Study on the Biology of *Stolephorous commersonii* (Commerson's Anchovy) from Junglighat Marine Fish Landing Center, South Andaman

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Abstract

Anchovies are small silvery pelagic fishes belonging to the family *Engraulidae* with 151 species placed under 17 genera where 13 species belonging to 7 genera were reported from Andaman and Nicobar Island. *Stolephorus commersonii* is an important fishery resource along with other pelagic fishes. The present study was carried out from January 2019 to March 2019 where the 100-114mm size group of *S. commersonii* was exposed to be dominant in landings. The length-weight relationship depicts isometric growth as both male and female show positive allometry with 'b' value of 3.384,and 3.215 respectively. Based on the Frequency of Occurrence method, the diet composition primarily consists of zooplanktons and crustaceans among which the most preferred food component were calanoid copepods, followed by invertebrate eggs, Chaetognatha, crustacean, bivalve and gastropod larvae. The Mature fishes were mostly found in the 100-114mm length class and were observed to have low gastrosomatic index. High gonadosomatic index value reflects in 130-144 mm length class indicates spawning occurs mostly in this length group. Proximate composition values were analyzed for both adults and juveniles of male and female *S. Commersonii* unveiled that the females of both adult and juveniles possess a slightly higher amount of protein whereas, lipid content was marginally dominant in males. *Stolephorus* collectively contribute to a major sharein anchovy fisheries from Andaman waters and this study subsidizes to be a database of biological information on this fishery resource.

Key words: *Stolephorus, Length-Weight relationship, Biology, Proximate composition, South Andaman*

Introduction

The Andaman and Nicobar islands on the east coast of India situated in the Bay of Bengal between 6° 45' and 13° 41'N latitude and 92° 12' and 93° 57'E comprise836 islands, islets and rocky outcrops having a coastal length of 1962 km which is nearly 26.10% of the Indian coast and continental shelf area is about 34965 sq.km which nearly form 6.60% of total Indian continental shelf and encompass an EEZ of 0.6 million sq.km. (Fisheries Department, Andaman and Nicobar Administration, 2018).

Anchovies belonging to the family *Engraulidae* with 151 species placed under 17 genera are small silvery pelagic fishes that are widely distributed along the tropic and subtropic regions of Indo-pacific (Eschmeyer et al., 2017). They are one of the major exploited pelagic finfish resources along the coastal waters of India which contributed significantly to the total marine fish production of India. Anchovies contributed 606518 tonnes which is around 6-18% of the total marine fish landings (CMFRI Annual Report, 2017-2018). Gopi and Mishra (2015) reported 34 species of anchovies from Indian seas belonging to Five genera - *Stolephorus, Coilia, Setipinna, Thryssa* and *Encrasicholina*. Most species of anchovies are small in size, under 20 cm in length, with translucent bodies, silver stripes down the side and a pig-like snout that projects beyond the tip of the lower jaw (Nelson, 1994). These small pelagic fish plays an important role in marine ecosystems, not only as plankton feeder but also as target fish for local commercial fisheries. Movement of anchovy shoals into the inshore region usually coincides with the piscivorous fishes such as carangids, ribbon fishes, tunas, seer fishes, billfishes, barracudas, sciaenids, sharks, wolf herrings, etc. for which anchovies are an important prey item (Job, 1940; Devasenan and Chidambaram, 1953;

Prabhu, 1955; James, 1967; Miller, 2007). Fishermen use this fish as bait for larger fish such as tunas and sea bass. Anchovies form an important percentage of the fish catch for fisher folks of the Andaman Islands whose livelihood depends on artisanal fishery (small scale).

In Andaman and Nicobar Islands, 13 species under the genera such as *Coilia, Encrasicholina, Scutengraulis, Setipinna, Stolephorus, Thryssina, Thryssa* have been reported so far. Among these *Stolephorus* collectively contribute to a major share of marine pelagic fisheries of (Ramakrishna et.al, 2010). The major gears employed in the anchovy fishery are boat seines, shore seines, bag nets and gillnets operated mainly by the catamarans and plank-built boats, most of them fitted with outboard engines. Anchovies are fished up to a distance of 5 km from the shore and to a maximum depth of 50 meters (Gopakumar and Pillai, 2000; Jayaprakash, 2003). *S. commersonii* is known for its influence on the pelagic food chain compared to planktivorous fishes as it spawns throughout the year, generating more recruits and

thereby maintaining almost a steady mature population. They have high economic importance because of their nutritional value and easy availability. The chance of overfishing is high which may lead to irreversible damage to the fish population pattern of both the top predators and planktonic group. The present study deals with length-frequency data, biochemical composition, food and feeding analysis in order to understand the biology and nutritional value of the fish and to plan a baseline outlook for sustainable fishery resource studies on anchovies from the Andaman coast.

Materials and Methodology

Study area

Junglighat landing centre (11°39'0"N, 92° 4center is the major fish landing centre with an adjoining fish market which is located in the North Western part of Port Blair, South Andaman. Fish landings starts early morning, 03 start 0400 hours onward for auctioning for international market as well as for domestic purposes.
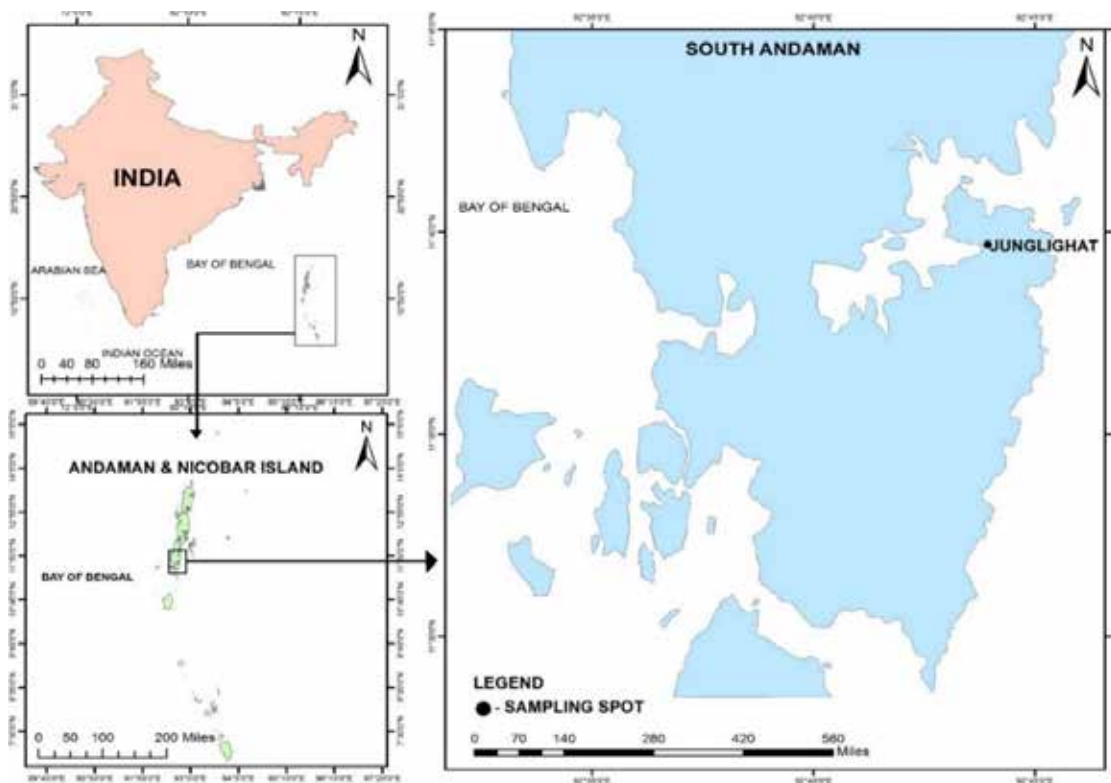

Fig. 1. Map showing the study area

Methods

The landing center and market of Junlighat center were visited twice/ thrice a week for an analysis of data on catch, demand and market price of anchovies. Random samples were collected during January 2019 to March 2019 for the estimation of biological studies and morphometric characters.

