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REARING AND GROWTH PERFORMANCE OF *AMBLYCEPS APANGI* IN EX-SITU CONDITIONS

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Abstract : This study investigates the impact of feeding frequency on the growth performance and survival of juvenile *Amblyceps apangi* during a 90-day feeding trial. Physico-chemical parameters in the rearing tank, including air and water temperature, pH, dissolved oxygen levels, FCO_2, and alkalinity, were closely monitored and maintained within specific ranges. The juveniles, acclimatized under captive conditions, were fed commercially available tubifex, and their growth performance metrics (average daily weight gain, specific growth rate, percent weight gain) and survival rate were evaluated. Results revealed that the feeding frequency significantly influenced weight gain, with the highest observed in the group fed three times per day (T1, 61.22%) and the lowest in the group fed once a day (T3, 33.33%). Moreover, T1 exhibited the highest average daily weight gain and length. Specific growth rate was also significantly greater in T1. Importantly, all treatments fed with Tubifex achieved a 100% survival rate. These findings suggest that increased feeding frequency positively correlates with improved growth performance and survival of juvenile *A. apangi* during the experimental period.

Keywords: *Feeding, growth rate, physico-chemical*.

Introduction

Captive breeding serves not only to conserve a species but also to simultaneously supplement and enhance fisheries yields (Philippart, 1995; Vrijenhock, 1998). This method proves particularly valuable for species at risk of extinction, as individuals can be induced to breed in captivity, raised, and subsequently reintroduced into their natural habitat, thereby offering a safeguard against extinction. Despite debates surrounding this technique (Synder et al., 1996, 1997; Hutchins et al., 1997), it remains the most common and widely accepted management approach for numerous fish species (Brown et al., 2000; Hedrick et al., 2000).

The success of captive breeding hinges on manipulating fish reproduction, achievable through either hormonal stimulation or environmental alterations in the rearing tank. Critical factors for success include the growth performance and survivability of fish, particularly in their early stages, and the proper management of broodstock in captive conditions. In ex-situ habitats, water quality emerges as a pivotal factor influencing the growth performance and health of fish (Owhonda et al., 2007) and significantly determines the success or failure of fish culture operations (Piper et al., 1982).

Given the importance of water quality in ex-situ habitats, a well-defined management protocol for captive rearing becomes imperative for the successful implementation of captive breeding techniques. In this context, understanding in-situ habitat conditions, especially the physical and chemical parameters of water, is essential for designing appropriate ex-situ habitat conditions for captive rearing and formulating effective management strategies for conservation (Kessler & Thorp, 1993; Wildhaber et al., 2000).

Materials and Methods

Captive maintenance: During field trips, fishes predominantly in the larval and juvenile stages were captured and collected from the wild. The transportation bags maintained a specific ratio of oxygen to water (2:5). Upon arrival at the laboratory, the fishes underwent an initial treatment with a 3% salt concentration for 30 seconds to disinfect them before being released into the acclimatizing unit (3/X3/X3 cement tank) for a duration of 7 days, ensuring optimal conditions.

Hardy fishes were then transferred to the rearing unit (9.0/X9.0/X4.5 cement tank), where the cistern's bottom had been pre-coated with sand and gravel (refer to Plate 1). Artificial rain simulation was achieved through showers, and high aeration was maintained using an air pump to replicate the required habitat characteristics in the cistern. Fishes were fed *ad libitum* with earthworms, tubifex, and zooplankton cultured in the laboratory. Prophylactic measures, including the administration of antifungal and antibiotics, were implemented to prevent disease outbreaks.

Given that the wild-collected fishes were sexually immature, specific ex-situ simulation strategies were employed, addressing physical and chemical habitat conditions, nutrition, and temperature, to induce sexual maturity in both male and female specimens for captive breeding. This simulation involved incorporating a bed of sand and gravel at the aquarium's bottom, a substantial pile of pebbles and uneven rocks, and bamboo planks for nesting and hiding (refer to Plate 1). A continuous water current, integrated into a water filtration system using a submerged pump, was provided. Regular water monitoring was conducted following standard protocols.

Growth performance: To assess the growth potential and survivability of *Amblyceps apangi* under captive conditions with artificial feed, three experimental setups (T1, T2, and T3) were devised. Each experimental setup consisted of a recirculating glass aquarium, accommodating 20 fishes with total lengths ranging from 4.00 cm to 5.39 cm and total weights spanning 0.43 gm to 1.25 gm. The observation period extended over 90 days. Following collection from the wild, a 7-day acclimatization period in the acclimatization unit preceded the feeding regimen.

A congenial captive environment in the aquarium was maintained and were fed @ of 10% of their average body weight with commercially available dry tubifex. Various feeding frequencies were tested: T1 was fed three times per day (0800-9000, 1200-1300, 1800-1900 hr), T2 was fed two times per day (1100-1200, 1600-1700 hr), and T3 was fed once per day (1200-1300 hr). Fish sampling occurred every 15 days to monitor changes in their body weight (gm) and total length (mm).

Growth and survival rate were calculated by the following formula as suggested by Francis (1995).

