existing populations. Banik et al. [10] have reported that till date the native distribution of *O. pabda* is not sufficiently documented. So, a thorough survey is really needed to identify the areas where their natural populations are still existing; and required steps to be taken to protect them. It could be done by banning its fishing during the breeding season (which has been documented already as a prime cause of its declination in nature), preventing catch of juvenile fishes by denoting size specific netting and prevention of habitat degradation.

Reduction of pressure on natural populations by captive culture

Over exploitation of *O. pabda* has already been reported to effect the natural populations of this fish species [27]. Thus some relevant steps are in need to reduce the pressure on wild stocks and in this context, captive culture can be the best strategy. Due to less genetic variation, less survivability and behavioural abnormalities, inefficiency of captive breeding to restore wild stock of endangered fish species has been reported by some researchers [28-31] while many others are with the view to promote captive breeding for conservation of fish species [32-42]. Captive culture in one hand will reduce the pressure on wild stock and on the other hand will also maintain the supply with increasing demand for this fish species in the markets. Success in captive culture of any fish species depends on so many factors like selection of proper inducing agent and the dose, proper rearing of brooders and seeds etc. In the current decade, considerable research has been done on these aspects of *O. pabda* to promote its captive culture which has been documented below.

Dose specification of the inducing agent

So far, many researchers have tried to induce breed *O. pabda* and too some extent they are successful enough in this aspect with

the achievement of getting good number of hatchlings after the experiments. In this regard, works of Chakrabarty and Chakrabarti [22], Chakrabarty et al. [7,8] and Chakrabarti et al. [5,9] are worth to be mentioned. Most of the researchers have used ovaprim as the inducing agent for this purpose except Hussain [3] and Purkayastha et al. [12] who have used ovatide for the same purpose. In their experiment, Chakrabarty and Chakrabarti [22] used ovaprim at a dose of 1-2 ml/kg of body weight in female and 1 ml/kg of body weight in male. They tried to induce breed both by keeping the brooders in hapa (spawning in natural condition) and also following stripping method. Later Chakrabarty et al. [7] continued the experiment using ovaprim just with a comparative low dose; 1-1.5 ml/kg of body weight in female and 0.5 ml/kg of body weight in male for natural breeding in hapa while for induced breeding following stripping method they used ovaprim only in female fishes. Chakrabarti et al. [9] attempted induce breeding using ovaprim keeping the dose same as used earlier by Chakrabarty et al. [7,8] for female fish but a comparative slight increment in dose (0.5-1 ml/kg of body weight) for male following the stripping method. Chakrabarti et al. [5] continued the experiment using ovaprim keeping the dose same for female but with a reduced dose (0.5 ml/kg of body weight) in male following both stripping as well as natural breeding in hapa. Hussain [3] experimented induced breeding of *O. pabda* using ovatide at a dose of 0.5-2 ml/kg of body weight for both the sexes while Purkayastha et al. [12] have experimented the same using ovatide in hapa applying dose of 0.6 ml/kg of body weight in female and 0.5 ml/kg of body weight in male as the best dose in respect to fertilization and hatching success. So, fair enough information is now available on effective dose of ovaprim to induce breed *O. pabda* in captivity, but further research is needed to standardize the dose of ovatide as so far only couple of experiments have been performed using this inducing agent. As per the information documented so far; dose of 1-2 ml/kg of body weight in female and 0.5-1 ml/kg of body weight in male of ovaprim are effective to get success. So following the success achieved in the previous experiments, ovaprim can be referred as a potent inducing agent to successfully raise pabda seeds in captivity.

