International Journal Of

Recent Scientific Research

ISSN: 0976-3031

Volume: 7(11) November -2015

SOME ASPECTS OF BIOLOGY OF STARGAZER URANOSCOPUS ARCHIONEMA REGAN, 1921 (PERCIFORMES: URANOSCOPIDAE) OFF VISAKHAPATNAM, EAST COAST OF INDIA

Yedukondala Rao P, Naga Krishna Veni D, Rukmini Sirisha I and Sudha Rani D

THE OFFICIAL PUBLICATION OF
INTERNATIONAL JOURNAL OF RECENT SCIENTIFIC RESEARCH (IJRSR)
http://www.recentscientific.com/ recentscientific@gmail.com

ISSN: 0976-3031

Available Online at http://www.recentscientific.com

International Journal of Recent Scientific Research
Vol. 6, Issue, 11, pp. 7247-7253, November, 2015

International Journal of Recent Scientific Research

RESEARCH ARTICLE

SOME ASPECTS OF BIOLOGY OF STARGAZER *URANOSCOPUS ARCHIONEMA* REGAN, 1921 (PERCIFORMES: URANOSCOPIDAE) OFF VISAKHAPATNAM, EAST COAST OF INDIA

Yedukondala Rao P*, Naga Krishna Veni D, Rukmini Sirisha I and Sudha Rani D

Department of Marine Living Resources, College of Science and Technology, Andhra University, Visakhapatnam-530003, A. P., India

ARTICLE INFO

Article History:

Received 16th August, 2015
Received in revised form 24th September, 2015
Accepted 23rd October, 2015
Published online 28st November, 2015

Key words

Uranoscopus archionema, spawning biology, food and feeding habits, Length -weight relationship, Visakhapatnam

ABSTRACT

Males dominated the populations of *U. archionema* from Visakhapatnam during the study period. Sex ratio for male to females was 1:0.67. A scale of seven stages of maturity of gonads was identified in females. The mean length at first maturity was found to be 152mm in females. Peak spawning takes place during February-March and again in October-December. GSI has been found to be high during January to April and again in October to December in males; February, March, August, October and December in females. *U. archionema* was a fractional spawner and releases ripe eggs in two batches during the spawning season. The fecundity ranged from 3,583 to 8,773 ova. *U. archionema* was a carnivore feeds on fish, shrimp, cephalopods, crab, gastropods and miscellaneous items. There was no marked difference in the food composition between males and females. A common regression equation was given for both the sexes as $W=2.85233E - 05 L^{2.87047}$ ($r = 0.89$). Analysis of covariance conducted to test the difference between regression slopes of males and females showed a significant difference ($p<0.05$). Relative condition factor was low during June, August, October to December in males; February, March, August and October in females.

INTRODUCTION

The fishes of genus *Uranoscopus* are commonly called as stargazers. These are marine, benthic predators occurring in the littoral waters and on continental shelf and upper slope, caught by trawl in 60-300m depth (Smith and Heemstra, 1986; Hureau, 1986; Demestre *et al*., 2000). There are about twenty five species belonging to eight genera (Smith and Heemstra, 1986). Stargazers are have two large venomous spines situated behind their opercles and above their pectoral fins and they also possess electric organs (Heemstra, 1986 and Baron, 2009). There was no published data on the biology of *U. archionema* in India so far. Due to paucity of information on biology and ecological importance of *U. archionema* from Visakhapatnam, the present study aims to obtain some basic information on maturation, spawning season, length at first maturity, sex ratio, fecundity, food and feeding habits and length-weight relationship as a first attempt.

MATERIALS AND METHODS

The present study was based on 122 specimens of *U. archionema* (males: 73; females: 49) ranging in size from 45mm to 185mm and weight 2 to 114.5g collected from commercial trawl catches at Visakhapatnam fishing harbor (Lat 17°41'45"N, Lon 77°40'15"E,) twice in a month during January to December 2008. The samples were not available during May due to fishing holidays from 15th April to 31st May which has been implemented for conservation of fishery resources. The collected samples were immediately brought to the laboratory for further analysis. After measuring the total length (nearest 1mm) and weight (nearest 0.5gm) of each specimen, the belly was cut open to note the sex, color and general appearance of the gonads. The gonads were then carefully removed and preserved in 5% formalin in labeled bottles for further analysis. The sex ratio of the sampled population was analyzed according to month. Maturity of the gonads was determined by external appearance like color, size, area occupied by them in the body cavity and microscopic observations of the ova (Prabhu, 1955).

