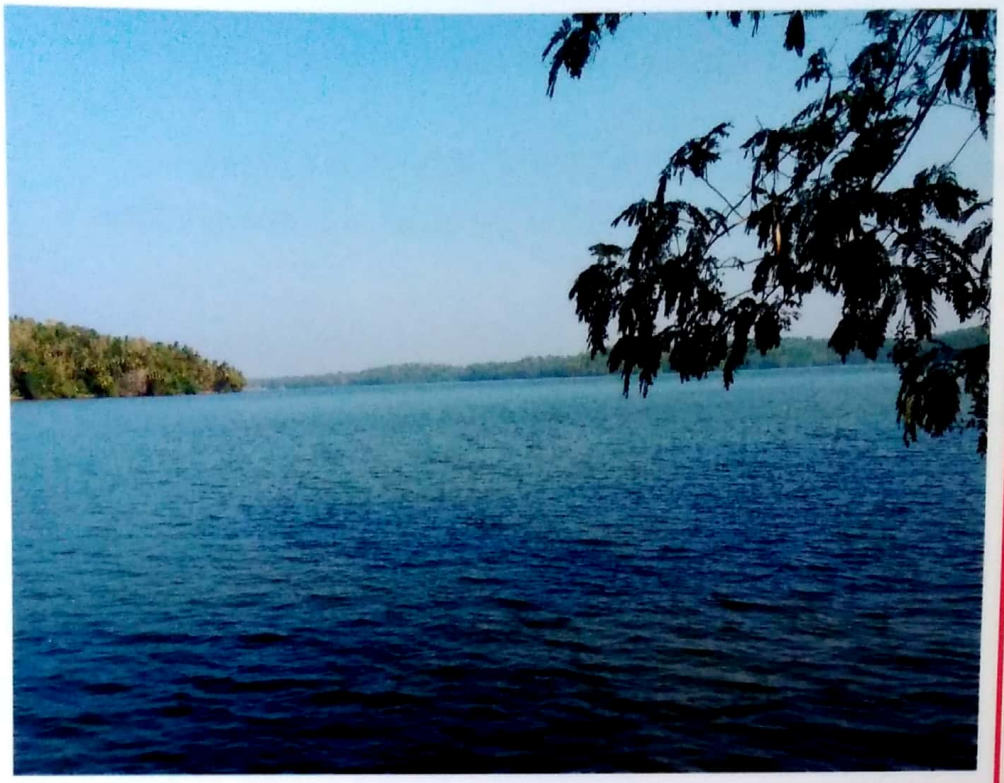

BIOLOGY OF TENTACLED GOBY *Oxyurichthys tentacularis* (VALENCIENNES, 1837) FROM ASHTAMUDY ESTUARY.

Dissertation submitted to the University of Kerala in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF SCIENCE

IN

ZOOLOGY

Submitted by

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DEPARTMENT OF ZOOLOGY

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KOLLAM-5

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CERTIFICATE

This is to certify that the dissertation entitled "Biology of Tentacled Goby *Oxyurichthys tentacularis* (Valenciennes, 1837) from Ashtamudy Estuary" is an authentic record of the work done by .... under my supervision as partial fulfillment of the requirements for the Degree of ***Bachelor of Science*** in **Zoology** and this report has not been submitted earlier for the award of any degree or diploma or any other similar titles anywhere.

ROHINI KRISHNA M V
(*Supervisor*)
Asst. Professor
Dept. of Zoology

Certified bona fide:

18/4/18

Dr.Jasin Rahman.V.K
Asst. Professor & HOD
Dept. of Zoology

EXAMINERS:

1.

2.

DECLARATION

I do hereby declare that this dissertation "Biology of Tentacled Goby *Oxyurichthys tentacularis* (Valenciennes, 1837) from Ashtamudy Estuary" is a bona fide report of the project work carried out by me, under the supervision and guidance of Rohini Krishna M V, Asst. Professor, Department of Zoology, TKM College of Arts and Science, Kollam as partial fulfillment of the requirements for the award of the Degree of *Bachelor of Science* in Zoology.

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CONTENTS

INTRODUCTION

Ashtamudi Lake was declared as a Ramsar site of international importance on 19th of August, 2012. The estuary is the source of livelihood for thousands of fishermen and is stated to be the second largest after the Vembanad estuary. The lake has many branches such as Kandachira, Kureepuzha, Thekumbhagam, Kallada, Perumon, Vellimon and Chavara.

AshtamudyLake is endowed with a variety of ichthyofauna. It supports 97 species of fish (42 are typically marine, 3 estuarine, 9 estuarine-riverine, 15 marine-estuarine). 22 fish species belonging to 10 orders and 17 families were recorded in a study conducted by Seethal Lal et al (2013) in the Vattakayal part of Ashtamudy Lake. A survey conducted by Vimal Raj et al (2014) in the Ashtamudy Lake revealed the presence of 91 species of finfishes and shellfishes belonging to 39 families. It is also a congenial habitat for species of Penaeid and Palaemonid prawns, edible crabs and the short neck clam *Paphia malabarica*. Clams found in the estuary are exported.

The lake contains a variety of food fishes such as *Etroplus surantensis* (Pearl spot cichild), *Channa striata*(Snakehead murrel), *Anabas testudineus* (Climbing perch), *Awaous grammepomus*(Scribbled goby), *Oreochromis mossambicus* (Tilapia), *Brachiurus orientalis* (Oriental sole), *Stolephorus indicus* (Indian anchovy), *Arius maculates* (Spotted catfish), *Gerres abbrevatius* (Short silver belly), *Pseudoetroplus maculates* (Orange chromid), *Scathophagus argus*(Spotted scat), *Parambassis thomassi* (Western Ghat glassy perchlet), *Hyporhamphus xanthopternus* (Red tipped half-beak), *Heteropneustes fossili*(Asian stinging catfish), *Anguilla bicolar* (Short fineel), *Chanos chanos* (Milk fish), *Dayella malabarica*

(Day's herring fish), *Caranx ignobilis*(Giant trevally), *Terapon jarbua* (Target fish), *Mugil cephalus*(Flat head grey mullet), *Clarias batrachus* (Walking cat fish), *Megalops cyprinoides* (Bony mullet), *Ephinephlus malabaricus* (Malabar group), *Mystus gulio* (Long whiskers catfish), *Siganus javus* (Streaked spine foot) and *Nematalosa nasus*(Bloch's gizzard shad).

