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We certify that the above statement made by the candidate is true and that this thesis is suitable for submission to the University for the purpose of evaluation.



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Preliminary investigations on the effects of photoperiod and substrate on breeding activity of Black ruby barb (*Puntius nigrofasciatus* Gunther) and Cherry barb (*Puntius titteya*)

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ABSTRACT

Preliminary investigations were carried out to determine the effect of photoperiod and substrate on the breeding activity of two endemic species, *Puntius nigrofasciatus* and *Puntius titteya* from 30th August 2003 to 11th March 2004.

Both species were subjected to three photoperiods ((12 hrs dark – 12 hrs light, 08 hrs dark – 16 hrs light, 16 hrs dark – 8 hrs light) with natural sun light as the control in triplicate and the hatching rates were observed .

These two species were also provided with three different substrates (*Hydrilla* as natural substrate, artificial (plastic) branches artificial substrate and a mixture of *Hydrilla* and artificial (plastic) branches as a third substrate) and their hatching rates were observed in duplicate.

According to the observations made in this research it is revealed that the manipulation of photoperiod has no effect on *Puntius nigrofasciatus* or *Puntius titteya* and natural sunlight is the best for their breeding. In contrast to this, substrate that is used for their breeding plays an important role and *Hydrilla* is a very good natural substrate that can be used.

The study also revealed that the alkaline water conditions may be acting as a triggering agent for the spawning activity of *Puntius titteya* and it may also be having an effect on the intensity of breeding of *Puntius nigrofasciatus*. In addition, stocking density may be having an effect on the spawning activity of fish. However, these two aspects need further investigations.

CHAPTER 1 - INTRODUCTION

1.0 History of Fish Keeping

The custom of keeping fish in captivity is a very old practice. The Romans are reported to have maintained a place where fish were kept alive to provide fresh fish for eating as and when needed. That tradition has continued and aquaria with live edible fish, for example eels, groupers etc. can be found in present day restaurants, where the customers can select and order the fish that they wish to have for a meal.

Keeping gold fish for ornamental purposes in aquarium tanks has a long history among the Chinese, which goes as far back as thousand years. Gold fish were probably introduced into Europe during the 17th century to be kept as ornamental fish. But the interest in aquaria got intensified in the 19th century in England, Germany and Paris. At the beginning, the temperate freshwater fish species were popular but during the second half of the century, tropical freshwater fish were imported to these countries on a large scale which rapidly replaced the cold water species (Axelrod, 1961).

The main reason for this was the attractive and more varied colors and shapes of the tropical freshwater fish species. They were also easier to keep in tanks with the development of modern devices such as thermostatically controlled electric heaters. However, their prices were relatively high due to difficulties faced in transporting these

delicate fish over long distances in ships which resulted in high mortalities (Axelrod, 1961).

The development of transport technology changed this situation. These live specimens can now be packed to maximize the survival rate and they can be transported by air to any destination of the world within a matter of few hours thus ornamental fish keeping has become popular universally (Andrews, 1990). An innovation to fish keeping was the introduction of tropical marine fish species and this is gaining fast popularity due to the fact that they are even more colourful than the tropical freshwater species. Both freshwater and marine tropical fish species have thus become a foreign exchange earner and most tropical countries including Sri Lanka have an industry to cater for the foreign market (Andrews, 1994).

1.1 Present Status of the ornamental fish industry in the world

Ornamental fish are called living jewels due to their color, shape and behavior. All these factors determine their value in the market. About 98% of the ornamental fish trade comprises tropical fish and only about 2% cold water species. In addition 90% of the fish traded are of freshwater origin while 10% are marine fish. 0.1% is from brackishwater (Ekaratne, 1998).

The market for ornamental fish consists of home hobbyists (99%) and public aquaria and research institutes (1%). This market is mostly located in heavily populated industrial areas

with cool climates in countries such as Germany, Netherlands, France, Japan and USA (Ekaratne , 1998).

The fish traded are either tank or pond raised or caught from the wild. They are transported by air or delivered by vans or trucks to importers, distributors or wholesalers who sell them to retail stores which is the final link with the hobbyists. The total wholesale value of live ornamental fish in 1992 was estimated at US\$ 900 million. The total retail value of ornamental fish in 1992 was US\$ 3 billion (Ekaratne, 1998).

1.2 Ornamental fish industry in Sri Lanka

Ornamental fish industry in Sri Lanka has a long history. This trade consists of freshwater, brackishwater and marine fish, invertebrates and plants. Marine and brackishwater fish are collected from the wild, while freshwater fish come from the wild and from aquaria where they are bred in captivity (Chandrasoma, 1998).