Rearing of the seeds

Production of seeds in induced breeding is not only just important, rather proper rearing of the seeds so as to get maximum survivability of the seeds is the prime significance to achieve the ultimate goal. Parameswaran et al. [18] have reported cannibalistic tendencies in fry and juveniles of *O. pabda* while Chakrabarti et al. [5] have reported the same in only fry stage. Cannibalism is a major problem in early stages of pabda seed rearing; so it is quite necessary to reduce the density of the stocked population along with timely supply of proper amount of food to avoid cannibalism. Number of experiments so far has been performed to get the information on suitable and preferred food for pabda seeds so that they attain maximum growth and survivability after the rearing period. Chakrabarty and Chakrabarti [22] following a feeding experiment have reported preference of pabda hatchlings for zooplankton; better survivability and growth of the fry has been reported when plankton has been supplied along with tubifex. Hussain [3] has reported the use of planktonic food and boiled egg yolk (while reared in cistern) and mustard oil cake and de-oiled rice bran at the ratio of 1:1 (while reared in earthen nursery) for successful nursing of the fry in his experiment. Chakrabarty et al. [8] have documented good growth rate and survivability from a trial of 15 days, where hatchlings (3-4 mm) were fed with natural food organism and sieved zooplankton at alternate days; and after a period of one week in addition to zooplankton the post larvae were fed on chopped tubifex worm. Chakrabarti et al. [9] have reported that larvae can be fed with mixed zooplankton, tubifex worm and egg custard; zooplankton can be supplied up to day 15 as per the acceptance of the larvae. In fry stages and onwards, the fish can be fed with compound feed (rice polish, silk worm pupae and boiled egg) at 100% of body weight of the population. Fry can also be reared in fibre glass tanks and cement cisterns fed with both zooplankton 2-3 ml on alternate days and tubifex worm as a live feed. Later Chakrabarti et al. [5] have provided the required methodology for seed rearing in details; they have reported that mixed zooplankton, tubifex worm, egg custard may be provided as larval feed up to 15 days to obtain better survival and growth of the fry; however, grinded tubifex worm along with finely sieved zooplankton is the best food for them to control their cannibalistic habit. Plankton, rich in zooplankton may be supplied thrice a day @ 8-10 cc/50 L water while tubifex may be provided twice a day about 25% of the body weight of spawn. After 15 days they can be provided with nutritious and balanced formulated diets comprising with egg custard, fish meal and silk worm pupae powder. In addition, they can also be fed with boiled and finely chopped chicken viscera and/or any kinds of animal protein particularly low cost trash fish. The feed should be provided daily @ 3-5% of the body weight and the feeding frequency should be 2-3 times a day including once in the evening. They have reported that following this feeding programme, fry are used to attain fingerling size (5-6 cm and 3-4.5 gm) within a rearing period of 40-45 days with 80% survivability. The acceptance of the feeds has been reported to be better when mixed with tubifex and boiled trash fish. Banik and Malla [43] have reported the efficiency of combined supply of zooplankton and tubifex for better survivability and growth of pabda larvae when reared in a cycling water-flow system. Chakrabarti et al. [5] have suggested that pabda spawn can be reared in FRP tank and cement cisterns. The water temperature and dissolved oxygen level are to be maintained in between 28°C-32°C and >5 ppm respectively. Initially the water level of the container should be kept at 7-10 cm, which can be gradually raised up to 15-20 cm after a period of one week. The water level can be adjusted in accordance with different stages of larval development so as to minimize stress on the larvae. The container used for larval rearing should be provided with a soil base of 5-6 cm thick. Periodically water exchange is essentially required. It is always better to use pond water after filtration during larval rearing. Provision of maintenance of feeble water current or flow of water in the container/fibreglass tank is necessary for obtaining better survival. Non-chlorinated water having lower alkalinity and hardness in carbon rich base is conducive for better spawn growth. In a better management practice, stocking density may be as high as 10-20 larvae /L of water. So about seed rearing of *O. pabda*, ample information is available which should be followed to get success in captive culture of this fish species in coming days.

Rearing of the brood fish

In captive culture, proper rearing of the brood fish is also essential and in this regard, supplying proper food is very much important issue. Some researchers [3,8,12] have documented information on brood stock rearing of *O. pabda*. Hussain [3] has documented that in his experiment brooders were supplied with mustard oil cake and de-oiled rice bran at the rate of 5-10% of their body weight along with animal protein including crushed molluscs, crabs and aquatic insects. Chakrabarty et al. [8] have reported that in their experiment brooders were fed with supplementary feed, mixture of ground nut oil cake, rice bran and fish meal (1:1:0.5) fortified with vitamin and mineral mix @ 10% of the body weight apart from the natural food organisms (insect larvae, small trash fish and prawn) present in the pond. Purkayastha et al. [12] have documented that in their trial they fed brooders with supplementary feed consisting of mustard oil cake, rice bran (1:1),

small live prawn and small fishes like Puntius sp., Danio sp. @ 5% of body weight per day. All of them have reported successful rearing of the brood stocks and thus these feed formulations can be used effectively in coming days.

