Length frequency analysis and length-weight relationship of pony fish, *Leiognathus splendens* (Cuvier, 1829) off Ratnagiri coast, Maharashtra

Acharya KV[1*] and Naik SD[2]

[*1]. Research Scholar, Fisheries Resource Management (Dept. of Fisheries Biology), College of Fisheries, Ratnagiri, Maharashtra, India.
[2]. Head, Department of Fisheries Biology, College of Fisheries, Ratnagiri.

*Corresponding author: Research Scholar, Fisheries Resource Management (Dept. of Fisheries Biology), College of Fisheries, Ratnagiri, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India.(email : acharyakanishk89@gmail.com)

ABSTRACT: In the present study, length frequency and length weight relationship analysis of *Leiognathus splendens* (Cuvier,1829) from Ratnagiri coast were done. The fishes studied ranged between 6.1 to 12.5 cm. in Total length (TL.) during the period February 2012 to January 2013. From the cumulative frequency calculations, it was observed that *L. splendens* attained first maturity at the size of 10.5 cm. L ∞ calculated for *L. splendens* was 155.4 mm, K value was 0.28 monthly. The fish attained 6.4 cm in 1st year, 10.2 cm in 2nd year, and 12.3 cm in 3rd years respectively, The analysis of covariance did not show significant difference in length-weight relationship between sexes. The relationship was described as : Log W = -1.7280 + 2.9802 Log L

Keywords: *Leiognathus splendens*, Length frequency analysis and length-weight relationship of pony fish, Maharashtra, India.

— — — — — — — ◆ — — — — — — — —

INTRODUCTION

The pony fish, *Leiognathus splendens* (Cuvier, 1829) is widely distributed in the indo-Pacific region. They are silvery in colour, generally small (< 200mm SL.) and laterally compressed. They derive their common name ponyfish or slipmouth from their highly protractible mouth, which protract either dorsorostrally, rostrally, or ventrorostrally (Chakrabary and Sparks, 2010). The silverbelly or pony fish belonging to the Kingdom-Animalia, Phylum-Chordata, Class-Actinopterygii, Order-Perciformes, Family- Leiognathidae, The fishes of the family Leiognathidae (Silverbellies, pony fishes or slip mouths) commonly called as Splendid Silver- Belly: (English), Kaaral or KilliKaaral: (Tamil), Karah,:(Telgu), Kanai, Kuruchi: (Kannada), Thalimullan: (Malayalam), Karali, Tikata, Kap: (Marathi), Tunka Chandee: (Oriya). Synonyms- Equula splendens Cuvier; 1829; Day, 1878; *L. splendens* Munro, 1955; FAO. 1974.

Although it is commercially important and has wide distribution along the Indian coast, no detailed information on the biology is available from Indian waters (Jayabalan, 1986).

A total of 21 species of silverbelly are known from the seas around India. Almost all are known from southern Tamil Nadu, the dominant species being *L. dussumiri*, *L. jonesi*, *L. splendens, L. brevirostris* and *L. equulus*. In the northern Tamil Nadu and along Andhra Pradesh about 12 species are known to contribute to the fishery of which *L. bindus, L. splendens* and *Secutor insidiator* are most dominant accounting for nearly 70-80% of the silverbelly landings (Murty *et al*., 2003). Along the Indian coast, the silverbelly are abundant only along the south-east coast, especially in the Gulf of Mannar and Palk Bay (Ayyappan *et al*.,2011). In view of the above, the present study focuses on the pony fish which is an important demersal resource along Ratnagiri coast. This fish resource plays major role in the landing along the Ratnagiri coast of Maharashtra with wide annual fluctuation in landings. An understanding of the biology of a species is thus an important prerequisite for providing scientific advice for fisheries management to achieve optimum exploitation of the concerned species in tune with its reproductive characteristics. As the reproductive potential of individual fishes within the spawning stock affects recruitments, most fish biomass assessment programmes require inputs on reproductive parameters such as the age/length at maturity, proportion of mature fishes in the population, fecundity and spawning frequency (Nikolskii,1969). These parameters are widely applied to formulated capture fisheries management strategies such as enforcement of minimum catch at size restriction, close fishing season during peak breeding period etc. Thus, the present paper would definitely throw some light on these aspects. The biological studies of the fish during the period February 2012 to January 2013 will provide a baseline data on this fish along the Ratnagiri coast of Maharashtra. The present investigation was undertaken on the aims biological aspects of *L. splendens* along the coast of Ratnagiri, Maharashtra

