Assessment of Biodiversity of Brackishwater Ornamental Fish Species in Vaikom- Vechoor Locality of Vembanad Backwaters and Studies on the Biology of Selected Species.

Report of Minor Research Project submitted to UGC

by

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DECLARATION

I, Dr.K.J. Abraham, do hereby declare that this project entitled '**Assessment of Biodiversity of Brackishwater Ornamental Fishes in Vaikom-Vechoor Locality of Vembanad Backwaters and Studies on the Biology of Selected Species**' has been undertaken by me as the Minor Research Project from University Grants Commission. I also declare that this is a genuine work and has not been submitted by me for the award of any degree, diploma, title or recognition before.

Vaikom   Dr.K.J.Abraham.
25/11/2015

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CONTENTS

ABSTRACT

The Taxonomy, some aspects of biology and fishery of selected species of fishes, some of potential ornamental value have been studied. Length Weight relationship has been studied in 9 species and and the ‘b’ values estimated, which ranged between 2.47 and 3.69. Study of morphometrics have been done in five species and the r^2 values of the relationship estimated. In reproductive biology, ova-diameter frequency, Gonadosomatic index, maturity stages and fecundity have been studied in fourspecies. The important fishing gears in and around Vaikom backwaters and their catch composition have been estimated.

INTRODUCTION

The state of Kerala, lying between $8^0 18'$ and $12^0 48'$ North and Longitude $74^0 52'$ and $77^0 2'$ East, is bordered on the east by the Western Ghats and on the west by the Lakshadweep sea. The state, with an area of 38828 sq.km. has a mean width of just 67 km and nowhere more than 129 km. (Nair, 1971). Kerala has 41 west flowing and 3 east flowing rivers constituting 5% of India's total freshwater potential. An outstanding feature of Kerala coast is the presence of a large number of perennial/seasonal estuaries known as backwaters (Kayals). These water bodies are connected by canals stretching from Tiruvallam in the south, extending upto Ponnani in the north, offering an important artery for inland navigation from one end of the state to the other. The entire estuarine system along the coast of Kerala is exposed to tides from the sea and hence water is brackish almost throughout the year. The estimated area of estuaries/ backwaters in Kerala is 2,43,000 hectares forming 67% of the total inland water bodies of the state. There is an estimated 1,21,600 hectares of brackishwater marshy wetlands lying adjacent to estuaries and exposed to tidal effects.

Vembanad lake (9° 34' 60 N, 76° 25' 0 E) is a transitional ecotone between sea and land and the largest tropical wetland in the west coast of India with a length of 96 km. Based on the rich biodiversity and socioeconomic importance, Vembanad lake with adjacent Kole lands was declared as a Ramsar site – a wetland of international importance. Vembanad kole wetlands and its 10 associated drainage basins are characterized by its rich biodiversity of flora and fauna. Vembanad lake is also renowned for its fin and shellfish resources which a plays a major role in protecting the livelihood security, employment security and food security of the population living in the vicinity of the backwaters.

Investigations on the distribution and abundance of fishes of Vembanad lake extending from Cochin to Alappuzha have been done by a number of workers. Pillai (1960) made a record of distribution of *Hilsa ilisha* in the lake while Shetty (1965) made a comprehensive description of the fishing practice along with a listing of the commercially important fish and prawn species of Vembanad lake. Kuttyamma (1980) assessed the distribution and abundance of prawns and prawn larvae in Cochin backwaters. Raman (1964) made the first contribution on the biology of *Macrobrachium rosenbergii* and tried to quantify its fishery in the lake. The fishery estimation during the post barrage phase of Vembanad lake were reported by Kurup and Samuel (1987), Shetty (1965) and Kurian and Sebastian (1982). Enumeration of the gear and fish landings was done by them category wise, sector wise and species wise. Kurup and Samuel (1985) listed 150 species of fishes belonging to 56 families. Pauly (1991) made a comprehensive study on the indigenous gears of the Vembanad lake. Bijoy Nandan (2012) preapared a field guide for the identification of

Backwater Fishery Resources, listing the identifying characters and describing 165 species of finfishes, 18 species of crustaceans and 8 species of mollusks.

Extensive water and land remodeling efforts in Vembanad Lake has drastically changed the lake's water and landscapes. Kerala's brackishwater fishery wealth is composed of several species of finfishes, crustaceans and mollusks, belonging to both freshwater and brackishwater habitats. The milkfish (*Chanos chanos*), the mullets (*Mugil sp.*) and the pearl spot (*Etroplus suratensis*), represent an ideal combination of species for brackishwater fish culture. The prawns, *Penaeus indicus*, *P.monodon*, *Metapenaeus dobsoni*, *M.monoceros*, *M.affinis* , *Macrobrachium rosenbergii* and the crab, *Scylla serrata* have great potential for culture in brackishwater ponds. Oyster, *Crassostrea madrasensis*, and clams, *Meretrix spp*, *Katelysis spp* , *Villorita sp* and *Paphia spp* are important representatives of the mollusks, ideal for aquaculture.

According to the State Department of Fisheries, about 2.5 lakh fishermen population are dependent on the fishery resources of these water bodies, with 50,000 active fishermen who are engaged in fishery for earning this livelihood. The inland fishermen population is mainly confined to Kollam, Alappuzha, Kottayam and Ernakulam districts.

The present work focuses on the fishery and biology of fishes from the Vaikom- Vechoor area of the Vembanad backwaters. Vaikom is situated in the northwest of Kottayam district in Kerala. Its western border is the lake Vembanad and is crossed by various estuaries of the river Muvattupuzha. Vechoor, another village in Vaikom Taluk, Kottayam district is bordered by Vembanadu lake on the west and Kaipuzha river on the south. The regions abound in clams and catfishes. The primary aim of the project is to study the biodiversity of the selected regions and focus on the biological aspects of the species. Another aspect was to identify the potentially important ornamental fishes of the backwaters. Though the ornamental fish industry is dominated by the freshwater species, there are quite a few brackishwater species, with unique colour combinations and body shapes, that would make it worthwhile and guarantee its entry into the ornamental fish trade.

The report of the present work has been split into four major sections. Each chapter has three major divisions, namely, Introduction- which familiarizes the reader with the background and need of the study; Materials and methods- a section dealing with how the study is conducted and the methods followed; Results and Discussion- dealing with the importance and impact of the study.

The First Chapter studies the Length – Weight relationship of 9 species of fishes common in backwaters and adjacent rivers. Length-Weight Relationship is an important parameter studying the growth of fishes and their condition. The Growth coefficient values obtained indicates the suitability of the environment for growth.

The second chapter deals with morphometrics of five species and gives the species description for 11 species. Brackishwaters being highly productive ecosystems, exhibits high biodiversity and harbours a number of closely resembling species. Biological studies, or for that matter any further studies on a specimen is based on its correct identification upto the species or subspecies level. Morphometric studies help in distinguishing between closely related species.

Reproduction constitutes one of the most important evens in the life history of an animal. It facilitates the perpetuation of the species, from a biological point of view and from a fishery point of view, it is a factor influencing the dynamics of a population. Different aspects of reproductive biology like, Gonadosomatic index, Maturity stages, ova –diameter frequency, fecundity etc have been studied for different species.

Vembanad lake abounds in a variety of gears and techniques used in capturing its diverse fish population. Fishermen by their experience have designed gears suitable for a particular species and particular environment prevailing in an area. A study has been made on the conventional gears and their catches. The species composition and diversity of species in different gears have been studied.

LENGTH- WEIGHT RELATIONSHIP

INTRODUCTION

Length weight relationship is of great importance in fishery assessments. Length and weight measurements can give information on stock composition, life span, mortality, growth and production. Length weight relationships are very useful for fisheries and ecological research because they are used

- To convert growth in length equations to growth in weight for stock assessment models
- For the estimation of the biomass of a species based on length frequency distributions
- As an estimate of the condition of the fish
- For between region comparison of life histories of certain species

The relationship between weight and length in fishes has the form

$$W= aL^b$$

In this equation, the parameters ***a*** and ***b***, usually termed as length weight parameters are to be estimated with the available length- weight data. Each species of fish will have a specific length-weight relationship. It may also differ between the sexes and between stocks or those belonging to different geographical regions.

The Length-Weight relationships were originally used for estimating the weight corresponding to a given length and to provide information on the condition of the fish.

Length is one dimensional, whereas weight, which depends on volume is 3 dimensional. Hence weight of a fish is proportional to cube of the length of the fish. The estimation procedure for length weight relationship is through linear regression. Since the Length Weight relationship is not linear, it has to be transformed into linear type by applying logarithmic transformation.

$$Ln(W) = Ln(a) +b\ Ln(l) \text{ or}$$

$$Y=a+ bx$$

Where Ln(a) is the intercept and (b) the slope or regression coefficient.

MATERIALS AND METHODS

The study is based on the length and weight data of 9 species of teleosts commonly found in the fresh and brackishwaters around Vaikom. The Length weight data is based on 54 specimens of *Puntius filamentosus* ranging in length from 10.3 to 13.7 cm, 119 specimens of *Xenentedon cancila* ranging in length from 12.2 to 24.2 cm,60 specimens of *Hyporhamphus limbatus* ranging from 13 to 17.5

cms, 107 specimens of specimens of *Amblypharyngodon melletina* ranging in size from5.7 -8.9 cms, 31 specimens of *Mystus oculatus*, ranging in size from 7.7 – 12 cms, 48 specimens of *Parambassis thomassi* ranging in size from 5.20-13.0 cms, 71 specimens of *Ambassis nalua* ranging in size from 5.20 – 6.8 cms, 38 specimens of *Arius acutirostris* ranging in size from 14.9 -22.7 cms and 30 specimens of *Mystus gulio* ranging in size from 6.3 – 11.8 cms. The Length Weight relationship has been calculated following Le Cren (1951).

The samples collected were brought to the laboratory and frozen. The length and weight measurements for these samples were measured in the next two to three days. The length is measured to nearest mm and weight to nearest to 0.01 grams. As the relationship is curvilinear, the relationship has been calculated after converting the data into logarithmic values, using the logarithmic form of the above exponential equation.

$$\log W = \log a + b \log L$$

The length-weight relationship of all the species studied are given in the Table (1) and figures (1,2,3).

RESULTS AND DISCUSSION

The number of the specimens taken for Length Weight Regression analysis ranged between 30 specimens for *Mystus gulio* to 119 specimens for *Xenentedon cancila*. The 'b' values ranged from 2.47 in *Parambassis thomassi* to 3.69 in *Amblypharyngodon melletina*. The correlation coefficient values for the Length weight regressions range from 0.50 in *Mystus oculatus* to 0.97 in *Xenentedon cancila*.

The value of 3 or close to 3 for the slope of regression ie 'b' value indicates an isometric or proportionate growth in fishes. As such the 'b' values obtained for the species under study indicates an isometry in gowth. The length- weight relationship in fishes can be affected by a number of factors including season, habit, gonad maturity, sex, diet and stomach fullness, health and preservation techniques and differences in length ranges of the specimen caught. The exact relationship between length and weight differs among species of fish according to their inherited body shape, and within a species according to the condition or robustness of the individual fish. Sex and gonad development are other important variables in some species (Somy Kuriakose,2015)

The accuracy of the 'b' value obtained from Length Weight regressions depend to a great extent upon the sampling method. If the sample size is large and covers a wide length range, an isometric value for 'b' may be expected. In the present study care was taken to include all the length groups available. The best variation in length ranges were obtained for *Xenentedon cancila* (12.2 – 24.2

cms) and *Arius acutirostris* (14.9 – 22.7 cms). The 'b' values and correlation coefficients (3.50 and 0.97 for *Xenentedon cancila* and 3.28 and 0.91 respectively for A*rius acutirostris* , also reflects the accuracy of the measurements. The closeness of the 'b' values to 3 also suggests a healthy environment for the fishes with respect to feeding and growth.

