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Threatened Fishes of the World *Ompok bimaculatus* (Bloch, 1974): Recommendations for Sustainable Conservation

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ABSTRACT

The threatened butterfish, *Ompok bimaculatus*, is one of the most important food fish in Asian countries, enriched with high nutritional value. However, this freshwater catfish is facing significant threats due to habitat modification, overexploitation, and pollution of ecosystems. This paper reviewed the current conservation status of *O. bimaculatus*, highlighting its ecological importance and the challenges that it encounters in its native habitats across Southeast Asia. We also suggest a set of recommendations for sustainable management and conservation of this species. Key strategies include ecosystem restoration, community engagement in conservation efforts, and the implementation of sustainable fishing methods and fishing ban period during spawning season. The proposed recommendations are essential for creating a suitable habitat for the species to thrive. Future research should focus on continuously monitoring the population dynamics of *O. bimaculatus*, evaluating the effectiveness of the proposed conservation strategies, and exploring other potential threats and solutions.

Introduction

The butter fish, *Ompok bimaculatus* (Bloch 1794) locally referred to as ‘Pabda’ small indigenous fish species (SIFS) belongs to the family Siluridae of the order Siluriformes is extensively dispersed throughout South and Southeast Asian regions (Talwar and Jhingran 1991). This freshwater catfish commonly known as the two-spotted catfish is popular among those countries due to its good flesh quality and nutritional value especially rich in polyunsaturated fatty acids (Alam et al. 2016). Furthermore, they are suitable for pond culture due to their fast growth rate and fast adaptability to the culture conditions (Biswas et al. 2023). In addition to this capability, they are listed as "Endangered" on the IUCN red list, which means they have a very high risk of extinction in the wild (IUCN Bangladesh 2015). Furthermore, the reasons for facing threats from habitat shrinkage due to siltation and wetland conversion as well as recent studies suggest a 60% decline in its population over the last two decades, making it unlikely to halt or reverse its decline (Mollah and Rahman 2015).

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To ensure the sustainability of the *O. bimaculatus* population in Bangladesh, it is essential to develop and implement effective management and conservation strategies. Numerous studies have been conducted on various aspects of the species, including its morphology, biology, ecology, feeding habits, genetics, and reproduction, as summarized in Table 1. However, despite its ecological significance, a consolidated body of work on *O. bimaculatus* in Bangladesh is lacking. This gap presents a significant challenge to the formulation of effective conservation and management strategies. Therefore, this document aims to serve as a foundational resource for the development of appropriate and comprehensive management and conservation strategies for *O. bimaculatus* in Bangladesh.

Table 1. Available studies on *Ompok bimaculatus* from different countries

Country	Aspects	Reference
India	Morphological characteristics, reproductive biology, and culture potentials	Biswas et al. (2023)
India	Proximate and fatty acid composition	Paul et al. (2020)
India	Highlight gaps for future fishery and conservation studies	Gupta (2015)
Bangladesh	Nutritional status	Alam et al. (2016)
India	Gonadal maturity during the spawning season	Mishra et al. (2018)
India	Chromosomal studies	Sharma (2008)
India	Inter-population reproductive patterns	Sarkar et al. (2017)
India	Biological characteristics	Mishra et al. (2013)
India	Body composition	Debnath and Sahoo (2013)
India	Reproductive biology	Arthi et al. (2013)
North-East India	Reproductive biology	Malla and Banik (2015)
Northeast India	Adoption behavior	Shil et al. (2022)
India	Draft genome	Dhar et al. (2019)
Northern India	Captive breeding and embryonic development	Raizada et al. (2013)

Taxonomy

Kingdom: Animalia
Phylum: Chordata
Class: Actinopterygii
Order: Siluriformes
Family: Siluridae
Genus: Ompok
Species: *Ompok bimaculatus*

Identification

The fish has an elongated body with a depressed head and rounded snout, reaching a maximum length of 45 cm SL (Talwar and Jhingran 1991). It has a superior mouth with a lower jaw longer than the upper jaw. It has two pairs of barbels, nostrils, teeth, a long anal fin, and a deep forked caudal fin. The fish has a silvery body with purple dorsally, greenish-dark, golden yellow, and whitish on the abdomen. Fins are pale golden (Fig. 1). The available fin formulae are-

