

CHAPTER 3 - REVIEW OF LITERATURE

3.1. Status of Gourami species:

Gourami is one of the most important and valuable small ornamental fish. Numerous Gourami species are very much popular aquarium fish widely kept throughout the world. The order Perciformes (perchlike) which also called the Percomorphi or Acanthopteri are commonly known as gourami fish. Among the 18 suborders Anabantoidei contains 3 families i.e. Anabantidae (climbing perches), Osphronemidae (gouramies), Helostomatidae (kissing gourami) and 16 genera and 149 species they are distributed throughout most of southern Asia, India and central Africa (Ruber, 2009). The labyrinth fishes are classified into four families: Osphronemidae (genera: *Osphronemus*, *Trichopsis*, *Trichogaster*, *Malpulutta*, *Sphaerichthys*, *Parosphromenus*, *Pseudosphromenus*, *Ctenops*, *Betta*, *Colisa* and *Belontia*); Anabantidae (genera: *Ctenopoma*, *Microctenopoma*, *Sandelia* and *Anabas*); and Helostomatidae (genera: *Helostoma*) (Nelson, 1994). First phylogenetic relationship of different anabantoid was discovered by Lauder and Liem, 1983. Wakiyama *et al.*, 1997 studied the genetical relationships of the 17-anabantoid fishes, and divided them into three groups on the basis of their alleles similarities. Based on these works, the Macropodinae (excluding Ctenops), Anabantidae and Trichogastrinae are considered to be suitable taxonomic units. Gunther, 1870, listed *Trichogaster leeri*, *Trichogaster trichopterus* and *Trichogaster microlepis*, from Thailand from the genus *Osphronemus*. The tiny Sumatran Gourami, *Parosphronemus desiineri* and Chocolate Gourami, *Sphaerichthys osphromenoides* has

been also placed into the genus *Osphronemus*. Details of 8 Indian gourami species are described in **table 2**.

Table 2. Details of Indian Gourami species

Scientific name	Common name	Culture practice	Utilization	Conservation Status
<i>Anabas testudineus</i>	Climbing perch	Yes	Food	Data Deficient
<i>Anabas cobojius</i>	Gangetic koi	Yes	Food	Data Deficient
<i>Pseudosphromenus cupanus</i>	Spike tailed paradise fish/ Rosy paradise fish	No	Food	Least Concern
<i>Pseudosphromenus dayi</i>	Brown Spike-tailed Paradise Fish	No	Ornamental	Vulnerable
<i>Ctenops nobilis</i>	Frail gourami/ Indian paradisefish	No	Ornamental	Near Threatened
<i>Trichogaster fasciata</i>	Banded gourami/ Giant gourami/ Striped gourami	No	Food and Ornamental	Least Concern
<i>Trichogaster chuna</i>	Honey gourami/ Sunset gourami	No	Food and Ornamental	Least Concern
<i>Trichogaster lalius</i>	Dwarf gourami	No	Food and Ornamental	Least Concern

3.2. General description of *Ctenops nobilis*:

Ctenops nobilis McClelland, 1845, is one of the important indigenous ornamental Gourami species under Perciformes order and genus Osphronemidae under subfamily Luciocephalinae. The fish is only species under its genus. Croaking gourami, *Trichopsis*

vittata (Cuvier, 1831) and Sprakling gourami, *Trichopsis pumila* (Arnold, 1936) were classified under *Ctenops* but later they were removed and reorder in *Trichopsis* genus. *Ctenops* can be easily differentiate from *Trichopsis* by: 1) more elongated preorbital region; 2) the 2:1 ratio of ascending process length and premaxillary body; 3) presence of ossified vetral form of basisphenoid; 4) sinuous vertebral column (Liem, 1965).