Fig: 3.L-W relationship in selected fishes

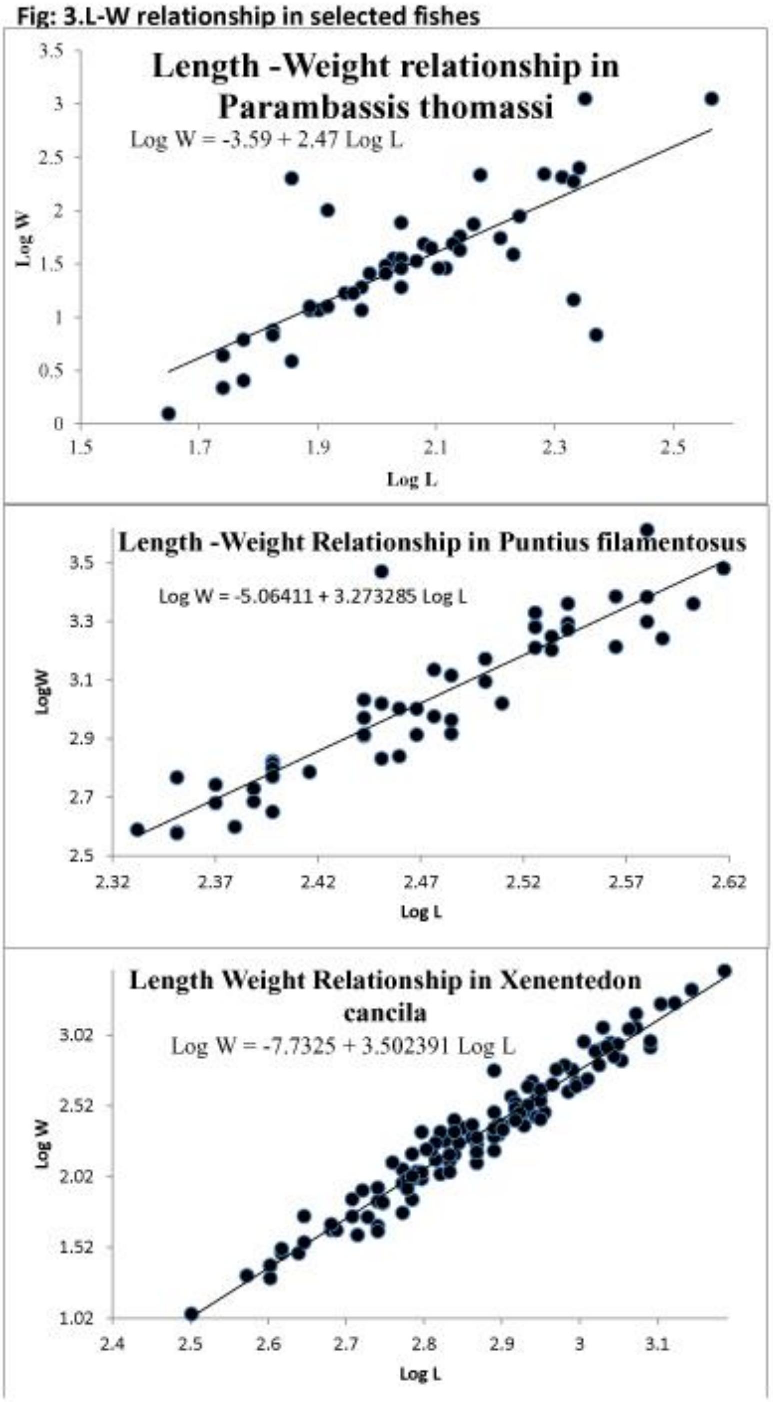


Fig: 2 L-W relationship in selected fishes

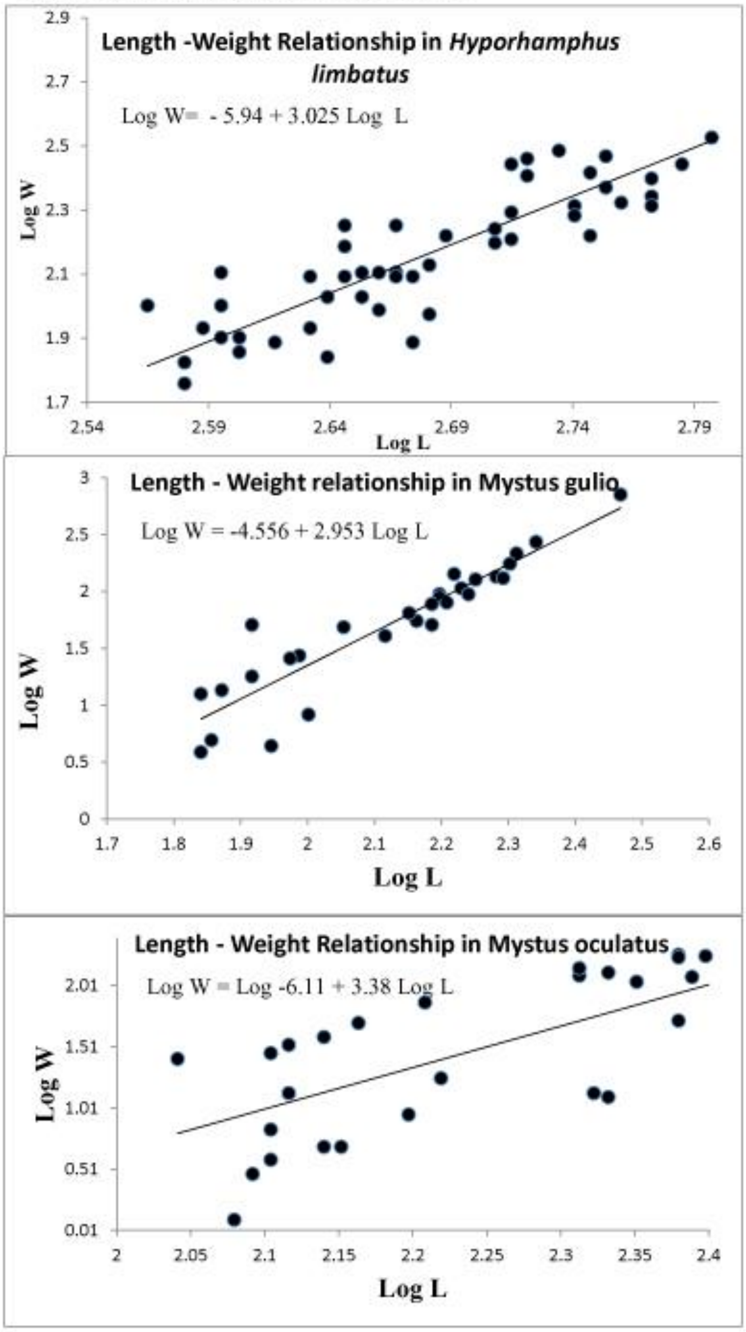
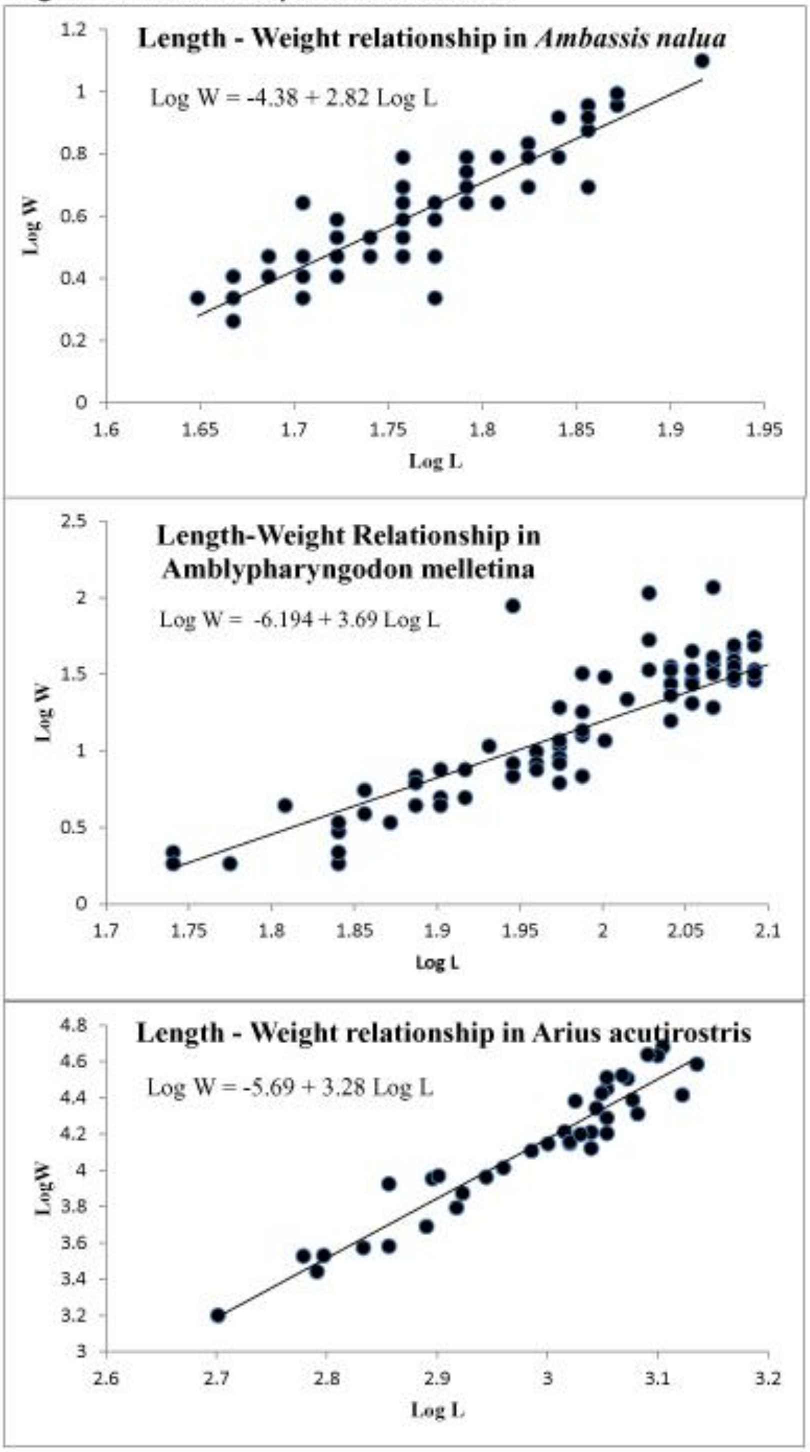


Fig: 1 L-W relationship in selected fishes



Sl.No.	Specimen	No. of specimens examined	Length range (cm)	Weight Range (gms)	a value	b value	R^2 Value	Length Weight Equation
1.	*Puntius filamentosus*	54	10.3-13.7	13.16-37.01	0.00632	3.273	0.83	Log W = -5.06 + 3.27 Log L
2.	*Xenentedon cancila*	119	12.2 – 24.2	2.85- 32.25	0.000438	3.50	0.97	Log W = -7.732 + 3.50Log L
3.	*Hyporhamphus limbatus*	60	13-17.5	5.8 – 17.6	0.002617	3.025	0.85	Log W = -5.94 + 3.02 Log L
4.	*Amblyophayngodon melletina*	107	5.7-8.9	1.3 – 7.9	0.002041	3.69	0.78	Log W = -6.19+3.69 Log L
5.	*Mystus oculatus*	31	7.7 - 12	1.1-10.9	0.002219	3.38	0.5	Log W = -6.11+3.38 Log L
6.	*Parambassis thomassi*	48	5.20-13.0	1.1-21.1	0.027	2.47	0.58	Log W = -3.59 + 2.47 Log L
7.	*Ambassis nalua*	71	5.20-6.8	1.3-3	0.012	2.82	0.78	Log W = -4.38 + 2.82 Log L
8.	*Arius acutirostris*	38	14.9 – 22.7	24.5- 107.70	0.00337	3.28	0.91	Log W = -5.69 + 3.28 Log L
9.	*Mystus gulio*	30	6.3-11.8	1.8-17.3	0.0104	2.953	0.85	Log W = -4.556+2.953 Log L

Table 1 : Length –Weight Relationship in selected fishes

MORPHOMETRICS AND SPECIES DESCRIPTION

INTRODUCTION

The validity of any work on the biology, ecology, physiology etc, of a species depends upon the correct identification of the particular species. Without a sound taxonomic background, any further work on the species in question is rendered useless. Pioneering studies on taxonomy of Indian fishes began in the late 18th century by European scientists and officers of the British East India Company. The pioneering works in the identification and Taxonomy of fishes in India includes that of Bloch (1795), Schneider (1801), Lacepede (1798-1803), Hamilton (1822), Day (1889) etc.

The important and pioneering studies on Inland and Brackishwater fishes, includes that of Kurup (1982), Talwar and Jhingran (1991), Jhingran (1991), Jayaram (1999) etc. Recent studies include that of Shaji (2013), Easa and Shaji (2003), Bijoy Nandan (2012) etc.

MATERIALS AND METHODS

Specimens for the study were collected from the fish landing centres in and around Vaikom, especially from Kovilakathum Kadavu in Vaikom and also from the T.V.Puram, Thalayolaparambu, Kaduthuruthy, Thanneermukkom, Vechoor, and Neraekadavu fish markets at regular intervals. Fishes were also collected on the spot from Chinese nets, cast nets and ring seines. After noting the fresh colour and pigmentation of the specimens they were injected with 5 % formalin. The specimens were then stored in 5 % formalin. In taking morphometric data, the methodology of Hubbs and Lagler (1947) was followed. All the linear measurements were made as staright lines between the perpendiculars to the median longitudinal axis of the body. The various morphometric measurements taken are shown (Fig. 9).

Most measurements were made using a fish measuring board, which consists of a graduated graph paper placed underneath a plastic acrylic sheet and supported on a wide horizontal board. The latter is fixed between two vertical wooden pieces, which acts as a support for the horizontal board, with one of the vertical wooden pieces, acting as a head block, against which the anterior region of the fish is placed against in taking measurements. The Height of dorsal and anal fins, eye diameter, snout length, and height of body were taken using vernier calipers.

The various linear measurements taken on the body and the abbreviations used are given below.

1. **Snout Length (SNL) -** Distance between the tip of snout to the base of the first ray of the caudal fin.
2. **Pre Orbital Length (POB) -** Distance between the tip of snout and anterior margin of the orbit
3. **Head Length (HL) -** Distance between tip of snout and posteriormost border of the operculum
4. **Pre Dorsal Length (PDL**) - Distance between the tip of snout and base of the first dorsal spine or ray
5. **Pre-Pelvic Length (PPL)** – Distance between tip of snout and the anteriormost point of the base of dorsal fin.
6. **Total Length (TL)** – Distance between tip of snout and posteriormost tip of the longest caudal ray
7. **Eye Diameter (ED)** – Distance between the anteriormost and poteriormost margins of the orbit.
8. **Dorsal Fin Base (DFB) –** Straight line distance between the base of the first spine/ray and the last spine/ray of the dorsal fin
9. **Distance between Rayed and Adipose dorsal (RAD)** – Straight line distance between the base of the last spine/ray of the rayed dorsal fin and anteriormost point of the adipose dorsal fin.
10. **Caudal Peduncle Length (CPL)** – Distance between the base of the last spine/ray of the anal fin and anteriormost point of the last ray of the caudal fin.
11. **Body Depth (BD)** – The maximum distance between the dorsal and ventral margins of the body, usually measured from a point at the base of the first dorsal spine/ray, in a straight line towards the ventral margin of the body.
12. **Height of caudal peduncle (CPH)** – The least height or minimum depth of the caudal peduncle.
13. **Base of the anal fin (BAF**) - Straight line distance between the base of the first spine/ray and the last spine/ray of the anal fin.
14. **Pectoral Length (PL)** – Straight line distance between the base and tip of the pectoral fin.
15. **Pre Pectoral Length (PPeL) -** Distance between tip of snout and the anteriormost point of the base of pectoral fin.
16. **Pre-anal Length (PAL) -** Distance between tip of snout and the anteriormost point of the base of anal fin.
17. **Length of caudal fin (CFL)** – Straight line distance between the anteriormost and poteriormost point of the caudal fin
18. **Height of dorsal fin (HDF)** – Straight line distance between the base and tip of the longest spine/ray of the dorsal fin.

19. **Height of anal fin (HAF)** – Straight line distance between the base and tip of the longest spine/ray of the anal fin.

The relationship between certain body lengths and standard length were calculated after ascertaining the type of relationship through a scatter diagram, following the least squares method (Snedecor and Cochran, 1967). The results are presented in the figures (4,5,6,7 and 8) and the calculated values of slope and elevation, along with the values of the coefficient of determination (R^2) are also shown in the figures for each species. The body proportions for each species, are expressed as percentage of standard length and given in the descriptions; the means are given, following the range for each proportion.

Colour descriptions of species are based on specimens in the fresh condition. For the identification of each species, standard descriptions given by various authors were consulted. The classification followed by Nelson (1976) was adopted.

The study on morphometrics were based on 25 specimens of *Arius acutirostris*, 5 specimens of *Euryglossa orientalis*, 30 specimens of *Mystus gulio*, 14 specimens of *Mystus oculatus* and 10 specimens of *Ompok bimaculatus*. For the other 6 species ie. *Puntius filamentosus*, *Xenentedon cancila*, *Hyporhamphus limbatus*, *Amblypharyngodon melletina*, *Parambassis thomassi* and *Ambassis nalua*, only species descriptions are given.

