CHAPTER 4 - TAXONOMY

4.1. INTRODUCTION

Morphology is the study of the shape and external structures of a particular organism which can differentiate that from others. Studies on morphology, the functional analysis of structural features (i.e., anatomy) of animals (Schwenk, 2000), can provide the information about the fishes behaviours that allow them to survive, and how the performance of a species secured them when environmental parameters are altered. Morphometric and meristic characters are helpful in easy & correct identification of fish species in laboratory as well as at natural places (Jayaram, 1999). Morphometric characters are important for identifying fish species and their habitat as well as ecological criteria in any stream, lake or sea. It is common to use morphometric measurements to identify and classify fishes (Begenal and Tesch, 1978). The taxonomic hierarchy of an organism helps to classify the species and can easily communicate the biological information. Each level of the hierarchy can distinguish the organisms from other.

The taxonomic classification of *Ctenops nobilis* is –

Kingdom: Animalia

Phylum: Chordata

Sub-phylum: Vertebrata

Super class: Osteichthyes

Class: Actinopterygii (Rayfinned fishes)

Sub-class: Neopterygii

Infraclass: Teleostei

Superorder: Acanthopterygii

Order: Perciformes (Perch likes)

Sub-order: Anabantoidei

Family: Osphronemidae (Gouramis)

Subfamily: Luciocephalinae

Genus: *Ctenops*

Species: *Ctenops nobilis* McClelland, 1845

Some synonyms of the fish are also used in different literatures (**table 3**) but the valid scientific name of the fish is *Ctenops nobilis*.

Table 3. Synonyms used for *C. nobilis*

Synonym	Author	Status	Valid
Ctenops nobilis	McClelland, 1845	Accepted	Yes
Osphronemus nobilis	(McClelland, 1845)	Synonym	No
Osphromenus nobilis	(McClelland, 1845)	Synonym	No (Marked as misspelled)

Like other Anabantoidei, *Ctenops* also possess labyrinth organ as suprabranchial auxiliary respiratory organ. After reviewing the concerned literature it became explicit that no details study on the details biology of *C. nobilis* has been performed so far. Definitely some scattered information on the fish biology and breeding are collected from different previous literatures (McClelland, 1845; Talwar and Jhingran, 1991; Shafi and

Quddus, 2001; Rahman, 1989 and 2005; IUCN Bangladesh, 2000; Liem, 1965). Body structure of the fish is elongated and head is depressed. Pipe-shaped lower jaw is little longer than upper. The caudal fin is rounded.

4.2. MATERIALS AND METHODS

Study of morphology was consisting of: i) morphometric and ii) morphomeristics. Morphometric and meristic studies were made following Jayaram, 1999. A total of 100 number of specimens were used for morphometric study and 50 specimens were used for morphomeristic study. The lengths of the specimens were ranging between 37 – 72 mm. The fishes are preserved in 10% formaldehyde solution and all relationship of different morphometric measurements were analysed by Microsoft Excel software.

4.2.1. Morphometric study:

Morphometric measurements were measured by using vernier calliper (**Figure 11**). All morphometric measurements were taken in nearest millimeter. The following 34 parameters studied for analysing the detailed morphology of the fish (**Figure 12**):

Total length (TL), Standard length (SL), Eye diameter (ED), Body depth (BD), Body width (BW), Head length (HL), Head width (HW), Snout length (SNL), Pectoral fin length (PCL), Pelvic fin length (PVL), Anal fin length (AFL), Caudal fin length (CFL), Dorsal fin length (DFL), Dorsal fin base length (DBL), Anal fin base length (ABL), Caudal fin base length (CBL), Pectoral fin base length (PCBL), Pelvic fin base length (PVBL), Pre dorsal length (PDL), Post dorsal length (PODL), Pre pectoral length (PPCL), Post pectoral length (POPCL), Pre pelvic length (PPVL), Post pelvic length

(POPVL), Dorsal fin height (DFH), Anal fin height (AFH), Pre anal length (PAL), Caudal peduncle length (CPL), Length of upper jaw (LUJ), Length of lower jaw (LLJ), Inter-orbital length (IOL), Post-orbital length (POOL), Pectoral and pelvic fin distance (PPD) and Snout isthmus length (SIL).

a) Snout length **b) Total length**

Figure 11 (a-b). Morphometric data collection of *C. nobilis*

(See colour photo in Plate No. V, Fig. 11)