MATERIALS AND METHODS

From the length data, the frequencies of the length classes were tabulated. The samples were collected from the fish landing Centre Mirkarwada of Ratnagiri, individuals were studied for length frequency analysis for a period of eleven months from at weekly intervals during February 2012 to January 2013. Sampling for June – July could not be collected due to ban on fishing during monsoon. The Mirkarwada landing centre of Ratnagiri (160 59' 42" North and 730 16' 14" East) located in coastal region of Maharashtra along the west coast of India was selected for the present study. In this sampling station samples of *L. splendens* landed from the purse seine and trawl were procured.

From the size frequency analysis, dominant modes of size distribution of *L. splendens* were noted. The shifting of the mode values in the graphs for different months was used as the base for interpretation of growth. The length frequencies are used for separating the polymodal length frequency distribution into modal lengths of different year classes. The estimation of growth parameters were also supplemented by analyzing the data by using FISAT (FAO - ICLARM Stock Assessment Tools) computer software package, which includes direct, fit of length frequency data by ELEFAN - II (Electronic Length Frequency Analysis) method and developed into a computer software package. The present study is based on the total of 400 fish

specimens in the size range of 6.1 to 12.5 cm. Total length (TL.) in which 154 males and 206 females and 40 indeterminants were studied, for estimation of length-weight relationship by using linear regression analysis The data of total length and weight were statistically treated by the method of least square using the equation given as: log W = log a + b log L, where 'a' and 'b' are constants estimated by linear regression of the log transformed varieties. Length-weight relationship was determined separately for males, females, indeterminates and total.

RESULTS

1. LENGTH FREQUENCY DISTRIBUTION

Random samples of fish collected from the commercial catches from February 2012 to January 2013 ranged in total length from 6.1 to 12.6 cm, mainly clustering between size groups 6.1-6.5 cm, 6.6-7.0 cm, 7.1-7.5 cm, 7.6-8.0 cm, 8.1-8.5 cm, 8.6- 9.0 cm, 9.1-9.5 cm, 9.6-10.0 cm, 10.1-10.5 cm, 10.6-11.0 cm, 11.1-11.5 cm, 11.6-12.0 cm, 12.1-12.5 cm and 12.6-13.0 cm (Table 1. & fig.1). The month wise length frequency distribution has been shown. It was observed that fishes of modal group 10.1-10.5 cm and 10.6- 11.0 cm were caught during all the months along the Ratnagiri coast. Shifting of modes to next modal class was evident from the ELEFAN-II analysis. The analysis showed two curve indicating two broods or spawning peaks annually. The recruitment was observed in March and December (fig.2) Sexual maturity of *L. splendens* was estimated at 10.05cm. It attains 6.4 cm. lengths in first year, 10.2 cm. in second year and 12.3 cm. in third year. Thus, it indicated that growth of *L. splendens* was faster in first year than second and third year. The asymptotic length (L∞) obtained in the present study was 155.4 mm. and K value was 0.28 monthly.
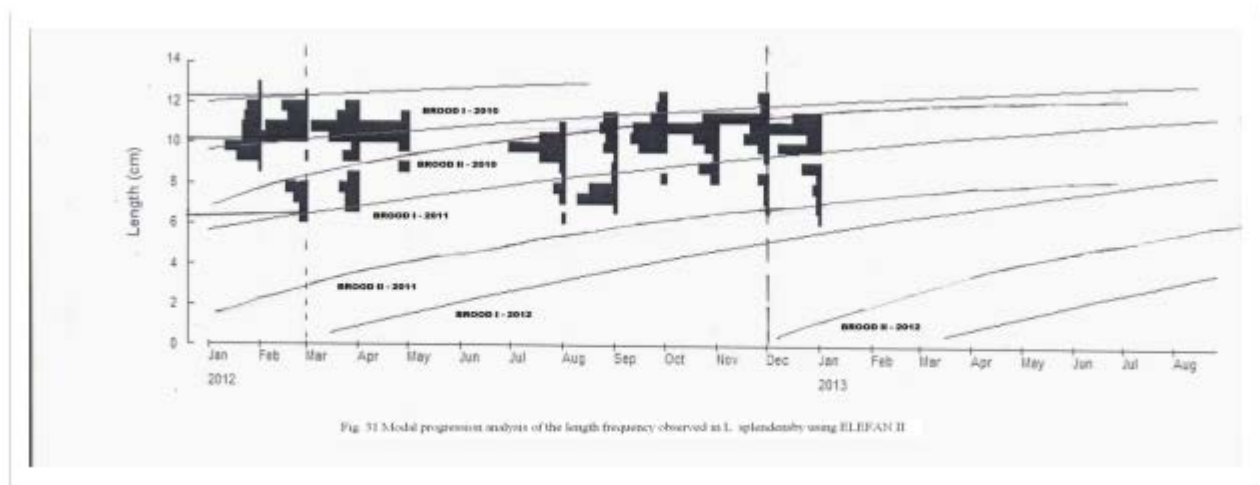
Fig 2: Modal progression analysis of length frequency observed in *L. splendens*