The present study focuses on *Oxyuricthys tentacularis*. In Greek *Oxy*=sharpen, *oura*=tail, *icthys*=fish. They are Marine, brackish, demersal, amphidromous and tropical. They are mostly found in Indo West Pacific, Transkei northwards, Zanzibar, Madagascar to tropical West Pacific and Mekong delta. It occurs inshore, enters rivers and lagoons. *Oxyuricthys tentacularis* is listed under the category of low to moderate vulnerability in Red Data.*Oxyurichthys is* a genus of belonging to Order Perciformes of the Family Gobiidae.

Gobidae makes up currently 212 genera and 1,875 species. Gobies are the largest marine fish family and the most species-rich family of vertebrates. Gobies are among the most successful teleost groups in the warm temperate and tropical waters. They are typically inshore marine benthic fishes but many inhabit estuarine and fresh waters and are mostly small-sized fish forming generally tropic niche of small predators (Miller, 1986)

Gobies and blennies combined make up a dominant portion of the small fish inhabiting benthic tropical reefs around the world. Additionally, gobies are usually the most abundant freshwater fish on oceanic islands. This group is so poorly known due to their cryptic and secretive nature that 10 to 20 new species are described each year, making them the marine family with the greatest number of newly described species. The range of morphology, behavior, habitat and reproductive strategies within this family is undeniably impressive. (Hoese, 1998; Nelson, 1994; Thresher, 1984). Most gobies are remarkably small and attains a small body size of often less than 50mm.The recognizable feature of Gobidae

family is the existence of two dorsal fins (the first with eight flexible spines and the second soft), and a blunt round head with large eyes. The pelvic fins fuse to form a disc-shaped sucker so they are often seen using the sucker to adhere to rocks and corals, and in aquariums they will stick to glass walls of the tank. Their colouration ranges from drab to a variety of bright patterns (Christine E. Thacker and Dawn M Roje, 2011)

For the life in tidal or estuarine environments many of them have evolved significant physical adaptations. In most of the family of Gobidae, the incubation period is one to five days and then they grow rapidly within a few days. The larvae are quite advanced with pigmented eyes, well developed jaws, digestive tracts, and vertical fin folds. The small transparent larvae (between 2 and 10 mm long) are usually dispersed in the water column where they swim for 3 to 20 days. Finally, the larvae settle into suitable habitat and develop a colour that helps them to blend in with the surroundings. They reach sexual maturity within a few months. The development may take longer, with sexual maturity occurring after 1 to 2 years in temperate climates (Hoese, 1998)

Gobidae exhibit a wide range of mating system. There are evidence of monogamy in some species. Most of them have extended spawning seasons and the peak spawning depends on the species. Females deposit from five to several hundred eggs, which the male then fertilizes. In some species lunar cycle is thought to play a role in larval recruitment and spawning behavior (Thresher, 1984). In most cases, the male guards the eggs after they are fertilized. The young probably stay close to adults for a period of time after hatching.

Many fishes of this family are quite selective in their feeding habits. They are classified as zooplanktivores, omnivores and carnivores, as they feed on a wide variety of small

organisms like crab, shrimps, smaller crustaceans, molluscs, annelids, sponges, small fishes and eggs of various invertebrates and fishes.

Gobidae exhibit distinct sexual dimorphism. Because of their relative abundance, Gobies are extremely important in almost any ecosystem they occupy. It also makes them an essential part of the food chain and has greatest impact on the benthic environment since most of them reside there. A number of gobies have been successfully bred in captivity, and some are also popular in the aquarium trade.

Without proper knowledge for the life, habits and behavior of fishes, it would not be possible to plan, control and manage fishery resources in a sustainable manner. *Oxyurichthys* species are large and distinctive gobies, widespread in the tropical Indo-west Pacific in a range of estuarine and coastal marine habitats. They are often collected by trawling and are usually present in artisanal fish markets throughout Southeast Asia.

The present study focuses on the reproductive biology of *Oxyurichthys tentacularis*.The fish *Oxyurichthys tentacularis* is endemic to Ashtamudy lake and it's one the most commonly sort after fishes in this region. Occurs inshore, enters rivers and lagoons. Exclusively in brackish habitat, is known as 'kuravali' in Malayalam. A modified gill net, "koozhalivala" is used for its fishing. The easiness to catch the fish and low price has made this fish a favourite of the locals. Though its abundance and distributions is noted in other estuaries and backwaters of India, perhaps this is the only estuary in India where there is a commercial fishery for a Goboid species (Kurup and Thomas, 2001).

The presence of *Oxyurichthys microlepis and O.tentacularis*in Ashtamudy Lake were recorded by Raghunathan(2007). The presence of *Oxyurichthys formonasnous, O. microlepis,*

*O.tentacularis*were recorded from the lake by Vimal Raj et al (2014). During a preliminary investigation conducted at the landing centre, it was understood that *Oxyurichthys tentacularis* dominated the catch so, this was one of the reasons for selecting *Oxyurichthys tentacularis* for study.

Studies on the reproductive status of food fishes are very essential. Different aspects of reproductive biology studied may include spawning season and fecundity. Studies on these aspects require prior knowledge of the stage of gonad development. The most common method of studying the Gonadal development is through visual observation of the Gonads which can be accomplished easily in fishes such as *Oxyurichthys* due to the large size of testis, ovaries and ova which can be observed macroscopically. This technique can easily be accomplished but for detailed study histological investigation of Gonads are essential (West 1990). Investigations on the ovarian cycle and fecundity of fishes were made by Fischer *et al* (1970).