The samples were collected randomly and taken to the laboratory and photos of the specimen were taken for further pictorial reference and the specimen was identified till the species level by using standard identification keys (Fisher and Bianchi, 1984; Froese and Pauly, 2017).The morphometric measurements of the specimen was doneby using a Verniercaliper and further biological analysis was carried out.

Length-weight relationship (Krishna et al., 2015); Food and Feeding Analysis (Sivadas and Bhaskaran, 2009); GaSI (Desai, 1970); Sex ratio (Rao, 1988); GSI (Qasim, 1957); was followed for the study of fish biology and for the proximate composition analysis, for the estimation of carbohydrate (Dubois et al., 1956); Protein (Ninfa et al., 2009); lipid (Cox and Pearson, 1962) was followed.

Results

Systematics

Kingdom	: Animalia Linnaeus, 1758
Phylum	: Chordata Haeckel, 1874
Class	: Actinopterygii Klein, 1885
Order	: Clupeiformes Bleeker, 1959
Family	: Engraulidae Gill, 1861
Genus	: *Stolephorus* Lacepede, 1803
Species	: *Commersonii* Lacepede, 1803

Fig. 2. *Stolephorous commersonii*

Description

Body slender, translucent golden brown, oval in cross-section with a silver striped down flank; pair of dark patches posterior to occiput, followed by a pair of dark lines on dorsum to dorsal fin origin. Abdomen slightly rounded, with 1 to 5 (more often 1 to 4) small needle-like pelvic: no scutes post pelvic scutes. No pre-dorsal spine like scute and pelvic scute without spine. Maxilla tip pointed, reaching posteriorly to or slightly beyond the posterior border of preopercle; Small teeth present on the upper edge of hyoid bones. Gill rakersare slender ; lower gill rakersare usually 23 to 28. Anal fin is short, usually origins below the posterior half of dorsal fin. Tips of pelvic fin rays reaching posteriorly to vertical through anterior dorsal fin rays. Scales moderate, about 35 to 38 (usually 36 to 37) in lateral series.

Biology of *Stolephorus commersonii*

Length frequency distribution

The length frequency distribution analysis of *S. commersonii* showed that the dominant length class observed was 100-114 mm (46.39%) followed by the length class 85-99mm (40.22%) and the length class 115-129 mm was found to have lesser number of the specimen (2.06%) and out of the male specimens, the length class

which showed highest length frequency was 100-114 mm (25.77%) and the least percentage of length frequency was observed in the length class 145-160 mm (1.03%). In the case of female specimen collected, the percentage of length frequency was observed to be equally dominant among 100-114 mm length class and 85-99 mm length class (20.62%) and the least percentage of length frequency of female specimen was observed in the length class 115-129 (0%) that no female was obtained from the collected specimen in this length class (figure 3).
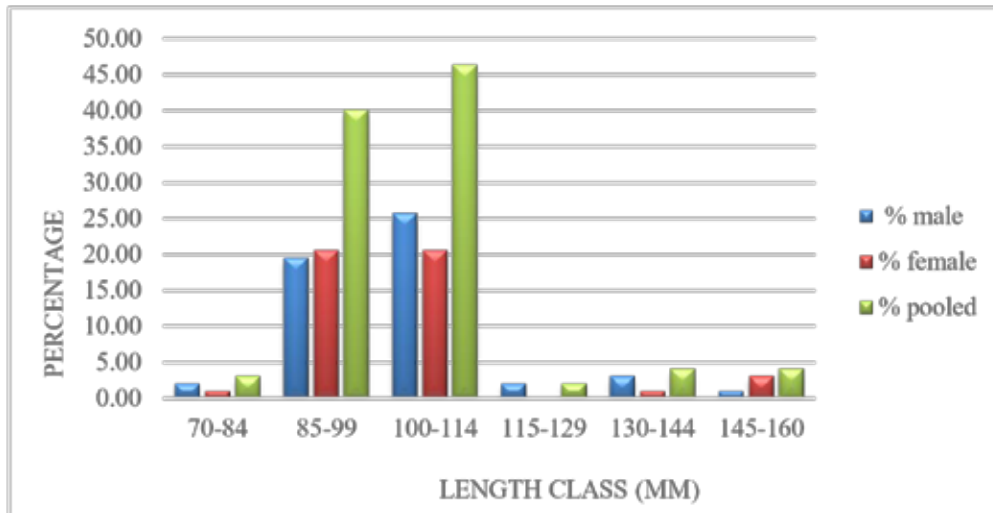
Fig. 3. Percentage of length frequency of male, female and pooled in each length class

Length-weight

Length-weight relationship of *S. commersonii* showed a positive allometry that implies isometric growth where there would be an increase in the size of the sample according to the increase in length (Figure 4a-c).
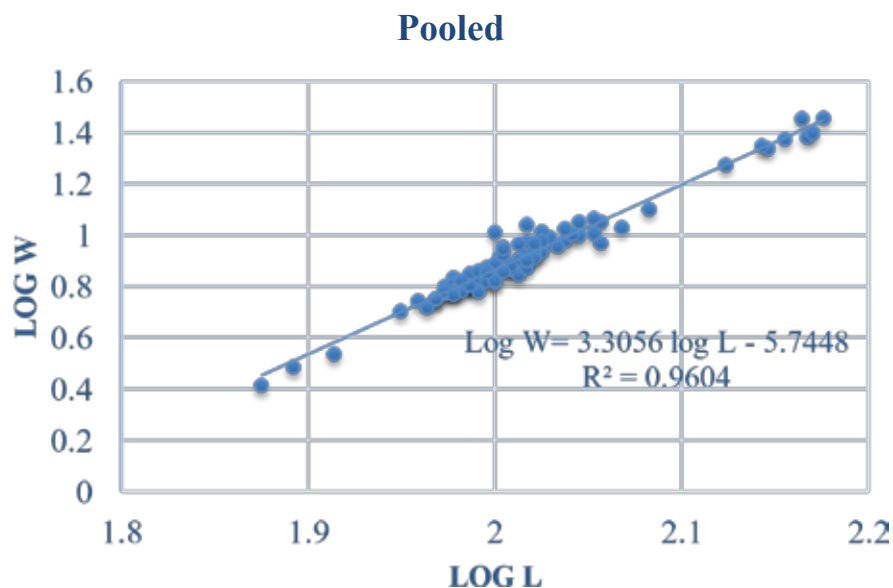

$$Log\ W = 3.3056\ log\ L - 5.7448$$
$$R^2 = 0.9604$$

Fig. 4a. Length weight relationship (Pooled)