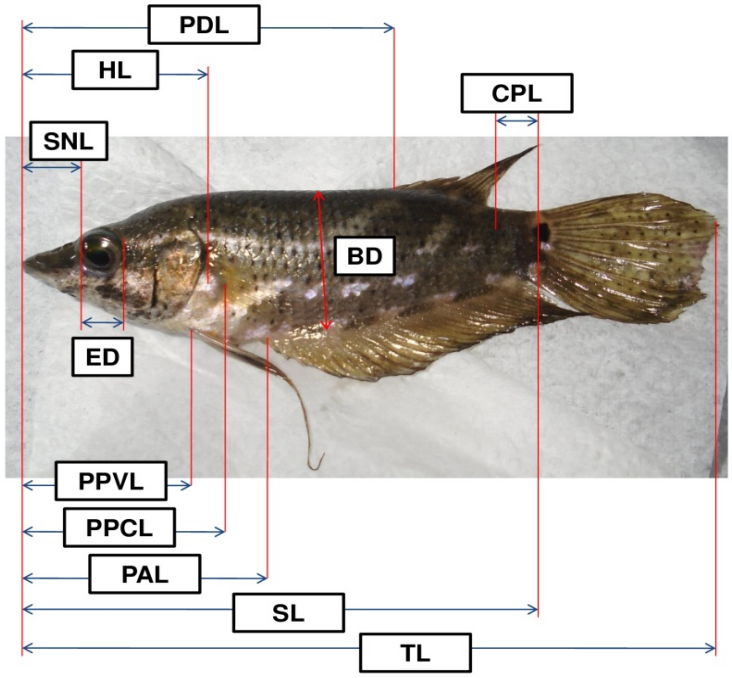

Figure 12. Different Morphometric parameters of the fish

(See colour photo in Plate No. V, Fig. 12)

4.2.2. Morphomeristic study:

Morphomeristic characters were counted by using magnifying glass and microscope from preserved specimen. The following 19 morphomeristic parameters studied of the fish:

CFR: Caudal fin ray; PCFR: Pectoral fin ray; AFS: Anal fin spine; AFR: Anal fin ray; DFS: Dorsal fin spine; DFR: Dorsal fin ray; PVFS: Pelvic fin long spine; PVFR: Pelvic fin ray; TS: Transverse scale; LLS: Lateral line scale; CPS: Caudal peduncle scale; PDS: Pre dorsal scale; PODS: Post dorsal scale; PPCS: Pre pectoral scale; POPCS: Post pectoral scale; SLL: Scale above latera line; HS: Head scale; SBL: Scale below lateral line and CT: Cranial teeth.

The vertebral column and vertebral spine were calculated from digital X-ray plate. Number of gill arch, gill filaments and gill rakers were also counted by dissecting the preserved fish.

4.3. RSULTS

4.3.1. General Description:

The colouration of the fish varies between grey, black and brown with several black and brown strips present at the belly portion of the fish. A black ocelli present at the dorsal base of caudal fin and fins with brown to black colour and redish edge of the fish. *C. nobilis* have streamline sagittiform body covered with small ctenoid scales (**Figure 13**). 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. Lateral line is not prominent or distinguishable at every time but the line is continuous and curved. The scales over the lateral line are generaly white in colour. The fish possessing sub-terminal mouth with slightly upturned lower lip.

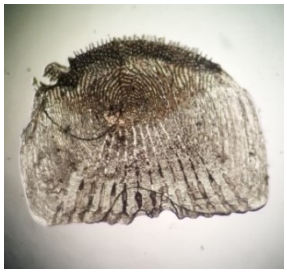

Figure 13. Ctenoid scale of *C. nobilis*

(See colour photo in Plate No. V, Fig. 13)

4.3.2. Mophometric study:

The total 34 morphometric characters are tabulated in **table 5**. The total length of the observed fish specimen varies between 37-72 mm. The average total length of the fish is near about 55 mm. The relationship of various morphometric measurements compared with total length, standard length and head length (**Table 6**) in *C. nobilis* is calculated to identify the fish. Head length is 26.75±5% of total length of the fish. Head length is 3.71 part of the total body length. Eyes are highly protruding. The eye diameter of the fish is 3-6 mm which is 28.55±5% of head length of the fish. The relationship of standards length with body depth, body width, head length, head width and caudal peduncle length are also described in **Figure 14**.