Although the reproductive biology of temperate marine gobies has been well studied, little is known about reproduction in tropical and subtropical marine gobiids. This paucity of information is surprising, given that the vast majority of the nearly 2000 species in the family Gobiidae (Nelson 1994) inhabit tropical and subtropical coastal regions. The biology and ecology of several gobiid species still remain unknown (Ahnelt & Kovacic, 1997). M. Kovacic *et al* (2001) studied the biology of Roule's goby, *Gobiusroulei* from the northern Adriatic Sea. Abdel - Magwd (1997) studied the growth, feeding habits, reproduction beside mortalities and exploitation rates for *Gobius niger* inhabiting the Egyptian Mediterranean waters of Alexandria, Privitera (2002) studied the Reproductive biology of the coral-reef goby, *Asterropteryx semipunctata*. Khaironizamandy Norma-Rashidin (2002) studied the

Length-weight relationship of Mudskippers in Malaysia. Panikar (2003) studied Morphometry and Length-weight Relationship of Goby, *Parachaeturichthys ocellatus* FeridHajji(2013) studied the Age and Growth of the Grass goby *Zosterisess orophiocephalus*.

Even though studies were conducted on the Sexual Dimorphism of *Oxyurichthys tentacularis* (Sherly Williams,2014) literature is unavailable on the reproductive biology and length-weight relationship *Oxyurichthys tentacularis*. So the present study is promising as it helps to throw light on the reproductive biology and length-weight relationship of *Oxyurichthys tentacularis*.

MATERIALS AND METHODS

The specimens were obtained from Anchalummodu fish market (Fig:1), the specimens obtained were caught from Ashtamudy Lake. The sampling was carried out monthly during the months of November, December, January, February and March. The collection was carried out during the early morning hours. 15 specimens were collected each month.

A preliminary investigation at the landing centre revealed that the specimens were caught by fishermen using Pattuvala, Noolvala which are different types of local gill nets.

Gill net is a wall type of net which gets stretched in between a head drop at the top and a foot drop at the bottom. Foot drop is floated by disc shaped floats tied at the interval of 1m. Foot drop is weighed down by lead sinkers tied at 2 m intervals. The floats and sinkers keep the net stretched. These nets are mostly used during night time preferably during the dark face of the moon. Fishes are caught when they get entangled in the net. Dugout canoes are used as craft for this fishing method. Usually 1 or 2 fishermen go for fishing. During the early morning they will haul the net and collect all the fishes entangled and bring it to the landing centre. From the landing centres fishes are purchased by middle men or fish hawkers. Sometimes the fishermen directly bring the catch to the fish market for sale.

The specimens were brought to the college laboratory and the morphometric measurements were recorded. Studies on the reproductive biology were also carried out. Examinations of ovaries were carried out and they were classified into 5 stages. For the analysis of gonadal maturity and to calculate the GSI (Gonado-Somatic Index) the Gonads were weighed.

The GSI can be calculated according to the following equation:

$$\textbf{Gonado Somatic index(GSI)} = \frac{\textbf{Gonadweight}}{\textbf{Totalweight}} \times 100$$

The gonads were photographed and the ova were measured up to the nearest millimetre. In order to calculate the fecundity the number of mature ova in each ovary was counted.

For length-weight relationship studies, total length and body weight for each sex were recorded. The relationship was calculated by correlating Ln TL to Ln Wt for both male and female specimen and was compared by the equation;

$\mathbf{W = q \times L^b}$ (Sparre, 1998)

The W= Total weight of Fish in grams,

L= Length of fish in centimeter,

q = Rate of change of weight with length (regression intercept),

b = weight at unit length (regression slope).

The equation can be transformed into logarithmic scale by taking logarithms on both sides.

$\mathbf{LnW = Ln\ q + b \times Ln\ L}$

Fig. 1: Map showing the position of the Ashtamudy Lake and the market from where the fishes were obtained.

Fig. 2: Students executing the project work

Fig. 3: Students executing the project work

RESULTS

Oxyurichthys tentacularis, Tentacled goby, (Valenciennes, 1837)

Classification

Kingdom	:	Animalia
Phylum	:	Chordata
Subphylum	:	Vertebrata
Superclass	:	Gnathostomata
Superclass	:	Pisces
Class	:	Actinopterygii
Order	:	Perciformes
Suborder	:	Gobioidei
Family	:	Gobiidae
Subfamily	:	Gobionellinae
Genus	:	*Oxyurichthys*
Species	:	*tentacularis*

Fig 4: *Oxyurichthys tentacularis*

Body is very elongate, compressed, and the body profile is convex. Snout is obtuse, a little longer than the eye or shorter than eye, tip before margin of eye. Anterior nostril is in a short tube. Mouth is oblique and the lower jaw prominent. Maxillary extends to below posterior part of eye. On each side 20 curved teeth are present in the upper jaw. Some longitudinal mucous canals are present on the cheek. (Fig 4)

The fish has a dull greenish colour. They are omnivorous bottom-dwelling fishes. They are relatively inactive, hence, function as food of larger fishes and are also used as food fish locally.

Distribution	**India; China; Indonesia; Philippines; Thailand; Taiwan; Vietnam; Hong Kong; Cambodia; Australia; Papua New Guinea; South Africa; Tanzania; Madagascar; American Soma; Micronesia; New Caledonia; Samoa**

Biology of *Oxyurichthys tentacularis*

The tentacled goby, *Oxyurichthys tentacularis*, was observed throughout the period of study from November 2017 to March 2018. In the landing centre the fishes were sold along with other species such as *Mugil cephalus, Gerrus punctatus, Arius maculates, Lutjanus malabaricus, Etroplus suratensis, Pseudoetroplus maculates, Stolophorous indicus, Leiognathus brevirostris, Strongulur astrongulura* and *Ambasis ambasis*. *Oxyurichthys tentacularis* was available all around the year but the availability peaked during the rainy months. Details of the samples collected such as total length, standard length, weight, sex, stage of maturity, the weight of gonad and ova diameter for the month of November, December, January, February and March are presented in the tables 1, 2,3, 4 and 5 respectively.