Female

$$Log\ W = 3.2151\ Log\ L - 5.5661$$
$$R^2 = 0.9533$$
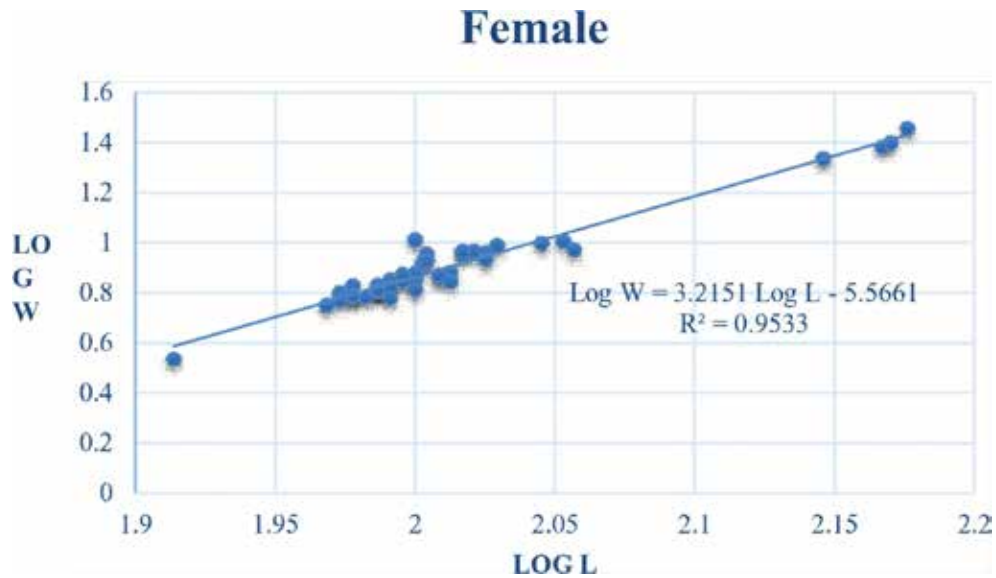
Fig. 4b. Length weight relationship (Female)

Male

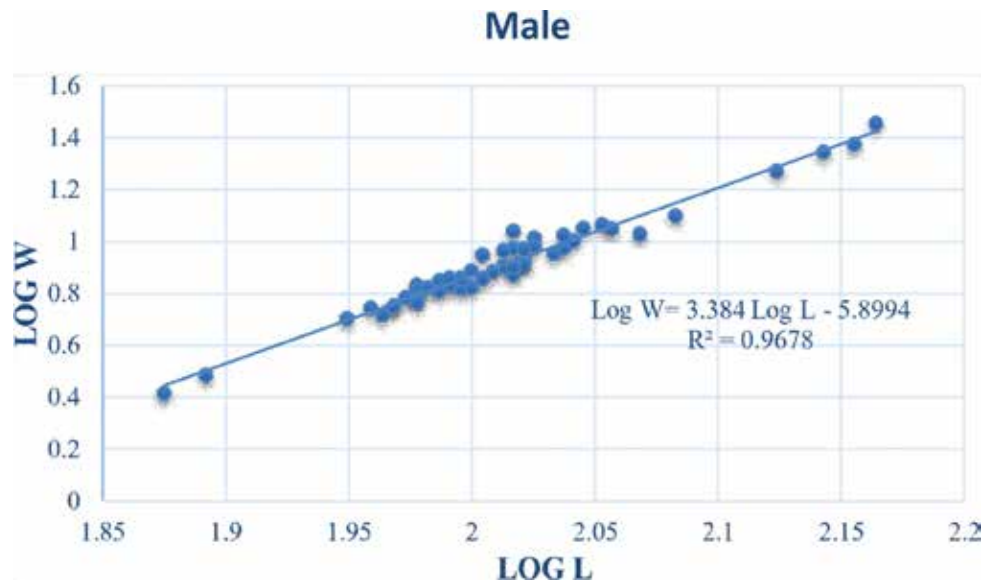

$$Log\ W = 3.384\ Log\ L - 5.8994$$
$$R^2 = 0.9678$$

Fig. 4c. Length weight relationship (Male)

Sex ratio

During the study period, it was observed that out of 97 fishes dissected, 52 were male (54%) and 45 were female (46%) and the Chi-square analysis for male and female (Table 1) showed no significance since all the χ^2 value is less than the table χ^2 value.

Table 1. χ² analysis of sex ratio

Length class (mm)	Total no. of fish	Male : Female	Expected	χ² value	Significance
70-84	3	01:02	1.5	0.6666	NS
85-99	39	01:01.0	19.5	0.051	NS
100-114	45	01:01.3	22.5	2.177	NS
115-129	2	1:0	1	0.577	NS
130-144	4	01:03	2	1.25	NS
145-160	4	01:00.3	2	1.25	NS
*P<3.841					

Food and feeding analysis

The analysis of feeding intensity carried out during the present study revealed that 3% of the total fish had its gut "full", 16% of the fish had "3/4 full" gut, 44% fish had "1/2 full "gut, 23% had "1/4 full" gut, 11% of the fish with "trace" amount of food particle in its gut and 3% with "empty" gut (Figure 5). The major food component from the gut content analysis were calanoid copepods (18.35%) followed by invertebrate eggs (11.01%) and chaetognaths (9.17%) and the least found food items during the study was crustacean shell and fish eggs (0.92%) respectively (Table 2),(Figure 6).
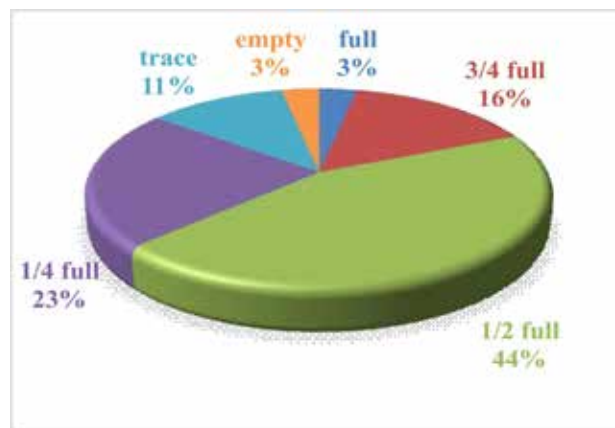

Fig. 5. Feeding intensity of pooled

Table 2. Number and percentage of food items observed during the gut content analysis of *Stolephorus commersonii*