by using ELEFAN II

Table 1. Month wise length frequency distribution of *L. splendens* of Ratnagiri coast during February 2012 to January 2013

| Class Interval (cm)	Feb	Mar	Apr	May	Aug	Sep	Oct	Nov	Dec	Jan	Total No.	Cumulative frequency	Relative frequency	Percentage frequency
6.1-6.5	0	0	0	0	1	0	0	0	0	0	1	1	0.0020	0.2000
6.6-7.0	0	0	0	0	0	1	0	0	0	0	1	2	0.0020	0.2000
7.1-7.5	0	0	0	0	2	14	0	0	0	0	16	18	0.0320	3.2000
7.6-8.0	0	0	0	0	4	10	0	0	0	0	14	32	0.0280	2.8000
8.1-8.5	0	0	0	0	1	2	2	3	1	0	9	41	0.0180	1.8000
8.6-9.0	1	0	0	4	2	2	0	7	0	0	16	57	0.0320	3.2000
9.1-9.5	9	1	6	0	9	1	0	2	2	0	30	87	0.0600	6.0000
9.6-10.0	13	0	3	4	20	5	10	5	4	15	79	166	0.1580	15.8000
10.1-10.5	7	17	11	19	9	4	13	9	9	5	103	269	0.2060	20.6000
10.6-11.0	7	15	17	20	2	6	12	18	7	20	124	393	0.2480	24.8000
11.1-11.5	6	7	8	3	0	5	6	6	20	10	71	464	0.1420	14.2000
11.6-12.0	5	9	5	0	0	0	4	0	3	0	26	490	0.0520	5.2000
12.1-12.5	1	1	0	0	0	0	3	0	4	0	9	499	0.0180	1.8000
12.6-13.0	1	0	0	0	0	0	0	0	0	0	1	500	0.0020	0.2000
Total	50	50	50	50	50	50	50	50	50	50	500			
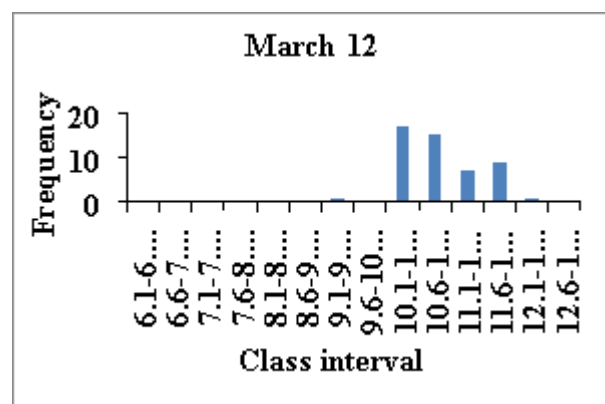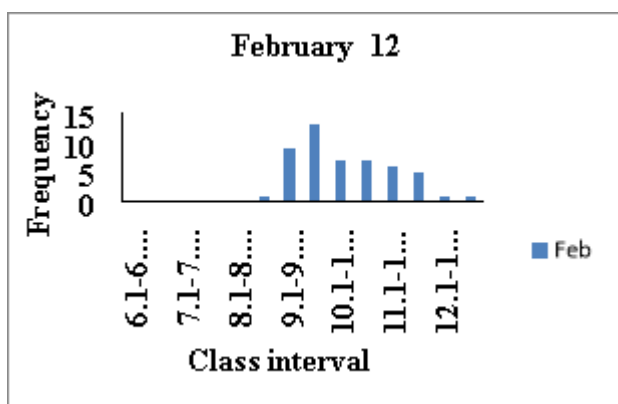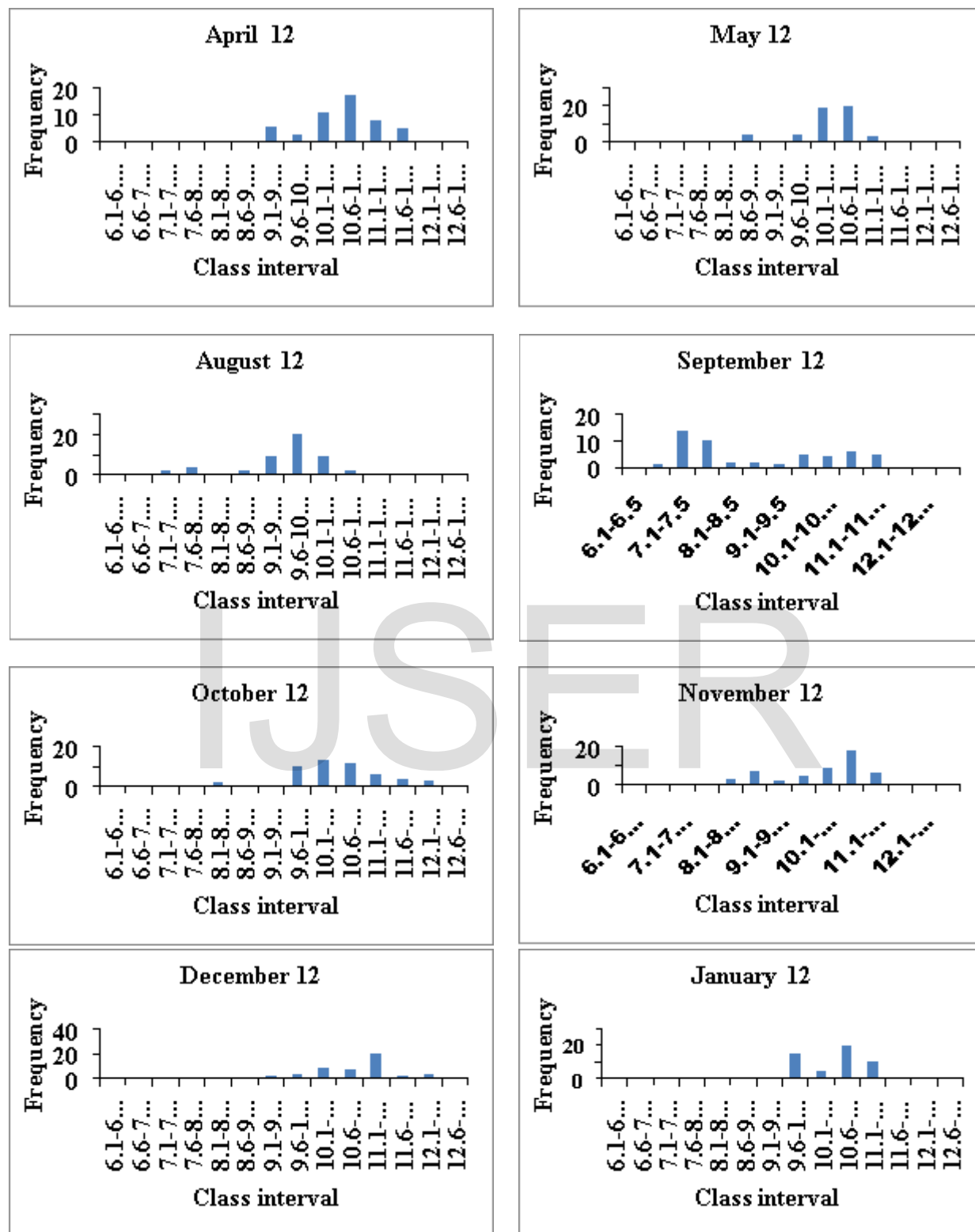
Fig. 1. Month-wise length frequency distribution of *L. splendens* of Ratnagiri coast
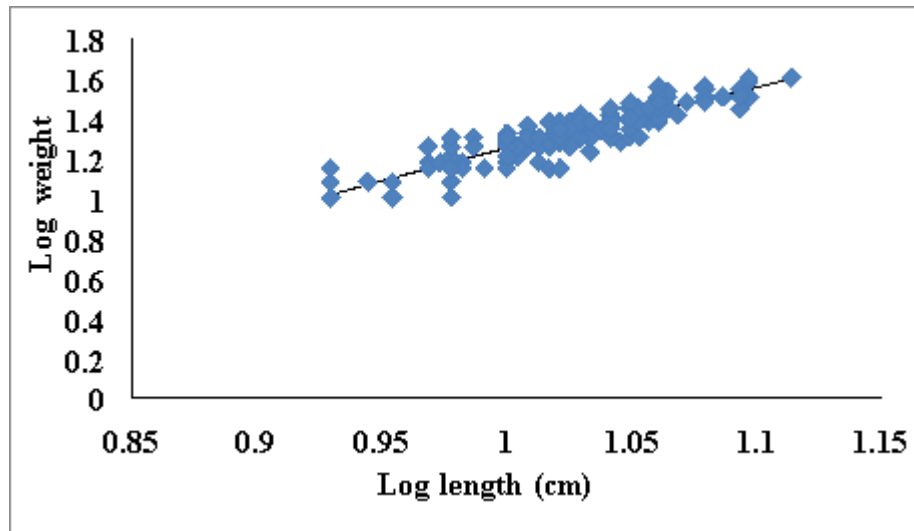
2. LENGTH WEIGHT RELATIONSHIP

