ISSN (online): 3008-0436 ISSN (print): 3008-0428

Aquatic Resource Sciences

Journal homepage: www.journal.inrrd.com/ars

Threatened Species Series

Threatened fishes of Bangladesh *Wallago attu* (Bloch & Schneider, 1801): Recommendations for Sustainable Conservation

Mst. Rownk Zahan[1], Bijoya Dash Bisa[2], Sourov Chandra Dey[1], Md. Fahad Hossain[3], Md. Akhtar Hossain[4], Md. Abdul-Aziz[5], Md. Abidul Hasan[4], Zoarder Faruque Ahmed[6*]

[1]*Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh.*
[2]*Department of Fisheries Biology and Genetics, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh.*
[3]*Department of Zoology, National University, Gazipur-1704, Bangladesh.*
[4]*Department of Fisheries, University of Rajshahi, Rajshahi-6205, Bangladesh.*
[5]*Department of Geography and Environmental Studies, University of Rajshahi, Rajshahi-6205, Bangladesh.*
[6]*Department of Fisheries Management, Bangladesh Agriculture University, Mymensingh-2202, Bangladesh.*

ARTICLE INFO

Article history
Received 07 April 2025
Revised 06 May 2025
Accepted 13 June 2025
Available online 30 June 2025

Keywords

Wallago attu
Asian sheat catfish
Threatened fish
Vulnerable
Conservation

ABSTRACT

Wallago attu commonly known as the Asian sheat catfish or freshwater shark which locally called Boal fish, is a commercially important freshwater predator widely distributed across South and Southeast Asia. In Bangladesh, it inhabits major rivers, floodplains, reservoirs, and wetlands, contributing significantly to inland fisheries and local food security. The species is nutritionally rich, providing high-quality protein, essential amino acids, and vital minerals, alongside a balanced composition of omega-3 and omega-6 fatty acids. Despite its ecological and economic importance, *W. attu* populations have declined by approximately 30% over the last six decades, resulting in its classification as Vulnerable by the IUCN. Major threats include overfishing, habitat degradation, pollution, invasive species, and climate change, with additional pressures from illegal fishing and recreational exploitation. Conservation efforts, including habitat protection, regulation of destructive fishing practices, and artificial breeding, are essential to restore and sustain populations. This review synthesizes current knowledge on the taxonomy, distribution, habitat, ecology, feeding, growth, reproductive biology, genetics, threats, and conservation strategies for *W. attu* in Bangladesh. Recommendations are provided to inform sustainable management and support biodiversity conservation aligned with the Sustainable Development Goals.

Introduction

Wallago attu (Bloch and Schneider 1801), commonly known as the Asian sheat catfish, is a. It is rapidly growing species of catfish belonging to the family Siluridae under the order Siluriformes. It is a commercially valuable freshwater fish widely distributed across rivers of South and Southeast Asia (Lilabati 1996; Poulsen et al. 2004; Renjithkumar et al. 2011). The Asian silurid catfish, commonly referred to as the freshwater shark, is recognized as one of the twenty mega fish species found worldwide (Stone 2007; Rufus et al. 2015). It is a freshwater fish widely distributed across the Indian subcontinent, including countries such as India, Bangladesh, Pakistan, Sri Lanka, Myanmar, Nepal, Afghanistan, and Indonesia (Mirza 1982; Talwar and Jhingran 1991; Froese and Pauly 2020). The fish distributed in both standing and running inland waters, including rivers, flood plains, lakes, reservoirs, and watersheds (Talwar and Jhingran 1991; Poulsen et al. 2004; Renjithkumar et al. 2011). Boal fish

*Corresponding author
Email address: zoarder@bau.edu.bd (Zoarder Faruque Ahmed)

holds significant nutritional importance due to its high-quality flesh and rich nutrient composition. It is an excellent source of high biological value protein**,** essential amino acids, and important minerals such as calcium, phosphorus, potassium, iron, and zinc and provides a favorable balance of omega-3 and omega-6 fatty acids**,** contributing to cardiovascular health and brain function (Lilabati and Vishwanath 1996; Bibi et al. 2016; Kyaw 2017; Babare 2024). The population of *W. attu* has declined by about 30 percent over the past 60 years, making it classified as Vulnerable according to the IUCN Red List published in 2019 (Ng et al. 2019). It faces major threats from overexploitation for food, collection of juveniles for the ornamental trade, and recreational fishing (Mishra et al. 2009, Patra et al. 2005; Baran et al. 2018). Additional pressures include habitat destruction, competition from alien species, and in Sri Lanka, illegal gill netting and climate change impacts such as altered rainfall and irrigation-related habitat degradation (Ng et al. 2019).