Thought some local folk of Assam and Bangladesh may use the fish as food fish but it is more popular and demanding in form of ornamental fish (IUCN, 2010). A number of Gene bank data available for the species: rRNAs + tRNA-Val complete sequence available in accession number AY763702; cytb and tRNA partial sequence available in accession number AY763748; RAG1 partial cds available in accession number AY763781 (Ruber *et al.*, 2006). *Ctenops nobilis* is described by McClelland in the year 1845 from the rivers at the foothills of Bhutan. The fish is mainly temperate region fish. The fish is commonly known as Frail gourami, Noble gourami and Indian paradise fish (Talwar and Jhingran, 1991). More local names, common names used for *C. nobilis* are showing in the **table 3**.

Table 3. Common and local names of *C. nobilis*

COMMON NAME	PLACE & LANGUAGE	SOURCE
Frail gourami	Global	Fishbase
Neftani (নেফতানী), Madhumala (মধুমলা), Naptekhoira (নাপতেখয়রা), Naptekolisha (নাপতেখলিসা)	Bangladesh, Bengali	Shafi and Quddus, 2001
Indian paradise fish, Frail gourami, Noble	India, English	BdFISH feature

gourami		and Fishbase
Neftani (নেফতানী)	India, Bengali	Fishbase
Koleehona	Assam	Talwar and Jhingran, 1991
Nokkarihmakala	Finland, Finnish	Fishbase
Frail gourami	USA, English	Fishbase
Spitzkopfgurami	Germany, German	Fishbase
Grate intended betta (拟篋斗鱼)	China, Mandarin Chinese	Fishbase

3.3. Natural distribution:

Gouramis are frequently distributed throughout East, Southeast and South Asia and also in Africa. They are endemic in slow-moving, low oxygenated water. In Africa their concentration is more in rainforest than the Southern part (Pinter, 1986).

All records of the *C. nobilis* pertaining to the Ganges and Brahmaputra river systems in the region north of their confluence (Ng, 2005). This species are mainly found in India, Bangladesh and some foothills of Bhutan and Nepal. In India the species only found in North Bengal, Assam, Sikim and Bihar (Mahapatra *et al.*, 2004b, Rahman, 1989; Rahman, 2005 and BedFISH, 2011) (**Figure 9**). As per IUCN, 2011 assessment the fish extent of occurrence 34,040 KM² (**Figure 10**) and probably the fish at present found only in India and Bangladesh.



Figure 9. Geographical distribution of *C. nobilis*
(See colour photo in Plate No. IV, Fig. 9)



Figure 10. Geographical distribution evaluated by IUCN, 2010
(See colour photo in Plate No. IV, Fig. 10)

3.4. Biometric study:

The study on functional morphology is one of the most critical factors for its behaviour and performance which can determine its survival and condition (Schwenk, 2000; Arnold, 1983, 2003; Irschick, 2003). Length-weight relationship and condition factor are very important quantitative parameter determining present and future population success by its strong impact on survival, growth and reproduction of fish (Hossain *et al.* 2006). Morphological studies as well as study on length-weight relationship and condition factor in different ornamental fish were studied by numbers of authors (Mojekwu and Anumudu, 2015; Kamboj and Kamboj, 2019; Keivany and Zamani, 2016; Mahapatra *et al.*, 2018; Chuctaya *et al.*, 2017; Pal *et al.*, 2013; Pal *et al.*, 2014; Mahapatra *et al.*, 2014; Mahapatra and Lakra, 2014; Banerjee *et al.*, 2016; Mahapatra, 2016c; Mahapatra *et al.*, 2016). A large number of contributions in this sector of work are also available in gourami group. Munshi *et al.*, 1986 worked on *A. testudeni*; Mahalder and Mustafa, 2011 observed the morphology of *Trichogaster lalius*; Jafrayan *et al.*, 2014 studied the length-weight relationship and growth of *Trichopodus trichopterus*; Azrita, 2015; Akter *et al.*, 2016 studied the morphological characters of *Osphronemus gouramy*; most recently Sahoo *et al.*, 2019 observed the morphometrics and length-weight relationship of *T. lalia*.