Sl. No.	Item	Occurence	Percentage
1	Calanoid copepod	20	18.35
2	Chaetognatha	10	9.17
3	Cladocera	3	2.75
4	Copepodite	5	4.59
5	Crustacean chelate	4	3.67
6	Crustacean shell	1	0.92
7	Cyclopoid copepod	3	2.75
8	Euphausia	9	8.26
9	Fish egg	1	0.92
10	Fish larvae	2	1.83

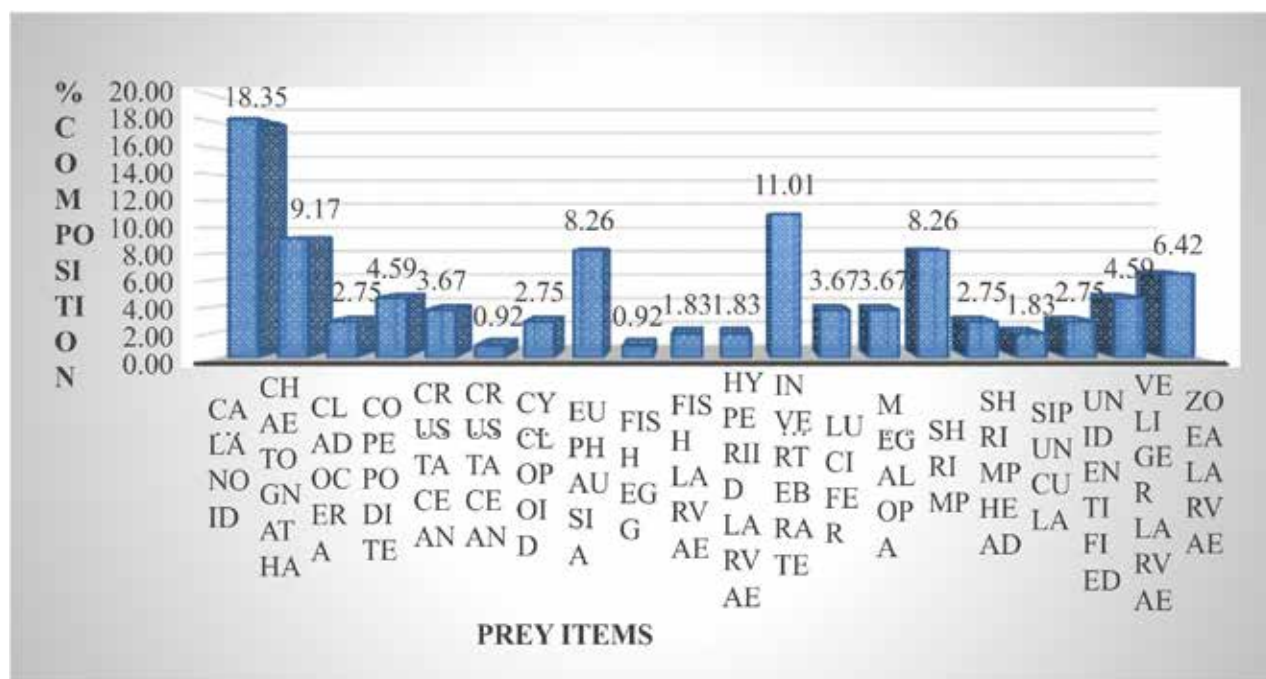| 11 | Hyperiid larvae | 2 | 1.83 |
12	Invertebrate egg	12	11.01
13	Lucifer	4	3.67
14	Megalopa larvae	4	3.67
15	Shrimp	9	8.26
16	Shrimp head	3	2.75
17	Sipuncula	2	1.83
18	Unidentified	3	2.75
19	Veliger larvae	5	4.59
20	Zoea larvae	7	6.42

Fig. 6. Percentage food composition of *S. commersonii*

Gastro Somatic Index of *Stolephorus commersonii*

The gastro somatic index of each fish was calculated according to the length class and was found to be higher in the length class 70-84 mm for male (3.21), female (3.50) and pooled (3.31) respectively (Figure 7) and it was observed that the average GaSI for pooled was very low for 85-99 mm length class (0.99) (Figure 7).
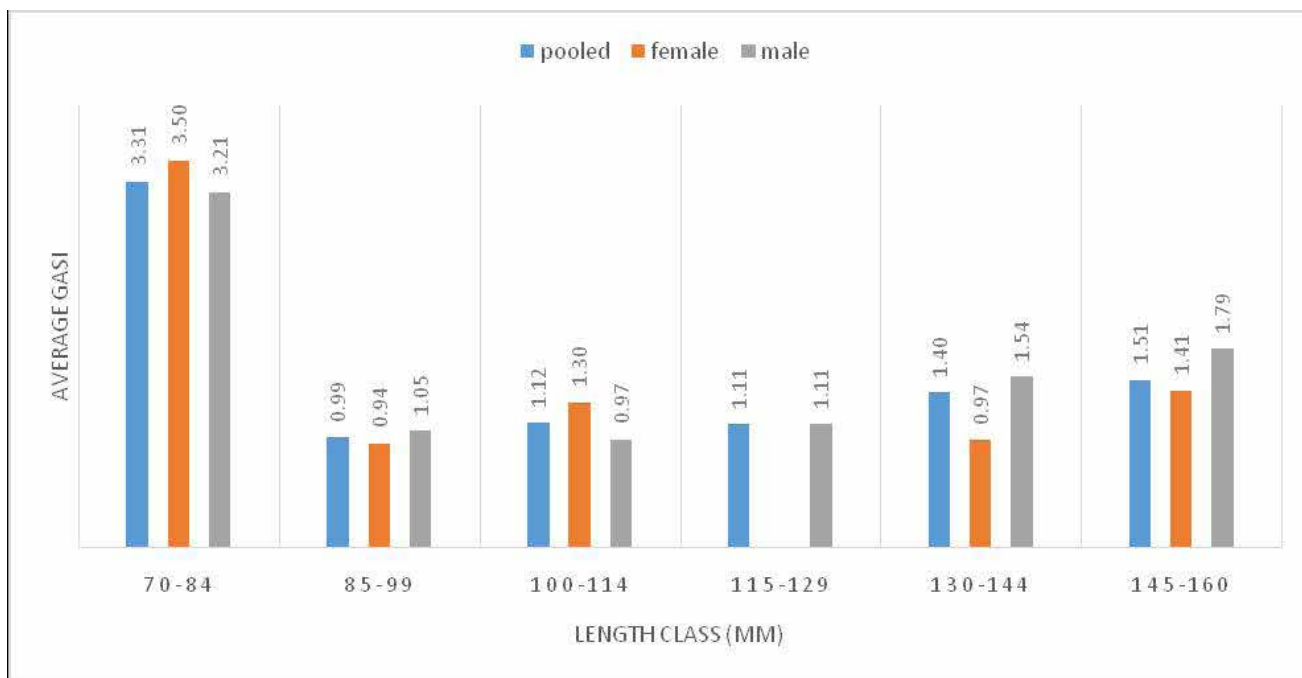
Fig. 7. Average GaSI of pooled, female and male