D. 4; P1.12-15(1/11-14); P2. 8; A. 66-73. (Rahman 2005).

D. 4-5; P. I/1113; V. 8; A. 2/52-60; C. 18 (Shafi and Quddus 2001)

D 4; P I 12-14; A ii-iii 57-58; V i 7-8 (Talwar and Jhingran 1991)

D. 4-5; P. I/11-13; V. 8; A. 2/52-58; C. 18 (Bhuiyan 1964)

Common name

Boali pabda, kani pabda, pupta, paibba in Bangladesh (Rahman 1989; 2005); pabho, pabo, pahboh, pava in India (Daniels 2002; Nath and Dey 1989); Walapoththa in Sri Lanka (Pethiyagoda 1991); Lalmuha chachar, nauni, pabhta in Nepal (Shrestha 1994); Nga-nu-than in Myanmar (Khin 1948).

Fig. 1. *Ompok bimaculatus* collected from the Chalan *beel* in Bangladesh on 27 September, 2024 (by Md. Yeamin Hossain).

Distribution and abundance

According to Talwar and Jingran (1991) and Parween (2007), *O. bimaculatus* is widely distributed throughout the Indian subcontinent and Southeast Asia, including Bangladesh, India, Pakistan, Myanmar, and Sri Lanka (Fig. 2). In case of Bangladesh, they found across the country as well (Parween 2007).

However, specifically from the Bangali River in Bogra (De et al. 2011), Halda River of Chittagong (Alam et al. 2013), Hakaluki *Haor* and Tanguar *Haor* (IUCN Bangladesh 2015), Brahmaputra-Jamuna (Rahman and Akhter 2007), River Mahanada, and Padma river (Mohsin et al. 2013). This fish is indigenous to freshwater environments and is often found in lakes, ponds, canals, floodplains, streams, and rivers with moderate to low water currents. Its preferred habitat is calm, shallow, muddy water (Talwar and Jhingran 1991).

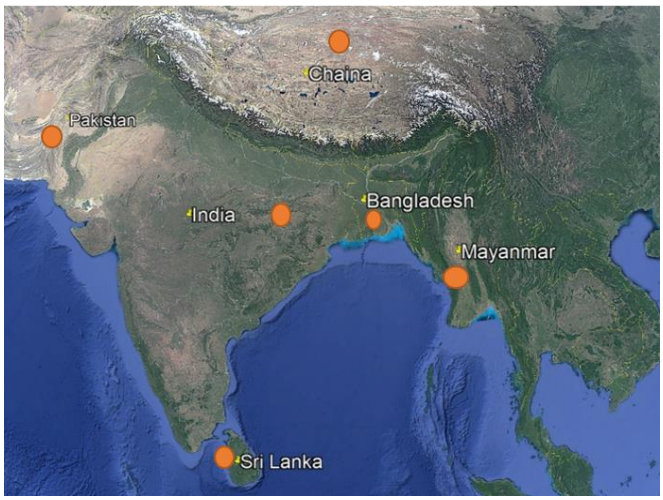

Fig. 2. Map showing the geographical distribution of *Ompok bimaculatus*

Habitat and ecology

The *O. bimaculatus*, is a versatile aquatic species found in freshwater and brackish waters. Its water pH preferences range from 6.0 to 8.0, with varying degrees of hardness from 4 to 28 ppm (Riede 2004). This potamodromous fish migrate within freshwater systems, often moving between bodies for breeding or feeding. They thrive in tropical climates with an optimal temperature range of 20°C to 26°C, supporting their growth and reproductive activities (Riede 2004; Riehl and Baensch 1991).

Food and feeding habit

This fish is omnivorous and predatory in nature (Arthi et al. 2011). They primarily feed on vegetable matter and fish (Pethiyagoda 1991). They also consume crustacean adults, larvae, insects, and molluscs as secondary and supplementary foods. The frequency of fish and vegetable matter in their gut contents is higher than other food items. Feeding intensity was more in December (48.3%) with minimum (34.4%) in May as well as increases during peak breeding seasons (Arthi et al. 2011). Furthermore, they consume small amount of sand and mud as well (Parween 2007).