The main objectives of studying the length - weight relationship of fishes was to determine mathematical relationship between the two variables, Data for all the four groups such as males, females, indeterminants and total have been analyzed separately. The regression equations obtained are shown in (Table 2) and (fig.3 to 6) with "X" variable as length and "Y" variable as weight. It was found that out of the total 400 specimens examined for the length-weight relationship 157 males (TL =8.5-12 cm, W= 10.4 to 34 g), 203 were female (TL =8.5-13 cm, W= 10 to 40 g) and 40 were the indeterminants (TL = 6.1-10.3 cm, W= 3.8 to18 g). Independent statistical analysis of their length and weight relationship gave the following regression equations.

Table 2. Linear Regression equations of length-weight relationship of males, females and indeterminants of _L. splendens_

| Parameters	Equation	a	b	r	n
Males	Log W = -1.4609 + 2.7184 Log L	-1.4609	2.7184	0.5988	157
Females	Log W = -1.8949 + 3.1419 Log L	-1.8949	3.1419	0.8162	203
Indeterminants	Log W = -1.4401 + 2.6550 Log L	-1.4401	2.6550	0.8421	40
Total	Log W = -1.7280 + 2.9802 Log L	-1.7280	2.9802	0.8792	400
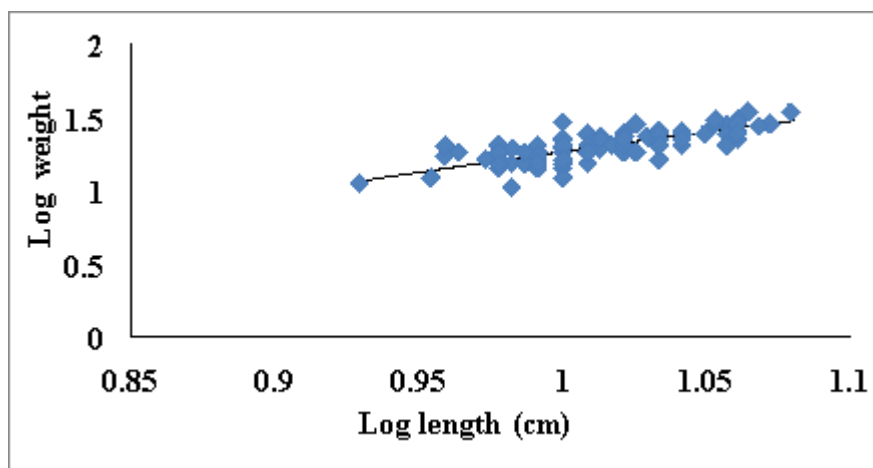
Fig. 3 Logarithmic relationship between length and weight in the males of _L. splendens_