SPECIES DESCRIPTION AND MORPHOMETRICS

1. *Arius acutirostris*

Distinguishing characters: Body elongate. Head broad and depressed, snout elongate, acute and overhanging mouth. Head shield granulated. Median longitudinal groove on head not reaching the base of occipital process. Barbels three pairs, maxillary pair reach beyond the hind edge of eye, shorter than head length. Mouth inferior, jaw teeth villiform; teeth on palate as a single oblique oval patch on each side. Colour, brownish above, flanks grey and belly whitish. Upper portion of rayed dorsal fin and upper two thirds of dorsal adipose fin black; pectoral, pelvic and anal fins stained grey.

Morphometrics: Snout Length (12.5 – 18, 15.5), Preorbital Length (18.18 – 23.3, 21.17), Head Length (29.3 – 39.5, 33.3), Predorsal Length (39.1 – 54.1, 42.8), Prepelvic Length (52.2 – 60.69, 56.81), Total Length (118.95 – 146.6, 125.5), Eye Diameter (5.17 – 7.55, 6.22), Body Depth (17.29 – 25.5, 20.53), Dorsal Fin Base (7.69 - 13.21, 10.37), Distance between the rayed and adipose dorsal fins (22.9 – 31.7, 29.2), Length of caudal peduncle (12.7 – 18.3, 14.9), Least Height of caudal peduncle (5.29 – 8.5, 6.4), Base of Anal Fin (6.06 – 10.71, 8.47).

2. ***Euryglossa orientalis***

Distinguishing characters: Body oblong, both its contours equally arched. Mouth small, its cleft extending to below the middle of the eye; lower lip feebly fringed. Two tubular nostrils on ocular side in front of lower eye. Posterior rays of dorsal and anal completely joined with caudal, which is rounded. Pectoral fins well developed, left fin somewhat smaller. Scales ctenoid on both sides of body; head scales on blind side modified into cutaneous sensory processes. Greyish or brownish, blotched or spotted with dark and a number of short, dark, vertical streaks crossing the lateral line. Right pectoral dusky.

Morphometrics: Snout Length (4.34 – 6.45,5.52), Preorbital Length (9.33 – 19.56, 13.27), Head Length (18.47 – 21.33, 20.03), Length of pectoral fin (4-8.92, 6.39), Prepectoral Length (19.56 – 21.42,20.65), Total Length (111.95 – 120, 115.69), Eye diameter (3.26 – 4.30,3.84), Body Depth (47.82 – 56.25, 51.66), Preanal Length (12.24 – 16, 14.34), Length of caudal fin (13.3 – 17.3, 15.08), Height of dorsal fin (4-8.60, 7.07), Height of Anal fin (4-8.60, 6.42).

3. ***Mystus gulio***

Distinguishing characters: Body elongate and compressed. Head depressed, its upper surface rough granulated; occipital process triangular, extending to basal bone of dorsal fin. Mouth terminal; teeth villiform, in bands on jaws. Barbels 4 pairs; maxillary barbels extend posteriorly to end of pelvic fins. Dorsal spine strong, serrated on its inner edge; adipose fin small, inserted considerably behind rayed dorsal fin. Caudal fin forked. Colour bluish brown on head and back, dull white below; maxillary barbels black. Fins dull orange with dark tips.

Morphometrics: Snout Length (7.69 – 11.53, 8.93), Preorbital Length (11.5- 17.54, 14.60), Head Length (23.94 – 32.69, 26.83), Predorsal Length (36.36 – 46.15,40.79) Total Length (118.18 – 134.61,126.8), Eye Diameter (3.40 – 8, 5.43), Body Depth (19.48 – 36, 26.3),Dorsal Fin Base (8-12.6, 10.52), Distance between the rayed and adipose dorsal fins (18.36 – 32.69, 29.98), Length of caudal peduncle (13.8 – 22, 17.28), Least Height of caudal peduncle (6.94 – 16.6, 12), Base of Anal Fin (8.82 – 15.95, 11.94).

4.***Mystus oculatus***

Distinguishing characters: Body elongate and compressed. Head depressed; occipital process extends to base of dorsal fin; median longitudinal groove on head extends to base of occipital process. Mouth terminal, teeth villiform, in bands in jaws, vomerine tooth band continuous and crescentic. Barbels four pairs, maxillary barbel extend posteriorly to middle of anal fin. Dorsal spine moderately strong; adipose fin base short. Caudal fin forked. Colour silvery grey above, lighter below; a dark spot at the origin of base of dorsal fin. Dorsal fin with dark band along its middle.

Morphometrics: Snout Length (4.83 – 9.72, 7.55), Preorbital Length (6.34 – 14.70, 11.35), Head Length (16.6 – 25, 22.05), Predorsal Length (12.90 – 36.11, 30.47), Prepelvic Length (16.6 – 47.69, 38.63), Total Length (130.15 – 157.89, 135.72), Eye Diameter (4.61 – 8.33, 6.29), Dorsal Fin Base (9.67 – 17.07, 13.18), Distance between rayed and Adipose Dorsal Fin (15 – 23.80, 19.12), Length of Caudal Peduncle (5-19.40, 11.69), Body Depth (11.84 – 23.33, 19.76), Least height of caudal peduncle (5 – 8.53, 7.47), Base of anal fin (9.67 – 13.41, 11.62).

5. ***Ompok bimaculatus***

Distinguishing characters: Body elongate and strongly compressed. Eyes moderate, its lower border below level of cleft of mouth. Mouth large and oblique; teeth in villiform bands on jaws; vomerine teeth in two oval patches. Barbels two pairs; maxillary barbels long and extend to or slightly beyond anal fin origin, the mandibular pair very short. Anal fin long, inserted well behind dorsal fin. Pectoral spine moderately long, feebly serrated on its inner edge. Caudal fin deeply forked, with pointed lobes. Silvery in colour, shot with purple, dorsally dark grey-green to brownish with a tinge of golden yellow; a large dusky spot on shoulder on lateral line; a small black spot on caudal peduncle just above lateral line; often a dark transverse bar across base of caudal fin. Fins pale golden.

Morphometrics: Snout Length (4.44-7.11, 5.56), Preorbital Length (7.56-10.04,8.85), Head Length (17.29-21.90,19.24), Predorsal Length (28.03-33.33, 30.55), Prepelvic Length (23.35-51.93, 34.2), Total Length (110.21 – 115.50, 112.93), Eye Diameter (2.70-3.80,3.29), Body Depth (19.04 – 27, 21.98).

6. ***Xenentedon cancila***

Distinguishing characters: Body elongate, slender and slightly compressed. Eyes rather small; dorsal and anal fins opposite and inserted towards the posterior end of the body. Pectorals inserted high up. Ventral abdominal with six rays. Jaws produced and beak tip needle like. Operculum not scaly. Caudal fin truncate. Green- silvery in colour fading to whitish below; a silvery lateral band, a series of four or five blotches on sides of the body between pectoral and anal fins. Dorsal and anal fins dark edged.

7. ***Puntius filamentosus***

Distinguishing characters: Body elongate. Mouth moderate; barbells, a very small pair of maxillary only, often hidden in grooves around corners of mouth. Dorsal fin inserted equidistant between tip of snout and base of caudal fin, its last unbranched ray non- osseus, weak and smooth. Scales large, lateral line complete with about 21 scales. Adult males studded with large tubercles on snout. Adult fishes uniformly silvery to greenish silvery, with a dull rainbow sheen; a distinct dark oval blotch on lateral line extending generally from 14-16 lateral line scales. Fins delicate yellow-greenish; dorsal fin rays partly dark violet, often dark tipped.

8. ***Parambassis thomassi***

Distinguishing characters: Body rather stout, deep and compressed. Head large, snout elongate with pronounced elevated tip. Mouth large; teeth on jaws villiform; scales large, cheek with 4 transverse scale rows. Greenish in colour, shot with silvery. Fins hyaline.

9. ***Hyporhamphus limbatus***

Distinguishing characters: Body subcylindrical and elongate. Abdomen rounded. Head and snout pointed. Mouth superior, wide, cleft extending beyond anterior margin of orbit. Eyes small, superior, in anterior part of head, not visible from below ventral surface. Lips thin, jaws not equal. Upper jaw short, more or less triangular, covered with scales. Lower jaw in adults elongated far beyond the upper. Teeth villiform on jaws. Dorsal fin inserted in posterior half, in between pelvic and anal fins. Anal fin long. Caudal fin moderately forked or emarginate. Lateral line complete.

10.***Amblypharyngodon melletina***

Distinguishing characters: Body moderately elongated and subcylindrical. Abdomen rounded. Head well compressed. Snout obtusely rounded. Mouth wide, eyes large, centrally placed, not visible from below ventral surface. Upper lip absent. Lower lip with a short labial fold. Lower jaw prominent with a thin sharp edge and a symphyseal knob fitting into upper jaw. Dorsal fin inserted slightly behind insertion of pelvic fins. Caudal fin forked. Scales very small.

11. ***Ambassis nalua***

Distinguishing characters: Body short, rather deep and compressed. Head small, tip of snout elevated. Supraorbital ridge smooth, often with a single spine. Preopercular and interopercular margin serrated. Scales large. Lateral line complete. Colour pale green above with a purple gloss below. Spinous dorsal fin dusky between second and third spines; a dark longitudinal band along either caudal lobe.

RESULTS AND DISCUSSION

The value of the correlation coefficient is a fairly good indicator of the relation between or the proportionate growth of the body parts with reference to the standard length.

In *Arius acutirostris*, the highest value for the correlation co-efficient (r^2) were obtained for Prepelvic distance (0.95) and the distance between the rayed and adipose dorsal fins (0.80). In *Mystus oculatus* the highest values were for Total Length (0.83) and Dorsal fin base (0.89). In *Mystus gulio*, Total length and predorsal length (0.92 and 0.89 respectively) exhibited the highest values. *Ompok bimaculatus* showed the highest values for Total Length (0.99) and Predorsal Length (0.94), respectively, whereas in *Euryglossa orientalis* the highest values of 0.97 and 0.94 were exhibited for Total Length and Pectoral Length respectively. (Table. 2)

In comparing the relationship of the various body dimensions with standard length for different species , the highest values obtained were 0.81 for Snout Length in *Ompok bimaculatus*, 0.88 for Preorbital length in *Ompok bimaculatus*, 0.92 for Head Length and 0.94 for predorsal length in the same species, 0.95 for Prepelvic length in *Arius acutirostris*, 0.99 for total length in *Ompok bimavulatus*, 0.85 in eye diameter for the same species, 0.89 for Dorsal fin base in *Mystus oculatus*, 0.80 for distance between the rayed and adipose dorsal fin in A*rius acutirostris*, 0.53 for length of caudal peduncle in the same, 0.93 for body depth in *Euryglossa orientalis*, 0.76 for least height of caudal peduncle in *Mystus oculatus* and 0.78 for base of anal fin in *Mystus gulio*. The other parameters were Pectoral Length, Prepectoral Length, Preanal length, caudal fin length, height of dorsal fin and height of anal fin which were measured only for *Euryglossa orientalis* showing values of 0.94,0.93, 0.58, 0.88, 0.83 and 0.72 respectively. (Table 2.)

These body proportions are useful in comparing and differentiating between closely resembling species of a genus (e.g. Murty 1978) and comparison of the stocks of the same species from different localities. (Lachner and Jenkins, 1971). Since the body proportions are known to vary with growth i.e., the rate of growth of a body part changes with increase in length, a study like this assumes greater importance. Understanding such variations in growth (allometric growth) will help in understanding the intraspecific variations in each species.

Table: 2 R^2 values for the regression of different body dimensions with standard Length of different species of fishes

Body Dimension	*Arius acutirostris*	*Mystus oculatus*	*Mystus gulio*	*Ompok bimaculatus*	*Euryglossa orientalis*
Snout Length	0.71	0.63	0.76	0.81	0.52
Pre-orbital Length	0.75	0.28	0.74	0.88	0.38
Head Length	0.79	0.72	0.86	0.92	0.86
Predorsal Length	0.77	0.58	0.89	0.94	
Prepelvic Length	0.95	0.15	0.80	0.25	
Total Length	0.84	0.83	0.92	0.99	0.97
Eye Diameter	0.50	0.56	0.22	0.85	0.52
Dorsal Fin Base	0.02	0.89	0.68		
Distance between Rayed and adipose dorsal	0.80	0.61	0.76		
Length of caudal peduncle	0.53	0.37	0.008		
Body Depth	0.75	0.11	0.72	0.86	0.93
Least Height of caudal peduncle	0.16	0.76	0.21		
Base of Anal Fin	0.42	0.65	0.78		
Pectoral Fin Length					0.94
Prepectoral Length					0.93
Preanal Length					0.58
Caudal Fin Length					0.88
Height of dorsal fin					0.83
Height of anal fin					0.72

Fig: 4. Regression of body dimensions with Standard length in *Arius acutirostris*

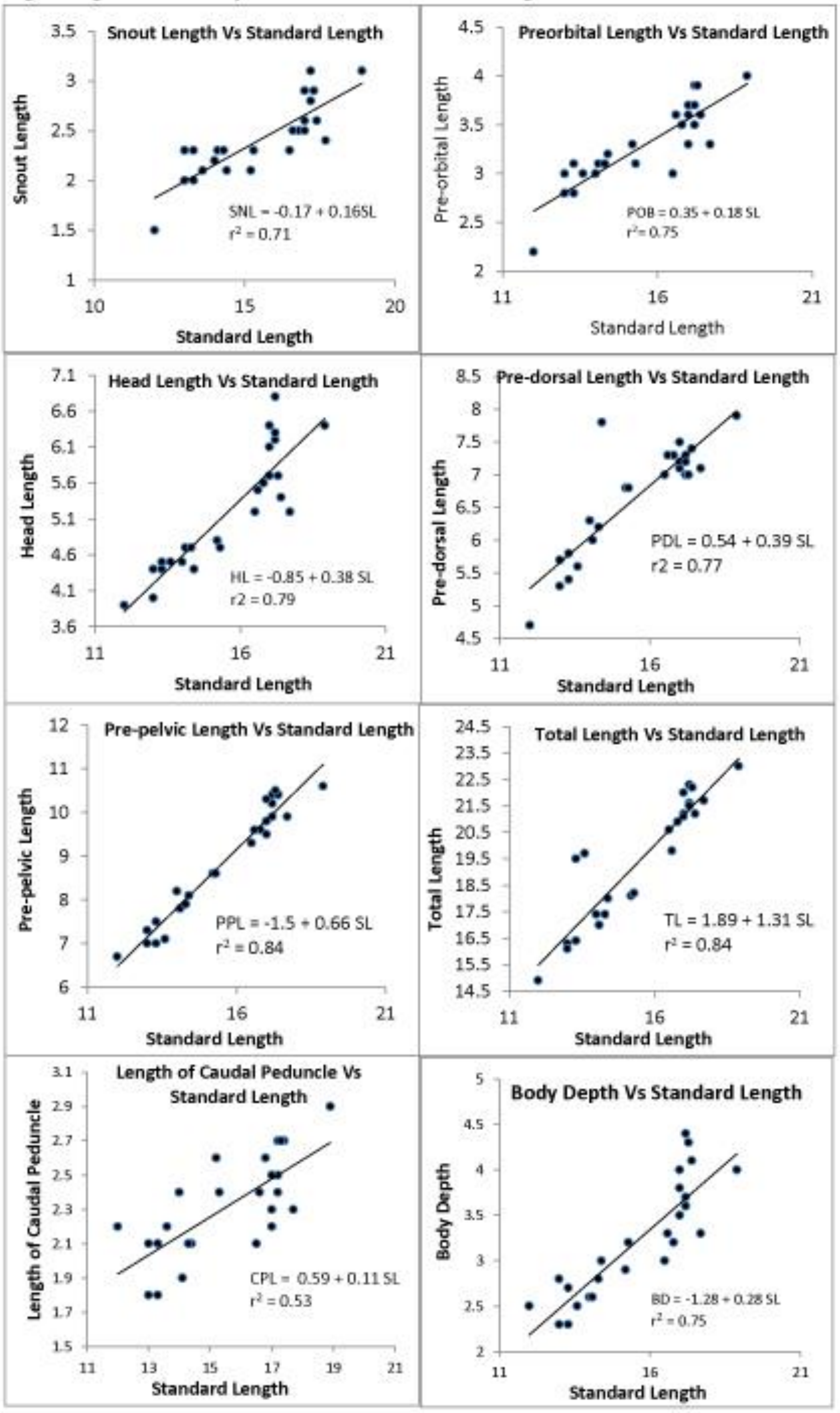


Fig: 5. Regression of body dimensions with Standard Length in *Euryglossa orientalis*