When the average GaSI was compared with the maturity stage it was clear that the average GaSI was more for immature fishes of length class 70-84 mm (3.31) followed by spent individuals of length class 100-114 mm (2.63)and the average GaSI was very less for maturing individuals of length class 85-99 mm (0.94) respectively (Figure 8)
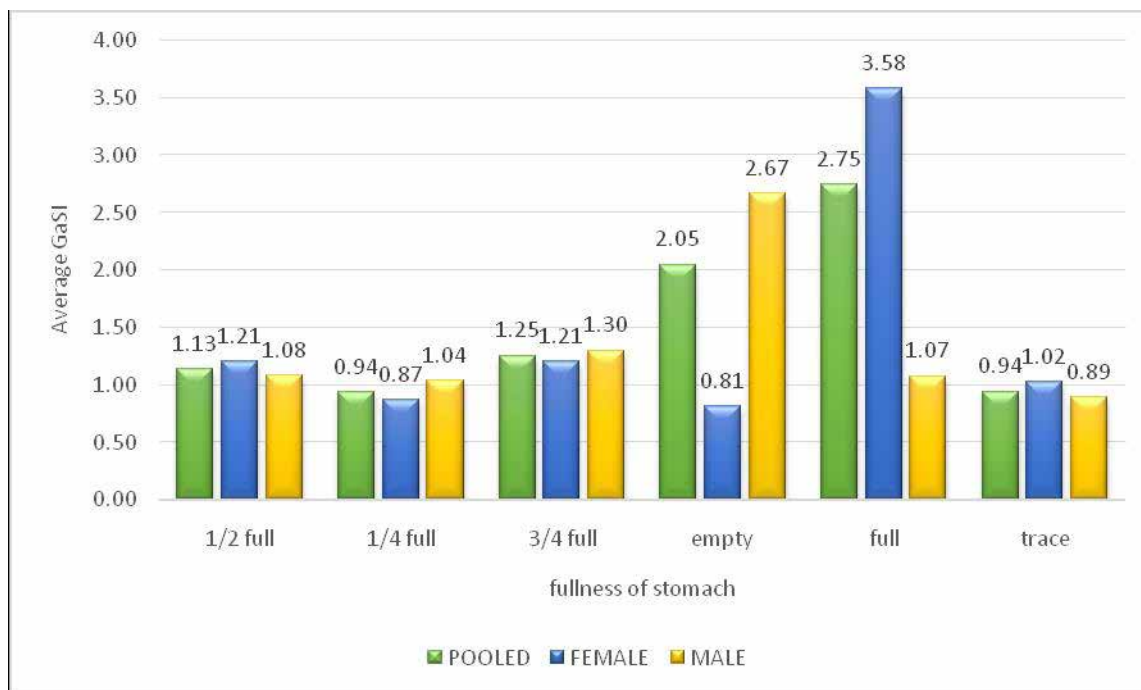

Fig. 8. Comparison of average GaSI of total fish with maturity stage.

Maturity stage

Among the entire fish specimen collected, it was observed that mature fishes were maximum (28.86%) followed by maturing fishes (21.65%) and minimum number of fishes were found in spent stage (2.062%) respectively. Most of the matured fishes were found in the length class 100-114 mm (28.87%) and in length class 70-84 mm it was immature (3.09%) (Figure 9).
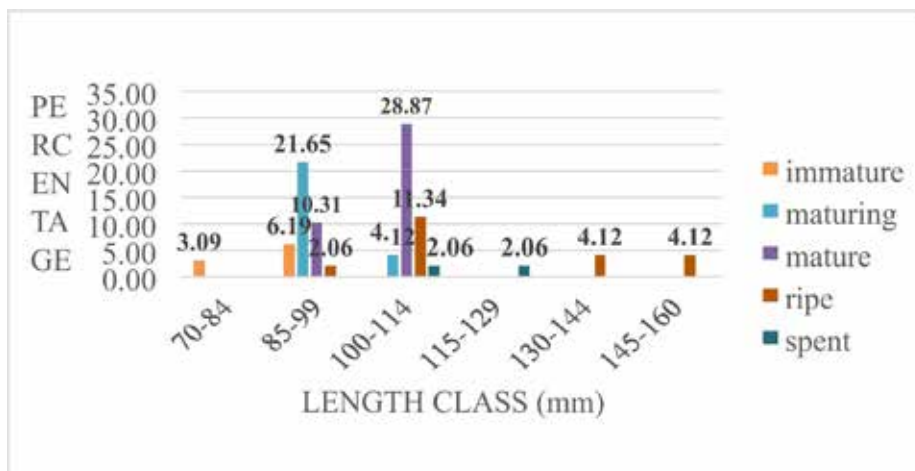

Fig. 9. Maturity stage of pooled

Among female individuals, the analysis of the maturity stage revealed that the percentage of mature female was found to be high in 100-114 mm length class (15.46%) and maturing female was more in 85-99 mm length class (13.4%). Immature female was obtained high in 85-99 mm length class (5.16%). In the case of ripe female it was observed to be equal in 100-114 and 145-160 mm length class (3.09%) and less in 130-144 mm length class (1.03%) and no female was obtained in spent stage from the collected sample (Figure 10).
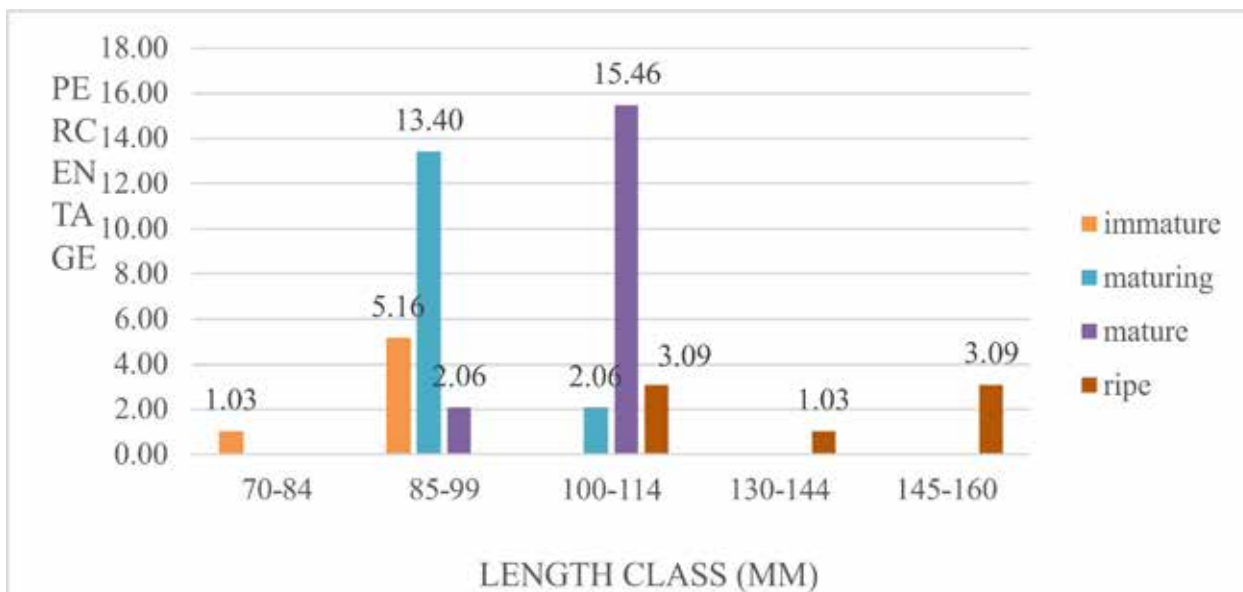