Table 5. Morphological characters of *C. nobilis*

	Range	Min	Max	Mean		SD	Variance
	Stat	Stat	Stat	Stat	SE	Stat	Stat
TL	35.00	37.00	72.00	54.96	1.04	10.40	108.24
SL	31.00	33.00	64.00	45.07	0.94	9.47	89.76
BD	16.00	7.00	23.00	15.03	0.46	4.69	22.07
BW	9.00	8.00	17.00	12.49	0.23	2.38	5.68
HL	13.00	10.00	23.00	15.05	0.34	3.45	11.92
HW	5.00	4.00	9.00	5.78	0.14	1.40	1.97
PCL	6.00	4.00	10.00	7.61	0.15	1.53	2.36
PVL	8.00	5.00	13.00	7.36	0.17	1.70	2.89
AFL	15.00	13.00	28.00	17.63	0.43	4.31	18.63
CFL	13.00	4.00	17.00	11.14	0.22	2.25	5.07
DFL	14.00	6.00	20.00	10.12	0.35	3.58	12.85
DBL	7.00	5.00	12.00	8.11	0.17	1.78	3.19
ABL	19.00	12.00	31.00	22.42	0.59	5.96	35.60
CBL	2.00	3.00	5.00	4.11	0.06	0.61	0.38
PCBL	2.00	2.00	4.00	3.49	0.05	0.55	0.31
PVBL	2.00	3.00	5.00	3.94	0.06	0.60	0.36
PDL	26.00	18.00	44.00	27.68	0.78	7.80	60.98
PODL	3.00	3.00	6.00	4.60	0.08	0.89	0.81
PPCL	17.00	10.00	27.00	16.39	0.45	4.55	20.74
POPCL	16.50	17.50	34.00	25.97	0.49	4.98	24.88
PAL	26.00	12.00	38.00	20.30	0.72	7.22	52.21
PPVL	15.00	11.00	26.00	16.90	0.70	5.00	25.07
POPVL	18.00	19.00	37.00	28.14	0.54	5.42	29.47
PPD	3.00	2.00	5.00	3.70	0.08	0.87	0.75
DFH	3.00	4.00	7.00	5.41	0.10	1.07	1.15
AFH	2.00	4.00	6.00	4.95	0.07	0.75	0.573

CPL	4.00	4.00	8.00	6.00	0.12	1.20	1.45
SNL	4.00	3.00	7.00	4.36	0.14	1.43	2.05
SIL	9.00	8.00	17.00	11.16	0.25	2.57	6.64
LLJ	6.00	5.00	11.00	7.23	0.15	1.57	2.48
LUJ	5.00	4.00	9.00	5.77	0.13	1.37	1.89
IOL	5.00	4.00	9.00	5.59	0.13	1.35	1.84
POOL	5.00	3.00	8.00	5.10	0.11	1.18	1.40
ED	3.00	3.00	6.00	4.13	0.11	1.15	1.32

Table 6. Relationship between TL, SL and HL with different morphometric measurements of *C. nobilis*

Different morphometric characters	Percent of TL	Percent of SL	Percent of HL
SL	81.87		
BD	26.72	32.68	
BW	22.73	27.89	
HL	27.28	33.38	
HW	10.45	12.81	
CPL	11.03	13.54	
SNL			29.38
ED			23.89
SIL			74.17
LLJ			48.17
LUJ			38.34
IOL			37.09
POOL			33.93
CFL	20.38	25.26	

PCL	13.83		
PVL	13.50		
AFL	32.07		
DFL	18.17		
DBL	14.92		
ABL	40.52		
CBL	7.66		
PCBL	6.44		
PVBL	7.33		
PPD	6.69		
PDL	49.99		
PPCL	29.51		
PAL	36.31		
PPVL	33.22		
DFH	9.98		
AFH	9.32		
PODL	8.37		
POPCL	47.22		
POPVL	51.17		

