Habitat and Breeding Ground Preferences of the Vulnerable Fish Species Sri Lankan Cherry Barb (*Puntius Titteya*) According to the Water Quality in Aquatic Habitats in Lowland Wet Zone, Sri Lanka

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Abstract - Sri Lankan Cherry Barb (*Puntius titteya*) is a vulnerable endemic fish seen in Sri Lanka. This magnificent creature is well-established in freshwater habitats located in both low and mid-country wet zones of Sri Lanka, especially in the Kelani, Kalu, Gin and Nilwala river basins. This study aims to reveal the habitat and breeding ground preferences of the Cherry barb in the natural environment. This investigation used four water quality parameters including water pH, Total dissolved solids (TDS), Electrical conductivity (EC) and water temperature. Each of these ecosystems and fish were identified, photographed and mapped using Global Positioning System (GPS) for further studies. This study demonstrated that Sri Lankan Cherry Barb preferred acidic conditions in the water pH 6.29±0.29 (5.06-7.11) with low TDS at 16.81±2.32 ppm (8.50-22.67 ppm), EC of 32.22±4.23 µS/cm (17.00-44.00 µs/cm), and water temperature of 28.98±0.71 ^{0}C (28.00-31.97 ^{0}C). The three breeding grounds (Site 01, Site 04 and Site 06), where offspring were located, got significant lower pH (5.95±0.45), TDS (15.44±0.49 ppm), and EC conditions (28.44±6.14 µs/cm) with similar temperature range (28.93±0.47 ^{0}C). These breeding grounds were established with a medium flow rate and thick-submerged-leaf-debris layer that can reduce water pH due to the release of organic acids and polyphenols from terrestrial and organic matter debris. These findings highlighted the value of the Sri Lankan Cherry Barb as an important biological indicator of water quality in aquatic habitats. Hence, playing a critical role in biodiversity conservation.

Keywords: Puntius titteya, Ecological Habitats, Breeding grounds, Water quality

I. Introduction

Sri Lankan Cherry Barb is a tropical freshwater fish endemic to Sri Lanka and belonging to the Cyprinidae family. The cherry barb is a tiny, elongated fish with two maxillary barbs and a fairly compressed body. The Kelani River basin, Nilwala river basin and the Gin river basin are home to the two primary colour variants. The "neon" colour variety features a distinct boundary between the dorsal and lateral sides and a dorsal side that is dark brown with a mild yellowish tint. Starting at the tip of the snout, a dark brown horizontal line crosses the eye line and continues to the centre of the base of the caudal fin. Females have paler skin tones. The "Ruby" colour variant from the Nilwala and Gin River basins has a dorsal side that is dark red and a lateral side that is brighter red in colour. In this colour variant, the horizontal line is not present. Their fins have a vivid pink-red colour. They favour shallow, shady streams with slow flows and submerged aquatic vegetation with leaf litter as their preferred substratum [1]. When mating, the male swims close to the female while trying to chase other males away. The female will lay 200 to 300 eggs, which she will disperse over the substrate and on the plants. It could consume its little fry and eggs. The eggs hatch in one to two days, and after another two days, the fry is swimming freely. The cherry barb hatchlings will be around 1 cm long and clear to identify after five weeks [2]. The well-being of aquaculture animals is closely correlated with the water quality conditions in grow-out systems. Poor water quality can directly result in death, but more frequently it strains aquatic life, making it more vulnerable to infectious illnesses and infertility. Water temperature, salinity, cation imbalance, pH, gas supersaturation, electrical conductivity, toxic algae, dissolved oxygen, ammonia, nitrite, carbon dioxide, and hydrogen sulphide are the main stressors on water quality. The purpose of this study is to identify the habitat and breeding grounds that the *Puntius titteya* prefers in the wild. In six native freshwater habitats, this inquiry measured the water's pH, total dissolved solids (TDS), electrical conductivity (EC), and temperature. This species' habitat is not protected from development and disturbance since its limited distribution is primarily outside or on the fringe of protected areas.

II. Materials And Methods

A. Study area

The study areas were chosen within the Kelani river basin bordered by the Western province and the Sabaragamuwa province of Sri Lanka (6.9543° N, 80.2046° E). Six habitat locations of the *Puntius titteya* habitat locations were investigated throughout this area: Site 01 (Madola-Avissawella), Site 02 (Hewainna), Site 03 (Meethirigala), Site 04 (Galapitamadama-Avissawella), Site 05 (Waga-Indikadamukalana), and Site 06 (Wewila-Marambe). The locations were situated within the banks of lowland rainforest areas and forest patches.

B. Methods

Habitats and locations were identified using field observations. Species identification was conducted using visual observations and occasional fish catching was conducted using

standard hand-picking pond nets. All the locations were photographed by using Canon 80D Digital Single Lens Reflex (DSLR) camera with an 18-135mm lens. Moreover, all the locations were mapped using Global Positioning System (GPS) for further studies. Underwater photos were taken using a GoPro hero black-version 9 camera. Water sample collection and the on-site parameter measurements were conducted for the water pH, Total dissolved solids (TDS), Electrical conductivity (EC) and water temperature. Parameters were measured using a portable multimeter (Thermoscintific multimeter) at the site itself. The results were analyzed and graphs were formed using Microsoft Excel 2010. The statistical analyses were conducted using Graph Pad Prism 9 with a 95% confidence level.

III. Results And Discussion

Within the study schools of the fish and the breeding points and the fingerlings were studied in the breeding points. During the mating season, the body colour change turned brighter, especially males becoming brighter in red colour fins. With the water quality parameter, the TDS ranged between 8.50-22.00 ppm while the highest was recorded at site 5. The highest pH level was recorded at site 4 as 7.11±0.01, and others tend to be slightly acidic. The highest EC was recorded at site 5 as 44.00±27.11µS/cm (Table 1).