Percentage survival = Numbers recovered x 100 / Numbers stocked

Average daily weight gain = final weight (gm) – initial weight (gm) /

Number of days

Weight gain (%) = Final mean weight - Initial mean weight x 100

Initial mean weight

Similarly, specific growth rate (%SGR) was calculated as per the protocol mentioned by De Silva & Anderson (1998) using the following equations %SRG= [(log Wt_2 – log Wt_1) x 100]/ T

Plate 1. Rearing unit of *A. apangi*

Results

Captive rearing and Growth Performance

The physico-chemical parameters in the rearing tank were both measured and maintained throughout the experimental period (refer to Table I). The measured parameters encompassed a range of values, including air temperature (17-28°C) and water temperature (16-25°C), pH (6.5-7.87), dissolved oxygen (DO) levels (7.5-9 mg/l), FCO2 (2-3.2 mg/l), and alkalinity (65-80 mg/l).

Throughout the 90-day feeding trial, the juvenile *Amblyceps apangi*, acclimatized under captive conditions, demonstrated a comfortable adaptation to consuming commercially available feed, specifically tubifex. Growth performance details, including average daily weight gain (gm), specific growth rate (SGR %), percent weight gain (% WG), and survival rate (%), are presented in Table II. Notably, T1, where the fish were fed three times per day, exhibited the highest weight gain (61.22%), while the lowest weight gain (33.33%) was observed in T3, where the fishes were fed once a day. A significant difference ($P<0.05$) in percent weight gain was evident among the three treatments with different feeding frequencies. T1 also recorded the highest average daily weight gain (gm) and length (mm). Juveniles of *A. apangi* with different feeding frequencies exhibited a significantly greater specific growth rate ($P<0.05$), with the highest value observed in T1. Importantly, a 100% survival rate was noted in the treatments fed with Tubifex.

Table I. Physical chemical environment maintained in the rearing tank

Parameter	Cement Cistern
Air Temperature (°C)	17-28
Water Temperature (°C)	16-25
pH	6.5-7.87
Dissolved Oxygen(mgl^{-1})	7.5-9
Carbon dioxide (mgl^{-1})	2-3.2
Alkalinity(mgl^{-1})	65-80

Table II. Growth and survival rate of juveniles of *A.apangi* fed with different feeding frequencies of tubifex

Parameters	Treatment 1 (T1)	Treatment 2 (T2)	Treatment 3 (T3)
Initial mean length (mm)	45.10 ± 0.35	43.10 ± 0.40	45.60 ± 0.30
Final mean Length (mm)	48.95 ± 0.42	44.70 ± 0.52	47.40 ± 0.37
Initial mean weight (gm)	0.49±0.15	0.54 ± 0.15	0.52 ± 0.19
Final mean weight (gm)	0.79 ± 0.20	0.72 ± 0.27	0.67 ± 0.66
Average daily weight gain (gm)	0.0033	0.0020	0.0016
Specific growth rate (%SGR)	0.26	0.17	0.12
weight gain (% WG)	61.22	33.33	28.84
Survival rate (%)	100	100	100

Discusssion

The health and growth performance of fish, as well as their overall efficacy, are intricately linked to environmental factors (Brett, 1979). Therefore, creating a congenial environment is crucial for the optimal growth and survivability of fish species. In the current experiment, *Amblyceps apangi* thrived under artificial conditions, with the water temperature ranging from 16-25°C in the confined cement cistern. Literature suggests that a water temperature between 28-32°C is beneficial for fishes (Bhatnagar et al., 2004), while others propose a productive temperature range for fish culture to be between 24-30°C (Santosh & Singh, 2007). The maintained pH of 6.5-7.8 and dissolved oxygen (DO) levels above 7.5 mg/l in the rearing unit fell within the recommended productive range.

According to Santosh & Singh (2007), catfish and other air-breathing fishes can endure low oxygen concentrations (< 4 mg/l), but maintaining oxygen levels above 5 mg/l is essential for good health and productivity. The concentration of CO2 and alkalinity in the experiment was within the ranges of 2-3.2 mg/l and 65-80 mg/l, respectively. High CO_2 concentration (>30 mg/l) can be lethal for fish (Chow, 1958), while maintaining CO_2 concentration below 5 mg/l is preferred for optimal fish population health (Santhosh & Singh, 2007). Alkalinity below 20 mg/l is considered low productive, and the range between 40-200 mg/l is considered medium to high productivity for fish culture (Wurts & Durborow, 1992; Swann, 1997; Bhatnagar et al., 2004).

In addition to physical and chemical factors, the availability of suitable diets is crucial for the successful rearing and survivability of a fish species, providing necessary nutrients for growth and well-being (Malla & Banik, 2015). The growth performance of *A. apangi* in the present study was significantly influenced by feeding regimes, with the highest growth observed in T1 (fed thrice/day), followed by T2 (fed twice/day) and T3 (fed once/day). Similar trends in growth increments with increased feeding intensity have been reported in various fish species. The weight gain and 100% survival rate in all experimental fish indicate the palatability of dry tubifex in *A. apangi's* diet. Successful incorporation of artificial feed in the diet of various fish species has been reported in previous studies.

The controlled environmental conditions in the cement cistern were found to be conducive for the survival and growth of *A. apangi* in this study. As the fish thrived under the provided environmental stimulants and artificial feed in captive conditions, the findings from this study could serve as a standard protocol for the future captive rearing of *A. apangi*.

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