To ensure the survival of *W. attu*, sustainable conservation is essential. Protecting habitats, regulating fishing, and preventing overexploitation help the population recover. This not only stabilizes their numbers but also maintains ecological balance and supports local livelihoods. Ensuring the long-term survival of the *W. attu* population in Bangladesh requires the development and implementation of effective conservation and management strategies. Numerous studies have been conducted on various aspects of the species, including its morphology, biology, ecology, feeding habits, larval survival and growth, genetic diversity, spatial connectivity, population structure, population dynamics, and reproduction, as summarized in Table 1. In Bangladesh, data on the current population status, distribution, and habitat connectivity of *W. attu* remain limited. The effects of overfishing, pollution, and climate change on local populations are poorly understood, indicating a critical need for targeted research to guide effective conservation and management strategies. The aim of this research, therefore, is to assess the current status, distribution, and ecological challenges facing *W. attu* in Bangladesh, with a view to generating evidence-based recommendations for its sustainable conservation and management.

Taxonomy

Kingdom: Animalia
Phylum: Chordata
Class: Actinopterygii
Order: Siluriformes
Family: Siluridae
Genus: *Wallago*
Species: *W. attu*

Identification

The fish has an elongated, laterally compressed, scaleless body with a straight dorsal profile and a rounded abdomen. Its large, depressed head has a wide mouth extending past the eyes, small eyes, and numerous cardiform teeth. Two pairs of long barbels are present, with the maxillary pair reaching beyond the anal fin. The dorsal fin is short and spineless, pelvic fins are small, and the anal fin is very long but separate from the forked caudal fin. The body is silvery-grey to olive with a golden sheen and dusky fins (Gupta 2015; Basharat et al. 2016).

Fin formula

D 5; A iii 74-93; P I 13-15; V i 7-9 (Talwar and Jhingran 1991)

D.5; P_1.1/13-14; P_2.10; A.85-89. (Rahman 2005)

D.5; P15 (11/4); V.10; A.91 (4/87); C.17; Barbles two pairs (Dahire 2008)

Fig. 1. *Wallago attu* (Reezwan 2011)

Common name

W. attu, a large freshwater catfish species, is commonly referred to by several vernacular names including *helicopter fish, freshwater shark, and Asian sheat catfish* (Sherzada et al. 2024). The fish is known by a variety of regional names across South Asia: *Boal* in Bengali, *Nga* in Burmese, *Attu Valai* in Malayalam, *Sareng* in Manipuri, *Baloo* in Marathi, *Bohari* in Nepali, *Boallee* in Odia, *Valai* in Tamil, and *Valaga* in Telugu. In other parts of India, it is also referred to as *Boali*, *Barhari*, *Poil*, and *Baralie*. In Pakistan, the fish is commonly known as *Mullee* or *Jarko (*Mirza 2003; Mandal et al. 2021*)*.

Table 1. Available studies on *Wallago attu* from different countries

Country	Aspects	References
Bangladesh	Fish assemblage of a traditional fishery and the seasonal variations in diet of its most abundant species *Wallago attu* (Siluriformes: Siluridae) from a tropical floodplain	Islam et al. (2006)
Bangladesh	Threatened fishes of the world: *Wallago attu* (Bloch and Schneider, 1801) (Siluriformes: Siluridae)	Hossain et al. (2008)
Bangladesh	A comparative study on quality aspect of three native species *Wallago attu* (Boal), *Notopterus chitala* (Chital), *Mystus aor* (Ayr) as fresh and frozen storage condition	Naher et al. (2018)
India	Development and characterization of a cell line WAF from freshwater shark *Wallago attu*	Dubey et al. (2014)
India	Length-Weight relationship and condition factor of a large predatory catfish, *Wallago attu* (Schneider, 1801) from the rivers of central Kerala, India	Rufus et al. (2015)
India	*Wallago attu* (Bloch and Schneider, 1801), a threatened catfish of Indian waters	Gupta (2015)
India	Fecundity, spawning and ova diameter of the *Wallago attu* from Bhadar reservoir of Gujarat, India	Prasad and Desai (2020)
India	Assessment of Morphometric Variations among the Populations of Asian Sheat Catfish *Wallago attu* (Siluridae) from Five Indian Rivers	Kumar at al. (2023)
India	Comparative Analysis of Proximate, Amino Acid and Mineral Content of Two Freshwater Fish Species, *Wallago attu* and Heteropneustes fossilis and their Quality Restoration with the Use of Additives During Cold Preservation	Khatun et al. (2024)
India	Genetic diversity, spatial connectivity, and population structure of Asian silurid catfish *Wallago attu* (Bloch and Schneider, 1801) in the Ganga River System: insights from mitochondrial DNA analysis	Kumar at al. (2024)
Myanmar	Studies on the Nutritional Values of *Wallago attu* from Ayeyarwady River	Kyaw (2017)
Pakistan	Age and growth study of Fresh water shark, *Wallago attu* (Bloch and Schneider) from Manchar Lake, District Jamshoro, Sindh, Pakistan	Wadhar et al. (2013)
Pakistan	Diversity and genetic structure of freshwater shark *Wallago attu*: an emerging species of commercial interest.	Sherzada et al. (2024)

Distribution and abundance

According to Talwar and Jhingran (1991), Giri et al. (2002) and Mirza (2003) *W. attu* is widely distributed across South and Southeast Asia. Its range includes Afghanistan, Pakistan, India, Nepal, Bangladesh, and Sri Lanka in the Indian subcontinent, as well as Myanmar (Burma), Thailand, Laos, Cambodia (Kampuchea), Vietnam, Malaysia (Malay Peninsula), and Indonesia, including the islands of Sumatra and Java. This species is found in major river systems of Bangladesh, including the Padma (Chakraborty et al. 2019), Meghna (Sultana et al. 2023), and Gurukchi River (Pandit et al. 2020), as well as around Nijhum Dweep (Sarker et al. 2021). It is a large catfish species that plays a vital role in inland fisheries, thriving across rivers, lakes, wetlands, reservoirs, canals, and natural ponds (Talwar and Jhingran 1991, Rufus et al. 2015, Kumar et al. 2023).

