Research Article

# Identification and domestication of native ornamental fishes of Begnas Lake, Pokhara, Nepal

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## Abstract

Native fishes have great values as an ornamental fish in Nepal as well as in the global fair. Most of the ornamental fish species of Nepal are imported from India and Thailand. The main goal of this study was to identify and domesticate indigenous ornamental fishes for commercial production. Begnas area, Pokhara was selected as the study site as it has different small indigenous fish species which might have great potential as ornamental fish. The study was carried out for eight months from February to September 2020. Native fishes were collected from outlets and irrigation canal of Begnas Lake by using a cast net. Five fish species *Puntius conchonius*, *Puntius sophore*, *Barilius barna*, *Danio devario* and *Danio rerio* were identified and found suitable for ornamental purpose. These fish species were domesticated with different feed maintaining the water quality parameters in an aquarium during the experiment period. Survivability of these fish species was low during the winter season; and at the same time, they could adapt to any kind of food. *Danio devario* was selected for the breeding purpose; and among all, 33 individuals were selected and placed in different conditions (-in the aquarium with heater and aerator, in the outer tank exposed to direct sunlight, the tank having continuous water flow without sunlight and in the open artificial pool) with 40% CP and bloodworms and maintaining the proper water quality. Out of all the different conditions, the environment that was artificially made pool with enough sunlight was found to be suitable for breeding. Their breeding was also influenced by the environmental condition since they bred one month later than their regular breeding periods in captive conditions.

**Keywords:** Aquarium; Breeding; Captive; Indigenous fish; Water parameters

## 1 | Introduction

Since Ornamental fish are 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 colorful fish has high aesthetic value. Ornamental aquaculture industry is a global industry where it is estimated that more than two million people are involved both directly and indirectly including hobbyists (Dominguez & Botella 2014). Throughout the world, ornamental fishkeeping is very popular as an interior decorative material, an easy and stress -relieving hobby. Besides home aquaria, public aquarium in hotels, parks and other public places are common in metropolis. The growing interest in aquarium fishes has resulted increase in the aquarium fish trade globally where European Union are the largest market, however, the United States is the single largest importer of ornamental fish in the world (Chapman 2000). In the USA, about 7.2 million houses and 3.2 million in the European Union have an aquarium (Ghosh et al. 2003). Ornamental fish culture is getting more popular now-a-days and is one of the fastest emerging branches of aquaculture due to its tremendous prospects and economic opportunities. About 120 countries contribute

to the global ornamental fish trade and more than 1,800 species of fishes are traded, of which over 1200 are of freshwater origin. Most of the ornamental species globally traded are warm water tropical fishes except some eurythermal carps. Advancement in breeding and aquarium technology has added a new dimension in the ornamental fish trade with more species and varieties being introduced to the aquarium trade. The global freshwater ornamental fish industry heavily relies on cultured fishes and fishes from the wild contribute only inadequate proportions.  In total contrast to this, the marine fish species constitute only 15% of the global market by value, however, nearly 98% of these fishes are wild caught and very few from captive-breeding (Sureshkumar et al. 2013). Captive fish species can be produced anywhere in the world once it is domesticated. Yet, aqua cultural operations tend to be focused on the more prosperous consumer countries for the high cost of developing the necessary infrastructure where there is sufficient capital investment required (Murray & Watson 2014; Tlusty 2002; Wood 2001). So, domestication and cultivation of ornamental fish mainly freshwater species raised on farms satisfy commercial demand which reduces pressure on wild populations. The domestication of ornamental fish, among others, has increased in recent decades worldwide (Teletchea 2016).