The mean length at first maturity (Lm) was determined for females by fitting logistic curve (King, 1995). To determine the length at first maturity females were grouped into 10mm length

*Corresponding author: **Yedukondala Rao P**
Department of Marine Living Resources, College of Science and Technology, Andhra University, Visakhapatnam-530003, A. P

intervals with gonads of stage IVand above (mature to ripe). The average length at which 50% of the population attains maturity was considered as length at first maturity. Percentage occurrence of matured fishes (fishes with gonad stage IV - VI) in different months and Gonado Somatic Index (GSI) were used to determine the spawning season (West, 1990). The Gonado Somatic Index (GSI) was calculated using the formula: GSI = GW/FW × 100 Where GW: gonad weight (g); TW: the total body weight (g).

Measurement of ova diameter (Clark, 1934) was made by taking sections from middle of the ovary. All the ova were teased out on a micro slide and their diameters were measured under a compound microscope with the help of an ocular micrometer at 40x, where each micrometer division (md) is equal to 0.02mm. About 500 – 600 ova were measured from early maturing to ripe ovaries (stage II to VI). For convenience, the ova were divided into diameter groups of two micrometer divisions each (i.e. 1-2, 3-4, 5-6 and so on) to determine the frequency distribution of ova of different sizes towards maturity. Estimation of fecundity gravimetrically (Simpson, 1959) was based on intact ovaries of ripe stage collected during the study period. Relationships between fecundity (F) against fish length (L), fish weight (W) and ovary weight (OW) were estimated using linear regression equation (Bagenal, 1978) as $F = aX^b$ where a = constant, b = exponent, F = fecundity, X = total length / body weight / gonad weight. Fecundity values were plotted against the respective total length, weight and ovary weight of fish.

For study of gut content analysis, six categories of stomach fullness namely empty, one fourth, half, three fourth, full and gorged could be recognized based on the nature of stomach folds (Rao, 1964) and their percentage was calculated. Each stomach was considered as a unit and the stomach contents were first identified qualitatively to the nearest taxon possible and their quantity was determined volumetrically. The points gained by each food item in all the stomachs were used to calculate the percentage of different food items (Hynes, 1950).

The length-weight relationship (LWR) was derived using exponential hypothetical formula $W = aL^b$ (Le Cren, 1951) where W is body weight (g), L is total length (mm), 'a' is a coefficient related to body form and 'b' is an exponent indicating isometric growth when equal to 3 (Sangun *et al* 2007). For testing the difference between the regression slopes of males and females, analysis of covariance was employed (Snedecor and Cochran, 1967). The monthly relative condition factor (Kn) for males and females was estimated adapting the formula of Le Cren (1951). Statistical analysis was carried out by Micro Soft Excel.

RESULTS

Sex ratio

The sex ratio in different months during study period from January to December, 2008 was shown in Table 1. Males dominated throughout the study period except in January, March and December, where females dominated. The sex ratio for male to female during this period was 1:0.67.

Table 1 Month-wise sex ratio of *U. archionema* at Visakhapatnam

Month	Males	Females	% of males	% of females	Male : Female
January	1	3	25.00	75.00	1:3
February	10	3	76.93	23.07	1:0.3
March	7	10	41.18	58.82	1:1.42
April	5	3	62.50	37.50	1:0.6
May	-	-	-	-	-
June	7	2	77.78	22.22	1:0.28
July	15	6	71.43	28.57	1:0.4
August	6	4	60.00	40.00	1:0.66
September	7	3	70.00	30.00	1:0.42
October	5	2	71.43	28.57	1:0.4
November	2	1	66.67	33.33	1:0.5
December	8	12	40.00	60.00	1:1.5
Total	73	49	59.84	40.16	1:0.67

Maturation

A scale of 7 stages of maturity of ovaries was adopted in this study.

Stage I (Immature)

The ovaries were thin, narrow and translucent. Ova were invisible to naked eye. The ova were transparent. Ovaries were milky white in color.

Stage II (Early maturing)

The ovaries were cylindrical, translucent and occupied about more than $1/4^{th}$ of the body cavity. Ovaries were milky white in colour. Ova attained a modal size of 9-10md (0.18-0.20mm)

Stage III (Maturing)

Ovaries were thick, narrow, cylindrical and occupied half of the body cavity. They were pale yellow in color, blood capillaries distinct. Ova attained a modal size of 29-30md (0.58-0.60mm).

Stage IV (Mature)

Ovaries occupied more than half of the length of body cavity, becoming bulky. The ovaries were creamy in color with numerous blood capillaries over the entire ovary. Ova were opaque and filled with yolk. Ova attained a modal size of 31-32md (0.62-0.64mm).

Stage V (Gravid)

Ovaries with thin ovarian wall, creamy in color and with numerous blood capillaries occupied $3/4^{th}$ of the body cavity. The mature ova were large, spherical and were easily separable. The ova becoming translucent with continued absorption of yolk. Ova were visible to naked eye. Ova attained a modal size of 39-40md (0.78-0.80mm).

Stage VI (Ripe/Spawning)

Ovaries with thin ovarian wall occupied entire body cavity.