Habitat and Ecology

W. attu is a widely distributed and highly valued freshwater catfish found across rivers, reservoirs, and connected watersheds throughout South and Southeast

Asia (Talwar and Jhingran 1991; Sherzada et al. 2024). *This* predatory freshwater catfish inhabits both lentic and lotic environments, including rivers, lakes, reservoirs, floodplains, tanks, *beels*, *haors, and jheels*, and is occasionally found in tidal waters. It prefers muddy habitats with grassy margins and often shelters in holes along riverbanks or canals. The species thrives in water bodies periodically connected to rivers or streams (Prasad 2019; Ng et al. 2019). It can tolerate a wide pH range from 6.1 to 8.7, with an optimum in slightly alkaline conditions (pH 7.4–8.1) (Giri et al. 2002; Prasad 2019). Water temperature ranged between 21.5°C and 32.5°C, with peak values around 28.7–28.8°C during the rainy seasons of 2016 and 2017. The species thrives in warmer conditions, as higher temperatures were linked to increased parasite prevalence (Prasad 2019; Alam et al. 2024). With the onset of the wet season, *W. attu* migrates from deep pools and reservoirs to flooded plains and tributaries to spawn once a year, thriving in both natural and captive environments (Goswami and Devaraj 1992; Sultana et al. 2020).

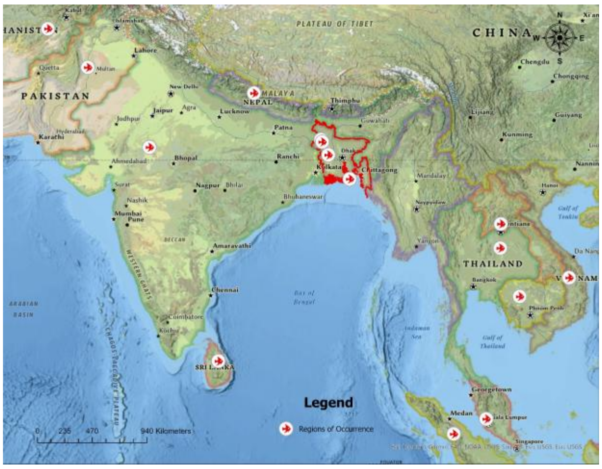

Figure 2. Geographical distribution of *Wallago attu* in Asia

Food and feeding habit

W. attu is a carnivorous, piscivorous predator throughout its life, actively foraging from the surface to the bottom and potentially impacting prey fish communities (Islam 2006; Hari 2019). Its diet includes the fry and fingerlings of carps and other fish, along with crustaceans (e.g., copepods and daphnids), aquatic insects such as water bugs, dragonflies, damselflies and their larvae, and mollusks (Sheshrao 2022). *W. attu* fry primarily feed on fish fry, insects, and crustaceans, while fingerlings consume fry and fingerlings of other fishes. Larvae fed on live zooplankton alone or combined with dry feeds (fish, meat, or shrimp meal) showed highest growth like final weight, SGR, and weight gain when given minced goat liver alongside live plankton (Giri et al. 2002; Sahoo et al. 2006; Hari 2019). The feeding intensity of *W. attu* is seasonal, low in February and peaking in August–September (Goswami and Devaraj 1992).

Nutritional profile

W. attu is a commercially important, rich in protein and valued for its taste. It contains significant amounts of crude protein, non-protein nitrogen, moisture, lipid, ash, and essential minerals such as potassium, calcium, phosphorus, chlorine, and aluminum. Trace and heavy metals like arsenic, mercury, and lead were also detected, while cadmium was absent (Lilabati and Vishwanath, 1996; Kyaw 2017; Babare 2024). Calcium showed the highest concentration, with essential minerals like Fe, Zn, Cu, Ni, Mn, K, Na, Ca, and Mg present at highly significant levels (Riaz and Naeem 2023). Leucine was the predominant amino acid in *W. attu*, while tryptophan was the least abundant (Khatun et al. 2024). The fish is also rich in essential fatty acids such as Ω-3 and Ω-6, which help protect against coronary heart disease (Bibi et al. 2016).

Table 2. Proximate composition of *Wallago attu* in fresh condition (Khatun et al., 2024)

Parameter	(Expressed in %)
Moisture	78.24 ± 0.41a
Crude protein	16.52 ± 0.20a
Crude fat	3.24 ± 0.34a
Ash	1.47 ± 0.20a
Carbohydrate	0.53 ± 0.28a

Growth pattern

The length–weight of *W. attu* with a = 0.156 and b = 1.98 cm total length, based on LWR estimates, which indicates a negative allometric growth pattern in middle stretch of river Ganga (Jayaswal et al. 2025). Similar findings were also reported by some other researchers, including Sani et al. (2010), Kumar et al. (2023). subsequent research revealed variations in growth patterns, with Muhammad et al. (2017), Kumar et al. (2023), Achakzai et al. (2013) documented a positive allometric pattern for this species.