Fig. 10. Maturity stage of female

Among male, the percentage of mature male was found to be high in 100-114mm length class (13.4%) and the other length class where mature male found was 85-99 mm (8.25%) and no mature male was obtained in any other length class. the number of maturing male was found to be high in 85-99 mm length class (8.25%). The number of ripe individuals were also found to be high in 100-114 mm length class (8.25%) respectively. In the current study, spent males were also available and they belonged to the length classes 100-124 mm and 115-120 mm (2.06%) and the immature males were only available in the length class 7084 mm and 85-99 mm respectively (Figure 11).
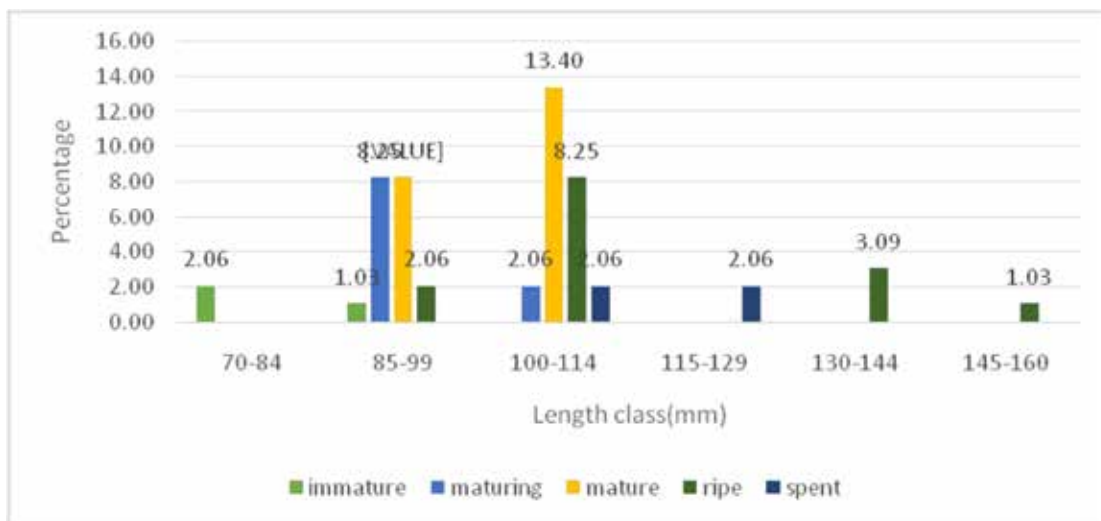

Fig. 11. Maturity stage of male

Gonado somatic index

It was observed that the average of GSI was high for length class 145-160 mm for pooled (4.08), male (3.11) and female (2.79) respectively. The average GSI was found to be very less in the length class 115-129mm since very less number of fish was obtained from this length class from the collected sample (Figure 12).
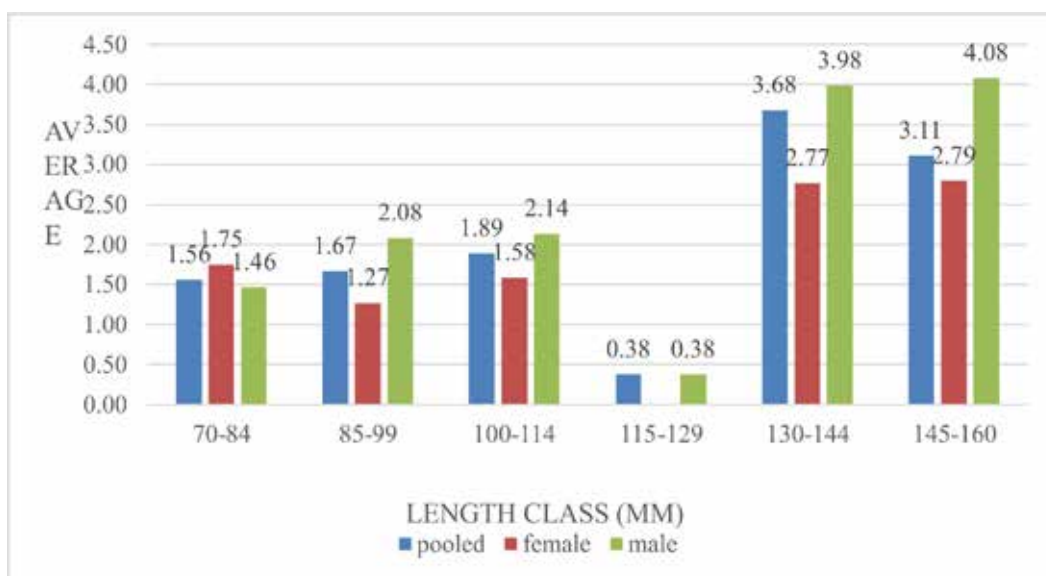

Fig. 12. Average GSI of pooled, female and male.

From the comparison of average GSI with maturity stage it was observed that the average GSI was high for 130-144 mm length class (3.68) and was for ripe stage of maturity. According to maturity stage, the average GSI was very low for fishes with spent stage of maturity (0.33) under 100-114 mm length class for pooled (Figure 13) and for male it was observed that the average GSI was more for ripe stage of maturity under 145-160 mm length class (4.08) and the least was for spent stage which was same as that of the pooled (Figure 14). For female, it was observed that the average GSI was more for ripe stage of maturity and was almost equal for 145-160mm (2.79), 130-144 mm (2.76) and 100-114 mm (2.47) respectively. The average GSI was found to be very less for immature individuals of 7084mm length class (0.83) and no spent female was obtained from the collected sample in any length class (Figure 15). Based on the study, it was observed that the average GSI showed an increasing trend when compared with the maturity stages according to increase in length.
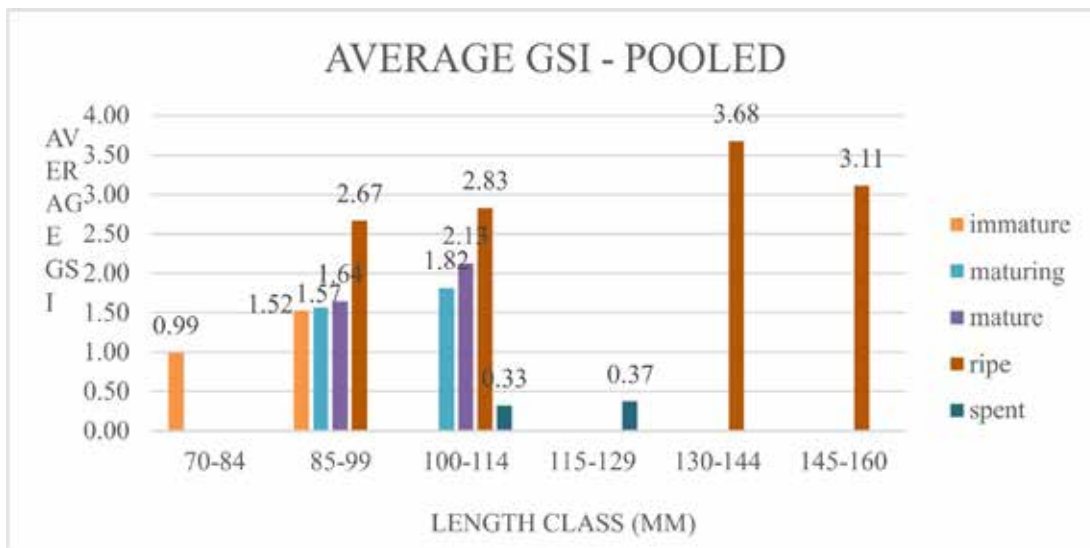