Ovaries were creamy in color with numerous blood capillaries, ova became translucent. Ova attained a modal size of 61-62md (1.22-1.24mm).

Stage VII (Spent)

The bulky ovaries were very much reduced, bag like and hollow. Some disintegrated, free and loosely connected, mature ova were present in the ovary, besides the large maturing and immature ova.

Length at first maturity (LM)

The percentage frequency of mature females in different stages of ovary in different length groups was given in Table 2. Ripe females were observed from 125mm onwards. However majority of females in the range of 131-170mm formed the spawning population and constituted a sizable quantity at Visakhapatnam. The average length at which 50% of the individuals attain first sexual maturity was 152mm length in females (Fig. 1).

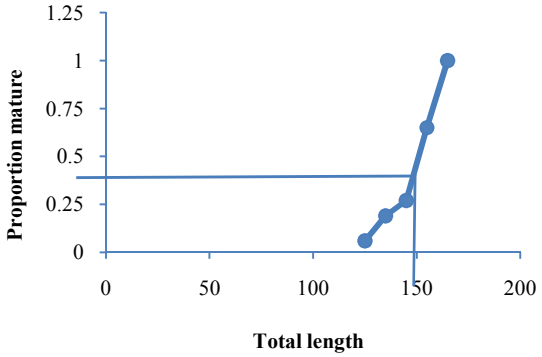

Fig. 1 Length at first maturity in females of *U. archionema*

Spawning season

Monthly percentage occurrence of females in different stages of maturity during the study period from January to December, 2008 was given in Table 3. The frequencies of female fish with ripe stage (VI) were available during February, March, October and December. V stage was observed almost entire study period except January, April, October and December. Mature stage IV was also observed in entire study period except February, June and November. More number of fishes with spent stages was noticed in March and December. The vailability of fishes with ripe stages (VI) during February, March, October and December indicated to be the peak spawning season of *U. archionema* from trawling grounds off Visakhapatnam

Gonado Somatic Index (GSI)

GSI has been found to be high during January to June and again from October to December in males; February, March, August, October and December in females indicating that spawning activity. A fall in GSI has been seen in July and August in males; June and September in females indicating the cessation of spawning activity in males and females of *U. archionema* (Fig. 2).

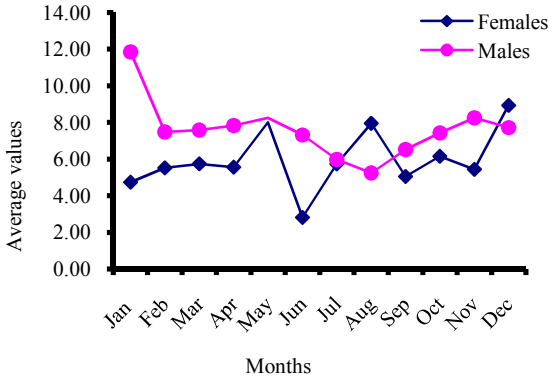

Fig. 2 Gonado Somatic Index of *U. archionema*

Development of ova to maturity and spawning

Ova diameter frequency in first stage of maturity showed a large number of immature ova, progressively increase in size with the advancement of maturity in subsequent stages (Fig. 3). In Stage II, a batch of ova released from parent stock and formed a mode 'a' around 9-10md (0.18-0.20mm). This mode progressed to 61-62md (1.22-1.24mm) in Stage VI. In Stage II another batch of ova was released from the parent stock and it formed a mode 'b' around 3-4md (0.06-0.08mm). This mode could be traced to 55-56md (1.10-1.12mm) in Stage VI. Two batches of ova were thus released from parent stock and under-went the process of maturation. The ova at mode 'a' in stage VI were ripe and to be released, the ova at mode 'b' in Stage VI were opaque and yet to become ripe. Thus, it appeared that U. archionema was a fractional spawner releasing ripe eggs in two batches during the spawning season.

Fecundity

The fecundity ranged from 3,583 to 8,773 with mean 6,136 ± 276.3025 in length ranging from 130mm to 172mm TL. The relationship between fecundity (F) and fish length (L), fish weight (W) and ovary weight (OW) showed linearity (Fig. 4A, B and C). The equations obtained were:

$F = 1.259505\ L^{1.6927}$
$F = 590.608917\ W^{0.3790}$
$F = 5045.45108\ OW^{0.2163}$

Food and feeding habits

The food items were classified into 7 major groups namely fish, shrimp, cephalopods, crab, gastropods, miscellaneous items and digested matter. Regular food items in the order of importance during January to December, 2008 (Fig. 5) were fish (50.59%) (represented by *Saurida sp*, apogonids, sciaenids, eel fishes and other unidentified teleostean fishes); shrimp (12.12%) (penaeoids and carideans), cephalopods (11.18%); crab (8.05%) (mostly *Charybdis* sps); miscellaneous items (1.88%) (sand, sea fans, fish scales) and gastropods (0.69%). The random variations of stomachs with different intensities of feeding in different months showed that highest feeding intensity was observed throughout the study period except in August, October and November (Table 4).