Form factor

Table 5. Growth pattern of *Wallago attu* from different water bodies (Jayaswal et al. 2025)

Author	Intercept (*a*)	Slope (*b*)	Correlation of determination (r^2)	Growth type	Form factor ($a_{3.0}$)	Study area
Sani et al. (2010)	0.025	2.56	0.97	Allometric (−)	0.0063	Gomti River
Muhammad et al. (2017)	−2.87	3.34	0.96	Allometric (+)	-	Indus River
Kumar et al. (2023)	0.0014	3.34	0.798	Allometric (+)	0.0041	Ganga Kanpur
Kumar et al. (2023)	0.0058	2.92	0.945	Allometric (−)	0.0045	Gomti Lucknow
Kumar et al. (2023)	0.0004	3.64	0.972	Allometric (+)	0.0029	Hooghly Kolkata
Kumar et al. (2023)	0.0047	2.98	0.903	Allometric (−)	0.0044	Yamuna Agra
Kumar et al. (2023)	0.0005	3.58	0.973	Allometric (+)	0.0031	Pampa Kerala
Achakzai et al. (2013)	0.0047	3.08	0.975	Allometric (+)	0.0060	Manchar Lake (Sindh, Pakistan)
Present study	0.005	2.96	0.95	Allometric (−)	0.0044	Ganga River

The form factor is calculated through this formula $a_{3.0} = 10^{loga-s(b-3)}$, where *a* and *b* represent the LWRs' regression parameters and *s* represents the slope of log *a vs. b*. According to Table 5, the computed form factor ($a_{3.0}$) was to range from 0.0029 to 0.0063, which indicates an elongated body shape.

Reproductive biology

According to PRASAD (2019) In *W. attu*, sexual dimorphism is observed at all stages. The species breeds once annually during the monsoon (May–August), peaking in June–July in eastern regions. The overall sex ratio was nearly equal (1:1.008), with females dominating in July–September 2018 and January–February 2019, while males dominated from

October to December. *W. attu* spawns year-round, with a peak in July–August. Spawning percentage was highest in August (82.56%) and lowest in December (53.34%), averaging 60.02%. Absolute fecundity ranged from 16,565 to 29,883, with fecundity per gram of body weight highest in July (10.95) and lowest in September (7.95). In captivity, male *W. attu* mature at about 50 cm and females at about 60 cm total length (Prasad and Desai, 2020). In Manchar Lake, Pakistan *W. attu* reaches first maturity around 18.6 cm, whereas the Bhadar Reservoir study in India did not report its size at first maturity (Wadhar et al. 2013).

Genetics

The diploid chromosome number in these species varies, with *W. attu* having 86 chromosomes (Nayyar 1966). Chromosomal analysis of WAF cells showed 76–88 chromosomes, with 86 as the modal number; small proportions of heteroploidy and aneuploidy were also observed (Dubey et al. 2014). The karyotype of this species consists of 12 metacentric, 6 submetacentric, 2 sub telocentric, and 66 acrocentric chromosomes, as reported from studies in Sirsa feeder canal, Haryana, India (Rishi and Singh 1983). DNA barcoding using the mitochondrial COI gene was applied to *W. attu* from the River Indus for taxonomic identification and conservation insights. Twenty-one nucleotide sequences were analyzed, with gaps and missing data removed, and evolutionary relationships were examined using MEGA 11 software (Karim et al. 2018; Sajjad et al. 2023).

Conservation status

W. attu is listed as vulnerable (VU) on the IUCN Red List of Threatened Species (Ng et al. 2019; Sherzada et al. 2024). Its populations are declining mainly due to multiple anthropogenic pressures such as over-exploitation for commercial fishing**,** habitat degradation caused by dam construction, river regulation, wetland loss, and siltation, along with pollution and the use of destructive fishing methods. Several regional assessments have reported that in certain localities, populations of *W. attu* are even more depleted, falling under Endangered or Critically Endangered categories, indicating serious conservation concern across its native range (Ng et al. 2019).

Threats

Overexploitation of *W. attu* for consumption poses a significant threat, leading to a noticeable decline in its population (Mishra et al. 2009, Patra et al. 2005, Baran et al. 2018). this species is valued as an ornamental and sport fish but faces several anthropogenic threats, including habitat destruction, destruction of brood fishes from freshwater habitats, environmental degradation, pesticide, competition from invasive species, poor water quality, habitat fragmentation, wetland degradation, pollution, illegal gill fishing and lack of proper management. In Sri Lanka, its population is further impacted by climate change, with altered rainfall patterns, droughts, and irrigation activities contributing to the decline in habitat quality (Mijkherjee et al. 2002; Patra et al. 2005; Ng et al. 2019; Sherzada et al. 2024; Alam et al. 2021).