Table 1: Details of Sample analysed-November

Serial Number	Length (cm)	Weight (g)	Sex	Gonad stage	Gonad weight (g)	Average Ova diameter(µm)	GSI
1	14	11.06	female	III	0.15	158.541	1.35
2	13	9.7	female	IV	0.28	235.079	2.88
3	13.2	10.24	female	IV	0.12	260.985	1.17
4	13.5	10.3	female	III	0.07	164.873	0.67
5	13.2	10.24	female	II	0.09	107.178	0.87
6	13.34	10.2	female	V	0.08	335.5	0.78
7	12.6	9.06	female	III	0.09	141.719	0.99
8	13.1	9.9	female	V	0.46	359.376	4.64
9	15.2	12.85	Male	IV	0.08	0	0.62
10	14.4	12	Male	IV	0.07	0	0.58
11	14.9	8.4	Male	III	0.04	0	0.47
12	13.7	9.22	Male	V	0.07	0	0.75
13	14.2	11.6	Male	III	0.03	0	0.25
14	14.2	11.62	Male	IV	0.03	0	0.25
15	15	12.8	Male	I	0.05	0	0.39

Table 2: Details of Sample analysed-December

Serial Number	Length (cm)	Weight (g)	Sex	Gonad stage	Gonad weight (g)	Average Ova diameter (µm)	GSI
1	13.7	10.6	Female	V	0.09	296.175	0.84
2	13.6	10.5	Female	IV	0.08	217.871	0.76
3	13	9.7	Female	V	0.07	287.558	0.72
4	13.3	10.24	Female	V	0.07	274.851	0.68
5	12.6	9.06	Female	III	0.12	168.314	1.32
6	13.7	9.22	Female	V	0.07	332.631	0.75
7	13.3	10.1	Female	III	0.07	164.356	0.69
8	13.9	10.9	Female	IV	0.03	261.036	0.27
9	14.5	12.1	Male	III	0.06	0	0.49
10	14.6	12.5	Male	I	0.05	0	0.40
11	14.2	11.62	Male	III	0.09	0	0.77
12	14	10.87	Male	IV	0.15	0	1.37
13	15	12.8	Male	IV	0.09	0	0.70
14	14.3	11.8	Male	III	0.05	0	0.42
15	14.5	12.1	Male	II	0.06	0	0.49
16	14	10.87	Male	III	0.15	0	1.37
17	13.9	9.5	Male	II	0.2	0	2.10
18	13.6	8.8	male	IV	0.08	0	0.90
19	14	10.87	male	III	0.15	0	1.37
20	14.6	12.5	male	V	0.05	0	0.40

Table 3: Details of Sample analysed-January

Serial number	Length (cm)	Weight (g)	Sex	Gonad stage	Gonad weight (g)	Average Ova diameter (µm)	GSI
1	12.9	9.66	female	V	0.14	283.486	1.45
2	13.2	10.24	female	III	0.03	143.415	0.29
3	13.6	8.8	female	III	0.06	164.147	0.68
4	12.5	8.5	female	III	0.14	162.411	1.65
5	13.4	10.2	female	III	0.04	179.144	0.39
6	12.7	9.06	female	V	0.04	305.835	0.44
7	13.1	9.9	female	IV	0.08	252.255	0.81
8	14	10.87	male	V	0.08	0	0.74
9	14.1	10.9	male	III	0.06	0	0.55
10	13	7	male	IV	0.05	0	0.71
11	14.2	11.6	male	III	0.05	0	0.43
12	13.8	9.4	male	III	0.03	0	0.32
13	13.2	7.2	male	III	0.02	0	0.28
14	10.6	4.7	male	III	0.03	0	0.64

Table 4: Details of Sample analysed-February

Serial Number	Length (cm)	Weight (g)	sex	gonad stage	gonad weight	Average Ova diameter (µm)	GSI
1	14.5	12	female	V	0.42	360.277	3.50
2	14	11.06	female	V	0.23	282.811	2.08
3	12.5	8.5	female	II	0.04	99.493	0.47
4	12.9	7.38	female	IV	0.03	252.308	0.41
5	15.4	13.9	male	III	0.43	0	3.09
6	13.6	8.8	male	II	0.06	0	0.68
7	14.5	12.1	male	II	0.06	0	0.50
8	15.5	13.92	male	V	0.12	0	0.86
9	13.9	9.5	male	III	0.07	0	0.74
10	13.6	8.8	male	III	0.02	0	0.23
11	14.3	11.8	male	III	0.04	0	0.34
12	13.5	7.63	male	III	0.05	0	0.66
13	15	12.8	male	II	0.04	0	0.31
14	7.1	3.29	male	IV	0.1	0	3.04
15	12.5	6.58	male	II	0.04	0	0.61

Table 5: Details of Sample analysed-March

Serial Number	Length (cm)	Weight (g)	Sex	Gonad stage	Gonad weight (g)	Average Ova diameter (µm)	GSI
1	11.4	7.5	female	II	0.01	97.051	0.1333
2	13.1	9.9	female	V	0.43	274.911	4.3434
3	13.2	10.24	female	V	0.21	274.911	2.0508
4	14.3	12	female	V	0.37	295.469	3.0833
5	12.2	8	female	V	0.11	281.632	1.3750
6	13	9.7	female	IV	0.12	217.706	1.2371
7	13.3	7.2	female	IV	0.09	252.308	1.2500
8	14.2	9.13	male	II	0.03	0	0.3286
9	13.6	8.8	male	III	0.03	0	0.3409
10	14	10.87	male	IV	0.02	0	0.1840
11	13.7	9.22	male	III	0.03	0	0.3254
12	14.4	12	male	IV	0.03	0	0.2500
13	14.6	12.5	male	I	0.04	0	0.3200
14	14.5	12.1	male	IV	0.03	0	0.2479
15	14.1	10.9	male	II	0.03	0	0.2752
16	13.3	7.73	male	III	0.05	0	0.6468