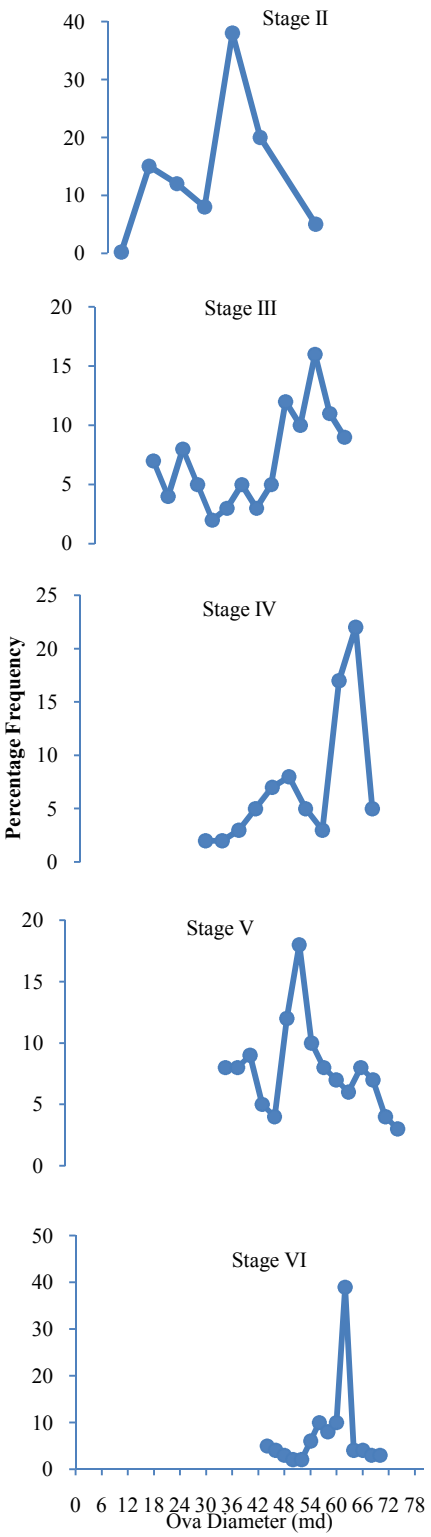

Fig 3 Frequency distribution of ova in different stages of maturity in *U. archionema*

Length – weight relationship (LWR)

Estimations of the constants 'a' and 'b' in the linear form were made using the method of least squares in the logarithmic form:

Males W = 1.67417E-05 L $^{2.9901}$ (r = 0.94)
Females W = 5.99515E-05 L $^{2.7130}$ (r = 0.85)
Combined W = 2.85233E-05 L $^{2.87047}$ (r = 0.89)

Table 2 Length –wise percentage frequency distribution of females with different stages of maturity

Lengths	Total No.	I	II	III	IV	V	VI	Spent
41-50	1	-	100.00	-	-	-	-	-
51-60	-	-	-	-	-	-	-	-
61-70	-	-	-	-	-	-	-	-
71-80	1	100.00	-	-	-	-	-	-
81-90	2	100.00	-	-	-	-	-	-
91-100	4	25.00	50.00	-	25.00	-	-	-
101-110	3	-	-	100.00	-	-	-	-
111-120	2	-	-	100.00	-	-	-	-
121-130	7	-	-	-	85.71	14.29	-	-
131-140	7	-	14.29	14.28	28.57	28.57	14.29	-
141-150	4	-	-	-	50	50.00	-	-
151-160	5	-	-	-	-	20.00	80.00	-
161-170	12	-	-	8.33	16.67	25	33.33	16.67
171-180	1	-	-	-	-	-	-	100.00

Table 3 Month –wise percentage frequency distribution of females with different stages of maturity.

	Total No.	I	II	III	IV	V	VI	Spent
January	3	-	33.33	33.33	33.34	-	-	-
February	3	-	33.33	-	-	33.33	33.34	-
March	10	-	-	10.00	30.00	10.00	30.00	20.00
April	3	33.33	33.33	-	33.34	-	-	-
May	-	-	-	-	-	-	-	-
June	2	-	-	-	-	100.00	-	-
July	6	16.67	33.33	16.67	16.67	16.66	-	-
August	4	-	25.00	25.00	25.00	25.00	-	-
Septembr	3	-	-	-	33.33	66.67	-	-
October	2	-	-	-	50.00	-	50.00	-
November	1	-	-	-	-	100.00	-	-
December	12	25.00	-	8.33	25.00	-	33.33	8.34

Table 4 Monthly percentage occurrence of guts in various degrees of fullness.