Sri Lanka has been exporting ornamental fish since the beginning of 1930's with the export of freshwater tropical fish to Europe. It played a major role in the collection and export of commercial species in the 1950's and 1960's. However, because of the internal and external factors such as lack of domestic technology and foreign competition, it lost its prominent role after this period (Evans, 1981).

Nevertheless, with the expansion of the existing market and access to new markets by Sri Lankan exporters, expansion of commercial air cargo space and routes and by gaining

knowledge in captive breeding of fish species, particularly that of freshwater species, the industry of exporting of ornamental fish and invertebrates from Sri Lanka revived in the recent past. In 1981, Sri Lanka had earned around Rupees 30 million by exporting ornamental fish. For the year 1998, it has earned Rupees 528 million. Further, within the year 1999, an amount of Rupees 558 million has been earned. But, at present, our contribution for the world demand is only about 1%. The major buyers of the Sri Lankan ornamental aquatics are Japan, USA, Germany and France. (Evans, 1981)

In 1998, Sri Lanka has earned Rupees 132 million by exporting ornamental fish to Japan. During the same period it has earned Rupees 110 million, 60 million and 45 million by exporting to USA, Germany and France respectively (Conroy, 1975).

For the year 1998, 66 ornamental fish exporters have send shipments to 49 countries throughout the world (Ekaratne, 1996). Of these, five regular exporters have contributed more than 80% of the total that was sent.

When the total export earnings of ornamental fish exports are considered, about 75% are from marine species and the balance is from freshwater and brackishwater species. At present, over 200 species of wild-caught, marine and brackishwater fish species and around 60 species of freshwater fish are being exported. The most important characteristic of the marine sector is its complete dependency (100%) on wild-caught fish. When considering the global marine fish sector, over 90% of all ornamental marine organisms are

wild-caught and, although well over 100 species of aquarium marine fish have been bred in captivity, relatively few are bred in commercial quantities (Axelrod, 1961). There are no records of any Sri Lankan breeder successfully breeding marine species on a commercial scale.

In contrast, exporters of ornamental freshwater fish species depend on both wild caught and captive bred stocks. Collection of freshwater fish from the wild (i.e. Rivers and streams) is somewhat unique in Sri Lanka in that the local collectors in the vicinity of their own villages collect the majority of fish. This is a very important factor in the maintenance of this resource as the individual collectors have a much higher stake in his product and the collection habitat. The methods commonly employed for collection of fish are small-meshed seines or occasionally hand or dip nets. The collected fish are transported to a holding facility owned by an exporter (Bassleer, 1998).

Pethiyagoda (1991) recorded 111 species of fresh water fish from Sri Lanka of which 21 are exotic species which have been introduced either intentionally or accidentally, over the past decades. As listed by Pethiyagoda (1991), 58 freshwater fish are caught from the wild for ornamental fish trade (Annex 1). The following species appear to have dominated the export market among the wild-caught freshwater ornamental fish.

<i>Danio malabaricus</i>	- Rath kailaya
<i>Puntius cumingii</i>	- Pothaya
<i>Puntius filamentosus</i>	- Pethiya

<i>Puntius nigrofasciatus</i>	- Bulath hapaya
<i>Puntius titteya</i>	- Ley thiththeya
<i>Monodactylus argutus</i>	- Kapuwa
<i>Scatophagus argus</i>	- Ilatthiya

About 50 freshwater species are commercially bred and cultured in Sri Lanka. Presently many exporters depend on their out-growers, both small scale and medium scale, for obtaining freshwater ornamental fish supply to the foreign market. Its growing success in breeding and culturing has helped to develop its overall species portfolio (Bassleer, 1995).

The aquarium bred and reared ornamental fish contribute around 10% to the total freshwater ornamental fish exports. The number of freshwater ornamental fish species that are currently being used for breeding and rearing in captivity is less than 50. These fish are either live-bearers or egg layers. The following are the important aquarium bred live bearers in the export market (Chandrasoma *et.al.*, 1994):

Guppy	<i>Poecilia reticulate</i>
Sword Tail	<i>Xiphophorus helleri</i>
Platy	<i>Xiphophorus maculates</i>
Molly	<i>Poecilio latipinna</i>

Among the egg layers commonly used aquarium bred species are

Gold fish	<i>Carassius auratus</i>
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