CHAPTER 1
INTRODUCTION

The Northeastern region with its diversified lotic lentic water bodies is considered as the global hotspot for fish bio-diversity. Out of the approximately 806 fish species inhabiting fresh waters of India (Talwar and Jhingran, 1991), the Northeast is reported by 266 species belonging to 114 genera under 38 families and order (Sen, 2000) out of which 196 fish species occurring in Northeast have potential ornamental value (Dey et al., 2001). In India, 288 species of exotic ornamental fishes exist, of which 261 species are egg layers and 27 species are live bearers. The egg laying exotic ornamental fish species belong to 10 orders, 26 families, 123 genera and 3 families of the order Cyprinodontiformes (Tiwari et al., 2005).

Ornamental fishes may be defined as fishes which are reared as pets and not for consumption (Anon 2001). Conventionally as well as technically, ornamental fishes are smaller in size, attractively coloured with majestic movement composure in the aquarium. However, non-colourful fish will also receive ornamental status if they inhabit peculiar body morphology, strange locomotive deportment and rare occurrences (Dey et al., 1984). Keeping attractive colourful fishes as pets in aquaria or garden pools is an age old hobby, which originate with keeping of gold fish in glass bowl in China several hundred
years ago. It was during 17th century that gold fish was introduced to several countries and became popular in England and Scotland. The first public display aquarium was opened at Regent Park in England in 1853 (Swain et. al, 2003)

In India, the hobby of keeping ornamental fishes as pets is of quite recent origin with the opening of the Taraporevala aquarium in Mumbai in 1951. In Northeastern region, aquarium keeping as a hobby got a boost with the setting up at Guwahati Nursery. In recent years, there has been an insatiable demand for newer unique or bizarre shaped fishes by overseas hobbyists which way not be beautiful in the conventional sense. Presently ornamental fish keeping has emerged as the second most popular hobby next to photography. What started as a hobby has now expanded in to a booming international trade valued at US $150 billion (Bartley 2000). During the year 2002, the Department of Fisheries, Govt. of Nagaland, has set up an aquarium display unit at Dimapur. The U.S.A. is the largest market for ornamental fish import followed by Japan and Germany. The South East Asian countries contribute about 69% of the total world production of ornamental fishes. Singapore is the largest exporter. In the oriental region Sri Lanka has already progressed on producing ornamental freshwater fishes where it has now developed into a thriving industry offering profits and employment to many.

India’s present overall trade in ornamental fish has crossed as 150 million dollar. Export of ornamental fishes from India accounted for Rs. 226.00 lakh during the year 2000 (Palanisamy, 2003). The ornamental fish trade is although growing almost continuously, our contribution to the global trade is
insignificant (0.007%). However, it may be possible for India to capture at least 10% of the market by utilizing its vast indigenous stock of fish species and unemployed trained manpower (Vijayakumar, 2001). In addition to the export market, the domestic demand for ornamental fishes has been estimated to be of Rs. 10.00 crore per year. The demand is increasing at the rate of 20% per year (Vijayakumar, 2001) offering enough scope for development of ornamental fish breeding and rearing on a commercial scale. Kolkata, Mumbai and Chennai have emerged as the pioneer breeding centers of India. The export of indigenous ornamental fishes from the country is mainly confined to freshwater varieties limited to the fishes from the Northeastern states (85%) and a few bred varieties of exotic species (Swain et.al, 2003). In India, especially Northeastern India, a good number of fish species exists in natural water bodies which have a good ornamental value due to their beautiful colour, shape, manageable size hardness, compatibility and longevity. Survey in the wholesale market at Hatibagan in Kolkata and information from exporters revealed that a large group of indigenous fish has increasing demand in overseas market like Japan and the Middle East. Although its price at the collecting site is nominal, the ultimate price is quite high so, there is a scope of developing the trade with varieties of indigenous fish species (Mahapatra et.al, 2003). Though India’s share (US$ 0.25 million in 1997) in global trade is very less, it has been noticed that Indian OFS are of great demand in the international market (Swain and Chakrabarty, 2008).

Nagaland with an area of 16,579 sq.kms lies between 25° 6’ and 27° 4’ N latitudes and between 93° 20’ and 95° 15’ E longitudes. Nagaland being formed of young hills is devoid of any plateau or tableland. Patkai range, the highest
mountain range in the state attaining a height of 3840 meters above sea level at Saramati traverses the extreme high hill ranges, separating the state of Nagaland from Myanmar and also acts as watershed between the rivers of India and Myanmar. This montane state of NER is dissected by a number of seasonal and perennial rivers, which affords lucrative abode of her ichthyodiversities including ornamental fishes. The paragon of pre-investment feasibility study extensively made, of late, by Dey et al (2002) on the Prospect of Ornamental Aquaculture in North Eastern Region (NER) under the aegis of North Eastern Development Finance Corporation Limited (NEDFi), Guwahati has ostensibly revealed that there is enough scope and potentialities for the NER – Ornamental Fish Species (OFS) including Nagaland to venture into the Ornamental Fish Farming and Trade in International market (Dey, 2002). A total of 149 species of ichthyfauna belonging to 64 genera under 22 families and 6 orders are recorded from the lotic, lentic and mixed habitat of the state. Out of these, as many as 118 species of fishes having good export potential are identified as ornamental fishes (Ao et al, 2008).