Months	N	Gorged	Full	3/4	Half	1/4	Empty
Jan	4	-	-	25.00		75.00	-
Feb	13	7.69	7.69	7.69	7.69	53.85	15.39
Mar	17	5.88	11.76	5.88	17.65	41.18	17.65
Apr	8	12.50	12.50	-	-	50.00	25.00
May	-	-	-	-	-	-	-
Jun	9	11.11	11.11	11.11	11.11	44.45	11.11
Jul	15	13.33	6.67	20.00	20.00	26.67	13.33
Aug	10	-	20.00	10.00	-	50.00	20.00
Sep	10	10.00	-	10.00	20.00	40.00	20.00
Oct	7	-	14.28	14.28	28.58	28.58	14.28
Nov	3	-	33.33	33.33	-	33.34	-
Dec	10	10.00	10.00	10.00	-	50.00	20.00

The comparision of regression lines in Table 5 showed a significant difference ($p<0.05$) between the slopes of the two sexes at 5% level and showed negative allometric growth for combined sex. The scattered diagram of observed weight against length of all the specimens reveals a curvi-linear relation between two variables (Fig. 6 & 7).

Relative condition factor

Variations in the relative condition factor in different months (Fig. 8) were studied for both males and females. Monthly variations in the relative condition factor showed high values in April, July and September, whereas low values were noticed in June, August and again from October to December in males. Highest values were observed in January, June and September and low values were observed in February, March, August,

October and December in females.

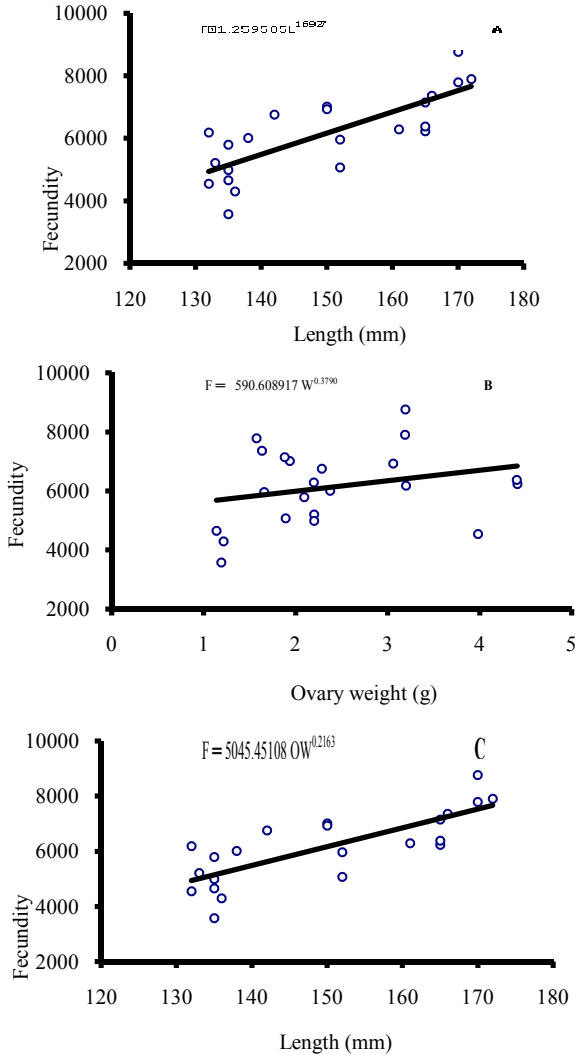

Fig. 4 Relationship between fecundity and fish length (A), fish weight (B) and ovary weight (C) of *U. archionema*

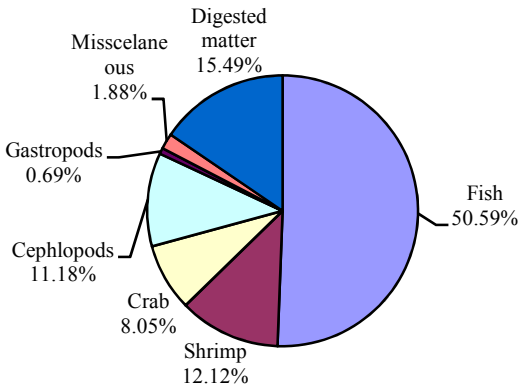

Fig. 5 Percentage composition of different food items in the gut of *U. archionema*