Table 2. Nutritional profile of *Ompok bimaculatus*

Nutrient	**Value**		
	Alam et al. (2016)	**Paul et al. (2018)**	**Hicks et al. (2019)**
Minerals	**Content (mg/kg)**	**Content (mg/100g)**	**Content (mg/100g)**
Sodium (Na)	1032.41±15.12		
Potassium (K)	13428.02±52.36		
Calcium (Ca)	3152.30±40.98	200.00	153.00
Iron (Fe)	60.75±2.63	0.460	0.647
Magnesium (Mg)	865.02±5.39		
Manganese (Mn)	4.52±1.02		
Zinc (Zn)	18.36±1.58	0.680	0.823
Arsenic (As)	0.02±0.01		
Mercury (Hg)	0.01±0.01		
Selenium(µg/100g)			28.5
Fatty acid compositions			
Saturated fatty acids (SFA)			
Myristic acid (C14: 0)	6.96±0.31%		
Palmitic acid (C16: 0)	21.22±2.01%		
Stearic acid (C18: 0)	2.91±0.24%		
Arachidic acid (C20: 0)	0.52±0.09%		
Tricosylic acid (C23: 0)	0.79±0.16%		
∑ SFA	32.40±2.83%		
Monounsaturated fatty acids (MUFA)			
Myristoleic acid (C14: 1)	0.74±0.16%		
Palmitoleic acid (C16: 1)	1.89±0.71%		
Oleic acid (C18: 1)	20.23±2.52%		
Eicosenoic acid (C20: 1)	1.98±0.24%		
Erucic acid (C22: 1)	1.70±0.34%		
∑ MUFA	26.54±1.42%		

Table 2 Continued

Nutrient	Value		
	Alam et al. (2016)	**Paul et al. (2018)**	**Hicks et al. (2019)**
Minerals	**Content (mg/kg)**	**Content (mg/100g)**	**Content (mg/100g)**
Polyunsaturated fatty acids (PUFA)			
Linoleic acid (C18: 2)	6.90±0.95%		
γ-Linolenic acid (C18: 3)	3.95±0.86%		
α-Linolenic acid (C18: 3)	4.89±1.25%		
cis-11, 14-Eicosadienoic acid (C20: 2)	2.45±0.73%		
cis-11, 14, 17-Eicosatrienoic acid (C20: 3)	3.93±0.91%		
cis-8, 11, 14-Eicosatrienoic acid (C20: 3)	2.42±0.36%		
Arachidonic acid (C20: 4)	4.86±0.53%		
cis-13, 16-Docosadienoic acid (C22: 2)	0.97±0.46%		
EPA (C20: 5)	5.75±0.51%		
DHA (C22: 6)	4.80±0.49%		
∑ PUFA	40.92±5.36%		0.129 (g/100g)
Essential Amino Acids (EAA)			
Leu	7.16		
Lys	6.81		
Thr	6.03		
Phe	5.26		
Val	5.11		
Tyr	4.7		
Iso	4.21		
His	3.80		
Met	3.01		
Trp	0.80		
Non-essential Amino Acids (NEAA)			
Glu	15.28		
Asp	12.11		
Gly	7.53		
Ser	6.81		
Ala	4.87		
Pro	3.18		
Arg	2.72		
EAA/NEAA	0.89		
Protein (g/100g)		13.9	16
Vitamins		**Content (µg/kg)**	
A	1460.23	317.400	90.8
D	13108.39		
E	7021.57		
K	12156.12		

Nutritional profile

Alam et al. (2016) reported that O. bimaculatus is a highly nutritious fish species, rich in polyunsaturated fatty acids and essential amino acids. It also contains minerals like K, Na, Ca, Fe and Mg. The fish is an excellent source of trace elements, including manganese and zinc, and lean flesh. It also contains fat-soluble vitamins like A, D, E, and K (Paul et al. 2018). Hicks et al. (2019) stated that *O. bimaculatus'* nutrient profile includes selenium, zinc, total omega-3 PUFA, protein (Table-2).

Growth pattern

Froese (2014) calculated the Bayesian length-weight for this species, with a = 0.0058 (0.0048 - 0.0069) and b = 3.03 (2.98 - 3.08) cm total length, based on LWR estimates, which indicates a positive allometric growth pattern. Similar findings were also reported by some other researchers, including Sandhya et al. (2019); Karna et al. (2018); Sani et al. (2016); Malla and Banik (2015); Mishra et al. (2013); Sani et al. (2010); and Sidthimunka (1973). However, a negative allometric growth pattern was reported by Sivakami

(1987) in Bhavanisagar Reservoir, Tamil Nadu, India (Table 3).