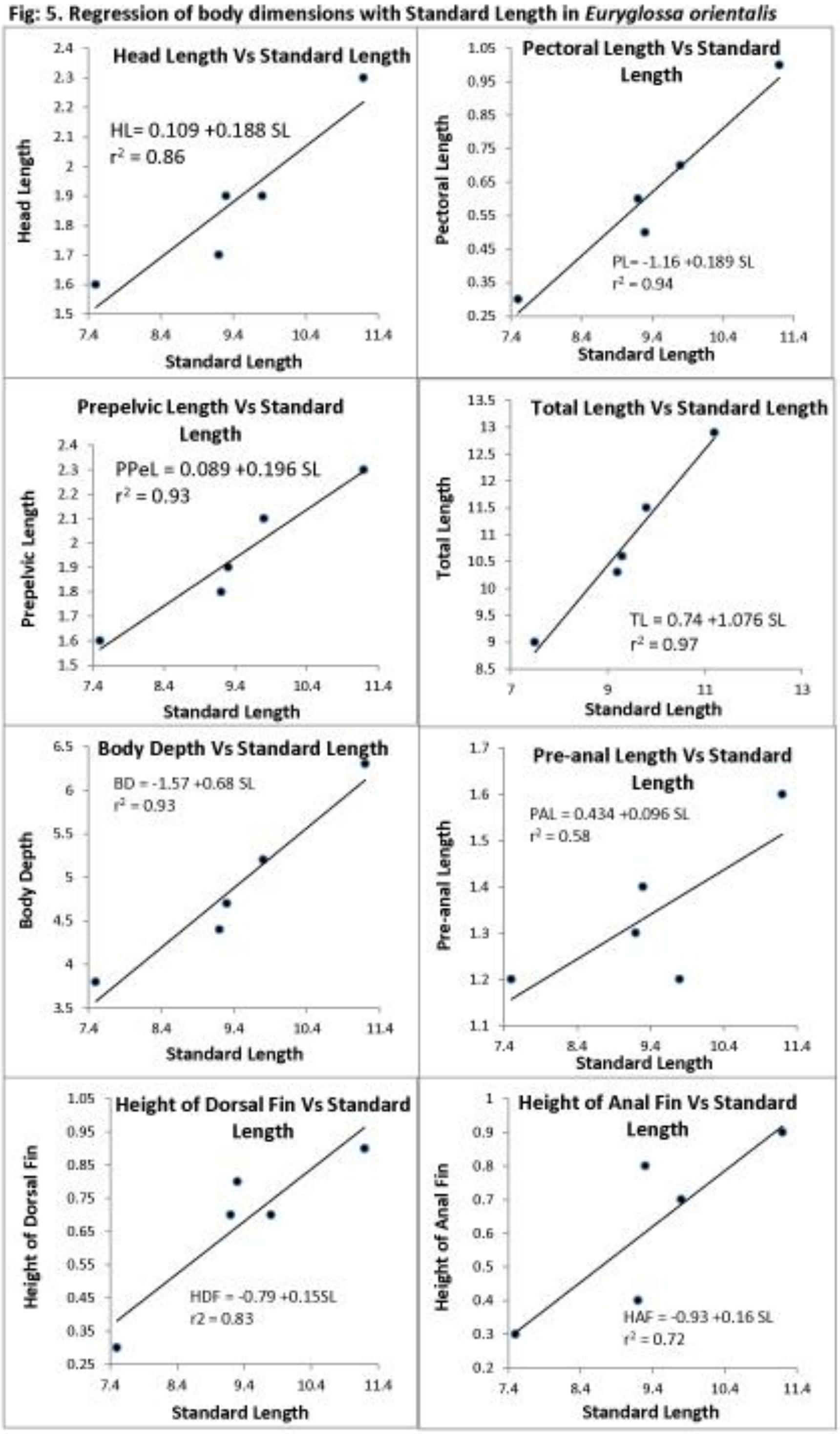


Fig:6. Regression of body dimensions with Standard Length in *Mystus gulio*

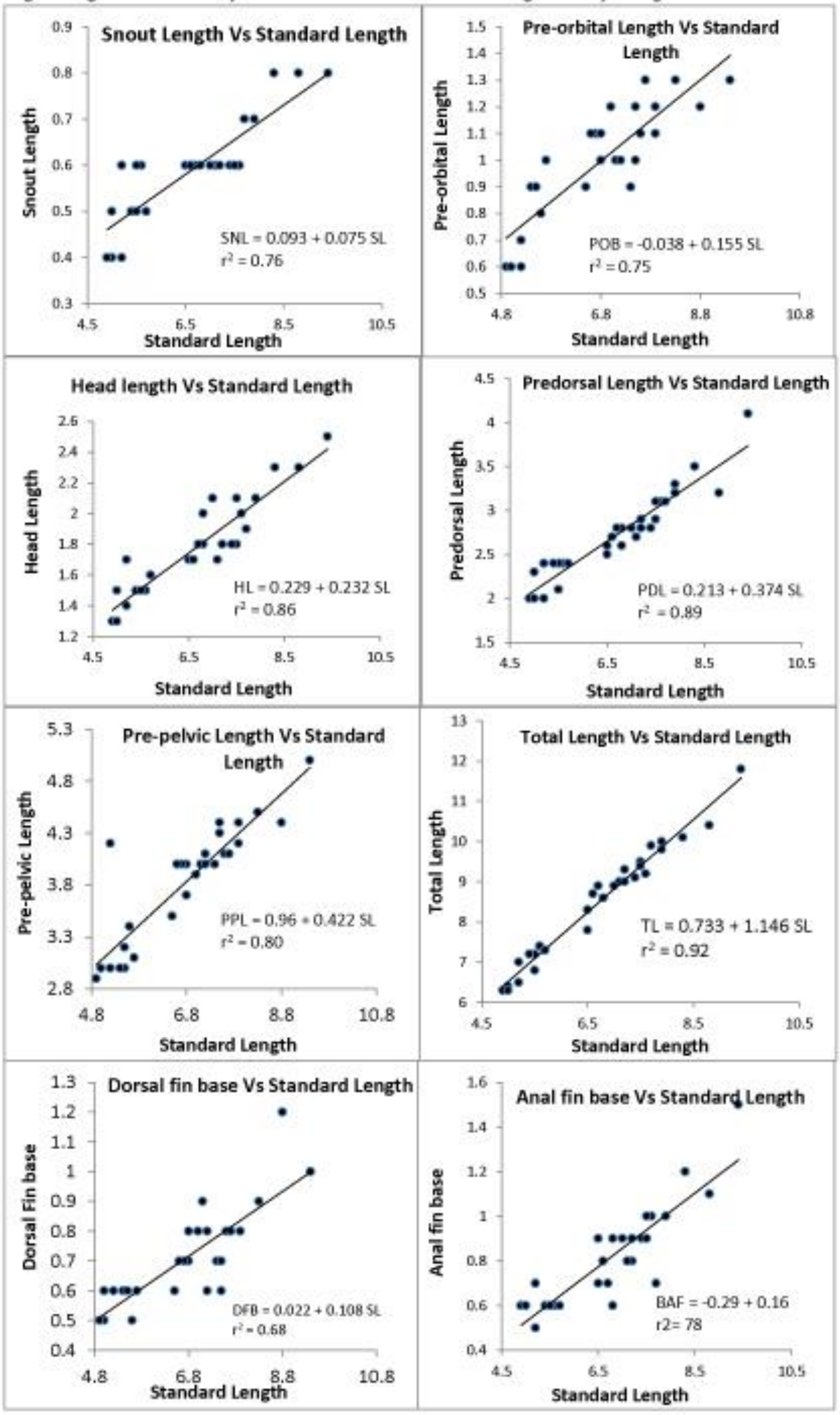


Fig:7. Regression of body dimensions with Standard Length in *Mystus oculatus*

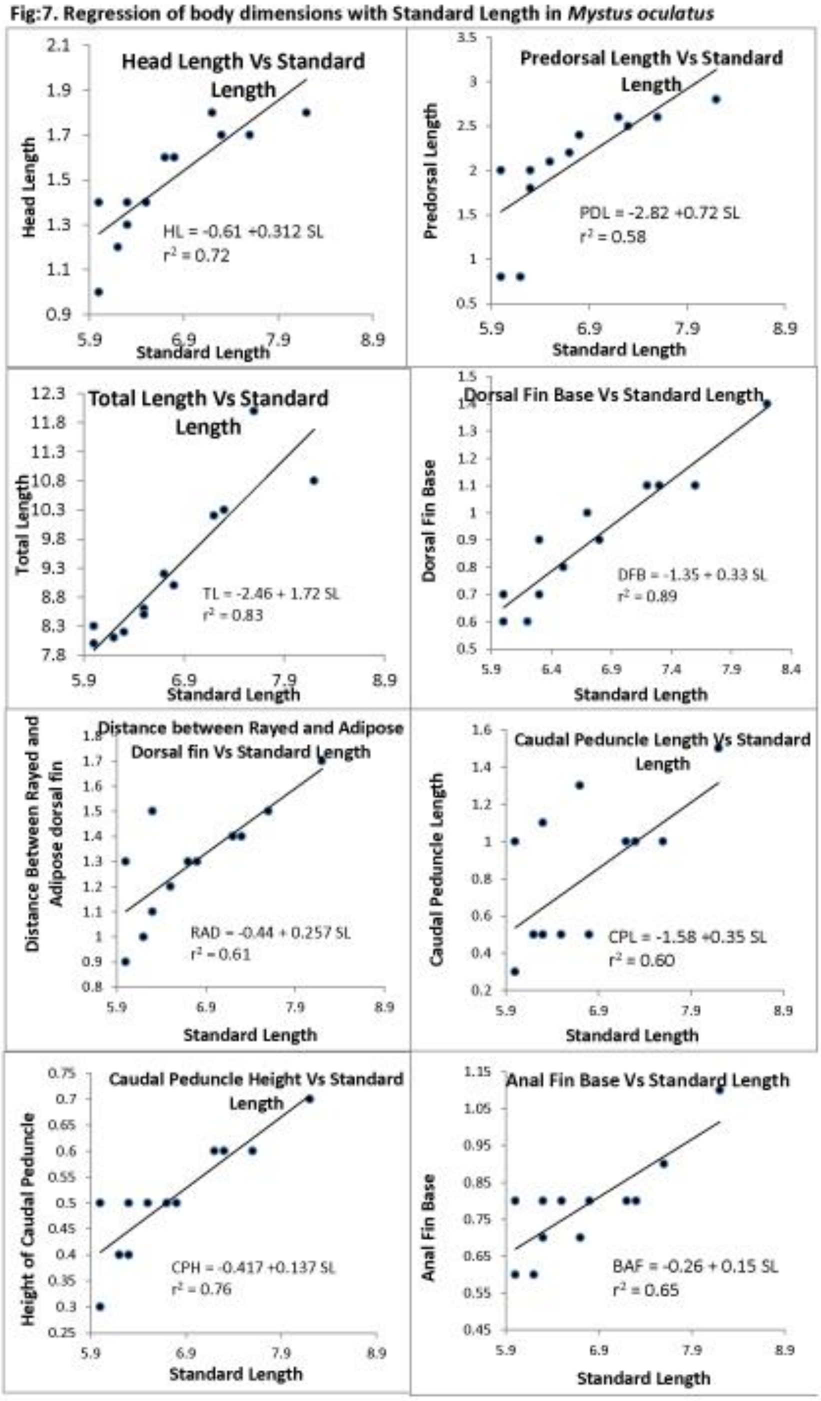
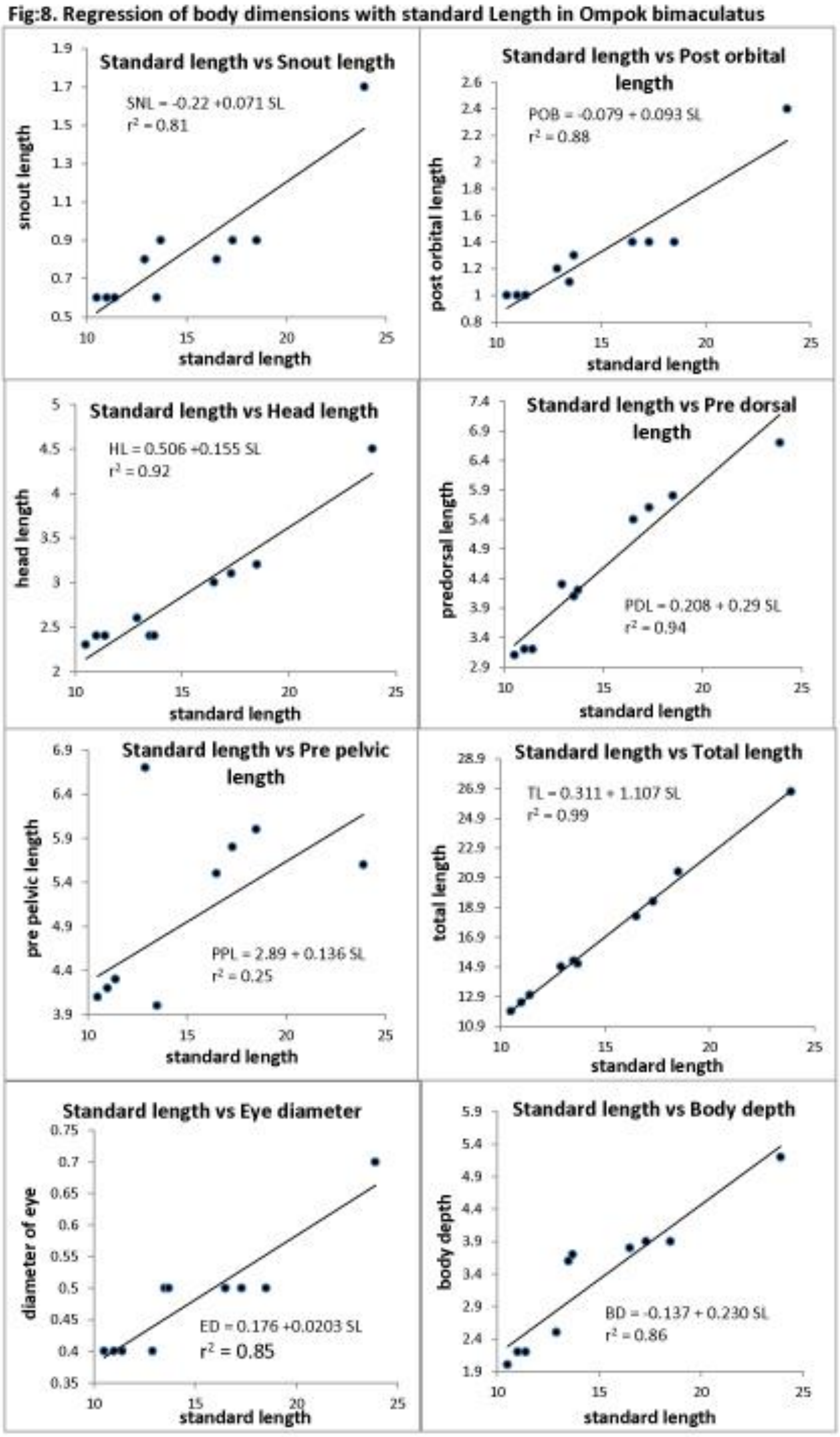


