Exploring the possibility of captive production of a near threatened catfish, *Rita chrysea* for Indian aquaculture

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Adult Rita chrysea.

Agriculture stands firm as the backbone of the Indian economy, encompassing the veterinary and fisheries sectors. The relentless efforts of researchers and development workers in these domains have significantly contributed to improving farmers' economic prosperity and enhancing overall productivity in the agriculture sector. Despite the immense potentiality of aquaculture, its benefits remain largely unrealised by farmers. The aquaculture sector's potential has yet to be explored fully, lagging other agricultural sectors. However, recent years have witnessed continuous efforts by aquaculture researchers through training and demonstration, shedding light on the untapped potential of this sector.

India's strides in fish production can be attributed to dedicated research and development initiatives in aquaculture. Carps play a pivotal role in aquaculture production due to their high growth rate, distinguishing them from slower-growing varieties such as prawns and catfish. Farmers and entrepreneurs are increasingly venturing into diverse fish varieties beyond carp, leveraging resources to meet the escalating demands of India's vast fish-consuming population.

Researchers at ICAR-CIFA, Bhubaneswar, have achieved successful breeding and rearing of *Rita chrysea*, a near-threatened catfish species identified by the IUCN. This continuous effort aims to popularise the species through "catfish breeding and rearing" training programs for farmers, fostering its adoption in the future. This communication on the performance of this species in captivity serves as a step forward, potentially paving the way for the adoption of this species. Furthermore, the insights provided in this literature may contribute to ensuring the captive breeding and rearing of two other species, *R. pavimentata* and *R. rita*, in the future. These species, belonging to the same genus, dominate Indian river systems.

Species history

R. chrysea, a member of the Bagridae family, is a medium-sized freshwater catfish predominantly inhabiting the Mahanadi River system, coursing through the states of Chhattisgarh and Odisha in India, spanning 857 km. Commonly known as the "Mahanadi rita," this catfish thrives in reservoirs, check dams, and rocky stretches within the river system. During 1978-79, substantial landings of this catfish from the Mahanadi River system were recorded, ranging from 15-20 tonnes. Its popularity in the market, where it fetches prices ranging from INR 200-300 per kilogram (US$ 3-4 per kilogram), fuelled extensive fishing activities. However, the overexploitation of this species, coupled with the gradual degradation of its breeding grounds due to anthropogenic activities, has led to concerns about its conservation status. Although assessed as least concern by the IUCN due to insufficient information, *R. chrysea* is now listed as near-threatened.

R. chrysea is characterised by a lead-grey hue with a whitish underside and greyish bands along the dorsal aspect of its body. Its mouth is sub-terminal, featuring a longer upper jaw with teeth present on both the upper and lower lips. Three pairs of barbels are visible in the maxillary, nasal, and mandibular regions. Notably, the pectoral and dorsal spines are robust and dentated, while the adipose tissue is prominent, and the anal fin is deeply forked. Mature individuals typically measure around 24-25 cm and weigh between 120-140 g.

This catfish exhibits nocturnal behaviour, often venturing out during the night to feed in riverbeds. It is omnivorous, with individuals reaching 50 g considered as 1+ year old. Mature catfish weighing 50 g and above can be found in both sexes. As a monsoon breeder, reports from fishermen indicate the presence of 1-2 g-sized fishes during the post-monsoon

period. The relative fecundity tends to increase with size, typically ranging from 8,000-10,000 in females weighing 50-130 g.

Captive broodstock development

The process of collecting fish from the Mahanadi River in Cuttack District, Odisha state, involved transporting the specimens to an indoor system for stress reduction. After spending two days in this controlled environment with aeration, the fish were released into a cement cistern measuring 50m^2 with a soil base. Within this environment, the fish exhibited shoaling behaviour and showed a preference for hiding within the rearing system. To accommodate this behaviour, hiding places were provided in the rearing tanks.

Initially, the fish were fed a pelleted feed containing 32% protein, placed in feeding baskets. However, it took the fish a week or more to acclimate to this feed, as they were accustomed to natural feed sources. Sensitivity to oxygen depletion was observed, with the fish surfacing during the morning hours, particularly noticeable in tank-reared fish. Regular water renewal was necessary to address this issue.

Observations notably revealed that broodstock were healthier in pond environments compared to tanks. This discrepancy in health could be attributed to the utilisation of compound feed along with the availability of natural food in pond water. Consequently, pond rearing of broodstock for this catfish species is considered a preferable option.