REPRODUCTIVE BIOLOGY

Description of Gonads:

Ovary

Stage I (Immature):(Fig. 5)

- Ovaries are narrow, small.
- Transparent or slightly reddish in colour and occupying 1/4th of the body cavity.
- Ova are extremely small and are extremely difficult to observe with the naked eye.
- Mean Ova diameter is 58.2 µm(Fig. 10)

Stage II (Maturing / Developing)(Fig. 6)

- Ovary is small
- Yellowish white in colour
- Ova is small, transparent and spherical in shape
- Mean Ova diameter is 108.3 µm (Fig. 11)

Stage III (Maturing)(Fig.7)

- The ovary is slightly larger than the previous stage. The ovary is yellowish in colour and has started maturing which is evident by the appearance of blood vessels.
- Ova are slight yellowish in colour
- Ovary contains ova with mean diameter of about 165.10 µm(Fig. 12)
- It also contains Stage I and II ova

Stage IV (Maturing)(Fig. 8)

- Ovary is larger than stage III
- Ovary is yellowish orange in colour and ova are visible from outside
- Ovary consists ova of different sizes
- Stage IV ova are yellowish in colour
- The ova present in both Stage II and Stage III are found in this stage
- Mean Ova diameter is 243 µm (Fig. 13)

Stage V (Mature)(Fig.9)

- Ovary is greatly enlarged
- Dark yellowish in colour and the ova is highly developed and starts to protrude from the ovary walls
- Ova is larger than other stages
- Ova is yellowish and spherical
- Blood vessels are clearly visible
- Mean Ova diameter of stage V ova is 350 µm (Fig:14)
- Ovary contains ova of different maturity stages

Fig.5:Stage I Ovary

Fig.6: Stage II Ovary

Fig.7:Stage III Ovary

Fig. 8: Stage IV Ovary

Fig.9: Stage V Ovary

Fig. 10: Stage I ova

Fig.11: Stage II ova

Fig.12: Stage III ova

Fig.13: Stage IV ova

Fig. 14: Stage V ova

Fig. 15: Stage I testis

Fig. 16: Stage II testis

Fig.17: Stage III testis

Fig.18: Stage IV testis

Fig.19: Stage V testis

TESTIS

Stage I (immature)

Testis thread like occupying less than a quarter of the body cavity. They are difficult to differentiate. The testis is reddish in colour, elongated and slender. (Fig.15)

Stage II (maturing)

Testis increased in size and became translucent, occupies about quarter of body cavity with developing white colour. (Fig.16)

Stage III (maturing)

Testis whitish, enlarged in size, occupies about half of body cavity. Thicker and softer than those of the previous stages. (Fig.17)

Stage IV (mature)

Testis white or creamy in colour and occupies more than half and less than three - fourth of the length of the body cavity. (Fig. 18)

Stage V (mature)

Testis greatly enlarged in size, convoluted in appearance and milky white, occupying about three-fourth of the length of the body cavity. (Fig.19)

Five gonadal maturity stages were recognized. Stage I (Immature), Stage II (Maturing/Developing), Stage III (Maturing), Stage IV (Maturing), Stage V (Mature). Characteristic features of ovary and testis are as mentioned above. During the 5 months of study, fully mature females were present in more numbers during the month of March. Although the gonads were classified based on physical appearance for a more detailed understanding histological analysis is required.

Length-weight relationship

The length and weight of 80 specimens were measured and based on that value, the length-weight relationship was calculated. Graphs showing length weight relationship of *Oxyurichthys tentacularis* are shown in (Fig. 20) and (Fig. 21)

Oxyurichthys tentacularis underwent allometric growth ($b \neq 3$). Both females and males where shown to undergo negative allometric growth with 'b' value of 2.0058 ($b<3$) for females and 'b' value of 2.1662 ($b<3$) for males. Regression on both male and female were significant ($P < 0.01$) and the coefficient of determination of female was higher than that of female ($R^2= 0.9445$, female; $R^2= 0.825$, male).

Negative allometric growth implies the fish becomes more slender as it becomes longer and is indicated by a $b < 3$. Positive allometric growth implies the fish becomes relatively stouter or deeper-bodied as it increases in length and is indicated by a $b > 3$.

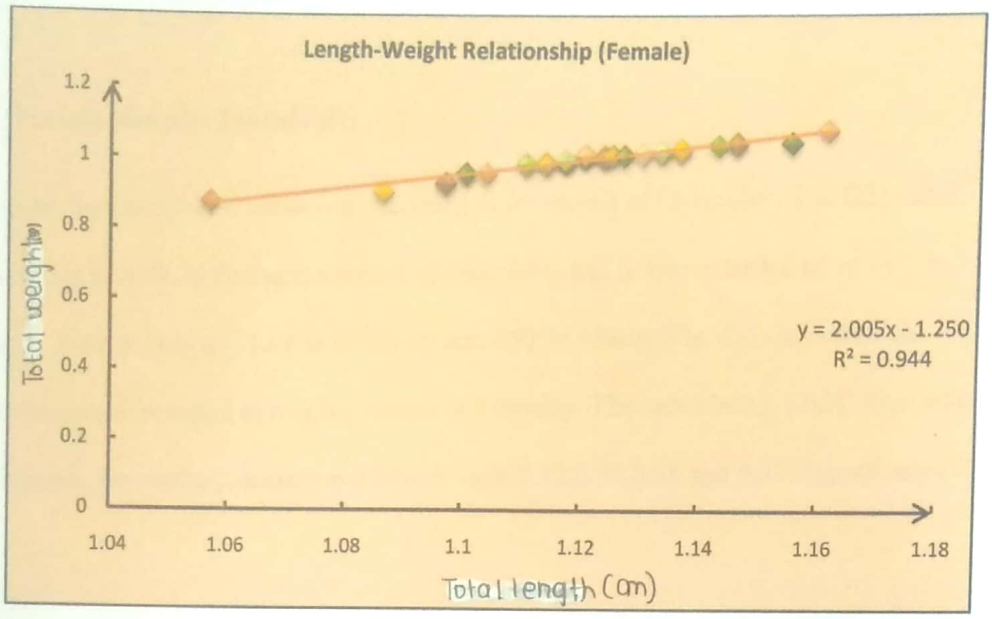

Fig.20: Graph showing length-weight relationship of *Oxyurichthys tentacularis* female