Fig:8. Regression of body dimensions with standard Length in Ompok bimaculatus



REPRODUCTIVE BIOLOGY

INTRODUCTION

Reproduction is an important event in the life of an organism in perpetuating its population. Reproduction and growth contribute to the increase in the biomass of the population. Determination of the timing of spawning and the total output of eggs is necessary for assessing the reproductive potential of a population.

The studies on reproductive biology were conducted on 4 species: The Freshwater garfish , *Xenentedon cancila*, The Filament barb, *Puntius filamentosus*, the Congaturi halfbeak, *Hyporhamphus limbatus* and the Western Ghat Glassy perchlet, *Parambassis thomassi*.

The different aspects of reproductive study involved the quantification of ovary into different maturity stages, ova-diameter frequency distribution, fecundity and Gonado-somatic index.

1. *Quantification of ovaries into different stages of maturation*:

Maturation refers to the cyclic morphological changes which the male and female gonads undergo to attain full growth and ripeness. Testes and ovaries undergo morphological and histological changes in gonads, leading to the production of gametes. The ovaries can be distinguished into different maturity stages based on different morphological characters. The appearance of the ovaries in fresh condition, the proportion of the area occupied by them in the body cavity and the structure and diameter range of the intraovarian ova were considered for quantification of ovaries into different stages of maturation. An independent scale of maturation stages was developed for the different species studied. On the basis of the above criteria, five stages (I-V) of maturation have been recognised in the species studied. The stages include Immature, Maturing, Mature , Ripe and spent stages.

2. *Ova diameter frequency distribution:*

The measurement of diameters of eggs , in ovaries well advanced towards spawning , gives evidence of the duration of spawning in a fish, whose spawning habits are unknown. According to this method, those species in which the spawning period is short and definite or where there is only one spawning in a year or a given period, there should be only a single group of the large sized ova in the frequency distribution. In cases where the spawning period is long and indefinite or where there is more than one spawning, there could be more than one or two batches of ova of the larger size groups in the ova – diameter frequency distribution.

In this method, random samples of the ovary from different areas are taken and the diameters of the ova are recorded. A graph is plotted with ova diameters along the X-axis and frequencies along the Y – axis. The resulting curve is known as an ova-diameter frequency polygon.

3. **Fecundity** :

Fecundity can be defined as the ‘number of ova that are likely to be laid by a fish during the spawning season’ or it is the number of ripening eggs in the female prior to the next spawning period. The number of eggs produced by a fish differ in different species, and depends on the size and age of the fish. Thus, fecundity is a measure of the reproductive capacity of a female fish, and is an adaptation to various conditions of the environment.

Fecundity is one of the most important biological parameters of a fish; and, it must be known to fishery scientists, to evaluate the commercial potentialities of marine fish stocks as well as to manage their exploitation judiciously. Fecundity of a fish population may undergo changes in relation to the length, weight, age, nourishment, etc. of the individual fishes, as well as based on the environmental parameters.

The replenishing potential of a fish population is a function of its fecundity; and, it is an useful tool to develop possible statistical models between egg production and recruitment.

Estimation of fecundity is based on the mature ovaries (penultimate stage of ripeness) as all the ova destined to be spawned during the ensuing season are mature in such ovaries (Bagenal, 1968). The estimated number of mature ova in such ovaries represents the fecundity. Ripe ovaries were not considered for estimation of fecundity since there is a possibility of some of the ripe, hydrated eggs being lost from the ovary, before it can be taken for fecundity estimation.

4. Gonadosomatic Index:

Gonads undergo regular seasonal and cyclical changes in weight in relation to the total weight of the fish. Such changes are indicative of the spawning season of the fish and the relationship is termed as Gonadosomatic index. If we take the simple gonad weight: body weight ratio, then its usefulness as an index of gonadal development would be highly reduced, as the size differences in the fish can influence this ratio. The most common means of accounting for the effects of differential body size on gonad size has been to express the gonadal weight as a percentage of body weight.(De Vlaming *et al*., 1982). According to Nikolsky (1963), “the effects of fish size on gonadal weight are eliminated by expressing gonadal weight as a percentage of body weight. In work with fishes, the GSI is widely used as an index for spawning preparedness (De Vlaming *et al*., 1982). This ratio is termed the Gonadosomatic index.

The Gonadosomatic index (GSI) is calculated by the equation:

$$GSI = (GW/BW)*100$$

Where, GW is the weight of the gonad and BW is the total body weight of the fish.

Gonadosomatic index of the species has also been widely used to indicate the maturity and periodicity of spawning and predicting the breeding season of the fish. Gonadosomatic index(GSI) of the fish increases with the maturation of the fish, being maximum during the peak period of maturity and declining abruptly after spawning. Seasonal changes in the ovaries of several teleosts have been studied histologically as well as by measuring ova diameter, and with the help of gonadosomatic index.

MATERIALS AND METHODS

The gonads are dissected out by cutting the fish from the vent towards the anterior side without rupturing the gonads .The sex of the fish was noted. The shape, position, and space occupied by the gonads in the body cavity are noted. The ovary is dissected out from the body cavity and the maturity stage was identified . The moisture is removed with a blotting paper. The total weight of the ovary is taken. A small portion of the gonad is taken, and teased on a slide to observe the eggs .The ovaries were preserved in 10% formalin, for further studies on fecundity and ova diameter. Fecundity was estimated by the Gravimetric Method. Representative samples were taken from the anterior, middle and posterior portions of the ovary to nullify the effect of differential distribution of ova if any.

1. Quantification of Maturity Stages: - The maturity stages of the different fishes studied were classified into the following stages, according to morphological observation of the ovary and microscopic observation of ova.

RESTING PHASE (IMMATURE)

The ovaries are small , thin , thread-like , translucent , pale or dirty white in colour with inconspicuous vascularisation. The ovaries occupy on a small part of the body cavity and ova are not visible to the naked eye. The immature oocytes are visible under a microscope.

MATURING PHASE

Ovaries becomes slightly larger, thicker, opaque and are light yellowish in colour. There is an increase in weight of the ovary and they occupy nearly ½ of the body cavity. There is an increase in the weight and volume of the ovaries, which have a deep yellow colour and in the later stages they occupy 2/3 to 3/4 of the body cavity. Vascular supply increases and the blood capillaries become conspicuous. Under microscopic observation, it can be seen that, immature oocytes are reduced in number while bigger oocytes are present in large numbers.

MATURE OR PRE- SPAWNING PHASE

The ovaries are further enlarged occupying almost the entire body cavity. They are turgid, deep yellow in colour and a large number of spherical ova are visible to the naked eye through the thin ovarian wall. The blood supply increases considerably. Both translucent and opaque ova are present, and the ovaries attain their maximum weight. The fish becomes gravid due to ripe ova tucked inside, and the abdomen becomes round. Microscopically, a large number of ripe eggs are seen in the ovary .

RIPE PHASE

Ovaries are very much enlarged , occupying the entire body cavity. They are turgid and yellow in colour with a large number of translucent eggs. Ovarian wall is very thin, almost transparent .Eggs are present in the oviduct also, and the fish spawns a number of times during this period. The ovary is now said to be in running phase.

SPENT PHASE

The ovaries are flaccid, shrunk and sac-like, reduced in volume and have a dull colour. The vascular supply is reduced. Some unspawned large ova and a large number of immature ova are present.

2. Ova diameter frequency distribution

The ovaries are preserved in Formalin or Gilson's fluid. For measurement of ova diameters, transverse sections were taken from the anterior, middle and posterior regions of the ovary, the ova were teased out on micro slides taking utmost care to separate out all the ova in the samples. The observations on ova diameter were made under microscope, using an ocular micrometer, at a set magnification where, one micrometer division equals 13 microns. The ova were measured from the different regions of the ovary to see whether differences in the distribution of ova in different regions of the ovary occur. It was observed that the ova diameter frequency distribution in different parts of the ovary was the same. Hence, samples were taken from the middle of the ovary in all further studies. The ova diameters were measured by placing the micrometer in a horizontal position across the field of microscope and then reading the diameter of the egg in the same plane, irrespective of the shape of the ova, following Clark (1925). As the ova, due to distortion in preservation are almost never spherical in shape, this method gives measurements of the longest diameters of some eggs, of the shortest of others, or measurements between these two (De Jong, 1940). This method was successfully employed by later workers like De Jong (1940), June (1953), Yuen (1955) and by several Indian workers: Prabhu (1956), Radhakrishnan (1957), Sarojini (1957), Dharmamba (1959), Jhingran (1961), Varghese (1961), Raju (1964), Rao (1967), Antony Raja (1967), Deshmukh (1973), Murty (1975, 1979, 1980, 1981), Vasudevappa and James (1980), Luther (1986), and many others.

To avoid measuring each ovum more than once, the ova were arranged in rows on the slide and the diameters of ova in each row were measured by moving the slide along one direction. In the immature ovaries in which the ova were minute and not possible to arrange them in rows; they were spread evenly on the slide and the diameters of the ova lying parallel to two horizontal guidelines on the slide were measured. In mature ovaries, samples for diameter measurements were taken after noting the total weight of the ovary and the sample weight. All the ova in each sample spread on the slide were measured without any selection. The ova diameters were grouped into five micrometer division (md) class intervals (i.e., 1-5, 6-10, 11-15 etc.) to determine the frequency distribution of ova in the ovary. About 800 - 1000 ova were measured from each ovary.

Fecundity

Ovaries preserved in Formalin were used for the determination of fecundity. After removal of the external formalin, the weights of the ovaries were taken to the nearest 0.001 g in a ‘Sartorius’ monopan chemical balance. A small piece cut out from the middle of the ovary was also similarly weighed and transferred to a labelled bottle containing 5% formalin; the bottle was shaken to free the ova from the ovarian tissue; ova still attached to the ovarian tissue were released on a slide, with fine needles. After separating all the ova from the ovarian tissue, they were transferred to a counting chamber (divided into 100 small squares by transverse and longitudinal lines) and all the mature ova having a fully yolked structure, were counted under the microscope. Using the number of mature ova in the sample, the fecundity was estimated as:

(Total weight of ovary/weight of the sample) X Number of mature ova in the sample

Gonadosomatic Index: The moisture is removed from a freshly dissected ovary using blotting paper, and weighed using a Sartorius Monopan Electronic balance. GSI is calculated using the standard formula.

RESULTS AND DISCUSSION

OVA-DIAMETR FREQUENCY STUDIES

Xenentedon cancila

The ova diameter ranged from 52 µ to 845 µ in maturing ovaries and from 65 µ to 988 µ in mature ovaries. Ova diameter frequency in maturing ovaries reveals the presence of two modes; one at (5*13 m.d) =65 µ, and the other at (25 *13 = 325 µ) . The second mode represents the group of ova to be shed during the spawning season. (Fig: 9)

The ova diameter analysis of mature ovaries reveals the presence of two modes, one at 15-25 m.d.(micrometer divisions) i.e., 180-325 µ and the other at 35-45 m.d. i.e., 455-565 µ. (Fig:9) The latter represents the mature group to be spawned immediately while the former is the maturing group or the second batch of eggs to be spawned. It can be assumed that the species under study spawns at least twice during the spawning season. The minor mode present in between, may be due to the inadequacies of sampling or due to the class interval of 5 m.d. taken. In tropical fishes, usually continuous modal values, overlapping one another is found indicating continuous spawning, but in the fresh water environment of the fish, the best time period for spawning may be limited to a short time when conditions are favourable for the development of eggs after spawning.

Puntius filamentosus

In *P. filamentosus* only a single prominent mode was seen the mature and ripe ovaries at 22 µ and 42 µ, respectively (Fig: 10). Though a few minor modes are seen, it can be assumed that, there will be only a single spawning in a season and at any time of the year, there will be only a single prominent group of eggs in the ovary.

Hyporhamphus limbatus

The ova diameter ranged from 14.54 µ to 508.9 µ in Immature ovaries , 7.27µ to 596.14 µ in mature ovaries and 72.7 µ to 523.44 µ in ripe ovaries (Fig 11). The ova diameter analysis of Immature and mature ovaries reveals the presence of a mode at 4 m.d. (micrometer divisions) ie. 29.08 µ. A number of minor modes are present from 16 m.d. to 76.m.d., suggesting a continuous spawning habit or intermittent shedding of eggs. Ripe ovaries exhibit two major modes at 26.m.d and 56. m.d. This represents a batch of eggs about to be shed and another batch which will be released almost soon after. The consolidated ova – diameter frequency polygon of the different ovaries reveals a stock of immature eggs at 4 m.d. and a series of minor modes representing eggs that will be shed in batches.(Fig.11)

From the above analysis it can be concluded that the fish is a continuous spawner. In tropical fishes, usually continuous modal values, overlapping one other is found indicating continuous spawning (De Martini and Fountain, 1981), and the present study corroborates the finding.