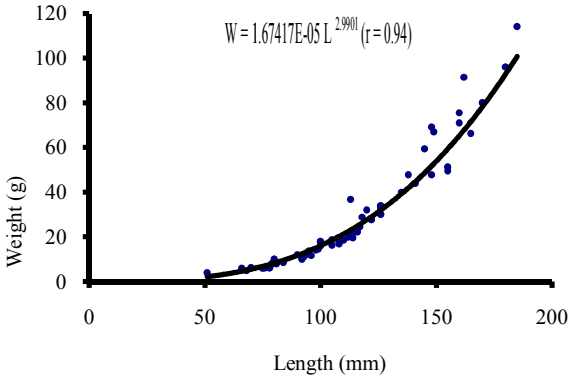

Fig 6 Scattered diagram of length-weight relationship in males of *U. archionema*

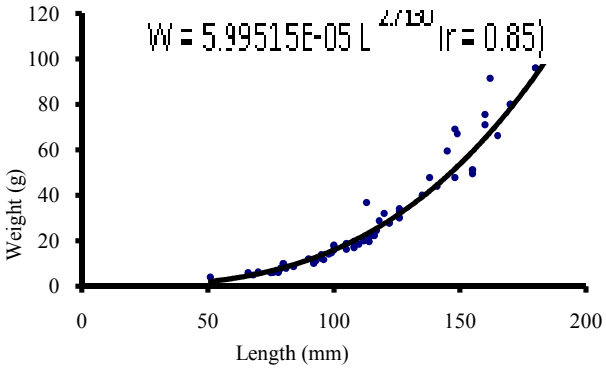

Fig. 7 Scattered diagram of length-weight relationship in females of *U. archionema*

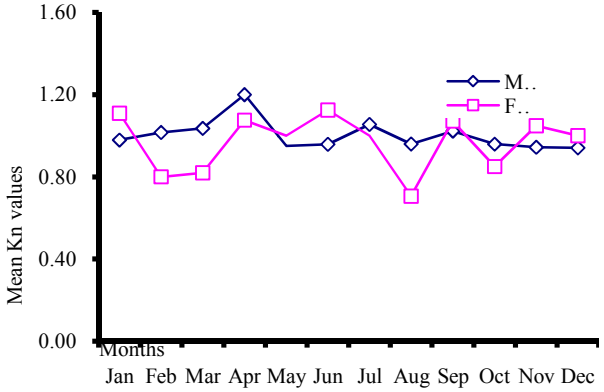

Fig. 8 Monthly relative condition factor in *U. archionema*

DISCUSSION

Males dominated the catches during the study period. Male dominance was also noticed in other stargazer *U. scaber* (Coker *et al*., 2008) from Aegean waters. Five stages of maturity of gonads were observed in females of *U. scaber* from Aegean Waters (Coker *et al* 2008), *Lagocephalus lunaris*

Table 5 Comparision of regression lines of length-weight relationship in males and females of *U. archionema*

	D.F.	X^2	Y^2	XY	Regression Coefficient Intercept (a)	Slope (b)	D.F.	SS	MSS
Within Females	33	4.567196	2.482830	3.367428	-4.2222	2.7130	32	0.442564	
Males	73	4.160784	1.750329	2.698655	-4.7762	2.9901	72	0.339214	
							104	0.781778	0.007517
Pooled	106	8.72798	4.233159	6.066083	-4.5448	2.8704	105	1.312448	0.012499
			Difference between slopes				1	0.53067	0.53067
Slopes	F = 70.5959		D.F. 1,104		P = 2.41617E-13		Significant at 5% level		

(Rukmini Sirisha and Yedukondala Rao, 2013) and *Parachaeturichthys polynema* (Yedukondala Rao *et al* 2015) from east coast of India. In the present investigation, a scale of seven stages of gonad maturity in *U. archionema* was adopted to evaluate variations in frequency of maturity stages more precisely and to determine the spawning period specifically.

The length at first maturity was found to be 152mm in females of *U. archionema* in the present study whereas the length at first maturity of other fishes represented in by-catches at Visakhapatnam was found to be 175mm and 141mm in *Lagocephalus spadiceus* and *Lagocephalus lunaris* respectively (Rukmini Sirisha and Yedukondala Rao, 2007 and 2013) which was almost similar to that of the present findings.The progression of monthly values of the Gonado Somatic Index indicated the spawning season of fishes (Hureau, 1986; West, 1990 and Coker *et al* 2008). GSI has been found to be high during January-June and October-December in males; February, March, August, October and December in females which may be indicative of spawning season of *U. archionema*. The oocyte development ranged from 0.18mm to 1.24mm in *U. archionema* in the present study. The oocyte diameter ranged from 0.06-1.86mm in *U. scaber* from Aegean waters (Coker *et al* 2008) and a 2mm maximum egg diameter in *U. scaber* from Mediterranean waters (Hureau, 1986; Yuksek, 1993) which were more or less similar to the findings of the present work. Fecundity ranged from 3,583 to 8,773 with mean 6,136 ± 276.3025 in length ranging from 130mm to 172mm TL and showed linearity with length, weight of fish and ovary weight in *U. archionema.* Batch fecundity noticed in *U. scaber* was 8408 in hydrated oocytes from Aegean waters (Coker *et al* 2008) which was more or less similar to the findings of the present work. Linear relationship between batch fecundity and fish size was also noticed in *U. scaber* from Aegean waters (Coker *et al* 2008). *U. archionema* was a fractional spawner releasing ripe eggs in two batches during the spawning season because ripe ovary of *U. archionema* contains large number of maturing ova besides ripe ova. Fractional spawning was also noticed in other stargazer *U. scaber* from Aegean waters (Coker *et al* 2008).