Table 6: Monthly Variation in Maturity and Spawning of *Wallagu attu* (Prasad and Desai 2020)

Month	No. of Fishes		Spawning %
	Observed	Matured	
July	15	8	75.68
August	34	20	82.56
September	15	11	73.34
October	38	23	60.53
November	35	29	58.83
December	37	28	53.34
January	29	22	65.87
February	22	15	68.19
Total	225	156	Average 60.02%

Conservation action

Regarding *W. attu*, the taxonomic relationship between populations inside and outside the Indian subcontinent needs careful assessment, as Roberts (2014) reported osteological differences between Indian and Indochinese populations, indicating that they may not belong to the same species. There is a need for data on exploitation levels of *W. attu* outside southwestern Bengal, and the impacts of pollution and habitat loss on its populations require further study. The species is widely distributed and occurs in several protected areas across its range (IUCN and UNEP-WCMC 2019). Several research institutes in Asian countries have conducted experimental trials on the artificial breeding and rearing of this species (Mijkherjee et al. 2002; Giri et al. 2002).

Impact of climate and environmental change

The environmental factors including climate, season and rainfall play an important role in the development of helminth parasites. Rising concentrations of greenhouse gases in the atmosphere are causing global climate change. In the coming decades, global average temperatures will increase, rainfall patterns will change, extreme weather events will become more severe, sea levels will rise and numerous other environmental changes will occur.

Table 7: Fecundity per gram body weight of *Wallagu attu* (Prasad and Desai 2020)

Month	Fecundity/gm body weight	Fecundity
July – 2018	10.95	22316
August – 18	9.75	16565
September – 18	7.95	9365
October – 18	10.5	29536
November – 18	10.8	29883
December – 18	10	21155
January – 2019	10.2	26581
February – 19	10.35	26340
Average	10	22717

Changes in precipitation will affect seasonal flooding patterns that drive inland fish production. While greater wet season flooding may boost production in some inland fisheries, drier dry seasons may threaten stocks of both wild and cultured fish. In the context of long-term and climate change scenarios, rising sea-level and water temperatures may have direct effects on the fish parasite composition within a respective habitat. Anthropogenic changes have greatly altered the fish species composition, especially of large predators at high trophic levels.

Geospatial technologies and remote sensing methods play a critical role in monitoring and quantifying habitat changes driven by climate impacts. By analyzing changes in river dynamics, floodplain inundation, and habitat connectivity over time, scientists can better understand habitat sensitivity, inform adaptive management strategies, and prioritize targeted conservation efforts. Integrating these spatial analyses with ecological data strengthens the development of effective conservation approaches that mitigate climate-related risks while sustaining fisheries and supporting local community livelihoods.

Recommendations for conservation

Establishment of sanctuaries in selected rivers, reservoirs, and floodplains. Destructive fishing practices should be completely banned, and law enforcement strengthened during the fishing season (Hossain et al. 2008). Successful conservation of *W. attu* requires reducing pressure on wild stocks and protecting existing populations. Overfishing can be addressed by prohibiting fishing during the breeding season, enforcing size-specific capture limits, and developing captive breeding programs. Captive culture has been challenging due to the species' predatory and cannibalistic behavior, as well as limited seed availability, but artificial breeding in captivity has already been successfully achieved by several researchers (Gupta et al. 1992; Parameswaran et al. 1988; Sahoo et al. 2006). Polyculture of *W. attu* is not feasible, so monoculture is recommended with adequate food supply to minimize cannibalism. Further research is needed on factors such as stocking density, dietary supplementation, and culture duration to optimize production. Successful artificial breeding depends on maximizing the survival of early life stages, as high larval mortality due to cannibalism is a major constraint (Gupta et al. 1992). Studies have shown that proper management and appropriate feeding can significantly reduce cannibalism among larvae (Sahoo et al. 2006). Supplementing live plankton with goat liver improves larval survival, and regular size grading enhances seed yield during hatchery rearing. Additionally, rearing under continuous red light has been found to increase survival and reduce cannibalism in larvae (Giri et al. 2002). Combining zooplankton with dry feeds promotes better growth and biomass, while also reducing cannibalistic behavior. The current status of *W. attu* populations needs reassessment, as the last comprehensive survey in India was over a decade ago, and overharvesting and other human activities may have further reduced populations. Key causes of habitat loss and environmental degradation should be identified and addressed, and local communities should be engaged and educated to support strengthened conservation efforts (Gupta 2015).

In connection with the Sustainable Development Goals (SDGs)

Research into its genetic diversity has revealed low-to-moderate diversity with high differentiation among populations, significant inbreeding, and recent bottlenecks, indicating reduced resilience to environmental changes (Safdar et al. 2025). These issues directly tie into several Sustainable Development Goals. First, SDG 14 (Life Below Water) is relevant since sustainable fisheries management, regulation of destructive fishing practices, and protection of aquatic habitats are essential to prevent further decline of *W. attu*. Second, SDG 15 (Life on Land) is implicated because freshwater ecosystems, rivers, floodplains, and wetlands are part of terrestrial–aquatic interface landscapes; their degradation via land use change, siltation, drying up harms *W. attu* (Islam 2022). Third, SDG 2 (Zero Hunger) is relevant because *W. attu* is an economically important food fish; reductions in its population threaten food security in communities reliant on inland fisheries. Additionally, sustainable use through captive breeding (which has been demonstrated) contributes to restoring stocks and supports livelihoods (SDG 1, No Poverty; SDG 8, Decent Work) (Raizada et al. 2015).