Amblypharyngodon melletina

The ova diameter ranged from 7.27 µ to 443.47 µ in mature ovaries , and 36.35 µ to 370.77 µ in ripe ovaries .The ova diameter analysis of mature ovaries reveals the presence of a mode at 12 m.d. (micrometer divisions) ie. 87.24 µ and a major mode at 36 m.d. ie 261.72 µ. The ripe ovaries show a mode at 4 m.d. ie 29.08 µ (Fig:12) and a major mode at 36 m.d. ie 261.72 µ. Both these stages present one group of mature and another group of immature ova. In a consolidated ova diameter frequency of all the ovaries sampled, two modes were exhibited at 16 m.d. and 36 m.d. The mode at 36. m.d. may represent the ova about to be spawned and the other mode at 12. m.d may represent the ova to be spawned, not very late. Thus it can be conclude that the fish may be spawning in two batches, though an year round study of all the stages may be required to corroborate the above conclusion.

FECUNDITY

Fecundity is an estimate of the spawning and recruitment potential of a fish population. Linear regression lines based on the equation Y= a + bx were fitted to estimate the relationship between fecundity and total length, body weight of the fish and weight of the ovary. The correlation coefficient values of the different relationships were also estimated. The relationships and values for r^2 are given in the figures (13,14,15,16)

The fecundity ranged between 113-1872 eggs for a length range of 14.1 cm – 24.2 cms in *Xenentodon cancila* (Fig:13), 468-851 eggs for a length range of 11-13 cms in *Puntius filamentosus*, 113-858 eggs (fig:14), for a length range of 13.4 – 17.5 cms in *Hyporhamphus limbatus* (fig:15) and 156- 4086 eggs for a length range of 7.3 – 8.5 cms in *Amblypharyngodon melletina*.(Fig:16)

The correlation coefficient (r^2)values were low, probably due to the small sample size. The most consistent values were for the regression of fecundity with ovary weight. The values were 0.41, 0.30,0,50 and 0.15 respectively for *X. cancila*, *P.filamentosus*, *H.limbatus*, and *A.melletina*. The other notable values were 0.32, for regression of fecundity with total length in *P. filamentosus* and 0.49, for the relation between total Weight and fecundity in the same fish

MATURITY STAGES

The gonads were classified into immature or spent, maturing, mature and ripe stages based on the appearance of ovaries in the fresh condition, the proportion of the area occupied by them in the body cavity and the structure and diameter of the intra ovarian ova. A seven point maturity scale was first proposed by the International Council for exploration of seas for classification of maturity stages in herring. It is applicable mostly in temperate fishes, as they have a short and definite spawning season and the progression in maturity of the ovaries can be followed through clearly distinguishable maturity stages. Tropical fishes show continuous spawning and at any time, ova in different stages of maturity can be distinguished in ovaries. Hence a seven point maturity scale (immature, early maturing, late maturing , early mature, late mature, ripe and spent stages) cannot be followed in the fishes studied and the ovaries were classified in to 4 recognizable maturity stages with difficulty to distinguish clearly between the immature and spent stages. In *X.cancila*, the 4 maturity stages ie. Immature, Maturing , mature and ripe, could be clearly distinguished, whereas in *H.limbatus* and *A.melletina*, the maturing stage could not be seen or in other words only 3 transitional stages, immature, mature and ripe stages could be seen in the ovaries. As for *P.filamentosus* only the mature and ripe stages could be distinguished, probably due to inadequate sampling.

GONADOSOMATIC INDEX

The Ganado somatic index is used as a tool for corroborating the spawning period, determined by other methods, like percentage occurrence of maturity stages, followed throughout an annual period. In the present study it was used to estimate the variation in GSI during different maturity stages. GSI was determined for the different maturity stages for two species , ie, *Xenentodon* cancila and *Hyporhamphus* limbatus. GSI was found to vary from 0.394 in immature ovaries to a high value of 4.31 in ripe ovaries in *X. cancila* , while in *H.limbatus*, it varied from 3.50 to 13.1 for the immature and ripe stages respectively. The values indicate the progression of size in gonads in relation to the body weight as maturity increases. A greater portion of the body weight is constituted by the ovaries in advanced maturity stages.

Fig: 9: Ova-diameter Frequency in *Xenentodon cancila*

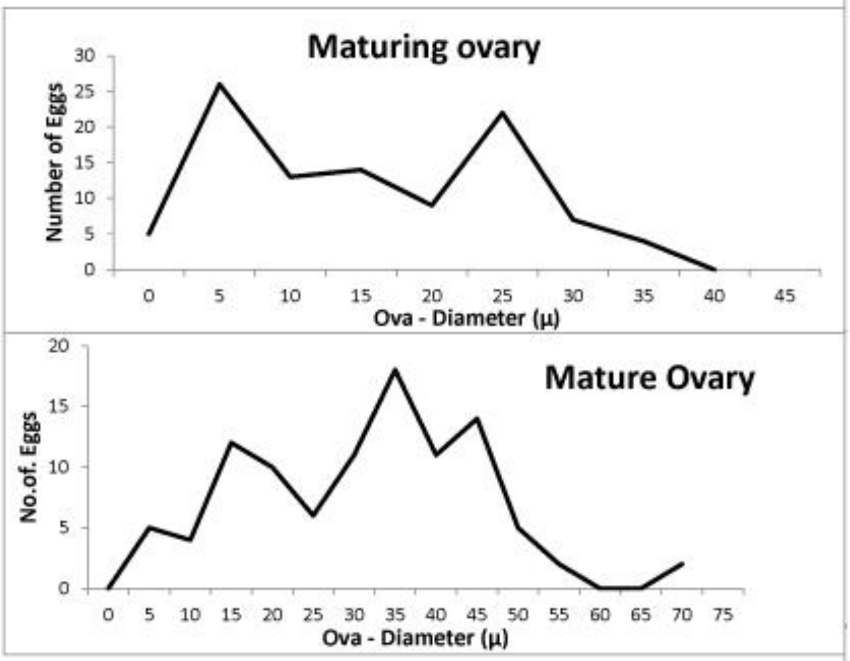


Fig: 10. Ova diameter frequency in *Puntius filamentosus*

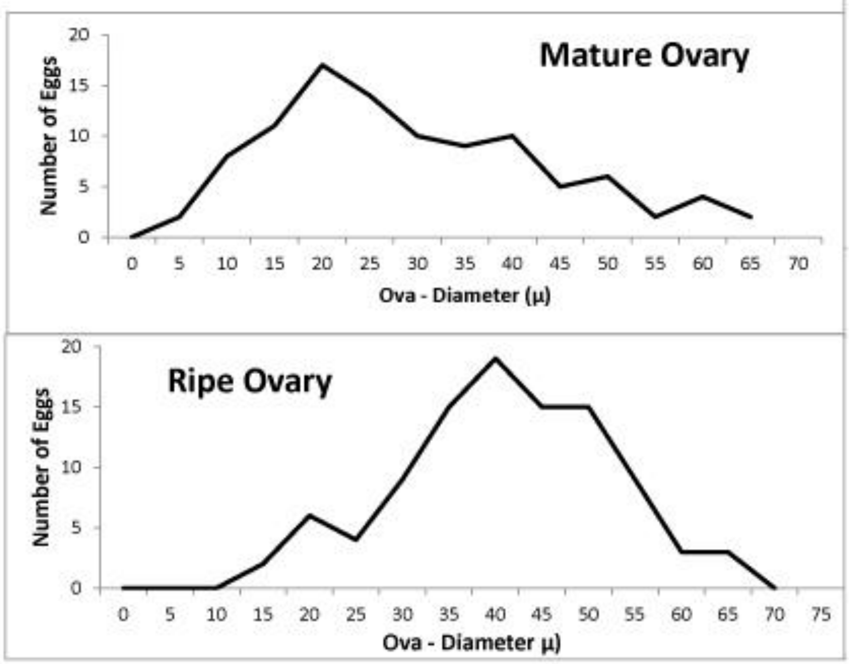


Fig: 11. Ova-diameter frequency in *Hyporhamphus limbatus*

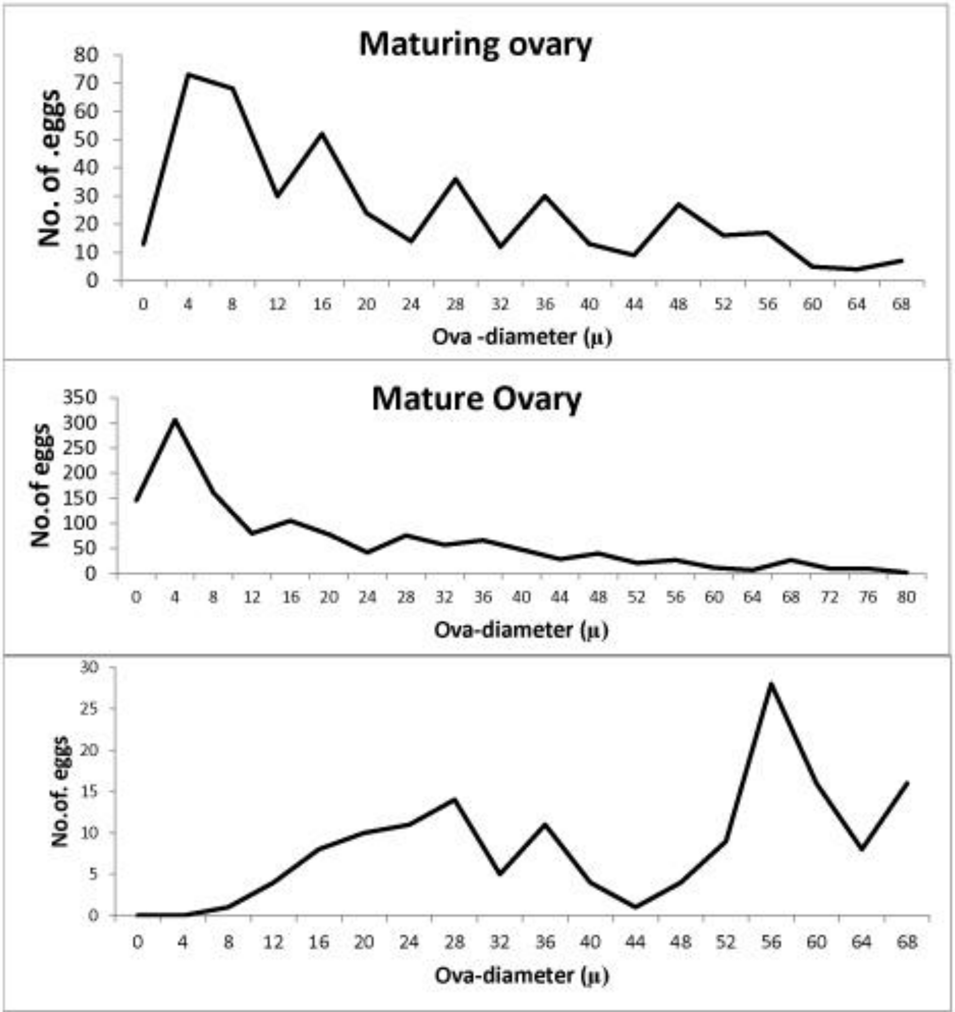


Fig: 12 . Diameter frequency polygon in *Amblypharyngodon melletina*

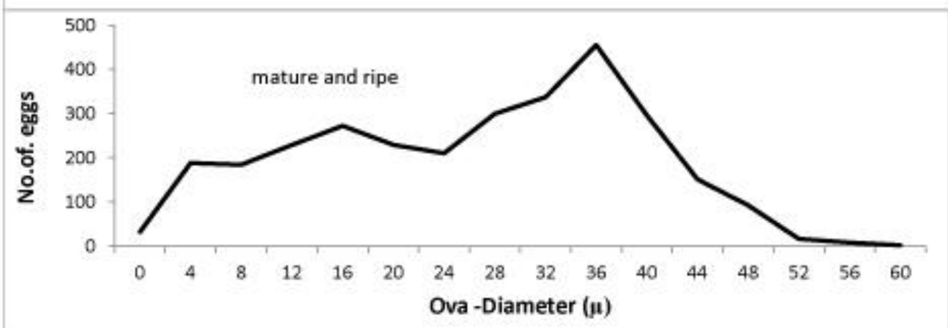


Fig 13 Relationship of fecundity with Fish Length, Fish Weight and Ovary Weight in *Xenentedon cancila*

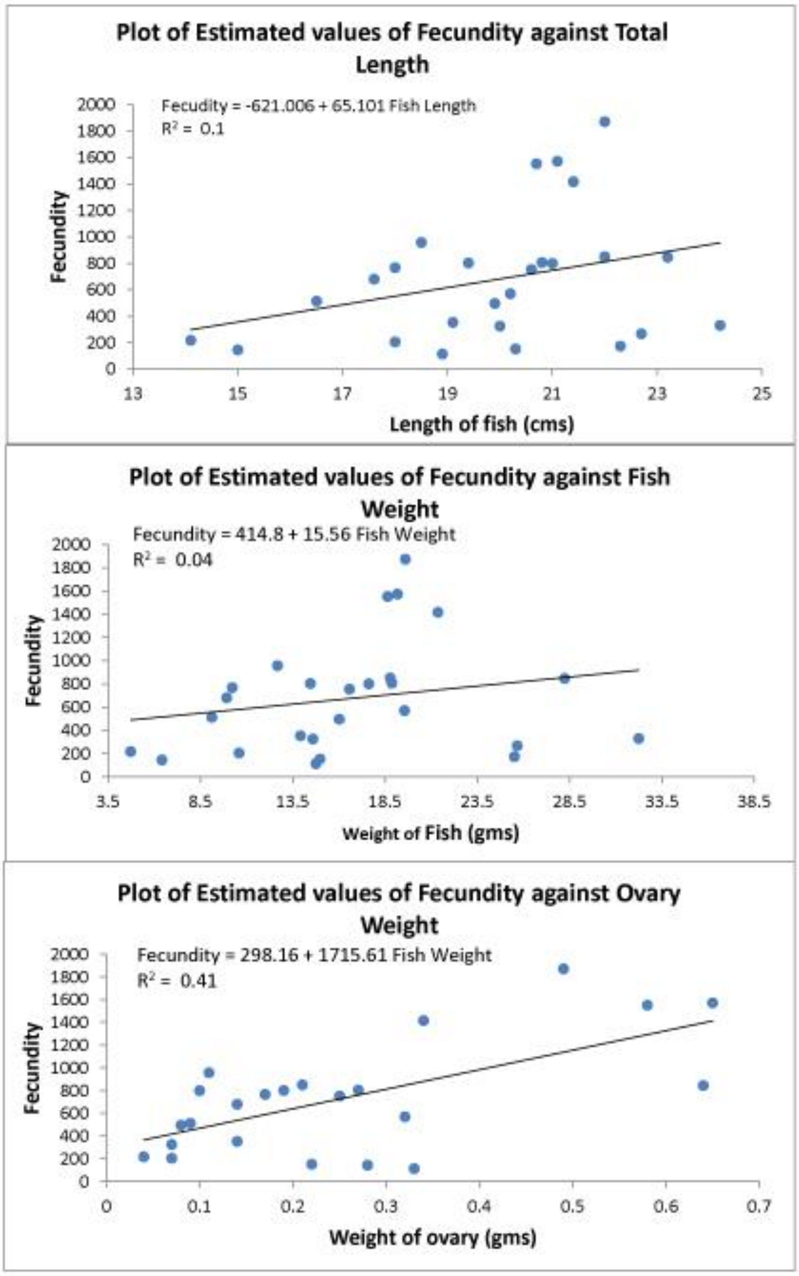


Fig 14 Relationship of fecundity with Fish Length, Fish Weight and Ovary Weight in *Puntius filamentosus*