Fig.4 Logarithmic relationship between length and weight in the females of

L. splendens
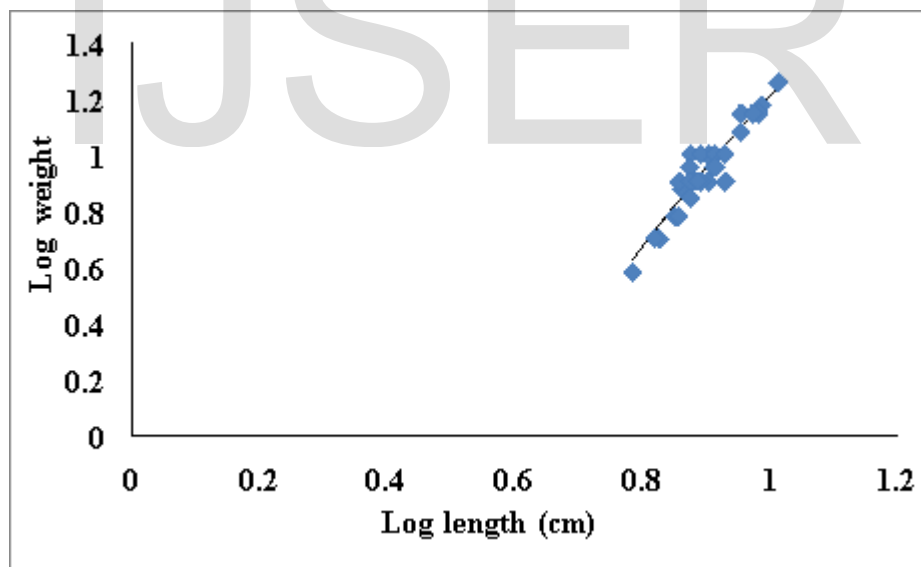
Fig.5 Logarithmic relationship between length and weight in the indeterminants of
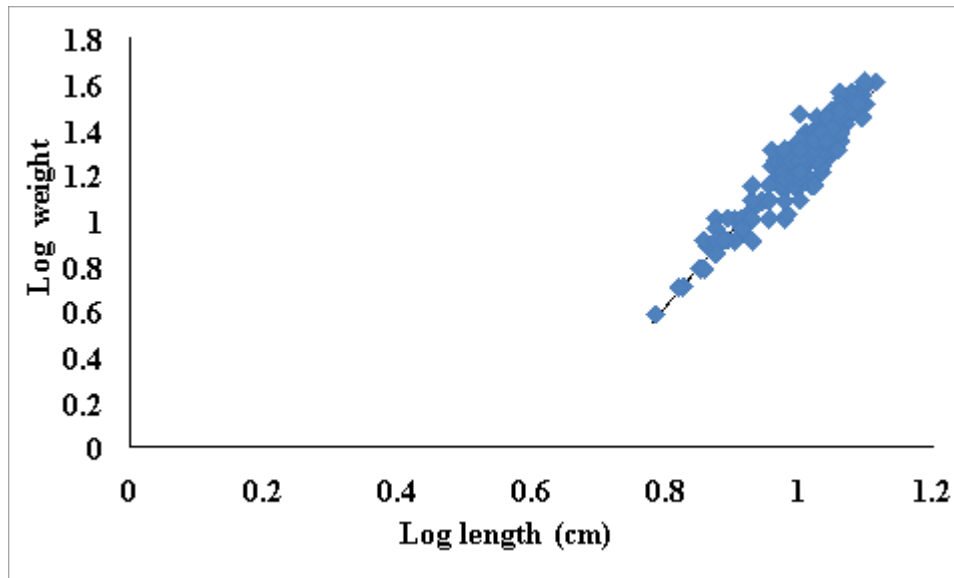
L. splendens