Culture and breeding of indigenous fresh water ornamental fish species (OFS) of North Eastern Region (NER) is very little known due to lack of awareness and interest among the fish farmers. Among the 196 OFS of NER, the exporter of kolkata and Chennai through some local suppliers exports nearly 27 OFS from NER. These OFS are all traded on wild caught and none venture for their culture and breeding. Therefore, the population of these valuable ichthyo-species is gradually declining due to over exploitations from their natural stock. The commercial organized export of freshwater OFS of NER depends primarily

The ethological perspectives of the fishes mainly their locomotive, ingestive, agonistic and procreatic behaviour have drawn the attention of various scientific workers (Gray, 1953; Tavolga, 1954; Harris, 1960; Brawn, 1961; Beukema, 1964; Milinski, 1979; Hoffman, 1980; Cole, 1982; Halliday, 1983; Lauder, 1983; Baerends, 1986; Wainwright and Lauder, 1986; Gladstone, 1987;
Houde, 1987; Bisazza and Marconato, 1988a, 1988b; Belles et.al, 1990; McAdam et.al, 1999 and Spears 2000).  

Important contribution have also been made by Plona (1962), Anderson (1962, 1963, 1965 a and 1965 b); Kaufman (1965); Fernado and Phang (1985), Andrew (1990); Leegelt (1986); Lee (1991) and Polonski (1991) on the culture and maintenance of exotic ornamental fishes.  

Further, a good many investigations have been accomplished from abroad and India (Richard, 1977a; 1977b, 1977c; Stojkovic, 1980; Giavemni, 1981; Gratzek, 1988; Varghese, 1988, Baskar, 1993 and Krishnakumar 1997) on diseases and treatment of freshwater ornamental fish species.  


Although some studies have been made in India namely by Basavaraja et.al, (1988), Tekriwal and Rao (1990), Sinha (2000), Mukhopadhyya (2001), Saktivel and Ramathilagam (2001), Sinha et.al, (2001), Anna Mercy (2001), Pandian et.al, (2001) and Swain and Das (2001) on the food, nutrition and rearing of some freshwater ornamental fishes, it was indeed Dey and Sarmah (2000), Sarmah and Dey (2000, 2003 and 2004) and Sarmah (2001, 2002 and
2003) who had made empirical studies on the breeding of some native ornamental fish species of N.E. India hitherto remain unattended.

According to Bhattacharjya et.al, (2000a) seven ornamental fishes viz. *Botia dario, Puntius geliues, Hara hara, Conta conta, Badis badis, Notopterus notopterus* and *Nandus nandus* caught from the wild are reportedly being exported from the NER states causing a decline in their wild stock rapidly. The present trend if allowed unabated, these species may be completely wiped out from nature in days to come including, perhaps, of *Esomus danricus* (Hamilton-Buchanan,1822) and *Puntius conchonius* (Hamilton-Buchanan,1822) to include in the list.

*Esomus danricus* (Hamilton-Buchanan, 1822) and *Puntius conchonius* (Hamilton-Buchanan, 1822) are classified ornamental fishes and it has a high demand value in the international market with their FOB prices varying from 1 – 3 USD per fish (Dey et al, 2002).

The present investigation, hitherto remained unattended, will depict a clear scenario of the fishes, *Esomus danricus* (Hamilton-Buchanan, 1822) and *Puntius conchonius* (Hamilton-Buchanan, 1822) as ornamental fishes of the North Eastern India especially on the technology of captive breeding and culture with their bionomics and early life history which in turn will lead to economic benefit for entrepreneurs and aquarists engaged in the OFS trade as well as unemployed youths for taking up freshwater ornamental fish trade and help generate income sources among the mass.
It may be relevant here to note that the Materials and Procedures followed in the present investigations have been extensively incorporated in each chapter to avoid repetition overlapping various observational profile.

The present investigation have been primarily aimed to achieve the following objectives

- To collect as many different samples of *Esomus danricus* (Hamilton-Buchanan, 1822) and *Puntius conchonius* (Hamilton-Buchanan, 1822) from different water bodies of Nagaland as needed and study their taxonomical characteristics.

- To study the ethology of the species especially in respect of their feeding and breeding profile.

- Detail investigations on its ecology, bionomics and breeding biology.

- To develop in-house breeding technology of the species to help produce their mass production for the benefit of the entrepreneurs who may be involved in ornamental fish trade on Nagaland fishes, on a commercial scale.