Form factor

The form factor is determined using the formula $a_{3.0} = 10^{\log a - s(b-3)}$ (Froese 2006), where *a* and *b* represent the LWRs' regression parameters and *s* represents the slope of log *a vs. b*. A mean slope (*s*) of -1.358 was used for the regression analysis of log *a vs. b*. According to Table 3, the computed form factor ($a_{3.0}$) was to range from 0.0053 to 0.0089, which indicates a moderately elongated body shape.

fish had a dominance of females, the fish had a dominance of females with a 1:1.65 male-female ratio. The fish's length and weight varied, with a significant correlation between length and weight. The spawning season ranged from May to August, with a maximum average Gonado-Somatic Index (GSI) of 2.195 and 15.582, respectively. The fecundity varied, with the highest during May to July. The findings provide valuable information for species restoration and captive breeding. In addition, some other researchers also reported the spawning season of this species

Table 3. Growth pattern of *Ompok Bimaculatus* from different water bodies

Habitat locality	Length (cm)	*a*	*b*	Sex	r^2	References	$a_{3.0}$
Panchet Reservoir, India	11.6 - 31.7 TL	0.0038	3.13	unsexed	0.98	Sandhya et al. (2019)	0.0085
Hirakud Reservoir, India	13.0 - 34.7 TL	0.0038	3.12	unsexed	0.98	Karna et al. (2018)	0.008
Gomti River, India	7.1 - 25.2 TL	0.0059	3.08	unsexed	0.98	Sani et al. (2016)	0.0089
Betwa River, Uttar, India	13.5 - 29.0 TL	0.0039	3.12	unsexed	0.96	Sani et al. (2016)	0.0053
Lotic waterbodies of Tripura, India	16.5 - 33.0 TL	0.0066	3.08	mixed	0.92	Malla and Banik (2015)	0.006
River Ghaghara, India	11.2 - 29.0 TL	0.0021	3.32	mixed	0.94	Mishra et al. (2013)	0.0057
Tamil Nadu, India	21.1 - 33.5 TL	0.0170	2.78	unsexed	0.98	Sivakami (1987)	0.0071
Major river systems, Thailand	5.0 - 15.0 TL	0.0047	3.14	unsexed		Sidthimunka (1973)	0.0057

TL, total length; *a*, intercept; *b*, slope; r^2, coefficient of determination; $a_{3.0}$, form factor

Reproductive biology

From several waterbodies, we calculated the minimal size at sexual maturity (L_m) using the maximum length-based model formulated by Binohlan and Froese (2009) as log (L_m) = -0.1189 +0.9157 ∗log (L_{max}) (Table 4). However, Malla and Banik (2015) observed that in lotic waterbodies in Tripura between 2008 and 2011, the minimum size of *O. bimaculatus* at sexual maturity was 17.0 cm for females and 16.3 cm for males. Furthermore, in the River Ghaghara between 2009 and 2010, Mishra et al. (2013) found that the length at maturity was 23.2 cm for males and 22.3 cm for females (Table 4).

(Table 5). Based on the observation, June to September could be considered the spawning season and July to August as the peak spawning season of *O. bimaculatus*.

The fecundity of this catfish ranged from 2190 to 41552 observed by Malla and Banik (2015) in lotic waterbodies of Tripura from 2008 to 2011. Further, Ukkatawewat (1984) recorded fecundity ranged from 1700 to 68000 in the freshwater bodies in Thailand.

Genetics

According to Sharma (2008), *O. bimaculatus* possesses diploid chromosome number 42, which has the chromosomal formulas of 12 metacentric, 14

Table 4. List of minimum size at sexual maturity (L_m) of *Ompok bimaculatus* from different waterbodies

Waterbodies	Sex	L_{max} (cm)	L_m	References	Estimated L_m (cm)
Lotic waterbodies of Tripura, India	Male Female	33	16.3 TL 17.0 TL	Malla and Banik (2015)	18.68 TL
River Ghaghara, India	Female	29	22.3 TL	Mishra et al. (2013)	16.60 TL
River Ghaghara, India	Male	26.6	23.2 TL		15.34 TL
Tamil Nadu, India	Male	-	23.6 TL	Sivakami (1987)	-
India and adjacent countries	-	45	-	Talwar and Jhingran (1991)	24.83 SL

