Spawning Biology of *Gerres filamentosus* Cuvier in the Cochin Estuary

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The maturation and spawning of *Gerres filamentosus* Cuvier in the Cochin estuary was studied from January to December 1980. The spawning season extends from October to February. Relatively high Gondo-somatic index values were observed from October to February. The fully ripe ovary is characterised with three batches of matured eggs which are not sharply differentiated among themselves and hence it is inferred that they may spawn in three successive batches within the same prolonged spawning season itself. Size at first maturity of males and females were respectively 117 and 118 mm SL. The sex ratio was significantly different in January, March, June and November and the mean ratio of males to females were 1:1.39. Fecundity of the species varied from 64,278 to 3,87,576 eggs.

Gerres filamentosus Cuvier is one of the common gerrids of Cochin estuary, and constitutes an important fishery in the estuaries and brackishwater of India. The annual production of this species from the Vembanad lake is computed at 112.7 tonnes and occupies 11th position among the species constituting this fishery (Kurup *et al.*, 1989). A perusal of the literature shows that the reproductive biology of other gerrids of Indian waters have been reported by several workers (Jones & Sujansingani, 1954; Jhingran & Natarajan, 1969; Prabhakara Rao, 1970 and Patnaik, 1971) whereas the spawning biology *G. filamentosus* is still unknown. Therefore, the present study was undertaken with a view to understand in detail some of the important aspects such as spawning periodicity, spawning season, minimum size at first maturity, fecundity and sex ratio of the stock available at Cochin estuary.

Materials and Methods

Fish specimens were collected fortnightly during the period between January and December 1980, from barmouth and nearby areas of Cochin estuary from gill nets, seines and cast nets. The observations were made on fresh specimens. 5 maturity stages were determined on the basis of colour, shape, size and microscopic structure of the gonads as suggested by Qasim (1973) and described by Kurup & Samuel (1983). The frequency of spawning was determined by measuring the diameter of intraovarian eggs (Clark, 1934; Hickling & Rutenberg, 1936). The gonado somatic index (GSI) was calculated by applying the method of June (1953) and fecundity was enumerated (Anon, 1974).

Results and Discussion

A total of 120 ovaries with 1-5 stages of maturity were examined and the diameter of eggs were measured with an occular micrometer at a magnification giving a value of 50.0 microns to each micrometer division (MD). The range in size of the intraovarian eggs was 1-10 MD. The diameter frequencies at different stages of ovaries are presented in Fig. 1. In the immature stage (Stage 1) most of the oocytes were less than 0.2 mm

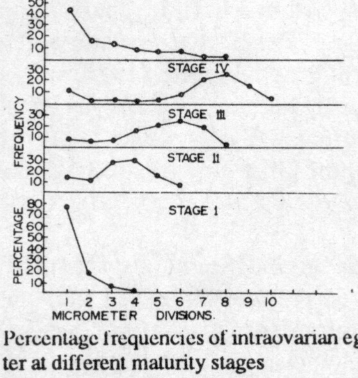

Fig1 Percentage frequencies of intraovarian egg diameter at different maturity stages

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with a very prominent mode at 0.05 mm. This group of immature ova were found to be present in the ovaries of all stages of development. In the second stage (maturing virgin and recovering spent), apart from the immature stock, another batch of ova with a prominent mode of 0.2 mm was discernible. In stage III (Ripening) a group of opaque ova with a mode of 0.3 mm was noticed and besides this major mode, two other minor modes were also observed at 0.25 and 0.35 mm respectively. In stage IV (Ripe), there was one batch of transparent ova with a mode at 0.45 mm. The highest mode (0.4 mm) was represented by another group of eggs which were characterised with peripheral transparent zone. The third batch of eggs was completely opaque and showed a mode at 0.35 mm. These three groups of oocytes were not distinctly differentiated by an evident gap among themselves, so it might be presumed that they were spawn in the ensuing spawning season itself in three successive batches. In fully spent fishes (Stage V) the mode again shifted back to 0.05 mm with a very few opaque ova having a maximum size of 0.4 mm, which were residual and almost in the state of resorption. The fully mature group of ova were not sharply differentiated from maturing group and hence it could well be inferred that the process of maturation was continuous and the spawning might take place within a prolonged time. Since there was only one group of ova with advanced stage of maturation in the fully ripe ovary, it can also be presumed that individual fish spawned only once within a definite spawning period in an year. These observations agree well with that of Prabhakra Rao (1970) and Patnaik (1971) who noticed that *Gerres oyens* and *G. setifer* spawn only once in an year in Pulicat and Chilka lakes respectively and the spawning period was a prolonged one.