Fig.6 Logarithmic relationship between length and weight in the totals of

L. splendens

The regression equations obtained are shown in (Table 2) and (fig.3 to 6) with "X" variable as length and "Y" variable as weight. It was found that out of the total 400 specimens examined for the length-weight relationship 157 males (TL =8.5-12 cm, W= 10.4 to 34 g), 203 were female (TL =8.5-13 cm, W= 10 to 40 g) and 40 were the indeterminants (TL = 6.1-10.3 cm, W= 3.8 to18 g). Independent statistical analysis of their length and weight relationship gave the following regression equations.

1. Male : Log W = -1.4609 + 2.7184 Log L

2. Female : Log W = -1.8949 + 3.1419 Log L

3. Indeterminate : Log W = -1.4401 + 2.6550 Log L

4. Total : Log W = -1.7280 + 2.9802 Log L

The analysis of covariance indicated that there was no significant difference in the slopes of male, female and indeterminant samples (P> 0.05). The t-test showed allometric growth, within the groups. The estimated "b" values indicated isometric growth in females (P<0.05) of *L. splendens.*

CONCLUSION

1. LENGTH FREQUENCY ANALYSIS

Specimens of *L. splendens* collected from the Ratnagiri coast ranged from 6.1 to 12.5 cm TL. During February 2012 to January 2013. L∞ was 155.4mm, K was 0.28 monthly, and the

length at maturity was estimated at 10.5cm. According to Abraham *et al.,* (2011) the estimated values of Von Bertalanffy growth parameters are L∞ = 154 mm, K = 0.52. Though the L∞ value calculated in the current work is on par with the L∞ values calculated by other workers, *L. splendens* occurring along the coast of Ratnagiri appears to attain maturity at length smaller than that reported by workers. It also revealed that growth rate was slow as compared to the length increment per year reported by other workers elsewhere.

2.   LENGTH WEIGHT RELATIONSHIP

In the present study, the scatter diagram of weight on total length in *L. splendens* indicated that the relation to the general pattern of allometric growth. The `T test employed to test the pattern of growth showed allometric growth in both male and female. The length-weight regression equations reveal that, the weight of fish decreased at a rate lower than the cube law of length. The difference in regression coefficients between male and female were not significant at 5% level. In the present study, the following length-weight relationships are observed.

5. Male : Log W = -1.4609 + 2.7184 Log L

6. Female : Log W = -1.8949 + 3.1419 Log L

7. Indeterminate : Log W = -1.4401 + 2.6550 Log L

8. Total : Log W = -1.7280 + 2.9802 Log L

The 'a' and 'b' values of the length-weight relationship for males were -1.4609 and 2.7184 respectively; while females, a and b value are -1.8949 and 3.1419 respectively and for in determinants, -1.4401 and 2.6550 respectively. The length-weight relationship of *L. splendens* has been studied by workers (Arora 1951, Jayabalan and Bhat 1997) established an equation of the values of regression coefficents of different stages of *L. splendens* ranged between 3.0315 and 3.2291, and 3.2000 for unsexed *L. splendens* from Thangachimadam on the East Coast. Whereas, in present investigation it is observed LS = -1.8949 + 3.1419 LT. Immature males log W = -4.7954 + 3.0315 log L. Mature males log W = -5.2154 + 3.2291 log L. Immature females log W = -5.0959 + 3.1848 log L Mature females log W = -5.1424 + 3.1973 log L. Thus in the present work, the growth of the fish was found to be allometric as the regression "b" value followed the cube law and did not significantly (P>0.05) differ from the cube. The weight of fish decreased at a rate lower than the cube of the length. Growth rate was highest in female fishes, followed by males and indeterminate. Results obtained from *L. splendens* indicated that there is no significant difference between the length – weight relationships of the sexes.

REFERENCES

Ayyappan S. 2011., Handbook of fisheries & aquaculture.