L_{max}, maximum length; TL, total length; L_m, minimum size at sexual maturity

The reproductive biological characteristics of *O. bimaculatus* were studied by Malla and Banik (2015) in Tripura between 2008 & 2011. They found that the

submetacentric, and 16 subtelocentnc and telocentnc. The fundamental arm number (NF) of 68 refers to the karyotype. The genome of *O. bimaculatus* from the

Ganges River was sequenced using a hybrid method that included structural annotations after Illumina short reads and PacBio long reads. With a N50 size of 81 kb, the draft genome assembly was found to be 718 Mb. (Dhar et al. 2019) 21,371 genes were predicted by the MAKER gene annotation system.

in nature (Hossain and Alam 2015; Hossain 2014). Establishment of sanctuaries in specific water bodies such as rivers, streams, lakes, and floodplains and strictly banning fishing practices during the spawning are suggested (Hossain et al. 2015). To support the conservation of this species, a fishing ban should be

Table 5. Spawning season on *Ompok bimaculatus* from different waterbodies

Waterbodies	Spawning season	References
Lotic waterbodies of Tripura, India	May – August	Singh (2019); Malla and Banik (2015)
Major rivers in India	June(late) - August	Mishra et al. (2018)
In captivity	June – August	Biswas et al. (2018); Debnath et al. (2013)
Ganga basin, India	April – August	Praveen et al. (2017)
Wild population	March – August	Sarkar et al. (2017)
The Ghaghara River, India	June – July	Mishra et al. (2013)
Amaravathy River, Tamil Nadu, India	August – September	Arthi et al. (2013)
Nong Koh Reservoir, Thailand	July – September	Renunuan and Silapachai (2005)
Kulgarhi Reservoir, India	July – August	Rao and Karamchandani (1986)

Conservation status

According to Ng et al. (2010), *O. bimaculatus* was listed as a Near Threatened species on the IUCN Red List of Threatened Species in 2009; nevertheless, it is listed as endangered in Bangladesh (IUCN Bangladesh 2015). In addition, the conservation assessment and management plan for freshwater fish in India also categorized it as an endangered species (Molur and Walker 1998).

Threats

The species' population abundance has most likely decreased by around 60% during the past 20 years. They are therefore at high risk of going extinct in the wild due to habitat loss from siltation and wetland conversion, as well as other factors like overexploitation during the spawning season, disease, pollution, poisoning, and so forth (Mollah and Rahman 2015; Gupta 2015).

Conservation action

Captive breeding and embryonic development of *O. bimaculatus* were conducted by Biswas et al. (2023). Furthermore, conservational aquaculture was also carried out by Biswas et al. (2023).

Recommendations for conservation

The conservation of *O. bimaculatus* in Bangladesh requires a multifaceted approach that can ensure the long-term viability of this important species and its ecosystem. Studies on population dynamics and stock assessment are required to understand the stock status

implemented from July to August. Restoring and preserving natural habitats to support the ecological needs of *O. bimaculatus* can ensure the availability of breeding grounds and food sources while maintaining water quality. Understanding the life history and biology of fish is crucial for hatchery managers and researchers to establish a successful breeding program, as well as implementing aquaculture practices that can reduce overfishing pressure on wild populations, promote breeding in controlled environments, and enhance local livelihoods (Biswas et al. 2023; Hossain et al. 2008). The conservation status of *O. bimaculatus* should be improved through effective involvement of local communities in conservation efforts through education and increasing public awareness and ranching. Prevent overfishing and allow populations to recover during critical breeding periods through the establishment and enforcement of regulations on fishing practices, including size limits and seasonal closures (Hossain 2014). On top of that, data are needed to inform management decisions and adapt strategies through conducting research to monitor population dynamics, habitat conditions, and environmental changes.

In connection with the Sustainable Development Goals (SDGs)

The conservation of *O. bimaculatus* in Bangladesh can be linked to several Sustainable Development Goals (SDGs). These goals focus on preserving biodiversity,

promoting sustainable use of oceans, seas, and freshwater resources (SDG-14), reducing poverty (SDG-1), ensuring zero hunger (SDG-2), promoting responsible consumption and production (SDG-12), and building partnerships among stakeholders (SDG-17). By aligning conservation efforts with these goals, Bangladesh can foster a comprehensive approach that protects the threatened species while supporting sustainability, economic development, and food security. By promoting responsible fishing practices, reducing overfishing, and fostering partnerships, the conservation of *O. bimaculatus* can contribute to these goals.

Conflict of Interest

There is no competing interest that might influence the research work.

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