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Research Article

Captive Rearing of Hill Stream Ornamental Fishes of Arunachal Pradesh, Northeast India

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Abstract: An investigation on the captive rearing of different 11 hill stream ornamental fishes has been conducted in aquarium during October, 2015 to May, 2016. Fishes were provided with artificial food and small fine floating pellets for 2 or 3 times daily. The average weight and length of each species were recorded monthly. The highest mean weight gain (1.9%) was found in *Devario aequipinnatus* and lowest mean weight gain (-0.47%) was observed in *Olyra praestigiosa*. Similarly, the maximum percentage growth rate (0.137) was recorded in *D. aequipinatus* and minimum (-0.097) was in *O. praestigiosa.* It reveals that *O. praestigiosa* was not suitable in the aquarium condition. Further, it also found that all the experimented fish species can be considered as ornamental fishes as they can acclimatize in the aquarium condition except *O. praestigiosa*. The survivality rate for all species was found to be 100% except *O. praestigiosa*. The Student's test (t) reveals that the initial and final weight was found to be significant at the 0.05 level in *Garra* sp. (t=-6.545); *M. dibrugarensis* (t=-8.211); *L. guntea* (t=-19); *A. apangi* (t=-7.053) and *O. praestigiosa* (t=-3.659). In case of the length, the initial and final was also significant in *D. aequipinatus* (t=-7.535); *Garra* sp. (t=-4.276); *P. ticto* (t=-3.449); *M. dibrugarensis* (t=-13.408); *B. bendelisis* (t=-4.392) and *A. apangi* (t=-10.292). The lowest water temperature (14ºC) was recorded in December and highest (27°C) in May; pH varied between 6.8 (April) and 7.6 (January). Dissolved oxygen (DO) was found within 6.55 ppm (medium size aquarium) to 7.91 ppm (cemented tank). Free carbon dioxide (FCO_2) concentration (1.0 ppm) was almost same trend in both cemented tank and aquaria. Total alkalinity ranged from 65 to 76 and the maximum was observed in large aquarium and the minimum in stocking tank. The recorded values of water quality were found within the permissible limit.

Keywords: Captive; Rearing; Ornamental fish; Arunachal Pradesh; India

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Introduction

Ornamental fish, also known as aquarium fish and they are the live jewels and the most attractive living organisms of the aquatic world. Their lively and fascinating activities are worth enjoying as colourful fish has high aesthetic value. Throughout the world, ornamental fish keeping is very popular as interior decorative materials; an easy and stress relieving hobby. Besides home aquaria, public aquarium in hotels, parks and other public places are common in metropolis. About 7.2 million houses in the USA and 3.2 million in the European Union have an aquarium and the number is increasing day by day throughout the world (Ghosh et al., 2003). As of now, the demand for fish has been increasing due to not only the increase in population but also aquarium fish trade and their values towards health benefits of human being. As fish farming intensifies and artificial propagation of the ornamental fish, so rearing feasibility is top priority as well as providing feed that are nutritionally balanced for the utmost growth in the aquarium.

Now a day, ornamental fish rearing in aquarium is so popular in urban India, in comparison to rural areas due to lack of awareness of such culture. Northeastern India has many species of fish that have great potential in the ornamental trade and many of them are attractive to foreign markets. There is great potential to expand this industry. At present production level of aquarium fishes does not cope with the demand of domestic market. Moreover, culture of the indigenous ornamental fish species can generate a source of income to the economically weaker section and the educated unemployed youth. There is hardly reported on the captive rearing of ornamental fishes in the region. Notably, (Dakua et al., 2013) investigated on the rearing feasibility of *Esomus danricus* and *Parluciosoma daniconius* from upper Assam, India. Therefore, the present study has been taken up on the captive rearing of certain wild ornamental fishes.

Materials and Methods

The experiment was conducted at the Fish and Aquatic Ecology laboratory of Department of Zoology, Rajiv Gandhi University, Rono Hills during October 2015 to May 2016. A total of different 11 (eleven) hill stream ornamental fish species were selected for this experiment. Live wild fishes were collected from sampling site of the Dikrong River. The coordinate of the site is N $27^0 09' 29.12''$ and E $93^0 45' 26.45''$ with 247 msl of Arunachal Pradesh **(Figure 1)**. After collection, the specimen was treated with one spoon of NaCl or 2 to 3 drops of $KMnO_4$ solution mixed in 16 liters of waters and kept for 2 days. Then transferred for standardize captive rearing in the cemented tank **(Figure 2).** Later, transferred all of them in their respective aquarium size of 120 × 60 × 50 cm^3 and 60 × 40 × 45 cm^3 maintain with a water depth of 25 cm for acclimatization having floating 2-3 weeds **(Figure 3)**. Before transferred, the length and weight of the individual of each species by using divider and measuring board having graduation in mm and electronic balance was nearest to 0.01 gm. The number of each species varies from one aquarium to other and for which 11 numbers of aquaria were used. Fishes were provided with artificial food such as freeze dried tubifex, grinded dry small fish (powder) and small fine floating pellets for 2 or 3 times daily and sometimes mosquito larvae. Growth rate in terms of length and weight were monitored by maintaining standard water quality and providing artificial fish feed periodically. The water quality of aquarium was constantly monitored on monthly basis as per procedure of APHA (1992). The survival and mean growth rate of the fishes were calculated by the following formula (Francis, 1995). Similarly, percentage growth rate (PGR) was determined by the following formula of (Sakthivel and Bhaskaran, 1995):