The high GSI values recorded from October to February (Fig. 2) indicated the intense gonadal activity during these periods

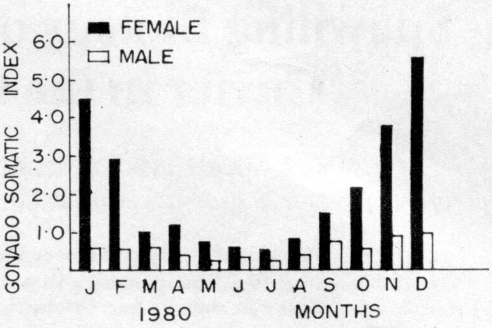

Fig.2 Monthly variations in Gonado Somatic Index

and confirmed that the major spawning season of this species was from October to February.

The percentage occurrence of different stages of maturity of ovary and testis are depicted in Fig. 3.

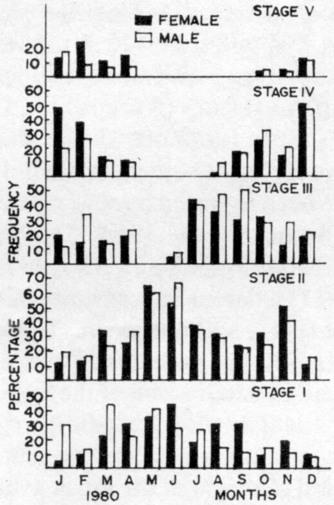

Fig.3 Percentage occurrence of different maturity stages of gonad

The percentage occurrence of fully ripe males and females were high from October to February, indicating that the spawning season was during the above period. This was further supported by the occurrence of spent individuals from October onwards with very high percentages during February to April.

Percentage occurrence of mature fishes

of both the sexes are shown in Fig. 4. It was

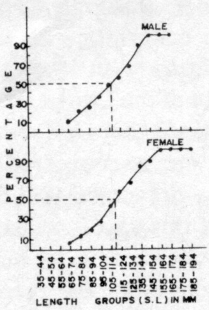

Fig.4 Percentage occurrence of mature fishes

observed that upto 55-64 and 65-74 mm SL group, all males and females were immature. Majority of fishes matured in the 115-124 mm SL group both in males (55%) as well as in females (58%). 100% mature males and females were registered in 145-154 and 155-164 mm SL respectively. The 50% level in the maturity curves which might be taken to represent the mean length at which maturity was attained, were 117 mm SL in males and 118 mm in females.

Fecundity was studied in 27 fishes ranging in size 100-148 mm SL and the number of ova found to vary from 64,278 to 3,87,576. The regressions of standard length (SL) as well as weight with number of ova were calculated and shown in figs. 5 and 6. The

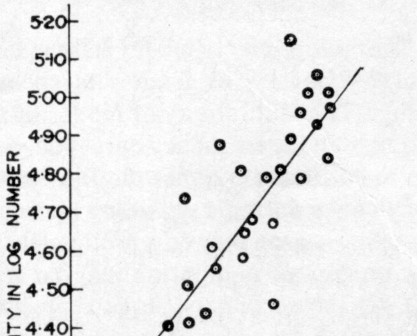

Fig.5 Regression between standard length and fecundity

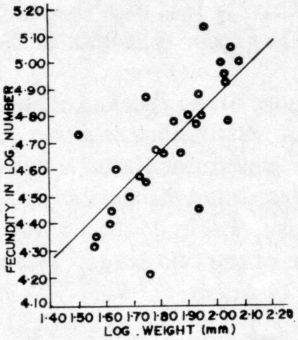

Fig. 6 Regression between body weight and fecundity

regression equation of the variables can be expressed as follows:

$$\log F = -2.110 + 3.2563 \log L$$

$$\log F = 2.8917 + 0.9896 \log W$$

The correlation co-efficients between fecundity - length and fecundity - weight were respectively 0.7178 and 0.6906.

The exponential value is usually reported as '3' when fecundity is related to length and '1' when fecundity is related to weight (Bagenal & Braum, 1978). But in the present studies, the exponential value is greater than cube when fecundity is related to standard length and less than '1' when fecundity is related to weight. The difference in exponential value and fecundity may be due to age, season and environment (Antony Raja, 1971; Ziglstra, 1973). According to Bagenal & Braum (1978) changes in the environment may also result in significant changes in fecundity. Prabhakara Rao (1970) observed that the fecundity of *G. oyena* varied from 1,04, 211 to 14,43,785 eggs in the size ranges from 148-282 mm. The correlation co-efficients between fecundity and length and weight were reported as 0.5306 and 0.4421 respectively. Similarly, Patnaik (1971) observed that the fecundity of *G. setifer* varied from 17,293 to 1,61,505 eggs in the size ranges 88-193 mm. On comparison with other Gerrids, it is clear that the fecundity of *G. filamen-*

tosus is relatively less than that of *G. oyena* whereas it is higher than that of *G. setifer*.