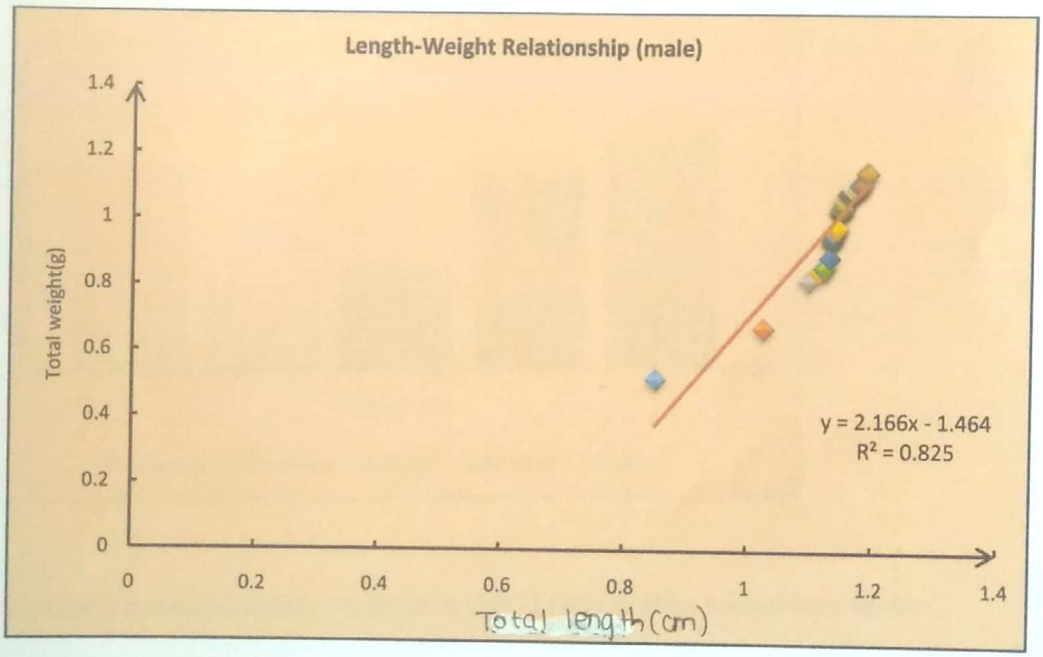

Fig.21: Graph showing length-weight relationship of *Oxyurichthys tentacularis* male

Ganado-Somatic Index(GSI)

In females, the lowest GSI value was recorded in the month of December. The GSI value was found out to be 0.76 during the month of December and it was recorded to be 1.67 in November, 0.81 in January, 1.61 in February and 1.92 in March (Fig. 22). In males, the highest value was recorded during the month of February. The value being 1.004. The values for November, December, January and March were 0.48,0.90,0.53 and 0.32 respectively (Fig 23).

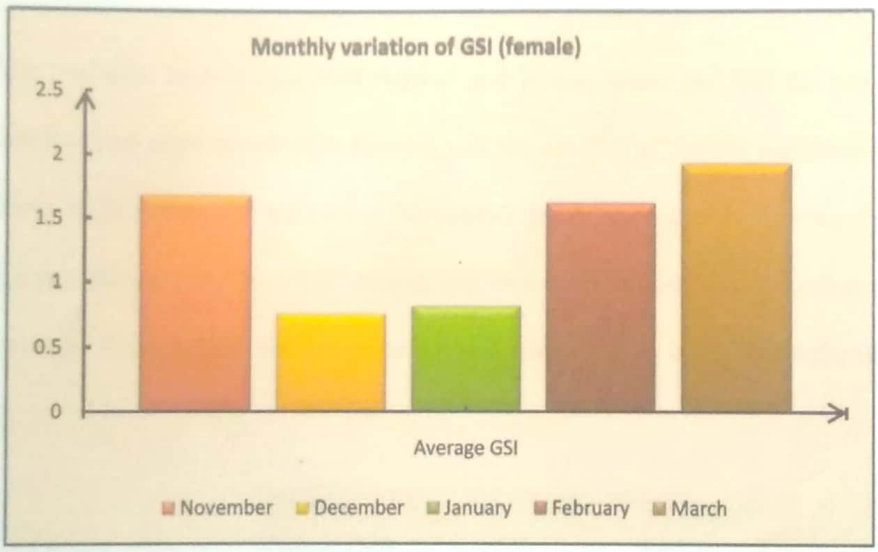

Fig. 22: Graph showing Monthly variation in GSI of *Oxyurichthys tentacularis* female

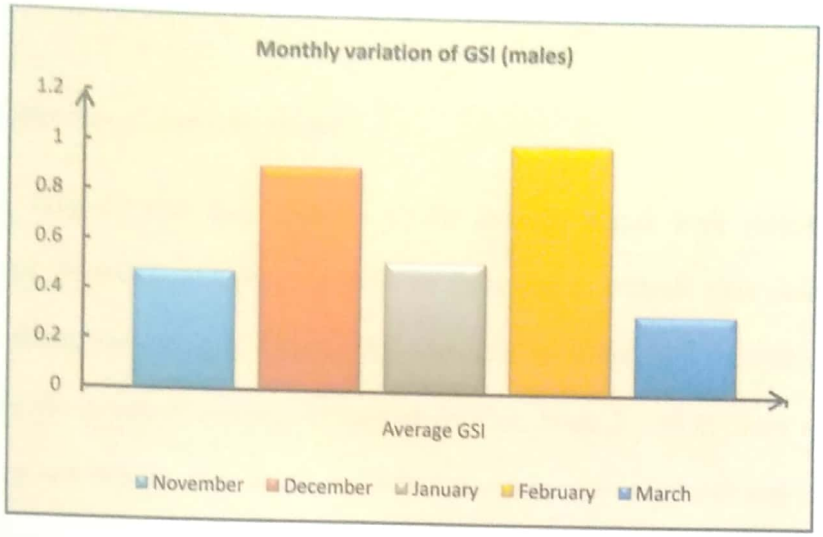

Fig. 23: Graph showing Monthly variation in GSI of *Oxyurichthys tentacularis* male

