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Role of Aquatic vegetation and artificial shelter in mitigating cannibalism in *Channa striata* fingerlings

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Abstract

The striped snakehead (*Channa striata*), an air-breathing freshwater fish of high economic and medicinal value, has been widely recognized for its potential in aquaculture in South and Southeast Asia. However, high mortality during the fingerling stage remains a significant bottleneck for large-scale farming, primarily due to cannibalism, territorial aggression, and environmental stress under captive conditions. Habitat enrichment through the introduction of Aquatic vegetation and shelter structures can mitigate these challenges by providing refuge, reducing aggressive interactions, and improving feed utilization. This article evaluates the role of natural forage cover and artificial shelters in enhancing fingerling survival, synthesizes available experimental evidence, and provides practical recommendations for aquaculture practices.

Keywords: *Channa striata*, Cannibalism, Aquatic vegetation

1. Introduction

C. striata, commonly known as the striped snakehead. It is a hardy freshwater carnivore widely cultured in Asia due to its ability to thrive in low-oxygen waters. It has rapid growth and high consumer demand. Despite its potential, one of the critical obstacles to the commercial aquaculture of this species is the poor survival rate of fingerlings during the early rearing stages.

In natural habitats, snakeheads exploit aquatic vegetation and substrate structures as concealment zones, which not only minimize predation but also promote ambush feeding. Replicating these ecological conditions in controlled aquaculture environments through habitat enrichment strategies offers a promising solution to fingerling mortality.

2. Cannibalism in *C. striata*

Cannibalism is a very serious problem in the culture of striped snakehead that starts from the early life stage and continues at all sizes, including during parenting (Raizada *et al*., 2021). Its aerodynamic body shape allows for fast movement in the water and easy prey capture. Striped murrel exhibits two types of cannibalism: filial and Intracohort.

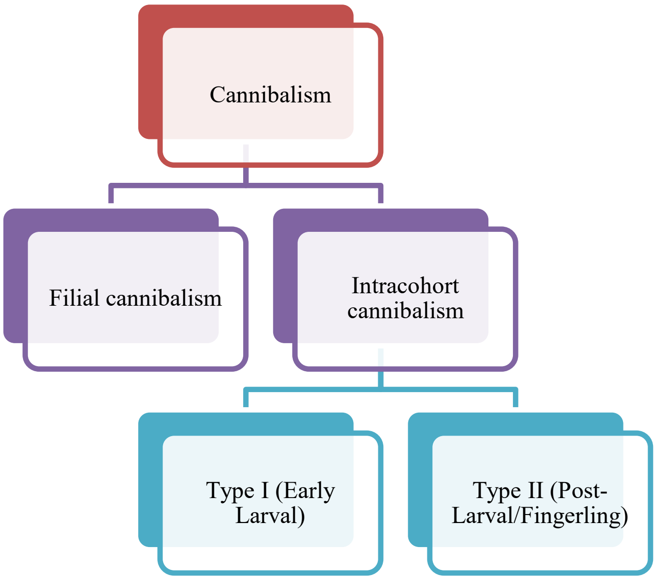

Fig. 1 Types of Cannibalism in *C. striata*

The parenting stiped snakehead observes the filial cannibalism (fig. 1), in which they eat their offspring. Filial cannibalism has also been recorded in at least seventeen different families of teleost fish. It starts from the early larval stage to a size of about 10 cm in length (Maniaca, 2002). Intracohort cannibalism (ICC) refers to eating their own siblings by the larvae in a population. Responsible factors of ICC are both genetic and environmental. Major biotic factors for ICC are size heterogeneity, population density and availability of some weaker siblings in a tank, whereas abiotic factors include a large number of parameters, such as food availability, food type, the nutritional composition of food and its metabolism in the body, temperature, photoperiod and shape and colour of internal walls of rearing tanks (Baras and Jobling, 2002; Krol and Zielenski, 2015).

Cannibalism in ***C. striata*** is influenced by multiple biological and environmental factors:

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2.1 Size Heterogeneity

Size difference among the larvae increases the Intracohort cannibalism in a population. Large larvae, also known as “shooters” should be removed as early as possible to minimize cannibalism. Larger individuals prey on smaller individuals, and predation is closely correlated with mouth size and body length (Qin and Fast, 1996).

2.2 Feeding Regime

The age at which larvae begin to consume external food, the types of food required at different ages, the amount of food, stock density, feeding frequency, and feeding methods are important feeding strategies for maintaining a population of uniformly sized larvae in fish. Inadequate food intake significantly increases cannibalism. Studies have shown that low feeding rates increase cannibalism, while adequate feeding reduces aggression and mortality (Kumari *et al*., 2018).

2.3 Stocking Density and Environment

High fish stocking densities and plain or empty rearing environments with no shelters or substrates increase encounter rates between individuals, thereby promoting aggressive interactions.

3. Concept of Aquatic Vegetation and artificial shelter (Habitat enrichment)

Habitat enrichment refers to adding structural or environmental complexity to enrichment systems to simulate natural habitats.

4. Types of Habitat Enrichment

4.1 Aquatic Vegetation

Aquatic macrophytes are being used as forage cover during the larval rearing of *C. striata* owing to their significant role in mitigating cannibalism.