Because of the absence of any external character to distinguish the two sexes, the sexes were determined after examining the gonads to determine the occurrence of males and females. Table 1 shows the monthly distribution of the two sexes. The ratio was tested by Chi-square ($\lambda^2 = \frac{(O-E)^2}{E}$) analysis for difference from the hypothetical 1:1 ratio or null hypothesis (Snedecor & Cochran, 1967). The ratio for the year 1980 was found to deviate from the normal expected value 1:1 ratio. The sex ratio was significantly different in January, March, June and November. The Chi-square value for the year was 21.73 and the mean ratio of males to females were 1:1.39. The skewed sex ratio was due to the ponderence of females over males. Qasim (1966) suggested that the ponderence of one sex in a population was because of sexual differences in growth rate between sexes. The faster growth rate lead increasingly to less loss from predation and this might influence the sex ratio. In *G. filamentosus* also the maximum size was recorded in the outnumbered sex. Reynolds (1974) suggested that the diversity in the sex ratio might be due to the partial segregation of mature forms, either through habitat preference or because of school formation, then rendering one sex to be more easily caught than the other. During the peak spawing season females were more compared to males in *G. filamentosus* and such preponderence could be due to behavioural differences between the two sexes (Polonsky & Tormosova, 1969).

The breeding biology of fishes of the family Gerridaeof Pulicat &Chilka lakes was investigated by Jhingran & Natarajan, (1969), Prabhakara Rao (1970) and Patnaik (1971). In Chilka lake, Jones & Sujansingani (1954) observed the male specimens of *G. setifer* in ripe condition with flowing milt and female with ovary almost in ripe condition but they were not able to say whether the species bred in the lake or not. Jhingran & Natrajan (1969) observed the occurrence of males and females of *G. setifer* with oozing gonads in the southern sector of the Chilka lake. Prabhakara Rao (1970) stated that *G. oyena* with oozing gonads were not encountered from Pulicat lake and so he presumed that the final stage of maturity of this species was attained only in the sea. Fishes with fully matured gonads occurred throughout the year and hence concluded that *G. oyena* bred in the east coast of India in the year round. Patnaik (1971) noticed that *G. setifer* bred in Chilka lake from May to September and unlike *G. oyena* the outwardly spawning migration of this species from Chilka lake had not been taking place. But in the present study specimens of *G. filamentosus* with oozing gonads were not encountered from the Vembanad lake and hence it was inferred that the final stage of maturity was attained only in the sea. From November to January the fishes collected from barmouth areas of the lake showed a higher degree of maturity than those specimens collected from adjacent areas and hence it could be presumed that the fully ripe fishes undergo migration to the nearby coastal areas for the purpose of spawning. A similar observation was also reported by Prabhakara Rao (1970) in *G. oyena* of Pulicat lake.

The multiplicity of modes in the mature ovary of *G. filamentosus* denotes its repeated spawning. The multiplicity of modes of the ovarian eggs in the frequency curves suggest three possibilities: (1) either the fish spawn more than once during a spawning period or the spawning season may be a prolonged one and the process of maturation may be continuous (2) the secondary mode represents the eggs which are to be carried over to the next spawning season (3) they comprise eggs which never ripen but will degenerate and be resorbed at the close of breeding season (Clark, 1934). But in *G. filamentosus* no maturing ova were present in ovaries

Table 1. Sex ratio of *G. filamentosus* in different months showing Chi-square values

1980 Months	Male	Female	% of males	%of females	Chi-square Value	Probability	F:M
January	32	54	37.20	62.79	5.63	0.01 < p < 0.025*	1.68: 1.00
February	30	34	46.86	53.12	0.25	0.50 < p < 0.750	1.13: 1.00
March	20	49	37.18	62.82	5.13	0.25 < p < 0.025*	1.68: 1.00
April	30	25	54.55	45.45	0.50	0.25 < p < 0.500	1.00: 1.20
May	17	26	39.53	60.47	1.88	0.10 < p < 0.250	1.52: 1.00
June	22	42	34.38	65.62	6.25	0.01 < p < 0.025*	1.90: 1.00
July	30	33	47.62	52.38	0.14	0.75 < p < 0.900	1.10: 1.00
August	25	36	40.98	59.02	1.98	0.10 < p < 0.250	1.44: 1.00
September	30	38	44.12	55.88	0.94	0.25 < p < 0.500	1.26: 1.00
October	26	34	43.33	56.67	1.06	0.25 < p < 0.500	1.30: 1.00
November	38	58	39.58	60.42	6.67	0.005 < p < 0.010*	1.52: 1.00
December	26	38	40.63	59.37	2.25	0.100 < p < 0.20	1.46: 1.00
Total	335	467	41.77	58.23	21.73	0.001*	1.39: 1.00

* Significant at 5% level

between two successive spawning interval, hence the possibility of being carried over to the next season could be ruled out. Similarly the percentage of degenerating ova in spent fishes were very low and so the possibility of complete degeneration or resorption of secondary and tertiary modes could also be ruled out. So the first possibility could be taken for granted as far as *G. filamentosus* is concerned. This conclusion disagreed with Clark's (1934) statement that if several groups of maturing ova were present in an ovary, but only one batch of egg spawned by each female in one breeding season, the number of eggs in maturing group was expected to maintain a constant ratio to the number of eggs in the mature group throughout the entire breeding season.

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