Sex Ratio

The variation in sex ratio was studied and it was found out that the population generally consisted of more males than females and the number of female members of the population were high during the months of November and March. During February males dominated the population and also the difference was well pronounced as compared to the other months. During January equal number of males and females were observed in the population. (Table 6)

Month	% Male	% Female
November	46.7	53.33
December	60	40
January	50	50
February	73.3	26.7
March	56.25	43.75

Table 6: Table showing the month-wise sex ratio of *Oxyurichthys tentacularis*

Percentage occurrence of maturity stages

It was evident from the data that in males all the maturity stages were visible in the population during the month of December while no immature individuals were observed in the population during the month of January. A Large number of maturing individuals were observed during the month of January. In case of females, Stage V and IV were obtained during February and March , so it is safe to assume that the month of March and February can be associated with maximum fertility in *Oxyurichthys tentacularis* female. The percentage occurrence of different maturity stages of Male and female is represented in the graph shown below. (Fig. 24 and 25 respectively)

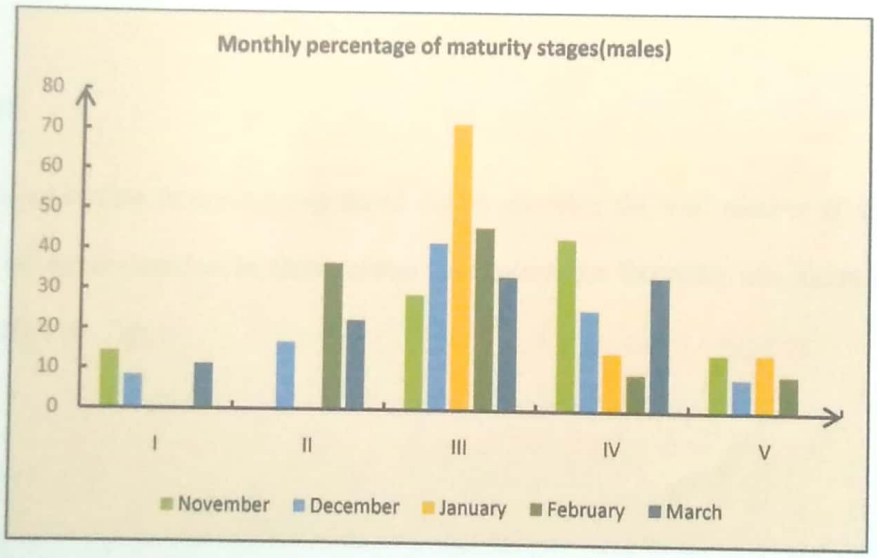

Fig. 24: Graph showing the monthly abundance of different maturity stages of *Oxyurichthys tentacularis* male

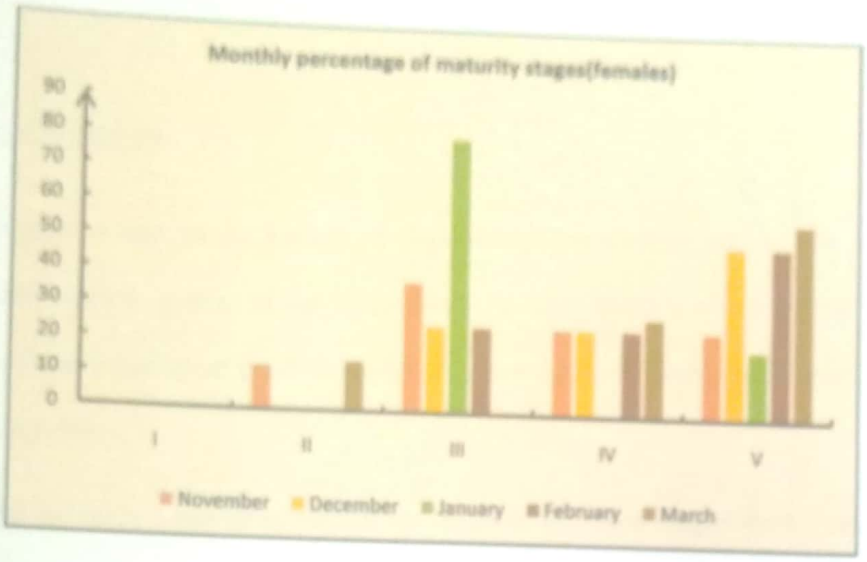

Fig. 25: Graph showing the monthly abundance of different maturity stages of *Oxyurichthys tentacularis* female

Fecundity

Fecundity (Absolute fecundity) was found out by counting the total number of spawnable eggs in the female ovaries. In *Oxyurichthys tentacularis* the fecundity was found out to be 1500 to 2000 per fish.

DISCUSSION

The present data on the biology of *Oxyurichthys tentacularis* can only be compared with closely related species of the Goby family or other Gobiids with a similar life style, and there is no information available on the Length-weight relationship and biology of this genus and species.

From the study it was observed that the length of the fishes ranged from 7 cm to 15.5cm but most of the fishes were in the size range of 11 to 14 cm. The decrease in the monthly mean length in March (7cm) could be explained by entrance of new recruits which are > than 7 cm to the fishing ground and to the migration of the larger fish to deeper waters.