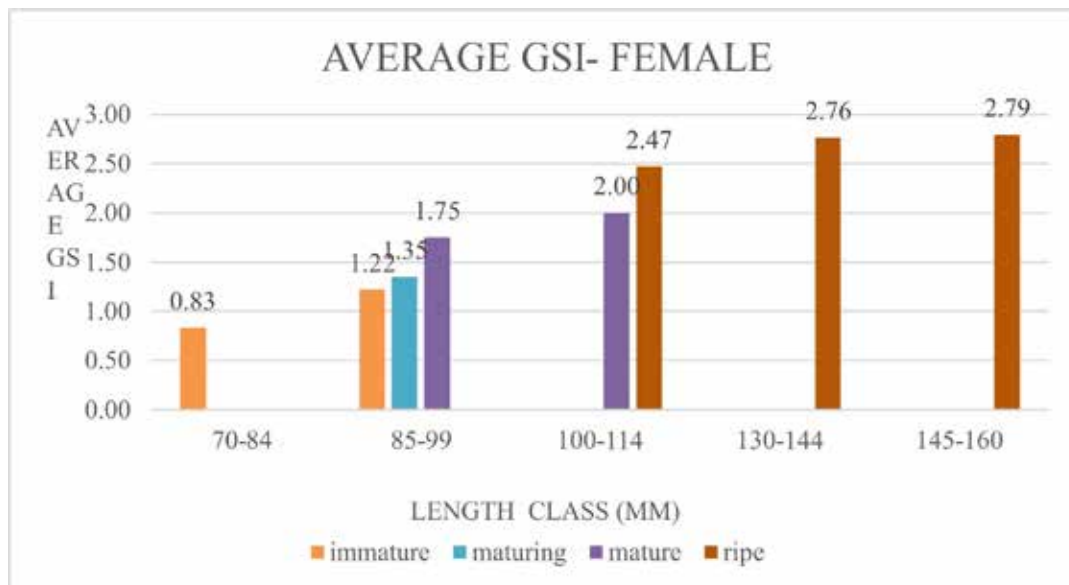**Fig. 13. Comparison of average GSI of pooled with maturity stage**

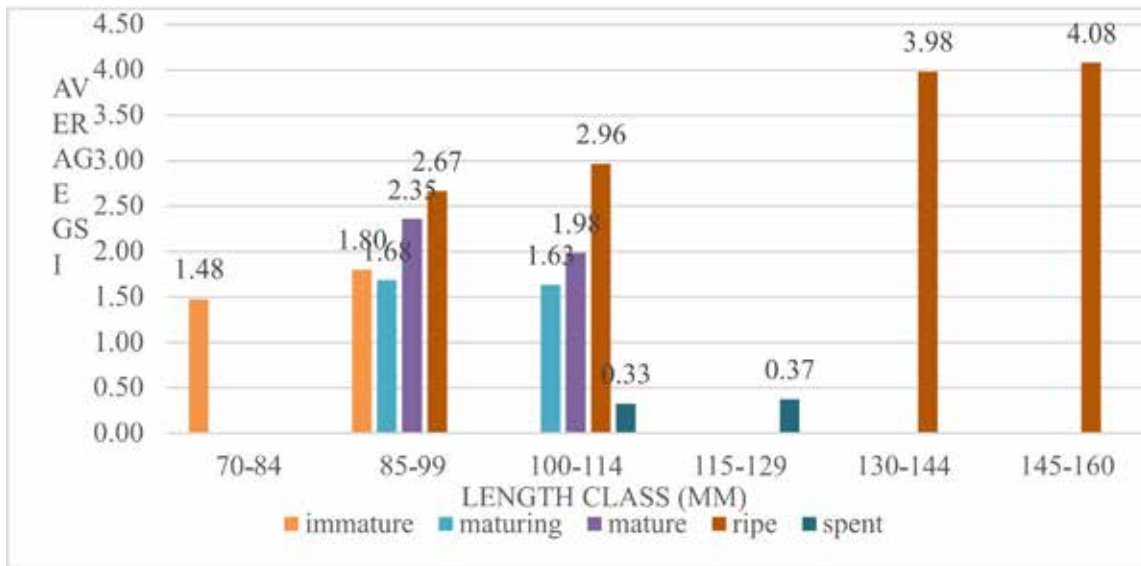**Fig. 14. Comparison of average GSI of female with maturity stage**

Fig. 15. Comparison of average GSI of male with maturity stage

Proximate composition analysis of *Stolephorus commersonii*

The present study of proximate composition values of *Stolephorus commersonii* revealed that in juvenile fish for both male and female, moisture content was maximum (7678 %) followed by protein content (13-15%) lipid (2-3%) and carbohydrate content (1-2%) (Figure 16). In adult specimens for both male and female, the moisture content was about 7779% and protein content was about 16 -20%, lipid (5-7%) and carbohydrate (2-2.5%) respectively (Figure 17).
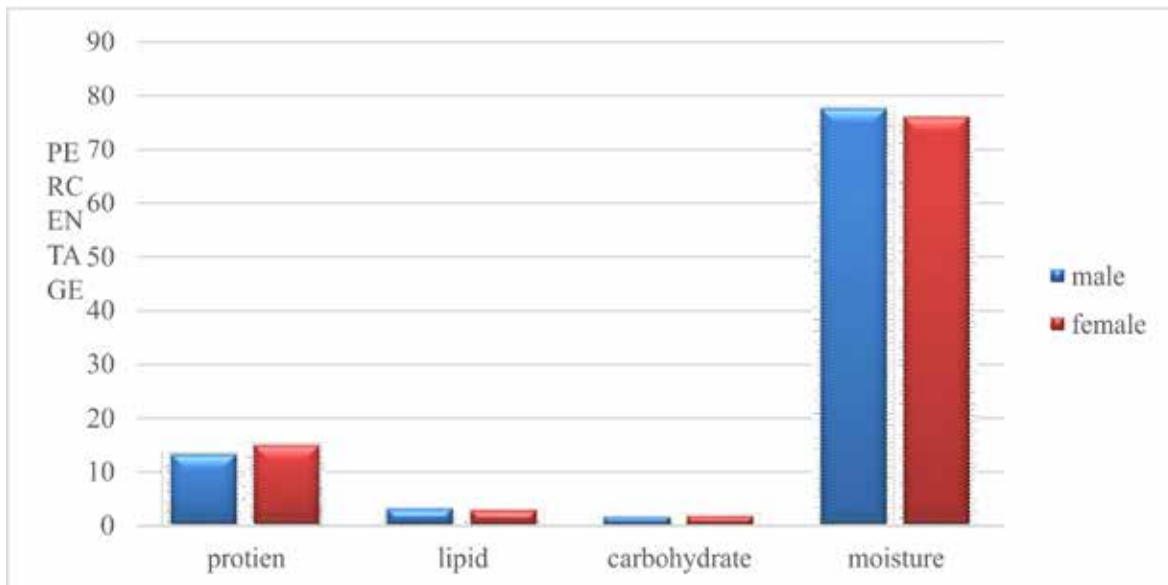