A total of  230 native fish species belonging to 104 genera, 34 family and 11 order are found in Nepal (Rajbanshi 2012) .  Among them some of the native fishes also have value as an ornamental fish and about 15 native fishes are potential candidate as an ornamental fish that possess a great color (Husen 2019). Some exotic fish species such as Goldfish, Fancy carp, Guppy, Platy and swordtail as well as native fish *Colisa sp.*, are reared for breeding purpose in the fishery research station, Begnas, Pokhara which are very popular in aquarium purpose in Pokhara Valley (FRS 2018). Most of the ornamental fish species are imported from India and Thailand. The main goal of this study is to identify the potential native ornamental fish species from Begnas Lake, domestic them and assess the suitable environment for breeding activities. So, this study helps to find out whether the native ornamental fish can replace the exotic ornamental fish.

## 2 | Materials and methods

### 2.1 | Study area

The study was conducted in the Fishery Research Station, Begnas, Pokhara.

### 2.2 | Selection and identification of ornamental fishes

Native fishes were collected from the irrigation canal of Begnas lake, Pokhara from 04 February to 04 March 2020 and from 26 June to 02 July 2020 by using a cast net. The collected fishes were identified by using the standard method of Shrestha (2008). Small to medium size native fishes ideal for aquarium having good coloration, different feeding habits (Carnivores, Herbivores, Omnivores), their behavior with other fish species and having ability to sustain in a controlled environment were selected.

### 2.3 | Domestication

After selecting their nature, initial length and weight of these fishes was taken before introducing them into the stocking tank for acclimatization and then theses fishes were kept in the aquaria having 40-liter capacity where proper aeration was maintained and water was replaced once a week by siphoning. Fishes were fed with autoclaved powdered feed having 40% CP thrice a day. The survival rate of the fishes was calculated by the following equation (Francis 1995).

$$\text{Percentage survival} = \frac{\text{Numbers recorded}}{\text{Numbers Stocked}} \times 100$$

### 2.4 | Floatation investigation of breeding activities of species and assessing the suitable environment

Out of the total domesticated native fish species, *Danio devario* was selected for investigating breeding activities and assessing the suitable environment. For assessing the suitable environment, 33 individual *Danio devario* were exposed into the four different conditions after measuring their weight to know which female layed the eggs. The first condition (A) fishes were kept in the aquarium with heater and aerator whereas natural bedding was made with sand, gravel, pebbles and aquatic submerged plant *Hydrilla verticillata* but there is absence of the direct sunlight. Likewise, second condition (B) fish was kept into the outer tank which is

**Table 1.** List of native fish species found in Begnas suitable for ornamental purpose

| S.N. | Fish species | Order | Family | Local name |
|------|--------------|-------|--------|------------|
| 1. | *Puntius conchonius* | | | Rato pothi |
| | | Cyprniformes | Cyprinidae | |
| 2. | *Puntius sophore* | | | Pothi machha |
| 3. | *Barilius barna* | | | Fageta |
| 4. | *Danio devario* | | | Sera vitta |
| 5. | *Danio rerio* | | | Chelawa,zebra fish |

exposed to direct sunlight and in natural bedding was made like the first condition. Similarly for the third condition (C) fishes were exposed to the tank with running water where natural bedding was like previous two condition but there is absence of direct sunlight. The fourth and the last condition (D) this is the open environment which can be called as semi captive condition where natural bedding was made like three condition which is exposed to direct sunlight. For all the condition aeration was properly maintained and those fishes were fed with autoclaved 40% CP powdered feed and sometimes bloodworms were also fed as supplement feed. Temperature, pH and DO for all these conditions were checked by the mercury filled thermometer, portable Hanna pH meter and wrinkle method, respectively.