Conflict of Interest

There is no conflict of interest among the authors for the publication.

Acknowledgements

The authors are very grateful to Institute of Natural Resource Research and development (INRRD) and Prof. Dr. Md. Yeamin Hossain for supporting this study.

References

Achakzai WM, Baloch WA, Saddozai S and Memon N (2013). Length-weight relationships (LWR s) of *Wallago attu* (Bloch and Schneider) from Manchar Lake Jamshoro, Sindh, Pakistan. Journal of Applied Ichthyology, 29(5), 1172-1172.

Alam S, Khanum H and Jahan N (2024). Impact of Climate on Parasite Infestation in *Wallago Attu* (Bloch-Schneider, 1801) and *Rita Rita* (Hamilton-Buchanan, 1822). Biomedical

Journal of Scientific and Technical Research, 59(4), 51867-51880.

Babare RS, Dudhmal DH and Padghane SN (2024). Amino Acid Composition in Edible *Wallago Attu* Muscles Represents a Significant Variation with Changes in Habitats in Different Seasons from the Godavari River Basin, India.

Baran E, Nwe KM, Swe T, Hanshein S, Keomonyneath P, Sokvisal R, Lunn Z and Gätke P (2018). Consultation of fishers on fishery resources and livelihoods in the Ayeyarwady Basin. Ayeyarwady State of the Basin Assessment (SOBA) Report 4.3. National Water Resources Committee, Myanmar.

Basharat H, Ghafoor A, Chavhan A, Zafar M, Abbas K and Parveen J (2016). Microsatellite markers revealed poor genetic structure of *Wallago attu* in Punjab, Pakistan. International Journal of Life Sciences, 4(3), 385-393.

Bibi C, Khan A, Shah N, Raziq S and Yousafzai AM (2016). Size Dependent Variation in Cholesterol and Fatty Acids Profile of Different Tissues of Carnivore Freshwater Catfish, *Wallago attu*. Pakistan Journal of Zoology, 48(4).

Chakraborty BK, Wahab A, Rahman J and Hossain A (2019). Conservation and promotion of Major Cat fishes and Chital in the Padma River system. International Journal of Oceanography and Aquaculture. Australia, 4(3), 000193.

Dahire VK (2008). Fish Diversity in the riverine resources of Janjgir-Champa district of Chhattisgarh, India. Vishwavidyalaya, Raipur).

Dubey A, Goswami M, Yadav K and Sharma BS (2014). Development and characterization of a cell line WAF from freshwater shark *Wallago attu*. Molecular biology reports, 41(2), 915-924.

Froese R and Pauly D (2022) FishBase. World Wide Web electronic publication. www.fishbase.org, version (6/2022).

Giri SS, Sahoo SK, Sahu BB, Mohanty SN, Mukhopadhyay PK and Ayyappan S (2002). Larval survival and growth in *Wallago attu* (Bloch and Schneider); effects of light, photoperiod and feeding regimes. Aquaculture, 213: 151-161.

Goswami PK and Devaraj M (1992). Breeding, Age and Growth of The Freshwater Shark *Wallago Attu* (Bloch and Schneider) From the Dhir *Beel* of The Brahmaputra Basin, Assam, India. Journal of Indian Fisheries Association, 22.

Gupta S (2015). *Wallago attu* (Bloch and Schneider, 1801), a threatened catfish of Indian waters. International Journal of Research in Fisheries and Aquaculture, 5(4), 140-142.

Gupta SD, Reddy PVGK, Natarajan E, Sar UK, Sahoo SK, Rath SC and Dasgupta S (1992). On the second breeding and some aspects of culture of *Wallago attu* (Schneider). Journal of Aquaculture, 1-6.

HARI P (2019). "Length-Weight Relationship and Biology of *Wallago Attu* (Fresh Water Shark) From Bhadar Reservoir"2923 (Doctoral dissertation, JAU, JUNAGADH.

Hossain MY, Ahmed ZF, Ohtomi J, Ibrahim AHM, El-kady MA, Fulanda B and Chakraborty SK (2008). Threatened fishes of the world: *Wallago attu* (Bloch and Schneider, 1801) (Siluriformes: Siluridae). *Environmental Biology of Fishes*, *82*(3), 277-278.

Islam MS, Rahman MM, Halder GC and Tanaka M (2006). Fish assemblage of a traditional fishery and the seasonal variations in diet of its most abundant species *Wallago attu* (Siluriformes: Siluridae) from a tropical floodplain. *Aquatic Ecology*, *40*(2), 263-272.

Islam R (2022). Habitat loss, climate change threatens Bangladesh's native freshwater fishes with extinction. Mongabay.

IUCN and UNEP-WCMC (2019). The World Database on Protected Areas (WDPA). Cambridge, UK Available at: https://www.protectedplanet.net/. (Accessed: 4 January 2019).