Table 1. Water quality parameters of the environmental habitats of the *Puntius titteya,* the results are represented with ± standard deviation of the mean.

Site No	Location	TDS (ppm)	Water Temperature (^{0}C)	Conductivity (µS/cm)	pH
1	Madola-Avissawella	8.50±1.90	29.40±0.65	17.00±3.80	5.06±0.11
2	Waga-Indikadamukalana	12.50±1.00	26.80±0.00	24.00±0.00	6.79±0.10
3	Hewainna	22.67±2.88	28.00±5.36	38.00±8.39	6.36±0.09
4	Wewila	20.00±3.00	28.40±0.00	40.00±6.00	7.11±0.01
5	Madola-Avissawella (Location 2)	22.00±13.56	31.97±1.47	44.00±27.11	5.95±0.41
6	Meethirigala	15.17±3.49	29.40±0.66	30.33±6.98	6.44±0.03

Considering the quality of the water for the residence habitat of the *P.titteya*, it was reflected that they prefer high purity in water considering the lack of contamination in the water bodies. Metals, minerals, and organic compounds that have been dissolved in a specific amount of water are referred to as TDS. Also, for the EC inorganic substances including alkalis, chlorides, sulphides, carbonate complexes, and dissolved salts form these conductive ions. Electrolytes are materials that break down into ions. The quantity of ions present affects the conductivity of water [3]. Lower TDS and EC conditions reflected that the water bodies have lower contaminations through environmental leachates and anthropogenic activities, and the species prefers high purity in the water to establish their breeding habitat [4].

Considering the breeding habitats, they selected significantly lower qualities of TDS, EC, and water temperature and pH conditions compared to the residence habitats (Fig. 1). Three breeding points were identified (Site 1, Site 2, and Site 3) and contemplate TDS 15.44±0.49 ppm, temperature 28.93±0.47, EC 28.44±6.14, and pH 5.95±0.45. For the breeding habitats, they tend to choose slightly acidic water conditions, and the pH conditions are significantly different (Fig. 1). Interestingly these locations are situated within the water flow and the pools where they lay eggs are more shaded by the surrounding tree canopies. The breeding location pH may effect by the leaf litter substratum that occurs in the breeding pools that build up through the fallen leaves and piled up with the water flow. During the breeding season starts, both male and female adults were frequently roaming around the pile of leaf substratum, but after the offspring occur more female adults were observed in the breeding habitats. Body lengths of around 1cm fingerlings were observed inside the layers of the substratum that may provide good hiding places and nourishment for the growth.

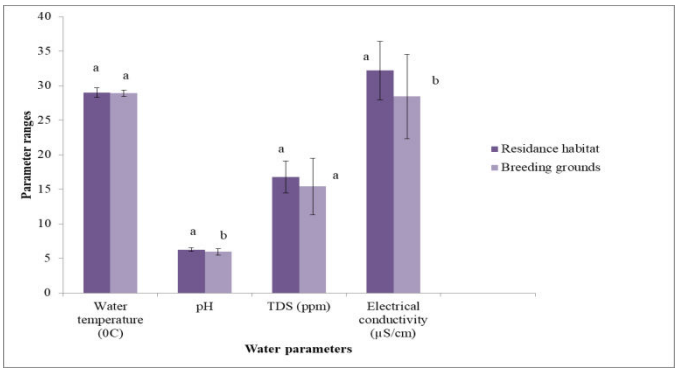

Fig.1 Water parameter comparison in the residence habitat and the breeding grounds of the *Puntius titteya*. The error bars represent the mean ± standard deviation of the mean. Means with the same letters are not significantly different among each water quality parameter (p>0.05).

IV. Conclusions

The study revealed that *P.titteya* tend to scatter more through highly purified water with a lack of contaminations and to form the breeding grounds they tend to find different water quality conditions with more cleared water. The results of the current study showed that *P. titteya* can survive in a variety of pH levels, shallow water bodies with medium flow rates, and submerged debris layers, but they need a greater purity of the water to reproduce and create effective populations. Instead of that, the presence of a healthy *P. titteya* reproducing population will provide a hint as to the higher water quality of the pertinent natural aquatic supply. The need for the conservation of this species is high because of the population depletion due to agricultural practices, energy and mining operations, natural system development with anthropogenic activities, invasive species, and climate change including storms and flooding. The findings may help to identify the habitat modification for the *P.titteya* in future place conservation plans.

References

[1] De Silva M., Hapuarachchi N., Jayaratne, T., Sri Lankan Freshwater Fishes, Wildlife Conservation Society Galle, Sri Lanka, p .207-209, 2015

[2] Sundarabarathy, T. V., Edirisinghe, U., & Dematawewa, C. M. B., Captive breeding and rearing of fry and juveniles of cherry barb (*Puntius titteya* Deraniyagala), a highly threatened endemic fish species in Sri Lanka, 2004
[3] Rusydi, A. F., Correlation between conductivity and total dissolved solid in various types of water: A review, In IOP conference series: earth and environmental science IOP Publishing, Vol. 118, No. 1, p. 012019, December. 2014
[4] Ranatunga, R. A. G. N., & Abeyrathne, P. A. B. P., Importance of Puntius titteya as a Biomarker to Determine the Water Quality of Aquatic Habitats in the Low and Mid-Country Wet Zone of Sri Lanka, In Proceedings of International Forestry and Environment Symposium, p.41, November. 2019