**Table 2.** Length weight of the native ornamental fish species collected form the Begnas Lake

| Fish species | Length (cm) Mean ± SD | Weight (gm) Mean ± SD |
|--------------|------------------------|------------------------|
| *Puntius sophore* | 5.7±0.9 | 3±1.4 |
| *Danio devario* | 6.3±0.5 | 3.1±0.7 |
| *Danio rerio* | 3.3±0.4 | 0.4±0.2 |
| *Puntius chonchonius* | 4.7±0.3 | 2.1±0.2 |

## 3 | Results

In this study, five native fishes are found suitable for the ornamental purposes from the Begnas Lake which are *Barilius barna*, *Danio devario*, *Danio rerio*, *Puntius sophore* and *Puntius conchonius* (Table 1, Fig. 1) belonging to order cypriniformes and family cyprinidae. The length weight of the fish species is given in the Table 2. The survivability for the *Barilius barna* was zero as it could not survive that's why there was no further domestication for it. Since *Puntius conchonius* and *Danio rerio* were not found during the catch of ornamental

fishes during the winter season and summer season so there is no survivality rate for the winter months and summer months for those species. Survivality rate for the *Puntius sophore* (86.66%) and *Danio devario* (94.59%) were higher in the months of summer than the winter months (Table 3).

Survivality rate for summer months are higher which could be due to the temperature, as temperature is directly related the dissolved oxygen. These fish species can be domesticated at the temperature range from 16 to 30℃, pH 7 to 8 and DO 4 to 7 mg/L. Among the four conditions to investigating breeding activities of *Danio devario* for assessing the suitable environment, breeding was successful in the fourth condition which is in the open environment (10 m Length, 0.75 m wide and 30cm depth) that can be called as the semi captive condition. *Danio devario* can be breed in the temperature range from 27 to 28℃, pH 7 to 7.8 and DO range 5.5 to 7.5 mg/l. Since only one female Danio was able to breed there was only 25 hatchlings were survived in open environment. For the hatchlings, they were kept in the aquaria and feed with micro feed thrice a day. The water quality for the species is all in acceptable range as shown in the table for four condition of breeding environment and normal domestication process (Table 4).

## 4 | Discussion

Native fishes are one of aquatic vertebrates which needs to be further studied however before completing understanding their occurrence, distribution and ecology, there are certain threats roaming around native fishes due to climate change, over fishing, pollution, alteration of natural habitats and poor understanding of fish ecology etc (Gurung 2012). Contribution of native fish to total production is declining worldwide, as most fishes have been over fished (Allan et al. 2005, Allen et al. 2010). Therefore, usually native fishes of Nepal considered as not valuable in the case of the economic

**Table 3.** Seasonal effects on domestication of local ornamental fish species

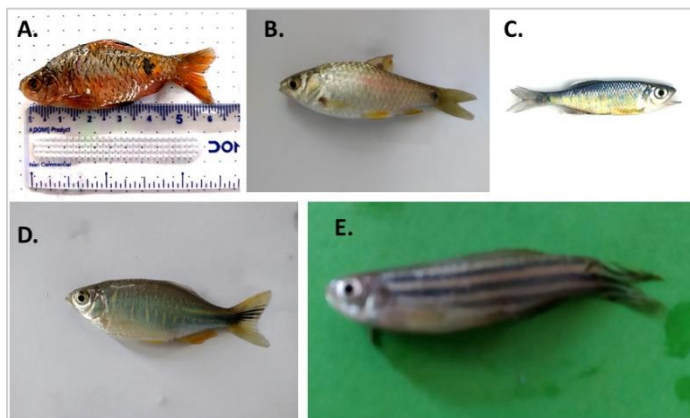| Scientific name | Local name | Winter month's survival (%) | Summer month's survival (%) |
|-----------------|------------|------------------------------|------------------------------|
| *Puntius conchonius* | Rato pothi | 66.6 | - |
| *Puntius sophore* | Pothi machha | 82.82 | 86.66 |
| *Danio devario* | Sera vitta | 62.35 | 94.59 |
| *Danio rerio* | Chelawa/ zebra fish | - | 84 |