Induced breeding

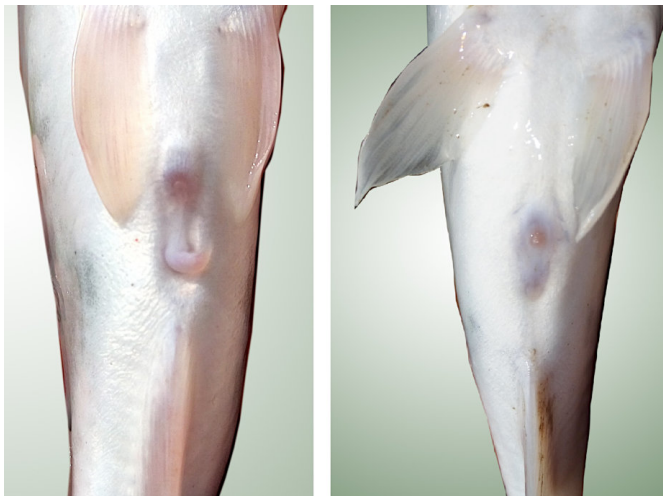
During the monsoon months, distinguishing between male and female fish is straightforward. Males exhibit a pointed papilla, while females display a bulging belly. Preference is given to females with a reddish vent and a soft, bulging belly for induced breeding. Cannulation can be performed to ensure uniformity in egg size before selecting suitable females.

For induced breeding, females are injected at the dorsal side of the body with a synthetic hormone (Ovatide), a combination of sGnRHa and domperidone, at a rate of 1 ml/kg body weight. Males, on the other hand, do not require hormone injections. Injected females are separated from males and placed in tanks equipped with aeration.

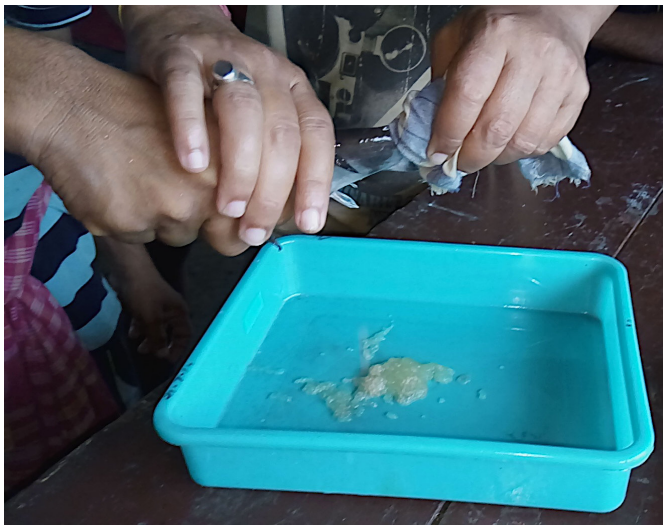
Male testes resemble an accumulated mass with pointed thin free threads projecting out. Unlike some other catfish species, such as Clarias batrachus, there is no observed oozing of milt while stripping the male. The testes are then operated out and macerated in normal saline solution (NSS) to obtain sperm suspension before stripping the females.

Stripping of the female usually occurs at 13-15 hours post-injection. The eggs are extruded in a mass resembling a grape bunch through the vent. Fecundity ranges from 10,000-13,000 in 90-120 g females. The eggs are whitish grey, with a very tender outer covering and a size of 1.2-1.4 mm. One male's sperm suspension can fertilise the eggs of two females of the same weight. The egg and sperm suspension, mixed with a little freshwater, undergo gentle mixing for fertilisation.

Broodstock.



Male (left) and female.



Stripping eggs.

The fertilised eggs are then incubated in the hatchery, where the water is in a constant moving condition. This movement is crucial as the eggs are demersal in nature, and settling at the bottom of the hatchery could impede hatching rates due to oxygen shortage. Continuous water renewal is essential until hatching occurs. The fertilised eggs typically take 22-24 hours to hatch. The resulting hatchlings measure 3.5 to 4.3 mm in size and weigh 0.9 to 1.2 mg. Even with the yolk sac, these newly hatched larvae remain active, with the yolk sac providing vital nutrition during their initial life stage.

Larval rearing

Seeing the larvae in the water column poses a challenge due to their transparent appearance. The yolk sac is absorbed within 72 hours of hatching, necessitating external feeding for the larvae. Typically, these larvae do not readily accept compound feed in the initial days after hatching. Live mixed zooplankton or *Artemia* nauplii are preferred feeds during this stage. Given their delicate nature, maintaining a favourable water environment with sufficient oxygen is crucial.

Proper cleaning of the rearing tank's bottom is essential to eliminate potential sources of dead animal-origin feed. Prolonged exposure of larvae to such an environment may lead to oxygen depletion or secondary infections. Therefore, daily cleaning of the tank bottom, coupled with water renewal, reduces the risk of mortality. Attention to population size during rearing is also important. Rearing larvae at a density of 2-3 individuals per litre yields a survival rate of ≥ 80%, whereas doubling the density results in a lower survival rate of ≤ 40%.