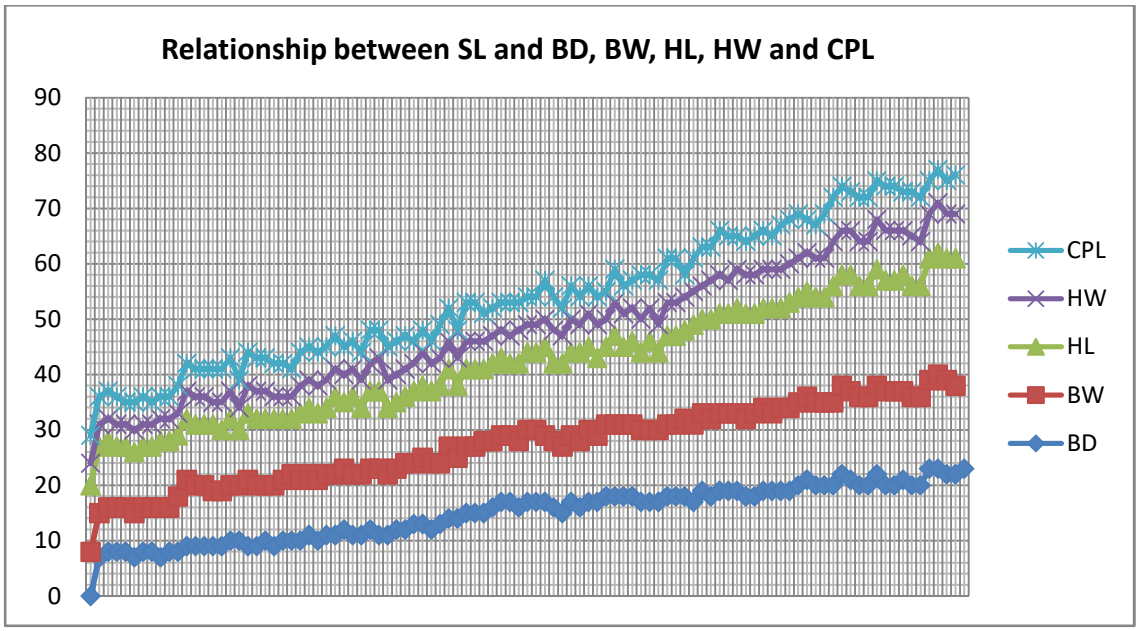

Figure 14. Relationship of Standards length with body depth, body width, head length, head width and caudal peduncle length

(See colour photo in Plate No. VI, Fig. 14)

4.3.3. Morphomeristic study:

In the present study 19 morphomeristic characters were recorded which are shown in **table 7**. The pectoral fin of the fish contains a large fin spine. Dorsal fin grows near the end of anus. Dorsal fin spines are short and rays are long. 2 nostrum present at the upper side of the eyes. Caudal fin is round shaped. The number of vertebral column of the fish is varies from 29-31 and vertebral spines varies from 43-50 of the fish (**Figure 13**).

Table 7. Morphomeristic characters of *C. nobilis*:

SL. NO.	CHARACTERS	MAX	MIN
1.	**AFS**	V	IV
2.	**AFR**	28	23

3.	**CFR**	16	14
4.	**DFS**	VII	IV
5.	**DFR**	8	5
6.	**PCFR**	13	11
7.	**PVFS**	I	I
8.	**PVFR**	5	5
9.	**LLS**	32	28
10.	**TS**	16	12
11.	**CPS**	8	5
12.	**CT**	U-16,L-14	U-13,L-12
13.	**PDS**	24	23
14.	**PODS**	7	6
15.	**PPCS**	10	6
16.	**POPCS**	33	30
17.	**SALL**	9	6
18.	**HS**	8	7
19.	**SBLL**	8	5

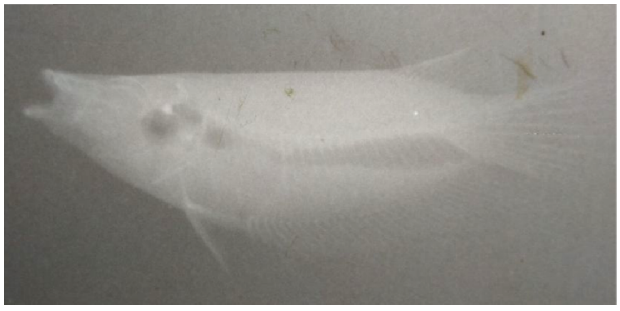

Figure 15. X-Ray image of *C. nobilis* showing skeleton structure

(See colour photo in Plate No. VI, Fig. 15)

4.3.4. Anatomical study:

Some other anatomical characters like gill arch, gill filaments and gill raker details were also observed (**Table 8, figure 16**) in this study. Apart from gill suprabranchial labyrinthine organ present for extra air consumption. This vascular labyrinth organ is the modification of first gill arch of the fish (**figure 17**).