Abraham K.J., V. S. R. Murty and K. K. Joshi.,2011.Fishery and population dynamics of silverbellies along the Kerala coast., Indian J. Fish.,58 (2):15-21pp

Abraham K.J. V. S. R. Murty and K. K. Joshi.,2011. Age and growth studies in silverbellies along Kerala coast., J.Mar.Biol.Ass.India,53(2) Abraham K.J. V. S. R. Murty and K.K.Joshi.,2011. Age and growth studies in silverbellies along Kerala coast.,

Abraham K.J. V. S. R. Murty and K. K. Joshi., 2011. Age and growth studies in silverbellies along Kerala coast., J.Mar.Biol.Ass.India,57(2)

Abraham K. J. V. S. R. Murty and K. K. Joshi., 2011. Age and groth studies in silverbellies along Kerela coast., J.Mar.Biol.Ass.India,53(2)

Arora, 1951; E prints. CMFRI eprints.cmfri.org.in/8838/1/4_1659.

Arora, 1952; E prints. CMFRI eprints.cmfri.org.in/8838/1/4_1660.

Bhattacharya.,1967methodLengthfrequencyAnalysis.www.discovery.org.in/PDF_Files/ d20130406.

Chakrabarty, P.Chu, J.Nahar, L.Sparks, J.S. (2010). Geometric morphometrics uncovers a new species of ponyfish (Teleostei: Leiognathidae: Equulites), with comments on the taxonomic status of Equula berbis Valenciennes. Zootaxa, 2427, 15-24.

Corti, M., Loy, A., Naylor, G. J. P. and Slice D. E. (Eds) 1996.Ihssen et al. 1981) Stock identification and fisheries management.Geometric morphometrics.

FAO 1974 species identification sheet. Fishery area vol II

Gulland1983. Length weight relationship of the fishes, worldfish.catalog.cgiar.org/naga/na_2 267.52

Gayanilo, F. C. Jr.;Sparre, P.; Pauly (1988). D. User's guide. FAO Computerized InformationSeries(Fisheries). No.8(1988). ICLARM Stock Assessment Tools II. www.ccs.mi ami.edu/~fgayanilo/documents/GayaniloPub05 a.

Gayanilo, F.C. Jr., Sparre, P. and Pauly, D.,1996, FAO-ICLARM Stock Assessment Tools (FiSAT) USERS GUIDE, FAO Computerized Information Series (Fisheries) No.8. FAO, Rome, 3 deskettes and 124 pp.

Jayabalan N. And Ch. Krishna Bhat.,1997. Length-Weight Relationship In The Pony Fishes Leiognathus Splendens (Cuvier) And Gazza Minuta (Bloch) Of Parangipettai. Indian J.Fish,44(3):291-294.54

Jayabalan N., 1986. Reproductive biology of silverbellies Leiognathus splendens (Cuvier,1829) at Porto Novo indian j.fish,33(171).

Le Cren 1951, Length weight relationship, www.worldfishcenter.org/Naga/23-2/fb3

Murty V., K. K. Joshi and Rekha J.Nair 2003., Status of Exploited Marine Fishery Resources Of In Munro (1955) biology of the silver belly, leiognathus bwdus (val) of the calicut coast,india.

Nikolskii, G.V., 1969. Theory of Fish Population Dynamics as the biological background for rational exploitation and management of fishery resources. Otlo koeltz Science Publishers,323 p.

Pauly and David (1981) Length and Mortality of the fish. Research myfwc.com/engine/downl oad_redirection_process.India.,4:185-200.

Pauly, D. and David,N., 1981. ELEFAN – I, a BASIC program for the objective extraction of growth parameters from length-frequency data. Meeresforschung, 28 (4): 205 – 21.

Pauly, D., 1984. Length-converted catch curves: a powerful tool for fisheries research in the tropics (Part II). ICLARM Fish byte., 2(1): 17-19.

Snedecor, G.W., and Cochran, W.G. (1967),statistical methods. Analysis of covariance, www.qmrg.org.uk/files/2008/11/20-analysis-of-covariance

Snedecor, G.W. and Cochran, W.G., 1967. Statistical methods, Sixth edition, Oxford and IBM publishing Co., New Delhi: 593 p.

Zar, J. H., 2006. Biostatistical analysis, (4th Eds.) Tan prints (I) Pvt. Ltd., Delhi, India. 663 pp.