The body structure of *C. nobilis* is compressed and elongate. Lower jaw is longer and pipe-shaped (BdFISH, 2011). Body covered with tiny ctenoid scales. Dorsal fin originates above the last third of anal. The ventral fins are small and soft, the dorsal and

anal broad, the former commencing on the back just above the pectorals (McClelland, 1844). Different authors give different fin formula for the fish (McClelland, 1845; Talwar and Jhingran, 1991; Shafi and Quddus, 2001; Rahman, 1989 and 2005). Lateral line present and it is a simple slit at centre of each scale. 28 to 33 scales are present in longitudinal series (Rahman, 1989; Rahman, 2005). The colouration of the fish is mainly brown with an interrupted silvery white band, from the eye to the base of caudal. The dark sombre colours are relieved by minute dots of vermilion and blue, dispersed indiscriminately over the upper parts of the body and sides, more particularly about the head (McClelland, 1844). The fish attain maximum 10cm in total length (IUCN, Bangladesh, 2000; Menon, 1999; Shafi and Quddus, 2001). The osteology of *Ctenops* and *Trichopsis* was investigated by (Liem, 1965). The ratio of the lengths of the ascending process and body of the premaxillary is 2:1 (Liem, 1965). As per Rahman, 1989 and Rahman, 2005 head length is 3.5-4.0 parts of total length. They also observed height is 2.3-3.0 parts of standard length and 3.0-3.3 parts of total length.

3.5. Eco-biological study:

Gouramis are endemic in slow moving lakes, ponds, rivers, and streams with plentiful vegetation overgrowth (Froese, 2014). Maintaining of proper ecological parameters are the important prerequisite for captive rearing and breeding of the fish. Impacts of ecological and hydrobiological parameters on different ornamental fish were done by various previous workers (Humphries *et al.*, 1999; Bjornsson *et al.*, 2007; Okamura *et al.*, 2007; Sahoo *et al.*, 2008; Kucuk, 2010; Russell *et al.*, 2011; Makori *et*

al., 2017; Bhattacharya and Mahapatra, 2018). A good number of works also occurred in gourami group of fishes. Impact of pH variation in survival and growth of *Trichogaster lalius* was also observed by Sahu and Datta, 2018; in the year 1990 Degani also analysed the effect of water quality for larval growth of *Trichogaster trichopterus*.

The fish are widely available in streams of upland hills (Talwar and Jhingran, 1991). Found mostly in clean water with bladderwort and a small quantity of water hyacinth (Zipcodezoo, 2015, Talwar and Jhingran, 1991). The fishes generally feel comfortable within the temperature range 20-24°C and even greater extremes being tolerated for short periods (Baensch, 1991). Average air temperature tends to fall between 59 – 90°F/15 – 32°C depending on locality and during winter though in the northern extreme of its range it can be remarkably cooler (Ng, 2005). During the winter season fishes are profusely found in comparatively hotter bushy roots of water hyacinth (Shafi and Quddus, 2001).

3.6. Food and feeding biology:

A successful scientific planning and management of fish are largely depending upon the knowledge of their food and feeding habits (Sarkar and Deepak, 2009). A good number of research works were done globally on the diet and feeding habit of fish (Dev, 1994; Lovell, 2000; Sales and Janssens, 2003; Mondol *et al.*, 2005; Begum *et al.*, 2008; Santamaria and Santamaria, 2011; Ribeiro *et al.*, 2012; Mondol *et al.*, 2013). Feeding habit and dietary intervention on different gourami species are observed by different workers. Shim *et al.*, 1989 documented the effect of dietary protein on growth and

gonadal development of *Trichogaster lalius*; effect of rotifers in *Trichogaster lalius* was studied by Lim *et al.*, 2003; Zuanon, 2004 observed the performance of *Trichogaster trichopterus* with different dietary level; Baron *et al.*, 2008 carried out studies on effects of dietary pigments on *Trichogaster lalius*; food and feeding habit of *Trichogaster fasciatus* was studied by Moitra and Ray, 1977.

The fish is mainly larvivorous in nature (IUCN Bangladesh, 2000). But sometimes they can also accept *Artemia* nauplii, small frozen red midge larvae, zooplankton viz. *Daphnia*, *Moina*, micro worm, etc. (Rossman, 2008).