$$\text{Percentage survival} = \frac{numbers\ recovered}{numbers\ stocked} \times 100$$

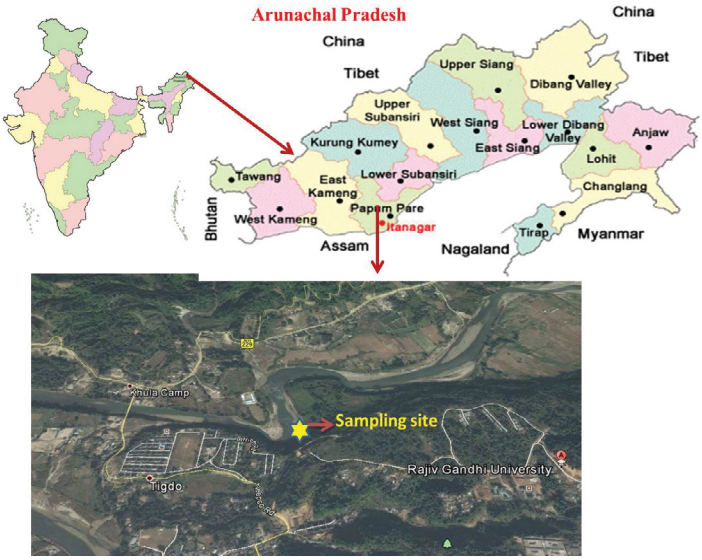

Figure 1: Sampling site in the Dikrong river.

Figure 2: Cemented tank (for temporary acclimatization).

Figure 3: Aquarium set for rearing of fish species.

$$\text{Mean weight gain} = \frac{\text{final weight (g)} - \text{initial weight (g)}}{\text{numbers of days}} \times 100$$

$$\text{PGR} = \frac{final\ weight\ (g) - initial\ weight\ (g)}{initial weight(g)}$$

Results and Discussion

Rearing feasibility of selected species

The rearing practice for selected fish species was shown in **Table 1**. For this experiment, different aquarium was used for each species. *Devario aequipinnatus,* while introduced, it was measured 72.5 mm (± 0.02) in average body length with 4.14 g (± 0.04) body weight and reached up to 75.6 mm (± 0.02) in length with 4.71 g (± 0.03) weight. *Garra* sp., the average initial length was 53.07 (± 0.01) mm and grows up to 53.1 (± 0.01) mm and their average weight 1.62 g (± 0.01) increases to 1.6 g (± 0.02). *Pethia ticto,* the average initial length was 93.1 mm (± 0.01) and grows up to 93.6 mm (± 0.01) and their average initial weight was 11.0 g (± 0.01) and increases to 11.1 g (± 0.01). *Mystus dibrugarensis,* the average initial weight was 4.42 g (± 0.02) with average length 81.2 mm (± 0.02) and attain a growth up to 4.57 g (± 0.03) in weight and 83.7 mm (± 0.02) in length. *Lepidocephalichthys guntea*, the initial average length was 60.9 mm (± 0.01) with the average weight was 1.45 g (± 0.01) and finally measured its length 61.0 mm (± 0.01) and weight 1.5 g (± 0.01). *Barilius bendelisis,* it was measured 106.6 mm (± 0.01) as initial average body length with 11.55 g (± 0.01) body weight and reached up to 107.7 mm (± 0.01) in length with 11.6 g (± 0.01) in weight. *Aborichthys kempi,* the average initial length was 84.7 mm (± 0.01) and grows up to 85.9 mm (± 0.01) while their average initial weight was 2.75 g (± 0.01) and increases to 2.85 g (± 0.01). *Botia rostrata*, the average initial weight was 2.55 g (± 0.01) with average length 69.1 mm (± 0.01) and attains a growth up to 69.2 mm (± 0.01) in length with 2.67 g (± 0.01) in weight. *Amblyceps apangi*, the initial average length was 84.2 mm (± 0.03) with the average weight 3.84 g (± 0.02) and finally measured its length as 85.8 mm (± 0.04) and weight as 4.0 g (± 0.03). *Danio rerio,* the initial average length was 39.3 mm (± 0.00) and grows up to 39.3 mm (± 0.00) while their average weight was 0.5 g (± 0.00) and remains up to 0.5 g (± 0.00). *Olyra praestigiosa,* the average initial length was 81.3 mm (± 0.03) and remains grow up to 81.3 mm (± 0.03) and their average initial weight was 1.44 g (± 0.02) and increases to 1.30 g (± 0.03).