Larvae and juveniles of *C. striata* exhibit aggressive behavior from early stages of development, resulting in heavy mortality due to cannibalism when reared under confined conditions (Kumari *et al*., 2018). The inclusion of aquatic macroplants such as *Ceratophyllum demersum*, *Hydrilla verticillata, Eichhornia crassipes*, Nymphaea spp., and *Pistia stratiotes* (fig. 2) creates a structurally complex habitat that serves as a refuge for smaller and weaker organisms, reducing direct visual contact and aggressive predation between larvae (War *et al*.,2011). Dense root systems and submerged plant structures increase habitat diversity,

Fig. 2 Rearing tank showing larval habitat enriched with *Pistia stratiotes*.

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reducing stress and spreading the larval population throughout the rearing area. Furthermore, these large plants support the growth of periphyton, zooplankton, and other natural food organisms, reducing competition for food and, consequently, reducing cannibalism.

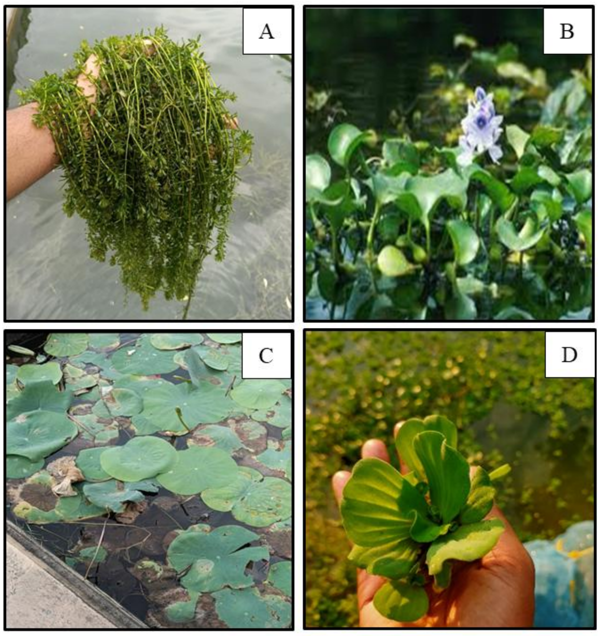

Fig no. 3 Aquatic macrophytes used as forage cover during larval rearing: (A) *Hydrilla verticillata*, (B) *Eichhornia crassipes*, (C) *Nymphaea* spp. (D) *Pistia stratiotes*.

4.2 Artificial shelter

1) Bamboo bundles and mats: Eco-friendly, locally available, and effective in reducing aggression.
2) PVC pipes, earthen pots, and ceramic tiles: Offer durable hiding spaces and establish territorial boundaries.
3) Synthetic mats and mesh structures: Increase surface area for biofilm and microbial colonization while providing refuge.

Fig. 4 Artificial shelter for larval development

5. Importance of Aquatic vegetation and artificial shelter

Aquatic vegetation and artificial shelter enhance the structural complexity of rearing units, thereby altering fish behaviour and improving survival. For *C. striata*, Aquatic vegetation and artificial shelter can

1) Minimize cannibalism and territorial aggression by providing refuges.
2) Reduce stress-related mortality through improved spatial distribution.
3) Enhance feeding efficiency and growth uniformity by lowering dominance hierarchies.
4) Create microhabitats that mimic natural ecosystems, promoting better adaptation of fingerlings.

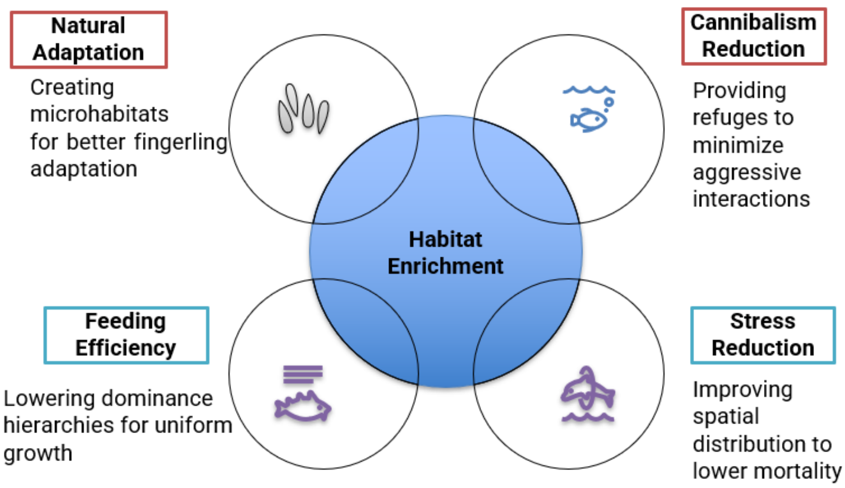

Fig.5 Benefits of Habitat enrichment

6. Conclusion

Aquatic vegetation and artificial shelter play an important role in improving the survival and growth of *C. striata* fingerlings in aquaculture. By mitigating cannibalism, reducing stress, and simulating natural ecological conditions, enrichment strategies can effectively address a major constraint in snakehead farming. Adoption of these simple, cost-effective practices can substantially improve fingerling survival and contribute to sustainable seed production for commercial aquaculture.

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