Table 8. Different anatomical characters of *C. nobilis*

SL. NO.	CHARACTERS	MAX	MIN
1.	**Gill arch**	6	-
2.	**Gill raker in 2nd gill arch**	9	8
3.	**Gill filament in 2nd gill arch**	51	50
4.	**Vertebrae**	31	29
5.	**Vertebral spine**	50	43

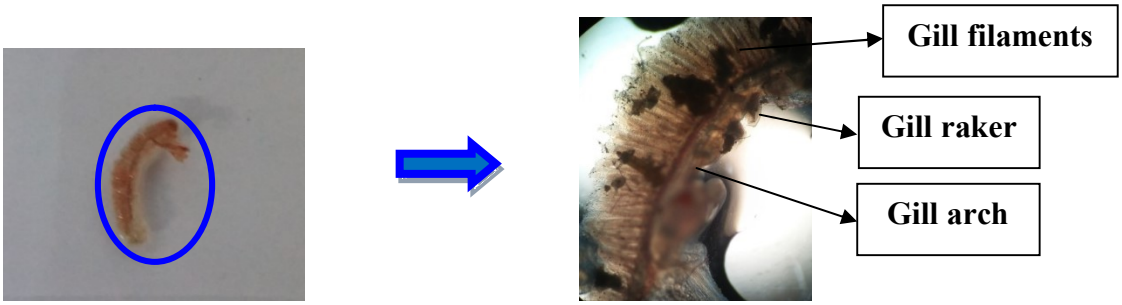

Figure 16. Gill structure of *C. nobilis*

(See colour photo in Plate No. VI, Fig. 16)

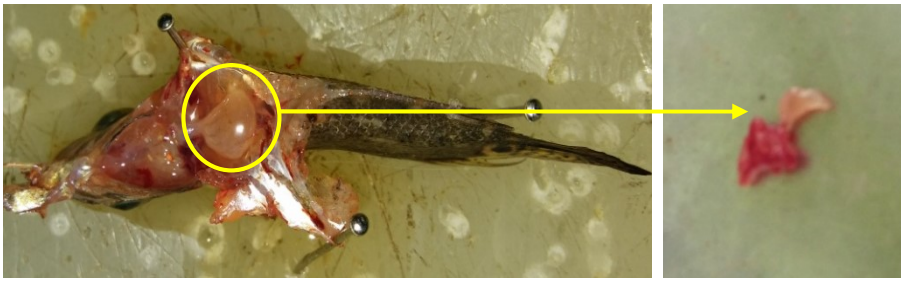

Figure 17. The accessory respiratory labyrinth organ of *C. nobilis*

(See colour photo in Plate No. VI, Fig. 17)

4.4. DISCUSSION

The taxonomical study gives almost similar data were given by the previous workers. The lateral line scale ranges from 28-32 which is closely related to the data given by Rahman, 1989 and Rahman, 2005 which was 28-33 number of lateral line scales. The comparative study between the fin formula observed by previous workers and the present study (**table 9**) also shows the close relationship of the data. Rahman in the year 1989 and 2005 observed that inter-orbital length is longer than eye diameter and the present study also reveals that eye diameter is approx 1.5 part of inter-orbital length. Like all other anabantoid fish (Tate *et al*., 2017) *Ctenops* also possess accessory respiratory labyrinth organ which is the modification of first gill arch.

Table 9. Fin formula of *C. nobilis* given by different previous authors along with the present study:

Author	DFS	DFR	AFS	AFR	PCFR	PVFS	PVFR	CFR
McClelland, 1845		4-8		34	14		5	13
Talwar and Jhingran,	IV-VI		IV-V	23-28	13	I	5	

1991								
Shafi and Quddus, 2001	V-VI	7-8	IV-V	23-25	12	I	5	16
Rahman, 1989 and 2005	V-VI	7-8	V	23-25	12	I	5	
IUCN Bangladesh, 2000	IV-VI	6-8	IV-V	23-28	12	I	5	
Present study, 2016	IV-VII	5-8	IV-V	23-28	11-13	I	5	14-16