Jayaswal R, Verma DK, Paul S, Alam A, Jha DN, Das BK and Johnson C (2025). Evaluating the Length-Weight Relationships and Growth Patterns of Seven Catfish Species in the Middle Stretch of the River Ganga, India: Insights for Sustainable Fisheries Management and Conservation Perspectives. Lakes and

Reservoirs: Research and Management, 30(1), e70018.

Karim A, Saif R, Ali FS, Gil Z and Ali W (2018). Use of CO1 gene sequences for computing genetic diversity between *Cirrhinus mrigala* from two different habitats (Farm and River). Journal of Fisheries and Life Sciences, 3, 54-57.

Khatun N, Basumatari D, Kalita T, Sharma P, Kalita K and Das S (2024). Comparative Analysis of Proximate, Amino Acid and Mineral Content of Two Fresh Water Fish Species, *Wallago attu* and *Heteropneustes fossilis* and their Quality Restoration with the Use of Additives During Cold Preservation. Egyptian Journal of Aquatic Biology and Fisheries, 28(5).

Kumar A, Dwivedi AC and Venkatesh RT (2023). The record of the largest Fresh water Shark, *Wallago attu* (Bloch and Schneider, 1801) from the Sarayu river, Uttar Pradesh, India. Journal of the Kalash Science, 11(2): 21-23.

Kumar A, Negi N, Yadav N, Badola R, Hussain SA and Gupta SK (2024). Genetic diversity, spatial connectivity, and population structure of Asian silurid catfish *Wallago attu* (Bloch and Schneider, 1801) in the Ganga River System: insights from mitochondrial DNA analysis. Molecular Biology Reports, 51(1), 378.

Kyaw T (2017). Studies on the nutritional values of *Wallago attu* from Ayeyarwady River (Doctoral dissertation, MERAL Portal.

Lilabati H and Vishwanath W (1996). Nutritional quality of fresh water catfish (*Wallago attu*) available in Manipur, India. Food chemistry, 57(2), 197-199.

Mandal M, Chatterjee ND and Burman S (2021). Boal (*Wallago Attu*) Fish Abandonment in Keleghai River, West Bengal: an idea-based clarification. Environment and Ecosystem Science, 5, 23-26.

Mijkherjee M, Praharaj A, Das S (2002) Conservation of endangered fish stocks through artificial propagation and larval rearing technique in West Bengal, India. Aquaculture Asia 7(2):8–11.

Mirza MR (2003) Checklist of freshwater fishes of Pakistan. Pak J Zool Suppl Series 3:1–30.

Mishra SS, Acherjee SK and Chakraborty SK (2009). Development of tools for assessing conservation categories of siluroid fishes of fresh water and brackish water wetlands of South West Bengal, India. Environmental Biology of Fishes 84(4): 395–407.

Montana CG, Choudhary SK, Dey S and Winemiller KO (2011). Compositional trends of fisheries in the River Ganges, India. Fisheries Management and Ecology, 18: 282–29.

Muhammad H, Iqbal Z and Saleemi S (2017). “Diversity and Distribution of Fish Fauna of the Indus River at Taunsa Barrage in Punjab, Pakistan.” Pakistan Journal of Zoology 49, no. 1.

Naher J, Akter S, Parvin R, Roy VC and Mansur A (2018). A comparative study on quality aspect of three native species *Wallago attu* (Boal), *Notopterus chitala* (Chital), *Mystus aor* (Ayr) as fresh and frozen storage condition. International Journal of Fisheries and Aquatic Studies, 6(6), 183-185

Nayyar RP (1966). Karyotype studies in thirteen species of fishes. Genetica, 37(1), 78-92.

Ng HH, de Alwis Goonatilake S, Fernado M and Kotagama O (2019). *Wallago attu (*errata version published in 2020). The IUCN Red List of Threatened Species, 2019, e. T166468A174784999.

Pandit D, Kunda M, Ray D and Rashid AHA (2020). Availability and diversity of fish fauna in the Gurukchi River of Sylhet district in Bangladesh. Journal of Sylhet Agricultural University, 7(1), 1-14.

Parameswaran S, Kumariah P and Singit GS (1988). Use of the LH-RH analogue, buserelin acetate for induced spawning in fishes. In The First Indian Fisheries Forum Proceedings. Mangalore, Asian Fisheries Society, Indian Branch (pp. 119-121).

Patra MK, Acharjee SK, Chakraborty SK (2005) Conservation categories of siluroid fishes in North-East Sundarbans, India. Biodivers Conserv 14:1863–1876.

Poulsen AF, Hortle KG, Valbo-Jorgensen J, Chan S, Chhuon CK, Viravong S, Bouakhamvongsa K, Suntornratana U, Yoorong N, Nguyen TT and Tran BQ (2004). Distribution and Ecology of Some Important Riverine Fish Species of the Mekong River Basin. MRC Technical Paper No. 10. ISSN: 1683 1489.

Prasad H (2019). Length-Weight Relationship and Biology of *Wallago attu* (Fresh Water Shark) From Bhadar Reservoir.