The Student's test (t) of significant for the differences between initial and final weights and lengths of all the species has calculated **(Table 1)**. At the 0.05 level, the values for initial and final weight of the *Garra* sp. was found to be significant (t=-6.545); the initial and final weight of *M. dibrugarensis* was also significant (t=-8.211); the initial and final weight of *L. guntea* was significant (t=-19); the initial and final weight of *A. apangi* was also significant (t=-7.053) and the initial and final weight of *O. praestigiosa* was significant (t=-3.659). The differences between initial and final weights of the other fish species were not significant at 0.05 level. In case of

Table 1: Growth performance, food intake and survivability rate of 11 wild ornamental fishes.

Name and No. of specimens	Average Weight (g)			Average length (mm)			Mean weight gain (%)	% survival	PGR	Feed/ fish (g)
	Initial	Final	Student's t Test	Initial	Final	Student's t Test				
D. aequipinatus (N=15)	4.14 ± 0.04	4.71 ± 0.03	-3.426	72.5 ± 0.02	75.6 ± 0.02	-7.535*	1.9	100	0.137	0.13
Garra sp. (N=4)	1.62 ± 0.01	1.69 ± 0.02	-6.545*	53.07 ± 0.01	53.1 ± 0.01	-4.276*	1.633	100	0.043	0.048
P. ticto (N=4)	11.0 ± 0.01	11.1 ± 0.01	-2.596	93.1 ± 0.01	93.6 ± 0.01	-3.449*	0.33	100	0.009	0.33
M. dibrugarensis (N=10)	4.42 ± 0.02	4.57 ± 0.03	-8.211*	81.2 ± 0.02	83.7 ± 0.02	-13.408*	0.5	100	0.034	0.132
L. guntea (N=2)	1.45 ± 0.01	1.5 ± 0.01	-19*	60.9 ± 0.01	61.0 ± 0.01	-1.0	0.17	100	0.034	0.04
B. bendelisis (N=4)	11.55 ± 0.01	11.6 ± 0.01	-3.068	106.6 ± 0.01	107.7 ± 0.01	-4.392*	0.33	100	0.004	0.342
A. kempi (N=3)	2.75 ± 0.01	2.85 ± 0.01	-3.464	84.7 ± 0.01	85.9 ± 0.01	-2.412	0.33	100	0.036	0.08
B. rostrata (N=2)	2.55 ± 0.01	2.67 ± 0.01	-1.769	69.1 ± 0.01	69.2 ± 0.01	-10.0	0.4	100	0.047	0.076
A. apangi (N=13)	3.84 ± 0.02	4.0 ± 0.03	-7.053*	84.2 ± 0.03	85.8 ± 0.04	-10.292*	0.53	100	0.042	0.104
D. rerio (N=2)	0.5 ± 0.00	0.5 ± 0.00	--	39.3 ± 0.00	39.3 ± 0.00	--	0	100	0	0.015
O. praestigiosa (N=16)	1.44 ± 0.02	1.30 ± 0.03	-3.659*	81.3 ± 0.03	81.3 ± 0.03	0.009	-0.47	37.5	-0.097	0.04

* Significant at the 0.05 level; without * not Significant.

the length, the values of initial and final of *D. aequipinatus* was found to be significant (t=-7.535); the values of initial and final of *Garra* sp. was significant (t=-4.276); the values of initial and final of *P. ticto* was significant (t=-3.449); the values of initial and final of *M. dibrugarensis* was significant (t=-13.408); the values of initial and final of *B. bendelisis* was significant (t=-4.392) and the values of initial and final of *A. apangi* was also significant (t= -10.292). The differences between initial and final length of the other species were not significant at 0.05 level.