**Figure 1.** Native ornamental fish species suitable for ornamental purpose: Puntius conchonius (A), Puntius sophore (B), Barilius barna (C), Danio devario (D), Danio rerio (E)

benefit so there needs to be proper management for the native fish species. That's why in Kali Gandaki Fish Hatchery as designated research station for native fish and nine native fishes has been bred in captivity successfully (KGFH 2005-06). This station is produced about one million fingerlings of native fishes for the purpose of restocking in the regulated rivers for the conservation of native fishes (Gurung and Baidya 2012). Different native ornamental fish species such as *Puntius* sp., *Colisa* sp., Bhurluk etc. were collected from different water bodies and reared for domestication and propagation in plastic tank. Similarly, broods of some exotic species such as Goldfish, Fancy carp, Guppy, Platy and Swordtail were also reared for breeding purposes. Native fish *Colisa* sp are successfully breed in fishery research station. (FRS 2018). However, there are not much work done in the case of domestication and breeding native ornamental fishes of Nepal.

commercialized and conserve the native fishes. The present study shows five native fishes are found as the potential for the ornamental purpose from the Begnas Lake which can be domesticated from wild to captivity that can promote the native fish species in the ornamental fish industry of Nepal. According to McClure et al. (2006) *Danio devario* species typically inhabits faster flowing water unlike zebrafish, which inhabits the margins of streams and rivers. Therefore, similarly in this study, *Danio devario* was able to breed in the semi captive condition in the open environment without use of hormone where continuous water was supplied through pipe for the moderate amount of water current. Breeder and Rosen (1996) noted that the sudden cooing of the temperature in the spawning aquarium by the artificial rain and then gradual increasing temperature is the main induction for the breeding of *D. aequipinnatus*. In the same way for the induction for the breeding of *Danio devario* in this experiment is seen due to natural rain cooling the temperature of the water.

Although freshwater ornamental fish industry mainly relies on the cultured fishes from captive conditions, significant numbers are still removed from the wild (Andrew 1990). Therefore, domestication and breeding of the native ornamental fishes can play a great role for promotion of native ornamental fishes in Nepali market as well as for conservation which can be used by aquarium keepers so that this species can remain sufficient number in the natural environment along with its habitat protection.

**Table 4.** Mean and standard error (SE) of water quality parameters

| Water quality | 1st condition (A) | 2nd condition (B) | 3rd condition (C) | 4th condition (D) | Normal |
|---|---|---|---|---|---|
| Temperature | 29.21±0.159 | 28.01±0.138 | 27.87±0.183 | 27.43±0.139 | 27.93±0.1581 |
| DO | 5.25±0.086 | 6.32±0.156 | 5.55±0.07 | 5.85±0.03 | 5.31±0.07 |
| PH | 7.43±0.064 | 7.55±0.043 | 7.45±0.084 | 7.65±0.03 | 7.37±0.056 |

According to (Husen 2019), there are about 43 ornamental fish shops from the Kathmandu and Pokhara Valley of Nepal which sales the 27 exotic ornamental fishes which are mostly imported from India, Thailand and some of the native fishes are also popular in the market however Nepal also has great native ornamental fish which can contribute as ornamental fishes in Nepal as well as global fair and there are 15 potential native fish species in Nepal which can contribute as an ornamental fish that possess an attractive colour. This kind of the activity can help to

# 5 | Conclusions

This study documents native fishes possess the great potential as ornamental fishes in Nepal and it can be domesticated from the wild to the captive conditions. In cases of *Danio devario* it can be breed in the semi captive condition in the open environment where all the water qualities are maintained. This study could provide the insight in the native ornamental fishes which can contribute to ornamental fish industry in Nepal.

## Acknowledgements

## Authors' contributions

Chand S. collected field data, analyzed data and wrote the manuscript. Prasad A., provided useful suggestions/concept, reviewed critically to the drafts. Husen M.A., provided concept to experiments, useful suggestions and manage the funding. All authors final approval to submit manuscript for publication. The research fund was provided by Fisheries Research Station, Begnas, Pokhara for Overall experimental research.

## Conflicts of interest

Authors declare no conflict of interest.

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