Fig. 16. Proximate composition of juvenile male and female of *S. commersonii*
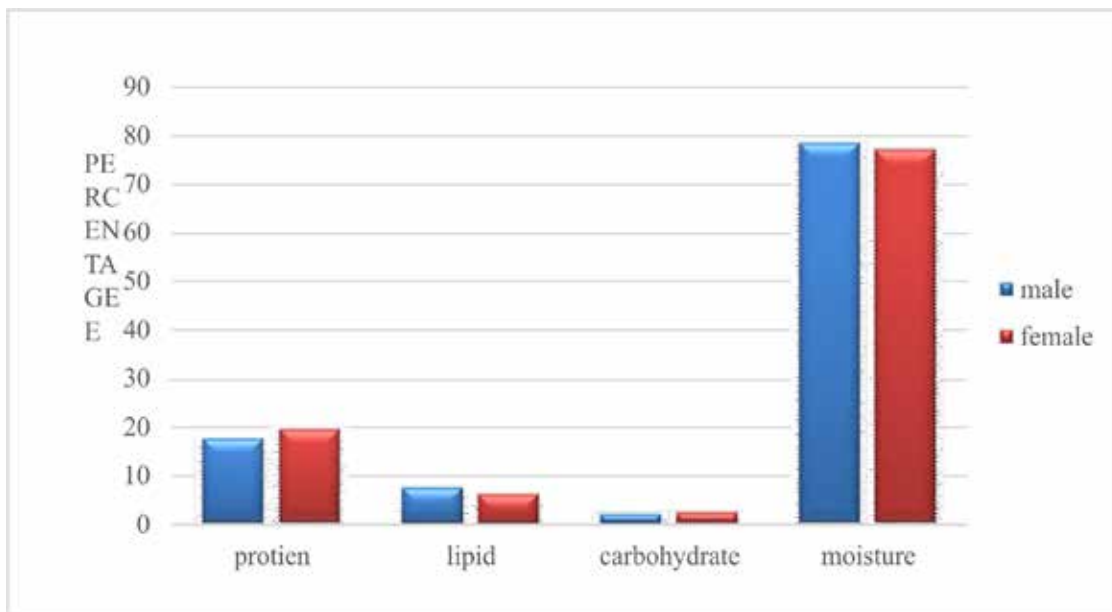
Fig. 17. Proximate composition of adult male and female of *S. commersonii*

Discussion

In the recent study, a total of 97 specimen of *S. commersonii* were collected and distributed among 6 different length class starting from 70 mm to 160 mm with an interval of 15 mm. The length frequency distribution of *S. commersonii* exposed that among the total fish the length frequency of male was dominant (54%) compared to female (46%)and the length classes which showed high length frequency distribution was 100-114mm (46.39%) and 8599 mm (40.21%), from which we can construe that the major seizure of *S. commersonii* were from these length group.

The exact relationship between length and weight differs among various species according to their inherited body shape and within a species according to the condition of individual fish (Froese, 2006; Venu, 2009). During the present LWR study on *S. commersonii* showed a positive allometric growth with 'b' value of 3.30, 3.21 & 3.38 for pooled, female and male that followed Cube's law portraying strong relationship between length and weight of the fish with the R^2 value of pooled 0.9533, male 0.9624 and female (0.9678) respectively. The study on the length weight relationship of *S. commersonii* along the Kerala coast by Nair et al. (2015) contributes virtually

similar result. In the analysis of sex ratio, there wasn't any significance observed in Chi-square test in any length group in this study.

This study exhibits that the chief diet of *S. commersonii* comprises planktonic copepod which reveals that *S. commersonii* is a planktonivorus fish showing high carnivorous mode of feeding. The result of the current study corroborated similarities with earlier observation on the diet of *S. commersonii* from Indian waters (Bapat and Bal, 1950; Venkataraman, 1960; Kumar et al., 2015). The stomach content of this fish shows a good relationship with the contiguous plankton leading towards the conclusion that there can be strong correlation between the occurrence and the abundance of *S. commersonii* with the respective availability and population density of zooplankton (prey) in the environment.

The average gastro somatic index of *S. commersonii* during the study period was observed as higher in the length class 70-84 mm among the whole collected sample. This result point out that the initial growth stages pursue more food. The comparison of average value of GaSI against maturity stage disclosed that the immature fish feeds more followed by the spent fishes.

The analysis on maturity stages during this study infers that mature fishes are obtained more for *S. commersonii* followed by maturing, ripe, immature and spent. Females and males also followed the same trend but no spent females were obtained during the study period. The average value of GSI of *S. commersonii* showed that the GSI was more for the higher length class individuals. On comparison of average GSI with the maturity stage it unveiled that there was an increasing trend in the GSI of the fish according to the change in maturity stage. Ripe stage of maturity showed high average GSI which denote that the abdominal cavity was fully occupied by ripe gonad .The review of previous literature indicated that the studies on the reproductive biology was scanty from the Andaman waters.

The analysis of proximate composition of *S. commersonii* revealed that among both male and female individual of immature and adult fishes, moisture content was more (76- 79%) followed by protein content (13-20%) and then lipid content (2-7%) and very less carbohydrate content (1-3%) which was similar to the observation of Kumar and Padmavati (2017). According to the present study, in the case of both juvenile and adult, male individuals exhibits slightly more moisture content when compared with female individuals while, females had higher protein when compared to male.

Summary and conclusion

The results obtained from the present study depicted that *S. commersplani*is aplanktivorous fish which is one of the important fishes of the marine food chains. Also, they are a good food source for almost every predator fish in the environment such as halibut, yellowtail, rockfish etc. with high protein content. These are one among the group of highly exploited fishes in these island waters and the length class which was exploited maximum was 100-114mm followed by 85-99 mm. Very few studies have been conducted on the biology of *Stolephorus commersonii* from these waters, the contribution through this study will add more information to the database for further research from this study area.

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