U. archionema was a carnivore feeding on fish, shrimp, cephalopods, crab, gastropods and miscellaneous items. There was no marked difference in the food composition between males and females of *U. archionema*. Similar findings were also noticed in other stargazer *U. scaber* from Spanish waters (Sanz, 1985), Mediterranean waters (Samir and Philips, 2008) and Tunisian waters (Boundka and Katari, 1996), but algae and sea grass were not observed in the gut content of *U. archionema*. High feeding intensity was observed throughout the study period except January, August, October and November in *U. archionema* in the present study where as high feeding intensity was observed during April in *U. scaber* from Mediterranean waters (Samir and Philips, 2008). There occurs a variation of fish species in the diet of stargazers in different areas which can be attributed to the difference in the biodiversity of different seasons of these areas.

Males exhibited higher total length than females reaching 190mm while maximum total length was 180mm in females of *U. archinema* in the present study, but higher total length in females was observed in *U. scaber* (Samir and Bakhoum, 2009) from Mediterranean waters and Spanish waters (Sanz, 1985).

The growth was found to be isometric if b = 3, negative allometric if b < 3, positive allometric if b > 3 (Morey *et al*., 2003 and Sangun, 2007). In the present study on *U. archionema* a common regression equation was given for both the sexes as $W = 2.85233E\text{-}05\ L^{2.87047}$ ($r = 0.89$) which showed negative allometric growth, but isometric growth was noticed in *U. scaber* from Mediterranean Waters where a combined regression equation was given for both the sexes as $W = 0.0142\ L^{2.9944}$ ($r^2 = 0.9147$) (Samir and Bakhoum, 2009). The comparision of regression lines showed a significant difference ($p<0.05$) between the slopes of the two sexes at 5% level in *U. archionema* in the present study, but no significant difference was observed in *U. scaber* from Spanish waters (Sanz, 1985) and Mediterranean waters (Samir and Bakhoum, 2009).

References

1. Baron, V. D., 2009. Electric Discharges of Two Species of Stargazers from the South China Sea (Uranoscopidae, Perciformes). J. Ichthyol. 49 (11): 1065–1072.
2. Boundka. B., and Katari M. H. 1996. Contribution a 1'etude du regime alimentaire de IUranoscope (*Uranoscopus scaber Linnaeus,* 1758) poisson teleosteen des cotes tunisiennes. Bull. INSTM 23 (2): 150-160.
3. Bagenal, T.B., 1978. Aspects of fish fecundity. In: Gerking, S.D. (ed.). Ecology of freshwater fish production. Blackwell Scientific Publications: Oxford.
4. Clark, F N., 1934. Maturity of the California Sardine (*Sardina caerulea*) determined by ova diameter measurements. Fisheries Bulletin, California Division of Fish and Game. 42, Pp 49.
5. Coker, T., O. Akyol, O.Ozaydın, S. Leblebici and Z. Tosunoglu, 2008. Determination of batch fecundity in *Uranoscopus scaber* Linnaeus, 1758 from the Aegean Sea, Turkey, Journal of Applied Ichthyology. 24: 85–87.
6. Demestre, M., P. Sanchez and P. Abello, 2000. Demersal fish assemblages and habitat characteristics on the continental shelf and upper slope of the north-western Mediterranean, Journal of Marine Biological Association of India. 80(6): 981- 988.
7. Heemstra, P.C., 1986. Uranoscopidae. In: M. M. Smith & P.C. Heemstra (eds.). Smith's Sea fishes, Springer Verlag, Berlin.
8. Hureau, J., 1986. Fishes of the North - Eastern Atlantic and the Mediterranean. In: P.J.P. Whitehead, M. L. Bauchot, J.C. Hureau, J. Nielsen and E. Tortonese (Eds.). Fishes of the North-Eastern Atlantic and the Mediterranean, UNESCO, Paris. 2: 955-956.
9. Hynes, H.B.N., 1950. The food of stickle-backs (*Gasterosteus aculeatus* and *Pygosteus pungitis*) with a review of methods used in studies of the food of fishes, Journal of Animal Ecology. 19: 36-58.