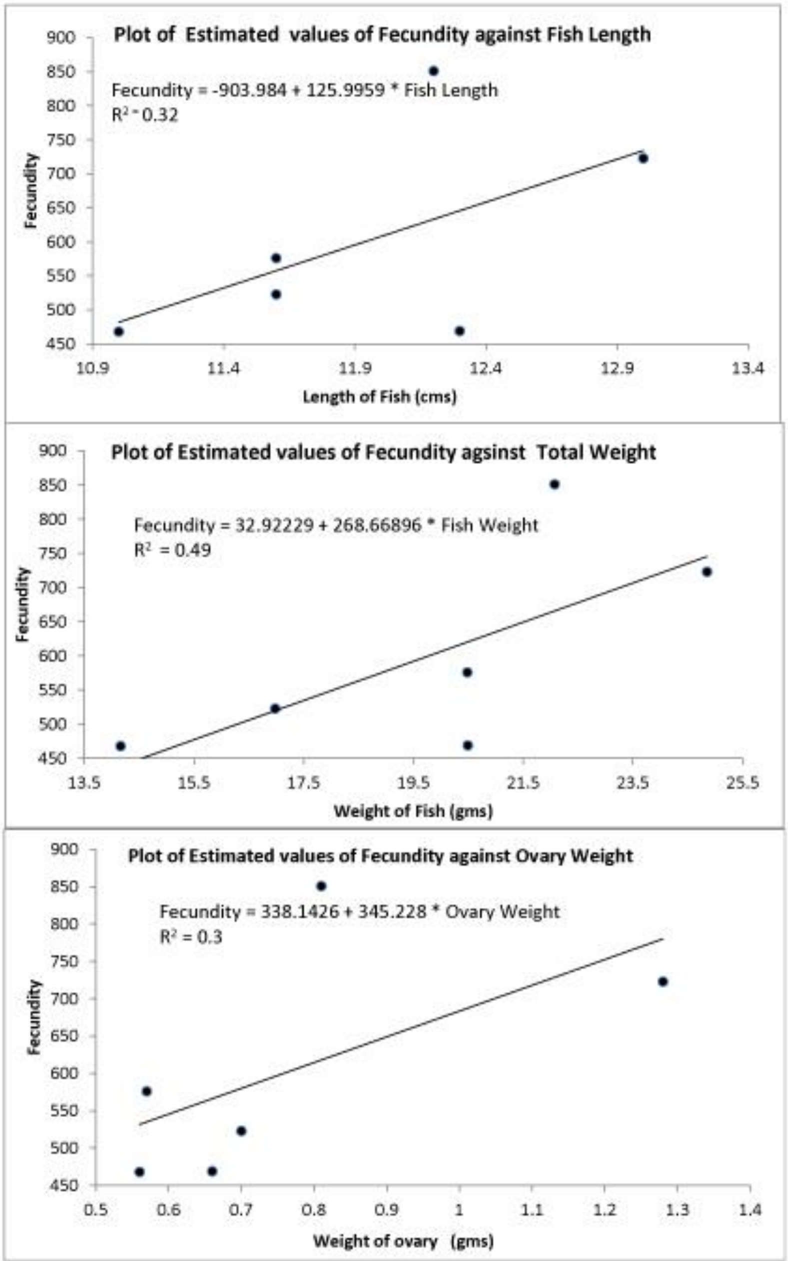


Fig: 15 Relationship of fecundity with Fish Length, Fish Weight and Ovary Weight in *Hyporhamphus limbatus*

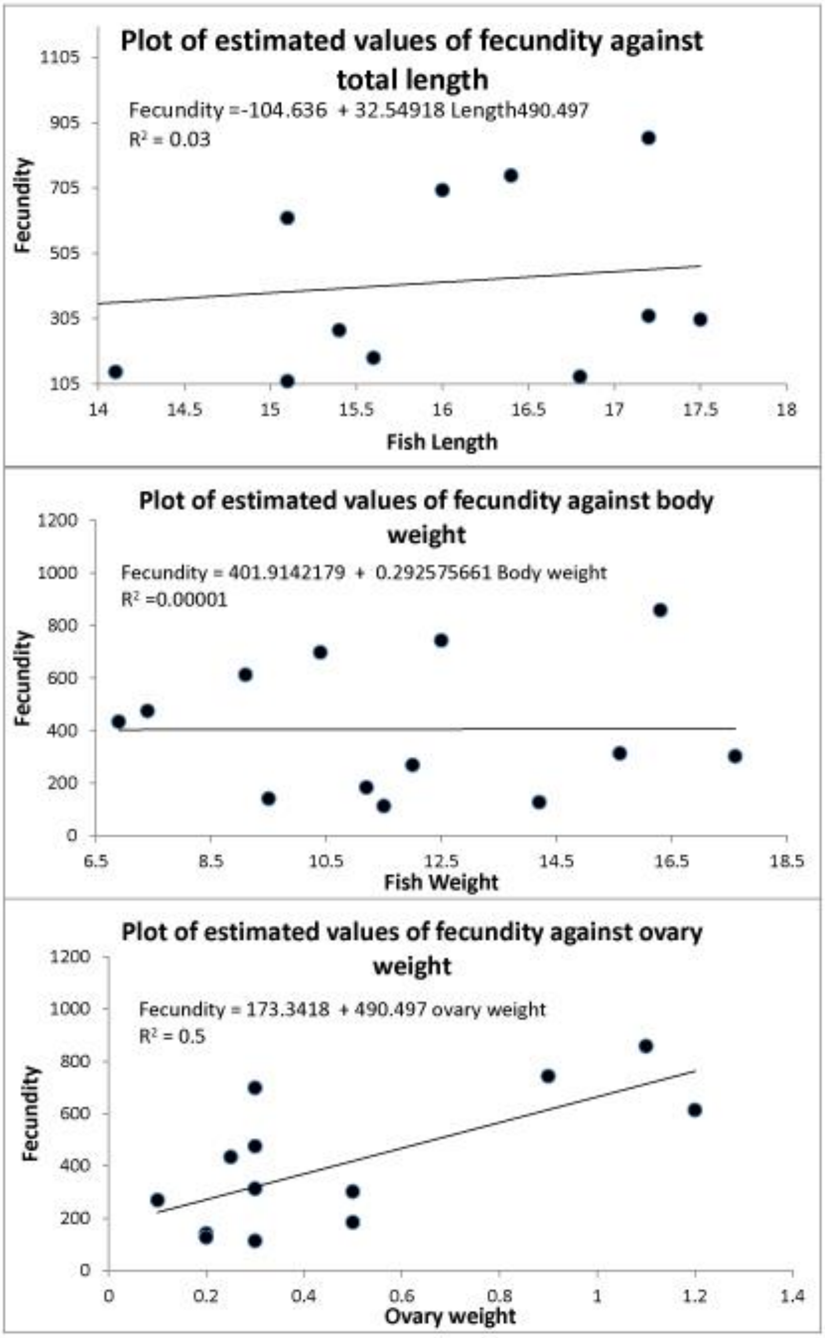
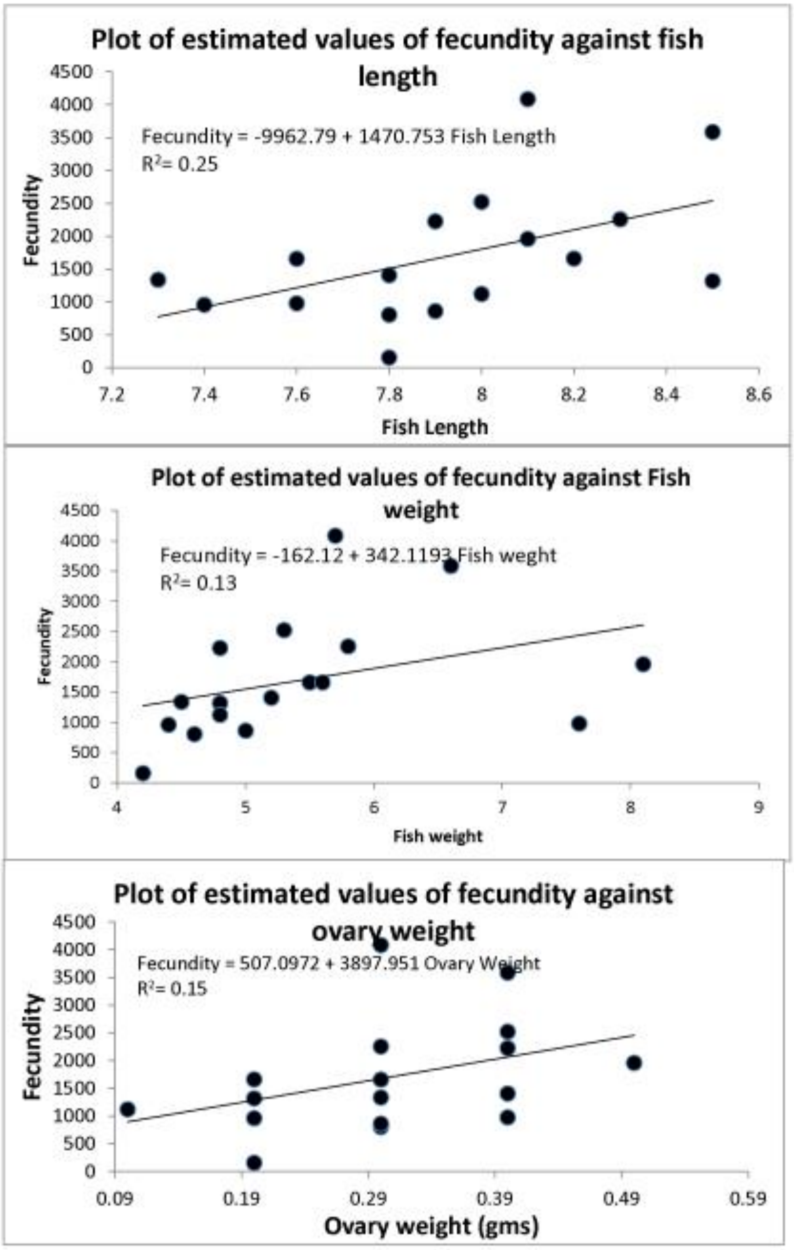


Fig :16 .Relationship of fecundity with Fish Length, Fish Weight and Ovary Weight in *Amblypharyngodon melletina*



FISHERY AND CATCH COMPOSITION

The Vembanadu backwaters constitute a most productive ecosystem and the total landings from Kerala backwaters is to the tune of 14000-17000 tonnes per year in addition to about 88000 tonnes of live clams and 0.17 million tones of dead mollusk shells collected annually. Besides forming a specialized ecosystem , it offers livelihood to thousands of people living along its banks. Vembanad estuarine system is known to be abundantly enriched with diverse fishery resources, providing feeding, spawning and rearing areas for a very large proportion of commercial (fin) fish and shellfish. Vembanadu Fish count (2009) enlists about 65 species of finfishes and 14 species of shellfishes from the lake. The list includes some of the most commercially important and high quality species like mullets, murrels, sea bass, mud crabs, prawns etc. In addition the many protected inlets and enclosed areas of the lake provides a nursery environment for the juveniles of a number of species which have their spawning grounds in the sea.

A multitude of gears are used for harvesting of fishes in the lake. In addition to the conventional designs, a number of ingeniously designed gears are used by the local fishermen. The fishing techniques vary from a small knot at the tip of a coconut palm fibre used to catch prawns from crevices of stones on the banks of canals to Chinese and large sized seine nets. The most important gears contributing to the fishery could be classified into

1. Stake nets 2. Gill nets. 3. Cast nets 4. Seine Nets 5. Traps 6. Chinese nets

Among the gill nets , a variety of gears are met with, mostly with specific mesh sizes and specially designed for a particular species. They are (a). Disco Vala (b). Malan Vala (c). Kola Vala (d). Koori Vala (e) Podi Vala (f) Kanambu Vala (g) Nangu Vala and (h). Vaisali net.

Seine nets exhibit different varieties of which peruvala is the most important.

A brief description of the different gears are given below.

1. STAKE NET:

The stake net , known as ‘Oonnivala’ in Malayalam, is very common in the backwaters of Kerala, especially in the Vembanad lake. They constitute the most important gear used for backwater fishing in the lake. As per the classification of fishing gear by Brandt (1972), the stake nets comes under the group of bag nets without wings. This class of nets can be defined as bags of netting which are kept open vertically by a frame on the opening side, and horizontally by the current. The basic principle of the net is filtering and hence they can be operated only when and where a strong current runs. In Vaikom, backwaters they are mostly operated against the direction of the tides.

2. GILL NETS:

Single walled nets whose lower edge is weighted by sinkers and upper edge is raised by floats, and with a mesh opening of such a size that fish of the required size group can gill themselves in the netting, are classified as gill nets (Brandt, 1972). The principle of the net is that the mesh size is lesser than the girth of the fish, that it is not able to pass through. If it tries to pass backwards the net meshes get hooked in the gill covering or operculum of the fish. Based on the mode of operation, gill nets can be classified into two main types (i) Fixed gill nets and (ii) Floating gill nets. Both the types can be operated in surface, column or bottom waters. The different local varieties are.