The description of different stages of gonadal development is of prime importance in evaluating reproductive characteristics of a species. Macroscopic examination of the gonads of revealed that during the maturation stages the gonads underwent gradual but notable changes in size and form which are more evident in the ovaries than the testis. In general, the ovarian development process in teleost can be divided into two phases (Wallace and Selman 1981); the previtellogenic phase, when growth is comparatively slow, with few cytoplasmic changes, and the vitellogenic phase, characterised by faster growth and the deposition of large amounts of yolk in the ooplasm. The mature stage is the one occupying the biggest size, which is due to increase in the number of mature ova. Variations can be observed in both colour and size in which the immature gonads are reddish and small and start losing their reddish nature as they develop. In the case of the male gonads, it progresses from slight off-white to milky white. While in females it progresses from light yellow to yellowish

orange. The ovaries become lobular as they become fully mature. The diameter of the mature ova ranged from 274.851 to 359.376 µm

There is a drastic change in the ova too in which the ova change from small and transparent to yellowish after vitellogenesis with blood vessels clearly visible supplying food for the developing embryo. Absence of Stage VI and VII (the spend and recovering stage) indicates that the fish is a continuous spawner.

Both females and males of *Oxyurichthys tentacularis* showed negative allometric growth with 'b' value of 2.0058 (b<3) for females and 'b' value of 2.1662 (b<3) for males. Similar values were obtained in *Parachaeturichthys ocellatus* which showed a regression value of 2.88 for males and 2.18 for females and exhibited negative allometric growth and also the fish *Zosterisessor ophiocephalus* showed a negative allometry in the growth for females and males. (Haji et al,2013)

Some other members of the Goby family such as *Periophthalmodon schlosseri* and *Boleophthalmus boddarti* followed isometric growth and fishes such as *Periophthalmus argentilineatus, Periophthalmus spilotus* showed positive allometric growth with (b>3.0). (Khaironizamandy and Norma-Rashidin 2002). Some other species of goby which show positive allometric growth include *Boleophthalmus dussumeiri* (Mutsaddi 1964) with value 3.71 for male and 3.44 female, *Bathygobius soporator* (Adeboyejo, 2011) with a value of 4.58 for males and 3.98 for females.

The tentacled goby is a short-lived species. In many fish species, in order to the estimate the reproduction period study of gonad weight and its different stage of development is an appropriate approach (Fowler et al. 2000; Brown-Peterson et al. 2001). Examination of GSI

variation in different months and in different stages of development shows that *Oxyurichthys tentacularis* has a prolonged active reproductive period with a peak in February and March from the limited data available.

The oocytes are small and such small oocytes are observed in many other fishes belonging to Gobidae family such as *Gobius roulei*. All gobies are less than 28 cm except *Mesogobius batrachocephalus* (34.5cm) but most of them are below 15 cm (Miller, 1986).

The 1:1 sex ratio found during the month of January is typical of gobiids (Miller 1984). But during most months this species exhibit a male biased sex ratio. Sex differences in susceptibility to capture during breeding can often account for seasonal biases in sex ratio (Gibson & Ezzi 1978, Miller 1984).

In most teleost species from the region, the process of gonadal development is positively correlated with the progress of the dry season, in such a manner that the maximum maturational stage is achieved by the end of the dry season (Gonzalez 1980; Gentile et al. 1986). This holds true in the case of *Oxyurichthys tentacularis* as the dry months such as January, February and March showed the prevalence of Gonads in IV and V mature stages.

The breeding season of *Oxyurichthys tentacularis* is similar to *Gobius niger* which breeds during spring and summer, over a season of 2–6 months (Miller, 1986; Rogers,1988; Bouchereau et al., 1989, 1990; Joyeux et al., 1991b; Patzner et al., 1991;Arruda et al., 1993; Silva & Gordo, 1997,Kovacic,2001).

Fecundity of *Oxyurichthys tentacularis* is similar to many species of the same Family such as *Gobius paganellus*,1054–8978 (Miller, 1961); *G. cobitis*, 2000–12000 (Gibson, 1970); *L. friesii*, 2500–11000 (Gibson & Ezzi, 1978)., while smaller species have fewer

eggs: *P. norvegicus*, 1200–3800 (Gibson & Ezzi (1981); *P. microps*, 460–2030 (Bouchereau *et al*., 1989); *P. minutus*, 998–5100 (Bouchereau *et al*., 1990).

So the present study revealed information regarding size composition, maturity stages and availability of mature specimens during summer and winter months. This information will be important in evaluating the status of the species, aquaculture prospects and its need for conservation.

CONCLUSION

Oxyurichthys tentacularis is an important species of the Gobidae family as it is available in large quantities in the Ashtamudy Lake and the fish is a local delicacy consumed by large number of residents. The importance of this fish lies in the fact that it is less costly compared to other estuarine fishes such as *Etroplus suratensis* and 1 kg of this fish will cost less than 100 rupees. This fish is a cheap source of protein for the local people. So the study of this species holds importance from the nutritional and economic point of view.

From the study it was observed that the length of the fishes ranged from 7 cm to 15.5 but most of the fishes were in the size range of 11 to 14 cm. Juveniles were not present in the sample due to the comparatively larger mesh size used in capturing them.

The findings of the present study are of importance because this is the first study on the length weight relationship and reproductive characteristics of this species from Ashtamudy Backwaters. The fish exhibits negative allometric growth and so the fish becomes more slender as the length increases. High GSI values were observed during March in females and February in males. This high GSI values co-relates with the maturity period.

Males were observed more in the population in all the months except January. During January males and females were present in equal numbers.

By observing the percentage of maturity stages it was observed that males of different maturity stages were present during the month of December and stage IV and V individuals were observed in females during the month of February and March. From this data we can deduce the fact that the fishing of this species must be abstained during the month of

February and March. Analysis of the gonads revealed that *Oxyurichthys tentacularis* is a continuous spawner.

Fecundity studies were also conducted and it was found out that there are 1500-2000 mature ova per fish. Fecundity is also a measure of the vulnerability of the fish. The low fecundity indicates that this fish also might be having parental care like other Gobid fishes.

A few species of Ornamental marine Gobies have been cultured. But the culture of this species has not been attempted. The high demand of this species as a food fish makes it a suitable candidate for aquaculture. More studies are required on the seed production of this species and also the ability of this species to withstand high density culture to make their culture economically viable.

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