Larvae reared for 10-12 days on live feed can be transitioned to compound feed for the remaining duration. During this period, the larvae typically grow to 40-60 mg over three weeks. At this size, catfish larvae exhibit hiding behaviour. However, it's noteworthy that these catfish larvae require an extended period during larval rearing, making the process time-consuming.

An attempt was made to rear them for 7-8 days and subsequently stock them for outdoor rearing to shorten the rearing period. Unfortunately, this approach resulted in a low survival rate, with complete mortality observed in 2-6% of cases.

Fingerling rearing

Optimal fingerling development involves rearing the fry for three weeks or more before transitioning them to outdoor rearing. The outdoor rearing system typically consists of a series of cement tanks equipped with water inlets and complete drainage facilities. While some rearing tanks may have their bottom covered with soil or sand to emulate a natural water environment, a notable drawback is the potential entry of compound feed into the substrate during fish feeding. This complicates feeding for the tiny fish. Therefore, tanks with a bare bottom are preferred.

Experimental results suggest that fish tend to grow better when provided with shelter or hiding places during rearing. Consequently, tanks are prepared with a minimum water height of one foot and equipped with hiding places before fry

R. chrysea fingerlings.

Haul of juveniles.

stocking for fingerling production. To promote better growth, it is advisable to stock fewer than 200 fry per square meter, considering their slow growth rate.

Compound feed, in the form of crumble or dough containing 30-35% protein, can be provided near the hiding places, as most fish tend to take shelter there. Care must be taken to remove uneaten feed promptly, as its accumulation can negatively impact water quality. Additionally, the low water height in the tank may encourage the growth of filamentous algae, potentially restricting fish movement or leading to oxygen depletion.

The occurrence of asphyxiation in fish during the morning hours is a common observation during rearing. Therefore, intermittent water renewal is necessary throughout the 2-3 month rearing period. The fish typically exhibit a growth rate of 2-3 grams during this period, with a survival rate ranging from 50-70%.

Grow out culture

This catfish is recognised for its slow growth, both in natural water and captivity. Consequently, the stocking size significantly influences overall production. It is recommended to stock fingerlings weighing 8-10 grams, typically around 6-7 months old. Since the catfish lacks an air-breathing organ,

utmost care is essential when transporting stocking material, whether sourced from the wild or a hatchery, to maintain optimal oxygen levels in the water.

Farmers often employ oxygen pipes connected to oxygen cylinders or small water pumps fitted in transport vehicles to ensure continuous aeration, preventing oxygen depletion. Minimising stress on the stocking material is crucial, and stocking seeds during the early morning can help reduce heat stress. In tank culture systems, providing shelter becomes necessary due to the catfish's inclination for hiding, while in pond conditions, ample natural hiding places are available.

Maintaining a water height of around 1.5 meters is recommended. The catfish readily accepts pelleted feed containing 30-32% protein and should be fed slightly over 3% of their body weight. However, feed consumption significantly decreases during winter months when water temperatures drop below 20°C. Adjusting feeding to less than 2% of body weight during this period can help manage feed costs.

Farmers can monitor feed consumption patterns throughout the year by inspecting feed trays, providing valuable insights for effective feed management. Fish cultured in tank conditions may exhibit asphyxiation during the early morning, a challenge often mitigated by water renewal. Notably, fish cultured in pond conditions demonstrate superior growth, with sizes ranging from 40-60g compared to 28-40g in tank conditions. This enhanced growth in pond conditions may be attributed to the utilisation of natural food alongside compound feed. Despite the slow growth, achieving a net production of up to two tons per hectare is feasible, and this size commands a robust demand in the fish market.

Disease incidence

High-density larval rearing (10-12 individuals per litre) can lead to stress-induced bacterial infections. The larvae exhibit sluggish movement and show reluctance to accept feed during the initial stages of infection. In such cases, it is imperative to promptly thin out the larvae and rear them in a new environment. This immediate action significantly reduces the risk of mortality without the need for additional treatment.

During the winter months, when fingerlings are exposed to low temperatures (below 20°C), observable symptoms include small red patches on the body and the loss of barbells. These manifestations are typically attributed to the combined effects of low temperature and poor water quality. Addressing this issue involves water renewal coupled with the application of CIFAX at a dosage of 1 litre per hectare in one meter water height, effectively treating the affected fishes.

Salient observations

- The wild stock can be successfully domesticated, and a broodstock raising program can be effectively carried out in captivity before initiating breeding.
- Due to the delicate nature of ovulated eggs, it is crucial to avoid incorporating hard substances while mixing egg and sperm suspension.
- Frequent checking of females may lead to stripping failure.
- All life stages of the fish respond well to compound feed.
- This catfish exhibits slow growth in nature and performs optimally at low population sizes in captivity.
- A minimum three-week larval rearing period is essential to achieve a high survival rate during subsequent rearing stages.