3.7. Reproductive biology and breeding:

For successful captive breeding and seed production knowledge on reproductive biology is a vital aspect. Reproductive biology, maturity and breeding are the vast area of research and till now a huge number of researchers work on these aspects. Mahapatra *et al.*, 2004c; Macuiane *et al.*, 2009; Solomon *et al.*, 2011; Mondal and Kaviraj, 2013; Dey *et al.*, 2014; Pal and Mahapatra, 2016; Mahapatra, 2016d. Reproductive biology and other breeding related works on gourami species were also done by numerous scientists. Gupta, 2015 studied on reproductive biology of *Trichogaster fasciatus*; captive breeding experiments on *Trichogaster fasciatus* and *Trichogaster lalius* were done by Das and Kalita, 2006; fecundity and sexual dimorphism of *Trichogaster fasciatus* were carried out by Swarup *et al.*, 1972 and Behara *et al.*, 2005; induced breeding of *Anabas testudineus* was studied by Zalima *et al.*, 2012; reproductive biology of *Trichopodus trichopterus* were done by Axelord *et al.*, 1993 and McKinnon *et al.*, 1987.

Gourami shows different types of breeding behaviour viz. *Trichogaster fasciatus*, *T. lalius*, *T. sota*, *T. leeri*, *Macropodus chinensis*, *M. Concolor*, *Ctenopoma nanum* etc. fishes show foam like nest building behaviour and their eggs are floating type whereas in case of *Betta imbellis* and *B. Splendens* although they are nest builder but they lay sinking eggs. In the other hand some other Betta species like *B. picta*, *B. Pugnax* are mouthbrooders and *Helostoma temmincki*, *Ctenopoma muriei*, *C. maculatum* etc. fishes give free floating spawn (Schurmann, 1989).

The male of *C. nobilis* are clearly recognizable with their broad and bigger “spout” and a comparatively smaller female did not display any intraspecific aggressiveness (Rossman, 2008). Unlike the other gouramis which are bubble nest builders, Noble gourami shows mouth-breeding behaviour (Armitage, 1987; Bilke, 1992; Britz, 1992 & 1993). Chocolate Gourami is also a mouthbrooder and parental care shows by female fish but in case of *C. nobilis* both the sexes can show parental care (Britz, 1992; Ruber, 2006). The courtship of *Ctenops* was recorded by Armitage, 1987. Bitsch, 1987 observed that male chase the female at the time of courtship and 150 free swimming fry of 5-6mm long were spat out from one male fish (Labyrinth Anabantoid association of Great Britain, 2011).

One of the most unusual characters that *Luciocephalus* shares with the osphronemid genera *Parasphaerichthys*, *Ctenops*, and *Sphaerichthys* is the presence of spiraling ridges and intermittent grooves on the egg surface that lead to the micropyle (Ruber, 2006). The almost spherical eggs of *C. nobilis* measure from 1.9 to 2.1 mm in

diameter (Britz *et al.*, 1995). The population has declined in Assam (due to habitat loss), but there is no information on the population or its habitat in other parts of its range (IUCN, 2010).

3.8. Conservation status:

Due to its small size and non-popular captive breeding practice natural resources of Gourami fishes are in declining condition. A long time ago plenty distribution of these fish recorded from lakes, rivers, ponds and to meet the market need they are collected randomly. But now a days due to its population degradation captive breeding is a must need to conserve the Gouramis diversity.

The population of *C. nobilis* has drastically declined in Assam due to habitat loss, but there is no information on the population or its habitat in other parts. The species appears to be near threatened in part of its available range. *C. nobilis* is assessed as Near Threatened by IUCN, 2010 as there is insufficient information to determine its population declines from the natural resource, however the status must be re-evaluated after urgent studies on the species' distribution, biology, use, trends and threats reveal more information.

After reviewing all concerned literatures it became clear that obviously some scattered information on the fish are available but there is a huge lack of details study on the biology, captive maturation and sustainable breeding of *C. nobilis*.