10. King, M., 1995. Fisheries Biology, Assessment and Management, Fishing News Books: Blackwell Science Ltd, London. Pp 382.
11. Le Cren, C.P., 1951. Length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*), Journal of Animal Ecology. 20(2): 201-219.
12. Morey, G., Moranta, J., Massuti, E., Grau, A., Linde, M., Riera, F and Morales-Nin, B. 2003. Weight-length relationships of littoral to lower slope fishes from the Western Mediterranean, Fisheries Research. 62: 89-96.
13. Prabhu, M.S., 1955. Some aspects of the biology of the ribbon fish, *Trichurus haumila* (Forsskal), Indian Journal of Fisheries. 2 (1): 132-163.
14. Rao, K.S., 1964. Food and feeding habits of fishes from trawl catches in the Bay of Bengal with observations of diurnal variations in the nature of food, Journal of Fisheries. 11: 277-314.
15. Rukmini Sirisha, I., and P. Yedukondala Rao, 2007. Reproductive biology of half-rough back pufferfish, *Lagocephalus spadiceus* (Richardson, 1844) off Visakhapatnam, east coast of India, Journal of Marine Biological Association of India. 49 (1): 70-75.
16. Rukmini Sirisha, I., and P. Yedukondala Rao, 2013. Maturation and spawning of green-rough-back pufferfish, *Lagocephalus lunaris* (Bloch and Schneider, 1801) off Visakhapatnam, east coast of India, International Journal of Current Biotechnology. 1(10): 8-14.
17. Sangun, L., E. Akamca and M. Akar, 2007. Weight-length relationships for 39 species from the north-eastern Mediterranean coast of Turkey, Turkish Journal of fisheries and Aquatic Sciences. 7: 37- 40.
18. Sanz, A., 1985. Contribucion al estudio de la bilogia de *Uranoscopus scaber* Linnaeus, 1758 (Osteichthyes, Uranoscopidae) del Mediterraneo occidental, Inv. Pesq. 49 (1): 35-46.
19. Samir, I., Rizkalla and Amal I. Philips, 2008. Feeding habits of the Atlantic stargazer fish *Uranoscopus scaber* Linnaeus, 1758 (Family: Uranoscopidae) in Egyptian Mediterranean Waters, Egyptian Journal of Aquatic Biology and Fisheries. 12(1): 1-11.
20. Simpson, A.C., 1959. Methods used for separating and counting the eggs in fecundity studies on the plaice (*Pleuronectes platessa*) and herring (*Clupea herengus*), FAO Occasional Papers, Indo Pacific Fish Conference, No. 59/12.
21. Snedecor, G.W. and W.G. Cochran, 1967. Statistical methods, 6th edition, New Delhi: Oxford and IBH Publishing Co.
22. Smith, M.M. and P.C. Heemstra, 1986. Smith's Sea Fishes. Springer Verlag, New York, Pp 1047.
23. Samir, I., Rizkalla and Shnoudy A. Bakhoum, 2009. Some Biological Aspects of Atlantic Stargazer *Uranoscopus scaber* Linnaeus, 1758 (Family: Uranoscopidae) in The Egyptian Mediterranean Waters, Turkish Journal of Fisheries and Aquatic Sciences. 9: 59-66.
24. Snedecor, G.W. and W.G. Cochran, 1967. Statistical methods, 6th edition, New Delhi: Oxford and IBH Publishing Co.
25. Smith, M.M. and P.C. Heemstra, 1986. Smith's Sea Fishes. Springer Verlag, New York, Pp 1047.
26. Samir, I., Rizkalla and Shnoudy A. Bakhoum, 2009. Some Biological Aspects of Atlantic Stargazer *Uranoscopus scaber* Linnaeus, 1758 (Family: Uranoscopidae) in The Egyptian Mediterranean Waters, Turkish Journal of Fisheries and Aquatic Sciences. 9: 59-66.
27. West, G., 1990. Methods of assessing ovarian development in fishes: A review, Australian Journal of Marine and Freshwater Research. 41: 199-222.
28. Yedukondala Rao, P., D. Naga Krishna Veni., I. Rukmini Sirisha and D. Sudha Rani, 2015. Some aspects of biology of tail eyed goby *Parachaeturichthys polynema* (Bleeker, 1853), off Visakhapatnam, east coast of India. Global Journal of Biology and Health Sciences. 4(1): 238-247.
29. Yuksek, A., 1993. Distribution and abundance of pelagic eggs and larvae of teleost fishes in northern Marmara Sea. Ph.D. Thesis, IU Institute of Marine Sciences and Management, Istanbul, Turkish.

****

How to cite this article:
Yedukondala Rao P *et al.,* Some Aspects of Biology of Stargazer Uranoscopus archionema Regan, 1921 (Perciformes: Uranoscopidae) off Visakhapatnam, East Coast of India. *International Journal of Recent Scientific Research Vol. 6, Issue, 11, pp. 7247-7253, November, 2015*

ISSN 0976-3031