The mean weight gain was found to be highest (1.9%) in *D. aequipinnatus* and followed by *Garra* sp. (1.633%) while, the lowest mean weight gain was observed in *O. praestigiosa* (-0.47%) and *D. rerio* (0.0%). The other species like *P. ticto, M. dibrugarensis, L. guntea, B. bendelisis, A. apangi, B. rostrata* and *A. kempi* were also recorded their slight weight gain. In case of percentage growth rate (PGR), the maximum (0.137) was recorded in *D. aequipinatus* followed by *Garra* sp. (0.043) and its minimum was in *O. praestigiosa* (-0.097) and *D. rerio* (0.0). The average PGR were observed in the remaining species viz. *P. ticto, M. dibrugarensis, L. guntea, B. bendelisis, A. apangi, B. rostrata* and *A. kempi*. Based on these aspects, *O. praestigiosa* was not successfully reared in spite of best effort while, *D. rerio* was found neither weight gain nor increase of percentage growth rate during the rearing practice. Hence, *O. praestigiosa* and *D. rerio* was not fit in the aquarium condition from the ornamental fish point of view.

Survival rate and timing of feed provided

In overall, the survival rate for all species was found to be 100% except *O. praestigiosa* and indicating that they can easily acclimatized and survived in aquarium condition for long time. Similar results were also observed by Singh (2011) and Dakua et al. (2013) for various ornamental fishes from the Brahmaputra River**.** In case of *O. praestigiosa,* the survivality rate was 37.5% as out of the 16 specimens only 6 of them has been survived**.** The feed supplement was provided at 3% body-weight of individual species mainly during morning and evening (daily 2-3 times). As the fish increase in size the proportion of feed required for maintenance of species also increased (Pillai and Lakra, 2000). In overall of rearing, the provided supplementary feed rate was ranged from 0.015 to 0.342 mg**.** The lowest feed rate was recorded in *D. rerio* while its highest was in *B. bendelisis.* Supplied artificial diets are tokyo feed (Discus Thailand), tubifex (Royal Feast) and other natural live feed (earthworm and mosquito larva)**.** Most of the reared fishes preferred tubifex in comparison to other feeds**.** The result reveals that they can grow well and easily acclimatize in aquarium condition except *O. praestigiosa.*

Further, it is clear that, out of the 11 experimental species, *O. praestigiosa* was found to be unfit for rearing in the aquarium condition due to their poor response in respect of the length and weight**.** It was repeatedly tried to attempt the domestication of the *O. praestigiosa* in the aquarium condition but its outcome was negative as it difficult to maintain their natural habitat. However, the rest of the species were found to be suitable for rearing and could be considered as hill stream ornamental fish species.

Table 2: Parameters of the aquarium for captive rearing experiments.

Parameters	Stocking tank	Aquarium 1 (Large-size)	Aquarium 2 (Medium-size)
Water Temperature (°C)	14 -24	14-27	14-27
pH	6.8-7.5	7.0-7.6	7.1-7.5
Dissolved oxygen (ppm)	6.98-7.91	6.88-7.69	6.55-7.12
CO_2 (ppm)	1.0	1.0	1.0
Alkalinity (ppm)	65-72	70-76	70-72

Practically, attempt to domestication on certain species could also help in the artificial propagation of endangered species.

Physico-chemical parameters of the tank and aquarium

The water quality of the tank and aquarium has been monitored every month from October to May **(Table 2)**. The 50% of the water volume in aquarium was changed after every month. The water temperature ranged from 14°C to 27°C, as the lowest was observed in December (stocking tank) and highest in May (medium aquarium). pH varied between 6.8 (Apr) and 7.6 (Jan) and the lowest was recorded in stocking tank and highest in large aquarium**.** Dissolved oxygen (DO) found within 6.55 to 7.91 ppm and the highest was observed in cemented tank and the lowest in medium aquarium**.** Free carbon dioxide (CO_2) concentration (1.0 ppm) was almost same trend in tank and aquaria while, total alkalinity ranged from 65 to 76 and the maximum was observed in large aquarium and the minimum in cemented tank during April and December respectively. The finding values of the water quality were found within the permissible limit. A pH range of 6.5 to 9.0 is suitable for fish culture (Hora and Pillay, 1962); dissolved oxygen within 5 to 8 ppm, as the concentration was above 5 ppm is favourable for most fish species (Lichtenberger, 1985). Dakua et al. (2013) was also observed the similar results in the rearing of ornamental fish in the aquarium.

Conclusion

From the above findings, it reveals that as the length of fish increase with slight increases of weight in each species except *O. praestigiosa* and *D. rerio*. In overall, the survival rate was found to be cent percent (100%) for most of the species. The water quality of the tank and aquarium was monitored constantly during the experiment because survivability of the fish also depends on the water condition. It indicates that they can easily acclimatize and survive in aquarium condition for long time. The prevailing environmental factors are suitable for culture and propagation of the rearing species in aquarium condition. Ornamental fish farming/rearing can be a promising alternative for local people of the region from trading point of view.

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