Popularization of culture

Despite its great preference as a table fish, *O. pabda* even in recent past has not received sufficient attention in aquaculture mainly due to unavailability of information on its breeding and culture technique, little availability of live samples in nature and poor survivability of the larvae. Even, no definite culture methodology has been practiced for this fish species so far. Recently with the advancement of its breeding technique, culture of this fish species has been started mainly in West Bengal, Bihar and Tripura of India. Kohinoor et al. [44] have reported production performance of *O. pabda* in a polyculture system with Indian Major Carps and gulsha tengra (Mystus cavasius) in Bangladesh. In a culture period of six months, best production (2,986±78 kg/ha) has been documented when fingerlings of *O. pabda* and M. cavasius were stocked at the rate of 5,000 (1:1)/ha while carps (Catla catla, Labeo rohita, and Cirrhinus mrigala) were stocked at the rate of 5,000/ha. They have reported suitability of pabda and gulsha as good culture species which could be cultured in low input carp polyculture management. Popularization of its culture is really needed not only to keep the supply smooth but also to reduce pressure on the wild stocks. So, further studies are needed to analyze its culture potential with other fish species.

Pollution control and Public awareness

Extensive use of pesticides and insecticides in agricultural fields and contamination of waterbodies with these has been reported as one of the reasons behind declination of *O. pabda* population in nature. So this problem must be solved by controlled and restricted use of pesticides and insecticides in the field along with making public aware on this issue. The successful conservation of fish species in their natural habitat requires the involvement of general people as they act as the excellent ambassadors to promote the conservation issues of the fish species. Most of the general public is not at all aware about the recent problems in fish biodiversity; so at first they must be informed about the problems and then using their willingness and support, conservation campaigns can be promoted through education and extension programmes.

Concluding Remarks

Considering the information documented in this paper, it can be stated that so far, little research has been carried out on feeding biology of *O. pabda*, and thus firm conclusion on its feeding habit is still lacking. Some researchers have reported it as a carnivorous fish while some others have documented its omnivorous feeding habit. This kind of contradiction regarding feeding habit has earlier been reported for many other fish species [45-58]. Most of the earlier researchers have concluded on feeding habit of only adult *O. pabda* except Chakrabarti et al. [5] who have studied feeding habit of both fry and adult stages. Stage wise variation in food preference has been documented by Chakrabarti et al. [5]; but further study on this aspect is needed to get in depth information on stage-wise, age-wise and sex-wise variation in food preference if existing there for this fish species. Seasonal variation in feeding activity is very natural in fish species, but so far no such information is available on this aspect for this fish species which should also be studied. Apart from gut content analysis which is a very basic technique, morpho-histological study of the alimentary canal and enzymatic analysis of the digestive tract can be effective methodologies to ascertain firmly on feeding habit of any fish species. During brood fish rearing, all the earlier researchers have used a supplementary food along with supply of animal protein source. If further study will confirm its comparative more preference for animal food; then additional feeding trials can be performed to know whether this will promote growth of the brooders earlier to reach the preferred size for captive breeding or not. Many researchers already have provided information on breeding periodicity of *O. pabda*. Little spatial variation has been reported in respect to breeding season for this fish species; in all cases breeding season has been observed to be in correspondence to the monsoon season of the particular region. So, there must be some relation between breeding periodicity and monsoon season for this fish species. This kind of correlation of breeding periodicity with season and other hydrological parameters has not been studied so far except the work by Chakraborty et al. [26] who have documented a correlation of ova maturation with increment of temperature in *O. pabda*. So, further investigation is really needed to get information on relationship of breeding periodicity with climatic and hydrological factors in *O. pabda* if any. On the other hand, information on sex-ratio, length at first maturity and fecundity are very scarce; these are very vital information in respect to captive culture and conservation of any fish species. So, further study is needed on these aspects to fill up the information gap. Finally, it can be concluded that further studies are needed to gather more information on feeding and reproductive biology of *O. pabda* to fill up the information gap mentioned in this article which will be beneficial to conserve and to sustain its fishery in a long run.

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