Prasad H and Desai AY (2020). Fecundity, spawning, and ova diameter of the *Wallago attu* from Bhadar reservoir of Gujarat, India. Journal of Entomology and Zoology Studies, 8(4), 540-542.

Rahman AKA (2005). Freshwater Fishes of Bangladesh (Second edition). The Zoological Society of Bangladesh, Department of Zoology, University of Dhaka, Dhaka-1000. 394 pp.

Raizada S, Srivastava PP, Sahu V, Yadav KC and Jena JK (2015). Observations on captive breeding of the threatened freshwater shark *Wallago attu* (Bloch and Schneider, 1801). Indian Journal of Fisheries, 62(4).

Renjithkumar CR, Harikrishnan M and Kurup BM (2011). Exploited fisheries resources of the Pampariver, Kerala, India. Indian Journal of Fisheries, 58(3), 13-22.

Riaz P and Naeem M (2023). Elemental composition of carnivorous fish *Wallago attu* (Siluridae, Siluriformes) from River Chenab, Pakistan. Brazilian Journal of Biology, 84, e270501.

Rishi KK and Singh J (1983). Chromosomal analysis of the Indian silurid, *Wallago attu* (Schneider) (family: Siluridae). Chrom Inf. Serv, 34, 10-11.

Roberts TR (2014). Wallago Bleeker, 1851 and Wallagonia Myers, 1938 (Ostariophysi, Siluridae), distinct genera of tropical Asian catfishes, with description of †Wallago maemohensis from the Miocene of Thailand. Bulletin of the Peabody Museum of Natural History 55(1): 35–47.

Rufus T, Eldho PS, Ali A, Dahanukar N and Raghavan R (2015). Length-weight relationship and condition factor of a large predatory catfish, *Wallago attu* (Schneider, 1801) from the rivers of central Kerala, India. Journal of Aquatic Biology and Fisheries, 3, 105-110.

Safdar T, Abbas K, Gondro C, Abdullah S and Zia MA (2025). Assessing Genetic Variation and Population Connectivity in *Wallago attu*: A Call for Enhanced Conservation Measures. Biochemical Genetics, 1-29.

Sahoo SK, Giri SS, Sahu AK and Gupta SD (2006). Effect of feeding and management on growth and survival of *Wallago attu* (Schneider) larvae during hatchery rearing. Indian Journal of Fisheries, 53, 327-332.

Sajjad A, Jabeen F, Ali M and Zafar S (2023). DNA barcoding and phylogenetics of *Wallago attu* using mitochondrial COI gene from the River Indus. Journal of King Saud University-Science, 35(6), 102725.

Sani R, Gupta BK, Sarkar UK, Pandey A, Dubey VK and Lakra WS (2010). "Length–Weight Relationships of 14 Indian Freshwater Fish Species from the Betwa (Yamuna River Tributary) and Gomti (Ganga River tributary) Rivers." Journal of Applied Ichthyology, 26(3), 456–459.

Sarkar UK, Khan GE, Dabas A, Pathak AK, Mir JI, Rebello SC, Pal A and Singh SP (2013). Length weight relationship and condition factor of selected freshwater fish species found in River Ganga, Gomti and Rapti, India. Journal of environmental biology, 34(5), 951.

Sarker KK, Saha MS, Sultana I, Khandakar N, Islam S, Baki MA and Das DK (2021). Diversity and conservation status of fish in the Nijhum Dweep National Park, Bangladesh. Journal of Fisheries, 9(2), 92206-92206.

Sherzada S, Hussain N, Hussain A, El-Tabakh MA and Khan SA (2024). Diversity and genetic structure of freshwater shark Wallago attu: an emerging species of commercial interest. Environmental Science and Pollution Research, 31(10), 15571-15579.

Sheshrao KS (2022). Wallago Attu: Fresh Water Shark. Ashok Yakkaldevi.

Sultana MA, Hussain MA, Schneider P, Nahiduzzaman M, Barman BK, Wahab MA, Mozumder MMH and Kunda M (2023). Community-driven insights into fish assemblage, microhabitats, and management strategies in the Meghna River basin of Bangladesh. Sustainability, 15(14), 11466.

Sultana N, Chowdhury MA and Shahnawaj M (2020). Seasonal movement of fish species of Rajshahi and Khulna division in Bangladesh. International Journal of Fisheries and Aquatic Studies, 8(3), 639-645.

Talwar PK and Jhingran AG (1991). Inland Fishes of India and Adjacent Countries. Volume 1. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, Calcutta. p 590.

Wadhar GM, Narejo NT, Mahar GM and Dars BA (2013). Age and growth study of fresh water shark, *Wallago attu* (Bloch and Schneider) from Manchar Lake, District Jamshoro, Sindh, Pakistan. Sindh University Research Journal-SURJ (Science Series), 45(2).

How to cite this article: Zahan MR, Bisa BD, Dey SC, Hossain MF, Hossain MA, Abdul-Aziz M, Hasan MA, & Ahmed ZF (Year). Threatened fishes of Bangladesh *Wallago attu* (Bloch & Schneider, 1801): Recommendations for sustainable conservation. Aquatic Resource Sciences, 02, 33-43.