(a). **Disco Vala**: is a long net made up of 3 layers. The outer and inner layer are of large mesh size, while the middle layer consists of small meshed webbing. Prawns and other small fishes enter through the outer webbing, gets entangled in the middle webbing and extends as a pouch through the large meshes of the inner webbing. 150 floats are inserted in the upper part of the rope of the net. Sinkers are tied to the lower part. It is operated based on the direction of water current and usually against the tides., during the ebb and flow of water. Two persons are needed for the operation.

(b). **Malan Vala**: This is also a wall type net of mesh size 32-34 mm. The small sinkers are attached to the bottom rope, and the many floats (buoys) are attached to the head rope. This net can be operated by one or two persons, on the water surface on the basis of water current. It is used seasonally.

©. **Kola Vala**: It is a wall type net of mesh 18-20.mm. This net can be operated by a single person, seasonally and against the water current.

(d). **Koori Vala**: It is a type of gill net. The mesh size of net is 55- 60mm. It is operated by a single person, mainly at dusk. Fishes caught in this net are mainly cat fishes.

(e)**Podivala**: It is a type of gill net with mesh size of 32 mm. It is operated by a single person, launched from a boat and set in a straight line. It is also operated at dusk. The fishes caught include *Parambassis thomassi, Gerres filamentosus,* and *Etroplus maculatus.*

(f)**Kanambu Vala**: Kanambu vala is another type of gill net with a mesh size of 90mm. It is operated by a single person, during evening time. The fishes caught in this net are mainly mullets.

(g)**Vaisali net**: Vaisali net is yet another type of gill net, with a mesh size of 65mm. It is laid out during evening time and the catch is taken by next morning. Fishes caught in this net are mainly *Cyanoglossus, Caranx* spp etc.

(h)**Nangu vala**: Nangu vala is a gill net , mainly for catching flatfishes.

3. CAST NETS:

These are circular nets, that have to be thrown or cast into the water. They are circular in shape with little weights attached to the edges. The net is cast or thrown by the hand in such a manner that it spreads out on the water and sinks. Fishes are caught as the net is hauled back in. They have a radius of 4-12 feet. Attached to the net is a handline, one end of which is held in the hand as the net is thrown.

4. CHINESE NET:

The Chinese net belongs to the class of nets known as dip or lift nets. The catch of the fish is effected by the lifting of the net, when the fish sought to be caught have gathered over the nets. The gear has two distinct parts, the net proper and the supporting structure. It works on the lever principle. The net when attached to the supporting structure is a square, gradually assuming a conical shape towards the middle and ending in a bag.

5. SEINE NET:

These are surrounding nets in which one end of the net is held in water and the other end is laid out in a semicircle , surrounding the fishes to be caught and finally both the ends are brought into contact, after it it is hauled up from water either manually or mechanically. A pursing mechanism, by which the bottom can be closed by pulling a string pursed through the bottom of the net, may sometimes be present.

The most common seine net used in Vaikom backwaters is the 'Peruvala' which is an encircling net with a mesh size of 10. mm. It has a foot rope and a head rope, with the net stretching between them. One person operates the boat, while one end of the rope is tied to a bamboo stick. That end is held by another person, while the third person encircles the shoal by the other end of the net, enclosing the shoal between the boat and the net. Prawn and anchovies are mainly caught by this net.

6. TRAPS:

Generally in fishery trapping means that the prey enters a catching chamber from which escaping is difficult or even impossible. The fishes enters the trap voluntarily, may be when searching for a shelter or lured by some bait or when frightened and guided by fisherman. The traps are varied in accordance with the types of behaviour and species of the fishes to be captured. Commonly used traps are tubular and mechanical traps.

Besides the above listed methods, Hook and Lines, Plunge baskets and even handpicking are used for fish harvest.

MATERIALS AND METHODS

The above mentioned gears are sampled at frequent intervals, either after the fishes have been brought into the market or data is recorded first hand by renting a boat and reaching the fish harvesting spot. Data were collected on the details of operation of the net and a random sample of fishes are brought back to the laboratory, cleaned, sorted by species and the numbers and weight of each species is recorded. The data is taken for a period of time to know the catching pattern of the gears.

RESULTS AND DISCUSSION

The crustaceans observed during the study included *Scylla serrata*, the penaeid prawns, *Metapenaeus dobsoni* and *M.monoceros* and the carideans, *Macrobrachium rosenbergii* amd *M.idella*. The majority ie more than 80% was contributed by *M.dobsoni*. Among the gears, the highest contribution was by stake nets (95.5%), and trammel nets contributed to the rest of the catches.(Fig:18)

Among the finfishes , catfishes dominated the catch, *Tachysurus* contributing to 25.2% and *Mystus* 7.81%, whereas *Labeo* dussumieri came second with 21 % of the catches and *stolephorus* with 13.2 % of the catches.. In contrast to crustaceans, gill nets, with its different varieties contributed to the majority of (40%) the catches. Trammel nets which can be classified as an entangling net, rather than as a gill net, contributed nearly 30 % of the catches, while stake and seine nets contributed 22 and 8 percent respectively to the catches. (Fig: 19& 20.)

If the combined data on crustaceans and finfishes are taken, stake nets and trammel nets are the dominant gear contributing to nearly 84% of the catches.

While considering a sampling period from July to January, The months of August and September were found to be the most productive contributing to nearly 50% of the catches and the catches were lowest in October and November.(Fig. 17)

The monthly variation in the catches of the five most productive species were studied ie. *Metapenaeus dobsoni*, *M.monoceros*, *Labeo dussumieri*, *Tachysurus* and *Stolephorus*. *Metapenaeus monoceros* exhibited a variation of 50.5 kg in july to 251 kg in September. Catches of *Tachysurus* fluctuated between 3.3 kg in October to 85 kg in July. *Labeo* exhibited a variation from 3.5 kg in January to 43.5 kg in August. *Stolephorus* exhibited a variation of 11 kg in December to 59 kg in January, and conspicuous by its absence from August to November. *Metapenaeus monoceros* was absent from November to January and showed the highest catches in August.(Fig: 21)

The catches of the Chinese nets were completely dominated by 3 species, *Parambassis thomassi*, A*mblypharyngodon melletina* and *Metapenaeus dobsoni*. *Pangasius pangasius*, though an important component by weight, does not occur in large numbers. Catfishes, especially *Mystus gulio*, were the most important among catfishes.(Fig.22).

It can be concluded that the most effective gear in backwaters are stake nets and gill nets with its many varieties. The most important groups include, catfishes, ambassids and prawns.

Fig:17 Monthly catch composition of different fishing gears

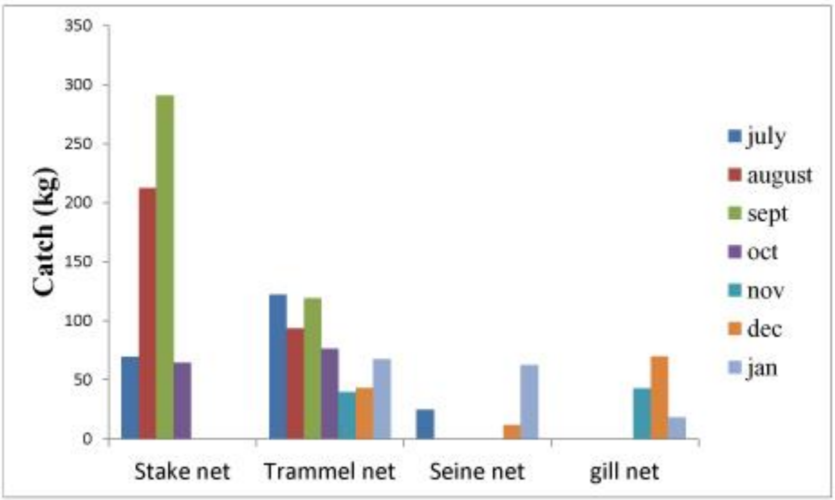


Fig 18: Catch composition of crustaceans in different gears

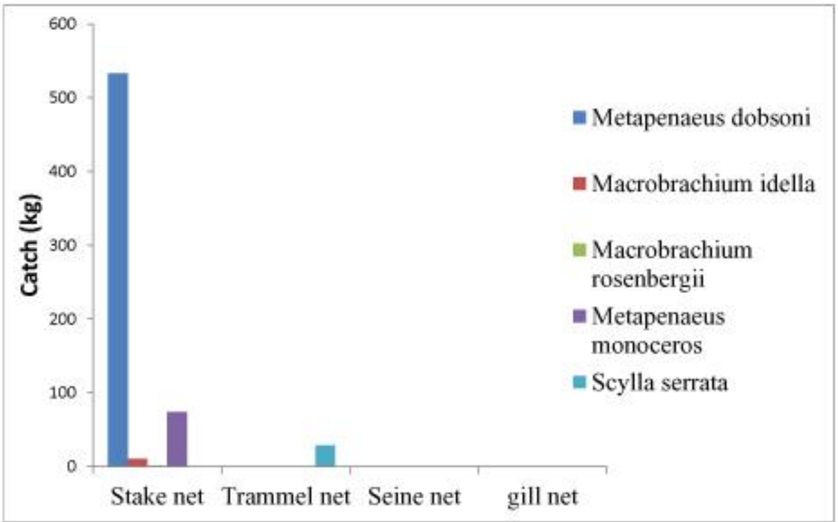


Fig: 19 **Catch Composition of selected fishes in the in the indigenous gears sampled**

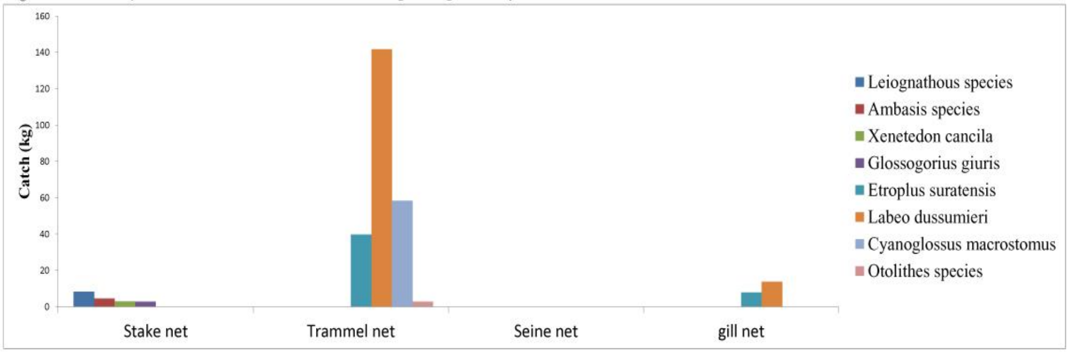


Fig: 20 **Catch composition of fishes in different gears**

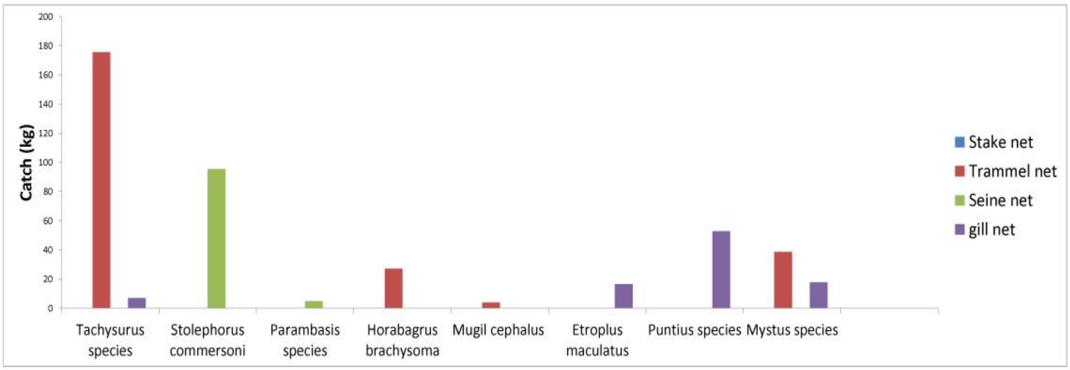


Fig: 21: Variation in the monthly catch of important species

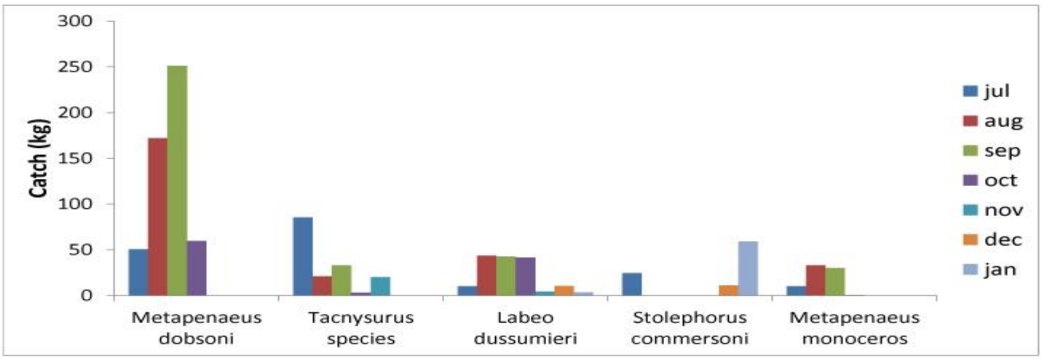
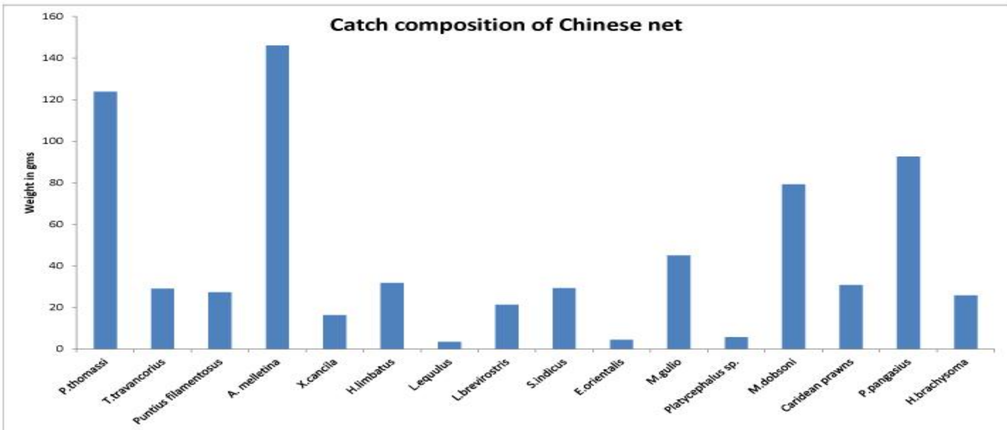


Fig: 22. Catch Composition of Chinese Nets



Amblypharyngodon melletina

Arius acutirostris

Mystus oculatus

Parambassis thomassi

Puntius filamentosus

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